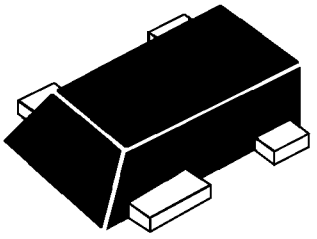
PRELIMINARY DATA SHEET

NEC

NPN SILICON RF TRANSISTOR | NE662M04

FEATURES

- **HIGH GAIN BANDWIDTH:** f_T = 22 GHz
- **LOW NOISE FIGURE:** NF = 1.2 dB at 2 GHz
- **HIGH MAXIMUM STABLE GAIN:** 19.5 dB at f = 2 GHz
- **NEW LOW PROFILE M04 PACKAGE:**
  - SOT-343 footprint, with a height of just 0.59 mm
  - Flat Lead Style for better RF performance



M04

DESCRIPTION

The NE662M04 is fabricated using NEC's state-of-the -art SH0 25 GHz f_T wafer process. With a typical transition frequency of 22 GHz the NE662M04 is usable in applications from 100 MHz to over 10 GHz. Maximum DC current input of 30 mA provides a device with a usable current range of 250 μA to 20 mA. The NE662M04 provides excellent low voltage/low current performance.

NEC's new low profile/flat lead style "M04" package is ideal for today's portable wireless applications. The NE662M04 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			NE662M04 2SC5508 M04			
SYMBOLS		PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
DC	I_{CBO}	Collector Cutoff Current at V_{CB} = 3 V, I_E = 0	μA			0.1
	I_{EBO}	Emitter Cutoff Current at V_{EB} = 1 V, I_C = 0	μA			0.1
	h_{FE}[2]	Forward Current Gain at V_{CE} = 2 V, I_C = 5 mA			100	
RF	C_{re}[3]	Feedback Capacitance at V_{CB} = 2 V, I_C = 0, f = 1 MHz	pF		0.18	
	f_T	Gain Bandwidth at V_{CE} = 2 V, I_C = 20 mA, f = 2 GHz	GHz		22	
	NF	Noise Figure at V_{CE} = 2 V, I_C = 5 mA, f = 2 GHz, Z_{IN} = Z_{OUT}	dB		1.2	
	$\|S_{21E}\|^2$	Insertion Power Gain at V_{CE} = 2 V, I_C = 20 mA, f = 2 GHz	dB		18	
	MSG[4]	Maximum Stable Gain at V_{CE} = 2 V, I_C = 20 mA, f = 2 GHz	dB		19.5	
	P_{1dB}	Output Power at 1 dB compression point at V_{CE} = 2 V, I_C = 20 mA, f = 2 GHz	dBm		12	
	IP_3	Third Order Intercept Point at V_{CE} = 2 V, I_C = 20 mA, f = 2 GHz			23	

Notes:

1. Electronic Industrial Association of Japan.
2. Pulsed measurement, pulse width ≤ 350 μs, duty cycle ≤ 2 %.
3. Capacitance is measured with emitter and case connected to the guard terminal at the bridge.
4. MSG = $\left|\frac{S_{21}}{S_{12}}\right|$

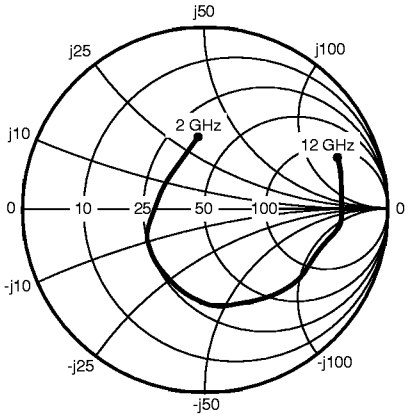
ABSOLUTE MAXIMUM RATINGS[1] (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{CBO}	Collector to Base Voltage	V	15
V_{CEO}	Collector to Emitter Voltage	V	3
V_{EBO}	Emitter to Base Voltage	V	2
I_C	Collector Current	mA	30
P_T	Total Power Dissipation	mW	150
T_J	Junction Temperature	°C	150
T_{STG}	Storage Temperature	°C	-65 to +150

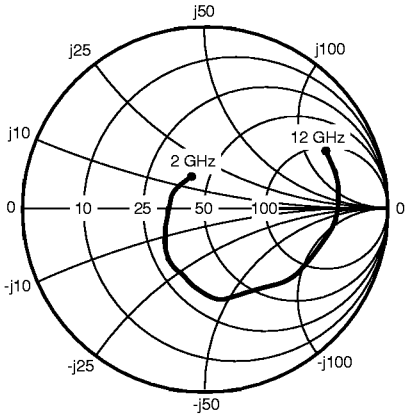
Note:
1. Operation in excess of any one of these parameters may result in permanent damage.

TYPICAL OPTIMAL NOISE MATCHING (T_A = 25°C)

V_C = 2 V, I_C = 5 mA



V_C = 2 V, I_C = 10 mA

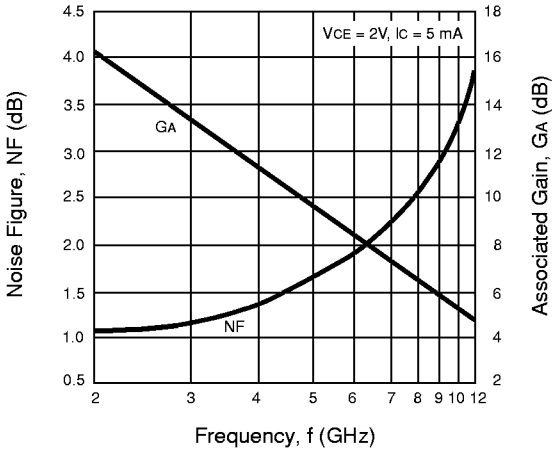


TYPICAL NOISE PARAMETERS (T_A = 25°C)

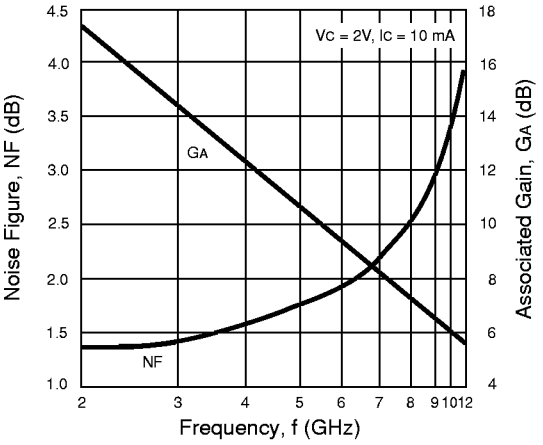
FREQ. (GHz)	NF_{OPT} (dB)	G_A (dB)	Γ_{OPT} MAG	Γ_{OPT} ANG	Rn/50
V_C = 2 V, I_C = 5 mA					
2.00	1.05	15.57	0.45	95.47	0.22
2.50	1.13	14.45	0.30	124.48	0.13
3.00	1.22	13.34	0.27	162.59	0.07
3.50	1.32	12.25	0.30	-167.37	0.04
4.00	1.43	11.23	0.35	-147.79	0.04
4.50	1.55	10.31	0.40	-133.27	0.07
5.00	1.67	9.54	0.42	-120.55	0.14
5.50	1.81	8.94	0.44	-108.10	0.24
6.00	1.95	8.49	0.46	-95.32	0.37
6.50	2.09	8.16	0.48	-82.19	0.53
7.00	2.24	7.89	0.51	-69.11	0.72
7.50	2.40	7.65	0.54	-56.66	0.95
8.00	2.56	7.38	0.59	-45.25	1.20
8.50	2.72	7.05	0.64	-35.03	1.49
9.00	2.89	6.63	0.69	-25.88	1.81
9.50	3.05	6.13	0.74	-17.53	2.16
10.00	3.22	5.58	0.77	-9.63	2.54
10.50	3.39	5.06	0.80	-1.78	2.96
11.00	3.56	4.77	0.80	6.52	3.40
11.50	3.73	4.92	0.79	15.89	3.88
12.00	3.91	5.68	0.77	27.15	4.39
V_C = 2 V, I_C = 10 mA					
2.00	1.39	16.94	0.25	110.87	0.19
2.50	1.41	15.72	0.19	156.61	0.12
3.00	1.44	14.49	0.23	-164.16	0.09
3.50	1.49	13.27	0.29	-142.79	0.08
4.00	1.56	12.12	0.35	-128.89	0.09
4.50	1.63	11.10	0.38	-117.46	0.13
5.00	1.72	10.26	0.41	-106.59	0.20
5.50	1.83	9.63	0.43	-95.49	0.29
6.00	1.94	9.21	0.45	-83.97	0.41
6.50	2.07	8.93	0.47	-72.18	0.55
7.00	2.20	8.73	0.50	-60.54	0.72
7.50	2.35	8.54	0.54	-49.48	0.91
8.00	2.50	8.29	0.58	-39.30	1.13
8.50	2.65	7.95	0.63	-30.07	1.38
9.00	2.82	7.49	0.67	-21.71	1.65
9.50	2.99	6.90	0.71	-13.98	1.94
10.00	3.16	6.23	0.75	-6.62	2.26
10.50	3.34	5.61	0.77	0.71	2.61
11.00	3.52	5.30	0.77	8.42	2.98
11.50	3.70	5.65	0.77	17.00	3.38
12.00	3.88	6.77	0.75	27.13	3.80

TYPICAL PERFORMANCE CURVES (T_A = 25°C)

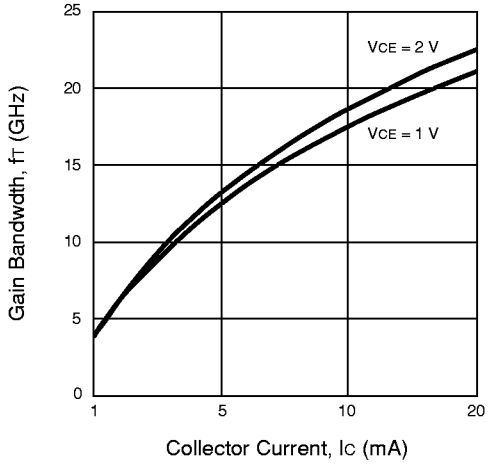
NOISE FIGURE AND ASSOCIATED GAIN vs. FREQUENCY



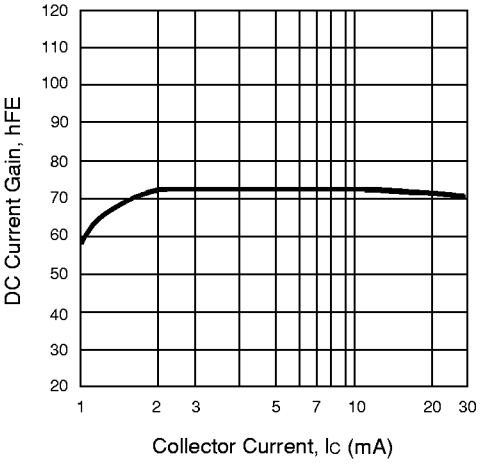
NOISE FIGURE AND ASSOCIATED GAIN vs. FREQUENCY



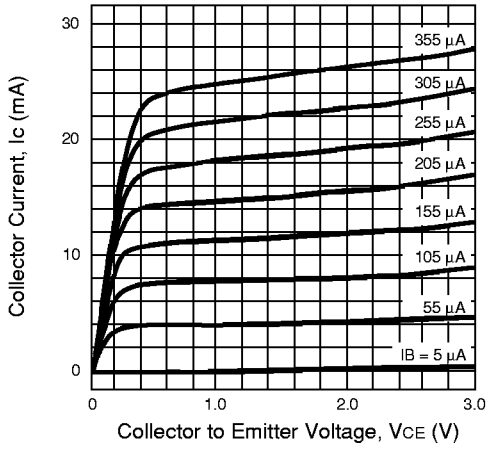
GAIN BANDWIDTH vs. COLLECTOR CURRENT



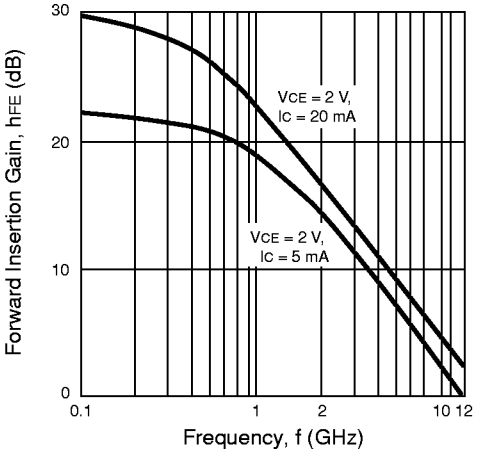
DC CURRENT GAIN vs. COLLECTOR CURRENT



COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE

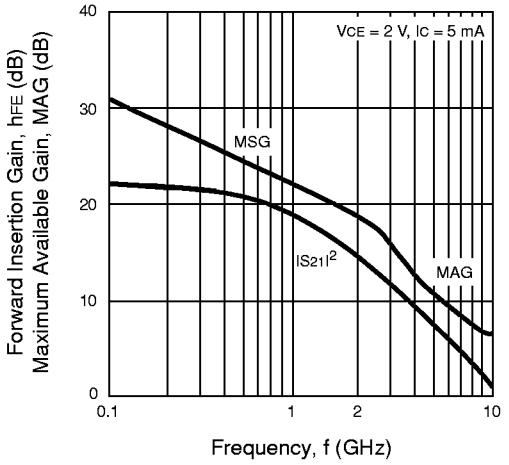


FORWARD INSERTION GAIN vs. FREQUENCY

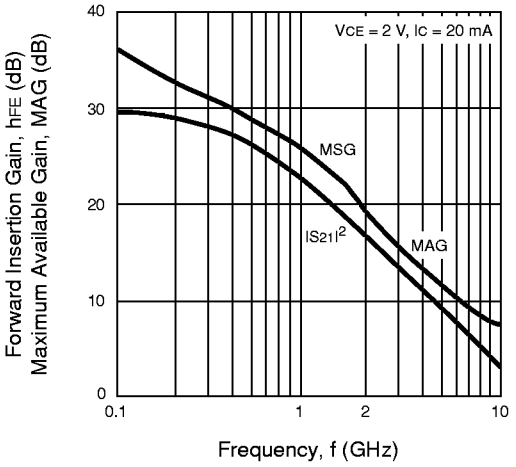


TYPICAL PERFORMANCE CURVES (T_A = 25°C)

FORWARD INSERTION GAIN AND MAXIMUM AVAILABLE GAIN vs. FREQUENCY

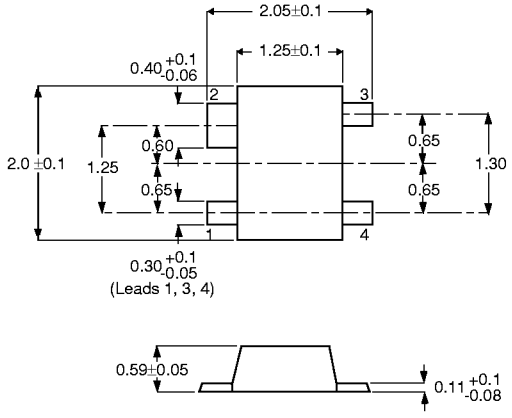


FORWARD INSERTION GAIN AND MAXIMUM AVAILABLE GAIN vs. FREQUENCY



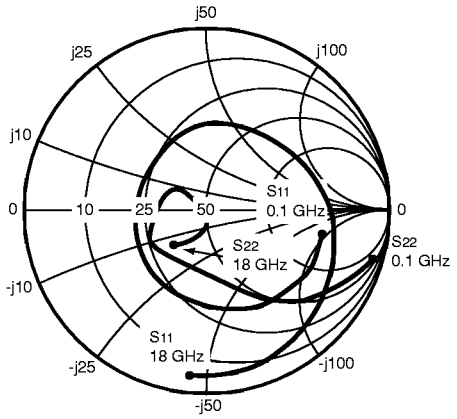
OUTLINE DIMENSIONS (Units in mm)

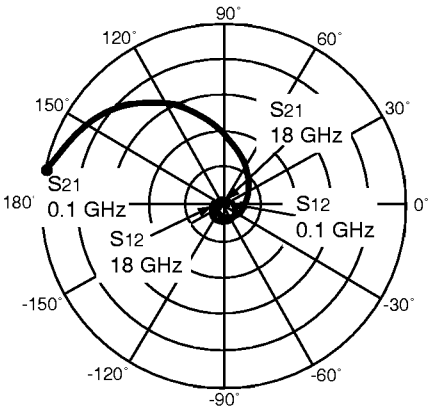
PACKAGE OUTLINE M04



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

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)





NE662M04
V_{DS} = 2 V, I_{DS} = 10 mA

FREQUENCY	S11		S21		S12		S22		K	MAG[1]
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.10	0.656	-12.55	21.524	167.65	0.009	79.73	0.953	-15.38	0.17	33.8
0.50	0.558	-72.63	16.388	130.46	0.032	54.65	0.704	-43.47	0.39	27.1
1.00	0.459	-117.32	11.085	102.71	0.045	44.24	0.505	-61.57	0.64	23.9
1.50	0.411	-147.32	8.116	84.49	0.055	40.54	0.416	-71.56	0.83	21.7
2.00	0.390	-170.12	6.357	70.11	0.064	37.88	0.371	-79.33	0.95	19.9
2.50	0.380	169.60	5.209	57.41	0.074	34.88	0.345	-86.61	1.04	17.2
3.00	0.384	151.78	4.404	45.78	0.084	31.26	0.329	-94.15	1.10	15.3
3.50	0.396	135.61	3.812	34.81	0.093	27.22	0.318	-102.20	1.13	13.9
4.00	0.417	121.45	3.357	24.31	0.103	22.52	0.313	-110.82	1.14	12.8
4.50	0.441	109.14	2.999	14.09	0.112	17.49	0.312	-119.93	1.15	11.9
5.00	0.462	98.03	2.707	4.16	0.121	12.11	0.316	-128.31	1.14	11.2
5.50	0.478	88.13	2.466	-5.47	0.129	6.79	0.323	-135.75	1.14	10.5
6.00	0.489	78.58	2.270	-14.88	0.138	1.28	0.331	-141.92	1.14	9.9
6.50	0.502	69.13	2.100	-24.15	0.145	-4.55	0.338	-147.40	1.13	9.4
7.00	0.516	59.69	1.958	-33.35	0.153	-10.53	0.336	-152.31	1.12	8.9
7.50	0.533	50.19	1.835	-42.50	0.160	-16.66	0.329	-157.13	1.12	8.5
8.00	0.552	40.84	1.724	-51.68	0.166	-22.97	0.314	-161.77	1.12	8.1
8.50	0.578	32.06	1.624	-60.85	0.172	-29.26	0.298	-167.85	1.11	7.8
9.00	0.606	23.80	1.533	-70.03	0.177	-35.77	0.279	-175.31	1.09	7.5
9.50	0.635	16.08	1.448	-79.10	0.182	-42.17	0.262	176.18	1.07	7.4
10.00	0.662	9.25	1.373	-88.08	0.186	-48.81	0.249	167.10	1.04	7.4
10.50	0.687	2.66	1.303	-97.24	0.190	-55.36	0.238	157.82	1.02	7.5
11.00	0.708	-3.68	1.240	-106.32	0.193	-62.02	0.228	150.01	0.99	8.1
11.50	0.725	-10.23	1.180	-115.51	0.196	-68.84	0.216	143.52	0.98	7.8
12.00	0.740	-16.97	1.129	-124.94	0.198	-75.82	0.196	139.24	0.97	7.6
12.50	0.759	-23.90	1.078	-134.43	0.200	-82.99	0.165	136.32	0.96	7.3
13.00	0.778	-31.43	1.026	-144.36	0.200	-90.81	0.130	133.05	0.96	7.1
13.50	0.797	-39.26	0.971	-154.44	0.197	-98.62	0.089	132.98	0.97	6.9
14.00	0.817	-46.37	0.917	-164.53	0.193	-105.96	0.043	134.60	0.99	6.8
14.50	0.836	-53.18	0.862	-174.70	0.189	-113.50	0.008	-126.17	1.00	6.2
15.00	0.854	-59.55	0.809	175.14	0.184	-121.17	0.045	-78.36	1.02	5.5
15.50	0.870	-65.38	0.760	164.91	0.178	-128.62	0.074	-82.90	1.03	5.3
16.00	0.879	-71.31	0.714	154.41	0.171	-136.43	0.100	-92.08	1.07	4.6
16.50	0.883	-77.25	0.668	143.35	0.163	-144.44	0.126	-102.52	1.16	3.7
17.00	0.888	-83.09	0.622	132.27	0.153	-152.15	0.161	-113.78	1.27	3.0
17.50	0.891	-89.24	0.576	121.03	0.143	-159.23	0.204	-124.99	1.43	2.2
18.00	0.890	-95.45	0.539	110.25	0.134	-166.19	0.250	-133.10	1.60	1.5

Note:

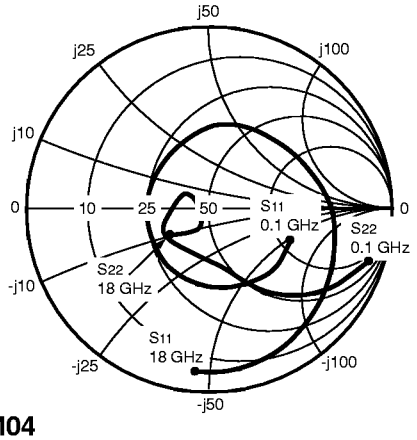
1. Gain Calculations:

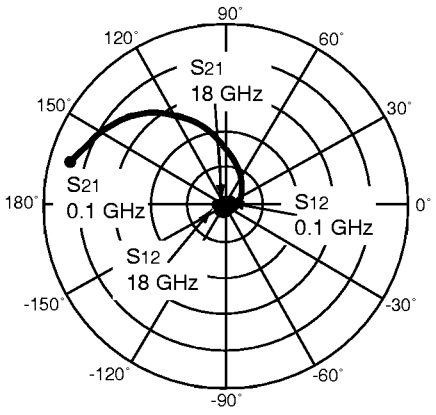
$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When $K \le 1$, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)





NE662M04
V_{DS} = 2 V, I_{DS} = 20 mA

FREQUENCY	S11		S21		S12		S22		K	MAG[1]
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.10	0.478	-21.17	30.628	164.59	0.008	77.90	0.920	-18.24	0.27	35.8
0.50	0.420	-95.65	20.411	122.80	0.027	55.26	0.608	-50.41	0.54	28.8
1.00	0.377	-140.33	12.654	96.57	0.039	50.55	0.413	-66.91	0.81	25.1
1.50	0.361	-167.18	8.963	79.99	0.051	48.74	0.338	-75.34	0.96	22.5
2.00	0.356	173.00	6.924	66.76	0.063	45.98	0.304	-82.29	1.03	19.4
2.50	0.356	155.15	5.625	54.91	0.075	42.06	0.287	-89.18	1.08	17.1
3.00	0.366	139.53	4.733	43.94	0.087	37.36	0.276	-96.76	1.10	15.4
3.50	0.383	125.38	4.086	33.53	0.098	32.17	0.268	-105.14	1.12	14.1
4.00	0.405	112.90	3.595	23.51	0.109	26.52	0.265	-114.14	1.12	13.1
4.50	0.429	101.89	3.211	13.68	0.120	20.61	0.266	-123.63	1.12	12.2
5.00	0.449	91.80	2.900	4.06	0.129	14.46	0.271	-132.09	1.11	11.5
5.50	0.464	82.65	2.645	-5.30	0.138	8.45	0.278	-139.34	1.11	10.8
6.00	0.474	73.73	2.438	-14.52	0.147	2.28	0.285	-145.15	1.10	10.2
6.50	0.485	64.85	2.260	-23.66	0.155	-4.15	0.291	-150.18	1.10	9.7
7.00	0.498	55.95	2.109	-32.75	0.163	-10.60	0.287	-154.60	1.09	9.2
7.50	0.514	47.03	1.978	-41.81	0.170	-17.22	0.279	-158.90	1.09	8.8
8.00	0.533	38.18	1.861	-50.95	0.176	-23.96	0.262	-162.87	1.09	8.4
8.50	0.558	29.93	1.755	-60.07	0.181	-30.61	0.244	-168.45	1.09	8.1
9.00	0.586	22.10	1.658	-69.20	0.186	-37.43	0.224	-175.58	1.07	7.8
9.50	0.616	14.75	1.568	-78.26	0.190	-44.07	0.206	176.14	1.06	7.7
10.00	0.643	8.23	1.489	-87.24	0.194	-50.92	0.191	167.23	1.04	7.6
10.50	0.669	1.93	1.415	-96.42	0.196	-57.75	0.178	158.39	1.02	7.7
11.00	0.691	-4.15	1.347	-105.57	0.198	-64.56	0.166	151.79	1.00	8.2
11.50	0.709	-10.52	1.286	-114.82	0.200	-71.54	0.153	147.66	0.99	8.1
12.00	0.725	-17.06	1.229	-124.30	0.201	-78.71	0.135	147.52	0.98	7.9
12.50	0.746	-23.83	1.172	-133.88	0.202	-85.96	0.110	151.92	0.97	7.6
13.00	0.766	-31.30	1.115	-143.85	0.200	-93.76	0.084	160.86	0.97	7.5
13.50	0.787	-39.12	1.055	-153.89	0.196	-101.42	0.066	-176.40	0.98	7.3
14.00	0.809	-46.23	0.996	-163.89	0.191	-108.56	0.063	-144.57	0.99	7.2
14.50	0.829	-53.03	0.936	-173.90	0.186	-115.98	0.078	-121.33	1.00	6.6
15.00	0.847	-59.39	0.879	176.00	0.180	-123.53	0.102	-112.73	1.02	6.0
15.50	0.864	-65.18	0.828	165.89	0.173	-130.77	0.122	-114.28	1.03	5.8
16.00	0.875	-71.13	0.779	155.45	0.166	-138.24	0.141	-119.68	1.06	5.2
16.50	0.879	-77.09	0.731	144.58	0.158	-146.13	0.160	-127.09	1.14	4.4
17.00	0.885	-82.91	0.681	133.70	0.148	-153.64	0.188	-133.94	1.24	3.7
17.50	0.888	-89.06	0.633	122.64	0.137	-160.49	0.225	-141.26	1.40	2.9
18.00	0.887	-95.33	0.595	112.04	0.129	-167.16	0.263	-146.76	1.56	2.2

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