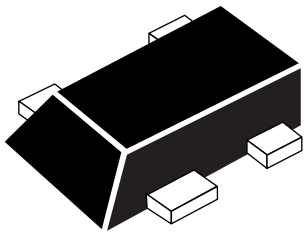
NEC

NPN SILICON HIGH FREQUENCY TRANSISTOR

NE661M04

FEATURES

- **HIGH GAIN BANDWIDTH:** f_T = 25 GHz
- **HIGH POWER GAIN:** $|S_{21E}|^2$ = 17 dB TYP at 2 GHz
- **LOW NOISE FIGURE:** NF = 1.2 dB at 2 GHz
- **HIGH MAXIMUM STABLE GAIN:** 22 dB @ 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 NE661M04 is fabricated using NEC's state-of-art UHS0 25 GHz f_T wafer process. With a typical transition frequency of 25 GHz the NE661M04 is usable in applications from 100 MHz to over 10 GHz. Maximum DC current input of 10 mA provides a device with a usable current range of 100 µA to 8 mA. The NE661M04 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 NE661M04 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			NE661M04 2SC5507 M04			
SYMBOLS		PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
DC	I_{CBO}	Collector Cutoff Current at V_{CE} = 5 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		50	70	100
RF	f_T	Gain Bandwidth at V_{CE} = 3 V, I_C = 10 mA, f = 2 GHz	GHz	20	22	
	MSG[4]	Maximum Stable Gain at V_{CE} = 2 V, I_C = 10 mA, f = 2 GHz	dB		22	
	$\|S_{21E}\|^2$	Insertion Power Gain at V_{CE} = 2 V, I_C = 5 mA, f = 2 GHz	dB	14	17	
	NF	Noise Figure at V_{CE} = 2 V, I_C = 2 mA, f = 2 GHz, Z_{IN} = Z_{OPT}	dB		1.2	
	P1dB	Output Power at 1 dB compression point at V_{CE} = 2 V, I_C = 5 mA, f = 2 GHz	dBm		5	
	IP_3	Third Order Intercept Point at V_{CE} = 2 V, I_C = 5 mA, f = 2 GHz	dBm		TBD	
	C_{re}[3]	Feedback Capacitance at V_{CB} = 2 V, I_C = 0, f = 1 MHz	pF		0.08	0.12

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	12
P_T	Total Power Dissipation	mW	50
T_J	Junction Temperature	°C	150
T_{STG}	Storage Temperature	°C	-65 to +150

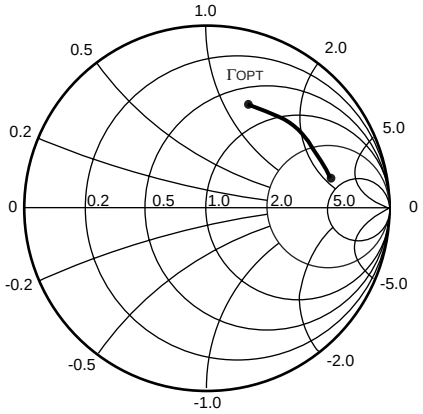
Note:
1. Operation in excess of any one of these parameters may result in permanent damage.

TYPICAL NOISE PARAMETERS (T_A = 25°C)

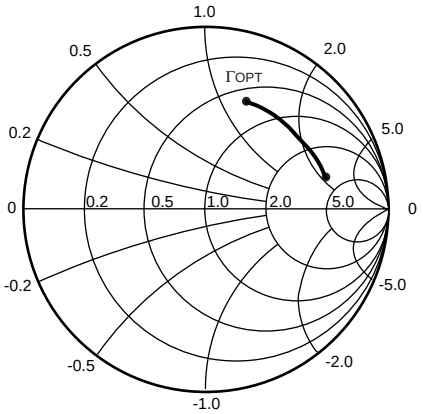
FREQ. (GHz)	NF_{OPT} (dB)	G_A (dB)	Γ_{OPT} MAG	Γ_{OPT} ANG	Rn/50
V_C = 1 V, I_C = 1 mA					
0.50	1.08	21.40	0.67	13	0.60
0.90	1.13	18.90	0.64	31	0.64
1.00	1.14	18.40	0.64	33	0.64
1.50	1.20	15.70	0.63	43	0.64
2.00	1.29	14.20	0.62	50	0.62
2.50	1.40	13.20	0.61	59	0.55
3.00	1.55	12.50	0.60	67	0.45
V_C = 2 V, I_C = 1 mA					
0.50	1.12	21.70	0.69	13	0.57
0.90	1.15	19.50	0.66	26	0.56
1.00	1.16	19.10	0.65	30	0.55
1.50	1.23	16.50	0.64	37	0.69
2.00	1.32	14.70	0.64	46	0.68
2.50	1.45	13.90	0.63	60	0.55
3.00	1.60	13.30	0.62	69	0.52
V_C = 2 V, I_C = 5 mA					
0.50	1.69	27.41	0.41	14	0.60
0.90	1.70	23.80	0.41	30	0.64
1.00	1.70	23.00	0.41	34	0.64
1.50	1.72	20.24	0.40	40	0.64
2.00	1.75	17.93	0.39	47	0.62
2.50	1.79	16.77	0.38	55	0.55
3.00	1.85	16.30	0.36	64	0.45

TYPICAL OPTIMAL NOISE MATCHING (T_A = 25°C)

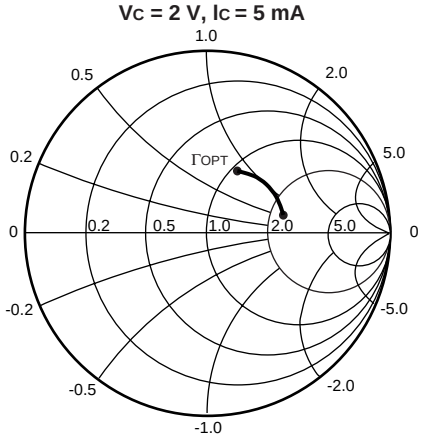
V_C = 1 V, I_C = 1 mA



V_C = 2 V, I_C = 1 mA

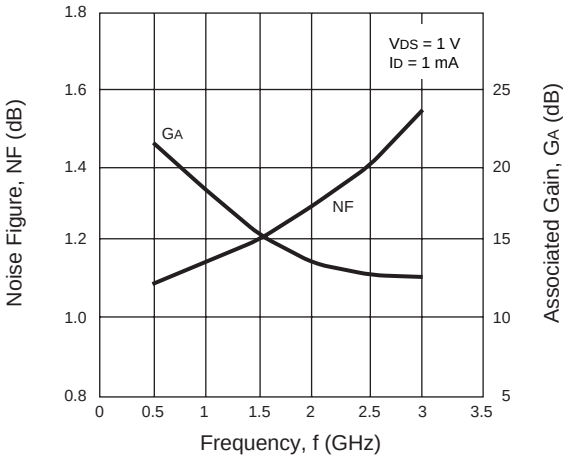


V_C = 2 V, I_C = 5 mA

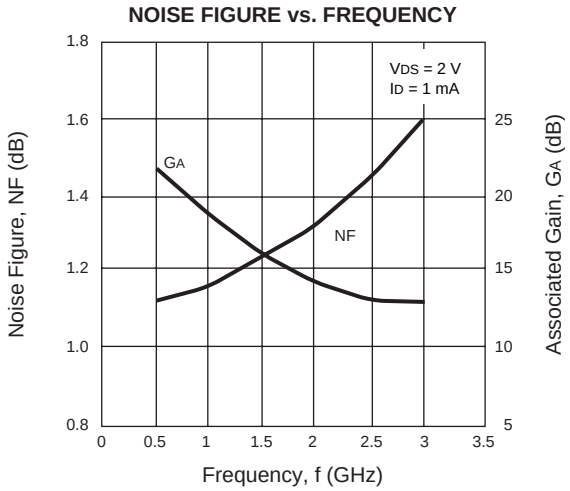


TYPICAL PERFORMANCE CURVES (T_A = 25°C)

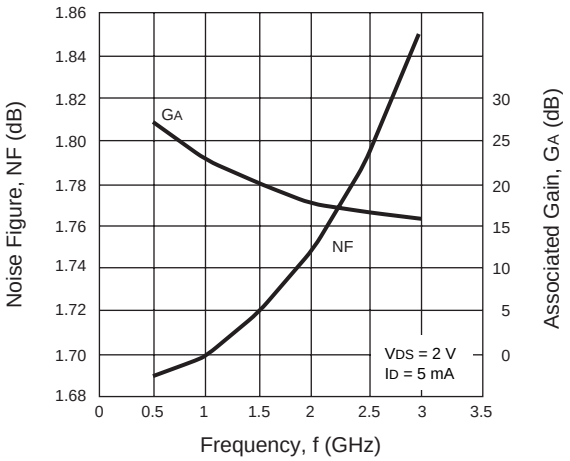
NOISE FIGURE vs. FREQUENCY



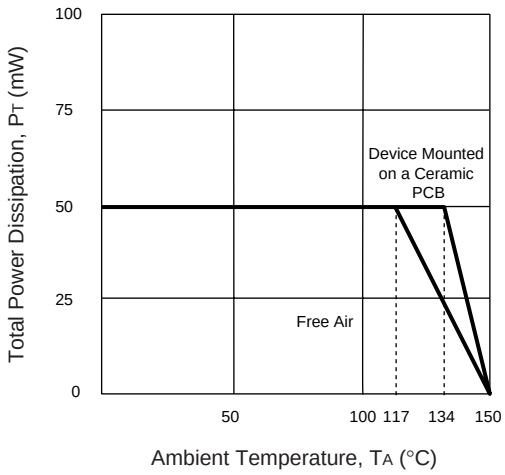
NOISE FIGURE vs. FREQUENCY



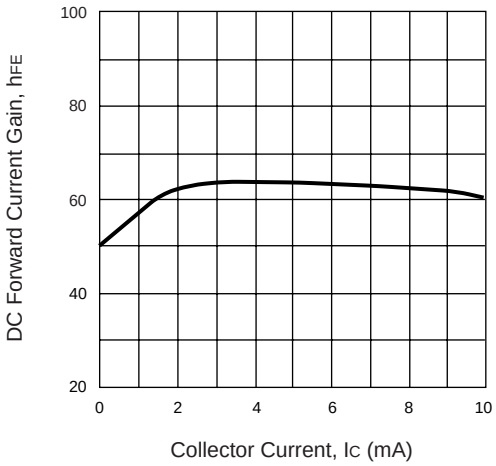
NOISE FIGURE vs. FREQUENCY



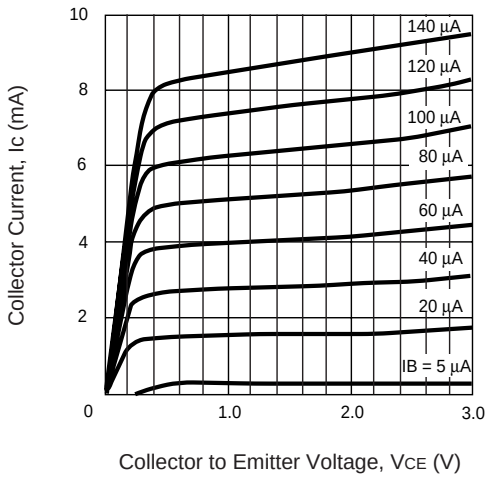
DC POWER DERATING CURVES



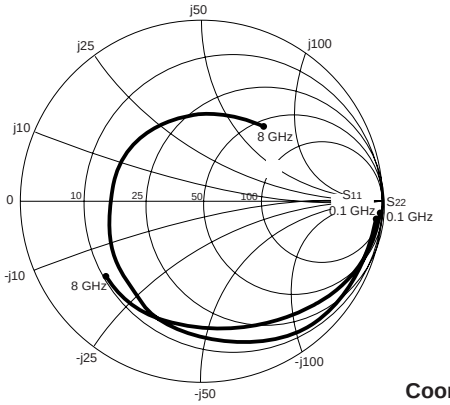
FORWARD CURRENT GAIN vs. COLLECTOR GAIN

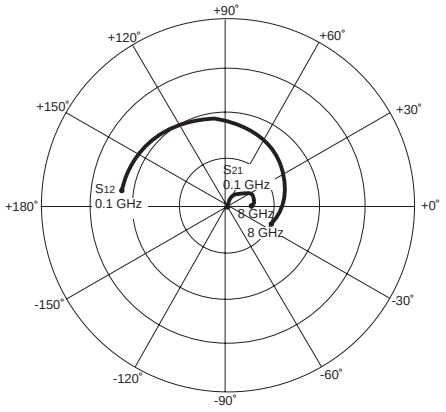


COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



TYPICAL SCATTERING PARAMETERS (TA = 25°C)





Coordinates in Ohms
Frequency in GHz
(V_{CE} = 1 V, I_C = 1 mA)

V_C = 1 V, I_C = 1 mA

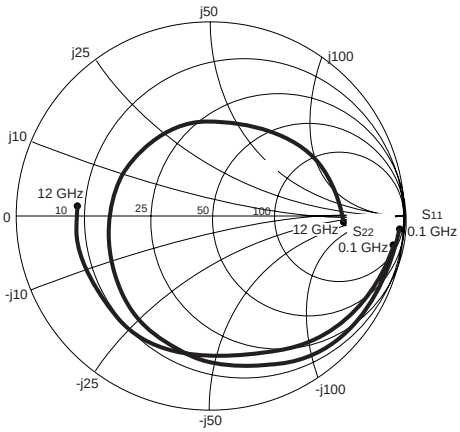
FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K	MAG[1]
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.10	0.944	-4.3	2.912	172.0	0.005	84.9	0.991	-4.3	0.15	27.53
0.20	0.943	-8.0	2.868	171.3	0.009	77.9	0.970	-7.6	0.22	24.88
0.30	0.941	-11.9	2.845	168.3	0.013	75.1	0.955	-10.2	0.22	23.30
0.40	0.939	-15.4	2.837	164.2	0.017	73.0	0.943	-12.8	0.23	22.21
0.50	0.935	-19.2	2.845	160.7	0.021	70.8	0.935	-15.2	0.22	21.37
0.70	0.930	-26.7	2.807	153.5	0.028	66.3	0.922	-19.9	0.22	20.00
1.00	0.916	-37.4	2.734	144.1	0.038	59.6	0.906	-26.7	0.22	18.57
1.50	0.862	-55.4	2.614	126.2	0.051	46.5	0.850	-37.3	0.39	17.08
2.00	0.807	-72.7	2.526	110.8	0.061	36.2	0.821	-46.6	0.49	16.16
2.50	0.755	-89.4	2.337	96.3	0.068	26.8	0.794	-55.1	0.61	15.38
3.00	0.693	-106.9	2.236	82.4	0.071	18.3	0.768	-62.8	0.75	14.96
3.50	0.636	-124.7	2.095	68.9	0.072	10.7	0.744	-70.1	0.92	14.61
4.00	0.585	-143.5	1.977	55.6	0.071	4.5	0.723	-77.2	1.11	12.45
5.00	0.515	178.7	1.746	30.4	0.066	-2.9	0.696	-91.7	1.53	9.96
6.00	0.489	143.2	1.521	6.9	0.061	-1.9	0.689	-106.9	1.89	8.49
7.00	0.480	109.3	1.325	-14.4	0.066	0.9	0.688	-119.9	2.05	7.22
8.00	0.495	75.6	1.155	-34.5	0.076	2.0	0.679	-131.9	2.04	5.98

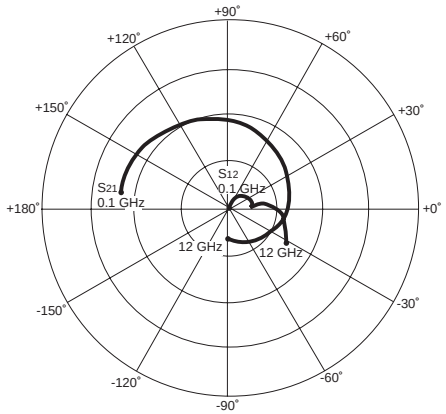
Note:
1. Gain Calculation:

$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$. 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 (TA = 25°C)





Coordinates in Ohms
Frequency in GHz
(V_{CE} = 2 V, I_C = 1 mA)

V_C = 2 V, I_C = 1 mA

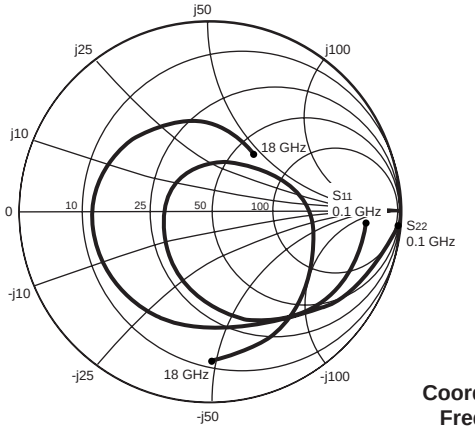
FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K	MAG[1]
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.10	0.946	-4.2	2.929	172.1	0.005	84.2	0.992	-4.2	0.16	28.12
0.20	0.945	-7.7	2.882	171.5	0.008	76.7	0.971	-7.4	0.25	25.51
0.30	0.943	-11.6	2.860	168.6	0.012	74.8	0.956	-10.0	0.24	23.91
0.40	0.941	-14.9	2.853	164.6	0.015	72.6	0.944	-12.4	0.25	22.79
0.50	0.938	-18.6	2.861	161.2	0.018	70.6	0.937	-14.7	0.24	21.95
0.70	0.933	-25.9	2.825	154.2	0.025	66.5	0.924	-19.3	0.23	20.61
1.00	0.921	-36.3	2.756	145.0	0.033	60.4	0.909	-25.9	0.23	19.19
1.50	0.869	-53.9	2.643	127.4	0.045	47.8	0.856	-36.2	0.40	17.72
2.00	0.816	-70.7	2.563	112.3	0.053	38.1	0.829	-45.2	0.50	16.82
2.50	0.765	-87.0	2.377	98.0	0.059	29.2	0.805	-53.4	0.62	16.05
3.50	0.647	-121.6	2.142	70.9	0.063	14.4	0.759	-68.1	0.94	15.33
3.00	0.703	-104.1	2.281	84.2	0.062	21.3	0.781	-60.9	0.76	15.65
4.00	0.593	-139.9	2.027	57.7	0.062	9.4	0.740	-75.2	1.14	12.87
5.00	0.518	-177.4	1.799	32.7	0.057	4.6	0.716	-89.6	1.58	10.51
6.00	0.485	147.0	1.573	9.1	0.056	8.2	0.711	-104.7	1.86	9.10
7.00	0.472	112.6	1.372	-12.2	0.064	11.0	0.711	-117.7	1.89	7.86
8.00	0.483	78.3	1.197	-32.2	0.078	10.5	0.704	-129.7	1.82	6.62
9.00	0.541	49.9	1.039	-51.0	0.098	4.2	0.700	-142.3	1.56	5.85
10.00	0.604	28.4	0.914	-67.6	0.120	-3.8	0.697	-154.8	1.30	5.53
11.00	0.653	10.2	0.821	-84.2	0.144	-15.4	0.698	-169.7	1.07	5.90
12.00	0.691	-7.9	0.734	-101.2	0.168	-29.3	0.693	173.1	0.96	6.41

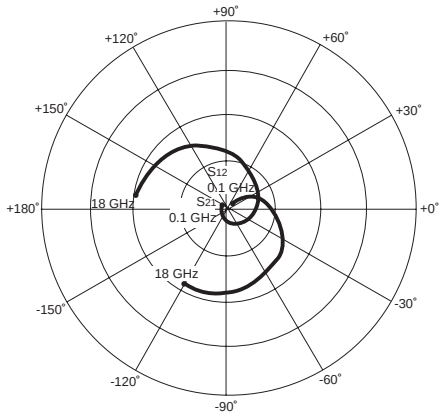
Note:
1. Gain Calculation:

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

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

TYPICAL SCATTERING PARAMETERS (TA = 25°C)





Coordinates in Ohms
Frequency in GHz
(V_{CE} = 2 V, I_C = 5 mA)

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)
0.10	0.823	-5.3	10.113	172.3	0.004	81.5	0.979	-5.1	0.27	34.04
0.20	0.816	-11.4	9.907	167.9	0.008	75.6	0.954	-9.1	0.32	31.13
0.30	0.807	-17.0	9.734	163.0	0.011	72.1	0.933	-12.5	0.34	29.55
0.40	0.797	-22.0	9.571	158.1	0.014	70.1	0.916	-15.5	0.34	28.41
0.50	0.784	-27.2	9.433	153.3	0.017	67.9	0.902	-18.5	0.35	27.54
0.70	0.757	-37.1	9.037	144.0	0.022	63.3	0.873	-23.9	0.37	26.18
1.00	0.710	-51.0	8.386	131.4	0.029	57.0	0.836	-31.3	0.43	24.69
1.50	0.592	-71.5	7.208	111.1	0.036	47.3	0.748	-41.2	0.67	23.00
2.00	0.498	-89.6	6.429	95.0	0.042	41.5	0.704	-49.1	0.83	21.77
2.50	0.417	-106.7	5.446	80.7	0.046	37.6	0.672	-55.9	0.98	20.73
3.00	0.345	-124.2	4.809	67.8	0.050	34.7	0.649	-62.1	1.11	17.80
3.50	0.289	-143.0	4.283	55.9	0.054	32.2	0.631	-68.0	1.23	16.15
4.00	0.249	-163.9	3.862	44.7	0.058	30.0	0.619	-74.1	1.30	14.95
5.00	0.221	153.2	3.218	23.5	0.067	25.3	0.606	-87.3	1.37	13.17
6.00	0.235	117.2	2.732	3.3	0.078	19.5	0.614	-101.9	1.35	11.92
7.00	0.255	84.3	2.369	-15.7	0.090	11.9	0.621	-114.5	1.31	10.86
8.00	0.298	53.7	2.074	-33.9	0.101	3.5	0.622	-125.8	1.30	9.84
9.00	0.371	32.9	1.834	-51.5	0.114	-5.1	0.625	-138.3	1.20	9.31
10.00	0.439	18.4	1.657	-67.9	0.130	-13.2	0.624	-150.4	1.08	9.33
11.00	0.497	5.3	1.521	-85.1	0.149	-23.8	0.625	-165.1	0.93	10.10
12.00	0.547	-9.8	1.395	-103.4	0.167	-36.4	0.622	178.1	0.83	9.22
13.00	0.597	-26.5	1.269	-121.9	0.185	-50.4	0.606	162.0	0.76	8.37
14.00	0.648	-42.6	1.147	-140.2	0.193	-64.4	0.575	146.0	0.76	7.73
15.00	0.693	-53.5	1.041	-158.0	0.204	-77.1	0.522	127.4	0.77	7.08
16.00	0.732	-64.5	0.963	-176.4	0.221	-91.0	0.488	106.8	0.71	6.39
17.00	0.758	-77.4	0.864	163.2	0.230	-107.7	0.434	79.8	0.77	5.75
18.00	0.787	-89.6	0.756	144.0	0.230	-122.4	0.368	52.7	0.88	5.16

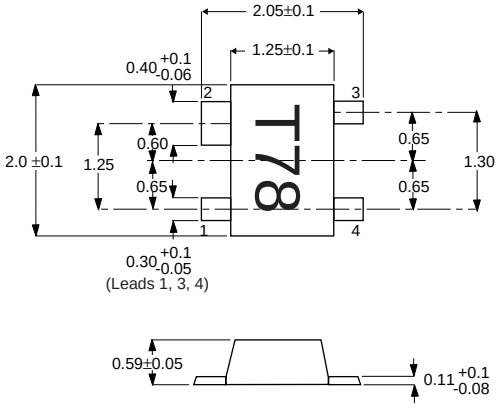
Note:
1. Gain Calculation:

$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$. 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

OUTLINE DIMENSIONS (Units in mm)

PACKAGE OUTLINE M04



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

ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKAGING
NE661M04-T2	3000	Tape & Reel