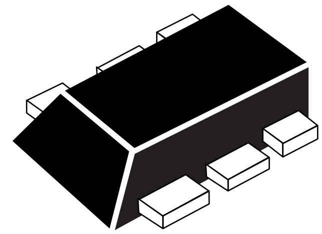
NEC

NPN SILICON HIGH FREQUENCY TRANSISTOR

NE662M16

FEATURES

- **HIGH GAIN BANDWIDTH:** f_T = 25 GHz
- **LOW NOISE FIGURE:** NF = 1.1 dB at 2 GHz
- **HIGH MAXIMUM STABLE GAIN:** 20 dB at f = 2 GHz
- **NEW LOW PROFILE M16 PACKAGE:**
  • Flat Lead Style with a height of just 0.50mm



M16

DESCRIPTION

The NE662M16 is fabricated using NEC's UHS0 25 GHz f_T wafer process. With a typical transition frequency of 25 GHz the NE662M16 is usable in applications from 100 MHz to over 10 GHz. The NE662M16 provides excellent low voltage/low current performance.

NEC's new low profile/flat lead style "M16" package is ideal for today's portable wireless applications. The NE662M16 is an ideal choice for LNA and oscillator requirements in all mobile communication systems.

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

		PART NUMBER EIAJ[1] REGISTERED NUMBER PACKAGE OUTLINE	NE662M16 2SC5704 M16			
SYMBOLS		PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
DC	I_{CBO}	Collector Cutoff Current at V_{CB} = 5V, I_E = 0	nA			200
	I_{EBO}	Emitter Cutoff Current at V_{EB} = 1 V, I_C = 0	nA			200
	h_{FE}	Forward Current Gain[2] at V_{CE} = 2 V, I_C = 5 mA		50	70	100
RF	f_T	Gain Bandwidth at V_{CE} = 3 V, I_C = 30 mA, f = 2 GHz	GHz	20	25	
	MSG	Maximum Stable Gain[4] at V_{CE} = 2 V, I_C = 20 mA, f = 2 GHz	dB		20	
	$\|S_{21E}\|^2$	Insertion Power Gain at V_{CE} = 2 V, I_C = 20 mA, f = 2 GHz	dB	14	17	
	NF	Noise Figure at V_{CE} = 2 V, I_C = 5 mA, f = 2 GHz, $Z_{IN} = Z_{OPT}$	dB		1.1	1.5
	P_{1dB}	Output Power at 1 dB compression point at V_{CE} = 2 V, I_C = 20 mA, f = 2 GHz	dBm		11	
	IP_3	Third Order Intercept Point at V_{CE} = 2 V, I_C = 20 mA, f = 2 GHz			22	
	Cre	Feedback Capacitance[3] at V_{CB} = 2 V, I_C = 0, f = 1 MHz	pF		0.14	0.24

Notes:
1. Electronic Industrial Association of Japan.
2. Pulsed measurement, pulse width ≤ 350 μs, duty cycle ≤ 2 %.
3. Capacitance is measured by capacitance meter (automatic balance bridge method) when emitter pin is connected to the guard pin.
4. $MSG = \left|\frac{S_{21}}{S_{12}}\right|$

ABSOLUTE MAXIMUM RATINGS[1] (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{CBO}	Collector to Base Voltage	V	15
V_{CEO}	Collector to Emitter Voltage	V	3.3
V_{EBO}	Emitter to Base Voltage	V	1.5
I_C	Collector Current	mA	35
P_T	Total Power Dissipation	mW	115
T_J	Junction Temperature	°C	150
T_{STG}	Storage Temperature	°C	-65 to +150

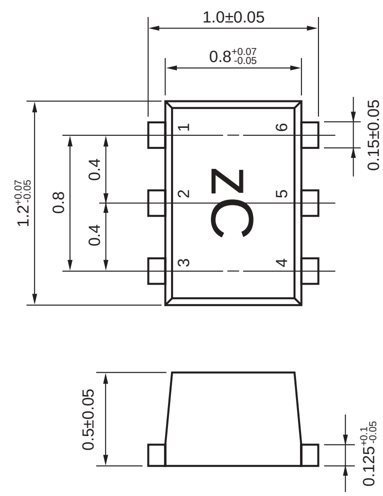
Note:
1. Operation in excess of any one of these parameters may result in permanent damage.

ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKAGING
NE662M16-T3	10 kpcs/reel	Pin 1 (Collector), Pin 6 (Emitter) face the perforation side on the tape.

OUTLINE DIMENSIONS (Units in mm)

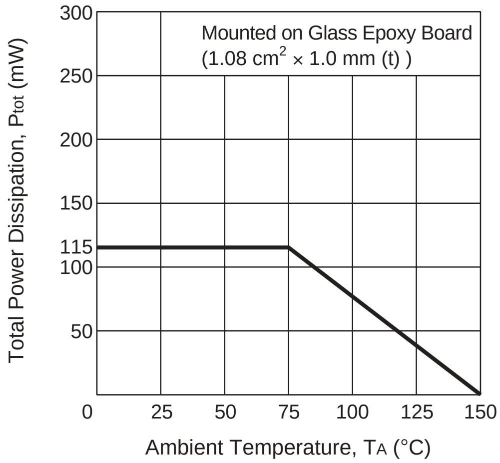
PACKAGE OUTLINE M16



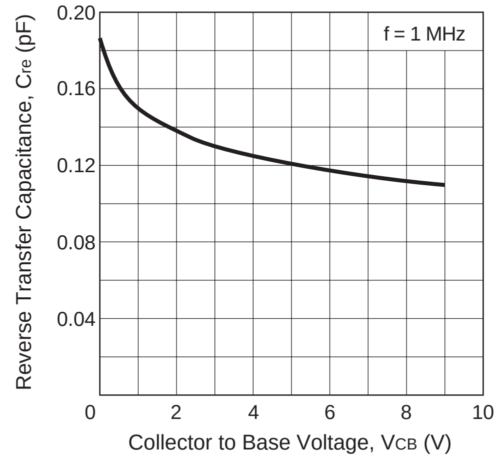
PIN CONNECTIONS
1. Collector
2. Emitter
3. Emitter
4. Base
5. Emitter
6. Emitter

TYPICAL PERFORMANCE CURVES (T_A = 25°C)

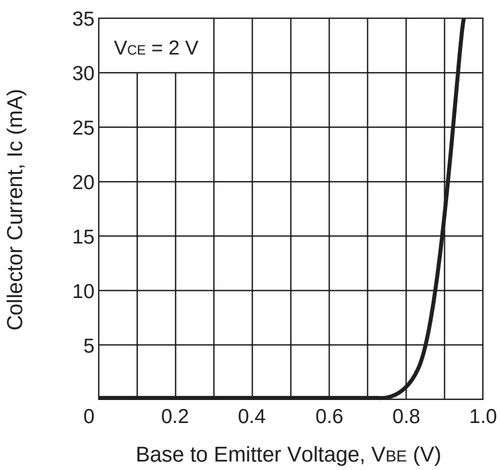
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



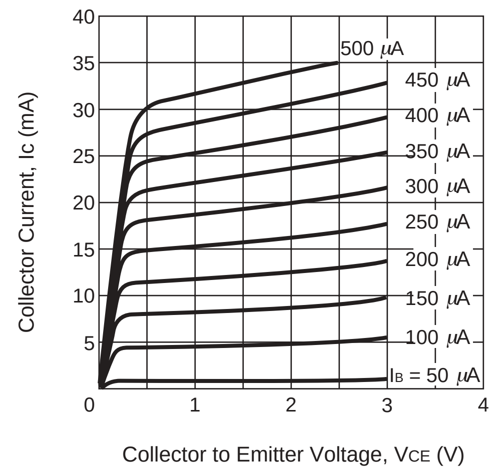
REVERSE TRANSFER CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE



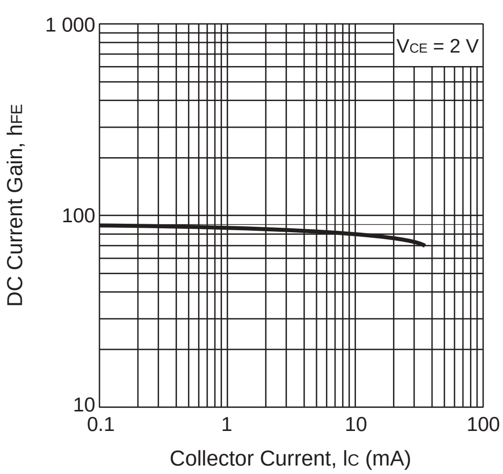
COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



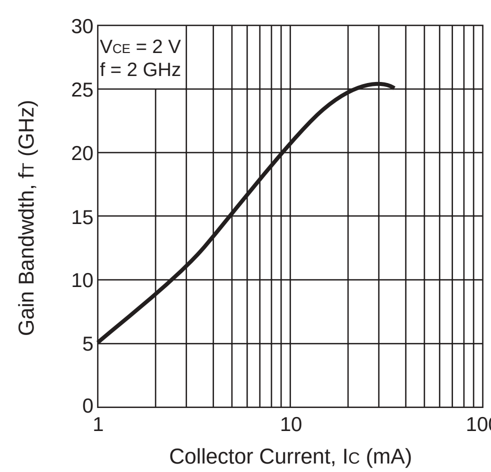
COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



DC CURRENT GAIN vs. COLLECTOR CURRENT

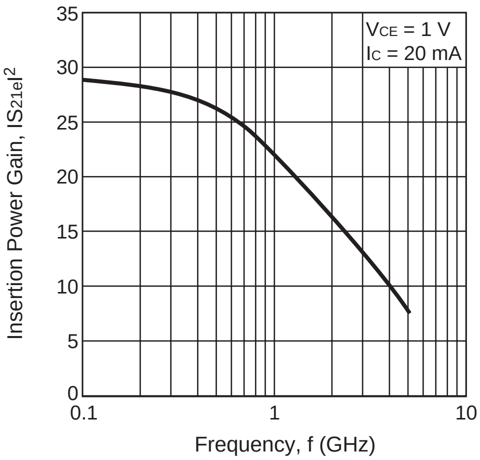


GAIN BANDWIDTH vs. COLLECTOR CURRENT

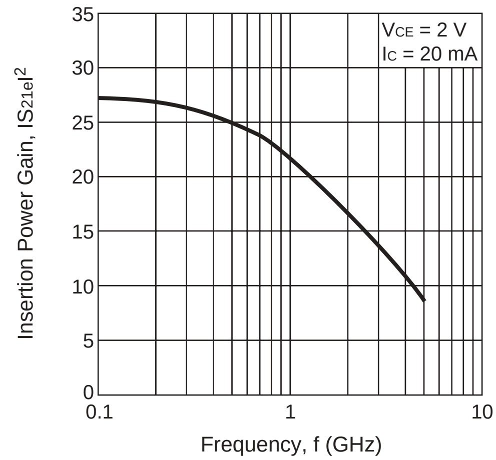


TYPICAL PERFORMANCE CURVES (T_A = 25°C)

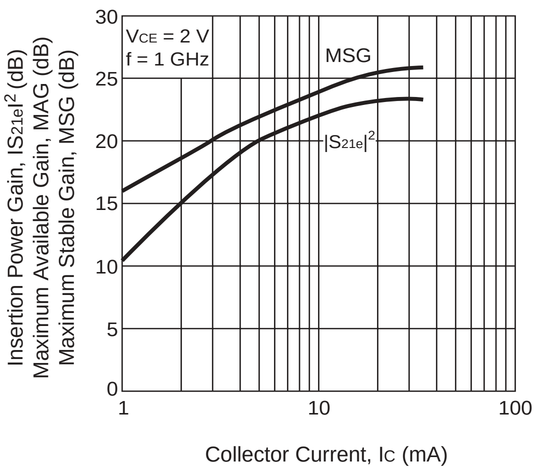
INSERTION POWER GAIN vs. FREQUENCY



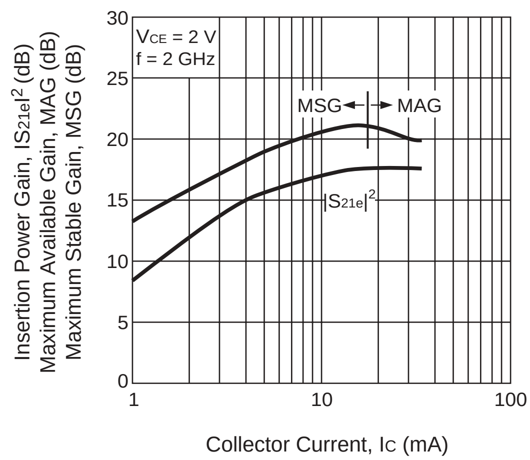
INSERTION POWER GAIN vs. FREQUENCY



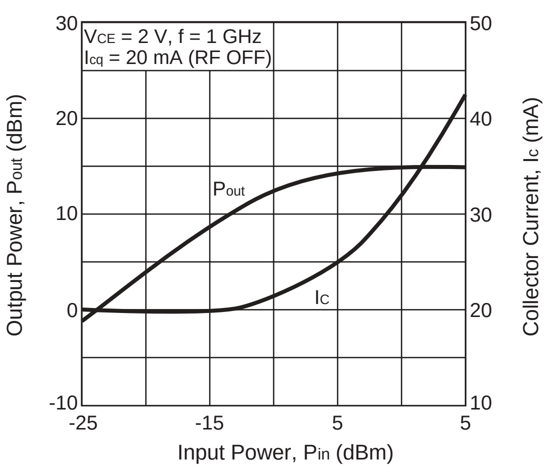
INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



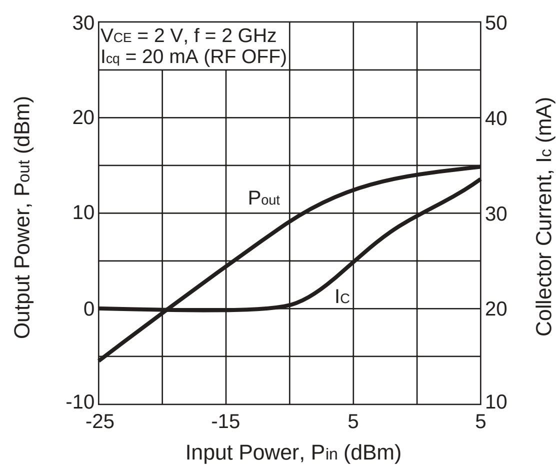
INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT



OUTPUT POWER, COLLECTOR CURRENT vs. INPUT POWER

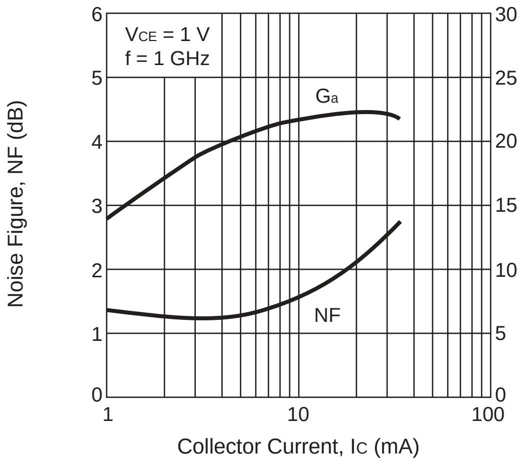


OUTPUT POWER, COLLECTOR CURRENT vs. INPUT POWER

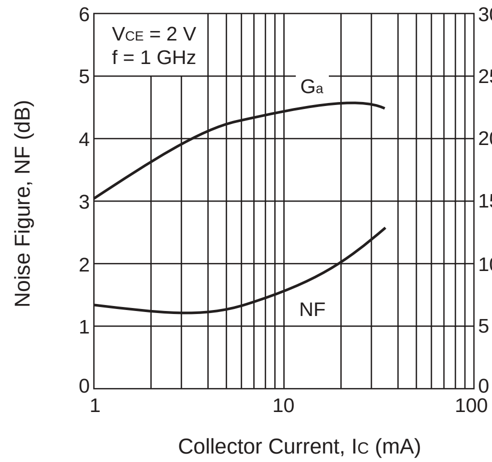


TYPICAL PERFORMANCE CURVES (TA = 25°C)

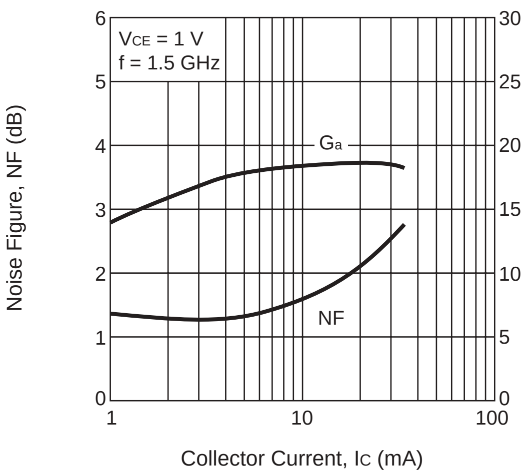
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



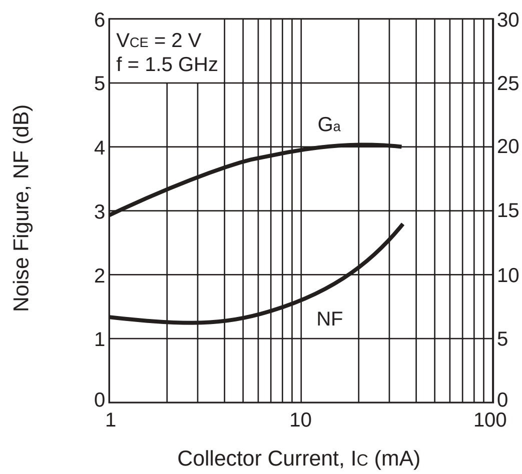
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



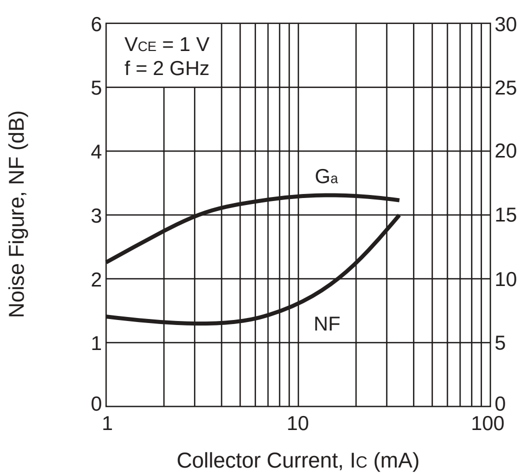
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



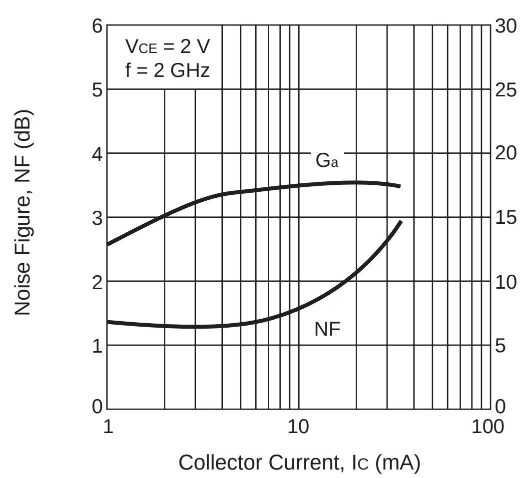
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



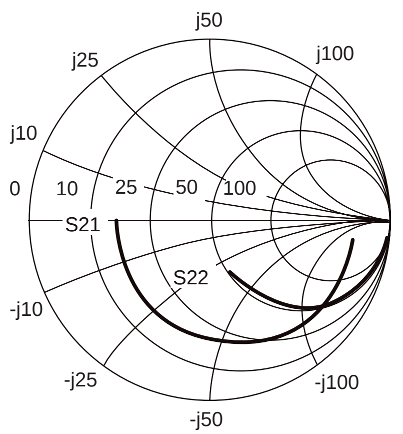
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

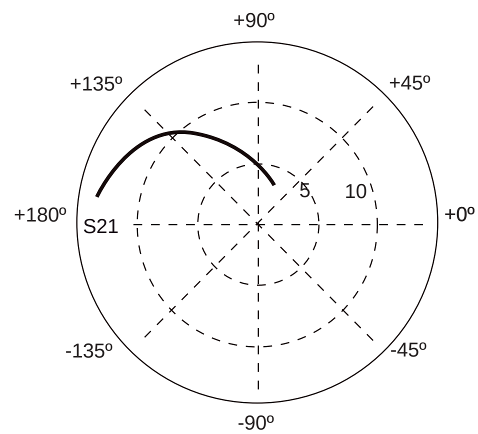


NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



TYPICAL SCATTERING PARAMETERS (T_A = 25°C)





NE662M16
V_C = 2 V, I_C = 5 mA

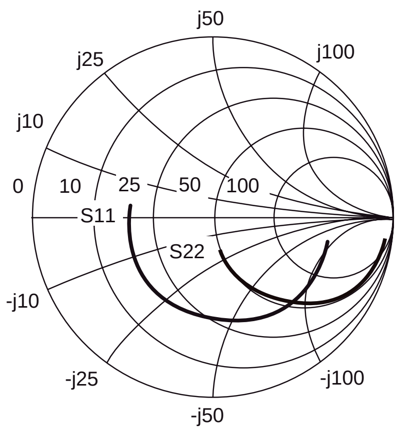
FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K	MAG[1]
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.100	0.79	-8.34	13.52	171.32	0.01	84.69	0.98	-5.81	0.13	32.18
0.200	0.79	-20.52	13.20	165.06	0.02	78.92	0.96	-11.66	0.09	29.17
0.300	0.78	-30.77	12.77	158.29	0.02	73.38	0.93	-16.99	0.11	27.36
0.400	0.76	-39.87	12.28	152.12	0.03	68.92	0.90	-21.91	0.14	26.09
0.500	0.74	-48.66	11.75	146.29	0.04	64.34	0.87	-26.38	0.17	25.11
0.600	0.73	-56.79	11.15	140.96	0.04	60.23	0.83	-30.37	0.20	24.28
0.700	0.71	-64.12	10.59	136.12	0.05	56.71	0.79	-33.94	0.24	23.60
0.800	0.69	-71.30	10.02	131.99	0.05	53.36	0.76	-37.10	0.26	22.99
0.900	0.68	-77.50	9.48	128.20	0.05	50.48	0.72	-39.91	0.29	22.47
1.000	0.66	-83.36	8.98	124.77	0.06	47.89	0.69	-42.40	0.32	21.99
1.100	0.65	-88.67	8.55	121.61	0.06	45.67	0.66	-44.60	0.35	21.59
1.200	0.64	-93.70	8.15	118.55	0.06	43.73	0.64	-46.56	0.38	21.22
1.300	0.64	-98.23	7.79	115.75	0.06	42.02	0.61	-48.38	0.40	20.88
1.400	0.63	-102.48	7.45	113.15	0.07	40.50	0.59	-49.89	0.43	20.57
1.500	0.62	-106.53	7.14	110.70	0.07	39.06	0.57	-51.38	0.46	20.28
1.600	0.61	-110.24	6.82	108.22	0.07	37.77	0.55	-52.58	0.49	19.99
1.700	0.60	-113.97	6.57	105.79	0.07	36.69	0.53	-53.71	0.52	19.74
1.800	0.60	-117.60	6.36	103.81	0.07	35.72	0.51	-54.81	0.55	19.54
1.900	0.59	-120.80	6.11	102.01	0.07	34.87	0.50	-55.74	0.58	19.31
2.000	0.58	-124.09	5.86	99.85	0.07	34.09	0.48	-56.51	0.61	19.06
2.100	0.58	-127.67	5.69	97.73	0.07	33.33	0.47	-57.44	0.64	18.89
2.200	0.57	-130.76	5.51	95.62	0.07	32.59	0.46	-57.89	0.66	18.68
2.300	0.57	-133.98	5.37	94.20	0.08	32.26	0.44	-58.61	0.68	18.53
2.400	0.56	-136.85	5.16	92.25	0.08	31.81	0.43	-59.18	0.71	18.31
2.500	0.56	-139.86	5.03	90.06	0.08	31.21	0.42	-59.83	0.74	18.17
2.600	0.55	-142.72	4.88	88.26	0.08	30.84	0.41	-60.32	0.77	17.98
2.700	0.55	-145.66	4.75	86.62	0.08	30.55	0.40	-60.89	0.80	17.83
2.800	0.54	-148.25	4.58	84.94	0.08	30.18	0.39	-61.28	0.83	17.63
2.900	0.54	-151.04	4.46	82.99	0.08	30.00	0.38	-61.71	0.87	17.50
3.000	0.53	-153.76	4.35	81.42	0.08	29.61	0.37	-62.28	0.90	17.34
3.100	0.52	-156.67	4.21	79.85	0.08	29.45	0.36	-62.64	0.93	17.17
3.200	0.52	-159.41	4.09	78.16	0.08	29.21	0.36	-63.08	0.96	17.02
3.300	0.52	-162.03	4.00	76.53	0.08	28.97	0.35	-63.54	0.99	16.88
3.400	0.52	-164.80	3.89	75.17	0.08	28.78	0.34	-64.05	1.02	15.94
3.500	0.51	-167.55	3.78	73.64	0.08	28.67	0.33	-64.59	1.05	15.28
3.600	0.51	-170.15	3.68	71.91	0.08	28.50	0.32	-65.11	1.07	14.77
3.700	0.51	-172.65	3.61	70.42	0.08	28.28	0.32	-65.78	1.09	14.44
3.800	0.51	-174.91	3.51	69.29	0.08	28.15	0.31	-66.41	1.12	14.02
3.900	0.51	-177.27	3.40	67.93	0.09	28.08	0.30	-67.07	1.16	13.59
4.000	0.51	-179.59	3.31	66.28	0.09	27.96	0.29	-67.74	1.19	13.22

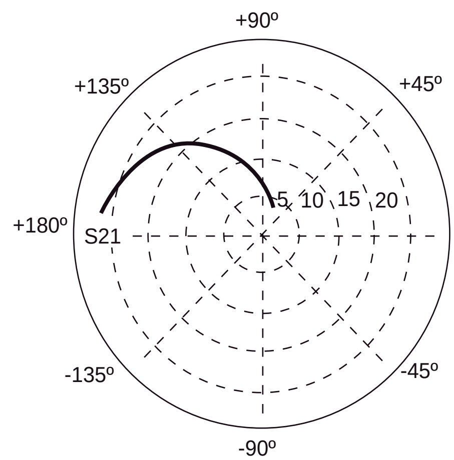
Note:
1. Gain Calculations:

MAG = $\frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When K ≤ 1, MAG is undefined and MSG values are used. MSG = $\frac{|S_{21}|}{|S_{12}|}$, K = $\frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\ |S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

TYPICAL SCATTERING PARAMETERS ($T_A = 25°C$)





NE662M16
V_C = 2 V, I_C = 10 mA

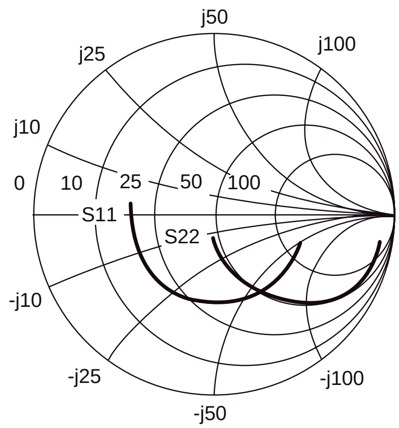
FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K	MAG[1]
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.100	0.66	-12.81	21.08	170.08	0.01	81.45	0.96	-7.79	0.19	34.48
0.200	0.66	-28.48	20.34	161.46	0.01	76.90	0.94	-15.60	0.13	31.43
0.300	0.65	-41.93	19.32	153.18	0.02	70.56	0.90	-22.67	0.16	29.60
0.400	0.63	-53.87	18.18	145.93	0.03	65.20	0.85	-28.92	0.20	28.32
0.500	0.61	-64.70	16.97	139.38	0.03	60.63	0.80	-34.46	0.24	27.29
0.600	0.60	-74.41	15.75	133.63	0.04	56.67	0.75	-39.19	0.28	26.47
0.700	0.58	-82.86	14.65	128.64	0.04	53.54	0.70	-43.27	0.33	25.76
0.800	0.57	-90.61	13.62	124.38	0.04	50.71	0.66	-46.77	0.37	25.14
0.900	0.56	-97.18	12.70	120.59	0.04	48.39	0.62	-49.77	0.41	24.59
1.000	0.55	-103.22	11.88	117.23	0.05	46.60	0.58	-52.36	0.45	24.11
1.100	0.55	-108.53	11.17	114.18	0.05	45.17	0.55	-54.59	0.49	23.68
1.200	0.54	-113.37	10.51	111.31	0.05	43.92	0.52	-56.54	0.52	23.28
1.300	0.54	-117.69	9.95	108.65	0.05	42.92	0.50	-58.27	0.56	22.91
1.400	0.53	-121.63	9.43	106.24	0.05	42.14	0.47	-59.73	0.59	22.57
1.500	0.53	-125.35	8.96	103.96	0.05	41.39	0.45	-61.06	0.63	22.24
1.600	0.52	-128.85	8.50	101.70	0.05	40.83	0.43	-62.21	0.66	21.92
1.700	0.52	-132.25	8.13	99.47	0.06	40.51	0.42	-63.19	0.70	21.65
1.800	0.52	-135.50	7.82	97.63	0.06	40.23	0.40	-64.16	0.73	21.39
1.900	0.51	-138.46	7.48	96.05	0.06	39.88	0.38	-64.99	0.76	21.12
2.000	0.51	-141.58	7.14	94.06	0.06	39.77	0.37	-65.63	0.80	20.83
2.100	0.51	-144.72	6.89	92.12	0.06	39.58	0.36	-66.43	0.82	20.62
2.200	0.50	-147.54	6.66	90.21	0.06	39.38	0.35	-66.83	0.84	20.38
2.300	0.50	-150.41	6.44	88.94	0.06	39.49	0.34	-67.39	0.87	20.17
2.400	0.50	-153.04	6.17	87.15	0.06	39.53	0.33	-67.86	0.90	19.91
2.500	0.50	-155.65	5.98	85.19	0.06	39.40	0.32	-68.39	0.93	19.72
2.600	0.49	-158.30	5.80	83.57	0.07	39.29	0.31	-68.81	0.95	19.50
2.700	0.49	-160.91	5.61	82.16	0.07	39.33	0.30	-69.31	0.98	19.29
2.800	0.49	-163.29	5.40	80.62	0.07	39.31	0.29	-69.61	1.01	18.53
2.900	0.48	-165.82	5.24	78.93	0.07	39.52	0.28	-70.04	1.04	17.69
3.000	0.48	-168.40	5.09	77.50	0.07	39.41	0.27	-70.48	1.06	17.14
3.100	0.47	-171.02	4.93	76.12	0.07	39.56	0.27	-70.87	1.09	16.67
3.200	0.47	-173.52	4.78	74.60	0.07	39.47	0.26	-71.30	1.11	16.22
3.300	0.47	-175.90	4.66	73.12	0.07	39.46	0.25	-71.76	1.13	15.88
3.400	0.47	-178.39	4.53	71.93	0.07	39.49	0.24	-72.30	1.15	15.52
3.500	0.47	179.16	4.39	70.55	0.07	39.50	0.24	-72.89	1.17	15.17
3.600	0.47	176.86	4.27	69.00	0.08	39.45	0.23	-73.50	1.19	14.85
3.700	0.47	174.73	4.18	67.66	0.08	39.36	0.22	-74.30	1.21	14.60
3.800	0.47	172.77	4.06	66.70	0.08	39.24	0.22	-75.12	1.23	14.28
3.900	0.47	170.80	3.93	65.49	0.08	39.22	0.21	-75.94	1.25	13.93
4.000	0.47	168.82	3.83	63.99	0.08	39.15	0.20	-76.91	1.27	13.64

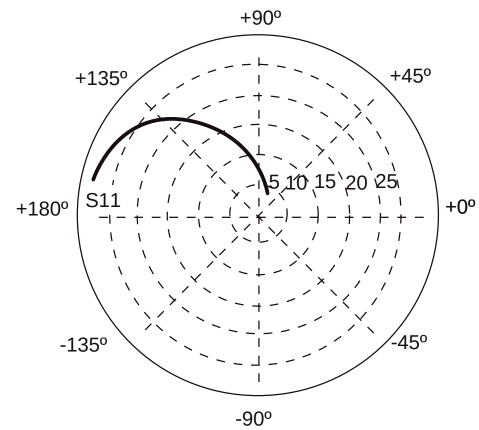
Note:
1. Gain Calculations:

$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When $K \leq 1$, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)





NE662M16
V_C = 2 V, I_C = 20 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K	MAG[1]
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.100	0.51	-19.24	28.64	168.38	0.01	79.10	0.94	-9.68	0.26	36.13
0.200	0.51	-39.58	27.18	157.71	0.01	74.03	0.90	-19.55	0.20	33.13
0.300	0.51	-56.67	25.27	148.17	0.02	67.79	0.85	-28.23	0.23	31.27
0.400	0.51	-71.47	23.19	140.08	0.02	62.44	0.79	-35.68	0.28	29.98
0.500	0.50	-83.85	21.13	133.18	0.03	58.17	0.72	-41.91	0.33	28.93
0.600	0.50	-94.44	19.22	127.33	0.03	54.93	0.66	-47.08	0.39	28.06
0.700	0.49	-103.20	17.57	122.40	0.03	52.50	0.61	-51.40	0.44	27.33
0.800	0.49	-110.77	16.11	118.27	0.03	50.56	0.56	-55.03	0.49	26.69
0.900	0.49	-117.07	14.85	114.65	0.04	49.13	0.52	-58.07	0.54	26.11
1.000	0.49	-122.58	13.76	111.47	0.04	48.10	0.49	-60.66	0.59	25.60
1.100	0.48	-127.34	12.83	108.63	0.04	47.35	0.46	-62.85	0.64	25.12
1.200	0.48	-131.56	11.98	105.97	0.04	46.96	0.43	-64.73	0.68	24.67
1.300	0.48	-135.30	11.27	103.49	0.04	46.65	0.41	-66.43	0.72	24.27
1.400	0.48	-138.62	10.62	101.28	0.04	46.44	0.39	-67.82	0.75	23.88
1.500	0.48	-141.83	10.04	99.19	0.04	46.48	0.37	-69.05	0.79	23.50
1.600	0.48	-144.87	9.49	97.12	0.05	46.28	0.35	-70.13	0.83	23.14
1.700	0.48	-147.80	9.04	95.06	0.05	46.44	0.33	-71.09	0.86	22.81
1.800	0.47	-150.55	8.66	93.37	0.05	46.55	0.32	-71.97	0.89	22.51
1.900	0.47	-153.08	8.25	91.95	0.05	46.81	0.31	-72.73	0.92	22.19
2.000	0.47	-155.81	7.86	90.10	0.05	46.88	0.29	-73.33	0.95	21.87
2.100	0.47	-158.52	7.56	88.29	0.05	46.96	0.28	-74.04	0.97	21.60
2.200	0.47	-161.02	7.29	86.54	0.05	47.15	0.27	-74.48	0.99	21.33
2.300	0.47	-163.41	7.03	85.38	0.05	47.44	0.26	-74.96	1.01	20.46
2.400	0.47	-165.69	6.72	83.75	0.06	47.56	0.26	-75.41	1.04	19.60
2.500	0.47	-167.97	6.50	81.93	0.06	47.55	0.25	-75.93	1.06	19.05
2.600	0.46	-170.37	6.29	80.42	0.06	47.65	0.24	-76.35	1.07	18.61
2.700	0.46	-172.58	6.07	79.19	0.06	47.79	0.23	-76.85	1.09	18.15
2.800	0.46	-174.73	5.84	77.76	0.06	47.81	0.22	-77.18	1.12	17.64
2.900	0.46	-177.01	5.65	76.22	0.06	47.96	0.21	-77.67	1.14	17.23
3.000	0.45	-179.36	5.49	74.88	0.06	47.89	0.21	-78.08	1.16	16.88
3.100	0.45	178.28	5.31	73.63	0.07	48.00	0.20	-78.62	1.17	16.51
3.200	0.45	176.08	5.14	72.22	0.07	47.97	0.19	-79.11	1.19	16.16
3.300	0.45	173.87	5.00	70.83	0.07	47.81	0.19	-79.69	1.20	15.87
3.400	0.45	171.68	4.86	69.75	0.07	47.81	0.18	-80.42	1.22	15.56
3.500	0.45	169.53	4.71	68.47	0.07	47.78	0.18	-81.20	1.23	15.26
3.600	0.46	167.47	4.58	67.03	0.07	47.68	0.17	-82.06	1.24	14.97
3.700	0.46	165.67	4.47	65.80	0.07	47.46	0.16	-83.19	1.25	14.74
3.800	0.46	163.96	4.34	64.93	0.08	47.30	0.16	-84.30	1.27	14.44
3.900	0.46	162.28	4.21	63.80	0.08	47.24	0.15	-85.66	1.29	14.12
4.000	0.46	160.56	4.09	62.37	0.08	46.96	0.15	-87.01	1.30	13.86

Note:

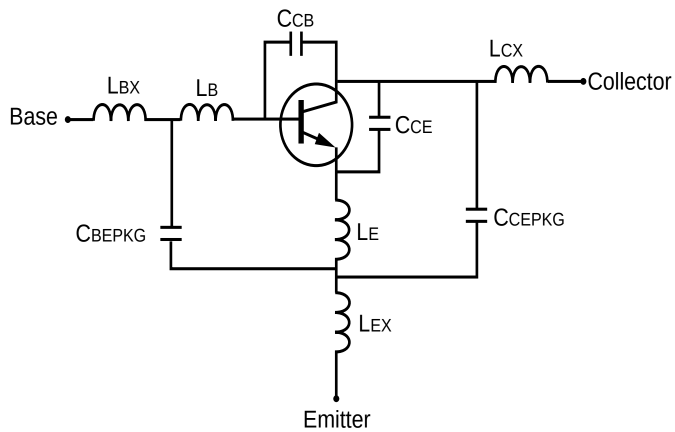
1. Gain Calculations:

$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When K ≤ 1, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

NE662M16 NONLINEAR MODEL

SCHEMATIC



BJT NONLINEAR MODEL PARAMETERS [1]

Parameters	Q1	Parameters	Q1
IS	1.6e-16	MJC	0.3
BF	105	XCJC	0.1
NF	1.02	CJS	0
VAF	23	VJS	0.75
IKF	0.38	MJS	0
ISE	1e-6	FC	0.6
NE	30	TF	2e-12
BR	12	XTF	0.2
NR	1.02	VTF	0.2
VAR	2.5	ITF	0.03
IKR	0.1	PTF	0
ISC	3e-15	TR	1e-11
NC	1.28	EG	1.11
RE	1.1	XTB	0
RB	6	XTI	3
RBM	3.5	KF	0
IRB	1.3e-3	AF	1
RC	8.75		
CJE	0.4e-12		
VJE	0.6		
MJE	0.5		
CJC	0.1e-12		
VJC	0.75		

(1) Gummel-Poon Model

ADDITIONAL PARAMETERS

Parameters	NE662M16
C_{CB}	0.07e-12
C_{CE}	0.09e-12
L_B	0.4e-9
L_E	0.14e-9
C_{CEPKG}	0.12e-12
C_{BEPK}	0.1e-12
L_{BX}	0.1e-9
L_{CX}	0.6e-9
L_{EX}	0.04e-9

MODEL RANGE
Frequency: 0.1 to 4 GHz
Bias: V_{CE} = 0.5 V to 3 V, I_C = 1 mA to 30 mA
Date: 01/15/2002