General Purpose Transistor

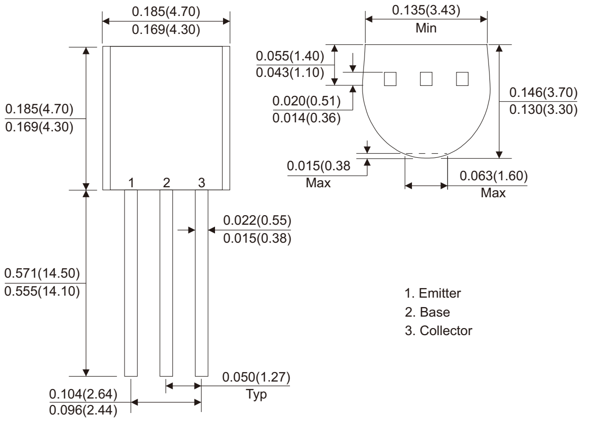
2N3904-HF (NPN)

RoHS Device
Halogen Free

Features

- NPN silicon epitaxial planar transistor for switching and amplifier applications.

TO-92

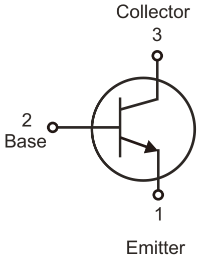


Dimensions in inches and (millimeter)

Mechanical Data

- Case: TO-92, molded plastic.
- Mounting position: Any.

Circuit Diagram



Maximum Ratings (at Ta=25°C unless otherwise noted)

Parameter	Symbol	Value	Unit
Collector-base voltage	V_{CBO}	60	V
Collector-emitter voltage	V_{CEO}	40	V
Emitter-base voltage	V_{EBO}	6	V
Collector current-continuous	I_C	0.2	A
Collector power dissipation	P_C	0.625	W
Operation junction and storage temperature range	T_J, T_{STG}	-55 to +150	°C

Electrical Characteristics (at T_A=25°C unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Collector-base breakdown voltage	$V_{(BR)CBO}$	$I_C = 10\mu A$, $I_E = 0$	60			V
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = 1mA$, $I_B = 0$	40			V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	$I_E = 10mA$, $I_C = 0$	6			V
Collector cut-off current	I_{CBO}	$V_{CB} = 60V$, $I_E = 0$			0.1	μA
Collector cut-off current	I_{CEX}	$V_{CE} = 30V$, $V_{EB(off)} = 3V$			0.05	μA
Emitter cut-off current	I_{EBO}	$V_{EB} = 5V$, $I_C = 0$			0.1	μA
DC current gain	$h_{FE(1)}$	$V_{CE} = 1V$, $I_C = 10mA$	100		400	
	$h_{FE(2)}$	$V_{CE} = 1V$, $I_C = 50mA$	60			
	$h_{FE(3)}$	$V_{CE} = 1V$, $I_C = 100mA$	30			
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = 50mA$, $I_B = 5mA$			0.3	V
Base-emitter saturation voltage	$V_{BE(sat)}$	$I_C = 50mA$, $I_B = 5mA$			0.95	V
Transition frequency	f_T	$V_{CE} = 20V$, $I_C = 10mA$, f = 100MHz	300			MHz
Delay time	t_d	$V_{CC} = 3V$, $V_{BE} = 0.5V$, $I_C = 10mA$, $I_{B1} = 1mA$			35	nS
Rise time	t_r				35	nS
Storage time	t_s	$V_{CC} = 3V$, $I_C = 10mA$, $I_{B1} = I_{B2} = 1mA$			200	nS
Fall time	t_f				50	nS

Classification of $h_{FE(1)}$

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

Typical Rating and Characteristic Curves (2N3904-HF)

Fig.1 - Static Characteristic

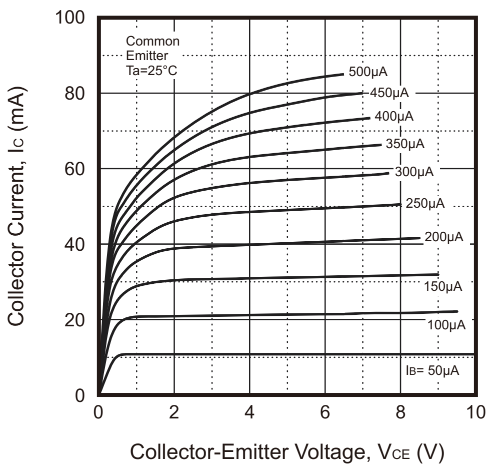
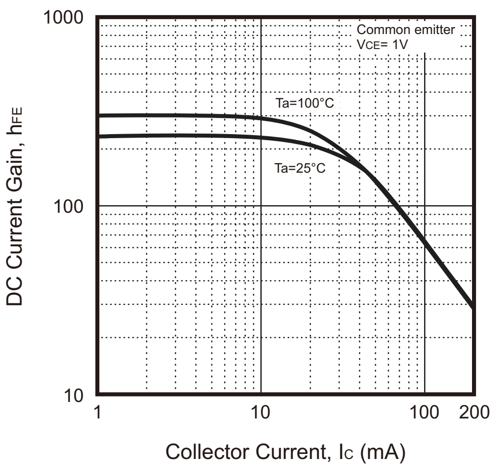


Fig.2 - h_{FE} — I_C



Typical Rating and Characteristic Curves (2N3904-HF)

Fig.3 - V_{CEsat} — I_C

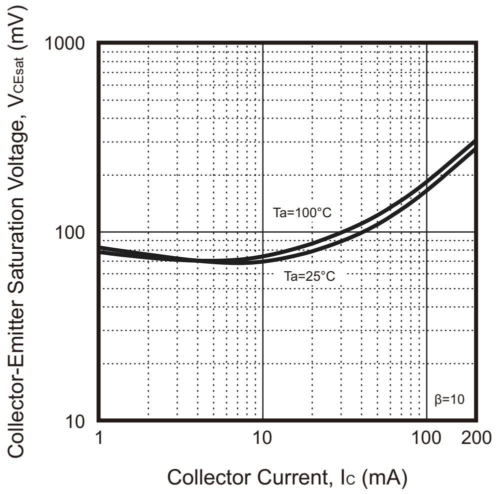


Fig.4 - V_{BEsat} — I_C

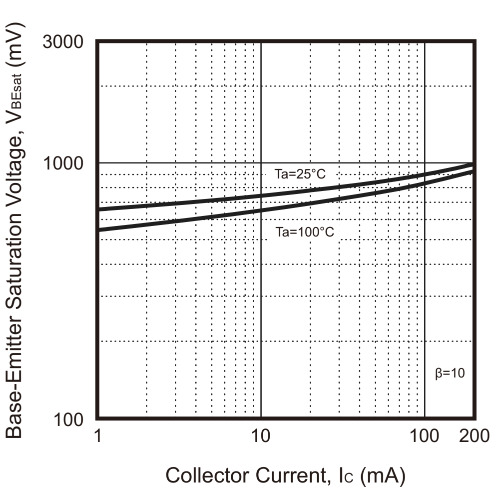


Fig.5 - I_C — V_{BE}

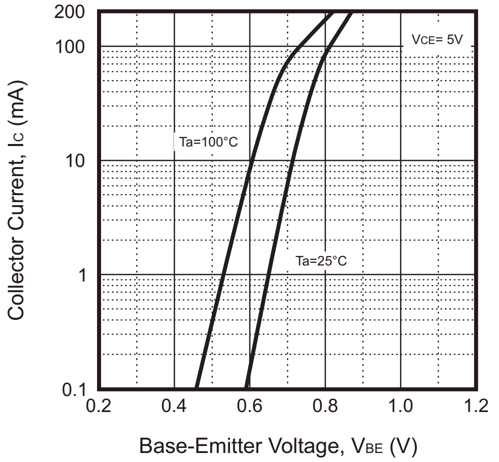


Fig.6 - C_{ob}/C_{ib} — V_{CB}/V_{EB}

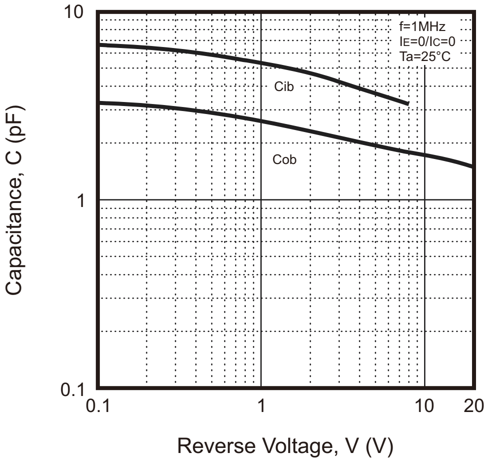


Fig.7 - f_T — I_C

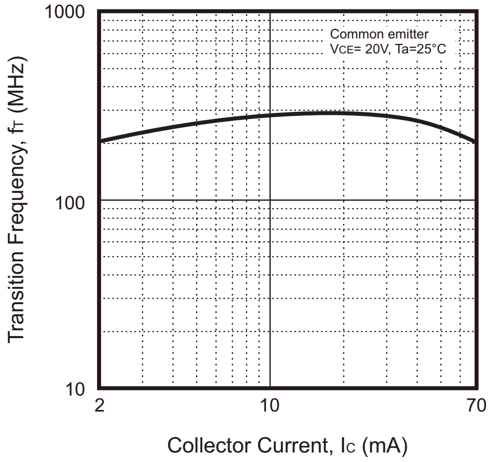
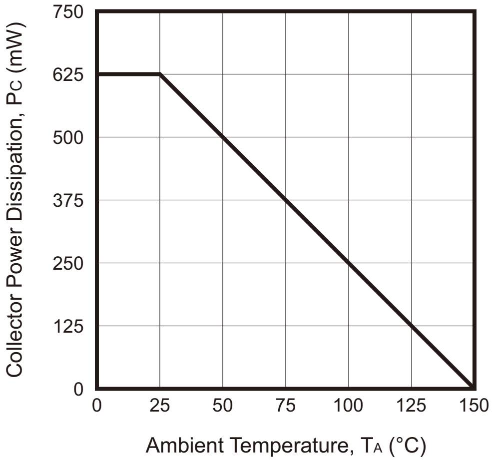
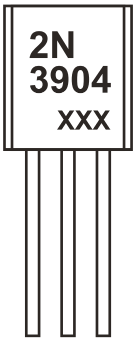


Fig.8 - P_C — T_A



Marking Code

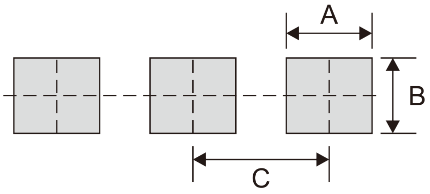
Part Number	Marking Code
2N3904-HF	2N3904



XXX = Control code

Suggested P.C.B. PAD Layout

SIZE	TO-92	
	(mm)	(inch)
A	0.80	0.031
B	0.70	0.028
C	1.27	0.050



Standard Packaging

Case Type	BULK PACK
	BAG (pcs)
TO-92	1,000