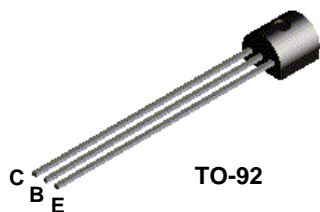
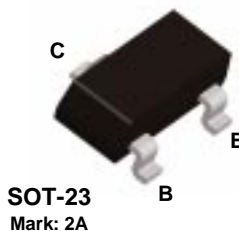


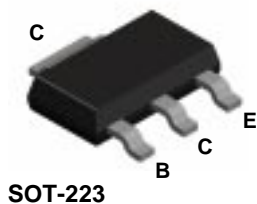
2N3906



MMBT3906



PZT3906



PNP General Purpose Amplifier

This device is designed for general purpose amplifier and switching applications at collector currents of 10 μ A to 100 mA. Sourced from Process 66.

Absolute Maximum Ratings*

TA = 25°C unless otherwise noted

Symbol	Parameter	Value	Units
V _{CEO}	Collector-Emitter Voltage	40	V
V _{CB0}	Collector-Base Voltage	40	V
V _{EBO}	Emitter-Base Voltage	5.0	V
I _C	Collector Current - Continuous	200	mA
T _J , T _{stg}	Operating and Storage Junction Temperature Range	-55 to +150	°C

*These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

NOTES:

- 1) These ratings are based on a maximum junction temperature of 150 degrees C.
- 2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

PNP General Purpose Amplifier

(continued)

Electrical Characteristics

TA = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Max	Units
OFF CHARACTERISTICS					
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage*	$I_C = 1.0 \text{ mA}, I_B = 0$	40		V
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	$I_C = 10 \text{ } \mu\text{A}, I_E = 0$	40		V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 10 \text{ } \mu\text{A}, I_C = 0$	5.0		V
I_{BL}	Base Cutoff Current	$V_{CE} = 30 \text{ V}, V_{BE} = 3.0 \text{ V}$		50	nA
I_{CEX}	Collector Cutoff Current	$V_{CE} = 30 \text{ V}, V_{BE} = 3.0 \text{ V}$		50	nA

ON CHARACTERISTICS

h_{FE}	DC Current Gain *	$I_C = 0.1 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 100 \text{ mA}, V_{CE} = 1.0 \text{ V}$	60 80 100 60 30	300	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$		0.25 0.4	V V
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$	0.65	0.85 0.95	V V

SMALL SIGNAL CHARACTERISTICS

f_T	Current Gain - Bandwidth Product	$I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V},$ $f = 100 \text{ MHz}$	250		MHz
C_{obo}	Output Capacitance	$V_{CB} = 5.0 \text{ V}, I_E = 0,$ $f = 100 \text{ kHz}$		4.5	pF
C_{ibo}	Input Capacitance	$V_{EB} = 0.5 \text{ V}, I_C = 0,$ $f = 100 \text{ kHz}$		10.0	pF
NF	Noise Figure (except MMPQ3906)	$I_C = 100 \text{ } \mu\text{A}, V_{CE} = 5.0 \text{ V},$ $R_S = 1.0 \text{ k}\Omega, f = 10 \text{ Hz to } 15.7 \text{ kHz}$		4.0	dB

SWITCHING CHARACTERISTICS (except MMPQ3906)

t_d	Delay Time	$V_{CC} = 3.0 \text{ V}, V_{BE} = 0.5 \text{ V},$		35	ns
t_r	Rise Time	$I_C = 10 \text{ mA}, I_{B1} = 1.0 \text{ mA}$		35	ns
t_s	Storage Time	$V_{CC} = 3.0 \text{ V}, I_C = 10 \text{ mA}$		225	ns
t_f	Fall Time	$I_{B1} = I_{B2} = 1.0 \text{ mA}$		75	ns

*Pulse Test: Pulse Width $\leq 300 \text{ } \mu\text{s}$, Duty Cycle $\leq 2.0\%$

Spice Model

PNP (Is=1.41f Xti=3 Eg=1.11 Vaf=18.7 Bf=180.7 Ne=1.5 Ise=0 Ikf=80m Xtb=1.5 Br=4.977 Nc=2 Isc=0 Ikr=0 Rc=2.5 Cjc=9.728p Mjc=.5776 Vjc=.75 Fc=.5 Cje=8.063p Mje=.3677 Vje=.75 Tr=33.42n Tf=179.3p Itf=.4 Vtf=4 Xtf=6 Rb=10)

2N3906 / MMBT3906 / PZT3906

PNP General Purpose Amplifier

(continued)

2N3906 / MMBT3906 / PZT3906

Thermal Characteristics

TA = 25°C unless otherwise noted

Symbol	Characteristic	Max		Units
		2N3906	*PZT3906	
P _D	Total Device Dissipation Derate above 25°C	625	1,000	mW
		5.0	8.0	mW/°C
R _{θJC}	Thermal Resistance, Junction to Case	83.3		°C/W
R _{θJA}	Thermal Resistance, Junction to Ambient	200	125	°C/W

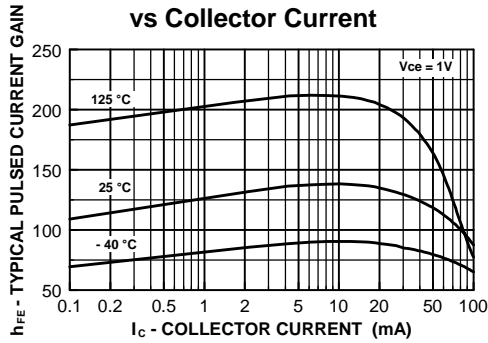
Symbol	Characteristic	Max		Units
		**MMBT3906	MMPQ3906	
P _D	Total Device Dissipation Derate above 25°C	350	1,000	mW
		2.8	8.0	mW/°C
R _{θJA}	Thermal Resistance, Junction to Ambient Effective 4 Die Each Die	357		°C/W
			125	°C/W
			240	°C/W

* Device mounted on FR-4 PCB 36 mm X 18 mm X 1.5 mm; mounting pad for the collector lead min. 6 cm².

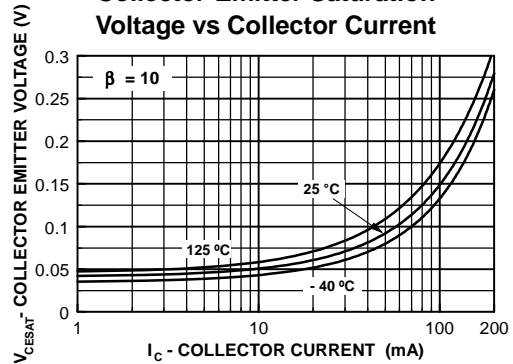
** Device mounted on FR-4 PCB 1.6" X 1.6" X 0.06."

Typical Characteristics

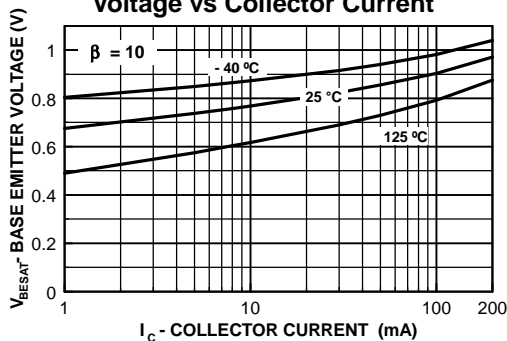
Typical Pulsed Current Gain vs Collector Current



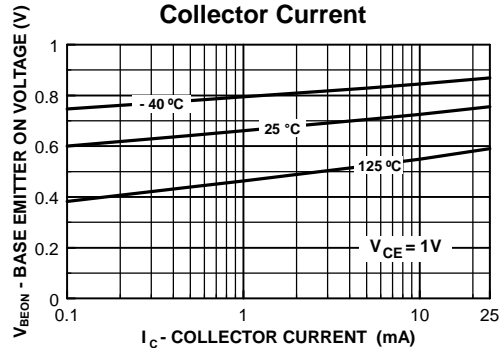
Collector-Emitter Saturation Voltage vs Collector Current



Base-Emitter Saturation Voltage vs Collector Current

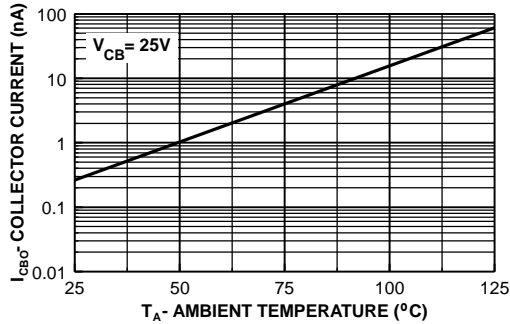


Base Emitter ON Voltage vs Collector Current

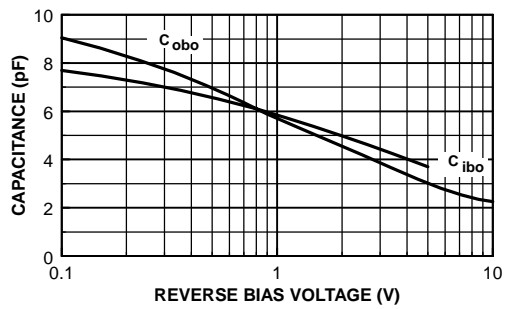


Typical Characteristics (continued)

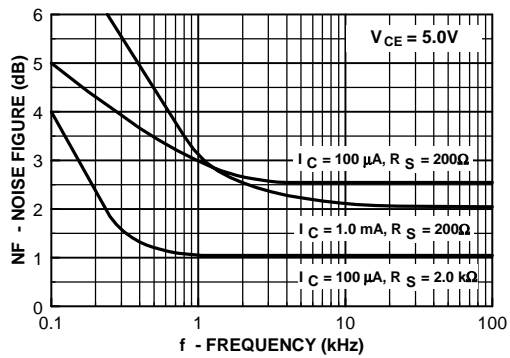
Collector-Cutoff Current vs. Ambient Temperature



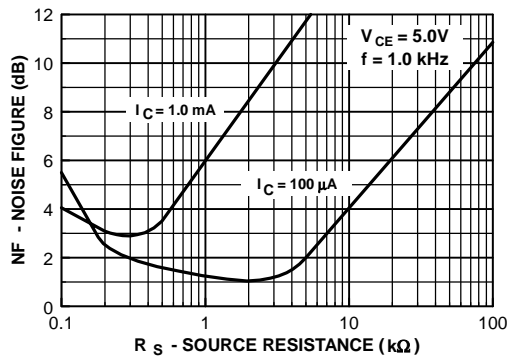
Common-Base Open Circuit Input and Output Capacitance vs Reverse Bias Voltage



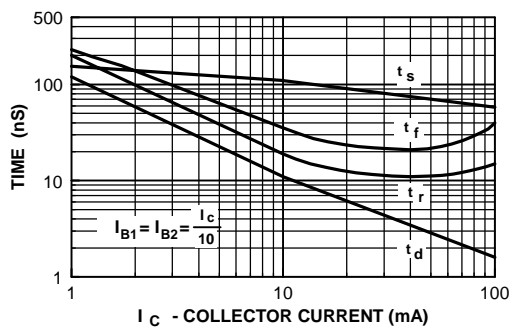
Noise Figure vs Frequency



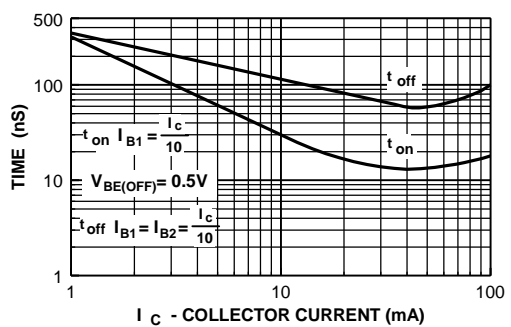
Noise Figure vs Source Resistance



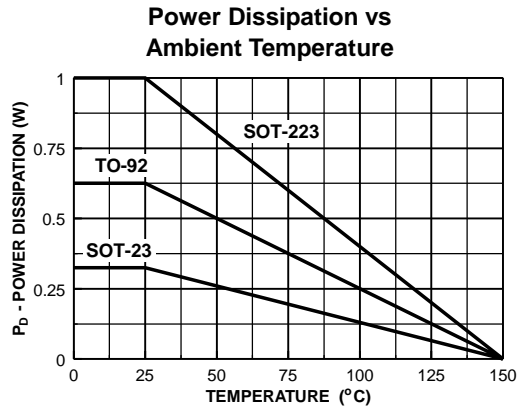
Switching Times vs Collector Current



Turn On and Turn Off Times vs Collector Current

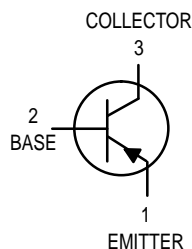


Typical Characteristics (continued)



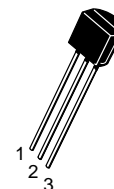
General Purpose Transistors

PNP Silicon



2N3905
2N3906*

*Motorola Preferred Device



CASE 29-04, STYLE 1
TO-92 (TO-226AA)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V_{CEO}	40	Vdc
Collector–Base Voltage	V_{CBO}	40	Vdc
Emitter–Base Voltage	V_{EBO}	5.0	Vdc
Collector Current — Continuous	I_C	200	mAdc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	625 5.0	mW mW/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 60^\circ\text{C}$	P_D	250	mW
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	1.5 12	Watts mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$

THERMAL CHARACTERISTICS(1)

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	$^\circ\text{C}/\text{W}$

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
----------------	--------	-----	-----	------

OFF CHARACTERISTICS

Collector–Emitter Breakdown Voltage (2) ($I_C = 1.0 \text{ mAdc}, I_B = 0$)	$V_{(BR)CEO}$	40	—	Vdc
Collector–Base Breakdown Voltage ($I_C = 10 \mu\text{Adc}, I_E = 0$)	$V_{(BR)CBO}$	40	—	Vdc
Emitter–Base Breakdown Voltage ($I_E = 10 \mu\text{Adc}, I_C = 0$)	$V_{(BR)EBO}$	5.0	—	Vdc
Base Cutoff Current ($V_{CE} = 30 \text{ Vdc}, V_{EB} = 3.0 \text{ Vdc}$)	I_{BL}	—	50	nAdc
Collector Cutoff Current ($V_{CE} = 30 \text{ Vdc}, V_{EB} = 3.0 \text{ Vdc}$)	I_{CEX}	—	50	nAdc

1. Indicates Data in addition to JEDEC Requirements.
2. Pulse Test: Pulse Width $\leq 300 \mu\text{s}$; Duty Cycle $\leq 2.0\%$.

Preferred devices are Motorola recommended choices for future use and best overall value.

REV 2

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FACT™	QS™
FACT Quiet Series™	Quiet Series™
FAST®	SuperSOT™-3
FASTr™	SuperSOT™-6
GTO™	SuperSOT™-8
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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.

2N3905 2N3906

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Max	Unit
ON CHARACTERISTICS(1)				
DC Current Gain ($I_C = 0.1 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)	h_{FE}	30	—	—
2N3905		60	—	
2N3906				
($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)		40	—	
2N3905		80	—	
2N3906				
($I_C = 10 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)		50	150	
2N3905		100	300	
2N3906				
($I_C = 50 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)		30	—	
2N3905		60	—	
2N3906				
($I_C = 100 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)		15	—	
2N3905		30	—	
2N3906				
Collector–Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)	$V_{CE(sat)}$	—	0.25 0.4	Vdc
Base–Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)	$V_{BE(sat)}$	0.65 —	0.85 0.95	Vdc

SMALL–SIGNAL CHARACTERISTICS

Current–Gain — Bandwidth Product ($I_C = 10 \text{ mAdc}$, $V_{CE} = 20 \text{ Vdc}$, $f = 100 \text{ MHz}$)	f_T	200 250	— —	MHz
Output Capacitance ($V_{CB} = 5.0 \text{ Vdc}$, $I_E = 0$, $f = 1.0 \text{ MHz}$)	C_{obo}	—	4.5	pF
Input Capacitance ($V_{EB} = 0.5 \text{ Vdc}$, $I_C = 0$, $f = 1.0 \text{ MHz}$)	C_{ibo}	—	10.0	pF
Input Impedance ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	h_{ie}	0.5 2.0	8.0 12	k Ω
Voltage Feedback Ratio ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	h_{re}	0.1 0.1	5.0 10	$\times 10^{-4}$
Small–Signal Current Gain ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	h_{fe}	50 100	200 400	—
Output Admittance ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	h_{oe}	1.0 3.0	40 60	μhos
Noise Figure ($I_C = 100 \mu\text{Adc}$, $V_{CE} = 5.0 \text{ Vdc}$, $R_S = 1.0 \text{ k } \Omega$, $f = 1.0 \text{ kHz}$)	NF	— —	5.0 4.0	dB

SWITCHING CHARACTERISTICS

Delay Time	$(V_{CC} = 3.0 \text{ Vdc}$, $V_{BE} = 0.5 \text{ Vdc}$, $I_C = 10 \text{ mAdc}$, $I_{B1} = 1.0 \text{ mAdc}$)	t_d	—	35	ns
Rise Time		t_r	—	35	ns
Storage Time	$(V_{CC} = 3.0 \text{ Vdc}$, $I_C = 10 \text{ mAdc}$, $I_{B1} = I_{B2} = 1.0 \text{ mAdc}$)	t_s	— —	200 225	ns
Fall Time		t_f	— —	60 75	ns

1. Pulse Test: Pulse Width $\leq 300 \mu\text{s}$; Duty Cycle $\leq 2.0\%$.

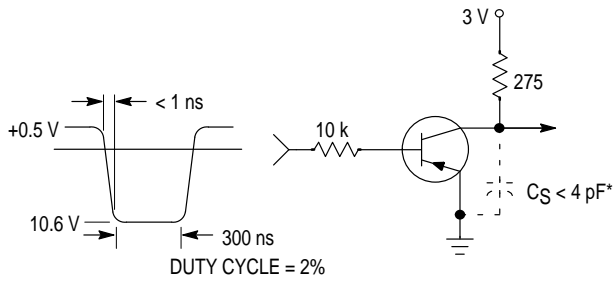


Figure 1. Delay and Rise Time Equivalent Test Circuit

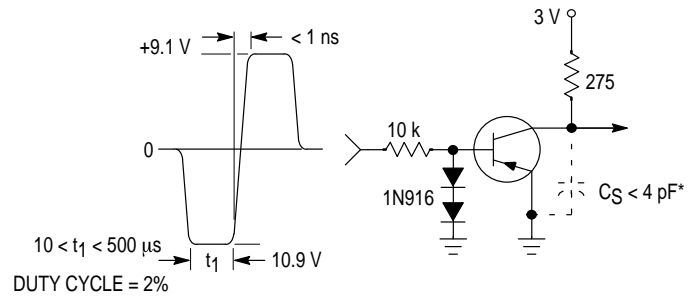


Figure 2. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

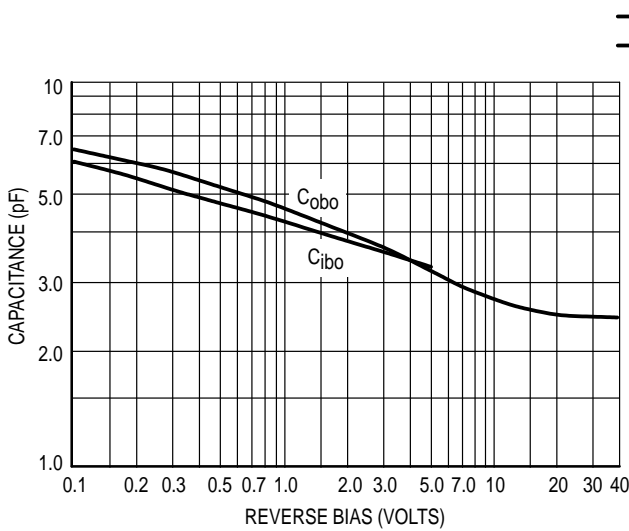


Figure 3. Capacitance

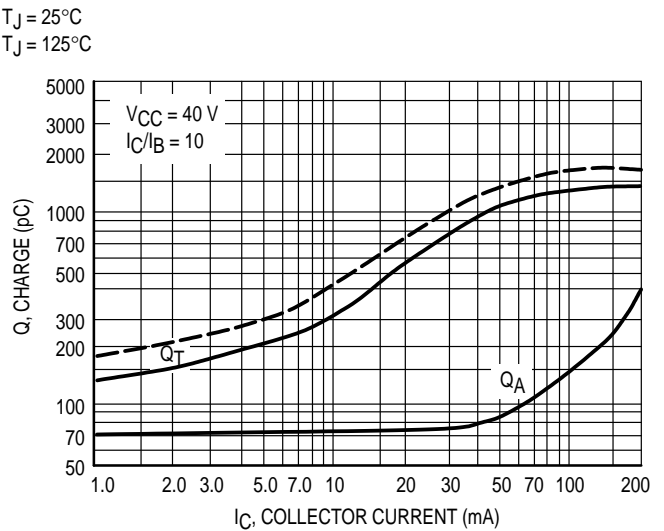


Figure 4. Charge Data

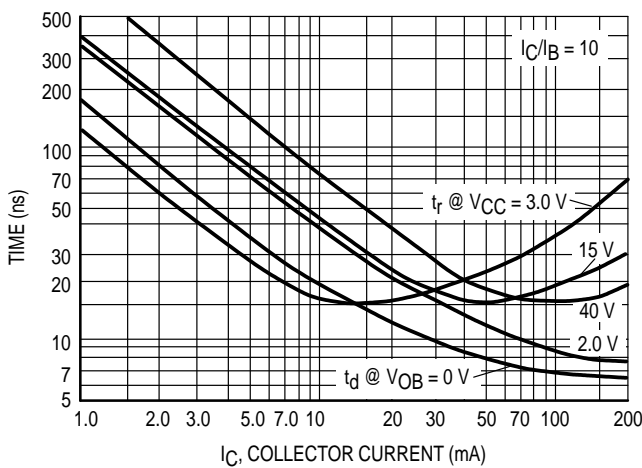


Figure 5. Turn-On Time

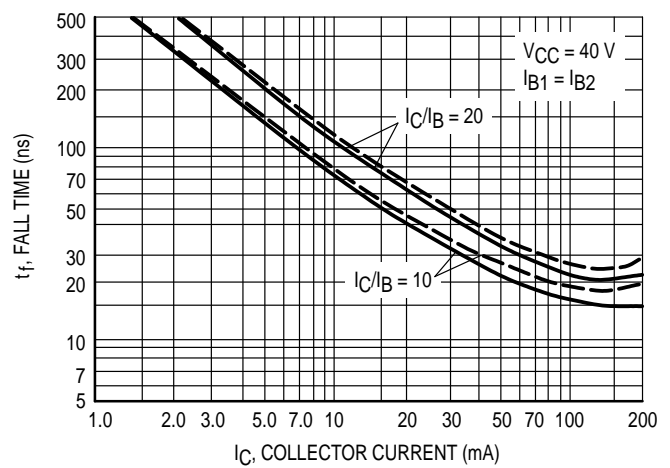


Figure 6. Fall Time

**TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS**

($V_{CE} = -5.0$ Vdc, $T_A = 25^\circ\text{C}$, Bandwidth = 1.0 Hz)

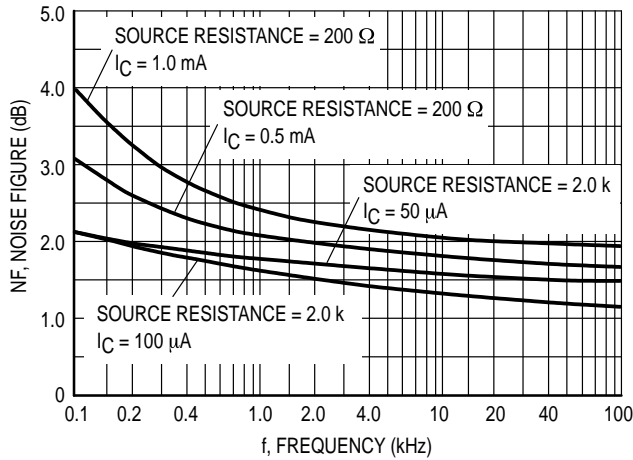


Figure 7.

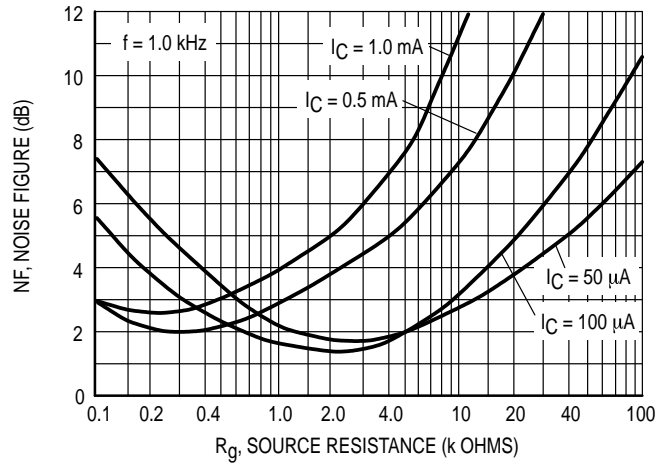


Figure 8.

h PARAMETERS

($V_{CE} = -10$ Vdc, $f = 1.0$ kHz, $T_A = 25^\circ\text{C}$)

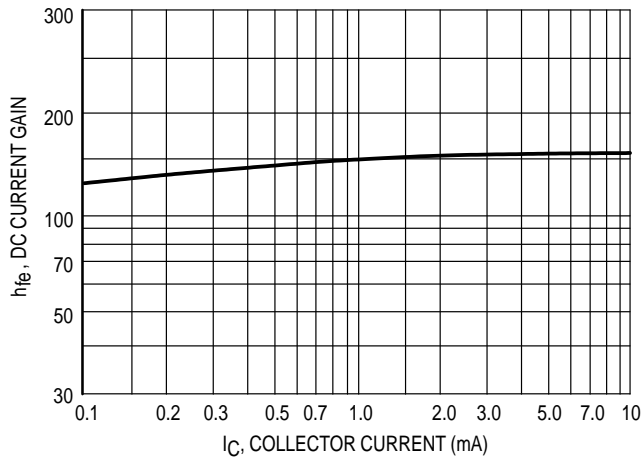


Figure 9. Current Gain

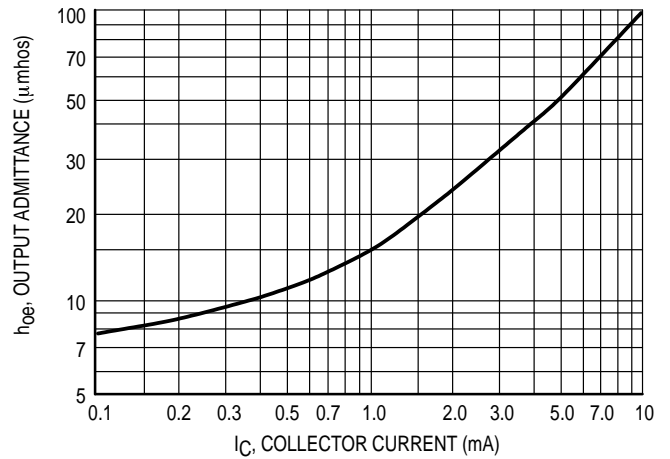


Figure 10. Output Admittance

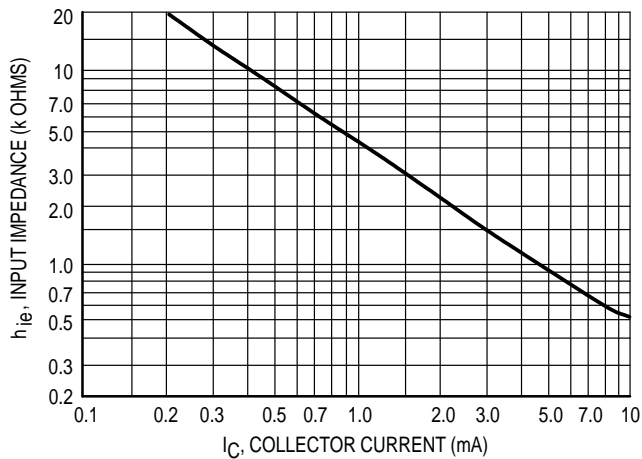


Figure 11. Input Impedance

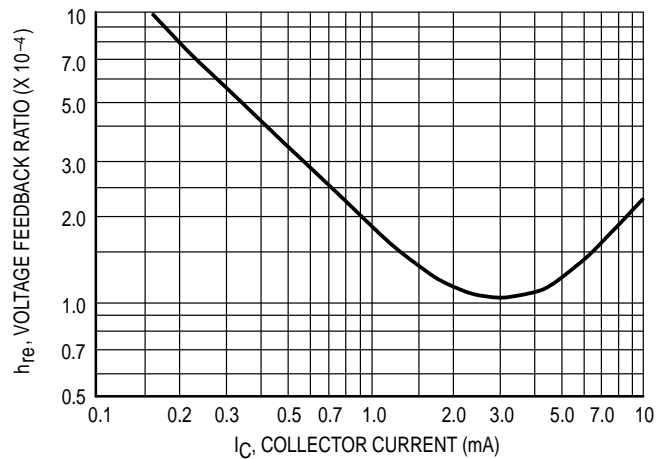


Figure 12. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

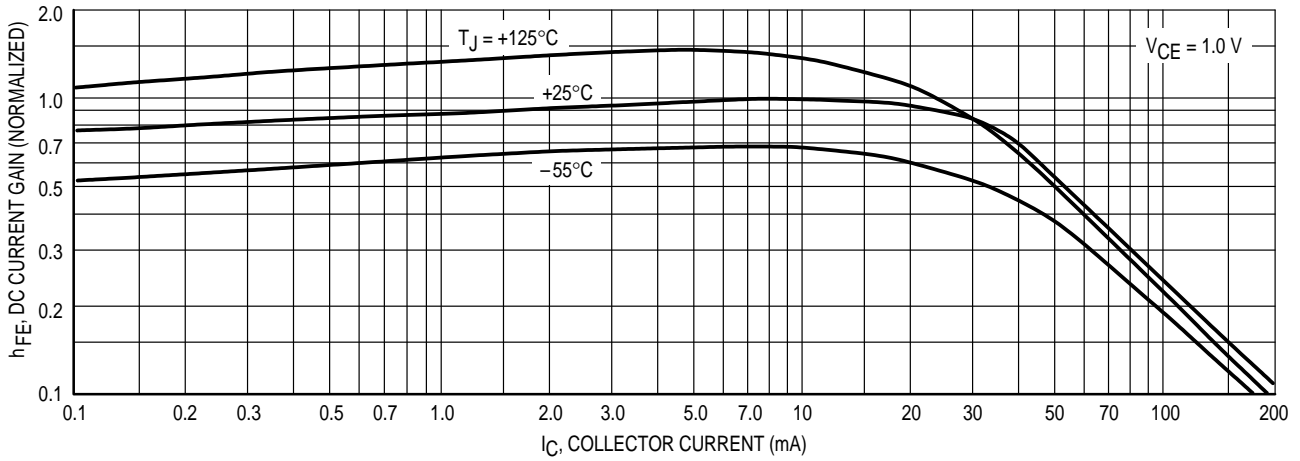


Figure 13. DC Current Gain

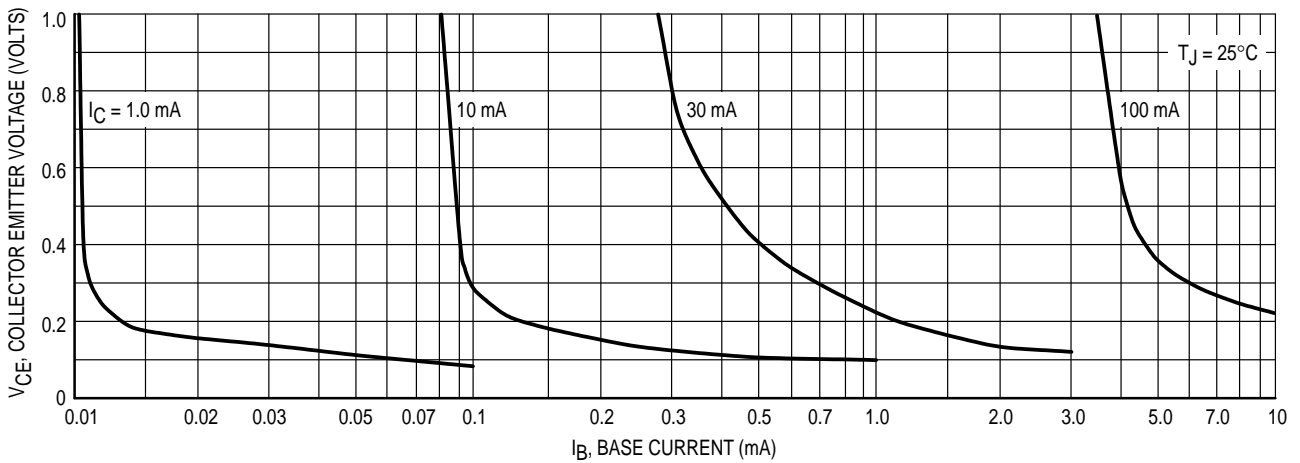


Figure 14. Collector Saturation Region

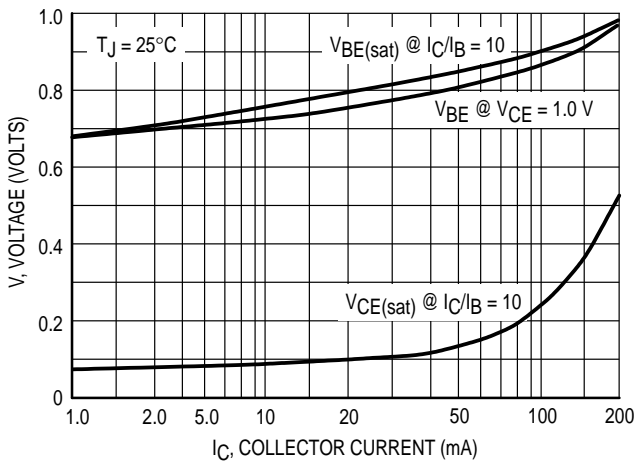


Figure 15. "ON" Voltages

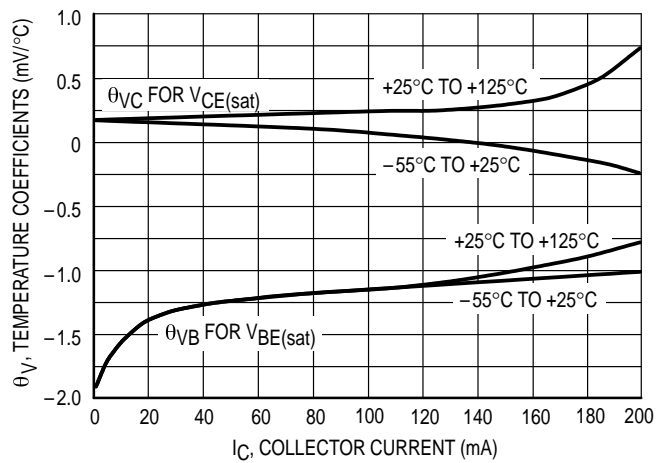
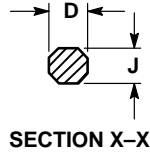
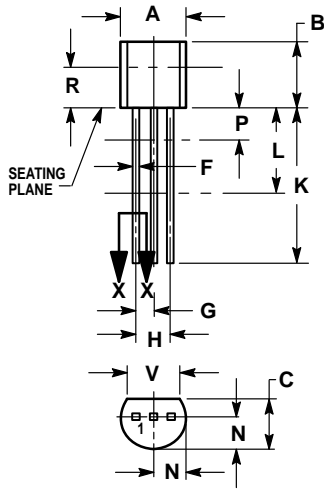


Figure 16. Temperature Coefficients

PACKAGE DIMENSIONS



**CASE 029-04
(TO-226AA)
ISSUE AD**


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. DIMENSION F APPLIES BETWEEN P AND L. DIMENSION D AND J APPLY BETWEEN L AND K. MINIMUM LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.175	0.205	4.45	5.20
B	0.170	0.210	4.32	5.33
C	0.125	0.165	3.18	4.19
D	0.016	0.022	0.41	0.55
F	0.016	0.019	0.41	0.48
G	0.045	0.055	1.15	1.39
H	0.095	0.105	2.42	2.66
J	0.015	0.020	0.39	0.50
K	0.500	—	12.70	—
L	0.250	—	6.35	—
N	0.080	0.105	2.04	2.66
P	—	0.100	—	2.54
R	0.115	—	2.93	—
V	0.135	—	3.43	—

STYLE 1:

- PIN 1. EMITTER
2. BASE
3. COLLECTOR

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