PROFESSIONAL SEMICONDUCTOR

DATABOOK 1

SGS ATES

SMALL SIGNAL TRANSISTORS
SPECIAL ASSEMBLIES
1974/75

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SGS-ATES

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INTRODUCTION

This databook contains data sheets on the SGS-ATES range of discrete devices intended for professional applications, with the exclusion of high power devices which are listed in a separate databook.
To permit ease of consultation, this book has been divided into three product sections:
Transistors, Special Assemblies and Other Devices.
The information on each product has been specially presented in order that the performance of the product can be readily evaluated within any required equipment design.

OTHER SGS-ATES DATABOOKS

Data sheets on the SGS-ATES range of integrated circuits for professional applications, discrete devices and integrated circuits for consumer applications, and high power devices for professional and consumer applications can be found in the following databooks:

SGS-ATES Professional Semiconductor Databook 2 (Bipolar digital integrated circuits)

SGS-ATES Professional Semiconductor Databook 3 (MOS, COS/MOS, linear integrated circuits)

SGS-ATES Consumer Semiconductor Databook (Integrated circuits, small signal transistors)

SGS-ATES Power Semiconductor Databook (Power transistors)

SGS-ATES GROUP OF COMPANIES

INTERNATIONAL HEADQUARTERS
SGS-ATES Componenti Elettronici S.p.A.
Via C. Olivetti 2 - 20041 Agrate Brianza - Italy
Tel.: 039-650341÷4 - 650441÷5 - 650841÷5
Telex: 36141-36131

BENELUX
SGS-ATES Componenti Elettronici
Benelux Sales Office
-B- 1180 Bruxelles
81 Avenue Montjoie
Tel.: 432439
Telex: 011-24149

DENMARK
SGS-ATES Scandinavia AB
Sales Office:
2730 Herlev
Marielundvej 46A
Tel.: 01-948533

FRANCE
SGS-ATES France S.A.
75643 Paris Cedex 13
Résidence "Le Palatino"
17, Avenue de Choisy
Tel.: 5841255
Telex: 021-25938

GERMANY
SGS-ATES Deutschland Halbleiter-Bauelemente GmbH
809 Wasserburg/Inn
Tel.: 08071-721
Telex: 05-25143
Sales Offices:
1000 Berlin 33
Warmbrunner Strasse 39
Tel.: 0311-8233038
Telex: 185418
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Tel.: 0511-17522/3
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8000 München 40
Gernotstrasse 10
Tel.: 0811-304270-304485
Telex: 05215784
7000 Stuttgart 81
Filderbahnstrasse 37
Tel.: 0711-713091/2
Telex: 07255545

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SGS-ATES Componenti Elettronici S.p.A.
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c/o Sit Siemens
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20149 Milano
Via Tempesta 2
Tel.: 02-4695651
00199 Roma
Piazza Gondar 11
Tel.: 06-8392848-8312777
10134 Torino
Via La Loggia 51/7
Tel.: 011-634572

NORWAY
SGS-ATES Scandinavia AB
Sales Office:
Oslo 4
Sandakerveien 104B
Tel.: 213755
Telex: 11796

SINGAPORE
SGS-ATES Singapore (Pte) Ltd.
Singapore 12
Lorong 4 & 6 - Toa Payoh
Tel.: 531411
Telex: ESGIES RS 21412

SWEDEN
SGS-ATES Scandinavia AB
19501 Märsta
Industrigatan 2
Tel.: 0760-40120
Telex: 042-10932

UNITED KINGDOM
SGS-ATES (United Kingdom) Ltd.
Aylesbury, Bucks
Planar House, Walton Street
Tel.: 0296-5977
Telex: 041-83245

U.S.A.
SGS-ATES Semiconductor Corporation
Newtonville, Mass. 02160
435 Newtonville Avenue
Tel.: 617-9691610
Telex: 922482

ALPHA-NUMERICAL INDEX

TRANSISTORS

SPECIAL ASSEMBLIES

OTHER DEVICES

ALPHA-NUMERICAL INDEX

Sections: t = transistors
s = special assemblies
o = other devices

TRANSISTORS

NPN diffused silicon planar transistors — BCY 58-59

AF amplifiers

The BCY 58 and BCY 59 are NPN silicon planar epitaxial transistors designed for use in AF input-stages, driver stages and low noise input stages. These types are available in four gain bands (VII - VIII - IX - X).

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain *				
h_{fe}	Small Signal Current Gain *				
NF	Narrow Band Noise Figure *				
V_{BEsat}	Base Saturation Voltage (5)				
	I_C=10mA I_B=0.25mA	0.6	0.7	0.85	V
	I_C=100mA I_B=2.5mA	0.75	0.9	1.2	V
V_{BEon}	Base-Emitter On Voltage				
	I_C=2mA V_{CE}=5V	0.55	0.65	0.7	V
	I_C=100mA V_{CE}=1V		0.75		V
V_{CEsat}	Collector Saturation Voltage (5)				
	I_C=10mA I_B=0.25mA		0.12	0.35	V
	I_C=100mA I_B=2.5mA		0.4	0.8	V
I_{CES}	Collector Reverse Current (5)				
	V_{CE}=32V V_{EB}=0 BCY 58		0.1	10	nA
	V_{CE}=45V V_{EB}=0 BCY 59		0.1	10	nA
	V_{CE}=32V V_{EB}=0 T_A=150°C BCY 58		0.1	10	µA
	V_{CE}=45V V_{EB}=0 T_A=150°C BCY 59		0.1	10	µA
I_{CEX}	Collector Reverse Current				
	V_{CE}=32V V_{EB}=-0.2V T_A=100°C BCY 58			20	µA
	V_{CE}=45V V_{EB}=-0.2V T_A=100°C BCY 59			20	µA
I_{EBO}	Emitter Reverse Current				
	V_{EB}=5V I_C=0			10	nA
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C=100mA I_B=0	32			V
	I_C=10mA I_B=0	45			V
h_{fe}	High Freq. Current Gain				
	I_C=10mA V_{CE}=5V f=100 MHz		2		
C_{TE}	Emitter Transition Capacitance				
	I_C=0 V_{EB}=0.5V		11	15	pF
C_{ob}	Base-Collector Capacitance				
	I_E=0 V_{CB}=10V		3.5	6	pF
t_{on}	Turn On Time (7)				
	I_C=10mA I_{B1}=1mA		85	150	nsec
	I_C=100mA I_{B1}=10mA		55	150	nsec
t_{off}	Turn Off Time (7)				
	I_C=10mA I_{B1}=1mA I_{B2}=1mA		480	800	nsec
	I_C=100mA I_{B1}=10mA I_{B2}=10mA		480	800	nsec

* For these parameters, see table on next page.

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/W (derating factor of 6.85 mW/°C); junction-to-ambient thermal resistance of 486°C/W (derating factor of 2.06 mW/°C).
4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
5) Measured under pulse conditions : pulse length = 300 µsec; duty cycle = 1%.
6) f = 1 kHz; R_S = 2 kΩ; Power Bandwidth of 200 Hz.
7) See switching circuits for exact values of I_C, I_{B1} and I_{B2}.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages and Current

Collector to Emitter (4)		
BCY 58	V_{CEO}	32 V
BCY 59		45 V
Collector to Emitter		
BCY 58	V_{CES}	32 V
BCY 59		45 V
Emitter to Base	V_{EBO}	7 V
DC Collector Current	I_C	200 mA

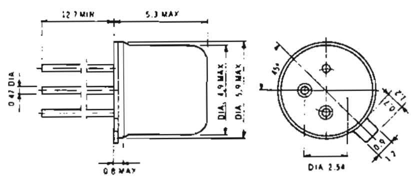
Temperatures

Storage Temperature Range	T_{STG}	-55°C to 200°C
Operating Junction Temperature	T_J	200°C
Lead Temperature (Soldering, 10 sec. time limit)	T_L	260°C

Power (2 and 3)

Dissipation at 25°C Case Temperature	P_D	1.2 W
Dissipation at 25°C Ambient Temperature	P_D	0.36 W

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-18 outline



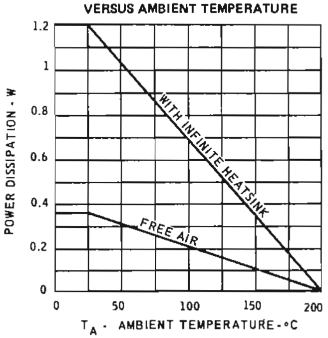
Note : all dimensions in mm.

ELECTRICAL CHARACTERISTICS (contd.) (T_A = 25°C unless otherwise noted)

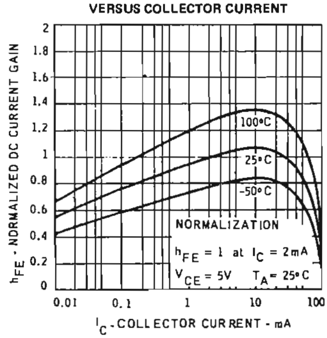
Symbol	Characteristic and Test Conditions	BCY58 BCY59			Group VII			Group VIII			Group IX			Group X			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
h_{FE}	DC Current Gain I_C = 10 µA V_{CE}=5V		195			100		20	140		40	195		100	280		
h_{FE}	DC Current Gain (5) I_C=2mA V_{CE}=5V	120	350	630	120	170	220	180	250	310	250	350	460	380	500	630	
	I_C=10mA V_{CE}=1V	80	365		80	175		120	260		160	365		240	520		
	I_C=100mA V_{CE}=1V	40			40			45			60			60			
h_{fe}	Small Signal Current Gain I_C=2mA V_{CE}=5V f=1kHz	125			125		250	175		350	250		500	350		700	
NF	Narrow Band Noise Figure (6) I_C=200 µA V_{CE}=5V		2			2			2	6		2	6		2	6	dB

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

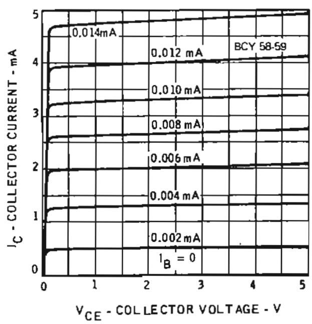
MAXIMUM ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



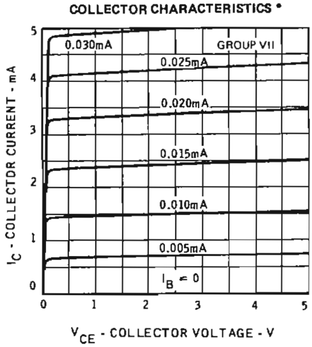
NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR CHARACTERISTICS *



COLLECTOR CHARACTERISTICS *



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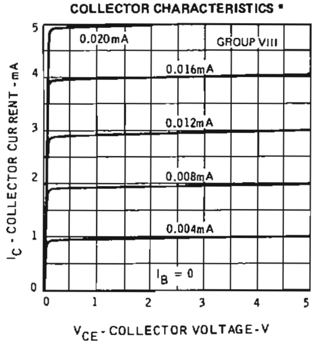

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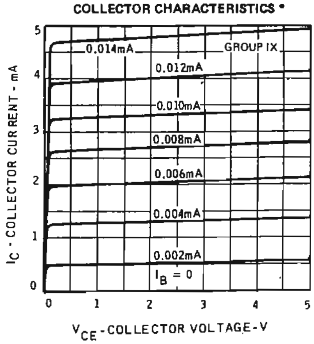
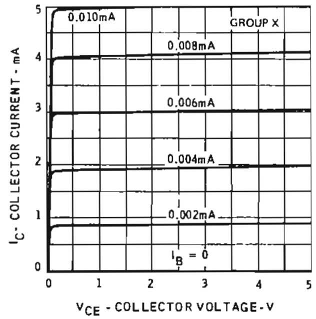


* Single family characteristics on Transistor Curve Tracer

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

COLLECTOR CHARACTERISTICS *



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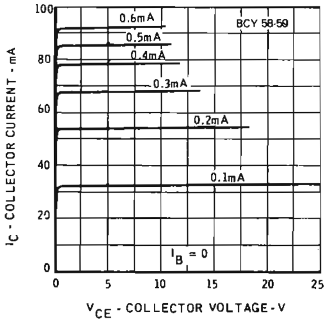
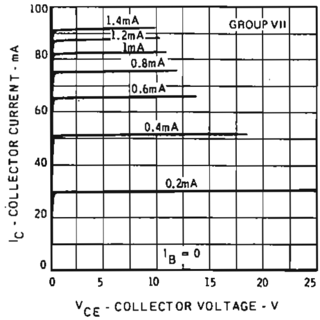
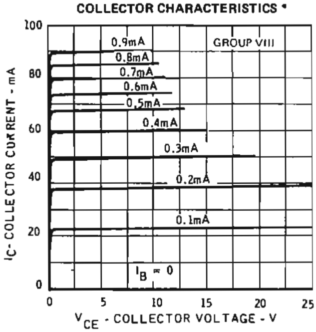


COLLECTOR CHARACTERISTICS *



COLLECTOR CHARACTERISTICS *



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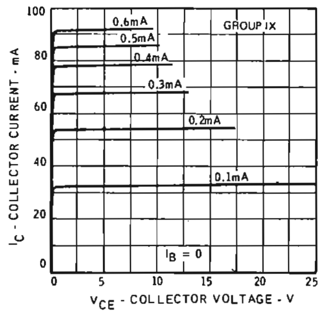
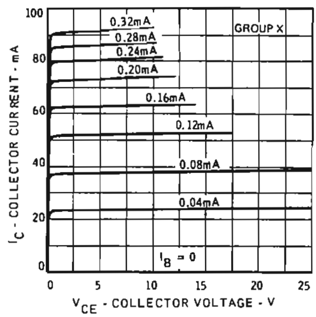
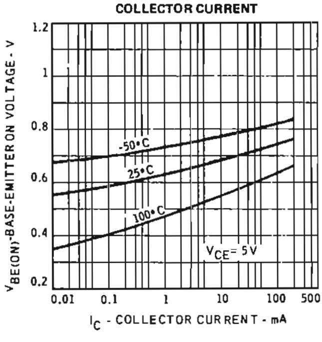


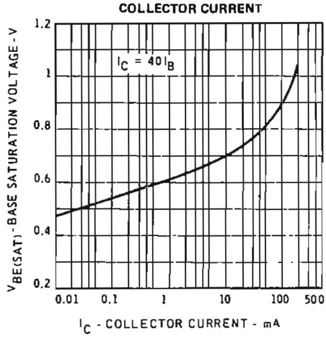
COLLECTOR CHARACTERISTICS *



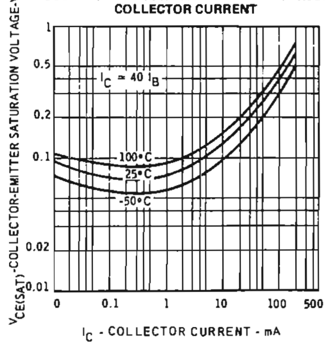
BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



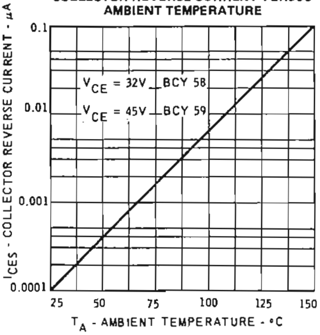
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



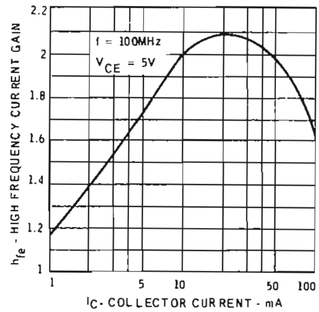
* Single family characteristics on Transistor Curve Tracer.

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

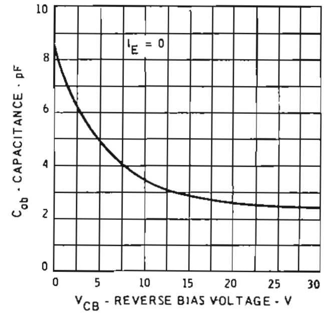
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



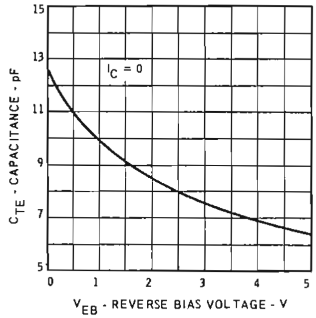
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



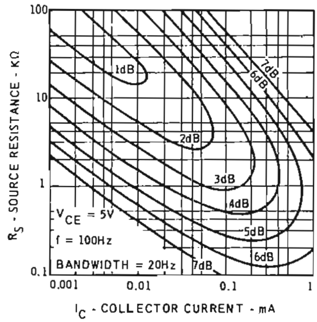
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



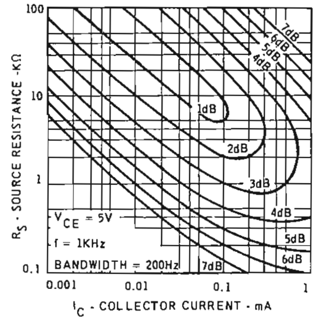
INPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



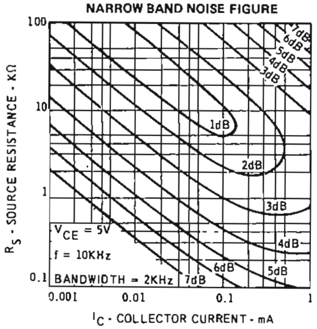
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



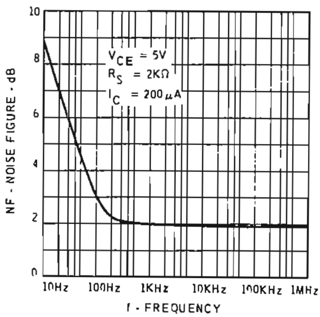
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



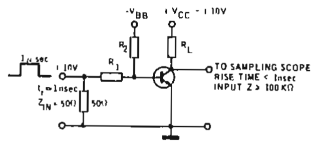
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



NOISE FIGURE VERSUS FREQUENCY



TURN ON AND TURN OFF TEST CIRCUIT



I_C, I_{B1}, I_{B2} = 10, 1, 1 (mA), R_1 = 5KΩ, R_2 = 5KΩ; V_{BB} = -3.6V, R_L = 990Ω

I_C, I_{B1}, I_{B2} = 100, 10, 10 (mA), R_1 = 500Ω, R_2 = 700Ω; V_{BB} = -5V; R_L = 98Ω

NPN diffused silicon planar transistor BFR10

RF amplifier and high speed switch

The BFR 10 is an NPN silicon planar epitaxial transistor designed for RF applications and high speed switching applications.
This device features a minimum f_T of 250MHz at 50 mA, V_{CE} = 10 V together with a maximum V_{CE} (sat) of 0.6 V at 500 mA.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain				
	I_C = 100 µA, V_{CE} = 10 V	25	50		
	I_C = 10 mA, V_{CE} = 10 V (5)	50	85		
	I_C = 150 mA, V_{CE} = 10 V (5)	60	90	120	
	I_C = 500 mA, V_{CE} = 10 V (5)	40	65		
$V_{BE\ sat}$	Base Saturation Voltage (5)				
	I_C = 150 mA, I_B = 15 mA	0.7	0.85	1	V
	I_C = 500 mA, I_B = 50 mA		1.05	1.3	V
$V_{CE\ sat}$	Collector Saturation Voltage (5)				
	I_C = 150 mA, I_B = 15 mA		0.14	0.22	V
	I_C = 500 mA, I_B = 50 mA		0.40	0.60	V
I_{CES}	Collector Reverse Current				
	V_{CE} = 60 V, V_{EB} = 0			10	nA
	V_{CE} = 60 V, V_{EB} = 0 (150°C)			10	µA
I_{EBO}	Emitter Reverse Current V_{EB} = 3 V, I_C = 0			10	nA
BV_{CES}	Collector to Emitter Breakdown Voltage I_C = 10 µA, V_{EB} = 0	75			V
BV_{EBO}	Emitter to Base Breakdown Voltage I_E = 10 µA, I_C = 0	6			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5) I_C = 30 mA, I_B = 0	40			V
h_{fe}	Small Signal Current Gain (f=1kHz) I_C = 10 mA, V_{CE} = 10 V		90		
h_{ie}	Input Resistance (f=1kHz) I_C = 10 mA, V_{CE} = 10 V		350		Ω
h_{oe}	Output Conductance (f=1kHz) I_C = 10 mA, V_{CE} = 10 V		50		µmho
h_{re}	Voltage Feedback Ratio (f=1kHz) I_C = 10 mA, V_{CE} = 10 V		12		$\times 10^{-4}$
h_{fe}	High Freq. Current Gain (f=100MHz) I_C = 50 mA, V_{CE} = 10 V	2.5	3.5		
C_{TE}	Emitter Transition Capacitance I_C = 0, V_{EB} = 0.5 V		14	25	pF
C_{obo}	Base-Collector Capacitance I_E = 0, V_{CB} = 10 V		5	8	pF
t_{on}	Turn On Time I_C = 300 mA, I_{B1} = 30 mA		14	60	ns
t_{off}	Turn Off Time I_C = 300 mA, I_{B1} = 30 mA, I_{B2} = 30 mA		80	150	ns

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/W (derating factor of 17,2 mW/°C); junction - to ambient thermal resistance of 219°C/W (derating factor of 4,56 mW/°C).
(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
(5) Measured under pulse conditions: pulse length = 300 µsec; duty cycle = 1%.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Emitter (4)	V_{CEO}	40 V
Collector to Emitter	V_{CES}	75 V
Emitter to Base	V_{EBO}	6 V

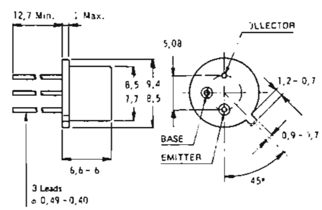
Temperatures

Storage Temperature Range	T_{STG}	-55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering, 10 sec.)	T_L	260°C

Power (2 and 3)

Dissipation at 25°C Case Temperature	P_D	3 W
Dissipation at 25°C Ambient Temperature	P_D	0.8 W

PHYSICAL DIMENSIONS
Similar Jedec TO-39



Note All dimensions are in mm

NOVEMBER 1970

NPN diffused silicon planar transistor BFR 11

RF amplifier and high speed switch

The BFR 11 is an NPN silicon planar epitaxial transistor designed for RF amplifiers and high speed switching applications.
This device features a minimum f_T of 250 MHz at 50 mA, V_{CE} = 10 V together with a maximum $V_{CE\ (sat)}$ of 0.6 V at 500 mA.

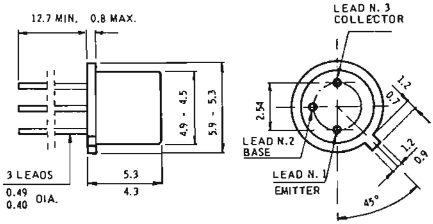
ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain				
	I_C = 100 µA V_{CE} = 10 V	25	50		
	I_C = 10 mA V_{CE} = 10 V (5)	50	85		
	I_C = 150 mA V_{CE} = 10 V (5)	60	90	120	
	I_C = 500 mA V_{CE} = 10 V (5)	40	65		
$V_{BE\ sat}$	Base Saturation Voltage				
	I_C = 150 mA I_B = 15 mA	0.7	0.85	1	V
	I_C = 500 mA I_B = 50 mA		1.05	1.3	V
$V_{CE\ sat}$	Collector Saturation Voltage (5)				
	I_C = 150 mA I_B = 15 mA		0.14	0.22	V
	I_C = 500 mA I_B = 50 mA		0.10	0.60	V
I_{CES}	Collector Reverse Current				
	V_{CE} = 60 V V_{EB} = 0		0.2	10	nA
	V_{CE} = 60 V V_{EB} = 0 (150°C)		0.2	10	µA
I_{EBO}	Emitter Reverse Current				
	V_{EB} = 3 V I_C = 0			10	nA
BV_{CES}	Collector to Emitter Breakdown Voltage				
	I_C = 10 µA V_{EB} = 0	75			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E = 10 µA I_C = 0	6			V
LV_{CER}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 30 mA I_B = 0	40			V
h_{fe}	Small Signal Current Gain (f=1kHz)				
	I_C = 10 mA V_{CE} = 10 V		90		
h_{ie}	Input Resistance (f=1kHz)				
	I_C = 10 mA V_{CE} = 10 V		350		Ω
h_{oe}	Output Conductance (f=1kHz)				
	I_C = 10 mA V_{CE} = 10 V		30		µmho
h_{re}	Voltage Feedback Ratio (f=1kHz)				
	I_C = 10 mA V_{CE} = 10 V		12		$x10^{-4}$
h_{fe}	High Freq. Current Gain (f=100MHz)				
	I_C = 50 mA V_{CE} = 10 V	2.5	3.5		
C_{TE}	Emitter Transition Capacitance				
	I_C = 0 V_{EB} = 0.5 V		14	25	pF
C_{obo}	Base-Collector Capacitance				
	I_E = 0 V_{CB} = 10 V		5	8	pF
t_{on}	Turn On Time				
	I_C = 300 mA I_{B1} = 30 mA		14	60	ns
t_{off}	Turn Off Time				
	I_C = 300 mA I_{B1} = 30 mA I_{B2} = 30mA		80	150	ns

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages		
Collector to Emitter (4)	V_{CEO}	40 V
Collector to Emitter	V_{CES}	75 V
Emitter to Base	V_{EBO}	6 V
Temperatures		
Storage Temperature Range	T_{STG}	-55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering, 10 sec.)	T_L	260°C
Power (2 and 3)		
Dissipation at 25°C Case Temperature	P_D	1.5 W
Dissipation at 25°C Ambient Temperature	P_D	0.4 W

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-18 outline



NOTES : All dimensions in mm.
Collector internally connected to case.

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 117°C/W (derating factor of 8.6 mW/°C); junction to-ambient thermal resistance of 438°C/W (derating factor of 2.28 mW/°C).
(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
(5) Measured under pulse conditions: pulse length = 300 µsec; duty cycle 1%.

NOVEMBER 1970

NPN diffused silicon planar transistor BFR 16

Low-level, low-noise high gain amplifier

The BFR 16 is an NPN silicon planar transistor designed for use in high performance, low level, low noise amplifier applications.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 10 μA V_{CE} = 5V		150		
	I_C = 100 μA V_{CE} = 5V	80	220		
	I_C = 1 mA V_{CE} = 5V	150	350	490	
	I_C = 10 mA V_{CE} = 5V	150	370		
$V_{BE\ on}$	Base - Emitter On Voltage I_C = 1 mA V_{CE} = 5V	0.5	0.64	0.70	V
$V_{CE\ sat}$	Collector Saturation Voltage (5) I_C = 1 mA I_B = 0.1 mA		0.15	0.35	V
I_{CES}	Collector Reverse Current V_{CE} = 50V V_{EB} = 0		0.1	10	nA
I_{CES} (150°C)	Collector Reverse Current V_{CE} = 50V V_{EB} = 0		0.1	10	μA
I_{EBO}	Emitter Reverse Current V_{EB} = 5V I_C = 0		0.1	10	nA
BV_{CES}	Collector to Emitter Breakdown Voltage I_C = 10 μA V_{EB} = 0	60			V
BV_{EBO}	Emitter to Base Breakdown Voltage I_E = 10 μA I_C = 0	6			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5) I_C = 10 mA I_B = 0	60			V
h_{fe}	Small Signal Current Gain (f = 1 kHz) I_C = 1 mA V_{CE} = 5V		350		
h_{ie}	Input Resistance (f=1 kHz) I_C = 1 mA V_{CE} = 5V		10		KΩ
h_{oe}	Output Conductance (f=1 kHz) I_C = 1 mA V_{CE} = 5V		17		μmho
h_{re}	Voltage Feedback Ratio (f=1 kHz) I_C = 1 mA V_{CE} = 5V		4.3		$\times 10^{-4}$
h_{fe}	High Freq. Current Gain (f=20 MHz) I_C = 1 mA V_{CE} = 5V	3.5	5		
C_{TE}	Emitter Transition Capacitance I_C = 0 V_{EB} = 0.5V		3.5	6	pF
C_{obo}	Base - Collector Capacitance I_E = 0 V_{CB} = 5V		3.5	6	pF
NF	Wide Band Noise Figure (6) I_C = 10 μA V_{CE} = 5V		1.5	4	dB
NF	Narrow Band Noise Figure (7) I_C = 10 μA V_{CE} = 5V		1	4	dB

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/W (derating factor of 6.9 mW/°C); junction - to - ambient thermal resistance of 486°C/W (derating factor of 2.1 mW/°C).
(4) These ratings refer to a high - current point where collector - to - emitter voltage is lowest. For more information send for SGS - AR 5.
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.
(6) R_S = 10 kΩ; Power Bandwidth of 15.7 kHz with 3 dB points at 10 Hz and 10 kHz.
(7) f = 1 kHz; R_S = 10 kΩ; Power Bandwidth of 200 Hz.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages and Currents

Collector to Emitter (4)	V_{CEO}	60 V
Collector to Emitter	V_{CES}	60 V
Emitter to Base	V_{EBO}	8 V
DC Collector Current	I_C	50 mA

Temperatures

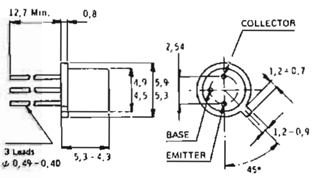
Storage Temperature	T_{STG}	-55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering 10 sec.)	T_L	260°C

Power (2 - 3)

Dissipation at 25°C Case Temperature	P_D	1.2 W
Dissipation at 25°C Ambient Temperature	P_D	0.36 W

PHYSICAL DIMENSIONS

Similar to Jedec TO-18



Note All dimensions are in mm

JUNE 1970

NPN diffused silicon planar transistor BFR 17

Low-level, low-noise, very high gain ampl.

The BFR 17 is an NPN silicon planar transistor designed for use in high performance low level, low noise amplifier applications.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 10 μA, V_{CE} = 5V	130	220		
	I_C = 100 μA, V_{CE} = 5V	220	300		
	I_C = 1 mA, V_{CE} = 5V	450	530		
	I_C = 10 mA, V_{CE} = 5V		530		
$V_{BE\ on}$	Base - Emitter On Voltage				
	I_C = 1 mA, V_{CE} = 5V		0.64		V
	I_C = 100 μA, V_{CE} = 5V		0.58	0.70	V
$V_{CE\ sat}$	Collector Saturation Voltage (5) I_C = 1 mA, I_B = 0.1 mA		0.15	0.35	V
I_{CES}	Collector Reverse Current V_{CE} = 50V, V_{EB} = 0		0.1	20	nA
I_{CES} (150°C)	Collector Reverse Current V_{CE} = 50V, V_{EB} = 0		0.1	20	μA
I_{EBO}	Emitter Reverse Current V_{EB} = 5V, I_C = 0		0.1	20	nA
BV_{CES}	Collector to Emitter Breakdown Voltage I_C = 10 μA, V_{EB} = 0	60			V
BV_{EBO}	Emitter to Base Breakdown Voltage I_E = 10 μA, I_C = 0	8			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5) I_C = 10 mA, I_B = 0	60			V
h_{fe}	Small Signal Current Gain (f=1 kHz) I_C = 1 mA, V_{CE} = 5V		530		
h_{ie}	Input Resistance (f=1 kHz) I_C = 1 mA, V_{CE} = 5V		10		KΩ
h_{oe}	Output Conductance (f=1 kHz) I_C = 1 mA, V_{CE} = 5V		20		μmho
h_{re}	Voltage Feedback Ratio (f=1 kHz) I_C = 1 mA, V_{CE} = 5V		4.5		×10-4
h_{fe}	High Freq. Current Gain (f = 20 MHz) I_C = 1 mA, V_{CE} = 5V	3.5	5		
C_{TE}	Emitter Transition Capacitance I_C = 0, V_{EB} = 0.5V		3.5	6	pF
C_{obo}	Base - Collector Capacitance I_E = 0, V_{CB} = 5V		3.5	6	pF
NF	Wide Band Noise Figure (6) I_C = 10 μA, V_{CE} = 5V		1.5	4	dB
NF	Narrow Band Noise Figure (7) I_C = 10 μA, V_{CE} = 5V		1	3	dB
NF	Narrow Band Noise Figure (f=10 kHz) I_C = 10 μA, V_{CE} = 5V		1	3	dB

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/W (derating factor of 6.9 mW/°C); junction - to - ambient thermal resistance of 486°C/W (derating factor of 2.1 mW/°C).
(4) These ratings refer to a high - current point where collector - to - emitter voltage is lowest. For more information send for SGS - AR 5.
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.
(6) R_S = 10 kΩ; Power Bandwidth of 15.7 kHz with 3 dB points at 10 Hz and 10 kHz.
(7) f = 1 kHz; R_S = 10 kΩ; Power Bandwidth of 200 Hz.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages and Currents

Collector to Emitter (4)	V_{CEO}	60 V
Collector to Emitter	V_{CES}	60 V
Emitter to Base	V_{EBO}	8 V
DC Collector Current	I_C	50 mA

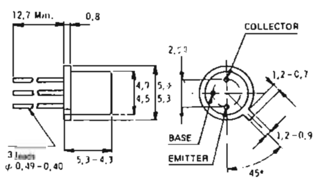
Temperatures

Storage Temperature	T_{STG}	-55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering 10 sec.)	T_L	260°C

Power (2 - 3)

Dissipation at 25°C Case Temperature	P_D	1.2 W
Dissipation at 25°C Ambient Temperature	P_D	0.36 W

PHYSICAL DIMENSIONS
Similar to Jedec TO-18



Note All dimensions are in mm

JUNE 1970

NPN diffused silicon planar transistor BFR 18

High voltage, high current amplifier

The BFR 18 is an NPN silicon planar epitaxial transistor designed for amplifier applications over a wide range of voltage and current. It features a useful beta range from 100 μA to 500 mA.

ELECTRICAL CHARACTERISTICS
(T_A = 25° C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC current Gain (5)				
	I_C = 100 μA, V_{CE} = 1V	30	75		
	I_C = 10 mA, V_{CE} = 1V	70	120	180	
	I_C = 150 mA, V_{CE} = 1V	60	90	180	
	I_C = 500 mA, V_{CE} = 1V	30	45		
h_{FE} (-55°C)	DC Current Gain (5)				
	I_C = 150 mA, V_{CE} = 1V	15			
$V_{BE\ sat}$	Base Saturation Voltage (5)				
	I_C = 150 mA, I_B = 15 mA		0.85	1	V
	I_C = 500 mA, I_B = 50 mA		1.1		V
	I_C = 1A, I_B = 0.1A		1.35	1.6	V
$V_{BE\ on}$	Base Emitter On Voltage				
	I_C = 10 mA, V_{CE} = 1V		0.66		V
$V_{CE\ sat}$	Collector Saturation Voltage (5)				
	I_C = 150 mA, I_B = 15 mA		0.13	0.25	V
	I_C = 500 mA, I_B = 50 mA		0.30		V
	I_C = 1A, I_B = 0.1A		0.65	1	V
I_{CES}	Collector Reverse Current				
	V_{CE} = 60V, V_{EB} = 0		0.2	10	nA
I_{CES} (150°C)	Collector Reverse Current				
	V_{CE} = 60V, V_{EB} = 0		0.2	10	μA
I_{EBO}	Emitter Reverse Current				
	V_{EB} = 5V, I_C = 0		0.1		nA
BV_{CES}	Collector to Emitter Breakdown Voltage				
	I_C = 100 μA, V_{EB} = 0	85			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E = 100 μA, I_C = 0	7			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 30 mA, I_B = 0	55			V
h_{fe}	Small Signal Current Gain (f=1kHz)				
	I_C = 1 mA, V_{CE} = 5V		120		
h_{ie}	Input Resistance (f=1kHz)				
	I_C = 1 mA, V_{CE} = 5V		2.2		KΩ
h_{oe}	Output Conductance (f=1 kHz)				
	I_C = 1 mA, V_{CE} = 5V		8.5		μmho
h_{re}	Voltage Feedback Ratio (f=1 kHz)				
	I_C = 1 mA, V_{CE} = 5V		2.4		$\times 10^{-4}$
h_{fe}	High Freq. Current Gain (f=20 MHz)				
	I_C = 50 mA, V_{CE} = 10V	3	4.5		
C_{TE}	Emitter Transition Capacitance				
	I_C = 0, V_{EB} = 0.5V		50	80	pF
C_{obo}	Base Collector Capacitance				
	I_E = 0, V_{CB} = 10V		12	20	pF
NF	Narrow Band Noise Figure (6)				
	I_C = 30 μA, V_{CE} = 10V		2	7	dB

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 97°C/W (derating factor of 10.3 mW/°C); junction - to - ambient thermal resistance of 350°C/W (derating factor of 2.85 mW/°C).
(4) These ratings refer to a high - current point where collector - to - emitter voltage is lowest. For more information send for SGS - AR 5.
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.
(6) f = 1 kHz; R_S = 1 kΩ; Power Bandwidth of 200 Hz.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Emitter (4)	V_{CEO}	55 V
Collector to Emitter	V_{CES}	85 V
Emitter to Base	V_{EBO}	7 V

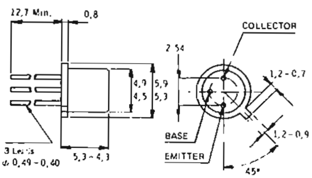
Temperatures

Storage Temperature	T_{STG}	-55° C to 200° C
Junction Temperature	T_J	200° C
Lead Temperature (Soldering 10 sec.)	T_L	260° C

Power (2 - 3)

Dissipation at 25° C Case Temperature	P_D	1.8 W
Dissipation at 25° C Ambient Temperature	P_D	0.5 W

PHYSICAL DIMENSIONS
Similar to Jedec TO-18



Note All dimensions are in mm

JUNE 1970

NPN diffused silicon planar transistor

BFR 19

High voltage, high current amplifier

The BFR 19 in an NPN silicon planar epitaxial transistor designed for amplifier applications over a wide range of voltage and current. It features a useful beta range from 100 μA to 500 mA.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 100 μA V_{CE} = 1V	30	60		
	I_C = 5 mA V_{CE} = 1V	70	95	120	
	I_C = 50 mA V_{CE} = 1V		95		
	I_C = 150 mA V_{CE} = 1V	40	80	120	
	I_C = 500 mA V_{CE} = 1V	30	45		
$V_{BE\ sat}$	Base Saturation Voltage (5)				
	I_C = 50 mA I_B = 5 mA		0.77		V
	I_C = 150 mA I_B = 15 mA		0.85	1	V
	I_C = 1A I_B = 0.1A		1.35	1.6	V
$V_{BE\ on}$	Base Emitter On Voltage				
	I_C = 5 mA V_{CE} = 1V		0.65		V
$V_{CE\ sat}$	Collector Saturation Voltage (5)				
	I_C = 50 mA I_B = 5 mA		0.08		V
	I_C = 150 mA I_B = 15 mA		0.13	0.25	V
	I_C = 1A I_B = 0.1A		0.65	1	V
I_{CES}	Collector Reverse Current				
	V_{CE} = 50V V_{EB} = 0		0.1	10	nA
$I_{CES\,(150°C)}$	Collector Reverse Current				
	V_{CE} = 50V V_{EB} = 0		0.1	10	μA
I_{EBO}	Emitter Reverse Current				
	V_{EB} = 5V I_C = 0		0.1	10	nA
BV_{CES}	Collector to Emitter Breakdown Voltage				
	I_C = 100 μA V_{EB} = 0	75			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E = 100 μA I_C = 0	7			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 30 mA I_B = 0	35			V
h_{fe}	Small Signal Current Gain (f=1kHz)				
	I_C = 1 mA V_{CE} = 5V		90		
h_{ie}	Input Resistance (f=1 kHz)				
	I_C = 1 mA V_{CE} = 5V		2.2		kΩ
h_{oe}	Output Conductance (f=1kHz)				
	I_C = 1 mA V_{CE} = 5V		8.5		μmho
h_{ro}	Voltage Feedback Ratio (f=1kHz)				
	I_C = 1 mA V_{CE} = 5V		2.4		$\times 10^{-4}$
h_{fe}	High Freq. Current Gain (f=20MHz)				
	I_C = 50 mA V_{CE} = 10V	3	5		
C_{TE}	Emitter Transition Capacitance				
	I_C = 0 V_{EB} = 0.5V		50	80	pF
C_{obo}	Base Collector Capacitance				
	I_E = 0 V_{CB} = 10V		12.5	20	pF
NF	Narrow Band Noise Figure (6)				
	I_C = 30 μA V_{CE} = 10V		2	7	dB

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 35°C/W (derating factor of 28.6 mW/°C); junction - to - ambient thermal resistance of 219°C°W (derating factor of 4.57 mW/°C).
(4) These ratings refer to a high - current point where collector - to - emitter voltage is lowest. For more information send for SGS - AR 5.
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle =1%.
(6) f = 1 kHz; R_S = 1 kΩ; Power Bandwith of 200 Hz.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Emitter (4)	V_{CEO}	35 V
Collector to Emitter	V_{CES}	75 V
Emitter to Base	V_{EBO}	7 V

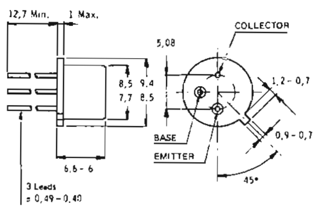
Temperatures

Storage Temperature	T_{STG}	-55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering 10 sec.)	T_L	260°C

Power (2 - 3)

Dissipation at 25°C Case Temperature	P_D	5 W
Dissipation at 25°C Ambient Temperature	P_D	0.8 W

PHYSICAL DIMENSIONS
Similar to Jedec TO-5



Note All dimensions are in mm

JUNE 1970

NPN diffused silicon planar transistor

BFR 20

General purpose

The BFR 20 is an NPN silicon planar epitaxial transistor designed primarily for amplifier and switching applications over a wide range of voltage and current. This device features a useful beta range from 100 μA to 500 mA and low saturation voltage permitting switching operation at 1 ampere.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 100 μA V_{CE} = 1V	40			
	I_C = 5 mA V_{CE} = 1V	100		500	
	I_C = 150 mA V_{CE} = 1V	90	250	450	
	I_C = 500 mA V_{CE} = 1V	30			
$V_{BE\ sat}$	Base Saturation Voltage (5)				
	I_C = 150 mA I_B = 15 mA		0.9	1	V
	I_C = 1A I_B = 0.1A		1.25	1.6	V
$V_{BE\ on}$	Base Emitter On Voltage I_C = 150 mA V_{CE} = 15 V		0.13	0.25	V
$V_{CE\ sat}$	Collector Saturation Voltage (5) I_C = 1A I_B = 0.1A		0.65	1	V
I_{CES}	Collector Reverse Current V_{CE} = 50V V_{EB} = 0		0.1	10	nA
I_{CES} (150°C)	Collector Reverse Current V_{CE} = 50V V_{EB} = 0		0.1	10	μA
I_{EBO}	Emitter Reverse Current V_{EB} = 5V I_C = 0		0.1	10	nA
BV_{CES}	Collector to Emitter Breakdown Voltage I_C = V_{EB} = 0	75			V
BV_{EBO}	Emitter to Base Breakdown Voltage I_E = I_C = 0	7			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5) I_C = I_B = 0	35			V
h_{fe}	High Freq. Current Gain (f=20 MHz) I_C = 50 mA V_{CE} = 10V	3	4.5		
C_{TE}	Emitter Transition Capacitance I_C = 0 V_{EB} = 0.5V		50	80	pF
C_{obo}	Base Collector Capacitance I_E = 0 V_{CB} = 10V		13	20	pF
t_{on}	Turn On Time I_C = 150 mA I_{B1} = 7.5 mA		130	200	ns
t_{off}	Turn Off Time I_C = 150 mA I_{B1} = 7.5 mA I_{B2} = 7.5 mA		450	800	ns

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Emitter (4)	V_{CEO}	35 V
Collector to Emitter	V_{CES}	75 V
Emitter to Base	V_{EBO}	7 V

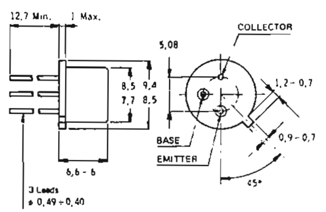
Temperatures

Storage Temperature	T_{STG}	-55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering 10 sec.)	T_L	260°C

Power (2 - 3)

Dissipation at 25°C Case Temperature	P_D	5 W
Dissipation at 25°C Ambient Temperature	P_D	0.8 W

PHYSICAL DIMENSIONS
Similar to Jedec TO-5



Note: All dimensions are in mm

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 35°C/W (derating factor of 28.6 mW/°C); junction - to - ambient thermal resistance of 219°C/W (derating factor of 4.57 mW/°C).
(4) These ratings refer to a high - current point where collector - to - emitter voltage is lowest. For more information send for SGS - AR 5.
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.

NPN diffused silicon planar transistor

BFR 21

High voltage, amplifier and switch

The BFR 21 is an NPN silicon planar epitaxial transistor designed primarily for amplifier and switching applications over a wide range of voltage and current. This device features a useful beta range from 100 μA to 500 mA and low saturation voltage permitting switching operation at 1 ampere. High collector-to-emitter voltage allows operation to 70V.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions		Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)					
	I_C = 100 μA	V_{CE} = 1V	20	50		
	I_C = 10 mA	V_{CE} = 1V	50	85		
	I_C = 150 mA	V_{CE} = 1V	40	70		
	I_C = 500 mA	V_{CE} = 1V	20	35		
$V_{BE\ sat}$	Base Saturation Voltage (5)					
	I_C = 150 mA	I_B = 15 mA		0.85	1.1	V
	I_C = 500 mA	I_B = 50 mA		1.1		V
	I_C = 1A	I_B = 0.1 A		1.35	2	V
$V_{CE\ sat}$	Collector Saturation Voltage (5)					
	I_C = 150 mA	I_B = 15 mA		0.13	0.25	V
	I_C = 500 mA	I_B = 50 mA		0.30		V
	I_C = 1A	I_B = 0.1A		0.65	1	V
I_{CES}	Collector Reverse Current					
	V_{CE} = 80V	V_{EB} = 0		0.1	10	nA
I_{CES} (150°C)	Collector Reverse Current					
	V_{CE} = 80V	V_{EB} = 0		0.1	10	μA
I_{EBO}	Emitter Reverse Current					
	V_{EB} = 5V	I_C = 0		0.05	10	nA
BV_{CES}	Collector to Emitter Breakdown Voltage					
	I_C = 100 μA	V_{EB} = 0	120			V
BV_{EBO}	Emitter to Base Breakdown Voltage					
	I_E = 100 μA	I_C = 0	7			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)					
	I_C = 30 mA	I_B = 0	70			V
h_{fe}	Small Signal Current Gain (f=1 kHz)					
	I_C = 1 mA	V_{CE} = 5V		80		
h_{ie}	Input Resistance (f=1 kHz)					
	I_C = 1 mA	V_{CE} = 5V		2		kΩ
h_{oe}	Output Conductance (f=1 KHz)					
	I_C = 1 mA	V_{CE} = 5V		8		μmho
h_{re}	Voltage Feedback Ratio (f=1 kHz)					
	I_C = 1 mA	V_{CE} = 5V		2.1		$\times 10^{-4}$
h_{fe}	High Freq. Current Gain (f=20 MHz)					
	I_C = 50 mA	V_{CE} = 10V	2.5	4.5		
C_{TE}	Emitter Transition Capacitance					
	I_C = 0	V_{EB} = 0.5V		50	80	pF
C_{obo}	Base Collector Capacitance					
	I_E = 0	V_{CB} = 10V		13	20	pF
t_{on}	Turn on Time					
	I_C = 150 mA	I_{B1} = 7.5 mA		130	200	ns
t_{off}	Turn Off Time					
	I_C = 150 mA	I_{B1} = 7.5 mA I_{B2} = 7.5 mA		450	800	ns

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 35°C/W (derating factor of 28.6 mW/°C); junction - to - ambient thermal resistance of 219°C/W (derating factor of 4.57 mW/°C).
(4) These ratings refer to a high - current point where collector - to - emitter voltage is lowest. For more information send for SGS - AR 5.
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Emitter (4)	V_{CEO}	70 V
Collector to Emitter	V_{CES}	120 V
Emitter to Base	V_{EBO}	7 V

Temperatures

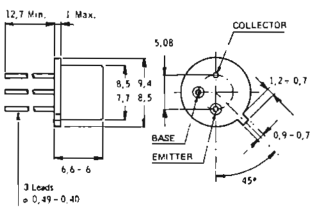
Storage Temperature	T_{STG}	-55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering 10 sec.)	T_L	260°C

Power (2 - 3)

Dissipation at 25°C Case Temperature	P_D	5 W
Dissipation at 25°C Ambient Temperature	P_D	0.8 W

PHYSICAL DIMENSIONS

Similar to Jedec TO-5



Note All dimensions are in mm.

JUNE 1970

NPN multi-emitter silicon planar transistor **BFR 36**

CATV ultra-linear high gain transistor

The BFR 36 is a NPN multi-emitter silicon planar epitaxial transistor particularly suited for CATV-MATV amplifier application in a wide frequency range (40 - 860MHz).
It features :
- Very good intermodulation properties
- Very low feedback capacitance (C_{re} = 1.7pF)
- High power gain (16dB at 200 MHz)
- High power dissipation

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 70mA V_{CE} = 5V	60	130		
	I_C = 150mA V_{CE} = 5V	60			
	I_C = 70mA V_{CE} = 15V	65			
	I_C = 150mA V_{CE} = 15V	65			
V_{BEon}	Base-Emitter On Voltage				
	I_C = 70mA V_{CE} = 5V		750		mV
I_{CBO}	Collector Reverse Current				
	V_{CB} = 20V I_E = 0 T_A = 25°C			150	nA
	T_A = 150°C			20	µA
BV_{CBO}	Collector to Base Breakdown Voltage				
	I_C = 100 µA I_E = 0	40			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E = 100 µA I_C = 0	3			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 10 mA I_B = 0	30			V
C_{re}	Reverse Transfer Capacitance				
	I_C = 0 V_{CE} = 15V f = 1MHz		1.7	2.2	pF
C_{obo}	Base-Collector Capacitance				
	I_E = 0 V_{CB} = 15V f = 1MHz			3	pF
h_{fe}	High Frequency Current Gain				
	I_C = 70mA V_{CE} = 15V f = 100MHz	10	14		
	I_C = 150mA V_{CE} = 15V f = 100MHz		12		
P_G	Power Gain (not neutralized)				
	I_C = 70mA V_{CE} = 18V f = 200MHz		16		dB
	f = 500MHz		9.5		dB
	f = 800MHz		6.5		dB
P_o	Power Output (7 and 9)				
	I_C = 70mA V_{CE} = 18V f = 200MHz	130	150		mW
	(8 and 9) f = 800MHz	70	90		mW
NF	Noise Figure (f = 200 MHz),				
	I_C = 30mA V_{CE} = 15V R_S = 50 Ω		4		dB
	I_C = 70mA V_{CE} = 15V R_S = 50 Ω		4.5		dB
V_{CEK}	Knee Voltage				
	I_C = 100mA I_B = value for which I_C = 110mA at V_{CE} = 1V		700	750	mV
C_{TE}	Emitter Transition Capacitance				
	I_C = 0 V_{BE} = 0.4V f = 1MHz		7		pF

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 30°C/W (derating factor of 33.3 mW/°C); junction-to-ambient thermal resistance of 200°C/W (derating factor of 5 mW/°C).
4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
5) Measured under pulse conditions : pulse length ≤ 300 µsec; duty cycle = 1%.
6) See switching circuits for exact values of I_C, I_{B1} and I_{B2}.
7) V.S.W.R. at output < 2; f_p = 202MHz; f_q = 205MHz; dim -30dB measured at f(2 q-p) 208MHz (channel 9).
8) V.S.W.R. at output < 2; f_p 798MHz; f_q = 802MHz; dim = -30dB measured at f(2 q-p) – 806MHz (channel 62).
9) See test circuit.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages and Currents

Collector to Base	V_{CBO}	40 V
Collector to Emitter (4)	V_{CEO}	30 V
Emitter to Base	V_{EBO}	3 V
DC Collector Current	I_C	200 mA
Collector Peak Current	I_{CM}	400 mA

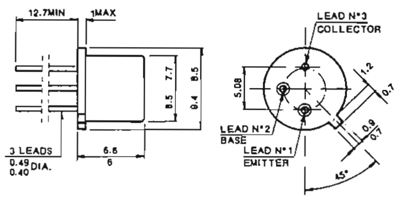
Temperatures

Storage Temperature Range	-55°C to + 200°C
Operating Junction Temperature	+ 200°C

Power (2 and 3)

Dissipation at 50°C Case Temperature	P_D	5 W
Dissipation at 40°C Ambient Temperature	P_D	0.8 W

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-39 outline

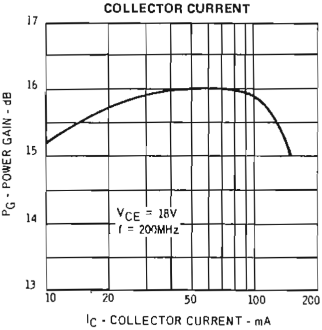


Notes: All dimensions in mm.
Collector internally connected to case.

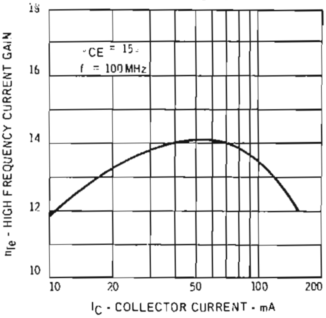
OCTOBER 1971

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

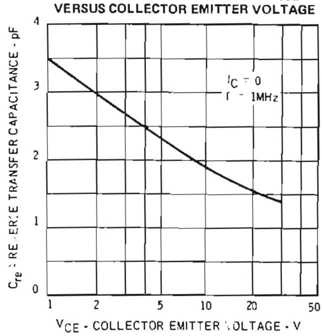
TYPICAL POWER GAIN VERSUS COLLECTOR CURRENT



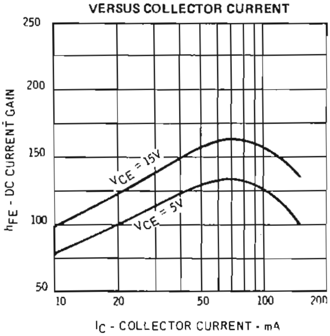
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



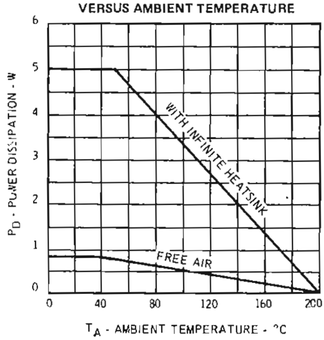
REVERSE TRANSFER CAPACITANCE VERSUS COLLECTOR EMITTER VOLTAGE



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



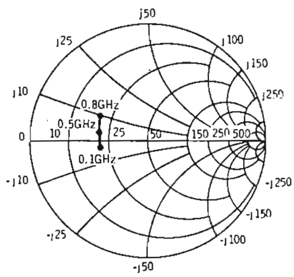
MAXIMUM ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



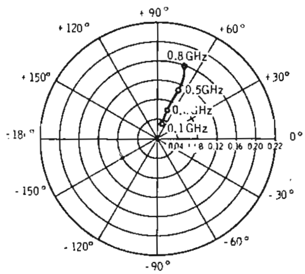
TYPICAL COMMON EMITTER S-PARAMETERS

(V_{CE} = 18V; I_C = 70mA; T_A = 25°C)

INPUT IMPEDANCE S_{11} E (Ω)

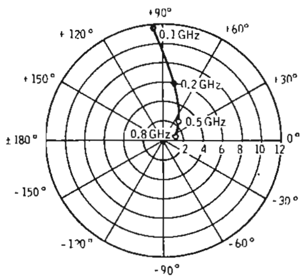


REVERSE TRANSFER COEFFICIENT S_{12} E

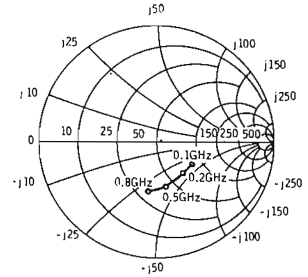


TYPICAL COMMON EMITTER S-PARAMETERS
(V_{CE} = 18V; I_C = 70mA; T_A = 25°C)

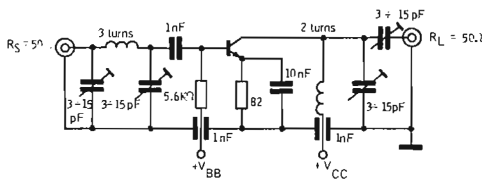
FORWARD TRANSFER COEFFICIENT $S_{21\,E}$



OUTPUT IMPEDANCE $S_{22\,E}$ (Ω)

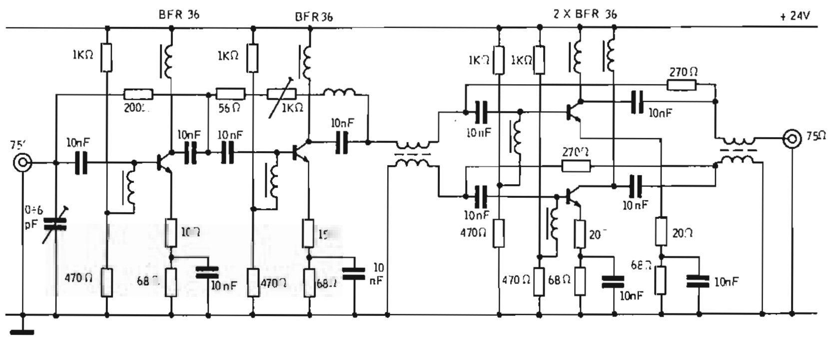


RF AMPLIFIER CIRCUIT FOR POWER GAIN TEST (f = 200 MHz)



TYPICAL APPLICATIONS :

CATV - EXTENDER LINE AMPLIFIER



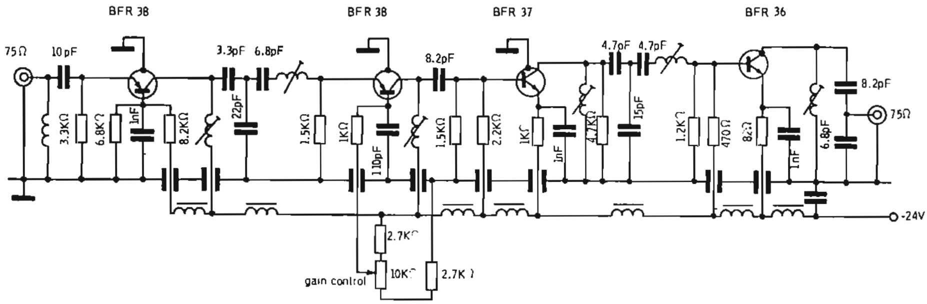
Second order distortion at V_{OUT} = + 46dBmV:

BW_{-3dB} = 10 ÷ 350MHz
P.G. = 25dB

d_{f1+f2} = -61dB   f1 = 159MHz
d_{f1-f2} = -66dB   f2 = 57MHz

TYPICAL APPLICATIONS (Contd.)

MATV - 200 MHz CHANNEL AMPLIFIER



Supply Voltage	: -24V	V.S.W.R.$_{IN}$	: <1.5
Current Drain	: 110mA	V.S.W.R.$_{OUT}$	: < 2
P.G.	: 70dB	P_{OUT} = 120mW at dim = -30dB	
N.F.	: 3dB	Gain Control	: >30dB

NPN diffused silicon planar transistor

BFR 37

UHF/VHF amplifier

The BFR 37 is a silicon planar epitaxial transistor with very high f_T (typ. 1.4GHz at I_C = 10mA), and very low C_{re} (typ. 0.22pF).
The BFR 37 is particularly suitable as driver in CATV applications.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5) I_C = 10mA V_{CE} = 15V	80	150	250	
$V_{BE\ on}$	Base-Emitter On Voltage I_C = 10mA V_{CE} = 15V		0.74	0.9	V
$V_{CE\ sat}$	Collector Saturation Voltage (5) I_C = 10mA I_B = 1mA		0.13		V
I_{CES}	Collector Reverse Current V_{CE} = 15V V_{EB} = 0 V_{CE} = 15V V_{EB} = 0 (125°C)			100 50	nA μA
BV_{CES}	Collector to Emitter Breakdown Voltage I_C = 10μA V_{EB} = 0	30			V
BV_{EBO}	Emitter to Base Breakdown Voltage I_E = 10μA I_C = 0	4			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5) I_C = 5mA I_B = 0	30			V
h_{fe}	High Freq. Current Gain I_C = 10mA V_{CE} = 15V f = 100MHz	8	14		
C_{re}	Reverse Transfer Capacitance I_C = 0 V_{CE} = 15V		0.22		pF
NF	Narrow Band Noise Figure (6) I_C = 3mA V_{CE} = 15V		5		dB
PG	Power Gain (7) I_C = 10mA V_{CE} = 15V		14		dB

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 400°C/W (derating factor of 2.5 mW/°C); junction-to-ambient thermal resistance of 700°C/W (derating factor of 1.43 mW/°C).
(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR5.
(5) Measured under pulse conditions: pulse length = 300μsec; duty cycle = 1%.
(6) f = 500MHz; R_S = 50Ω.
(7) f = 500MHz; R_S = 50Ω; R_L = 500Ω; P_o = 10mW

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages and Currents

Collector to Emitter (4)	V_{CEO}	30 V
Collector to Emitter	V_{CES}	30 V
Emitter to Base	V_{EBO}	4 V
DC Collector Current	I_C	50 mA

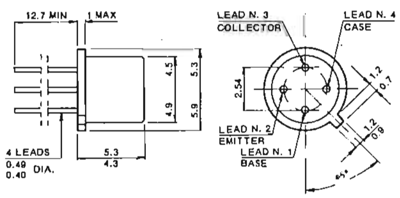
Temperatures

Storage Temperature Range	T_{STG}	-55°C to 200°C
Operating Junction Temperature	T_J	200°C
Lead Temperature (Soldering, 10sec. time limit)	T_L	260°C

Power (2 and 3)

Dissipation at 25°C Case Temperature	P_D	430 mW
Dissipation at 25°C Ambient Temperature	P_D	250 mW

PHYSICAL DIMENSIONS
In accordance with
JEDEC TO-72 outline



NOTE: all dimensions in mm.

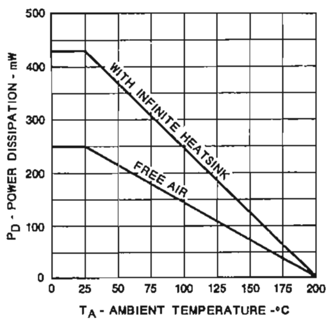
DECEMBER 1970

TYPICAL HIGH FREQUENCY Y PARAMETERS (I_C = 10mA; V_{CE} = 15V)

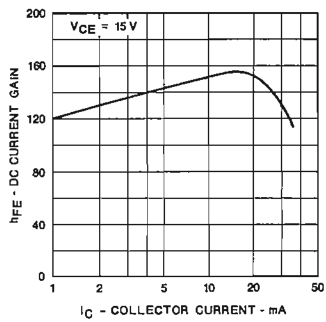
SYMBOL	CHARACTERISTIC	200MHz	500MHZ	800MHZ	UNIT
g_{11e}	Input Conductance	12	22	30	mmho
b_{11e}	Input Susceptance	9.5	3	-7	mmho
g_{21e}	Forward Transfer Conductance	45	-3	-28	mmho
b_{21e}	Forward Transfer Susceptance	-92	-48	-26	mmho
g_{22e}	Output Conductance	0.36	0.45	1.1	mmho
b_{22e}	Output Susceptance	1.7	4.1	7	mmho

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

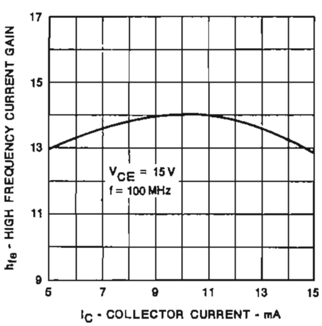
DERATING FACTOR



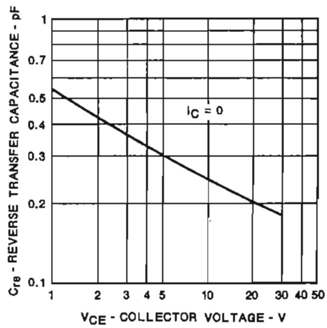
DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT



HIGH FREQUENCY CURRENT GAIN
VERSUS COLLECTOR CURRENT



REVERSE TRANSFER CAPACITANCE
VERSUS COLLECTOR VOLTAGE



PNP diffused silicon planar transistor BFR 38

Low-noise UHF/VHF amplifier

The BFR 38 is a PNP silicon planar epitaxial transistor designed as very low noise UHF/VHF amplifier up to 1GHz. The BFR 38 is particularly intended for TV aerial amplifiers and MATV preamplifier applications.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5) I_C = 3mA V_{CE} = -10V	25	50		
V_{BEon}	Base-Emitter On Voltage I_C = 3 mA V_{CE} = -10V		-0.75		V
I_{CBO}	Collector Reverse Current V_{CB} = -20V I_E = 0		0.1	50	nA
	V_{CB} = -20V I_E = 0 T_A = 150°C		0.1		µA
BV_{CBO}	Collector to Base Breakdown Voltage I_C = 10µA I_E = 0	-40			V
BV_{EBO}	Emitter to Base Breakdown Voltage I_E = 10µA I_C = 0	-3			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5) I_C = 5mA I_B = 0	-35			V
h_{fe}	High Freq. Current Gain V_{CE} = -10V I_C = 3mA f = 100 MHz	7	8.5		
C_{re}	Reverse Transfer Capacitance I_C = 0 V_{CE} = -10V f = 1 MHz		0.3		pF
C_{rb}	Common Base Feedback Capacitance I_C = 0 V_{CB} = -10V f = 1 MHz		0.05	0.09	pF
NF	Noise Figure (6) I_C = 3mA V_{CB} = -10V		2.5		dB
NF	Narrow Band Noise Figure I_C = 3mA V_{CB} = -10V (7)		2.7		dB
	I_C = 3mA V_{CB} = -10V (8)		3.5	5.5	dB
PG	Power Gain I_C = 3mA V_{CB} = -10V f=200 MHz		19		dB
	I_C = 3mA V_{CB} = -10V f=500 MHz		16		dB
	I_C = 3mA V_{CB} = -10V f=800 MHz	11	14		dB

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages and Current

Collector to Base	V_{CBO}	-40 V
Collector to Emitter (4)	V_{CEO}	-35 V
Emitter to Base	V_{EBO}	-3 V
DC Collector Current	I_C	20 mA

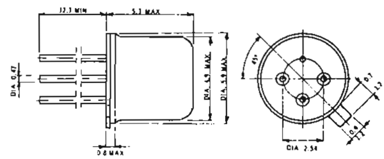
Temperatures

Storage Temperature Range	T_{STG}	-55°C to 200°C
Operating Junction Temperature	T_J	200°C
Lead Temperature (Soldering, 10 sec. time limit)	T_L	260°C

Power (2 and 3)

Dissipation at 25°C Ambient Temperature	P_D	200 mW
Dissipation at 45°C Ambient Temperature	P_D	175 mW

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-72 outline



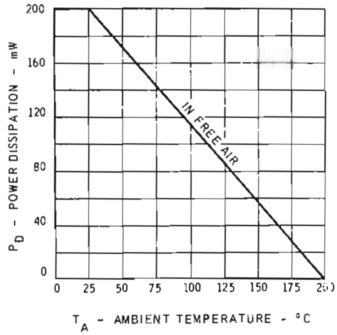
Note: all dimensions in mm.

NOTES :

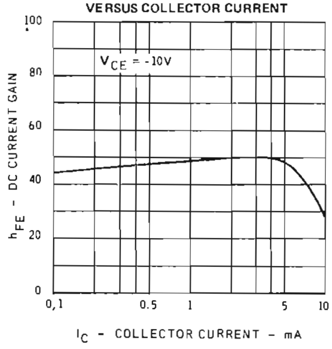
1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3) These ratings give a maximum junction temperature of 200°C and junction-to-ambient thermal resistance of 875°C/W (derating factor of 1.14 mW/°C).
4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR5.
5) Measured under pulse conditions: pulse length = 300 µsec; duty cycle = 1%.
6) f = 200 MHz; R_S = 50Ω
7) f = 500 MHz; R_S = 50 Ω
8) f = 800 MHz; R_S = 50 Ω

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

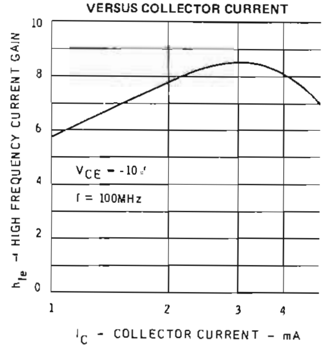
DERATING FACTOR



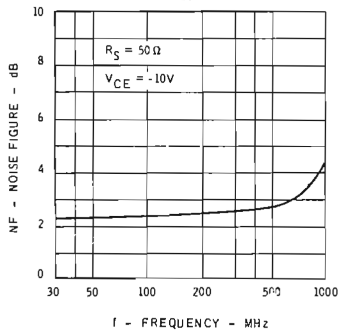
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



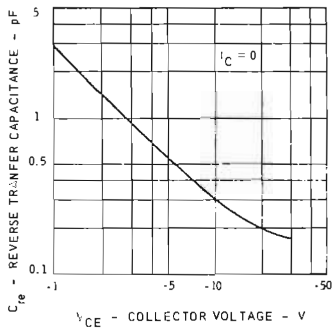
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



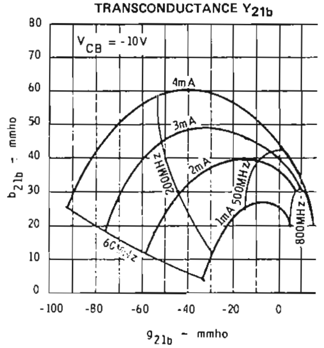
NOISE FIGURE VERSUS FREQUENCY



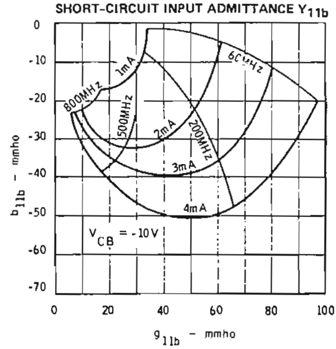
REVERSE TRANSFER CAPACITANCE VERSUS COLLECTOR VOLTAGE



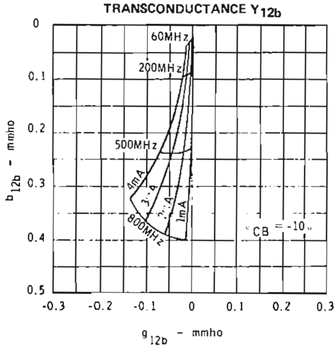
SHORT-CIRCUIT FORWARD TRANSCONDUCTANCE Y_{21b}



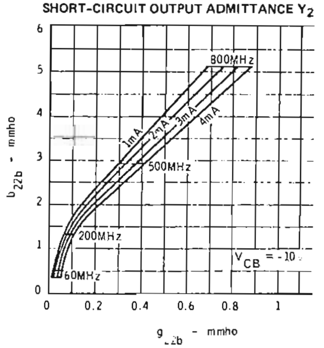
SHORT-CIRCUIT INPUT ADMITTANCE Y_{11b}



SHORT- CIRCUIT REVERSE TRANSCONDUCTANCE Y_{12b}

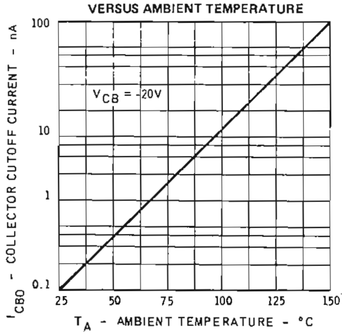


SHORT-CIRCUIT OUTPUT ADMITTANCE Y_{22b}

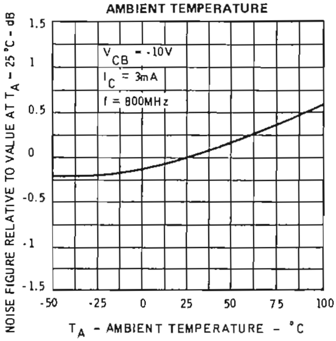


TYPICAL ELECTRICAL CHARACTERISTICS (25° C free air temperature unless otherwise noted)

COLLECTOR CUTOFF CURRENT
VERSUS AMBIENT TEMPERATURE

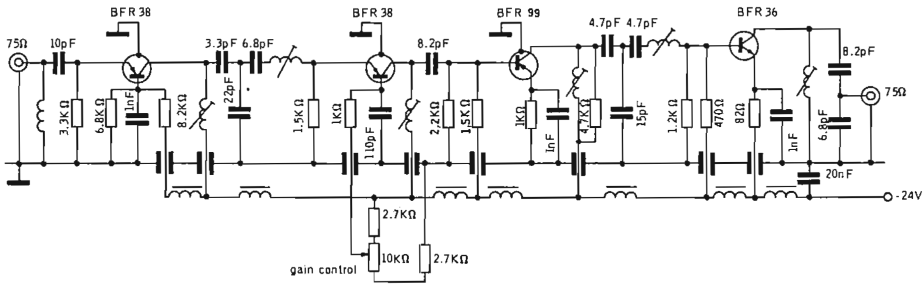


NOISE FIGURE VERSUS
AMBIENT TEMPERATURE



TYPICAL APPLICATIONS:

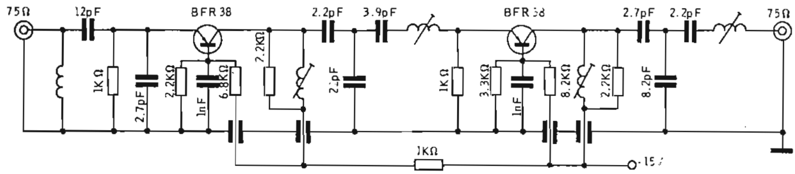
MATV 200MHz CHANNEL AMPLIFIER



Supply Voltage	: -24V	V.S.W.R.$_{IN}$	: <1.5
Current Drain	: 110mA	V.S.W.R.$_{OUT}$	: <2
PG	: 70dB	'P$_{OUT}$	= 120mW at dim = -30 dB
NF	: 3dB	Gain Control	: >30dB

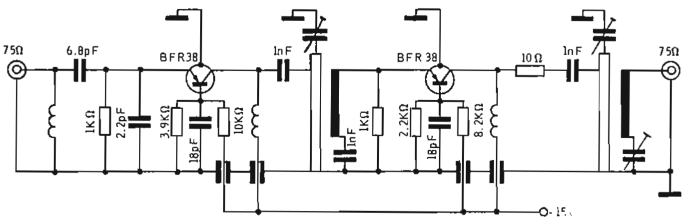
TYPICAL APPLICATIONS (Contd.)

213MHz VHF AERIAL AMPLIFIER (TV - CH. 10)



Supply Voltage	: -15V	NF	: 3dB
Current Drain	: 8mA	V.S.W.R.$_{IN}$	: <1.5
PG	: 28dB	V.S.W.R.$_{OUT}$	: <1.5

800MHz UHF AERIAL AMPLIFIER (TV - CH. 62)



Supply Voltage	: -15V	NF	: 4dB
Current Drain	: 8mA	V.S.W.R.$_{IN}$	: <2
PG	: 26dB	V.S.W.R.$_{OUT}$	: <1.5

NPN multi-emitter silicon planar transistor

BFR 97-2N3866

VHF-UHF oscillator power amplifier

The BFR 97/2N 3866 is a NPN, silicon planar epitaxial transistor designed for VHF–UHF class A, B or C amplifier circuits and oscillator applications.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 50 mA V_{CE} = 5 V	10		200	
	I_C = 360 mA V_{CE} = 5 V	5			
$V_{CE\,sat}$	Collector Saturation Voltage (5)				
	I_C = 100 mA I_B = 20 mA			1	V
I_{CEO}	Collector Reverse Current				
	V_{CE} = 28V I_B = 0			20	μA
BV_{CES}	Collector to Emitter Breakdown Voltage				
	I_C = 0.1 mA V_{EB} = 0	55			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E = 100 μA I_C = 0	3.5			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 5 mA I_B = 0	30			V
h_{fe}	High Freq. Current Gain				
	I_C = 50 mA V_{CE} = 15V f = 200 MHz	2.5			
C_{obo}	Base-Collector Capacitance				
	I_E = 0 V_{CB} = -28V f = 1 MHz			3	pF
P_o	RF Power Output				
	P_{in} = 100mW V_{CC} = -28V f = 400 MHz See Fig. 1	1			W
η	Collector Efficiency				
	P_{out} = 1 W V_{CC} = 28V f = 400 MHz See Fig. 1	45			%

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Emitter (4)	V_{CEO}	30 V
Collector to Emitter	V_{CES}	55 V
Emitter to Base	V_{EBO}	3.5 V

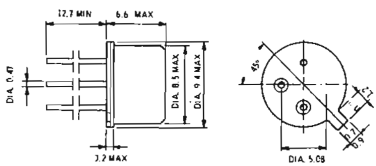
Temperatures

Storage Temperature Range	T_{STG}	-65°C to + 200°C
Operating Junction Temperature	T_J	+ 200°C

Power (2 and 3)

Dissipation at 25°C Case Temperature	P_D	5 W

PHYSICAL DIMENSIONS
Similar to
JEDEC TO-39 outline



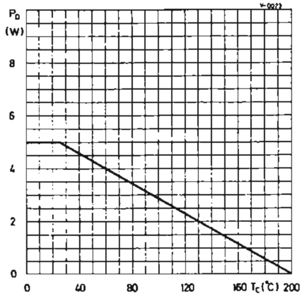
Note: all dimensions in mm.

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 35°C/W (derating factor of 28.5 mW/°C).
4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS - AR 5.
5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%

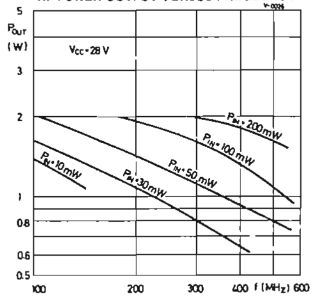
APRIL 1972

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

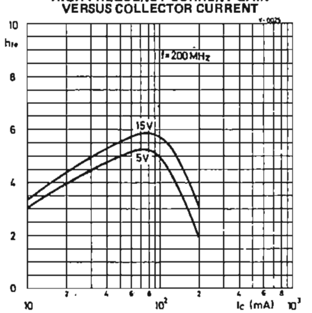
POWER DISSIPATION VERSUS
CASE TEMPERATURE



RF POWER OUTPUT VERSUS FREQUENCY



HIGH FREQUENCY CURRENT GAIN
VERSUS COLLECTOR CURRENT



OUTPUT CAPACITANCE VERSUS
COLLECTOR BIAS VOLTAGE

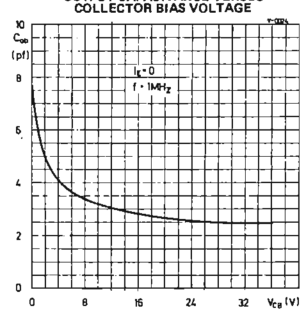
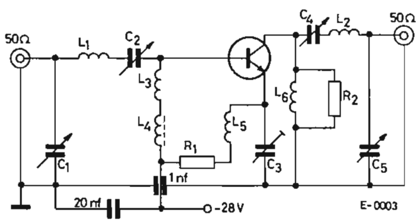


FIG. 1 - RF AMPLIFIER CIRCUIT POWER OUTPUT TEST
(400 MHz OPERATION)



C_1, C_2, C_4, C_5 = 3 ÷ 25 pF
C_3 = 7 ÷ 15 pF
R_1 = 5.6 Ω
R_2 = 1 KΩ

L_1, L_2 = 5 cm Line (2 x 5 mm)
L_3, L_5, L_6 = RF choke 0.1 μH
L_4 = Ferrite choke 1 lum

NPN multi-emitter silicon planar transistor — BFR 98-2N4427

VHF oscillator power amplifier

The BFR 98/2N 4427 is a NPN, silicon planar epitaxial transistor designed for VHF class A, B, or C amplifier and oscillator applications.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 100 mA V_{CE} = 5V	10		200	
	I_C = 360 mA V_{CE} = 5V	5			
$V_{CE\,sat}$	Collector Saturation Voltage (5)				
	I_C = 100 mA I_B = 20 mA			0.5	V
I_{CEO}	Collector Reverse Current				
	V_{CE} = 12V I_B = 0			20	μA
BV_{CBO}	Collector to Base Breakdown Voltage				
	I_C = 100 μA I_E = 0	40			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E = 100 μA I_C = 0	3.5			V
LV_{CER}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 5 mA R_{BE} = 10Ω	40			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 5 mA I_B = 0	20			V
h_{fe}	High Freq. Current Gain				
	I_C = 50 mA V_{CE} = 15V f = 200 MHz	2.5			
C_{obo}	Base-Collector Capacitance				
	I_E = 0 V_{CB} = 12V f = 1 MHz			4	pF
P_o	RF Power Output				
	P_{in} = 100mW V_{CC} = 12V f = 175 MHz See Fig. 1	1			W
η	Collector Efficiency				
	P_{out} = 1 W V_{CC} = 12V f = 175 MHz See Fig. 1	50			%

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Base	V_{CBO}	40 V
Collector to Emitter (4)	V_{CEO}	20 V
Emitter to Base	V_{EBO}	3.5 V

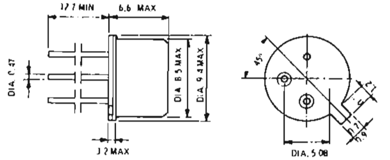
Temperatures

Storage Temperature Range	T_{STG}	-65°C to + 200°C
Operating Junction Temperature	T_J	+ 200°C

Power (2 and 3)

Dissipation at 25°C Case Temperature	P_D	3.5 W

PHYSICAL DIMENSIONS
Similar to
JEDEC TO-39 outline



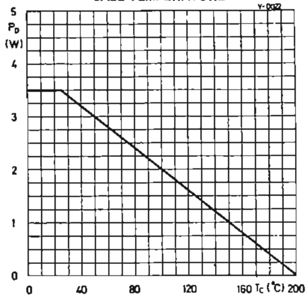
Note: all dimensions in mm.

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/W (derating factor of 20 mW/°C).
4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS - AR 5.
5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle - 1%.

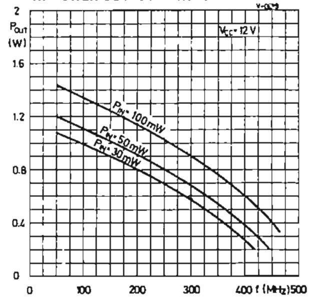
APRIL 1972

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

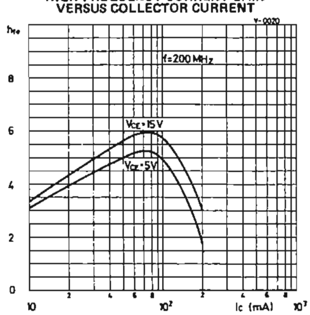
POWER DISSIPATION VERSUS CASE TEMPERATURE



RF POWER OUTPUT VERSUS FREQUENCY



HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



OUTPUT CAPACITANCE VERSUS COLLECTOR BIAS VOLTAGE

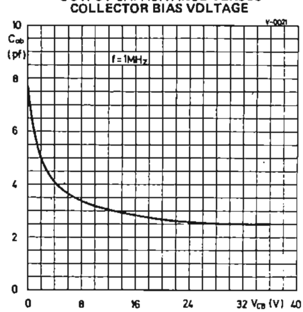
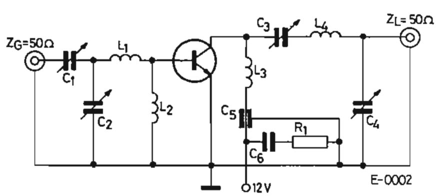


FIG. 1 - RF AMPLIFIER CIRCUIT FOR POWER OUTPUT TEST
(175 MHz OPERATION)



C_1, C_2, C_3, C_4 = 3 ÷ 30 pF
C_5 = 1000 pF
C_6 = 20 KpF
R_1 = 10Ω

L_1 = 2 turns 16 wire, 3/16 "ID, 1/4" long
L_2 = ferrite choke, Z = 450Ω
L_3 = 2 turns 16 wire, 1/4 "ID, 1/4" long
L_4 = 4 turns 16 wire, 3/8 "ID, 3/8" long

PNP diffused silicon planar transistor — BFR 99

Wide band VHF-UHF amplifier

The BFR 99 is a PNP silicon planar epitaxial transistor particularly designed for wide band linear amplifier applications up to 1GHz. It features: very high f_T (2.3GHz typ).

- very low feedback capacitance
- very good cross modulation properties
- very low noise

ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 1 mA V_{CE} = -10V		75		
	I_C = 10mA V_{CE} = -10V	25	80		
	I_C = 20mA V_{CE} = -10V	20			
V_{BEon}	Base-Emitter On Voltage				
	I_C = 10mA V_{CE} = -10V		0.75		V
I_{CBO}	Collector Reverse Current				
	V_{CB} = -15V I_E = 0			50	nA
BV_{CBO}	Collector to Base Breakdown Voltage				
	I_C = 100μA I_E = 0	-30			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E = 10 μA I_C = 0	- 3			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 5 mA I_B = 0	-25			V
C_{obo}	Base-Collector Capacitance				
	I_E = 0 V_{CB} = -15V f = 1 MHz		1.1		pF
C_{re}	Reverse Transfer Capacitance				
	I_C = 0 V_{CE} = -15V f = 1 MHz		0.4		pF
G	Power Gain				
	I_C = 10 mA V_{CE} = -15V 800 MHz		10		dB
P_o	Power Output				
	I_C = 10 mA V_{CE} = -15V f = 800MHz		14		mW
V_{CEK}	Knee Voltage				
	I_C = 20 mA I_B value for which I_C = 22 mA at V_{CE} = -1V		0.8		V
f_T	Gain Bandwidth Product				
	I_C = 10 mA V_{CE} = -15V	1.4	2.3		GHz
f_{max}	Maximum Oscillation Frequency				
	I_C = 10 mA V_{CB} = -15V		6.5		GHz
NF	Noise Figure (R_S = 50Ω)				
	I_C = 3 mA V_{CE} = -15V f = 200MHz		2.5		dB
	I_C = 3 mA V_{CE} = -15V f = 800MHz		3.5		dB
	I_C = 10 mA V_{CE} = -15V f = 200MHz		3		dB
	I_C = 10mA V_{CE} = -15V f = 800MHz		4	6	dB
PG	Wide-Band Power Gain (see fig. 1)				
	f=40÷860 MHz R_S = R_L = 75Ω		16		dB
$\|S_{21e}\|^2$	Trasducer Gain (R_S = R_L = 50Ω)				
	I_C = 10 mA V_{CE} = -15V f = 800MHz		8		dB

ABSOLUTE MAXIMUM RATINGS (1)

(T_A = 25°C unless otherwise noted)

Voltages and Currents

Collector to Base	V_{CBO}	-30V
Collector to Emitter (4)	V_{CEO}	-25V
Emitter to Base	V_{EBO}	-3V
DC Collector Current	I_C	50mA

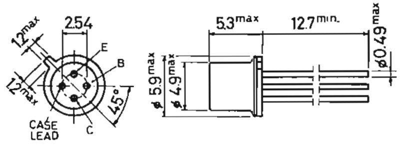
Temperatures

Storage Temperature Range	T_{STG}	-55°C to + 200°C
Operating Junction Temperature	T_J	200°C

Power (2 and 3)

Dissipation at 25°C Case Temperature	P_D	360mW
Dissipation at 25°C Ambient Temperature	P_D	225mW

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-72 outline



Note : all dimensions in mm.

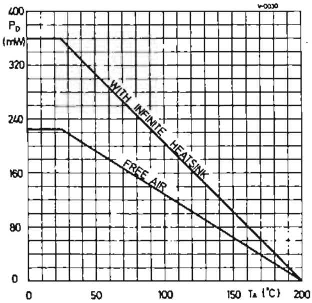
NOTES

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 485°C/W, junction-to-ambient thermal resistance of 775°C/W.
4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
5) Measured under pulse conditions : pulse length 300 μsec. duty cycle - 1%.

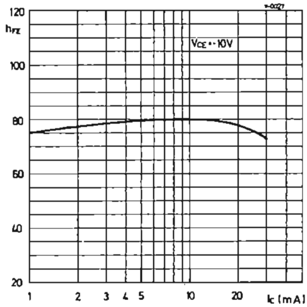
MARCH 1972

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

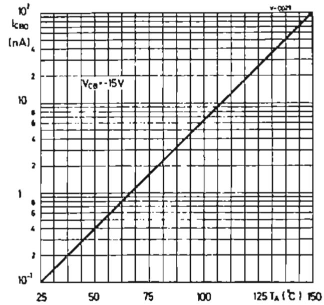
DERATING FACTOR



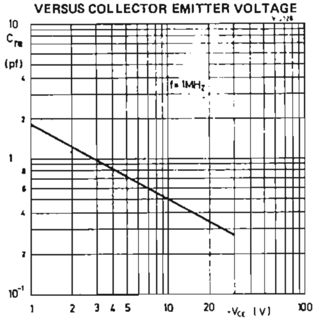
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



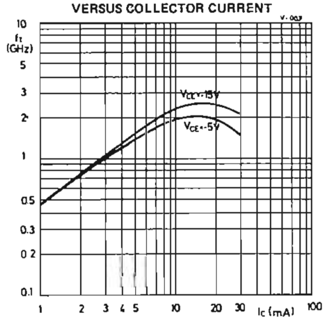
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



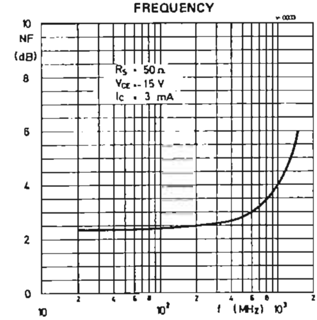
REVERSE TRANSFER CAPACITANCE VERSUS COLLECTOR EMITTER VOLTAGE



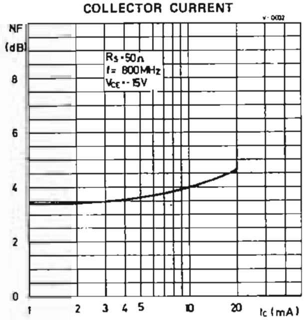
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



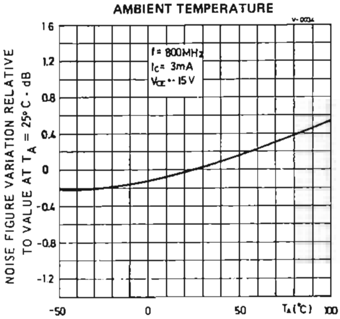
NOISE FIGURE VERSUS FREQUENCY



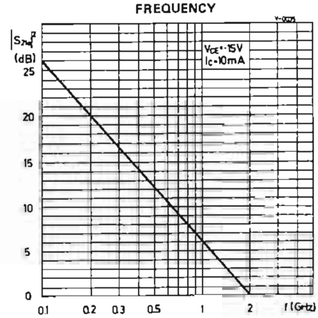
NOISE FIGURE VERSUS COLLECTOR CURRENT



NOISE FIGURE VERSUS AMBIENT TEMPERATURE

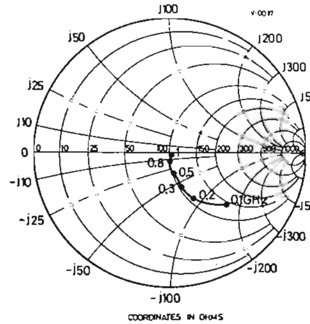


TRANSDUCER GAIN VERSUS FREQUENCY

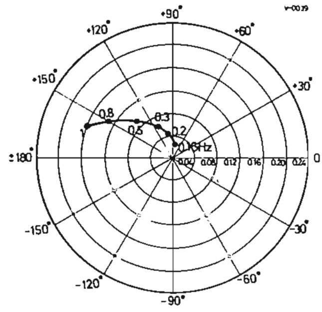


TYPICAL COMMON EMITTER S - PARAMETERS
(V_{CE} = -15V; I_C = 10mA; T_A = 25°C)

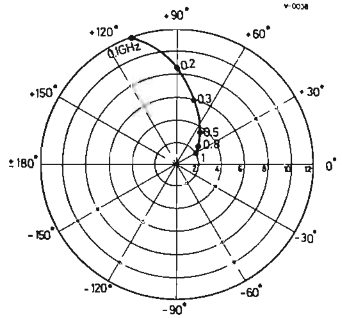
INPUT IMPEDANCE S_{11E}



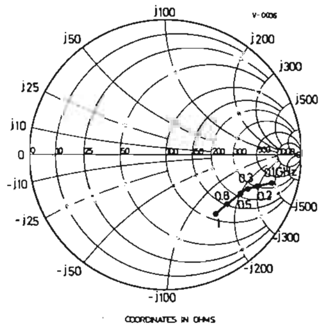
REVERSE TRANSFER COEFFICIENT S_{12E}



FORWARD TRANSFER COEFFICIENT S_{21E}

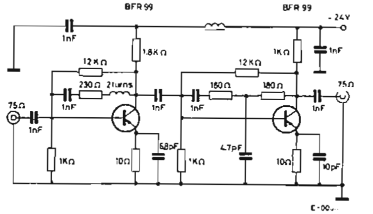


OUTPUT IMPEDANCE S_{22E}



TYPICAL APPLICATIONS :

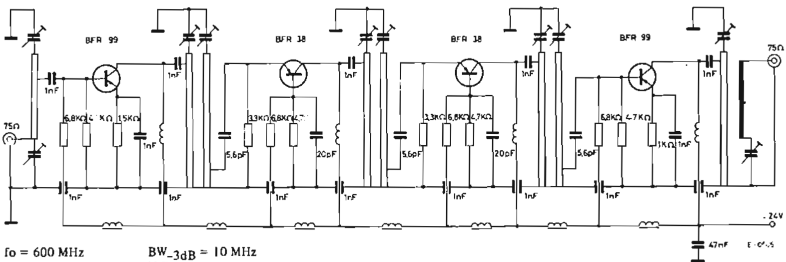
FIG. 1 - WIDE BAND MATV AMPLIFIER



BW = 40 ÷ 860 MHz
G_T = 16 dB
NF < 5 dB

V.S.W.R.$_{IN}$ < 2
V.S.W.R.$_{OUT}$ ≤ 2
V_{OUT} = 100 mV for 1% Crossmodulation

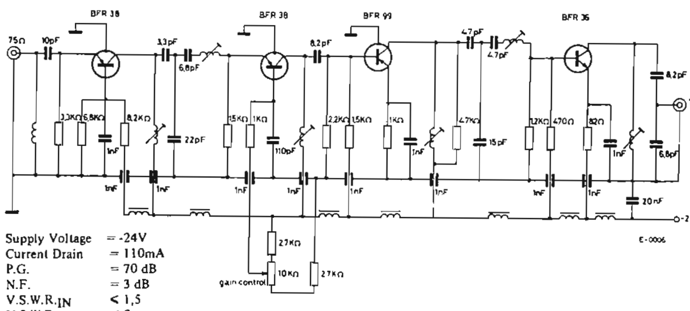
FIG. 2 - MATV CHANNEL AMPLIFIER



fo = 600 MHz
G_T = 40 dB
V.S.W.R.$_{IN}$ < 1,5
V.S.W.R.$_{OUT}$ < 1,5

BW_{-3dB} = 10 MHz
N.F. = 4 dB
P_{OUT} = 15 mW @ dim = -30 dB

FIG. 3 - 200 MHz MATV CHANNEL AMPLIFIER



Supply Voltage	= -24V
Current Drain	= 110mA
P.G.	= 70 dB
N.F.	= 3 dB
V.S.W.R.$_{IN}$	< 1,5
V.S.W.R.$_{OUT}$	< 2
P_{OUT}	= 120 mW at dim = -30 dB
Gain Control	> 30 dB

SILICON PLANAR **NPN**

BFS 89

NIXIE DRIVER

The BFS 89 is a silicon planar epitaxial NPN transistor in a Jedec TO-39 metal case. It is intended particularly as nixie driver, amplifier and for switching applications.

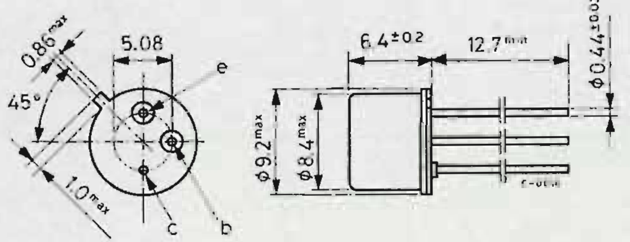
ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	300	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	300	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5	V
I_C	Collector current	150	mA
I_{CM}	Collector peak current	500	mA
P_{tot}	Total power dissipation at $T_{case} \leq 25$ °C	5	W
T_{stg}	Storage temperature	-55 to 175	°C
T_j	Junction temperature	175	°C

MECHANICAL DATA

Dimensions in mm

Collector connected to case



TO-39

10/72

BFS 89

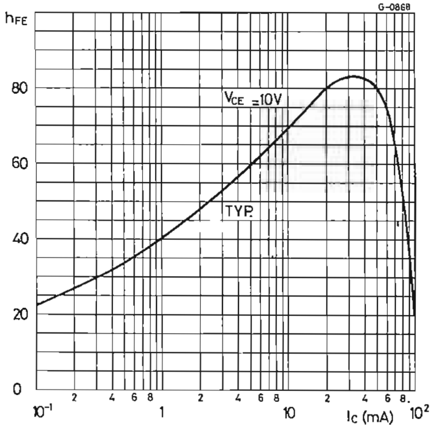
THERMAL DATA

$R_{th\ j-case}$	Thermal resistance junction-case	max	30	°C/W

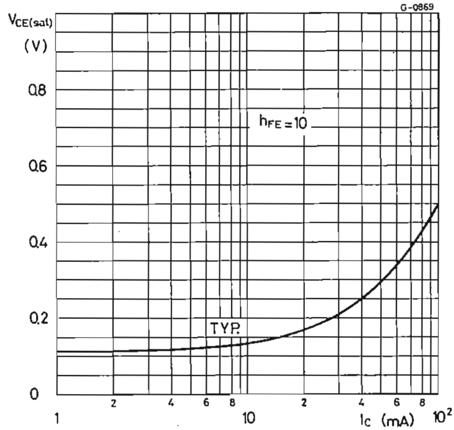
ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C unless otherwise specified)

Parameter		Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	V_{CB} = 250 V			50	nA
V_{CBO}	Collector-base voltage ($I_E = 0$)	I_C = 100 μA	300			V
$V_{CEO(sus)}$	Collector-emitter voltage ($I_B = 0$)	I_C = 10 mA	300			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	I_C = 30 mA I_B = 6 mA			1	V
h_{FE}	DC current gain	I_C = 50 mA V_{CE} = 10 V	25			—
f_T	Transition frequency	I_C = 30 mA V_{CE} = 10 V		90		MHz
$-C_{re}$	Reverse capacitance	V_{CE} = 30 V f = 1 MHz I_C = 1 mA		3		pF
C_{CBO}	Collector-base capacitance	V_{CB} = 30 V f = 1 MHz I_E = 0		3.5		pF

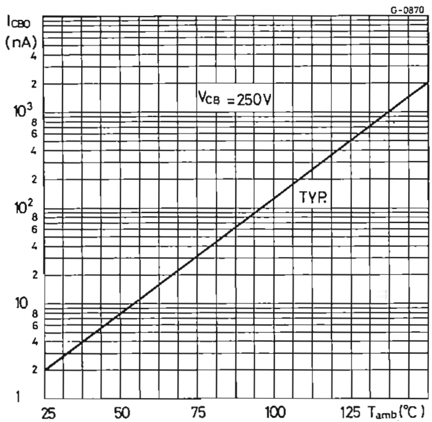
DC current gain



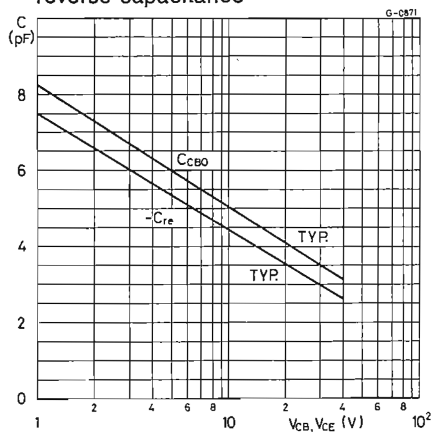
Collector-emitter saturation voltage



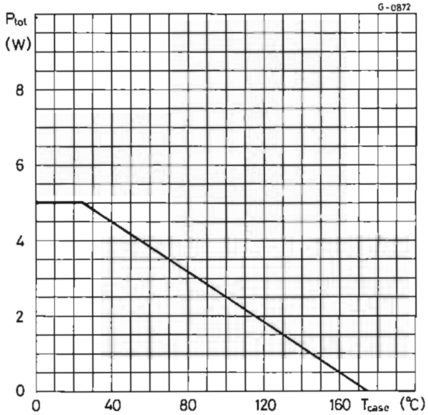
Collector cutoff current



Collector-base capacitance, reverse capacitance



Power rating chart

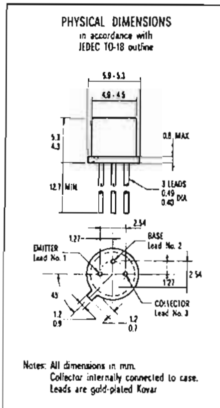


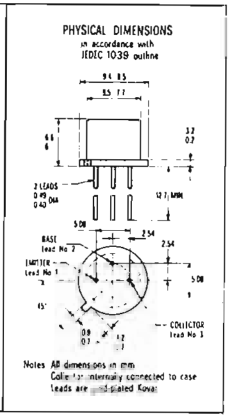
BFW 43 - BFW 44

HIGH VOLTAGE AMPLIFIERS

PNP DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The BFW 43 and BFW 44 are PNP silicon PLANAR epitaxial transistors designed for use in amplifiers where high voltage and high gain are necessary.
They particularly feature an LV_{CEO} of 150 V and are specified over a wide range of currents. These devices are covered by Semiconductor Users Reliability Evaluation (SURE) Programme.





ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to 200°C
T_J	Operating Junction Temperature	200°C
T_L	Lead Temperature (Soldering, 10 sec time limit)	260°C

Maximum Voltages (25°C free air temperature)

V_{CBO}	Collector to Base Voltage	- 150 V
V_{CEO}	Collector to Emitter Voltage (Note 4)	- 150 V
V_{EBO}	Emitter to Base Voltage	- 6 V

Maximum Power Dissipations (Notes 2 and 3)

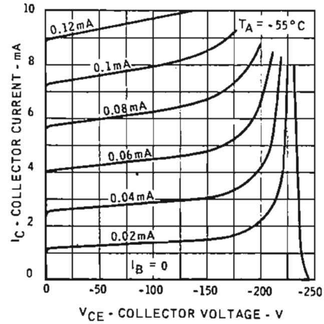
		BFW 43	BFW 44
P_D	Total Dissipation at 25°C Case Temperature	1.4 W	2.5 W
	at 25°C Ambient Temperature	0.4 W	0.7 W

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

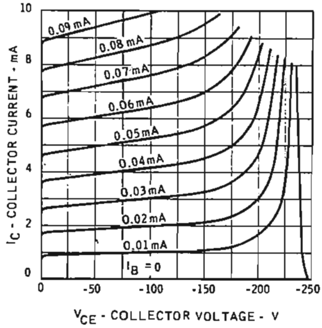
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain (Note 5)	40	85			I_C = 1 mA	V_{CE} = - 10 V
h_{FE}	DC Current Gain (Note 5)	40	100			I_C = 10 mA	V_{CE} = - 10 V
h_{FE} (-55°C)	DC Current Gain		30			I_C = 10 μA	V_{CE} = - 10 V
$V_{BE\ sat}$	Base - Emitter Saturation Voltage		-0.74	-0.9	V	I_C = 10 mA	I_B = 1 mA
$V_{CE\ sat}$	Collector - Emitter Saturation Voltage		-0.1	-0.5	V	I_C = 10 mA	I_B = 1 mA
I_{CBO}	Collector Cutoff Current		0.2	10	nA	I_E = 0	V_{CB} = - 100 V
I_{CBO} (125°C)	Collector Cutoff Current		0.03	10	μA	I_E = 0	V_{CB} = - 100 V
BV_{CBO}	Collector to Base Breakdown Voltage	-150			V	I_C = 10 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-6			V	I_E = 10 μA	I_C = 0
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-150			V	I_C = 2 mA	I_B = 0
h_{fe}	High Frequency Current Gain		2.5			I_C = 1 mA	V_{CE} = - 10 V f = 20 MHz
h_{fe}	High Frequency Current Gain	3				I_C = 10 mA	V_{CE} = - 10 V f = 20 MHz
C_{TE}	Emitter Transition Capacitance		20	25	pF	I_C = 0	V_{EB} = - 0.5 V
C_{obo}	Collector - Base Capacitance		5	7	pF	I_E = 0	V_{CB} = - 5 V

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

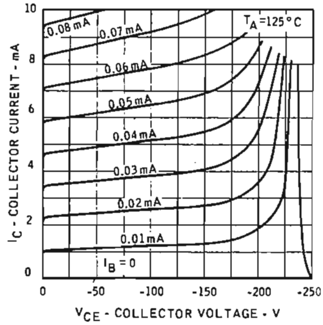
COLLECTOR CHARACTERISTICS *



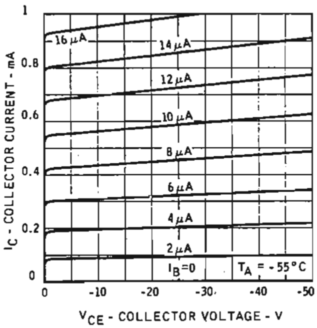
COLLECTOR CHARACTERISTICS *



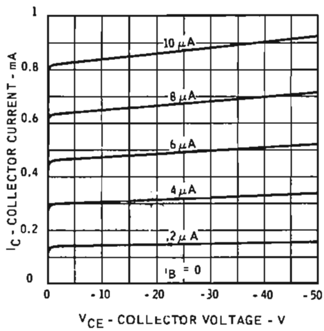
COLLECTOR CHARACTERISTICS *



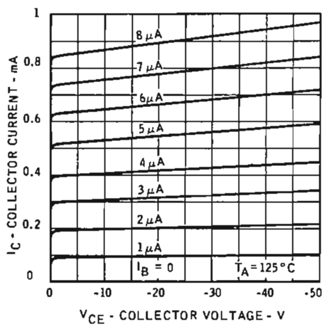
COLLECTOR CHARACTERISTICS *



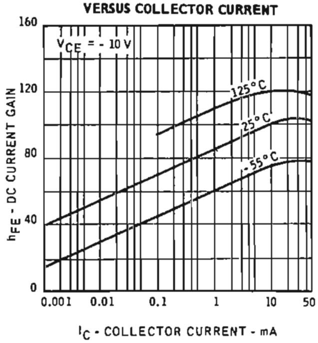
COLLECTOR CHARACTERISTICS *



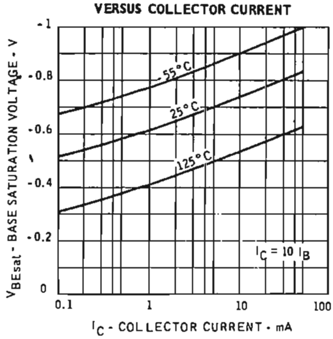
COLLECTOR CHARACTERISTICS *



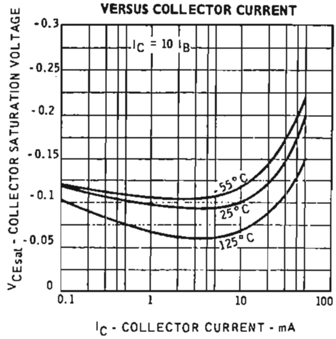
DC CURRENT GAIN VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

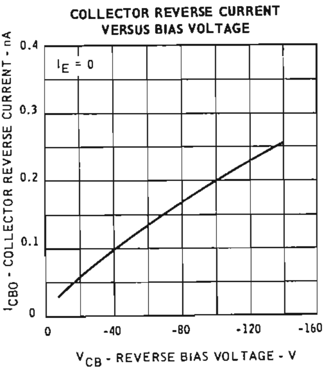


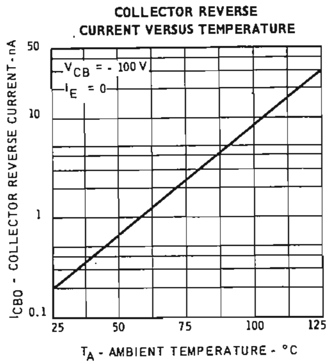
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

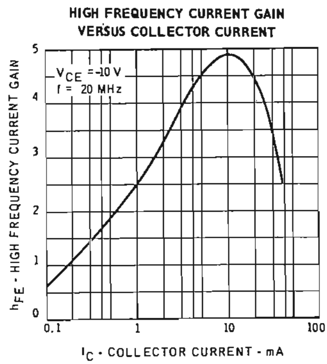


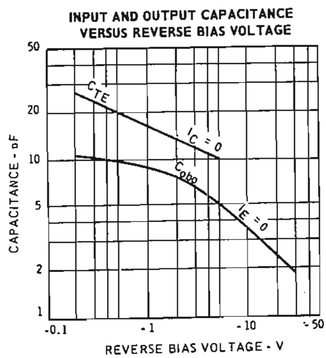
* Single family characteristics on Transistor Curve Tracer.

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









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 125°C/W (derating factor of 8 mW/°C); junction-to-ambient thermal resistance of 438°C/W (derating factor of 2.3 mW/°C); for BFW 43. Junction-to-case thermal resistance of 70°C/W (derating factor of 14.3 mW/°C); junction-to-ambient thermal resistance of 250°C/W (deroting factor of 4 mW/°C) for BFW 44.

(4) This rating refers to a high-current paint where collector-to-emitter voltage is lowest. For more information send for SGS - AR 5.

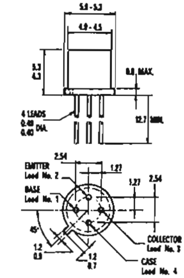
(5) Measured under pulse conditions: pulse length = 300 µsec; duty cycle = 1%

BFW 63

60 MHz SMALL SIGNAL AMPLIFIER

NPN DIFFUSED SILICON PLANAR TRANSISTOR

GENERAL DESCRIPTION - The BFW63 is an NPN Silicon Planar Transistor which has been designed for low noise, small signal amplifiers. It is suitable for the IF stages of radar and telecommunication systems.



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature Range	−55°C to 175°C
T_J	Operating Junction Temperature	175°C
T_L	Lead Temperature (Soldering, 10 s time limit)	260°C

Maximum Power Dissipations (Notes 2 and 3)

P_D	Total Dissipation at 25°C Case Temperature	0.215 W
	at 25°C Ambient Temperature	0.15 W

Maximum Voltages (25°C free air temperature)

V_{CBO}	Collector to Base Voltage	40 V
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 V
V_{EBO}	Emitter to Base Voltage	4 V

ELECTRICAL CHARACTERISTICS (25°C free air temperature)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain (Note 5)	25	70			I_C = 4 mA	V_{CE} = 10 V
V_{BE}	Base-Emitter Voltage		0.73	0.8	V	I_C = 4 mA	V_{CE} = 10 V
I_{CES}	Collector Reverse Current		0.001	0.5	μA	V_{CE} = 10 V	V_{EB} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	40			V	I_C = 100 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4			V	I_E = 100 μA	I_C = 0
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	30			V	I_C = 5 mA	I_B = 0
h_{fe}	High Frequency Current Gain	4	6			I_C = 4 mA	V_{CE} = 10 V f = 100 MHz
C_{re}	Reverse Transfer Capacitance		0.2	0.25	pF	I_C = 4 mA	V_{CE} = 10 V f = 1 MHz
NF	Noise Figure		3	5	dB	I_C = 4 mA f = 60 MHz	V_{CE} = 10 V R_S = 200 Ohm
G	Power Gain (neutralized)	30	35		dB	I_C = 4 mA	V_{CE} = 10 V f = 60 MHz
G	Power Gain (unneutralized)		33		dB	I_C = 4 mA stab. factor = 4	V_{CE} = 10 V f = 60 MHz

ELECTRICAL CHARACTERISTICS (25°C free air temperature)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
AGC	Automatic Gain Control Collector Current	8		12	mA	$G = G(I_C = 4\text{ mA}) - 30$ dB	f = 60 MHz
g_{ie}	Input Conductance		4.5		mmho	$I_C = 4$ mA	$V_{CE} = 10$ V f = 60 MHz
b_{ie}	Input Susceptance		9.5		mmho	$I_C = 4$ mA	$V_{CE} = 10$ V f = 60 MHz
g_{fe}	Transfer Conductance		103		mmho	$I_C = 4$ mA	$V_{CE} = 10$ V f = 60 MHz
b_{fe}	Transfer Susceptance		48		mmho	$I_C = 4$ mA	$V_{CE} = 10$ V f = 60 MHz
g_{oe}	Output Conductance		0.1		mmho	$I_C = 4$ mA	$V_{CE} = 10$ V f = 60 MHz
C_{oe}	Output Capacitance		1.35		pF	$I_C = 4$ mA	$V_{CE} = 10$ V f = 60 MHz

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 700°C/W (derating factor of 1.43 mW/°C); junction-to-ambient thermal resistance of 1000°C/W (derating factor of 1 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

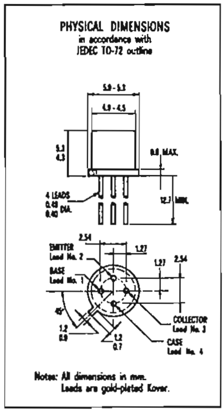
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.

BFW 64

200 MHz SMALL SIGNAL AMPLIFIER

NPN DIFFUSED SILICON PLANAR TRANSISTOR

GENERAL DESCRIPTION - The BFW64 is a high frequency NPN Silicon Planar Transistor which has been designed for low noise, small signal amplifiers. It is suitable for the VHF stages of radar and telecommunication systems.



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature Range	-55°C to 175°C
T_J	Operating Junction Temperature	175°C
T_L	Lead Temperature (Soldering, 10 s time limit)	260°C

Maximum Power Dissipations (Notes 2 and 3)

P_D	Total Dissipation at 25°C Case Temperature	0.215 W
	at 25°C Ambient Temperature	0.15 W

Maximum Voltages (25°C free air temperature)

V_{CBO}	Collector to Base Voltage	40 V
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 V
V_{EBO}	Emitter to Base Voltage	4 V

ELECTRICAL CHARACTERISTICS (25°C free air temperature)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain (Note 5)	30	70			I_C = 4 mA	V_{CE} = 10 V
V_{BE}	Base-Emitter Voltage		0.73	0.8	V	I_C = 4 mA	V_{CE} = 10 V
I_{CES}	Collector Reverse Current		0.001	0.5	μA	V_{CE} = 10 V	V_{EB} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	40			V	I_C = 100 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4			V	I_E = 100 μA	I_C = 0
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	30			V	I_C = 5 mA	I_B = 0
h_{fe}	High Frequency Current Gain	4.5	6.5			I_C = 4 mA	V_{CE} = 10 V f = 100 MHz
C_{re}	Reverse Transfer Capacitance		0.2	0.25	pF	I_C = 4 mA	V_{CE} = 10 V f = 1 MHz
NF	Noise Figure		5	6	dB	I_C = 4 mA f = 200 MHz	V_{CE} = 10 V R_S = 50 Ohm
G	Power Gain (neutralized)	18	21		dB	I_C = 4 mA	V_{CE} = 10 V f = 200 MHz
G	Power Gain (unneutralized)		17.7		dB	I_C = 4 mA stab. factor = 4	V_{CE} = 10 V f = 200 MHz
AGC	Automatic Gain Control Collector Current	10		15	mA	G = G (I_C = 4 mA) - 30 dB	f = 200 MHz

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steadystate limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 175°C and junction - to - case thermal resistance of 700°C/W (derating factor of 1.43 mW/°C); junction - to - ambient thermal resistance of 1000°C/W (derating factor of 1 mW/°C).

(4) This rating refers to a high - current point where collector - to - emitter voltage is lowest. For more information send for SGS - AR 5.

(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.

FEBRUARY 1968

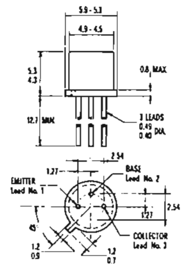
BFW 68

HIGH FREQUENCY AMPLIFIER

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BFW68 is an NPN Diffused Silicon Planar Transistor which has been designed for high frequency amplifier and oscillator applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-18 outline



Notes. All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature Range	−55°C to 200°C
T_J	Operating Junction Temperature	200°C
T_L	Lead Temperature (Soldering, 10 s time limit)	260°C

Maximum Power Dissipations (Notes 2 and 3)

P_D	Total Dissipation at 25°C Case Temperature	1.2 W
	at 25°C Ambient Temperature	0.36 W

Maximum Voltages (25°C free air temperature)

V_{CBO}	Collector to Base Voltage	50 V
V_{CEO}	Collector to Emitter Voltage (Note 4)	40 V
V_{EBO}	Emitter to Base Voltage	5 V

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

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain (Note 5)	35	80			I_C = 100 μA	V_{CE} = 10 V
h_{FE}	DC Current Gain (Note 5)	45	120			I_C = 1 mA	V_{CE} = 10 V
h_{FE}	DC Current Gain (Note 5)	50	120			I_C = 10 mA	V_{CE} = 1 V
h_{FE}	DC Current Gain (Note 5)	40	105			I_C = 50 mA	V_{CE} = 10 V
V_{BEsat}	Base Saturation Voltage (Note 5)		0.75	0.85	V	I_C = 10 mA	I_B = 1 mA
V_{BEsat}	Base Saturation Voltage (Note 5)		0.86	1	V	I_C = 50 mA	I_B = 5 mA
V_{CEsat}	Collector Saturation Voltage (Note 5)		0.09	0.15	V	I_C = 10 mA	I_B = 1 mA
V_{CEsat}	Collector Saturation Voltage (Note 5)		0.2	0.4	V	I_C = 50 mA	I_B = 5 mA
I_{CBO}	Collector Reverse Current		0.1	10	nA	V_{CB} = 30 V	I_E = 0
I_{CBO} (125°C)	Collector Reverse Current		0.1	30	μA	V_{CB} = 30 V	I_E = 0
BV_{CBO}	Collector to Base Breakdown Voltage	50			V	I_C = 10 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5			V	I_E = 10 μA	I_C = 0
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	40			V	I_C = 10 mA	I_B = 0

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

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{fe}	Small Signal Current Gain	40		200		I_C = 1 mA	V_{CE} = 5 V f = 1 kHz
h_{ie}	Input Resistance			6	kΩ	I_C = 1 mA	V_{CE} = 5 V f = 1 kHz
h_{oe}	Output Conductance			75	μmho	I_C = 1 mA	V_{CE} = 5 V f = 1 kHz
h_{re}	Voltage Feedback Ratio			5	$\times 10^{-4}$	I_C = 1 mA	V_{CE} = 5 V f = 1 kHz
h_{fe}	High Frequency Current Gain	2.5	4			I_C = 10 mA	V_{CE} = 15 V f = 100 MHz
C_{TE}	Emitter Transition Capacitance		6	10	pF	I_C = 0	V_{EB} = 0.5 V
C_{obo}	Base-Collector Capacitance		3	4	pF	I_E = 0	V_{CB} = 10 V
NF	Noise Figure		5.8		dB	I_C = 1 mA f = 100 MHz	V_{CE} = 5 V R_S = 200 Ω
h_{fe}	Small Signal Current Gain	50		200		I_C = 5 mA	V_{CE} = 5 V f = 1 kHz
h_{ie}	Input Resistance			2	kΩ	I_C = 5 mA	V_{CE} = 5 V f = 1 kHz
h_{oe}	Output Conductance			125	μmho	I_C = 5 mA	V_{CE} = 5 V f = 1 kHz
h_{re}	Voltage Feedback Ratio			5	$\times 10^{-4}$	I_C = 5 mA	V_{CE} = 5 V f = 1 kHz
t_{on}	Turn On Time		30		ns	I_C = 50 mA	I_{B1} = 5 mA
t_{off}	Turn Off Time		240		ns	I_C = 50 mA	I_{B1} = I_{B2} = 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/W (derating factor of 6.9 mW/°C); junction-to-ambient thermal resistance of 486°C/W (derating factor of 2.06 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.

NPN SILICON PLANAR TRANSISTOR **BFW 70**

60 MHz IF output amplifier

The BFW 70 is an NPN diffused silicon Planar epitaxial transistor specially designed for 60 MHz, fixed gain, IF amplifiers. Also suitable as oscillator or amplifier in the VHF and UHF ranges up to 1 GHz.

ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5) I_C = 10 mA V_{CE} = 10V	30	75		
$V_{BE\ on}$	Base Emitter On Voltage I_C = 5 mA V_{CE} = 10V		0.72	0.9	V
BV_{CBO}	Collector to Base Breakdown Voltage I_C = 10 µA I_E = 0	30			V
BV_{EBO}	Emitter to Base Breakdown Voltage I_E = 10 µA I_C = 0	4			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5) I_C = 1 mA I_B = 0	30			V
h_{fe}	High Freq. Current Gain I_C = 10 mA V_{CE} = 10V f = 100 MHz	7.5	9		
C_{re}	Reverse Transfer Capacitance I_C = 1 mA V_{CE} = 10V f = 1 MHz		0.22	0.3	pF
NF	Noise Figure (6) I_C = 2 mA V_{CE} = 10V		2.6		dB
NF	Noise Figure (7) I_C = 2 mA V_{CE} = 10V		3.5		dB
NF	Noise Figure (8) I_C = 2 mA V_{CE} = 10V		4.5		dB
GT	Trasducer Gain (Unneutralized) I_C = 7 mA V_{CE} = 10V f = 200 MHz I_C = 7 mA V_{CE} = 10V f = 100 MHz I_C = 7 mA V_{CE} = 10V f = 60 MHz Stability factor = 4		22 32 35		dB dB dB
G_{11e}	Input Conductance I_C = 7 mA V_{CE} = 10V f = 60 MHz		3.3		mmho
B_{11e}	Input Susceptance I_C = 7 mA V_{CE} = 10V f = 60 MHz		6.5		mmho
G_{21e}	Transfer Conductance I_C = 7 mA V_{CE} = 10V f = 60 MHz		145		mmho
B_{21e}	Transfer Susceptance I_C = 7 mA V_{CE} = 10V f = 60 MHz		75		mmho
R_{22e}	Output Impedance I_C = 7 mA V_{CE} = 10V f = 60 MHz		6		KΩ
C_{22e}	Output Capacitance I_C = 7 mA V_{CE} = 10V f = 60 MHz		1.7		pF
G_{11e}	Input Capacitance I_C = 7 mA V_{CE} = 10V f = 100 MHz		5.2		mmho
B_{11e}	Input Susceptance I_C = 7 mA V_{CE} = 10V f = 100 MHz		8		mmho
G_{21e}	Transfer Conductance I_C = 7 mA V_{CE} = 10V f = 100 MHz		110		mmho
B_{21e}	Transfer Susceptance I_C = 7 mA V_{CE} = 10V f = 100 MHz		85		mmho
R_{22e}	Output Impedance I_C = 7 mA V_{CE} = 10V f = 100 MHz		4		KΩ
C_{22e}	Output Capacitance I_C = 7 mA V_{CE} = 10V f = 100 MHz		1.6		pF
G_{11e}	Input Conductance I_C = 7 mA V_{CE} = 10V f = 200 MHz		11		mmho
B_{11e}	Input Susceptance I_C = 7 mA V_{CE} = 10V f = 200 MHz		10		mmho
G_{21e}	Transfer Conductance I_C = 7 mA V_{CE} = 10V f = 200 MHz		50		mmho
B_{21e}	Transfer Susceptance I_C = 7 mA V_{CE} = 10V f = 200 MHz		90		mmho
R_{22e}	Output Impedance I_C = 7 mA V_{CE} = 10V f = 200 MHz		3		KΩ
C_{22e}	Output Capacitance I_C = 7 mA V_{CE} = 10V f = 200 MHz		1.5		pF

ABSOLUTE MAXIMUM RATINGS (1)

(T_A = 25°C unless otherwise noted)

Voltages

Collector to Base Voltage	V_{CBO}	30	V
Collector to Emitter Voltage (4)	V_{CEO}	30	V
Emitter to Base Voltage	V_{EBO}	4	V

Temperatures

Storage Temperature	T_{STG}	- 55 °C to 175 °C
Operating Junction Temperature	T_J	175 °C
Lead Temperature (Soldering 10 sec. time limit)	T_L	260 °C

Power (2 - 3)

Dissipation at 25 °C Ambient Temperature	P_D	0.24	W

NOTE

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 175 °C and junction - to - ambient thermal resistance of 620°C/W (derating factor of 4.15 mW/°C).
4) These ratings refer to a high - current point where collector - to - emitter voltage is lowest. For more information send for SGS - AR 5'
5) Measured under pulse conditions pulso length = 300 usec; duty cycle = 1%
6) f = 60 MHz, R_S = 200 kΩ
7) f = 100 MHz; R_S = 150 Ω
8) f = 200 MHz; R_S = 100 Ω

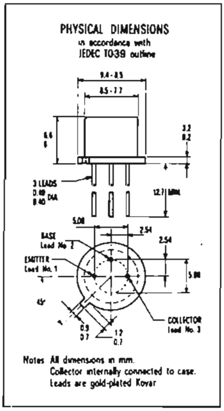
BFX17

CLASS C IF-VHF AMPLIFIER

NPN SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BFX 17 is a high-voltage, high-current transistor for applications requiring operating current up to 1 A. Its high minimum f_T (250 MHz) together with its high P_{out} and Power Gain (1.8 W and 6.5 dB at 150 MHz) make it ideal for use as Class C IF – VHF power amplifier.

This device is covered by Semiconductor Users Reliability Evaluation (SURE) Programme.



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	−55°C to 200°C
T_J	Operating Junction Temperature	200°C
T_L	Lead Temperature (Soldering, 10 sec time limit)	260°C

Maximum Power Dissipations (Notes 2 and 3)

P_D	Total Dissipation at 25°C Case Temperature	3.5 W
	at 25°C Ambient Temperature	0.8 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	60 V
V_{CEO}	Collector to Emitter Voltage (Note 4)	40 V
V_{EBO}	Emitter to Base Voltage	6 V
I_C	Maximum Collector Current (Note 5)	1 A

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

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain (Note 5)	25	60			I_C = 10 mA	V_{CE} = 1 V
h_{FE}	DC Current Gain (Note 5)	35	80			I_C = 100 mA	V_{CE} = 1 V
h_{FE}	DC Current Gain (Note 5)	20	50			I_C = 500 mA	V_{CE} = 1 V
h_{FE}	DC Current Gain (Note 5)		60			I_C = 1000 mA	V_{CE} = 5 V
$V_{BE\ sat}$	Base Saturation Voltage (Note 5)		0.64		V	I_C = 10 mA	I_B = 1 mA
$V_{BE\ sat}$	Base Saturation Voltage (Note 5)		0.8	0.9	V	I_C = 100 mA	I_B = 10 mA
$V_{BE\ sat}$	Base Saturation Voltage (Note 5)		0.89		V	I_C = 300 mA	I_B = 30 mA
$V_{BE\ sat}$	Base Saturation Voltage (Note 5)		0.95	1.3	V	I_C = 500 mA	I_B = 50 mA
$V_{BE\ sat}$	Base Saturation Voltage (Note 5)		1.05		V	I_C = 800 mA	I_B = 80 mA
$V_{BE\ sat}$	Base Saturation Voltage (Note 5)		1.1		V	I_C = 1000 mA	I_B = 100 mA
$V_{CE\ sat}$	Collector Saturation Voltage (Note 5)		0.17		V	I_C = 10 mA	I_B = 1 mA
$V_{CE\ sat}$	Collector Saturation Voltage (Note 5)		0.17	0.25	V	I_C = 100 mA	I_B = 10 mA
$V_{CE\ sat}$	Collector Saturation Voltage (Note 5)		0.27		V	I_C = 300 mA	I_B = 30 mA
$V_{CE\ sat}$	Collector Saturation Voltage (Note 5)		0.37	0.5	V	I_C = 500 mA	I_B = 50 mA
$V_{CE\ sat}$	Collector Saturation Voltage (Note 5)		0.5		V	I_C = 800 mA	I_B = 80 mA
$V_{CE\ sat}$	Collector Saturation Voltage (Note 5)		0.6	1	V	I_C = 1000 mA	I_B = 100 mA

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

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
I_{CBO}	Collector Reverse Current		0.25	2	μA	$I_E = 0$	$V_{CB} = 40$ V
I_{CBO} (100°C)	Collector Reverse Current		25	120	μA	$I_E = 0$	$V_{CB} = 40$ V
BV_{CBO}	Collector to Base Breakdown Voltage	60			V	$I_C = 10\ \mu$A	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6			V	$I_C = 0$	$I_E = 10\ \mu$A
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	40			V	$I_C = 10$ mA	$I_B = 0$
h_{fe}	High Frequency Current Gain	2.5	4			$I_C = 50$ mA	$V_{CE} = 10$ V f = 100 MHz
C_{obo}	Common - Base Output Capacitance, Input Open		6	12	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{ibo}	Common - Base Input Capacitance, Output Open		40	55	pF	$I_C = 0$	$V_{BE} = 0.5$ V
G	Class C Power Gain	8	11		dB		
P_o	Class C Power Out	1.3	2.5		W	f = 60 MHz	see test circuit
η	Class C Collector Efficiency	60			%		
G	Class C Power Gain		6.5		dB		
P_o	Class C Power Out	1	1.8		W	f = 150 MHz	see test circuit
η	Class C Collector Efficiency		50		%		

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.

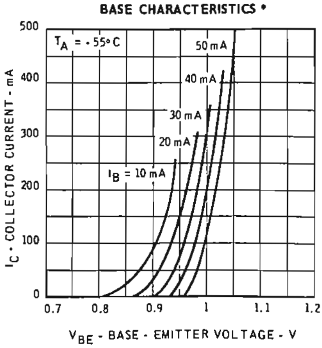
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 50°C/W (derating factor of 20 mW/°C); junction-to-ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).

(4) Ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS - AR 5.

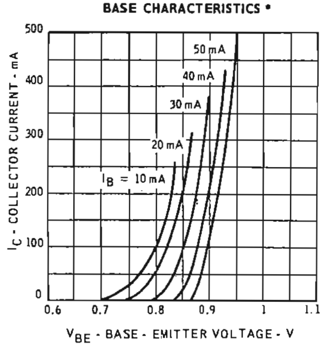
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.

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

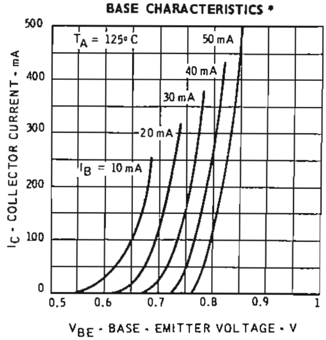
BASE CHARACTERISTICS •



BASE CHARACTERISTICS •



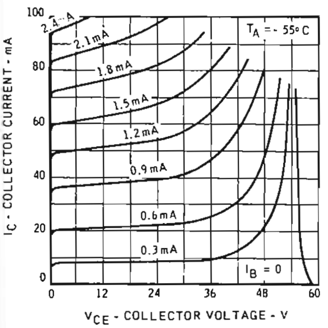
BASE CHARACTERISTICS •



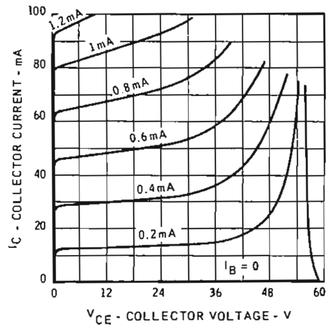
• Single family characteristics on Transistor Curve Tracer.

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

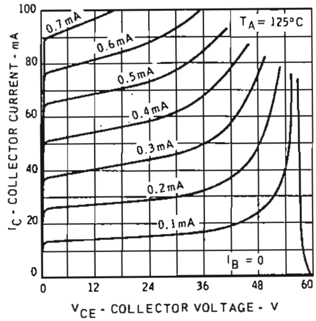
COLLECTOR CHARACTERISTICS *



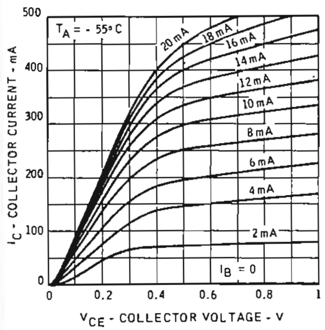
COLLECTOR CHARACTERISTICS *



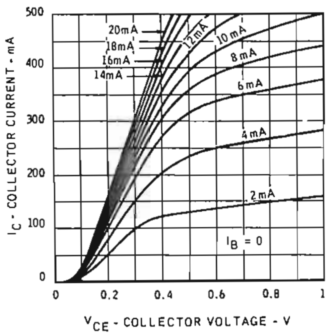
COLLECTOR CHARACTERISTICS *



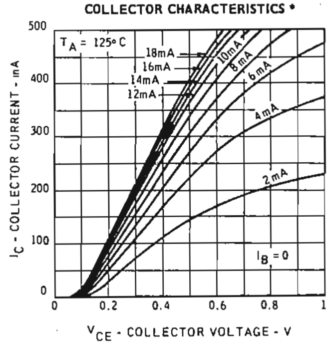
COLLECTOR CHARACTERISTICS *



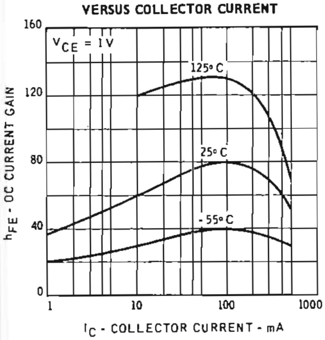
COLLECTOR CHARACTERISTICS *



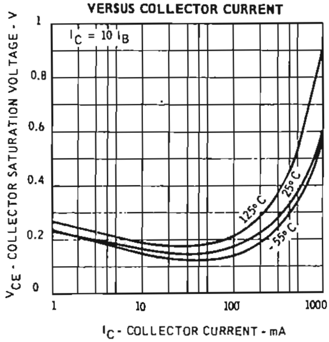
COLLECTOR CHARACTERISTICS *



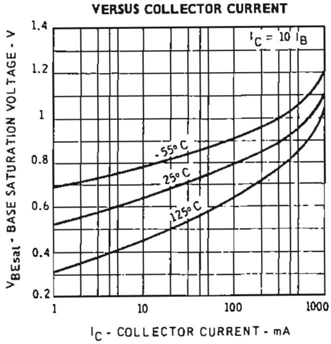
OC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



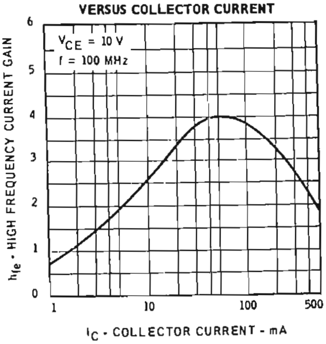
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



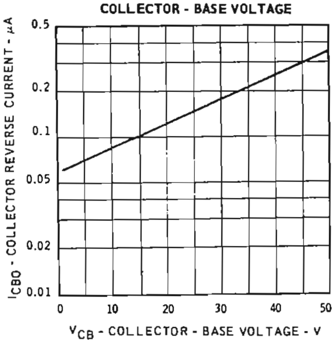
* Single family characteristics on Transistor Curve Tracer.

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

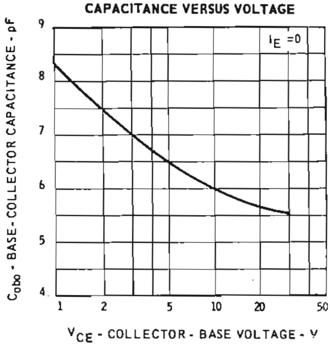
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



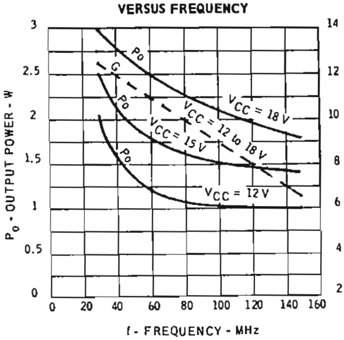
COLLECTOR REVERSE CURRENT VERSUS COLLECTOR - BASE VOLTAGE



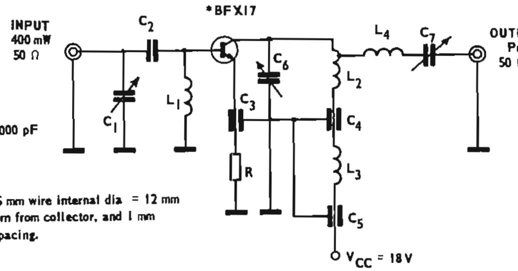
BASE - COLLECTOR CAPACITANCE VERSUS VOLTAGE



OUTPUT POWER AND POWER GAIN VERSUS FREQUENCY



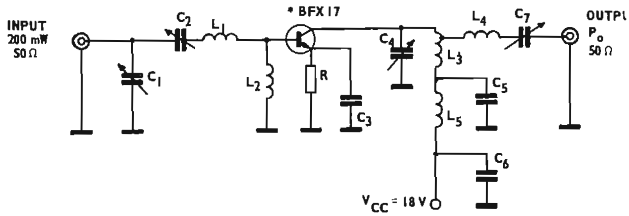
150 MHz CLASS C AMPLIFIER TEST CIRCUIT



C_1 = 10 ÷ 45 pF
C_2 = 150 pF
C_3; C_4; C_5 = 1000 pF
C_6 = 2 ÷ 8 pF
C_7 = 4 ÷ 20 pF
L_1 = 1.8 µH
L_2 = 2 t coil, 1.5 mm wire internal dia = 12 mm tapped 1 turn from collector, and 1 mm interturn spacing.
L_3 = 1.8 µH
L_4 = 0.15 µH
R = 2 Ω
* = Heat sink is required

60 MHz CLASS C AMPLIFIER TEST CIRCUIT

C_1 = 10 ÷ 45 pF
C_2; C_4; C_7 ≡ 6 ÷ 30 pF
C_3; C_5; C_6 = 5 nF
L_1; L_4 = 0.68 µH
L_2 = 3.9 µH
L_3 = 4 t coil; 1.5 mm wire internal dia = 12 mm. tapped 1 turn from collector, and 1 mm. interturn spacing.
L_5 = 5.6 µH
R = 5 Ω
* = Heat sink is required



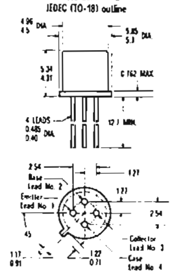
BFX 18

60 MHz LOW-NOISE, SMALL-SIGNAL AMPLIFIER

NPN DIFFUSED SILICON PLANAR TRANSISTOR

GENERAL DESCRIPTION - The BFX 18 is a high frequency NPN silicon PLANAR transistor specifically designed for low noise, small signal amplifiers and is particularly suitable for the IF stages of radar and telecommunications systems. It features 32 dB of Power Gain and 2.5 dB of NF at 60 MHz and excellent AGC characteristics.

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



Notes: All dimensions in mm.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_J	Operating Junction Temperature	200°C Maximum
T_L	Lead Temperature (Soldering, No Time Limit)	260°C Maximum

Maximum Power Dissipations

P	Total Dissipation at 25°C Case Temperature (Note 2)	0.26 Watt
	at 25°C Ambient Temperature (Note 2)	0.175 Watt

Maximum Voltages (25°C free air temperature unless otherwise noted)

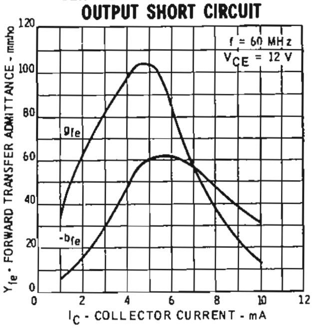
V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 3)	30 Volts
V_{EBO}	Emitter to Base Voltage	3 Volts

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

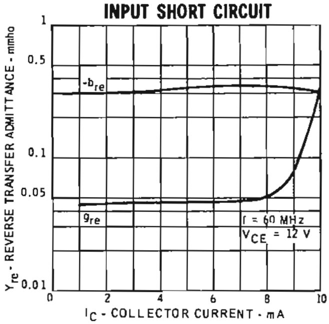
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 4)	20	75			I_C = 2.5 mA	V_{CE} = 24 V
h_{FE}	DC Pulse Current Gain (Note 4)	25	80			I_C = 4 mA	V_{CE} = 12 V
V_{BE} (on)	Base to Collector Voltage			0.9	V	I_C = 2.5 mA	V_{CE} = 24 V
I_{CBO}	Collector Cutoff Current		0.1	50	nA	I_E = 0	V_{CB} = 10 V
BV_{CBO}	Collector to Base Breakdown Voltage	30			V	I_C = 50 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3			V	I_C = 0	I_E = 50 μA
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 3 and 4)	30			V	I_C = 5 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 MHz)	4	5.5			I_C = 2.5 mA	V_{CE} = 12 V
C_{re}	Common Emitter Feedback Capacitance		0.4	0.6	pF	I_C = 4 mA	V_{CE} = 12 V
C_{re}	Common Emitter Feedback Capacitance		0.27	0.5	pF	I_C = 2.5 mA	V_{CE} = 24 V
PG_1	Power Gain (f = 60 MHz) (Note 5)	30	33		dB	I_C = 4 mA	V_{CC} = 12 V
PG_2	Power Gain (f = 60 MHz) (Note 5)	29	32		dB	I_C = 2.5 mA	V_{CC} = 24 V
AGC	Automatic Gain Control (f = 60 MHz) (Note 5)			12	mA	I_C = for which $P_G = P_{G1}$ - 30 dB	
NF	Noise Figure (Note 6)		2.8	5	dB	I_C = 4 mA	V_{CE} = 12 V
NF	Noise Figure (Note 6)		2.5	5	dB	I_C = 2.5 mA	V_{CE} = 24 V

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

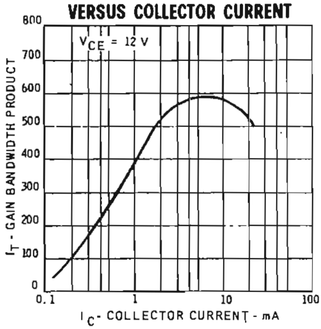
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



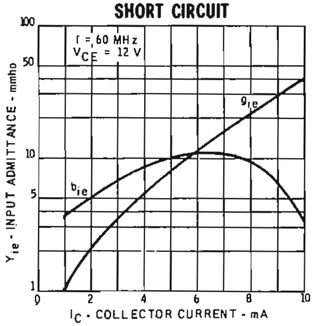
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



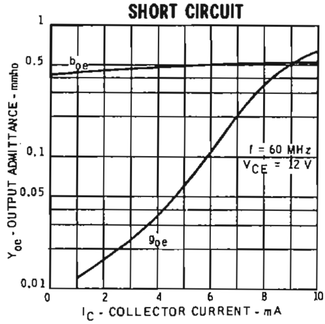
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



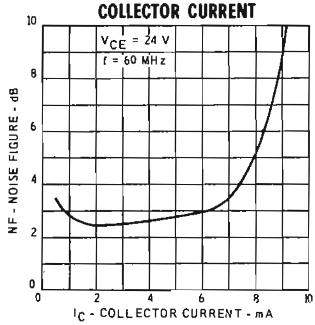
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



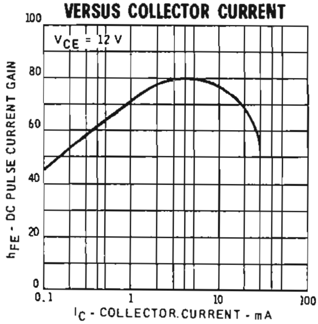
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



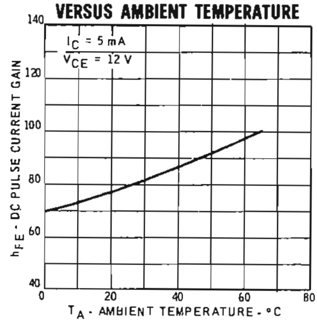
NOISE FIGURE VERSUS COLLECTOR CURRENT



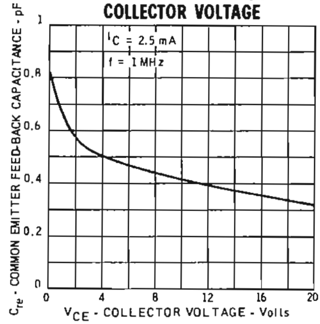
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



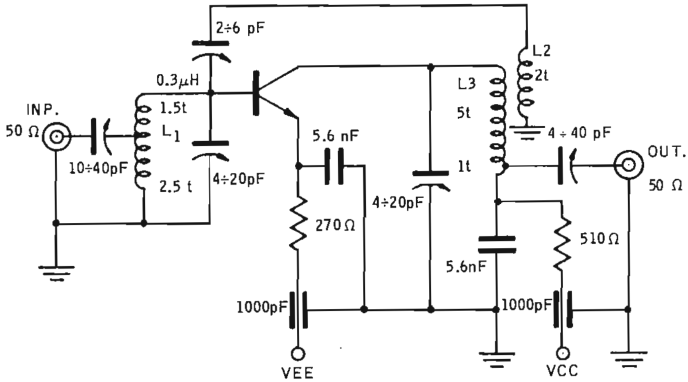
DC PULSE CURRENT GAIN VERSUS AMBIENT TEMPERATURE



COMMON EMITTER FEED-BACK CAPACITANCE VERSUS COLLECTOR VOLTAGE



60 MHz POWER GAIN TEST CIRCUIT

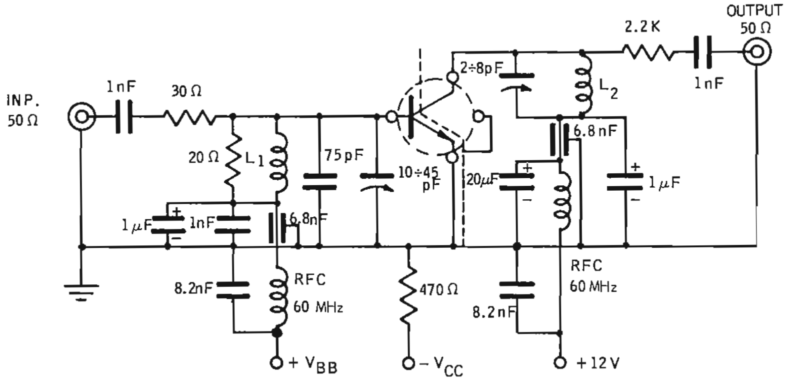


L_1 = 4 turns 1.5 mm. dia. copper wire. Internal dia = 11 mm

L_2 = 2 turns 1.5 mm. dia. copper wire. Internal dia = 11 mm

L_3 = 6 turns 1.5 mm. dia. copper wire. Internal dia = 11 mm

60 MHz POWER GAIN AND AGC TEST CIRCUIT



L_1 = 1 Turn 1 mm dia.; copper wire - internal dia. = 10 mm

L_2 = 0.68 μH

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 673°C/watt (derating factor of 1.48 mW/°C); junction-to-ambient thermal resistance of 1000°C/watt (derating factor of 1 mW/°C).

(3) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(4) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(5) See the 60 MHz Power Gain and AGC test circuits.

(6) f = 60 MHz; R_G = 200 Ω.

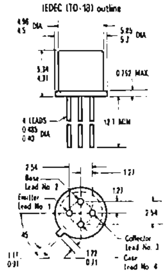
BFX 19

200 Mc/s LOW NOISE, SMALL SIGNAL AMPLIFIER

NPN DIFFUSED SILICON PLANAR TRANSISTOR

GENERAL DESCRIPTION - The BFX 19 is a high frequency NPN silicon PLANAR transistor specifically designed for low noise, small signal amplifiers and is particularly suitable for the VHF stages of radar and telecommunications systems. It features 20 dB of Power Gain and 3.5 dB of NF at 200 Mc/s and excellent AGC characteristics.

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



Notes: All dimensions in mm.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to + 200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	200°C Maximum

Maximum Power Dissipations

Total Dissipation at 25°C Case Temperature (Note 2)	0.26 Watt
at 25°C Ambient Temperature (Note 2)	0.175 Watt

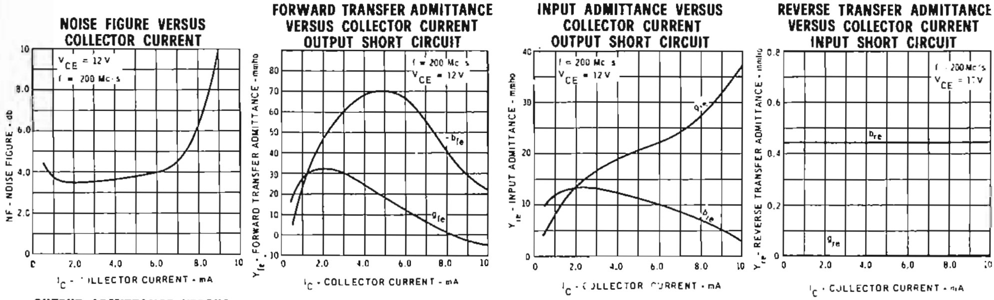
Maximum Voltages

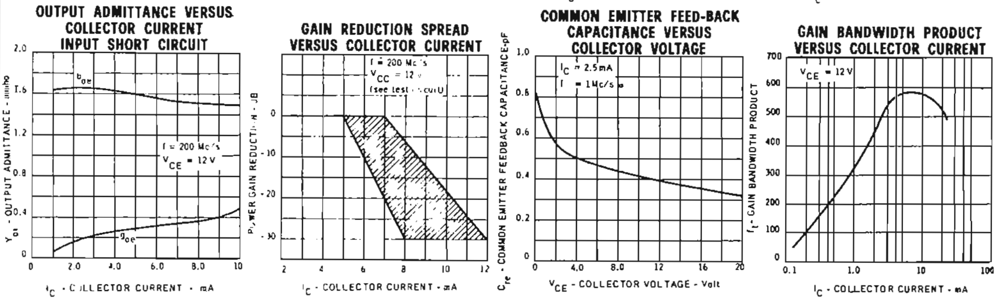
BV_{CBO}	Collector to Base Voltage	30 Volts
LV_{CEO}	Collector to Emitter Voltage (Note 3)	30 Volts
BV_{EBO}	Emitter to Base Voltage	3.0 Volts

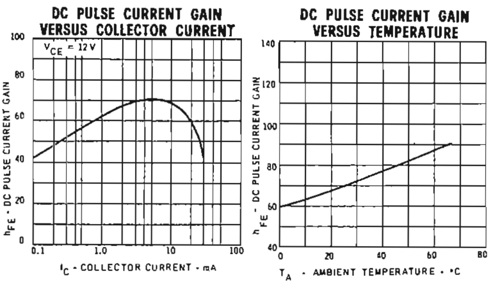
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 4)	20	70			I_C = 2.5 mA	V_{CE} = 12 V
h_{FE}	DC Pulse Current Gain (Note 4)	20	75			I_C = 2.5 mA	V_{CE} = 24 V
V_{BE} (on)	Base to Collector Voltage			0.9	V	I_C = 2.5 mA	V_{CE} = 24 V
I_{CBO}	Collector Cutoff Current		0.1	50	nA	I_E = 0	V_{CB} = 10 V
BV_{CBO}	Collector to Base Breakdown Voltage	30			V	I_C = 50 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			V	I_C = 0	I_E = 50 μA
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 3 and 4)	30			V	I_C = 5.0 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	4.0	5.5			I_C = 2.5 mA	V_{CE} = 12 V
C_{re}	Common Emitter Feedback Capacitance		0.4	0.6	pF	I_C = 2.5 mA	V_{CE} = 12 V
C_{re}	Common Emitter Feedback Capacitance		0.27	0.5	pF	I_C = 2.5 mA	V_{CE} = 24 V
PG_1	Power Gain (f = 200 Mc/s) (Note 5)	18	20		dB	I_C = 2.5 mA	V_{CC} = 12 V
PG_2	Power Gain (f = 200 Mc/s) (Note 5)	17	19		dB	I_C = 2.5 mA	V_{CC} = 24 V
AGC	Automatic Gain Control (f = 200Mc/s) (Note 5)	8.0		12	mA	I_C for which $P_G = P_{G1}$ - 30 dB	
NF	Noise Figure (Note 6)		3.5	6.0	dB	I_C = 2.5 mA	V_{CE} = 12 V
NF	Noise Figure (Note 6)		3.5	6.0	dB	I_C = 2.5 mA	V_{CE} = 24 V

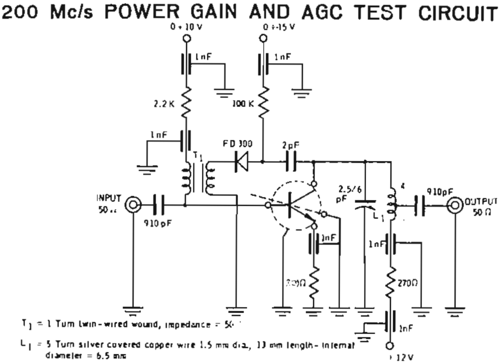
TYPICAL ELECTRICAL CHARACTERISTICS







200 Mc/s POWER GAIN AND AGC TEST CIRCUIT



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 673°C/watt (derating factor of 1.48 mW/°C); junction-to-ambient thermal resistance of 1000°C/watt (derating factor of 1.0 mW/°C).

(3) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(4) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(5) See the 200 Mc/s Power Gain and AGC test circuits.

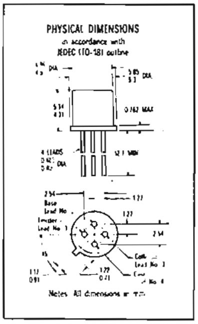
(6) f = 200 Mc/s; R_G = 50 Ω.

BFX 20

450 Mc/s LOW NOISE, SMALL SIGNAL AMPLIFIER

NPN DIFFUSED SILICON PLANAR TRANSISTOR

GENERAL DESCRIPTION - The BFX 20 is a high frequency NPN silicon PLANAR transistor specifically designed for low noise, small signal amplifiers and is particularly suitable for the UHF stages of radar and telecommunications systems. It features 16 dB of Power Gain and 5.5 dB of NF at 450 Mc/s and excellent AGC characteristics.



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to + 200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	200°C Maximum

Maximum Power Dissipations

Total Dissipation at 25°C Case Temperature (Note 2)	0.26 Watt
at 25°C Ambient Temperature (Note 2)	0.175 Watt

Maximum Voltages

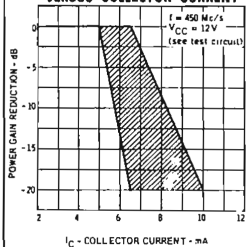
BV_{CBO}	Collector to Base Voltage	30 Volts
LV_{CEO}	Collector to Emitter Voltage (Note 3)	30 Volts
BV_{EBO}	Emitter to Base Voltage	3.0 Volts

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

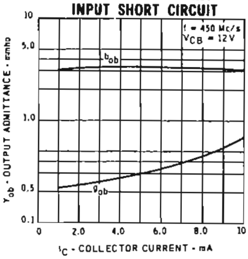
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 4)	20	75			I_C = 2.5 mA	V_{CE} = 24 V
h_{FE}	DC Pulse Current Gain (Note 4)	20	70			I_C = 2.5 mA	V_{CE} = 12 V
V_{BE} (on)	Base to Collector Voltage			0.9	V	I_C = 2.5 mA	V_{CE} = 24 V
I_{CBO}	Collector Cutoff Current		0.1	50	nA	I_E = 0	V_{CB} = 10 V
BV_{CBO}	Collector to Base Breakdown Voltage	30			V	I_C = 50 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			V	I_C = 0	I_E = 50 µA
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 3 and 4)	30			V	I_C = 5.0 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	4.0	5.5			I_C = 2.5 mA	V_{CE} = 12 V
C_{re}	Common Emitter Feedback Capacitance		0.4	0.6	pF	I_C = 2.5 mA	V_{CE} = 12 V
C_{re}	Common Emitter Feedback Capacitance		0.27	0.5	pF	I_C = 2.5 mA	V_{CE} = 24 V
PG_1	Power Gain (f = 450 Mc/s) (Note 5)	12	16		dB	I_C = 2.5 mA	V_{CC} = 12 V
PG_2	Power Gain (f = 450 Mc/s) (Note 5)	12	16		dB	I_C = 2.5 mA	V_{CC} = 24 V
AGC	Automatic Gain Control (f = 450Mc/s)(Note5)	6.5		10	mA	I_C for which $P_G = P_{G1}$ -20 dB	
NF	Noise Figure (Note 6)		5.5	7.5	dB	I_C = 2.5 mA	V_{CE} = 12 V
NF	Noise Figure (Note 6)		5.5	7.5	dB	I_C = 2.5 mA	V_{CE} = 24 V

TYPICAL ELECTRICAL CHARACTERISTICS

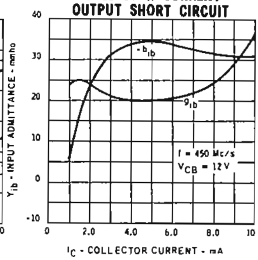
GAIN REDUCTION SPREAD VERSUS COLLECTOR CURRENT



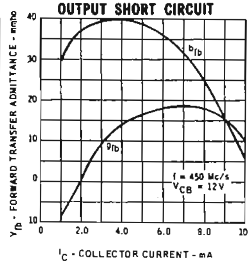
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



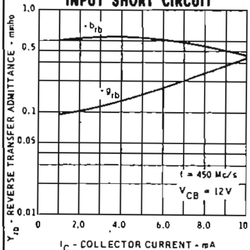
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



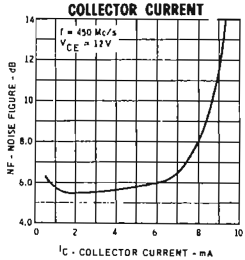
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



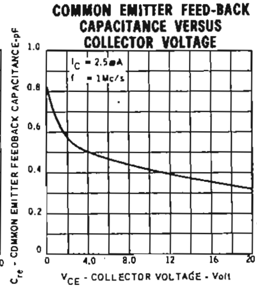
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



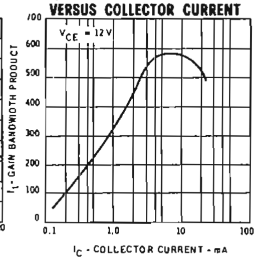
NOISE FIGURE VERSUS COLLECTOR CURRENT



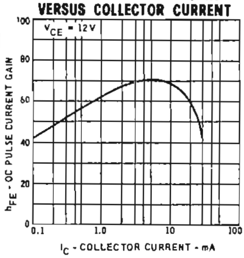
COMMON EMITTER FEED-BACK CAPACITANCE VERSUS COLLECTOR VOLTAGE



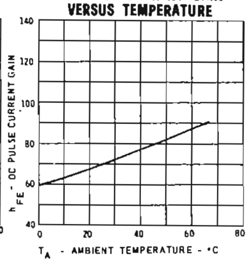
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



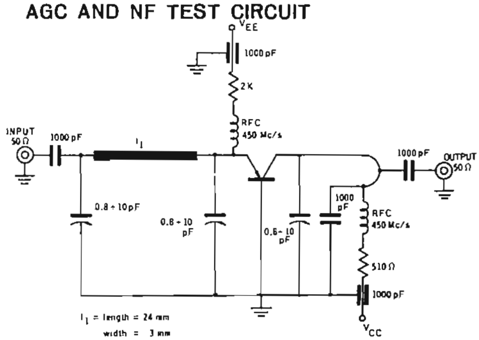
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



DC PULSE CURRENT GAIN VERSUS TEMPERATURE



450 Mc/s POWER GAIN, AGC AND NF TEST CIRCUIT



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 673°C/watt (derating factor of 1.48 mW/°C); junction-to-ambient thermal resistance of 1000°C /watt (derating factor of 1.0 mW/°C).

(3) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR5.

(4) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

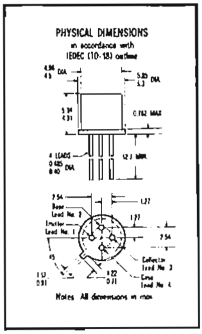
(5) See the 450 Mc/s Power Gain, AGC and NF test circuits.

(6) f = 450 Mc/s; R_G = 40 Ω.

BFX 21

800 Mc/s LOW NOISE, SMALL SIGNAL AMPLIFIER

NPN DIFFUSED SILICON PLANAR TRANSISTOR



GENERAL DESCRIPTION - The BFX 21 is a high frequency NPN silicon PLANAR transistor specifically designed for low noise, small signal amplifiers and is particularly suitable for rhe UHF stages of radar and telecommunications systems up to 800 Mc/s. It features 10 dB of Power Gain and 6.5 dB of NF at 800 Mc/s and excellenr AGC characteristics.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to + 200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	200°C Maximum

Maximum Power Dissipations

Total Dissipation at 25°C Case Temperature (Note 2)	0.26 Watt
at 25°C Ambient Temperature (Note 2)	0.175 Watt

Maximum Voltages

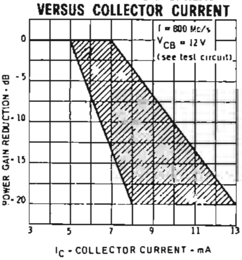
BV_{CBO}	Collecror to Base Voltage	30 Volts
LV_{CEO}	Collector to Emitter Volrage (Note 3)	30 Volts
BV_{EBO}	Emitter to Base Voltage	3.0 Volts

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

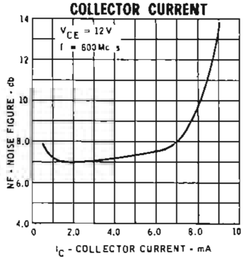
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 4)	20	70			I_C = 1.5 mA	V_{CE} = 24 V
h_{FE}	DC Pulse Current Gain (Note 4)	20	70			I_C = 2.5 mA	V_{CE} = 12 V
V_{BE} (on)	Base to Collector Voltage			0.9	V	I_C = 2.5 mA	V_{CE} = 24 V
I_{CBO}	Collector Cutoff Current		0.1	50	nA	I_E = 0	V_{CB} = 10 V
BV_{CBO}	Collector to Base Breakdown Voltage	30			V	I_C = 50 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			V	I_C = 0	I_E = 50 μA
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 3 and 4)	30			V	I_C = 5.0 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	4.0	5.5			I_C = 2.5 mA	V_{CE} = 12 V
C_{re}	Common Emitter Feedback Capacirance		0.4	0.6	pF	I_C = 2.5 mA	V_{CE} = 12 V
C_{re}	Common Emitter Feedback Capacitance		0.27	0.5	pF	I_C = 1.5 mA	V_{CE} = 24 V
PG_1	Power Gain (f = 800 Mc/s) (Note 5)	8.0	10		dB	I_C = 2.5 mA	V_{CB} = 12 V
PG_2	Power Gain (f = 800 Mc/s) (Note 5)	9.0	12		dB	I_C = 1.5 mA	V_{CB} = 24 V
AGC	Automatic Gain Control (f=800 Mc/s) (Note 5)	8.0		13	mA	I_C for which $P_G = P_{G1}$ - 20 dB	
NF	Noise Figure (Note 6)		7.0	9.0	dB	I_C = 2.5 mA	V_{CB} = 12 V
NF	Noise Figure (Note 6)		6.5	8.5	dB	I_C = 1.5 mA	V_{CB} = 24 V

TYPICAL ELECTRICAL CHARACTERISTICS

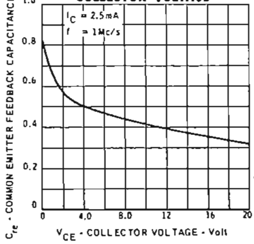
GAIN REDUCTION SPREAD VERSUS COLLECTOR CURRENT



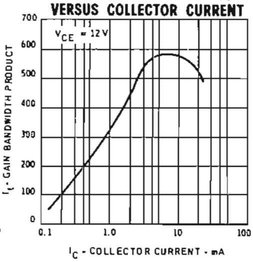
NOISE FIGURE VERSUS COLLECTOR CURRENT



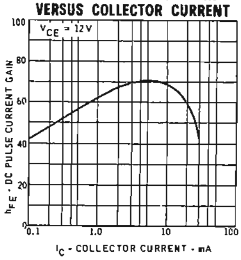
COMMON EMITTER FEED-BACK CAPACITANCE VERSUS COLLECTOR VOLTAGE



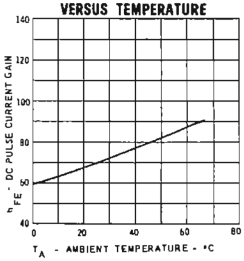
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



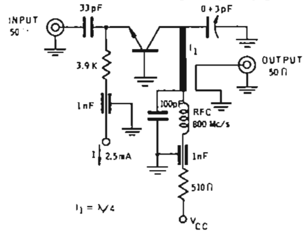
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



DC PULSE CURRENT GAIN VERSUS TEMPERATURE



800 Mc/s POWER GAIN, AGC AND NF TEST CIRCUIT



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 673°C/watt (derating factor of 1.48 mW/°C); junction-to-ambient thermal resistance of 1000°C/watt (derating factor of 1.0 mW/°C).

(3) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR5.

(4) Pulse Conditions: length = 300 µsec; duty cycle = 1%.

(5) See the 800 Mc/s Power Gain, AGC and NF test circuits.

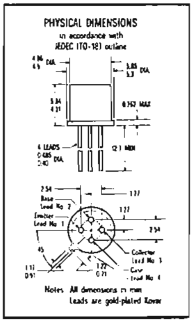
(6) f = 800 Mc/s; YG = 40 + j 4.0 mmho.

BFX 31

VERY LOW-NOISE, SMALL-SIGNAL AMPLIFIER

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BFX31 is an NPN silicon PLANAR transistor specially designed for very low noise, small signal, high frequency applications. It features 3 dB NF maximum at 60 MHz and 30 dB minimum P_G with excellent AGC characteristics.



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C Maximum
T_L	Lead Temperature (Soldering, 10 sec. Time Limit)	+ 260°C Maximum

Maximum Power Dissipations

P	Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.26 Watt
	at 25°C Ambient Temperature (Notes 2 and 3)	0.175 Watt

Maximum Voltages (25°C free air temperature unless otherwise noted)

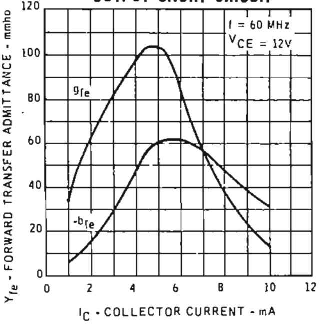
V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts
V_{EBO}	Emitter to Base Voltage	3 Volts

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

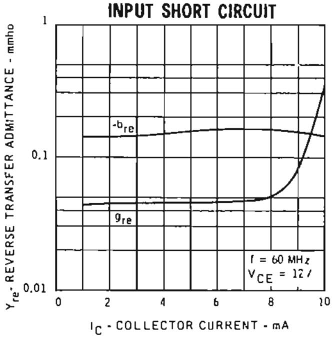
SIMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	20	75			I_C = 2.5 mA	V_{CE} = 24 V
h_{FE}	DC Pulse Current Gain (Note 5)	25	80			I_C = 4 mA	V_{CE} = 12 V
V_{BE} (on)	Base-Emitter On Voltage (Note 5)			0.9	V	I_C = 2.5 mA	V_{CE} = 24 V
I_{CBO}	Collector Cutoff Current		0.1	50	nA	V_{CB} = 10 V	I_E = 0
BV_{CBO}	Collector to Base Breakdown Voltage	30			V	I_C = 50 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3			V	I_E = 50 μA	I_C = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	30			V	I_C = 5 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 MHz)	4	5			I_C = 2.5 mA	V_{CE} = 12 V
PG1	Power Gain (neutralized, f = 60 MHz)	30	33		dB	I_C = 4 mA	V_{CE} = 12 V
PG2	Power Gain (neutralized, f = 60 MHz)	29	32		dB	I_C = 2.5 mA	V_{CE} = 24 V
AGC	Automatic Gain Control (f = 60 MHz)	7		12	mA	I_C = for which $P_G = P_{G1}$ = -30 dB	
NF	Noise Figure (Note 6)		2.3	3	dB	I_C = 2.5 mA	V_{CE} = 12 V
C_{re}	Reverse Transfer Capacitance		0.4	0.6	pF	I_C = 4 mA	V_{CE} = 12 V
C_{re}	Reverse Transfer Capacitance		0.27	0.5	pF	I_C = 2.5 mA	V_{CE} = 24 V

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

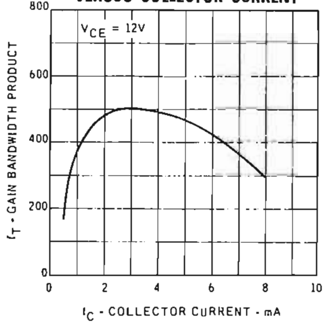
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



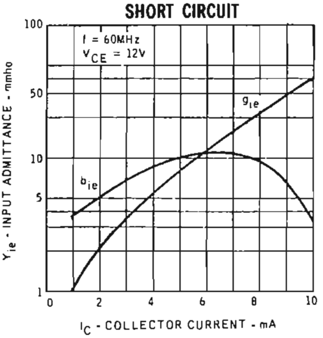
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



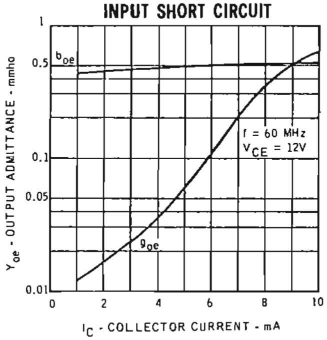
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



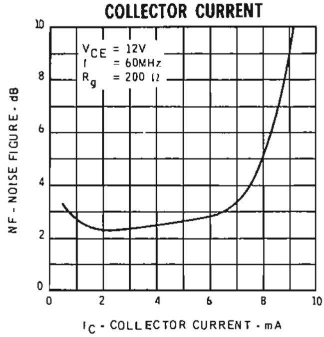
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



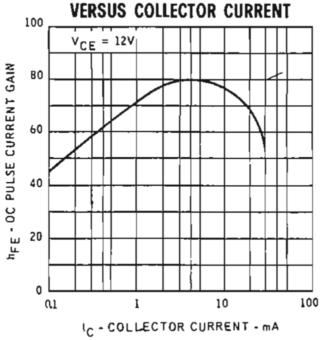
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



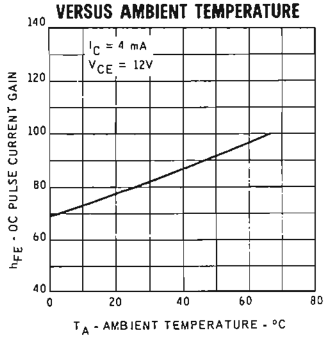
NOISE FIGURE VERSUS COLLECTOR CURRENT



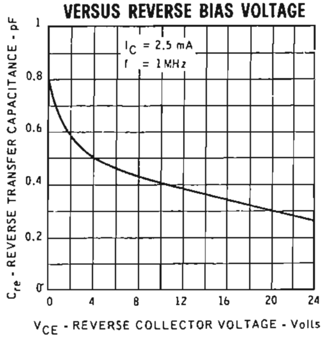
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



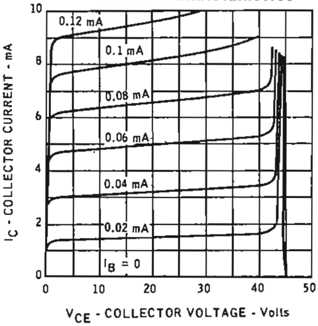
DC PULSE CURRENT GAIN VERSUS AMBIENT TEMPERATURE

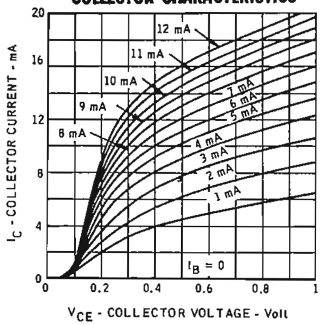


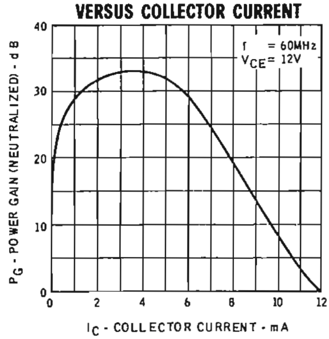
REVERSE TRANSFER CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



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



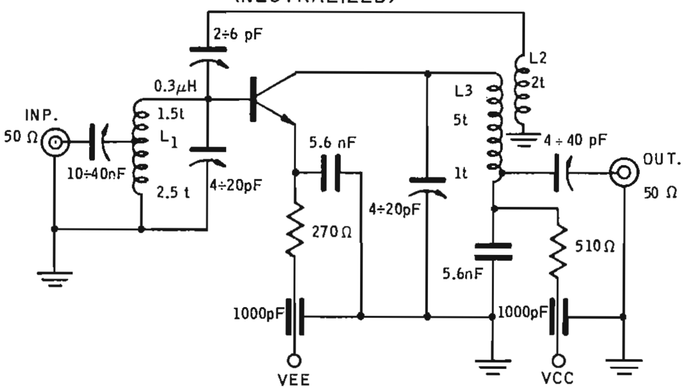




*Single family characteristics on Transistor Curve Tracer.

60 MHz POWER GAIN AND AGC TEST CIRCUIT

(NEUTRALIZED)



L_1 = 4 turns 1.5 mm. dia. copper wire. Internal dia = 11 mm

L_2 = 2 turns 1.5 mm. dia. copper wire. Internal dia = 11 mm

L_3 = 6 turns 1.5 mm. dia. copper wire. Internal dia = 11 mm

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 673°C/watt (derating factor of 1.48 mW/°C); junction-to-ambient thermal resistance of 1000°C/watt (derating factor of 1 mW/°C).

(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(5) Pulse Conditions: length = 300μsec; duty cycle = 1%.

(6) f = 60 MHz; R_G = 200 Ω.

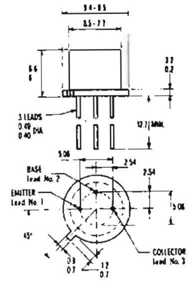
BFX 34

HIGH-CURRENT, GENERAL PURPOSE TYPE

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BFX34 is an NPN silicon PLANAR epitaxial transistor for high current applications. Very low saturation voltage (0.4 typ. at 5 Amp.) and high speed at high current levels make it ideal for power out drivers, power amplifiers, switching power supplies, relay drivers, inverters, etc.

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO39 outline



Notes: All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C Maximum

Maximum Power Dissipations

P	Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	5 Watts
	at 25°C Ambient Temperature (Notes 2 and 3)	0.87 Watt

Maximum Voltages (25°C free air temperature unless otherwise noted)

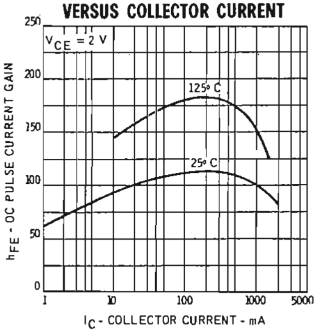
V_{CBO}	Collector to Base Voltage	120 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts
V_{EBO}	Emitter to Base Voltage	6 Volts

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

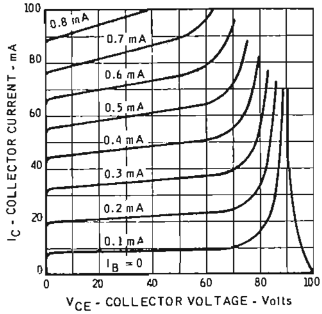
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)		100			I_C = 1 A	V_{CE} = 2 V
h_{FE}	DC Pulse Current Gain (Note 5)		75			I_C = 1.5 A	V_{CE} = 0.6 V
h_{FE}	DC Pulse Current Gain (Note 5)	40	80	150		I_C = 2 A	V_{CE} = 2 V
V_{BE} (sat)	Base Saturation Voltage (Note 5)		1.3	1.6	V	I_C = 5 A	I_B = 0.5 A
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.4	1	V	I_C = 5 A	I_B = 0.5 A
I_{CES}	Collector Reverse Current		0.02	10	μA	V_{CE} = 60 V	V_{BE} = 0
I_{EBO}	Emitter Cutoff Current		0.05	10	μA	I_C = 0	V_{EB} = 4 V
BV_{CBO}	Collector to Base Breakdown Voltage	120			V	I_C = 5 mA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	6			V	I_E = 1 mA	I_C = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	60			V	I_C = 100 mA (pulsed)	I_B = 0
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.5	5			I_C = 0.5 A	V_{CE} = 5 V
C_{ob}	Output Capacitance		40	100	pF	I_E = 0	V_{CB} = 10 V
C_{TE}	Emitter Transition Capacitance		300	500	pF	I_C = 0	V_{EB} = 0.5 V
t_{on}	Turn On Time		0.25	0.6	μsec	$I_C \approx$ 5 A	$I_{B1} \approx$ 0.5 A
t_{off}	Turn Off Time		0.6	1.2	μsec	$I_C \approx$ 5 A	$I_{B1} \approx$ 0.5 A, $I_{B2} \approx$ -0.5 A

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

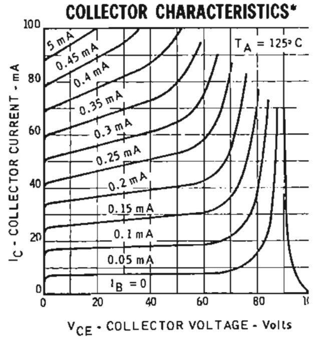
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



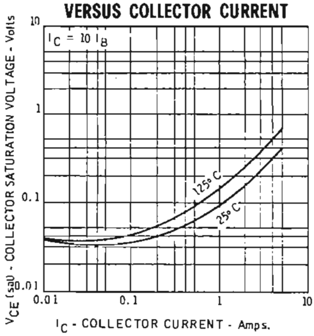
COLLECTOR CHARACTERISTICS*



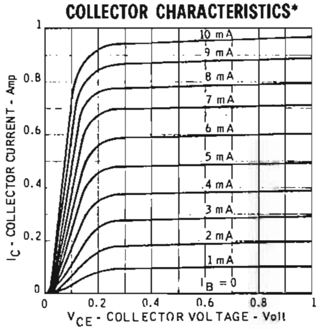
COLLECTOR CHARACTERISTICS*



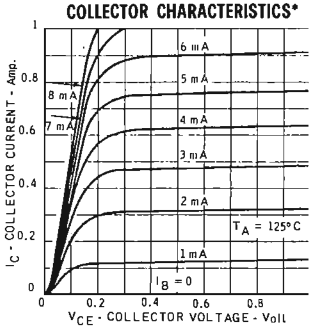
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



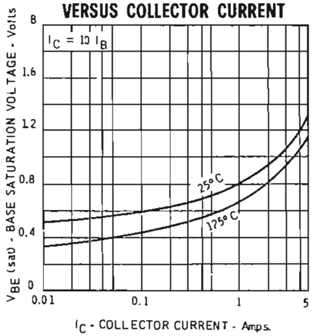
COLLECTOR CHARACTERISTICS*



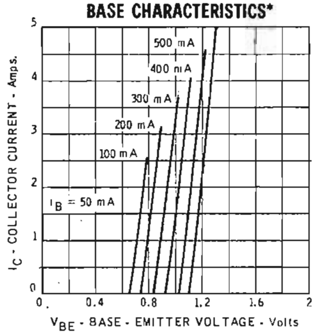
COLLECTOR CHARACTERISTICS*



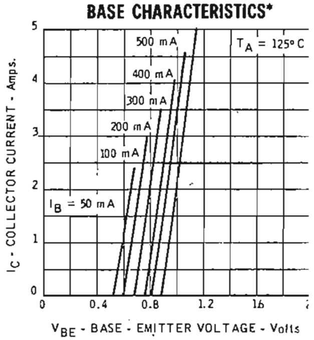
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



BASE CHARACTERISTICS*



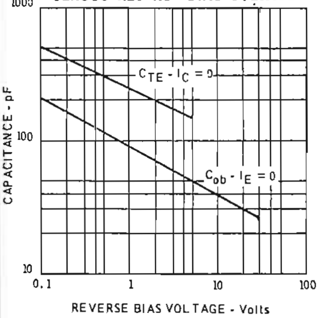
BASE CHARACTERISTICS*



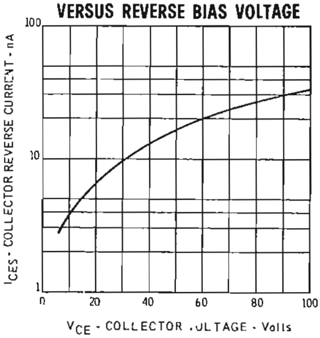
*Single family characteristics on Transistor Curve Tracer.

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

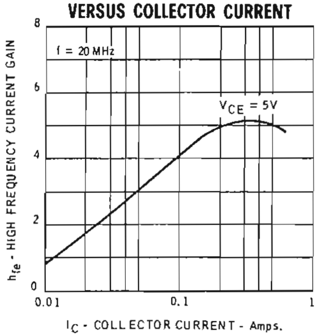
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



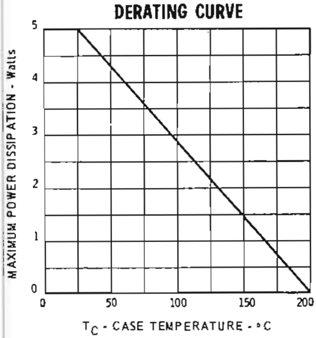
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



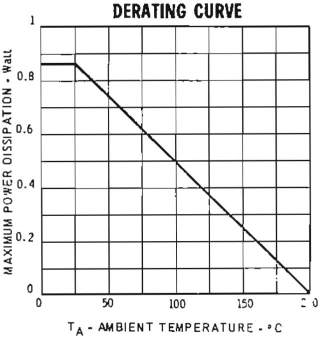
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



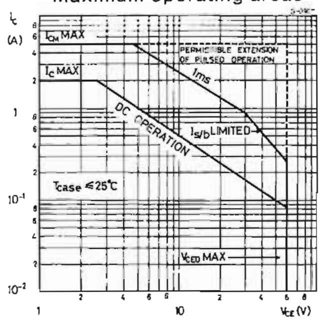
DERATING CURVE



DERATING CURVE



Maximum operating areas



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 35°C/watt (derating factor of 28.6 mW/°C); junction-to-ambient thermal resistance of 201°C/watt (derating factor of 4.97 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS- AR 5.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

PNP diffused silicon planar transistor

BFX 37

Low-level, low-noise amplifier

The BFX 37 is a PNP silicon Planar transistor designed for use in high-performance, low-level, low-noise amplifiers over a wide frequency range. It features high current gain over the range from 1 µA to 100 mA and excellent NF at low frequency.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristics and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain				
	I_C 1 µA V_{CE} -5V		130		
	I_C = 10 µA V_{CE} -5V	70	170	230	
	I_C = 100 µA V_{CE} -5V	125	200		
	I_C = 1 mA V_{CE} -5V	125	220	280	
	I_C 10 mA V_{CE} = -5V (5)	125	200		
V_{BEsat}	Base Saturation Voltage (5)				
	I_C 10 mA I_B 0.5 mA		-0.73	-0.90	V
	I_C 50 mA I_B 5 mA		-0.82	-0.95	V
V_{BEon}	Base- Emitter On Voltage				
	I_C = 1 mA V_{CE} = -5V		-0.65		V
V_{CEsat}	Collector Saturation Voltage (5)				
	I_C - 10 mA I_B - 0.5 mA		-0.1	-0.25	V
	I_C = 50 mA I_B = 5 mA		-0.15	-0.4	V
I_{CES}	Collector Reverse Current				
	V_{CE} = -70 V V_{EB} = 0		0.1	10	nA
	V_{CE} = -70V V_{EB} = 0 T_A - 150°C		0.1	10	µA
I_{EBO}	Emitter Reverse Current				
	V_{EB} = -4V I_C = 0		0.1	10	nA
BV_{CES}	Collector to Emitter Breakdown Voltage				
	I_C = 10 µA V_{EB} = 0	-90			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E = 10 µA I_C = 0	- 6			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 5 mA I_B = 0	-80			V
h_{fe}	Small Signal Current Gain				
	I_C = 1 mA V_{CE} = -5V f = 1 kHz		250		
h_{ie}	Input Resistance				
	I_C = 1 mA V_{CE} = -5V f = 1 kHz		6.5		K^
h_{oe}	Output Conductance				
	I_C = 1 mA V_{CE} = -5V f - 1 kHz		15		µmho
h_{re}	Voltage Feedback Ratio				
	I_C = 1 mA V_{CE} = -5V f = 1 kHz		2.5		$\times 10^{-4}$
h_{fe}	High Frequency Current Gain				
	I_C = 0.5 mA V_{CE} -5V f 20 MHz	2	3.5		
C_{TE}	Emitter Transition Capacitance				
	I_C = 0 V_{EB} = -0.5V		12	15	pF
C_{obo}	Base-Collector Capacitance				
	I_E = 0 V_{CB} = -5V		4.5	6	pF
NF	Wide Band Noise Figure (6)				
	I_C = 20 µA V_{CE} = -5V		1	3.5	dB
NF	Narrow Band Noise Figure (7)				
	I_C - 20 µA V_{CE} = -5V		0.8	2.5	dB

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages and Currents

Collector to Emitter Voltage (4))	V_{CEO}	-80 V
Collector to Emitter Voltage	V_{CES}	-90 V
Emitter to Base Voltage	V_{EBO}	- 6 V
DC Collector Current	I_C	100 mA

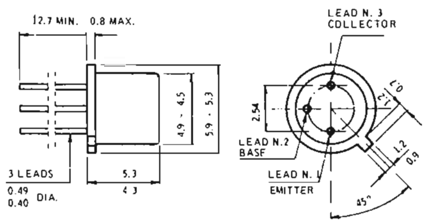
Temperatures

Storage Temperature	T_{STG}	-55°C to 200°C
Operating Junction Temperature	T_J	200°C
Lead Temperature (Soldering, 10 sec. time limit)	T_L	260°C

Power (2 - 3)

Dissipation at 25°C Case Temperature	P_D	1.2 W
Dissipation at 25°C Ambient Temperature	P_D	0.36 W

PHYSICAL DIMENSIONS
similar to JEDEC TO-18 outline



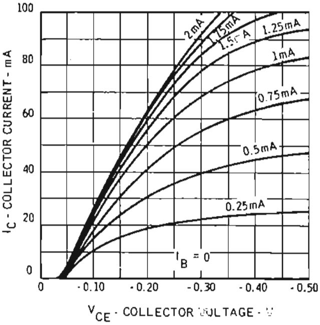
NOTES . All dimensions in mm.
Collector internally connected to case.
Leads are g ld-plated Kovar.

NOTES :

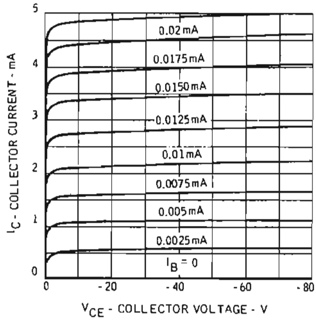
1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3) These ratings give a maximum junction temperature of 200°C and junction - to - case thermal resistance of 146 °C/W (derating factor of 6.9 mW/°C); junction-to-ambient thermal resistance of 480 °C/W (derating factor of 2.1 mW/°C).
4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
5) Measured under pulse conditions : pulse length 300 µsec; duty cycle - 1%.
6) R_S = 10 kΩ; Power Bandwidth of 15.7 kHz with 3 dB points at 10 Hz and 10 kHz.
7) f = 1 kHz; R_S = 10 k., Power Bandwidth of 200 Hz.

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

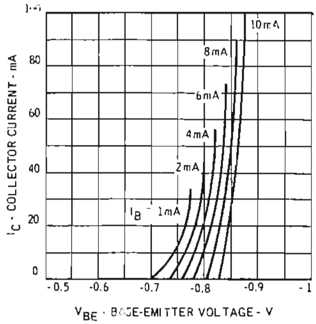
COLLECTOR CHARACTERISTICS*



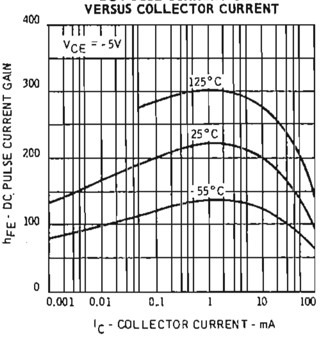
COLLECTOR CHARACTERISTICS*



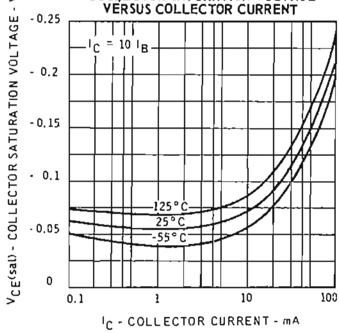
BASE CHARACTERISTICS*



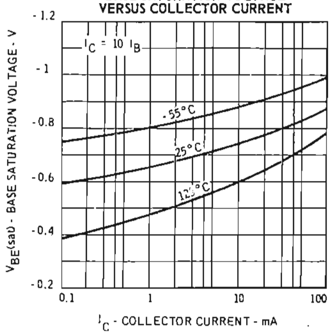
DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT



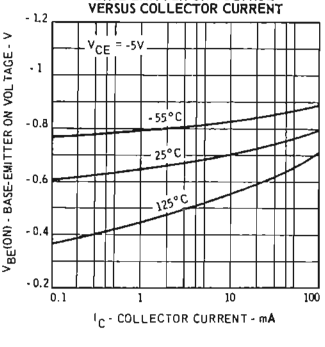
COLLECTOR SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT



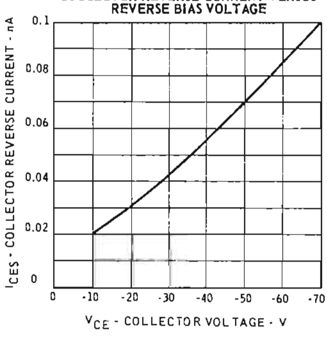
BASE SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT



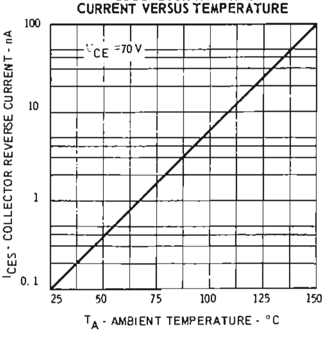
BASE-EMITTER ON VOLTAGE
VERSUS COLLECTOR CURRENT



COLLECTOR-REVERSE CURRENT VERSUS
REVERSE BIAS VOLTAGE



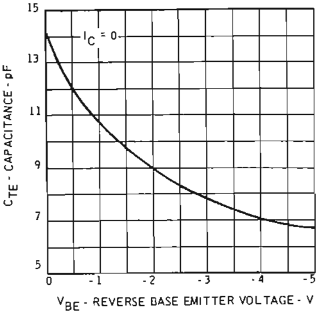
COLLECTOR-REVERSE
CURRENT VERSUS TEMPERATURE



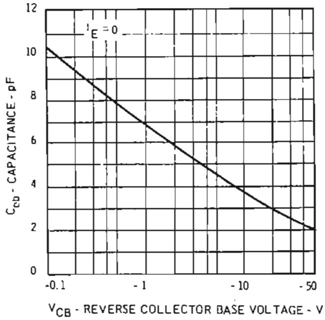
* Single family characteristics on Transistor Curve Tracer.

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

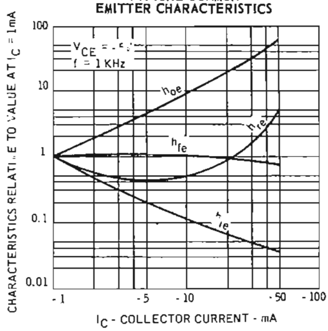
INPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



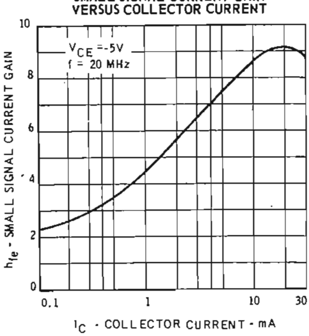
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



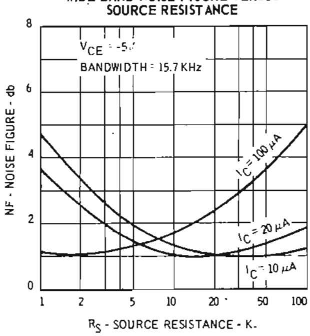
TYPICAL COMMON EMITTER CHARACTERISTICS



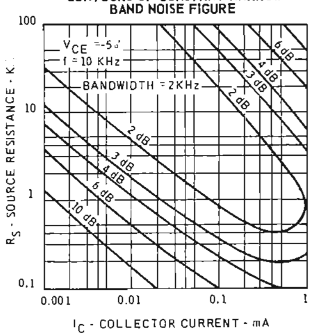
SMALL SIGNAL CURRENT GAIN VERSUS COLLECTOR CURRENT



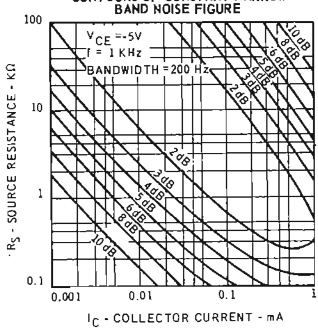
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



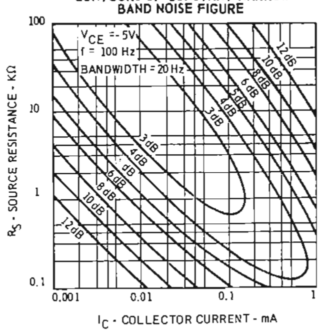
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



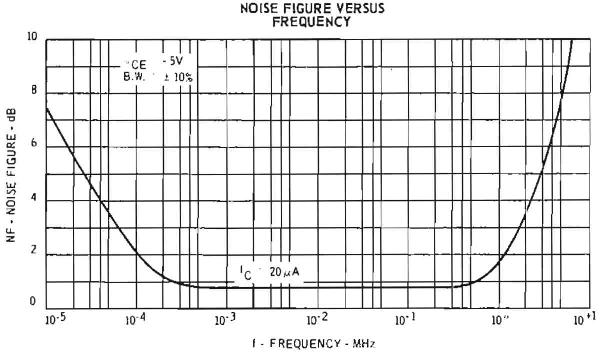
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



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



BFX38 - BFX39 - BFX40 - BFX41

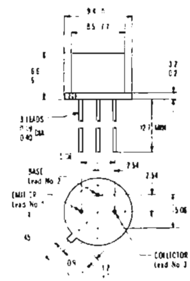
HIGH-VOLTAGE, GENERAL PURPOSE TYPES

PNP DIFFUSED SILICON PLANAR II EPITAXIAL DEVICES

GENERAL DESCRIPTION - The BFX 38 - 39 - 40 - 41 are PNP silicon PLANAR epitaxial transistors designed for a wide variety of applications. These devices feature 55 to 75 volts LV_{CEO}, current gain specified from 100 μA to 1000 mA, minimum f_T of 100 MHz and low saturation voltages. They are particularly useful as complementary drivers (BFY 56A is a good complement), in output applications operating from supply voltages up to 75volts, and in saturated and non-saturated switching applications where high voltage and high current are required.

These devices are covered by Semiconductor Users Reliability Evaluation (SURE) Programme.

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO39 outline



Notes: All dimensions in mm
Collector internally connected to case
Leads are gold-plated Kovar

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	- 55°C to 200°C
T_J	Operating Junction Temperature	200°C
T_L	Lead Temperature (Soldering, 10 sec time limit)	260°C

Maximum Power Dissipations (Notes 2 and 3)

P_D	Total Dissipation at 25°C Case Temperature	4 W
	at 25°C Ambient Temperature	0.8 W

Maximum Voltages and Current

		BFX 38 BFX 39	BFX 40 BFX 41
V_{CBO}	Collector to Base Voltage	- 55 V	- 75 V
V_{CEO}	Collector to Emitter Voltage (Note 4)	- 55 V	- 75 V
V_{EBO}	Emitter to Base Voltage	- 5 V	- 5 V
I_C	DC Collector Current	1 A	1 A

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

SYMBOL	CHARACTERISTIC	BFX39 BFX41 MIN.	TYP.	MAX.	BFX38 BFX40 MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	30	45		60	90			I_C = 100 μA	V_{CE} = -5 V
h_{FE}	DC Current Gain (Note 5)	40	70		85	130			I_C = 100 mA	V_{CE} = -5 V
h_{FE}	DC Current Gain (Note 5)	25	65		60	120			I_C = 500 mA	V_{CE} = -5 V
h_{FE}	DC Current Gain (Note 5)	10 (for BFX41 only)			25 (for BFX40 only)				I_C = 1 A	V_{CE} = -5 V
h_{FE}	DC Current Gain (Note 5)	15 (for BFX39 only)			30 (for BFX38 only)				I_C = 1 A	V_{CE} = -5 V
h_{FE} (-55°C)	DC Current Gain (Note 5)	15			30				I_C = 100 mA	V_{CE} = -5 V
$V_{BE\ sat}$	Base-Emitter Saturation Voltage (Note 5)		-0.8	-0.9		-0.8	-0.9	V	I_C = 150 mA	I_B = 15mA
$V_{BE\ sat}$	Base-Emitter Saturation Voltage (Note 5)		-0.9	-1.1		-0.9	-1.1	V	I_C = 500 mA	I_B = 50mA
$V_{CE\ sat}$	Collector-Emitter Saturation Voltage (Note 5)		-0.12	-0.15		-0.12	-0.15	V	I_C = 150 mA	I_B = 15mA
$V_{CE\ sat}$	Collector-Emitter Saturation Voltage (Note 5)		-0.3	-0.5		-0.3	-0.5	V	I_C = 500 mA	I_B = 50mA

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

SYMBOL	CHARACTERISTIC	BFX 38 / BFX 39 MIN.	BFX 38 / BFX 39 TYP.	BFX 38 / BFX 39 MAX.	BFX 40 / BFX 41 MIN.	BFX 40 / BFX 41 TYP.	BFX 40 / BFX 41 MAX.	UNIT	TEST CONDITIONS	
I_{CBO}	Collector Reverse Current		0.2	50				nA	$I_E = 0$	$V_{CB} = -40\,V$
I_{CBO} (125°C)	Collector Reverse Current		0.25	50				µA	$I_E = 0$	$V_{CB} = -40\,V$
I_{CBO}	Collector Reverse Current					0.2	50	nA	$I_E = 0$	$V_{CB} = -50\,V$
I_{CBO} (125°C)	Collector Reverse Current					0.25	50	µA	$I_E = 0$	$V_{CB} = -50\,V$
BV_{CBO}	Collector to Base Breakdown Voltage	-55			-75			V	$I_E = 0$	$I_C = 10\,\mu A$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5			-5			V	$I_C = 0$	$I_E = 10\,\mu A$
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-55			-75			V	$I_C = 10$ mA	$I_B = 0$
h_{fe}	High Frequency Current Gain	1	1.5		1	1.5			$I_C = 50$ mA	$V_{CE} = -10V$ $f = 100$ MHz
C_{obo}	Collector-Base Capacitance		15	20		15	20	pF	$I_E = 0$	$V_{CB} = -10\,V$
C_{TE}	Emitter Transition Capacitance		75	120		75	120	pF	$I_C = 0$	$V_{EB} = -0.5\,V$
t_{on}	Turn On Time		33	100		33	100	nsec	$I_C = 500$ mA	$I_{B1} = 50$ mA
τ_s	Storage Time		160	350		160	350	nsec	$I_C = 500$ mA,	$I_{B1} = I_{B2} = 50$mA
t_f	Fall Time		27	50		27	50	nsec	$I_C = 500$ mA,	$I_{B1} = I_{B2} = 50$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.

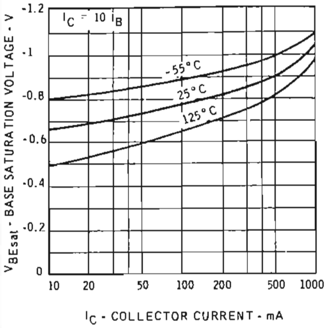
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 43.7°C/W (derating factor of 22.8 mW/°C); junction-to-ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

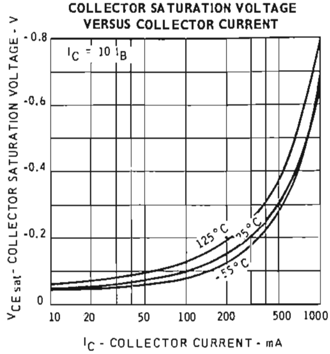
(5) Pulse conditions: length = 300 µsec; duty cycle = 1%

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

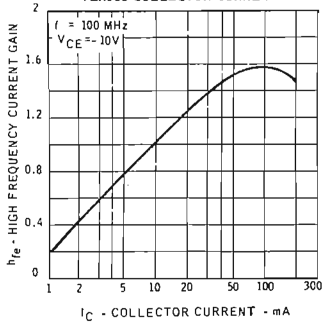
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



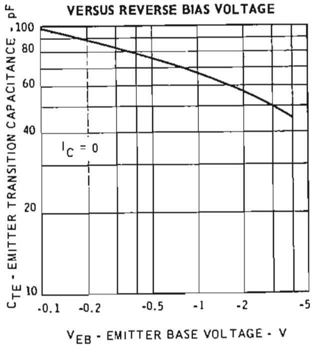
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



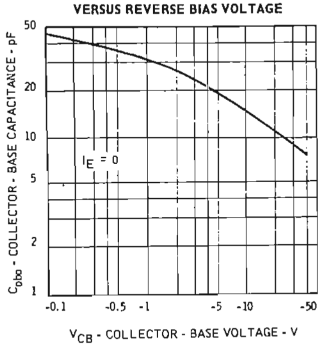
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



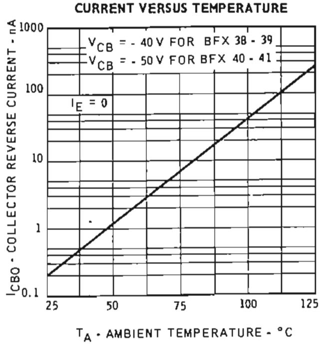
EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



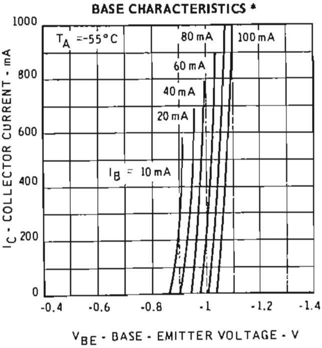
COLLECTOR - BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



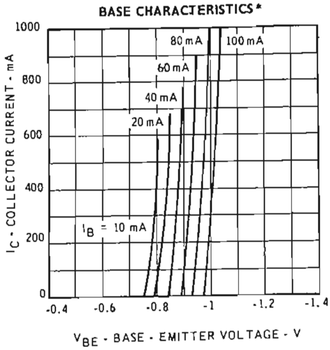
COLLECTOR REVERSE CURRENT VERSUS TEMPERATURE



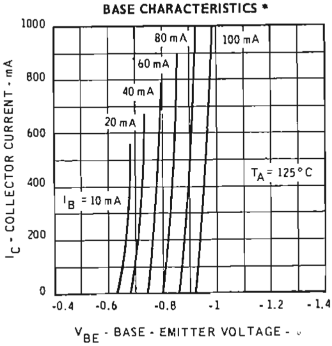
BASE CHARACTERISTICS *



BASE CHARACTERISTICS *



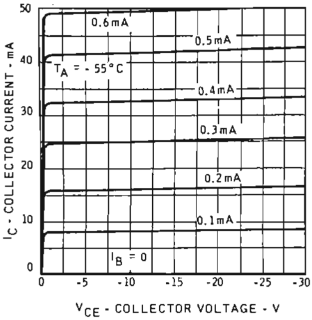
BASE CHARACTERISTICS *



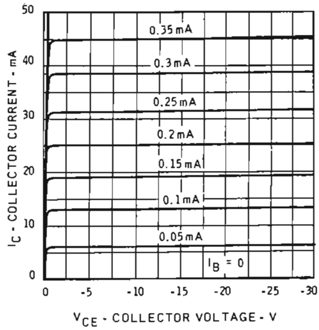
*Single family characteristics on Transistor Curve Tracer.

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

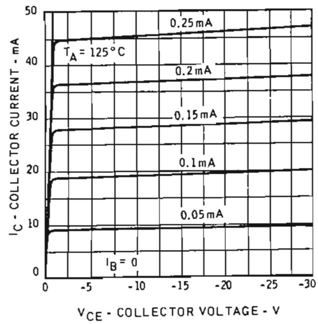
COLLECTOR CHARACTERISTICS *



COLLECTOR CHARACTERISTICS *



COLLECTOR CHARACTERISTICS *



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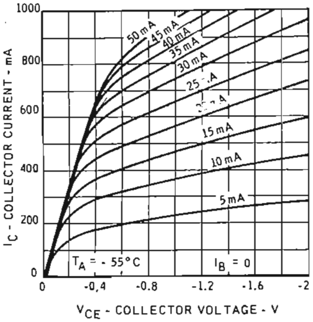

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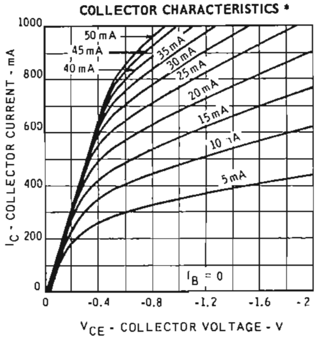
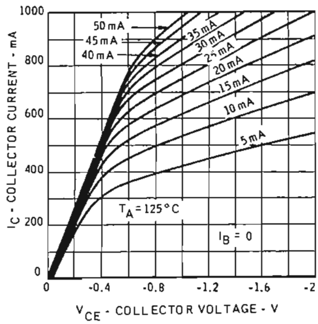
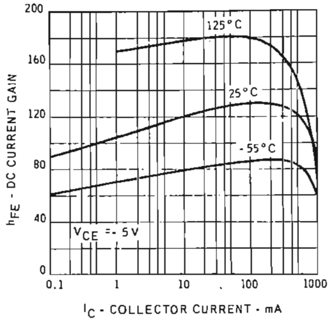


COLLECTOR CHARACTERISTICS *



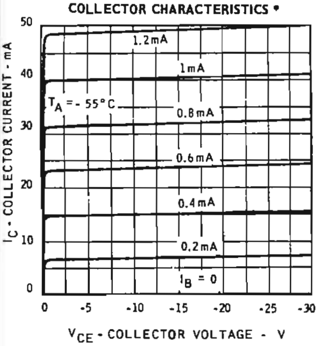
DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT



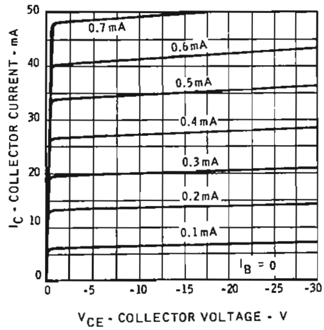
*Single family characteristics on Transistor Curve Tracer.

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

COLLECTOR CHARACTERISTICS •



COLLECTOR CHARACTERISTICS •



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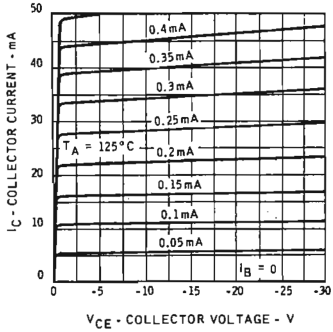

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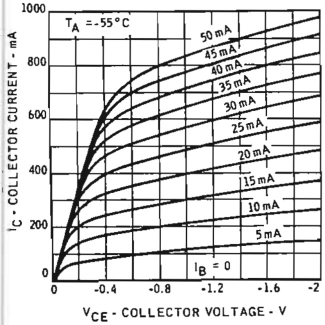
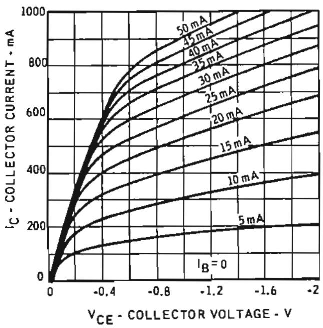
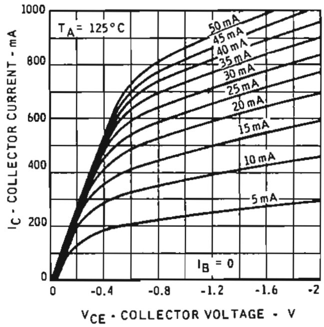


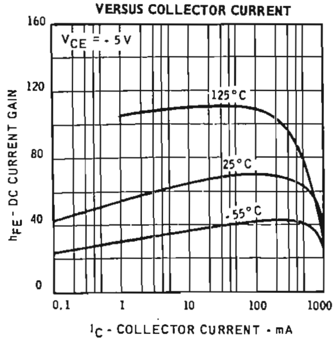
COLLECTOR CHARACTERISTICS •



COLLECTOR CHARACTERISTICS •



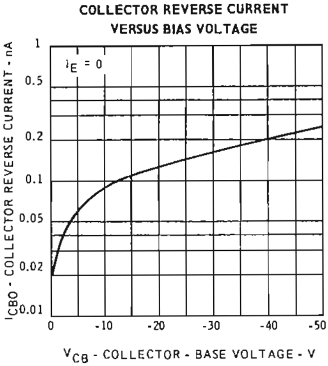
DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT



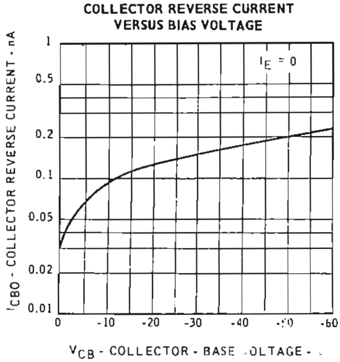
*Single family characteristics on Transistor Curve Tracer.

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

BFX38 • BFX39



BFX40 • BFX41



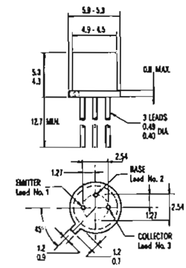
BFX 48

HIGH FREQUENCY AMPLIFIER

PNP DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BFX 48 is a PNP silicon PLANAR transistor suitable for a wide range of applications including low-noise, low current high gain RF, and wide band pulse amplifiers. Key performance parameters are: typical gain bandwidth product 550 Mc/s, low and high frequency noise figures of 3.5 dB, and typical turn-on and turn-off times of 20 and 95 nsec respectively.

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-18 outline



Notes: All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar.

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 Dissipations

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.36 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	-30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-30 Volts
V_{EBO}	Emitter to Base Voltage	-5 Volts
I_C	DC Collector Current	100 mA

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

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	40	80			I_C = 10 µA	V_{CE} = - 1 V
h_{FE}	DC Current Gain	70	130			I_C = 100 µA	V_{CE} = - 1 V
h_{FE}	DC Pulse Current Gain (Note 5)	90	160			I_C = 10 mA	V_{CE} = - 1 V
h_{FE}	DC Pulse Current Gain (Note 5)	20	40			I_C = 50 mA	V_{CE} = - 1 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	30				I_C = 10 mA	V_{CE} = - 1 V
V_{BE} (sat)	Base-Emitter Saturation Voltage			-0.75	V	I_C = 1 mA	I_B = 0.1 mA
V_{BE} (sat)	Base-Emitter Saturation Voltage		-0.77	-0.9	V	I_C = 10 mA	I_B = 1 mA
V_{BE} (sat)	Base-Emitter Saturation Voltage			-1.1	V	I_C = 50 mA	I_B = 5 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage			-0.13	V	I_C = 1 mA	I_B = 0.1 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage		-0.1	-0.14	V	I_C = 10 mA	I_B = 1 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage			-0.3	V	I_C = 50 mA	I_B = 5 mA
I_{CES}	Collector Cutoff Current			15	nA	V_{EB} = 0	V_{CE} = - 20 V
I_{CES}(+125°C)	Collector Cutoff Current			15	µA	V_{EB} = 0	V_{CE} = - 20 V
BV_{CBO}	Collector to Base Breakdown Voltage	-30			V	I_C = 10 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-5			V	I_C = 0	I_E = 10 µA
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-30			V	I_C = 10 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	4	5.5			I_C = 10 mA	V_{CE} = - 20 V
C_{ob}	Output Capacitance		2.2	3.5	pF	I_E = 0	V_{CB} = 10 V
C_{TE}	Emitter Transition Capacitance		4	5.5	pF	I_C = 0	V_{BE} = + 0.5 V
t_{on}	Turn On Time		20	50	nsec	I_C = 50 mA	I_{B1} = 5 mA
t_{off}	Turn Off Time		95	160	nsec	I_C = 50 mA	$I_{B1} = I_{B2}$ = 5 mA
NF	Noise Figure (f = 100 Mc/s)		3.5	6	dB	I_C = 1 mA, R_S = 100 Ω	V_{CE} = - 5 V, BW = 15 Mc/s
$r_b'c_c$	Collector Base Time Constant (f = 80 Mc/s)			40	psec	I_C = 10 mA	V_{CE} = - 20 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 175°C/watt (derating factor of 5.71 mW/°C); junction-to-ambient thermal resistance of 500°C/watt (derating factor of 2 mW/°C).

(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

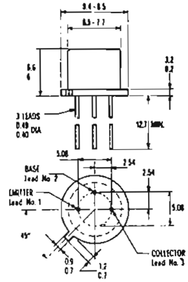
BFX68

GENERAL PURPOSE AMPLIFIER

NPN DIFFUSED SILICON PLANAR TRANSISTOR

GENERAL DESCRIPTION - The BFX68 is an NPN silicon PLANAR transistor suitable for use in high performance amplifier, oscillator and switching circuits. It has a current gain range from the microampere region up to 500 mA.

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO39 outline



Notes. All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C
T_L	Lead Temperature (Soldering, 10 sec. time limit)	+ 260°C

Maximum Power Dissipations (Notes 2 and 3)

P_D	Total Dissipation at 25°C Case Temperature	3 Watts
	at 100°C Case Temperature	1.7 Watt
	at 25°C Ambient Temperature	0.7 Watt

Maximum Voltages (T_A =25°C unless otherwise noted)

V_{CBO}	Collector to Base Voltage	75 Volts
V_{CER}	Collector to Emitter Voltage (R_{BE} = 10 Ω) (Note 4)	50 Volts
V_{EBO}	Emitter to Base Voltage	7 Volts

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

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	20	60			I_C = 10 μA	V_{CE} = 10 V
h_{FE}	DC Current Gain	35	80			I_C = 0.1 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	75	130			I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	100	130	300		I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	40	75			I_C = 500 mA	V_{CE} = 10 V
h_{FE} (-55°C)	DC Pulse Current Gain (Note 5)	35	65			I_C = 10 mA	V_{CE} = 10 V
V_{BE} (sat)	Base Saturation Voltage (Note 5)		0.95	1.3	V	I_C = 150 mA	I_B = 15 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.5	1.5	V	I_C = 150 mA	I_B = 15 mA
I_{EBO}	Emitter Cutoff Current		0.05	5	nA	I_C = 0	V_{EB} = 5 V
I_{CBO}	Collector Cutoff Current		0.3	10	nA	I_E = 0	V_{CB} = 60 V
I_{CBO} (125°C)	Collector Cutoff Current		0.4	10	μA	I_E = 0	V_{CB} = 60 V
BV_{CBO}	Collector to Base Breakdown Voltage	75			V	I_E = 0	I_C = 0.1 mA
BV_{EBO}	Emitter to Base Breakdown Voltage	7			V	I_C = 0	I_E = 0.1 mA
LV_{CER}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	50			V	R_{BE} ≤ 10 Ω	I_C = 100 mA (pulsed)

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

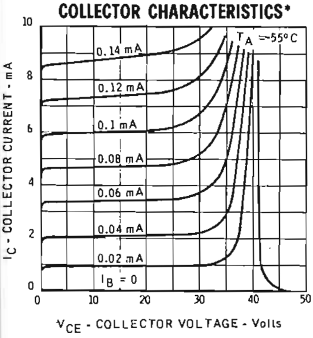
BFX 68

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{fe}	Small Signal Current Gain (f = 1 KHz)	50	115	200		I_C = 1 mA	V_{CE} = 5 V
h_{fe}	Small Signal Current Gain (f = 1 KHz)	70	135	300		I_C = 5 mA	V_{CE} = 10 V
h_{ie}	Input Resistance (f = 1 KHz)		4.4		Ω	I_C = 1 mA	V_{CE} = 5 V
h_{oe}	Output Conductance (f = 1 KHz)		23.8		μmho	I_C = 1 mA	V_{CE} = 5 V
h_{re}	Voltage Feedback Ratio (f = 1 KHz)		7.3		$\times 10^{-4}$	I_C = 1 mA	V_{CE} = 5 V
h_{ib}	Input Resistonce (f = 1 KHz)	24	27	34	Ω	I_C = 1 mA	V_{CB} = 5 V
h_{ib}	Input Resistance (f = 1 KHz)	4	6.3	8	Ω	I_C = 5 mA	V_{CB} = 10 V
h_{ob}	Outout Conductance (f = 1 KHz)	0.1	0.16	0.5	μmho	I_C = 1 mA	V_{CB} = 5 V
h_{ob}	Output Conductance (f = 1 KHz)	0.1	0.19	1	μmho	I_C = 5 mA	V_{CB} = 10 V
h_{rb}	Voltage Feedback Ratio (f = 1 KHz)		1.2	5	$\times 10^{-4}$	I_C = 1 mA	V_{CB} = 5 V
h_{rb}	Voltage Feedback Ratio (f = 1 KHz)		1.2	5	$\times 10^{-4}$	I_C = 5 mA	V_{CB} = 10 V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.5	5			I_C = 50 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance		18	25	pF	I_E = 0	V_{CB} = 10 V
C_{TE}	Emitter Transition Capacitonce		50	80	pF	I_C = 0	V_{EB} = 0.5 V
NF	Narrow Bond Noise Figure (Note 6)		3.5	8	dB	I_C = 0.3 mA	V_{CE} = 10 V

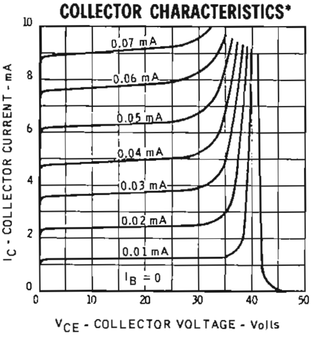
NOTES :
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 58.3°C/watt (derating factor of 17.2 mW/°C); junction-to-ambient thermal resistonce of 250°C/watt (derating factor of 4 mW/°C).
(4) These ratings refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.
(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.
(6) f = 1 KHz; R_S = 510 Ω; Power Bandwidth of 1 Hz.

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

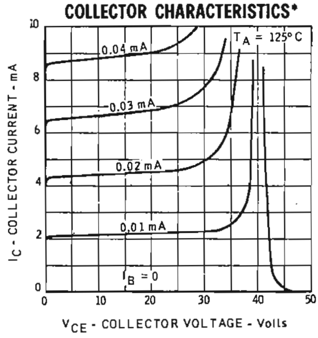
COLLECTOR CHARACTERISTICS*



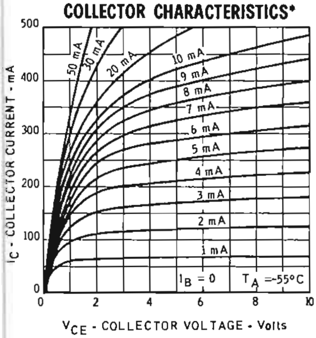
COLLECTOR CHARACTERISTICS*



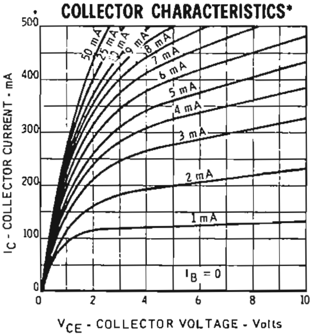
COLLECTOR CHARACTERISTICS*



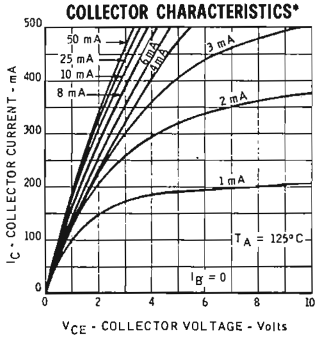
COLLECTOR CHARACTERISTICS*



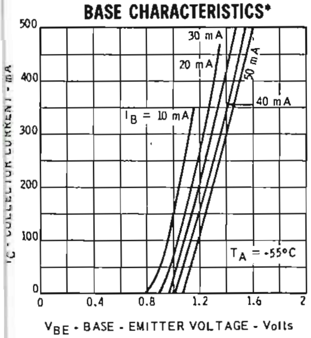
COLLECTOR CHARACTERISTICS*



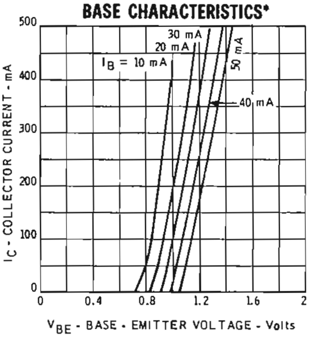
COLLECTOR CHARACTERISTICS*



BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



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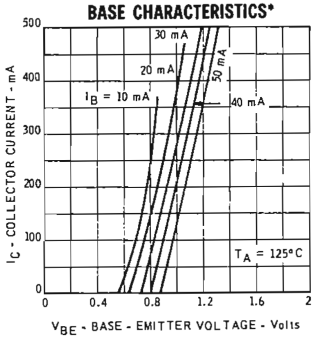
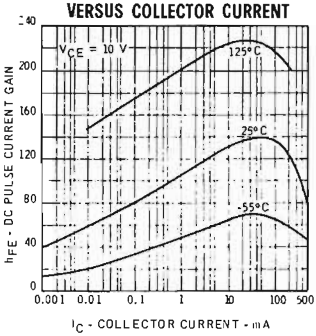


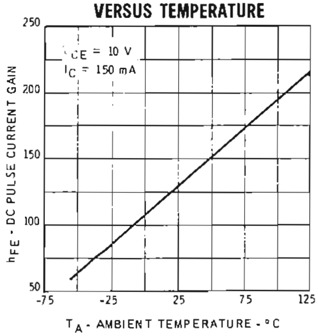
* Single family characteristics on Transistor Curve Tracer.

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

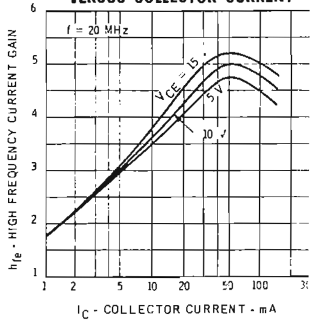
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



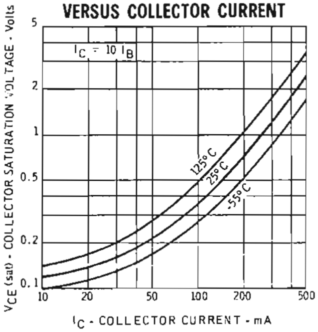
DC PULSE CURRENT GAIN VERSUS TEMPERATURE



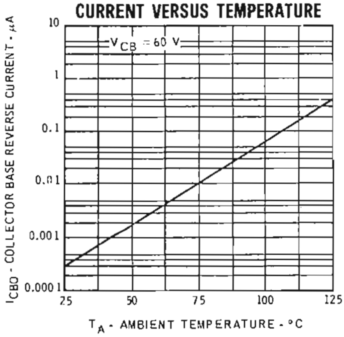
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



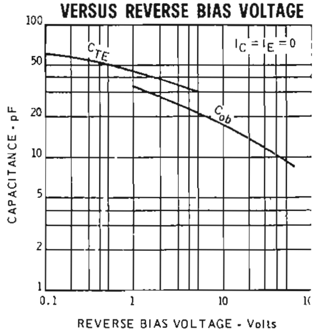
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



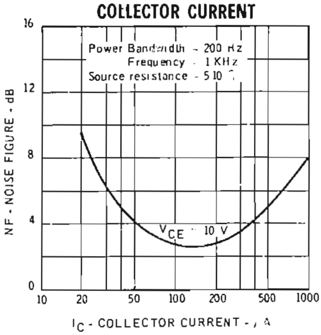
COLLECTOR-BASE REVERSE CURRENT VERSUS TEMPERATURE



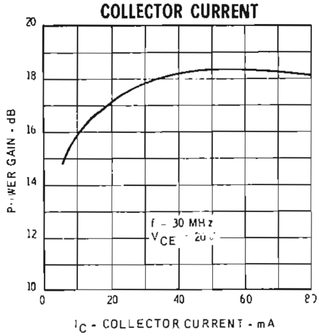
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



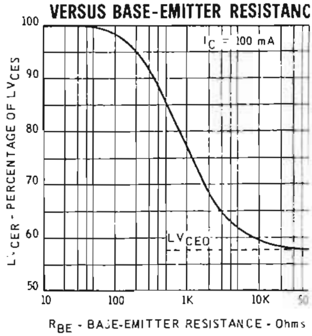
NOISE FIGURE VERSUS COLLECTOR CURRENT



POWER GAIN VERSUS COLLECTOR CURRENT

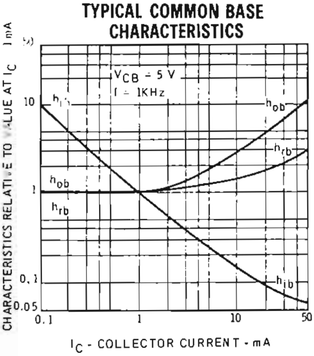


LOWER LIMITING VOLTAGE VERSUS BASE-EMITTER RESISTANC

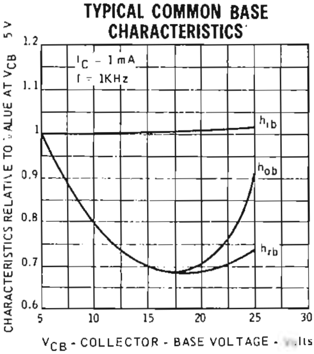


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

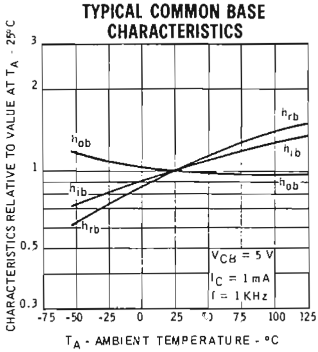
TYPICAL COMMON BASE CHARACTERISTICS



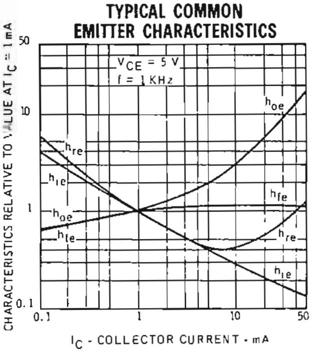
TYPICAL COMMON BASE CHARACTERISTICS



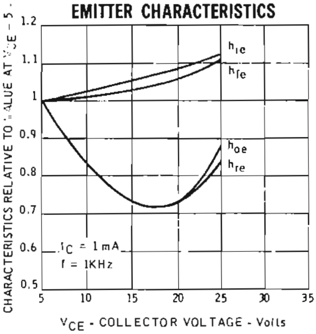
TYPICAL COMMON BASE CHARACTERISTICS



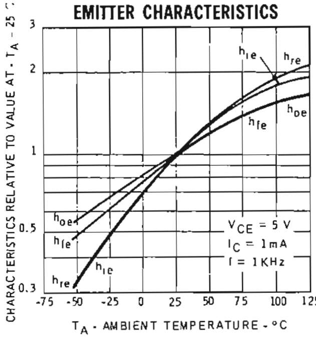
TYPICAL COMMON EMITTER CHARACTERISTICS



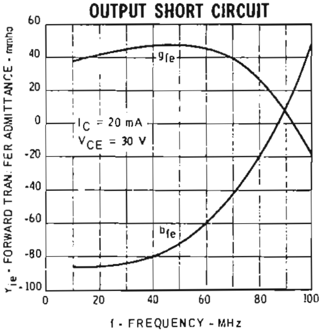
TYPICAL COMMON EMITTER CHARACTERISTICS



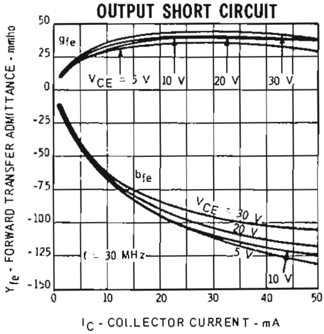
TYPICAL COMMON EMITTER CHARACTERISTICS



FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT

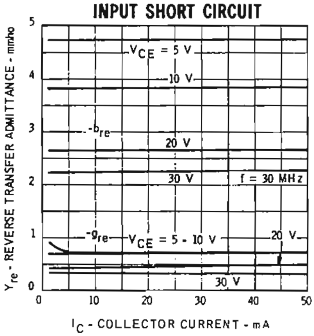


FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT

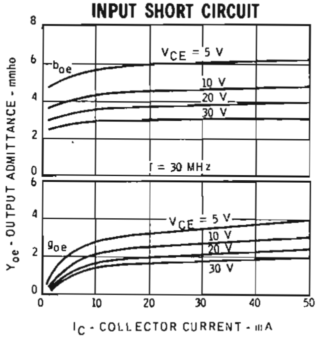


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

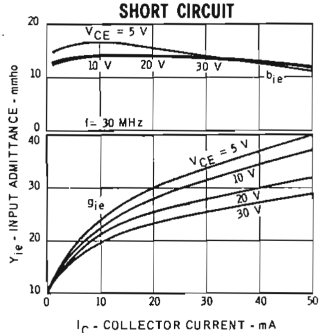
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



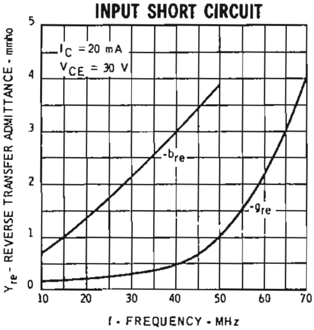
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



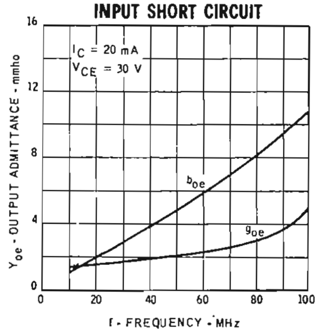
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



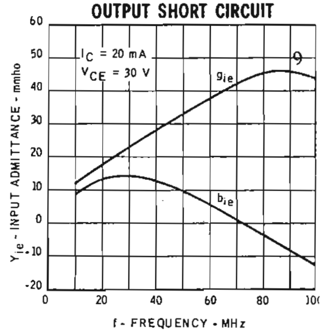
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



OUTPUT ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



INPUT ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT



BFX69-BFX69A

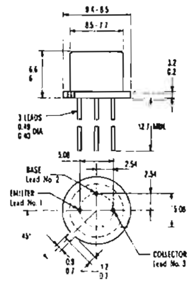
GENERAL PURPOSE AMPLIFIERS

NPN SILICON PLANAR TRANSISTORS

GENERAL DESCRIPTION - The BFX69 is an NPN silicon PLANAR transistor primarily designed for amplifier applications over a wide range of voltage and current.

For improved performance use the epitaxial BFX69A.

PHYSICAL DIMENSIONS in accordance with JEDEC TO-39 outline



Notes. All dimensions in mm
Collector internally connected to case.
Leads are gold-plated Kovar

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C
T_L	Lead Temperature (Soldering, 10 sec. time limit)	+ 260°C

Maximum Power Dissipations (Notes 2 and 3)

		BFX69	BFX69A
P_D	Total Dissipation at 25°C Case Temperature	3 Watts	5 Watts
	at 100°C Case Temperature	1.7 Watt	2.8 Watts
	at 25°C Ambient Temperature	0.8 Watt	0.8 Watt

Maximum Voltages (T_A = 25°C unless otherwise noted)

V_{CBO}	Collector to Base Voltage	75 Volts	80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts	40 Volts
V_{CER}	Collector to Emitter Voltage (R_{BE} = 10 Ω) (Note 4)	50 Volts	
V_{EBO}	Emitter to Base Voltage	7 Volts	7 Volts

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

		BFX69			BFX69A					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain		35			40			I_C = 10 μA	V_{CE} = 10 V
h_{FE}	DC Current Gain	20	50		30	60			I_C = 0.1 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	35	80		40	95			I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	40	80	120	40	90			I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	20	55		25	60			I_C = 500 mA	V_{CE} = 10 V
h_{FE} (-55°C)	DC Pulse Current Gain (Note 5)	20	35						I_C = 10 mA	V_{CE} = 10 V
h_{FE} (-55°C)	DC Pulse Current Gain (Note 5)				20	40			I_C = 150 mA	V_{CE} = 10 V
V_{BE} (sat)	Base Saturation Voltage (Note 5)		0.95	1.3		0.86	1.1	V	I_C = 150 mA	I_B = 15 mA
V_{BE} (sat)	Base Saturation Voltage (Note 5)						1.8	V	I_C = 500 mA	I_B = 50 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.6	1.5		0.4	0.8	V	I_C = 150 mA	I_B = 15 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)						1.2	V	I_C = 500 mA	I_B = 50 mA
I_{EBO}	Emitter Cutoff Current		0.05	10		0.05	10	nA	I_C = 0	V_{EB} = 5 V
I_{CBO}	Collector Cutoff Current		0.3	10		0.4	10	nA	I_E = 0	V_{CB} = 60 V
I_{CBO} (125°C)	Collector Cutoff Current		0.4	10		0.5	10	μA	I_E = 0	V_{CB} = 60 V
BV_{CBO}	Collector to Base Breakdown Voltage	75			80			V	I_E = 0	I_C = 0.1 mA
BV_{EBO}	Emitter to Base Breakdown Voltage	7			7			V	I_C = 0	I_E = 0.1 mA
LV_{CER}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	50						V	R_{BE} ≤ 10 Ω	I_C = 100 mA (pulsed)
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	30			40			V	I_B = 0	I_C = 30 mA (pulsed)

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

SYMBOL	CHARACTERISTIC	BFX 69 MIN.	BFX 69 TYP.	BFX 69 MAX.	BFX 69A MIN.	BFX 69A TYP.	BFX 69A MAX.	UNIT	TEST CONDITIONS	
h_{fe}	Small Signal Current Gain (f = 1 KHz)	30	55	100		70			I_C = 1 mA	V_{CE} = 5 V
h_{fe}	Small Signal Current Gain (f = 1 KHz)	35	70	150					I_C = 5 mA	V_{CE} = 10 V
h_{ie}	Input Resistance (f = 1 KHz)		2.2			1.8		KΩ	I_C = 1 mA	V_{CE} = 5 V
h_{oe}	Output Conductance (f = 1 KHz)		12.5			8		μmho	I_C = 1 mA	V_{CE} = 5 V
h_{re}	Voltage Feedback Ratio (f = 1 KHz)		3.6			2.1		$\times 10^{-4}$	I_C = 1 mA	V_{CE} = 5 V
h_{ib}	Input Resistance (f = 1 KHz)	24	27	34		27		Ω	I_C = 1 mA	V_{CB} = 5 V
h_{ib}	Input Resistance (f = 1 KHz)	4	6.3	8				Ω	I_C = 5 mA	V_{CB} = 10 V
h_{ob}	Output Conductance (f = 1 KHz)	0.1	0.16	0.5		0.12		μmho	I_C = 1 mA	V_{CB} = 5 V
h_{ob}	Output Conductance (f = 1 KHz)	0.1	0.19	1				μmho	I_C = 5 mA	V_{CB} = 10 V
h_{rb}	Voltage Feedback Ratio (f = 1 KHz)		0.7	3		0.5		$\times 10^{-4}$	I_C = 1 mA	V_{CB} = 5 V
h_{rb}	Voltage Feedback Ratio (f = 1 KHz)		0.8	3				$\times 10^{-4}$	I_C = 5 mA	V_{CB} = 10 V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3	4		3	4.2			I_C = 50 mA	V_{CE} = 10 V
C_{TE}	Emitter Transition Capacitance		50	80		62	80	pF	I_C = 0	V_{EB} = 0.5 V
C_{obo}	Common Base, Open Circuit, Output Capacitance		18	25		13	20	pF	I_E = 0	V_{CB} = 10 V
NF	Narrow Band Noise Figure (Note 6)		6	12				dB	I_C = 0.3 mA	V_{CE} = 10 V
NF	Narrow Band Noise Figure (Note 7)					3.5	7	dB	I_C = 30 μA	V_{CE} = 10 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) (BFX 69 only) 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 4.55 mW/°C).
(BFX 69A only) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 35°C/watt (derating factor of 28,6 mW/°C); junction-to-ambient thermal resistance of 218°C/watt (derating factor of 4.6 mW/°C).

(4) These ratings refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

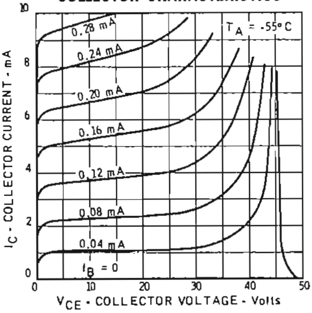
(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(6) f = 1 KHz; R_S = 510 Ω; Power Bandwidth of 200 Hz.

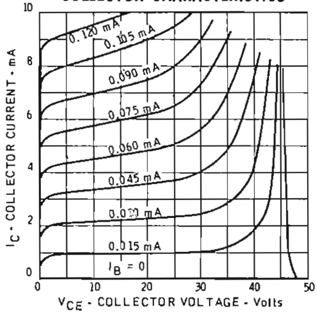
(7) f = 1 KHz; R_S = 1 KΩ; Power Bandwidth of 200 Hz.

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

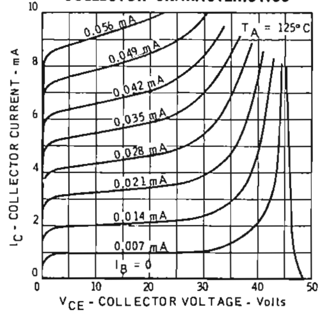
COLLECTOR CHARACTERISTICS*



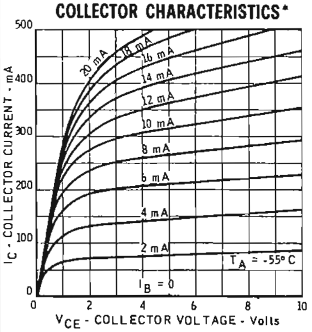
COLLECTOR CHARACTERISTICS*



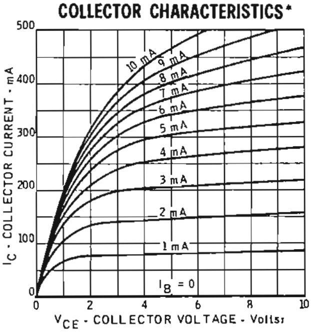
COLLECTOR CHARACTERISTICS*



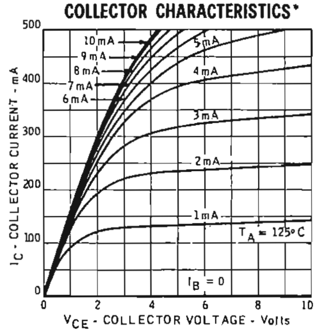
COLLECTOR CHARACTERISTICS*



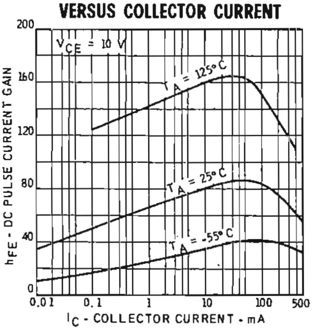
COLLECTOR CHARACTERISTICS*



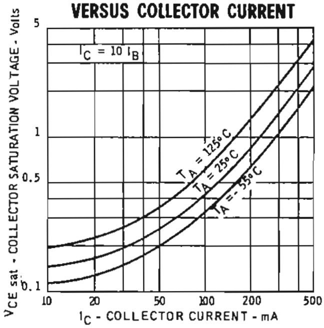
COLLECTOR CHARACTERISTICS*



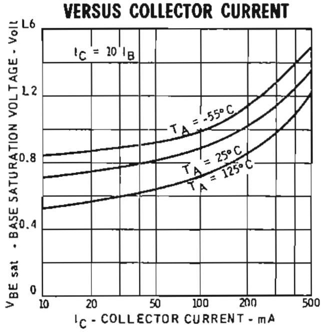
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



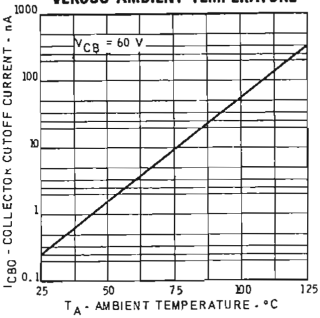
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



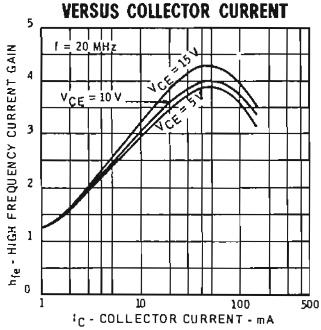
* Single family characteristics on Transistor Curve Tracer.

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

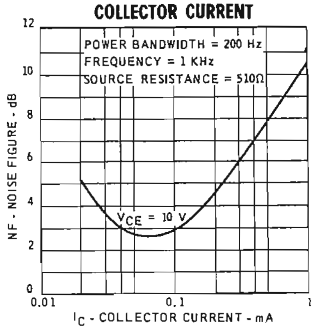
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



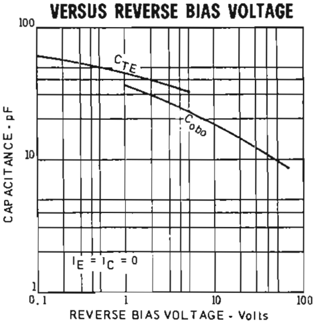
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



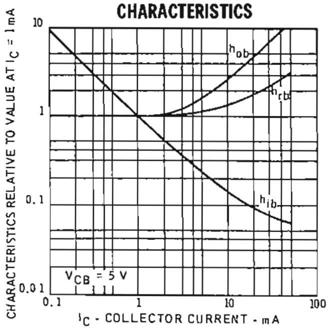
NOISE FIGURE VERSUS COLLECTOR CURRENT



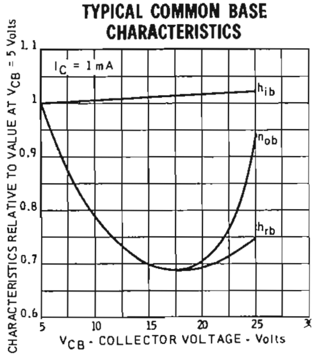
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



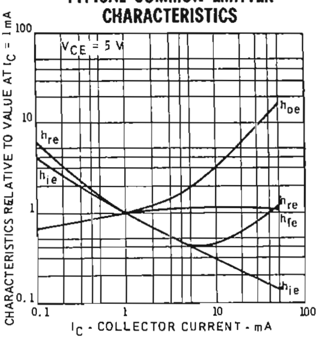
TYPICAL COMMON BASE CHARACTERISTICS



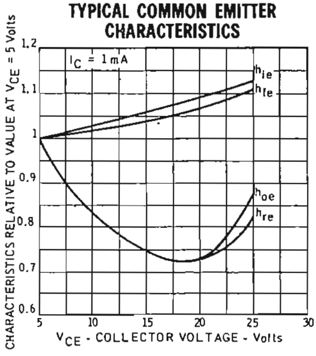
TYPICAL COMMON BASE CHARACTERISTICS



TYPICAL COMMON EMITTER CHARACTERISTICS

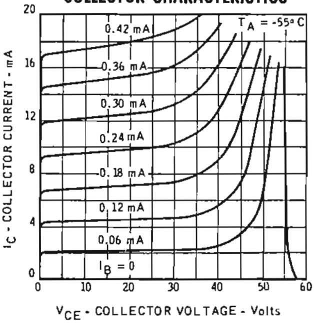


TYPICAL COMMON EMITTER CHARACTERISTICS



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

COLLECTOR CHARACTERISTICS*



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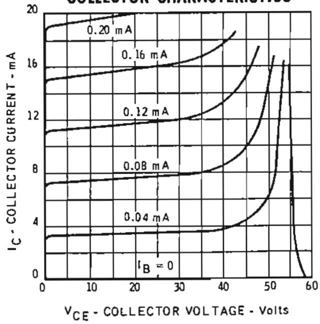

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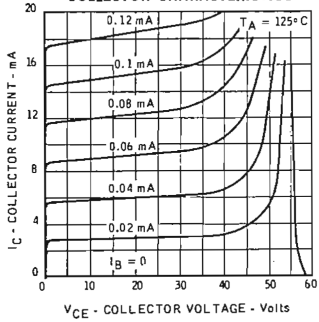
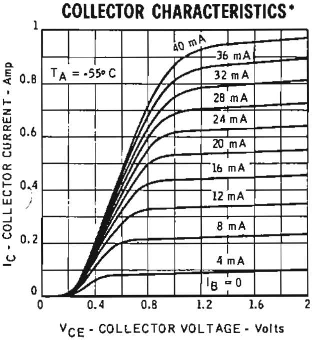


COLLECTOR CHARACTERISTICS*



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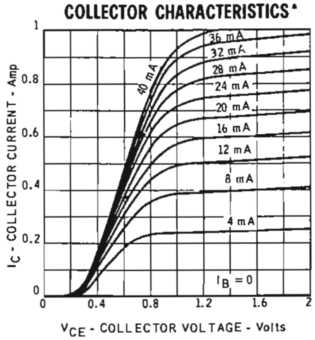

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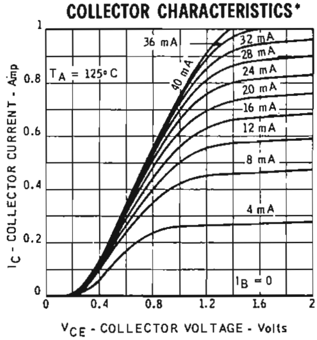
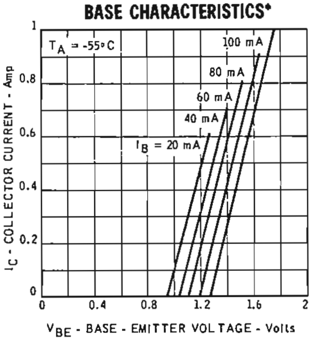
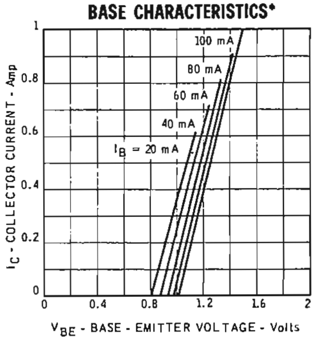


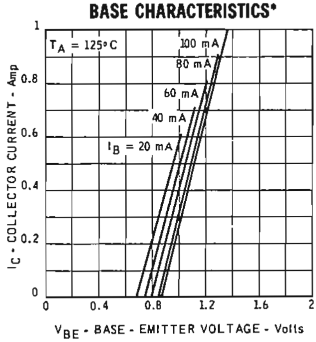
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



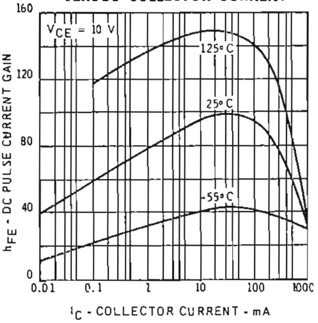
BASE CHARACTERISTICS*



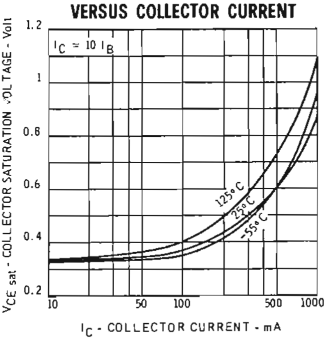
*Single family characteristics on Transistor Curve Tracer.

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

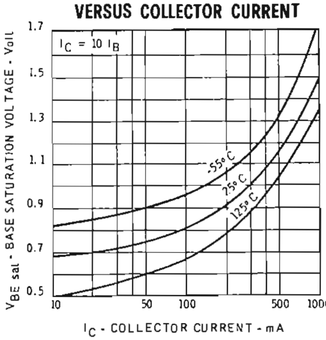
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



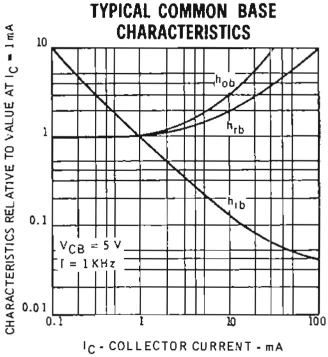
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



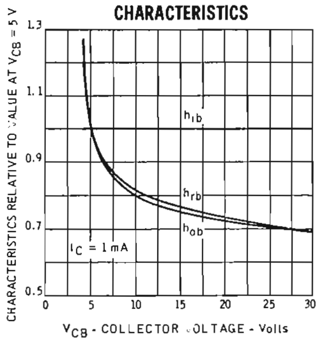
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



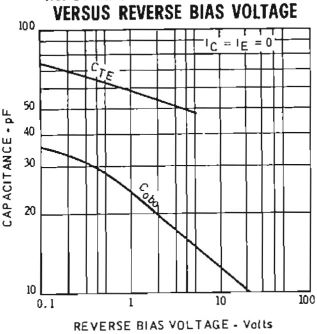
TYPICAL COMMON BASE CHARACTERISTICS



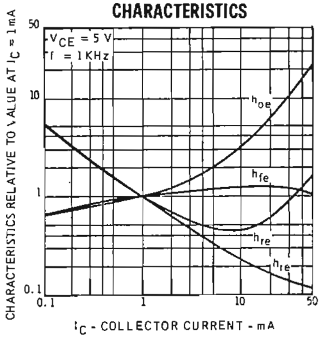
TYPICAL COMMON BASE CHARACTERISTICS



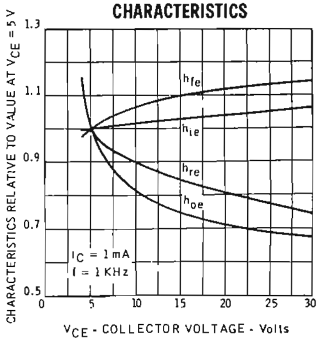
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



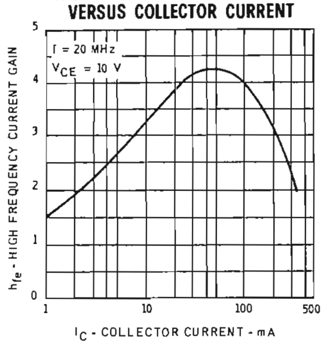
TYPICAL COMMON EMITTER CHARACTERISTICS



TYPICAL COMMON EMITTER CHARACTERISTICS



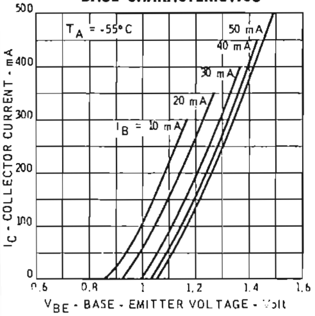
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



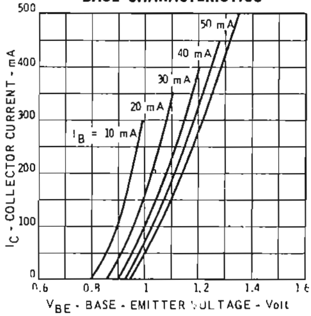
TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

* Single family characteristics on Transistor Curve Tracer.

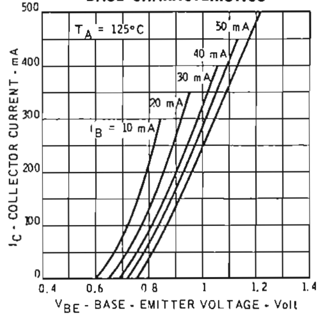
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



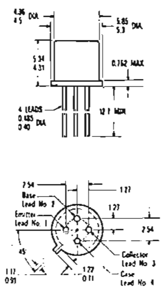
BFX 73

ULTRA HIGH FREQUENCY OSCILLATOR AND AMPLIFIER

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BFX73 is an NPN double diffused silicon PLANAR epitaxial transistor. It is designed for low noise high-frequency amplifiers; 1 MHz loeal oscillators; non-neutralized IF amplifiers and non-saturating circuits with rise and fall time of less than 2.5 nanoseeonds.

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



Notes: All dimensions in mm.
Leads are gold-plated Kovar

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	- 55°C to + 200°C
T_J	Operating Junction Temperature	200°C Maximum
T_L	Lead Temperature (Soldering, 10 sec. time limit)	260°C Maximum

Maximum Power Dissipations (Notes 2 and 3)

P	Total Dissipation at 25°C Case Temperature	0.3 Watt
	at 25°C Ambient Temperature	0.2 Watt

Maximum Voltages and Current (25°C free air temperature unless otherwise noted)

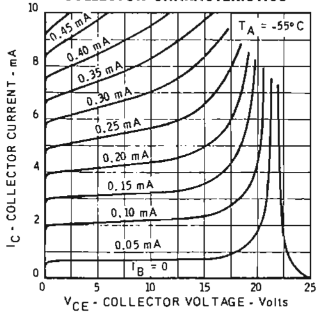
V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	3 Volts
I_C	DC Collector Current	50 mA

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

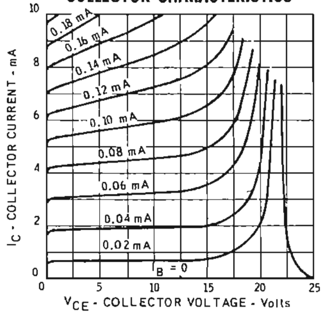
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	20	50			I_C = 3 mA	V_{CE} = 1 V
V_{BE} (sat)	Base-Emitter Saturation Voltage (Note 5)			1	V	I_C = 10 mA	I_B = 1 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage (Note 5)			0.4	V	I_C = 10 mA	I_B = 1 mA
I_{CBO}	Collector Cutoff Current			10	nA	I_E = 0	V_{CB} = 15 V
I_{CBO} (125°C)	Collector Cutoff Current			1	µA	I_E = 0	V_{CB} = 15 V
BV_{CBO}	Collector to Base Breakdown Voltage	30			V	I_C = 1 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3			V	I_C = 0	I_E = 10 µA
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	15			V	I_C = 3 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 MHz)	6	9			I_C = 4 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance		1	1.7	pF	I_E = 0	V_{CB} = 10 V
C_{ob}	Output Capacitance		1.8	3	pF	I_E = 0	V_{CB} = 0
C_{TE}	Emitter Transition Capacitance			2	pF	I_C = 0	V_{EB} = 0.5 V
NF	Noise Figure (Note 6)		3	6	dB	I_C = 1 mA	V_{CE} = 6 V
P_o	Power Output (f = 500 MHz)	30	40		mW	I_C = 8 mA	V_{CB} = 15 V
η	Collector Efficiency (f = 500 MHz)	25			%	I_C = 8 mA	V_{CB} = 15 V
G_{pe}	Available Power Gain (neutralized) (f = 200 MHz)	15	18		dB	I_C = 6 mA	V_{CE} = 12 V

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

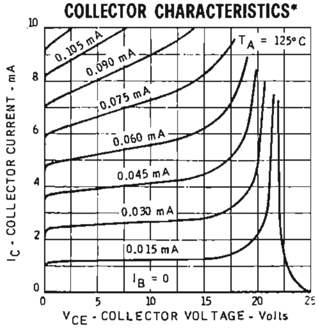
COLLECTOR CHARACTERISTICS*



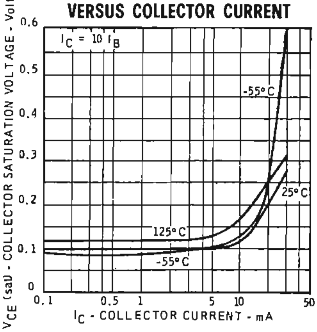
COLLECTOR CHARACTERISTICS*



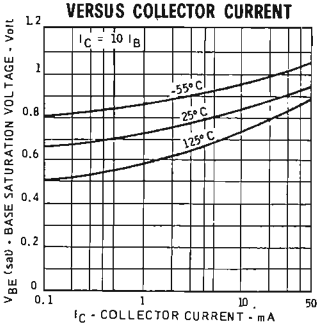
COLLECTOR CHARACTERISTICS*



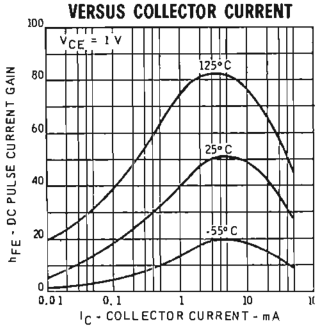
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



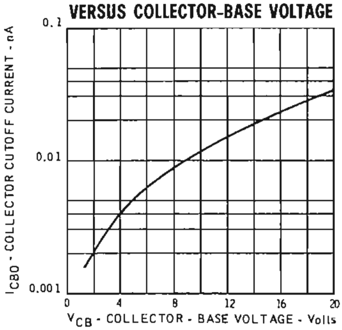
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



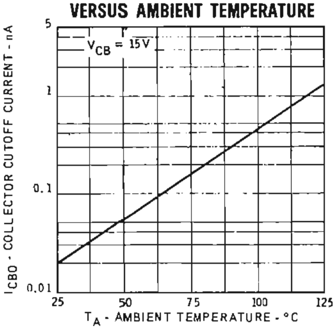
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



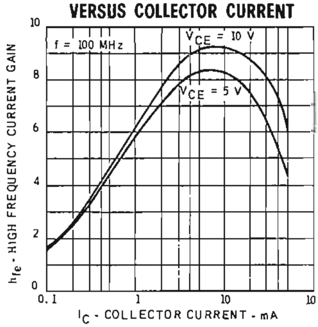
COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR-BASE VOLTAGE



COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



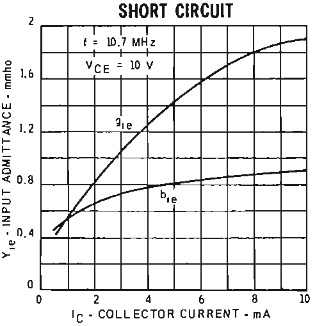
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



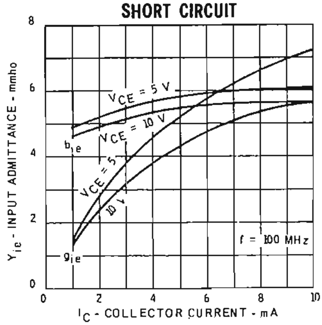
* Single family characteristics on Transistor Curve Tracer.

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

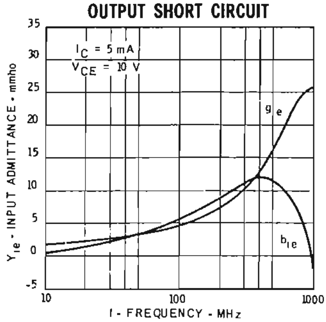
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



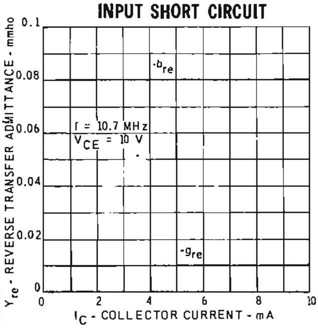
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



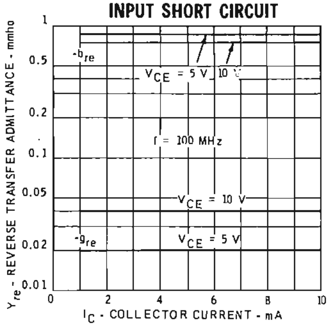
INPUT ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT



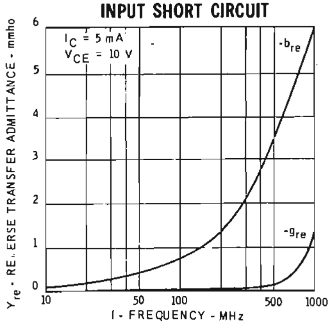
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



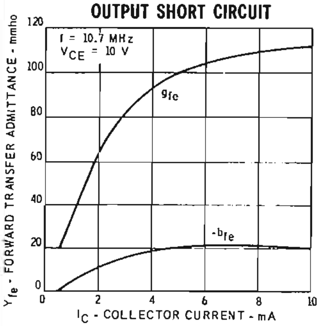
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



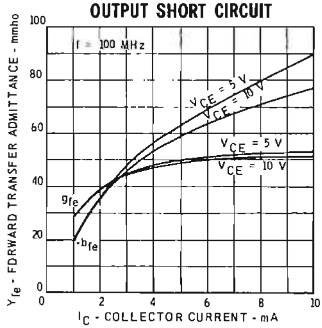
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



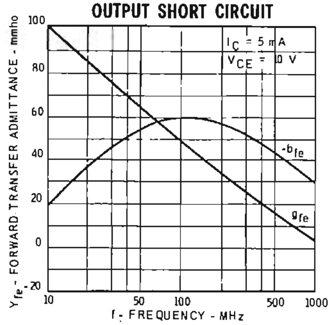
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT

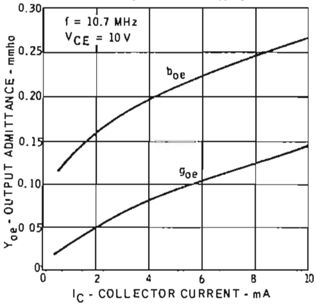


FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT

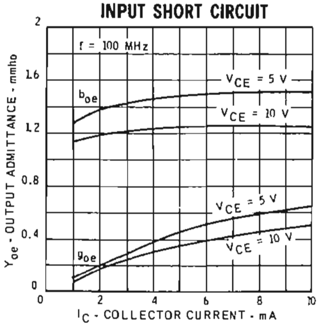


TYPICAL ELECTRICAL CHARACTERISTICS (25° C free air temperature unless otherwise noted)

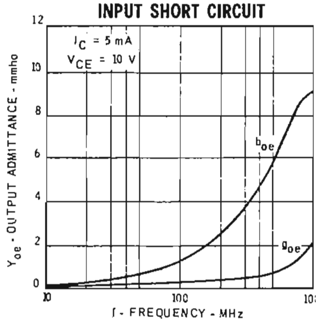
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



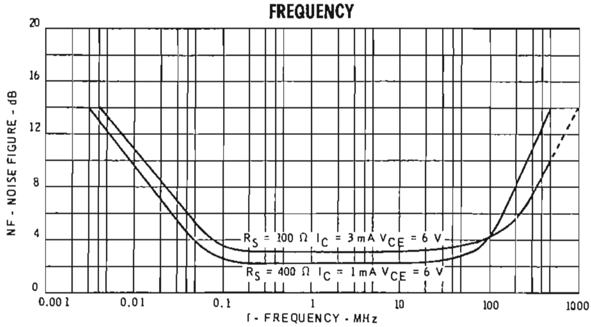
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



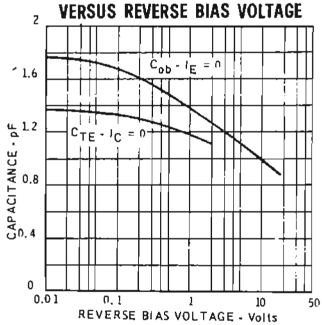
OUTPUT ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



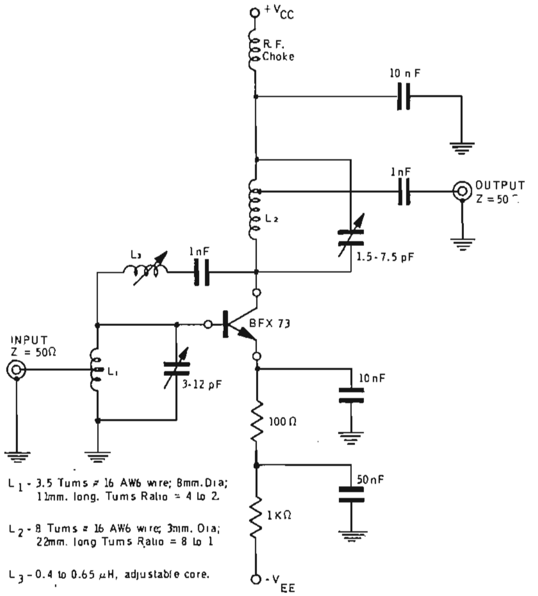
NOISE FIGURE VERSUS FREQUENCY



INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



NEUTRALIZED 200 MHz POWER GAIN AMPLIFIER TEST CIRCUIT

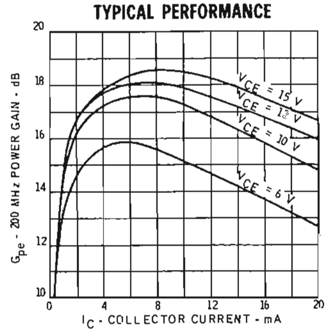


L_1 - 3.5 Turns # 16 AWG wire; 8mm. Dia; 11mm. long. Turns Ratio = 4 to 2.

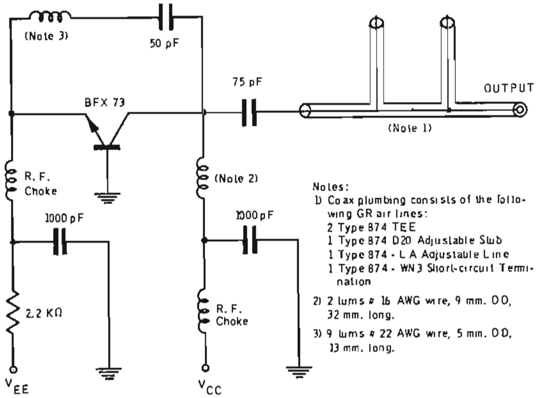
L_2 - 8 Turns # 16 AWG wire; 3mm. Dia; 22mm. long Turns Ratio = 8 to 1

L_3 - 0.4 to 0.65 μH, adjustable core.

TYPICAL PERFORMANCE

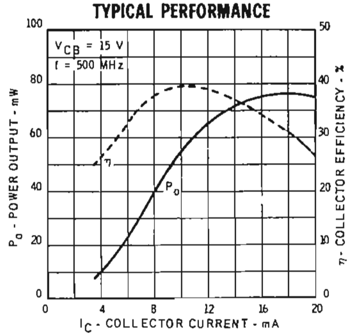


500 MHz OSCILLATOR TEST CIRCUIT

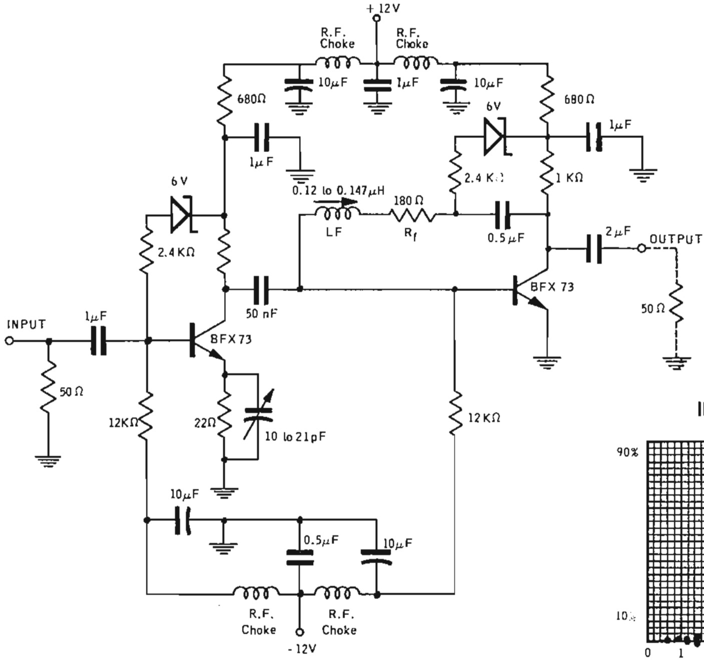


Notes:
1) Coax plumbing consists of the following GR air lines:
2 Type 874 TEE
1 Type 874 D20 Adjustable Stub
1 Type 874 - L A Adjustable Line
1 Type 874 - WN3 Short-circuit Termination
2) 2 turns # 16 AWG wire, 9 mm. OD, 32 mm. long.
3) 9 turns # 22 AWG wire, 5 mm. OD, 13 mm. long.

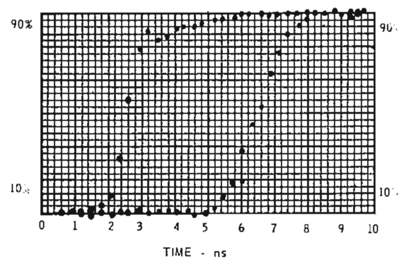
TYPICAL PERFORMANCE



TWO STAGE VIDEO AMPLIFIER



INPUT TO OUTPUT DELAY - 4 ns.



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 584°C/watt (derating factor of 1.71 mW/°C); junction-to-ambient thermal resistance of 875°C/watt (derating factor of 1.14 mW/°C).

(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

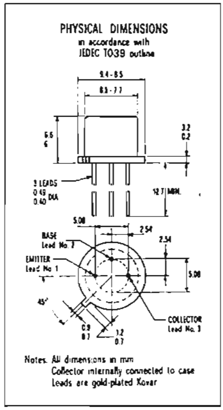
(6) f = 60 MHz; R_S = 400 Ω.

BFX74-BFX74A

GENERAL PURPOSE TYPES

PNP DIFFUSED SILICON PLANAR TRANSISTORS

GENERAL DESCRIPTION - The BFX74 is a PNP silicon PLANAR transistor suitable for high performance amplifiers, where high voltages and high current gain are requested. It features 50 Volts of LV_{CE} and an f_T of 90 MHz typ.
For improved performance use the BFX74A.



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C
T_L	Lead Temperature (Soldering, 10 sec. time limit)	+ 260°C

Maximum Power Dissipations (Notes 2 and 3)

		BFX74	BFX74A
P_D	Total Dissipation at 25°C Case Temperature	2 Watts	4 Watts
	at 100°C Case Temperature	1 Watt	
	at 25°C Ambient Temperature	0.6 Watt	0.8 Watt

Maximum Voltages (T_A = 25°C unless otherwise noted)

		BFX74	BFX74A
V_{CBO}	Collector to Base Voltage	-50 Volts	-60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-35 Volts	-60 Volts
V_{CER}	Collector to Emitter Voltage (R_{BE} = 10 Ω) (Note 4)	-50 Volts	
V_{EBO}	Emitter to Base Voltage	-5 Volts	-5 Volts

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

SYMBOL	CHARACTERISTIC	BFX74 MIN.	BFX74 TYP.	BFX74 MAX.	BFX74A MIN.	BFX74A TYP.	BFX74A MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain					50			I_C = 0.1 mA	V_{CE} = -10 V
h_{FE}	DC Pulse Current Gain (Note 5)	25	55		25	60			I_C = 5 mA	V_{CE} = -10 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	45	90	30	50			I_C = 150 mA	V_{CE} = -10 V
h_{FE}	DC Pulse Current Gain (Note 5)					40			I_C = 500 mA	V_{CE} = -10 V
V_{BE} (sat)	Base Saturation Voltage (Note 5)		-0.95	-1.3		-0.8	-1	V	I_C = 150 mA	I_B = 15 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		-1	-1.5		-0.2	-0.3	V	I_C = 150 mA	I_B = 15 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)					-0.5		V	I_C = 500 mA	I_B = 50 mA
I_{EBO}	Emitter Cutoff Current		0.1	1				μA	I_C = 0	V_{BE} = -2 V
I_{CBO}	Collector Cutoff Current		0.01	1				μA	I_E = 0	V_{CB} = -30 V
I_{CBO} (125°C)	Collector Cutoff Current		2	100				μA	I_E = 0	V_{CB} = -30 V
I_{EBO}	Emitter Cutoff Current						50	nA	I_C = 0	V_{BE} = -4 V
I_{CBO}	Collector Cutoff Current					0.2	50	nA	I_E = 0	V_{CB} = -50 V
I_{CBO} (125°C)	Collector Cutoff Current					0.2	50	μA	I_E = 0	V_{CB} = -50 V
BV_{CBO}	Collector to Base Breakdown Voltage	-50						V	I_E = 0	I_C = 100 μA
BV_{CBO}	Collector to Base Breakdown Voltage				-60			V	I_E = 0	I_C = 10 μA
BV_{EBO}	Emitter to Base Breakdown Voltage	-5						V	I_C = 0	I_E = 100 μA
BV_{EBO}	Emitter to Base Breakdown Voltage				-5			V	I_C = 0	I_E = 10 μA
LV_{CER}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-50						V	R_{BE} ≤ 10 Ω	I_C = 100 mA (pulsed)
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-35			-60			V	I_B = 0	I_C = 10 mA (pulsed)

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

SYMBOL	CHARACTERISTIC	BFX74 MIN.	BFX74 TYP.	BFX74 MAX.	BFX74A MIN.	BFX74A TYP.	BFX74A MAX.	UNIT	TEST CONDITIONS	
h_{fe}	Small Signal Current Gain (f = 1 KHz)	30	60						I_C = 5 mA	V_{CE} = -10 V
h_{ib}	Input Resistance (f = 1 KHz)		6.2	10				Ω	I_C = 5 mA	V_{CB} = -10 V
h_{ob}	Output Conductance (f = 1 KHz)		0.6	5				μmho	I_C = 5 mA	V_{CB} = -10 V
h_{rb}	Voltage Feedback Ratio (f = 1 KHz)		2	8				$\times 10^{-4}$	I_C = 5 mA	V_{CB} = -10V
h_{fe}	High Frequency Current Gain (f=20 MHz)	3	4.5						I_C = 50 mA	V_{CE} = -10 V
h_{fe}	High Frequency Current Gain (f=100 MHz)				1	1.5			I_C = 50 mA	V_{CE} = -10 V
C_{TE}	Emitter Transition Capacitance		57	80		75	110	pF	I_C = 0	V_{EB} = -0.5 V
C_{obo}	Common Base, Open Circuit, Output Capacitance		31	45		15	20	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) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

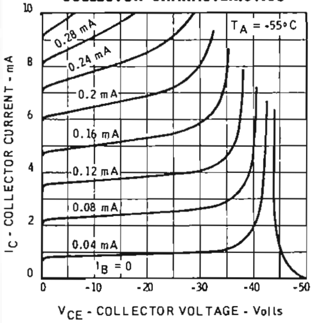
(3) (BFX 74 only) These rating give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 75°C/watt (derating factor of 13.3 mW/°C); junction-to-ambient thermal resistance of 250°C/watt (derating factor of 4 mW/°C).
(BFX 74A only) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 43.7°C/watt (derating factor of 22.8 mW/°C); junction-to-ambient thermal resistance of 219°C/watt (derating factor of 4.56 mW/°C).

(4) These ratings refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS- AR 5.

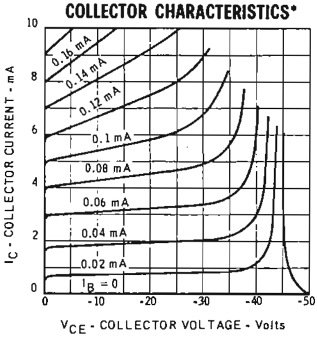
(5) Pulse Conditions : length = 300 μsec ; duty cycle = 1%.

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

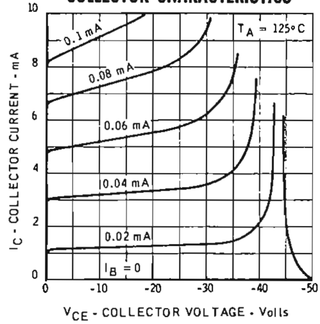
COLLECTOR CHARACTERISTICS*



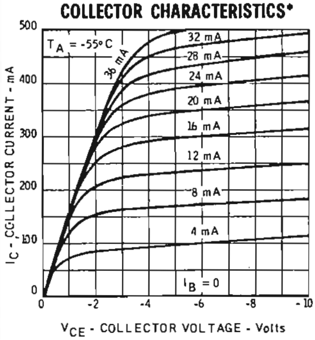
COLLECTOR CHARACTERISTICS*



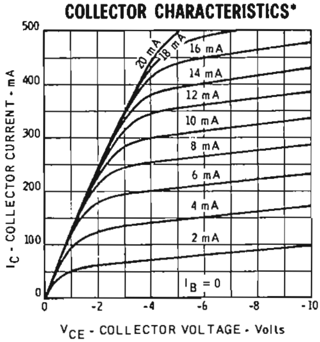
COLLECTOR CHARACTERISTICS*



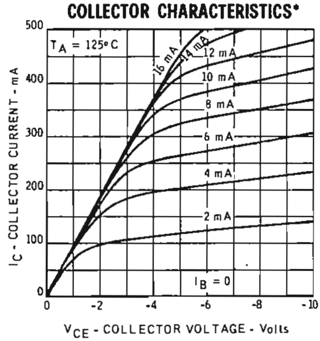
COLLECTOR CHARACTERISTICS*



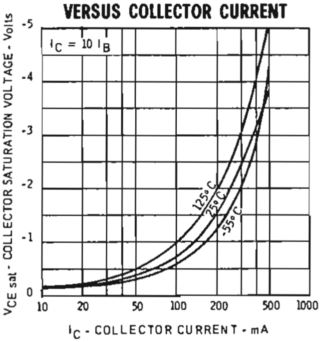
COLLECTOR CHARACTERISTICS*



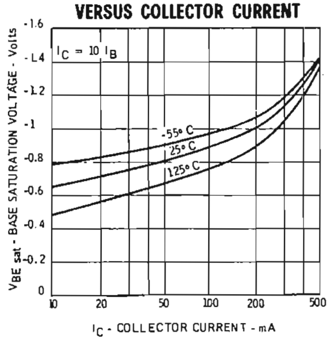
COLLECTOR CHARACTERISTICS*



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



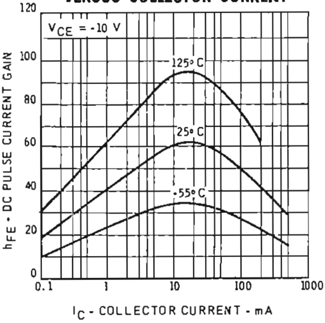
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



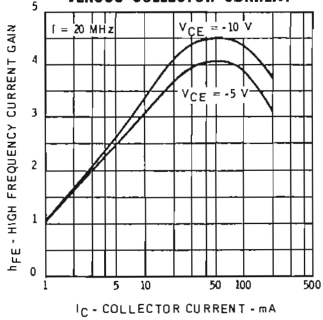
* Single family characteristics on Transistor Curve Tracer.

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

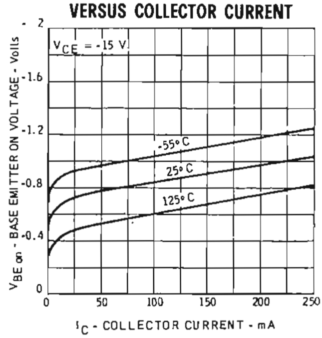
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



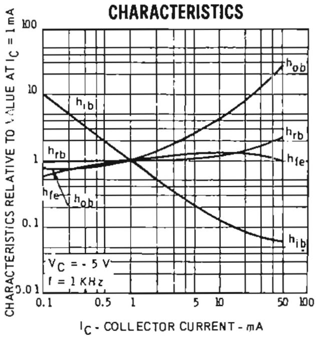
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



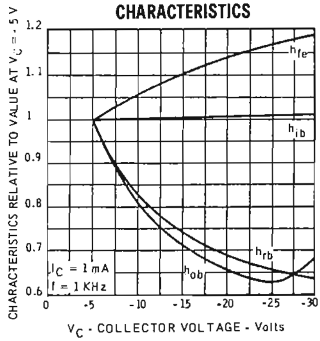
BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



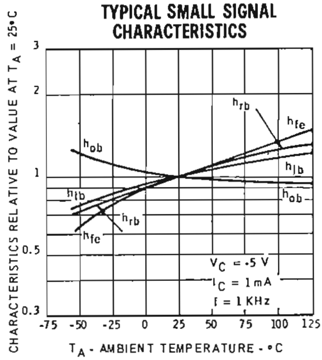
TYPICAL SMALL SIGNAL CHARACTERISTICS



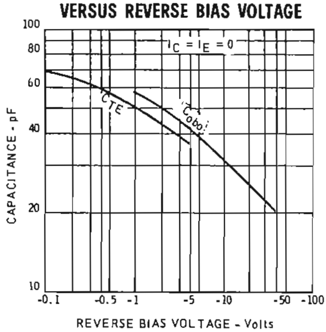
TYPICAL SMALL SIGNAL CHARACTERISTICS



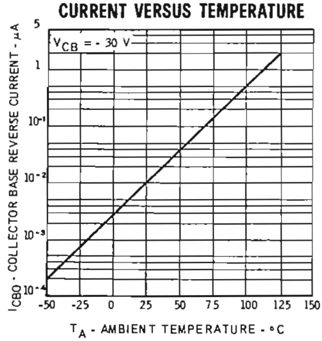
TYPICAL SMALL SIGNAL CHARACTERISTICS



INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

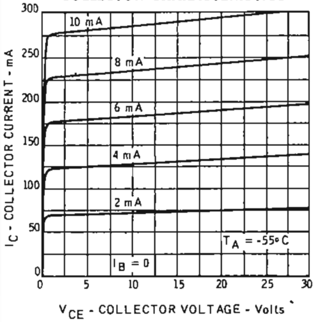


COLLECTOR-BASE REVERSE CURRENT VERSUS TEMPERATURE

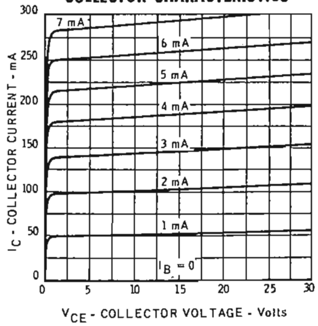


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

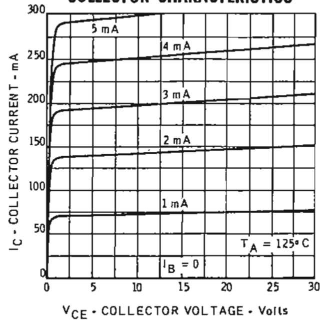
COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*



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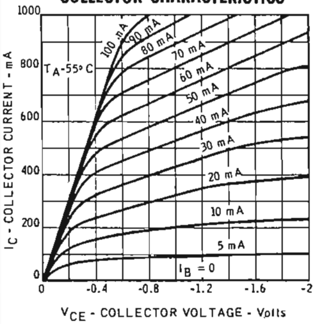
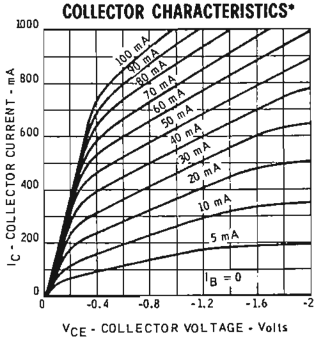
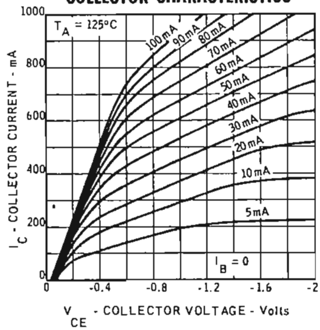


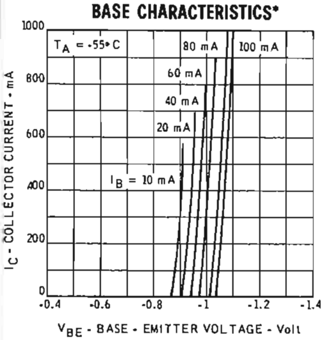
COLLECTOR CHARACTERISTICS*



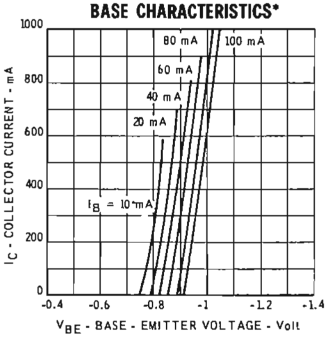
COLLECTOR CHARACTERISTICS*



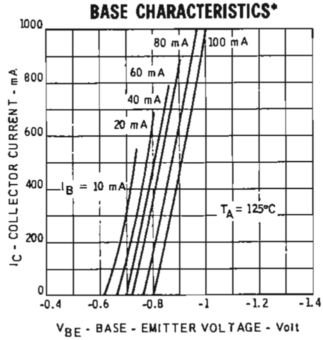
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



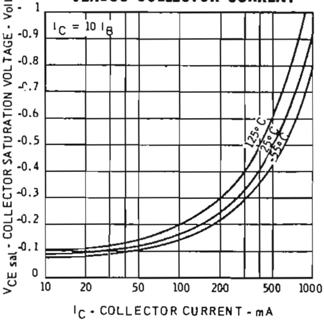
BASE CHARACTERISTICS*



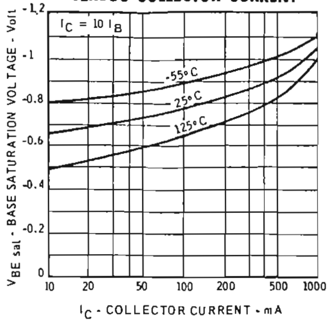
*Single family characteristics on Transistor Curve Tracer.

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

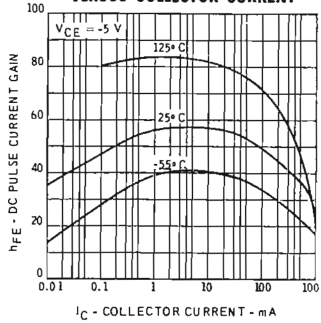
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



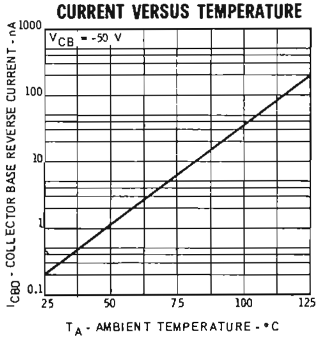
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



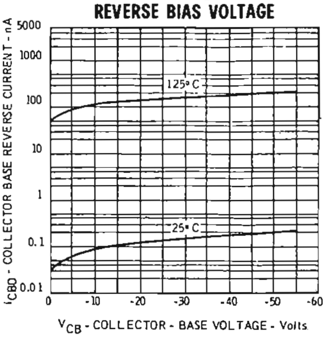
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



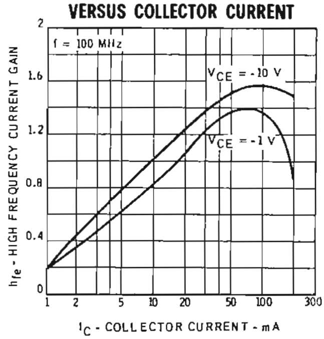
COLLECTOR-BASE REVERSE CURRENT VERSUS TEMPERATURE



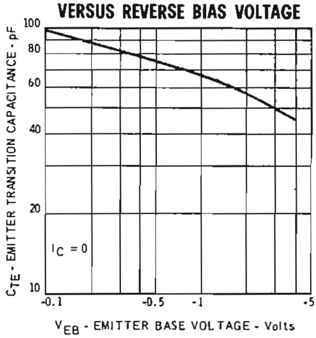
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



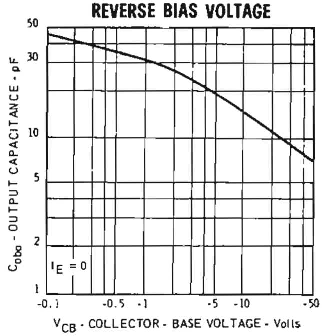
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

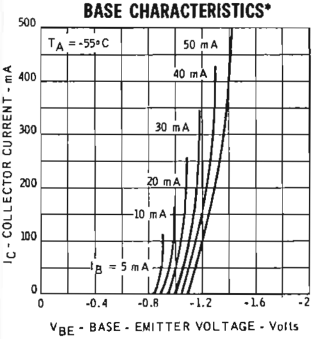


OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

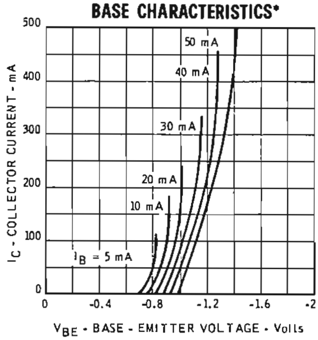


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

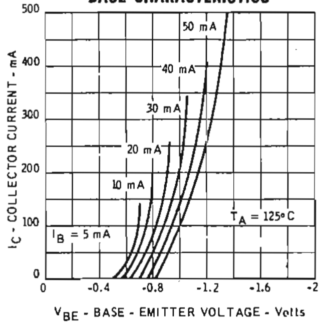
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



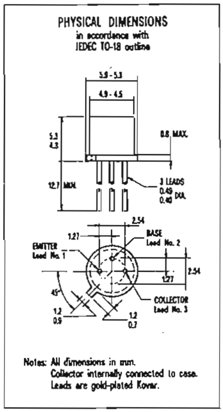
*Single family characteristics on Transistor Curve Tracer.

BFX90-BFX91

HIGH VOLTAGE AMPLIFIERS

PNP DIFFUSED SILICON PLANAR II TRANSISTORS

GENERAL DESCRIPTION - The BFX 90 and the BFX 91 are PNP silicon PLANAR epitaxial transistors featuring high voltage, high gain, low noise, excellent current gain linearity in the current range from 10 µA to 50 mA.
These devices are covered by Semiconductor Users Reliability Evaluation (SURE) Programme.



BFX 90

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	- 55°C to	200°C
T_J	Operating Junction Temperature		200°C
T_L	Lead Temperature (Soldering, 10 sec time limit)		260°C

Maximum Power Dissipations (Notes 2 and 3)

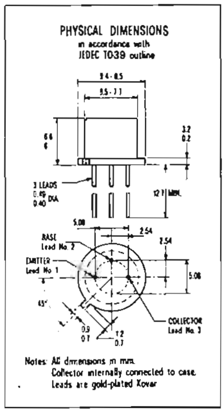
		BFX 90	BFX 91
P_D	Total Dissipation at 25°C Case Temperature	1.4 W	2.5 W
	at 25°C Ambient Temperature	0.4 W	0.7 W

Maximum Voltages (25°C free air temperature unless otherwise noted)

V_{CBO}	Collector to Base Voltage	- 180 V
V_{CEO}	Collector to Emitter Voltage (Note 4)	- 180 V
V_{EBO}	Emitter to Base Voltage	- 6 V

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

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	60	110			I_C = 10 µA	V_{CE} = -10 V
h_{FE}	DC Current Gain (Note 5)	80	170			I_C = 1 mA	V_{CE} = -10 V
h_{FE}	DC Current Gain (Note 5)	80	200	300		I_C = 10 mA	V_{CE} = -10 V
h_{FE} (-55°C)	DC Current Gain	15	60			I_C = 10 µA	V_{CE} = -10 V
h_{FE} (-55°C)	DC Current Gain	30	90			I_C = 100 µA	V_{CE} = -10 V
$V_{BE\ sat}$	Base Saturation Voltage (Note 5)		-0.74	-0.9	V	I_C = 10 mA	I_B = 1 mA
$V_{CE\ sat}$	Collector Saturation Voltage (Note 5)		-0.1	-0.25	V	I_C = 10 mA	I_B = 1 mA
I_{EBO}	Emitter Reverse Current		0.2	10	nA	I_C = 0	V_{EB} = -4 V
I_{CBO}	Collector Reverse Current		0.2	10	nA	I_E = 0	V_{CB} = -100V
I_{CBO}(125°C)	Collector Reverse Current		0.03	10	µA	I_E = 0	V_{CB} = -100V
BV_{CBO}	Collector to Base Breakdown Voltage	-180			V	I_C = 10 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-6			V	I_E = 10 µA	I_C = 0
LV_{CEO}	Collector to Emitter Sustaining Voltage	-180			V	I_C = 2 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2	3	8		I_C = 1 mA	V_{CE} = -10 V
h_{fe}	Small Signal Current Gain	100		400		I_C = 1 mA	V_{CE} = -10 V
h_{ie}	Input Resistance (f = 1 kHz)	2.5		12	kΩ	I_C = 1 mA	V_{CE} = -10 V
h_{oe}	Output Conductance (f = 1 kHz)	5		25	µmhos	I_C = 1 mA	V_{CE} = -10 V



BFX 91

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

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
C_{obo}	Base-Collector Capacitance		5	7	pF	$I_E = 0$	$V_{CB} = -5$ V
C_{TE}	Emitter Transition Capacitance		20	25	pF	$I_C = 0$	$V_{EB} = -0.5$ V
NF	Narrow Band Noise Figure (f = 10 kHz)		1	3	dB	$I_C = 10\ \mu A$ $R_S = 10\ k\Omega$	$V_{CE} = -5$ V BW = 2 kHz
NF	Narrow Band Noise Figure (f = 1 kHz)		1	3	dB	$I_C = 10\ \mu A$ $R_S = 10\ k\Omega$	$V_{CE} = -5$ V BW = 200 Hz
NF	Narrow Band Noise Figure (f = 100 Hz)		2	10	dB	$I_C = 10\ \mu A$ $R_S = 10\ k\Omega$	$V_{CE} = -5$ V BW = 20 Hz

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.

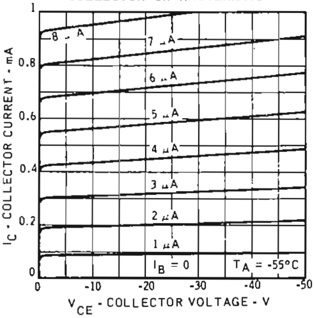
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 125°C/W (derating factor of 8 mW/°C); junction-to-ambient thermal resistance of 438°C/W (derating factor of 2.28 mW/°C) for the BFX 90. Junction-to-case thermal resistance of 70°C/W (derating factor of 14.3 mW/°C); junction-to-ambient thermal resistance of 250°C/W (derating factor of 4 mW/°C) for the BFX 91.

(4) This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for SGS-AR 5.

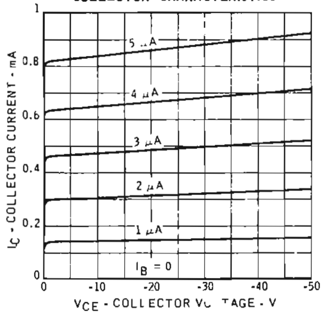
(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

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

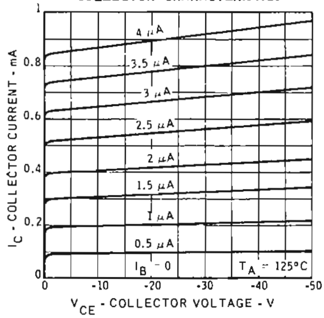
COLLECTOR CHARACTERISTICS*



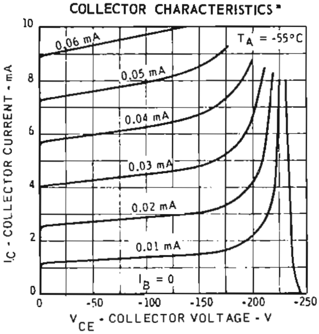
COLLECTOR CHARACTERISTICS*



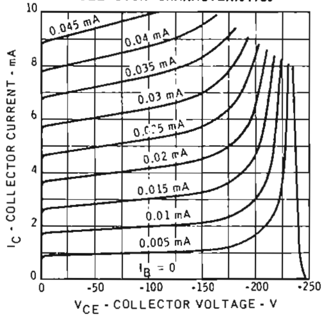
COLLECTOR CHARACTERISTICS*



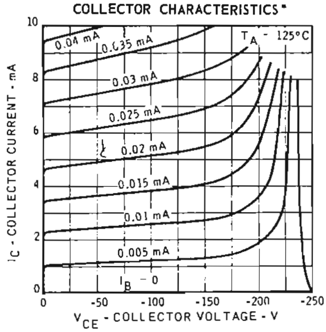
COLLECTOR CHARACTERISTICS*



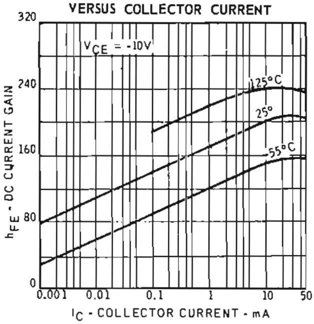
COLLECTOR CHARACTERISTICS*



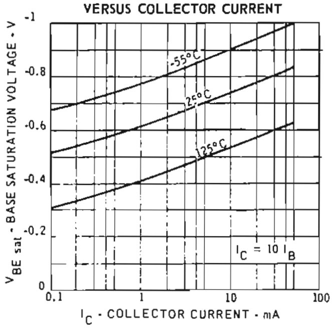
COLLECTOR CHARACTERISTICS*



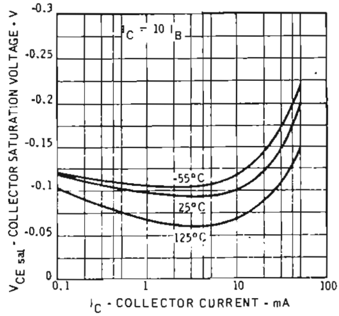
DC CURRENT GAIN
VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT



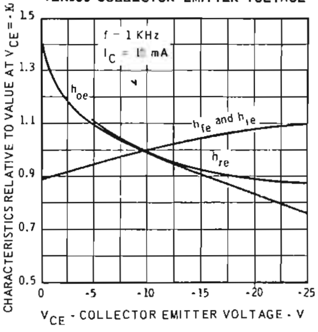
COLLECTOR SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT



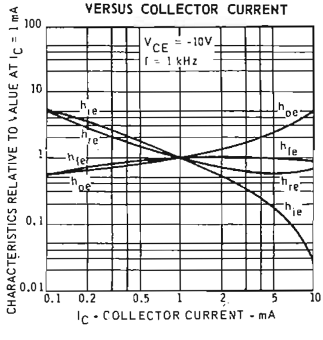
* Single family characteristics on Transistor Curve Tracer.

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

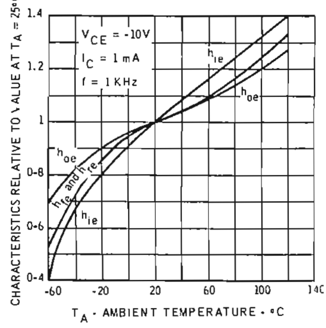
COMMON EMITTER CHARACTERISTICS
VERSUS COLLECTOR-EMITTER VOLTAGE



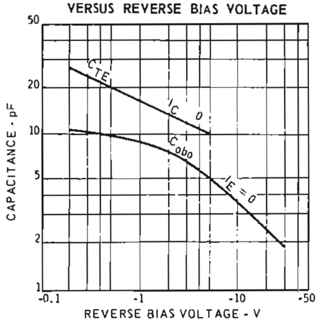
COMMON EMITTER CHARACTERISTICS
VERSUS COLLECTOR CURRENT



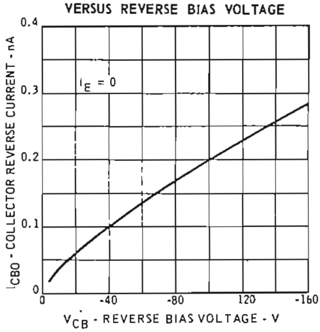
COMMON EMITTER CHARACTERISTICS
VERSUS AMBIENT TEMPERATURE



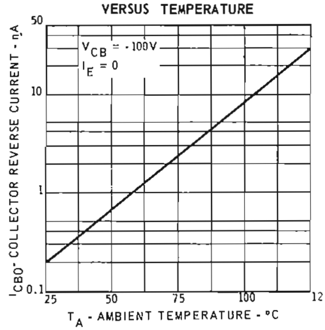
INPUT AND OUTPUT CAPACITANCE
VERSUS REVERSE BIAS VOLTAGE



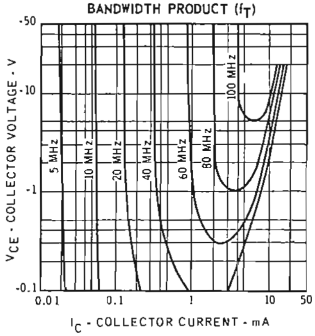
COLLECTOR REVERSE CURRENT
VERSUS REVERSE BIAS VOLTAGE



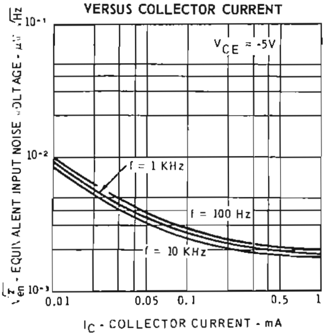
COLLECTOR REVERSE CURRENT
VERSUS TEMPERATURE



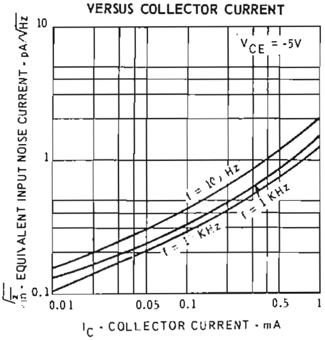
CONTOURS OF CONSTANT GAIN
BANDWIDTH PRODUCT (f_T)



EQUIVALENT INPUT NOISE VOLTAGE
VERSUS COLLECTOR CURRENT

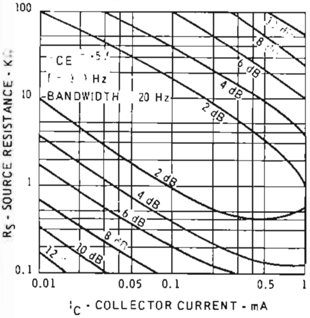


EQUIVALENT INPUT NOISE CURRENT
VERSUS COLLECTOR CURRENT

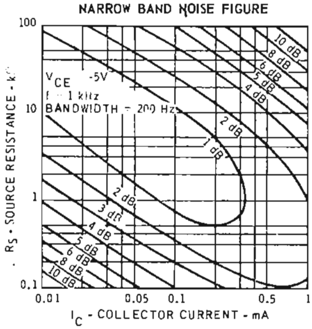


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

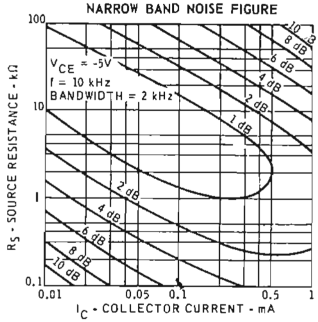
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



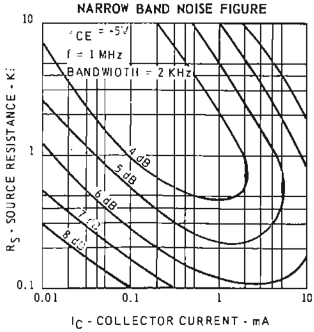
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



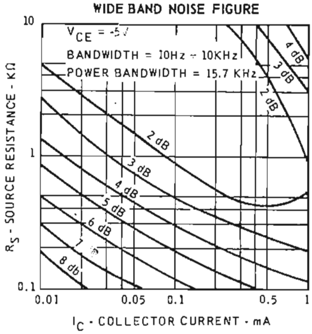
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



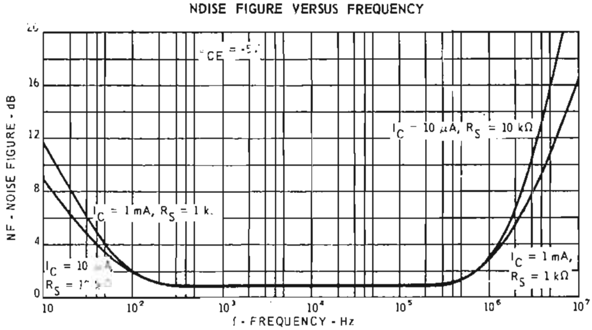
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT WIDE BAND NOISE FIGURE



NOISE FIGURE VERSUS FREQUENCY

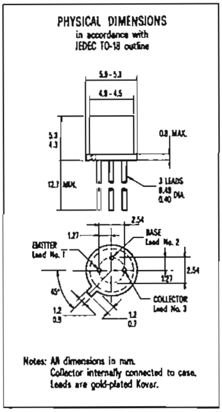


BFX94-BFX95-BFX96-BFX97

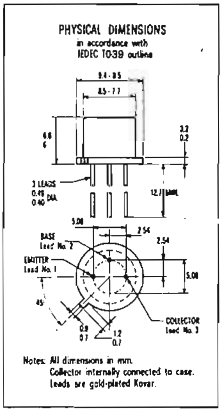
HIGH GAIN GENERAL PURPOSE AMPLIFIERS

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - These devices are NPN silicon PLANAR epitaxial transistors designed for high performance amplifier, high speed switching circuitry at collector currents up to 500 mA. They feature useful current gain over a wide range of collector current, low leakage currents, and low saturation voltages.



BFX 94-95



BFX 96-97

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to +200°C
T_J	Operating Junction Temperature	+175°C
T_L	Lead Temperature (Soldering, 10 sec. time limit)	+260°C

Maximum Voltages and Current (T_A = 25°C unless otherwise noted)

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 Volts
I_C	Collector Current	800 mA

Maximum Power Dissipations (Notes 2 and 3)

		BFX 94-95	BFX 96-97
P_D	Total Dissipation at 25°C Case Temperature	1.8 Watt	3 Watts
	at 25°C Ambient Temperature	0.5 Watt	0.8 Watt

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

		BFX 94-96			BFX 95-97					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	20			35				I_C = 0.1 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	25			50				I_C = 1 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	35			75				I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	20			50				I_C = 150 mA	V_{CE} = 1 V
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)	20			30				I_C = 500 mA	V_{CE} = 10 V
V_{BE} (sat)	Base Saturation Voltage			1.3			1.3	V	I_C = 150 mA	I_B = 15 mA
V_{BE} (sat)	Base Saturation Voltage			2.6			2.6	V	I_C = 500 mA	I_B = 50 mA
V_{CE} (sat)	Collector Saturation Voltage			0.4			0.4	V	I_C = 150 mA	I_B = 15 mA
V_{CE} (sat)	Collector Saturation Voltage			1.6			1.6	V	I_C = 500 mA	I_B = 50 mA
I_{EBO}	Emitter Cutoff Current			10			10	nA	I_C = 0	V_{EB} = 3 V
I_{CBO}	Collector Cutoff Current			10			10	nA	I_E = 0	V_{CB} = 50 V
I_{CBO} (125°C)	Collector Cutoff Current			10			10	µA	I_E = 0	V_{CB} = 50 V
BV_{CBO}	Collector to Base Breakdown Voltage	60			60			V	I_E = 0	I_C = 10 µA
BV_{EBO}	Emitter to Base Breakdown Voltage	5			5			V	I_C = 0	I_E = 10 µA
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	30			30			V	I_B = 0	I_C = 10 mA (pulsed)

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

		BFX 94-96			BFX 95-97				
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.5			2.5				I_C = 20 mA V_{CE} = 20 V
C_{obo}	Common Base, Open Circuit, Output Capacitance			8			8	pF	I_E = 0 V_{CB} = 10 V
R_e (h_{ie})	Real Part of Common Emitter High Frequency Input Impedance (f = 300 MHz)			60			60	Ω	I_C = 20 mA V_{CE} = 20 V

NOTES;

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) (BFX 94 and BFX 95 only). These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 83.5°C/watt (derating factor of 12 mW/°C); junction-to-ambient thermal resistance of 300°C/watt (derating factor of 3.33 mW/°C). (BFX 96 and BFX 97 only). These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 50°C/watt (derating factor of 20 mW/°C); junction-to-ambient thermal resistance of 188°C/watt (derating factor of 5.33 mW/°C).

(4) These ratings refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

NPN diffused silicon planar transistors

BFX 94A - BFX 96A

RF amplifiers, high-speed switches

The BFX 94A and BFX 96A are NPN silicon planar epitaxial transistors designed to cover a wide range of RF amplifier and high-speed switching applications. These devices feature a minimum LV_{CEO} of 30 Volt, a minimum f_T of 250 MHz at I_C = 50 mA, V_{CE} = 10 V, together with a maximum $V_{CE\ sat}$ of 0.6 Volt at 500 mA and h_{FE} specified from 100 μA to 500 mA collector current.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain				
	I_C = 100 μA V_{CE} = 10 V	20	40		
	I_C = 1 mA V_{CE} = 10 V (5)	25	58		
	I_C = 10 mA V_{CE} = 10 V (5)	35	70		
	I_C = 150 mA V_{CE} = 1 V (5)	20	50		
	I_C = 150 mA V_{CE} = 10 V (5)	40	75	120	
	I_C = 500 mA V_{CE} = 10 V (5)	35	62		
$V_{BE\ sat}$	Base Saturation Voltage (5)				
	I_C = 150 mA I_B = 15 mA		0.9	1.1	V
	I_C = 500 mA I_B = 50 mA		1.1	1.5	V
$V_{CE\ sat}$	Collector Saturation Voltage (5)				
	I_C = 150 mA I_B = 15 mA		0.14	0.22	V
	I_C = 500 mA I_B = 50 mA		0.4	0.6	V
I_{CES}	Collector Reverse Current				
	V_{CE} = 50 V V_{EB} = 0		0.2	10	nA
	V_{CE} = 50 V V_{EB} = 0 125°C		0.2	10	μA
I_{EBO}	Emitter Reverse Current				
	V_{EB} = 3 V I_C = 0		0.1	10	nA
BV_{CBO}	Collector to Base Breakdown Voltage				
	I_C = 10 μA I_E = 0	60			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E = 10 μA I_C = 0	5			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 10 mA I_B = 0	30			V
h_{fe}	High Freq. Current Gain				
	I_C = 50 mA V_{CE} = 10 V f = 100MHz	2.5	4		
C_{TE}	Emitter Transition Capacitance				
	I_C = 0 V_{EB} = 2 V f = 1MHz		14	20	pF
C_{obo}	Base-Collector Capacitance				
	I_E = 0 V_{CB} = 10 V f = 1MHz		6	8	pF
t_{on}	Turn On Time (6)				
	I_C = 300 mA I_{B1} = 30 mA		14	60	ns
t_{off}	Turn Off Time (6)				
	I_C = 300 mA I_{B1} = 30 mA I_{B2} = −30 mA		80	150	ns
h_{ie}	Input Resistance				
	V_{CE} = 1 V I_C = 10 mA f = 1KHz		380		Ω
	V_{CE} = 10 V I_C = 10 mA f = 1KHz		460		Ω
	V_{CE} = 1 V I_C = 50 mA f = 1KHz		170		Ω
	V_{CE} = 10 V I_C = 50 mA f = 1KHz		360		Ω
h_{oe}	Output Conductance				
	V_{CE} = 1 V I_C = 10 mA f = 1KHz		410		μmho
	V_{CE} = 10 V I_C = 10 mA f = 1KHz		56		μmho
	V_{CE} = 1 V I_C = 50 mA f = 1KHz		950		μmho
	V_{CE} = 10 V I_C = 50 mA f = 1KHz		405		μmho
h_{re}	Voltage Feedback Ratio				
	V_{CE} = 1 V I_C = 10 mA f = 1KHz		2250		$\times 10^{-6}$
	V_{CE} = 10 V I_C = 10 mA f = 1KHz		130		$\times 10^{-6}$
	V_{CE} = 1 V I_C = 50 mA f = 1KHz		2850		$\times 10^{-6}$
	V_{CE} = 10 V I_C = 50 mA f = 1KHz		500		$\times 10^{-6}$
h_{fe}	Small Signal Current Gain				
	V_{CE} = 1 V I_C = 10 mA f = 1KHz		72		
	V_{CE} = 10 V I_C = 10 mA f = 1KHz		90		
	V_{CE} = 1 V I_C = 50 mA f = 1KHz		48		
	V_{CE} = 10 V I_C = 50 mA f = 1KHz		97		

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 117°C/W (derating factor of 8.55 mW/°C); junction - to - ambient thermal resistance of 438°C/W (derating factor of 2.28 mW/°C) for the BFX 94A.
Junction - to - case thermal resistance of 58.3°C/W (derating factor of 17.2 mW/°C); junction - to - ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C) for the BFX 96A.
(4) These ratings refer to a high - current point where collector - to - emitter voltage is lowest. For more information send for SGS-AR 5.
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.
(6) See switching circuits for exact values of I_C, I_{B1} and I_{B2}

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Base	V_{CBO}	60 V
Collector to Emitter (4)	V_{CEO}	30 V
Emitter to Base	V_{EBO}	5 V

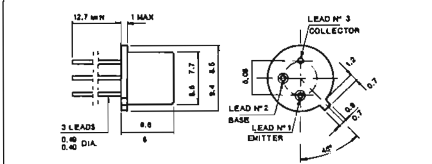
Temperatures

Storage Temperature Range	T_{STG}	-55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering, 10 sec. time limit)	T_L	260°C

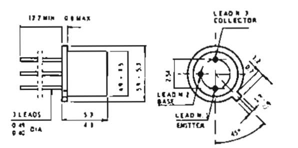
Power (2-3)

Dissipation at 25°C Case Temperature BFX 94A	P_D	1.5 W
BFX 96A	P_D	3 W
Dissipation at 25°C Ambient Temperature BFX 94A	P_D	0.4 W
BFX 96A	P_D	0.8 W

* TO-39 package for BFX 96A



* TO-18 package for BFX 94A

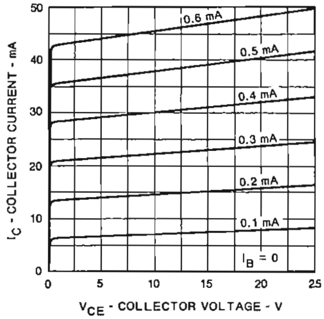


* Note: All dimensions in mm.

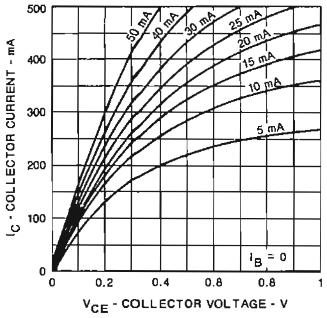
NOVEMBER 1970

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

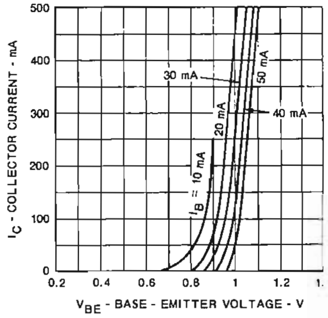
COLLECTOR CHARACTERISTICS *



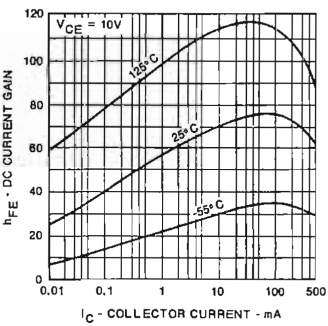
COLLECTOR CHARACTERISTICS *



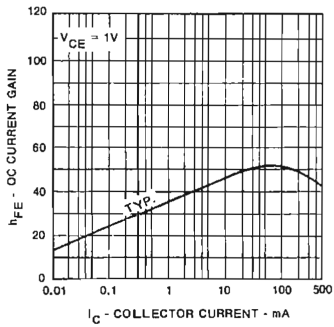
BASE CHARACTERISTICS



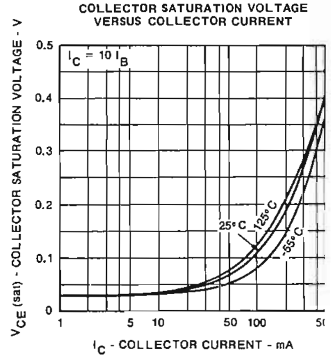
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



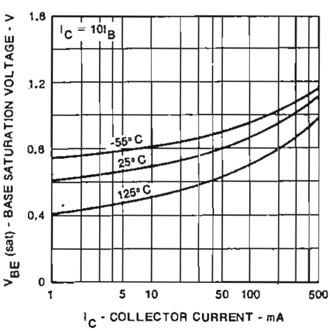
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



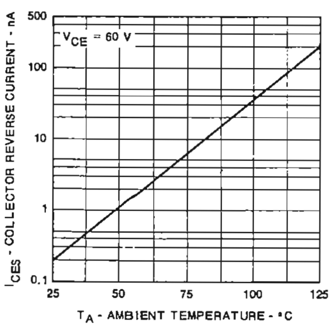
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



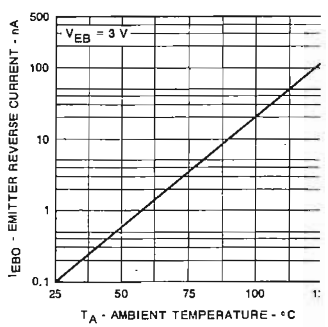
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



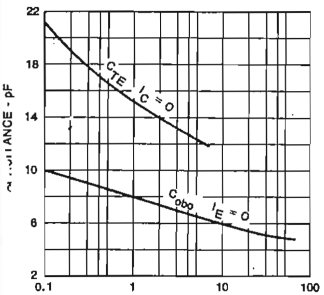
EMITTER REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



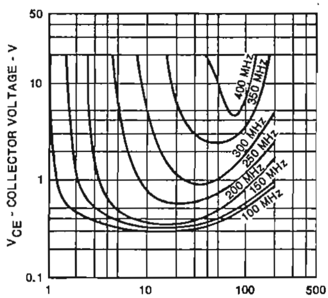
* Single family characteristics on Transistor Curve Tracer.

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

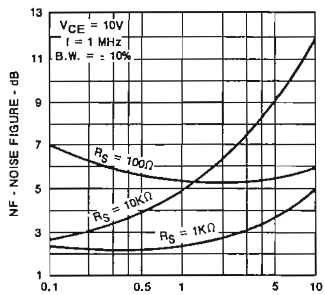
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



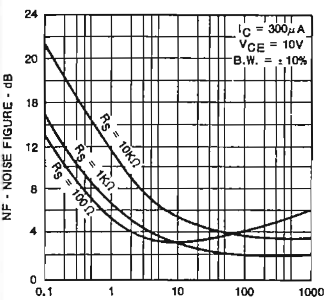
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



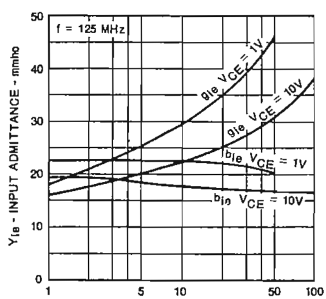
NOISE FIGURE VERSUS COLLECTOR CURRENT



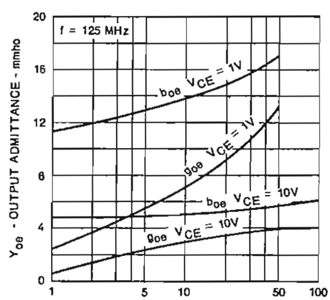
NOISE FIGURE VERSUS FREQUENCY



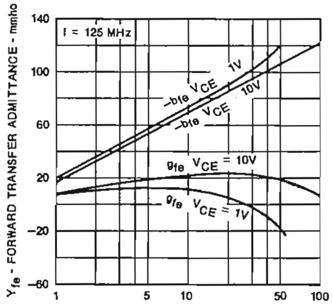
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



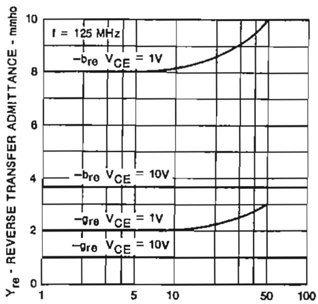
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



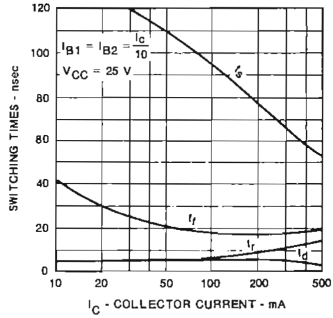
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT

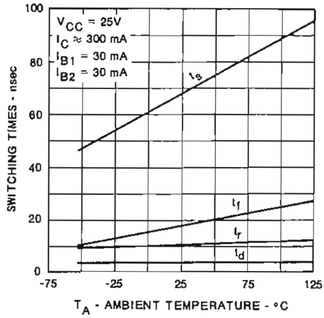


REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT

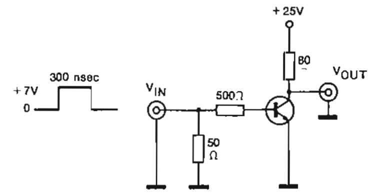


TYPICAL ELECTRICAL CHARACTERISTICS (25° C free air temperature unless otherwise noted)

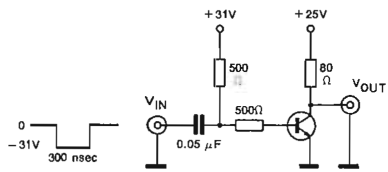




T_{on} TEST CIRCUIT



T_{off} TEST CIRCUIT



NPN diffused silicon planar transistors

BFX 95A - BFX 97A

RF amplifiers, high-speed switches

The BFX 95A and BFX 97A are NPN silicon planar epitaxial transistors designed to cover a wide range of RF amplifier and high-speed switching applications. These devices feature a minimum LV_{CEO} of 30 Volt, a minimum f_T of 250 MHz at I_C = 50 mA, V_{CE} = 10 V, together with a maximum $V_{CE\ sat}$ of 0.6 Volt at 500 mA and h_{FE} specified from 100 μA to 500 mA collector current.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain				
	I_C = 100 μA V_{CE} = 10 V	35	80		
	I_C = 1 mA V_{CE} = 10 V (5)	50	140		
	I_C = 10 mA V_{CE} = 10 V (5)	90	205		
	I_C = 150 mA V_{CE} = 10 V (5)	100	220	300	
	I_C = 150 mA V_{CE} = 1 V (5)	50	75		
	I_C = 500 mA V_{CE} = 10 V (5)	75	125		
$V_{BE\ sat}$	Base Saturation Voltage (5)				
	I_C = 150 mA I_B = 15 mA		0.9	1.1	V
	I_C = 500 mA I_B = 50 mA		1.1	1.5	V
$V_{CE\ sat}$	Collector Saturation Voltage (5)				
	I_C = 150 mA I_B = 15 mA		0.14	0.22	V
	I_C = 500 mA I_B = 50 mA		0.4	0.6	V
I_{CES}	Collector Reverse Current				
	V_{CE} = 50 V V_{EB} = 0		0.2	10	nA
	V_{CE} = 50 V V_{EB} = 0 125°C		0.2	10	μA
I_{EBO}	Emitter Reverse Current				
	V_{EB} = 3 V I_C = 0		0.1	10	nA
BV_{CBO}	Collector to Base Breakdown Voltage				
	I_C = 10 μA I_E = 0	60			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E = 10 μA I_C = 0	5			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 10 mA I_B = 0	30			V
h_{fe}	High Freq. Current Gain				
	I_C = 50 mA V_{CE} = 10 V f=100MHz	2.5	4		
C_{TE}	Emitter Transition Capacitance				
	I_C = 0 V_{EB} = 2 V f=1MHz		14	20	pF
C_{obo}	Base-Collector Capacitance				
	I_E = 0 V_{CB} = 10 V f=1MHz		6	8	pF
t_{on}	Turn On Time (6)				
	I_C = 300 mA I_{B1} = 30 mA		14	60	ns
t_{off}	Turn Off Time (6)				
	I_C = 300 mA I_{B1} = 30 mA I_{B2} = −30 mA		80	200	ns
h_{ie}	Input Resistance				
	V_{CE} = 1 V I_C = 10 mA f=1KHz		780		Ω
	V_{CE} = 10 V I_C = 10 mA f=1KHz		950		Ω
	V_{CE} = 1 V I_C = 50 mA f=1KHz		190		Ω
	V_{CE} = 10 V I_C = 50 mA f=1KHz		880		Ω
h_{oe}	Output Conductance				
	V_{CE} = 1 V I_C = 10 mA f=1KHz		440		μmho
	V_{CE} = 10 V I_C = 10 mA f=1KHz		83		μmho
	V_{CE} = 1 V I_C = 50 mA f=1KHz		1300		μmho
	V_{CE} = 10 V I_C = 50 mA f=1KHz		660		μmho
h_{re}	Voltage Feedback Ratio				
	V_{CE} = 1 V I_C = 10 mA f=1KHz		1900		$\times 10^{-6}$
	V_{CE} = 10 V I_C = 10 mA f=1KHz		205		$\times 10^{-6}$
	V_{CE} = 1 V I_C = 50 mA f=1KHz		5400		$\times 10^{-6}$
	V_{CE} = 10 V I_C = 50 mA f=1KHz		1500		$\times 10^{-6}$
h_{fe}	Small Signal Current Gain				
	V_{CE} = 1 V I_C = 10 mA f=1KHz		140		
	V_{CE} = 10 V I_C = 10 mA f=1KHz		170		
	V_{CE} = 1 V I_C = 50 mA f=1KHz		53		
	V_{CE} = 10 V I_C = 50 mA f=1KHz		220		

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 117°C/W (derating factor of 8.55 mW/°C); junction - to - ambient thermal resistance of 438°C/W (derating factor of 2.28 mW/°C) for the BFX 95A.
Junction - to - case thermal resistance of 58.3°C/W (derating factor of 17.2 mW/°C); junction - to - ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C) for the BFX 97A.
(4) These ratings refer to a high-current point where collector - to - emitter voltage is lowest. For more information send for SGS AR 5.
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.
(6) See switching circuits for exact values of I_C, I_{B1} and I_{B2}.

ABSOLUTE MAXIMUM RATINGS
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Base	V_{CBO}	60 V
Collector to Emitter (4)	V_{CEO}	30 V
Emitter to Base	V_{EBO}	5 V

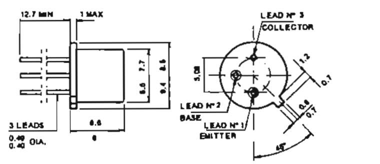
Temperatures

Storage Temperature Range	T_{STG}	-55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering, 10 sec. time limit)	T_L	260°C

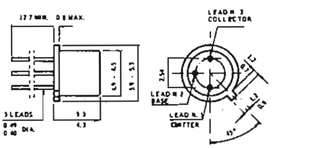
Power (2-3)

Dissipation at 25°C Case Temperature	BFX 95A	P_D	1.5 W
	BFX 97A	P_D	3 W
Dissipation at 25°C Ambient Temperature	BFX 95A	P_D	0.4 W
	BFX 97A	P_D	0.8 W

* TO-39 package for BFX 97A



* TO-18 package for BFX 95A

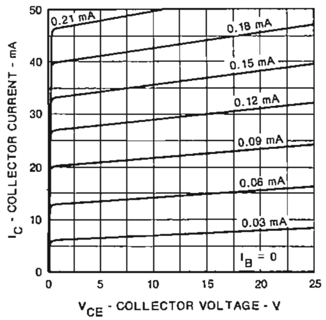


* Note: All dimensions in mm.

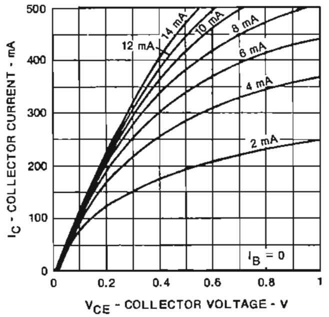
NOVEMBER 1970

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

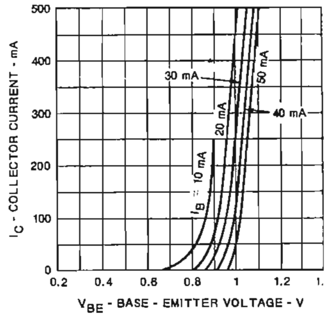
COLLECTOR CHARACTERISTICS *



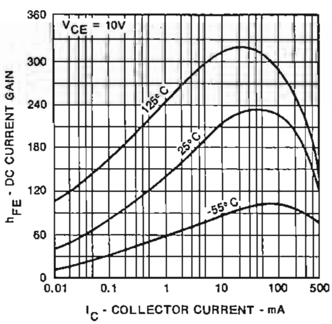
COLLECTOR CHARACTERISTICS *



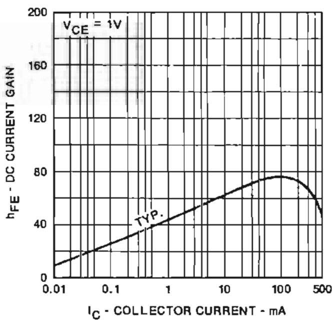
BASE CHARACTERISTICS



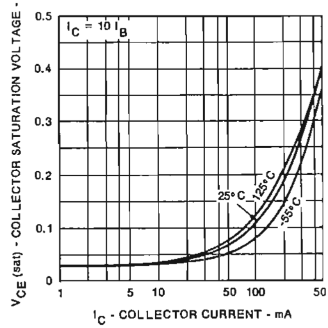
DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT



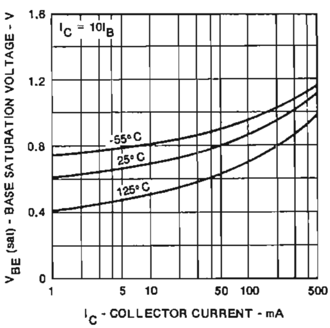
DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT



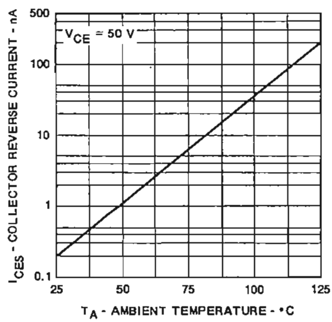
COLLECTOR SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT



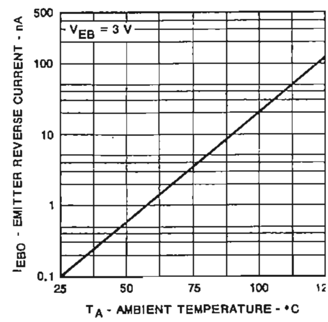
BASE SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT



COLLECTOR REVERSE CURRENT VERSUS
AMBIENT TEMPERATURE



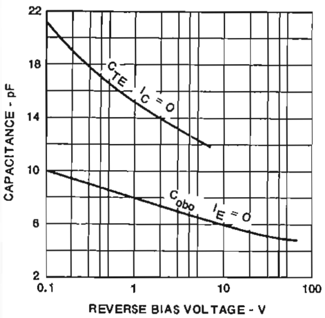
EMITTER REVERSE CURRENT VERSUS
AMBIENT TEMPERATURE



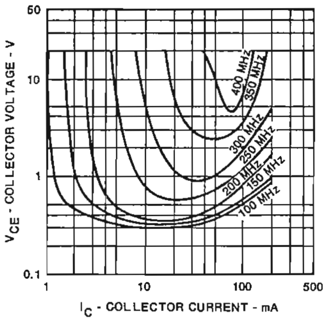
* Single family characteristics on Transistor Curve Tracer.

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

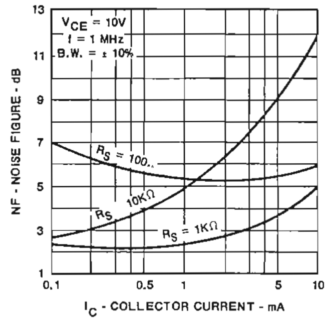
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



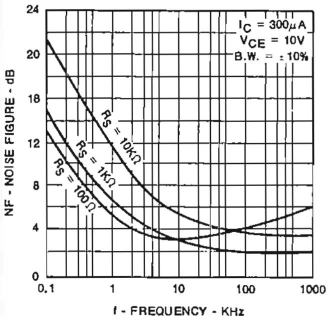
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



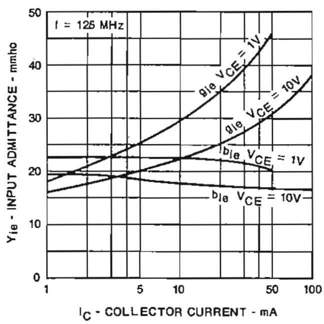
NOISE FIGURE VERSUS COLLECTOR CURRENT



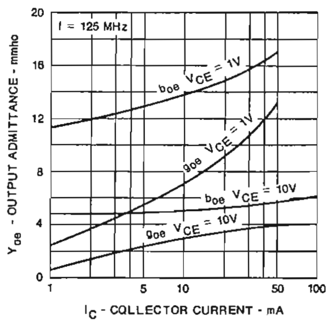
NOISE FIGURE VERSUS FREQUENCY



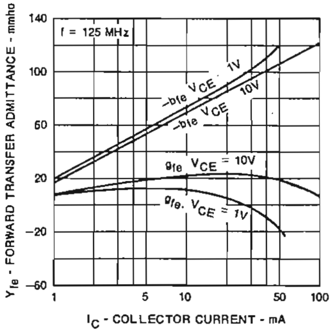
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



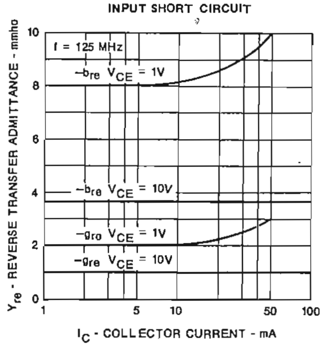
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



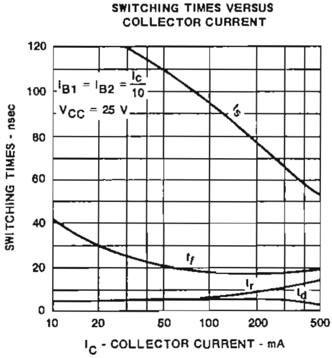
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT

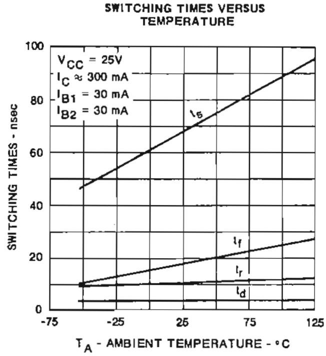


REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT

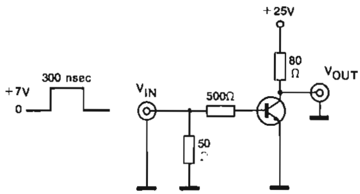


TYPICAL ELECTRICAL CHARACTERISTICS (25° C free air temperature unless otherwise noted)

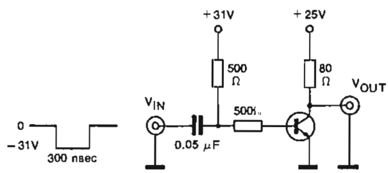




T_{on} TEST CIRCUIT



T_{off} TEST CIRCUIT



SILICON PLANAR NPN

BFY 50

PRELIMINARY DATA

GENERAL INFORMATION

TYPICAL APPLICATION: MEDIUM POWER AF AMPLIFIER

The BFY 50 is a silicon planar epitaxial NPN transistor in a Jedec TO-39 metal case. It is intended for general purpose linear and switching applications.

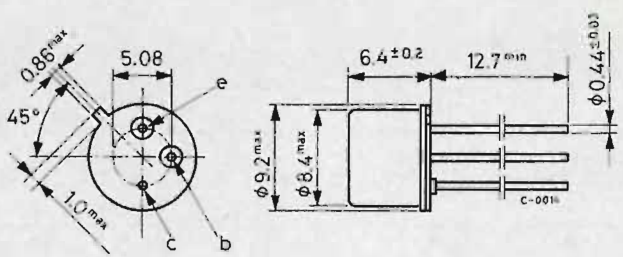
ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	80	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	35	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	6	V
I_C	Collector current	1	A
I_{CM}	Collector peak current	1	A
P_{tot}	Total power dissipation at $T_a \leq 25$ °C	0.8	W
	at $T_c \leq 25$ °C	5	W
T_s	Storage temperature	-65÷200	°C
T_j	Junction temperature	200	°C

MECHANICAL DATA

Dimensions in mm

Collector connected to case



3/71

BFY 50

THERMAL DATA

$R_{th\ j-c}$	Thermal resistance junction-case	max	35	°C/W
$R_{th\ j-a}$	Thermal resistance junction-ambient	max	218	°C/W

ELECTRICAL CHARACTERISTICS (T$_c$ = 25 °C unless otherwise specified)

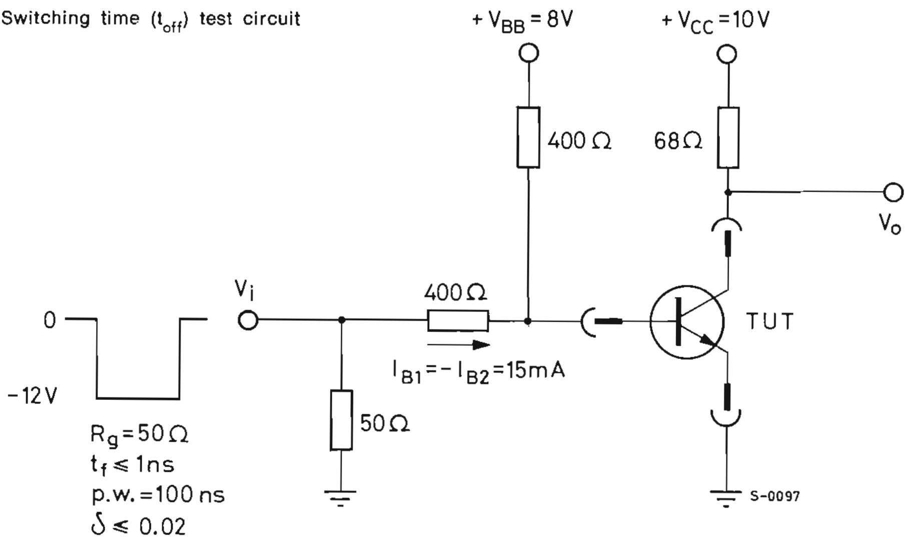
Parameter		Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 60$ V		2	50	nA
		$V_{CB} = 60$ V $T_C = 100$ °C		0.055	2.5	μA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5$ V		1	50	nA
		$V_{EB} = 5$ V $T_C = 100$ °C		0.016	2.8	μA
V_{CBO}	Collector-base voltage ($I_E = 0$)	$I_C = 100$ μA	80			V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_C = 100$ μA	6			V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	$I_C = 30$ mA	35			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$I_C = 150$ mA $I_B = 15$ mA		0.14	0.2	V
		$I_C = 1$ A $I_B = 0.1$ A		0.7	1	V
$V_{BE(sat)}$	Base-emitter saturation voltage	$I_C = 150$ mA $I_B = 15$ mA		0.95		V
		$I_C = 1$ A $I_B = 0.1$ A		1.5	2	V
h_{FE}	DC current gain	$I_C = 10$ mA $V_{CE} = 6$ V	20	40		—
		$I_C = 150$ mA $V_{CE} = 6$ V	30	55		—
		$I_C = 1$ A $V_{CE} = 6$ V	15	30		—
h_{fe}	Small signal current gain	$I_C = 10$ mA $V_{CE} = 6$ V, f = 1 kHz		45		—
f_T	Transition frequency	$I_C = 50$ mA $V_{CE} = 6$ V	60	100		MHz
C_{ob}	Output capacitance	$I_E = 0$ $V_{CB} = 12$ V		7	12	pF

ELECTRICAL CHARACTERISTICS (continued)

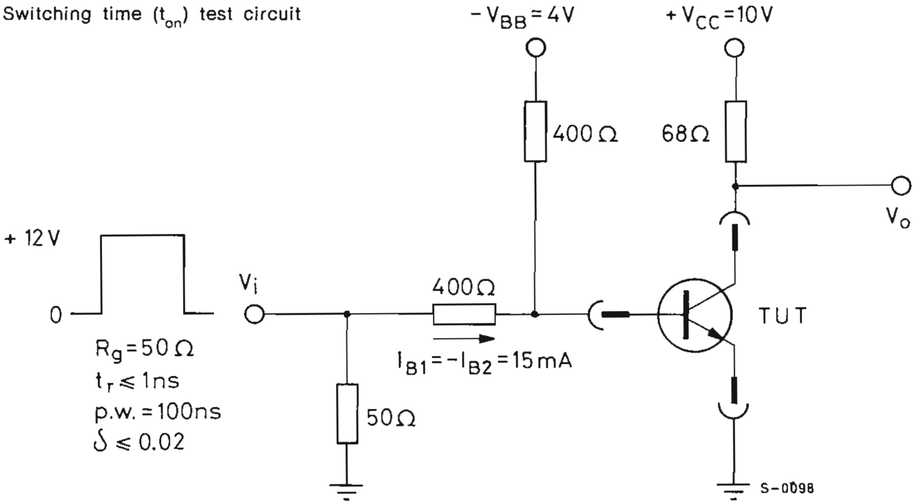
Parameter		Test Conditions	Min. Typ. Max.	Unit
h_{ie}	Input impedance	I_C = 10 mA V_{CE} = 6 V f = 1 kHz	180	Ω
h_{re}	Reverse voltage ratio	I_C = 10 mA V_{CE} = 6 V f = 1 kHz	55×10^{-6}	—
h_{oe}	Output admittance	I_C = 10 mA V_{CE} = 6 V f = 1 kHz	30	µS
t_d	Delay time	I_C = 150 mA I_{B1} = 15 mA $V_{BE\,(off)}$ = -2 V	25	ns
t_r	Rise time	I_C = 150 mA I_{B1} = 15 mA $V_{BE\,(off)}$ = -2 V	30	ns
t_s	Storage time	I_C = 150 mA I_{B1} = $-I_{B2}$ = 15 mA	140	ns
t_f	Fall time	I_C = 150 mA I_{B1} = $-I_{B2}$ = 15 mA	35	ns

TEST CIRCUITS

Switching time (t_{off}) test circuit



Switching time (t_{on}) test circuit



SILICON PLANAR NPN

BFY 51

PRELIMINARY DATA

GENERAL INFORMATION

TYPICAL APPLICATION: MEDIUM POWER AMPLIFIER

The BFY 51 is a silicon planar epitaxial NPN transistor in a Jedec TO-39 metal case. It is intended for general purpose linear and switching applications.

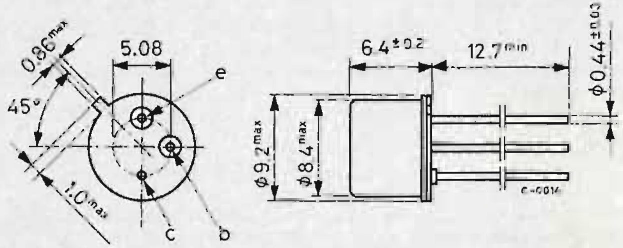
ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	60	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	30	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	6	V
I_C	Collector current	1	A
I_{CM}	Collector peak current	1	A
P_{tot}	Total power dissipation at $T_a \leq 25\ °C$	0.8	W
	at $T_c \leq 25\ °C$	5	W
T_s	Storage temperature	-65÷200	°C
T_j	Junction temperature	200	°C

MECHANICAL DATA

Dimensions in mm

Collector connected to case



BFY 51

THERMAL DATA

$R_{th\ j-c}$	Thermal resistance junction-case	max	35	°C/W
$R_{th\ j-a}$	Thermal resistance junction-ambient	max	218	°C/W

ELECTRICAL CHARACTERISTICS (T_c = 25 °C unless otherwise specified)

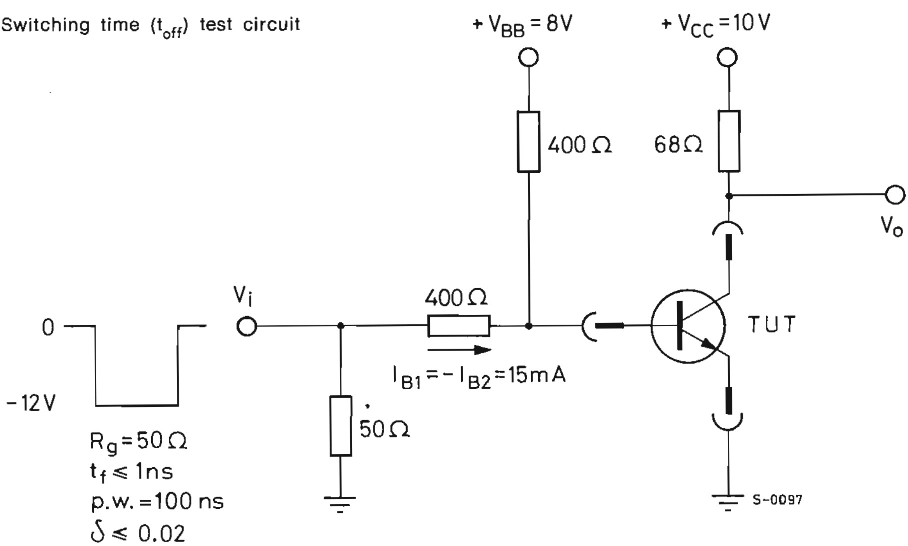
	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 40$ V		2	50	nA
		$V_{CB} = 40$ V $T_C = 100$ °C		0.055	2.5	μA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5$ V		1	50	nA
		$V_{EB} = 5$ V $T_C = 100$ °C		0.016	2.8	μA
V_{CBO}	Collector-base voltage ($I_E = 0$)	$I_C = 100$ μA	60			V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_C = 100$ μA	6			V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	$I_C = 30$ mA	30			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$I_C = 150$ mA $I_B = 15$ mA		0.14	0.35	V
		$I_C = 1$ A $I_B = 0.1$ A		0.7	1.6	V
$V_{BE(sat)}$	Base-emitter saturation voltage	$I_C = 150$ mA $I_B = 15$ mA		0.95		V
		$I_C = 1$ A $I_B = 0.1$ A		1.5	2	V
h_{FE}	DC current gain	$I_C = 10$ mA $V_{CE} = 6$ V	30	55		—
		$I_C = 150$ mA $V_{CE} = 6$ V	40	70		—
		$I_C = 1$ A $V_{CE} = 6$ V	15	40		—
h_{fe}	Small signal current gain	$I_C = 1$ mA $V_{CE} = 6$ V, f = 1 kHz		30	42	—
		$I_C = 10$ mA $V_{CE} = 6$ V, f = 1 kHz		60		—
f_T	Transition frequency	$I_C = 50$ mA $V_{CE} = 6$ V	50	110		MHz
C_{ob}	Output capacitance	$I_E = 0$ $V_{CB} = 12$ V		7	12	pF

ELECTRICAL CHARACTERISTICS (continued)

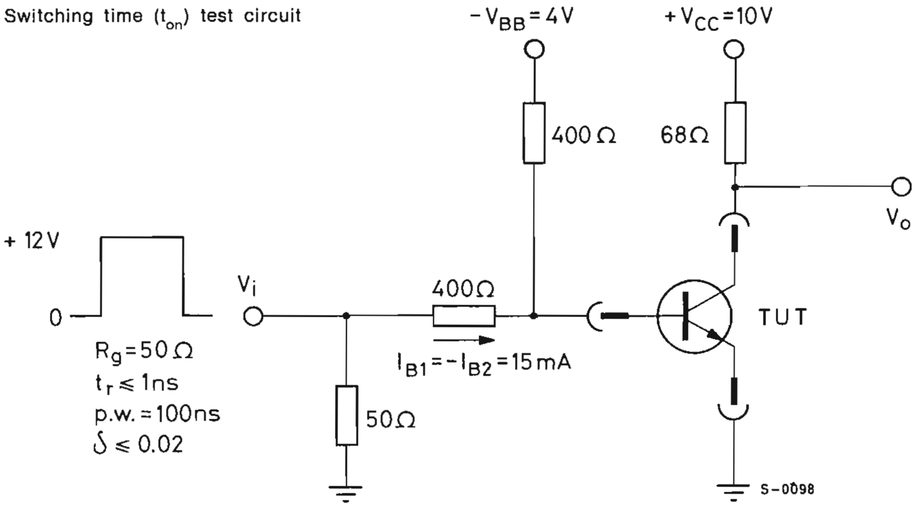
	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
h_{ie}	Input impedance	I_C = 10 mA V_{CE} = 6 V f = 1 kHz		220		Ω
h_{re}	Reverse voltage ratio	I_C = 10 mA V_{CE} = 6 V f = 1 kHz		70×10^{-6}		—
h_{oe}	Output admittance	I_C = 10 mA V_{CE} = 6 V f = 1 kHz		35		μS
t_d	Delay time	I_C = 150 mA I_{B1} = 15 mA $V_{BE\ (off)}$ = -2 V		25		ns
t_r	Rise time	I_C = 150 mA I_{B1} = 15 mA $V_{BE\ (off)}$ = -2 V		30		ns
t_s	Storage time	I_C = 150 mA I_{B1} = $-I_{B2}$ = 15 mA		160		ns
t_f	Fall time	I_C = 150 mA I_{B1} = $-I_{B2}$ = 15 mA		35		ns

TEST CIRCUITS

Switching time (t_{off}) test circuit



Switching time (t_{on}) test circuit



SILICON PLANAR NPN

BFY 52

PRELIMINARY DATA

GENERAL INFORMATION

TYPICAL APPLICATION: MEDIUM POWER AMPLIFIER

The BFY 52 is a silicon planar epitaxial NPN transistor in a Jedec TO-39 metal case. It is intended for general purpose linear and switching applications.

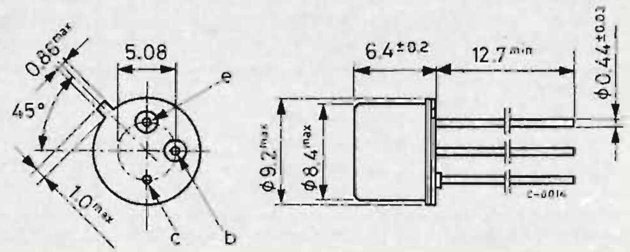
ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	40	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	20	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	6	V
I_C	Collector current	1	A
I_{CM}	Collector peak current	1	A
P_{tot}	Total power dissipation at $T_a \leq 25\ °C$	0.8	W
	at $T_c \leq 25\ °C$	5	W
T_s	Storage temperature	-65÷200	°C
T_j	Junction temperature	200	°C

MECHANICAL DATA

Dimensions in mm

Collector connected to case



3/71

BFY 52

THERMAL DATA

$R_{th\ j-c}$	Thermal resistance junction-case	max	35	°C/W
$R_{th\ j-a}$	Thermal resistance junction-ambient	max	218	°C/W

ELECTRICAL CHARACTERISTICS (T_c = 25 °C unless otherwise specified)

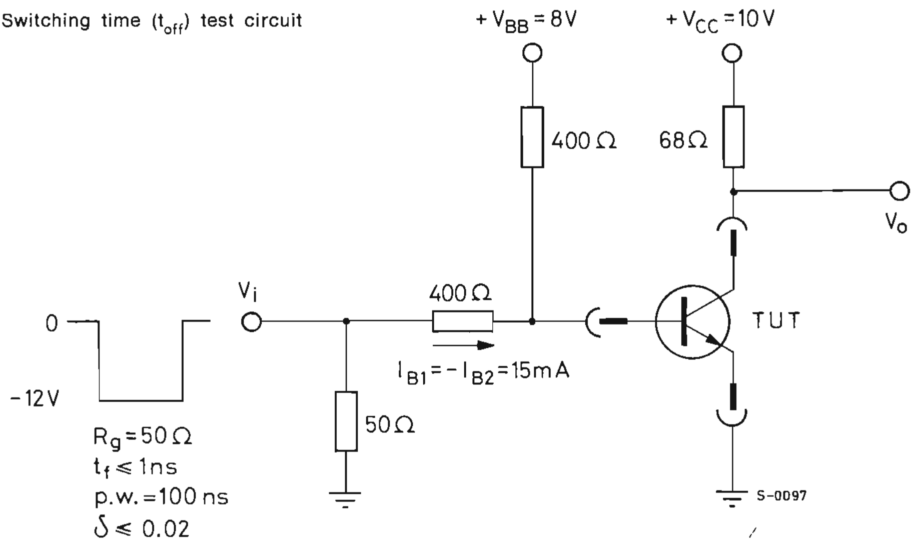
Parameter		Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	V_{CB} = 30 V		2	50	nA
		V_{CB} = 30 V T_C = 100 °C		0.055	2.5	μA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	V_{EB} = 5 V		1	50	nA
		V_{EB} = 5 V T_C = 100 °C		0.016	2.8	μA
V_{CBO}	Collector-base voltage ($I_E = 0$)	I_C = 100 μA	40			V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	I_C = 100 μA	6			V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	I_C = 30 mA	20			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	I_C = 150 mA I_B = 15 mA		0.14	0.35	V
		I_C = 1 A I_B = 0.1 A		0.7	1.6	V
$V_{BE(sat)}$	Base-emitter saturation voltage	I_C = 150 mA I_B = 15 mA		0.95		V
		I_C = 1 A I_B = 0.1 A		1.5	2	V
h_{FE}	DC current gain	I_C = 10 mA V_{CE} = 6 V	30	80		—
		I_C = 150 mA V_{CE} = 6 V	60	130		—
		I_C = 1 A V_{CE} = 6 V	15	60		—
h_{fe}	Small signal current gain	I_C = 1 mA V_{CE} = 6 V f = 1 kHz		30	84	—
		I_C = 1 mA V_{CE} = 6 V f = 1 kHz		120		—
f_T	Transition frequency	I_C = 50 mA V_{CE} = 6 V	50	120		MHz
C_{ob}	Output capacitance	I_E = 0 V_{CB} = 12 V		7	12	pF

ELECTRICAL CHARACTERISTICS (continued)

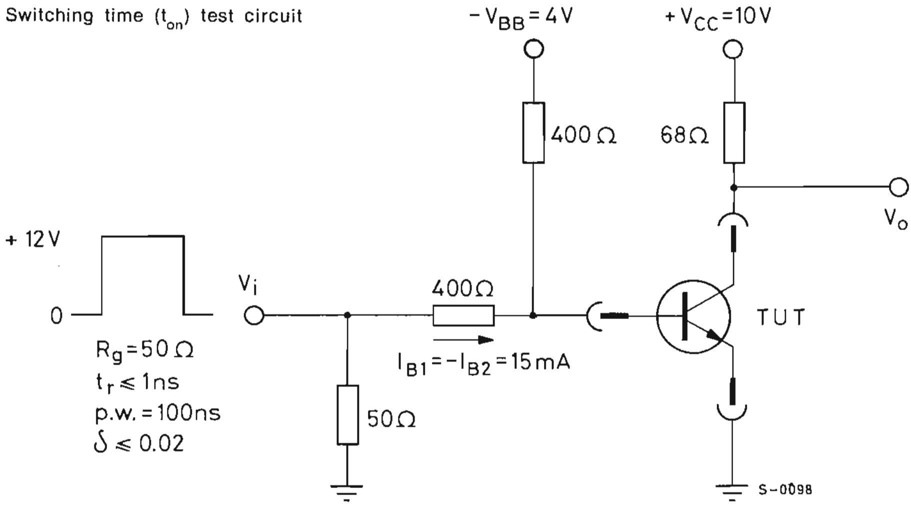
	Parameter	Test Conditions	Min. Typ. Max.	Unit
h_{ie}	Input impedance	I_C = 10 mA V_{CE} = 6 V f = 1 kHz	400	Ω
h_{re}	Reverse voltage ratio	I_C = 10 mA V_{CE} = 6 V f = 1 kHz	130×10^{-6}	—
h_{oe}	Output admittance	I_C = 10 mA V_{CE} = 6 V f = 1 kHz	70	μS
t_d	Delay time	I_C = 150 mA I_{B1} = 15 mA $V_{BE\,(off)}$ = -2 V	25	ns
t_r	Rise time	I_C = 150 mA I_{B1} = 15 mA $V_{BE\,(off)}$ = -2 V	30	ns
t_s	Storage time	I_C = 150 mA I_{B1} = $-I_{B2}$ = 15 mA	220	ns
t_f	Fall time	I_C = 150 mA I_{B1} = $-I_{B2}$ = 15 mA	40	ns

TEST CIRCUITS

Switching time (t_{off}) test circuit



Switching time (t_{on}) test circuit



NPN diffused silicon planar transistor

BFY 56

Amplifier and switch

The BFY 56 is an NPN silicon PLANAR epitaxial transistor designed primarily for amplifier and switching applications over a wide range of voltage and current. These devices feature a useful beta range from 100 μA to 500 mA and low saturation voltage permitting switching operation at 1 ampere. High collector - to - emitter voltage allows operation to 45 volts.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain I_C = 0.1 mA V_{CE} = 10V I_C = 500 mA V_{CE} = 10V (5) I_C = 150 mA V_{CE} = 1 V (5)	 15 20 30	 50 55 70	 150	
$V_{BE\ sat}$	Base Saturation Voltage (5) I_C = 150 mA I_B = 15 mA I_C = 1A I_B = 100 mA		 0.85 1.5	 1,5 2.3	 V V
$V_{CE\ sat}$	Collector Saturation Voltage (6) I_C = 150 mA I_B = 15 mA I_C = 1A I_B = 100 mA		 0.13 0.65	 0.3 1.2	 V V
I_{CES}	Collector Reverse Current V_{CE} = 50V V_{EB} = 0 V_{CE} = 50V V_{EB} = 0 (150°C)		 0.2 0.2	 20 20	 nA μA
I_{EBO}	Emitter Reverse Current V_{EB} = 4V I_C = 0		0.05	100	nA
BV_{CBO}	Collector to Base Breakdown Voltage I_C = 100 μA I_E = 0	80			V
BV_{EBO}	Emitter to Base Breakdown Voltage I_E = 100 μA I_C = 0	5			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5) I_C = 30 mA I_B = 0	45			V
h_{fe}	Small Signal Current Gain (f=1 kHz) I_C = 1 mA V_{CE} = 5V		60		
h_{ie}	Input Resistance (f=1 kHz) I_C = 1 mA V_{CE} = 5V		1800		Ω
h_{oe}	Output Conductance (f=1 kHz) I_C = 1 mA V_{CE} = 5V		8		μmho
h_{re}	Voltage Feedback Ratio (f=1 kHz) I_C = 1 mA V_{CE} = 5V		2.1		$\times 10^{-4}$
h_{ib}	Input Resistance (f=1 kHz) I_C = 1 mA V_{CB} = 5V		27		Ω
h_{ob}	Output Conductance (f=1 kHz) I_C = 1 mA V_{CB} = 5V		0.12		μmho
h_{rb}	Voltage Feedback Ratio (f=1 kHz) I_C = 1 mA V_{CB} = 5V		0.5		$\times 10^{-4}$
h_{fe}	High Freq. Current Gain (f=20 MHz) I_C = 50 mA V_{CE} = 10V	2	4.5		
C_{TE}	Emitter Transition Capacitance I_C = 0 V_{EB} = 0.5V		50	80	pF
C_{obo}	Base-Collector Capacitance I_E = 0 V_{CB} = 10V		14	25	pF
t_{on}	Turn On Time (6) I_C = 150 mA I_{B1} = 7.5 mA		150	225	ns
t_{off}	Turn Off Time (6) I_C = 150 mA I_{B1} = 7.5 mA I_{B2} = −7.5 mA		350	800	ns

(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 35°C/W (derating factor of 28.6 mW/°C); junction - to - ambient thermal resistance of 219°C/W (derating factor of 4.57 mW °C).
(4) These ratings refer to a high - current point where collector - to - emitter voltage is lowest. For more information send for SGS - AR 5.
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1} and I_{B2}

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Base	V_{CBO}	80 V
Collector to Emitter (4)	V_{CEO}	45 V
Emitter to Base	V_{EBO}	5 V

Temperatures

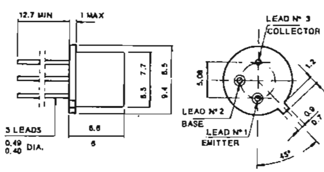
Storage Temperature Range	T_{STG}	-55°C to +200°C
Juntion Temperature	T_J	200°C
Lead Temperature (Soldering, 60 sec. time limit)	T_L	260°C

Power (2 and 3)

Dissipation at 25°C Case Temperature	P_D	5 W
Dissipation at 25°C Ambient Temperature	P_D	0.8 W

PHYSICAL DIMENSIONS

in accordance with JEDEC TO-39 OUTLINE

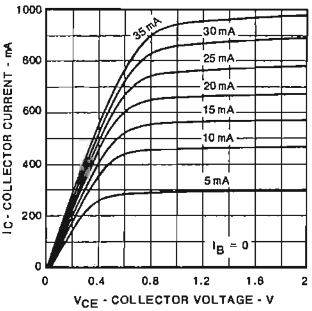


NOTES: All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar.

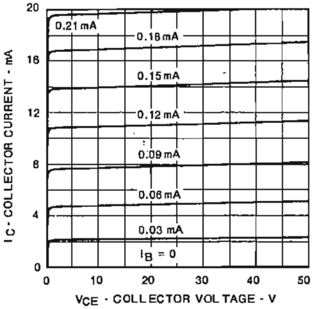
SEPTEMBER 1970

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

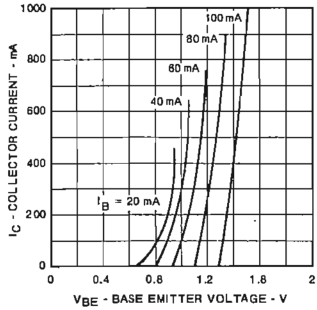
COLLECTOR CHARACTERISTICS *



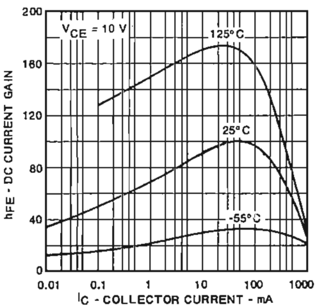
COLLECTOR CHARACTERISTICS *



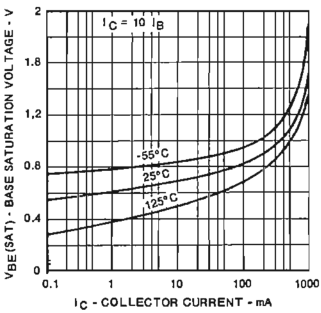
BASE CHARACTERISTIC *



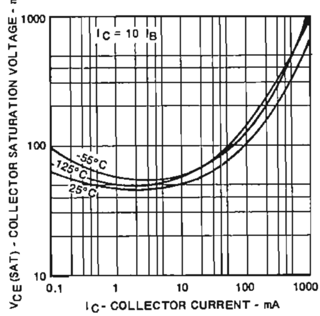
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



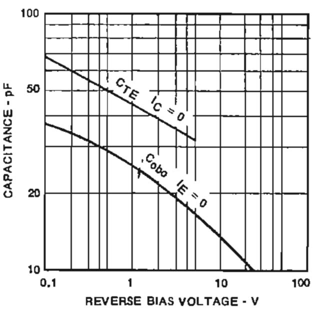
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



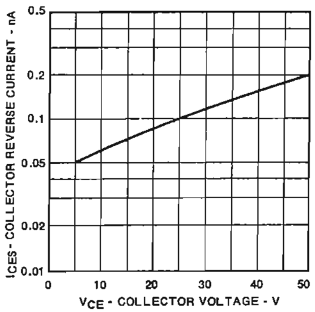
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



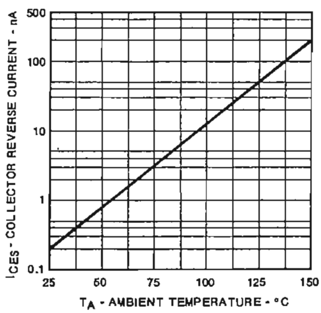
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE

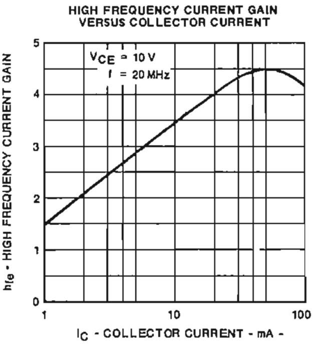


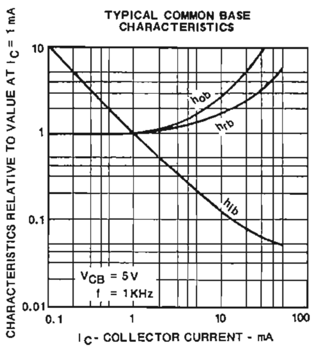
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE

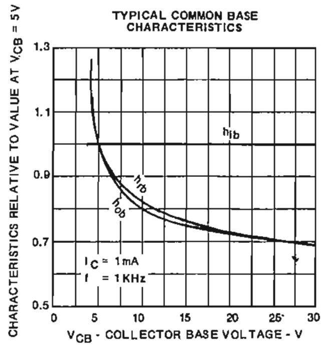


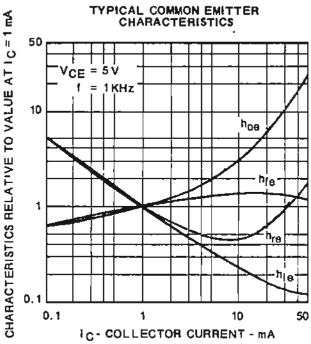
* Single family characteristics on Transistor Curve Tracer

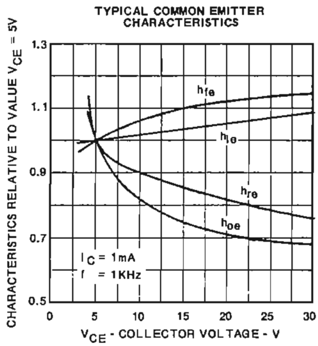
TYPICAL ELECTRICAL CHARACTERISTICS (25° C free air temperature unless otherwise noted)



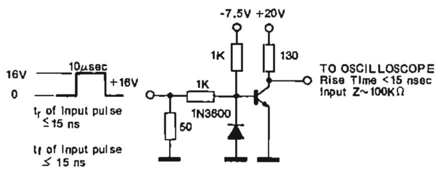








SWITCHING TIME TEST CIRCUIT



NPN diffused silicon planar transistor — BFY 56A

Amplifier and switch

The BFY 56A is an NPN silicon planar epitaxial transistor designed primarily for amplifier and switching applications over a wide range of voltage and current. This device features a useful beta range from 100 µA to 500 mA and low saturation voltage permitting switching operation at 1 ampere. High collector-to-emitter voltage allows operation to 55 volts.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 100 µA V_{CE} = 1V	20	50		
	I_C = 5 mA V_{CE} = 1V	50	85	120	
	I_C = 150 mA V_{CE} = 1V	40	80	120	
	I_C = 500 mA V_{CE} = 10V	25	55		
V_{BEsat}	Base Saturation Voltage (5)				
	I_C = 10 mA I_B = 1 mA		0.68	0.8	V
	I_C = 150 mA I_B = 15mA		0.85	1	V
	I_C = 1A I_B = 0.1A		1.3	1.6	V
V_{CEsat}	Collector Saturation Voltage (5)				
	I_C = 10mA I_B = 1 mA		0.05		V
	I_C = 150 mA I_B = 15 mA		0.13	0.25	V
	I_C = 1 A I_B = 0.1 A		0.65	1	V
I_{CES}	Collector Reverse Current				
	V_{CE} = 50V V_{EB} = 0		0.2	20	nA
	V_{CE} = 50V V_{EB} = 0 (150°C)		0.2	20	µA
I_{EBO}	Emitter Reverse Current				
	V_{EB} = 5V I_C = 0		0.1	20	nA
BV_{CES}	Collector to Emitter Breakdown Voltage				
	I_C = 100 µA V_{EB} = 0	85			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E = 100 µA I_C = 0	7			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 30 mA I_B = 0	55			V
h_{fe}	Small Signal Current Gain				
	I_C = 1 mA V_{CE} = 5V f = 1 kHz		80		
h_{ie}	Input Resistance				
	I_C = 1 mA V_{CE} = 5V f = 1 kHz		2		kΩ
h_{oe}	Output Conductance				
	I_C = 1 mA V_{CE} = 5V f = 1 kHz		8		µmho
h_{re}	Voltage Feedback Ratio				
	I_C = 1 mA V_{CE} = 5V f = 1 kHz		2.1		$\times 10^{-4}$
h_{ib}	Input Resistance				
	I_C = 1 mA V_{CB} = 5V f = 1 kHz		27		Ω
h_{ob}	Output Conductance				
	I_C = 1 mA V_{CB} = 5V f = 1 kHz		0.12		µmho
h_{rb}	Voltage Feedback Ratio				
	I_C = 1 mA V_{CB} = 5V f = 1 kHz		0.5		$\times 10^{-4}$
h_{fe}	High Freq. Current Gain				
	I_C = 50 mA V_{CE} = 10V f = 20 MHz	3	4.5		
C_{TE}	Emitter Transition Capacitance				
	I_C = 0 V_{EB} = 0.5V		50	80	pF
C_{obo}	Base - Collector Capacitance				
	I_E = 0 V_{CB} = 10V		14	25	pF
t_{on}	Turn On Time (6)				
	I_C = 150 mA I_{B1} = 7.5 mA		150	225	ns
t_{off}	Turn Off Time (6)				
	I_C = 150 mA I_{B1}=7.5mA I_{B2}=7.5mA		350	800	ns

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 35°C/W (derating factor of 28.6 mW/°C); junction-to-ambient thermal resistance of 219°C.W (derating factor of 4.57 mW/°C).
4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.
5) Measured under pulse conditions: pulse length = 300 µsec; duty cycle = 1%.
6) See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25° C unless otherwise noted)

Voltages

Collector to Emitter (4)	V_{CEO}	55 V
Collector to Emitter	V_{CES}	85 V
Emitter to Base	V_{EBO}	7 V

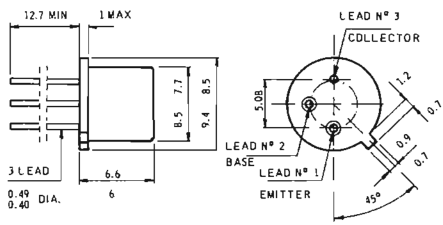
Temperatures

Storage Temperature	T_{STG}	-55° C to 200° C
Operating Junction Temperature	T_J	200° C
Lead Temperature (Soldering, 10 sec. time limit).	T_L	260° C

Power (2 - 3)

Dissipation at 25° C Case Temperature	P_D	5 W
Dissipation at 25° C Ambient Temperature	P_D	0.8 W

PHYSICAL DIMENSIONS
In accordance with Jedec TO-39 outline

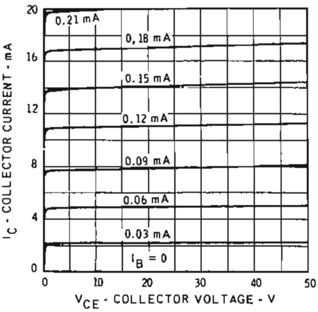


NOTES : All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar.

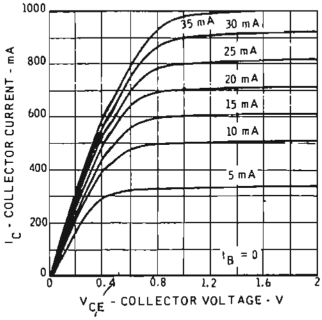
AUGUST 1970

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

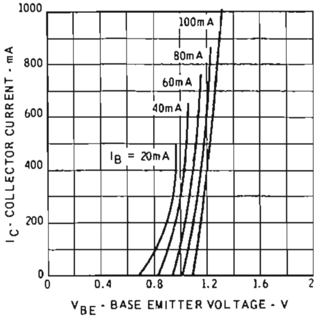
COLLECTOR CHARACTERISTICS*



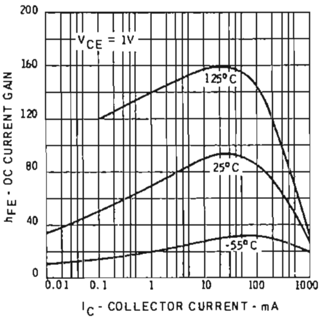
COLLECTOR CHARACTERISTICS*



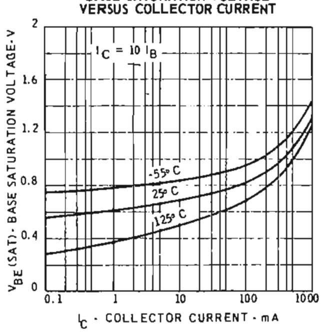
BASE CHARACTERISTICS*



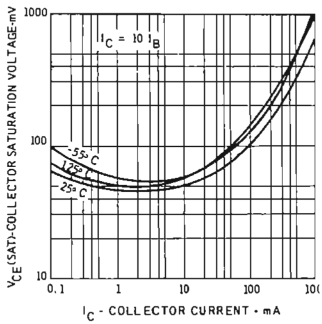
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



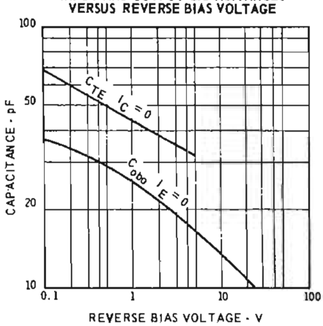
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



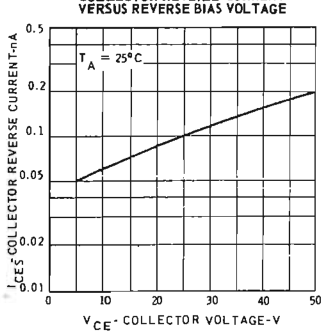
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



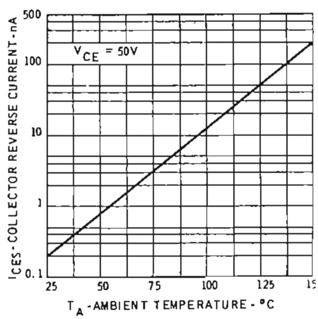
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE

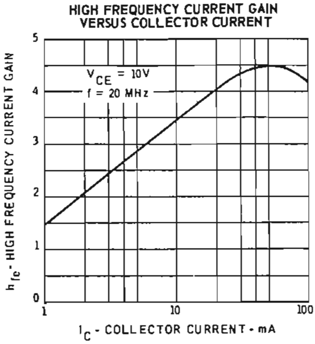


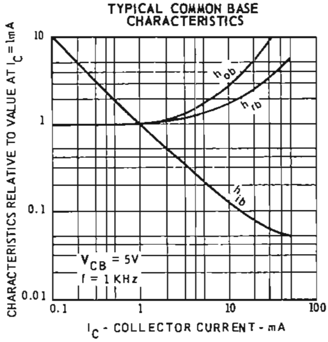
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE

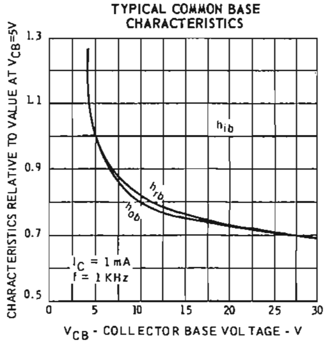


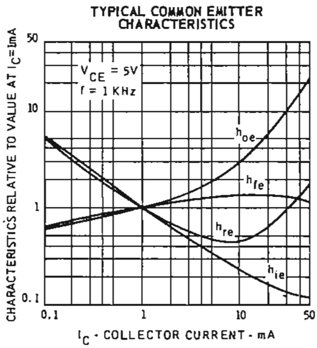
* Single family characteristics on Transistor Curve Tracer.

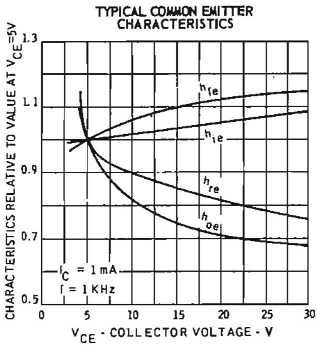
TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)



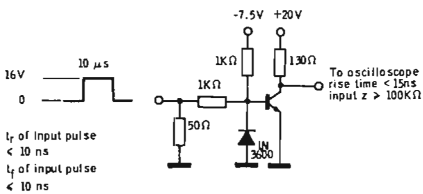








SWITCHING CIRCUIT



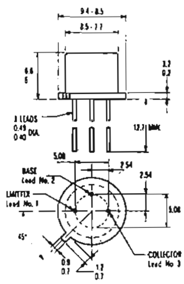
BFY64

HIGH CURRENT GENERAL PURPOSE TYPE

PNP DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BFY64 is a PNP silicon PLANAR epitaxial transistor designed for digital and analog applications at current levels up to 500 milliamperes. Its high beta, high f_T at high current, high LV_{CEO}, and low noise figure make it ideal for use in line driver, memory applications, and in low-noise amplifiers.

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO39 outline



Notes: All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

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

Maximum Power Dissipations

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	3.0 Watts
at 25°C Ambient Temperature (Notes 2 and 3)	0.7 Watt

Maximum Voltages

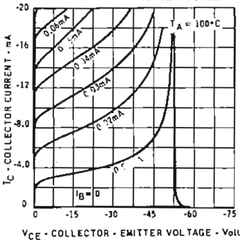
V_{CBO}	Collector to Base Voltage	-40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-40 Volts
V_{EBO}	Emitter to Base Voltage	-5.0 Volts

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

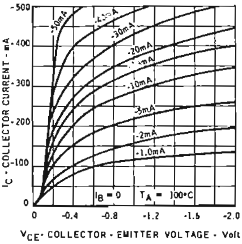
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain		130			I_C = 10 µA	V_{CE} = - 10 V
h_{FE}	DC Current Gain		200			I_C = 1.0 mA	V_{CE} = - 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	80	200			I_C = 10 mA	V_{CE} = - 10 V
h_{FE}	DC Pulse Current Gain (Note 5)		150			I_C = 50 mA	V_{CE} = - 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)		130			I_C = 150 mA	V_{CE} = - 10 V
V_{BE} (sat)	Base Saturation Voltage (Note 5)		-0.92	-1.1	V	I_C = 50 mA (pulsed)	I_B = 2.5 mA
V_{BE} (sat)	Base Saturation Voltage (Note 5)		-1.0	-1.4	V	I_C = 150 mA (pulsed)	I_B = 15 mA
V_{BE} (sat)	Base-Emitter Saturation Voltage (Note 5)			-2.2	V	I_C = 500 mA (pulsed)	I_B = 50 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		-0.08	-0.3	V	I_C = 50 mA (pulsed)	I_B = 2.5 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		-0.18	-0.5	V	I_C = 150 mA (pulsed)	I_B = 15 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		-0.6	-1.8	V	I_C = 500 mA (pulsed)	I_B = 50 mA
I_{CES}	Collector Cutoff Current		0.2	30	nA	V_{CE} = 25 V	V_{BE} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	-40			V	I_C = 10 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0			V	I_E = 10 µA	I_C = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-40			V	I_C = 10 mA (pulsed)	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	2.0	2.5			I_C = 50 mA	V_{CE} = - 20 V
C_{ob}	Output Capacitance		6.0	10	pF	I_E = 0	V_{CB} = - 10 V
C_{TE}	Emitter Transition Capacitance		15	25	pF	I_C = 0	V_{EB} = - 0.5 V
NF	Noise Figure (Note 6)		1.0		db	I_C = 30 µA	V_{CE} = - 5.0 V
t_{on}	Turn On Time (Note 7)		35	50	nsec	I_C = 300 mA	I_{B1} = 30 mA
t_{off}	Turn Off Time (Note 7)		70	120	nsec	I_C = 300 mA, I_{B1} = 30 mA, I_{B2} = - 30 mA	
h_{ie}	Input Resistance (f = 1 Kc/s)		1050		Ω	I_C = 10 mA	V_{CE} = - 10 V
h_{oe}	Output Conductance (f = 1 Kc/s)		110		µmho	I_C = 10 mA	V_{CE} = - 10 V
h_{re}	Voltage Feedback Ratio (f = 1 Kc/s)		240		$\times 10^{-6}$	I_C = 10 mA	V_{CE} = - 10 V
h_{fe}	Small Signal Current Gain (f = 1 Kc/s)		200			I_C = 10 mA	V_{CE} = - 10 V

TYPICAL ELECTRICAL CHARACTERISTICS

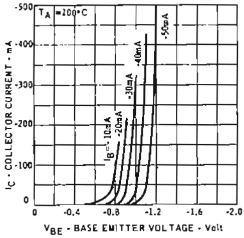
COLLECTOR CHARACTERISTICS *



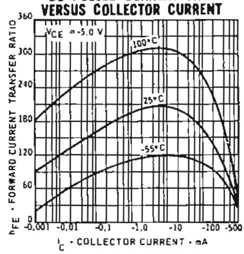
COLLECTOR CHARACTERISTICS *



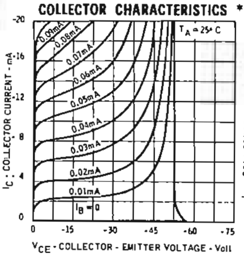
BASE CHARACTERISTICS *



DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR CHARACTERISTICS *



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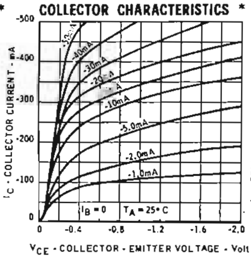
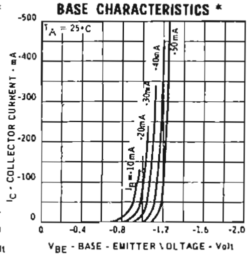
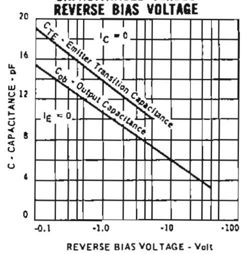


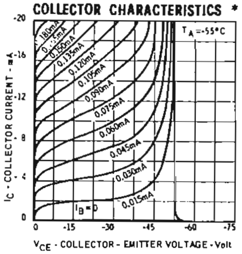
BASE CHARACTERISTICS *



INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



COLLECTOR CHARACTERISTICS *



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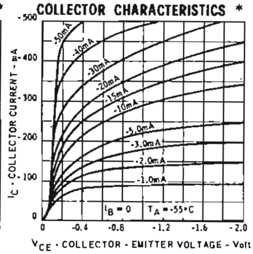
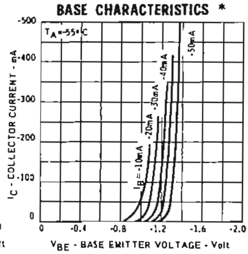
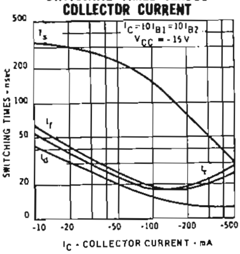


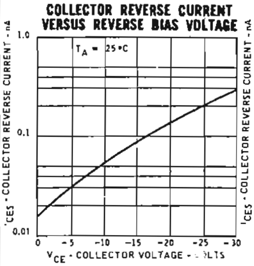
BASE CHARACTERISTICS *



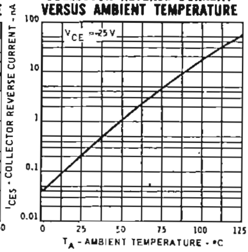
SWITCHING TIMES VERSUS COLLECTOR CURRENT



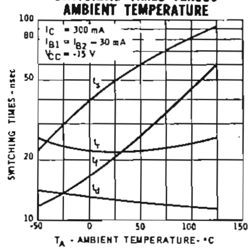
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



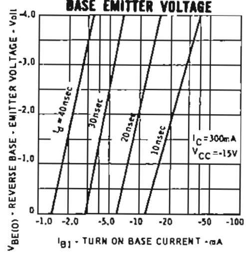
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



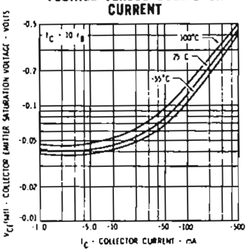
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



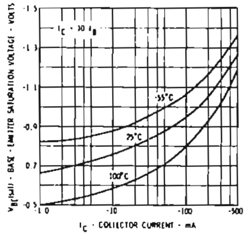
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

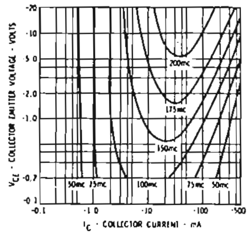
PULSED COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



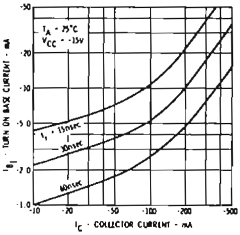
PULSED BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



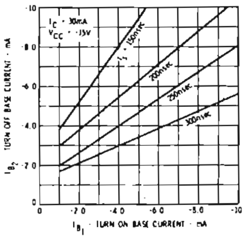
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



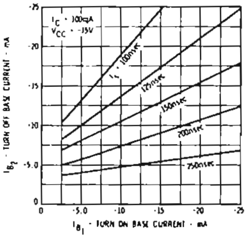
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



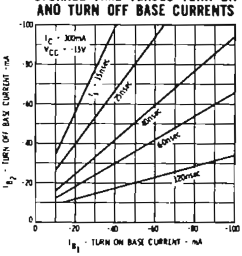
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



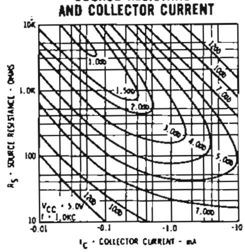
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



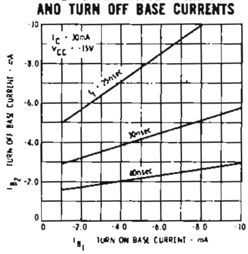
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



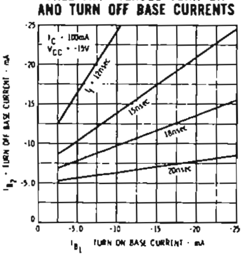
NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT



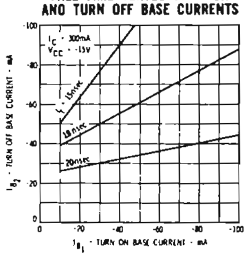
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



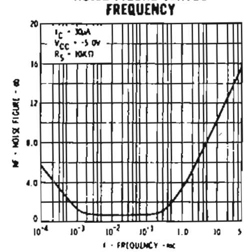
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



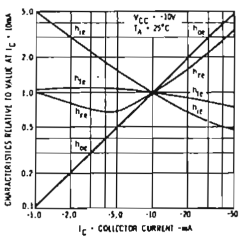
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

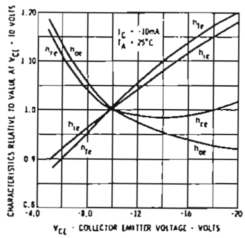


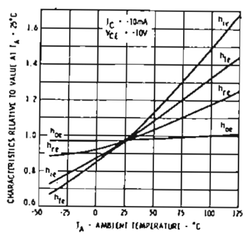
NOISE FIGURE VERSUS FREQUENCY



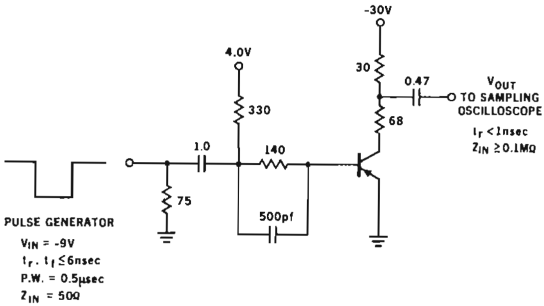
TYPICAL COMMON EMITTER CHARACTERISTICS







T_{ON} and T_{OFF} TEST CIRCUIT



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 250°C/Watt (derating factor of 4.0 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS Publication AR 5.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(6) f = 1.0 Kc/s; R_S = 10 KΩ.

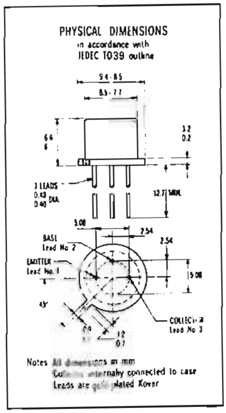
(7) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

BFY 72

RF AMPLIFIER AND HIGH-SPEED SWITCH

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BFY72 is an NPN silicon PLANAR epitaxial transistor designed for RF amplifier and high-speed switching applications. This device features a minimum f_T of 250 Mc/s at I_C = 50 mA together with a maximum V_{CE} (sat) of 0.7 volt at 500 mA.



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to + 300°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	300°C Maximum

Maximum Power Dissipations

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

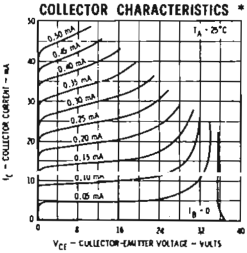
V_{CBO}	Collector to Base Voltage	50 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	28 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts

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

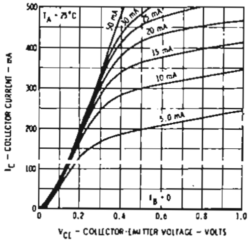
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	15	60			I_C = 100 μA	V_{CE} = 10 V
h_{FE}	DC Current Gain	20	85			I_C = 1.0 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	100			I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	40	100	150		I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	15	90			I_C = 500 mA	V_{CE} = 10 V
V_{BE} (sat)	Base Saturation Voltage		0.9	1.2	V	I_C = 150 mA	I_B = 15 mA
V_{BE} (sat)	Base Saturation Voltage		1.1	1.6	V	I_C = 500 mA	I_B = 50 mA
V_{CE} (sat)	Collector Saturation Voltage		0.15	0.25	V	I_C = 150 mA	I_B = 15 mA
V_{CE} (sat)	Collector Saturation Voltage		0.4	0.7	V	I_C = 500 mA	I_B = 50 mA
I_{CES}	Collector Reverse Current		0.3	20	nA	V_{CE} = 40 V	V_{EB} = 0
I_{EBO}	Emitter Cutoff Current		0.4	30	nA	I_C = 0	V_{EB} = 3.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	50			V	I_C = 10 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			V	I_E = 10 μA	I_C = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	28			V	I_C = 10 mA (pulsed)	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	2.5	3.5			I_C = 50 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance		5.0	8.0	pF	I_E = 0	V_{CB} = 10 V
C_{TE}	Emitter Transition Capacitance		14	30	pF	I_C = 0	V_{EB} = 2.0 V
t_{on}	Turn On Time (Note 6)		14	70	nsec	I_C = 300 mA	I_{B1} = 30 mA
t_{off}	Turn Off Time (Note 6)		80	170	nsec	I_C = 300 mA	I_{B1} = 30 mA, I_{B2} = -30 mA

TYPICAL ELECTRICAL CHARACTERISTICS

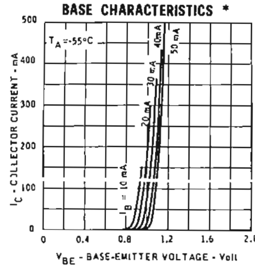
COLLECTOR CHARACTERISTICS *



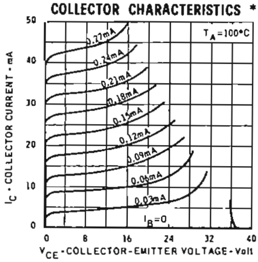
COLLECTOR CHARACTERISTICS *



BASE CHARACTERISTICS *



COLLECTOR CHARACTERISTICS *



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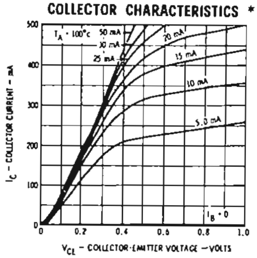
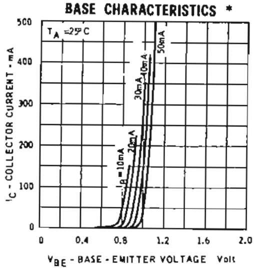


BASE CHARACTERISTICS *



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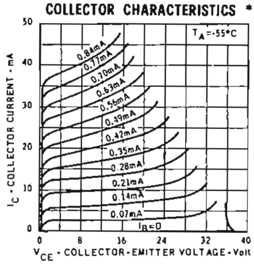

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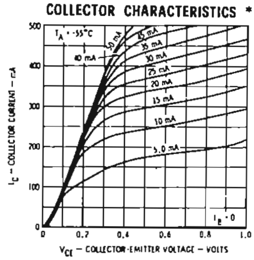
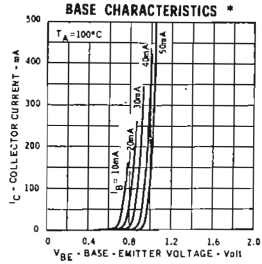


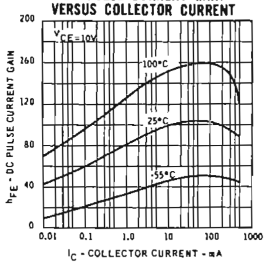
BASE CHARACTERISTICS *



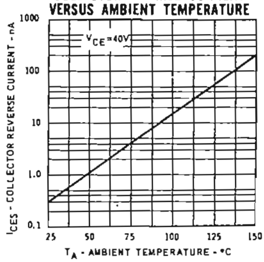
*Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

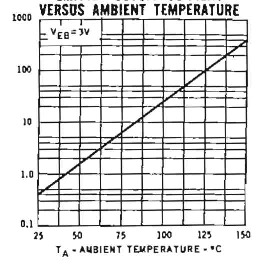
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



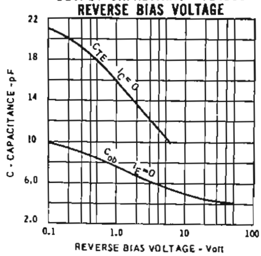
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



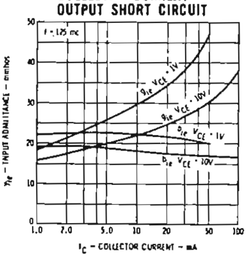
EMITTER CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



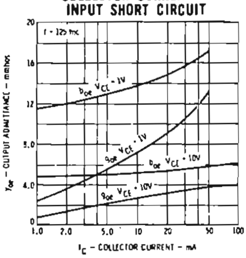
EMITTER TRANSITION AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



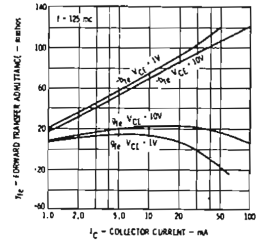
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



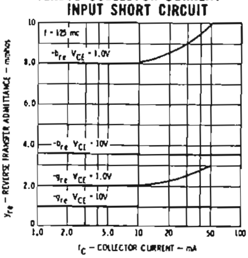
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



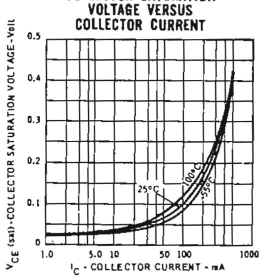
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



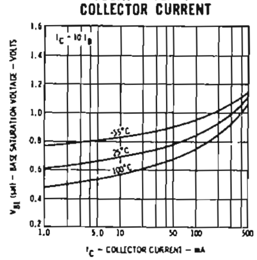
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



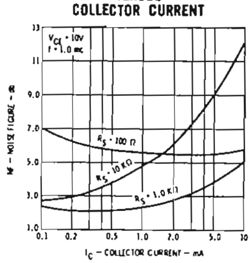
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



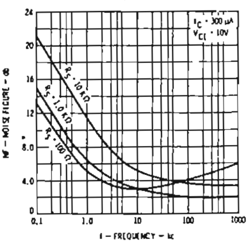
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



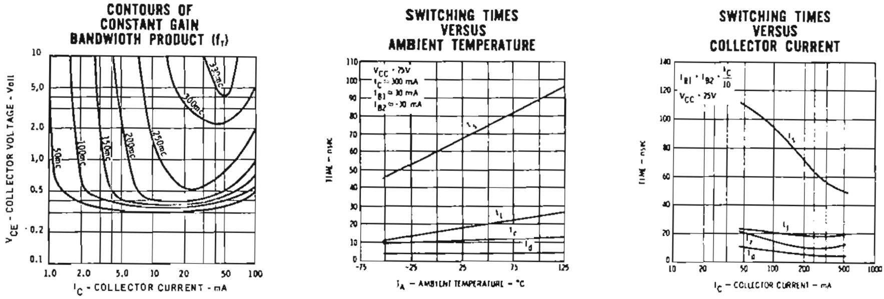
NOISE FIGURE VERSUS COLLECTOR CURRENT

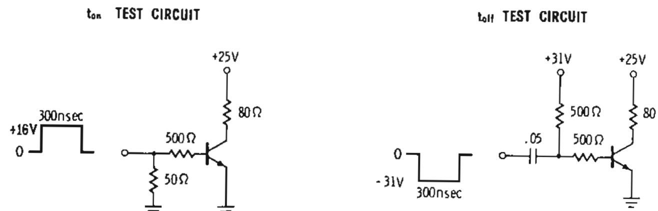


NOISE FIGURE VERSUS FREQUENCY



TYPICAL ELECTRICAL CHARACTERISTICS





TYPICAL SMALL SIGNAL CHARACTERISTICS (f = 1 Kc/s)

SYMBOL	CHARACTERISTIC	V_{CE}=1.0V, I_C=10mA	V_{CE}=10V, I_C=10mA	V_{CE}=1.0V, I_C=50mA	V_{CE}=10V, I_C=50mA	UNITS
h_{ie}	Input Resistance	380	460	170	350	Ω
h_{oe}	Output Conductance	410	55	950	405	μmho
h_{re}	Voltage Feedback Ratio	2250	130	2650	500	$\times 10^{-6}$
h_{fe}	Small Signal Current Gain	72	90	48	97	

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 4.56 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS Publication AR 5.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 2%.

(6) See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

BFY 74 - BFY 75

HIGH FREQUENCY AMPLIFIER AND OSCILLATOR

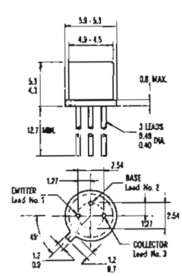
NPN DIFFUSED SILICON PLANAR TRANSISTORS

GENERAL DESCRIPTION - Type BFY74 is an NPN silicon PLANAR transistor intended for general purpose use including DC and video amplifiers, fast current-mode switching and RF/IF applications up to VHF.

The BFY74 utilises the PLANAR process to provide a 360 Mc/s gain bandwidth product, 45V V_{CEO} rating, and useful gain over a wide range of collector current (50 µA to 20 mA) together with low leakage and extreme parameter stability with life.

Type BFY75 is a higher gain version of the BFY74.

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-18 outline



Notes. All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to + 300°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	300°C Maximum

Maximum Power Dissipations

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.2 Watts
at 100°C Case Temperature (Notes 2 and 3)	0.68 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.36 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	45 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts

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

SYMBOL	CHARACTERISTIC	BFY 74 MIN.	BFY 74 TYP.	BFY 74 MAX.	BFY 75 MIN.	BFY 75 TYP.	BFY 75 MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain		45		35	70			I_C = 0.1 mA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain	30	65		40	105			I_C = 1.0 mA	V_{CE} = 5.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	40	75	180	65	114	300		I_C = 10 mA	V_{CE} = 5.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	60		40	100			I_C = 20 mA	V_{CE} = 4.0 V
h_{FE} (-55°C)	DC Pulse Current Gain (Note 5)	20			30				I_C = 10 mA	V_{CE} = 5.0 V
V_{BE} (sat)	Base Saturation Voltage		0.70	0.8		0.70	0.8	V	I_C = 1.0 mA	I_B = 0.1 mA
V_{BE} (sat)	Base Saturation Voltage	0.7	0.79	0.9	0.7	0.79	0.9	V	I_C = 10 mA	I_B = 1.0 mA
V_{CE} (sat)	Collector Saturation Voltage		0.3	0.8		0.3	0.8	V	I_C = 5.0 mA	I_B = 0.5 mA
V_{CE} (sat)	Collector Saturation Voltage		0.4	1.0		0.4	1.0	V	I_C = 10 mA	I_B = 1.0 mA
BV_{CBO}	Collector to Base Breakdown Voltage	60			60			V	I_C = 100 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			5.0			V	I_C = 0	I_E = 100 µA
LV_{CEO}	Collector to Emitter Sustaining Voltage	45			45			V	I_C = 10 mA	I_B = 0
I_{CBO}	Collector Cutoff Current		1.1	10		1.1	10	nA	I_E = 0	V_{CB} = 45 V
I_{CBO} (150°C)	Collector Cutoff Current		5.0	30		5.0	30	µA	I_E = 0	V_{CB} = 45 V
f_T	Transition Frequency	250	360		250	360		Mc/s	I_C = 10 mA	V_{CE} = 15 V
C_{ob}	Output Capacitance		3.0	4.0		3.0	4.0	pF	I_E = 0	V_{CB} = 10 V
C_{TE}	Emitter Transition Capacitance		6.5	10		6.5	10	pF	I_C = 0	V_{BE} = 0.5 V
h_{fe}	Small Signal Current Gain (f = 1 Kc/s)	40	90	200	65	130	310		I_C = 5.0 mA	V_{CE} = 5.0 V
h_{fe}	Small Signal Current Gain (f = 1 Kc/s)		75			100			I_C = 1.0 mA	V_{CE} = 5.0 V
h_{ie}	Input Resistance (f = 1 Kc/s)		0.8			1.0		KΩ	I_C = 5.0 mA	V_{CE} = 5.0 V
h_{ie}	Input Resistance (f = 1 Kc/s)		2.8			3.0		KΩ	I_C = 1.0 mA	V_{CE} = 5.0 V
h_{oe}	Output Conductance (f = 1 Kc/s)		20	100		30	125	µmho	I_C = 5.0 mA	V_{CE} = 5.0 V
h_{oe}	Output Conductance (f = 1 Kc/s)		6.0			10		µmho	I_C = 1.0 mA	V_{CE} = 5.0 V

NPN diffused silicon planar transistor BFY 76

Low-level, low-noise amplifier

The BFY 76 is an NPN double-diffused silicon Planar transistor designed for use in high-performance, low-level, low-noise amplifier circuits from audio through high-frequency ranges.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 10 µA V_{CE} = 5V	30	70	150	
	I_C = 100 µA V_{CE} = 5V		120		
	I_C = 1 mA V_{CE} = 5V	150	190	220	
	I_C = 5 mA V_{CE} = 5V		220		
$V_{BE\ on}$	Base-Emitter On Voltage I_C = 100 µA V_{CE} = 5V	0.5	0.58	0.70	V
$V_{CE\ sat}$	Collector Saturation Voltage (5) I_C = 1 mA I_B = 0.1 mA		0.15	0.35	V
I_{CES}	Collector Reverse Current				
	V_{CE} = 50V V_{EB} = 0		0.1	20	nA
	V_{CE} = 50V V_{EB} = 0 T_A = 150°C		0.1	20	µA
I_{EBO}	Emitter Reverse Current V_{EB} = 5V I_C = 0		0.1	20	nA
BV_{CES}	Collector to Emitter Breakdown Voltage I_C = 10 µA V_{EB} = 0	60			V
BV_{EBO}	Emitter to Base Breakdown Voltage I_E = 10 µA I_C = 0	8			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5) I_C = 10 µA I_B = 0	60			V
h_{fe}	Small Signal Current Gain (f = 1 kHz) I_C = 1 mA V_{CE} = 5V	80	220	300	
h_{ie}	Input Resistance (f = 1 kHz) I_C = 1 mA V_{CE} = 5V	1.5	8	15	kΩ
h_{oe}	Output Conductance (f = 1 kHz) I_C = 1 mA V_{CE} = 5V		11	35	µmho
h_{re}	Voltage Feedback Ratio (f = 1 kHz) I_C = 1 mA V_{CE} = 5V		3	8	$\times 10^{-4}$
h_{ib}	Input Resistan (f = 1 kHz) I_C = 1 mA V_{CB} = 5V	25	27	32	Ω
h_{fe}	High Freq. Current Gain (f = 20 MHz) I_C = 1 mA V_{CE} = 5V	3.5	5		
C_{TE}	Emitter Transition Capacitance I_C = 0 V_{EB} = 0.5V		3.5	6	pF
C_{obo}	Base-Collector Capacitance I_E = 0 V_{CB} = 5V		3.5	6	pF
NF	Wide Band Noise Figure (6) I_C = 10 µA V_{CE} = 5V		1.9	4	dB
NF	Narrow Band Noise Figure				
	I_C = 10 µA V_{CE} = 5V (7)		1.5	4	dB
	I_C = 10 µA V_{CE} = 5V (8)		4	15	dB

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/W (derating factor of 6.9 mW/°C); junction-to-ambient thermal resistance of 486°C/W (derating factor of 2.1 mW/°C).
(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
(5) Measured under pulse conditions: pulse length = 300 µsec; duty cycle = 1%.
(6) R_S = 10 kΩ; Power Bandwidth of 15.7 kHz with 3 dB points at 10 Hz and 10 kHz.
(7) f = 1 kHz; R_S=10 kΩ; Power Bandwidth of 200 Hz.
(8) f = 100 Hz; R_S = 10 kΩ; Power Bandwidth of 20 Hz.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages and Currents

Collector to Emitter Voltage (4)	V_{CEO}	60V
Collector to Emitter Voltage	V_{CES}	60V
Emitter to Base Voltage	V_{EBO}	8V
DC Collector Current	I_C	50 mA

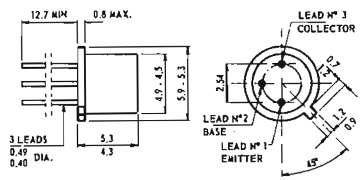
Temperatures

Storage Temperature	T_{STG}	-55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering, 10 sec.)	T_L	260°C

Power (2-3)

Dissipation at 25°C Case Temperature	P_D	1.2W
Dissipation at 25°C Ambient Temperature	P_D	0.36W

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-18 out-line

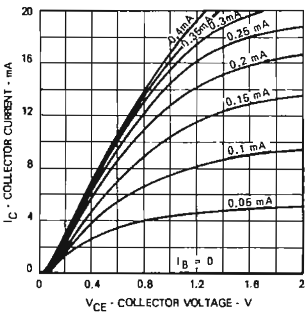


Notes: All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar.

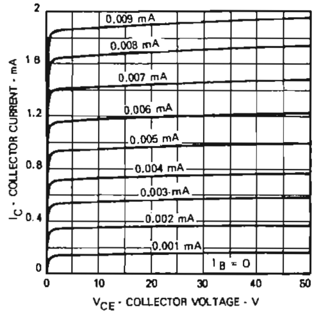
JULY 1970

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

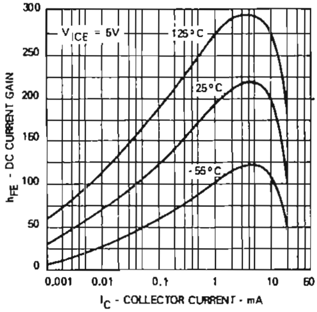
COLLECTOR CHARACTERISTICS *



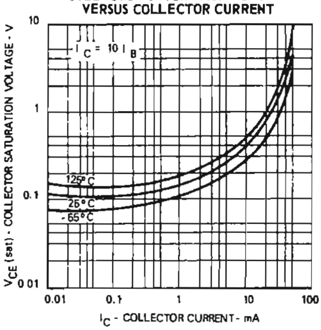
COLLECTOR CHARACTERISTICS *



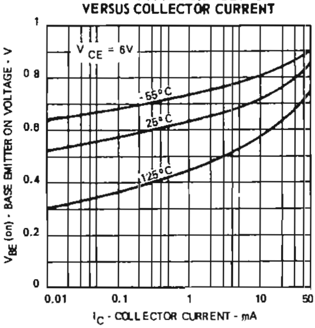
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



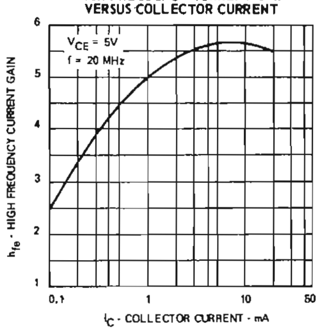
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



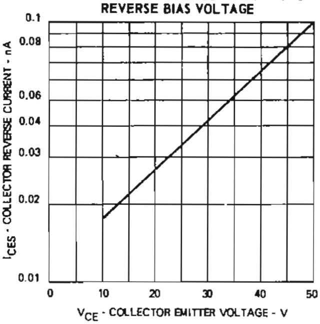
BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



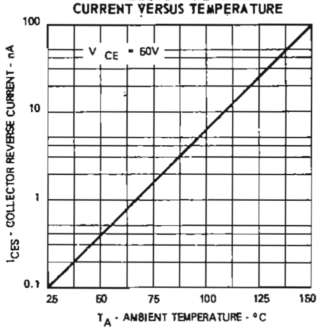
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



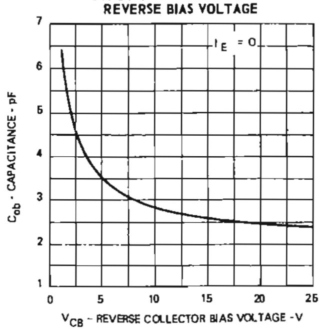
COLLECTOR-REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



COLLECTOR - REVERSE CURRENT VERSUS TEMPERATURE



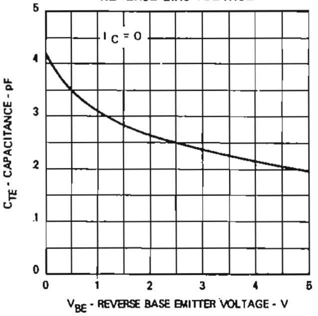
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



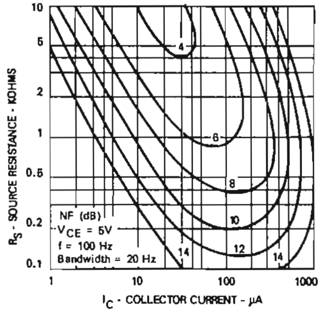
* Single family characteristics on Transistor Curve Tracer.

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

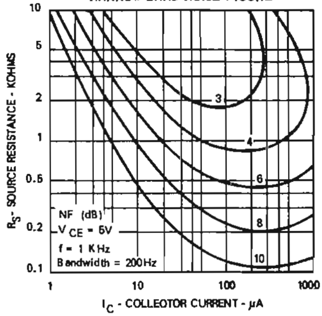
INPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



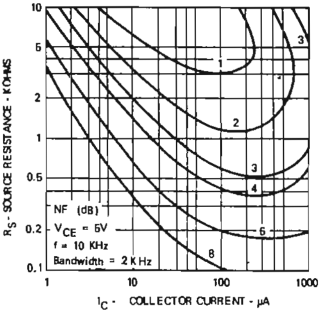
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



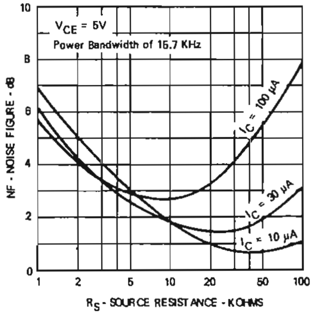
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



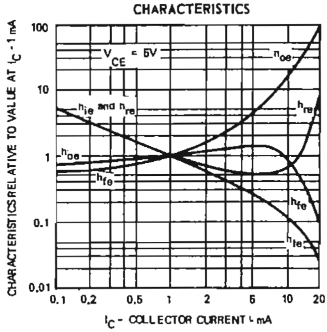
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



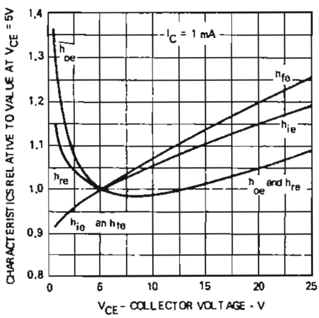
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



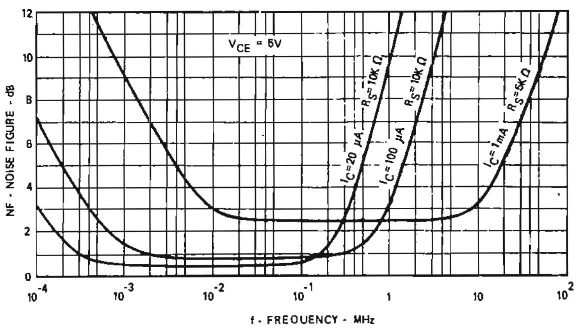
TYPICAL COMMON EMITTER CHARACTERISTICS



TYPICAL COMMON EMITTER CHARACTERISTICS



NOISE FIGURE VERSUS FREQUENCY



SILICON MESA NPN

GENERAL INFORMATION

TYPICAL APPLICATION: MEDIUM POWER AMPLIFIER

The BSS 15/2N 5320 is a silicon planar epitaxial NPN transistor in a Jedec TO-39 metal case. It is especially intended for high-voltage medium power applications in industrial and commercial equipments.
The complementary PNP type is the 2N 5322.

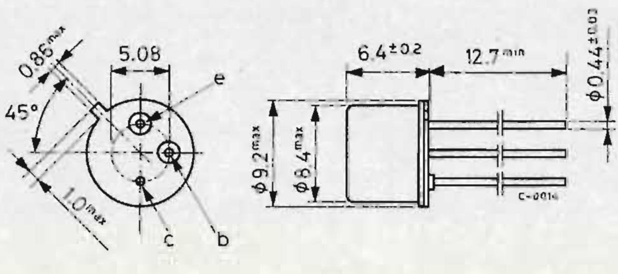
ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	100	V
$V_{CEO\ (sus)}$	Collector-emitter voltage ($I_B = 0$)	75	V
$V_{CEV\ (sus)}$	Collector-emitter voltage ($V_{BE} = -1.5$ V)	100	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	7	V
I_C	Collector current	2	A
I_B	Base current	1	A
P_{tot}	Total power dissipation at $T_a \leq 25$ °C	1	W
	at $T_c \leq 25$ °C	10	W
T_s	Storage temperature	-65÷200	°C
T_j	Junction temperature	200	°C

MECHANICAL DATA

Dimensions in mm

Collector connected to case



BSS 15
2N5320

THERMAL DATA

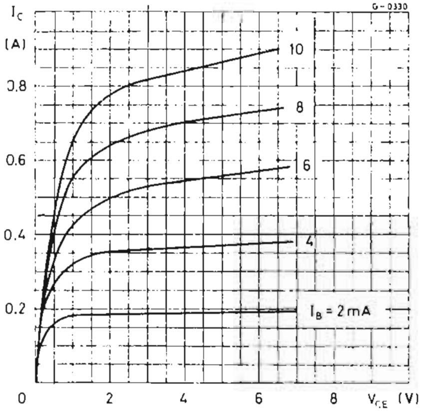
$R_{th\ j-c}$	Thermal resistance junction-case	max	17.5	°C/W
$R_{th\ j-a}$	Thermal resistance junction-ambient	max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_c = 25 °C unless otherwise specified)

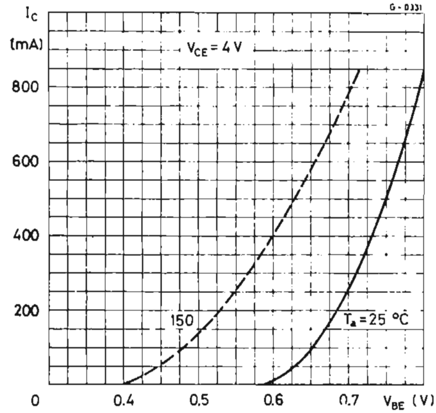
Parameter		Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 80$ V			0.5	μA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5$ V			0.1	μA
V_{EBO}	Emitter-base voltage ($I_C = 0$)	I_E = 0,1 mA	7			V
$V_{CEO\ (sus)}$	Collector-emitter voltage ($I_B = 0$)	I_C = 100 mA	75			V
$V_{CE\ (sat)}$	Collector-emitter saturation voltage	I_C = 500 mA I_B = 50 mA			0.5	V
V_{CEV}	Collector-emitter voltage ($V_{BE} = -1.5$ V)	I_C = 0.1 mA	100			V
V_{BE}	Base-emitter voltage	I_C = 500 mA $V_{CE} = 4$ V			1.1	V
h_{FE}	DC current gain * *	I_C = 500 mA $V_{CE} = 4$ V I_C = 1 A $V_{CE} = 2$ V	30 10		130	— —
f_T	Transition frequency	I_C = 50 mA $V_{CE} = 4$ V	50			MHz
t_{on}	Turn on time	I_C = 500 mA $V_{CE} = 30$ V I_B = 50 mA			80	ns
t_{off}	Turn off time	I_C = 500 mA $V_{CE} = 30$ V I_B = 50 mA			800	ns
$I_{S/B}$**	Second breakdown collector current	$V_{CE} = 50$ V	200			mA

* Pulse conditions
** 0.4 s non repetitive pulse

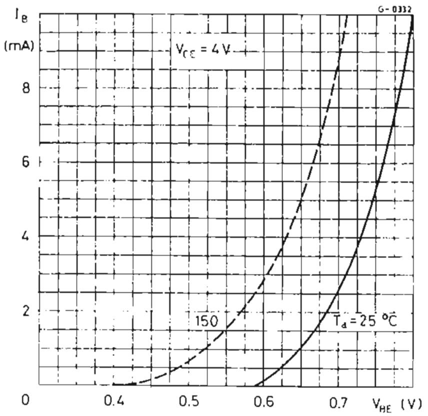
Typical output characteristics



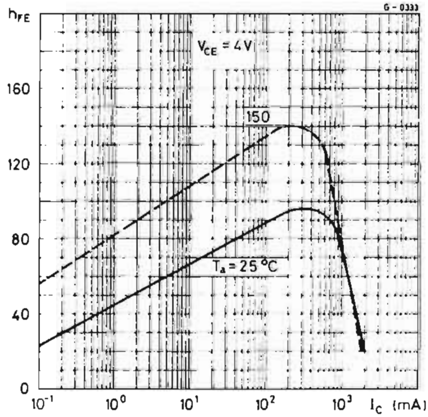
Typical DC transconductance



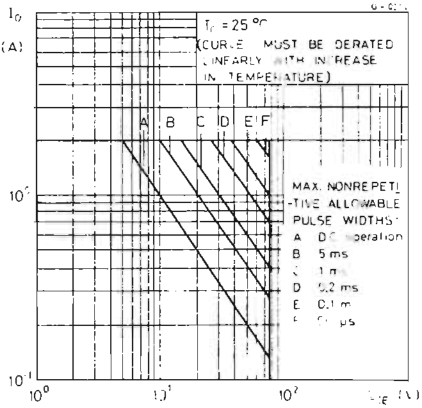
Typical input characteristics



Typical DC current gain

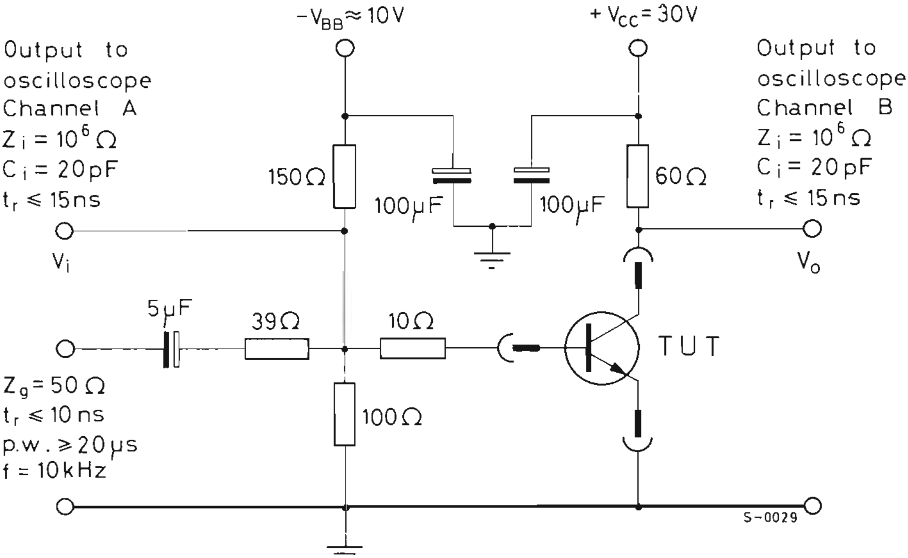


Maximum operating areas



TEST CIRCUIT

Switching times test circuit



SILICON PLANAR NPN

BSS 16
2N5321

GENERAL INFORMATION

TYPICAL APPLICATION: MEDIUM POWER AMPLIFIER

The BSS 16/2N 5321 is a silicon planar epitaxial NPN transistor in a Jedec TO-39 metal case. It is especially intended for small-signal medium-power applications in industrial and commercial equipments.
The complementary PNP type is the 2N 5323.

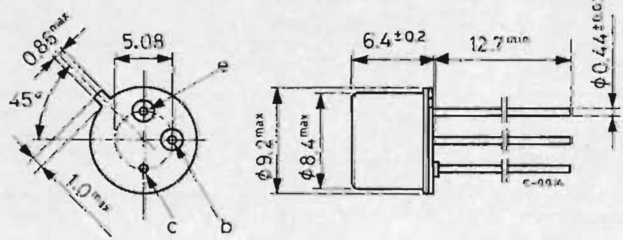
ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	75	V
$V_{CEO\,(sus)}$	Collector-emitter voltage ($I_B = 0$)	50	V
$V_{CE.\,(sus)}$	Collector-emitter voltage ($V_{BE} = -1.5$ V)	75	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5	V
I_C	Collector current	2	A
I_B	Base current	1	A
P_{tot}	Total power dissipation at $T_a \leq 25$ °C	1	W
	at $T_c \leq 25$ °C	10	W
T_s	Storage temperature	-65÷200	°C
T_j	Junction temperature	200	°C

MECHANICAL DATA

Dimensions in mm

Collector connected to case



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BSS 16
2N5321

THERMAL DATA

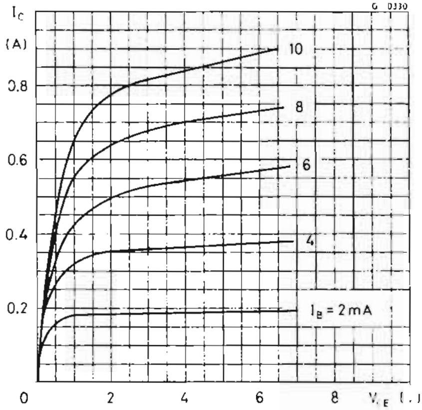
$R_{th\ j-c}$	Thermal resistance junction-case	max	17.5	°C/W
$R_{th\ j-a}$	Thermal resistance junction-ambient	max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_c = 25 °C unless otherwise specified)

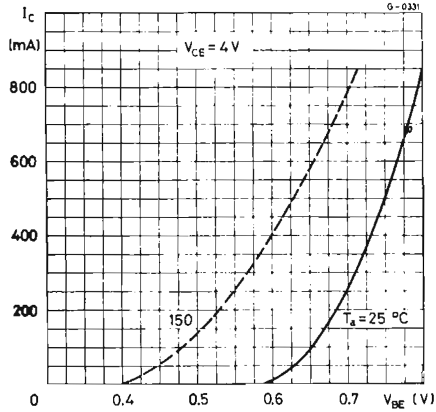
Parameter		Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 60$ V			5	μA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 4$ V			0.5	μA
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_E = 0.1$ mA	5			V
$V_{CEO(sus)}$	Collector-emitter voltage ($I_B = 0$)	$I_C = 100$ mA	50			V
$V_{CE\ (sat)}$	Collector-emitter saturation voltage	$I_C = 500$ mA $I_B = 50$ mA			0.8	V
V_{CEV}	Collector-emitter voltage	$I_C = 0.1$ mA $V_{BE} = -1.5$ V	75			V
V_{BE}	Base-emitter voltage	$I_C = 500$ mA $V_{CE} = 4$ V			1.4	V
h_{FE}	DC current gain *	$I_C = 500$ mA $V_{CE} = 4$ V	40		250	—
f_T	Transition frequency	$I_C = 50$ mA $V_{CE} = 4$ V	50			MHz
t_{on}	Turn on time	$I_C = 500$ mA $V_{CE} = 30$ V $I_B = 50$ mA			80	ns
t_{off}	Turn off time	$I_C = 500$ mA $V_{CE} = 30$ V $I_B = 50$ mA			800	ns
$I_{S/B}$**	Second breakdown collector current	$V_{CE} = 50$ V	200			mA

* Pulse conditions
** 0.4 s non repetitive pulse

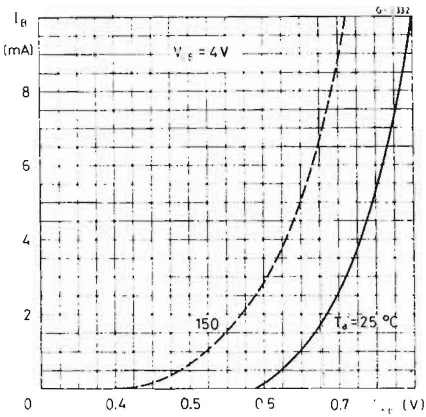
Typical output characteristics



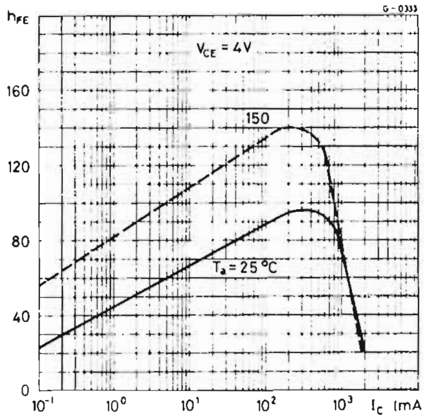
Typical DC transconductance



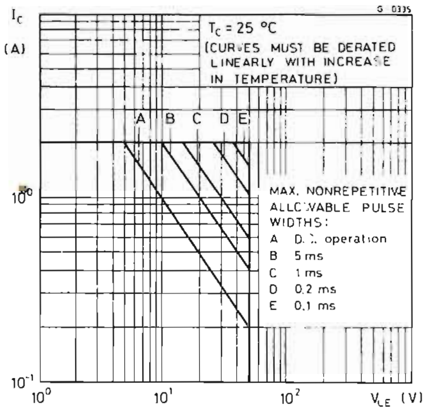
Typical input characteristics



Typical DC current gain

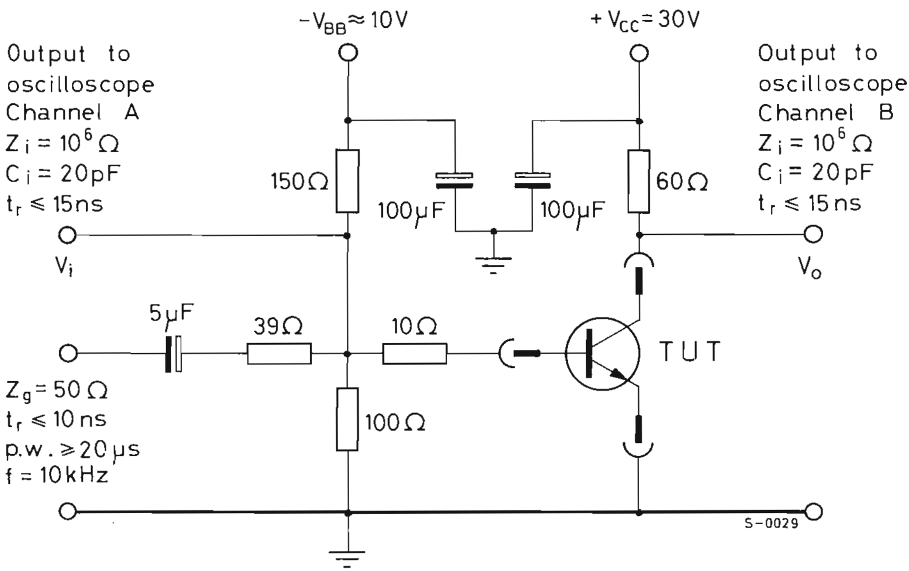


Maximum operating areas



TEST CIRCUIT

Switching times test circuit



SILICON PLANAR PNP

BSS 17
2N5322

GENERAL INFORMATION

TYPICAL APPLICATION: MEDIUM POWER AMPLIFIER

The BSS 17/2N 5322 is a silicon planar epitaxial PNP transistor in a Jedec TO-39 metal case. It is especially intended for high-voltage medium-power applications in industrial and commercial equipments.
The complementary NPN type is the 2N 5320.

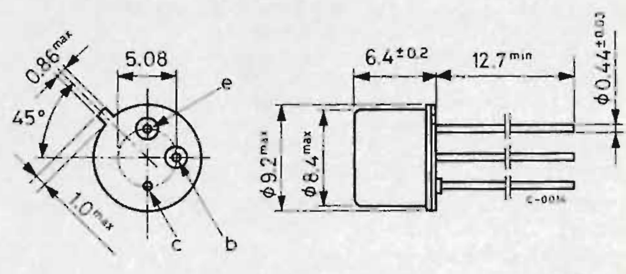
ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	-100	V
$V_{CEO\ (sus)}$	Collector-emitter voltage ($I_B = 0$)	-75	V
$V_{CEV\ (sus)}$	Collector-emitter voltage ($V_{BE} = 1.5$ V)	-100	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	-7	V
I_C	Collector current	-2	A
I_B	Base current	-1	A
P_{tot}	Total power dissipation at $T_a \leq 25$ °C	1	W
	at $T_c \leq 25$ °C	10	W
T_s	Storage temperature	-65÷200	°C
T_j	Junction temperature	200	°C

MECHANICAL DATA

Dimensions in mm

Collector connected to case



BSS 17
2N5322

THERMAL DATA

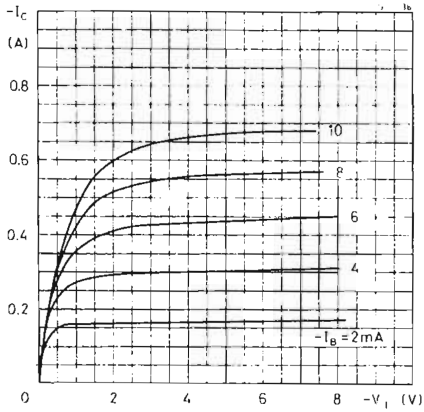
$R_{th\ j-c}$	Thermal resistance junction-case	max	17.5	°C/W
$R_{th\ j-a}$	Thermal resistance junction-ambient	max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_c = 25 °C unless otherwise specified)

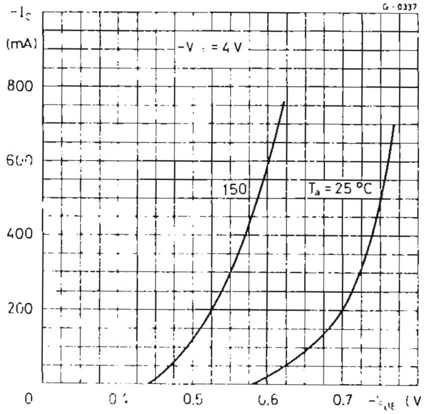
Parameter		Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = -80$ V			-0.5	μA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = -5$ V			-0.1	μA
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_E = -0.1$ mA	-7			V
$V_{CEO(sus)}$	Collector-emitter voltage ($I_B = 0$)	$I_C = -100$ mA	-75			V
$V_{CE\ (sat)}$	Collector-emitter saturation voltage	$I_C = -500$ mA $I_B = -50$ mA			-0.7	V
V_{CEV}	Collector-emitter voltage	$I_C = -0.1$ mA $V_{BE} = 1.5$ V	-100			V
V_{BE}	Base-emitter voltage	$I_C = -500$ mA $V_{CE} = -4$ V			-1.1	V
h_{FE}	DC current gain * *	$I_C = -500$ mA $V_{CE} = -4$ V $I_C = -1$ A $V_{CE} = -2$ V	30 10		130	— —
f_T	Transition frequency	$I_C = -50$ mA $V_{CE} = -4$ V	50			MHz
t_{on}	Turn on time	$I_C = -500$ mA $V_{CE} = -30$ V $I_B = -50$ mA			100	ns
t_{off}	Turn off time	$I_C = -500$ mA $V_{CE} = -30$ V $I_B = -50$ mA			1000	ns
$I_{S/B}$**	Second breakdown collector current	$V_{CE} = -35$ V	-285			mA

* Pulse conditions
** 0.4 s non repetitive pulse

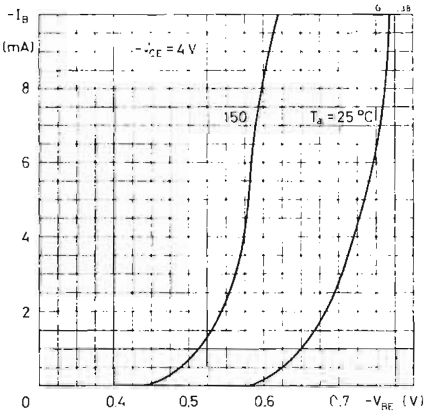
Typical output characteristics



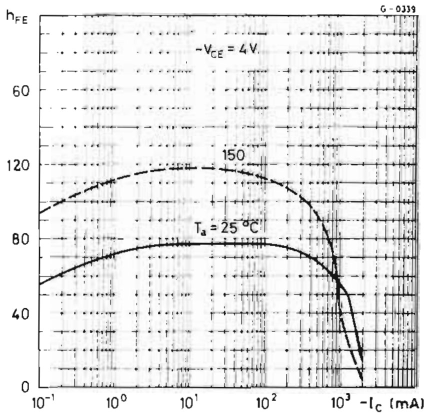
Typical DC transconductance



Typical input characteristics

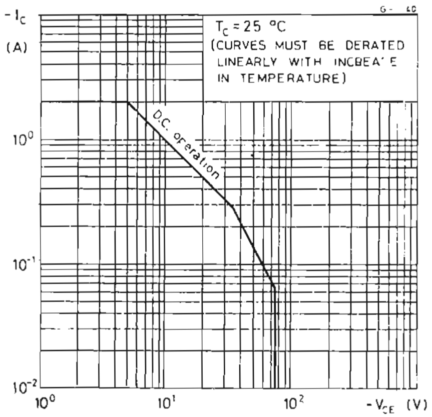


Typical DC current gain



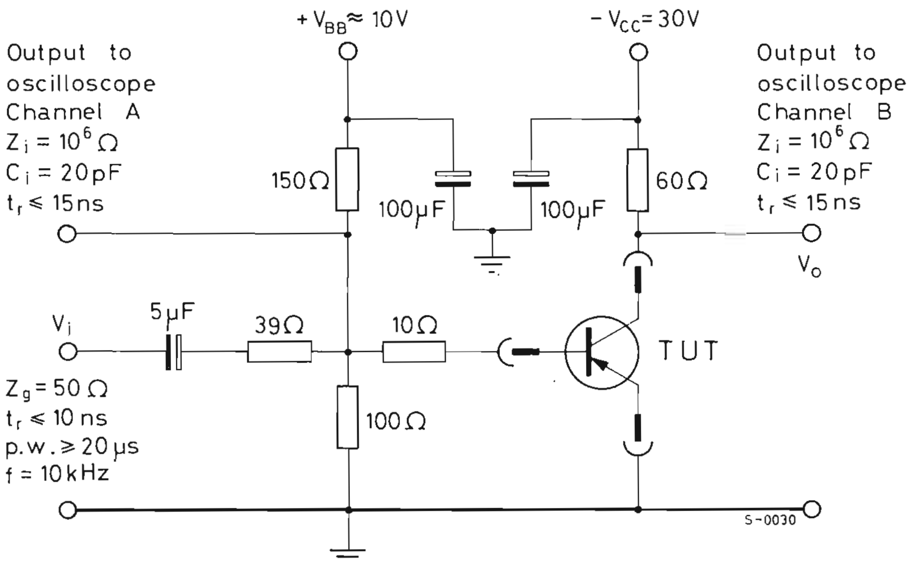
BSS 17
2N5322

Maximum operating areas



TEST CIRCUIT

Switching times test circuit



SILICON PLANAR PNP

BSS 18
2N5323

GENERAL INFORMATION

TYPICAL APPLICATION: MEDIUM POWER AMPLIFIER

The BSS 18/2N 5323 is a silicon planar epitaxial PNP transistor in a Jedec TO-39 metal case. It is especially intended for small-signal medium-power applications in industrial and commercial equipments.
The complementary NPN type is the 2N 5321.

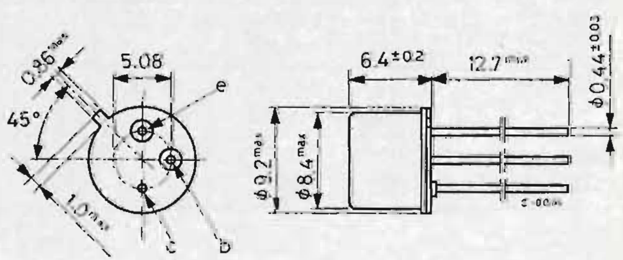
ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	-75	V
$V_{CEO\ (sus)}$	Collector-emitter voltage ($I_B = 0$)	-50	V
$V_{CEV\ (sus)}$	Collector-emitter voltage ($V_{BE} = 1.5$ V)	-75	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	-5	V
I_C	Collector current	-2	A
I_B	Base current	-1	A
P_{tot}	Total power dissipation at $T_a \leq 25$ °C	1	W
	at $T_c \leq 25$ °C	10	W
T_s	Storage temperature	-65÷200	°C
T_j	Junction temperature	200	°C

MECHANICAL DATA

Dimensions in mm

Collector connected to case



3/71

BSS 18
2N5323

THERMAL DATA

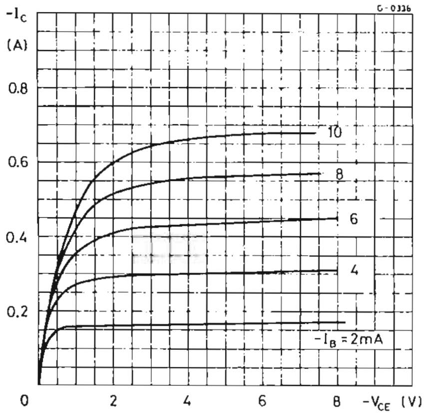
$R_{th\ j-c}$	Thermal resistance junction-case	max	17.5	°C/W
$R_{th\ j-a}$	Thermal resistance junction-ambient	max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_c = 25 °C unless otherwise specified)

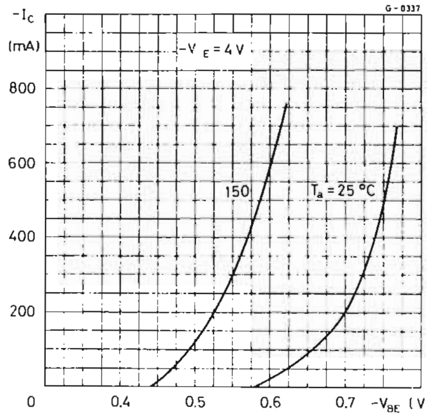
Parameter		Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = -60$ V			-5	µA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = -4$ V			-0.5	µA
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_E = -0.1$ mA	-5			V
$V_{CEO(sus)}$	Collector-emitter voltage ($I_B = 0$)	$I_C = -100$ mA	-50			V
$V_{CE\ (sat)}$	Collector-emitter saturation voltage	$I_C = -500$ mA $I_B = -50$ mA			-1.2	V
V_{CEV}	Collector-emitter voltage	$I_C = -0.1$ mA $V_{BE} = 1.5$ V	-75			V
V_{BE}	Base-emitter voltage	$I_C = -500$ mA $V_{CE} = -4$ V			-1.4	V
h_{FE}	DC current gain *	$I_C = -500$ mA $V_{CE} = -4$ V	40		250	—
f_T	Transition frequency	$I_C = -50$ mA $V_{CE} = -4$ V	50			MHz
t_{on}	Turn on time	$I_C = -500$ mA $V_{CE} = -30$ V $I_B = -50$ mA			100	ns
t_{off}	Turn off time	$I_C = -500$ mA $V_{CE} = -30$ V $I_B = -50$ mA			1000	ns
$I_{S/B}$**	Second breakdown collector current	$V_{CE} = -35$ V	-285			mA

* Pulse conditions
** 0.4 s non repetitive pulse

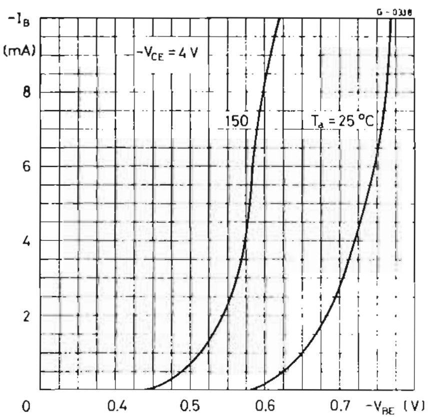
Typical output characteristics



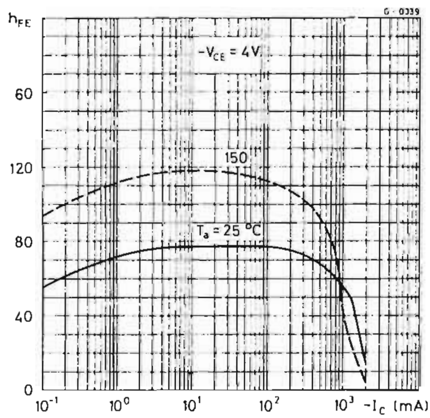
Typical DC transconductance



Typical input characteristics

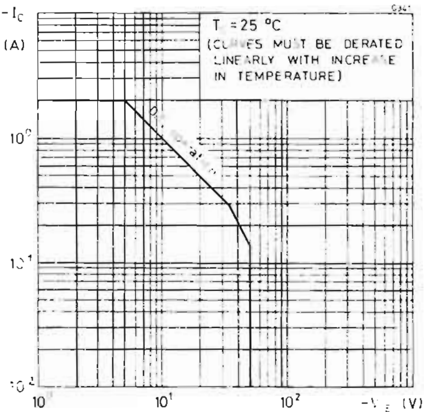


Typical DC current gain



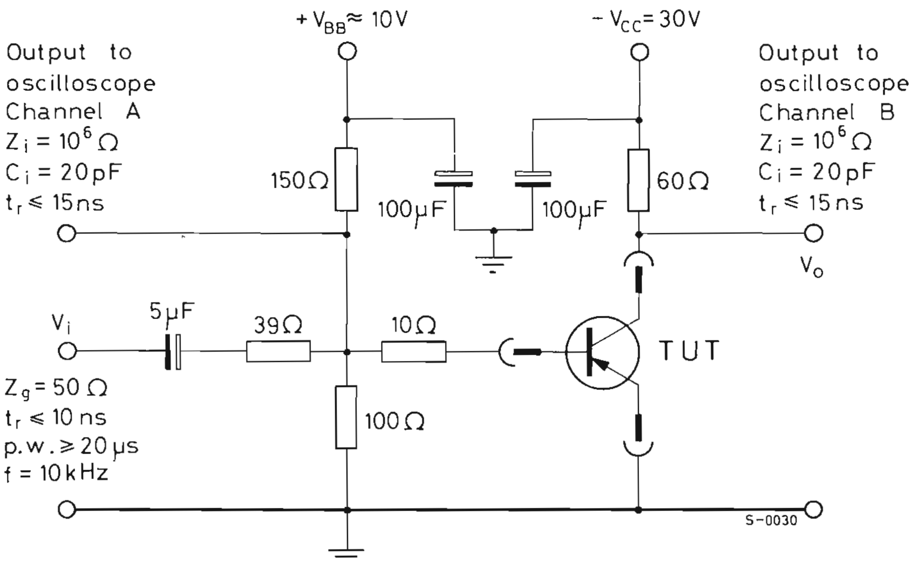
BSS 18
2N5323

Maximum operating areas



TEST CIRCUIT

Switching times test circuit



NPN diffused silicon planar transistor

BSS 26

High voltage high current switch

The BSS 26 is an NPN silicon planar epitaxial transistor suitable for high voltage, high current switching applications.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and Test Conditions		Min.	Typ.	Max.	Unit.
h_{FE}	DC Current Gain (5)					
	I_C = 10mA	V_{CE} = 1V	25	55		
	I_C = 100mA	V_{CE} = 1V	40	75		
	I_C = 500mA	V_{CE} = 1V	25	45		
	I_C = 1A	V_{CE} = 5V		45		
V_{BEsat}	Base Saturation Voltage (5)					
	I_C = 100mA	I_B = 10mA		0.78	0.9	V
	I_C = 500mA	I_B = 50mA	0.8	0.95	1.2	V
	I_C = 1A	I_B = 0.1A		1.05	1.7	V
V_{CEsat}	Collector Saturation Voltage (5)					
	I_C = 100mA	I_B = 10mA		0.17	0.3	V
	I_C = 500mA	I_B = 50mA		0.3	0.5	V
	I_C = 1A	I_B = 0.1A		0.5	0.95	V
I_{CBO}	Collector Reverse Current					
	V_{CB} = 40V	I_E = 0		0.1	1.7	μA
	V_{CB} = 40V I_E = 0	T_A = 100°C		20	120	μA
BV_{CBO}	Collector to Base Breakdown Voltage					
	I_C = 10μA	I_E = 0	60			V
BV_{CES}	Collector to Emitter Breakdown Voltage					
	I_C = 10μA	V_{EB}=0	60			V
BV_{EBO}	Emitter to Base Breakdown Voltage					
	I_E = 10μA	I_C = 0	6			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)					
	I_C = 10mA	I_B = 0	40			V
h_{fe}	High Freq. Current Gain					
	I_C = 50mA V_{CE} = 10V	f = 100MHz	2.5	4		
C_{TE}	Emitter Transition Capacitance					
	I_C = 0	V_{EB} = 0.5V		40	55	pF
C_{obo}	Base - Collector Capacitance					
	I_E = 0	V_{CB} = 10V		4.8	12	pF
t_{on}	Turn On Time (6)					
	I_C = 500mA	I_{B1} = 50mA		15	35	ns
t_{off}	Turn Off Time (6)					
	I_C = 500mA I_{B1} = 50mA	I_{B2} = 50mA		40	60	ns

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages and Currents

Collector to Base	V_{CBO}	60 V
Collector to Emitter (4)	V_{CEO}	40 V
Collector to Emitter	V_{CES}	60 V
Emitter to Base	V_{EBO}	6 V
DC Collector Current	I_C	1 A

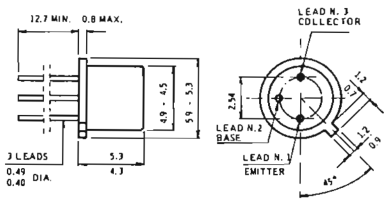
Temperatures

Storage Temperature Range	T_{STG}	-55°C to 200°C
Operating Junction Temperature	T_J	200°C
Lead Temperature (Soldering, 10 sec. time limit)	T_L	260°C

Power (2 and 3)

Dissipation at 25°C Case Temperature	P_D	1.2 W
Dissipation at 25°C Ambient Temperature	P_D	0.36 W

PHYSICAL DIMENSIONS
in accordance with JEDEC TO-18 outline



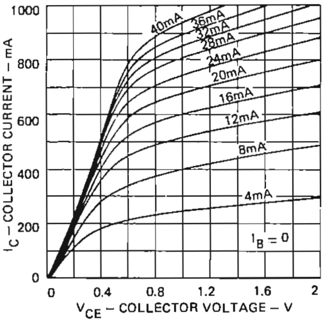
NOTES : All dimensions in mm.

NOTES :

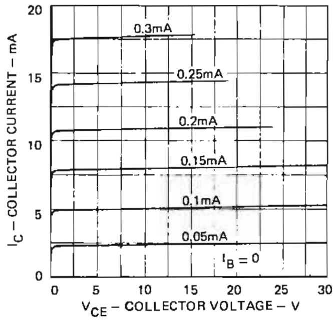
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/W (derating factor of 6.86 mW/°C); junction-to-ambient thermal resistance of 486°C/W (derating factor of 2.06 mW/°C).
(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.
(6) See switching circuits for exact values of I_C, I_{B1} and I_{B2}.

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

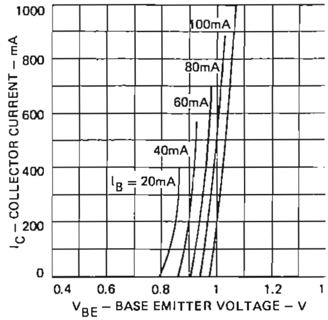
COLLECTOR CHARACTERISTICS *



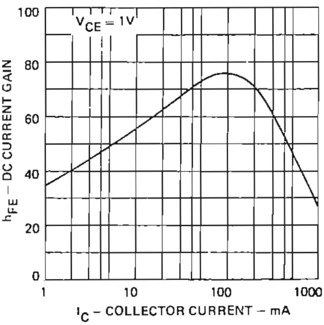
COLLECTOR CHARACTERISTICS *



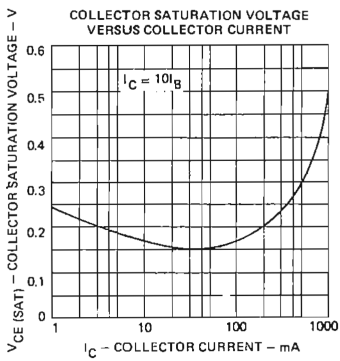
BASE CHARACTERISTICS *



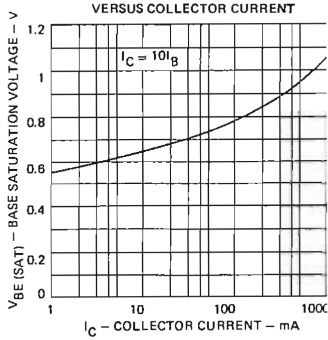
DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT



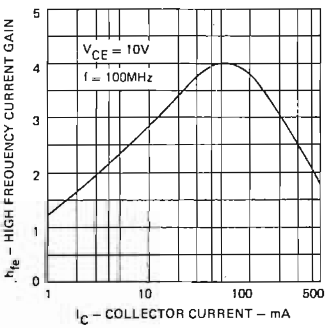
COLLECTOR SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT



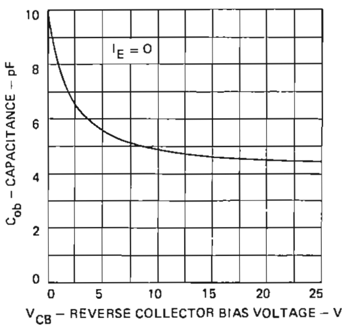
BASE SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT



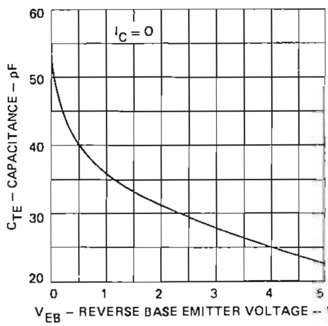
HIGH FREQUENCY CURRENT GAIN
VERSUS COLLECTOR CURRENT



OUTPUT CAPACITANCE VERSUS
REVERSE BIAS VOLTAGE



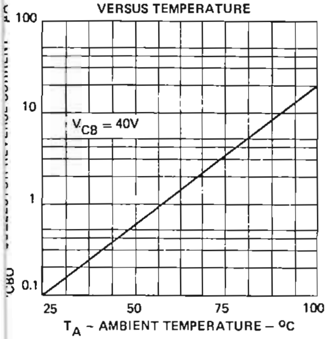
INPUT CAPACITANCE VERSUS
REVERSE BIAS VOLTAGE



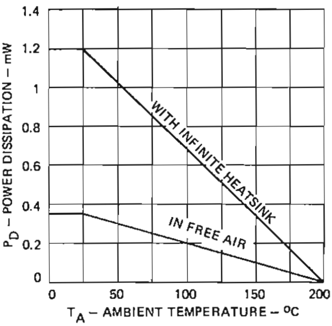
* Single family characteristics on Transistor Curve Tracer

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

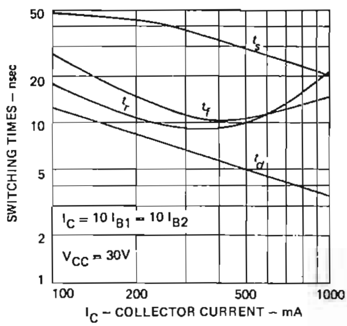
COLLECTOR REVERSE CURRENT VERSUS TEMPERATURE



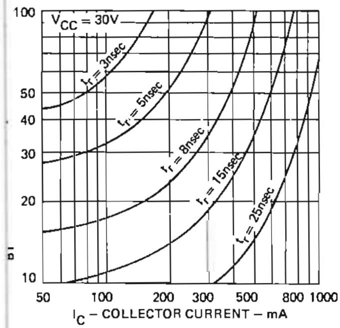
DERATING CURVE



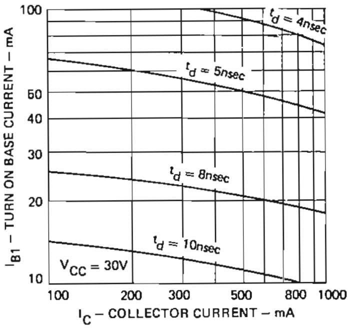
SWITCHING TIMES VERSUS COLLECTOR CURRENT



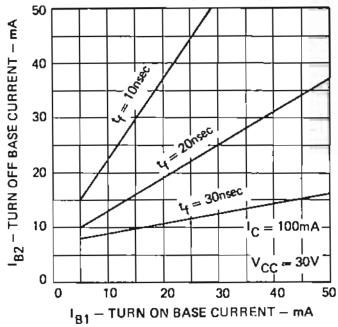
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



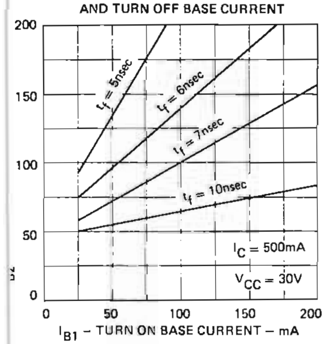
DELAY TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



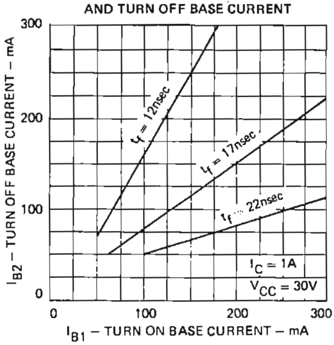
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



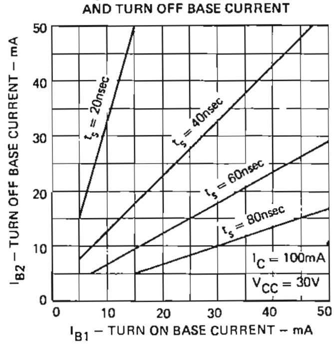
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



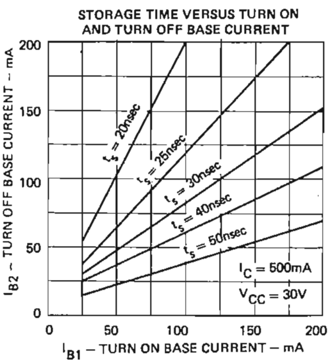
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

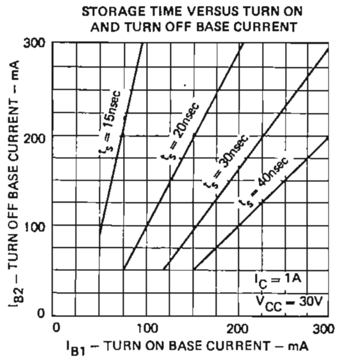


STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

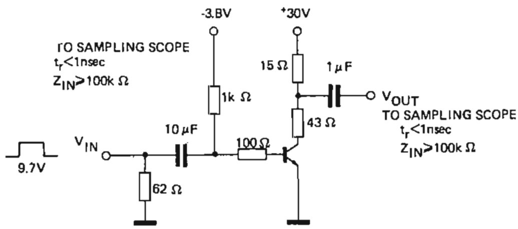


TYPICAL ELECTRICAL CHARACTERISTICS (25° C free air temperature unless otherwise noted)





SWITCHING TIMES TEST CIRCUIT



PULSE GENERATOR
t_r & t_f≤1nsec
PW≈1 μsec
Z_{OUT}=50Ω
DUTY CYCLE≤2%

I_C≈500mA, I_{B1}≈50mA, I_{B2}≈50mA

NPN diffused silicon planar transistor — BSV 59

High-speed saturated switch

The BSV 59 is an NPN double-diffused silicon planar epitaxial transistor designed primarily for high-speed switching applications at collector currents up to 500 mA. This is excellent driver, featuring 20 nano second transition times for rod and magnetic memory, clock driver for magnetic logic circuits, and general purpose circuitry. This device is also useful as high frequency DC to DC converter.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 50 mA, V_{CE} = 10 V		60		
	I_C = 150 mA, V_{CE} = 10 V	30	60	140	
	I_C = 500 mA, V_{CE} = 10 V	20	50		
	I_C = 500 mA, V_{CE} = 1 V	10	30		
	I_C = 150 mA, V_{CE} = 1 V		50		
$V_{BE\ sat}$	Base Saturation Voltage (5)				
	I_C = 150 mA, I_B = 15 mA		0.85	1.2	V
	I_C = 500 mA, I_B = 50 mA		1.12	1.6	V
	I_C = 50 mA, I_B = 5 mA		0.78		V
$V_{CE\ sat}$	Collector Saturation Voltage (5)				
	I_C = 150 mA, I_B = 15 mA		0.22	0.4	V
	I_C = 500 mA, I_B = 50 mA		0.48	1	V
	I_C = 50 mA, I_B = 5 mA		0.16		V
I_{CBO}	Collector Reverse Current				
	V_{CB} = 30 V, I_E = 0		40	200	nA
	V_{CB} = 30 V, I_E = 0, 125°C		20	200	µA
BV_{CBO}	Collector to Base Breakdown Voltage, I_C = 0.1 mA, I_E = 0	60			V
BV_{EBO}	Emitter to Base Breakdown Voltage, I_E = 0.1 mA, I_C = 0	5			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5), I_C = 30 mA, I_B = 0	30			V
h_{fe}	High Freq. Current Gain, I_C = 50 mA, V_{CE} = 10 V, f=100MHz	2.5	3.5		
C_{TE}	Emitter Transition Capacitance, I_C = 0, V_{EB} = 0.5 V, f=1MHz		38		pF
C_{obo}	Base-Collector Capacitance, I_E = 0, V_{CB} = 10 V, f=1MHz		6	8	pF
t_{on}	Turn On Time (6), I_C = 150 mA, I_{B1} = 15 mA		18	40	ns
t_{off}	Turn Off Time (6), I_C = 150 mA, I_{B1} = 15 mA, I_{B2} = 15 mA		25	40	ns

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Base	V_{CBO}	60 V
Collector to Emitter (4)	V_{CEO}	30 V
Emitter to Base	V_{EBO}	5 V

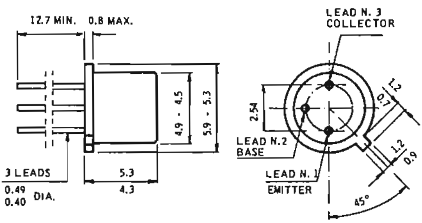
Temperatures

Storage Temperature Range	T_{STG}	- 55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering, 10 sec. time limit)	T_L	260°C

Power (2 - 3)

Dissipation at 25°C Case Temperature	P_D	1.2 W
Dissipation at 100°C Case Temperature	P_D	0.68 W
Dissipation at 25°C Ambient Temperature	P_D	0.36 W

PHYSICAL DIMENSIONS
In accordance with JEDEC TO-18 outline



NOTES : All dimensions in mm.
Collector internally connected to case.

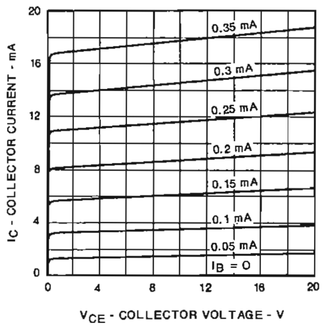
NOTES:

(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/W (derating factor of 6.9 mW/°C); junction - to - ambient thermal resistance of 486°C/W (derating factor of 2.1 mW/°C).
(4) These ratings refer to a high - current point where collector - to - emitter voltage is lowest. For more information send for SGS-AR 5.
(5) Measured under pulse conditions: pulse length = 300 µsec; duty cycle = 1%.
(6) See switching circuits for exact values of I_C, I_{B1} and I_{B2}.

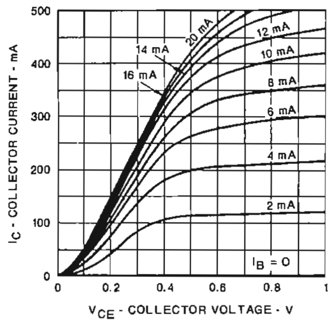
OCTOBER 1970

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

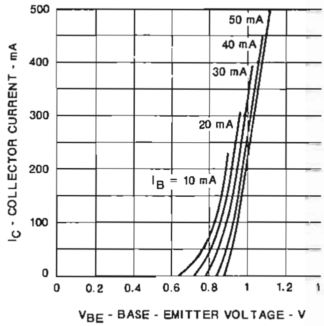
COLLECTOR CHARACTERISTICS *



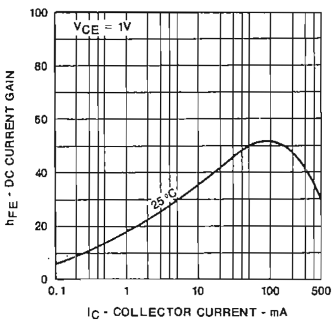
COLLECTOR CHARACTERISTICS *



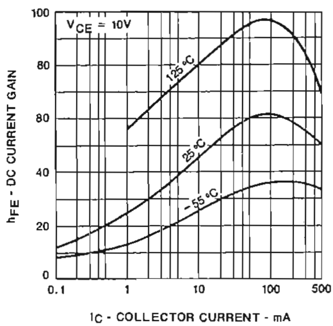
BASE CHARACTERISTICS *



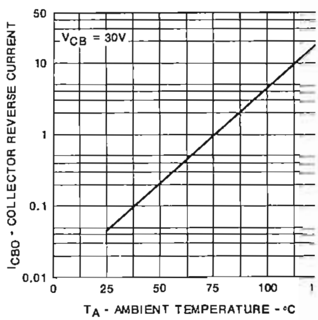
DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT



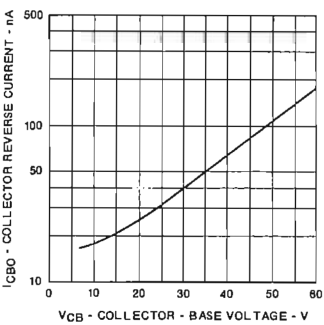
DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT



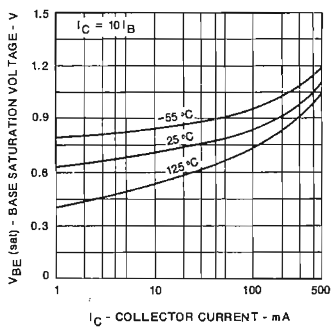
COLLECTOR REVERSE
CURRENT VERSUS TEMPERATURE



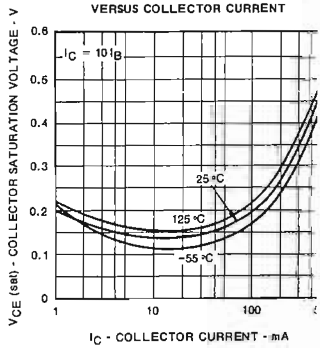
COLLECTOR REVERSE CURRENT VERSUS
REVERSE BIAS VOLTAGE



BASE SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT



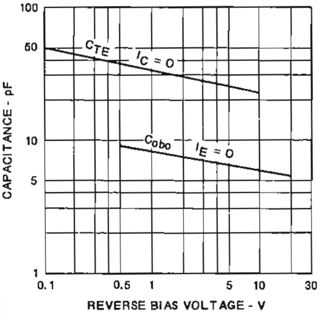
COLLECTOR SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT



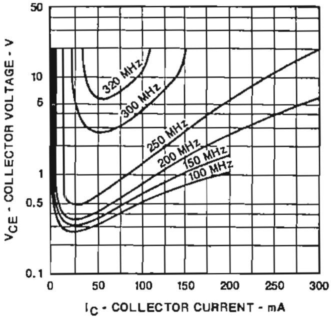
* Single family characteristics on Transistor Curve Tracer.

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

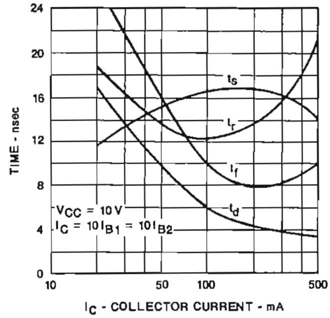
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



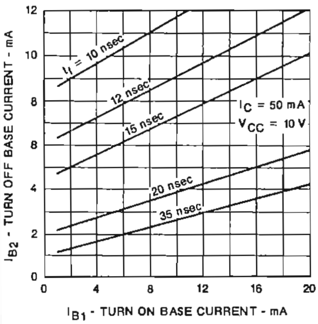
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



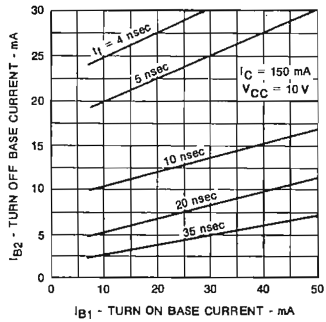
SWITCHING TIMES VERSUS COLLECTOR CURRENT



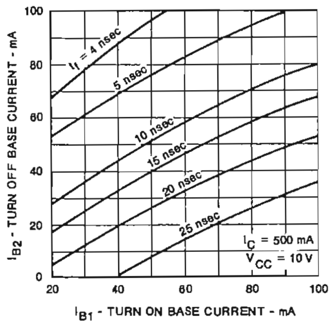
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



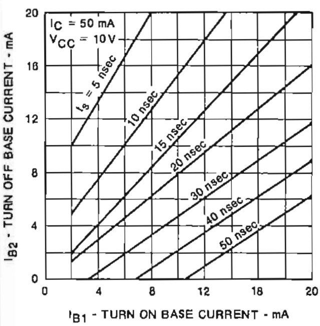
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



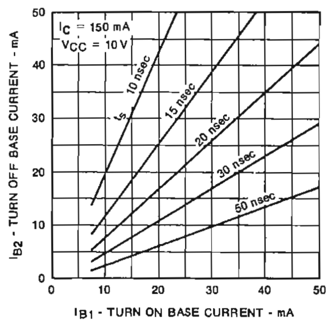
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



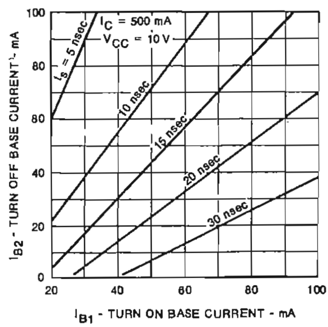
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



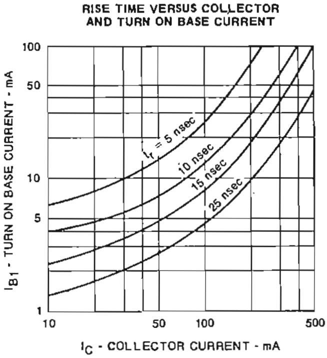
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

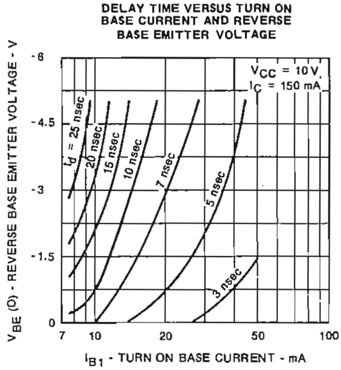


STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

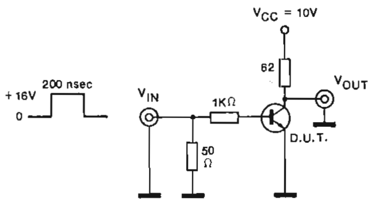


TYPICAL ELECTRICAL CHARACTERISTICS (25° C free air temperature unless otherwise noted)



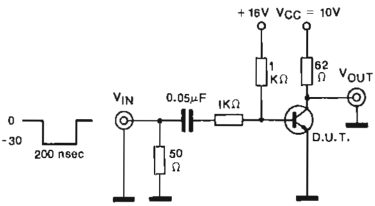


T_{on} TEST CIRCUIT



Rise Time of input pulse <2 nsec.

T_{off} TEST CIRCUIT



Rise Time of input pulse <2 nsec.

NPN diffused silicon planar transistor

BSV 77

High-voltage, high-current switch

The BSV77 is an NPN silicon planar epitaxial transistor suitable for high voltage, high current switching applications. The $V_{CEO(sust)}$ of 40V, $V_{CE(sat)}$ of 0.95V at 1A together with high speed at high current, make the BSV77 ideal for use in fast high current memory applications.

ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 10mA V_{CE} = 1V	30	60		
	I_C = 100mA V_{CE} = 1V	60	90	150	
	I_C = 500mA V_{CE} = 1V	30	50		
	I_C = 1A V_{CE} = 5V	20	50		
$V_{BE\ sat}$	Base Saturation Voltage (5)				
	I_C = 100mA I_B = 10mA		0.78		V
	I_C = 500mA I_B = 50mA	0.8	1	1.2	V
	I_C = 1A I_B = 0.1A		1.2	1.7	V
$V_{CE\ sat}$	Collector Saturation Voltage (5)				
	I_C = 100mA I_B = 10mA		0.17		V
	I_C = 500mA I_B = 50mA		0.35	0.50	V
	I_C = 1A I_B = 0.1A		0.65	0.95	V
I_{CBO}	Collector Reverse Current				
	V_{CB} = 40V I_E = 0		0.1	1.7	µA
	V_{CB} = 40V I_E = 0 100°C		20	120	µA
BV_{CES}	Collector to Emitter Breakdown Voltage				
	I_C = 10µA V_{EB} = 0	60			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E = 10µA I_C = 0	6			V
$L.V_{CEO}$	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 10mA I_B = 0	40			V
h_{fe}	High Freq. Current Gain				
	I_C = 50mA V_{CE} = 10V f = 100MHz	2.5	4		
C_{TE}	Emitter Transition Capacitance				
	I_C = 0 V_{EB} = 0.5V		40	55	pF
C_{obo}	Base-Collector Capacitance				
	I_E=0 V_{CB} = 10V		4.8	12	pF
t_{on}	Turn On Time				
	I_C = 500mA I_{B1} = 50mA		15	35	ns
t_{off}	Turn Off Time				
	I_C = 500mA I_{B1} = 50mA I_{B2} = 50mA		40	60	ns

ABSOLUTE MAXIMUM RATINGS (1)

(T_A = 25°C unless otherwise noted)

Voltages and Current

Collector to Emitter (4)	V_{CEO}	40V
Collector to Emitter	V_{CES}	60V
Emitter to Base	V_{EBO}	6V
DC Collector Current	I_C	1A

Temperatures

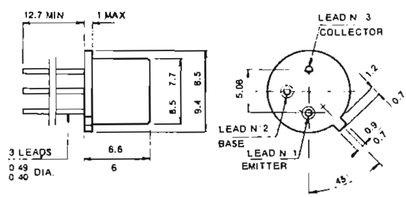
Storage Temperature	T_{STG}	-55°C to 200°C
Operating Junction Temperature	T_J	200°C
Lead Temperature (Soldering, 10 sec.)	T_L	260°C

Power (2-3)

Dissipation at 25°C Case Temperature	P_D	3.5W
Dissipation at 25°C Ambient Temperature	P_D	0.8W

PHYSICAL DIMENSIONS

in accordance with JEDEC TO-39 outline



NOTES All dimensions in mm.
Collector internally connected to case.

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/W (derating factor of 20 mW/°C); junction-to-ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).

(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(5) Measured under pulse conditions: pulse length = 300 µsec; duty cycle = 1%.

SILICON PLANAR PNP

BSV 82

PRELIMINARY DATA

GENERAL INFORMATION

TYPICAL APPLICATION: MEDIUM POWER AMPLIFIER

The BSV 82 is a silicon planar epitaxial PNP transistor in a Jedec TO-39 metal case. It is designed for a wide variety of applications, this device features minimum $V_{(BR)CEO}$ of 80 V, current gain specified from 100 μA to 500 mA and low saturation voltage for currents up to 1 A. It is particularly useful as complementary driver, in output stage applications and as medium speed switch, where high voltage and high current are required.

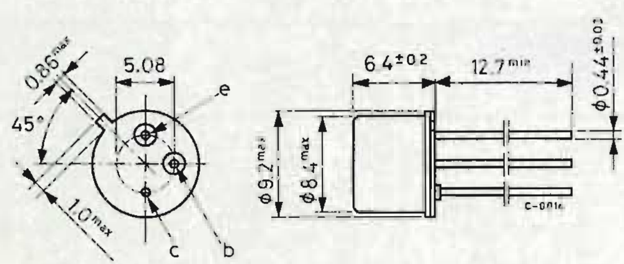
ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	-80	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	-80	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	-5	V
I_C	Collector current	-2	A
I_{CM}	Collector peak current	-3	A
P_{tot}	Total power dissipation at $T_a \leq 25\ °C$	1	W
	at $T_c \leq 25\ °C$	10	W
T_s	Storage temperature	-65÷200	°C
T_j	Junction temperature	200	°C

MECHANICAL DATA

Dimensions in mm

Collector connected to case



BSV 82

THERMAL DATA

$R_{th\ j-c}$	Thermal resistance junction-case	max	17.5	°C/W
$R_{th\ j-a}$	Thermal resistance junction-ambient	max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_c = 25 °C unless otherwise specified)

Parameter		Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current (I_E = 0)	V_{CB} = -50 V			-100	nA
		V_{CB} = -50 V T_C = 150 °C			-100	μA
V_{CBO}	Collector-base voltage (I_E = 0)	I_C = -10 mA	-80			V
V_{CEO}	Collector-emitter voltage (I_B = 0)	I_C = -10 mA	-80			V
V_{EBO}	Emitter-base voltage (I_C = 0)	I_E = -10 μA	-5			V
$V_{CE\,(sat)}$	Collector-emitter saturation voltage	I_C = -500 mA I_B = -50 mA			-0.5	V
		I_C = -1 A I_B = -100 mA			-1	V
$V_{BE\,(sat)}$	Base-emitter saturation voltage	I_C = -500 mA I_B = -50 mA			-1.1	V
h_{FE}	DC current gain	I_C = -0.1 mA V_{CE} = -0.5 V	25			—
		I_C = -50 mA V_{CE} = -1 V	45			—
		I_C = -50 mA V_{CE} = -0.5 V	40			—
		I_C = -150 mA V_{CE} = -1 V	40			—
		I_C = -150 mA V_{CE} = -0.5 V	30			—
		I_C = -500 mA V_{CE} = -1 V	15			—
		I_C = -500 mA V_{CE} = -0.5 V	10			—

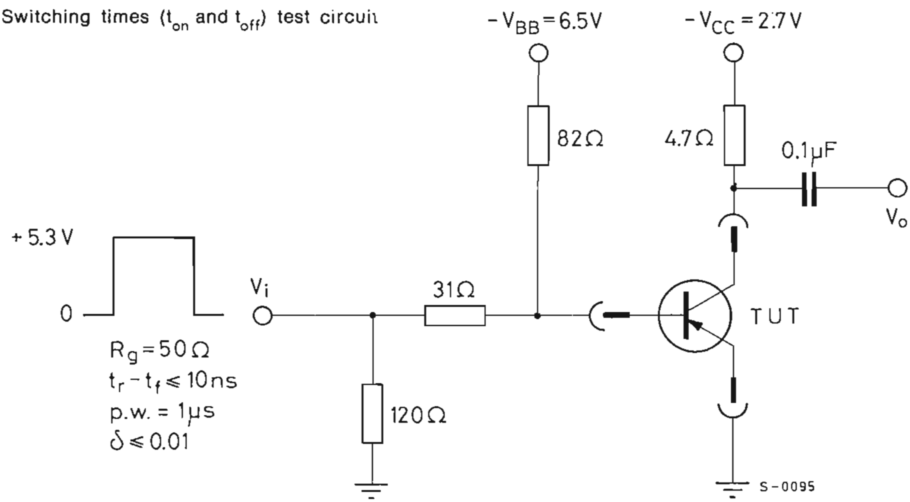
ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test Conditions	Min.	Typ.	Max.	Unit
h_{fe}	Small signal current gain	I_C = -50 mA V_{CE} = -20 V f = 100 MHz	100			—
C_{ob}	Output capacitance	I_E = 0 V_{CB} = -10 V			35	pF
t_{on}*	Turn-on-time	I_C = -500 mA I_{B1} ≅ 50 mA V_{BE} ($_{off}$) ≅ 1.6 V		50		ns
t_{off}*	Turn-off-time	I_C = -500 mA I_{B1} ≅ -I_{B2} = -50 mA		250	400	ns

* See switching circuit for exact values of I_C, I_{B1} and I_{B2}

TEST CIRCUIT

Switching times (t_{on} and t_{off}) test circuit



SILICON PLANAR NPN

BSV 84

PRELIMINARY DATA

GENERAL INFORMATION

TYPICAL APPLICATION: MEDIUM POWER AMPLIFIER

The BSV 84 is a silicon planar epitaxial NPN transistor in a Jedec TO-39 metal case. It is designed for a wide variety of applications. This device features minimum $V_{(BR)CEO}$ of 70 V, current gain specified from 100 μA to 500 mA and low saturation voltage for currents up to 500 mA. It is particularly useful as complementary driver, in output stage applications and as medium speed switch, where high voltage and high current are required.

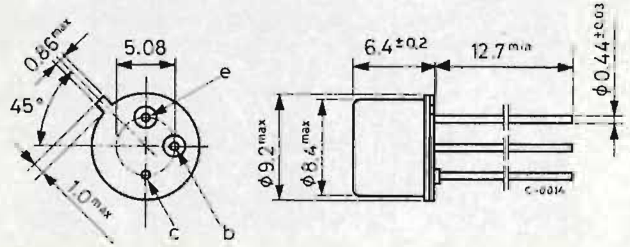
ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	120	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	70	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	7	V
I_C	Collector current	2	A
P_{tot}	Total power dissipation at $T_a \leq 25$ °C	1	W
	at $T_c \leq 25$ °C	10	W
T_s	Storage temperature	-65÷200	°C
T_j	Junction temperature	200	°C

MECHANICAL DATA

Dimensions in mm

Collector connected to case



BSV 84

THERMAL DATA

$R_{th\ j-c}$	Thermal resistance junction-case	max	17.5	°C/W
$R_{th\ j-a}$	Thermal resistance junction-ambient	max	175	°C/W

ELECTRICAL CHARACTERISTICS (T_c = 25 °C unless otherwise specified)

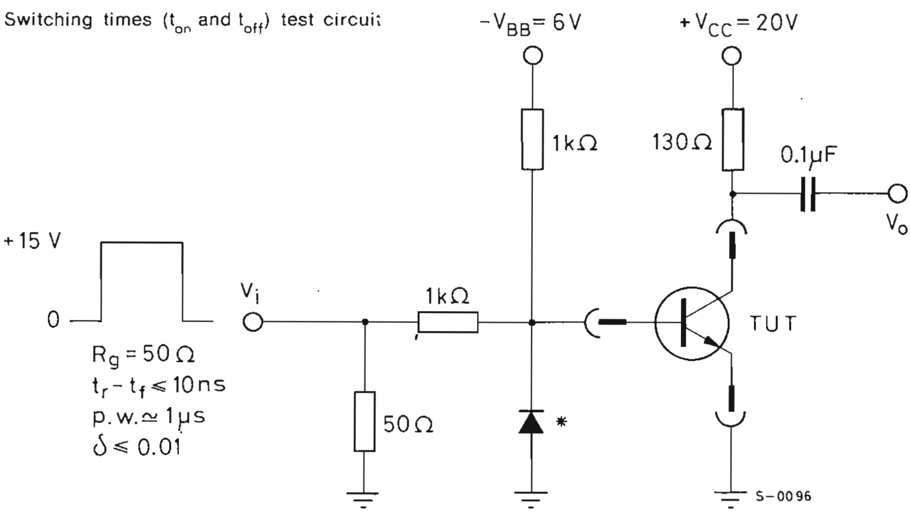
Parameter		Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 80$ V			30	nA
		$V_{CB} = 80$ V $T_C = 150$ °C			30	µA
I_{CES}	Collector cutoff current ($V_{BE} = 0$)	$V_{CE} = 80$ V			60	nA
I_{EBO}	Emitter cutoff current ($I_C = 0$)	$V_{EB} = 5$ V			100	nA
V_{CBO}	Collector-base voltage ($I_E = 0$)	$I_C = 0.1$ mA	120			V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	$I_C = 150$ mA	70			V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	$I_E = 0.1$ mA	7			V
$V_{CE\,(sat)}$	Collector-emitter saturation voltage	$I_C = 150$ mA $I_B = 15$ mA			0.35	V
		$I_C = 500$ mA $I_B = 50$ mA			1	V
$V_{BE\,(sat)}$	Base-emitter saturation voltage	$I_C = 150$ mA $I_B = 15$ mA			1.1	V
		$I_C = 500$ mA $I_B = 50$ mA			1.5	V
h_{FE}	DC current gain	$I_C = 0.1$ mA $V_{CE} = 1$ V	15			—
		$I_C = 0.1$ mA $V_{CE} = 0.5$ V	15			—
		$I_C = 5$ mA $V_{CE} = 1$ V	30			—
		$I_C = 5$ mA $V_{CE} = 0.5$ V	25			—
		$I_C = 50$ mA $V_{CE} = 1$ V	50			—
		$I_C = 50$ mA $V_{CE} = 0.5$ V	35			—
		$I_C = 150$ mA $V_{CE} = 1$ V	40			—
		$I_C = 150$ mA $V_{CE} = 0.5$ V	25			—
		$I_C = 500$ mA $V_{CE} = 10$ V	25			—

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test Conditions	Min.	Typ.	Max.	Unit
h_{fe}	Small signal current gain	I_C = 50 mA V_{CE} = 1 V f = 20 MHz	3			—
C_{ob}	Output capacitance	I_E = 0 V_{CB} = 10 V			25	pF
t_{on}	Turn-on-time	I_C = 150 mA I_{B1} = 7.5 mA $V_{BE\ (off)} \cong$ -3 V			250	ns
t_{off}	Turn-off-time	I_C = 150 mA I_{B1} = $-I_{B2}$ = 7.5 mA			700	ns

TEST CIRCUIT

Switching times (t_{on} and t_{off}) test circuit



* high speed diode

NPN diffused silicon planar transistor — BSV 89

High speed saturated switch

The BSV 89 is an NPN planar epitaxial transistor designed specifically for high - speed saturated switching applications.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 10 mA, V_{CE} = 0.35V	35	55		
	I_C = 10 mA, V_{CE} = 1V	40	60		
	I_C = 30 mA, V_{CE} = 1V	35	55		
	I_C = 100 mA, V_{CE} = 1V	25	45		
$V_{BE\,sat}$	Base Saturation Voltage (5)				
	I_C = 10 mA, I_B = 1 mA	0.7	0.77	0.85	V
	I_C = 30 mA, I_B = 3 mA		0.86	1.15	V
	I_C = 100 mA, I_B = 10 mA		0.97	1.6	V
$V_{CE\,sat}$	Collector Saturation Voltage (5)				
	I_C = 10 mA, I_B = 1 mA		0.14	0.20	V
	I_C = 30 mA, I_B = 3 mA		0.17	0.25	V
	I_C = 100 mA, I_B = 10 mA		0.30	0.80	V
I_{CES}	Collector Reverse Current V_{CE} = 15, V_{EB} = 0		5	200	nA
I_{CES} (125°C)	Collector Reverse Current V_{CE} = 15V, V_{EB} = 0		2	70	μA
BV_{CES}	Collector to Emitter Breakdown Voltage I_C = 10 μA, V_{EB} = 0	25			V
BV_{EBO}	Emitter to Base Breakdown Voltage I_E = 10 μA, I_C = 0	5			V
LV_{CER}	Collector to Emitter Sustaining Voltage (4 and 5) I_C = 10 mA, R_{BE} = 10Ω	15			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5) I_C = 10 mA, I_B = 0	10			V
h_{fe}	High Freq. Current Gain (f=100 MHz) I_C = 10 mA, V_{CE} = 10V	4	6		
C_{TE}	Emitter Transition Capacitance I_C = 0, V_{EB} = 0.5V		3.7	6	pF
C_{obo}	Base Collector Capacitance I_E = 0, V_{CB} = 5V		2	4	pF
τ_s	Charge Storage Time Constant $I_C \sim I_{B1} \sim I_{B2} \sim$ 10 mA			13	ns
t_{on}	Turn On Time $I_C \sim$ 10 mA, $I_{B1} \sim$ 3 mA			12	ns
t_{off}	Turn Off Time $I_C \sim$ 10 mA, $I_{B1} \sim$ 3 mA, $I_{B2} \sim$ 1,5 mA			18	ns

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Emitter (4)	V_{CEO}	10 V
Collector to Emitter (R_{BE} ≤ 10Ω) (4)	V_{CER}	15 V
Collector to Emitter	V_{CES}	25 V
Emitter to Base	V_{EBO}	5 V

Temperatures

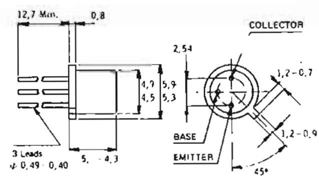
Storage Temperature	T_{STG}	-55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering 10 sec.)	T_L	260°C

Power (2 - 3)

Dissipation at 25°C Case Temperature	P_D	1 W
Dissipation at 25°C Ambient Temperature	P_D	0.36 W

PHYSICAL DIMENSIONS

Similar to Jedec TO-18



Note All dimensions are in mm

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 175°C/W (derating factor of 5.7mW/°C); junction - to - ambient thermal resistance of 480°C/W (derating factor of 2.1mW/°C.)
(4) These ratings refer to a high - current point where collector - to - emitter voltage is lowest. For more information send for SGS - AR 5.
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.

JUNE 1970

NPN diffused silicon planar transistor — BSV 90

High speed saturated switch

The BSV 90 is an NPN silicon planar epitaxial transistor designed specifically for high - speed saturated switching applications.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions		Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)					
	I_C = 1 mA	V_{CE} = 1V		70		
	I_C = 10 mA	V_{CE} = 1V	40	80	120	
	I_C = 30 mA	V_{CE} = 1V	35	75		
	I_C = 100 mA	V_{CE} = 1V	25	55		
$V_{BE\ sat}$	Base Saturation Voltage (5)					
	I_C = 10 mA	I_B = 1 mA	0.70	0.77	0.85	V
	I_C = 30 mA	I_B = 3 mA		0.86	1	V
	I_C = 100 mA	I_B = 10 mA		0.97	1.6	V
$V_{CE\ sat}$	Collector Saturation Voltage (5)					
	I_C = 10 mA	I_B = 1 mA		0.14	0.2	V
	I_C = 30 mA	I_B = 3 mA		0.17	0.25	V
	I_C = 100 mA	I_B = 10 mA		0.3	0.5	V
I_{CES}	Collector Reverse Current					
	V_{CE} = 20V	V_{EB} = 0		5	200	nA
I_{CES} (125°C)	Collector Reverse Current					
	V_{CE} = 20V	V_{EB} = 0		5	70	μA
BV_{CES}	Collector to Emitter Breakdown Voltage					
	I_C = 10 μA	V_{EB} = 0	30			V
BV_{EBO}	Emitter to Base Breakdown Voltage					
	I_E = 10 μA	I_C = 0	5			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)					
	I_C = 10 mA	I_B = 0	13.5			V
h_{fe}	High Freq. Current Gain (f=100 MHz)					
	I_C = 10 mA	V_{CE} = 10V	4	6		
C_{TE}	Emitter Transition Capacitance					
	I_C = 0	V_{EB} = 0.5V		3.7	6	pF
C_{obo}	Base - Collector Capacitance					
	I_E = 0	V_{CB} = 5V		2	4	pF
τ_s	Charge Storage Time Constant					
	$I_C \sim I_{B1} \sim I_{B2} \sim$ 10 mA				13	ns
t_{on}	Turn On Time					
	$I_C \sim$ 10 mA	$I_{B1} \sim$ 3 mA			12	ns
t_{off}	Turn Off Time					
	$I_C \sim$ 10 mA	$I_{B1} \sim$ 3 mA, $I_{B2} \sim$ 1.5 mA			18	ns

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Emitter (4)	V_{CEO}	13.5 V
Collector to Emitter	V_{CES}	30 V
Emitter to Base	V_{EBO}	5 V

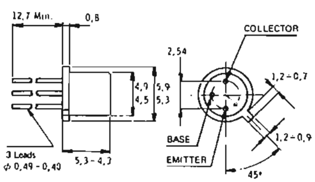
Temperatures

Storage Temperature	T_{STG}	-55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering 10 sec.)	T_L	260°C

Power (2 - 3)

Dissipation at 25°C Case Temperature	P_D	1 W
Dissipation at 25°C Ambient Temperature	P_D	0.36 W

PHYSICAL DIMENSIONS
Similar to Jedec TO-18



Note All dimensions are in mm.

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 175°C/W (derating factor of 5.7 mW/°C); junction-to-ambient resistance of 486°C/W (derating factor of 2.1 mW/°C).
(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.

NPN diffused silicon planar transistor BSV 91

High speed saturated switch

The BSV 91 is an NPN planar epitaxial transistor designed specifically for high - speed saturated switching applications.

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

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 10 mA, V_{CE} = 1V	40	60	270	
	I_C = 50 mA, V_{CE} = 1V		55		
	I_C = 100 mA, V_{CE} = 1V	25	45		
	I_C = 30 mA, V_{CE} = 1V	35	55		
$V_{BE\ sat}$	Base Saturation Voltage (5)				
	I_C = 10 mA, I_B = 1 mA		0.77	0.85	V
	I_C = 100 mA, I_B = 10 mA		0.97	1.6	V
$V_{CE\ sat}$	Collector Saturation Voltage (5)				
	I_C = 10 mA, I_B = 1 mA		0.15	0.25	V
	I_C = 100 mA, I_B = 10 mA		0.35	1	V
I_{CES}	Collector Reverse Current V_{CE} = 20V, V_{EB} = 0		5	200	nA
I_{CES} (125°C)	Collector Reverse Current V_{CE} = 20V, V_{EB} = 0		2	70	µA
BV_{CES}	Collector to Emitter Breakdown Voltage I_C = 10 µA, V_{EB} = 0	40			V
BV_{EBO}	Emitter to Base Breakdown Voltage I_E = 10 µA, I_C = 0	5			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5) I_C = 10 mA, I_B = 0	15			V
h_{fe}	High Freq. Current Gain (f= 100 MHz) I_C = 10 mA, V_{CE} = 10V	4	6		
C_{TE}	Emitter Transition Capacitance I_C = 0, V_{EB} = 0.5V		4		pF
C_{obo}	Base - Collector Capacitance I_E = 0, V_{CB} = 5V		2	4	pF
τ_s	Charge Storage Time Constant $I_C \sim I_{B1} \sim I_{B2} \sim$ 10 mA			13	ns
t_{on}	Turn On Time $I_C \sim$ 10 mA, $I_{B1} \sim$ 3 mA			12	ns
t_{off}	Turn Off Time $I_C \sim$ 10 mA, $I_{B1} \sim$ 3 mA, $I_{B1} \sim$ 1.5 mA			18	ns

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector Emitter (4)	V_{CEO}	15 V
Collector to Emitter	V_{CES}	40 V
Emitter to Base	V_{EBO}	5 V

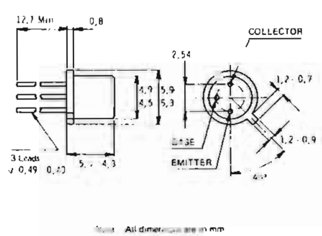
Temperatures

Storage Temperature	T_{STG}	-55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering 10 sec.)	T_L	260°C

Power (2 - 3)

Dissipation at 25°C Case Temperature	P_D	1 W
Dissipation at 25°C Ambient Temperature	P_D	0.36 W

PHYSICAL DIMENSIONS
Similar to Jedec TO-18



All dimensions are in mm

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 175°C/W (derating factor of 5.7 mW/°C); junction - to - ambient thermal resistance of 486°C/W (derating factor of 2.1 mW/°C).
(4) These ratings refer to a high - current point where collector - to - emitter voltage is lowest. For more information send for SGS - AR 5.
(5) Measured under pulse conditions: pulse length = 300 µsec; duty cycle = 1%.

JUNE 1970

NPN diffused silicon planar transistor — BSV 92

High speed saturated switch

The BSV 92 in an NPN planar epitaxial transistor designed specifically for high speed saturated switching applications.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5) I_C = 1 mA V_{CE} = 1V I_C = 10 mA V_{CE} = 0,35V I_C = 10 mA V_{CE} = 1V I_C = 100 mA V_{CE} = 1V	 55 70 25	 85 80 95 60	 120	
h_{FE} (-55°C)	DC Current Gain (5) I_C = 10 mA V_{CE} = 0.35V	 20			
$V_{BE\ sat}$	Base Saturation Voltage (5) I_C = 10 mA I_B = 1 mA I_C = 100 mA I_B = 10 mA	 0.7	 0.77 1	 0.85 1.5	 V V
$V_{CE\ sat}$	Collector Saturation Voltage (5) I_C = 10 mA I_B = 1 mA I_C = 100 mA I_B = 10 mA I_C = 1 mA I_B = 0.1 mA		 0.14 0.30 0.16	 0.20 0.50	 V V V
I_{CES}	Collector Reverse Current V_{CE} = 20V V_{EB} = 0		 5	 200	 nA
I_{CES} (150°C)	Collector Reverse Current V_{CE} = 20V V_{EB} = 0		 5	 70	 μA
BV_{CES}	Collector to Emitter Breakdown Voltage I_C = 10 μA V_{EB} = 0	 40			 V
BV_{EBO}	Emitter to Base Breakdown Voltage I_E = 10 μA I_C = 0	 5			 V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5) I_C = 10 mA I_B = 0	 15			 V
h_{fe}	High Freq. Current Gain (f = 100 MHz) I_C = 10 mA V_{CE} = 10V	 5	 6.5		
C_{TE}	Emitter Transition Capacitance I_C = 0 V_{EB} = 0.5V		 4		 pF
C_{obo}	Base - Collector Capacitance I_E = 0 V_{CB} = 5V		 2	 4	 pF
τ_s	Charge Storage Time Constant $I_C \sim I_{B1} \sim I_{B2} \sim$ 10 mA			 13	 ns
t_{on}	Turn On Time $I_C \sim$ 10 mA $I_{B1} \sim$ 3 mA			 12	 ns
t_{off}	Turn Off Time $I_C \sim$ 10 mA $I_{B1} \sim$ 3 mA, $I_{B2} \sim$ 1.5 mA			 18	 ns
$V_{CE\ sat}$ (125°C)	I_C = 10 mA I_B = 1 mA			0.3	V
$V_{BE\ sat}$ (-55 to 125°C)	I_C = 10 mA I_B = 1 mA	0.55		1.05	V
h_{FE}	I_C = 30 mA V_{CE} = 1V	50	75		

NOTES:
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) Those 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 175°C/W (derating factor of 5.7 mW/°C); junction - to - ambient thermal resistance of 486°C/W (derating factor of 2.1 mW/°C).
(4) These ratings refer to a high - current point where collector - to - emitter voltage is lowest. For more information send for SGS - AR 5.
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Emitter (4)	V_{CEO}	15 V
Collector to Emitter	V_{CES}	40 V
Emitter to Base	V_{EBO}	5 V

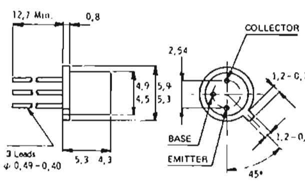
Temperatures

Storage Temperature	T_{STG}	-55°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering 10 sec.)	T_L	260°C

Power (2 - 3)

Dissipation at 25°C Case Temperature	P_D	1 W
Dissipation at 25°C Ambient Temperature	P_D	0.36 W

PHYSICAL DIMENSIONS
Similar to Jedec TO-18



Note: All dimensions are in mm.

JUNE 1970

NPN diffused silicon planar transistor BSV 95

High-voltage, high-current switch

The BSV95 is an NPN silicon planar epitaxial transistor suitable for high voltage, high current switching applications. The $V_{CEO\,(sust)}$ of 50 V, $V_{CE\,(sat)}$ of 0.95V at 1A together with an high speed at high current, make the BSV95 ideal for use in fast high current memory applications.

ABSOLUTE MAXIMUM RATINGS (1)

(T_A = 25°C unless otherwise noted)

Voltages and Current

Collector to Emitter (4)	V_{CEO}	50V
Collector to Emitter	V_{CES}	80V
Emitter to Base	V_{EBO}	6V
DC Collector Current	I_C	1A

Temperatures

Storage Temperature	T_{STG}	- 55° C to 200° C
Operating Junction Temperature	T_J	200° C
Lead Temperature (Soldering, 10 sec.)	T_L	260° C

Power (2-3)

Dissipation at 25° C Case Temperature	P_D	3.5W
Dissipation at 25° C Ambient Temperature	P_D	0.8W

ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted)

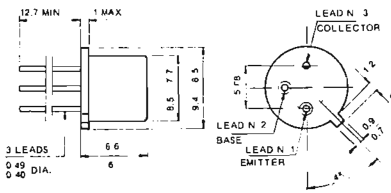
Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 10mA, V_{CE} = 1V	20	[illegible]		
	I_C = 100mA, V_{CE} = 1V	40	80	[illegible]	
	I_C = 300mA, V_{CE} = 1V	30	65		
	I_C = 500mA, V_{CE} = 1V	20	[illegible]		
	I_C = 800mA, V_{CE} = 2[illegible]	15	40		
$V_{BE\,sat}$	Base Saturation Voltage (5)				
	I_C = 300mA, I_B = 30mA		0.[illegible]	1.[illegible]	V
	I_C = 500mA, I_B = 50mA	0.8	1	1.[illegible]	V
	I_C = 1A, I_B = 0.1A		1.[illegible]	1.[illegible]	V
$V_{CE\,sat}$	Collector Saturation Voltage (5)				
	I_C = 300mA, I_B = 30mA		0.25	0.40	V
	I_C = [illegible]mA, I_B = [illegible]mA		0.35	[illegible]	V
	I_C = 1A, I_B = 0.1A		0.65	0.95	V
I_{CBO}	Collector Reverse Current				
	V_{CB} = 60V, I_E = 0		0.1	[illegible]	nA
	V_{CB} = 60V, I_E = 0, 100°C		20	[illegible]	μA
BV_{CES}	Collector to Emitter Breakdown Voltage				
	I_C = 10 μA, V_{BB} = 0	80			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E = [illegible] μA, I_C = 0	6			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 10mA, I_B = 0	50			V
h_{fe}	High Freq. Current Gain				
	I_C = 50mA, V_{CE} = 10[illegible], f = 100MHz	2.5	[illegible]		
C_{TE}	Emitter Transition Capacitance				
	I_C=0, V_{EB} = 0.5V		40	55	pF
C_{obo}	Base-Collector Capacitance				
	I_E=0, V_{CB} = 10 V		4.8	10	pF
t_{on}	Turn On Time				
	I_C = 500mA, I_{B1} = 50mA		15	35	ns
t_{off}	Turn Off Time				
	I_C = 500mA, I_{B1} = 50mA, I_{B2} = 50mA		40	60	ns

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/W (derating factor of 20mW/°C); junction-to-ambient thermal resistance of 219°C/W (derating factor of 4.56mW/°C).
(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-ARS.
(5) Measured under pulse conditions: pulse length = 300 μsec; duty cycle = 1%

PHYSICAL DIMENSIONS

in accordance with JEDEC TO-39 outline



NOTES All dimensions in mm.
Collector internally connected to case

OCTOBER 1970

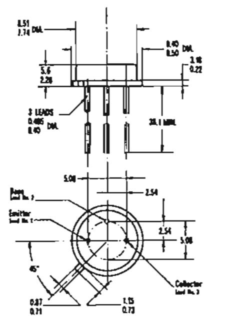
BSX 12

HIGH-SPEED, HIGH-CURRENT SWITCH

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BSX 12 is a silicon PLANAR epitaxial transistor with very high speed switching capability at high currents. A maximum V_{CE} (sat) of 0.7 V at one ampere and minimum f_T of 450 Mc/s qualify it especially for use as a thin film memory driver.

PHYSICAL DIMENSIONS



Notes: All dimensions in mm.
Lead 3 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 Dissipations

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	3.0 Watts
at 25°C Ambient Temperature (Notes 2 and 3)	0.6 Watt

Maximum Voltages and Current

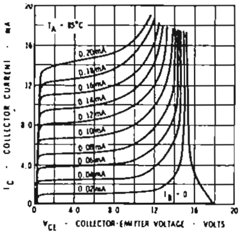
V_{CBO}	Collector to Base Voltage	25 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	12 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Collector Current	1.0 Amp

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

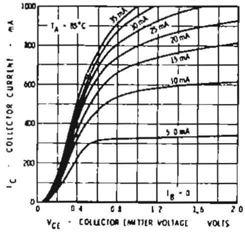
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	20	45			I_C = 10 mA	V_{CE} = 0.5 V
h_{FE}	DC Pulse Current Gain (Note 5)	30				I_C = 100 mA	V_{CE} = 0.5 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	60	120		I_C = 300 mA	V_{CE} = 0.5 V
V_{BE} (sat)	Base Saturation Voltage		0.68	0.78	V	I_C = 10 mA	I_B = 1.0 mA
V_{BE} (sat)	Base Saturation Voltage (Note 5)		0.84	1.1	V	I_C = 100 mA	I_B = 10 mA
V_{BE} (sat)	Base Saturation Voltage (Note 5)		1.0	1.3	V	I_C = 300 mA	I_B = 30 mA
V_{BE} (sat)	Base Saturation Voltage (Note 5)	0.9	1.36	2.1	V	I_C = 1000 mA	I_B = 100 mA
V_{CE} (sat)	Collector Saturation Voltage		0.17	0.25	V	I_C = 10 mA	I_B = 1.0 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.18	0.23	V	I_C = 100 mA	I_B = 10 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.24	0.33	V	I_C = 300 mA	I_B = 30 mA
V_{CE} (sat)	Collector Saturation Voltage (Notes 5 & 7)		0.51	0.7	V	I_C = 1000 mA	I_B = 100 mA
V_{CE} (sat)(85°C)	Collector Saturation Voltage (Note 5)		0.25	0.5	V	I_C = 300 mA	I_B = 30 mA
I_{CES}	Collector Reverse Current		1.5	100	µA	V_{CE} = 15 V	V_{EB} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	25			V	I_C = 500 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			V	I_E = 100 µA	I_C = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	12			V	I_C = 30 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f=100 Mc/s)	4.5	6.5			I_C = 100 mA	V_{CE} = 5.0 V
h_{fe}	High Frequency Current Gain (f=100 Mc/s)	2.0				I_C = 500 mA	V_{CB} = 0
C_{ob}	Output Capacitance			25	pF	V_{CB} = 0	I_E = 0
C_{ob}	Output Capacitance		6.2	15	pF	I_E = 0	V_{CB} = 5.0 V
C_{TE}	Emitter Transition Capacitance		14.8	25	pF	I_C = 0	V_{EB} = 0.5 V
τ_s	Charge Storage Time (Note 6)		13	15	nsec	I_C = 100 mA, I_{B1} = 100mA,	I_{B2} = -100mA
t_{on}	Turn On Time (Note 6)		10	15	nsec	I_C = 1000 mA	I_{B1} = 100mA
t_{off}	Turn Off Time (Note 6)		15	25	nsec	I_C = 1000 mA, I_{B1} = 100mA,	I_{B2} = -100mA

TYPICAL ELECTRICAL CHARACTERISTICS

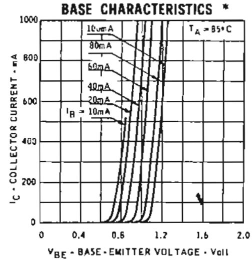
COLLECTOR CHARACTERISTICS *



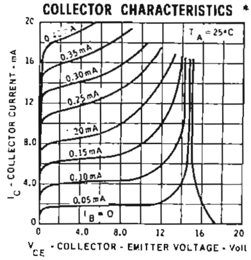
COLLECTOR CHARACTERISTICS *



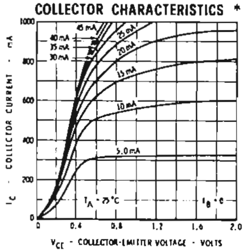
BASE CHARACTERISTICS *



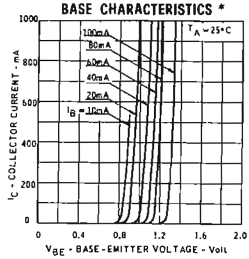
COLLECTOR CHARACTERISTICS *



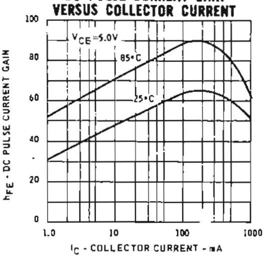
COLLECTOR CHARACTERISTICS *



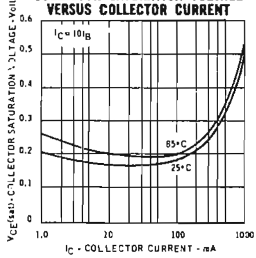
BASE CHARACTERISTICS *



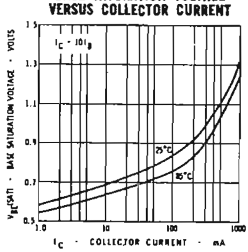
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

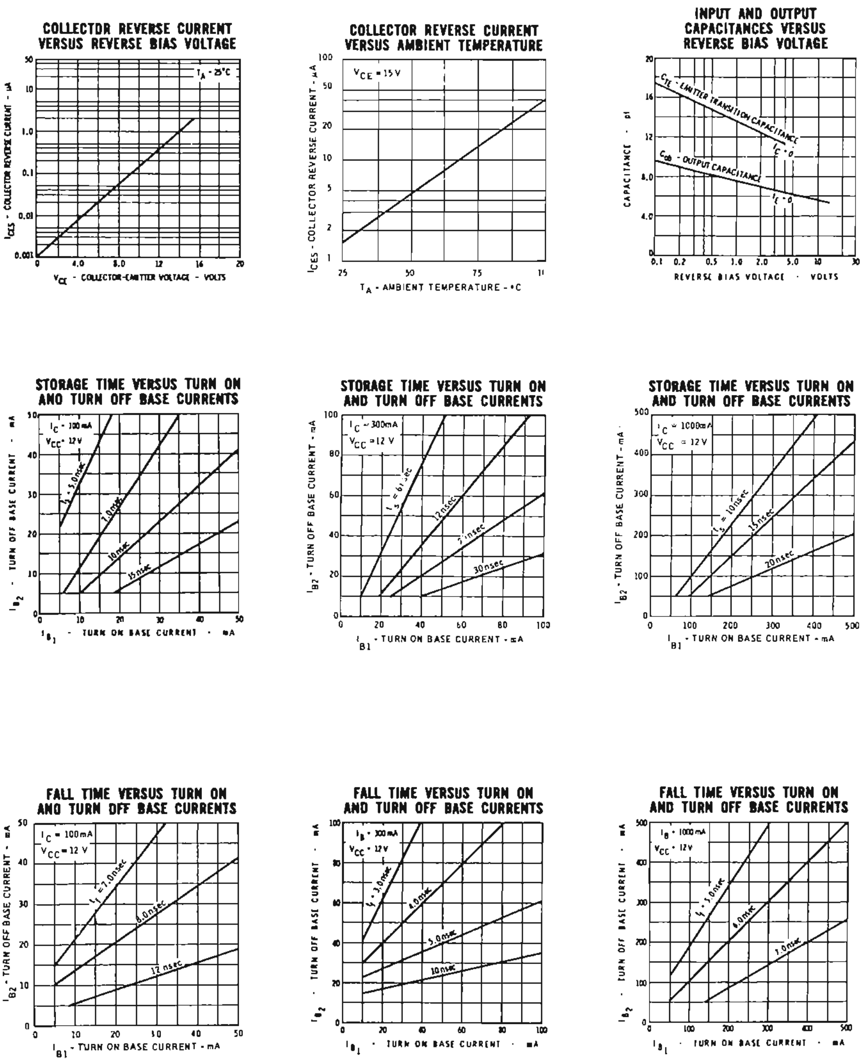


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



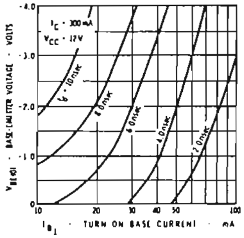
* Single family characteristics on Transistor Curve Tracer

TYPICAL ELECTRICAL CHARACTERISTICS

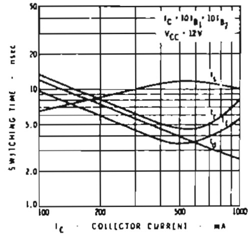


TYPICAL ELECTRICAL CHARACTERISTICS

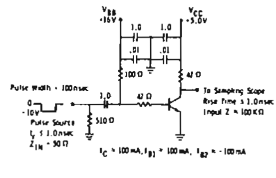
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



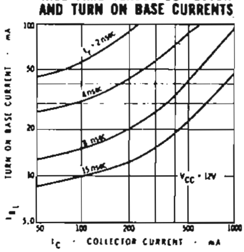
SWITCHING TIMES VERSUS COLLECTOR CURRENT



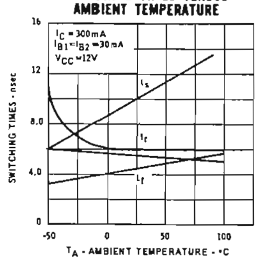
CHARGE STORAGE TIME TEST CIRCUIT



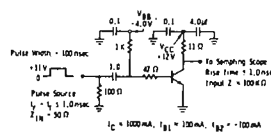
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



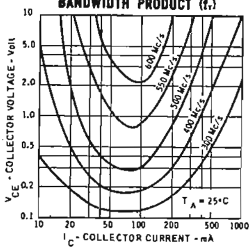
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



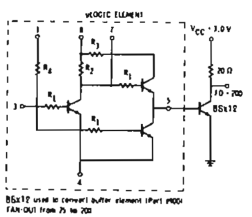
TURN ON AND TURN OFF TEST CIRCUIT



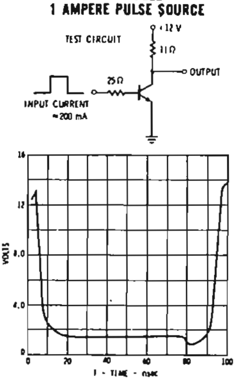
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



IMPROVING FAN-OUT CAPABILITY



HIGH SPEED 1 AMPERE PULSE SOURCE



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 291.6°C/Watt (derating factor of 3.43 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(5) Pulse Conditions: length ≈ 300 μsec; duty cycle ≈ 1%.

(6) See switching circuit for exact values of I_C, I_{B1}, I_{B2}.

(7) This limit applies for a measurement made 6.35 m m from the bottom of the case.

AUGUST 1965

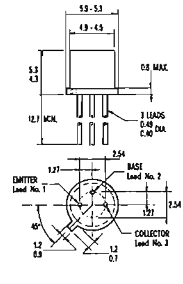
BSX 26

HIGH-SPEED SATURATED SWITCH

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BSX 26 is an NPN silicon PLANAR epitaxial transistor designed for memory applications up to 500 milliamperes. It features the unique combination of 350 Mc/s f_T minimum with a guaranteed 300 milliampere collector saturation voltage of 0.5 volt.

PHYSICAL DIMENSIONS in accordance with JEDEC TO-18 outline



Notes: All dimensions in mm. Collector internally connected to case. Leads are gold-plated Kovar.

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)	1.2 Watts
at 100°C Case Temperature (Notes 2 and 3)	0.68 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.36 Watt

Maximum Voltages

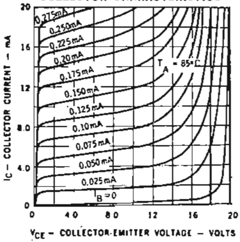
V_{CBO}	Collector to Base Voltage	40 Volts
V_{CES}	Collector to Emitter Voltage	40 Volts
V_{CEO}	Collector to Emitter Voltage	15 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts

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

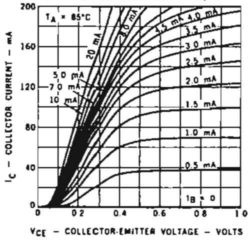
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 4)	30	60	120		I_C = 30 mA	V_{CE} = 0.4 V
h_{FE}	DC Pulse Current Gain (Note 4)	25	55			I_C = 100 mA	V_{CE} = 0.5 V
h_{FE}	DC Pulse Current Gain (Note 4)	15				I_C = 300 mA	V_{CE} = 1.0 V
V_{BE} (sat)	Base Saturation Voltage	0.75	0.82	0.95	V	I_C = 30 mA	I_B = 3.0 mA
V_{BE} (sat)	Base Saturation Voltage		0.97	1.2	V	I_C = 100 mA	I_B = 10 mA
V_{BE} (sat)	Base Saturation Voltage		1.3	1.7	V	I_C = 300 mA	I_B = 30 mA
V_{CE} (sat)	Collector Saturation Voltage		0.16	0.18	V	I_C = 30 mA	I_B = 3.0 mA
V_{CE} (sat)	Collector Saturation Voltage		0.18	0.28	V	I_C = 100 mA	I_B = 10 mA
V_{CE} (sat)	Collector Saturation Voltage		0.39	0.5	V	I_C = 300 mA	I_B = 30 mA
V_{CE} (sat)	Collector Saturation Voltage (+85°C)		0.18	0.3	V	I_C = 30 mA	I_B = 3.0 mA
I_{CES}	Collector Reverse Current		0.04	0.5	μA	V_{CE} = 20 V	V_{BE} = 0
I_{CES} (85°C)	Collector Reverse Current		0.5	15	μA	V_{CE} = 20 V	V_{BE} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	40			V	I_C = 100 μA	I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	40			V	I_C = 100 μA	V_{EB} = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			V	I_E = 100 μA	I_C = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	15			V	I_C = 10 mA (pulsed)	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	3.5	5.5			I_C = 30 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance		3.3	5.0	pF	I_E = 0	V_{CB} = 5.0 V
C_{TE}	Emitter Transition Capacitance		6.5	8.0	pF	I_C = 0	V_{EB} = 0.5 V
τ_s	Charge Storage Time Constant (Note 6)		8.0	18	nsec	I_C = I_{B1}=10 mA	I_{B2} = -10 mA
t_{on}	Turn On Time (Note 6)		9.0	15	nsec	I_C = 300 mA	I_{B1} = 30 mA
t_{off}	Turn Off Time (Note 6)		15	25	nsec	I_C = 300 mA	I_{B1} = 30 mA I_{B2} = -30 mA

TYPICAL ELECTRICAL CHARACTERISTICS

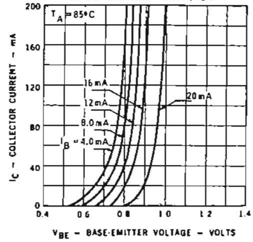
COLLECTOR CHARACTERISTICS*



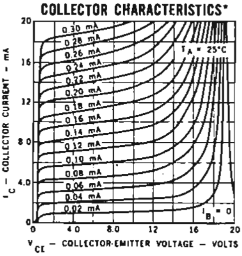
COLLECTOR CHARACTERISTICS*



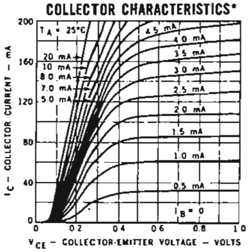
BASE CHARACTERISTICS*



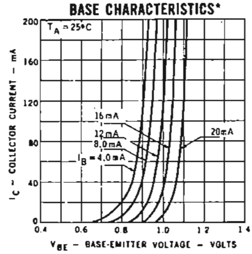
COLLECTOR CHARACTERISTICS*



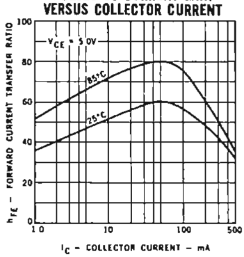
COLLECTOR CHARACTERISTICS*



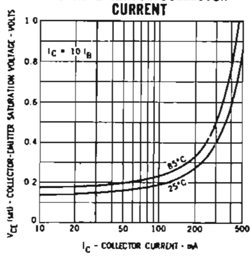
BASE CHARACTERISTICS*



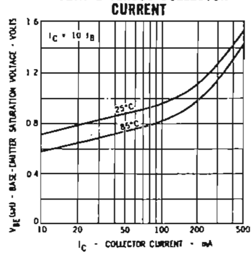
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



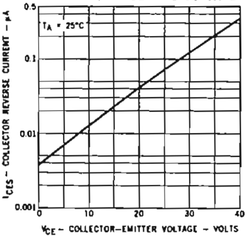
BASE-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



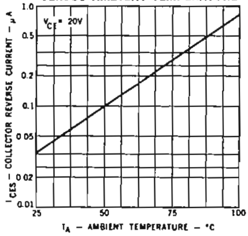
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

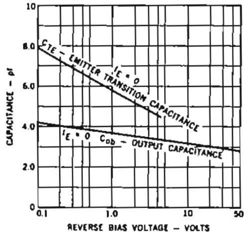
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



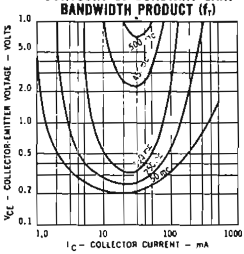
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



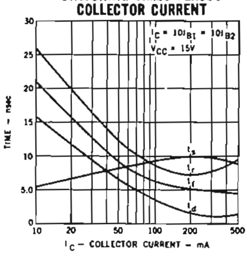
EMITTER TRANSITION AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



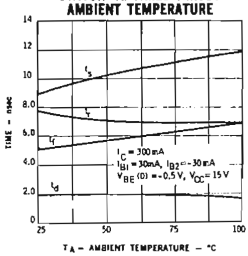
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



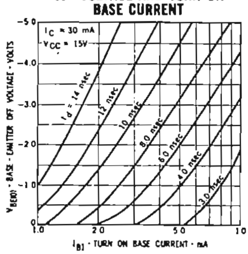
SWITCHING TIMES VERSUS COLLECTOR CURRENT



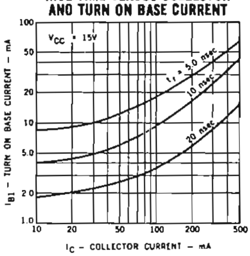
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



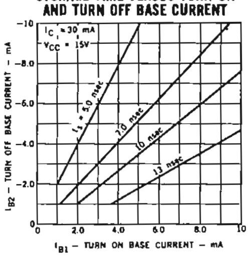
DELAY TIME VERSUS BASE-EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT



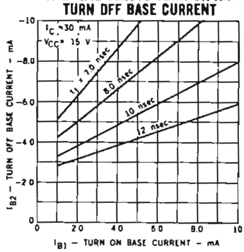
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



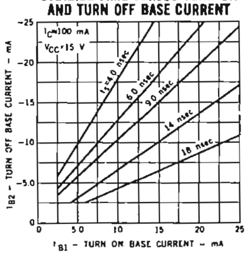
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



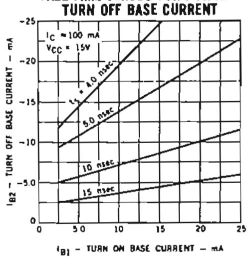
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



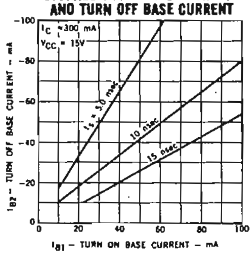
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



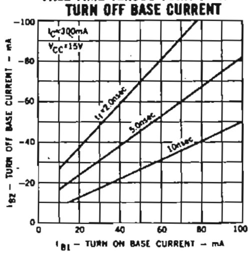
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



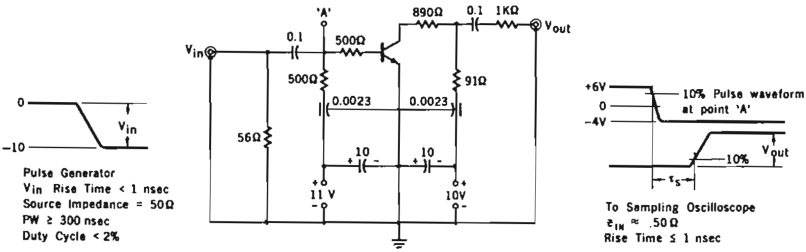
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



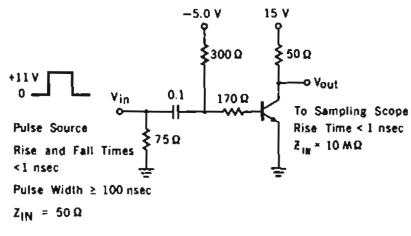
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



CHARGE STORAGE TIME MEASUREMENT CIRCUIT



t_{on}-t_{off} MEASUREMENT CIRCUIT



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) Pulse Conditions: length = 300μsec; duty cycle = 1%.

(5) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS Publication AR 5.

(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

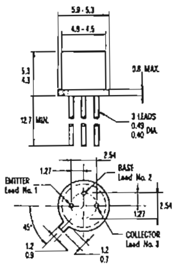
BSX 27

HIGH-SPEED SATURATED SWITCH

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BSX 27 is an NPN silicon PLANAR epitaxial transistor designed specifically for high-speed saturated switching applications in the 50 - 100 Mc/s range at power levels from 100 microwatts to 300 milliwatts. This device is suitable for most small-signal, RF, and digital type circuits.

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-18 outline



Notes: All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar.

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 Ambient Temperature (Notes 2 and 3)	0.3 Watt

Maximum Voltages

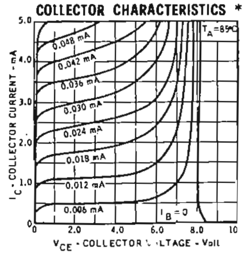
V_{CBO}	Collector to Base Voltage	15 Volts
V_{CES}	Collector to Emitter Voltage	11 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	6.0 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts

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

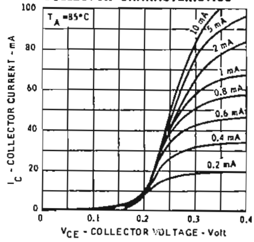
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	15				I_C = 1.0 mA	V_{CE} = 0.4 V
h_{FE}	DC Pulse Current Gain (Note 5)	25	80	125		I_C = 10 mA	V_{CE} = 0.4 V
h_{FE}	DC Pulse Current Gain (Note 5)	15	60			I_C = 30 mA	V_{CE} = 0.4 V
V_{BE} (sat)	Base Saturation Voltage	0.68	0.74	0.85	V	I_C = 1.0 mA	I_B = 0.1 mA
V_{BE} (sat)	Base Saturation Voltage	0.75	0.84	0.95	V	I_C = 10 mA	I_B = 1.0 mA
V_{BE} (sat)	Base Saturation Voltage		0.93	1.3	V	I_C = 30 mA	I_B = 3.0 mA
V_{CE} (sat)	Collector Saturation Voltage		0.18	0.25	V	I_C = 1.0 mA	I_B = 0.1 mA
V_{CE} (sat)	Collector Saturation Voltage		0.19	0.25	V	I_C = 10 mA	I_B = 1.0 mA
V_{CE} (sat)	Collector Saturation Voltage		0.23	0.38	V	I_C = 30 mA	I_B = 3.0 mA
V_{CE} (sat) (85°C)	Collector Saturation Voltage		0.2	0.4	V	I_C = 10 mA	I_B = 1.0 mA
I_{CES}	Collector Reverse Current		4.0	100	nA	V_{CE} = 5.0 V	V_{EB} = 0
I_{CES}	Collector Reverse Current		0.013	10	μA	V_{CE} = 11 V	V_{BE} = 0
I_{CES} (85°C)	Collector Reverse Current		0.2	5.0	μA	V_{CE} = 5.0 V	V_{BE} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	15			V	I_C = 10 μA	I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	11			V	I_C = 10 μA	V_{EB} = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			V	I_E = 10 μA	I_C = 0
V_{CEO} (sust)	Collector to Emitter Sustainig Voltage (Notes 4 and 5)	6.0			V	I_C = 10 mA (pulsed)	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	6.0	8.0			I_C = 10 mA	V_{CE} = 4.0 V
C_{ob}	Output Capacitance		2.3	3.0	pF	I_E = 0	V_{CB} = 5.0 V
C_{TE}	Emitter Transition Capacitance		1.7	2.0	pF	I_C = 0	V_{EB} = 0.5 V
τ_s	Charge Storage Time Constant (Note 6)		3.0	6.0	nsec	$I_C = I_{B1}$ = 5.0 mA, I_{B2} = -5.0 mA	
t_{on}	Turn On Time (Note 6)			12	nsec	I_C = 10 mA	I_{B1} = 2.0 mA
t_{off}	Turn Off Time (Note 6)			12	nsec	I_C = 10 mA, I_{B1}=1.0 mA, I_{B2}=-1.0 mA	

TYPICAL ELECTRICAL CHARACTERISTICS

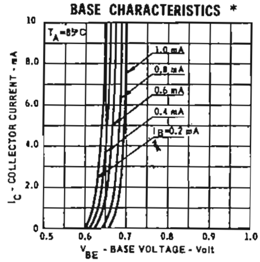
COLLECTOR CHARACTERISTICS *



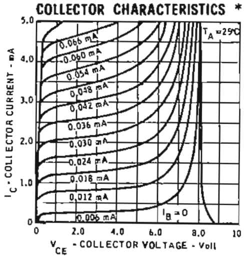
COLLECTOR CHARACTERISTICS *



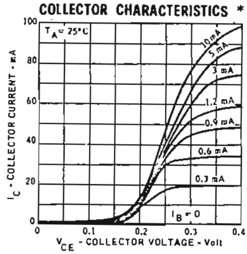
BASE CHARACTERISTICS *



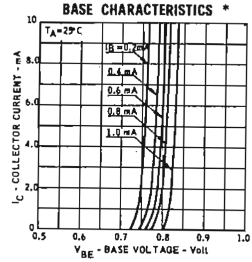
COLLECTOR CHARACTERISTICS *



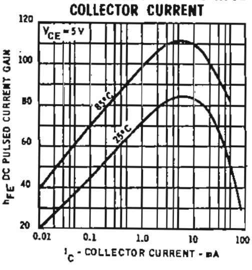
COLLECTOR CHARACTERISTICS *



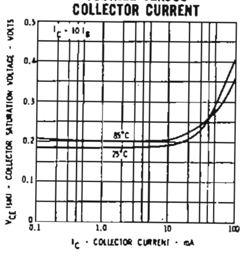
BASE CHARACTERISTICS *



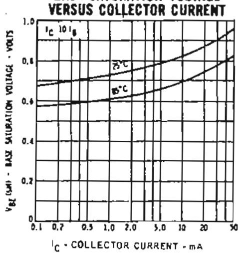
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



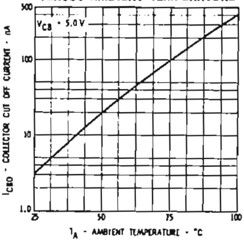
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



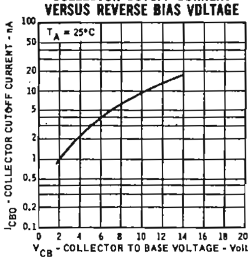
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

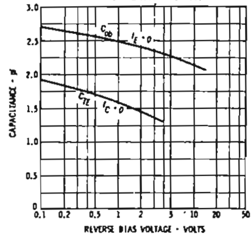
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



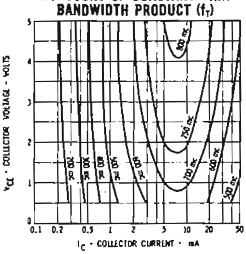
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



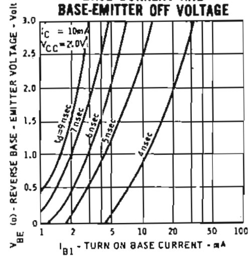
EMITTER TRANSISTION AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



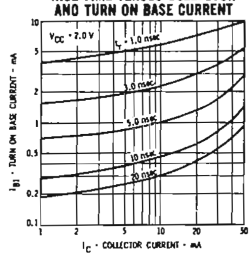
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



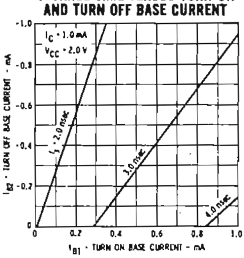
DELAY TIME VERSUS TURN ON BASE CURRENT AND BASE-EMITTER OFF VOLTAGE



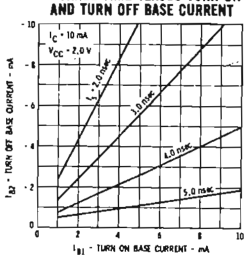
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



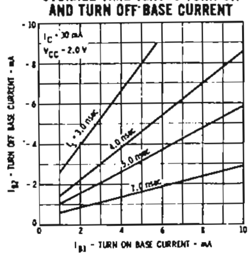
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



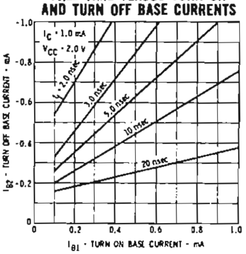
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



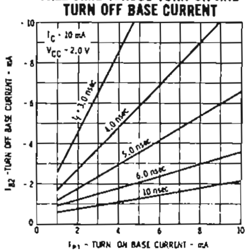
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



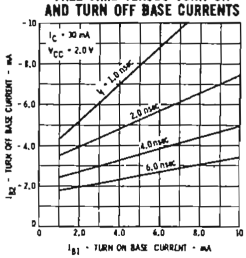
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

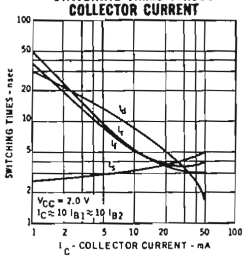


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

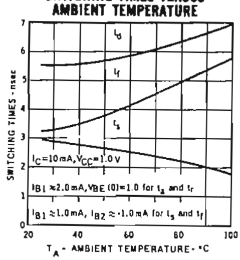


TYPICAL ELECTRICAL CHARACTERISTICS

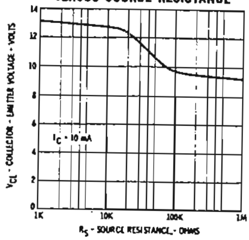
SWITCHING TIMES VERSUS COLLECTOR CURRENT



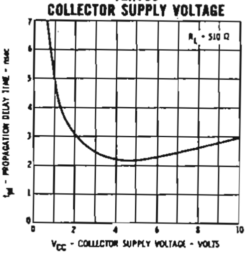
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



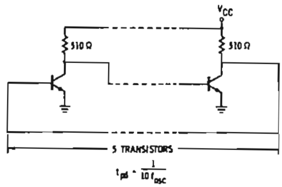
LOWER LIMITING VOLTAGE VERSUS SOURCE RESISTANCE



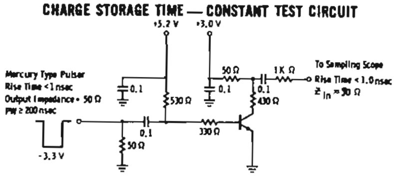
PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE



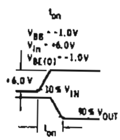
FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY

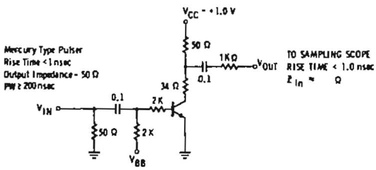


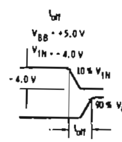
CHARGE STORAGE TIME — CONSTANT TEST CIRCUIT



t_{ON} AND t_{OFF} TEST CIRCUIT







NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) This is a steady state limit. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) This rating gives a maximum junction temperature of 200°C and junction-to-ambient thermal resistance of 583°C/watt (derating factor of 1.71 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS Publication AR 5.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

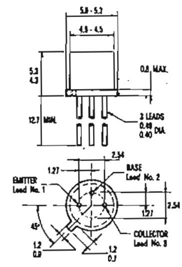
BSX 28

HIGH-SPEED SATURATED SWITCH

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BSX 28 is an NPN silicon PLANAR epitaxial transistor designed specifically for high-speed saturated switching applications in the 50 - 100 Mc/s range at current levels from 100 microamperes to 100 milliamperes. It is suitable for most small-signal, RF, and digital type circuits.

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-18 outline



Notes: All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

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

Maximum Power Dissipations

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.2 Watts
at 100°C Case Temperature (Notes 2 and 3)	0.68 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.36 Watt

Maximum Voltages

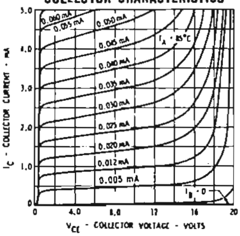
V_{CBO}	Collector to Base Voltage	30 Volts
V_{CES}	Collector to Emitter Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	12 Volts
V_{EBO}	Emitter to Base Voltage	4.5 Volts

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

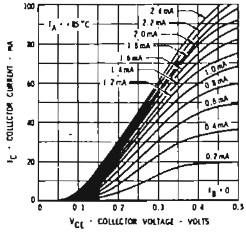
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	30	70	120		I_C = 10 mA	V_{CE} = 0.35 V
h_{FE}	DC Pulse Current Gain (Note 5)	25	70			I_C = 30 mA	V_{CE} = 0.4 V
h_{FE}	DC Pulse Current Gain (Note 5)	12	50			I_C = 100 mA	V_{CE} = 1.0 V
V_{BE} (sat)	Base Saturation Voltage	0.72	0.8	0.87	V	I_C = 10 mA	I_B = 1.0 mA
V_{BE} (sat)	Base Saturation Voltage		0.9	1.15	V	I_C = 30 mA	I_B = 3.0 mA
V_{BE} (sat)	Base Saturation Voltage		1.1	1.6	V	I_C = 100 mA	I_B = 10 mA
V_{CE} (sat)	Collector Saturation Voltage		0.15	0.2	V	I_C = 10 mA	I_B = 1.0 mA
V_{CE} (sat)	Collector Saturation Voltage		0.18	0.25	V	I_C = 30 mA	I_B = 3.0 mA
V_{CE} (sat)	Collector Saturation Voltage		0.3	0.5	V	I_C = 100 mA	I_B = 10 mA
V_{CE} (sat) (85°C)	Collector Saturation Voltage		0.17	0.3	V	I_C = 10 mA	I_B = 1.0 mA
I_{CES}	Collector Reverse Current		0.05	0.4	µA	V_{CE} = 20 V	V_{BE} = 0
I_{CES} (85°C)	Collector Reverse Current		1.0	10	µA	V_{CE} = 20 V	V_{BE} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	30			V	I_C = 10 µA	I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	30			V	I_C = 10 µA	V_{EB} = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.5			V	I_E = 100 µA	I_C = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Note 5)	12			V	I_C = 10 mA (pulsed)	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	4.0	6.5			I_C = 20 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance		2.3	4.0	pF	I_E = 0	V_{CB} = 5.0 V
τ_s	Charge Storage Time Constant (Note 6)		6.5	13	nsec	$I_C = I_{B1}$ = 10 mA, I_{B2} = - 10 mA	
t_{on}	Turn On Time (Note 6)		9.0	15	nsec	I_C = 30 mA	I_{B1} = 3.0 mA
t_{off}	Turn Off Time (Note 6)		13	20	nsec	I_C = 30 mA, I_{B1} = 3.0 mA, I_{B2} = -3.0 mA	

TYPICAL ELECTRICAL CHARACTERISTICS

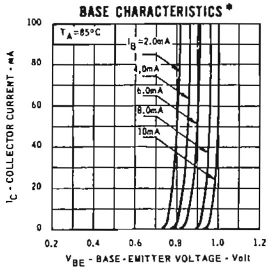
COLLECTOR CHARACTERISTICS*



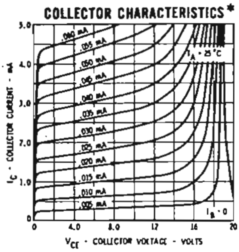
COLLECTOR CHARACTERISTICS*



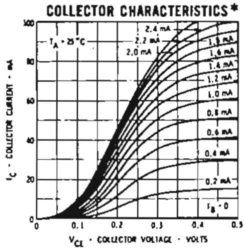
BASE CHARACTERISTICS*



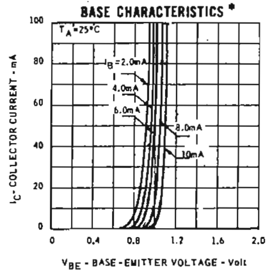
COLLECTOR CHARACTERISTICS*



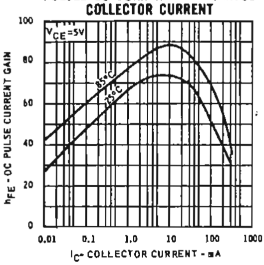
COLLECTOR CHARACTERISTICS*



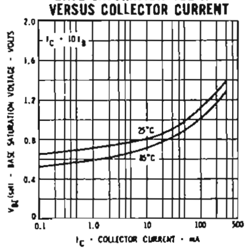
BASE CHARACTERISTICS*



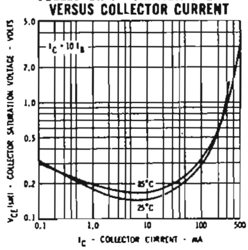
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



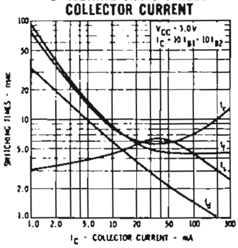
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



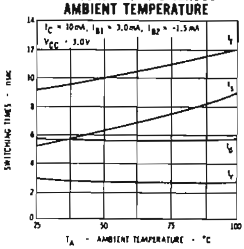
*Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

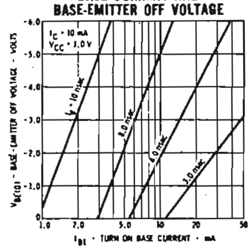
SWITCHING TIMES VERSUS COLLECTOR CURRENT



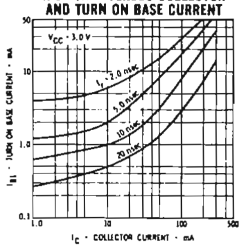
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



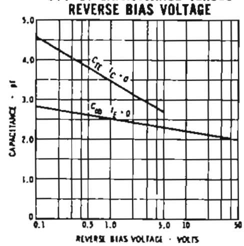
DELAY TIME VERSUS TURN ON BASE CURRENT AND BASE-EMITTER OFF VOLTAGE



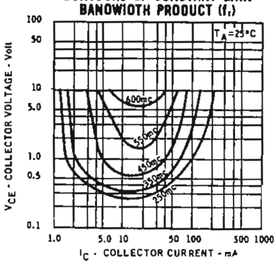
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



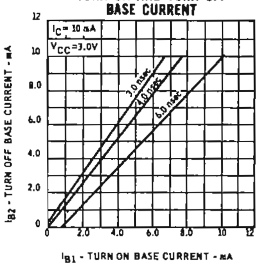
EMITTER TRANSITION AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



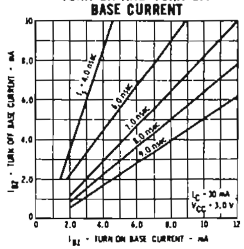
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



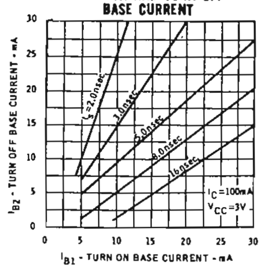
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



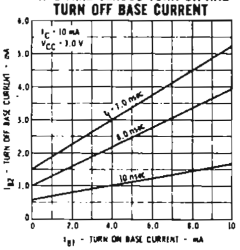
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



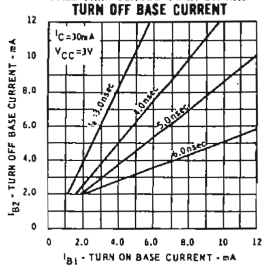
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



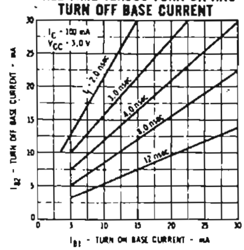
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

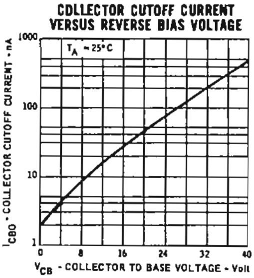


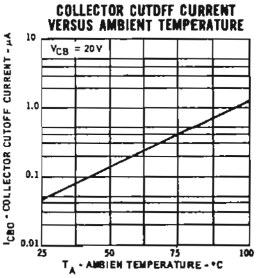
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

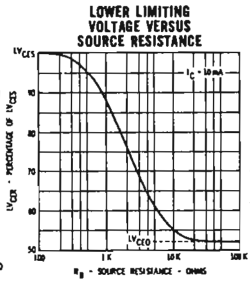


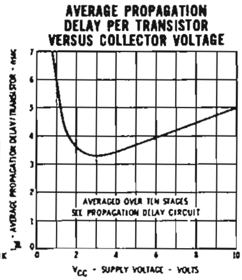
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



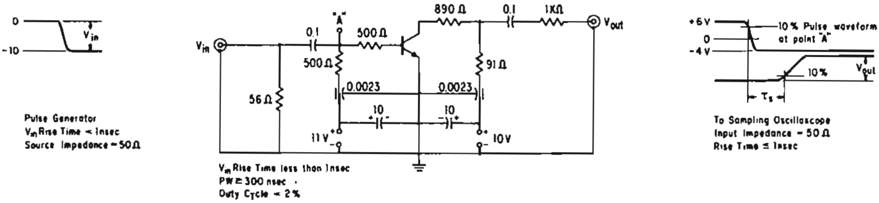




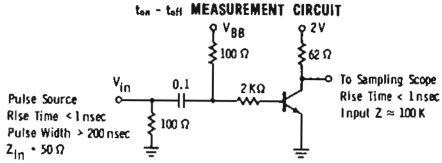




CHARGE STORAGE TIME — CONSTANT TEST CIRCUIT



t_{on} - t_{off} MEASUREMENT CIRCUIT



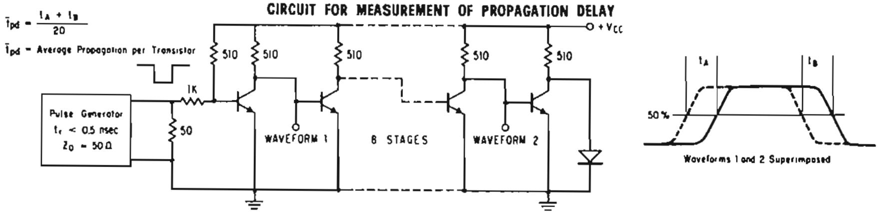
T_{on}: V_{CC} = 2V
V_{BB} Grounded
V_{in} = 7V

T_{off}: V_{CC} = 2V
V_{BB} = 7V
V_{in} = -13V

CIRCUIT FOR MEASUREMENT OF PROPAGATION DELAY

$$\bar{t}_{pd} = \frac{t_A + t_B}{20}$$

$\bar{t}_{pd}$ = Average Propagation per Transistor



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) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS Publication AR 5.

(5) Pulse Conditions: length = 300 µsec; duty cycle = 1%.

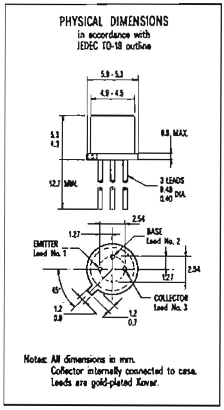
(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

BSX 29

HIGH-SPEED SWITCH AND RF AMPLIFIER

PNP DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BSX 29 is a 700 Mc/s PNP silicon PLANAR epitaxial transistor designed for saturated and nonsaturated switching circuits requiring up to 200 milliamperes of collector current. It is suitable for 20 Mc/s amplifiers, 10.7 Mc/s IF amplifiers, and 100 Mc/s oscillator converter circuits.



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 Dissipations

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

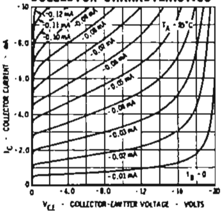
V_{CBO}	Collector to Base Voltage	-12 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-12 Volts
V_{CES}	Collector to Emitter Voltage	-12 Volts
V_{EBO}	Emitter to Base Voltage	-4.0 Volts

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

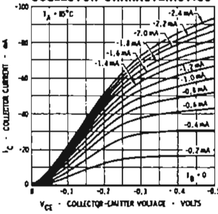
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	25	50			I_C = 10 mA	V_{CE} = - 0.3 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	60	120		I_C = 30 mA	V_{CE} = - 0.5 V
h_{FE}	DC Pulse Current Gain (Note 5)	20	40			I_C = 100 mA	V_{CE} = - 1.0 V
V_{BE} (sat)	Base Saturation Voltage	-0.78	-0.96	-0.98	V	I_C = 10 mA	I_B = 1.0 mA
V_{BE} (sat)	Base Saturation Voltage	-0.85	-1.12	-1.2	V	I_C = 30 mA	I_B = 3.0 mA
V_{BE} (sat)	Base Saturation Voltage		-1.4	-1.7	V	I_C = 100 mA	I_B = 10 mA
V_{CE} (sat)	Collector Saturation Voltage		-0.07	-0.15	V	I_C = 10 mA	I_B = 1.0 mA
V_{CE} (sat)	Collector Saturation Voltage		-0.1	-0.2	V	I_C = 30 mA	I_B = 3.0 mA
V_{CE} (sat)	Collector Saturation Voltage		-0.25	-0.5	V	I_C = 100 mA	I_B = 10 mA
V_{CE} (sat)(85°C)	Collector Saturation Voltage		-0.15	-0.4	V	I_C = 30 mA	I_B = 3.0 mA
I_{CES}	Collector Reverse Current		0.05	80	nA	V_{CE} = -6.0 V	V_{BE} = 0
I_{CES} (85°C)	Collector Reverse Current		0.003	5.0	μA	V_{CE} = -6.0 V	V_{BE} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	-12			V	I_C = 10 μA	I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	-12			V	I_C = 10 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0			V	I_E = 100 μA	I_C = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-12			V	I_C = 10 mA (pulsed)	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	4.0	7.0			I_C = 30 mA	V_{CE} = - 10 V
C_{ob}	Output Capacitance		3.3	6.0	pF	I_E = 0	V_{CB} = - 5.0 V
C_{TE}	Emitter Transition Capacitance		3.8	6.0	pF	I_C = 0	V_{EB} = - 0.5 V
t_{on}	Turn On Time (Note 6)		25	60	nsec	I_C = 30 mA	I_{B1} = 1.5 mA
t_{off}	Turn Off Time (Note 6)		35	90	nsec	I_C = 30mA, I_{B1} = 1.5mA, I_{B2} = -1.5mA	

TYPICAL ELECTRICAL CHARACTERISTICS

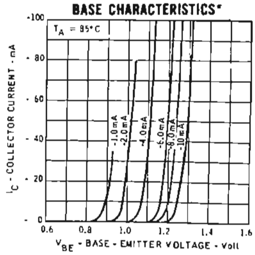
COLLECTOR CHARACTERISTICS*



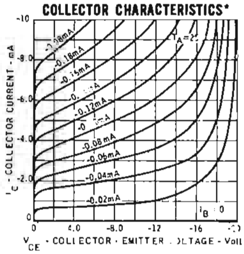
COLLECTOR CHARACTERISTICS*



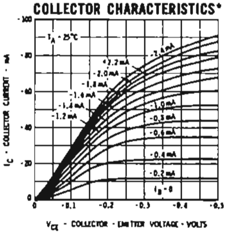
BASE CHARACTERISTICS*



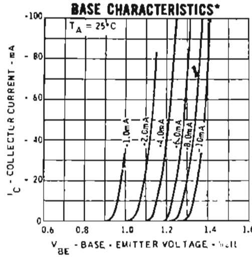
COLLECTOR CHARACTERISTICS*



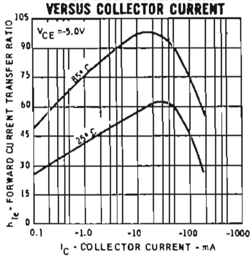
COLLECTOR CHARACTERISTICS*



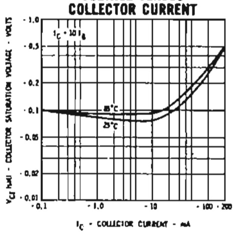
BASE CHARACTERISTICS*



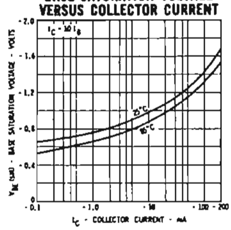
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



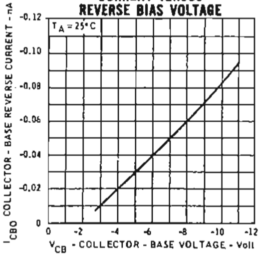
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



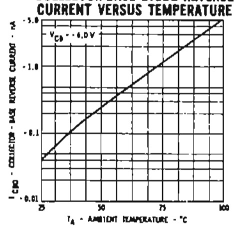
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



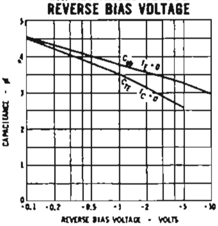
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



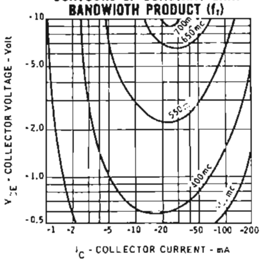
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



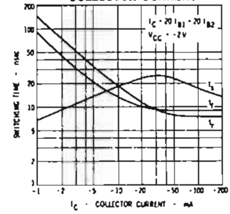
*Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

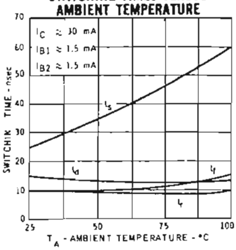
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



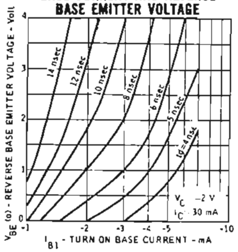
SWITCHING TIMES VERSUS COLLECTOR CURRENT



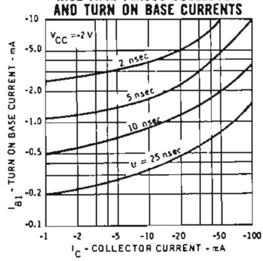
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



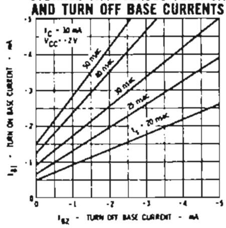
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



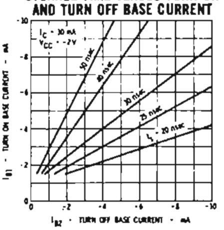
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



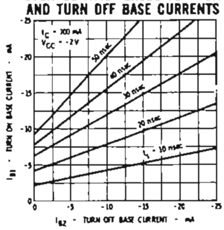
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



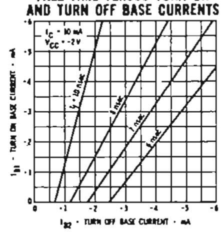
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



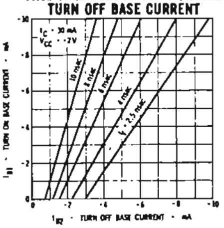
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



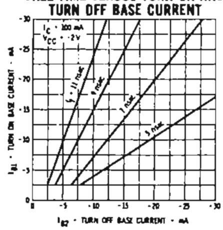
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



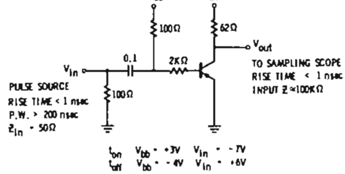
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

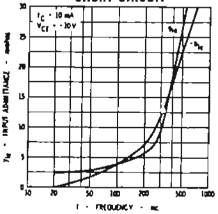


SWITCHING TIME TEST CIRCUIT

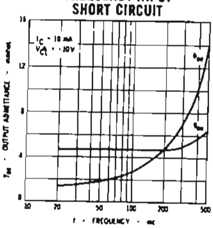


TYPICAL ELECTRICAL CHARACTERISTICS

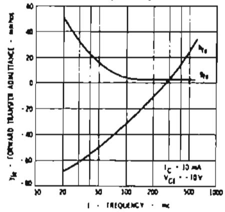
INPUT ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



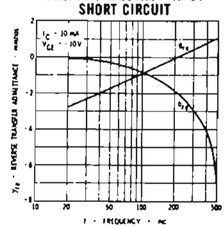
OUTPUT ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



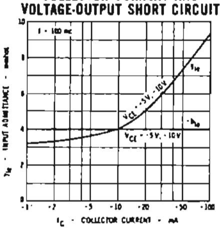
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



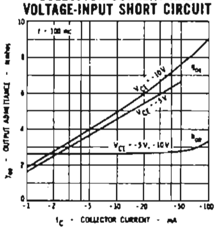
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



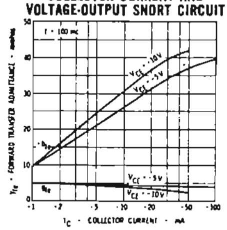
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT



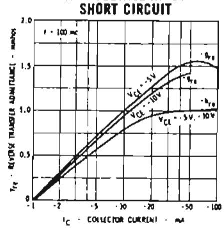
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT



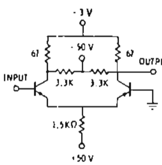
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT



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

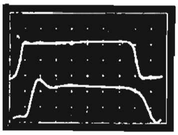


NON SATURATED SWITCHING PERFORMANCE



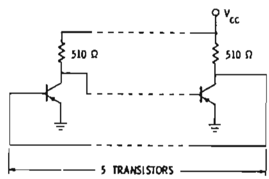
INPUT

OUTPUT



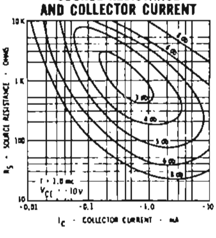
Scale • 2nsec / cm.

FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY

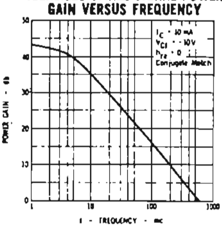


$t_{pd} = \frac{1}{10 f_{osc}}$

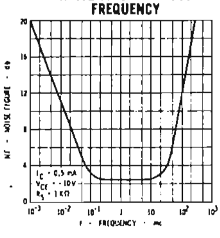
NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT



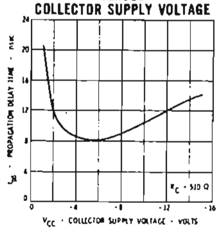
IDEALIZED SMALL SIGNAL POWER GAIN VERSUS FREQUENCY



NOISE FIGURE VERSUS FREQUENCY



PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE



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) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS Publication AR 5.

(5) Pulse Conditions: length = 300 µsec; duty cycle = 1%.

(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

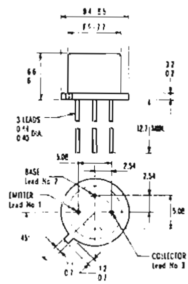
BSX 30

HIGH-SPEED SATURATED SWITCH

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BSX 30 is an NPN double-diffused silicon PLANAR epitaxial transistor designed primarily for high-speed commercial switching applications at collector currents up to 500 milliamperes and collector voltages up 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 TO39 outline



Notes: All dimensions in mm
Collector internally connected to case
Leads are gold-plated Kovar

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 Dissipations

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

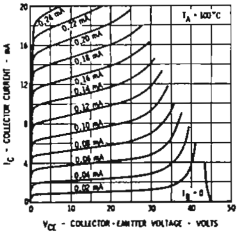
V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts

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

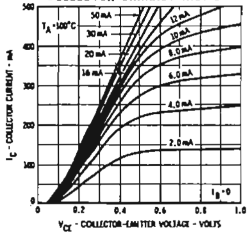
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	30	63	120		I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	10	50			I_C = 300 mA	V_{CE} = 0.7 V
V_{BE} (sat)	Base Saturation Voltage (Note 5)		0.85	1.2	V	I_C = 150 mA (pulsed)	I_B = 15 mA
V_{BE} (sat)	Base Saturation Voltage (Note 5)		1.12	1.6	V	I_C = 500 mA (pulsed)	I_B = 50 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.23	0.4	V	I_C = 150 mA (pulsed)	I_B = 15 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.46	1.0	V	I_C = 500 mA (pulsed)	I_B = 50 mA
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
BV_{CBO}	Collector to Base Breakdown Voltage	60			V	I_C = 100 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			V	I_E = 100 μA	I_C = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	30			V	I_C = 30 mA (pulsed)	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	2.5	3.3			I_C = 50 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance		5.0	8.0	pF	I_E = 0	V_{CB} = 10 V
t_{on}	Turn On Time (Note 6)		22	40	nsec	I_C = 300 mA	I_{B1} = 30 mA
t_{on}	Turn On Time (Note 6)		22	40	nsec	I_C = 500 mA	I_{B1} = 50 mA
t_{off}	Turn Off Time (Note 6)		22	60	nsec	I_C = 300 mA, I_{B1} = 30 mA,	I_{B2} = -30 mA
t_{off}	Turn Off Time (Note 6)		22	60	nsec	I_C = 500 mA, I_{B1} = 50 mA,	I_{B2} = -50 mA

TYPICAL ELECTRICAL CHARACTERISTICS

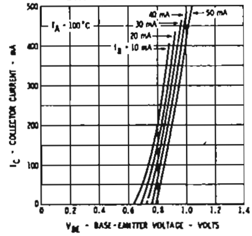
COLLECTOR CHARACTERISTICS*



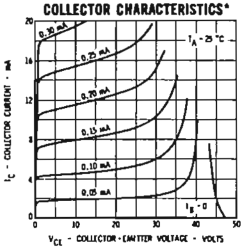
COLLECTOR CHARACTERISTICS*



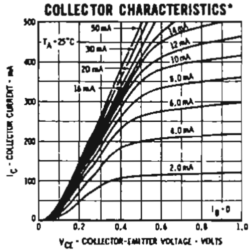
BASE CHARACTERISTICS*



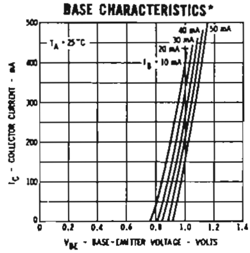
COLLECTOR CHARACTERISTICS*



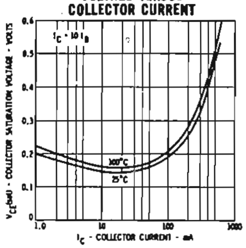
COLLECTOR CHARACTERISTICS*



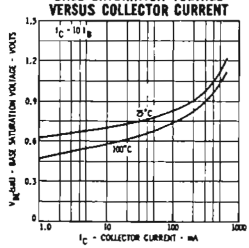
BASE CHARACTERISTICS*



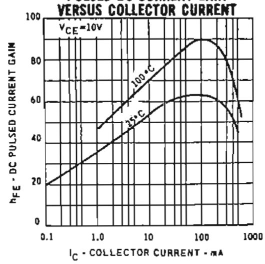
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



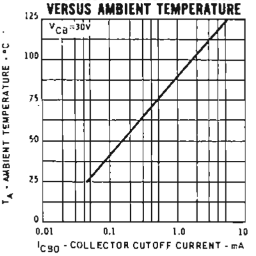
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



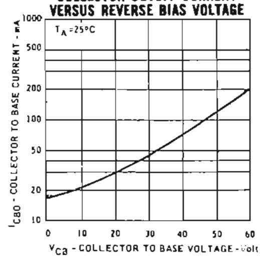
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

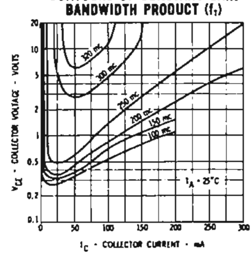
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



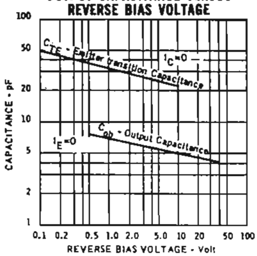
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



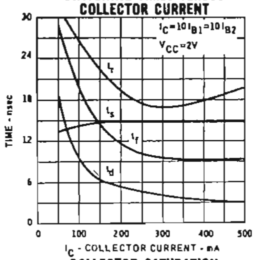
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



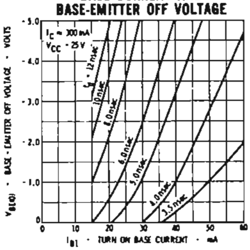
EMITTER TRANSISTION AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



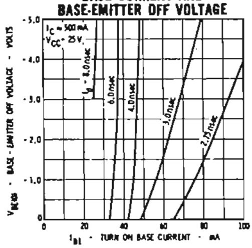
SWITCHING TIMES VERSUS COLLECTOR CURRENT



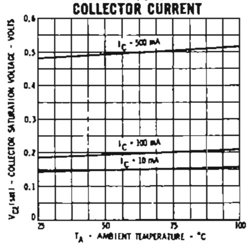
DELAY TIME VERSUS TURN ON BASE CURRENT AND BASE-EMITTER OFF VOLTAGE



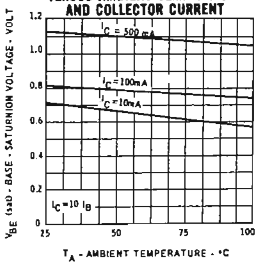
DELAY TIME VERSUS TURN ON BASE CURRENT AND BASE-EMITTER OFF VOLTAGE



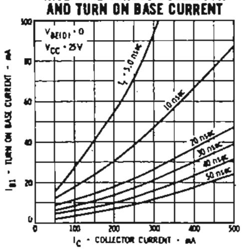
COLLECTOR SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE AND COLLECTOR CURRENT



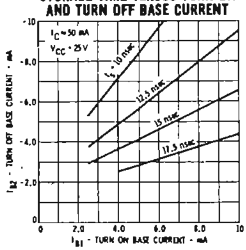
BASE SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE AND COLLECTOR CURRENT



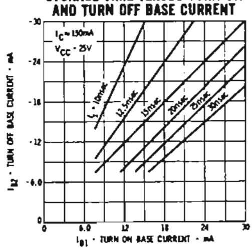
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

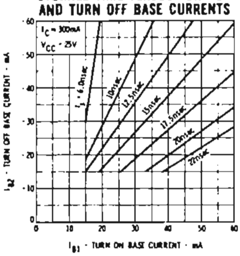


STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

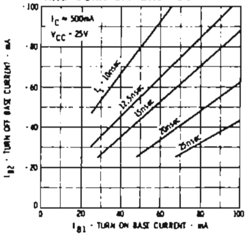


TYPICAL SWITCHING CHARACTERISTICS

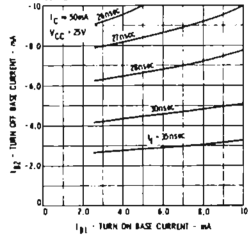
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



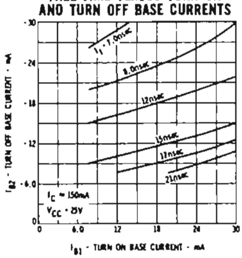
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



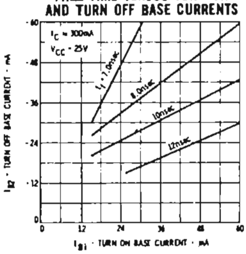
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



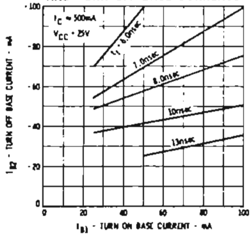
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



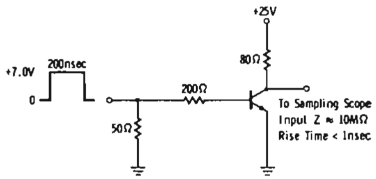
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

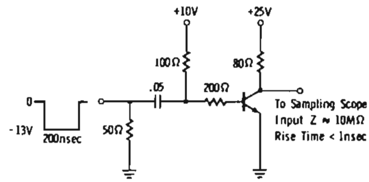


t_{on} TEST CIRCUIT ($I_C \approx 300$ mA)



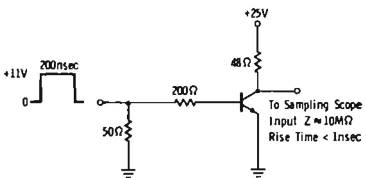
Rise time of input pulse < 2.0nsec
Input Impedance ≈ 50Ω

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



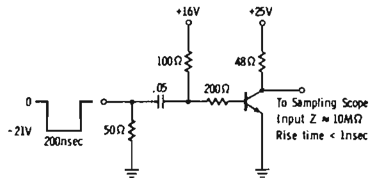
Rise Time of input pulse < 2.0nsec
Input impedance ≈ 50Ω

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

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).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS Publication AR 5.

(5) Pulse Conditions: length = 300 µsec; duty cycle = 1%.

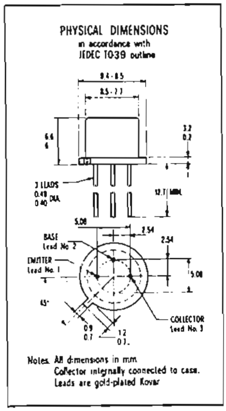
(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

BSX 32

HIGH-VOLTAGE, HIGH-CURRENT SWITCH

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BSX 32 is an NPN silicon PLANAR epitaxial transistor suitable for high-voltage, high-current switching applications. The V_{CEO} (sust) of 40 V, V_{CE} (sat) of 0.85V at 1A together with 300 MHz minimum f_T and tight control of storage time make the BSX 32 ideal for use in fast high-current memory applications.



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C Maximum
T_L	Lead Temperature (Soldering, 10 sec. time limit)	+ 260°C Maximum

Maximum Power Dissipations (Notes 2 and 3)

P	Total Dissipation at 25°C Case Temperature	3.5 Watts
	at 25°C Ambient Temperature	0.8 Watt

Maximum Voltages and Current (25°C free air temperature unless otherwise noted)

V_{CBO}	Collector to Base Voltage	65 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	40 Volts
V_{EBO}	Emitter to Base Voltage	6 Volts
I_C	DC Collector Current	1 Amp.

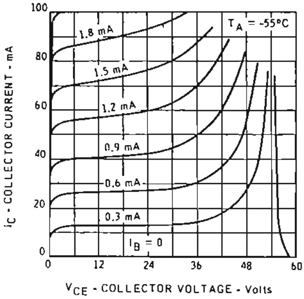
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	30	60			I_C = 10 mA	V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)	60	90	150		I_C = 100 mA	V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)	25	60			I_C = 500 mA	V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)	20	60			I_C = 1 A	V_{CE} = 5 V
h_{FE} (-55°C)	DC Pulse Current Gain (Note 5)	30	45			I_C = 100 mA	V_{CE} = 1 V
h_{FE} (-55°C)	DC Pulse Current Gain (Note 5)	15	35			I_C = 500 mA	V_{CE} = 1 V
V_{BE} (sat)	Base-Emitter Saturation Voltage (Note 5)		0.8	0.9	V	I_C = 100 mA	I_B = 10 mA
V_{BE} (sat)	Base-Emitter Saturation Voltage (Note 5)			1.5	V	I_C = 500 mA	I_B = 50 mA
V_{BE} (sat)	Base-Emitter Saturation Voltage (Note 5)			2	V	I_C = 1 A	I_B = 100 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage (Note 5)		0.17	0.25	V	I_C = 100 mA	I_B = 10 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage (Note 5)		0.36	0.50	V	I_C = 500 mA	I_B = 50 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage (Note 5)		0.60	0.85	V	I_C = 1 A	I_B = 100 mA
I_{CBO}	Collector Cutoff Current		0.25	4	μA	V_{CB} = 50 V	I_E = 0
BV_{CBO}	Collector to Base Breakdown Voltage	65			V	I_C = 100 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	6			V	I_E = 100 μA	I_C = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	40			V	I_C = 10 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3	4.5			I_C = 50 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance		6	10	pF	V_{CB} = 10 V	
C_{TE}	Emitter Transition Capacitance		40	55	pF	V_{EB} = 0.5 V	
t_{on}	Turn On Time		22	35	nsec	I_C = 500 mA	I_{B1} = 50 mA
t_{off}	Turn Off Time		40	60	nsec	I_C = 500 mA	I_{B1} = I_{B2} = 50mA

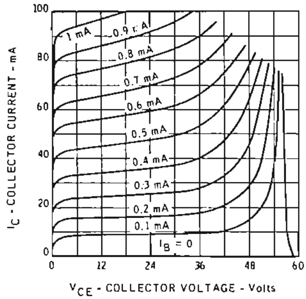
TYPICAL ELECTRICAL CHARACTERISTICS

(25° C free air temperature unless otherwise noted)

COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*



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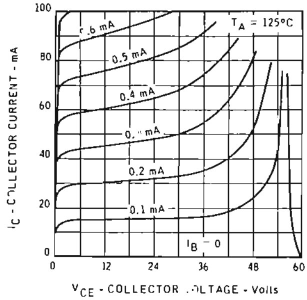

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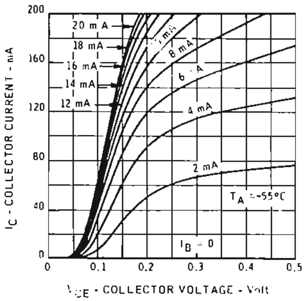

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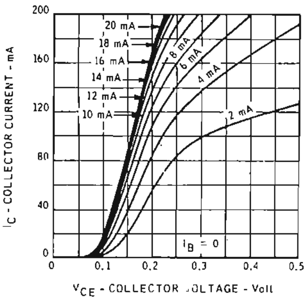

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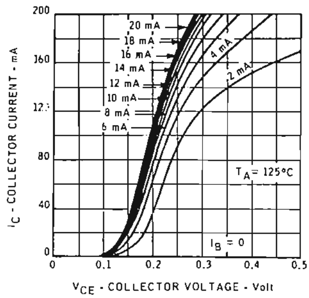
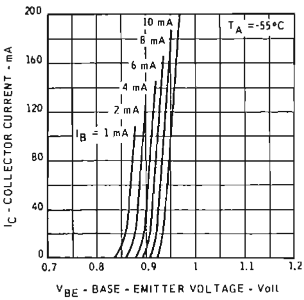
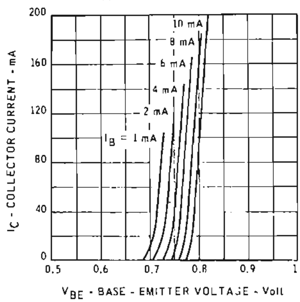


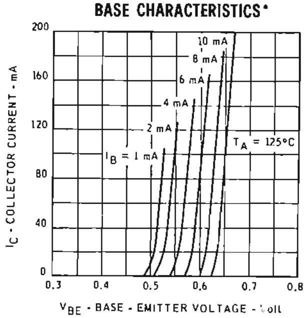
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



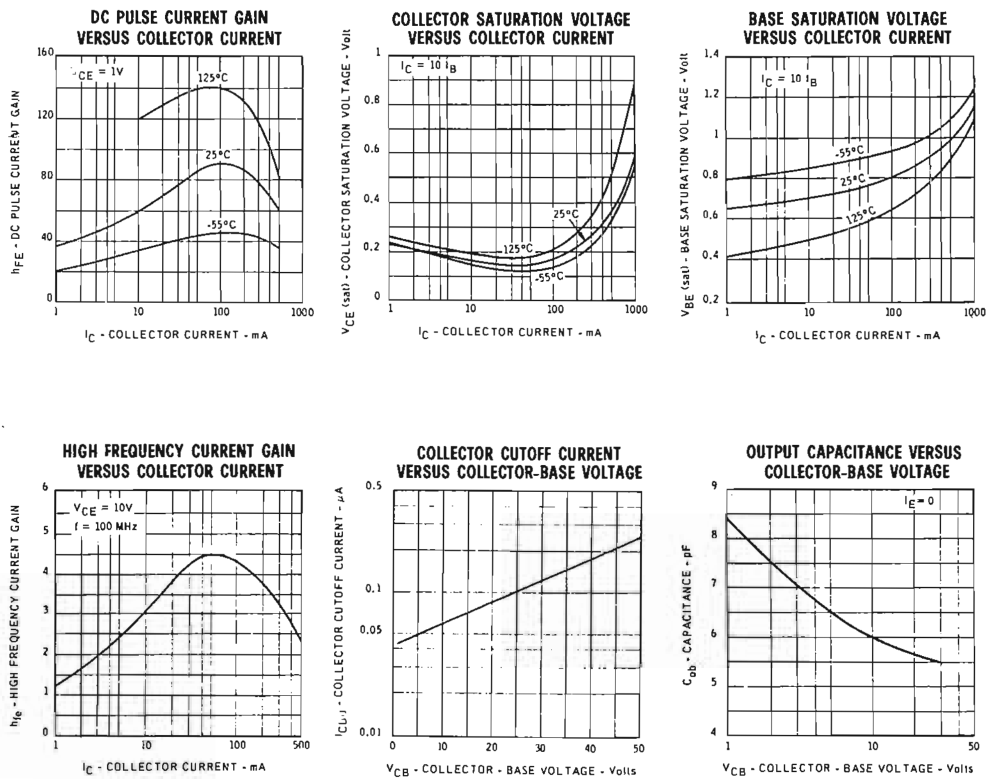
BASE CHARACTERISTICS*



* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

(25° C free air temperature unless otherwise noted)



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); junction-to-ambient thermal resistance of 219°C/watt (derating factor of 4.56 mW/°C).

(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

NPN diffused silicon planar transistor — BSX 33

High-voltage, high-current switch

The BSX 33 is an NPN silicon planar epitaxial transistor designed for high voltage and high current switching applications. It features a useful current gain range from 100 µA to 500 mA and a low saturation voltage allowing switching operation at 1 A.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5)				
	I_C = 100 µA, V_{CE} = 1 V	20	50		
	I_C = 5 mA, V_{CE} = 1 V	50	85		
	I_C = 50 mA, V_{CE} = 1 V	50	95		
	I_C = 150 mA, V_{CE} = 1 V	40	80		
	I_C = 500 mA, V_{CE} = 1 V	20	45		
V_{BEsat}	Base Saturation Voltage (5)				
	I_C = 50 mA, I_B = 5 mA		0.76		V
	I_C = 150 mA, I_B = 15 mA		0.85	1.1	V
	I_C = 1 A, I_B = 0.1 A		1.2	1.6	V
V_{CEsat}	Collector Saturation Voltage (5)				
	I_C = 50 mA, I_B = 5 mA		0.08		V
	I_C = 150 mA, I_B = 15 mA		0.15	0.30	V
	I_C = 1 A, I_B = 0.1 A		0.6	1	V
I_{EBO}	Emitter Reverse Current				
	V_{EB} = 5V, I_C = 0		0.1	10	nA
I_{CBO}	Collector Reverse Current				
	V_{CB} = 60V, I_E = 0		0.2	10	nA
	V_{CB} = 60V, I_E = 0 (150°C)		0.2	10	µA
BV_{CBO}	Collector to Base Breakdown Voltage				
	I_C = 100 µA, I_E = 0	85			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E = 100 µA, I_C = 0	7			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 30 mA, I_B = 0	55			V
h_{fe}	Small Signal Current Gain				
	I_C = 1 mA, V_{CE} = 5V, f = 1 kHz		85		
h_{ie}	Input Resistance				
	I_C = 1 mA, V_{CE} = 5V, f = 1 kHz		2		KΩ
h_{oe}	Output Conductance				
	I_C = 1 mA, V_{CE} = 5V, f = 1 kHz		8		µmho
h_{re}	Voltage Feedback Ratio				
	I_C = 1 mA, V_{CE} = 5 V, f = 1 kHz		2.2		$x10^{-4}$
h_{fe}	High Freq. Current Gain				
	I_C = 50 mA, V_{CE} = 10V, f = 20 MHz	3	4.5		
C_{TE}	Emitter Transition Capacitance				
	I_C = 0, V_{EB} = 0.5V		50	80	pF
C_{obo}	Base-Collector Capacitance				
	I_E = 0, V_{CB} = 10V		12	20	pF
t_{on}	Turn On Time				
	I_C = 150 mA, I_{B1} = 7.5mA		120	200	ns
t_{off}	Turn Off Time				
	I_C = 150 mA, I_{B1} = 7.5mA, I_{B2} = 7.5mA		350	800	ns

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages

Collector to Base	V_{CBO}	85 V
Collector to Emitter (4)	V_{CEO}	55 V
Emitter to Base	V_{EBO}	7 V

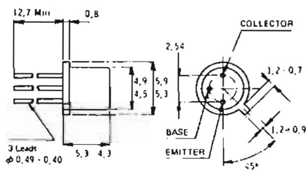
Temperatures

Storage Temperature Range	T_{STG}	-55°C to 200°C
Operating Junction Temperature	T_J	200° C
Lead Temperature (Soldering, 10 sec.)	T_L	260° C

Power (2-3)

Dissipation at 25° C Case Temperature	P_D	1.8 W
Dissipation at 25° C Ambient Temperature	P_D	0.5 W

PHYSICAL DIMENSIONS
Similar to Jedec TO-18



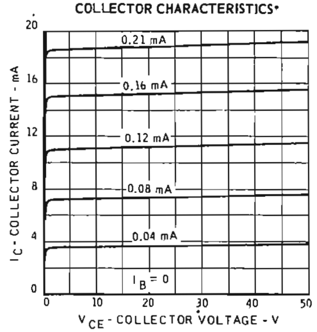
Note All dimensions are in mm

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 97°C/W (derating factor of 10.3 mW/°C); junction-to-ambient thermal resistance of 350°C/W (derating factor of 2.85 mW/°C).
4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
5) Measured under pulse conditions : pulse length = 300 µsec; duty cycle 1%.

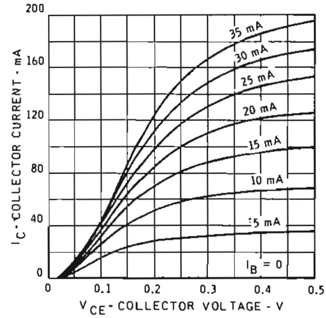
OCTOBER 1970

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

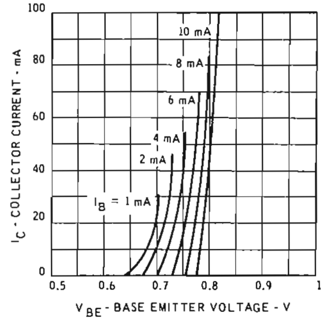
COLLECTOR CHARACTERISTICS*



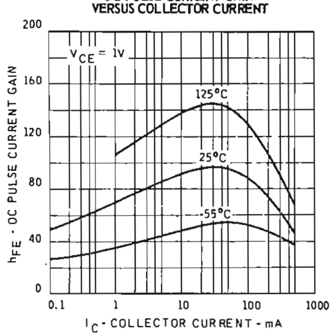
COLLECTOR CHARACTERISTICS*



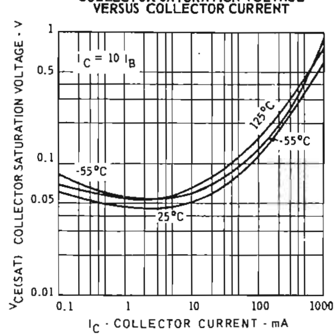
BASE CHARACTERISTICS*



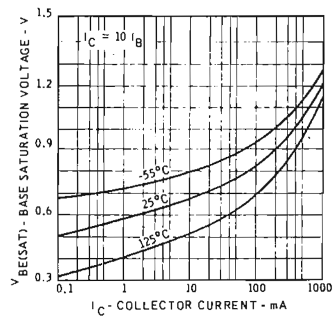
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



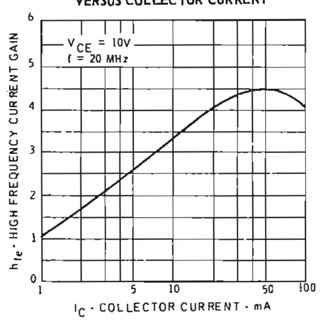
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



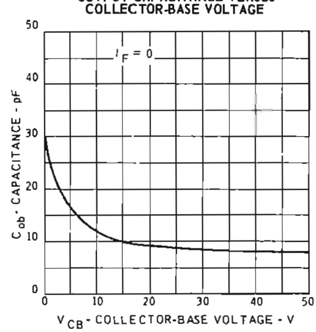
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



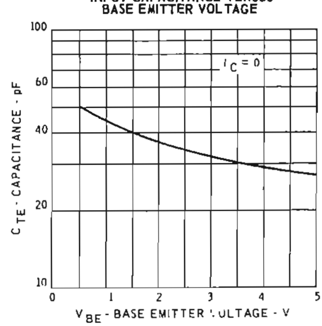
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



OUTPUT CAPACITANCE VERSUS COLLECTOR-BASE VOLTAGE

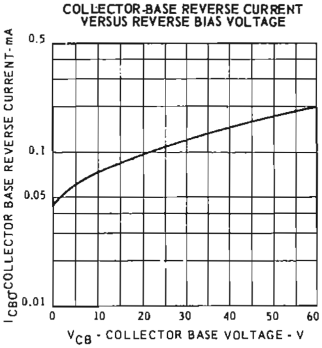


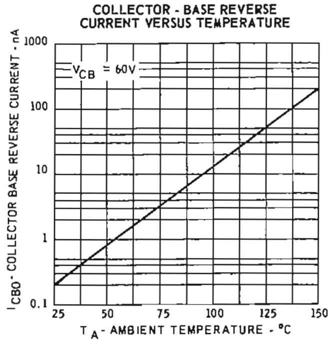
INPUT CAPACITANCE VERSUS BASE EMITTER VOLTAGE



* Single family characteristics on Transistor Curve Tracer.

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





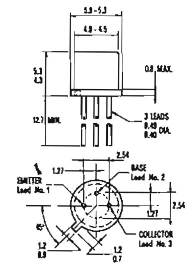
BSX 36

HIGH-CURRENT SWITCH

PNP DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BSX36 is a PNP silicon PLANAR II epitaxial transistor specially suitable for digital and analogue applications. Its high current gain high V_{CEO} (sust), low noise figure and low saturation voltage, make it ideal for line and relay drivers, memory applications and low noise amplifiers.

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-18 outline



Notes: All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

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

Maximum Power Dissipations

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.2 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.36 Watt

Maximum Voltages and Current

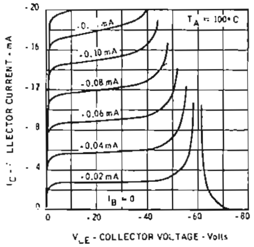
V_{CBO}	Collector to Base Voltage	-40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-40 Volts
V_{EBO}	Emitter to Base Voltage	-5 Volts
I_C	DC Collector Current	500 mA

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

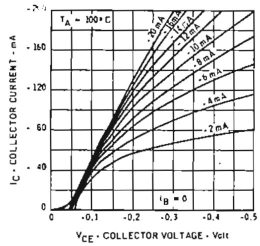
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain		50			I_C = 10 μA	V_{CE} = - 10 V
h_{FE}	DC Current Gain		75			I_C = 1 mA	V_{CE} = - 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	40	100			I_C = 10 mA	V_{CE} = - 10 V
h_{FE}	DC Pulse Current Gain (Note 5)		100			I_C = 50 mA	V_{CE} = - 10 V
h_{FE}	DC Pulse Current Gain (Note 5)		85			I_C = 150 mA	V_{CE} = - 10 V
V_{BE} (sat)	Base-Emitter Saturation Voltage (Note 5)		-0.92	-1.1	V	I_C = 50 mA	I_B = 5 mA
V_{BE} (sat)	Base-Emitter Saturation Voltage (Note 5)		-1	-1.4	V	I_C = 150 mA	I_B = 15 mA
V_{BE} (sat)	Base-Emitter Saturation Voltage (Note 5)			-2.2	V	I_C = 500 mA	I_B = 50 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage (Note 5)		-0.08	-0.3	V	I_C = 50 mA	I_B = 5 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage (Note 5)		-0.18	-0.5	V	I_C = 150 mA	I_B = 15 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage (Note 5)		-0.6	-1.8	V	I_C = 500 mA	I_B = 50 mA
I_{CBO}	Collector Cutoff Current		0.2	15	nA	V_{CB} = 25 V	I_E = 0
I_{CBO} (125°C)	Collector Cutoff Current			15	μA	V_{CB} = 25 V	I_E = 0
BV_{CBO}	Collector to Base Breakdown Voltage	-40			V	I_C = 10 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-5			V	I_E = 10 μA	I_C = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-40			V	I_C = 10 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	1	2			I_C = 50 mA	V_{CE} = - 20 V
C_{ob}	Output Capacitance		6	8	pF	I_C = 0	V_{CB} = - 10 V
C_{TE}	Emitter Transition Capacitance			25	pF	I_C = 0	V_{EB} = - 0.5 V
NF	Noise Figure (Note 6)		1		dB	I_C = 30 μA	V_{CE} = - 5 V
t_{on}	Turn On Time		17	40	nsec	I_C = 300 mA	I_{B1} = 30 mA
t_{off}	Turn Off Time		18	100	nsec	I_C = 300 mA	I_{B1} = 30 mA, I_{B2} = -30 mA

TYPICAL ELECTRICAL CHARACTERISTICS

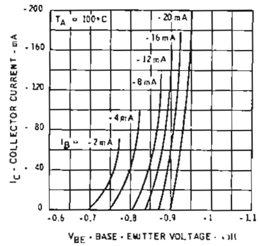
COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*



BASE CHARACTERISTICS*



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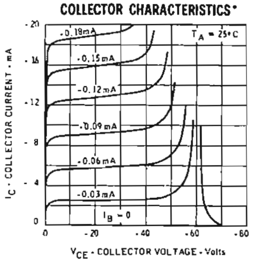
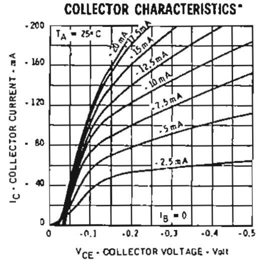
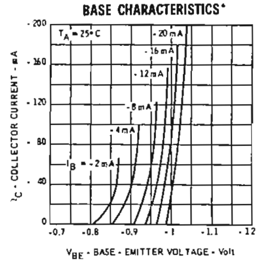


COLLECTOR CHARACTERISTICS*



BASE CHARACTERISTICS*



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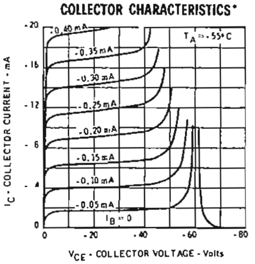

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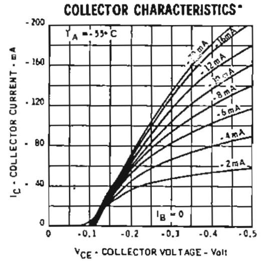
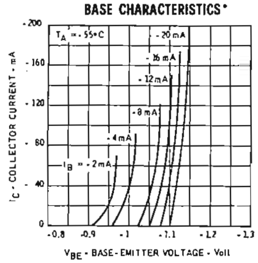


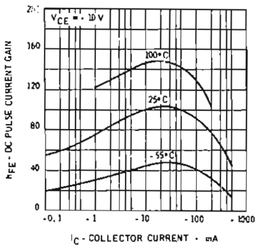
BASE CHARACTERISTICS*



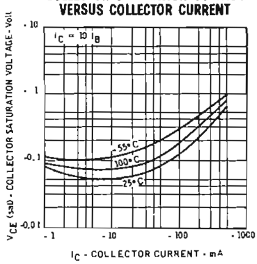
*Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

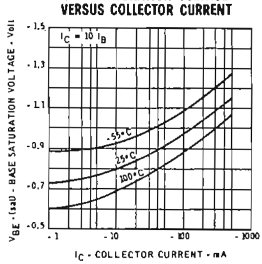
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



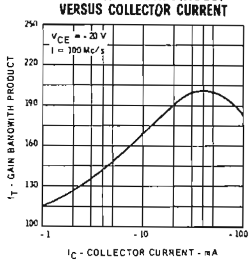
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



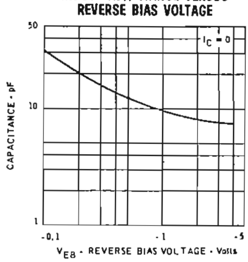
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



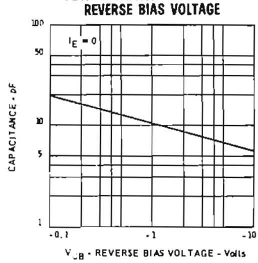
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



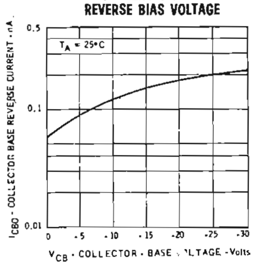
INPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



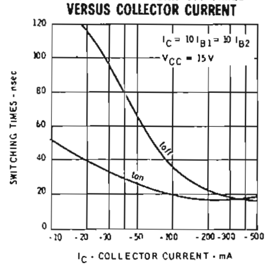
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



TURN ON AND TURN OFF TIMES VERSUS COLLECTOR CURRENT



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 6.86 mW/°C); junction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.06mW/°C).

(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS- AR 5.

(5) Pulse Conditions: length = 300μsec; duty cycle = 1%.

(6) f = 1 Kc/s; R_G = 10 KΩ.

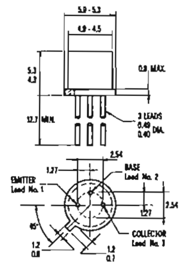
BSX 39

HIGH-SPEED SATURATED SWITCH

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The BSX 39 is an NPN silicon PLANAR epitaxial transistor designed for very fast switching applications up to 500mA collector current. This device is expecially suitable for memory applications and features a typical f_T of 600 MHz together with 20 V V_{CEO} and 0.39 V V_{CE} (sat) at 300 mA collector current.

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-18 outline



Notes: All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	- 55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C Maximum
T_L	Lead Temperature (Soldering, 10 sec. Time Limit)	+ 260°C Maximum

Maximum Power Dissipations

P	Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.2 Watt
	at 100°C Case Temperature (Notes 2 and 3)	0.68 Watt
	at 25°C Ambient Temperature (Notes 2 and 3)	0.36 Watt

Maximum Voltages (25°C free air temperature unless otherwise noted)

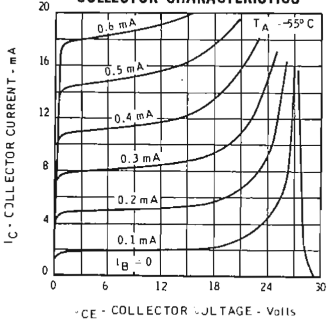
V_{CBO}	Collector to Base Voltage	45 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	20 Volts
V_{EBO}	Emitter to Base Voltage	5 Volts

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

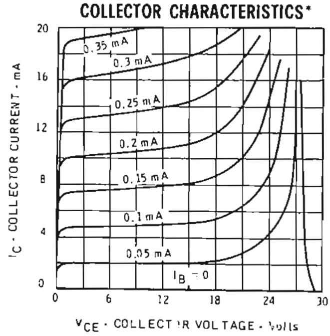
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	40	60	120		I_C = 30 mA	V_{CE} = 0.4 V
h_{FE}	DC Pulse Current Gain (Note 5)	25	55			I_C = 100 mA	V_{CE} = 0.5 V
h_{FE}	DC Pulse Current Gain (Note 5)	15	40			I_C = 300 mA	V_{CE} = 1 V
h_{FE} (-55°C)	DC Pulse Current Gain (Note 5)	12				I_C = 30 mA	V_{CE} = 0.4 V
V_{BE} (sat)	Base Saturation Voltage (Note 5)	0.75	0.80	0.95	V	I_C = 30 mA	I_B = 3 mA
V_{BE} (sat)	Base Saturation Voltage (Note 5)		0.90	1.2	V	I_C = 100 mA	I_B = 10 mA
V_{BE} (sat)	Base Saturation Voltage (Note 5)		1.1	1.7	V	I_C = 300 mA	I_B = 30 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.15	0.18	V	I_C = 30 mA	I_B = 3 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.18	0.28	V	I_C = 100 mA	I_B = 10 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.39	0.5	V	I_C = 300 mA	I_B = 30 mA
V_{CE} (sat)	Collector Saturation Voltage (85°C) (Note 5)		0.17	0.3	V	I_C = 30 mA	I_B = 3 mA
I_{CES}	Collector Cutoff Current		0.02	0.1	μA	V_{CE} = 20 V	V_{EB} = 0
I_{CES} (125°C)	Collector Cutoff Current			30	μA	V_{CE} = 20 V	V_{EB} = 0
BV_{CBO}	Collector Base Breakdown Voltage	45			V	I_C = 100 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5			V	I_E = 100 μA	I_C = 0
V_{CEO} (sust)	Collector Emitter Sustaining Voltage (Notes 4 and 5)	20			V	I_C = 10 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.5	6			I_C = 30 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance		4	5	pF	V_{CB} = 5 V	I_E = 0
C_{TE}	Emitter Transition Capacitance		7	8	pF	V_{EB} = 0.5 V	I_C = 0
τ_s	Charge Storage Time Constant		8	18	nsec	$I_C = I_{B1} = I_{B2}$ = 10 mA	
t_{on}	Turn On Time		9	15	nsec	I_C = 300 mA	I_{B1} = 30 mA
t_{off}	Turn Off Time		15	25	nsec	I_C = 300 mA	$I_{B1} = I_{B2}$ = 30 mA

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

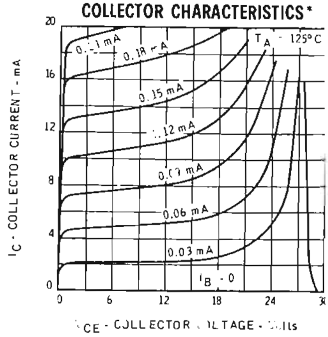
COLLECTOR CHARACTERISTICS*



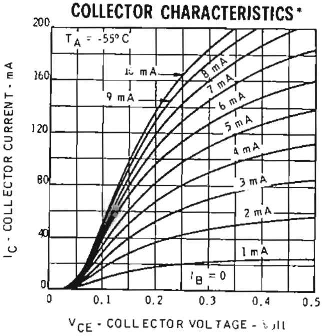
COLLECTOR CHARACTERISTICS*



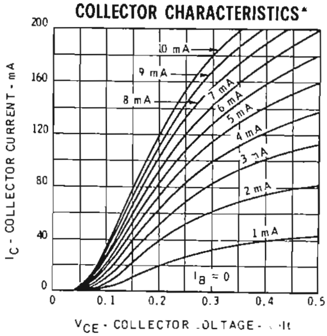
COLLECTOR CHARACTERISTICS*



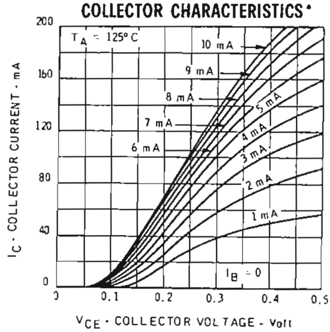
COLLECTOR CHARACTERISTICS*



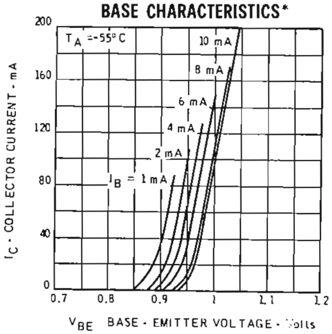
COLLECTOR CHARACTERISTICS*



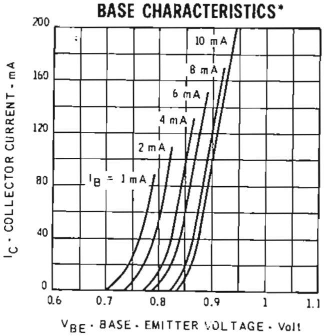
COLLECTOR CHARACTERISTICS*



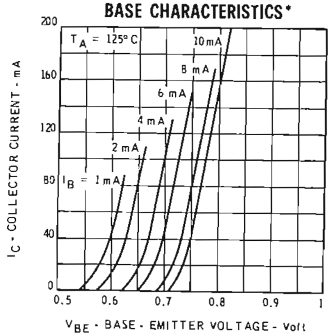
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



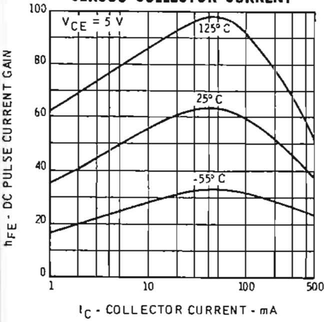
BASE CHARACTERISTICS*



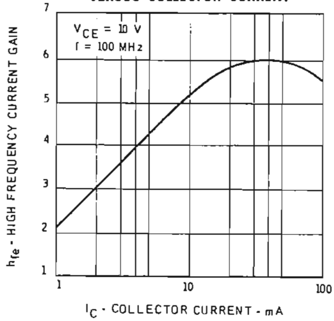
* Single family characteristics on Transistor Curve Tracer.

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

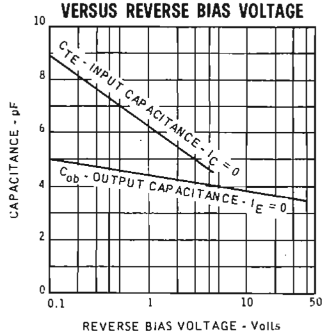
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



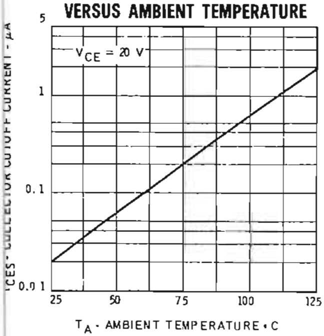
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



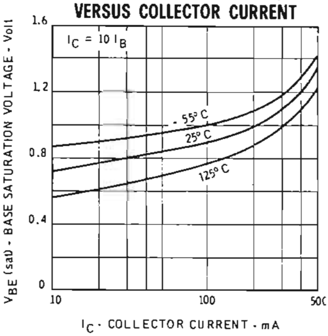
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



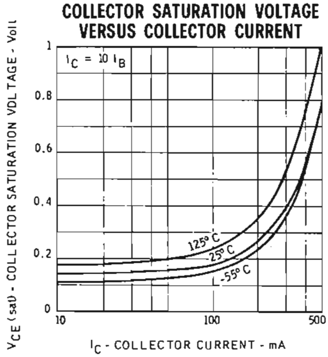
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



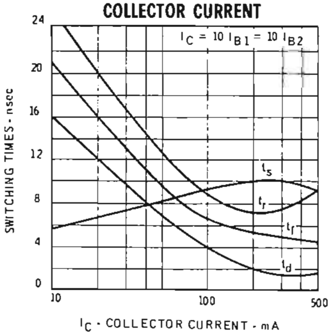
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



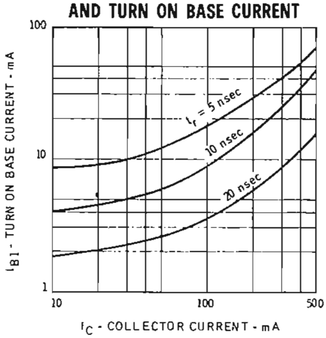
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS COLLECTOR CURRENT

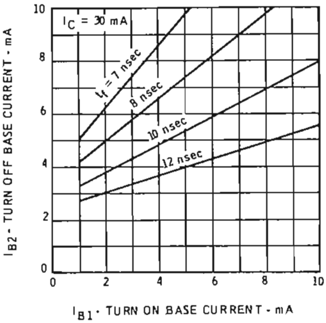


RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT

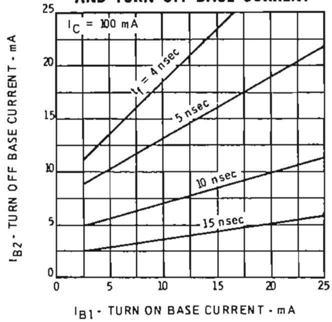


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

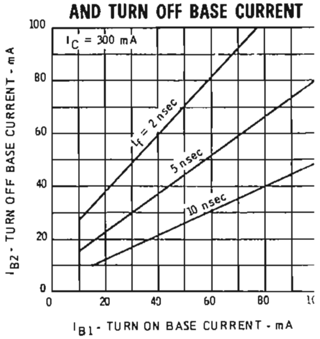
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



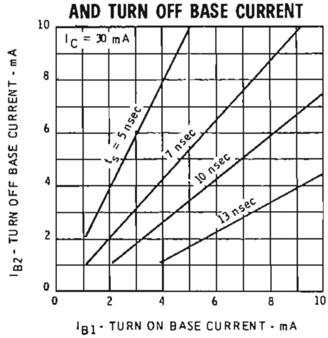
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



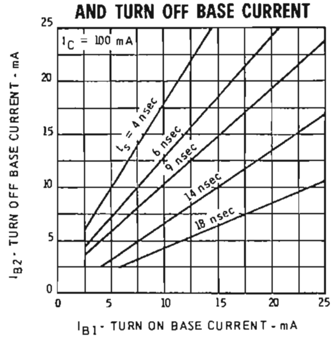
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



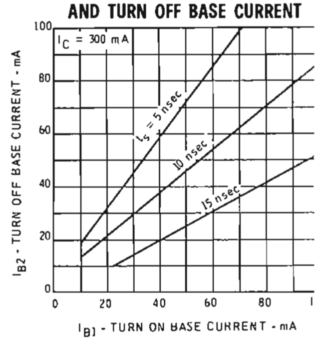
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



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) These ratings refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(5) Pulse Conditions: length ≤ 300 μsec; duty cycle ≤ 1%.

BSX 87 - BSX 87A

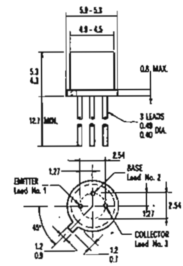
HIGH SPEED SATURATED SWITCHES

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The BSX 87 is an NPN silicon PLANAR epitaxial transistor designed for high saturated switch up to 500 mA collector current. It features high speed, high gain, low saturation voltages.

For improved performance use the BSX 87A.

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-18 outline



Notes: All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	- 55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C Maximum
T_L	Lead Temperature (Soldering, 10 sec. time limit)	+ 260°C Maximum

Maximum Power Dissipations (Notes 2 and 3)

P_D	Total Dissipation at 25°C Case Temperature	1.2 Watt
	at 100°C Case Temperature	0.68 Watt
	at 25°C Ambient Temperature	0.36 Watt

Maximum Voltages (T_A = 25°C unless otherwise noted)

		BSX 87	BSX 87A
V_{CBO}	Collector to Base Voltage	40 Volts	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts	15 Volts
V_{CER}	Collector to Emitter Voltage (R_{BE} = 10 Ω) (Note 4)	20 Volts	
V_{EBO}	Emitter to Base Voltage	5 Volts	5 Volts

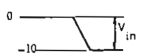
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	BSX 87 MIN.	BSX 87 TYP.	BSX 87 MAX.	BSX 87A MIN.	BSX 87A TYP.	BSX 87A MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)				18	35			I_C = 1 mA	V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	55	120	34	55			I_C = 10 mA	V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)				30	65			I_C = 30 mA	V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)				25	55			I_C = 100 mA	V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)	10	17		10	30			I_C = 500 mA	V_{CE} = 5 V
h_{FE} (-55°C)	DC Pulse Current Gain (Note 5)	12	28						I_C = 10 mA	V_{CE} = 1 V
V_{BE} (sat)	Base Saturation Voltage (Note 5)	0.7	0.75	0.8	0.7	0.75	0.8	V	I_C = 10 mA	I_B = 1 mA
V_{BE} (sat)	Base Saturation Voltage (Note 5)		0.8	0.87		0.85	1	V	I_C = 30 mA	I_B = 3 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.15	0.2		0.16	0.2	V	I_C = 10 mA	I_B = 1 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.17	0.22		0.17	0.22	V	I_C = 30 mA	I_B = 3 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.4	0.7		0.3	0.5	V	I_C = 200 mA	I_B = 20 mA
I_{CES}	Collector Cutoff Current					0.02	0.3	µA	V_{CE} = 20 V	V_{EB} = 0
I_{CES} (125°C)	Collector Cutoff Current						30	µA	V_{CE} = 20 V	V_{EB} = 0
I_{CEX} (125°C)	Collector Cutoff Current		3	10				µA	V_{CE} = 20 V	V_{BE} = 0.25 V
I_{EBO}	Emitter Cutoff Current		7	100				nA	V_{EB} = 4 V	I_C = 0
I_{CBO}	Collector Cutoff Current		4	25			300	nA	V_{CB} = 20 V	I_E = 0
I_{CBO} (125°C)	Collector Cutoff Current		3	15			30	µA	V_{CB} = 20 V	I_E = 0

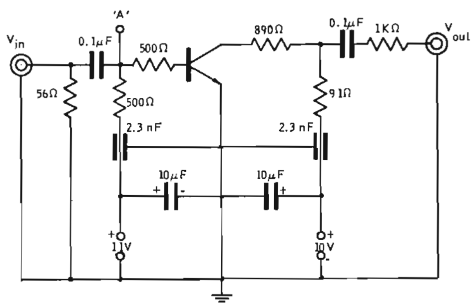
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

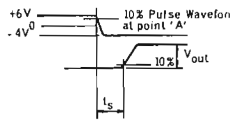
SYMBOL	CHARACTERISTIC	BSX87 MIN.	BSX87 TYP.	BSX87 MAX.	BSX87A MIN.	BSX87A TYP.	BSX87A MAX.	UNIT	TEST CONDITIONS	
BV_{CBO}	Collector to Base Breakdown Voltage	40						V	$I_C = 1\ \mu A$	$I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage				40			V	$I_C = 100\ \mu A$	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5						V	$I_E = 10\ \mu A$	$I_C = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage				5			V	$I_E = 100\ \mu A$	$I_C = 0$
V_{CER} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	20						V	$I_C = 30$ mA (pulsed)	$R_{BE} \leq 10\ \Omega$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	15						V	$I_C = 30$ mA (pulsed)	$I_B = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)				15			V	$I_C = 10$ mA (pulsed)	$I_B = 0$
h_{fe}	High Frequency Current Gain (f = 100MHz)	3	3.7		3.5	6			$V_{CE} = 10$ V	$I_C = 20$ mA
C_{ob}	Output Capacitance		4.5	6				pF	$V_{CB} = 10$ V	$I_E = 0$
C_{ob}	Output Capacitance					2.5	5	pF	$V_{CB} = 5$ V	$I_E = 0$
C_{TE}	Emitter Transition Capacitance			9		7	8	pF	$V_{EB} = 0.5$ V	$I_C = 0$
τ_s	Charge Storage Time Constant (Notes 6-7)		13	20				ns	$I_C = I_{B1} = I_{B2} = 20$ mA	
τ_s	Charge Storage Time Constant (Notes 6-7)					8	18	ns	$I_C = I_{B1} = I_{B2} = 10$ mA	
t_{on}	Turn On Time (Note 7)		25	40				ns	$I_C = 200$ mA	$I_{B1} = 40$ mA
t_{on}	Turn On Time (Note 7)					9	20	ns	$I_C = 300$ mA	$I_{B1} = 30$ mA
t_{off}	Turn Off Time (Note 7)		25	40				ns	$I_C = 200$ mA	$I_{B1} = 40$ mA, $I_{B2} = 20$ mA
t_{off}	Turn Off Time (Note 7)					15	30	ns	$I_C = 300$ mA	$I_{B1} = 30$ mA, $I_{B2} = 30$ mA

BSX87A CHARGE STORAGE TIME CONSTANT TEST CIRCUIT



Pulse Generator
V_{in}-Rise Time <1nsec
Source Impedance = 50Ω
PW ≥ 300 nsec
Duty Cycle < 2%





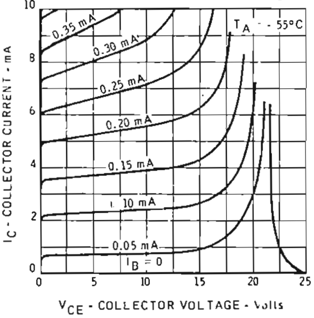
To Sampling Oscilloscope
Input Impedance = 50 Ω
Rise Time ≤ 1 nsec

NOTES:

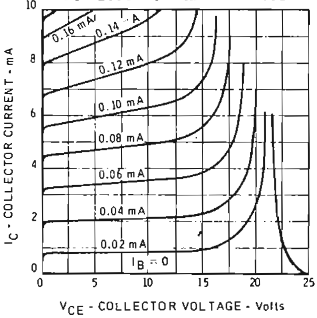
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 145°C/watt (derating factor of 6.9 mW/°C); junction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.09 mW/°C).
(4) These ratings refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.
(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.
(6) Measured on sampling scope PW = 200 ns.
(7) See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

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

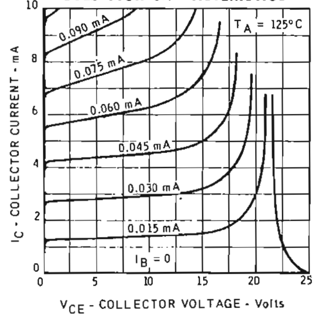
COLLECTOR CHARACTERISTICS*



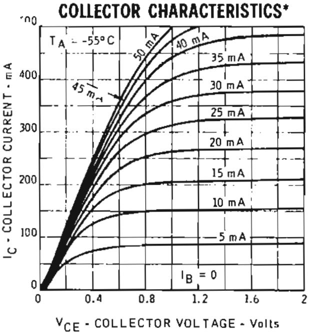
COLLECTOR CHARACTERISTICS*



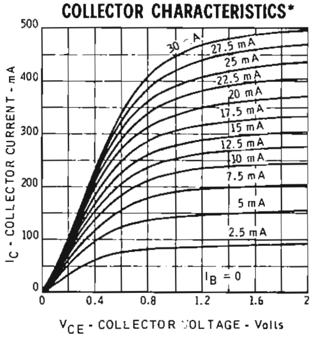
COLLECTOR CHARACTERISTICS*



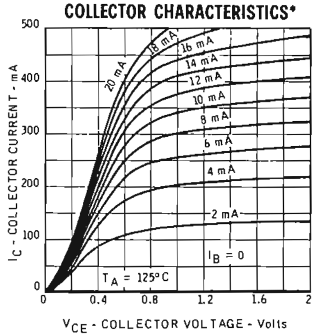
COLLECTOR CHARACTERISTICS*



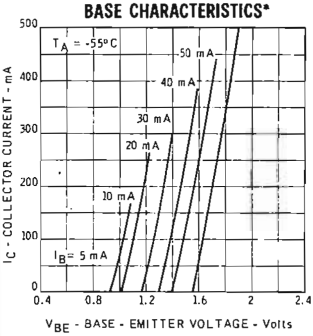
COLLECTOR CHARACTERISTICS*



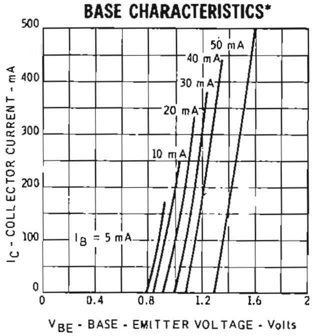
COLLECTOR CHARACTERISTICS*



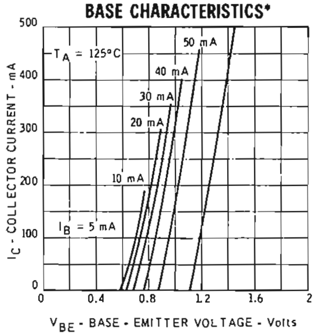
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



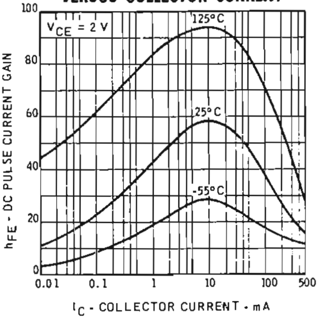
BASE CHARACTERISTICS*



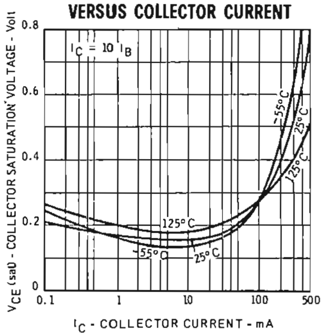
*Single family characteristics on Transistor Curve Tracer.

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

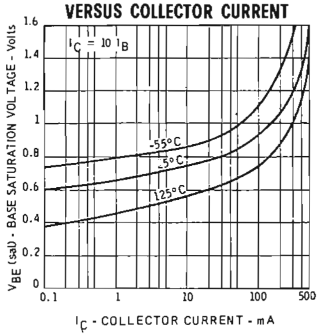
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



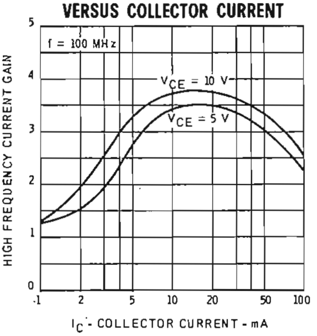
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



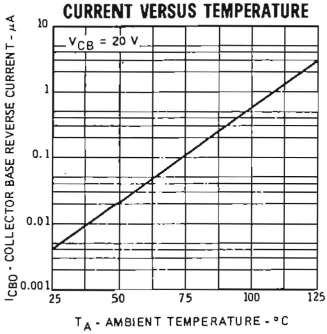
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



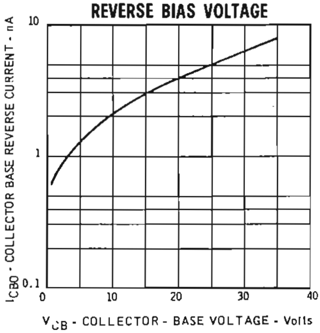
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



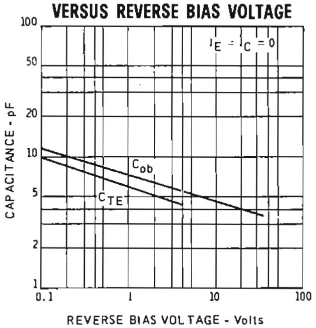
COLLECTOR-BASE REVERSE CURRENT VERSUS TEMPERATURE



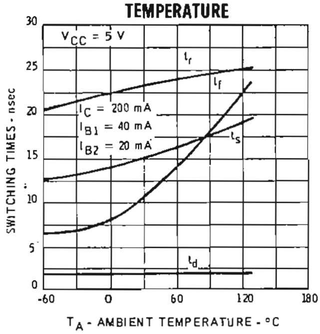
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



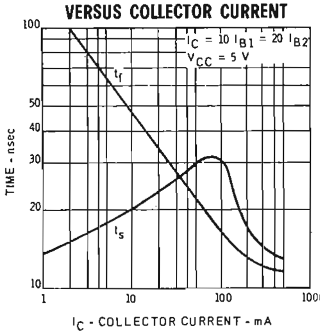
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



SWITCHING TIMES VERSUS TEMPERATURE

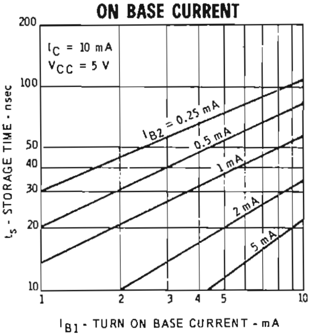


STORAGE AND FALL TIMES VERSUS COLLECTOR CURRENT

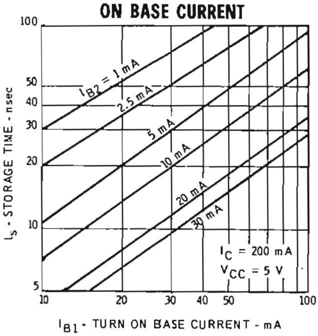


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

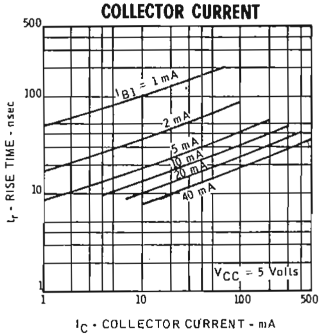
STORAGE TIME VERSUS TURN ON BASE CURRENT



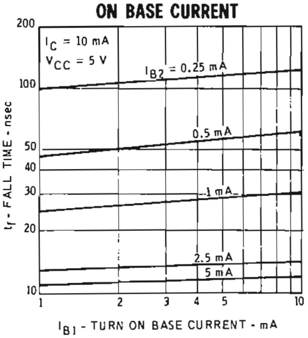
STORAGE TIME VERSUS TURN ON BASE CURRENT



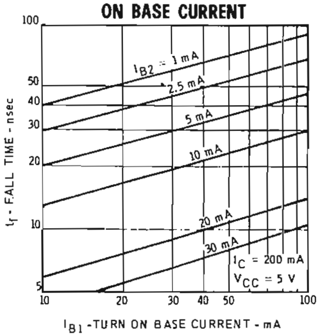
RISE TIME VERSUS COLLECTOR CURRENT



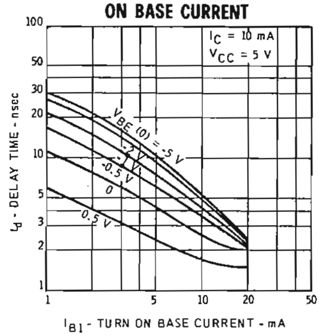
FALL TIME VERSUS TURN ON BASE CURRENT



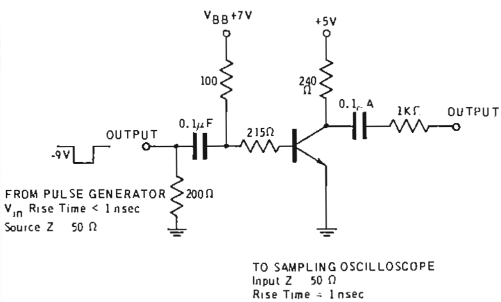
FALL TIME VERSUS TURN ON BASE CURRENT



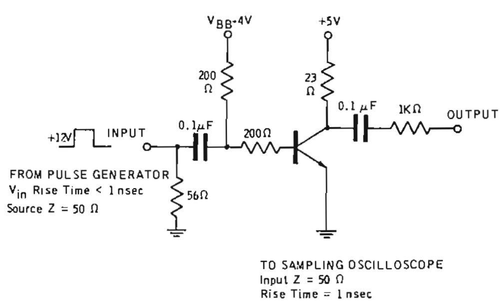
DELAY TIME VERSUS TURN ON BASE CURRENT



CHARGE STORAGE TIME CONSTANT TEST CIRCUIT

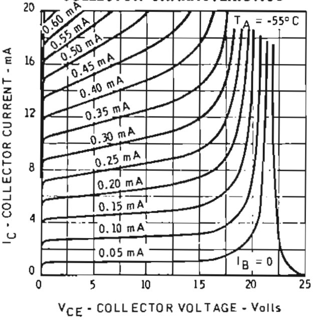


TURN ON AND TURN OFF TIMES TEST CIRCUIT

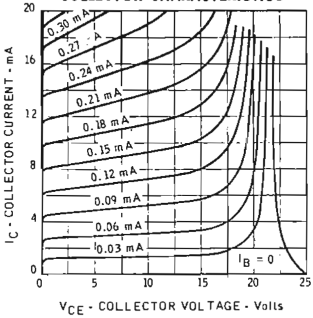


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

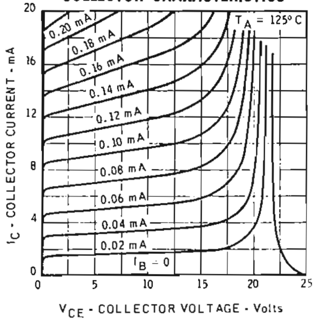
COLLECTOR CHARACTERISTICS*



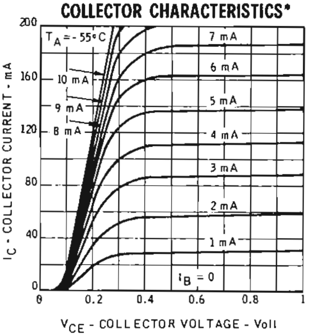
COLLECTOR CHARACTERISTICS*



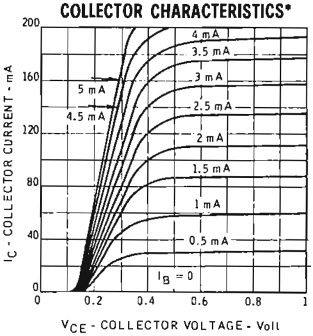
COLLECTOR CHARACTERISTICS*



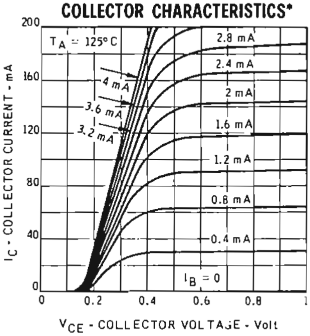
COLLECTOR CHARACTERISTICS*



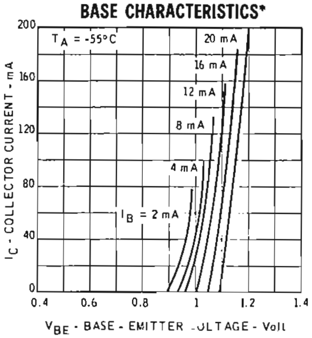
COLLECTOR CHARACTERISTICS*



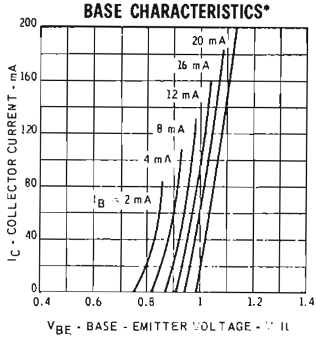
COLLECTOR CHARACTERISTICS*



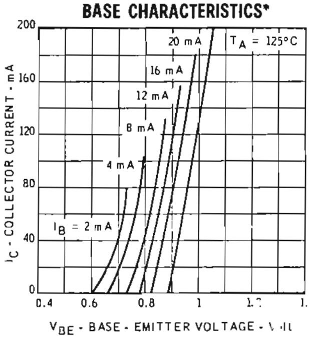
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



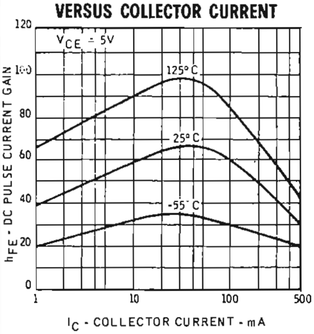
BASE CHARACTERISTICS*



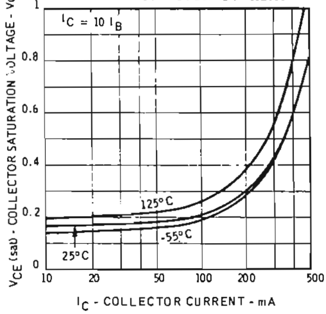
* Single family characteristics on Transistor Curve Tracer.

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

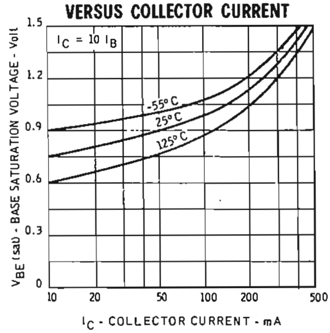
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



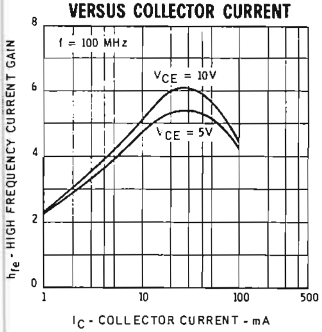
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



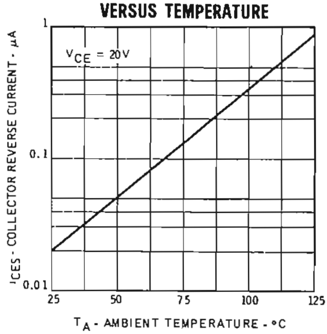
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



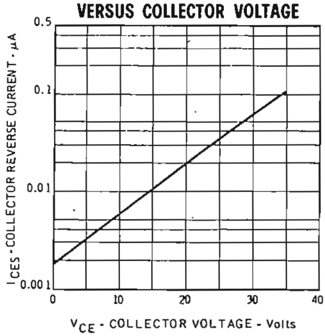
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



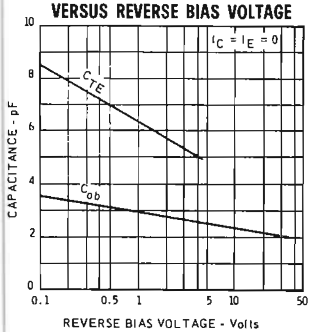
COLLECTOR REVERSE CURRENT VERSUS TEMPERATURE



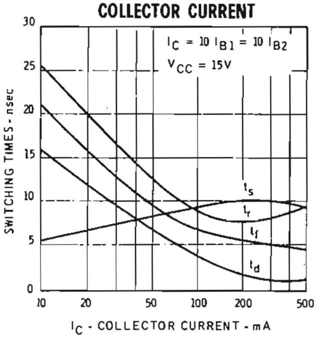
COLLECTOR REVERSE CURRENT VERSUS COLLECTOR VOLTAGE



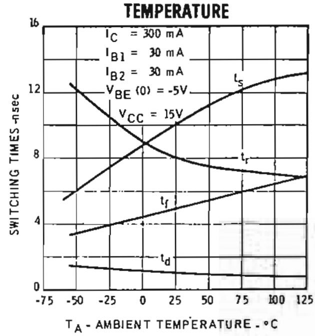
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



SWITCHING TIMES VERSUS COLLECTOR CURRENT

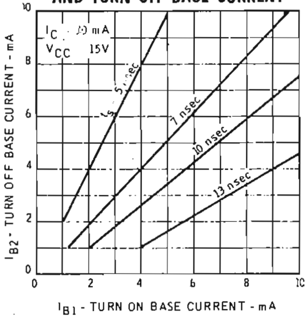


SWITCHING TIMES VERSUS TEMPERATURE

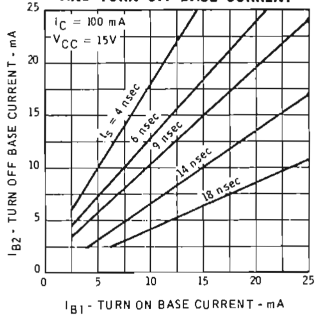


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

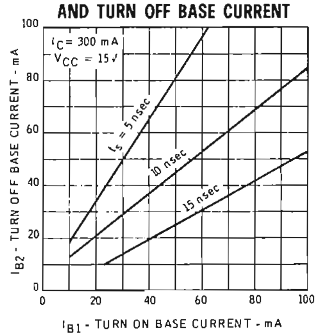
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



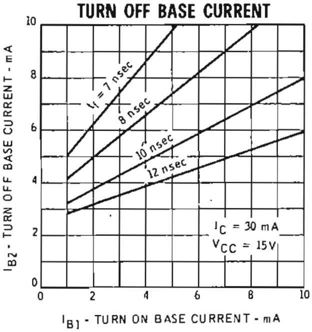
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



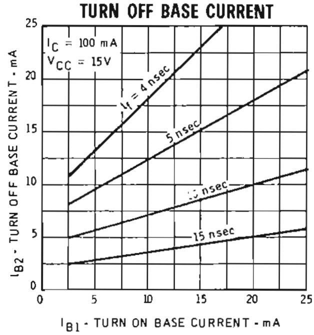
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



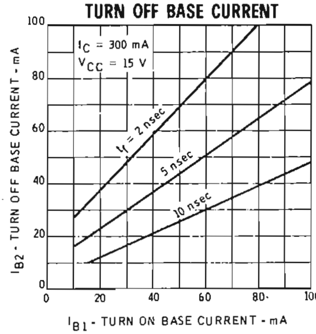
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



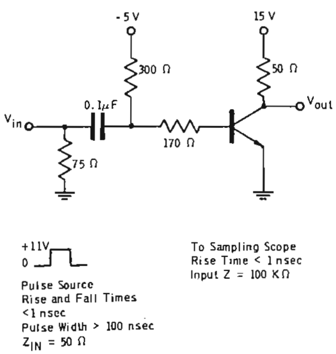
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



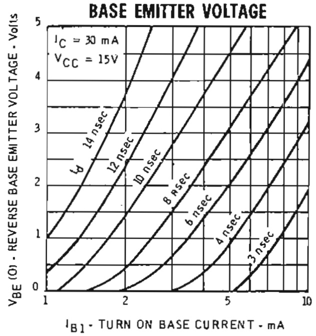
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



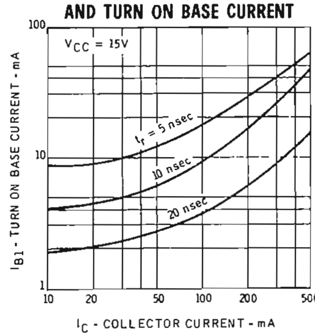
TURN ON AND TURN OFF TIMES TEST CIRCUIT



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



RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



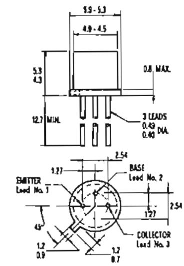
BSX88-BSX88A

HIGH FREQUENCY, HIGH SPEED TYPES

NPN DIFFUSED SILICON PLANAR TRANSISTORS

GENERAL DESCRIPTION - The BSX 88 is an NPN Silicon PLANAR Epitaxial Transistor specially designed as high-speed saturated logic switch. It features 15 Volts LV_{CEO}, low saturation voltages, low storage time, and a minimum f_T of 300 MHz.
For improved performance use the BSX 88A.

PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-18 outline



Notes: All dimensions in mm.
Collector internally connected to case.
Leads are gold-plated Kovar.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C
T_L	Lead Temperature (Soldering, 10 sec. time limit)	+ 260°C

Maximum Power Dissipations (Notes 2 and 3)

P_D	Total Dissipation at 25°C Case Temperature	1.2 Watt
	at 100°C Case Temperature	0.68 Watt
	at 25°C Ambient Temperature	0.36 Watt

Maximum Voltages (25°C free air temperature		BSX 88	BSX 88 A
V_{CBO}	Collector to Base Voltage	40 Volts	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts	20 Volts
V_{CER}	Collector to Emitter Voltage (R_{BE} = 10 Ω) (Note 4)	20 Volts	
V_{EBO}	Emitter to Base Voltage	5 Volts	5.5 Volts

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

		BSX 88			BSX 88A					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	15	35		15	30			I_C = 0.5 mA	V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	45	120	30	50			I_C = 10 mA	V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)				35	55			I_C = 100 mA	V_{CE} = 1 V
h_{FE} (-55°C)	DC Pulse Current Gain (Note 5)	15	25		15	25			I_C = 10 mA	V_{CE} = 1 V
V_{BEsat} (-55°C)	Base Saturation Voltage (Note 5)		0.86	0.9			0.9	V	I_C = 7 mA	I_B = 0.7 mA
$V_{BE\ sat}$	Base Saturation Voltage (Note 5)	0.72	0.77	0.8	0.72	0.77	0.8	V	I_C = 10 mA	I_B = 1 mA
$V_{BE\ sat}$	Base Saturation Voltage (Note 5)						1.2	V	I_C = 100 mA	I_B = 10 mA
$V_{CE\ sat}$	Collector Saturation Voltage (Note 5) (-55°C to + 125°C)			0.4			0.25	V	I_C = 7 mA	I_B = 0.7 mA
$V_{CE\ sat}$	Collector Saturation Voltage (Note 5)			0.4		0.15	0.18	V	I_C = 10 mA	I_B = 1 mA
$V_{CE\ sat}$	Collector Saturation Voltage (Note 5)						0.32	V	I_C = 100 mA	I_B = 10 mA
I_{CES}	Collector Cutoff Current					0.02	0.3	µA	V_{CE} = 20 V	V_{EB} = 0
I_{CES} (125°C)	Collector Cutoff Current						30	µA	V_{CE} = 20 V	V_{EB} = 0
I_{CEX} (125°C)	Collector Cutoff Current			10				µA	V_{CE} = 20 V	V_{BE} = 0.25 V
I_{EBO}	Emitter Cutoff Current			0.1				µA	I_C = 0	V_{EB} = 4 V
I_{CBO}	Collector Cutoff Current		4	25		20	300	nA	I_E = 0	V_{CB} = 20 V
I_{CBO} (125°C)	Collector Cutoff Current		1.5	15			30	µA	I_E = 0	V_{CB} = 20 V
BV_{CBO}	Collector to Base Breakdown Voltage	40						V	I_C = 1 µA	I_E = 0
BV_{CBO}	Collector to Base Breakdown Voltage				40			V	I_C = 100 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5						V	I_E = 10 µA	I_C = 0
BV_{EBO}	Emitter to Base Breakdown Voltage				5.5			V	I_E = 100 µA	I_C = 0

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

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
LV_{CER}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	20						V	I_C = 30 mA (pulsed	$R_{BE} \leq 10\ \Omega$
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	15						V	I_C = 30 mA (pulsed)	$I_B = 0$
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)				20			V	I_C = 10 mA (pulsed)	$I_B = 0$
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3	4						I_C = 10 mA	V_{CE} = 10 V
h_{fe}	High Frequency Current Gain (f = 100 MHz)				3.5	5.8			I_C = 30 mA	V_{CE} = 10 V
C_{obo}	Base-Collector Capacitance		4	6				pF	$I_E = 0$	V_{CB} = 10 V
C_{obo}	Base-Collector Capacitance					3	5	pF	$I_E = 0$	V_{CB} = 5 V
C_{TE}	Emitter Transition Capacitance		6	9		7	8	pF	$I_C = 0$	V_{BE} = -0.5 V
τ_s	Charge Storage Time Constant (Notes 6-7)			25		10	20	ns	$I_C \approx I_{B1} \approx I_{B2} \approx 10$ mA	
t_{on}	Turn On Time (Note 7)			40		18	30	ns	$I_C \approx 10$ mA, $I_{B1} \approx 3$ mA,	$V_{BE} \approx -2$ V
t_{off}	Turn Off Time (Note 7)			75		50	70	ns	$I_C \approx 10$ mA, $I_{B1} \approx 3$ mA,	$I_{B2} \approx 1$ mA
r_b'	Base Spreading Resistance (Note 8)			50				Ω	I_C = 10 mA	V_{CE} = 10 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 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) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS- AR 5.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

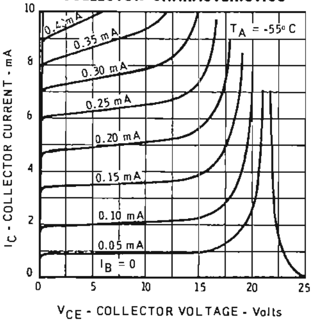
(6) Measured on Sampling Scope PW ≤ 400 ns.

(7) See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

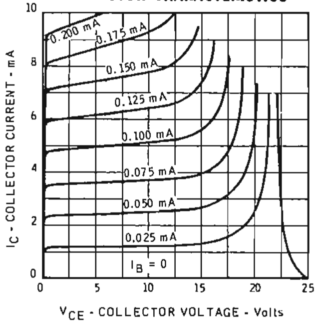
(8) $r_b' = h_{ie}$ (Real Part).

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

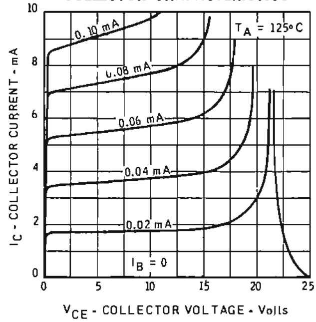
COLLECTOR CHARACTERISTICS*



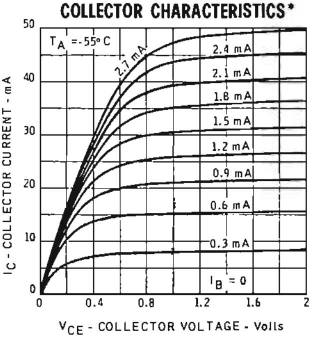
COLLECTOR CHARACTERISTICS*



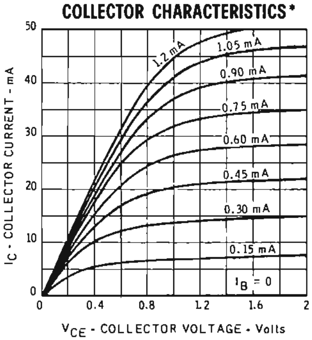
COLLECTOR CHARACTERISTICS*



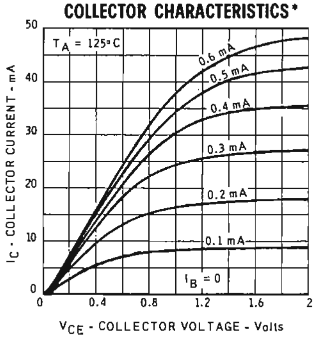
COLLECTOR CHARACTERISTICS*



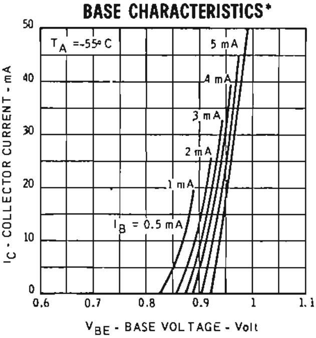
COLLECTOR CHARACTERISTICS*



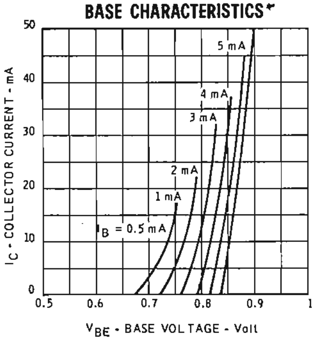
COLLECTOR CHARACTERISTICS*



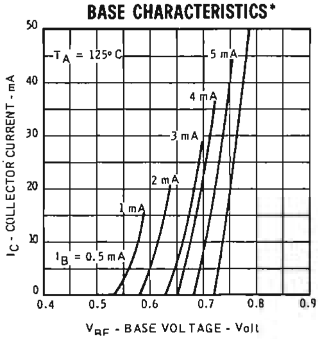
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



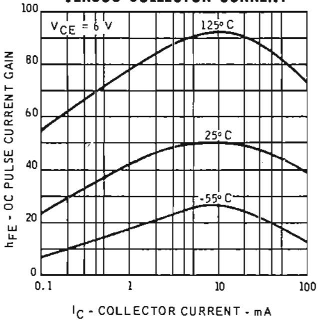
BASE CHARACTERISTICS*



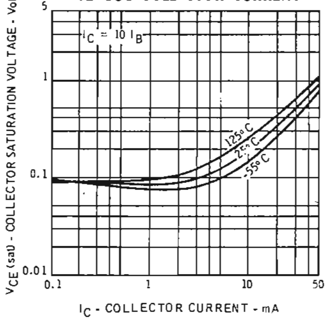
* Single family characteristics on Transistor Curve Tracer.

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

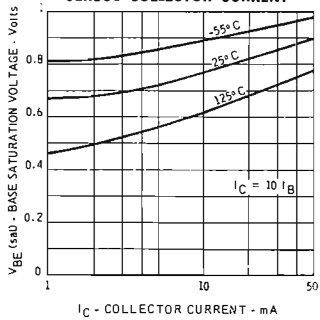
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



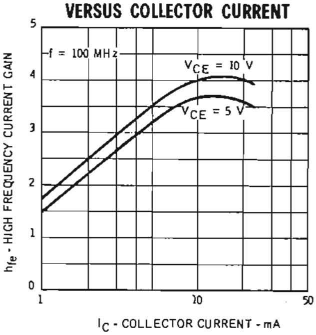
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



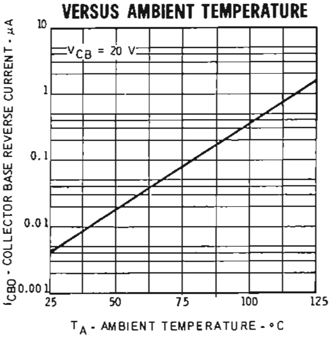
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



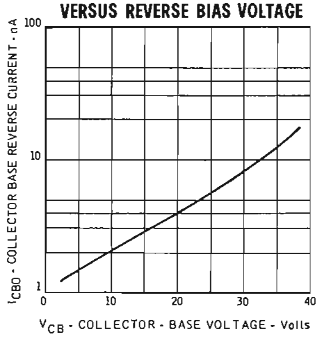
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



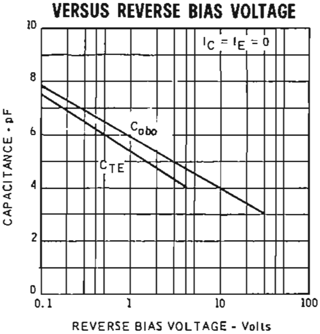
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



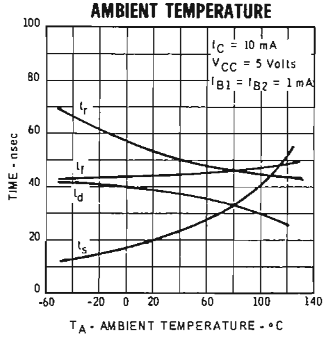
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



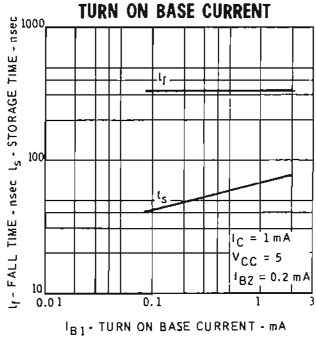
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE

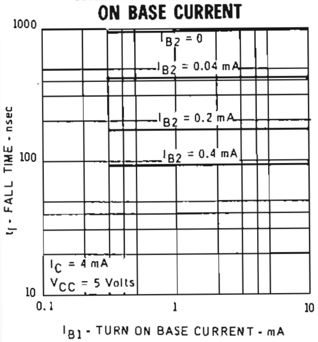


STORAGE AND FALL TIMES VERSUS TURN ON BASE CURRENT

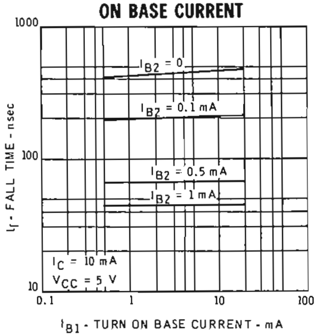


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

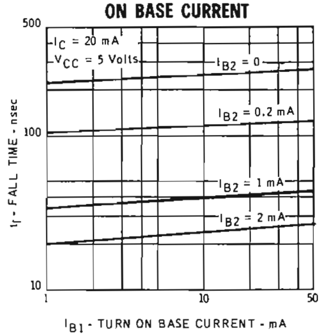
FALL TIME VERSUS TURN ON BASE CURRENT



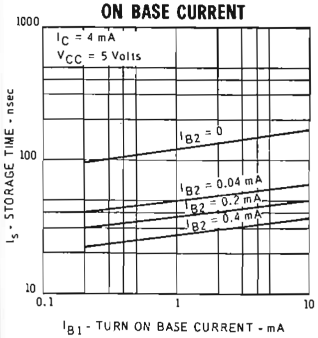
FALL TIME VERSUS TURN ON BASE CURRENT



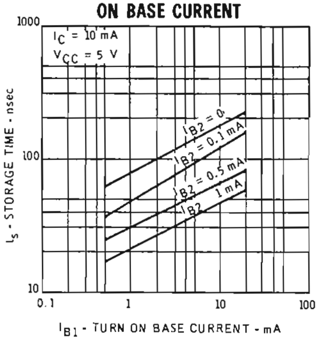
FALL TIME VERSUS TURN ON BASE CURRENT



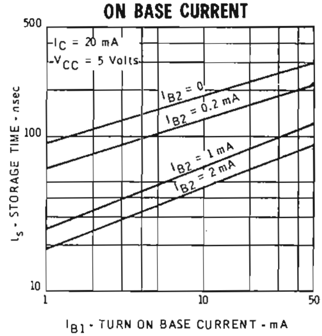
STORAGE TIME VERSUS TURN ON BASE CURRENT



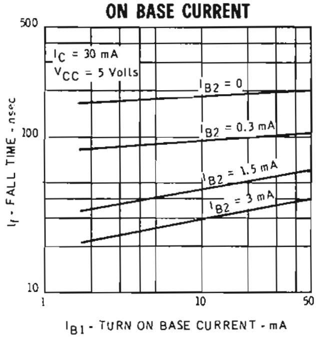
STORAGE TIME VERSUS TURN ON BASE CURRENT



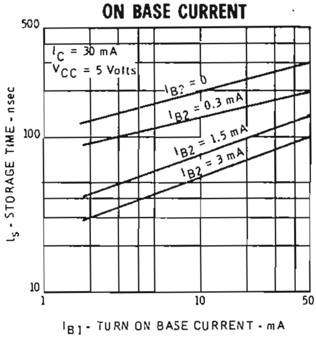
STORAGE TIME VERSUS TURN ON BASE CURRENT



FALL TIME VERSUS TURN ON BASE CURRENT

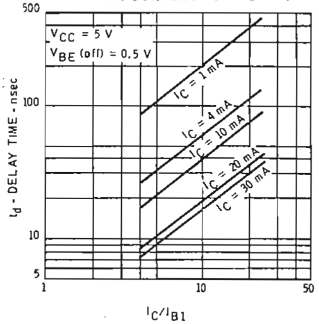


STORAGE TIME VERSUS TURN ON BASE CURRENT

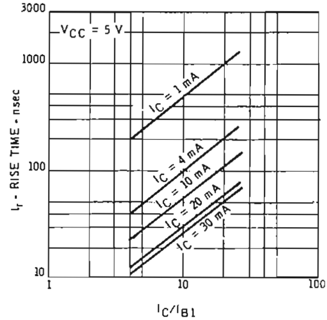


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

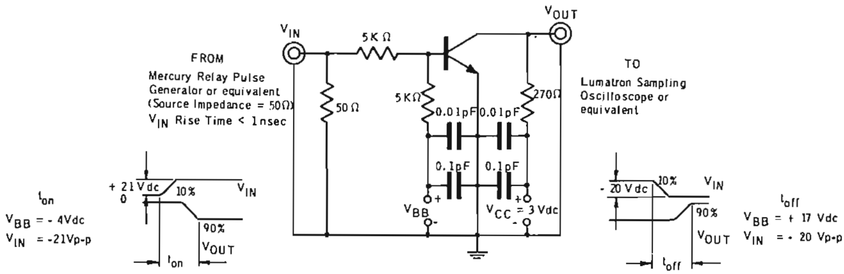
DELAY TIME VERSUS RATIO OF COLLECTOR CURRENT TO BASE DRIVE



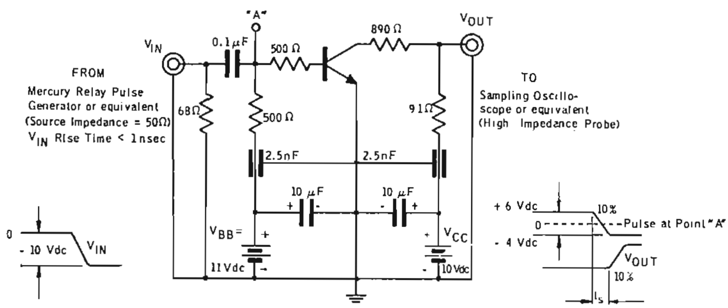
RISE TIME VERSUS RATIO OF COLLECTOR CURRENT TO BASE DRIVE



TURN ON AND TURN OFF TIMES TEST CIRCUIT

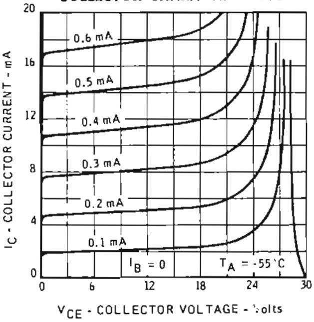


CHARGE STORAGE TIME CONSTANT TEST CIRCUIT

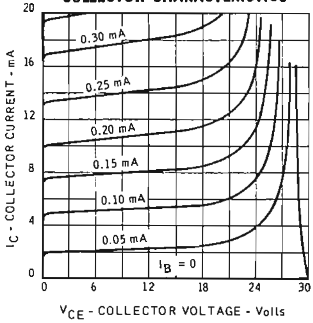


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

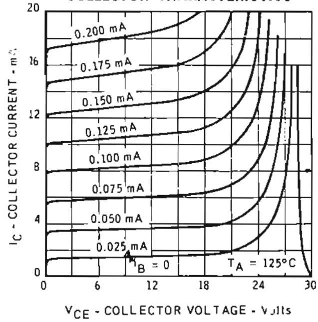
COLLECTOR CHARACTERISTICS*



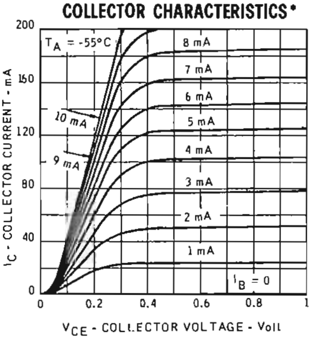
COLLECTOR CHARACTERISTICS*



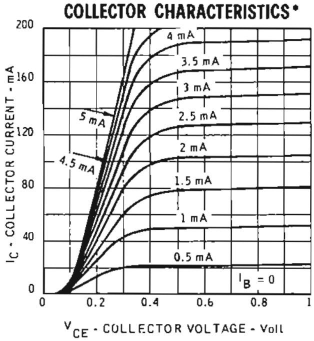
COLLECTOR CHARACTERISTICS*



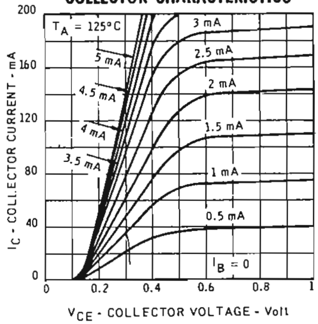
COLLECTOR CHARACTERISTICS*



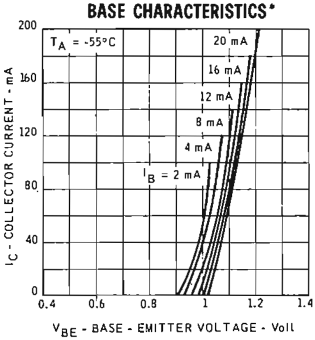
COLLECTOR CHARACTERISTICS*



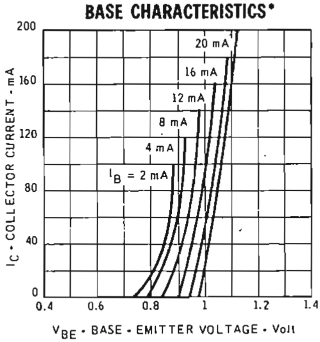
COLLECTOR CHARACTERISTICS*



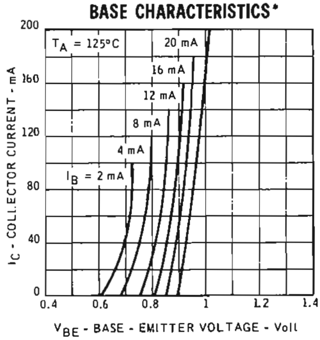
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



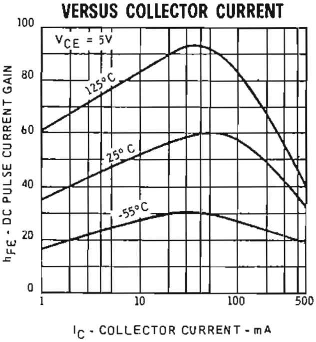
BASE CHARACTERISTICS*



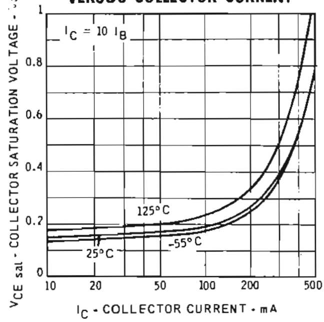
*Single family characteristics on Transistor Curve Tracer.

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

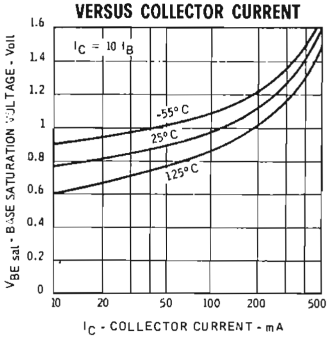
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



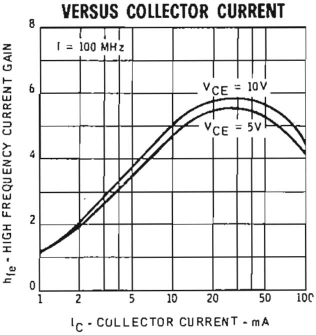
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



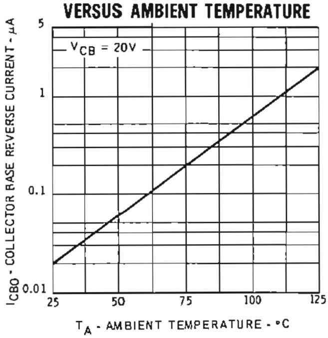
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



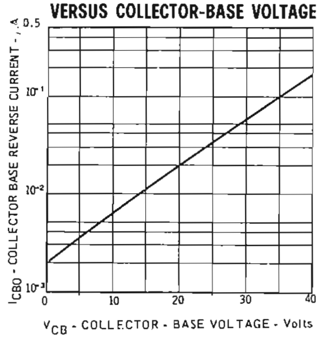
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



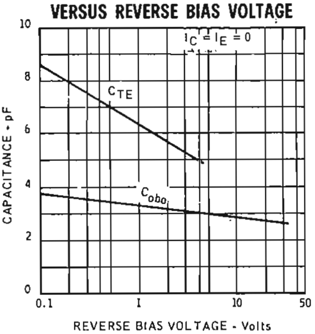
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



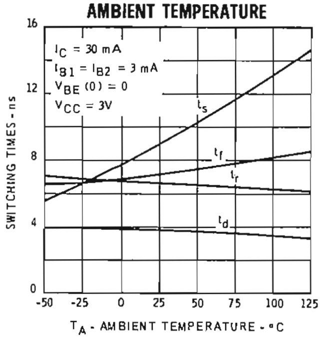
COLLECTOR REVERSE CURRENT VERSUS COLLECTOR-BASE VOLTAGE



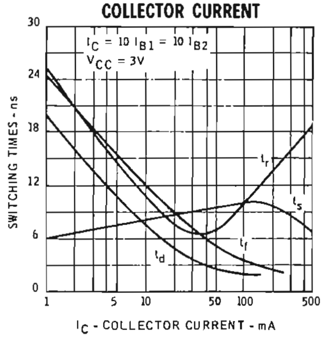
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE

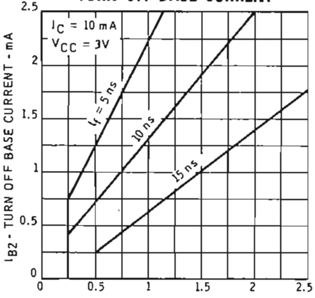


SWITCHING TIMES VERSUS COLLECTOR CURRENT

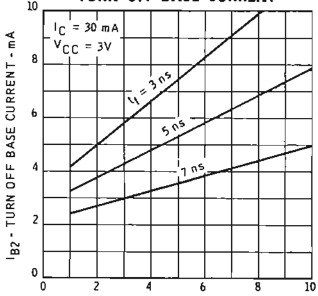


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

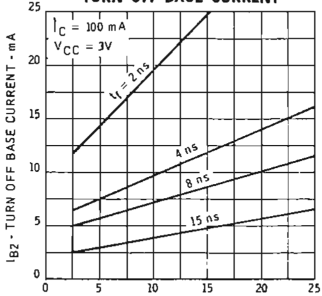
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



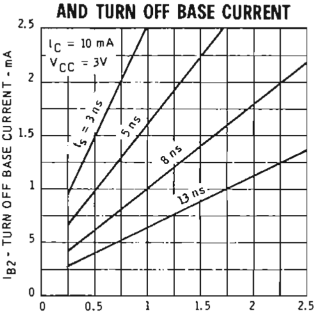
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



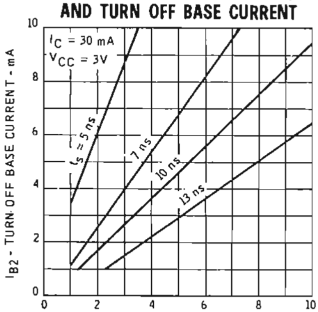
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



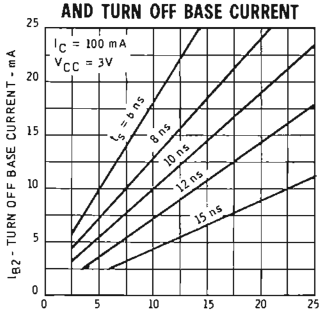
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



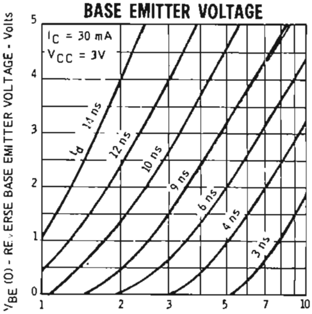
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



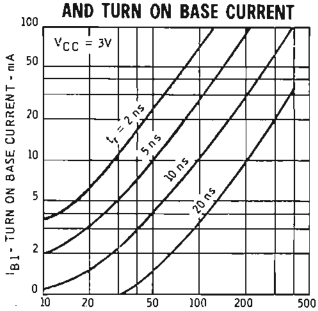
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



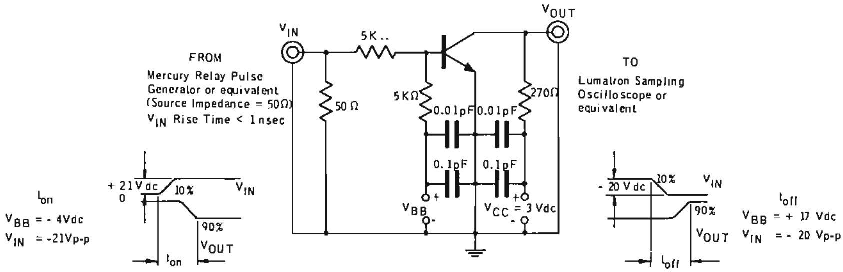
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



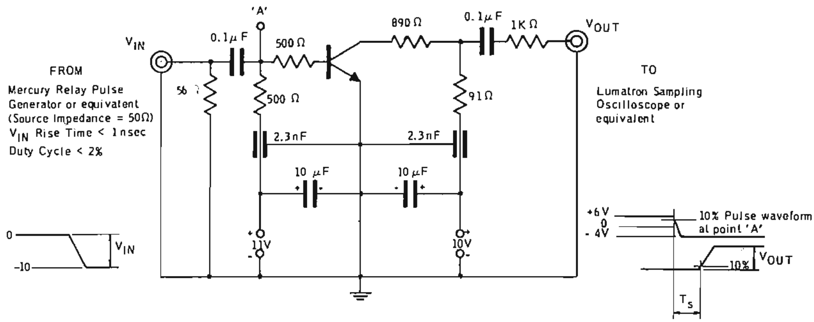
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



TURN ON AND TURN OFF TIMES TEST CIRCUIT



CHARGE STORAGE TIME CONSTANT TEST CIRCUIT



NPN diffused silicon planar transistor — BSX 93

High frequency saturated switch

The BSX 93 is an NPN silicon Planar epitaxial transistor designed specifically for high-speed saturated switching applications in the 50 - 100MHz range at current levels from 100 microamps to 100milliamps. It is suitable for most satellite and conventional, small signal, RF and digital type circuits.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5) I_C = 10 mA V_{CE} = 1V I_C = 100 mA V_{CE} = 1V	40 20	80 70	120	
h_{FE}	DC Current Gain (5) I_C = 10 mA V_{CE} = 1V T_A = 55°C	20	40		
$V_{BE\,sat}$	Base Saturation Voltage (5) I_C = 10 mA I_B = 1 mA	0.72	0.75	0.85	V
$V_{BE\,on}$	Base-Emitter On Voltage I_C = 10 mA V_{CE} = 1V		0.7		V
$V_{CE\,sat}$	Collector Saturation Voltage (5) I_C = 10 mA I_B = 1 mA		0.15	0.20	V
I_{CBO}	Collector Reverse Current V_{CB} = 20 V I_E = 0		0.1	0.2	µA
I_{CBO}	Collector Reverse Current V_{CB} = 20 V I_E = 0 T_A = 150°C		10	70	uA
BV_{CBO}	Collector to Base Breakdown Voltage I_C = 10 µA I_E = 0	40			V
BV_{CES}	Collector to Emitter Breakdown Voltage I_C = 10 µA V_{EB} = 0	40			V
BV_{EBO}	Emitter to Base Breakdown Voltage I_E = 10 µA I_C = 0	5			V
LV_{CEO}	Collector to Emitter Sustaining Voltage (4 and 5) I_C = 10 mA I_B = 0	15			V
h_{fe}	High Freq. Current Gain I_C = 10 mA V_{CE} = 10V f = 100 MHz	4	6.5		
C_{TE}	Emitter Transition Capacitance I_C = 0 V_{EB} = 0.5V		3.8	6	pF
C_{obo}	Base-Collector Capacitance I_E = 0 V_{CB} = 5V		2.5	4	pF
τ_s	Charge Storage Time Constant (6) $I_C = I_{B1} = I_{B2}$ = 10 mA		6	13	ns
t_{on}	Turn On Time (6) I_C = 10 mA I_{B1} = 3 mA		9	12	ns
t_{off}	Turn Off Time (6) I_C = 10 mA I_{B1} = 3 mA I_{B2} = 1.5 mA		13	18	ns

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages and Currents

Collector to Base	V_{CBO}	40V
Collector to Emitter (4)	V_{CEO}	15V
Collector to Emitter	V_{CES}	40V
Emitter to Base	V_{EBO}	5V
Collector Current (10 µsec Pulse)	I_C	500mA

Temperatures

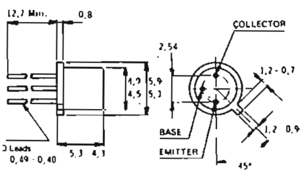
Storage Temperature	T_{STG}	-65°C to 200°C
Junction Temperature	T_J	200°C
Lead Temperature (Soldering, no time limit)	T_L	300°C

Power (2-3)

Dissipation at 25°C Case Temperature	P_D	1W
Dissipation at 25°C Ambient Temperature	P_D	0.36W

PHYSICAL DIMENSIONS

Similar to Jedec TO-18



Note All dimensions are in mm.

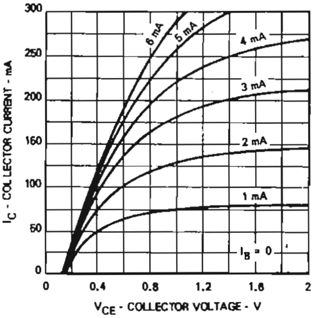
NOTES:

(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 175°C/W (derating factor of 5.7 mW/°C); junction-to-ambient thermal resistance of 486°C/W (derating factor of 2.06 mW/°C).
(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS - AR 5.
(5) Measured under pulse conditions: pulse length = 300 µsec; duty cycle = 1%.
(6) See switching circuits for exact values of I_C, I_{B1} and I_{B2}.

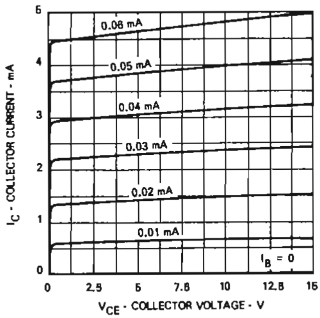
JUNE 1970

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

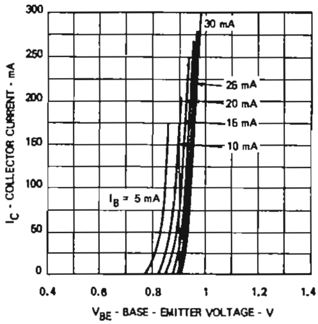
COLLECTOR CHARACTERISTICS *



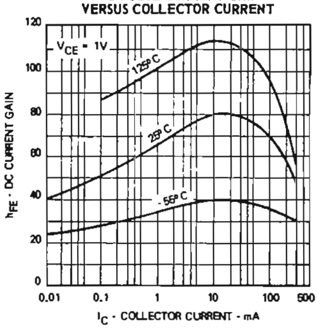
COLLECTOR CHARACTERISTICS *



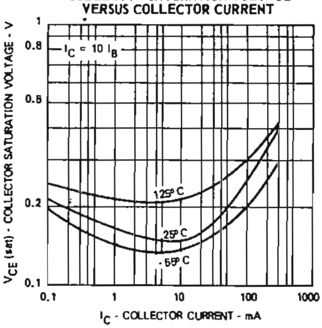
BASE CHARACTERISTICS *



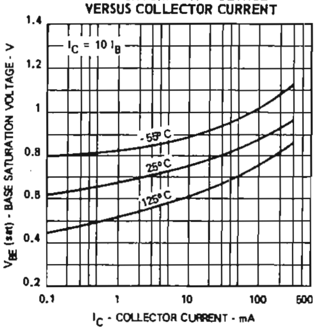
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



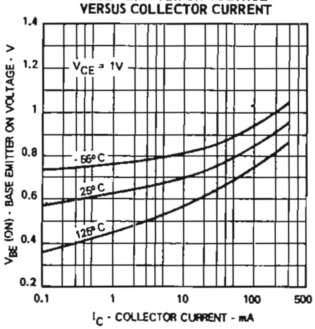
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



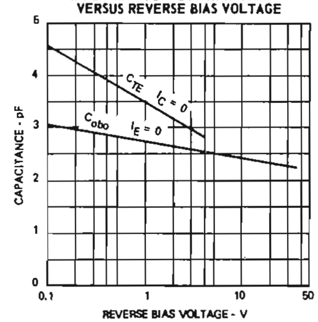
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



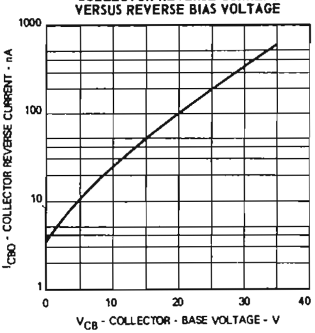
BASE - EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

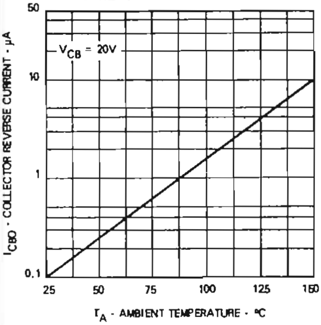


COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE

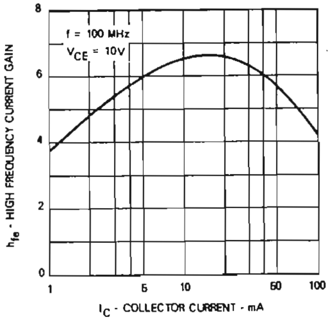


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

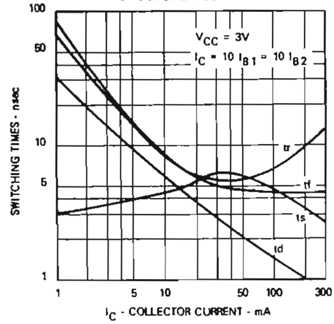
COLLECTOR REVERSE CURRENT VERSUS TEMPERATURE



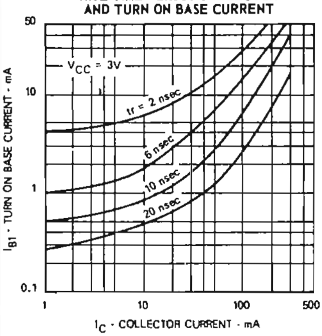
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



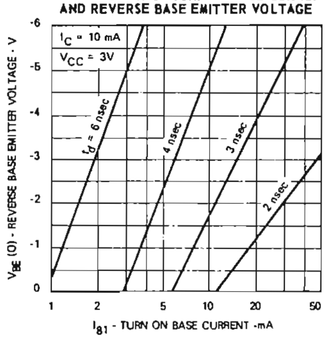
SWITCHING TIMES VERSUS COLLECTOR CURRENT



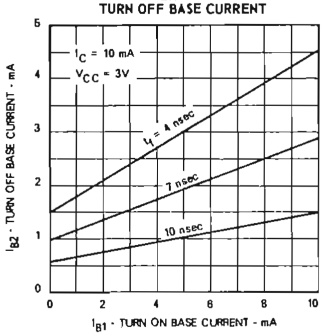
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



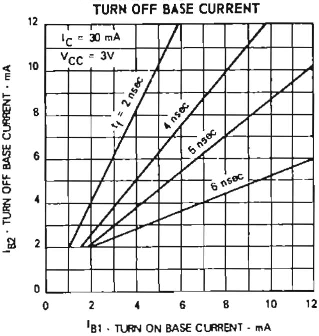
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



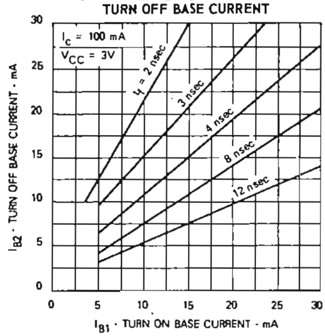
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



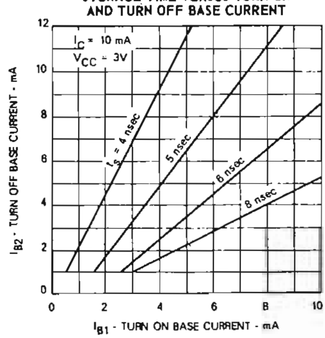
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

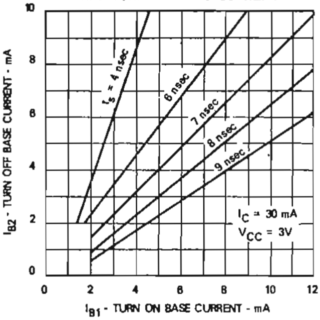


STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

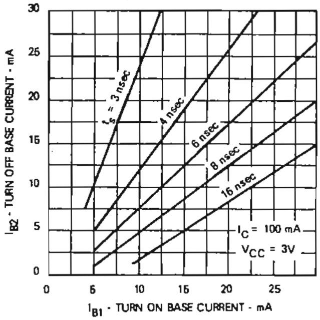


TYPICAL ELECTRICAL CHARACTERISTICS (25 °C free air temperature unless otherwise noted)

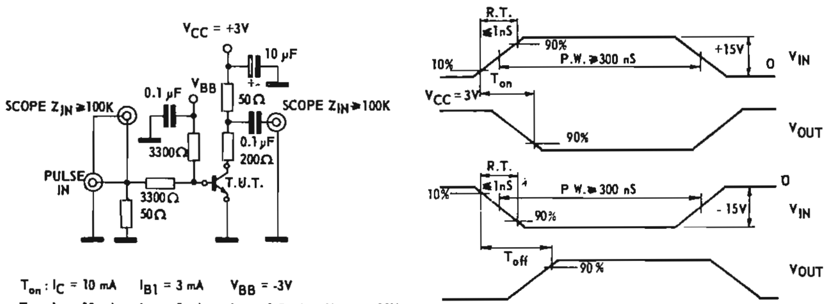
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



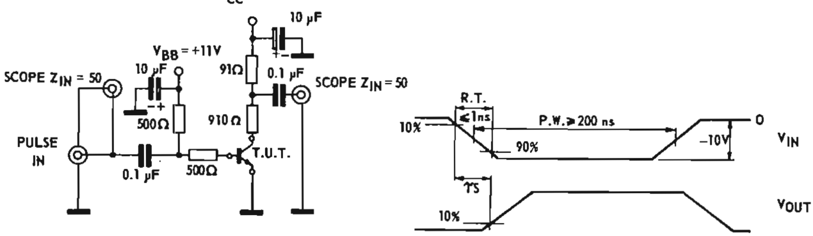
TEST CIRCUIT T_{ON} T_{OFF}



T_{on} : I_C = 10 mA I_{B1} = 3 mA V_{BB} = -3V

T_{off}: I_C = 10 mA I_{B1} = 3 mA I_{B2} = 1.5 mA V_{BB} = +12V

TEST CIRCUIT τ_s



τ_s = I_C = I_{B1} = I_{B2} = 10 mA

NPN diffused silicon planar transistor

2N 914

Saturated logic switch and VHF amplifier

The 2N914 is an NPN double-diffused silicon Planar epitaxial transistor encased in the JEDEC TO-18 package. It provides improved operation over the popular 2N706 and 2N708, and also gives greater latitude in circuit design. The Planar structure provides low leakage currents, wide beta range, and superior reliability. The epitaxial feature gives an extremely low V_{CEsat} that is relatively temperature insensitive. The 2N914 is primarily a universal switch but it is also an excellent high-speed high-gain logic and memory driver at collector currents up to 500 mA.

ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Pulse Current Gain (5)				
	I_C=10mA V_{CE}=1V	30	55	120	
	I_C=500mA V_{CE}=5V	10	17		
	I_C=10mA V_{CE}=1V T_A=-55°C	12	28		
V_{BEsat}	Base Saturation Voltage (5)				
	I_C=10mA I_B=1mA	0.70	0.74	0.80	V
V_{CEsat}	Collector Saturation Voltage (5)				
	I_C=200mA I_B=20mA		0.40	0.70	V
	I_C=10 I_B T_A=-55 to 125°C (5 and 6)		0.20	0.25	V
h_{fe}	High Frequency Current Gain				
	I_C=20mA V_{CE}=10V f=100mc	3	3.7		
C_{ob}	Output Capacitance				
	I_E=0 V_{CB}=10V		4.5	6	pF
C_{ib}	Input Capacitance				
	I_C=0 V_{EB}=0.5V			9	pF
I_{CBO}	Collector Cutoff Current				
	I_E=0 V_{CB}=20V		4	25	m µA
	I_E=0 V_{CB}=20V T_A=150°C		3	15	µA
BV_{CBO}	Collector to Base Breakdown Voltage				
	I_C=1 µA I_E=0	40			V
V_{CER}(sust)	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C=30mA (pulsed) R_{BE}≤10 Ω	20			V
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C=30mA (pulsed) I_B=0	15			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_C=0 I_E=10 µA	5			V
I_{EBO}	Emitter Current				
	I_C=0 V_{EB}=4V		0.007	0.1	µA
I_{CEX}	Collector Current				
	V_{CE}=20V V_{BE}=-0.25V T_A=125°C		3	10	µA
τ_s	Charge Storage Time Constant (7 and 8)				
	I_C=I_{B1} ≈ 20mA, I_{B2} ≈ -20mA		13	20	nsec
t_{d+r}	Turn on Time (8)				
	I_C ≈ 200mA, I_{B1} ≈ 40mA		25	40	nsec
t_{s+f}	Turn off Time (8)				
	I_C ≈ 200mA, I_{B1} ≈ 40mA, I_{B2} ≈ -20mA		25	40	nsec

ABSOLUTE MAXIMUM RATINGS (1)

(T_A = 25° C unless otherwise noted)

Voltages

Collector to Base	V_{CBO}	40 V
Collector to Emitter (4) (R_{BE} ≤ 10 Ω)	V_{CER}	20 V
Collector to Emitter (4)	V_{CEO}	15 V
Emitter to Base	V_{EBO}	5 V

Temperatures

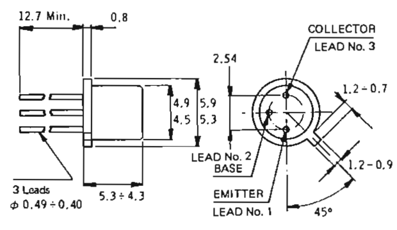
Storage Temperature	T_{STG}	-65°C to +300°C
Operating Junction Temperature	T_J	200°C max
Lead Temperature (Soldering, No Time Limit)	T_L	300°C max

Power (2 and 3)

Dissipation at 25°C Case Temperature	P_D	1.2 W
Dissipation at 100°C Case Temperature	P_D	0.68 W
Dissipation at 25°C Ambient Temperature	P_D	0.36 W

PHYSICAL DIMENSIONS

in accordance with JEDEC TO-18 outline



Notes : all dimensions in mm.

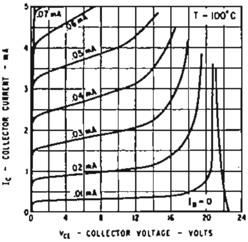
NOTES :

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 145°C/W (derating factor of 6.9 mW/°C) junction to-ambient thermal resistance of 486°C/W (derating factor of 2.1 mW/°C).
4) Rating refers to a high current point where collector-to-emitter voltage is lowest. For more information send for SGS AR5.
5) Pulse conditions: length = 300 µsec; duty cycle = 1%.
6) I_C= 1mA through 20 mA.
7) Measured on Sampling Scope. PW ≥ 200 nsec.
8) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

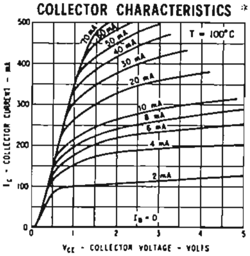
JULY 1971

TYPICAL ELECTRICAL CHARACTERISTICS

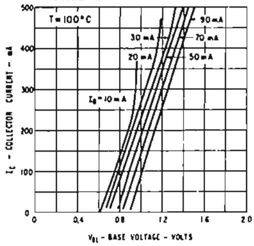
COLLECTOR CHARACTERISTICS *



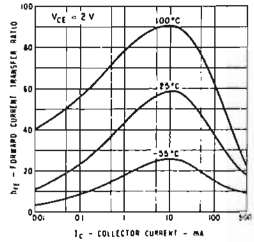
COLLECTOR CHARACTERISTICS *



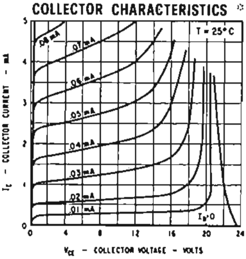
BASE CHARACTERISTICS *



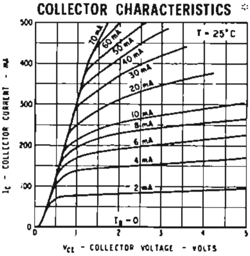
PULSED DC CURRENT GAIN VS. COLLECTOR CURRENT



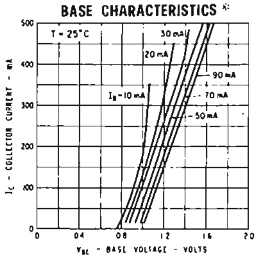
COLLECTOR CHARACTERISTICS *



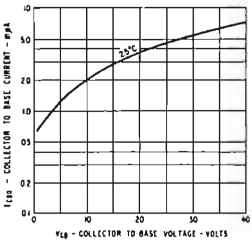
COLLECTOR CHARACTERISTICS *



BASE CHARACTERISTICS *



COLLECTOR-BASE DIODE REVERSE CURRENT VS. REVERSE BIAS VOLTAGE



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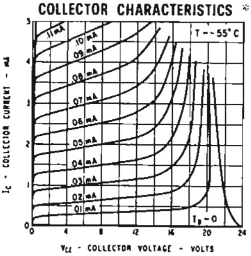
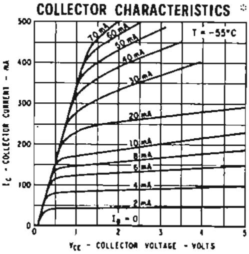
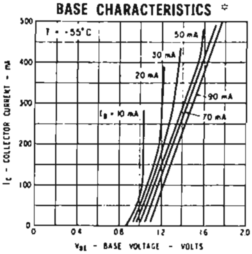


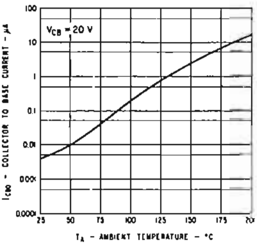
COLLECTOR CHARACTERISTICS *



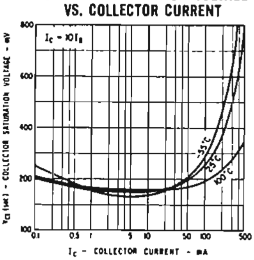
BASE CHARACTERISTICS *



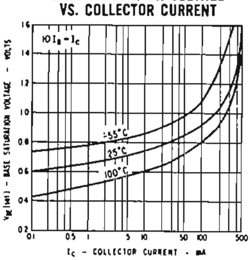
COLLECTOR-BASE DIODE REVERSE CURRENT VS. TEMPERATURE



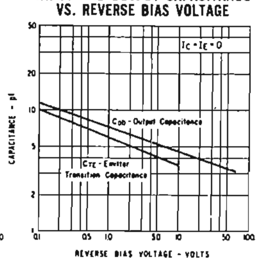
COLLECTOR SATURATION VOLTAGE VS. COLLECTOR CURRENT



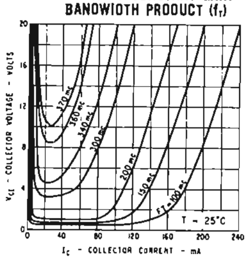
BASE SATURATION VOLTAGE VS. COLLECTOR CURRENT



INPUT AND OUTPUT CAPACITANCE VS. REVERSE BIAS VOLTAGE



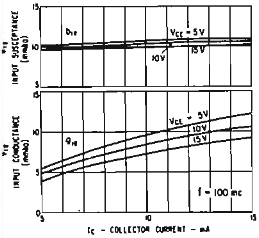
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



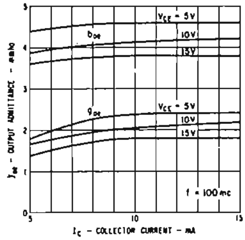
*Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

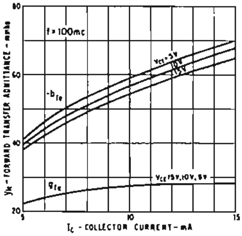
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



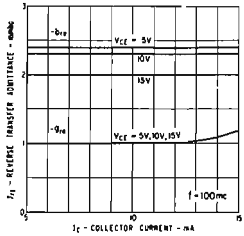
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



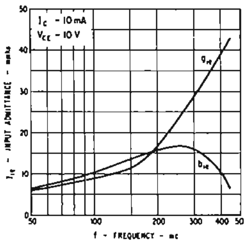
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



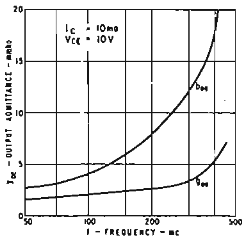
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



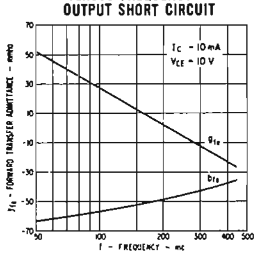
INPUT ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



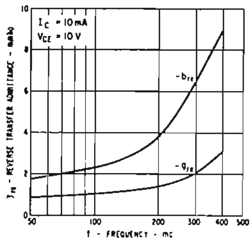
OUTPUT ADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT



FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT

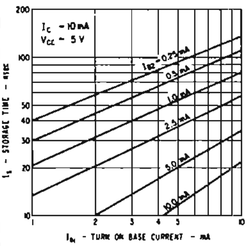


REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT

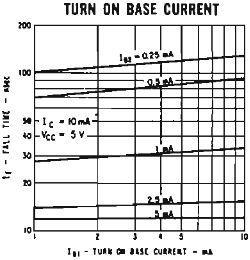


TYPICAL PERFORMANCE DATA

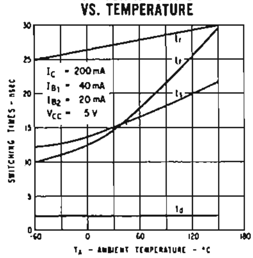
STORAGE TIME VS. TURN ON BASE CURRENT



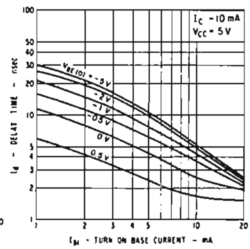
FALL TIME VS. TURN ON BASE CURRENT



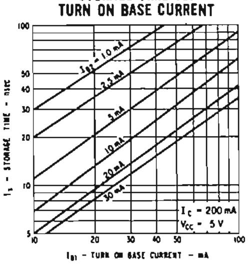
SWITCHING TIMES VS. TEMPERATURE



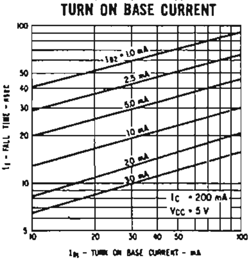
DELAY TIME VS. TURN ON BASE CURRENT



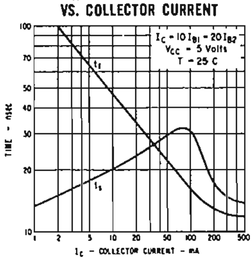
STORAGE TIME VS. TURN ON BASE CURRENT



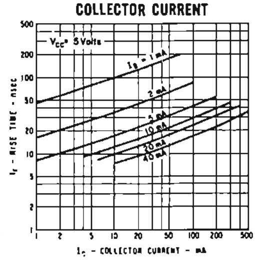
FALL TIME VS. TURN ON BASE CURRENT



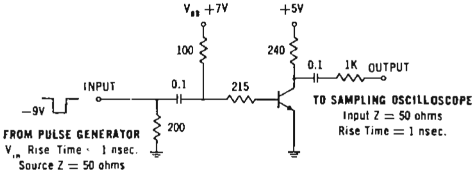
STORAGE AND FALL TIMES VS. VS. COLLECTOR CURRENT



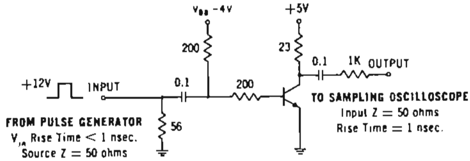
RISE TIME VS. COLLECTOR CURRENT



CHARGE STORAGE TIME-CONSTANT TEST CIRCUIT



T_{on} AND T_{off} TEST CIRCUIT



Ultra-high frequency oscillator and amplifier

The 2N918 is an NPN double-diffused silicon Planar epitaxial transistor. It is designed for low-noise high-frequency amplifiers; 1kMc/s local oscillators; non-neutralized IF amplifiers and non-saturating circuits with rise and fall times of less than 2.5 nsec.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A=25°C unless otherwise noted)

Voltages and Current

Collector to Base	V_{CBO}	30 V
Collector to Emitter (4)	V_{CEO}	15 V
Emitter to Base	V_{EBO}	3 V
Collector Current	I_C	50 mA

Temperatures

Storage Temperature	T_{STG}	-65°C to + 300°C
Operating Junction Temperature	T_J	200°C Max
Lead Temperature (Soldering, No Time Limit)	T_L	300°C Max

Power (2 and 3)

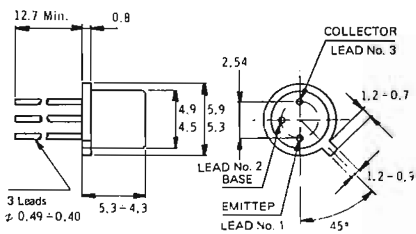
Dissipation at 25°C Case Temperature	P_D	0.3 W
Dissipation at 25°C Ambient Temperature	P_D	0.2 W

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain (5) I_C = 3mA V_{CE} = 1V	20	50		
V_{BEsat}	Base Saturation Voltage (5) I_C = 10mA I_B = 1mA			1	V
V_{CEsat}	Collector Saturation Voltage (5) I_C = 10mA I_B = 1mA			0.4	V
BV_{CBO}	Collector to Base Breakdown Voltage I_C = 1 μA I_E = 0	30			V
BV_{EBO}	Emitter to Base Breakdown Voltage I_{CO} = 0 I_E = 10 μA	3			V
$V_{CEOsust}$	Collector to Emitter Sustaining Voltage (4) I_C = 3mA I_B = 0	15			V
I_{CBO}	Collector Cutoff Current I_E = 0 V_{CB} = 15V			10	nA
	I_E = 0 V_{CB}=15V T_A=150°C			1	μA
h_{fe}	High Frequency Current Gain I_C =4mA V_{CE}=10V f=100 Mc/s	6	9		
C_{obo}	Common-Base, Open-Circuit Output Capacitance I_E=0 V_{CB}=10V		1	1.7	pF
	I_E=0 V_{CB}=0		1.8	3	pF
C_{ibo}	Input Capacitance I_C =0 V_{EB}= 0.5V			2	pF
G_{pe}	Available Power Gain (neutralized) I_C=6mA V_{CB}=12V f=200 Mc/s	15	18		dB
P_o	Power Output I_C=8mA V_{CB}=15V f=500 Mc/s	30	40		mW
η	Collector Efficiency I_C=8mA V_{CB}=15V f=500 Mc/s	25			%
NF	Noise Figure (5) I_C =1mA V_{CE}=6V		3	6	dB

NOTES :
1) These ratings are limiting values above which the serviceability of any 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 584°C/W (derating factor of 1.71 mW/°C). Junction-to-ambient thermal resistance of 875°C/W (derating factor of 1.14 mW/°C).
4) Rating refers to a high current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
5) f = 60 Mc/s; R_g = 400 Ω.
6) C_{cb} measured using three thermal measurement technique with case and emitter guarded.

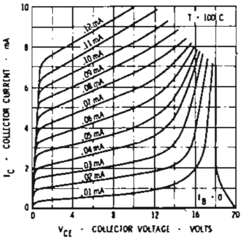
PHYSICAL DIMENSIONS
similar to JEDEC TO-18 outline

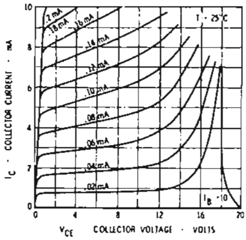


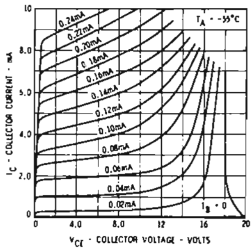
Note : all dimensions in mm.

JULY 1971

TYPICAL COLLECTOR CHARACTERISTICS *

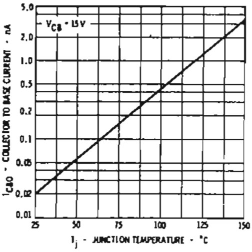




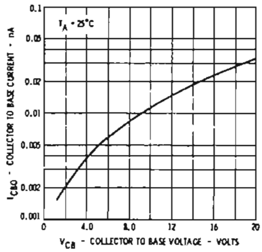


TYPICAL ELECTRICAL CHARACTERISTICS

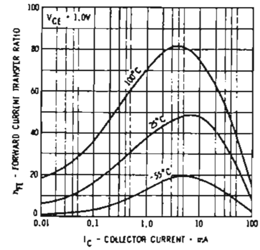
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



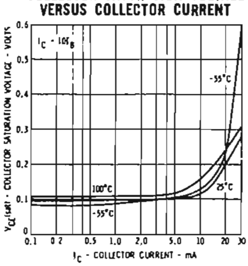
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



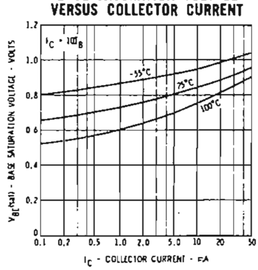
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



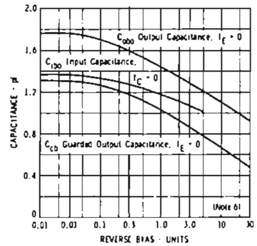
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



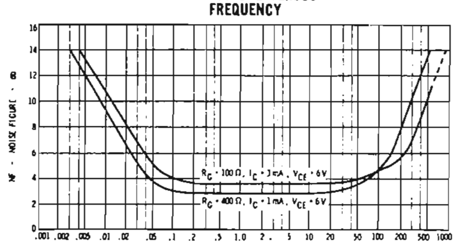
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



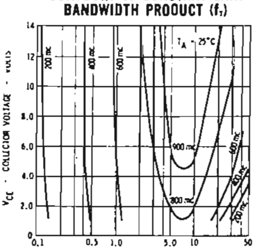
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



NOISE FIGURE VERSUS FREQUENCY



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

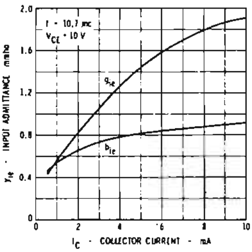


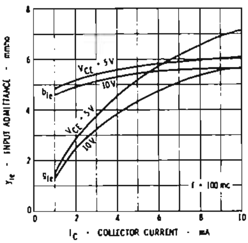
* Single family characteristics on Transistor Curve Tracer.

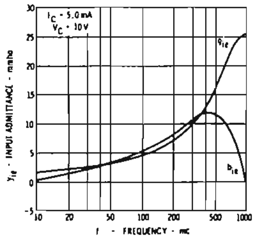
TYPICAL SMALL SIGNAL COMMON EMITTER "Y" PARAMETERS

10.7 Mc/s	100 Mc/s	vs. FREQUENCY
$V_{CE} = 10V$	vs. COLLECTOR CURRENT	$V_{CE} = 10V$ $I_C = 5$ mA

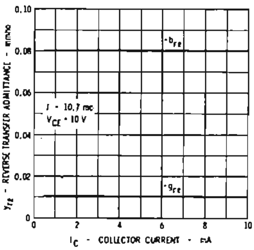
y_{ie}
Input Admittance
(output short circuit)

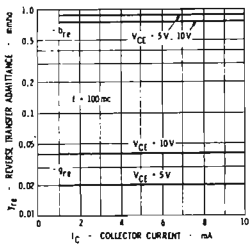


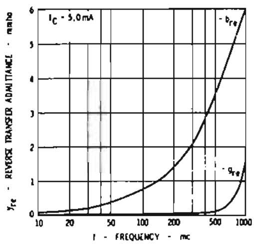




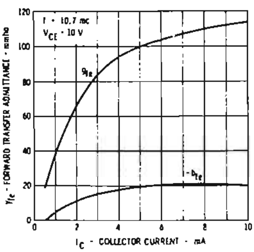
y_{re}
Reverse
Transfer Admittance
(input short circuit)

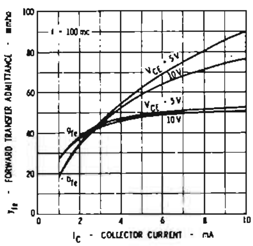


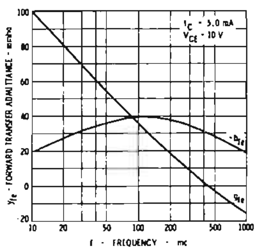




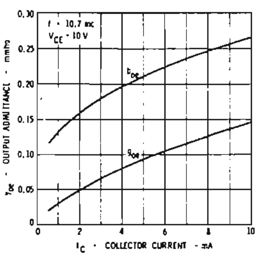
y_{fe}
Forward
Transfer Admittance
(output short circuit)

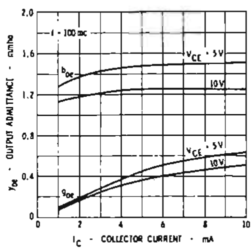


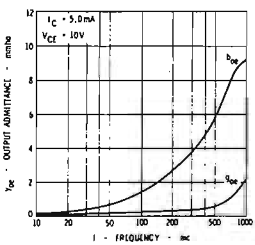




y_{oe}
Output Admittance
(input short circuit)

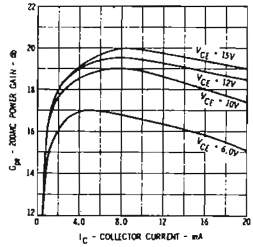


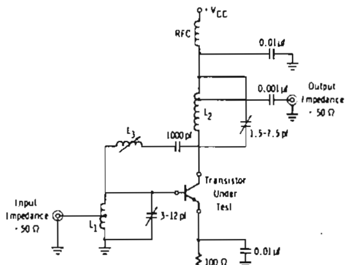




NEUTRALIZED 200 Mc/s POWER GAIN AMPLIFIER TEST CIRCUIT

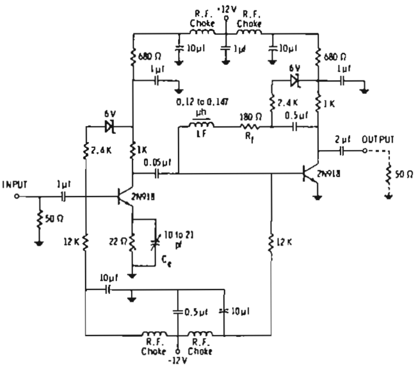
TYPICAL PERFORMANCE



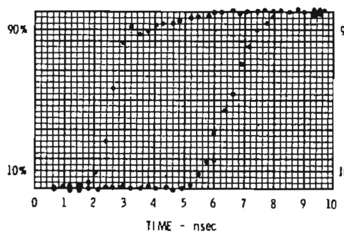


L_1 - 3.5 Turns #16 wire; 5/16" Dia.; 7/16" Long. Turns Ratio 4 to 2
L_2 - 8 Turns #16 wire; 1/8" Dia.; 7/8" Long. Turns Ratio 8 to 1
L_3 - 0.4-0.65μh, adjustable core

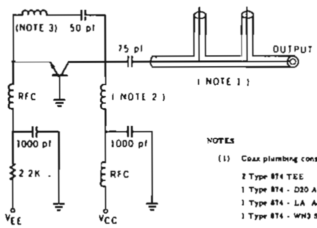
TWO STAGE VIDEO AMPLIFIER



INPUT TO OUTPUT DELAY – 4nsec



500 Mc/s OSCILLATOR TEST CIRCUIT



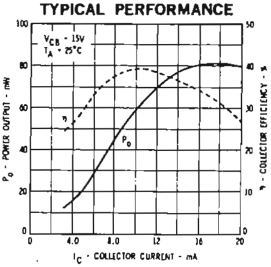
NOTES

(1) Coax plumbing consists of the following GR air lines
2 Type 874 TEE
1 Type 874 - D20 Adjustable Stub
1 Type 874 - LA Adjustable Line
1 Type 874 - WN3 Short - Circuit Termination

(2) 2 turns #16 AWG wire, 3/8 inch OD, 1-1/4 inch long

(3) 9 turns #22 AWG wire, 3/16 inch OD, 1/2 inch long

TYPICAL PERFORMANCE



NPN diffused silicon planar transistors

2N1613 - 2N1711

Switches and universal amplifiers

The 2N1613 and 2N1711 are NPN double-diffused silicon Planar transistors designed for use in high performance amplifier, oscillator and switching circuits. The 2N1711 is also used to advantage in amplifiers where low noise is an important factor. These transistors provide useful current gain from the microampere region up to 500mA and have the many desirable advantages of the Planar structure and diffusion techniques.

ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain •				
h_{fe}	High Frequency Current Gain •				
NF	Noise Figure •				
V_{BEsat}	Base Saturation Voltage (5) I_C=150mA I_B=15mA		0.95	1.3	V
V_{CEsat}	Collector Saturation Voltage (5) I_C=150mA I_B=15mA				
	2N 1613		0.6	1.5	V
	2N 1711		0.5	1.5	V
C_{ob}	Output Capacitance I_E=0 V_{CB}=10V		18	25	pF
C_{TE}	Emitter Transition Capacitance I_C=0 V_{EB}=0.5V		50	80	pF
I_{CBO}	Collector Cutoff Current I_E=0 V_{CB}=60V		0.3	10	m µA
	I_E=0 V_{CB}=60V T_A=150°C		0.4	10	µA
BV_{CBO}	Collector to Base Breakdown Voltage I_C=0.1mA I_E=0	75			V
$V_{CERsust}$	Collector to Emitter Sustaining Voltage (4 and 5) I_C=100mA (pulsed) $R_{BE} \leq 10\,\Omega$	50			V
BV_{EBO}	Emitter to Base Breakdown Voltage I_C=0 I_E=0.1mA	7			V
I_{EBO}	Emitter Current I_C=0 V_{EB}=5V				
	2N 1613		0.05	10	m µA
	2N 1711		0.05	5	m µA

• For these parameters, see table on next page.

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/W (derating factor of 17.2 mW/°C). Junction-to-ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).
4) Rating refers to a high current point where collector-to-emitter voltage is lowest. For more Information send for SGS AR5.
5) Pulse Conditions : length = 300 µsec; duty cycle ≤ 2%.
6) f = 1000 cps; R_G = 510 ..; 1 cycle bandwidth.

ABSOLUTE MAXIMUM RATINGS (1)

(T_A=25°C unless otherwise noted)

Voltages

Collector to Base	V_{CBO}	75 V
Collector to Emitter ($R_{BE} \leq 10\,\Omega$) (4)	V_{CER}	50 V
Emitter to Base	V_{EBO}	7 V

Temperatures

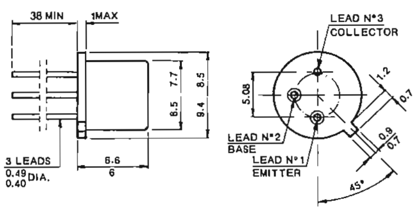
Storage Temperature	T_{STG}	-65°C to + 300°C
Operating Junction Temperature	T_J	200°C Max

Power (2 and 3)

Dissipation at 25°C Case Temperature	P_D	3 W
Dissipation at 100°C Case Temperature	P_D	1.7 W
Dissipation at 25°C Ambient Temperature	P_D	0.8 W

PHYSICAL DIMENSIONS

Similar to JEDEC TO-5 outline



Note : all dimensions in mm.

JULY 1971

ELECTRICAL CHARACTERISTICS (Contd.) (T_A = 25°C unless otherwise noted)

Symbol	Characteristic and Test Conditions	2N1613			2N1711			Uni
		Min.	Typ.	Max.	Min.	Typ.	Max.	
h_{FE}	DC Current Gain							
	I_C=0.1mA V_{CE}=10V	20	50		35	80		
	I_C=0.01mA V_{CE}=10V		35		20	60		
h_{FE}	DC Pulse Current Gain (5)							
	I_C=150mA V_{CE}=10V	40	80	120	100	130	300	
	I_C=10mA V_{CE}=10V	35	80		75	130		
	I_C=500mA V_{CE}=10V	20	55		40	75		
	I_C=10mA V_{CE}=10V T_A= -55°C	20	35		35	65		
h_{fe}	High Frequency Current Gain							
	I_C=50mA V_{CE}=10V f=20 mc	3	4		3.5	5		
NF	Noise Figure (6)							
	I_C=0.3mA V_{CE}=10V		6	12		3.5	8	dB

SMALL SIGNAL CHARACTERISTICS (f = 1Kc/s)

Symbol	Characteristic and Test Conditions	2N1613			2N1711			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
h_{ib}	Input Resistance							
	I_C= 1mA V_{CB}=5V	24	27	34	24	27	34	Ω
	I_C= 5mA V_{CB}=10V	4	6.3	8	4	6.3	8	Ω
h_{rb}	Voltage Feedback Ratio							
	I_C= 1mA V_{CB}=5V		0.7	3		1.2	5	x10^{-}
	I_C= 5mA V_{CB}=10V		0.8	3		1.2	5	x10^{-}
h_{fe}	Small Signal Current Gain							
	I_C= 1mA V_{CE}=5V	30	55	100	50	115	200	
	I_C= 5mA V_{CE}=10V	35	70	150	70	135	300	
h_{ob}	Output Conductance							
	I_C= 1mA V_{CB}=5V	0.1	0.16	0.5	0.1	0.16	0.5	μmho
	I_C= 5mA V_{CB}=10V	0.1	0.19	1	0.1	0.19	1	μmho
h_{ie}	Input Resistance							
	I_C= 1mA V_{CE}= 5V		2.2			4.4		KΩ
h_{re}	Voltage Feedback Ratio							
	I_C= 1mA V_{CE}= 5V		3.6			7.3		x10^{-4}
h_{oe}	Output Conductance							
	I_C= 1mA V_{CE}= 5V		12.5			23.8		μmhc

NPN diffused silicon planar transistor — 2N1893

General purpose high-voltage type

The 2N1893 is a high-voltage, NPN double-diffused silicon Planar transistor designed for use in high-performance amplifier, oscillator and switching circuits. The 2N1893 is rated at 3W. This transistor provides greater voltage swings in oscillator and amplifier circuits and more protection in inductive switching circuits due to its 120V collector-to-base voltage rating.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A=25°C unless otherwise noted)

Voltages		
Collector to Base	V_{CBO}	120 V
Collector to Emitter (4) ($R_{BE} \leq 10\ \Omega$)	V_{CER}	100 V
Collector to Emitter (4)	V_{CEO}	80 V
Emitter to Base	V_{EBO}	7 V

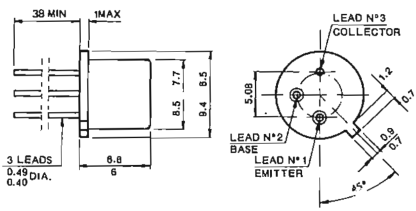
Temperatures		
Storage Temperature	T_{STG}	-65°C to + 300°C
Operating Junction Temperature	T_J	200°C
Lead Temperature (Soldering, No Time Limit)	T_L	300°C

Power (2 and 3)		
Dissipation at 25° Case Temperature	P_D	3 W
Dissipation at 100°C Case Temperature	P_D	1.7 W
Dissipation at 25°C Ambient Temperature	P_D	0.8 W

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Pulse Current Gain (5)				
	I_C=150mA V_{CE}=10V	40	80	120	
	I_C= 10mA V_{CE}=10V	35	80		
	I_C= 10mA V_{CE}=10V T_A=-55°C	20	40		
h_{FE}	DC Current Gain				
	I_C=0.1mA V_{CE}=10V	20	50		
V_{BEsat}	Base Saturation Voltage (5)				
	I_C=50mA I_B=5mA		0.82	0.9	V
	I_C=150mA I_B=15mA		0.96	1.3	V
V_{CEsat}	Collector Saturation Voltage (5)				
	I_C=50mA I_B=5mA		0.5	1.2	V
	I_C=150mA I_B=15mA		2	5	V
I_{CBO}	Collector Cutoff Current				
	I_E=0 V_{CB}=90V		0.3	10	nA
	I_E=0 V_{CB}=90V T_A=150°C		1.5	15	µA
BV_{CBO}	Collector to Base Breakdown Voltage				
	I_C=100 µA I_E=0	120			V
$V_{CER\,sust}$	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C=100mA (pulsed) $R_{BE} \leq 10\ \Omega$	100			V
$V_{CEO\,sust}$	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C=30mA (pulsed) I_B=0	80			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_C=0 I_E=100µA	7			V
I_{EBO}	Emitter Current				
	I_C=0 V_{EB}=5V		0.05	10	nA
C_{obo}	Output Capacitance				
	I_E=0 V_{CB}=10V		13	15	pF
C_{ibo}	Emitter Transition Capacitance				
	I_C=0 V_{EB}=0.5V		55	85	pF
h_{fe}	High frequency Current Gain				
	I_C=50mA V_{CE}=10V f = 20Mc	2.5	3.5		

PHYSICAL DIMENSIONS
similar to JEDEC TO-5 outline



Note : all dimensions in mm.

NOTES :
1) These ratings are limiting values above which the serviceability of any 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/W (derating factor of 17.2 mW/°C). Junction-to-ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).
4) Rating refers to a high current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
5) Pulse conditions : length = 300 µsec; duty cycle = 1%.

SMALL SIGNAL CHARACTERISTICS (f = 1KC)

Symbol	Characteristic and Test Conditions	Min.	Typ.	Max.	Unit
h_{ib}	Input Resistance				
	I_C = 1mA V_{CB} = 5V	20	27	30	Ω
	I_C = 5mA V_{CB} = 10V	4	6.4	8	Ω
h_{rb}	Voltage Feedback Ratio				
	I_C = 1mA V_{CB}=5V		0.5	1.25	$x10^{-4}$
	I_C = 5mA V_{CB}=10V		0.6	1.5	$x10^{-4}$
h_{fe}	Small Signal Current Gain				
	I_C = 1mA V_{CE} = 5V	30	70	100	
	I_C = 5mA V_{CE} = 10V	45	85		
h_{ob}	Output Conductance				
	I_C = 1mA V_{CB} = 5V		0.12	0.5	µmho
	I_C = 5mA V_{CB} = 10V		0.14	0.5	µmho
h_{ie}	Input Resistance				
	I_C = 1mA V_{CE} = 5V		2.8		kΩ
h_{re}	Voltage Feedback Ratio				
	I_C = 1mA V_{CE} = 5V		3.5		$x10^{-4}$
h_{oe}	Output Conductance				
	I_C = 1mA V_{CE} = 5V		11		µmho

NPN diffused silicon planar transistors

2N2218 - 19 - 21 - 22

High-speed switches

These devices are NPN silicon Planar epitaxial transistors designed for high-speed switching at collector currents up to 500mA. They feature useful beta over a wide range of collector current, low leakage currents, and low saturation voltages.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Max.	Unit
h_{FE}	DC Current Gain *			
h_{fe}	High Frequency Current Gain *			
V_{CEsat}	Collector Saturation Voltage (5)			
	I_C=150mA I_B=15mA		0.4	V
	I_C=500mA I_B=50mA		1.6	V
V_{BEsat}	Base Saturation Voltage (5)			
	I_C=150mA I_B=15mA		1.3	V
	I_C=500mA I_B=50mA		2.6	V
f_T	Gain-Bandwidth Product			
	I_C=20mA V_{CE}=20V f=100 Mc/s	250		Mc/s
I_{CBO}	Collector Cutoff Current			
	I_E=0 V_{CB}=50V		10	nA
	I_E=0 V_{CB}=50V T_A=150°C		10	µA
I_{EBO}	Emitter Cutoff Current			
	I_C=0 V_{EB}= 3V		10	nA
C_{ob}	Output Capacitance			
	I_E=0 V_{CB}=10V		8	pF
$R_{e(hie)}$	Real Part of Common-Emitter High-Frequency Input Impedance			
	I_C=20mA V_{CE}=20V f=300 Mc/s		60	Ω
BV_{CBO}	Collector to Base Breakdown Voltage			
	I_C=10 µA I_E=0	60		V
$V_{CEOsust}$	Collector to Emitter Sustaining Voltage (4 and 5)			
	I_C=10mA I_B=0	30		V
BV_{EBO}	Emitter to Base Breakdown Voltage			
	I_E=10 µA I_C=0	5		V

* For these parameters, see next page.

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 175°C and junction-to-case thermal resistance of 50°C/Watt (derating factor of 20 mW/°C); junction-to-ambient thermal resistance of 188°C/Watt (derating factor of 5.33mW/°C) for the 2N2218 and 2N2219. For the 2N2221 and 2N2222 junction-to-case thermal resistance of 83.5°C/Watt (derating factor of 12mW/°C); junction-to-ambient thermal resistance of 300°C/Watt (derating factor of 3.33mW/°C).
4) This rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
5) Pulse conditions : length = 300 µsec; duty cycle < 2%.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A=25°C unless otherwise noted)

Voltages and Current

Collector to Base	V_{CBO}	60 V
Collector to Emitter (4)	V_{CEO}	30 V
Emitter to Base	V_{EBO}	5 V
Collector Current	I_C	800 mA

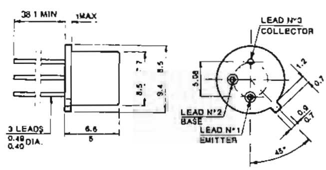
Temperatures

Storage Temperature	T_{STG}	-65°C to + 300°C
Operating Junction Temperature	T_J	-65°C to + 175° C

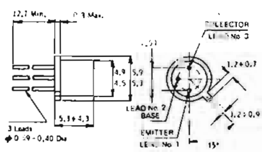
Power (2 and 3)

Dissipation at 25°C Case Temperature		
2N2218-2N2219	P_D	3 W
2N2221-2N2222	P_D	1.8 W
Dissipation at 25° C Ambient Temperature		
2N2218-2N2219	P_D	0.8 W
2N2221-2N2222	P_D	0.5 W

*** TO-5 package for 2N2218 - 19**



*** TO-18 package for 2N2221 - 22**



* Note : all dimensions in mm.

JULY 1971

ELECTRICAL CHARACTERISTICS (Contd.) (T_A = 25°C unless otherwise noted)

Symbol	Characteristic and Test Conditions	2N2218 - 2N2221		2N2219 - 2N2222		Unit
		Min.	Max.	Min.	Max.	
h_{FE}	DC Current Gain					
	I_C = 10 mA V_{CE} = 10V	35		75		
	I_C = 1 mA V_{CE} = 10V	25		50		
	I_C = 0.1 mA V_{CE} = 10V	20		35		
h_{FE}	DC Pulse Current Gain (5)					
	I_C = 150 mA V_{CE} = 10V	40	120	100	300	
	I_C = 150 mA V_{CE} = 1V	20		50		
	I_C = 500 mA V_{CE} = 10V	20		30		
h_{fe}	High Frequency Current Gain					
	I_C = 20 mA V_{CE} = 20V f = 100 Mc/s	2.5		2.5		
t_d	Turn–on Delay Time					
	I_C = 150 mA V_{CC} = 30V					
	I_{B1} = 15 mA V_{BEoff} = 0.5V		10		10	ns.
t_r	Rise Time					
	I_C = 150 mA V_{CC} = 30V					
	I_{B1} = 15 mA V_{BEoff} = 0.5V		25		25	ns.
t_s	Storage Time					
	I_C = 150 mA V_{CC} = 30V					
	I_{B1} = 15 mA I_{B2} = 15 mA		225		225	ns.
t_f	Fall Time					
	I_C = 150 mA V_{CC} = 30V					
	I_{B1} = 15 mA I_{B2} = 15 mA		60		60	ns.

NPN diffused silicon planar transistors 2N2218A-19A-21A-22A

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Max.	Unit
h_{FE}	DC Current Gain *			
h_{fe}	High Frequency Current Gain *			
V_{CEsat}	Collector Saturation Voltage (5)			
	I_C=150mA I_B=15mA		0.3	V
	I_C=500mA I_B=50mA		1	V
V_{BEsat}	Base Saturation Voltage (5)			
	I_C=150mA I_B=15mA	0.6	1.2	V
	I_C=500mA I_B=50mA		2	V
I_{CEX}	Collector Reverse Current			
	V_{EB}=3V V_{CE}=60V		10	nA
I_{CBO}	Collector Reverse Current			
	I_E=0 V_{CB}=60V		10	nA
	I_E=0 V_{CB}=60V T_A= +150°C		10	µA
I_{EBO}	Base Current			
	I_C=0 V_{EB}=3V		10	nA
C_{obo}	Common Base, Open Circuit Output Capacitance			
	I_E=0 V_{CB}=10V f=100 Kc		8	pF
C_{ibo}	Common Base, Open Circuit Input Capacitance			
	I_C=0 V_{EB}=0.5V f=100 Kc		25	pF
Re(h_{ie})	Real Part of Common-Emitter High Frequency Input Impedance			
	I_C=20mA V_{CE}=20V f=300 Mc		60	Ω
BV_{CBO}	Collector to Base Breakdown Voltage			
	I_C=10 µA I_E=0	70		V
BV_{CEO}	Collector to Emitter Breakdown Voltage (4 and 5)			
	I_C=10mA I_B=0	40		V
BV_{EBO}	Emitter to Base Breakdown Voltage			
	I_C=0 I_E=10 µA	6		V
I_{BL}	Base Current			
	V_{EB}=3V V_{CE}=60V		20	nA
t_d	Turn-on Delay Time			
	I_C =150mA V_{CC}=30V I_{B1}=15mA V_{BEoff} =0.5V		10	nsec
t_r	Rise Time			
	I_C =150mA V_{CC}=30V I_{B1}=15mA V_{BEoff} =0.5V		25	nsec
t_s	Storage Time			
	I_C =150mA V_{CC}=30V I_{B1}=15mA I_{B2}=15mA		225	nsec
t_f	Fall Time			
	I_C =150mA V_{CC}=30V I_{B1}=15mA I_{B2}=15mA		60	nsec
τ_A	Active Region Time Constant			
	I_C=150mA V_{CE}=30V		2.5	nsec
$r_b{}'C_c$	Collector Base Time Constant			
	I_C=20mA V_{CE}=20V f=31.8 Mc		150	psec
NF	Noise Figure			
	I_C=100 µA V_{CE}=10V R_g=1K Ω BW=1 cps f=1Kc		4	
f_T	Gain-Bandwidth Product			
	I_C=20mA V_{CE}=20V f=100 Mc			
	2N 2218A - 21A	250		Mc
	2N 2219A - 22A	300		Mc

* For these parameters, see table on next page.

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 175°C and junction-to-case thermal resistance of 50°C/Watt (derating factor of 20mW/°C); junction-to-ambient thermal resistance of 188°C/Watt (derating factor of 5.33mW/°C) for the 2N2218A and 2N2219A. For the 2N2221A and 2N2222A, junction-to-case thermal resistance of 83.5°C/Watt (derating factor of 12mW/°C); junction-to-ambient thermal resistance of 300°C/Watt (derating factor of 3.33mW/°C).
4) This ratings refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS ARS.
5) Pulse Conditions : length = 300 µsec; duty cycle = 1%.

High-speed switches

These SGS devices are NPN silicon Planar epitaxial transistors designed for high-speed switching at collector currents up to 500mA. They feature useful beta over a wide range of collector current, low leakage currents, and low saturation voltages.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A=25°C unless otherwise noted)

Voltages and Current

Collector to Base	V_{CBO}	75 V
Collector to Emitter (4)	V_{CEO}	40 V
Emitter to Base	V_{EBO}	6 V
Collector Current	I_C	800 mA

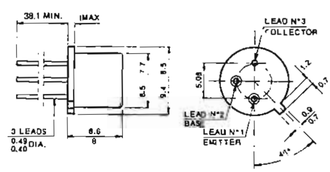
Temperatures

Storage Temperature	T_{STG}	-65°C to 200°C
Operating Junction Temperature	T_J	175°C

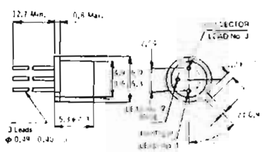
Power (2 and 3)

Dissipation at 25°C Case Temperature		
2N2218A - 19A	P_D	3 W
2N2221A - 22A	P_D	1.8 W
Dissipation at 25°C Ambient Temperature		
2N2218A - 19A	P_D	0.8 W
2N2221A - 22A	P_D	0.5 W

*** TO-5 package for 2N2218A - 19A**



*** TO-18 package for 2N2221A - 22A**



* Note all dimensions in mm.

JULY 1971

ELECTRICAL CHARACTERISTICS (Contd.) (T_A = 25°C unless otherwise noted)

Symbol	Characteristic and Test Conditions	2N2218A 2N2221A		2N2219A 2N2222A	
		Min.	Max.	Min.	Max.
h_{FE}	DC Current Gain				
	I_C = 100µA V_{CE}=10V	20		35	
	I_C = 1mA V_{CE}=10V	25		50	
h_{FE}	DC Pulse Current Gain (5)				
	I_C=10mA V_{CE}=10V	35		75	
	I_C=150mA V_{CE}=10V	40	120	100	300
	I_C=500mA V_{CE}=10V	25		40	
	I_C=150mA V_{CE}=1V	20		50	
	I_C=10mA V_{CE}=10V T_A= -55°C	15		35	
h_{fe}	High Frequency Current Gain				
	I_C=20mA V_{CE}=20V f=100 Mc	2.5		3	

SMALL SIGNAL CHARACTERISTICS (f = 1kc)

Symbol	Characteristic and Test Conditions	2N2218A 2N2221A		2N2219A 2N2222A		Unit
		Min.	Max.	Min.	Max.	
h_{ie}	Input Resistance					
	I_C= 1mA V_{CB}=10V	1	3.5	2	8	K Ω
	I_C=10mA V_{CB}=10V	0.2	1	0.25	1.25	K Ω
h_{oe}	Output Conductance					
	I_C= 1mA V_{CB}=10V	3	15	5	35	µmhos
	I_C=10mA V_{CB}=10V	10	100	25	200	µmhos
h_{re}	Voltage Feedback Ratio					
	I_C= 1mA V_{CB}=10V		500		800	$x10^{-6}$
	I_C=10mA V_{CB}=10V		250		400	$x10^{-6}$
h_{fe}	Forward Current Transfer Ratio					
	I_C= 1mA V_{CB}=10V	30	150	50	300	
	I_C=10mA V_{CB}=10V	50	300	75	375	

NPN diffused silicon planar transistor — 2N 2369

High frequency satu rated switching type

The 2N2369 is an NPN silicon Planar epitaxial transistor designed specifically for high-speed saturated switching applications in the 50-100mc range at current levels from 100 µA to 100mA. It is suitable for most satellite and conventional, small signal, RF and digital type circuits. A typical gain bandwidth product of 650 mc, typical τ_s of 6 nsec and C_{ob} of 4pF max. along with the Planar structure give high performance and proven reliability.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Pulse Current Gain (5)				
	I_C = 10mA V_{CE} = 1V	40		120	
	I_C = 100mA V_{CE} = 2V	20			
	I_C = 10mA V_{CE} = 1V T_A = -55°C	20			
V_{BEsat}	Base Saturation Voltage (5)				
	I_C = 10mA I_B = 1mA	0.7	0.75	0.85	V
V_{CEsat}	Collector Saturation Voltage (5)				
	I_C = 10mA I_B = 1mA		0.2	0.25	V
h_{fe}	High Frequency Current Gain				
	I_C = 10mA V_{CE} = 10V f = 100mc	5	6.5		
C_{ob}	Output Capacitance				
	I_E = 0 V_{CB} = 5V		2.5	4	pF
I_{CBO}	Collector Cutoff Current				
	I_E = 0 V_{CB} = 20V		0.1	0.4	µA
	I_E = 0 V_{CB} = 20V T_A = 150°C		10	30	µA
BV_{CBO}	Collector to Base Breakdown Voltage				
	I_C = 10µA I_E = 0	40			V
BV_{CES}	Collector to Emitter Breakdown Voltage				
	I_C = 10 µA I_B = 0	40			V
$V_{CEOsust}$	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 10mA (pulsed) I_B = 0	15			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_C = 0 I_E = 10 µA	4.5			V
τ_s	Charge Storage Time Constant (6) (see Figure 1)				
	I_C = I_{B1} ≈ 10mA, I_{B2} ≈ -10mA		6	13	nsec
T_{on}	Turn On Time (see Figure 2)				
	I_C ≈ 10mA, I_{B1} ≈ 3mA		9	12	nsec
T_{off}	Turn Off Time (see Figure 2)				
	I_C ≈ 10mA, I_{B1} ≈ 3mA, I_{B2} ≈ -1.5mA		13	18	nsec

NOTES :

1) These ratings are limiting values above which the serviceability of any 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/W (derating factor of 6.85 mW/°C). Junction-to-ambient thermal resistance of 486°C/W (derating factor of 2.06 mW/°C).
4) Rating refers to a high current point where collector-to-emitter voltage is lowest. For more information send for SGS AR5.
5) Pulse Conditions: length – 300 µsec; duty cycle ⩽ 2%.
6) Measured on Sampling Scope. PW ≥ 200 nsec.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages and Current

Collector to Base	V_{CBO}	40 V
Collector to Emitter	V_{CES}	40 V
Collector to Emitter (4)	V_{CEO}	15 V
Emitter to Base	V_{EBO}	4.5 V
Collector Current (10 µsec pulse)	I_C	500mA

Temperatures

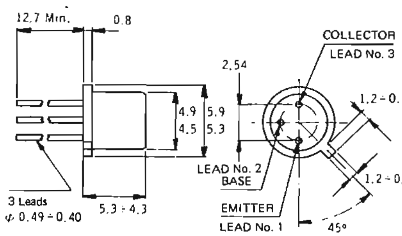
Storage Temperature	T_{STG}	-65°C to + 200°C
Operating Junction Temperature	T_J	200°C Max
Lead Temperature (Soldering, No Time Limit)	T_L	300°C Max

Power (2 and 3)

Dissipation at 25°C Case Temperature	P_D	1.2 W
Dissipation at 100°C Case Temperature	P_D	0.68 W
Dissipation at 25°C Ambient Temperature	P_D	0.36 W

PHYSICAL DIMENSIONS

Similar to Jedec TO-18



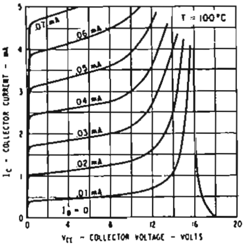
Note : All dimensions are in mm.

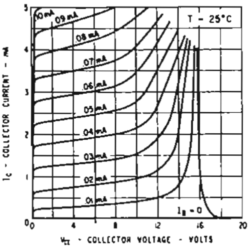
JULY 1971

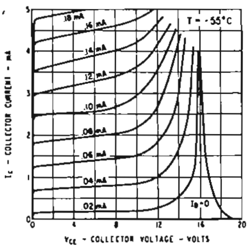
TYPICAL ELECTRICAL CHARACTERISTICS

HIGH VOLTAGE

COLLECTOR CHARACTERISTICS*

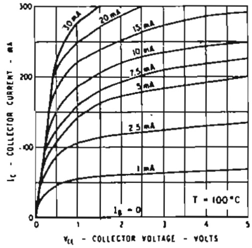


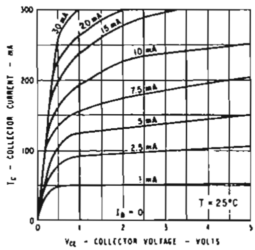


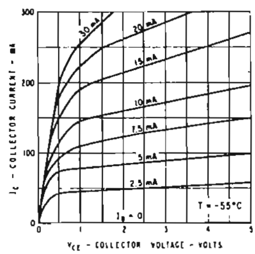


SATURATION REGION

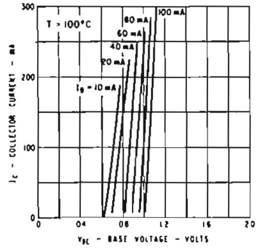
COLLECTOR CHARACTERISTICS*

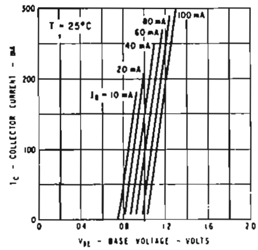


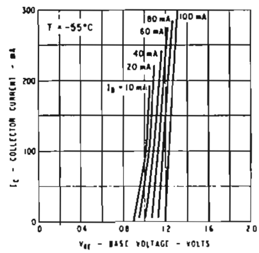




BASE CHARACTERISTICS*

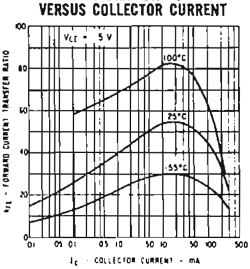




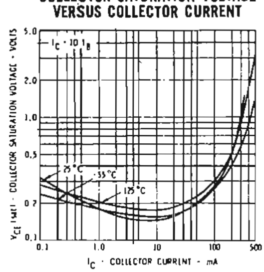


*Single family characteristics on Transistor Curve Tracer.

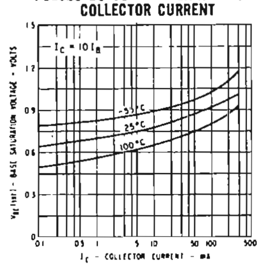
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

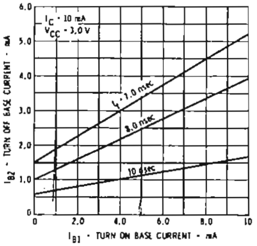


PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT

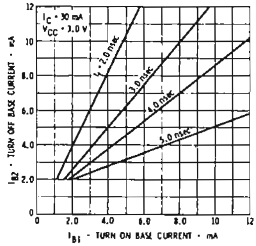


TYPICAL ELECTRICAL CHARACTERISTICS

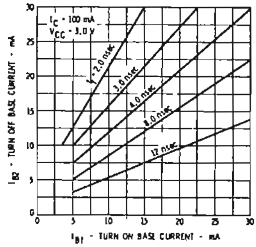
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



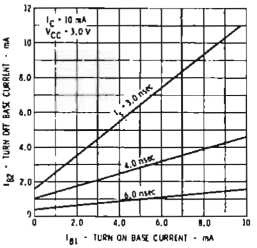
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



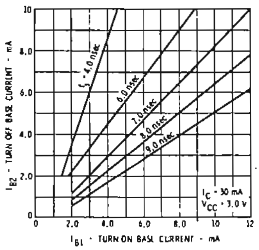
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



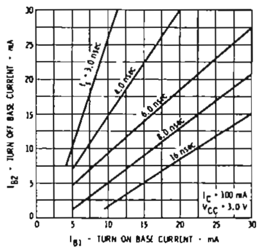
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



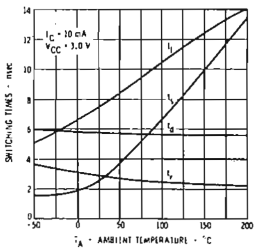
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



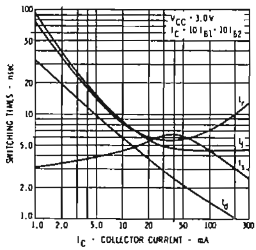
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



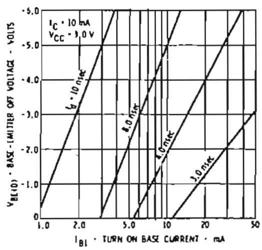
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



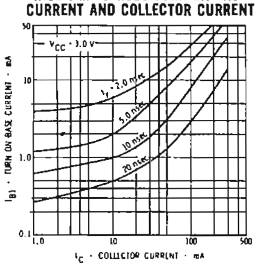
SWITCHING TIMES VERSUS COLLECTOR CURRENT



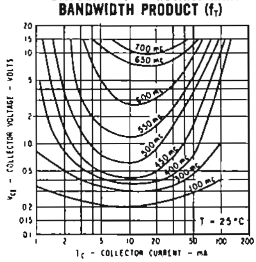
DELAY TIME VERSUS BASE-EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT



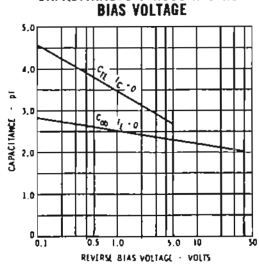
RISE TIME VERSUS TURN ON BASE CURRENT AND COLLECTOR CURRENT



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

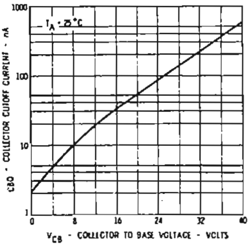


EMITTER TRANSITION AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE

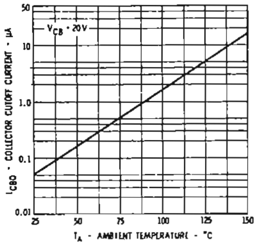


TYPICAL ELECTRICAL CHARACTERISTICS

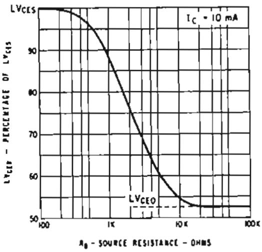
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



LOWER LIMITING VOLTAGE VERSUS SOURCE RESISTANCE



AVERAGE PROPAGATION DELAY PER TRANSISTOR VERSUS COLLECTOR VOLTAGE

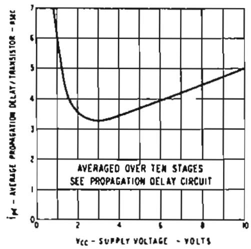


FIGURE 1

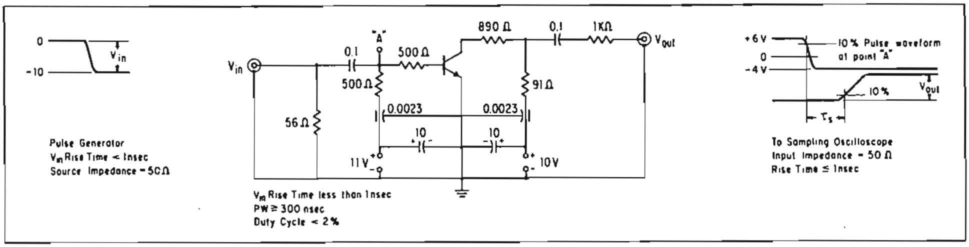
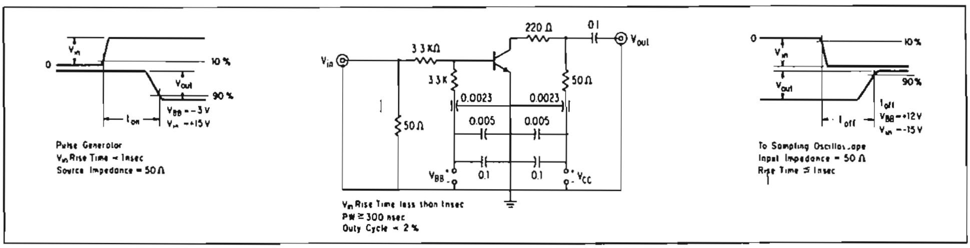
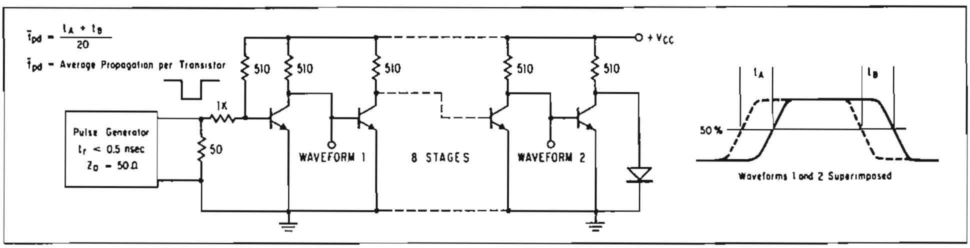


FIGURE 2



CIRCUIT FOR MEASUREMENT OF PROPAGATION DELAY



NPN diffused silicon planar transistor 2N 2369A

High-speed saturated switch

The 2N2369A is an NPN silicon Planar epitaxial transistor designed specifically for high-speed saturated switching applications in the 50 - 100 mc range at current levels from 100 μA to 100 mA. It is suitable for most satellite and conventional, small signal, RF and digital type circuits. A typical gain-bandwidth product of 675 mc, typical τ_s of 6 nsec and C_{ob} of 4 pF max. along with the Planar structure give high performance and proven reliability.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and Test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Pulse Current Gain (5)				
	I_C =10mA V_{CE}=1V	40	66	120	
	I_C =10mA V_{CE}=0.35V	40	63	120	
	I_C =30mA V_{CE}=0.4V	30	71		
	I_C =10mA V_{CE}=0.35V T_A= - 55°C	20	50		
	I_C =100mA V_{CE}=1V	20			
V_{BEsat}	Base Saturation Voltage (5)				
	I_C =10mA I_B=1mA	0.7	0.8	0.85	V
	I_C =10mA I_B=1mA (-55°C to 125°C)	0.59		1.02	V
	I_C =30mA I_B=3mA		0.9	1.15	V
	I_C =100mA I_B=10mA		1.1	1.6	V
V_{CEsat}	Collector Saturation Voltage (5)				
	I_C =10mA I_B=1mA		0.14	0.2	V
	I_C =30mA I_B=3mA		0.17	0.25	V
	I_C =10mA I_B=1mA T_A=125°C		0.19	0.3	V
	I_C =100mA I_B=10mA		0.28	0.5	V
h_{fe}	High Frequency Current Gain				
	I_C =10mA V_{CE}=10V f = 100 mc	5	6.75		
C_{ob}	Output Capacitance				
	I_E = 0 V_{CB} = 5V		2.3	4	pF
I_{CES}	Collector Reverse Current				
	V_{BE} = 0 V_{CE} = 20V		0.05	0.4	µA
I_{CBO}	Collector Cutoff Current				
	I_E = 0 V_{CB} = 20V T_A=150°C		10	30	µA
BV_{CES}	Collector to Emitter Breakdown Voltage				
	I_C=10µA V_{BE} = 0	40			V
BV_{CBO}	Collector to Base Breakdown Voltage				
	I_C=10 µA I_E = 0	40			V
$V_{CEO\,sust}$	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C=10mA (pulsed) I_B = 0	15			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_E=10 µA I_C = 0	4.5			V
τ_s	Charge Storage Time Constant (6)				
	I_C=I_{B1} ≈ 10mA, I_{B2} ≈ -10mA		6	13	nsec
t_{on}	Turn On Time (6)				
	I_C ≈ 10mA I_{B1} ≈ 3mA		9	12	nsec
t_{off}	Turn Off Time (6)				
	I_C ≈ 10mA, I_{B1} ≈ 3mA, I_{B2} ≈ -1.5mA		13	18	nsec

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/W (derating factor of 6.85 mW/°C). Junction-to-ambient thermal resistance of 486°C/W (derating factor of 2.06 mW/°C).
4) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
5) Pulse Conditions : length = 300 µsec; duty cycle ≤ 2%.
6) See switching circuits for exact value of I_C, I_{B1} and I_{B2}.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages and Currents

Collector to Base	V_{CBO}	40 V
Collector to Emitter	V_{CES}	40 V
Collector to Emitter (4)	V_{CEO}	15 V
Emitter to Base	V_{EBO}	4.5 V
Collector Current (10 µsec Pulse)	I_C	500mA
DC Collector Current	I_C	200mA

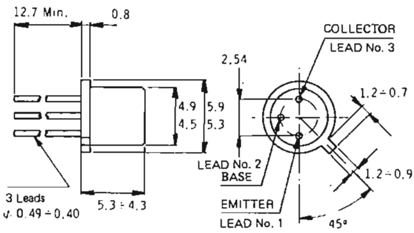
Temperatures

Storage Temperature	T_{STG}	-65°C to +200°C
Operating Junction Temperature	T_J	200°C Max
Lead Temperature (Soldering, 60 sec Time Limit)	T_L	300°C Max

Power (2 and 3)

Dissipation at 25°C Case Temperature	P_D	1.2 W
Dissipation at 100°C Case Temperature	P_D	0.68 W
Dissipation at 25°C Ambient Temperature	P_D	0.36 W

PHYSICAL DIMENSIONS
Similar to Jedec TO-18

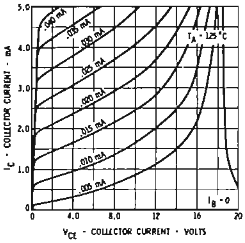


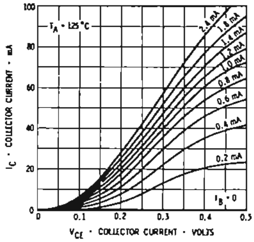
Note : All dimensions are in mm.

JULY 1971

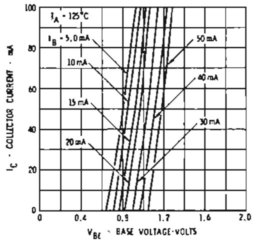
TYPICAL ELECTRICAL CHARACTERISTICS

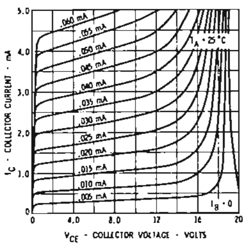
COLLECTOR CHARACTERISTICS*

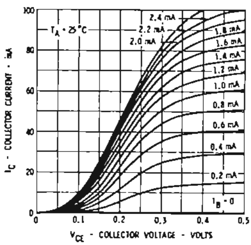


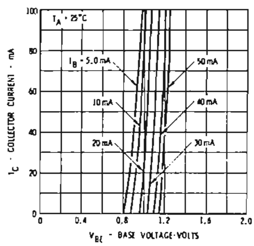


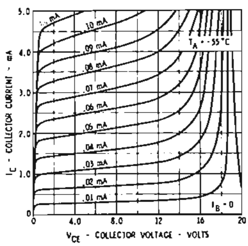
BASE CHARACTERISTICS*

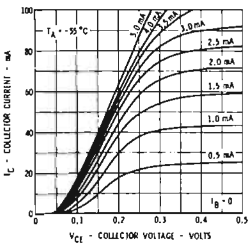


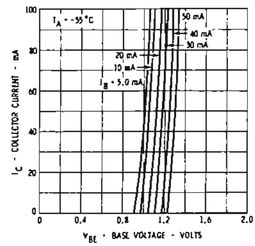




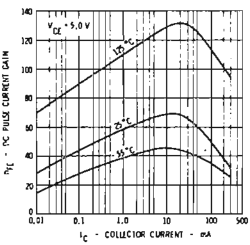




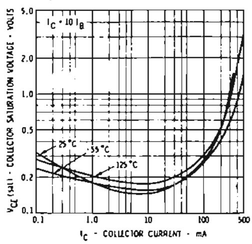




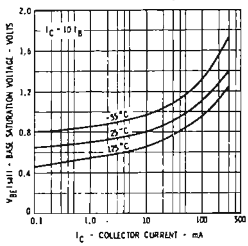
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



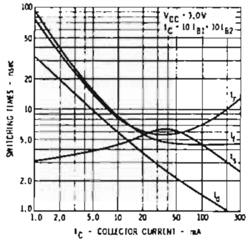
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



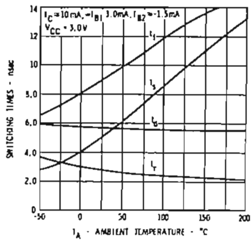
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

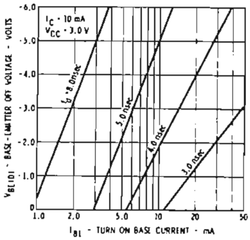
SWITCHING TIMES VERSUS COLLECTOR CURRENT



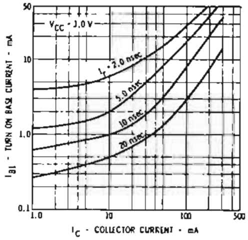
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



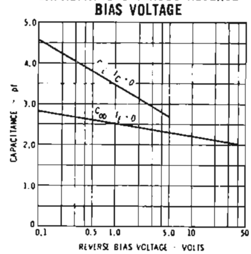
DELAY TIME VERSUS BASE-EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT



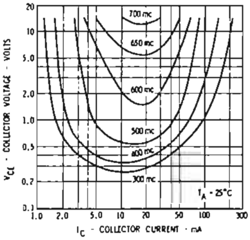
RISE TIME VERSUS TURN ON BASE CURRENT AND COLLECTOR CURRENT



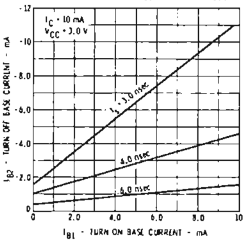
EMITTER TRANSITION AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



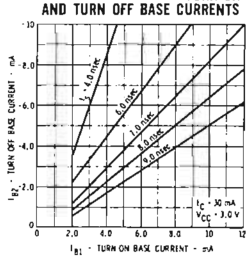
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



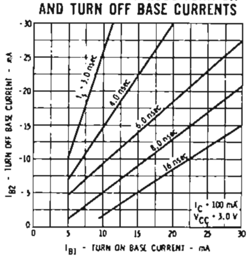
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



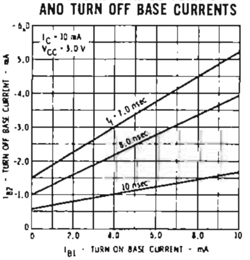
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



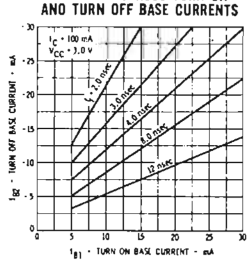
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



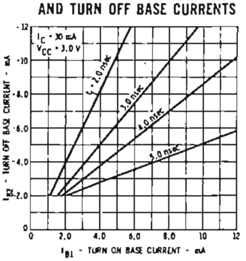
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

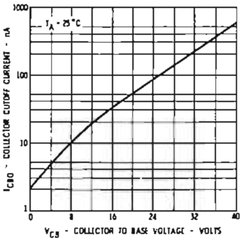


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

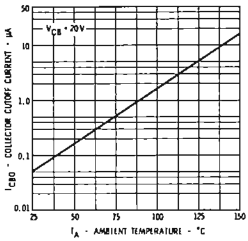


TYPICAL ELECTRICAL CHARACTERISTICS

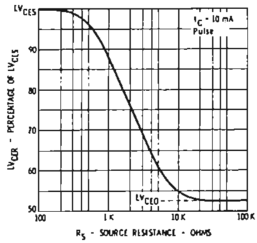
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



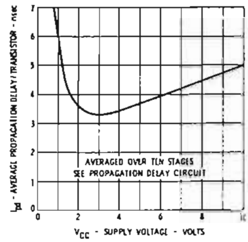
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



LOWER LIMITING VOLTAGE VERSUS SOURCE RESISTANCE

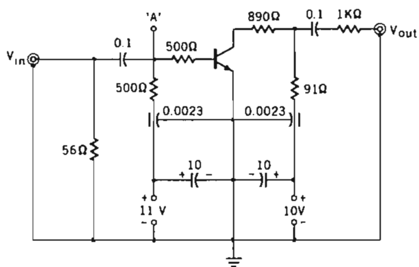


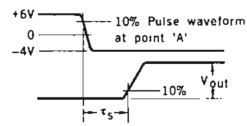
AVERAGE PROPAGATION DELAY PER TRANSISTOR VERSUS COLLECTOR VOLTAGE



CHARGE STORAGE TIME MEASUREMENT CIRCUIT

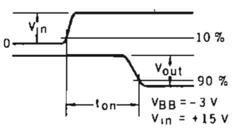
Pulse Generator
V_{in} Rise Time < 1 nsec
Source Impedance = 50Ω
PW ≥ 300 nsec
Duty Cycle < 2 %





To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 nsec

t_{ON} — t_{OFF} MEASUREMENT CIRCUIT



Pulse Generator
V_{in} Rise Time < 1 nsec
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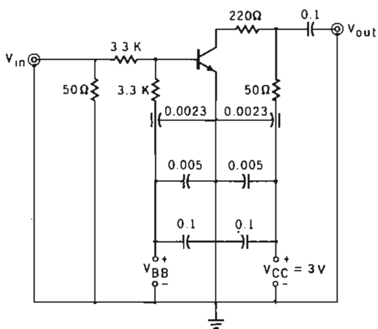
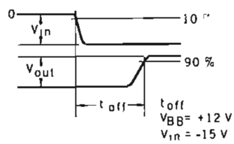
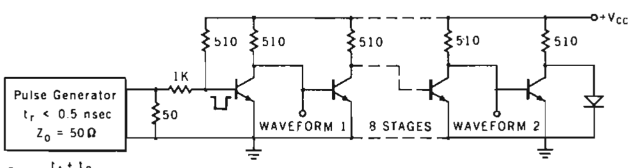
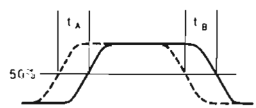




To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 nsec

CIRCUIT FOR MEASUREMENT OF PROPAGATION DELAY





Waveforms 1 and 2 Superimposed

$$\bar{t}pd = \frac{t_A + t_B}{20}$$

$\bar{t}pd$ = Average Propagation per Transistor

NPN diffused silicon planar transistors

2N2483 - 2N2484

Low-level, low-noise types

The 2N2483 and 2N2484 are NPN silicon Planar transistors designed for use in high-performance, low-noise amplifier circuits from audio to high-frequency ranges.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Typ.	Max.	Unit
h_{FE}	DC Current Gain *				
h_{fe}	High Frequency Current Gain *				
h_{fe}	Small Signal Current Gain *				
NF	Wide Band Noise Figure *				
NF	Narrow Band Noise Figure *				
h_{ie}	Input Resistance *				
h_{oe}	Output Conductance *				
h_{re}	Voltage Feedback Ratio *				
h_{ib}	Input Resistance *				
V_{BEon}	Emitter-Base On Voltage				
	I_C = 100 µA V_{CE} = 5V	0.5	0.57	0.7	V
V_{CEsat}	Collector Saturation Voltage				
	I_C = 1mA I_B = 0.1mA		0.2	0.35	V
I_{CBO}	Collector Cutoff Current				
	I_E = 0 V_{CB} = 45V		0.1	10	nA
	I_E = 0 V_{CB} = 45V T_A 150°C		0.2	10	µA
I_{EBO}	Emitter Cutoff Current				
	I_C 0 V_{EB} 5V		0.1	10	nA
I_{CEO}	Collector-Emitter Cutoff Current				
	I_B = 0 V_{CE} = 5V		0.1		nA
BV_{CBO}	Collector to Base Breakdown Voltage				
	I_C = 10 µA I_E = 0	60			V
BV_{EBO}	Emitter to Base Breakdown Voltage				
	I_C = 0 I_E = 10 µA	6			V
$V_{CEOsust}$	Collector to Emitter Sustaining Voltage (4 and 5)				
	I_C = 10mA (pulsed) I_B = 0	60			
C_{ob}	Output Capacitance				
	I_E = 0 V_{CB} = 5V		3.5	6	pF
C_{TE}	Emitter Transition Capacitance				
	I_C = 0 V_{EB} = 0.5V		3.5	6	pF

* For these parameters, see table on next page.

ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages and Current

Collector to Base	V_{CBO}	60 V
Collector to Emitter (4)	V_{CEO}	60 V
Emitter to Base	V_{EBO}	6 V
Collector Current	I_C	50 mA

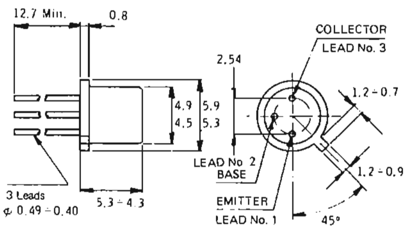
Temperatures

Storage Temperature	T_{STG}	-65°C to + 300°C
Operating Junction Temperature	T_J	200°C Max
Lead Temperature (Soldering, No Time Limit)	T_L	300°C Max

Power (2 and 3)

Dissipation at 25°C Case Temperature	P_D	1.2 W
Dissipation at 25°C Ambient Temperature	P_D	0.36 W
Dissipation at 100°C Case Temperature	P_D	0.68 W

PHYSICAL DIMENSIONS
similar to JEDEC TO-18 outline



Note all dimensions in mm.

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/W (derating factor of 6.9 mW/°C); junction-to-ambient thermal resistance of 486°C/W (derating factor of 2.1 mW/°C).
4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR 5.
5) Pulse Conditions : length = 300 µsec; duty cycle 1%.
6) R_s = 10 KΩ, Power Bandwidth of 15.7 Kc/s with dB points at 10 cps and 10 Kc/s.
7) f = 1 Kc/s; R_s = 10 KΩ; Power Bandwidth of 200 cps.
8) f = 10Kc/s; R_s = 10 KΩ, Power Bandwidth of 2 Kc/s.
9) f = 100 cps; R_s = 10 KΩ Power Bandwidth of 20 cps.

JULY 1971

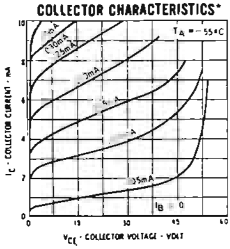
ELECTRICAL CHARACTERISTICS (Contd.) (T_A=25°C unless otherwise noted)

Symbol	Characteristic and Test Conditions	2N2483			2N2484			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
h_{FE}	DC Current Gain							
	I_C=1 μA V_{CE}=5V				30	200		
	I_C=10 μA V_{CE}=5V	40	80	120	100	290	500	
	I_C=100 μA V_{CE}=5V	75	140		175	375		
	I_C=500 μA V_{CE}=5V	100	200		200	430		
	I_C=1mA V_{CE}=5V	175	230		250	450		
	I_C=10 μA V_{CE}=5V T_A= -55°C	10			20			
h_{FE}	DC Pulse Current Gain (5)							
	I_C=10mA V_{CE}=5V		280	500		430	800	
h_{fe}	High Frequency Current Gain							
	I_C=50 μA V_{CE}=5V f= 5 Mc/s	2.4	4		3	4		
	I_C=500 μA V_{CE}=5V f= 30 Mc/s	2	2.3		2	2.6		
h_{fe}	Small Signal Current Gain							
	I_C=1mA V_{CE}=5V f= 1 Kc/s	80	280	450	150	400	900	
NF	Wide Band Noise Figure (6)							
	I_C=10 μA V_{CE}=5V		1.9	4		1.8	3	dB
NF	Narrow Band Noise Figure							
	I_C=10 μA V_{CE}=5V (7)		1.9	4		1.8	3	dB
	I_C=10 μA V_{CE}=5V (8)		0.7	3		0.6	2	dB
	I_C=10 μA V_{CE}=5V (9)		4	15		4	10	dB
h_{ie}	Input Resistance							
	I_C=1mA V_{CE}=5V f=1 Kc/s	1.5	7.5	13	3.5	15	24	KΩ
h_{oe}	Output Conductance							
	I_C=1mA V_{CE}=5V f=1 Kc/s		11	30		15	40	μmho
h_{re}	Voltage Feedback Ratio							
	I_C=1mA V_{CE}=5V f=1 Kc/s		300	800		425	800	$x10^{-6}$
h_{ib}	Input Resistance							
	I_C=1mA V_{CB}=5V f=1 Kc/s	25	27	32	25	27	32	Ω

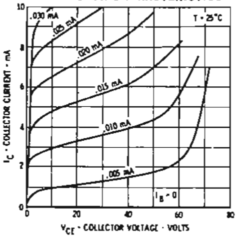
TYPICAL ELECTRICAL CHARACTERISTICS

2N2483

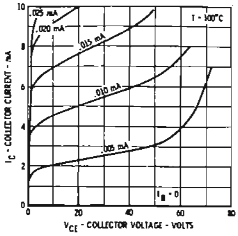
COLLECTOR CHARACTERISTICS*



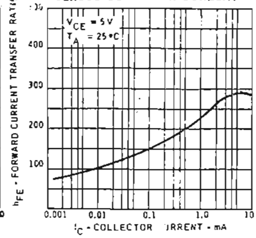
COLLECTOR CHARACTERISTICS*



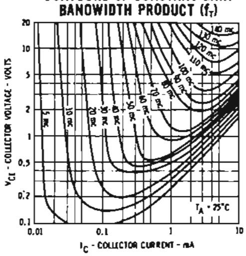
COLLECTOR CHARACTERISTICS*



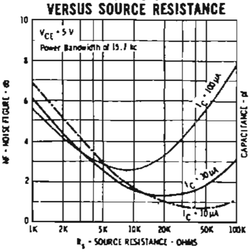
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



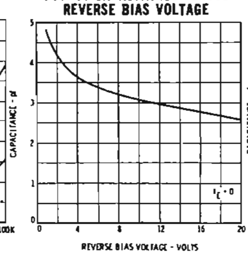
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



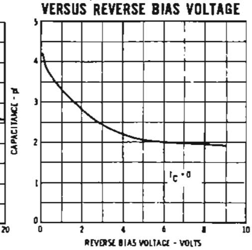
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



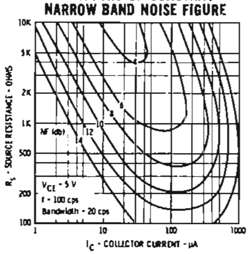
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



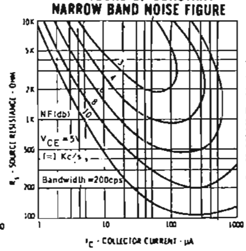
EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



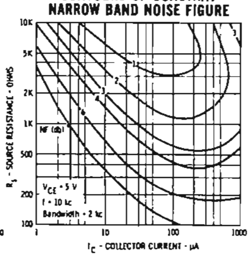
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



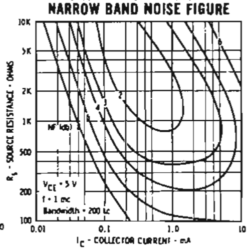
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



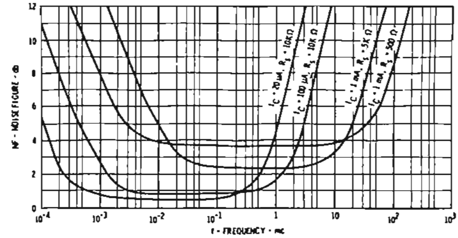
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



NOISE FIGURE VERSUS FREQUENCY

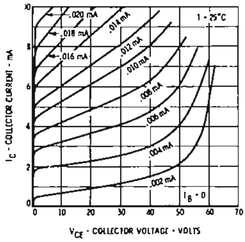


* Single family characteristics on Transistor Curve Tracer.

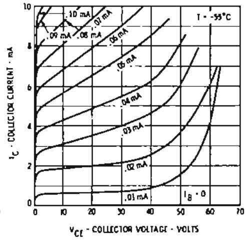
TYPICAL ELECTRICAL CHARACTERISTICS

2N2484

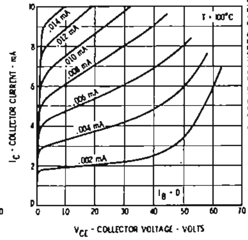
COLLECTOR CHARACTERISTICS*



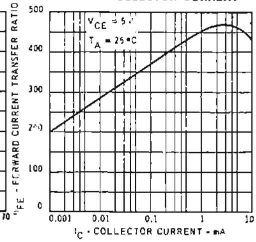
COLLECTOR CHARACTERISTICS*



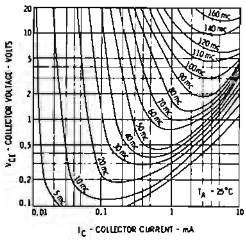
COLLECTOR CHARACTERISTICS*



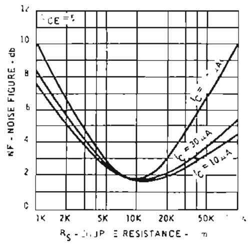
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



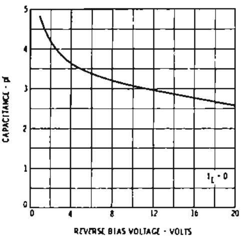
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



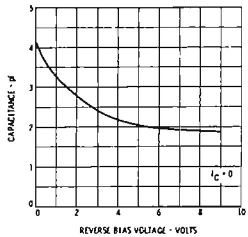
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



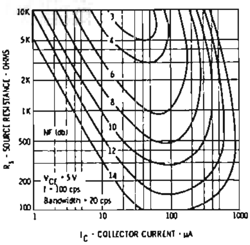
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



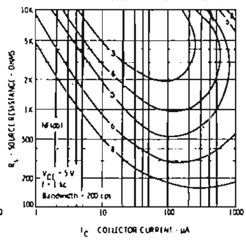
EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



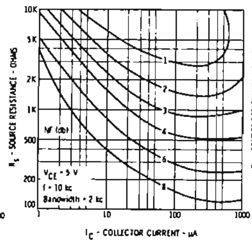
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



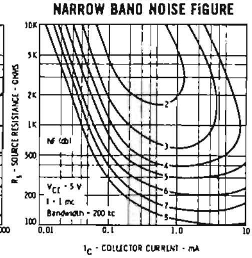
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



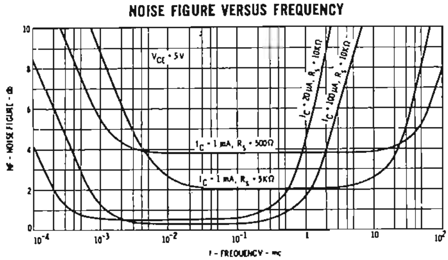
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



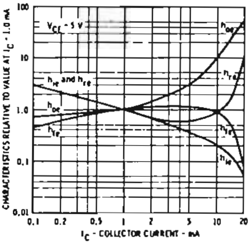
NOISE FIGURE VERSUS FREQUENCY

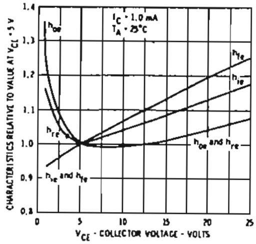


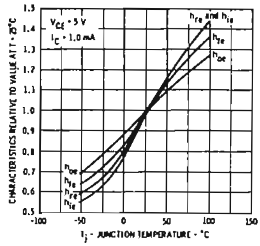
* Single family characteristics on Transistor Curve Tracer.

2N2483

COMMON EMITTER CHARACTERISTICS

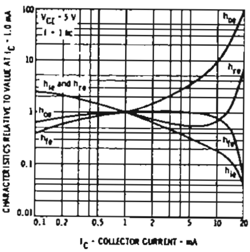


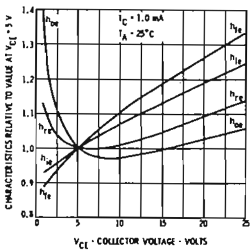


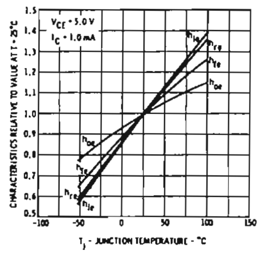


2N2484

COMMON EMITTER CHARACTERISTICS

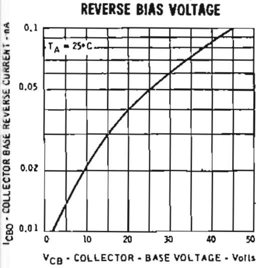




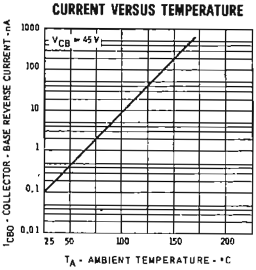


2N2483 - 2N2484

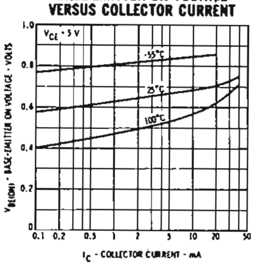
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



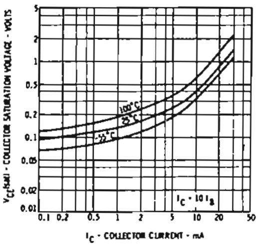
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



PNP diffused silicon planar transistors

2N2904 - 5 - 6 - 7
2N2904A - 5A - 6A - 7A

High-speed switches and core drivers

These PNP silicon Planar epitaxial transistors are designed primarily for high-speed saturated switching and core driver applications.

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

Symbol	Characteristic and test conditions	Min.	Max.	Unit
h_{FE}	DC Pulse Current Gain *			
h_{fe}	High Frequency Current Gain *			
V_{CEsat}	Collector Saturation Voltage (5)			
	I_C = 150mA I_B = 15mA		-0.4	V
	I_C = 500mA I_B = 50mA		-1.6	V
V_{BEsat}	Base Saturation Voltage (5)			
	I_C = 150mA I_B = 15mA		-1.3	V
	I_C = 500mA I_B = 50mA		-2.6	V
t_d	Turn-On Delay Time (see figure 1) I_C = 150mA I_{B1} = 15mA		10	nsec
t_r	Rise Time (see figure 1) I_C = 150mA I_{B1} = 15mA		40	nsec
t_s	Storage Time (see figure 2) I_C = 150mA I_{B1} = I_{B2} = 15mA		80	nsec
t_f	Fall Time (see figure 2) I_C = 150mA I_{B1} = I_{B2} = 15mA		30	nsec
t_{on}	Turn On Time (see figure 1) I_C = 150mA I_{B1} = 15mA 2N2904A-5A-6A-7A only		45	nsec
t_{off}	Turn Off Time (see figure 2) I_C = 150mA I_{B1} = I_{B2} = 15mA 2N 2904A - 5A - 6A - 7A only		100	nsec
I_{CBO}	Collector Cutoff Current			
	I_E = 0 V_{CB} = -50V			
	2N 2904 - 05 - 06 - 07		20	nA
	2N 2904A - 05A - 06A - 07A		10	nA
	I_E = 0 V_{CB} = -50V T_A = 150°C			
	2N2904 - 05 - 06 - 07		20	µA
	2N2904A - 05A - 06A - 07A		10	µA
I_{CEX}	Collector Reverse Current V_{CE} = -30V V_{BE} = +0.5V		50	nA
I_B	Base Current V_{CE} = -30V V_{BE} = +0.5V		50	nA
C_{ob}	Output Capacitance I_E = 0 V_{CB} = -10V f = 100 Kc		8	pF
C_{TE}	Emitter Transition Capacitance I_C = 0 V_{EB} = -2V f = 100Kc		30	pF
BV_{CBO}	Collector to Base Breakdown Voltage I_C = 10 µA I_B = 0	-60		V
$V_{CEOsust}$	Collector to Emitter Sustaining Voltage (4 and 5) I_C = 10mA I_B = 0			
	2N2904 - 05 - 06 - 07	-40		V
	2N2904A - 05A - 06A - 07A	-60		V
BV_{EBO}	Emitter to Base Breakdown Voltage I_E = 10 µA I_C = 0	5		V

* For these parameters, see table on next page.

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 17.2mW/°C); junction-to-ambient thermal resistance of 292°C/Watt (derating factor of 3.42mW/°C) for the 2N2904, 2N2904A, 2N2905, and 2N2905A. Junction-to-case thermal resistance of 97.3°C/Watt (derating factor of 10.3mW/°C); junction-to ambient thermal resistance of 437°C/Watt (derating factor of 2.28mW/°C) for the 2N2906, 2N2906A, 2N2907 and 2N2907A.
4) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS AR5.
5) Pulse Conditions : length ≤ 300 µsec; duty cycle ≤ 2%.

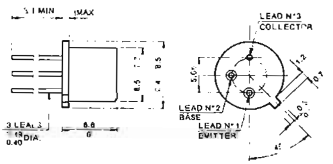
ABSOLUTE MAXIMUM RATINGS (1)
(T_A = 25°C unless otherwise noted)

Voltages and Current		
Collector to Base	V_{CBO}	-60 V
Collector to Emitter (4)		
2N2904 - 05 - 06 - 07	V_{CEO}	-40 V
2N2904A - 05A - 06A - 07A		-60 V
Emitter to Base	V_{EBO}	- 5 V
Collector Current (2)	I_C	600 mA

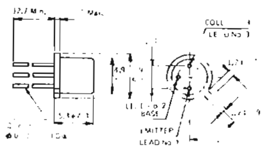
Temperatures		
Storage Temperature	T_{STG}	-65°C to 300°C
Operating Junction Temperature	T_J	200°C Max.

Power (2 and 3)		
Dissipation at 25°C Case Temperature		
2N2904 - 04A - 05 - 05A	P_D	3 W
2N2906 - 06A - 07 - 07A	P_D	1.8 W
Dissipation at 25°C Ambient Temperature		
2N2904 - 04A - 05 - 05A	P_D	0.6 W
2N2906 - 06A - 07 - 07A	P_D	0.4 W

* TO-5 package for 2N2904 - 4A - 5 - 5A



* TO-18 package for 2N2906 - 6A - 7 - 7A



* Note . All dimensions in mm.

JULY 1971

ELECTRICAL CHARACTERISTICS (Contd.) (T_A = 25°C unless otherwise noted)

Symbol	Characteristic and Test Conditions	2N2904 2N2906		2N2904A 2N2906A		2N2905 2N2907		2N2905A 2N2907A	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
h_{FE}	DC Pulse Current Gain (5)								
	I_C = 150mA V_{CE} = -10V	40	120	40	120	100	300	100	300
	I_C = 500mA V_{CE} = -10V	20		40		30		50	
h_{FE}	DC Current Gain								
	I_C = 10mA V_{CE} = -10V	35		40		75		100	
	I_C = 1mA V_{CE} = -10V	25		40		50		100	
	I_C = 0.1mA V_{CE} = -10V	20		40		35		75	
h_{fe}	High Frequency Current Gain								
	I_C = 50mA V_{CE} = -20V f = 100mc	2		2		2		2	

FIGURE 1
TEST CIRCUIT FOR DETERMINING DELAY TIME AND RISE TIME

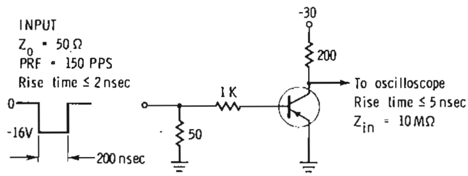
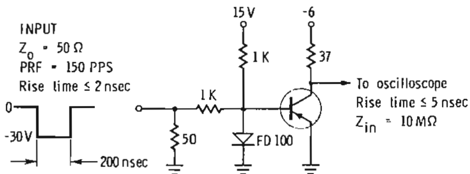


FIGURE 2
TEST CIRCUIT FOR DETERMINING STORAGE TIME AND FALL TIME



SILICON PLANAR NPN

2N 3725

HIGH VOLTAGE, HIGH CURRENT SWITCH

The 2N3725 is a silicon planar epitaxial transistor in a TO-39 metal case. It is a high-voltage, high-current switch used for memory applications requiring breakdown voltages up to 50V and operating currents to 1 A. Fast switching times are assured because of the high minimum f_T (300 MHz) and tight control on storage time.

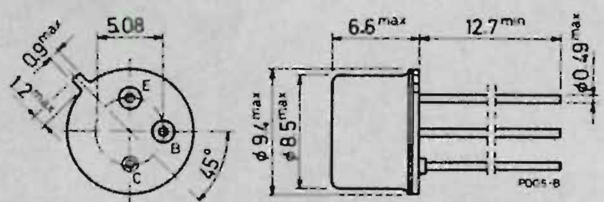
ABSOLUTE MAXIMUM RATINGS

V_{CBO}	Collector-base voltage ($I_E = 0$)	80	V
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	80	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	50	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	6	V
I_C	Collector current	1	A
P_{tot}	Total power dissipation at $T_{amb} \leqslant 25\ °C$	0.8	W
	at $T_{case} \leqslant 25\ °C$	3.5	W
T_{stg}	Storage temperature	- 65 to 200	°C
T_j	Junction temperature	200	°C

MECHANICAL DATA

Dimensions in mm

Collector connected to case.



TO-39

3/73

2N 3725

THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	50 °C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	220 °C/W

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C unless otherwise specified)

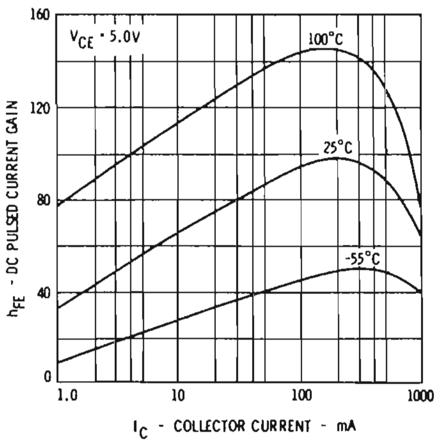
Parameter		Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector cutoff current ($I_E = 0$)	$V_{CB} = 60V$ $V_{CB} = 60V$ $T_{amb} = 100°C$		0.33 25	1.7 120	µA µA
$V_{(BR)CBO}$	Collector-base breakdown voltage ($I_E = 0$)	$I_C = 10\,\mu A$	80			V
$V_{(BR)CES}$	Collector-emitter breakdown voltage ($V_{BE} = 0$)	$I_C = 10\,\mu A$	80			V
$V_{CEO(sus)}$ *	Collector-emitter sustaining voltage ($I_B = 0$)	$I_C = 10$ mA	50			V
$V_{(BR)EBO}$	Emitter-base breakdown voltage ($I_C = 0$)	$I_E = 10\,\mu A$	6			V
$V_{CE(sat)}$ *	Collector-emitter saturation voltage	$I_C = 10mA$ $I_B = 1$ mA $I_C = 100mA$ $I_B = 10$ mA $I_C = 300mA$ $I_B = 30$ mA $I_C = 500mA$ $I_B = 50$ mA $I_C = 800$ mA $I_B = 80$ mA $I_C = 1000$ mA $I_B = 100$ mA		0.19 0.21 0.31 0.4 0.5 0.6	0.25 0.26 0.4 0.52 0.8 0.95	V V V V V V

ELECTRICAL CHARACTERISTICS (Continued)

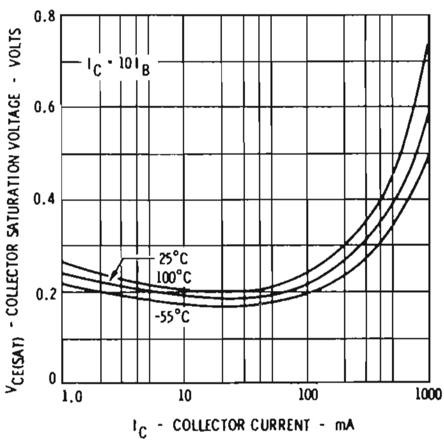
Parameter		Test Conditions	Min.	Typ.	Max.	Unit
$V_{BE(sat)}$ *	Base-emitter saturation voltage	$I_C = 10$ mA $I_B = 1$ mA		0.64	0.76	V
		$I_C = 100$ mA $I_B = 10$ mA		0.75	0.86	V
		$I_C = 300$ mA $I_B = 30$ mA		0.89	1.1	V
		$I_C = 500$ mA $I_B = 50$ mA	0.8		1.1	V
		$I_C = 800$ mA $I_B = 80$ mA		1.0	1.5	V
		$I_C = 1000$ mA $I_B = 100$ mA		1.1	1.7	V
h_{FE} *	DC current gain	$I_C = 10$ mA $V_{CE} = 1$ V	30	60		–
		$I_C = 100$ mA $V_{CE} = 1$ V	60	90	150	–
		$I_C = 300$ mA $V_{CE} = 1$ V	40	60		–
		$I_C = 1000$ mA $V_{CE} = 5$ V	25	65		–
		$I_C = 800$ mA $V_{CE} = 2$ V	20	40		–

* Pulsed: pulse duration = 30 μs; duty factor = 1%.

DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT

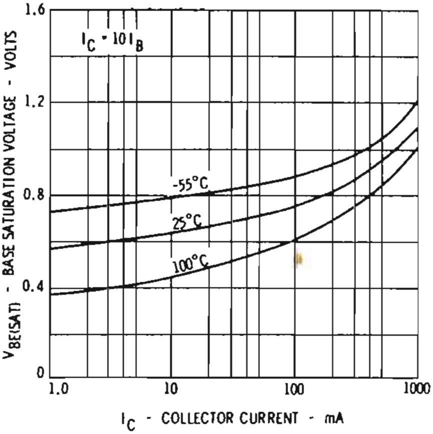


COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

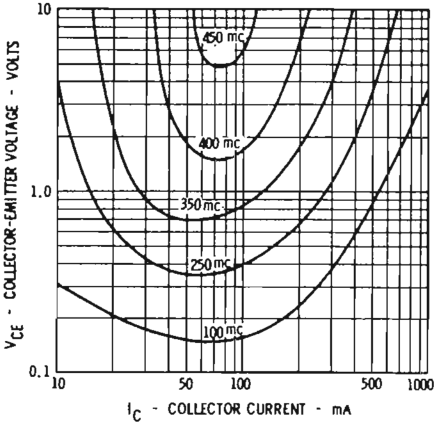


2N 3725

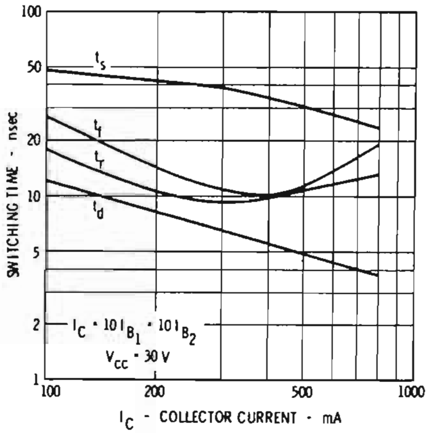
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



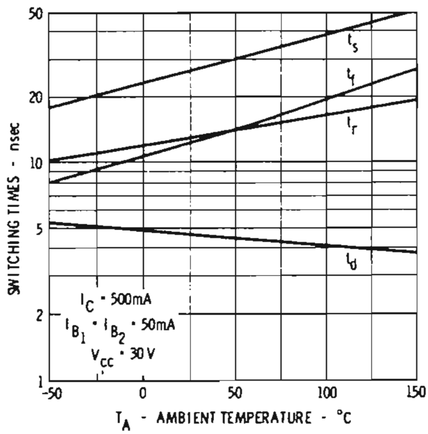
CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



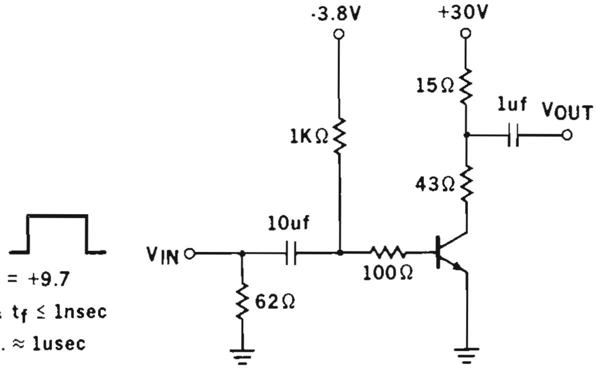
SWITCHING TIMES VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



SWITCHING TIME TEST CIRCUIT



TO SAMPLING SCOPE
t_r < 1nsec
$Z_{IN} \geq 100K\Omega$

V_{IN} = +9.7
t_r & $t_f \leq$ 1nsec
P.W. ≈ 1usec
Z_{IN} = 50Ω
DUTY CYCLE < 2%

$I_C \approx 500mA,\ I_{B_1} \approx 50mA,\ I_{B_2} \approx -50mA$

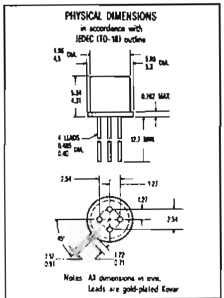
SPECIAL ASSEMBLIES

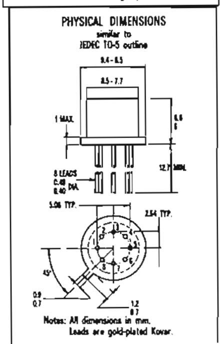
BAX45 to BAX51

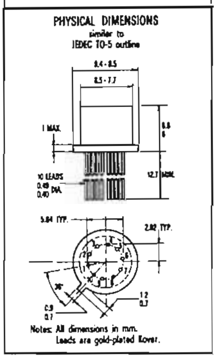
ULTRA FAST DIODE MATRIX ASSEMBLIES

SILICON PLANAR EPITAXIAL DIODES

GENERAL DESCRIPTION - These silicon PLANAR epitaxial diode matrix assemblies are designed for high speed core driver applications. They are hermetically sealed in either TO-5 or TO-18 packages. The excellent thermal conductivity of these packages permits operation up to 400 mW.







ABSOLUTE MAXIMUM RATINGS of each diode (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_A	Operating Temperature	+ 175°C Maximum

Maximum Power Dissipation (Note 2)

P	Total Dissipation at 25°C Ambient Temperature	0.4 Watt

Maximum Voltage (T_A = 25°C unless otherwise noted)

WIV	Working Inverse Voltage	40 Volts

Maximum Currents (T_A = 25°C unless otherwise noted)

I_F	Forward Continuous DC Current	300 mA
I_O	Average Rectified Current	200 mA
i_F (surge)	Peak Forward Surge Current (1 sec. Pulse Width)	1 Amp.
i_F (surge)	Peak Forward Surge Current (1 μsec. Pulse Width)	4 Amps.

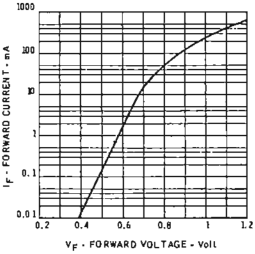
ELECTRICAL CHARACTERISTICS of each diode (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
V_F	Forward Voltage (Note 3)	0.98	1.15	1.5	V	I_F = 500 mA
V_F	Forward Voltage (Note 3)	0.94	1.05	1.2	V	I_F = 300 mA
V_F	Forward Voltage (Note 3)	0.89	0.98	1.1	V	I_F = 200 mA
V_F	Forward Voltage (Note 3)	0.82	0.88	1	V	I_F = 100 mA
V_F	Forward Voltage (Note 3)	0.75	0.8	0.9	V	I_F = 50 mA
V_F	Forward Voltage	0.65	0.68	0.75	V	I_F = 10 mA
V_F	Forward Voltage	0.63	0.65	0.71	V	I_F = 5 mA
V_F	Forward Voltage	0.55	0.58	0.66	V	I_F = 1 mA
I_R	Reverse Current (Note 5)		20	100	nA	V_R = 40 V
I_R (125°C)	Reverse Current (Note 5)		15	100	μA	V_R = 40 V
BV	Breakdown Voltage	60			V	I_R = 100 μA
t_{rr}	Reverse Recovery Time (Note 4)			25	nsec	$I_F = I_R$ = 10 ÷ 200 mA
C_o	Capacitance (Note 6)		1.2	3	pF	V_R = 0 f = 1 MHz

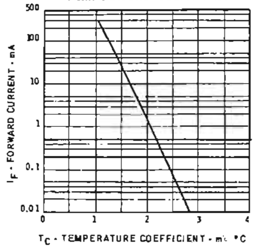
TYPICAL ELECTRICAL CHARACTERISTICS OF EACH DIODE

(25° C free air temperature unless otherwise noted)

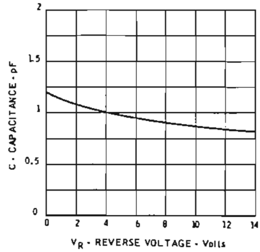
FORWARD CURRENT VERSUS FORWARD VOLTAGE



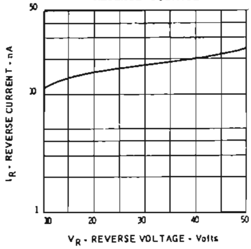
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



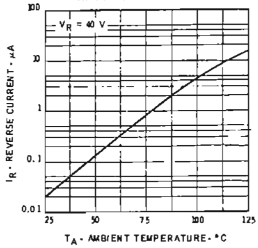
CAPACITANCE VERSUS REVERSE VOLTAGE



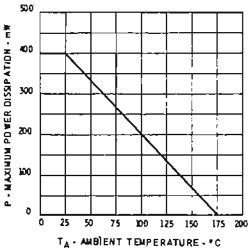
REVERSE CURRENT VERSUS REVERSE VOLTAGE



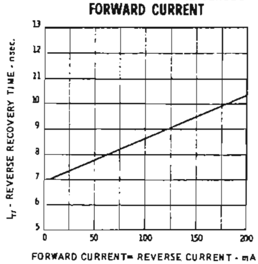
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



POWER DERATING CURVE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT



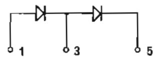
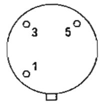
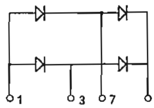
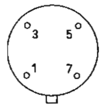
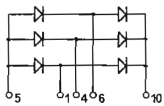
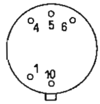
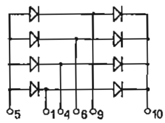
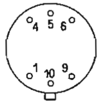
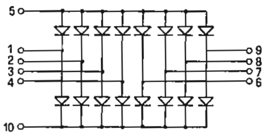
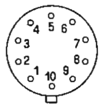
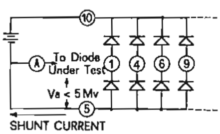
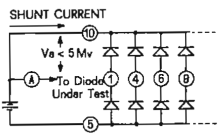
TYPE NUMBER		CIRCUIT CONFIGURATION	PACKAGE CONFIGURATION (bottom view)	
TO-5	TO-18		TO-5	TO-18
BAX 45	**BAX 46**			AS FOR TO-5
BAX 47	**BAX 48**			AS FOR TO-5
BAX 49	NONE			NONE
BAX 50	NONE			NONE
BAX 51	NONE			NONE

FIGURE 1



TEST CONNECTIONS FOR COMMON-CATHODE DIODES



TEST CONNECTIONS FOR COMMON-ANODE DIODES

NOTES:

(1) Ratings apply to individual diodes. For multiple diode operation total power must not exceed power dissipation rating listed.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) Pulse Conditions : length = 300 µsec; duty cycle = 1%.

(4) Recovery to 10% of i_R.

(5) Reverse current measurements between terminals result in substantial leakage contributions from other diodes in the array. To measure diodes individually (specification limit is for individual diodes), current may be shunted by employing test configuration of figure 1.

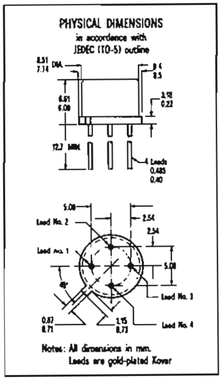
(6) Capacitance cannot conveniently be measured on individual diodes due to contributions of other diodes in the array.

BAX52 - BAX53

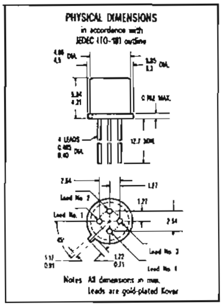
ULTRA FAST DIODE BRIDGE ASSEMBLIES

SILICON PLANAR EPITAXIAL DIODES

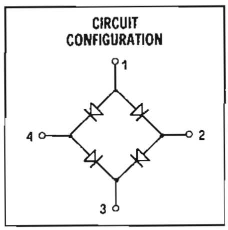
GENERAL DESCRIPTION - These silicon PLANAR epitaxial diode bridges are designed for very high speed applications. They are hermetically sealed in either TO-5 or TO-18 packages. The excellent thermal conductivity of the packages permits operation up to 400 mW.



BAX52



BAX53



ABSOLUTE MAXIMUM RATINGS of each diode (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to +200°C
T_A	Operating Temperature	+175°C Maximum

Maximum Power Dissipation (Note 2)

P	Total Dissipation at 25°C Ambient Temperature	0.4 Watt

Maximum Voltage (T_A = 25°C unless otherwise noted)

WIV	Working Inverse Voltage	40 Volts

Maximum Currents (T_A = 25°C unless otherwise noted)

I_F	Forward Continuous DC Current	300 mA
I_O	Average Rectified Current	200 mA
i_F (surge)	Peak Forward Surge Current (1 sec. Pulse Width)	1 Amp.
i_F (surge)	Peak Forward Surge Current (1 μsec. Pulse Width)	4 Amps.

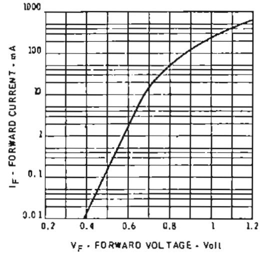
ELECTRICAL CHARACTERISTICS of each diode (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
V_F	Forward Voltage (Note 3)	0.98	1.15	1.5	V	I_F = 500 mA
V_F	Forward Voltage (Note 3)	0.94	1.05	1.2	V	I_F = 300 mA
V_F	Forward Voltage (Note 3)	0.89	0.98	1.1	V	I_F = 200 mA
V_F	Forward Voltage (Note 3)	0.82	0.88	1	V	I_F = 100 mA
V_F	Forward Voltage (Note 3)	0.75	0.8	0.9	V	I_F = 50 mA
V_F	Forward Voltage	0.65	0.68	0.75	V	I_F = 10 mA
V_F	Forward Voltage	0.63	0.65	0.71	V	I_F = 5 mA
V_F	Forward Voltage	0.55	0.58	0.66	V	I_F = 1 mA
I_R	Reverse Current		20	100	nA	V_R = 40 V
I_R (125°C)	Reverse Current		15	100	μA	V_R = 40 V
BV	Breakdown Voltage	60			V	I_R = 100 μA
t_{rr}	Reverse Recovery Time (Note 4)			25	nsec	$I_F = I_R$ = 10 ÷ 200 mA
C_o	Capacitance (Note 5)		1.2	3	pF	V_R = 0 f = 1 MHz
ΔV_F/°C	Forward Voltage Temperature Coefficient		-1.8		mV/°C	

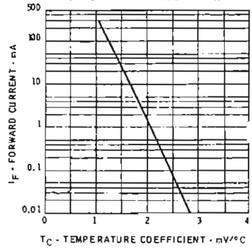
TYPICAL ELECTRICAL CHARACTERISTICS OF EACH DIODE

(25° C free air temperature unless otherwise noted)

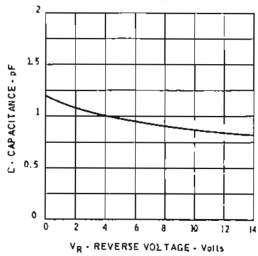
FORWARD CURRENT VERSUS FORWARD VOLTAGE



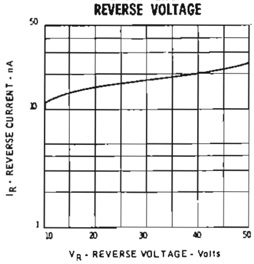
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



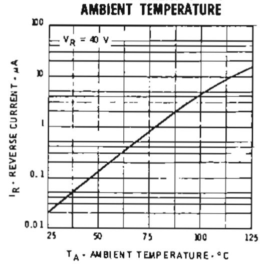
CAPACITANCE VERSUS REVERSE VOLTAGE



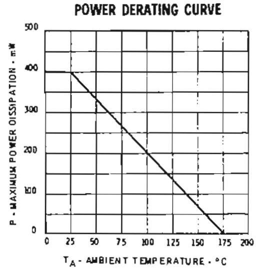
REVERSE CURRENT VERSUS REVERSE VOLTAGE



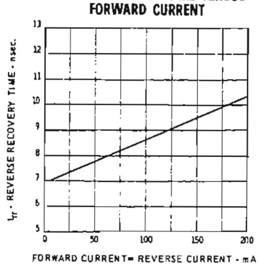
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



POWER DERATING CURVE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT



NOTES:

(1) Ratings apply to individual diodes. For multiple diode operation total power must not exceed power dissipation rating listed.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) Pulse Conditions: length = 300 µsec; duty cycle = 1%.

(4) Recovery to 10% of i_R.

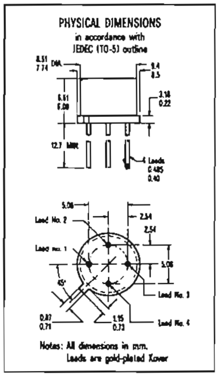
(5) Capacitance C_o cannot be monitored indipendently on each diode in a bridge configuration. In measuring this parameter on bridge configurations, the capacitance limit is 4/3 the limit listed in the electrical characteristics.

BAX54 - BAX55

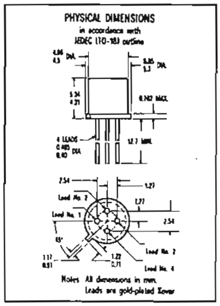
ULTRA FAST DIODE RING MODULATOR ASSEMBLIES

SILICON PLANAR EPITAXIAL DIODES

GENERAL DESCRIPTION - These silicon PLANAR epitaxial diode ring modulator assemblies are designed for applications in multichannel equipments working at very high speed. They are hermetically sealed in either TO-5 or TO-18 packages. The excellent thermal conductivity of the packages permits operation up to 400 mW.

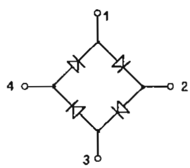


BAX54



BAX55

CIRCUIT CONFIGURATION



ABSOLUTE MAXIMUM RATINGS of each diode (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_A	Operating Temperature	+ 175°C Maximum

Maximum Power Dissipation (Note 2)

P	Total Dissipation at 25°C Ambient Temperature	0.4 Watt

Maximum Voltage (T_A = 25°C unless otherwise noted)

WIV	Working Inverse Voltage	40 Volts

Maximum Currents (T_A = 25°C unless otherwise noted)

I_F	Forward Continuous DC Current	300 mA
I_O	Average Rectified Current	200 mA
i_F (surge)	Peak Forward Surge Current (1 sec. Pulse Width)	1 Amp.
i_F (surge)	Peak Forward Surge Current (1 µsec. Pulse Width)	4 Amps.

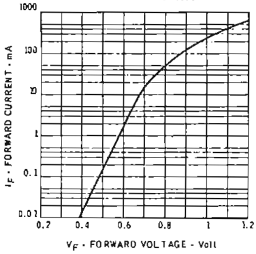
ELECTRICAL CHARACTERISTICS of each diode (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
V_F	Forward Voltage (Note 3)	0.98	1.15	1.5	V	I_F = 500 mA
V_F	Forward Voltage (Note 3)	0.94	1.05	1.2	V	I_F = 300 mA
V_F	Forward Voltage (Note 3)	0.89	0.98	1.1	V	I_F = 200 mA
V_F	Forward Voltage (Note 3)	0.82	0.88	1	V	I_F = 100 mA
V_F	Forward Voltage (Note 3)	0.75	0.8	0.9	V	I_F = 50 mA
V_F	Forward Voltage	0.65	0.68	0.75	V	I_F = 10 mA
V_F	Forward Voltage	0.63	0.65	0.71	V	I_F = 5 mA
V_F	Forward Voltage	0.55	0.58	0.66	V	I_F = 1 mA
I_R	Reverse Current		20	100	nA	V_R = 40 V
I_R (125°C)	Reverse Current		15	100	µA	V_R = 40 V
BV	Breakdown Voltage	60			V	I_R = 100 µA
t_{rr}	Reverse Recovery Time (Note 4)			25	nsec	$I_F = I_R$ = 10 ÷ 200 mA
C_o	Capacitance (Note 5)		1.2	3	pF	V_R = 0 f = 1 MHz
ΔV_F/°C	Forward Voltage Temperature Coefficient		- 1.8		mV/°C	
MATCHED CHARACTERISTICS						
ΔV_F	Forward Voltage Match (-55°C to 100°C)			5	mV	I_F = 10 µA to 10 mA

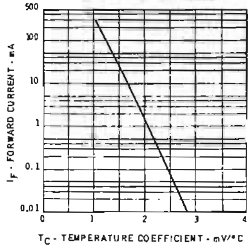
TYPICAL ELECTRICAL CHARACTERISTICS OF EACH DIODE

(25° C free air temperature unless otherwise noted)

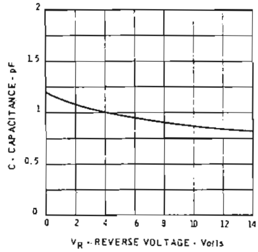
FORWARD CURRENT VERSUS FORWARD VOLTAGE



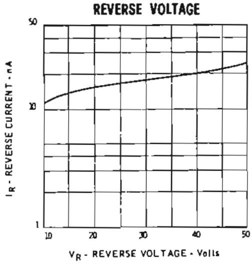
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



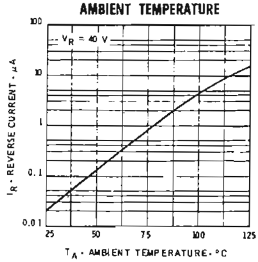
CAPACITANCE VERSUS REVERSE VOLTAGE



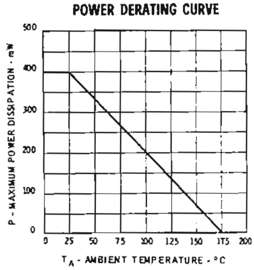
REVERSE CURRENT VERSUS REVERSE VOLTAGE



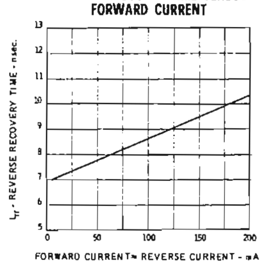
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



POWER DERATING CURVE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT



NOTES:

(1) Ratings apply to individual diodes. For multiple diode operation total power must not exceed power dissipation rating listed.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) Pulse Conditions : length = 300µsec; duty cycle = 1%.

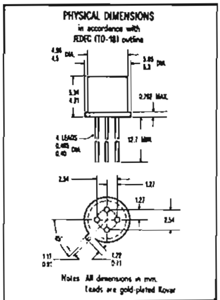
(4) Recovery to 10% of i_R.

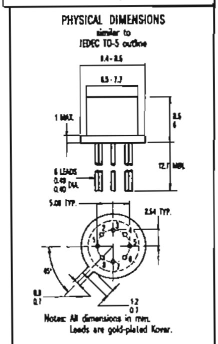
(5) Capacitance C_o cannot be monitored indipendently on each diode in a bridge configuration In measuring this on parameter bridge configurations, the capacitance limit is 4/3 the limit listed in the electrical characteristics.

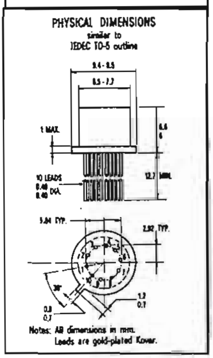
BAX56 to BAX73

ULTRA FAST COMMON ANODE AND COMMON CATHODE ARRAYS

SILICON PLANAR EPITAXIAL DIODES







GENERAL DESCRIPTION - These silicon PLANAR epitaxial diode arrays are designed for high speed core driver applications. They are hermetically sealed in either TO-5 or TO-18 packages. The excellent thermal conductivity of the packages permits operation up to 400 mW.

ABSOLUTE MAXIMUM RATINGS of each diode (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_A	Operating Temperature	+ 175°C Maximum

Maximum Power Dissipation (Note 2)

P	Total Dissipation at 25°C Ambient Temperature	0.4 Watt

Maximum Voltage (T_A = 25°C unless otherwise noted)

WIV	Working Inverse Voltage	40 Volts

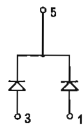
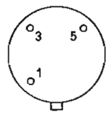
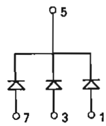
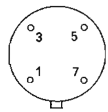
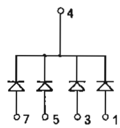
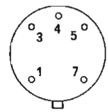
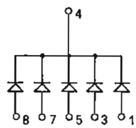
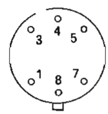
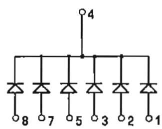
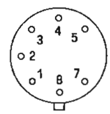
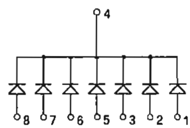
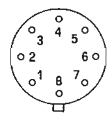
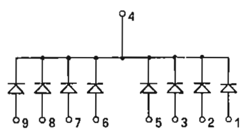
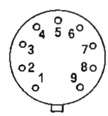
Maximum Currents (T_A = 25°C unless otherwise noted)

I_F	Forward Continuous DC Current	300 mA
I_O	Average Rectified Current	200 mA
i_F (surge)	Peak Forward Surge Current (1 sec. Pulse Width)	1 Amp.
i_F (surge)	Peak Forward Surge Current (1μsec. Pulse Width)	4 Amps.

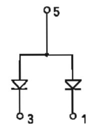
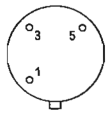
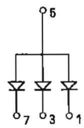
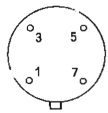
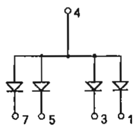
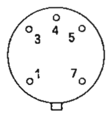
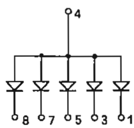
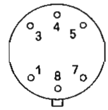
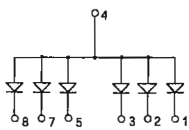
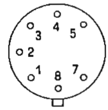
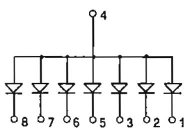
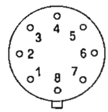
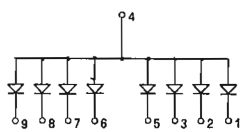
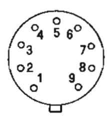
ELECTRICAL CHARACTERISTICS of each diode (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
V_F	Forward Voltage (Note 3)	0.98	1.15	1.5	V	I_F = 500 mA
V_F	Forward Voltage (Note 3)	0.94	1.05	1.2	V	I_F = 300 mA
V_F	Forward Voltage (Note 3)	0.89	0.98	1.1	V	I_F = 200 mA
V_F	Forward Voltage (Note 3)	0.82	0.88	1	V	I_F = 100 mA
V_F	Forward Voltage (Note 3)	0.75	0.8	0.9	V	I_F = 50 mA
V_F	Forward Voltage	0.65	0.68	0.75	V	I_F = 10 mA
V_F	Forward Voltage	0.63	0.65	0.71	V	I_F = 5 mA
V_F	Forward Voltage	0.55	0.58	0.66	V	I_F = 1 mA
I_R	Reverse Current		20	100	nA	V_R = 40 V
I_R (125°C)	Reverse Current		15	100	μA	V_R = 40 V
BV	Breakdown Voltage	60			V	I_R = 100 μA
t_{rr}	Reverse Recovery Time (Note 4)			4	nsec	$I_F = I_R$ = 10 ÷ 200 mA
C_o	Capacitance		1.2	3	pF	V_R = 0 f = 1 MHz

COMMON CATHODE ARRAYS

TYPE NUMBER		CIRCUIT CONFIGURATION	PACKAGE CONFIGURATION (bottom view)	
TO-5	TO-18		TO-5	TO-18
BAX 56	**BAX 58**			AS FOR TO-5
BAX 60	**BAX 62**			AS FOR TO-5
BAX 65	NONE			NONE
BAX 67	NONE			NONE
BAX 69	NONE			NONE
BAX 71	NONE			NONE
BAX 73	NONE			NONE

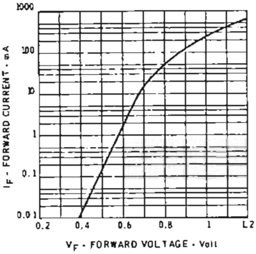
COMMON ANODE ARRAYS

TYPE NUMBER		CIRCUIT CONFIGURATION	PACKAGE CONFIGURATION (bottom view)	
TO-5	TO-18		TO-5	TO-18
BAX 57	**BAX 59**			AS FOR TO-5
BAX 61	**BAX 63**			AS FOR TO-5
BAX 64	NONE			NONE
BAX 66	NONE			NONE
BAX 68	NONE			NONE
BAX 70	NONE			NONE
BAX 72	NONE			NONE

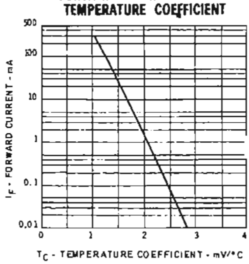
TYPICAL ELECTRICAL CHARACTERISTICS OF EACH DIODE

(25°C free air temperature unless otherwise noted)

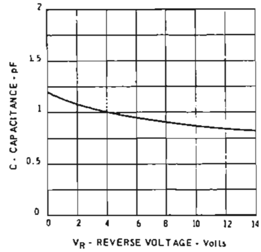
FORWARD CURRENT VERSUS FORWARD VOLTAGE



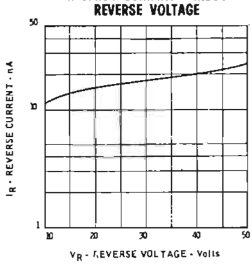
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



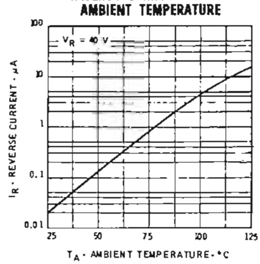
CAPACITANCE VERSUS REVERSE VOLTAGE



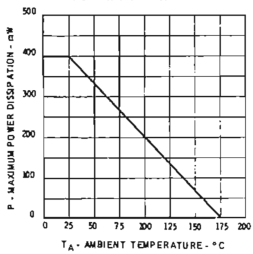
REVERSE CURRENT VERSUS REVERSE VOLTAGE



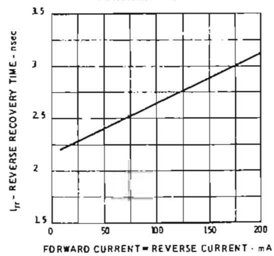
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



POWER DERATING CURVE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT



NOTES:

(1) Ratings apply to individual diodes. For multiple diode operation total power must not exceed dissipation rating listed.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

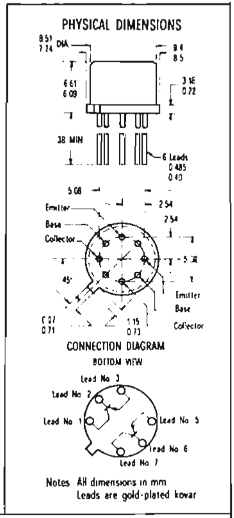
(3) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(4) Recovery to 10% of i_R.

BFX 11

LOW-LEVEL, LOW-NOISE DIFFERENTIAL AMPLIFIER

PNP DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR



GENERAL DESCRIPTION - The BFX11 is a six terminal device containing two isolated high gain, low noise PNP silicon PLANAR epitaxial transistors in one hermetically sealed enclosure. The SGS-ATES Planar process guarantees the stability of the initial match with time and the good thermal tracking over a wide current and temperature range. The BFX11 offers the circuit designer matched transistors with specified performance, for differential amplifier and low level DC amplifier applications.

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 Dissipations

	One Side	Both Sides
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.85 Watt	1.4 Watt
at 100°C Case Temperature (Notes 2 and 3)	0.48 Watt	0.80 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.40 Watt	0.50 Watt

Maximum Voltages

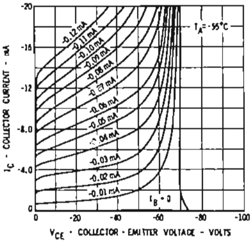
V_{CBO}	Collector to Base Voltage	-45 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-45 Volts
V_{EBO}	Emitter to Base Voltage	-4.5 Volts

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

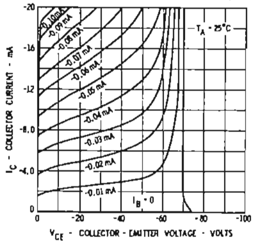
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	50	130			I_C = 10 µA	V_{CE} = - 5 V
h_{FE}	DC Current Gain	80	170			I_C = 100 µA	V_{CE} = - 5 V
h_{FE}	DC Current Gain	90	200			I_C = 1 mA	V_{CE} = - 5 V
h_{FE}	DC Pulse Current Gain (Note 5)	80	170			I_C = 50 mA	V_{CE} = - 5 V
h_{FE1}/h_{FE2}	DC Current Gain Ratio (Note 7)	0.8		1		I_C = 100 µA	V_{CE} = - 5 V
V_{BE} (sat)	Base-Emitter Saturation Voltage			- 1	V	I_C = 50 mA	I_B = 2.5 mA
ΔV_{BE}	Base to Emitter Voltage Differential			5	mV	I_C = 100 µA	V_{CE} = - 5 V
$\Delta V_{BE}/\Delta T$	Base to Emitter Voltage Differential Change			20	µV/°C	I_C = 100 µA T_A = -55 ÷ + 125°C	V_{CE} = - 5 V
V_{CE} (sat)	Collector-Emitter Saturation Voltage		-0.1	-0.25	V	I_C = 50 mA	I_B = 2.5 mA
I_{EBO}	Emitter Cutoff Current			100	nA	I_C = 0	V_{EB} = - 3 V
I_{CBO}	Collector Cutoff Current		0.05	10	nA	I_E = 0	V_{CB} = - 30 V
I_{CBO} (150°C)	Collector Cutoff Current		0.08	10	µA	I_E = 0	V_{CB} = - 30 V
BV_{CBO}	Collector to Base Breakdown Voltage	-45			V	I_C = 10 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.5			V	I_C = 0	I_E = 10 µA
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-45			V	I_C = 10 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	1.3				I_C = 50 mA	V_{CE} = - 20 V
C_{ob}	Output Capacitance			8	pF	I_E = 0	V_{CB} = - 10 V
C_{ib}	Input Capacitance			25	pF	I_C = 0	V_{EB} = - 0.5 V
NF	Narrow Band Noise Figure (Note 6)		1.5	5	dB	I_C = 30 µA	V_{CE} = - 5 V

TYPICAL ELECTRICAL CHARACTERISTICS

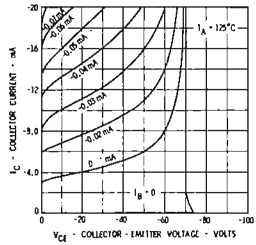
COLLECTOR CHARACTERISTICS*



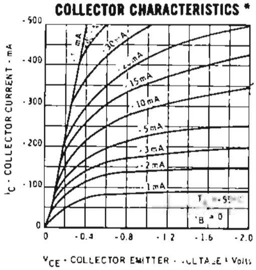
COLLECTOR CHARACTERISTICS*



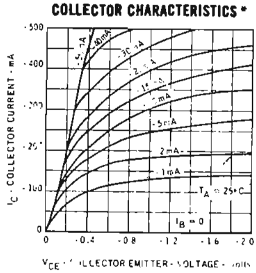
COLLECTOR CHARACTERISTICS*



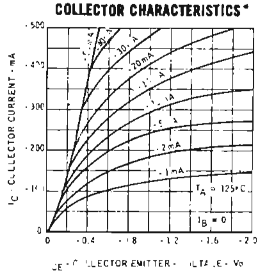
COLLECTOR CHARACTERISTICS *



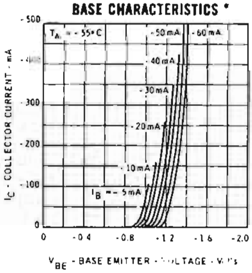
COLLECTOR CHARACTERISTICS *



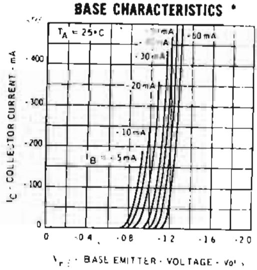
COLLECTOR CHARACTERISTICS*



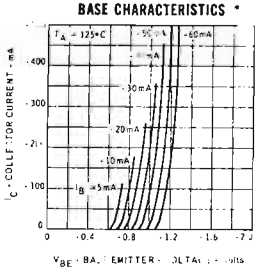
BASE CHARACTERISTICS *



BASE CHARACTERISTICS *



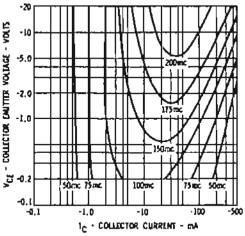
BASE CHARACTERISTICS *



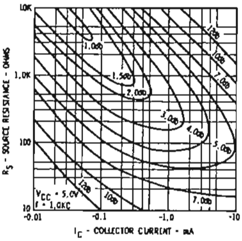
* **Single family characteristics on Transistor Curve Tracer.**

TYPICAL ELECTRICAL CHARACTERISTICS

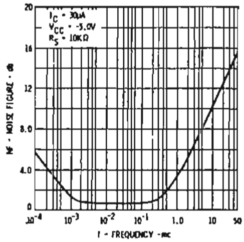
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



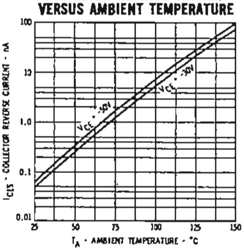
NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT



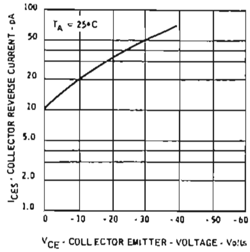
NOISE FIGURE VERSUS FREQUENCY



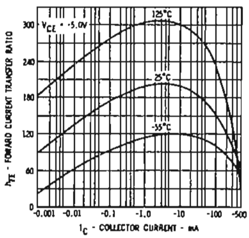
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



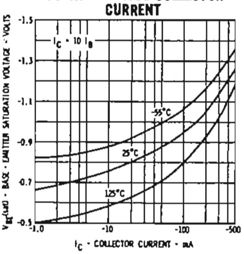
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



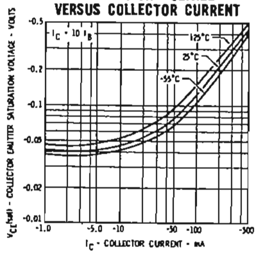
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



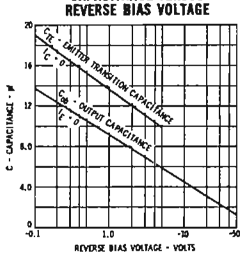
PULSED BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



PULSED COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



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-ambient thermal resistance of 431°C/Watt (derating factor of 2.29 mW/°C) for one side; 350°C/Watt (derating factor of 2.86 mW/°C) for both sides. Junction-to-case thermal resistance of 206°C/Watt (derating factor of 4.85 mW/°C) for one side; 125°C/Watt (derating factor of 8 mW/°C) for both sides.

(4) Ratings refer to a high current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(5) Pulse Conditions: = 300 µsec; duty cycle = 1%.

(6) f = 1 Kc/s; R_S = 10 KΩ. BW = 200 cps.

(7) Lowest of two h_{FE} readings is taken as h_{FE1} for purposes of this ratio.

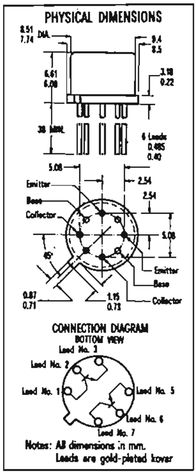
DECEMBER 1965

BFX 15

EXTREMELY LOW DRIFT DIFFERENTIAL AMPLIFIER

DUAL NPN SILICON PLANAR TRANSISTORS

GENERAL DESCRIPTION - The BFX 15 is an extremely low-drift differential amplifier especially suitable for low source impedance applications. In such circuits the differential V_{BE} temperature drift is guaranteed to be less than 2.5 µV/°C over a temperature range 0°C/ to 70°C.



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to + 200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	300°C Maximum

Maximum Power Dissipations

	One Side Only	Both Sides
Total Dissipation at 25°C Case Temperature (Note 2)	1.2 Watt	1.8 Watt
at 100°C Case Temperature (Note 2)	0.68 Watt	1.2 Watt
at 25°C Ambient Temperature (Note 2)	0.5 Watt	0.6 Watt

Maximum Voltages

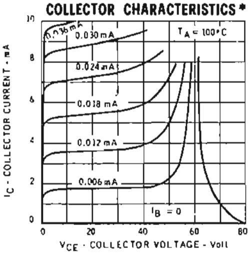
BV_{CBO}	Collector to Base Voltage	80 Volts
LV_{CER}	Collector to Emitter Voltage ($R_{BE} > 10\Omega$)	60 Volts
LV_{CEO}	Collector to Emitter Voltage	40 Volts
BV_{EBO}	Emitter to Base Voltage	5.0 Volts

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

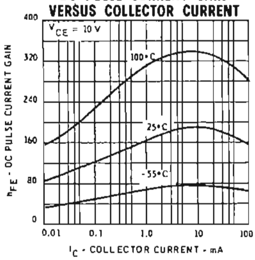
SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	30			I_C = 0.01 mA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain	60			I_C = 0.1 mA	V_{CE} = 5.0 V
h_{FE}	DC Pulse Current Gain (Note 3)	90			I_C = 10 mA	V_{CE} = 5.0 V
h_{FE}/h_{FE2}	DC Current Gain Ratio	0.9	1.0		I_C = 0.1 mA	V_{CB} = 5.0 V
V_{BE} (sat)	Base Saturation Voltage		0.6	V	I_C = 1.0 mA	I_B = 0.1 mA
(V_{BE1}/V_{BE2})	Base Voltage Differential		5.0	mV	I_C = 0.1 mA	V_{CE} = 5.0 V
$\Delta V_{BE}/\Delta T$	Base Voltage Differential Change (Note 4)		2.5	µV/°C	$I_{C1} + I_{C2}$ = 200µA	T=0°C to +70°C
$\Delta V_{BE}/\Delta T$	Base Voltage Differential Change (Note 5)		10	µV/°C	$I_{C1} = I_{C2}$ = 100 µA	V_{CE} = 5.0 V
V_{CE} (sat)	Collector Saturation Voltage		1.0	V	I_C = 1.0 mA	I_B = 0.1 mA
I_{CBO}	Collector Cutoff Current		10	nA	I_E = 0	V_{CB} = 40 V
I_{CBO} (150°C)	Collector Cutoff Current		10	µA	I_E = 0	V_{CB} = 40 V
I_{EBO}	Emitter Cutoff Current		10	nA	I_C = 0	V_{EB} = 4.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	80		V	I_C = 0.1 mA	I_E = 0
BV_{EBO}	Emitter Breakdown Voltage	5.0		V	I_C = 0	I_E = 0.1 mA
LV_{CER}	Collector to Emitter Sust. Voltage (Note 3)	60		V	I_C = 100 mA	R_{BE} = 10 Ω
LV_{CEO}	Collector to Emitter Sust. Voltage (Note 3)	40		V	I_C = 30 mA	I_B = 0
h_{fe}	Small Signal Current Gain (f = 1 Kc/s)	30			I_C = 1.0 mA	V_{CE} = 5.0 V
h_{fe}	High Frequency Current Gain (f = 20 Mc/s)	2.5			I_C = 50 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance (f = 1 Kc/s)		15	pF	I_E = 0	V_{CB} = 10 V
C_{TE}	Input Capacitance (f = 1 Kc/s)		85	pF	I_C = 0	V_{EB} = 0.5 V

TYPICAL ELECTRICAL CHARACTERISTICS

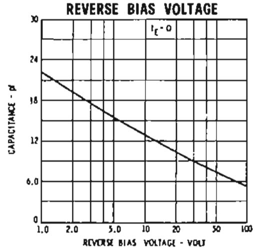
COLLECTOR CHARACTERISTICS *



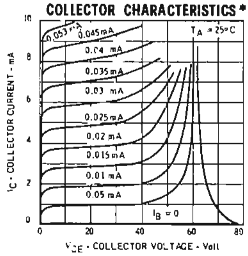
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



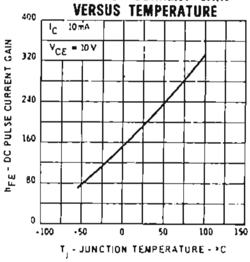
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



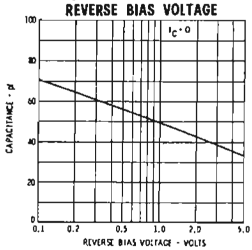
COLLECTOR CHARACTERISTICS *



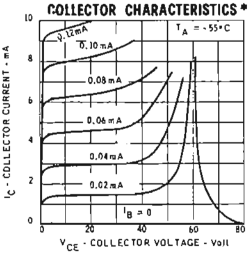
DC PULSE CURRENT GAIN VERSUS TEMPERATURE



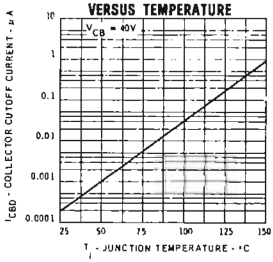
EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



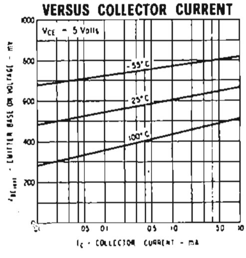
COLLECTOR CHARACTERISTICS *



COLLECTOR CUTOFF CURRENT VERSUS TEMPERATURE



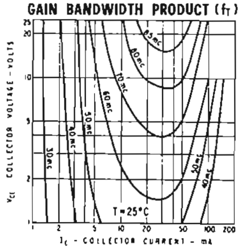
BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



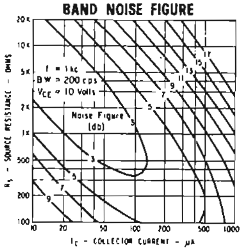
* Single family characteristics on Transistor Curve Tracer

TYPICAL ELECTRICAL CHARACTERISTICS

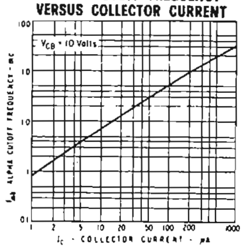
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



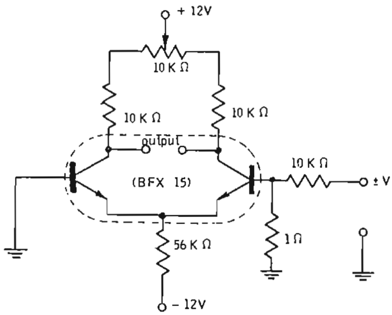
CONTOURS OF NARROW BAND NOISE FIGURE



ALPHA CUTOFF FREQUENCY VERSUS COLLECTOR CURRENT



TEST CIRCUIT



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/watt for one side and 97°C/watt for both sides.

(3) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(4) See circuit for test conditions.
Care should be taken to avoid spurious effects due to thermoelectric contacts, component temperature differences, temperature coefficient, etc....

(5) T_A = - 55°C to + 25°C or + 25°C to + 125°C

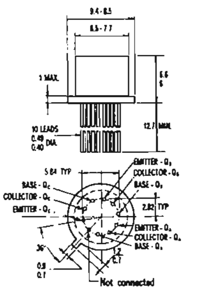
BFX 16

ULTRA LOW DRIFT DIFFERENTIAL AMPLIFIER

THREE NPN SILICON PLANAR TRANSISTORS

GENERAL DESCRIPTION - The BFX 16 is intended for ultra-low-drift compensated D.C. amplifiers. The maximum total amplifier drift is guaranteed less than 0.5 µV/°C from 0°C to 70°C. In order to ensure that this low drift does not change with life, it is advisable not to operate the device permanently much above this ambient temperature range.

PHYSICAL DIMENSIONS
similar to
JEDEC TO-5 outline



Notes: All dimensions in mm.
Leads are gold-plated Kovar.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C Maximum
T_L	Lead Temperature (Soldering, 10 sec. time limit)	+ 260°C Maximum

Maximum Power Dissipations

		Each One	Total
P	Total Dissipation at 25°C Case Temperature	0.75 Watt	1,3 Watt
	at 100°C Case Temperature	0.43 Watt	0.75 Watt
	at 25°C Ambient Temperature	0.3 Watt	0.5 Watt

Maximum Voltages (25°C free air temperature unless otherwise noted)

V_{CBO}	Collector to Base Voltage	45 Volts
V_{CEO}	Collector to Emitter Voltage	45 Volts
V_{EBO}	Emitter to Base Voltage	6 Volts

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted) Q_A, Q_B; Q_C

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNIT	TEST CONDITIONS	
V_{BE} (on)	Emitter to Base On Voltage		0.7	V	I_C = 100 µA	V_{CE} = 5 V
V_{CE} (sat)	Collector Saturation Voltage (Note 2)		0.35	V	I_C = 1 mA	I_B = 0.1 mA
BV_{CBO}	Collector to Base Breakdown Voltage	45		V	I_C = 10 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	6		V	I_E = 10 µA	I_C = 0
V_{CEO} (sust)	Colleetor to Emitter Sustaining Voltage (Note 2)	45		V	I_C = 10 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 30 MHz)	2			I_C = 500 µA	V_{CE} = 5 V
C_{ob}	Output Capacitance (f = 1 KHz)		6	pF	I_E = 0	V_{CB} = 5 V

Continued on page 2

NOTES:
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) Pulse Conditions: length = 300 µsec; duty cycle = 1%.
(3) f = 1 KHz; R_S = 10 KΩ; Power Bandwidth of 200 Hz.

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

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	175			I_C = 10 μA	V_{CE} = 5 V
h_{FE1}/h_{FE2}	DC Current Gain Ratio	0.8	1		I_C = 10 μA	V_{CE} = 5 V
h_{FE1}/h_{FE2}	DC Current Gain Ratio	0.9	1		I_C = 100 μA	V_{CE} = 5 V
V_{BE1}/V_{BE2}	Base Voltage Differential		5	mV	I_C = 10 μA to 1 mA	V_{CE} = 5 V
ΔV_{in}	Equivalent Input Drift (see circuit)		0.5	μV/°C	T_A = 0 to 70°C	
I_{CBO}	Collector Cutoff Current		2	nA	I_E = 0	V_{CB} = 25 V
I_{CBO} (150°C)	Collector Cutoff Current		10	μA	I_E = 0	V_{CB} = 25 V
I_{EBO}	Emitter Cutoff Current		2	nA	I_C = 0	V_{EB} = 4 V
I_{CEO}	Collector to Emitter Cutoff Current		2	nA	I_B = 0	V_{CE} = 4 V
NF	Noise Figure (Note 3)		3	dB	I_C = 10 μA	V_{CE} = 5 V

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

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	75			I_C = 100 μA	V_{CE} = 5 V
I_{CBO}	Collector Cutoff Current		10	nA	I_E = 0	V_{CB} = 25 V
I_{CBO} (150°C)	Collector Cutoff Current		15	μA	I_E = 0	V_{CB} = 25 V
I_{EBO}	Emitter Cutoff Current		10	nA	I_C = 0	V_{EB} = 4 V
I_{CEO}	Collector to Emitter Cutoff Current		10	nA	I_B = 0	V_{CE} = 4 V

APPLICATIONS INFORMATION

The BFX 16 is a compensated dc amplifier which furnishes an exceedingly low drift in a wide range of circuits. A typical circuit, which is the one used to measure the drift specified, is shown in fig. 1.

The procedure used to reduce the drift to a minimum in this amplifier is the following:

1. With "S" OPEN, R_6 is adjusted for zero output.
2. With "S" CLOSED, R_2 is adjusted for zero output independent of the position of R_9.
3. With the amplifier brought up to any temperature, R_9 is adjusted for zero output. If the drift is linear, this adjustment will be acceptable for the full temperature range. It may be that, in some cases, this zeroing procedure should be repeated.

Although the circuit looks complicated, its operation is really quite simple and can be understood in the following manner. The resistive chain of R_1 through R_5 furnishes a constant voltage on the base of Q_C. Since the V_{BE} of this transistor decreases with an increase in temperature, the current furnished to the emitters of Q_A and Q_B increases with the increase of temperature. The collectors, therefore, fall in voltage, and consequently, the current which is then furnished into resistor R_9 from the resistive chain can be fed more into one transistor than into the other by varying the position of the tap on R_9.

Since these drift phenomena are reasonably linear over a eertain temperature range as is the variation of V_{BE} of the compensating transistor Q_C the drift due to all factors (ΔV_{BE}, ΔI_{CBO}, Δh_{FE}) can thus be compensated.

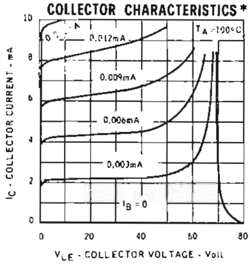
The voltage sources, e_1, e_2 can be put to ground simply by having a negative supply instead of ground on the resistors R_5 and R_{10}.

For further information, the user is referred to Ref. 1 or to our Application Service.

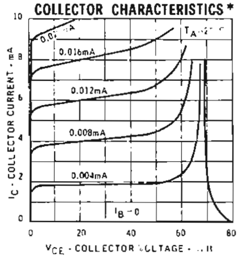
Ref. 1: " Drift Compensation in DC Amplifiers" SGS AR 121

TYPICAL ELECTRICAL CHARACTERISTICS Q_A, Q_B

COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*



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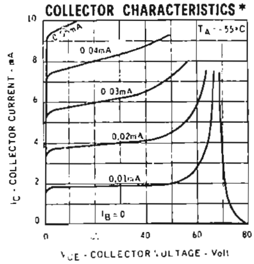
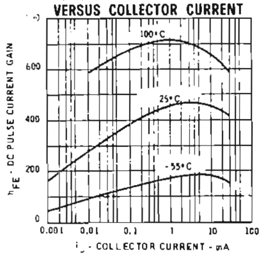
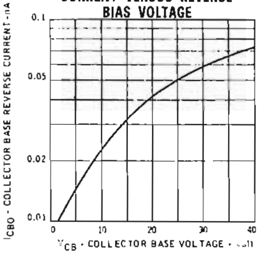


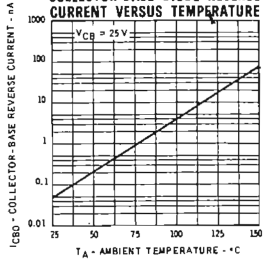
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE

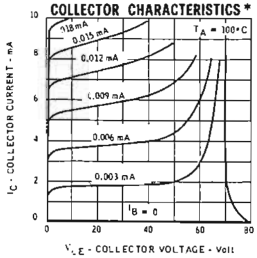


COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE

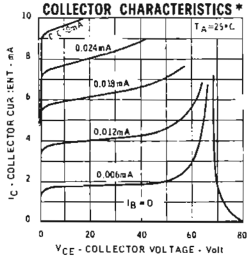


TYPICAL ELECTRICAL CHARACTERISTICS Q_C

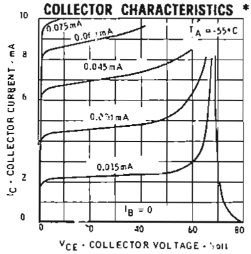
COLLECTOR CHARACTERISTICS*



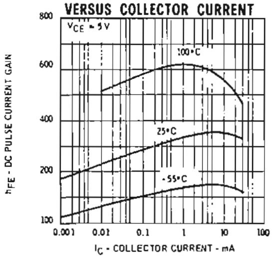
COLLECTOR CHARACTERISTICS*



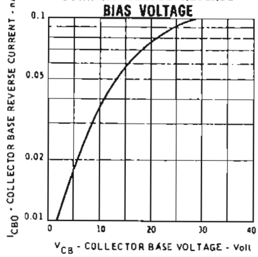
COLLECTOR CHARACTERISTICS *



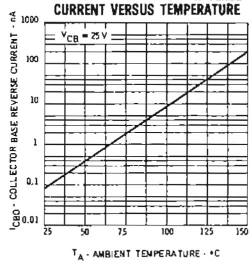
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



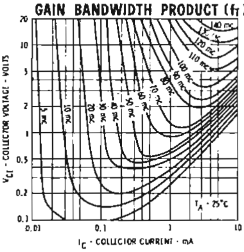
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



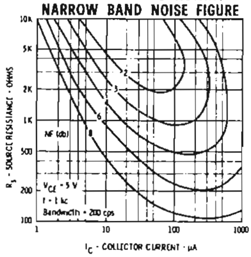
*Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS Q_A, Q_B, Q_C

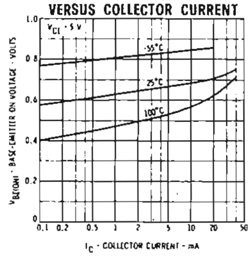
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



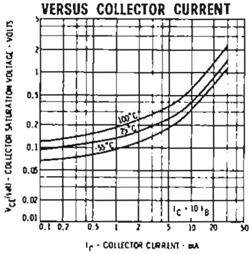
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



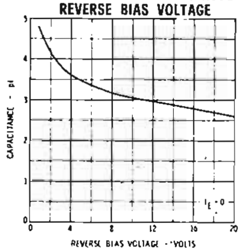
BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



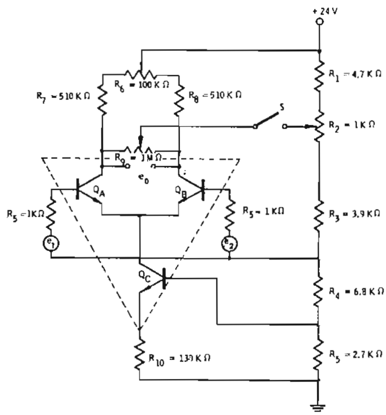
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



COMPENSATED AMPLIFIER



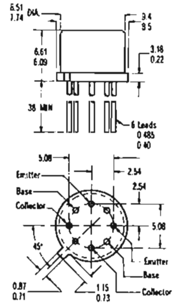
BFX 36

DUAL HIGH-GAIN, LOW–NOISE DIFFERENTIAL AMPLIFIER

PNP DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The BFX 36 is a six-terminal device containing two isolated high-gain, low-noise, PNP silicon PLANAR epitaxial transistors in one hermetically sealed enclosure. They are designed for use in high performance amplifier and differential amplifier circuits requiring high-gain and low-noise in a very wide current range, from 1 μA up to 100 mA.

PHYSICAL DIMENSIONS



Notes: All dimensions in mm.
Leads are gold-plated kovar

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 Dissipations

	One Side	Both Sides
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.80 Watt	1.3 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.40 Watt	0.6 Watt

Maximum Voltages for Each Transistor

V_{CBO}	Collector to Base Voltage	-60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-60 Volts
V_{EBO}	Emitter to Base Voltage	-6 Volts

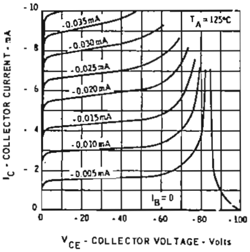
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	60	140			I_C = 1 μA	V_{CE} = - 5 V
h_{FE}	DC Current Gain	100	160	300		I_C = 10 μA	V_{CE} = - 5 V
h_{FE}	DC Current Gain	100	180			I_C = 100 μA	V_{CE} = - 5 V
h_{FE}	DC Current Gain	100	200			I_C = 1 mA	V_{CE} = - 5 V
h_{FE} (-55°C)	DC Pulse Current Gain (Note 5)	40	90			I_C = 10 μA	V_{CE} = - 5 V
h_{FE}	DC Pulse Current Gain (Note 5)	90	190			I_C = 50 mA	V_{CE} = - 5 V
V_{BE} (sat)	Base-Emitter Saturation Voltage			-0.9	V	I_C = 10 mA	I_B = 0.5 mA
V_{BE} (sat)	Base-Emitter Saturation Voltage		-0.85	-0.95	V	I_C = 50 mA	I_B = 5 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage			-0.25	V	I_C = 10 mA	I_B = 0.5 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage		-0.14	-0.4	V	I_C = 50 mA	I_B = 5 mA
I_{EBO}	Emitter Cutoff Current			10	nA	I_C = 0	V_{EB} = - 4 V
I_{CBO}	Collector Cutoff Current		0.5	10	nA	I_E = 0	V_{CB} = - 50 V
I_{CBO} (125°C)	Collector Cutoff Current		0.5	10	μA	I_E = 0	V_{CB} = - 50 V
BV_{CBO}	Collector to Base Breakdown Voltage	-60			V	I_C = 10 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-6			V	I_E = 10 μA	I_C = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-60			V	I_C = 5 mA (pulsed)	I_B = 0
h_{ie}	Input Resistance (f = 1 Kc/s)	2.5	5.7	20	KΩ	I_C = 1 mA	V_{CE} = - 5 V
h_{oe}	Output Conductance (f = 1 Kc/s)	5	22	50	μmho	I_C = 1 mA	V_{CE} = - 5 V
h_{re}	Voltage Feedback Ratio (f = 1 Kc/s)		2.9	10	$\times 10^{-4}$	I_C = 1 mA	V_{CE} = - 5 V
h_{fe}	High Frequency Current Gain (f = 20 Mc/s)	2	5.5	8		I_C = 1 mA	V_{CE} = - 5 V
C_{ob}	Output Capacitance		5	6	pF	I_E = 0	V_{CB} = - 5 V
NF	Narrow Band Noise Figure (Note 6)			3	dB	I_C = 20 μA	V_{CE} = - 5 V
NF	Narrow Band Noise Figure (Note 7)			10	dB	I_C = 20 μA	V_{CE} = - 5 V
h_{FE1}/h_{FE2}	DC Current Gain Ratio (Note 8)	0.9		1		I_C = 100 μA	V_{CE} = - 5 V
$\vert V_{BE1}-V_{BE2}\vert$	Base Voltage Differential			3	mV	I_C = 100 μA	V_{CE} = - 5 V
$\vert V_{BE1}-V_{BE2}\vert/\Delta T$	Base Voltage Differential Change			10	μV/°C	I_C = 100 μA	V_{CE} = - 5 V

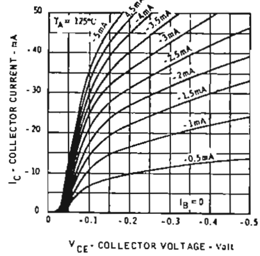
TYPICAL ELECTRICAL CHARACTERISTICS - ONE SIDE

(25° C free air temperature unless otherwise noted)

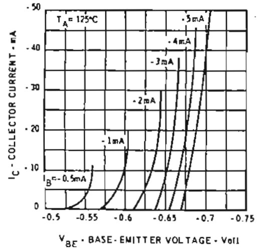
COLLECTOR CHARACTERISTICS*



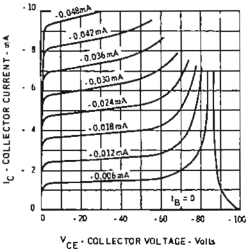
COLLECTOR CHARACTERISTICS*



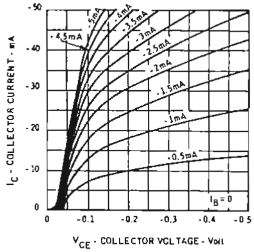
BASE CHARACTERISTICS*



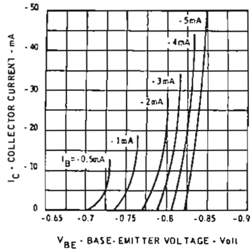
COLLECTOR CHARACTERISTICS*



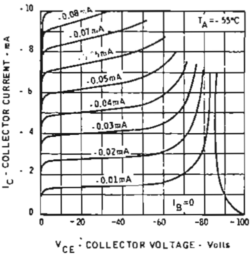
COLLECTOR CHARACTERISTICS*



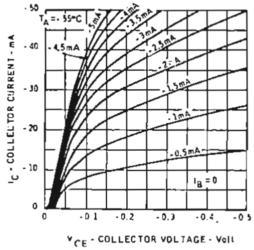
BASE CHARACTERISTICS*



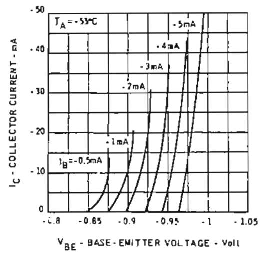
COLLECTOR CHARACTERISTICS*



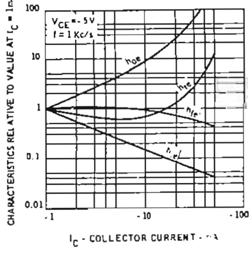
COLLECTOR CHARACTERISTICS*



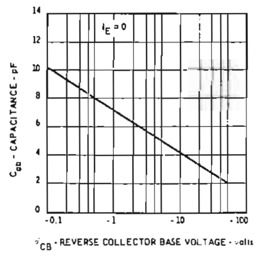
BASE CHARACTERISTICS*



TYPICAL COMMON EMITTER CHARACTERISTICS



OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

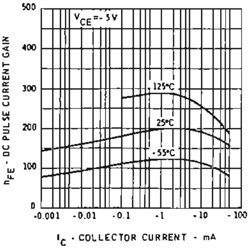


* Single family characteristics on Transistor Curve Tracer.

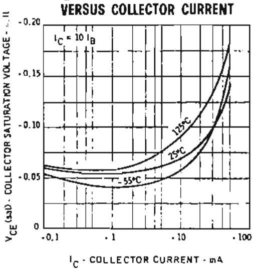
TYPICAL ELECTRICAL CHARACTERISTICS - ONE SIDE

(25° C free air temperature unless otherwise noted)

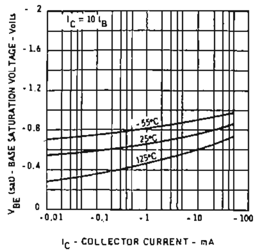
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



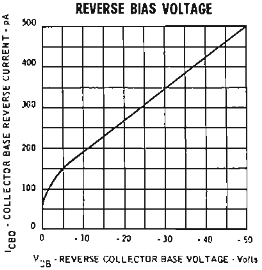
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



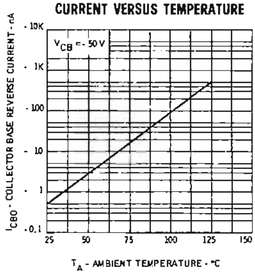
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



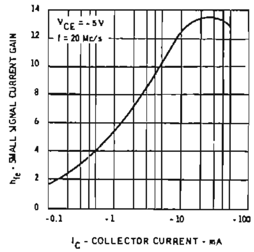
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



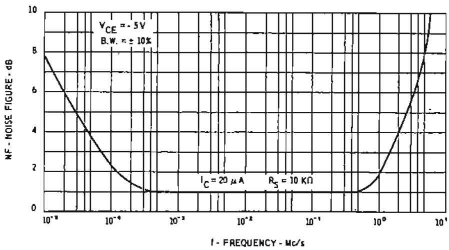
COLLECTOR-BASE REVERSE CURRENT VERSUS TEMPERATURE



SMALL SIGNAL CURRENT GAIN AT 20 Mc/s VERSUS COLLECTOR CURRENT



NOISE FIGURE VERSUS FREQUENCY



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 220°C/W (derating factor of 4.55 mW/°C) for one side, and junction-to-case thermal resistance of 135°C/W (derating factor of 7.4 mW/°C) for both sides; junction-to-ambient thermal resistance of 440°C/W (derating factor of 2.26 mW/°C) for one side, and junction-to-ambient thermal resistance of 293°C/W (derating factor of 3.42 mW/°C) for both sides.

(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(6) f = 1 Kc/s; R_S = 10 KΩ; Power Bandwidth of 200 cps.

(7) f = 100 cps; R_S = 10 KΩ; Power Bandwidth of 20 cps.

(8) Lowest of two h_{FE} reading is taken as h_{FE1} for purpose of this ratio.

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.

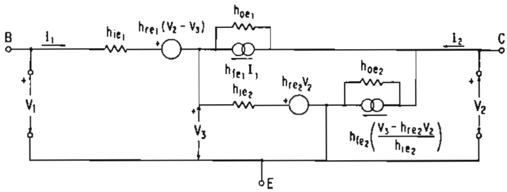
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 97.2°C/Watt (derating factor of 10.3 mW/°C); junction-to-ambient thermal resistance of 350°C/Watt (derating factor of 2.86 mW/°C).

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest. For more information send for SGS· AR 5.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

SMALL SIGNAL ANALYSIS

The common emitter hybrid parameters of the compound amplifier may be determined by analysis of the equivalent circuit shown below.



By definition:
$h_{ie} = \frac{V_1}{I_1}\Big/_{V_2 = 0}$ $\quad h_{oe} = \frac{I_2}{V_2}\Big/_{I_1 = 0}$ $\quad h_{re} = \frac{V_1}{V_2}\Big/_{I_1 = 0}$ $\quad h_{fe} = \frac{I_2}{I_1}\Big/_{V_2 = 0}$

The exact expressions can be shown to be:

$$h_{ie} = h_{ie_1} + \frac{(1 - h_{re_1})(1 + h_{fe_1})h_{ie_2}}{h_{oe_1}h_{ie_2} + 1}$$

$$h_{fe} = h_{fe_1} + \frac{(h_{fe_2} - h_{oe_1}h_{ie_2})(1 + h_{fe_1})}{h_{oe_1}h_{ie_2} + 1}$$

$$h_{oe} = h_{oe_2} + \frac{(1 + h_{fe_2})(1 - h_{re_2})h_{oe_1}}{h_{oe_1}h_{ie_2} + 1}$$

$$h_{re} = h_{re_2} + \frac{(h_{ie_2}h_{oe_1} + h_{re_1})(1 - h_{re_2})}{h_{oe_1}h_{ie_2} + 1}$$

Where the subscripts 1 and 2 refer to the input and output transistors, respectively.

By considering typical values of the h parameters of the individual transistors we can make the following statements:

$h_{oe_1}h_{ie_2} \ll 1$ $\qquad h_{re_1} \ll 1$

$h_{oe_1}h_{ie_2} \ll h_{fe_2}$ $\qquad h_{re_2} \ll 1$

The above equations suggest these approximate formulas for the h parameters:

$h_{ie} \simeq h_{ie_1} + h_{ie_2} + h_{fe_1}h_{ie_2}$ $\qquad h_{re} \simeq h_{re_1} + h_{re_2} + h_{ie_2}h_{oe_1}$

$h_{oe} \simeq h_{oe_1} + h_{oe_2} + h_{fe_2}h_{oe_1}$ $\qquad h_{fe} \simeq h_{fe_1} + h_{fe_2} + h_{fe_1}h_{fe_2}$

COMMON EMITTER PARAMETERS MEASURED AT f = 1 kc, I_C = 1 mA, V_{CE} = 5 V

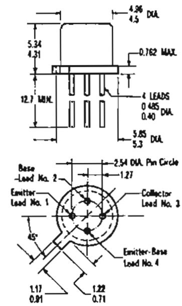
Symbol	Characteristic	Typical Value
h_{ie}	Input resistance, output shorted	40 Kohms
h_{oe}	Output conductance, input open	130 μmhos
h_{re}	Reverse open-circuit voltage amplification factor	4×10^{-3}
h_{fe}	Forward short-circuit current amplification factor	1200

BFX67

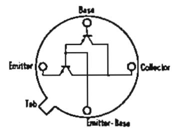
ULTRA HIGH GAIN COMPOUND AMPLIFIER

NPN DIFFUSED SILICON PLANAR TRANSISTORS

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



CONNECTION DIAGRAM



Notes: All dimensions in mm.
Collector internally connected to case

GENERAL DESCRIPTION - The BFX67 is a four terminal device containing two high-gain silicon PLANAR transistors connected as a Darlington compound amplifier in one hermetically sealed enclosure. This device is particularly useful in circuits requiring very high gain and high input impedance.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C Maximum
T_L	Lead Temperature (Soldering, 10 sec. Time Limit)	+ 260°C Maximum

Maximum Power Dissipations (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.8 Watt
at 100°C Case Temperature	1 Watt
at 25°C Ambient Temperature	0.5 Watt

Maximum Voltages and Current (25°C free air temperature unless otherwise noted)

V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts
V_{EBO}	Emitter to Base Voltage	15 Volts
I_C	Collector Current	500 mA

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

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	7000	70000		I_C = 100 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	4000			I_C = 10 mA	V_{CE} = 10 V
h_{FE} (-55°C)	DC Pulse Current Gain (Note 5)	1000			I_C = 100 mA	V_{CE} = 10 V
h_{FE}	DC Current Gain	1000			I_C = 100 μA	V_{CE} = 10 V
V_{CE} (sat)	Collector Saturation Voltage		1.6	V	I_C = 100 mA	I_B = 1 mA
V_{BE} (sat)	Base Saturation Voltage		1.8	V	I_C = 100 mA	I_B = 1 mA
I_{CBO}	Collector Cutoff Current		10	nA	I_E = 0	V_{CB} = 45 V
I_{CBO} (125°C)	Collector Cutoff Current		10	μA	I_E = 0	V_{CB} = 45 V
I_{EBO}	Emitter Cutoff Current		10	nA	I_C = 0	V_{EB} = 10 V
BV_{CBO}	Collector to Base Breakdown Voltage	60		V	I_C = 100 μA	I_E = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	60		V	I_C = 30 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	15		V	I_C = 0	I_E = 100 μA
C_{ob}	Output Capacitance		20	pF	I_E = 0	V_{CB} = 10 V
C_{TE}	Emitter Transition Capacitance		10	pF	I_C = 0	V_{EB} = 0.5 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 97.2°C/Watt (derating factor of 10.3 mW/°C); junction-to-ambient thermal resistance of 350°C/Watt (derating factor of 2.86 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

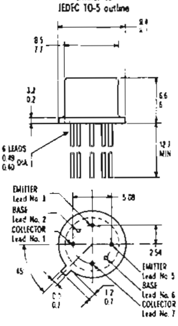
(5) Pulse Conditions: length = 300 µsec; duty cycle = 1%.

BFX70-BFX71-BFX72

DUAL DIFFERENTIAL AMPLIFIERS

NPN DIFFUSED SILICON PLANAR TRANSISTORS

PHYSICAL DIMENSIONS
similar to
JEDEC TO-5 outline



Notes: All dimensions in mm.
Leads are gold-plated Kovar.

GENERAL DESCRIPTION - These six-terminal devices each contain two isolated high-gain NPN double-diffused silicon PLANAR transistors in one hermetically sealed enclosure. They are designed for use in high-performance differential amplifier circuits.
These devices are covered by Semiconductor Users Reliability Evaluation (SURE) Programme.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C
T_L	Lead Temperature (Soldering, 10 sec time limit)	+ 260°C

Maximum Power Dissipations (Notes 2 and 3)

		One Side	Both Sides
P_D	Total Dissipation at 25°C Case Temperature	1.5 Watt	3 Watts
	at 100°C Case Temperature	0.86 Watt	1.7 Watt
	at 25°C Ambient Temperature	0.5 Watt	0.6 Watt

Maximum Voltages and Current for Each Transistor (T_A = 25°C unless otherwise noted)

V_{CBO}	Collector to Base Voltage	100 Volts
V_{CER}	Collector to Emitter Voltage (Note 4)	80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts
V_{EBO}	Emitter to Base Voltage	7 Volts
I_C	Collector Current	500 mA

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

		BFX70		BFX71		BFX72				
SYMBOL	CHARACTERISTIC	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	UNIT	TEST	CONDITIONS
$\frac{h_{FE1}}{h_{FE2}}$	DC Current Gain Ratio (Note 8)	0.9	1	0.8	1	0.9	1		100 µA	V_{CE} = 5 V
$\frac{h_{FE1}}{h_{FE2}}$	DC Current Gain Ratio (Note 8)	0.9	1						1 mA	V_{CE} = 5 V
$\lvert V_{BE1}-V_{BE2}\rvert$	Base-Emitter Voltage Difference		5		15		5	mV	I_C = 100 µA	V_{CE} = 5 V
$\lvert V_{BE1}-V_{BE2}\rvert$	Base-Emitter Voltage Difference		5					mV	I_C = 1 mA	V_{CE} = 5 V
$\left\lvert \frac{\Delta(V_{BE1}-V_{BE2})}{\Delta T} \right\rvert$	Temperature Coefficient of Base-Emitter Voltage Difference (T_A -55°C to + 125°C)		10		25		25	µV/°C	I_C = 100 µA	V_{CE} = 5 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 117°C/watt (derating factor of 8.6 mW/°C) for one side; 58.3°C/watt (derating factor of 17.2 mW/°C) for both sides. Junction-to-ambient thermal resistance of 350°C/watt (derating factor of 2.86 mW/°C) for one side; 292°C/watt (derating factor of 3.42 mW/°C) for both sides

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(8) Lowest of the two h_{FE} readings is taken as h_{FE1} for purposes of this ratio.

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

SYMBOL	CHARACTERISTIC	BFX 70 MIN.	BFX 70 TYP.	BFX 70 MAX.	BFX 71 BFX 72 MIN.	BFX 71 BFX 72 TYP.	BFX 71 BFX 72 MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	25	50	75	15	50			I_C = 10 µA	V_{CE} = 5 V
h_{FE}	DC Current Gain	30	60	90	25	65	150		I_C = 100 µA	V_{CE} = 5 V
h_{FE}	DC Pulse Current Gain (Note 5)	40	80	120					I_C = 1 mA	V_{CE} = 5 V
h_{FE}	DC Pulse Current Gain (Note 5)	50	100	150	50	125	200		I_C = 10 mA	V_{CE} = 5 V
$V_{BE\ sat}$	Base Saturation Voltage (Note 5)		0.7	0.9		0.7	0.9	V	I_C = 50 mA	I_B = 5 mA
$V_{CE\ sat}$	Collector Saturation Voltage (Note 5)		0.35	1.2		0.35	1.2	V	I_C = 50 mA	I_B = 5 mA
I_{CBO}	Collector Cutoff Current		0.4	2		0.4	10	nA	I_E = 0	V_{CB} = 80 V
I_{CBO} (125°C)	Collector Cutoff Current		1.3	10		1.3	15	µA	I_E = 0	V_{CB} = 80 V
BV_{CBO}	Collector to Base Breakdown Voltage	100			100			V	I_C = 100 µA	I_E = 0
LV_{CER}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	80			80			V	I_C = 100 mA (pulsed)	R_{BE} ≤ 10 Ω
LV_{CEO}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	60			60			V	I_C = 30 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	7			7			V	I_C = 0	I_E = 100 µA
I_{EBO}	Emitter Cutoff Current		0.1	2		0.1	10	nA	I_C = 0	V_{EB} = 5 V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3	5		2.5	5			I_C = 50 mA	V_{CE} = 10 V
C_{obo}	Base-Collector Capacitance		12	15		12	15	pF	I_E = 0	V_{CB} = 10 V
C_{TE}	Emitter Transition Capacitance		60	85		60	85	pF	I_C = 0	V_{EB} = 0.5 V
NF	Narrow Band Noise Figure (Note 6)		3.2	8				dB	I_C = 0.3 mA	V_{CE} = 10 V
NF	Broad Band Noise Figure (Note 7)			8				dB	I_C = 0.3 mA	V_{CE} = 10 V
h_{fe}	Small Signal Current Gain (f = 1 KHz)	50	80	150	40	125	200		I_C = 1 mA	V_{CE} = 5 V
h_{ie}	Input Resistance (f = 1 KHz)	1	2.3	4				KΩ	I_C = 1 mA	V_{CE} = 5 V
h_{oe}	Output Conductance (f = 1 KHz)	4	9	16				µmhos	I_C = 1 mA	V_{CE} = 5 V
h_{ib}	Input Resistance (f = 1 KHz)	20	27	30	20	27	30	Ω	I_C = 1 mA	V_{CB} = 5 V
h_{ob}	Output Conductance (f = 1 KHz)					0.2	0.5	µmhos	I_C = 1 mA	V_{CB} = 5 V
h_{rb}	Voltage Feedback Ratio (f = 1 KHz)					0.9	3	$\times 10^{-4}$	I_C = 1 mA	V_{CB} = 5 V

NOTES:

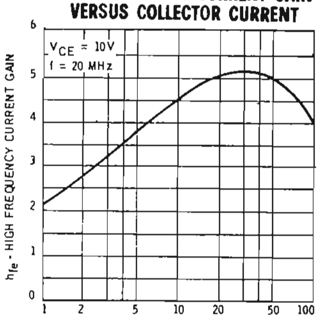
(5) Pulse Conditions: length = 300 µsec; duty cycle = 1%.

(6) Frequency = 1000 Hz, 200 Hz power bandwidth, R_G = 510 Ω. For more information send for SGS - AR 5.

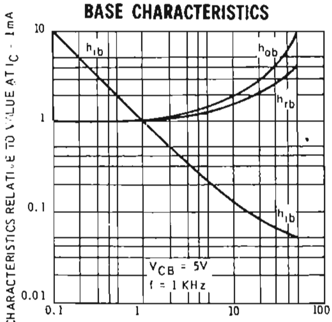
(7) R_G = 1 KΩ. The amplifier used for this measurement has a power bandwidth of 15.7 KHz and a response which rolls of 6 dB per octave where the 3 dB points are approximately at 25 Hz and 10 KHz.

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

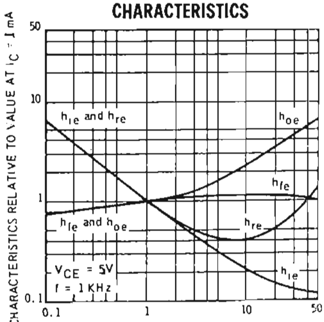
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



TYPICAL COMMON BASE CHARACTERISTICS

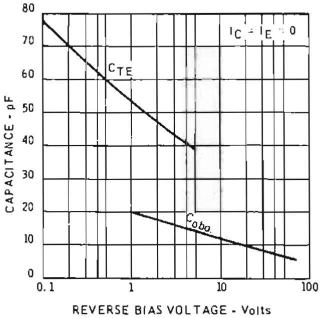


TYPICAL COMMON EMITTER CHARACTERISTICS

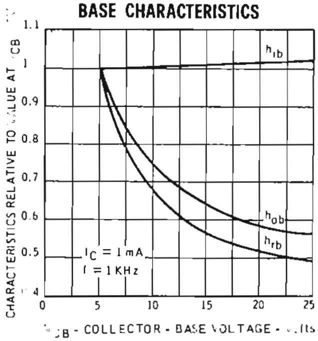


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

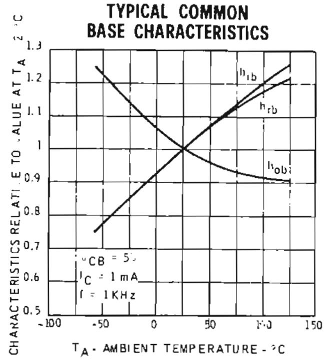
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



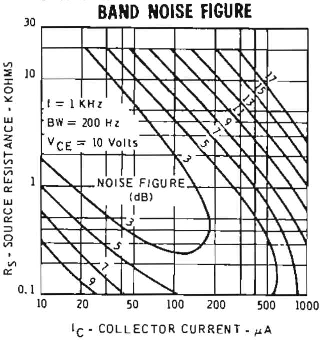
TYPICAL COMMON BASE CHARACTERISTICS



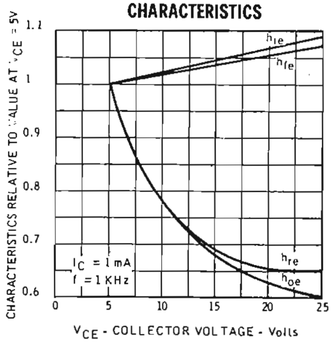
TYPICAL COMMON BASE CHARACTERISTICS



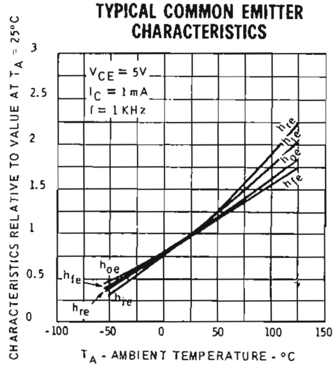
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



TYPICAL COMMON EMITTER CHARACTERISTICS

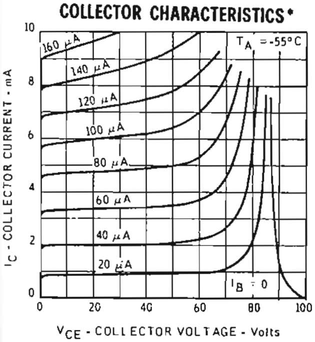


TYPICAL COMMON EMITTER CHARACTERISTICS

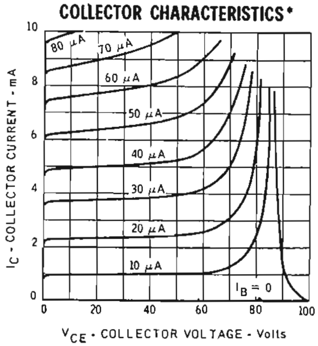


BFX71•BFX72

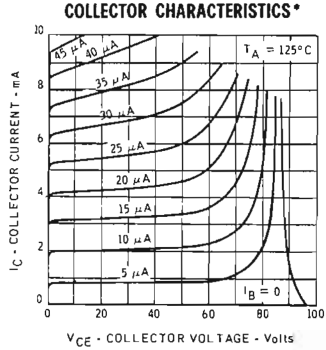
COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*

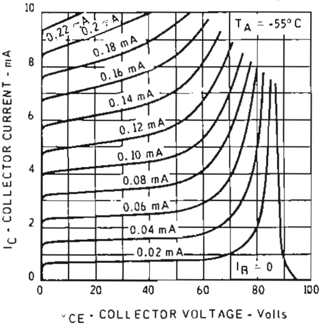


* Single family characteristics on Transistor Curve Tracer.

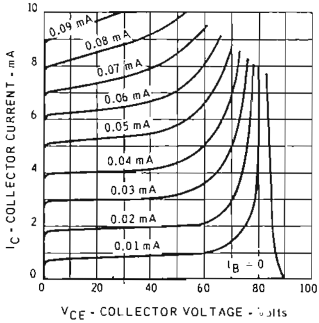
TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

BFX70

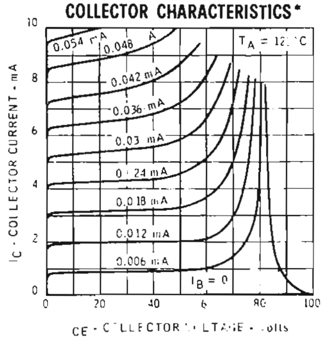
COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*



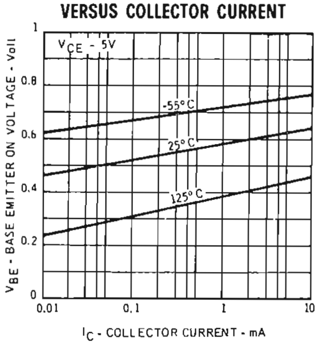
COLLECTOR CHARACTERISTICS*



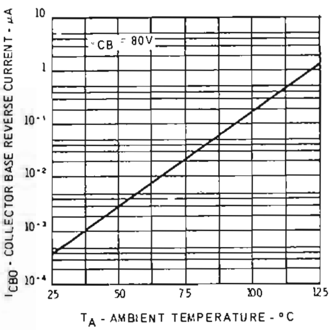
*Single family characteristics on Transistor Curve Tracer.

BFX70•71•72

BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT

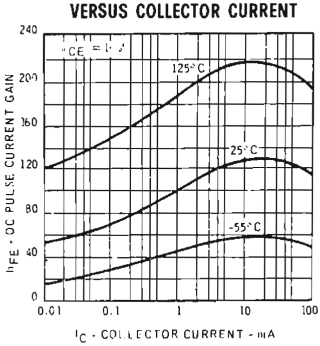


COLLECTOR-BASE REVERSE CURRENT VERSUS TEMPERATURE

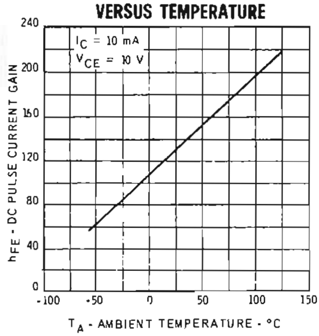


BFX71•72

DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

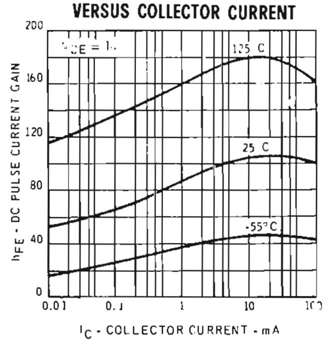


DC PULSE CURRENT GAIN VERSUS TEMPERATURE

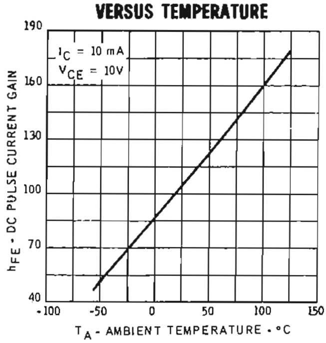


BFX70

DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



DC PULSE CURRENT GAIN VERSUS TEMPERATURE



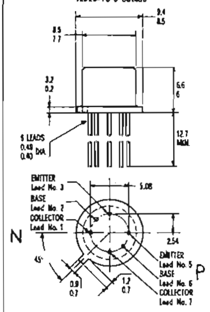
BFX79

HIGH-VOLTAGE, HIGH-CURRENT COMPLEMENTARY AMPLIFIER

NPN/PNP DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The BFX79 is a six terminal device containing a pair of NPN/PNP complementary isolated double diffused silicon PLANAR epitaxial transistors in one hermetically sealed encapsulation. The high voltage and high current capabilities make this device particularly suitable for use in complementary driver amplifiers, complementary output stages and many other applications.

PHYSICAL DIMENSIONS
similar to JEDEC TO-5 outline



Notes: All dimensions in mm.
Leads are gold-plated Kovar.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C Maximum
T_L	Lead Temperature (Soldering, 10 sec. time limit)	+ 260°C Maximum

Maximum Power Dissipations (Notes 2 and 3)

		One Side	Both Sides
P	Total Dissipation at 25°C Case Temperature	1.2 Watt	1.8 Watt
	at 100°C Case Temperature	0.68 Watt	1.06 Watt
	at 25°C Ambient Temperature	0.5 Watt	0.6 Watt

Maximum Voltages (25°C free air temperature unless otherwise noted)

V_{CBO}	Collector Base Voltage	80 Volts
V_{CEO}	Collector Emitter Voltage (Note 4)	60 Volts
V_{EBO}	Emitter Base Voltage	5 Volts

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

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	40	100			I_C = 0.1 mA	V_{CE} = 5 V
h_{FE}	DC Pulse Current Gain (Note 5)	60	125			I_C = 150 mA	V_{CE} = 5 V
h_{FE}	DC Pulse Current Gain (Note 5)	40	100			I_C = 500 mA	V_{CE} = 5 V
V_{BE} (on)	Base-Emitter On Voltage		0.6	0.8	V	I_C = 0.1 mA	V_{CE} = 5 V
V_{BE} (sat)	Base-Emitter Saturation Voltage		0.7	1.1	V	I_C = 150 mA	I_B = 15 mA
V_{BE} (sat)	Base-Emitter Saturation Voltage		1.2	2	V	I_C = 1 A	I_B = 0.1 A
V_{CE} (sat)	Collector-Emitter Saturation Voltage		0.1	0.25	V	I_C = 150 mA	I_B = 15 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage		0.25	0.5	V	I_C = 500 mA	I_B = 50 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage		0.6	1.5	V	I_C = 1 A	I_B = 0.1 A
I_{CBO}	Collector-Cutoff Current		1	50	nA	V_{CB} = 60 V	I_E = 0
I_{CBO} (125°C)	Collector-Cutoff Current		0.1	50	µA	V_{CB} = 60 V	I_E = 0
BV_{CBO}	Collector-Base Breakdown Voltage	80			V	I_C = 100 µA	I_E = 0
BV_{EBO}	Emitter-Base Breakdown Voltage	5			V	I_E = 100 µA	I_C = 0
V_{CEO} (sust)	Collector-Emitter Sustaining Voltage (Notes 4 and 5)	60			V	I_C = 10 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3	5			I_C = 50 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance (f = 1 MHz)		12	20	pF	V_{CB} = 10 V	I_E = 0
C_{TE}	Emitter Transition Capacitance (f = 1 MHz)		75	110	pF	V_{EB} = 0.5 V	I_C = 0
NF	Narrow Band Noise Figure (Note 6)		3		dB	I_C = 30 µA	V_{CE} = 5 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any 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-ambient thermal resistance of 350°C/W (derating factor of 2.86 mW/°C) for one side; 292°C/W (derating factor of 3.42 mW/°C) for both sides. Junction-to-case thermal resistance of 146°C/W (derating factor of 6.85 mW/°C) for one side; 97.2°C/W (derating factor of 10.3 mW/°C) for both sides.

(4) These ratings refer to a high current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(5) Pulse Conditions ≤ 300 µsec; duty cycle ≤ 1%.

(6) f = 1 KHz; R_S = 10 KΩ; Power Bandwidth of 200 Hz.

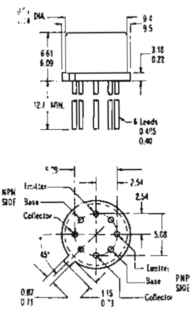
BFX80

LOW-LEVEL, LOW-NOISE COMPLEMENTARY AMPLIFIER

NPN/PNP DIFFUSED SILICON PLANAR TRANSISTORS

GENERAL DESCRIPTION - The BFX80 is a six terminal device containing an NPN/PNP complementary pair of isolated double diffused silicon PLANAR transistors in one hermetically sealed encapsulation. The low level and low noise characteristics make this device particularly suitable for use in logarithmic amplifiers in computers and for many other applications.

PHYSICAL DIMENSIONS (SIMILAR TO TO-5)



Notes. All dimensions in mm.
Leads are gold-plated Kovar

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C Maximum
T_L	Lead Temperature (Soldering, 10 sec. time limit)	+ 260°C Maximum

Maximum Power Dissipations (Notes 2 and 3)

		One Side	Both Sides
P	Total Dissipation at 25°C Case Temperature	0.8 Watt	1.3 Watt
	at 100°C Case Temperature	0.46 Watt	0.75 Watt
	at 25°C Ambient Temperature	0.4 Watt	0.5 Watt

Maximum Voltages (25°C free air temperature unless otherwise noted)

V_{CBO}	Collector Base Voltage	60 Volts
V_{CEO}	Collector Emitter Voltage (Note 4)	60 Volts
V_{EBO}	Emitter Base Voltage	6 Volts

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

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	150	200			I_C = 0.01 mA	V_{CE} = 5 V
h_{FE}	DC Current Gain	150	210			I_C = 0.1 mA	V_{CE} = 5 V
h_{FE}	DC Pulse Current Gain (Note 5)	160	230			I_C = 1 mA	V_{CE} = 5 V
V_{BE} (on)	Base-Emitter On Voltage		0.65	0.8	V	I_C = 1 mA	V_{CE} = 5 V
V_{CE} (sat)	Collector-Emitter Saturation Voltage		0.15	0.35	V	I_C = 1 mA	I_B = 0.1 mA
I_{EBO}	Emitter-Cutoff Current		0.05	10	nA	V_{EB} = 5 V	I_C = 0
I_{CBO}	Collector-Cutoff Current		0.05	10	nA	V_{CB} = 45 V	I_E = 0
I_{CBO} (125°C)	Collector-Cutoff Current		0.05	10	μA	V_{CB} = 45 V	I_E = 0
BV_{CBO}	Collector-Base Breakdown Voltage	60			V	I_C = 0.01 mA	I_E = 0
BV_{EBO}	Emitter-Base Breakdown Voltage	6			V	I_E = 0.01 mA	I_C = 0
V_{CEO} (sust)	Collector-Emitter Sustaining Voltage (Notes 4 and 5)	60			V	I_C = 10 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2				I_C = 1 mA	V_{CE} = 5 V
C_{ob}	Output Capacitance (f = 1 MHz)		5	6	pF	V_{CB} = 5 V	I_E = 0
C_{TE}	Emitter Transition Capacitance (f = 1 MHz)		11	15	pF	V_{EB} = 0.5 V	I_C = 0
NF	Narrow Band Noise Figure (Note 6)			4	dB	I_C = 0.01 mA	V_{CE} = 5 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any 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-ambient thermal resistance of 438°C/W (derating factor of 2.28 mW/°C) for one side; 350°C/W (derating factor of 2.86 mW/°C) for both sides. Junction-to-case thermal resistance of 219°C/W (derating factor of 4.57 mW/°C) for one side; 134°C/W (derating factor of 7.45 mW/°C) for both sides.

(4) These ratings refer to a high current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(5) Pulse Conditions $\leq$ 300 µsec; duty cycle $\leq$ 1%.

(6) f = 1 KHz; R_S = 10 KΩ; Power Bandwidth of 200 Hz.

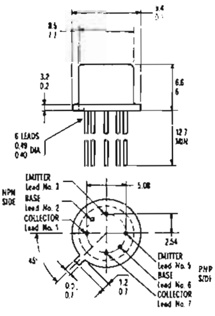
OCTOBER 1966

BFX81

HIGH-SPEED COMPLEMENTARY AMPLIFIER

NPN/PNP DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

PHYSICAL DIMENSIONS
similar to
JEDEC TO-5 outline



Notes. All dimensions in mm.
Leads are gold-plated Kovar

GENERAL DESCRIPTION - The BFX81 is a six terminal device containing an NPN/PNP complementary pair of double diffused silicon PLANAR epitaxial transistors in one hermetically sealed encapsulation. The high speed characteristics make this device particularly suitable for use in counting and computing complementary circuits.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	- 55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C Maximum
T_L	Lead Temperature (Soldering, 10 sec. Time Limit)	+ 260°C Maximum

Maximum Power Dissipations (Notes 2 and 3)

		One Side	Both Sides
P	Total Dissipation at 25°C Case Temperature	0.65 Watt	1.1 Watt
	at 100°C Case Temperature	0.37 Watt	0.63 Watt
	at 25°C Ambient Temperature	0.38 Watt	0.5 Watt

Maximum Voltages (25°C free air temperature unless otherwise noted)

V_{CBO}	Collector Base Voltage	25 Volts
V_{CEO}	Collector Emitter Voltage (Note 4)	20 Volts
V_{EBO}	Emitter Base Voltage	5 Volts

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

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	30				I_C = 10 mA	V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)	40				I_C = 30 mA	V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)	25				I_C = 100 mA	V_{CE} = 1 V
V_{BE} (sat)	Base-Emitter Saturation Voltage			0.98	V	I_C = 10 mA	I_B = 1 mA
V_{BE} (sat)	Base-Emitter Saturation Voltage			1.2	V	I_C = 30 mA	I_B = 3 mA
V_{BE} (sat)	Base-Emitter Saturation Voltage			1.7	V	I_C = 100 mA	I_B = 10 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage			0.15	V	I_C = 10 mA	I_B = 1 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage			0.2	V	I_C = 30 mA	I_B = 3 mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage			0.5	V	I_C = 100 mA	I_B = 10 mA
I_{CBO}	Collector-Cutoff Current			300	nA	V_{CB} = 20 V	I_E = 0
I_{CBO} (125°C)	Collector-Cutoff Current			30	µA	V_{CB} = 20 V	I_E = 0
BV_{CBO}	Collector-Base Breakdown Voltage	25			V	I_C = 100 µA	I_E = 0
BV_{EBO}	Emitter-Base Breakdown Voltage	5			V	I_E = 100 µA	I_C = 0
V_{CEO} (sust)	Collector-Emitter Sustaining Voltage (Notes 4 and 5)	20			V	I_C = 10 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.5				I_C = 30 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance (f = 1 MHz)			6	pF	V_{CB} = 5 V	I_E = 0
C_{TE}	Emitter Transition Capacitance (f = 1 MHz)			8	pF	V_{EB} = 0.5 V	I_C = 0
t_{on}	Turn On Time			60	nsec.	I_C = 30 mA	I_{B1} = 1.5 mA
t_{off}	Turn Off Time			90	nsec.	I_C = 30 mA	$I_{B1} = I_{B2}$ = 1.5 mA

NOTES:

(1) These ratings are limiting values above which the serviceability of any 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-ambient thermal resistance of 460°C/W (derating factor of 2.18 mW/°C) for one side; 350°C/W (derating factor of 2.85 mW/°C) for both sides. Junction-to-case thermal resistance of 270°C/W (derating factor of 3.7 mW/°C) for one side; 159°C/W (derating factor of 6.3 mW/°C) for both sides.

(4) These ratings refer to a high current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

(5) Pulse Conditions ≤ 300 µsec; duty cycle ≤ 1%.

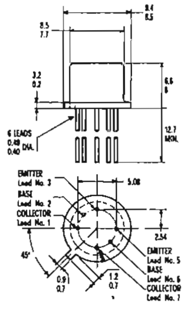
BFX 99

DUAL DIFFERENTIAL AMPLIFIER

NPN DIFFUSED SILICON PLANAR TRANSISTORS

GENERAL DESCRIPTION - The BFX99 is a six terminal device containing two isolated high gain, low noise NPN silicon PLANAR transistors in one hermetically sealed enclosure. It is designed for use in high performance amplifier and differential amplifier circuits, requiring tight V_{BE} matching, tight V_{BE} tracking, low noise in a very wide current range from 100 µA to 50 mA.

PHYSICAL DIMENSIONS
similar to
JEDEC TO-5 outline



Notes: All dimensions in mm.
Leads are gold-plated Kovar.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to + 200°C
T_J	Operating Junction Temperature	+ 200°C
T_L	Lead Temperature (Soldering, 10 sec. time limit)	+ 260°C

Maximum Power Dissipations (Notes 2 and 3)

		One Side	Both Sides
P_D	Total Dissipation at 25°C Case Temperature	1.5 Watt	3 Watts
	at 100°C Case Temperature	0.86 Watt	1.7 Watt
	at 25°C Ambient Temperature	0.5 Watt	0.6 Watt

Maximum Voltages and Current (25°C free air temperature unless otherwise noted)

V_{CBO}	Collector Base Voltage	100 Volts
V_{CEO}	Collector Emitter Voltage (Note 4)	60 Volts
V_{CER}	Collector Emitter Voltage ($R_{BE} \leq 10\,\Omega$) (Note 4)	80 Volts
V_{EBO}	Emitter Base Voltage	7 Volts
I_C	DC Collector Current	500 mA
$V_{1C\text{-}2C}$	$\text{Collector}_1 - \text{Collector}_2$ Voltage	$\pm$ 200 Volts

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

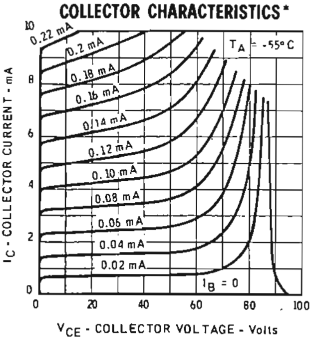
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
h_{FE}	DC Current Gain	25	50	75		I_C = 10 µA	V_{CE} = 5 V
h_{FE}	DC Current Gain	30	60	90		I_C = 100 µA	V_{CE} = 5 V
h_{FE}	DC Pulse Current Gain (Note 6)	40	80	120		I_C = 1 mA	V_{CE} = 5 V
h_{FE}	DC Pulse Current Gain (Note 6)	50	100	150		I_C = 10 mA	V_{CE} = 5 V
$V_{BE\ sat}$	Base-Emitter Saturation Voltage (Note 6)			0.9	V	I_C = 50 mA	I_B = 5 mA
$V_{CE\ sat}$	Collector-Emitter Saturation Voltage (Note 6)			0.6	V	I_C = 50 mA	I_B = 5 mA
I_{EBO}	Emitter-Cutoff Current			2	nA	V_{EB} = 5 V	I_C = 0
I_{CBO}	Collector-Cutoff Current		0.4	2	nA	V_{CB} = 80 V	I_E = 0
I_{CBO} (125°C)	Collector-Cutoff Current		1.3	10	µA	V_{CB} = 80 V	I_E = 0
BV_{CBO}	Collector-Base Breakdown Voltage	100			V	I_C = 100 µA	I_E = 0
BV_{EBO}	Emitter-Base Breakdown Voltage	7			V	I_E = 100 µA	I_C = 0

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

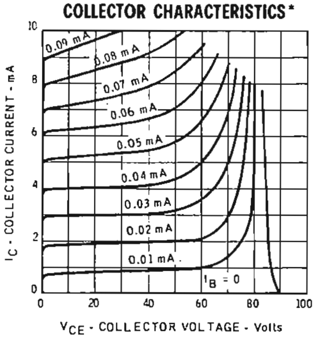
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS	
LV_{CER}	Collector-Emitter Sustaining Voltage (Notes 4 and 6)	80			V	I_C = 100 mA	$R_{BE} \leq 10\Omega$
LV_{CEO}	Collector-Emitter Sustaining Voltage (Notes 4 and 6)	60			V	I_C = 30 mA	I_B = 0
h_{fe}	Small Signal Current Gain (f = 1 KHz)	50		150		I_C = 1 mA	V_{CE} = 5 V
h_{ie}	Input Resistance (f = 1 KHz)	1		4	KΩ	I_C = 1 mA	V_{CE} = 5 V
h_{oe}	Output Conductance (f = 1 KHz)	4		16	μmho	I_C = 1 mA	V_{CE} = 5 V
h_{re}	Voltage Feedback Ratio (f = 1 KHz)			10	$\times 10^{-4}$	I_C = 1 mA	V_{CE} = 5 V
h_{ib}	Input Resistance (f = 1 KHz)	20		30	Ω	I_C = 1 mA	V_{CB} = 5 V
h_{fe}	High Frequency Current Gain (f = 20MHz)	3	5	8		I_C = 50 mA	V_{CE} = 10 V
C_{obo}	Base-Collector Capacitance		12	15	pF	V_{CB} = 10 V	I_E = 0
C_{TE}	Emitter Transition Capacitance		60	85	pF	V_{EB} = 0.5 V	I_C = 0
NF	Broad Band Noise Figure (Note 7)			8	dB	I_C = 300 μA	V_{CE} = 10 V
NF	Narrow Band Noise Figure (Note 8)		3.2	8	dB	I_C = 300 μA	V_{CE} = 10 V
$\frac{h_{FE1}}{h_{FE2}}$	DC Current Gain Ratio (Note 5)	0.9		1		I_C = 100 μA to 1 mA	V_{CE} = 5 V
$\frac{h_{FE1}}{h_{FE2}}$	DC Current Gain Ratio (Note 5) (T_A = -55°C to +125°C)	0.85		1		I_C = 100 μA to 1 mA	V_{CE} = 5 V
$\lvert V_{BE1}-V_{BE2}\rvert$	Base Emitter Voltage Difference			1.5	mV	I_C = 100 μA to 1 mA	V_{CE} = 5 V
$\Delta\lvert V_{BE1}-V_{BE2}\rvert$	Base Emitter Voltage Difference Change (T_A = -55°C to +25°C)			0.4	mV	I_C = 100 μA	V_{CE} = 5 V
$\Delta\lvert V_{BE1}-V_{BE2}\rvert$	Base Emitter Voltage Difference Change (T_A = +25°C to +125°C)			0.5	mV	I_C = 100 μA	V_{CE} = 5 V

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

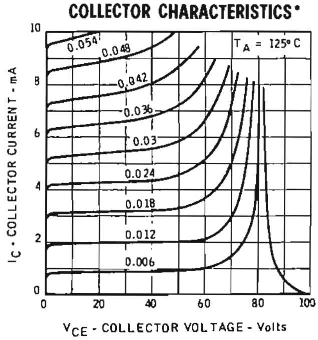
COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*



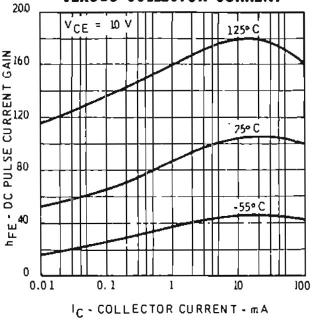
COLLECTOR CHARACTERISTICS*



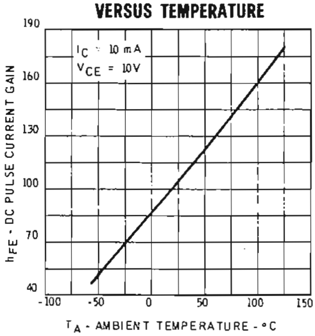
* Single family characteristics on Transistor Curve Tracer.

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

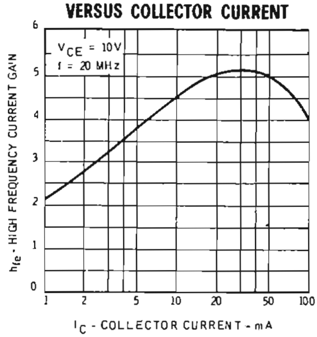
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



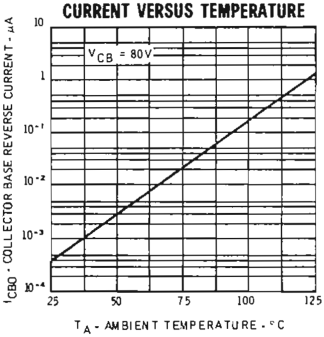
DC PULSE CURRENT GAIN VERSUS TEMPERATURE



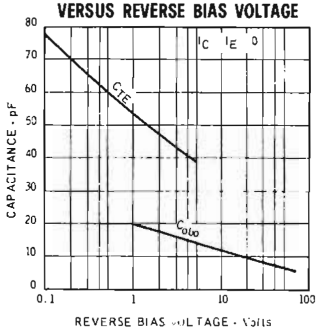
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



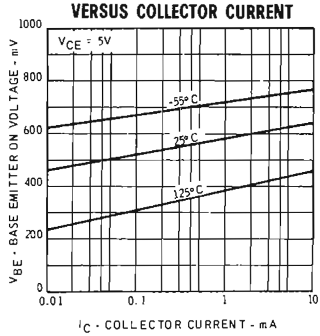
COLLECTOR-BASE REVERSE CURRENT VERSUS TEMPERATURE



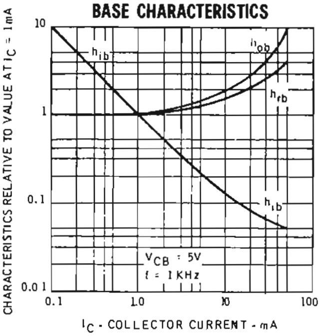
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



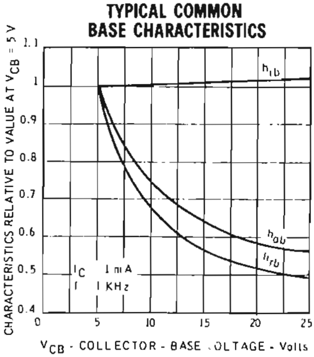
BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



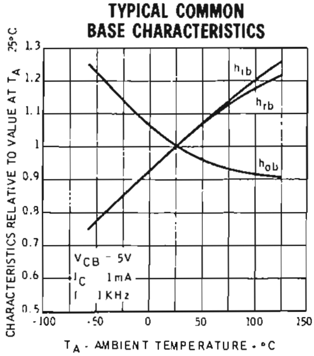
TYPICAL COMMON BASE CHARACTERISTICS



TYPICAL COMMON BASE CHARACTERISTICS

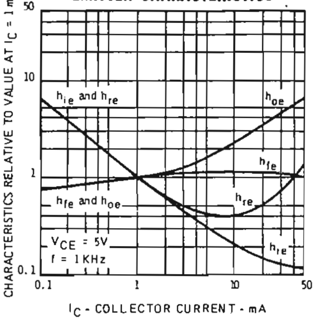


TYPICAL COMMON BASE CHARACTERISTICS

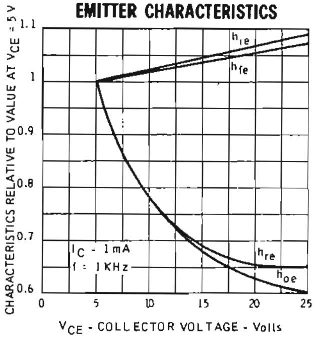


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

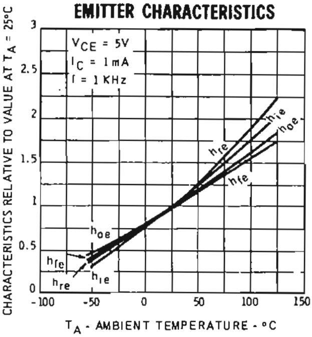
TYPICAL COMMON EMITTER CHARACTERISTICS



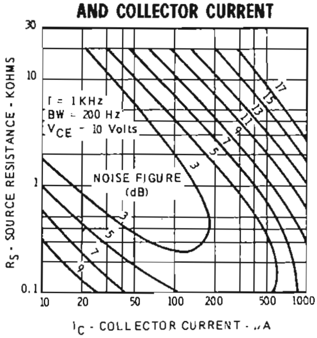
TYPICAL COMMON EMITTER CHARACTERISTICS



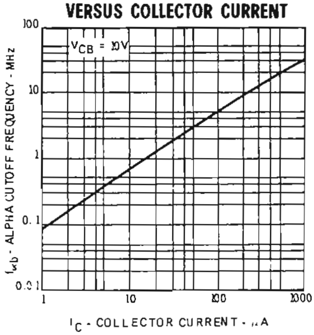
TYPICAL COMMON EMITTER CHARACTERISTICS



NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT



ALPHA CUTOFF FREQUENCY VERSUS COLLECTOR CURRENT



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-ambient thermal resistance of 350°C/W (derating factor of 2.86 mW/°C) for one side; 292°C/W (derating factor of 3.43 mW/°C) for both sides. Junction-to-case thermal resistance of 117°C/W (derating factor of 8.6 mW/°C) for one side; 58.3°C/W (derating factor of 17.2 mW/°C) for both sides.

(4) These ratings refer to a high current point where collector-to-emitter voltage is lowest. For more information send for SGS - AR 5.

(5) Lowest of two h_{FE} reading is taken as h_{FE1} for purposes of this ratio.

(6) Pulse Conditions ≤ 300 μsec; duty cycle ≤ 1%.

(7) R_S = 1 KΩ; Power Bandwidth of 15.7 KHz with 3 dB points at 25 Hz and 10 KHz.

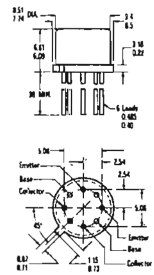
(8) f = 1 KHz; R_S = 510 Ω; Power Bandwidth of 200 Hz.

BFY 81

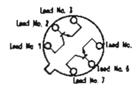
DUAL, HIGH-GAIN, LOW-NOISE, LOW-CURRENT TYPE

NPN DIFFUSED SILICON PLANAR TRANSISTORS

PHYSICAL DIMENSIONS



CONNECTION DIAGRAM
BOTTOM VIEW



Notes: All dimensions in m.m.
Leads are gold-plated kovar

GENERAL DESCRIPTION - The BFY81 is a six terminal device containing two isolated high gain NPN double diffused silicon PLANAR transistors. The SGS-ATES planar process guarantees the stability of the initial match time The good thermal tracking over a wide current and temperature range offers the circuit designer matched transistors with specified performance for differential amplifiers and low level DC amplifiers.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to + 200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	300°C Maximum

Maximum Power Dissipations

	One Side Only	Both Sides
Total Dissipation at 25°C Case Temperature (Note 2)	0.8 Watt	1.3 Watt
at 100°C Case Temperature (Note 2)	0.45 Watt	0.75 Watt
at 25°C Ambient Temperature (Note 2)	0.4 Watt	0.5 Watt

Maximum Voltages

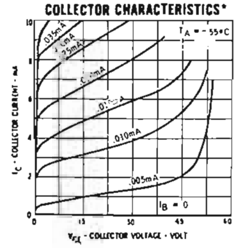
BV_{CBO}	Collector to Base Voltage	45 Volts
LV_{CEO}	Collector to Emitter Voltage	45 Volts
BV_{EBO}	Emitter to Base Voltage	6.0 Volts

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

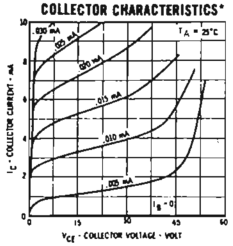
SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	60			I_C = 10 µA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain	100			I_C = 100 µA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain	150			I_C = 1.0 mA	V_{CE} = 5.0 V
h_{FE1}/h_{FE2}	DC Current Gain Ratio	0.8	1.0		I_C = 100 µA	V_{CE} = 5.0 V
V_{BE} (on)	Emitter to Base On Voltage		0.7	V	I_C = 100 µA	V_{CE} = 5.0 V
$V_{BE1}-V_{BE2}$	Base Emitter Voltage Differential		10	mV	I_C = 100 µA	V_{CE} = 5.0 V
$\Delta(V_{BE1}-V_{BE2})$	Base Emitter Voltage Differential Change		25	µV/°C	I_C = 100 µA	V_{CE} = 5.0 V
V_{CE} (sat)	Collector Saturation Voltage		0.35	V	I_C = 1.0 mA	I_B = 0.1 mA
I_{CBO}	Collector Cutoff Current		10	nA	I_E = 0	V_{CB} = 40 V
I_{CBO}(150°C)	Collector Cutoff Current		10	µA	I_E = 0	V_{CB} = 40 V
I_{EBO}	Emitter Cutoff Current		10	nA	I_C = 0	V_{EB} = 5.0 V
I_{CEO}	Collector to Emitter Cutoff Current		10	nA	I_B = 0	V_{CE} = 5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	45		V	I_C = 10 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		V	I_E = 10 µA	I_C = 0
LV_{CEO}	Collector to Emitter Sustaining Voltage (Note 3)	45		V	I_C = 10 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 30 Mc/s)	2.0			I_C = 500 µA	V_{CE} = 5.0 V
C_{ob}	Output Capacitance		6.0	pF	I_E = 0	V_{CB} = 5.0 V
NF	Noise Figure (Narrow Band) (f=1 Kc/s)		4.0	db	I_C = 10 µA	V_{CE} = 5.0 V

TYPICAL ELECTRICAL CHARACTERISTICS

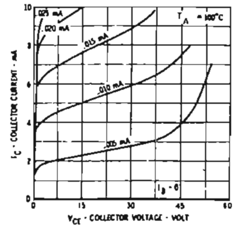
COLLECTOR CHARACTERISTICS*



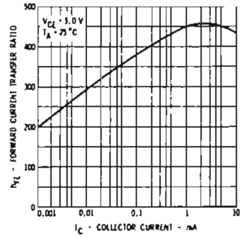
COLLECTOR CHARACTERISTICS*



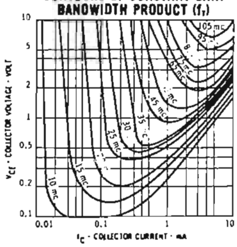
COLLECTOR CHARACTERISTICS*



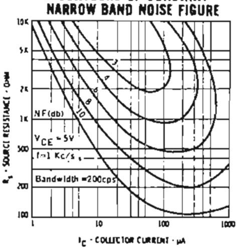
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



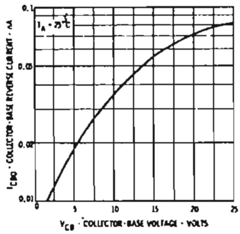
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



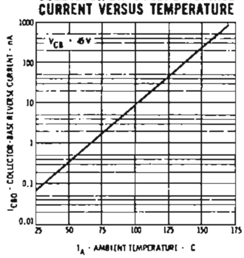
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



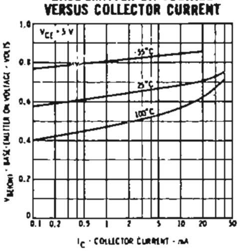
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



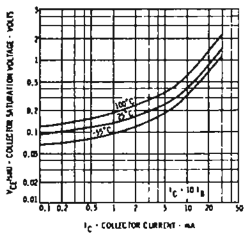
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



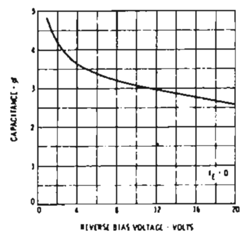
BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



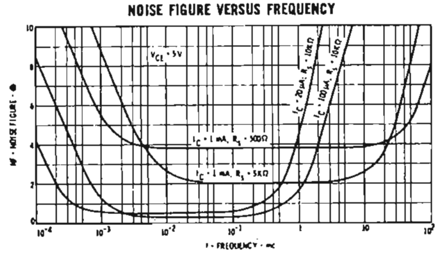
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



NOISE FIGURE VERSUS FREQUENCY



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semi-conductor device may be impaired.

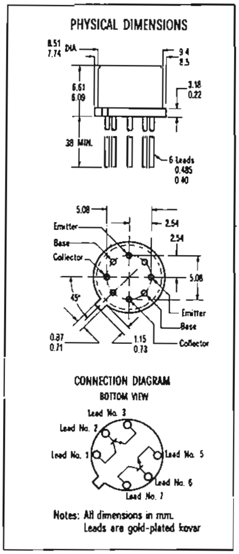
(2) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 218°C/Watt for one side and 134°C/Watt for both sides.

(3) Pulse Conditions: length = 300 µsec; duty cycle = 1%.

BFY 82

DUAL, HIGH-FREQUENCY TYPE

NPN DIFFUSED SILICON PLANAR TRANSISTORS



GENERAL DESCRIPTION - The BFY82 is a six terminal device containing two isolated high frequency NPN double diffused silicon PLANAR transistors. The SGS-ATES planar process guarantees the stability of the initial match with time. The good thermal tracking over a wide current and temperature range, offers the circuit designer matched transistors with specified performance for differential amplifiers.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to + 200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	300°C Maximum

Maximum Power Dissipations	One Side Only	Both Sides
Total Dissipation at 25°C Case Temperature (Note 2)	0.8 Watt	1.3 Watt
at 100°C Case Temperature (Note 2)	0.46 Watt	0.75 Watt
at 25°C Ambient Temperature (Note 2)	0.4 Watt	0.5 Watt

Maximum Voltages

BV_{CBO}	Collector to Base Voltage	60 Volts
LV_{CEO}	Collector to Emitter Voltage	45 Volts
BV_{EBO}	Emitter to Base Voltage	5.0 Volts

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

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 3)	50			I_C = 10 mA	V_{CE} = 5.0 V
h_{FE1}/h_{FE2}	DC Current Gain Ratio	0.8	1.0		I_C = 1.0 mA	V_{CE} = 5.0 V
V_{BE} (sat)	Base Saturation Voltage (Note 3)		0.9	V	I_C = 10 mA	I_B = 1.0 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 3)		1.0	V	I_C = 10 mA	I_B = 1.0 mA
$V_{BE1}-V_{BE2}$	Base Emitter Voltage Differential		15	mV	I_C = 1.0 mA	V_{CE} = 5.0 V
$\Delta(V_{BE1}-V_{BE2})$	Base Emitter Voltage Differential Change		25	µV/°C	I_C = 1.0 mA	V_{CE} = 5.0 V
I_{CBO}	Collector Cutoff Current		10	nA	I_E = 0	V_{CB} = 45 V
I_{CBO} (150°C)	Collector Cutoff Current		30	µA	I_E = 0	V_{CB} = 45 V
BV_{CBO}	Collector to Breakdown Voltage	60		V	I_C = 100 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	I_C = 0	I_E = 100 µA
LV_{CEO}	Collector to Emitter Sustaining Voltage (Note 3)	45		V	I_C = 10 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	2.5			I_C = 10 mA	V_{CE} = 15 V
C_{ob}	Output Capacitance		3.5	pF	I_E = 0	V_{CB} = 10 V
C_{TE}	Emitter Transition Capacitance		10	pF	I_C = 0	V_{EB} = 0.5 V

NOTES:

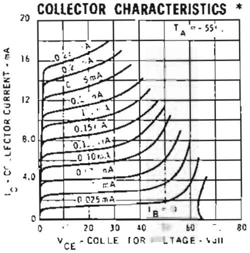
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 218°C/Watt for one side and 134°C/Watt for both sides.

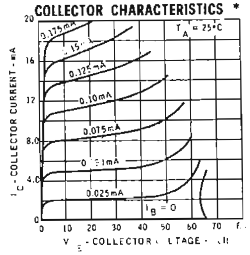
(3) Pulse Conditions: length = 300 µsec; duty cycle = 1%.

TYPICAL ELECTRICAL CHARACTERISTICS

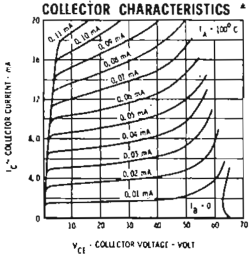
COLLECTOR CHARACTERISTICS *



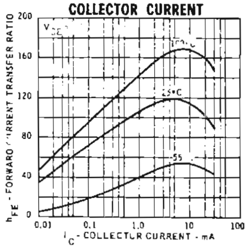
COLLECTOR CHARACTERISTICS *



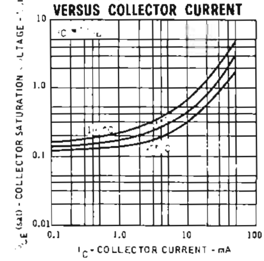
COLLECTOR CHARACTERISTICS *



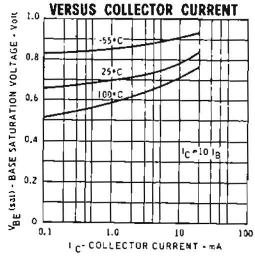
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



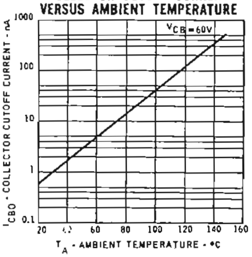
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



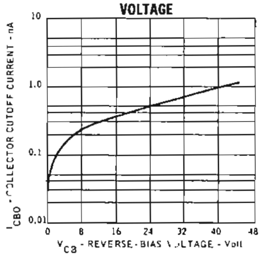
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



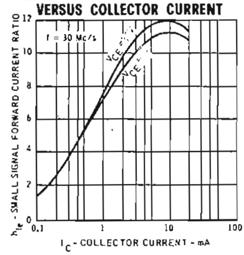
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



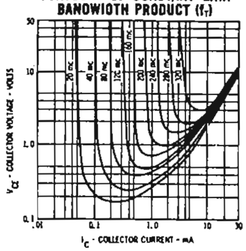
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



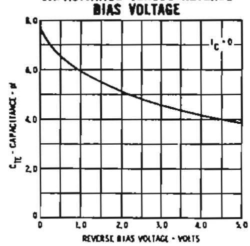
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



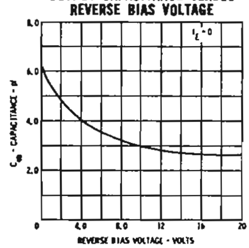
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



* Single family characteristics on Transistor Curve Tracer.

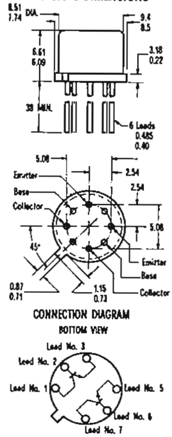
BFY 83

DUAL, HIGH-VOLTAGE TYPE

NPN DIFFUSED SILICON PLANAR TRANSISTORS

GENERAL DESCRIPTION - The BFY83 is a six terminal device containing two isolated high voltage NPN double diffused silicon PLANAR transistors. The SGS-ATES planar process guarantees the stability of the initial match with time. The good thermal tracking over a wide current and temperature range, offers the circuit designer matched transistors with specified performance for differential amplifiers and low level DC amplifiers.

PHYSICAL DIMENSIONS



Notes: All dimensions in mm.
Leads are gold-plated kovar

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperature

Storage Temperature	-65°C to + 200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	300°C Maximum

Maximum Power Dissipations

	One Side	Both Sides
Total Dissipation at 25°C Case Temperature (Note 2)	1.2 Watt	1.8 Watt
at 100°C Case Temperature (Note 2)	0.68 Watt	1.2 Watt
at 25°C Ambient Temperature (Note 2)	0.5 Watt	0.6 Watt

Maximum Voltages

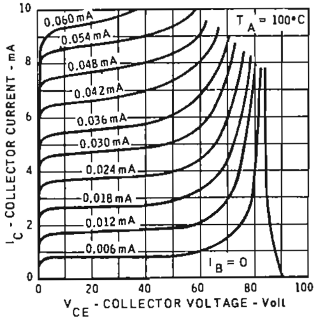
BV_{CBO}	Collector to Base Voltage	100 Volts
LV_{CEO}	Collector to Emitter Voltage	60 Volts
BV_{EBO}	Emitter to Base Voltage	7.0 Volts

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

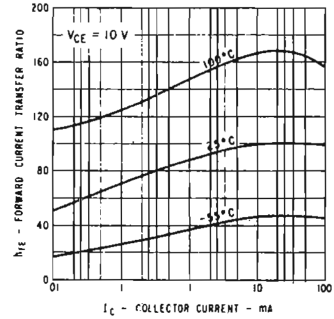
SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	25			I_C = 0.1 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 3)	50			I_C = 10 mA	V_{CE} = 10 V
h_{FE}/h_{FE2}	DC Current Gain Ratio	0.8	1.0		I_C = 0.1 mA	V_{CE} = 10 V
V_{BE} (sat)	Base Saturation Voltage		0.8	V	I_C = 10 mA	I_B = 1.0 mA
V_{BE} (sat)	Base Saturation Voltage (Note 3)		0.9	V	I_C = 50 mA	I_B = 5.0 mA
V_{CE} (sat)	Collector Saturation Voltage		0.4	V	I_C = 10 mA	I_B = 1.0 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 3)		1.2	V	I_C = 50 mA	I_B = 5.0 mA
$V_{BE1}-V_{BE2}$	Base Emitter Voltage Differential		15	mV	I_C = 0.1 mA	V_{CE} = 10 V
$\Delta(V_{BE1}-V_{BE2})$	Base Emitter Voltage Differential Change		25	µV/°C	I_C = 0.1 mA	V_{CE} = 10 V
I_{CBO}	Collector Cutoff Current		25	nA	I_E = 0	V_{CB} = 75 V
I_{CBO} (150°C)	Collector Cutoff Current		15	µA	I_E = 0	V_{CB} = 75 V
I_{EBO}	Emitter Cutoff Current		25	nA	I_C = 0	V_{EB} = 5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	100		V	I_C = 100 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		V	I_C = 0	I_E = 100 µA
LV_{CEO}	Collector to Emitter Sustaining Voltage (Note 3)	60		V	I_C = 30 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 20 Mc/s)	2.5			I_C = 50 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance		15	pF	I_E = 0	V_{CB} = 10 V
C_{TE}	Input Capacitance		85	pF	I_C = 0	V_{EB} = 0.5 V
NF	Noise Figure (Note 4)		8.0	db	I_C = 0.3 mA	V_{CB} = 10 V

TYPICAL ELECTRICAL CHARACTERISTICS

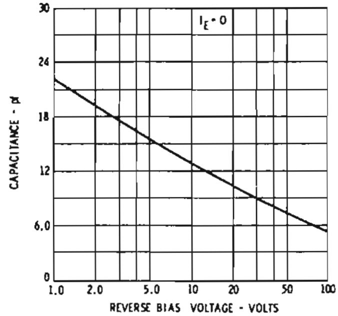
COLLECTOR CHARACTERISTICS *



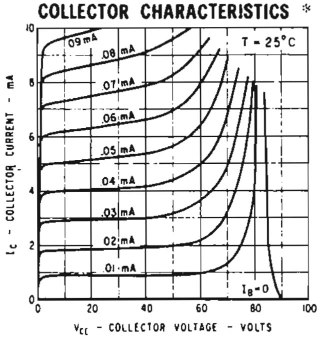
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



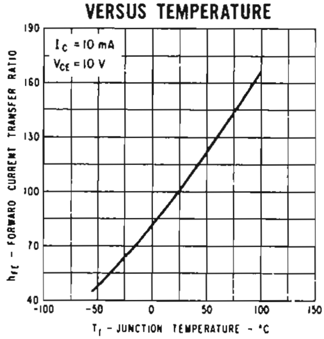
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



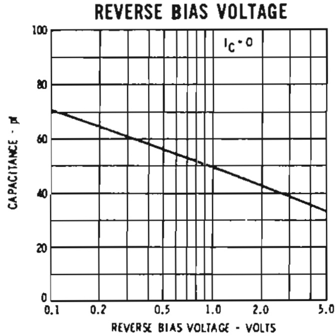
COLLECTOR CHARACTERISTICS *



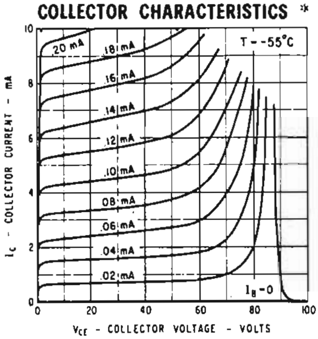
DC PULSE CURRENT GAIN VERSUS TEMPERATURE



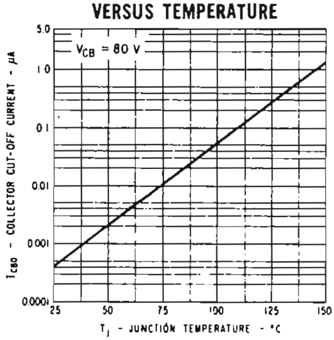
EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



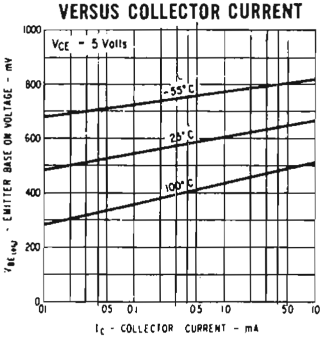
COLLECTOR CHARACTERISTICS *



COLLECTOR CUTOFF CURRENT VERSUS TEMPERATURE

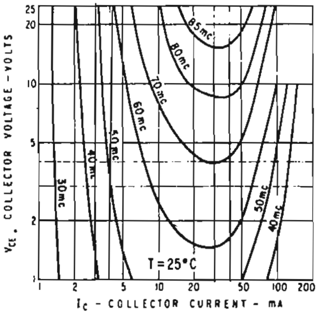


EMITTER-BASE ON VOLTAGE VERSUS COLLECTOR CURRENT

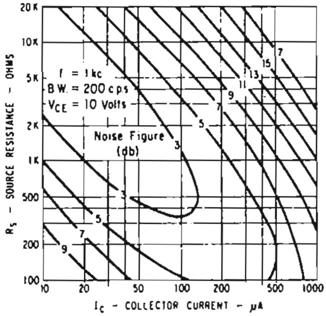


* Single family characteristics on Transistor Curve Tracer

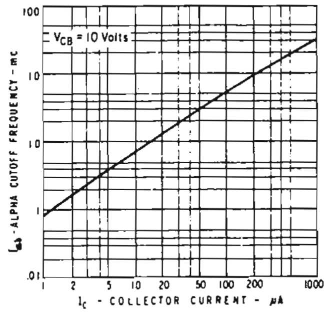
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



CONTOURS OF NARROW BAND NOISE FIGURE



ALPHA CUTOFF FREQUENCY VERSUS COLLECTOR CURRENT



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/Watt for one side and 97°C/Watt for both sides.

(3) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

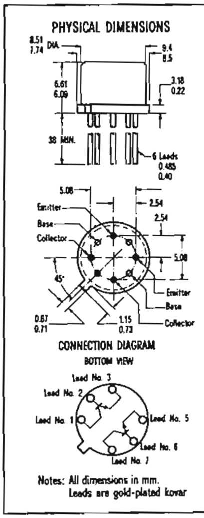
(4) f = 1 Kc/s; R_S = 1 KΩ; Power Bandwidth of 200 cps.

BFY 84

DUAL, ULTRA-HIGH FREQUENCY TYPE

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The BFY84 is a six terminal device containing two isolated ultra high frequency NPN double diffused silicon PLANAR transistors. The SGS-ATES planar process guarantees the stability of the initial match with time. The good thermal tracking over a wide current and temperature range, offers the circuit designer matched transistors with specified performance for differential amplifiers and operational amplifiers.



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to + 200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	300°C Maximum

Maximum Power Dissipations

	One Side Only	Both Sides
Total Dissipation at 25°C Case Temperature (Note 2)	0.6 Watt	0.98 Watt
at 100°C Case Temperature (Note 2)	0.34 Watt	0.56 Watt
at 25°C Ambient Temperature (Note 2)	0.3 Watt	0.38 Watt

Maximum Voltages

BV_{CBO}	Collector to Base Voltage	30 Volts
LV_{CEO}	Collector to Emitter Voltage	12 Volts
BV_{EBO}	Emitter to Base Voltage	3.0 Volts

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

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	20			I_C = 3.0 mA	V_{CE} = 1.0 V
h_{FE1}/h_{FE2}	DC Current Gain Ratio	0.8	1.0		I_C = 3.0 mA	V_{CE} = 1.0 V
V_{BE} (sat)	Base Saturation Voltage		1.0	V	I_C = 10 mA	I_B = 1.0 mA
V_{CE} (sat)	Collector Saturation Voltage		0.4	V	I_C = 10 mA	I_B = 1.0 mA
V_{BE1} - V_{BE2}	Base Emitter Voltage Differential		15	mV	I_C = 3.0 mA	V_{CE} = 1.0 V
$\Delta(V_{BE1}-V_{BE2})$	Base Emitter Voltage Differential Change		25	µV/°C	I_C = 3.0 mA	V_{CE} = 1.0 V
I_{CBO}	Collector Cutoff Current		10	nA	I_E = 0	V_{CB} = 15 V
I_{CBO} (150°C)	Collector Cutoff Current		1.0	µA	I_E = 0	V_{CB} = 15 V
BV_{CBO}	Collector to Base Breakdown Voltage	30		V	I_C = 1.0 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		V	I_C = 0	I_E = 10 µA
LV_{CEO}	Collector to Emitter Sustaining Voltage(Note 3)	12		V	I_C = 3.0 mA	I_B = 0
h_{fe}	High Frequency Current Gain (f = 100 Mc/s)	6.0			I_C = 4.0 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance		3.0	pF	I_E = 0	V_{CB} = 0 V
C_{ob}	Output Capacitance		1.7	pF	I_E = 0	V_{CB} = 10 V
C_{TE}	Input Capacitance		2.0	pF	I_C = 0	V_{EB} = 0.5 V
NF	Noise Figure (f =60 Mc/s)		6.0	db	I_C = 1 mA	V_{CE} = 6.0 V

NOTES:

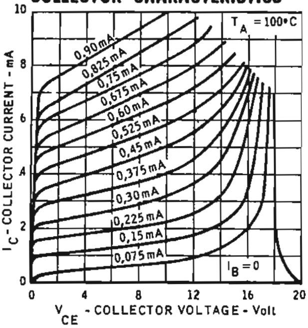
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 290°C/Watt for one side and 145°C/Watt for both sides.

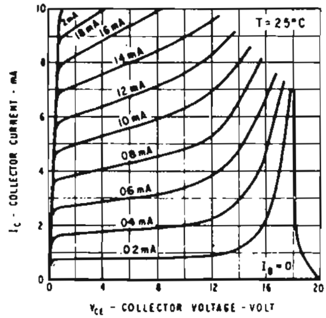
(3) Pulse Conditions: length = 300 µsec; duty cycle = 1%.

TYPICAL ELECTRICAL CHARACTERISTICS

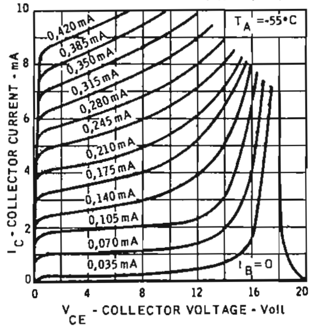
COLLECTOR CHARACTERISTICS *



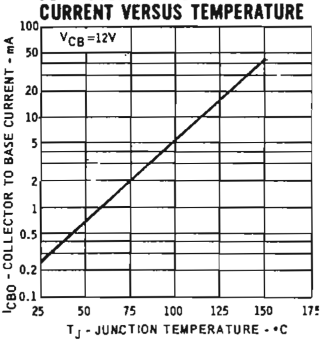
COLLECTOR CHARACTERISTICS *



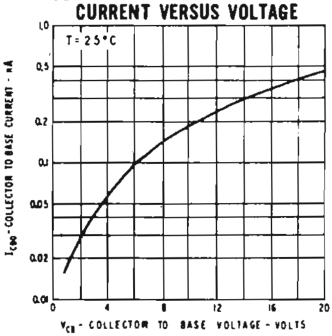
COLLECTOR CHARACTERISTICS *



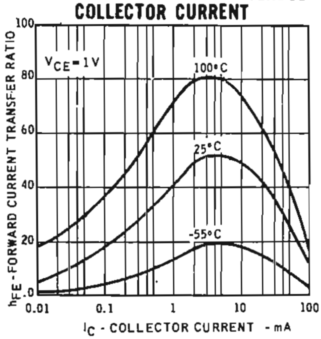
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



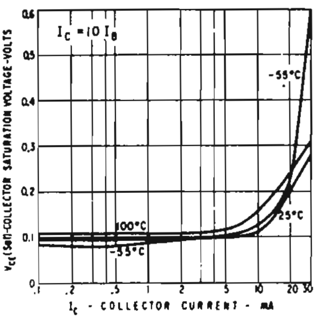
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS VOLTAGE



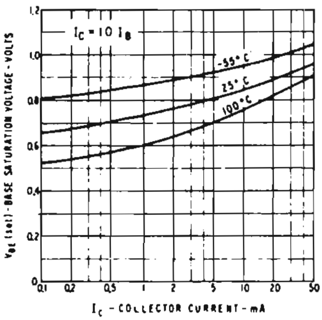
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



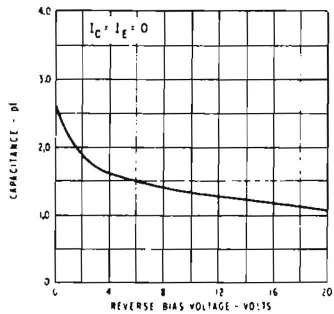
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VS. COLLECTOR CURRENT

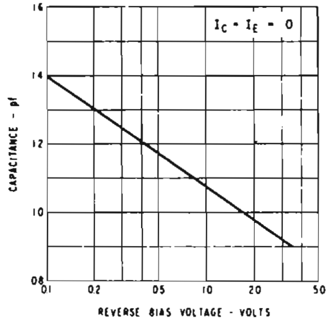


OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

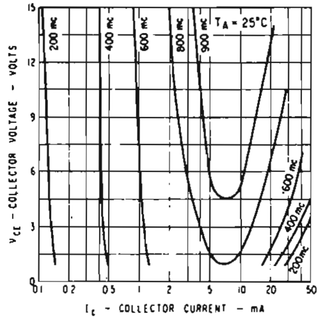


* Single family characteristics on Curve Tracer.

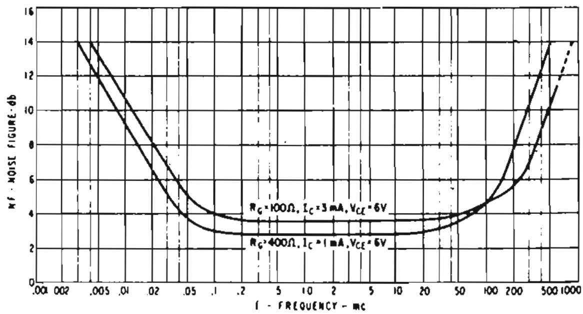
INPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



NOISE FIGURE VERSUS FREQUENCY



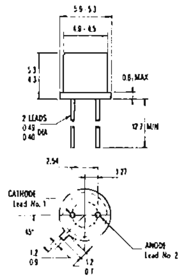
OTHER DEVICES

BZX 43 - BZX 44 - BZX 45

VOLTAGE REFERENCE DIODES

SILICON PLANAR DIODES

PHYSICAL DIMENSIONS
similar to
JEDEC TO-18 outline



Notes: All dimensions in mm.
Anode internally connected to case
Leads are gold-plated Kovar

GENERAL DESCRIPTION - These SGS - Silicon Planar Diodes are Temperature Compensated Voltage Reference elements designed for low power applications.
Main features are low temperature coefficient over wide range of temperatures, low dynamic impedance at 100 µA not obtainable with conventional valtage reference elements, low leakage at biases approaching the reference voltage.
For applications where available power is quite low, these devices are exceptional in performances.

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Reference Voltage	6.7 V
Voltage Tolerance	± 5%
Operating Temperature	0°C to 100°C

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
V_Z	Reference Voltage	6.3	6	7.03	V	I_Z = 100 µA
I_R	Reverse Leakage			100	nA	V_R = 5 V
z_Z	Dynamic Impedance			750	Ω	I_Z = 100 µA
TC	Temperature Coefficient (BZX 43) (Note 1)			± 0.001	% /°C	I_Z = 100 µA T_C = 0°C to 100°C
TC	Temperature Coefficient (BZX 44) (Note 1)			± 0.002	% /°C	I_Z = 100 µA T_C = 0°C to 100°C
TC	Temperature Coefficient (BZX 45) (Note 1)			± 0.005	% /°C	I_Z = 100 µA T_C = 0°C to 100°C

NOTE:
(1) Temperature coefficient is determined by measuring V_Z at the two temperature extremes and using the following formula.

$$TC = \frac{(V_{T1} - V_{T2})\ 100}{V\,(T_1 - T_2)} \quad \text{where } V = \frac{(V_{T1} + V_{T2})}{2}$$

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ALPHA-NUMERICAL INDEX

TRANSISTORS

SPECIAL ASSEMBLIES

OTHER DEVICES