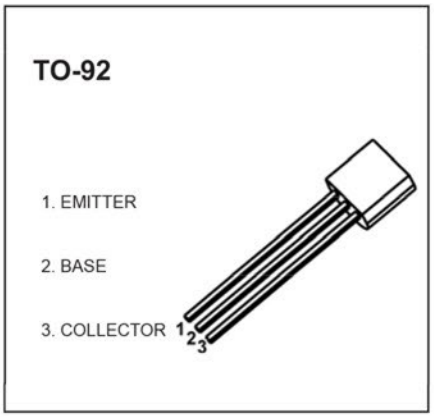
TO-92 Plastic-Encapsulate Transistors

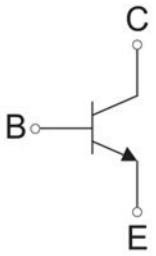
2N3904 TRANSISTOR (NPN)

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



Equivalent Circuit



MAXIMUM RATINGS (T_a=25℃ unless otherwise noted)

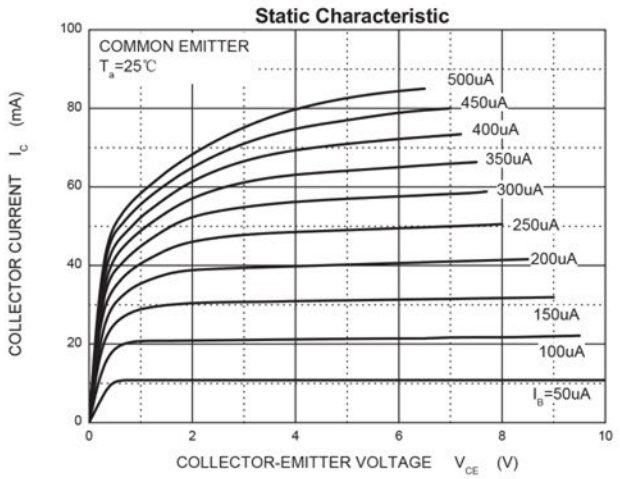
Symbol	Parameter	Value	Unit
V_{CBO}	Collector-Base Voltage	60	V
V_{CEO}	Collector-Emitter Voltage	40	V
V_{EBO}	Emitter-Base Voltage	6	V
I_C	Collector Current -Continuous	0.2	A
P_C	Collector Power Dissipation	0.625	W
T_J,T_{stg}	Operation Junction and Storage Temperature Range	-55-150	℃

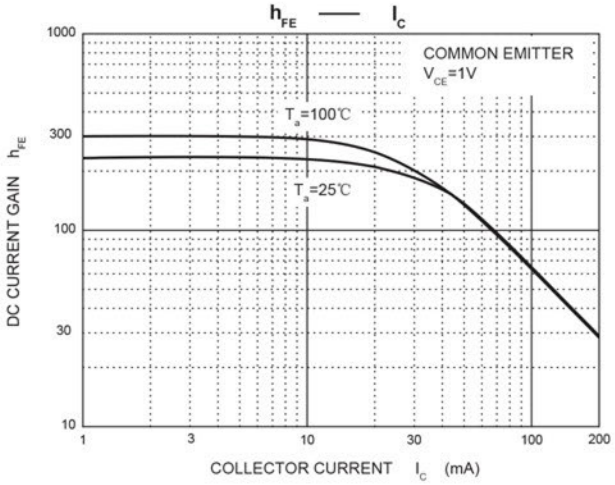
T_a=25℃ unless otherwise specified

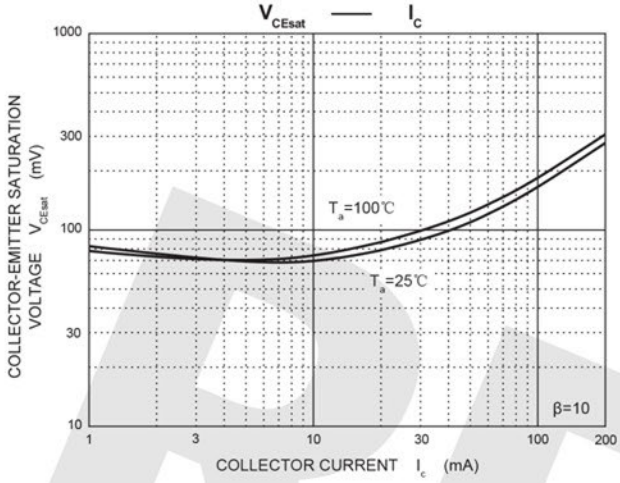
Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
Collector-base breakdown voltage	$V_{(BR)CBO}$	I_C=10mA, I_E=0	60			V
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	I_C= 1mA , I_B=0	40			V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	I_E= 10mA, I_C=0	6			V
Collector cut-off current	I_{CBO}	V_{CB}=60V, I_E=0			0.1	uA
Collector cut-off current	I_{CEX}	V_{CE}=30V, $V_{EB(off)}$=3V			0.05	uA
Emitter cut-off current	I_{EBO}	V_{EB}= 5V, I_C=0			0.1	uA
DC current gain	h_{FE1}	V_{CE}=1V, I_C=10mA	100		400	
	h_{FE2}	V_{CE}=1V, I_C=50mA	60			
	h_{FE3}	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,			35	ns
Rise Time	t_r	I_C=10mA,I_{B1}=1mA			35	ns
Storage Time	t_s	V_{CC}=3V, I_C=10mA			200	ns
Fall Time	t_f	I_{B1}=I_{B2}=1mA			50	ns

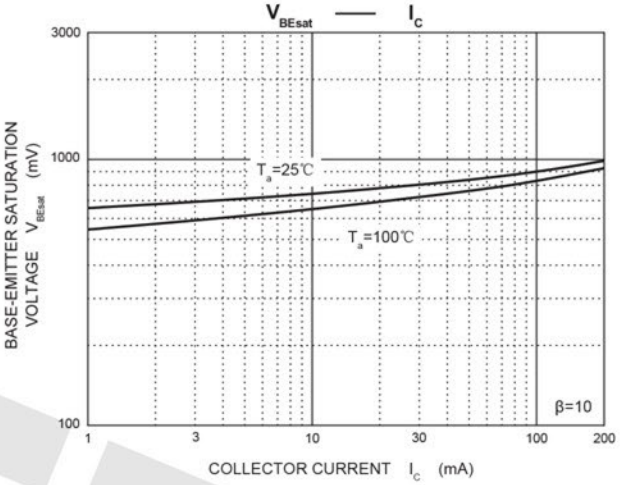
CLASSIFICATION OF h_{FE1}

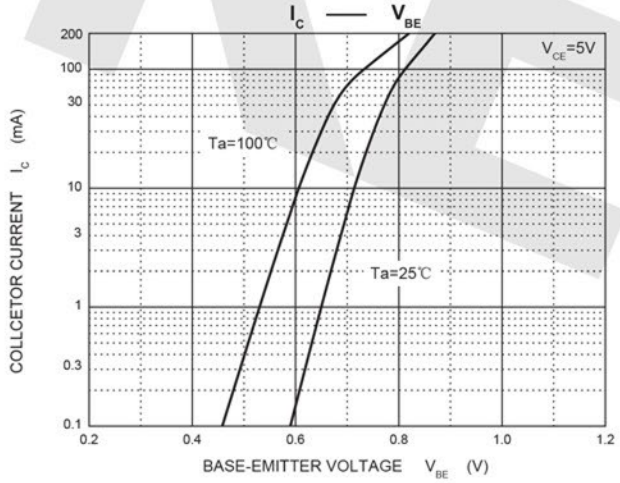
Rank	O	Y	G
Ra nge	100-200	200-300	300-400

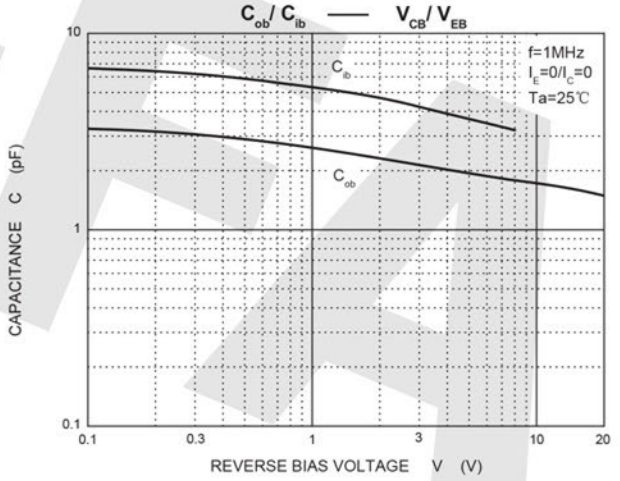

Static Characteristic
COMMON EMITTER
T_a=25℃
500uA
450uA
400uA
350uA
300uA
250uA
200uA
150uA
100uA
I_B=50uA
COLLECTOR CURRENT I_C (mA)
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)

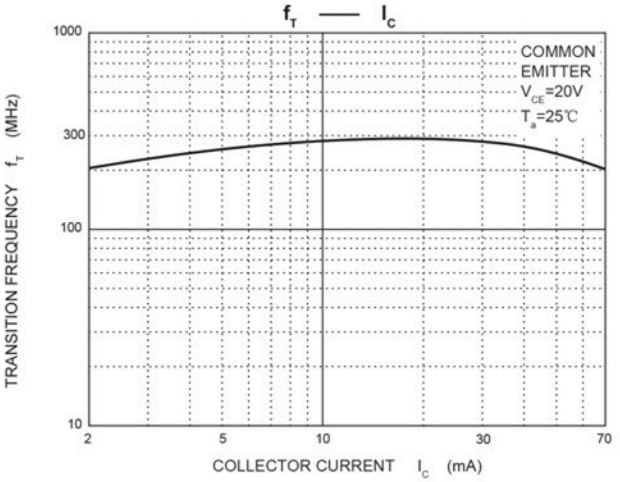

h_{FE} — I_C
COMMON EMITTER
V_{CE}=1V
T_a=100℃
T_a=25℃
DC CURRENT GAIN h_{FE}
COLLECTOR CURRENT I_C (mA)

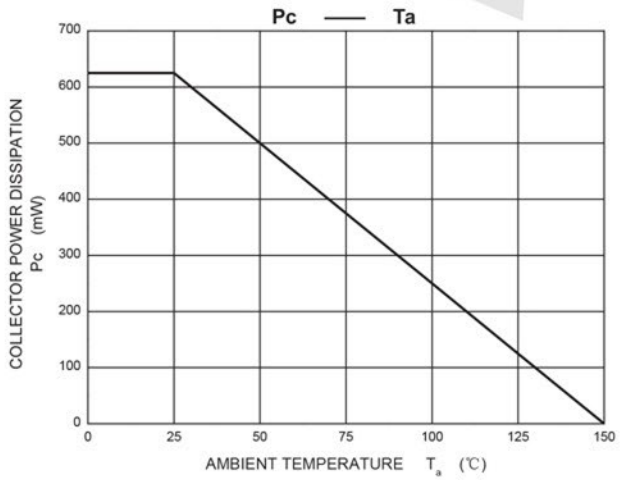

V_{CEsat} — I_C
T_a=100℃
T_a=25℃
β=10
COLLECTOR-EMITTER SATURATION VOLTAGE V_{CEsat} (mV)
COLLECTOR CURRENT I_c (mA)


V_{BEsat} — I_C
T_a=25℃
T_a=100℃
β=10
BASE-EMITTER SATURATION VOLTAGE V_{BEsat} (mV)
COLLECTOR CURRENT I_C (mA)


I_C — V_{BE}
V_{CE}=5V
Ta=100℃
Ta=25℃
COLLCETOR CURRENT I_C (mA)
BASE-EMITTER VOLTAGE V_{BE} (V)


C_{ob}/ C_{ib} — V_{CB}/ V_{EB}
f=1MHz
I_E=0/I_C=0
Ta=25℃
C_{ib}
C_{ob}
CAPACITANCE C (pF)
REVERSE BIAS VOLTAGE V (V)


f_T — I_C
COMMON EMITTER
V_{CE}=20V
T_a=25℃
TRANSITION FREQUENCY f_T (MHz)
COLLECTOR CURRENT I_C (mA)


Pc — Ta
COLLECTOR POWER DISSIPATION Pc (mW)
AMBIENT TEMPERATURE T_a (℃)