

NPN Transistor

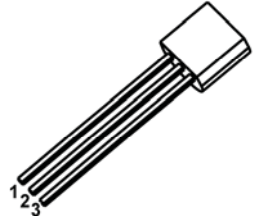
2N3904

FEATURE

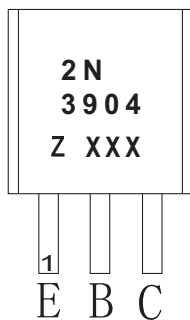
- NPN silicon epitaxial planar transistor for switching and Amplifier applications
- As complementary type, the PNP transistor 2N3906 is Recommended
- This transistor is also available in the SOT-23 case with the type designation MMBT3904

TO-92

1. EMITTER
2. BASE
3. COLLECTOR



MARKING



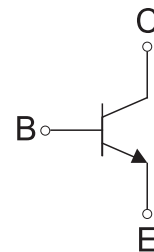
2N3904=Device code

Solid dot=Green molding compound device,
if none,the normal device

Z=Rank of h_{FE}

XXX=Code

Equivalent Circuit



MAXIMUM RATINGS ($T_a=25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-Base Voltage	60	V
V_{CEO}	Collector-Emitter Voltage	40	V
V_{EBO}	Emitter-Base Voltage	6	V
I_C	Collector Current -Continuous	0.2	A
P_C	Collector Power Dissipation	0.625	W
T_J, T_{stg}	Operation Junction and Storage Temperature Range	-55-150	$^\circ\text{C}$

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ELECTRICAL CHARACTERISTICS

$T_a=25^{\circ}\text{C}$ unless otherwise specified

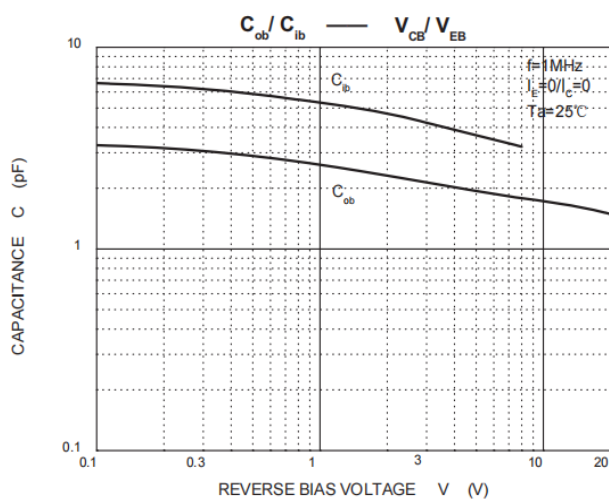
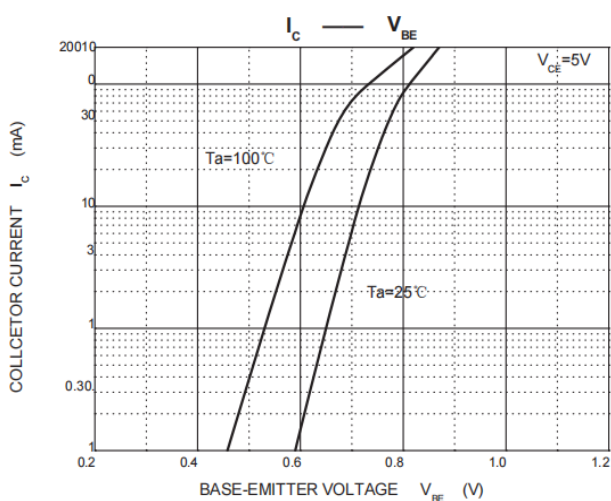
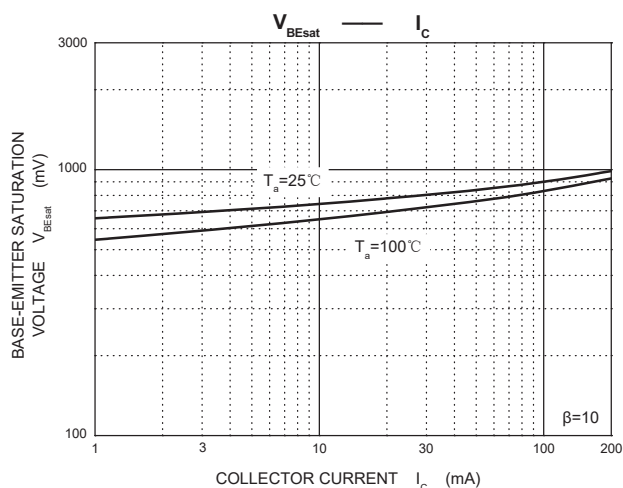
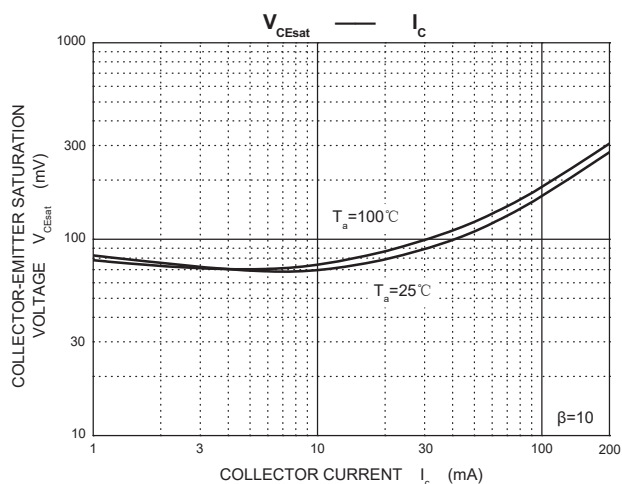
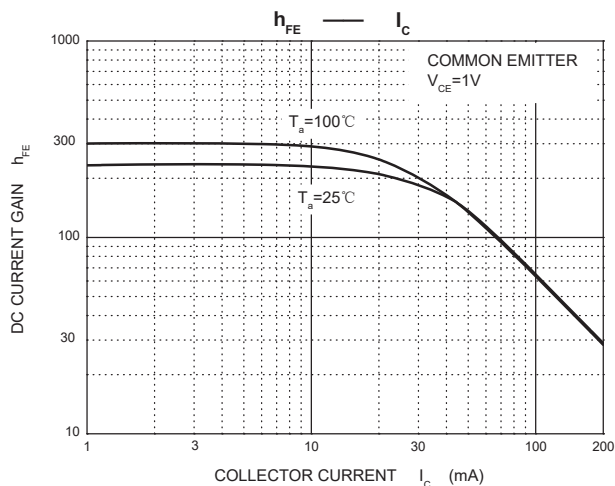
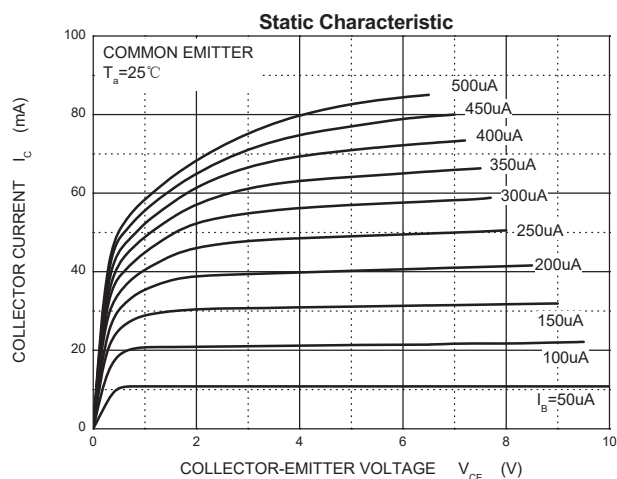
Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
Collector-base breakdown voltage	$V_{(BR)CBO}$	$I_C=10\text{mA}$, $I_E=0$	60			V
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C=1\text{mA}$, $I_B=0$	40			V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	$I_E=10\text{mA}$, $I_C=0$	6			V
Collector cut-off current	I_{CBO}	$V_{CB}=60\text{V}$, $I_E=0$			0.1	μA
Collector cut-off current	I_{CEX}	$V_{CE}=30\text{V}$, $V_{EB(off)}=3\text{V}$			0.05	μA
Emitter cut-off current	I_{EBO}	$V_{EB}=5\text{V}$, $I_C=0$			0.1	μA
DC current gain	h_{FE1}	$V_{CE}=1\text{V}$, $I_C=10\text{mA}$	100		400	
	h_{FE2}	$V_{CE}=1\text{V}$, $I_C=50\text{mA}$	60			
	h_{FE3}	$V_{CE}=1\text{V}$, $I_C=100\text{mA}$	30			
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C=50\text{mA}$, $I_B=5\text{mA}$			0.3	V
Base-emitter saturation voltage	$V_{BE(sat)}$	$I_C=50\text{mA}$, $I_B=5\text{mA}$			0.95	V
Transition frequency	f_T	$V_{CE}=20\text{V}$, $I_C=10\text{mA}$, $f=100\text{MHz}$	300			MHz
Delay Time	t_d	$V_{CC}=3\text{V}$, $V_{BE}=0.5\text{V}$, $I_C=10\text{mA}$, $I_{B1}=1\text{mA}$			35	ns
Rise Time	t_r				35	ns
Storage Time	t_s	$V_{CC}=3\text{V}$, $I_C=10\text{mA}$ $I_{B1}=I_{B2}=1\text{mA}$			200	ns
Fall Time	t_f				50	ns

CLASSIFICATION OF h_{FE1}

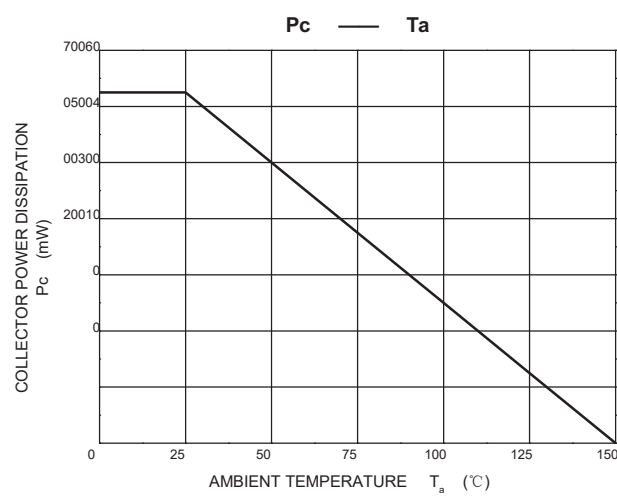
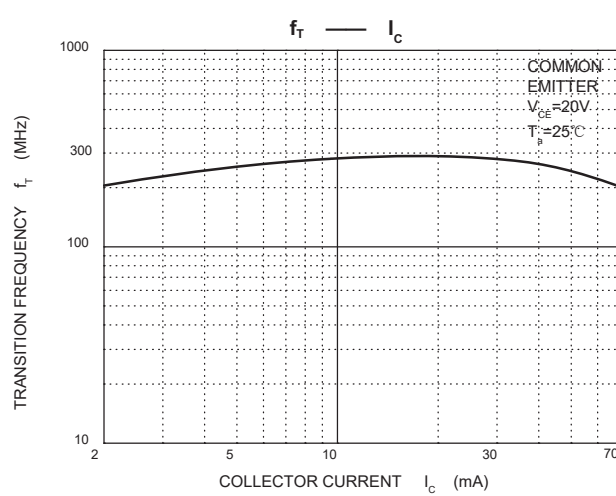
Rank	O	Y	H
Range	100-200	200-300	300-400

NPN Transistor 2N3904

Typical Characteristics

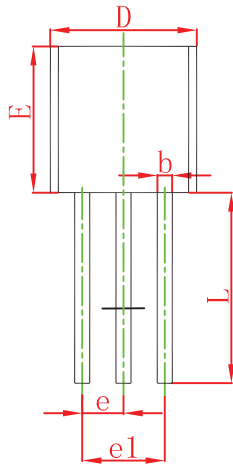
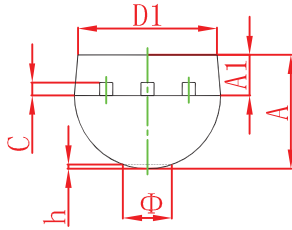


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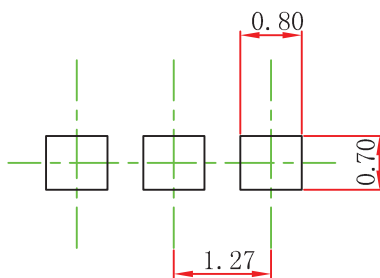
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TO-92 Package Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.	3.	0.	0.
A1	3001.	7001.	1300.	1460.
b	1000.	4000.	0430.	0550.
c	3800.	5500.	0150.	0220.
D	4300.	45700.	00149.	00185.
D1	3.430		0.135	
E	4.300	4.700	0.169	0.185
e	1.270 TYP		0.050 TYP	
e1	2.440	2.640	0.096	0.104
L	14.100	14.500	0.555	0.571
K		1.600		0.063
h	0.000	0.380	0.000	0.015

TO-92 Suggested Pad Layout



Note:

1. Controlling dimension: in millimeters.
2. General tolerance: $\pm 0.05\text{mm}$.
3. The pad layout is for reference purposes only.