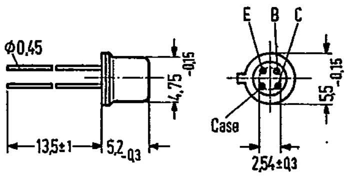
PNP Germanium RF Transistor **AF 139**

for input stages, mixer and oscillator stages up to 860 MHz

AF 139 is a germanium PNP mesa transistor in TO 92 case (18 A 4 DIN 41876). The leads are electrically insulated from the case.

Type	Ordering code
AF 139	Q60106-X139



Approx. weight 0.4 g Dimensions in mm

Maximum ratings

Collector-emitter voltage	$-V_{CEO}$	15	V
Collector-base voltage	$-V_{CBO}$	20	V
Emitter-base voltage	$-V_{EBO}$	0.3	V
Collector current	$-I_C$	10	mA
Emitter current	I_E	11	mA
Base current	$-I_B$	1	mA
Junction temperature	T_j	90	°C
Storage temperature range	T_{stg}	−30 to +75	°C
Total power dissipation (T_{amb} = 45°C)	P_{tot}	60	mW

Thermal resistance

Junction to ambient air	R_{thJA}	≤750	K/W
Junction to case	R_{thJC}	≤400	K/W

Static characteristics (T_{amb} = 25 °C)

$-V_{CE}$ V	$-I_C$ mA	$-I_B$ µA	h_{FE} I_C/I_B	$-V_{BE}$ mV
12	1.5	30	50 (>10)	380 (320 to 430)
6	2	36	55	380 (320 to 430)
6	5	66	75	405 (360 to 450)

Collector cutoff current ($-V_{CBO}$ = 20 V)	$-I_{CBO}$	0.5 (<8)	µA
Emitter cutoff current ($-V_{EBO}$ = 0.3 V)	$-I_{EBO}$	2 (<100)	µA
Collector cutoff current ($-V_{CEO}$ = 15 V)	$-I_{CEO}$	<500	µA

Dynamic characteristics (T_{amb} = 25 °C)

Operating point: $-I_C$ = 1.5 mA; $-V_{CE}$ = 12 V.			
Transition frequency (f = 100 MHz)	f_T	550	MHz
Feedback time constant (f = 2.5 MHz)	$r_{bb'} \cdot C_{b'c}$	3	ps
Max. frequency of oscillation $f_{max} = \sqrt{\frac{f_T}{8\pi \cdot r_{bb'} \cdot C_{b'c}}}$	f_{max}	2.7	GHz
Reverse transfer capacitance (f = 450 kHz)	$-C_{12e}$	0.25	pF
Power gain (f = 800 MHz; R_L = 1.4 kΩ)	G_{pb} 1)	11 (>9)	dB
Power gain (f = 900 MHz)	G_{pb}	9 (>6.5)	dB
Feedback damping (f = 800 MHz)	$-G_{pbinv}$ 1)	23	dB
Noise figure (f = 800 MHz; R_g = 60 Ω)	NF 1)	7 (<8.2)	dB
Noise figure (f = 900 MHz; R_L = 0.5 kΩ; $-V_{CE}$ = 10 V; I_E = 2 mA)	NF	7.5 (≤9)	dB

Four-pole characteristics:

$-I_C$ = 1,5 mA; $-V_{CE}$ = 12 V; f = 200 MHz

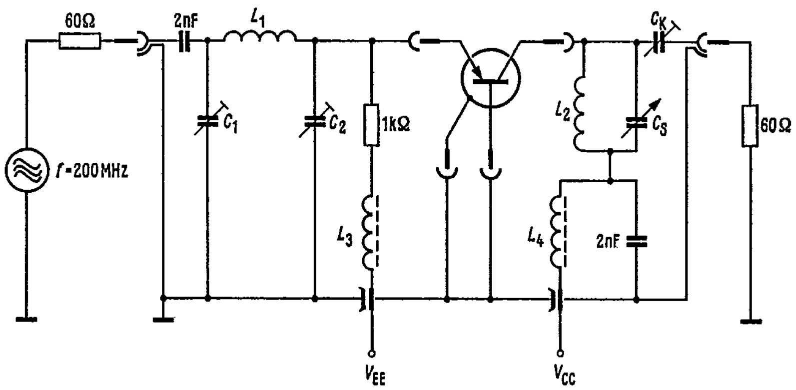
g_{11b} = 28 mS	$-g_{12b}$ = 0,06 mS	$-g_{21b}$ = 22 mS	g_{22b} = 0,09 mS
$-b_{11b}$ = 24 mS	$-b_{12b}$ = 0,16 mS	b_{21b} = 30 mS	b_{22b} = 1,9 mS

$-I_C$ = 1,5 mA; $-V_{CE}$ = 12 V; f = 800 MHz

g_{11b} = 7 mS	y_{12b} = 0,4 mS	$\lvert y_{21b}\rvert$ = 14 mS	g_{22b} = 0,5 mS
$-b_{11b}$ = 11 mS	φ_{12b} = −120°	φ_{21b} = 35°	b_{22b} = 7,5 mS

1) measured in circuit shown on page 106

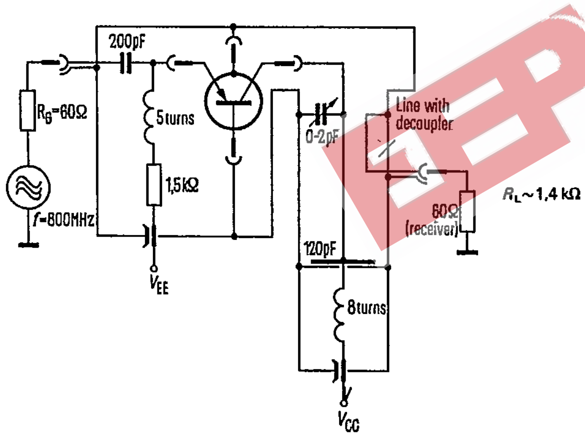
Test circuit for power gain and noise figure at f = 200 MHz



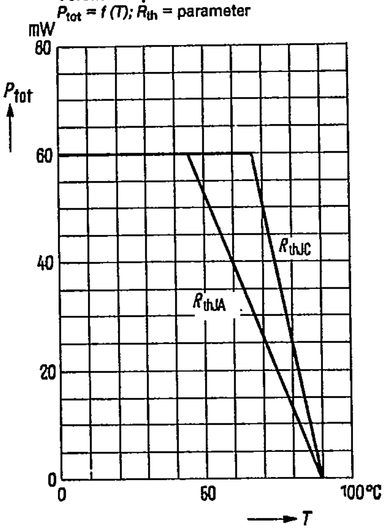
L_1 = 3 turns; d = 1 mm; dia = 6.5 mm
L_2 = 2 turns; d = 1 mm; dia = 6.5 mm
L_3 = L_4 = 20 turns 0.5 CuLs
on core B63310-K1-A12.3

C_K = 1.5 to 5 pF so that R_L = 920 Ω
C_1 = 6.5 to 18 pF
C_2 = 9.5 to 20 pF
C_s = 3 to 10 pF

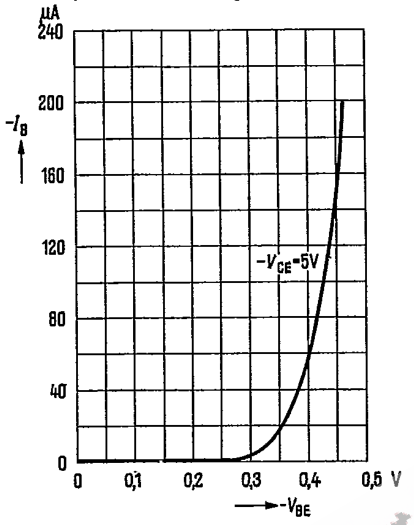
Test circuit for power gain and noise figure at f = 800 MHz



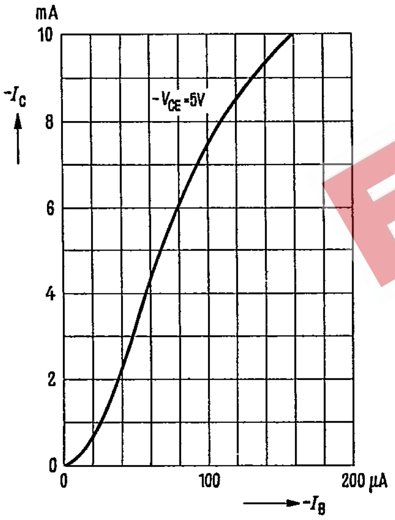
Total perm. power dissipation versus temperature
$P_{tot} = f(T)$; R_{th} = parameter



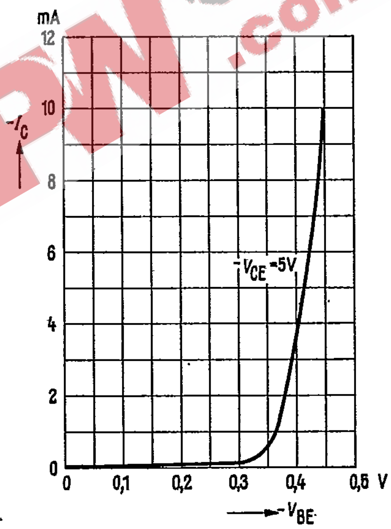
Input characteristic $I_B = f(V_{BE})$;
$-V_{CE} = 5$ V
(common emitter configuration)



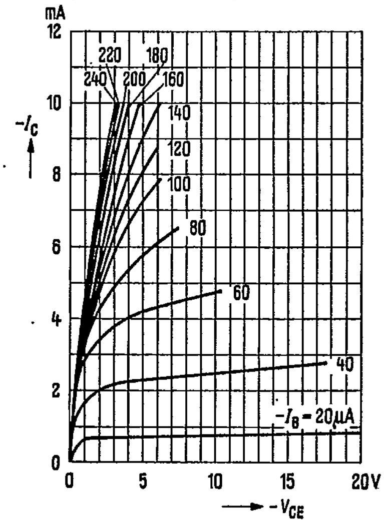
Collector current $I_C = f(I_B)$;
$-V_{CE} = 5$ V
(common emitter configuration)



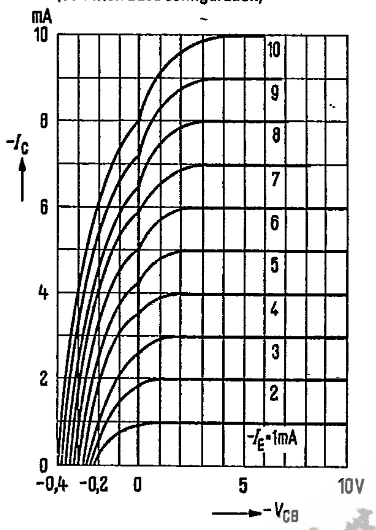
Collector current $I_C = f(V_{BE})$;
$-V_{CE} = 5$ V
(common emitter configuration)



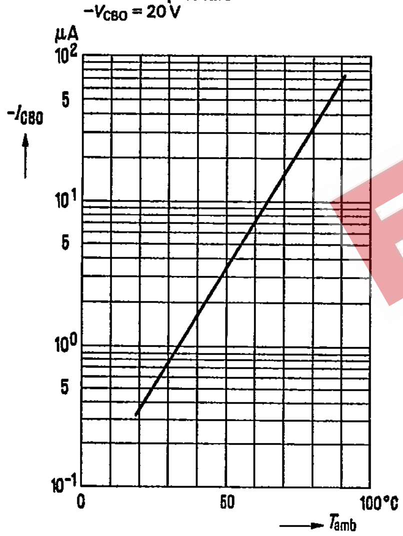
Output characteristics $I_C = f(V_{CE})$;
I_B = parameter
(common emitter configuration)



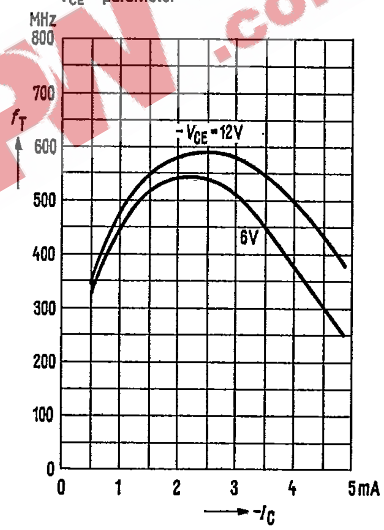
Output characteristics $I_C = f(V_{CB})$;
I_E = parameter
(common base configuration)



Collector cutoff current $I_{CBO} = f(T_{amb})$;
versus temperature
$-V_{CBO} = 20$ V

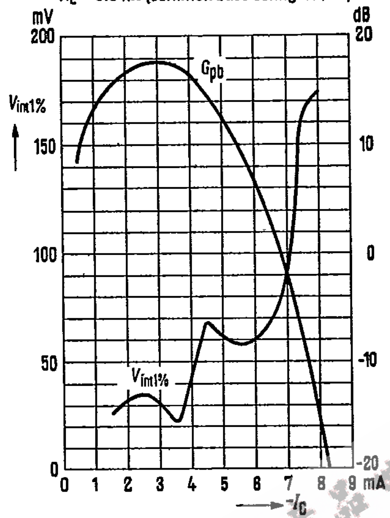


Transition frequency $f_T = f(I_C)$;
V_{CE} = parameter

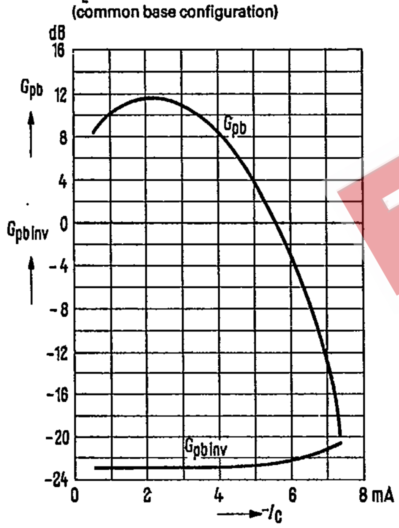


1) V_{int} 1% is the rms value of half the EMF (terminal voltage under matching condition) of a 100% sine wave modulated TV-carrier at a generator impedance of 240 Ω which causes a 1% amplitude modulation on the signal carrier.

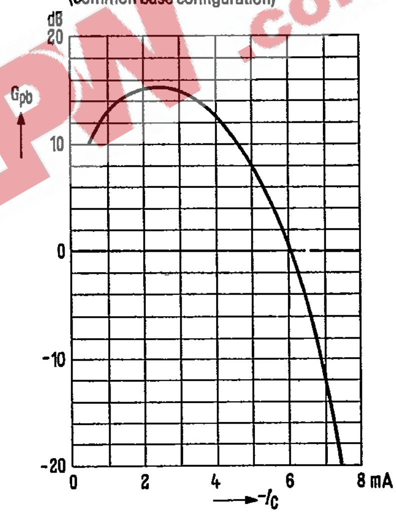
Interference voltage V_{int} 1%[1] = $f(I_C)$
Power gain $G_{pb} = f(I_C)$
f = 200 MHz; $-V_{batt}$ = 12 V; R_V = 1 kΩ;
R_L = 0.9 kΩ (common base configuration)



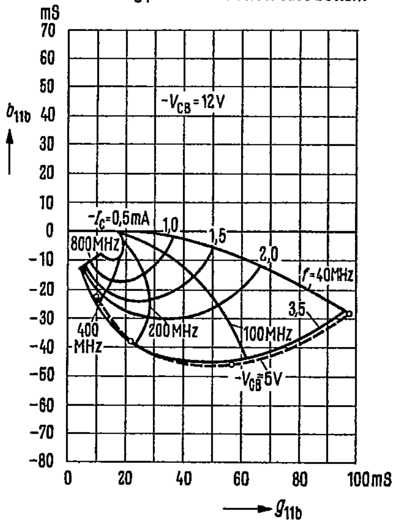
Power gain $G_{pb} = f(I_C)$
f = 800 MHz; $-V_{batt}$ = 12 V; R_V = 1 kΩ
R_L = 1.4 kΩ
(common base configuration)



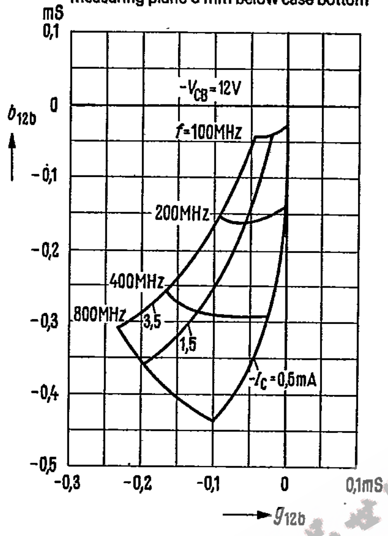
Power gain $G_{pb} = f(I_C)$
f = 500 MHz; $-V_{batt}$ = 12 V; R_V = 1 kΩ
R_L = 1.4 kΩ
(common base configuration)



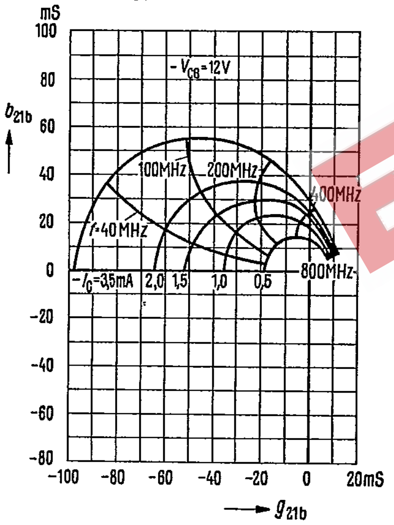
Small signal short circuit input admittance y_{11b}; $-V_{CB}$ = 12 V (common base configuration) measuring plane 5 mm below case bottom



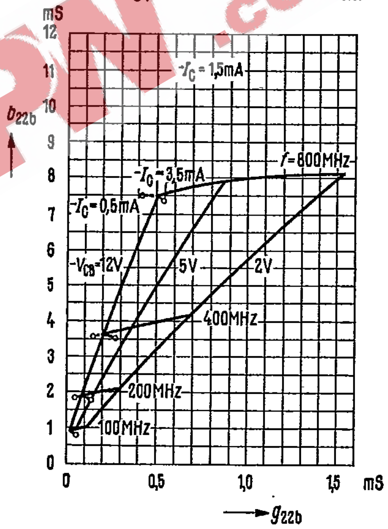
Small signal circuit reverse transfer admittance y_{12b}; $-V_{CB}$ = 12 V (common base configuration) measuring plane 5 mm below case bottom



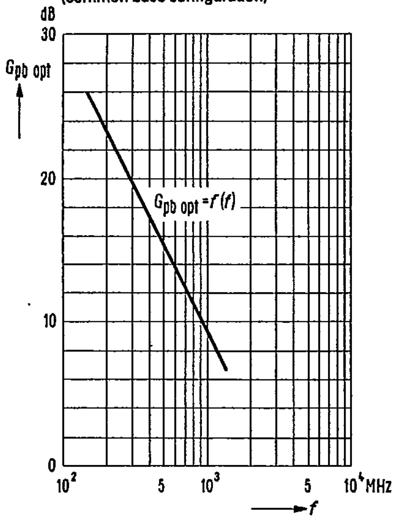
Small signal short circuit forward transfer admittance y_{21b}; $-V_{CB}$ = 12 V (common base configuration) measuring plane 5 mm below case bottom



Small signal short circuit output admittance y_{22}; I_E = 1.5 mA (common emitter, base configuration) measuring plane 5 mm below case bottom



Power gain versus frequency
$G_{pbopt} = f(f)$; $-I_C = 1.5$ mA; $-V_{CE} = 12$ V
(common base configuration)



Noise figure versus frequency $NF = f(f)$
$-V_{CE} = 12$ V
$-I_C = 1.5$ mA; $R_g = 60\ \Omega$