FAIRCHILD
SEMICONDUCTOR ™

2N3906   **MMBT3906**   **PZT3906**

C   C

          E   E

C   C
 B E   B   B
        TO-92   **SOT-23**   **SOT-223**
                          Mark: 2A
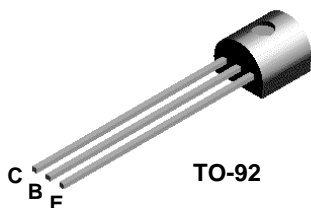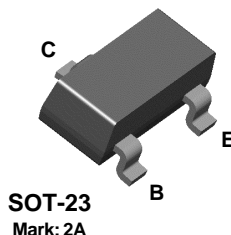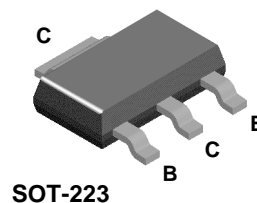
PNP General Purpose Amplifier

This device is designed for general purpose amplifier and switching
applications at collector currents of 10 µA to 100 mA.

Absolute Maximum Ratings* T_A = 25°C unless otherwise noted

Symbol	Parameter	Value	Units
V_{CEO}	Collector-Emitter Voltage	40	V
V_{CBO}	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.
3) All voltages (V) and currents (A) are negative polarity for PNP transistors.

Thermal Characteristics T_A = 25°C unless otherwise noted

Symbol	Characteristic	Max			Units
		2N3906	***MMBT3906**	****PZT3906**	
P_D	Total Device Dissipation	625	350	1,000	mW
	Derate above 25°C	5.0	2.8	8.0	mW/°C
$R_{\theta JC}$	Thermal Resistance, Junction to Case	83.3			°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	200	357	125	°C/W

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

**Device mounted on FR-4 PCB 36 mm X 18 mm X 1.5 mm; mounting pad for the collector lead min. 6 cm^2.

PNP General Purpose Amplifier
(continued)

Electrical Characteristics $T_A = 25°C$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Max	Units
OFF CHARACTERISTICS					
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage*	$I_C = 1.0$ mA, $I_B = 0$	40		V
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	$I_C = 10$ µA, $I_E = 0$	40		V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 10$ µA, $I_C = 0$	5.0		V
I_{BL}	Base Cutoff Current	$V_{CE} = 30$ V, $V_{BE} = 3.0$ V		50	nA
I_{CEX}	Collector Cutoff Current	$V_{CE} = 30$ V, $V_{BE} = 3.0$ V		50	nA
ON CHARACTERISTICS					
h_{FE}	DC Current Gain *	$I_C = 0.1$ mA, $V_{CE} = 1.0$ V	60		
		$I_C = 1.0$ mA, $V_{CE} = 1.0$ V	80		
		$I_C = 10$ mA, $V_{CE} = 1.0$ V	100	300	
		$I_C = 50$ mA, $V_{CE} = 1.0$ V	60		
		$I_C = 100$ mA, $V_{CE} = 1.0$ V	30		
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C = 10$ mA, $I_B = 1.0$ mA		0.25	V
		$I_C = 50$ mA, $I_B = 5.0$ mA		0.4	V
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	$I_C = 10$ mA, $I_B = 1.0$ mA	0.65	0.85	V
		$I_C = 50$ mA, $I_B = 5.0$ mA		0.95	V
SMALL SIGNAL CHARACTERISTICS					
f_T	Current Gain - Bandwidth Product	$I_C = 10$ mA, $V_{CE} = 20$ V, f = 100 MHz	250		MHz
C_{obo}	Output Capacitance	$V_{CB} = 5.0$ V, $I_E = 0$, f = 100 kHz		4.5	pF
C_{ibo}	Input Capacitance	$V_{EB} = 0.5$ V, $I_C = 0$, f = 100 kHz		10.0	pF
NF	Noise Figure	$I_C = 100$ µA, $V_{CE} = 5.0$ V, $R_S = 1.0$kΩ,f=10 Hz to 15.7 kHz		4.0	dB
SWITCHING CHARACTERISTICS					
t_d	Delay Time	$V_{CC} = 3.0$ V, $V_{BE} = 0.5$ V,		35	ns
t_r	Rise Time	$I_C = 10$ mA, $I_{B1} = 1.0$ mA		35	ns
t_s	Storage Time	$V_{CC} = 3.0$ V, $I_C = 10$mA		225	ns
t_f	Fall Time	$I_{B1} = I_{B2} = 1.0$ mA		75	ns

*Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%

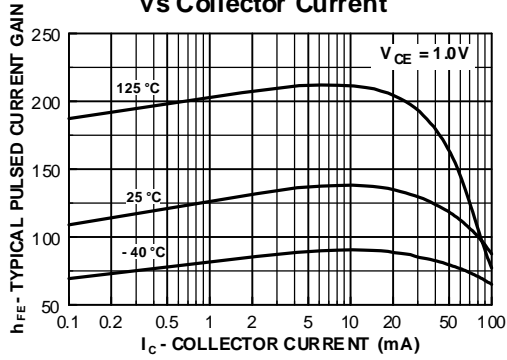**NOTE:** All voltages (V) and currents (A) are negative polarity for PNP transistors.

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)
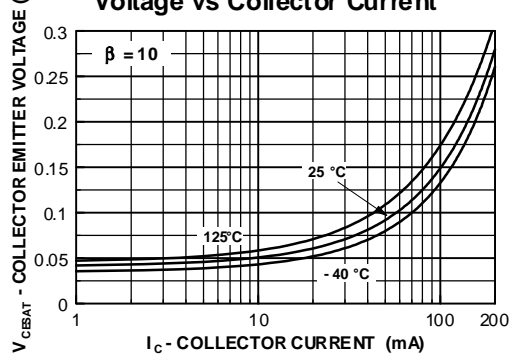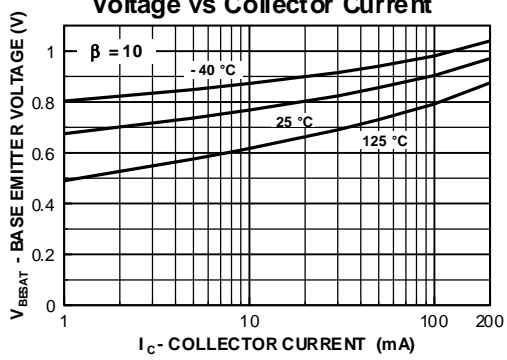
Typical Characteristics

**Typical Pulsed Current Gain
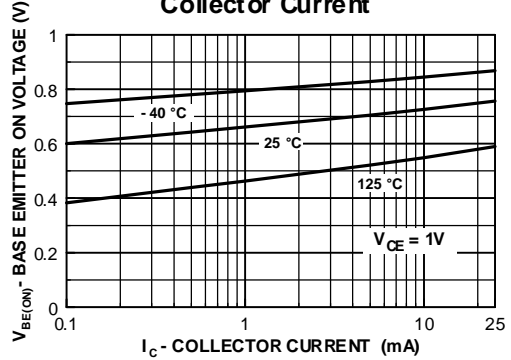vs Collector Current**

**Collector-Emitter Saturation
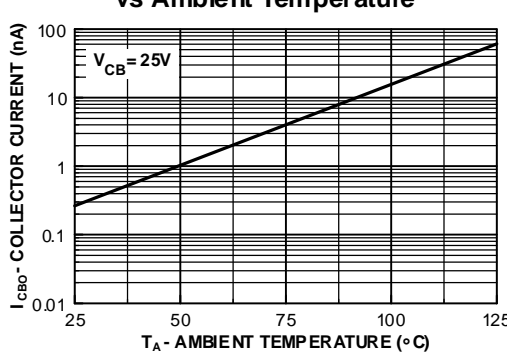Voltage vs Collector Current**
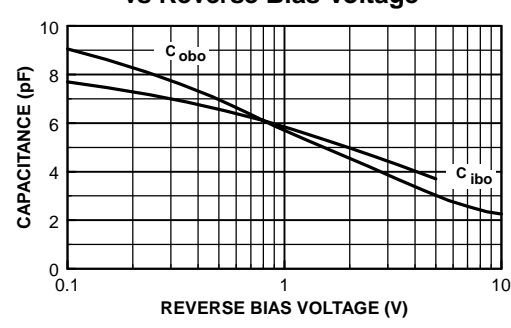
**Base-Emitter Saturation
Voltage vs Collector Current**

**Base Emitter ON Voltage vs
Collector Current**

**Collector-Cutoff Current
vs Ambient Temperature**

**Common-Base Open Circuit
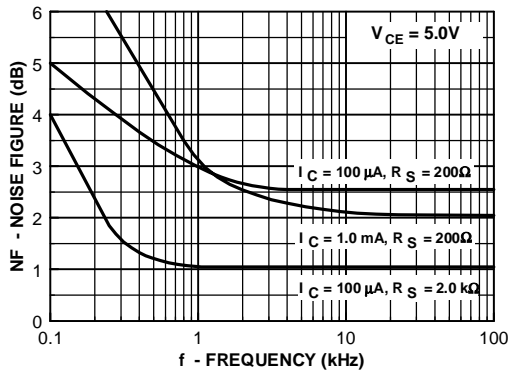Input and Output Capacitance
vs Reverse Bias Voltage**
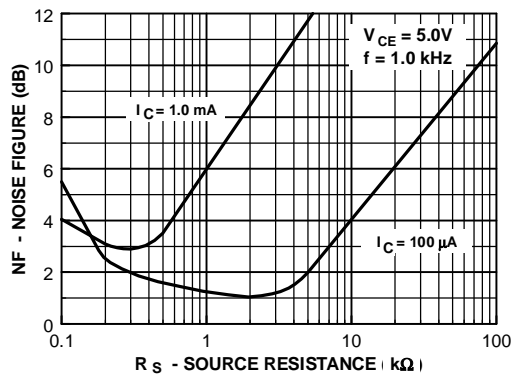
Typical Characteristics (continued)

Noise Figure vs Frequency

$V_{CE} = 5.0V$

$I_C = 100 \mu A, R_S = 200\Omega$

$I_C = 1.0 mA, R_S = 200\Omega$

$I_C = 100 \mu A, R_S = 2.0 k\Omega$

NF - NOISE FIGURE (dB)

f - FREQUENCY (kHz)

Noise Figure vs Source Resistance

$V_{CE} = 5.0V$
$f = 1.0 kHz$

$I_C = 1.0 mA$

$I_C = 100 \mu A$

NF - NOISE FIGURE (dB)

R_S - SOURCE RESISTANCE (kΩ)

Switching Times vs Collector Current

t_s

t_f

t_r

$I_{B1} = I_{B2} = \dfrac{I_C}{10}$

t_d

TIME (nS)

I_C - COLLECTOR CURRENT (mA)
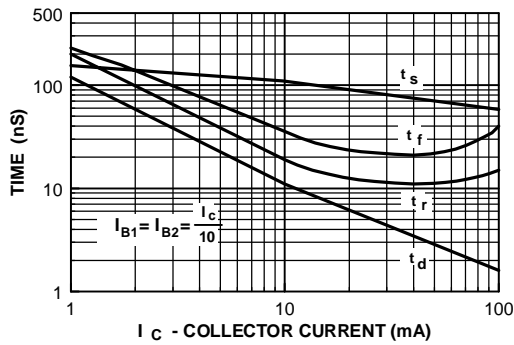
Turn On and Turn Off Times vs Collector Current

t_{off}

$t_{on} \, I_{B1} = \dfrac{I_C}{10}$

$V_{BE(OFF)} = 0.5V$

t_{on}

$t_{off} \, I_{B1} = I_{B2} = \dfrac{I_C}{10}$

TIME (nS)

I - COLLECTOR CURRENT (mA)
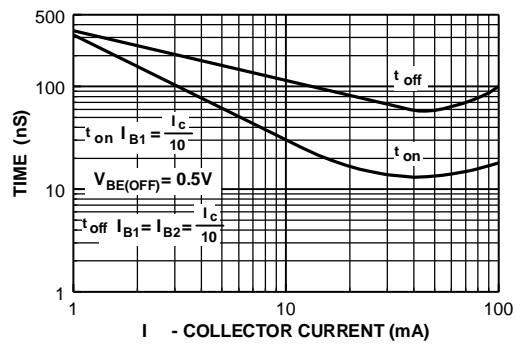
Power Dissipation vs Ambient Temperature
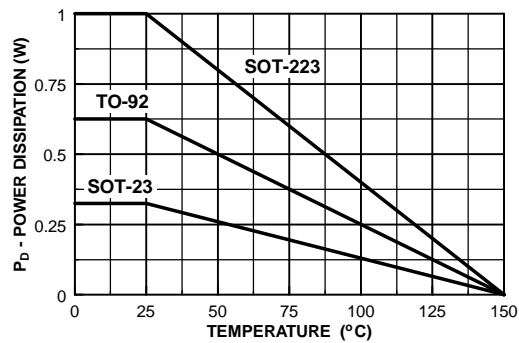
SOT-223

TO-92

SOT-23

P_D - POWER DISSIPATION (W)

TEMPERATURE (°C)

Typical Characteristics (continued)

Voltage Feedback Ratio

h$_{re}$ - VOLTAGE FEEDBACK RATIO (x10^{-4})

I$_C$ - COLLECTOR CURRENT (mA)

Input Impedance

h$_{ie}$ - INPUT IMPEDANCE (kΩ)

V$_{CE}$ = 10 V
f = 1.0 kHz

I$_C$ - COLLECTOR CURRENT (mA)

Output Admittance

h$_{oe}$ - OUTPUT ADMITTANCE (μnhos)

V$_{CE}$ = 10 V
f = 1.0 kHz

I$_C$ - COLLECTOR CURRENT (mA)

Current Gain

h$_{fe}$ - CURRENT GAIN

V$_{CE}$ = 10 V
f = 1.0 kHz

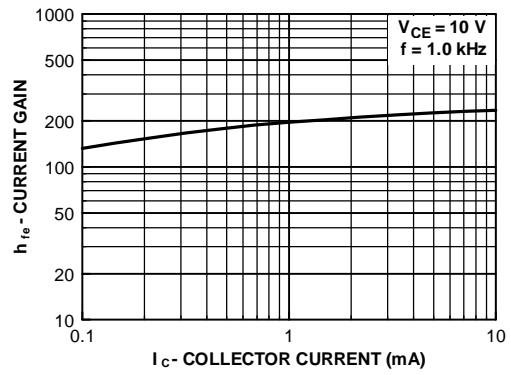I$_C$ - COLLECTOR CURRENT (mA)
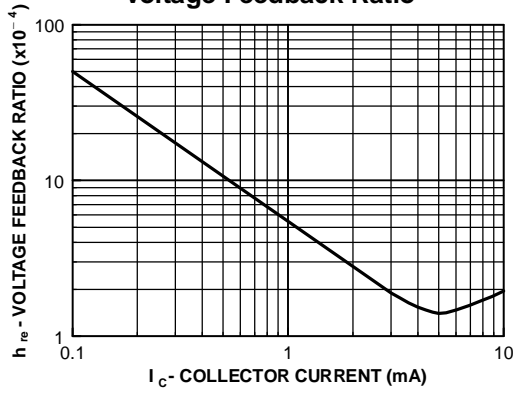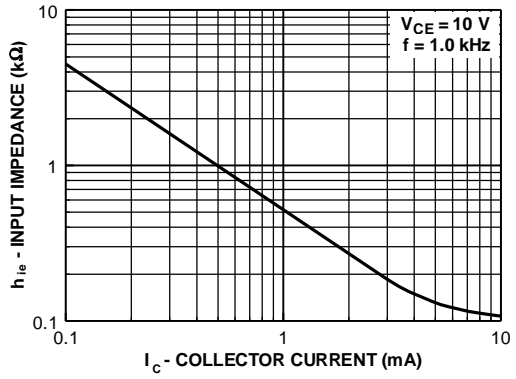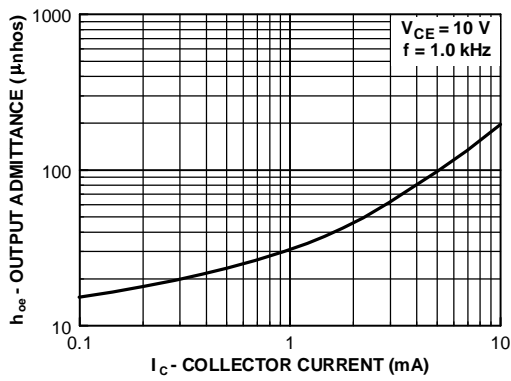
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FACT™	OPTOPLANAR™	SuperSOT™-3	
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FAST ®	POP™	SuperSOT™-8	

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