



NPN SILICON RF TRANSISTOR

NE678M04 / 2SC5753 JEITA Part No.

NPN SILICON RF TRANSISTOR FOR MEDIUM OUTPUT POWER AMPLIFICATION (60 mW) FLAT-LEAD 4-PIN THIN-TYPE SUPER MINIMOLD

FEATURES

- Ideal for medium output power amplification
- $P_{O(1\text{ dB})} = 18.0\text{ dBm TYP. @ } V_{CE} = 2.8\text{ V, } f = 1.8\text{ GHz, } P_{in} = 7\text{ dBm}$
- HFT3 technology ($f_T = 12\text{ GHz}$) adopted
- High reliability through use of gold electrodes
- Flat-lead 4-pin thin-type super minimold package

ORDERING INFORMATION

Part Number	Quantity	Supplying Form
NE678M04-A 2SC5753-A	50 pcs (Non reel)	• 8 mm wide embossed taping • Pin 1 (Emitter), Pin 2 (Collector) face the perforation side of the tape
NE678M04-T2-A 2SC5753-T2-A	3 kpcs/reel	

Remark To order evaluation samples, please contact your nearby sales office.
Unit sample quantity is 50 pcs.

ABSOLUTE MAXIMUM RATINGS ($T_A = +25^\circ\text{C}$)

Parameter	Symbol	Ratings	Unit
Collector to Base Voltage	V_{CBO}	9.0	V
Collector to Emitter Voltage	V_{CEO}	6.0	V
Emitter to Base Voltage	V_{EBO}	2.0	V
Collector Current	I_C	100	mA
Total Power Dissipation	P_{tot} Note	205	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-65 to +150	$^\circ\text{C}$

Note Mounted on $1.08\text{ cm}^2 \times 1.0\text{ mm (t)}$ glass epoxy PCB

Caution: Observe precautions when handling because these devices are sensitive to electrostatic discharge

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

THERMAL RESISTANCE

Parameter	Symbol	Value	Unit
Junction to Ambient Resistance	$R_{th\ j-a}$ Note	600	°C/W

Note Mounted on $1.08\text{ cm}^2 \times 1.0\text{ mm}$ (t) glass epoxy PCB

ELECTRICAL CHARACTERISTICS ($T_A = +25^\circ\text{C}$)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
DC Characteristics						
Collector Cut-off Current	I_{CBO}	$V_{CB} = 5\text{ V}, I_E = 0\text{ mA}$	—	—	100	nA
Emitter Cut-off Current	I_{EBO}	$V_{BE} = 1\text{ V}, I_C = 0\text{ mA}$	—	—	100	nA
DC Current Gain	h_{FE} Note 1	$V_{CE} = 3\text{ V}, I_C = 30\text{ mA}$	75	120	150	—
RF Characteristics						
Gain Bandwidth Product	f_T	$V_{CE} = 3\text{ V}, I_C = 30\text{ mA}, f = 2\text{ GHz}$	—	12.0	—	GHz
Insertion Power Gain	$ S_{21e} ^2$	$V_{CE} = 3\text{ V}, I_C = 30\text{ mA}, f = 2\text{ GHz}$	8.0	10.5	—	dB
Noise Figure	NF	$V_{CE} = 3\text{ V}, I_C = 7\text{ mA}, f = 2\text{ GHz}, Z_S = Z_{opt}$	—	1.7	2.5	dB
Reverse Transfer Capacitance	C_{re} Note 2	$V_{CB} = 3\text{ V}, I_E = 0\text{ mA}, f = 1\text{ MHz}$	—	0.42	0.7	pF
Maximum Available Power Gain	MAG Note 3	$V_{CE} = 3\text{ V}, I_C = 30\text{ mA}, f = 2\text{ GHz}$	—	13.5	—	dB
Linear Gain	G_L	$V_{CE} = 2.8\text{ V}, I_{Cq} = 10\text{ mA}, f = 1.8\text{ GHz}, P_{in} = -5\text{ dBm}$	—	13.0	—	dB
Gain 1 dB Compression Output Power	$P_{O(1\text{ dB})}$	$V_{CE} = 2.8\text{ V}, I_{Cq} = 10\text{ mA}, f = 1.8\text{ GHz}, P_{in} = 7\text{ dBm}$	—	18.0	—	dBm
Collector Efficiency	η_C	$V_{CE} = 2.8\text{ V}, I_{Cq} = 10\text{ mA}, f = 1.8\text{ GHz}, P_{in} = 7\text{ dBm}$	—	55	—	%

Notes 1. Pulse measurement: $PW \leq 350\text{ }\mu\text{s}$, Duty Cycle $\leq 2\%$

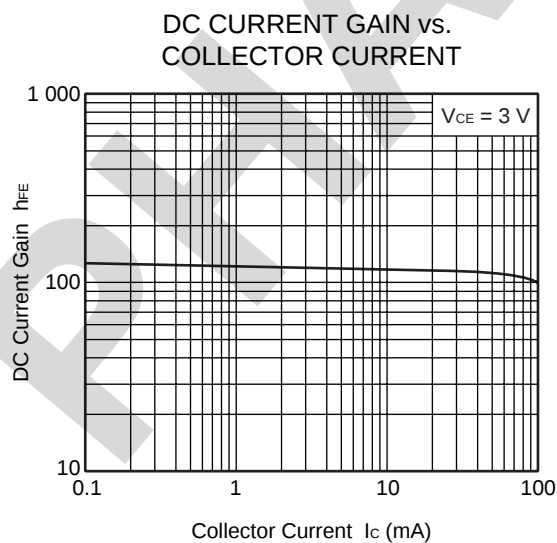
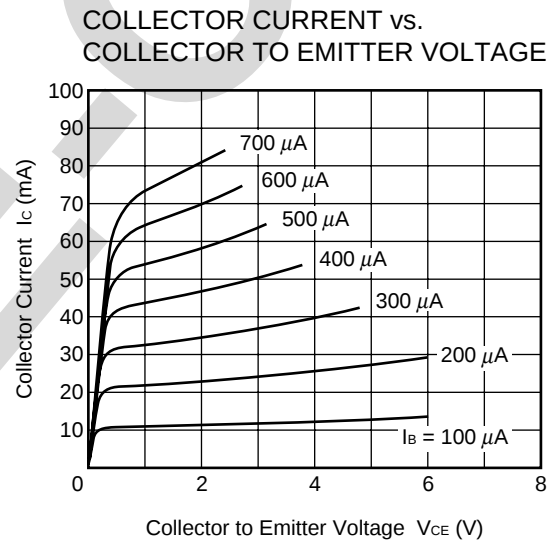
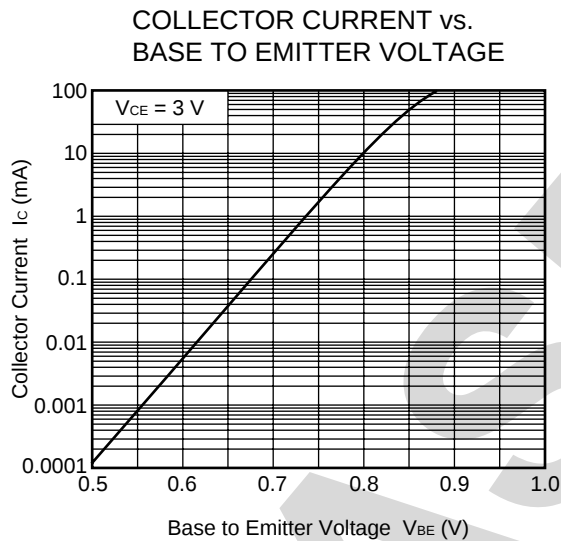
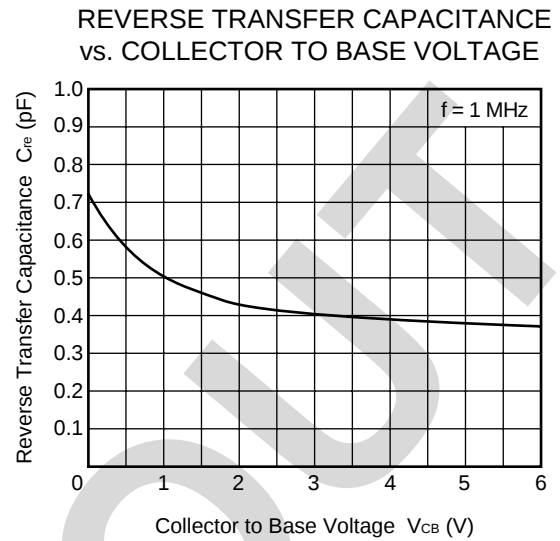
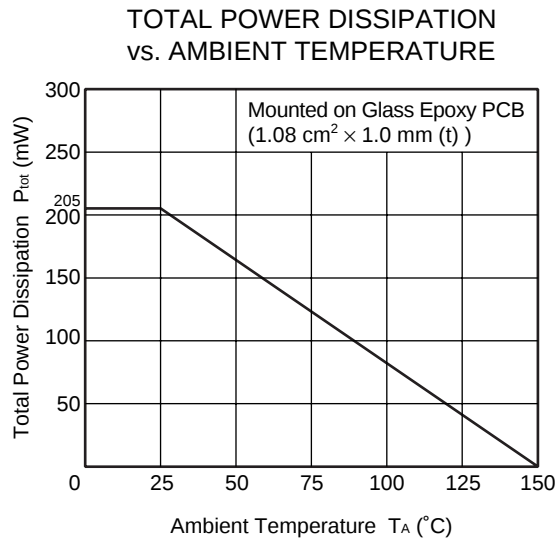
2. Collector to base capacitance when the emitter grounded

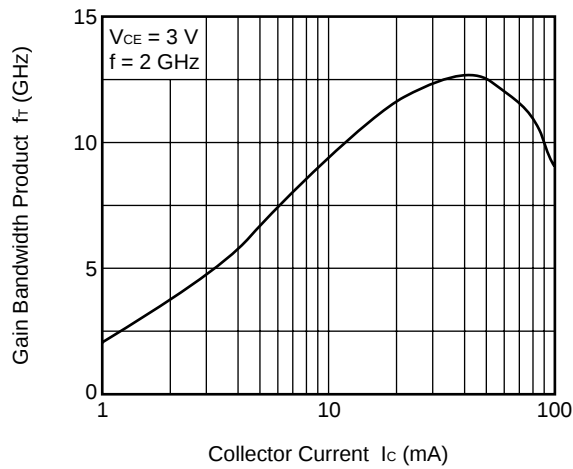
$$3. \text{ MAG} = \left| \frac{S_{21}}{S_{12}} \right| (K - \sqrt{K^2 - 1})$$

 h_{FE} CLASSIFICATION

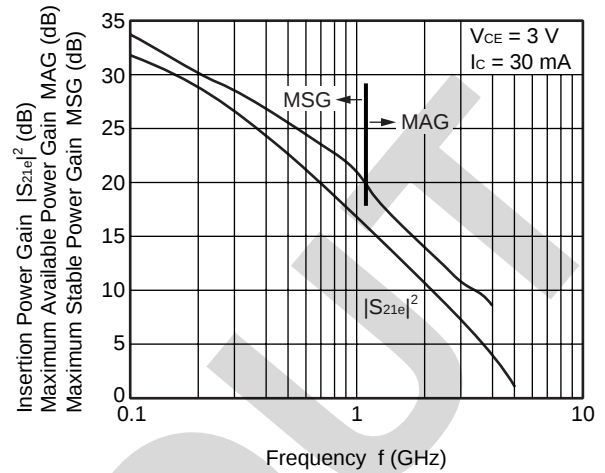
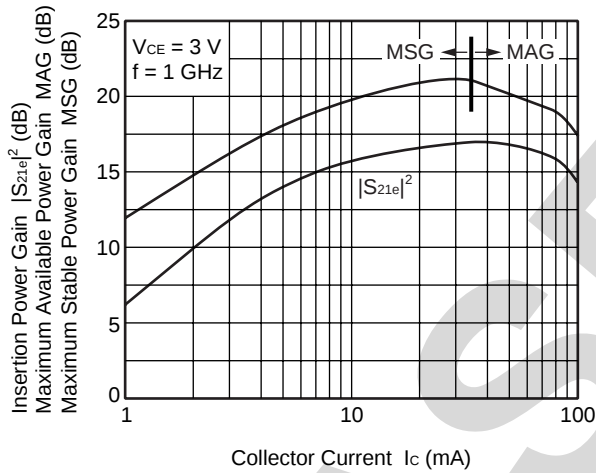
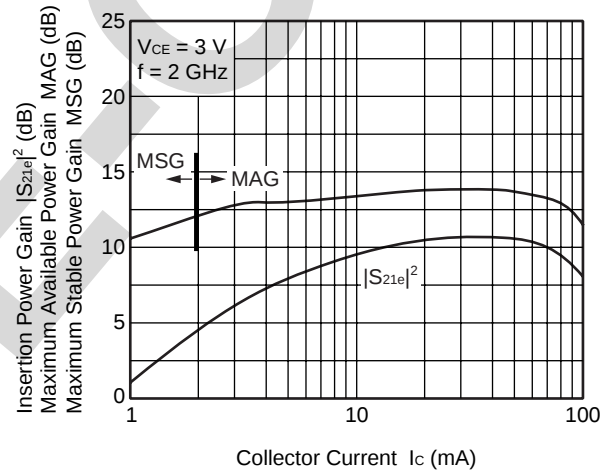
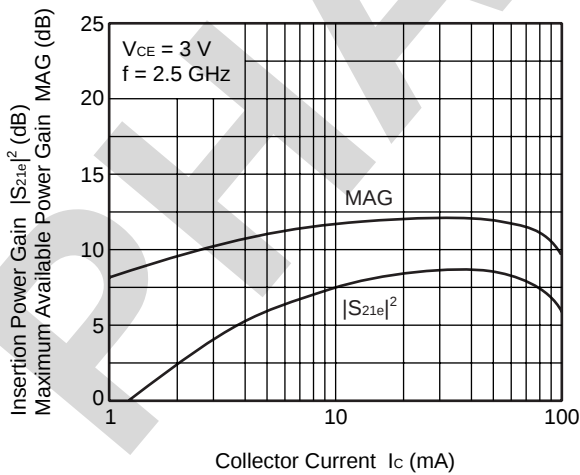
Rank	FB
Marking	R55
h_{FE} Value	75 to 150

TYPICAL CHARACTERISTICS (Unless otherwise specified, $T_A = +25^\circ\text{C}$)

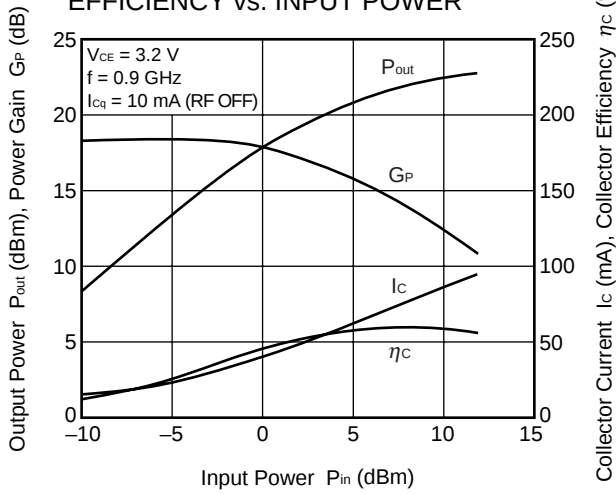


GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT

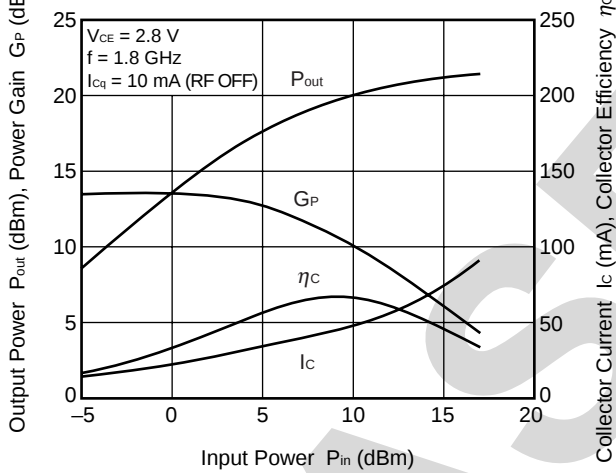
INSERTION POWER GAIN, MAG, MSG vs. FREQUENCY

INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENTINSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENTINSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT

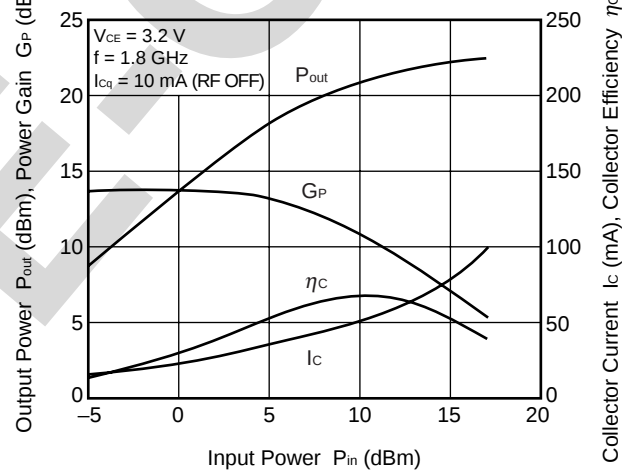
OUTPUT POWER, POWER GAIN,
COLLECTOR CURRENT, COLLECTOR
EFFICIENCY vs. INPUT POWER



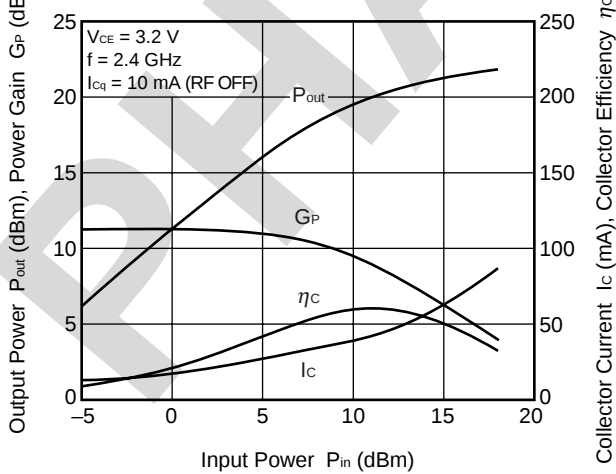
OUTPUT POWER, POWER GAIN,
COLLECTOR CURRENT, COLLECTOR
EFFICIENCY vs. INPUT POWER

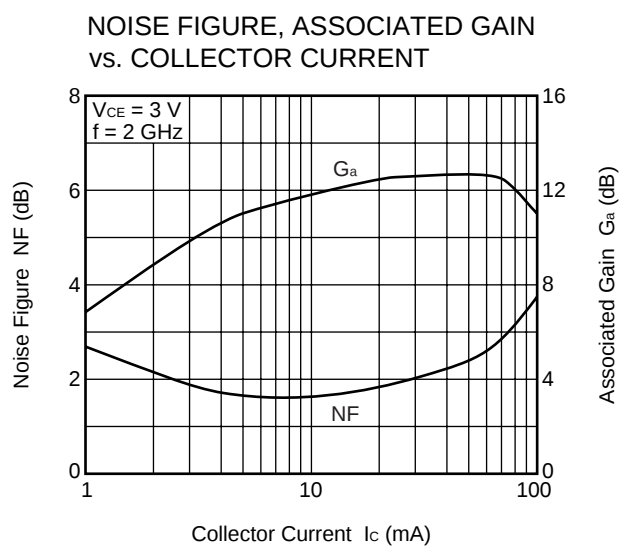


OUTPUT POWER, POWER GAIN,
COLLECTOR CURRENT, COLLECTOR
EFFICIENCY vs. INPUT POWER



OUTPUT POWER, POWER GAIN,
COLLECTOR CURRENT, COLLECTOR
EFFICIENCY vs. INPUT POWER





Remark The graphs indicate nominal characteristics.

S-PARAMETERS

Note When $K \geq 1$, the MAG (Maximum Available Power Gain) is used. $MAG = \left| \frac{S_{21}}{S_{12}} \right| (K - \sqrt{K^2 - 1})$

When $K < 1$, the MSG (Maximum Stable Power Gain) is used. $MSG = \left| \frac{S_{21}}{S_{12}} \right|$

$V_{CE} = 3 \text{ V}$, $I_C = 1 \text{ mA}$, $Z_O = 50 \Omega$

Frequency (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		K	MAG/MSG ^{Note} (dB)
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)		
0.1	0.960	-15.6	3.628	169.4	0.025	75.7	0.998	-6.6	0.094	21.54
0.2	0.955	-31.3	3.476	157.2	0.050	69.6	0.976	-13.4	0.074	18.43
0.3	0.931	-47.1	3.363	145.9	0.071	60.5	0.958	-19.6	0.095	16.73
0.4	0.903	-61.1	3.161	135.7	0.090	51.7	0.924	-25.7	0.129	15.47
0.5	0.874	-74.1	2.967	126.2	0.104	43.3	0.895	-31.1	0.167	14.56
0.6	0.847	-86.6	2.756	117.8	0.114	35.9	0.856	-36.0	0.199	13.82
0.7	0.822	-97.7	2.565	109.7	0.122	29.6	0.826	-40.4	0.233	13.22
0.8	0.804	-107.6	2.373	102.5	0.126	23.7	0.793	-44.8	0.275	12.74
0.9	0.786	-117.2	2.222	95.5	0.130	18.4	0.771	-48.6	0.309	12.31
1.0	0.775	-126.0	2.069	89.0	0.131	13.7	0.748	-52.6	0.346	11.98
1.1	0.766	-134.2	1.939	83.1	0.132	9.2	0.736	-56.4	0.373	11.67
1.2	0.756	-142.0	1.809	77.6	0.131	5.3	0.720	-60.2	0.412	11.41
1.3	0.753	-149.1	1.707	71.9	0.129	1.2	0.714	-64.0	0.441	11.21
1.4	0.748	-155.6	1.600	66.6	0.126	-2.2	0.704	-67.8	0.490	11.04
1.5	0.748	-161.8	1.507	61.6	0.123	-5.6	0.702	-71.8	0.520	10.90
1.6	0.745	-167.6	1.415	56.6	0.118	-8.4	0.695	-75.6	0.582	10.77
1.7	0.749	-172.8	1.341	52.0	0.113	-11.1	0.694	-79.7	0.616	10.73
1.8	0.751	-177.8	1.259	47.4	0.108	-13.3	0.686	-83.6	0.690	10.65
1.9	0.751	177.2	1.190	43.1	0.103	-15.2	0.692	-87.7	0.740	10.62
2.0	0.755	172.8	1.123	38.6	0.097	-16.6	0.686	-91.8	0.829	10.62
2.1	0.763	168.7	1.067	34.7	0.092	-17.0	0.696	-96.2	0.844	10.65
2.2	0.763	165.1	1.012	30.6	0.085	-17.0	0.695	-100.1	0.963	10.74
2.3	0.766	161.1	0.963	26.8	0.079	-16.4	0.707	-104.5	1.022	9.96
2.4	0.770	157.7	0.917	23.1	0.073	-14.9	0.707	-108.2	1.151	8.66
2.5	0.774	154.2	0.872	19.7	0.067	-12.7	0.713	-112.5	1.252	8.10
2.6	0.778	151.0	0.824	16.4	0.063	-8.8	0.716	-116.4	1.375	7.50
2.7	0.784	147.7	0.786	13.1	0.061	-3.3	0.719	-120.5	1.420	7.23
2.8	0.790	145.0	0.748	10.3	0.062	0.6	0.719	-124.0	1.405	7.00
2.9	0.793	142.5	0.720	7.6	0.061	0.3	0.719	-126.7	1.510	6.52
3.0	0.793	139.6	0.687	4.7	0.056	4.4	0.719	-130.4	1.765	5.78
4.0	0.836	115.8	0.425	-16.0	0.087	39.7	0.759	-166.7	1.580	2.42

$V_{CE} = 3\text{ V}$, $I_C = 3\text{ mA}$, $Z_O = 50\ \Omega$

Frequency (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		K	MAG/MSG (dB)
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)		
0.1	0.902	-21.1	9.755	165.3	0.023	74.9	0.981	-11.4	0.086	26.28
0.2	0.874	-44.6	9.014	150.2	0.046	64.7	0.924	-22.2	0.086	22.90
0.3	0.830	-64.7	8.271	136.9	0.063	53.2	0.862	-31.3	0.140	21.18
0.4	0.789	-81.9	7.402	126.0	0.075	44.8	0.787	-39.0	0.178	19.94
0.5	0.748	-96.5	6.634	116.5	0.083	37.1	0.724	-45.2	0.234	19.02
0.6	0.722	-109.6	5.921	108.6	0.088	31.1	0.663	-50.5	0.281	18.28
0.7	0.701	-121.0	5.351	101.3	0.092	26.5	0.619	-54.6	0.326	17.66
0.8	0.685	-130.4	4.816	95.2	0.093	22.5	0.578	-58.8	0.381	17.15
0.9	0.673	-139.6	4.407	89.4	0.094	19.0	0.550	-62.5	0.427	16.70
1.0	0.665	-147.3	4.033	83.9	0.094	16.5	0.524	-66.0	0.483	16.33
1.1	0.666	-154.7	3.729	78.9	0.094	13.9	0.507	-69.5	0.519	15.99
1.2	0.659	-161.0	3.449	74.6	0.093	12.2	0.491	-73.0	0.579	15.70
1.3	0.660	-167.2	3.212	69.8	0.092	10.3	0.483	-76.3	0.624	15.43
1.4	0.661	-172.5	2.989	65.5	0.090	9.1	0.473	-80.0	0.681	15.19
1.5	0.665	-177.9	2.795	61.5	0.089	8.1	0.469	-83.4	0.729	14.98
1.6	0.667	177.6	2.623	57.4	0.087	7.4	0.461	-87.0	0.794	14.79
1.7	0.670	173.3	2.469	53.6	0.085	7.0	0.462	-90.6	0.849	14.62
1.8	0.675	169.4	2.320	49.9	0.083	6.9	0.457	-94.2	0.917	14.44
1.9	0.680	165.4	2.193	46.3	0.082	7.2	0.462	-98.1	0.967	14.29
2.0	0.684	161.4	2.063	42.4	0.080	7.5	0.460	-101.8	1.040	12.87
2.1	0.691	158.3	1.968	38.9	0.079	9.0	0.470	-105.9	1.064	12.41
2.2	0.695	154.9	1.861	35.5	0.078	10.3	0.472	-109.5	1.134	11.57
2.3	0.697	152.1	1.778	32.3	0.077	12.1	0.484	-113.3	1.177	11.10
2.4	0.705	149.1	1.694	28.8	0.076	13.9	0.487	-116.7	1.218	10.67
2.5	0.708	146.2	1.615	25.6	0.076	15.8	0.497	-120.4	1.257	10.24
2.6	0.716	143.6	1.537	22.7	0.076	18.1	0.503	-123.8	1.273	9.89
2.7	0.724	140.9	1.468	19.6	0.078	20.6	0.512	-127.6	1.250	9.71
2.8	0.732	138.6	1.403	16.7	0.082	21.5	0.516	-130.9	1.218	9.54
2.9	0.740	136.7	1.345	14.0	0.082	20.3	0.518	-133.7	1.229	9.27
3.0	0.736	133.9	1.296	11.3	0.081	21.9	0.520	-136.8	1.333	8.59

$V_{CE} = 3\text{ V}$, $I_C = 5\text{ mA}$, $Z_O = 50\ \Omega$

Frequency (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		K	MAG/MSG (dB)
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)		
0.1	0.838	-28.3	14.824	162.0	0.025	72.2	0.963	-15.4	0.102	27.76
0.2	0.805	-55.1	13.172	144.8	0.043	60.5	0.873	-29.1	0.120	24.91
0.3	0.755	-78.0	11.588	130.4	0.056	49.3	0.780	-39.8	0.181	23.16
0.4	0.711	-96.3	10.045	119.5	0.065	41.4	0.687	-48.4	0.241	21.92
0.5	0.682	-111.1	8.751	110.6	0.070	35.1	0.613	-54.8	0.301	20.97
0.6	0.659	-124.0	7.650	103.2	0.073	30.5	0.549	-60.2	0.364	20.19
0.7	0.643	-134.8	6.808	96.6	0.076	27.4	0.504	-64.4	0.423	19.53
0.8	0.631	-143.5	6.069	91.1	0.077	24.9	0.465	-68.6	0.491	18.99
0.9	0.628	-151.5	5.506	85.9	0.078	22.8	0.436	-72.2	0.546	18.51
1.0	0.625	-158.7	5.017	81.1	0.078	21.4	0.414	-76.0	0.602	18.09
1.1	0.626	-165.2	4.607	76.7	0.078	20.2	0.399	-79.5	0.654	17.71
1.2	0.625	-170.8	4.236	72.9	0.078	19.5	0.385	-83.2	0.713	17.33
1.3	0.630	-176.3	3.937	68.4	0.078	18.8	0.377	-86.4	0.757	17.01
1.4	0.632	-179.0	3.656	64.7	0.078	18.5	0.369	-90.2	0.818	16.69
1.5	0.635	-174.2	3.415	61.0	0.078	18.5	0.366	-93.4	0.868	16.40
1.6	0.639	-170.3	3.199	57.3	0.078	18.7	0.360	-97.2	0.925	16.12
1.7	0.646	-166.4	3.011	54.0	0.078	18.9	0.361	-100.7	0.964	15.86
1.8	0.651	-162.8	2.827	50.6	0.078	19.3	0.358	-104.4	1.020	14.72
1.9	0.655	-159.3	2.665	47.2	0.079	19.8	0.364	-108.1	1.058	13.84
2.0	0.659	-155.9	2.516	43.8	0.079	20.5	0.364	-111.8	1.106	13.04
2.1	0.670	-153.0	2.396	40.6	0.080	21.7	0.373	-115.7	1.108	12.76
2.2	0.672	-150.3	2.271	37.5	0.080	22.9	0.377	-119.1	1.158	12.10
2.3	0.676	-147.2	2.167	34.4	0.081	23.9	0.389	-122.5	1.177	11.71
2.4	0.684	-145.0	2.064	31.2	0.083	24.9	0.394	-125.7	1.189	11.34
2.5	0.688	-142.3	1.978	28.3	0.084	26.1	0.405	-129.0	1.198	11.03
2.6	0.694	-139.8	1.886	25.4	0.086	27.1	0.412	-132.0	1.205	10.67
2.7	0.703	-137.4	1.802	22.5	0.089	28.2	0.423	-135.6	1.180	10.49
2.8	0.713	-135.1	1.720	19.8	0.093	28.1	0.428	-138.8	1.152	10.32
2.9	0.720	-133.3	1.652	17.2	0.093	26.8	0.432	-141.6	1.157	10.07
3.0	0.716	-130.8	1.597	14.5	0.094	27.5	0.434	-144.4	1.220	9.49

$V_{CE} = 3\text{ V}$, $I_C = 7\text{ mA}$, $Z_O = 50\ \Omega$

Frequency (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		K	MAG/MSG (dB)
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)		
0.1	0.810	-33.1	18.981	159.3	0.022	68.5	0.943	-18.7	0.128	29.30
0.2	0.754	-63.1	16.372	140.6	0.040	57.5	0.828	-34.7	0.159	26.11
0.3	0.703	-88.1	13.946	126.0	0.051	47.1	0.717	-46.4	0.219	24.40
0.4	0.663	-106.8	11.785	115.2	0.057	40.4	0.615	-55.5	0.293	23.13
0.5	0.639	-121.6	10.092	106.7	0.061	35.1	0.539	-62.0	0.364	22.17
0.6	0.624	-133.6	8.735	99.9	0.064	31.4	0.477	-67.5	0.437	21.35
0.7	0.614	-144.0	7.702	93.7	0.066	29.5	0.433	-71.9	0.502	20.66
0.8	0.607	-151.9	6.827	88.6	0.067	28.0	0.397	-76.4	0.576	20.06
0.9	0.606	-159.2	6.169	83.9	0.069	26.6	0.371	-80.2	0.635	19.54
1.0	0.606	-166.0	5.598	79.3	0.070	26.1	0.351	-84.3	0.694	19.05
1.1	0.609	-171.7	5.128	75.3	0.070	25.7	0.338	-87.9	0.746	18.62
1.2	0.609	-177.0	4.698	71.6	0.071	25.6	0.327	-91.8	0.808	18.19
1.3	0.613	178.1	4.355	67.6	0.072	25.4	0.320	-95.2	0.853	17.80
1.4	0.617	173.8	4.045	64.0	0.073	25.7	0.314	-99.0	0.905	17.43
1.5	0.623	169.6	3.777	60.7	0.074	26.0	0.312	-102.3	0.942	17.07
1.6	0.627	165.8	3.537	57.3	0.075	26.3	0.307	-106.2	0.992	16.73
1.7	0.635	162.3	3.327	54.1	0.076	26.5	0.309	-109.7	1.018	15.58
1.8	0.639	159.1	3.124	51.0	0.077	27.1	0.308	-113.5	1.064	14.52
1.9	0.644	155.6	2.946	47.8	0.079	27.3	0.314	-117.2	1.092	13.89
2.0	0.649	152.5	2.780	44.6	0.080	28.1	0.316	-120.8	1.123	13.26
2.1	0.656	149.8	2.649	41.6	0.082	28.7	0.325	-124.4	1.126	12.92
2.2	0.662	147.1	2.507	38.6	0.084	29.4	0.331	-127.7	1.151	12.40
2.3	0.666	144.6	2.395	35.7	0.086	30.2	0.342	-130.8	1.160	12.04
2.4	0.673	142.1	2.281	32.6	0.087	30.6	0.347	-133.8	1.174	11.65
2.5	0.679	139.8	2.187	29.7	0.090	31.2	0.359	-136.8	1.167	11.40
2.6	0.684	137.6	2.089	27.1	0.092	31.5	0.366	-139.6	1.168	11.06
2.7	0.692	135.1	2.001	24.3	0.096	32.1	0.378	-142.7	1.151	10.85
2.8	0.700	132.9	1.909	21.6	0.099	31.6	0.384	-145.9	1.132	10.62
2.9	0.711	131.1	1.838	18.9	0.101	30.2	0.388	-148.6	1.120	10.52
3.0	0.707	128.8	1.778	16.6	0.101	30.4	0.390	-151.3	1.172	9.94

$V_{CE} = 3\text{ V}$, $I_C = 10\text{ mA}$, $Z_O = 50\ \Omega$

Frequency (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		K	MAG/MSG (dB)
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)		
0.1	0.750	-39.3	23.934	156.0	0.022	67.6	0.918	-22.9	0.142	30.39
0.2	0.689	-73.0	19.813	135.8	0.037	54.3	0.774	-41.0	0.210	27.30
0.3	0.653	-99.4	16.269	121.1	0.045	45.2	0.646	-53.7	0.274	25.56
0.4	0.623	-118.0	13.426	111.1	0.050	39.8	0.543	-63.3	0.358	24.27
0.5	0.605	-132.2	11.340	103.0	0.053	35.6	0.469	-70.0	0.443	23.28
0.6	0.596	-143.3	9.711	96.7	0.056	33.7	0.411	-76.0	0.524	22.39
0.7	0.588	-152.5	8.486	91.0	0.058	32.7	0.370	-80.6	0.602	21.66
0.8	0.590	-160.0	7.507	86.4	0.059	32.1	0.338	-85.5	0.671	21.01
0.9	0.591	-166.6	6.758	81.9	0.061	31.6	0.316	-89.6	0.731	20.43
1.0	0.590	-172.5	6.112	77.8	0.063	31.9	0.300	-94.2	0.793	19.87
1.1	0.597	-177.9	5.593	74.0	0.064	32.0	0.289	-98.0	0.839	19.38
1.2	0.598	177.4	5.135	70.6	0.066	32.3	0.281	-102.4	0.892	18.89
1.3	0.605	173.0	4.742	67.0	0.068	32.4	0.276	-105.9	0.927	18.43
1.4	0.610	168.9	4.398	63.6	0.070	32.7	0.271	-110.0	0.969	17.99
1.5	0.616	165.3	4.101	60.5	0.072	33.1	0.271	-113.2	0.998	17.57
1.6	0.620	161.7	3.837	57.3	0.074	33.3	0.269	-117.2	1.036	16.00
1.7	0.626	158.7	3.610	54.2	0.076	33.5	0.272	-120.7	1.055	15.35
1.8	0.631	155.6	3.393	51.3	0.078	33.8	0.272	-124.5	1.090	14.58
1.9	0.637	152.5	3.198	48.3	0.080	33.8	0.280	-128.0	1.102	14.07
2.0	0.642	149.3	3.017	45.3	0.082	34.1	0.283	-131.5	1.126	13.48
2.1	0.649	146.9	2.872	42.3	0.085	34.4	0.293	-134.8	1.127	13.13
2.2	0.656	144.3	2.723	39.6	0.087	34.8	0.299	-137.8	1.138	12.68
2.3	0.659	142.1	2.601	36.7	0.090	35.0	0.310	-140.7	1.139	12.34
2.4	0.665	139.6	2.480	33.8	0.092	35.0	0.316	-143.3	1.148	11.96
2.5	0.671	137.6	2.376	31.1	0.095	35.3	0.327	-145.8	1.142	11.70
2.6	0.676	135.3	2.273	28.7	0.098	35.2	0.334	-148.3	1.141	11.37
2.7	0.685	133.1	2.175	26.0	0.102	35.2	0.346	-151.2	1.122	11.18
2.8	0.694	131.0	2.081	23.3	0.106	34.3	0.354	-154.2	1.102	11.00
2.9	0.703	129.3	1.998	20.7	0.107	32.7	0.359	-156.9	1.101	10.79
3.0	0.700	126.9	1.937	18.5	0.108	32.7	0.360	-159.3	1.136	10.29
4.0	0.751	109.1	1.355	-3.1	0.130	28.2	0.437	176.8	1.142	7.90

$V_{CE} = 3\text{ V}$, $I_C = 20\text{ mA}$, $Z_O = 50\ \Omega$

Frequency (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		K	MAG/MSG (dB)
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)		
0.1	0.610	-55.9	34.181	148.7	0.019	62.1	0.853	-31.8	0.209	32.56
0.2	0.594	-95.5	25.762	126.9	0.030	51.6	0.661	-53.8	0.289	29.37
0.3	0.582	-121.8	19.844	113.1	0.035	45.1	0.522	-67.9	0.396	27.48
0.4	0.571	-138.1	15.813	104.3	0.039	42.0	0.426	-78.4	0.511	26.04
0.5	0.568	-149.8	13.058	97.2	0.042	40.8	0.362	-85.9	0.610	24.92
0.6	0.568	-159.1	11.068	91.9	0.045	40.3	0.317	-92.9	0.699	23.95
0.7	0.570	-166.4	9.596	87.1	0.047	41.0	0.286	-98.5	0.772	23.07
0.8	0.572	-172.4	8.436	83.0	0.050	41.8	0.265	-104.5	0.841	22.28
0.9	0.577	-177.6	7.564	79.1	0.053	42.3	0.250	-109.5	0.887	21.56
1.0	0.580	177.3	6.829	75.5	0.056	42.7	0.241	-114.9	0.931	20.87
1.1	0.587	173.1	6.229	72.2	0.059	43.1	0.236	-118.9	0.964	20.27
1.2	0.588	169.2	5.712	69.1	0.062	43.5	0.234	-123.9	1.000	19.53
1.3	0.597	165.7	5.260	65.8	0.065	43.5	0.232	-127.2	1.020	18.24
1.4	0.600	162.2	4.873	62.8	0.068	43.6	0.233	-131.6	1.048	17.23
1.5	0.609	158.9	4.542	59.9	0.071	43.8	0.235	-134.4	1.058	16.59
1.6	0.615	155.8	4.241	57.1	0.074	43.5	0.236	-138.6	1.074	15.91
1.7	0.622	153.2	3.994	54.4	0.077	43.5	0.242	-141.6	1.081	15.41
1.8	0.627	150.4	3.752	51.7	0.080	43.2	0.245	-145.3	1.097	14.80
1.9	0.633	147.6	3.533	48.9	0.084	42.6	0.255	-148.2	1.102	14.31
2.0	0.637	145.1	3.337	46.1	0.087	42.3	0.260	-151.1	1.115	13.79
2.1	0.647	142.7	3.173	43.4	0.090	42.0	0.270	-153.7	1.106	13.49
2.2	0.652	140.4	3.007	41.0	0.094	41.7	0.277	-156.2	1.111	13.04
2.3	0.654	138.2	2.871	38.3	0.097	41.4	0.288	-158.2	1.116	12.66
2.4	0.661	136.1	2.741	35.6	0.100	41.0	0.295	-160.5	1.113	12.34
2.5	0.669	134.0	2.630	33.1	0.103	40.4	0.305	-162.2	1.103	12.12
2.6	0.673	132.0	2.516	30.8	0.107	39.7	0.311	-164.2	1.101	11.78
2.7	0.681	129.9	2.414	28.2	0.111	39.3	0.324	-166.3	1.085	11.62
2.8	0.690	128.0	2.311	25.6	0.114	38.1	0.332	-169.0	1.073	11.41
2.9	0.698	126.6	2.219	23.2	0.116	36.5	0.338	-171.5	1.071	11.19
3.0	0.695	124.3	2.152	21.1	0.118	36.0	0.338	-173.8	1.098	10.72
4.0	0.742	107.1	1.524	0.8	0.140	27.9	0.406	166.3	1.114	8.32

$V_{CE} = 3\text{ V}$, $I_C = 30\text{ mA}$, $Z_O = 50\ \Omega$

Frequency (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		K	MAG/MSG (dB)
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)		
0.1	0.544	-66.7	39.410	144.7	0.017	62.8	0.809	-36.9	0.227	33.67
0.2	0.549	-107.7	28.114	122.6	0.027	50.3	0.600	-60.6	0.362	30.19
0.3	0.560	-132.6	21.063	109.4	0.031	45.9	0.464	-75.3	0.480	28.33
0.4	0.560	-147.0	16.586	101.3	0.035	44.6	0.377	-86.3	0.599	26.77
0.5	0.557	-157.7	13.593	94.8	0.038	44.1	0.322	-94.2	0.705	25.56
0.6	0.564	-165.9	11.461	89.9	0.041	44.6	0.283	-101.9	0.788	24.51
0.7	0.565	-172.1	9.910	85.4	0.044	46.1	0.258	-107.9	0.855	23.52
0.8	0.571	-177.5	8.708	81.7	0.047	46.8	0.242	-114.3	0.912	22.68
0.9	0.574	177.5	7.797	77.9	0.050	47.3	0.231	-119.5	0.952	21.90
1.0	0.583	173.3	7.035	74.5	0.054	47.9	0.227	-125.1	0.982	21.17
1.1	0.587	169.5	6.397	71.3	0.057	48.0	0.223	-129.1	1.008	19.94
1.2	0.590	166.0	5.861	68.5	0.061	48.3	0.225	-133.9	1.034	18.71
1.3	0.598	162.4	5.405	65.1	0.064	48.1	0.225	-137.0	1.047	17.93
1.4	0.603	159.3	5.003	62.4	0.068	48.1	0.227	-141.3	1.067	17.11
1.5	0.610	156.3	4.649	59.6	0.071	48.0	0.230	-143.9	1.075	16.47
1.6	0.614	153.3	4.360	56.9	0.075	47.7	0.233	-147.9	1.088	15.84
1.7	0.624	150.9	4.100	54.1	0.078	47.0	0.240	-150.4	1.086	15.42
1.8	0.630	148.5	3.850	51.6	0.082	46.7	0.244	-154.0	1.094	14.86
1.9	0.635	145.7	3.630	49.0	0.085	45.9	0.254	-156.4	1.099	14.37
2.0	0.639	143.1	3.425	46.3	0.089	45.2	0.261	-159.1	1.108	13.86
2.1	0.646	140.9	3.256	43.7	0.092	44.8	0.271	-161.4	1.104	13.50
2.2	0.652	139.0	3.086	41.3	0.096	44.2	0.278	-163.6	1.104	13.10
2.3	0.657	136.7	2.947	38.7	0.100	43.6	0.289	-165.4	1.103	12.76
2.4	0.664	134.5	2.813	36.1	0.103	43.0	0.295	-167.4	1.101	12.44
2.5	0.668	132.8	2.698	33.7	0.106	42.4	0.305	-168.8	1.098	12.16
2.6	0.671	130.7	2.584	31.4	0.110	41.4	0.311	-170.7	1.097	11.81
2.7	0.682	128.6	2.478	28.8	0.114	40.7	0.323	-172.5	1.078	11.68
2.8	0.691	126.6	2.371	26.4	0.118	39.5	0.332	-175.0	1.066	11.47
2.9	0.701	125.0	2.279	23.9	0.119	37.8	0.339	-177.3	1.060	11.31
3.0	0.697	123.1	2.211	22.0	0.121	37.3	0.339	-179.6	1.087	10.82
4.0	0.745	106.2	1.573	2.1	0.144	28.1	0.402	161.8	1.099	8.48

$V_{CE} = 3\text{ V}$, $I_C = 40\text{ mA}$, $Z_O = 50\ \Omega$

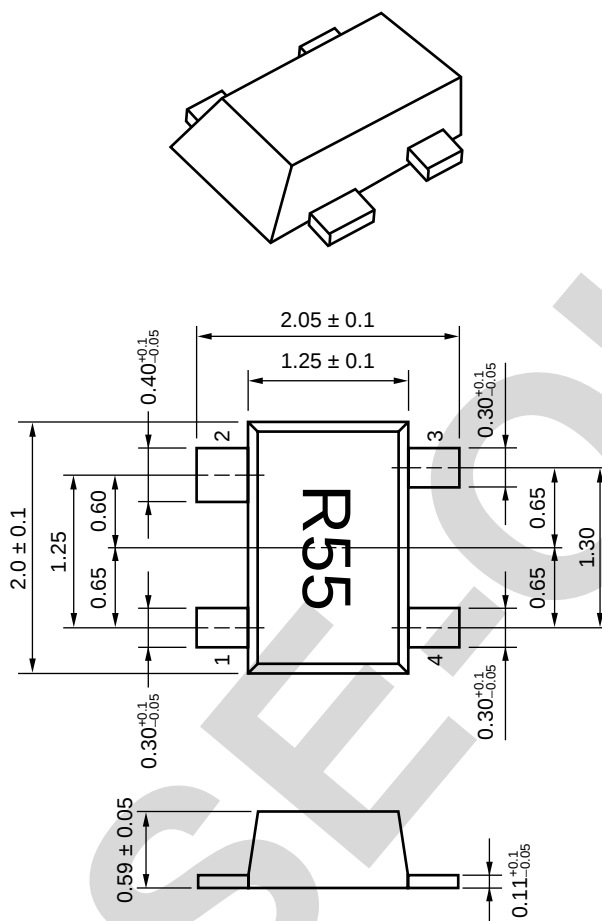
Frequency (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		K	MAG/MSG (dB)
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)		
0.1	0.527	-73.8	42.107	142.0	0.017	60.5	0.775	-40.3	0.260	34.03
0.2	0.537	-116.7	29.136	119.9	0.025	50.6	0.560	-64.8	0.401	30.75
0.3	0.553	-139.2	21.480	107.4	0.029	46.4	0.429	-79.7	0.534	28.70
0.4	0.553	-152.3	16.778	99.6	0.032	46.3	0.349	-91.0	0.665	27.15
0.5	0.560	-162.1	13.713	93.5	0.035	46.6	0.299	-99.1	0.761	25.89
0.6	0.567	-169.6	11.529	88.7	0.039	47.9	0.266	-107.2	0.839	24.73
0.7	0.572	-175.5	9.975	84.4	0.042	48.8	0.244	-113.3	0.894	23.72
0.8	0.575	179.6	8.750	80.8	0.046	49.7	0.231	-119.9	0.946	22.80
0.9	0.580	175.2	7.828	77.2	0.049	50.1	0.222	-125.0	0.981	22.01
1.0	0.585	171.1	7.054	73.7	0.053	50.7	0.220	-130.4	1.007	20.69
1.1	0.591	167.5	6.420	70.7	0.057	50.8	0.218	-134.4	1.030	19.47
1.2	0.594	164.1	5.889	68.0	0.061	50.8	0.220	-139.1	1.048	18.53
1.3	0.601	160.8	5.422	64.7	0.064	50.4	0.222	-141.9	1.061	17.76
1.4	0.607	157.8	5.014	62.0	0.068	50.5	0.225	-146.1	1.077	16.99
1.5	0.615	154.8	4.662	59.3	0.072	50.0	0.229	-148.5	1.079	16.41
1.6	0.619	152.1	4.368	56.6	0.075	49.7	0.233	-152.2	1.091	15.79
1.7	0.627	149.8	4.108	54.0	0.079	48.9	0.240	-154.7	1.091	15.33
1.8	0.632	147.2	3.862	51.5	0.083	48.3	0.245	-158.0	1.098	14.79
1.9	0.637	144.7	3.631	48.9	0.086	47.4	0.255	-160.3	1.105	14.28
2.0	0.642	142.2	3.434	46.2	0.090	46.8	0.262	-162.9	1.106	13.82
2.1	0.652	140.1	3.263	43.7	0.093	46.1	0.272	-165.0	1.101	13.50
2.2	0.656	138.2	3.094	41.4	0.097	45.5	0.280	-167.1	1.103	13.07
2.3	0.661	135.9	2.953	38.7	0.101	44.7	0.290	-168.7	1.100	12.74
2.4	0.665	133.9	2.821	36.1	0.104	44.1	0.296	-170.7	1.101	12.39
2.5	0.672	131.9	2.704	33.7	0.108	43.4	0.306	-172.0	1.094	12.13
2.6	0.675	129.9	2.586	31.6	0.112	42.4	0.313	-173.8	1.095	11.77
2.7	0.687	128.0	2.480	29.1	0.116	41.6	0.324	-175.4	1.072	11.68
2.8	0.695	125.9	2.377	26.6	0.119	40.3	0.334	-177.9	1.063	11.45
2.9	0.704	124.7	2.280	24.2	0.121	38.7	0.340	179.9	1.058	11.26
3.0	0.702	122.4	2.219	22.1	0.123	38.0	0.341	177.6	1.078	10.86
4.0	0.744	106.0	1.573	2.7	0.146	28.2	0.403	159.7	1.102	8.38

$V_{CE} = 3\text{ V}$, $I_C = 80\text{ mA}$, $Z_O = 50\ \Omega$

Frequency (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		K	MAG/MSG (dB)
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)		
0.1	0.476	-99.1	42.800	135.1	0.016	56.9	0.663	-48.2	0.364	34.30
0.2	0.542	-135.9	27.390	113.7	0.022	48.4	0.449	-73.5	0.529	30.92
0.3	0.574	-153.8	19.547	102.4	0.025	48.0	0.340	-88.2	0.682	28.87
0.4	0.588	-164.1	15.094	95.5	0.029	48.9	0.279	-99.7	0.796	27.13
0.5	0.591	-171.7	12.238	90.0	0.032	50.5	0.242	-107.6	0.898	25.76
0.6	0.598	-177.5	10.240	85.7	0.036	51.6	0.220	-115.7	0.968	24.53
0.7	0.605	177.5	8.834	81.7	0.040	53.4	0.207	-121.6	1.013	22.74
0.8	0.609	173.6	7.729	78.2	0.044	54.0	0.201	-128.2	1.054	21.04
0.9	0.612	169.8	6.920	74.8	0.048	54.5	0.197	-132.8	1.080	19.89
1.0	0.618	166.0	6.227	71.5	0.052	54.9	0.199	-137.9	1.098	18.89
1.1	0.624	163.0	5.666	68.6	0.056	54.7	0.201	-141.2	1.111	18.05
1.2	0.628	159.9	5.192	65.8	0.060	54.6	0.206	-145.4	1.122	17.25
1.3	0.635	157.0	4.765	62.8	0.064	54.2	0.209	-147.7	1.131	16.54
1.4	0.639	154.4	4.422	60.0	0.068	53.7	0.215	-151.5	1.141	15.87
1.5	0.649	151.7	4.111	57.4	0.072	53.2	0.221	-153.4	1.136	15.34
1.6	0.651	149.2	3.845	54.7	0.076	52.6	0.226	-156.9	1.146	14.74
1.7	0.657	146.8	3.613	52.2	0.079	51.7	0.235	-158.9	1.146	14.26
1.8	0.664	144.4	3.397	49.6	0.083	51.0	0.241	-161.9	1.149	13.77
1.9	0.669	141.9	3.199	47.0	0.087	50.0	0.252	-163.9	1.147	13.31
2.0	0.674	139.7	3.018	44.5	0.091	49.1	0.260	-166.3	1.147	12.85
2.1	0.680	137.7	2.865	41.9	0.095	48.3	0.271	-168.1	1.144	12.49
2.2	0.687	135.6	2.719	39.5	0.099	47.6	0.280	-170.0	1.140	12.12
2.3	0.687	133.7	2.592	36.9	0.103	46.8	0.291	-171.5	1.147	11.70
2.4	0.693	131.8	2.475	34.3	0.106	46.1	0.299	-173.3	1.143	11.38
2.5	0.700	129.8	2.369	32.0	0.110	45.1	0.308	-174.5	1.131	11.14
2.6	0.703	127.9	2.272	29.8	0.114	44.1	0.316	-176.2	1.129	10.82
2.7	0.712	125.9	2.177	27.3	0.118	43.0	0.327	-177.8	1.110	10.65
2.8	0.721	124.1	2.082	24.9	0.122	41.7	0.337	179.9	1.098	10.42
2.9	0.729	122.7	2.004	22.4	0.124	40.1	0.345	178.0	1.088	10.28
3.0	0.724	120.6	1.943	20.4	0.126	39.5	0.346	175.7	1.119	9.79

PACKAGE DIMENSIONS

FLAT-LEAD 4-PIN THIN-TYPE SUPER MINIMOLD (UNIT: mm)



PIN CONNECTIONS

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

NOTICE

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. California Eastern Laboratories and Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
2. California Eastern Laboratories has used reasonable care in preparing the information included in this document, but California Eastern Laboratories does not warrant that such information is error free. California Eastern Laboratories and Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
3. California Eastern Laboratories and Renesas Electronics do not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of California Eastern Laboratories or Renesas Electronics or others.
4. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part. California Eastern Laboratories and Renesas Electronics assume no responsibility for any losses incurred by you or third parties arising from such alteration, modification, copy or otherwise misappropriation of Renesas Electronics product.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots etc. "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; and safety equipment etc. Renesas Electronics products are neither intended nor authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems, surgical implantations etc.), or may cause serious property damages (nuclear reactor control systems, military equipment etc.). You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application for which it is not intended. California Eastern Laboratories and Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for which the product is not intended by California Eastern Laboratories or Renesas Electronics.
6. You should use the Renesas Electronics products described in this document within the range specified by California Eastern Laboratories, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. California Eastern Laboratories shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or systems manufactured by you.
8. Please contact a California Eastern Laboratories sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. California Eastern Laboratories and Renesas Electronics assume no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You should not use Renesas Electronics products or technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. When exporting the Renesas Electronics products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations.
10. It is the responsibility of the buyer or distributor of California Eastern Laboratories, who distributes, disposes of, or otherwise places the Renesas Electronics product with a third party, to notify such third party in advance of the contents and conditions set forth in this document, California Eastern Laboratories and Renesas Electronics assume no responsibility for any losses incurred by you or third parties as a result of unauthorized use of Renesas Electronics products.
11. This document may not be reproduced or duplicated in any form, in whole or in part, without prior written consent of California Eastern Laboratories.
12. Please contact a California Eastern Laboratories sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

NOTE 1: "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

NOTE 2: "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

NOTE 3: Products and product information are subject to change without notice.

CEL Headquarters • 4590 Patrick Henry Drive, Santa Clara, CA 95054 • Phone (408) 919-2500 • www.cel.com

For a complete list of sales offices, representatives and distributors,
Please visit our website: www.cel.com/contactus