CEL

SILICON TRANSISTOR

NE68019 / 2SC5008

JEITA Part No.

NPN SILICON EPITAXIAL TRANSISTOR
3 PINS ULTRA SUPER MINI MOLD

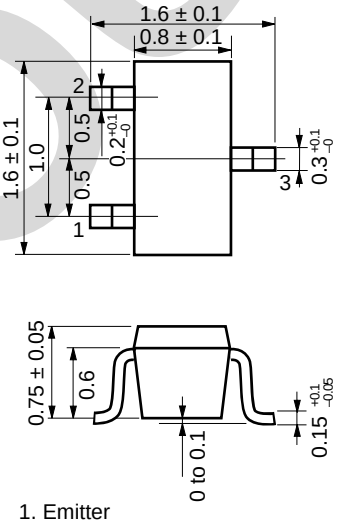
PHASE-OUT

DESCRIPTION

The NE68019 / 2SC5008 is an NPN epitaxial silicon transistor designed for use in low noise and small signal amplifiers from VHF band to L band. Low noise figure, high gain, and high current capability achieve a very wide dynamic range and excellent linearity. This is achieved by direct nitride passivated base surface, process (NEST2 process) which is a proprietary fabrication technique.

PACKAGE DIMENSIONS

in millimeters



1. Emitter
2. Base
3. Collector

FEATURES

- Low Voltage Use.
- High f_T: 8.0 GHz TYP. (@ V_{CE} = 3 V, I_C = 5 mA, f = 2 GHz)
- Low C_{re}: 0.3 pF TYP. (@ V_{CE} = 3 V, I_E = 0, f = 1 MHz)
- Low NF: 1.9 dB TYP. (@ V_{CE} = 3 V, I_C = 5 mA, f = 2 GHz)
- High $|S_{21e}|^2$: 7.5 dB TYP. (@ V_{CE} = 3 V, I_C = 5 mA, f = 2 GHz)
- Ultra Super Mini Mold Package.

ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKING STYLE
NE68019-A 2SC5008-A	50 pcs./Unit	Embossed tape 8 mm wide. Pin3 (Collector) face to perforation side of the tape.
NE68019-T-A 2SC5008-T-A	3 kpcs./Reel	

***** To order evaluation samples, please contact your nearby sales office.
Unit sample quantity shall be 50 pcs.

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C)

Collector to Base Voltage	V_{CBO}	20	V
Collector to Emitter Voltage	V_{CEO}	10	V
Emitter to Base Voltage	V_{EBO}	1.5	V
Collector Current	I_C	35	mA
Total Power Dissipation	P_T	125 mW	
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	–65 to + 150	°C

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ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Collector Cutoff Current	I_{CBO}			1.0	μA	V_{CB} = 10 V, I_E = 0
Emitter Cutoff Current	I_{EBO}			1.0	μA	V_{EB} = 1 V, I_C = 0
DC Current Gain	h_{FE}	80		160		V_{CE} = 3 V, I_C = 5 mA*1
Gain Bandwidth Product	f_T	5.5	8.0		GHz	V_{CE} = 3 V, I_C = 5 mA
Feed-back Capacitance	C_{re}		0.3	0.7	pF	V_{CB} = 3 V, I_E = 0, f = 1 MHz*2
Insertion Power Gain	$\|S_{21e}\|^2$	5.5	7.5		dB	V_{CE} = 3 V, I_C = 5 mA, f = 2 GHz
Noise Figure	NF		1.9	3.2	dB	V_{CE} = 3 V, I_C = 5 mA, f = 2 GHz

***1** Pulse Measurement PW ≤ 350 μs, Duty Cycle ≤ 2 %

***2** The emitter terminal and the case shall be connected to the guard terminal of the three-terminal capacitance bridge.

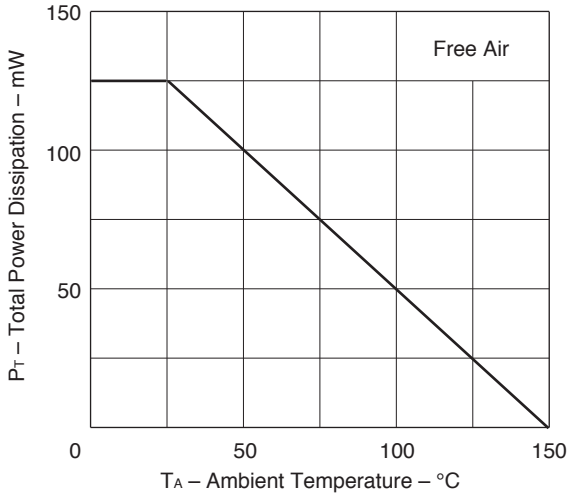
h_{FE} Classification

RANK	FB
Marking	44
h_{FE}	80 to 160

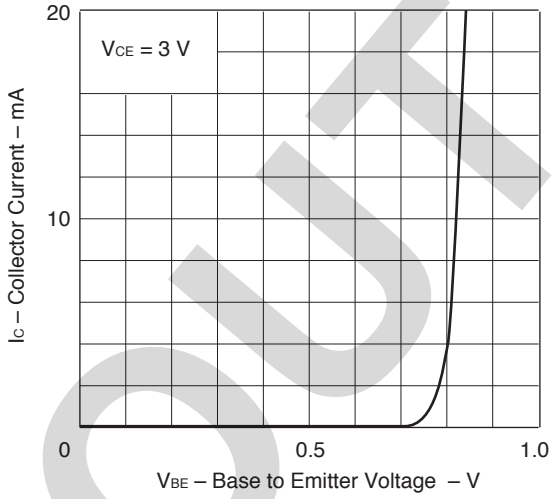
PHASE-OUT

TYPICAL CHARACTERISTICS (T_A = 25 °C)

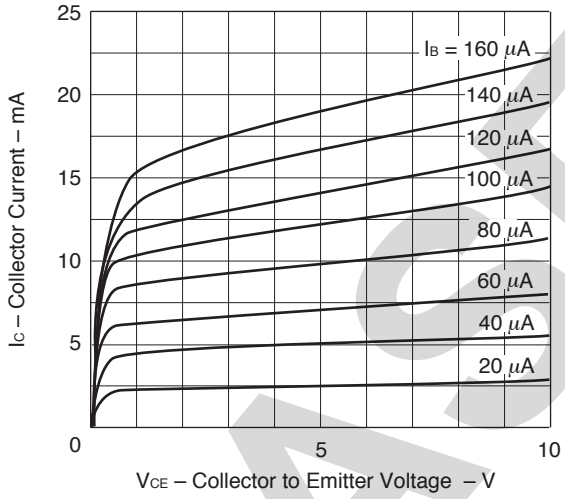
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



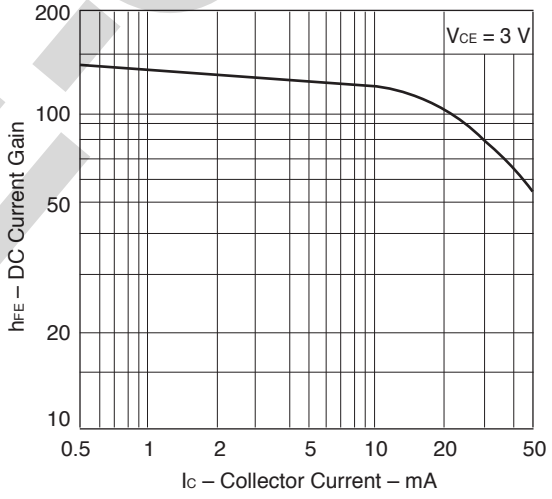
COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



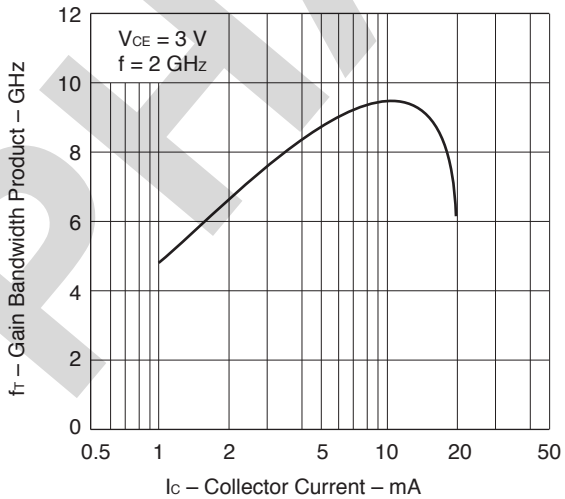
COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



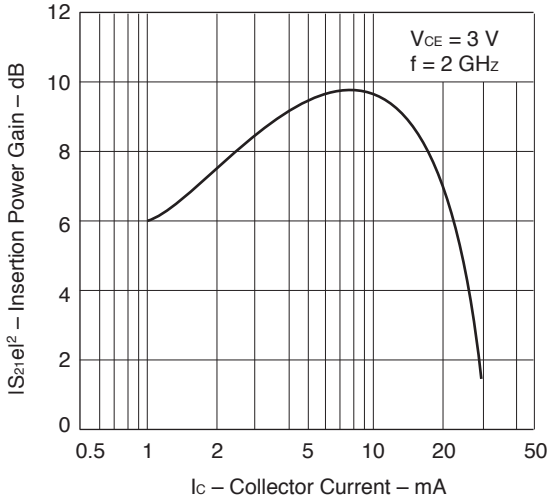
DC CURRENT GAIN vs. COLLECTOR CURRENT



GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT

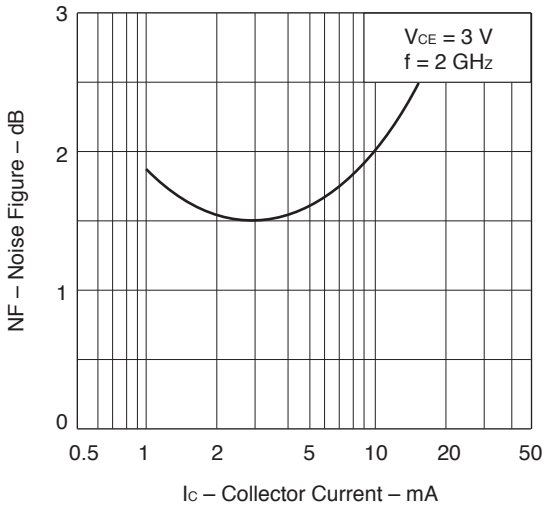


INSERTION POWER GAIN vs. COLLECTOR CURRENT

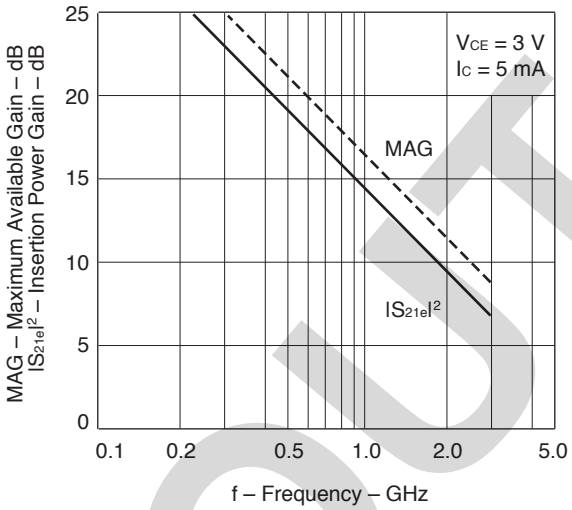


PHASE OUT

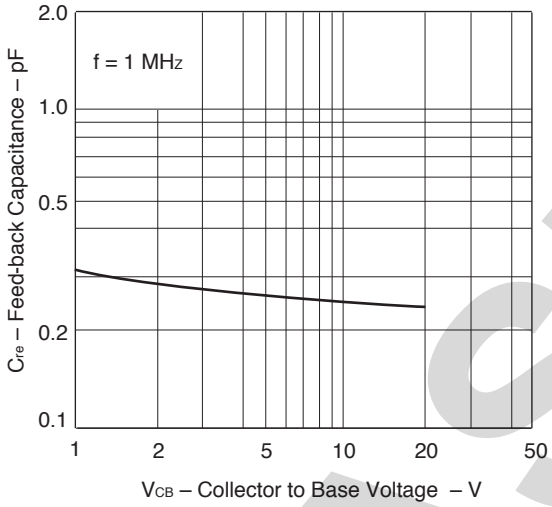
NOISE FIGURE vs. COLLECTOR CURRENT



MAXIMUM AVAILABLE GAIN, INSERTION POWER GAIN vs. FREQUENCY



FEED-BACK CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE



PHASE-OUT

S-PARAMETER

V_{CE} = 3 V, I_C = 10 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.739	–23.1	15.190	151.5	.016	74.9	.922	–13.6
200.00	.617	–45.5	13.966	131.9	.027	63.0	.804	–22.2
300.00	.507	–64.6	12.474	115.9	.035	57.3	.699	–25.8
400.00	.414	–81.0	10.826	102.7	.042	51.8	.632	–27.3
500.00	.344	–94.7	9.421	91.8	.049	49.7	.583	–28.1
600.00	.296	–105.9	8.147	82.9	.055	47.0	.550	–28.1
700.00	.260	–116.6	7.211	74.9	.062	44.4	.525	–28.3
800.00	.236	–126.3	6.434	67.7	.068	41.8	.506	–28.7
900.00	.218	–136.2	5.806	60.9	.075	39.1	.490	–28.9
1000.00	.205	–144.8	5.288	54.6	.083	36.4	.477	–29.6
1100.00	.199	–153.1	4.864	48.6	.089	33.4	.466	–29.9
1200.00	.194	–161.6	4.500	42.7	.096	30.2	.457	–31.0
1300.00	.193	–168.9	4.191	37.0	.102	27.7	.449	–31.7
1400.00	.194	–175.6	3.908	31.4	.111	24.2	.441	–32.8
1500.00	.196	178.7	3.680	26.2	.118	21.0	.435	–33.9
1600.00	.202	173.5	3.489	20.7	.125	17.6	.429	–35.5
1700.00	.214	167.9	3.317	15.0	.133	12.6	.417	–37.2
1800.00	.222	161.7	3.154	9.6	.139	9.4	.406	–38.2
1900.00	.229	156.3	2.994	4.2	.145	6.0	.397	–39.4
2000.00	.237	151.7	2.857	–1.0	.152	2.6	.390	–40.5
2100.00	.246	147.5	2.748	–6.1	.159	–.9	.381	–42.1
2200.00	.253	144.6	2.626	–11.1	.167	–4.6	.374	–43.6
2300.00	.263	140.9	2.539	–16.2	.174	–8.0	.366	–45.2
2400.00	.271	137.9	2.445	–21.3	.182	–11.6	.357	–46.8
2500.00	.283	134.8	2.363	–26.3	.190	–15.2	.347	–48.4
2600.00	.292	132.0	2.288	–31.4	.197	–19.2	.338	–50.6
2700.00	.303	129.7	2.218	–36.4	.204	–22.9	.328	–52.5
2800.00	.315	127.4	2.147	–41.4	.211	–26.7	.318	–54.8
2900.00	.326	125.0	2.085	–46.3	.220	–30.8	.309	–56.9
3000.00	.339	122.7	2.032	–51.2	.227	–34.2	.299	–59.5

V_{CE} = 3 V, I_C = 7 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.815	–17.7	11.972	155.6	.016	77.0	.947	–11.5
200.00	.732	–34.0	11.228	138.4	.029	63.4	.855	–20.4
300.00	.634	–50.1	10.480	123.5	.039	56.1	.757	–25.1
400.00	.539	–64.9	9.549	110.7	.047	51.8	.687	–27.9
500.00	.455	–78.9	8.722	99.0	.054	47.4	.630	–29.6
600.00	.392	–89.6	7.703	89.1	.060	44.0	.589	–30.5
700.00	.336	–100.4	6.951	80.3	.066	41.4	.557	–30.9
800.00	.297	–110.0	6.265	72.2	.073	38.5	.532	–31.5
900.00	.268	–119.5	5.700	64.9	.079	35.8	.511	–31.9
1000.00	.244	–128.0	5.221	58.3	.086	32.7	.494	–32.5
1100.00	.228	–136.6	4.802	51.8	.092	29.7	.480	–32.9
1200.00	.216	–145.2	4.479	45.5	.098	27.4	.468	–33.8
1300.00	.208	–153.4	4.169	39.6	.106	24.0	.459	–34.4
1400.00	.203	–160.8	3.900	33.9	.113	21.1	.449	–35.6
1500.00	.202	–167.7	3.674	28.2	.121	17.5	.440	–36.6
1600.00	.205	–173.8	3.478	22.7	.128	14.3	.433	–37.8
1700.00	.214	179.6	3.316	17.3	.135	10.2	.421	–39.7
1800.00	.219	172.5	3.153	11.6	.141	6.4	.409	–40.7
1900.00	.223	165.7	3.001	6.0	.146	3.5	.399	–41.7
2000.00	.230	160.0	2.874	.7	.153	0.0	.391	–43.0
2100.00	.236	155.4	2.753	–4.6	.160	–3.2	.382	–44.4
2200.00	.244	151.6	2.631	–9.6	.167	–6.9	.374	–45.7
2300.00	.254	147.1	2.548	–14.9	.174	–10.4	.365	–47.2
2400.00	.262	143.5	2.453	–20.0	.181	–13.8	.356	–49.0
2500.00	.273	140.2	2.370	–25.0	.189	–17.4	.346	–50.5
2600.00	.281	137.1	2.295	–30.2	.196	–21.0	.337	–52.7
2700.00	.293	134.1	2.228	–35.2	.203	–24.9	.328	–54.6
2800.00	.303	131.4	2.156	–40.2	.211	–28.3	.317	–56.7
2900.00	.315	128.6	2.092	–45.2	.218	–32.3	.307	–58.8
3000.00	.326	126.2	2.040	–50.1	.227	–36.1	.298	–61.4

PHASE-OUT

S-PARAMETER

V_{CE} = 3 V, I_C = 5 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.870	–13.9	9.067	158.8	.017	76.2	.964	–9.7
200.00	.809	–27.3	8.687	143.1	.031	65.8	.897	–17.8
300.00	.733	–40.3	8.368	129.3	.042	58.0	.814	–23.3
400.00	.661	–53.0	7.864	117.5	.052	51.2	.748	–27.0
500.00	.575	–66.1	7.479	106.3	.059	45.9	.687	–29.5
600.00	.510	–76.2	6.765	96.3	.066	41.4	.643	–31.2
700.00	.440	–87.2	6.297	86.6	.072	38.2	.604	–32.3
800.00	.387	–96.8	5.812	77.7	.078	34.7	.574	–33.3
900.00	.345	–106.1	5.365	69.7	.083	32.7	.547	–33.9
1000.00	.309	–114.9	4.964	62.4	.090	29.2	.527	–34.7
1100.00	.283	–123.3	4.616	55.4	.096	25.9	.509	–35.2
1200.00	.261	–131.9	4.298	49.0	.101	23.0	.493	–36.1
1300.00	.246	–139.7	4.032	42.4	.107	20.4	.481	–36.7
1400.00	.234	–147.4	3.784	36.7	.115	17.1	.471	–37.8
1500.00	.227	–154.7	3.568	30.8	.122	14.2	.460	–38.9
1600.00	.227	–161.3	3.385	25.0	.129	11.2	.450	–40.2
1700.00	.231	–168.9	3.230	19.1	.137	7.1	.438	–41.9
1800.00	.231	–176.7	3.069	13.5	.141	3.4	.425	–42.8
1900.00	.233	176.3	2.929	7.8	.148	.7	.413	–44.0
2000.00	.237	169.5	2.802	2.3	.153	–2.4	.405	–45.2
2100.00	.242	163.9	2.690	–3.0	.159	–6.1	.396	–46.5
2200.00	.247	159.4	2.583	–8.3	.166	–9.3	.387	–48.0
2300.00	.256	154.3	2.495	–13.6	.173	–12.8	.377	–49.5
2400.00	.264	150.1	2.404	–18.8	.179	–16.2	.367	–51.1
2500.00	.274	146.2	2.324	–23.9	.187	–19.3	.358	–52.7
2600.00	.282	142.3	2.251	–29.2	.194	–23.3	.348	–54.8
2700.00	.292	139.2	2.188	–34.3	.200	–26.9	.339	–56.8
2800.00	.303	135.9	2.117	–39.4	.207	–30.2	.328	–59.0
2900.00	.313	132.9	2.056	–44.5	.215	–34.1	.319	–60.9
3000.00	.325	130.0	2.003	–49.5	.223	–37.5	.309	–63.5

V_{CE} = 3 V, I_C = 3 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.936	–10.5	5.612	163.6	.017	79.6	.981	–7.1
200.00	.892	–20.4	5.628	148.9	.034	69.7	.944	–14.0
300.00	.842	–30.5	5.602	136.8	.048	60.6	.887	–19.3
400.00	.785	–41.2	5.393	126.0	.060	53.2	.837	–23.7
500.00	.732	–50.8	5.328	116.2	.069	46.4	.782	–27.2
600.00	.681	–59.2	4.924	106.6	.077	40.6	.740	–29.9
700.00	.618	–68.7	4.767	97.2	.084	35.8	.698	–32.0
800.00	.564	–77.9	4.575	88.0	.090	31.0	.663	–33.9
900.00	.510	–86.9	4.365	79.4	.094	27.0	.627	–35.2
1000.00	.459	–96.0	4.191	70.9	.100	23.5	.599	–36.5
1100.00	.413	–104.8	3.991	62.9	.106	19.8	.577	–37.5
1200.00	.375	–113.0	3.790	55.7	.110	17.1	.558	–38.5
1300.00	.350	–120.8	3.588	48.7	.116	14.2	.542	–39.6
1400.00	.325	–128.3	3.410	42.0	.121	11.1	.525	–40.8
1500.00	.307	–135.8	3.234	35.7	.126	7.8	.513	–41.8
1600.00	.295	–142.9	3.086	29.5	.134	4.9	.499	–43.2
1700.00	.289	–150.9	2.960	23.3	.140	1.0	.486	–44.8
1800.00	.283	–158.6	2.830	17.0	.143	–2.7	.471	–46.0
1900.00	.276	–166.4	2.707	11.2	.148	–5.6	.457	–47.1
2000.00	.273	–174.1	2.597	5.4	.153	–8.5	.448	–48.4
2100.00	.273	179.6	2.504	–.3	.159	–11.6	.435	–49.8
2200.00	.275	174.0	2.405	–5.9	.164	–14.4	.428	–51.3
2300.00	.280	167.8	2.332	–11.5	.170	–17.9	.417	–52.7
2400.00	.284	162.6	2.248	–16.9	.176	–20.9	.406	–54.2
2500.00	.292	157.7	2.177	–22.2	.182	–23.8	.396	–55.9
2600.00	.298	152.8	2.109	–27.6	.187	–27.3	.386	–57.9
2700.00	.307	148.7	2.051	–32.9	.194	–30.7	.376	–59.9
2800.00	.316	144.7	1.988	–38.1	.200	–33.8	.366	–61.8
2900.00	.326	140.9	1.934	–43.4	.207	–37.3	.356	–64.0
3000.00	.337	137.3	1.885	–48.6	.214	–40.5	.346	–66.6

PHASE OUT

S-PARAMETER

V_{CE} = 3 V, I_C = 1 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.986	–6.4	1.963	167.5	.019	82.2	.996	–4.0
200.00	.971	–13.0	2.022	157.2	.036	73.4	.987	–8.1
300.00	.958	–19.5	2.075	147.4	.053	66.7	.966	–11.8
400.00	.936	–26.5	2.082	137.6	.070	58.7	.953	–15.4
500.00	.914	–32.8	2.114	129.5	.084	52.1	.929	–18.7
600.00	.890	–39.0	2.011	120.8	.098	45.0	.909	–22.0
700.00	.859	–45.3	1.993	112.4	.109	38.5	.883	–24.9
800.00	.833	–51.7	1.967	103.7	.120	32.1	.859	–27.7
900.00	.801	–58.0	1.916	95.7	.127	25.8	.830	–30.5
1000.00	.769	–65.2	1.952	88.0	.137	20.2	.803	–33.0
1100.00	.732	–72.5	1.972	79.8	.143	14.4	.776	–35.0
1200.00	.693	–80.0	1.987	72.4	.148	9.7	.754	–37.1
1300.00	.663	–86.7	1.945	64.6	.154	4.5	.734	–39.0
1400.00	.626	–93.9	1.936	57.2	.157	–.1	.712	–41.1
1500.00	.596	–100.5	1.893	49.6	.162	–4.4	.693	–42.9
1600.00	.570	–107.2	1.852	42.8	.165	–8.3	.676	–44.6
1700.00	.542	–114.9	1.845	35.3	.170	–12.9	.660	–46.5
1800.00	.523	–121.5	1.786	28.6	.172	–17.5	.640	–48.3
1900.00	.497	–129.1	1.766	21.5	.174	–21.5	.622	–49.9
2000.00	.471	–137.3	1.746	14.6	.174	–25.3	.610	–51.7
2100.00	.456	–144.2	1.707	8.2	.174	–28.5	.595	–53.3
2200.00	.443	–151.0	1.661	1.6	.176	–31.9	.583	–55.0
2300.00	.430	–158.3	1.648	–4.8	.177	–35.1	.567	–56.8
2400.00	.424	–164.8	1.598	–10.9	.178	–38.1	.557	–58.6
2500.00	.419	–171.3	1.565	–17.0	.180	–40.5	.545	–60.5
2600.00	.414	–177.8	1.534	–23.1	.182	–43.6	.534	–62.6
2700.00	.412	176.4	1.504	–29.1	.183	–46.5	.523	–64.6
2800.00	.413	170.5	1.466	–34.9	.186	–48.7	.515	–66.9
2900.00	.414	164.7	1.442	–40.6	.189	–51.4	.504	–69.2
3000.00	.419	159.5	1.413	–46.3	.191	–53.5	.495	–71.7

V_{CE} = 1 V, I_C = 5 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.849	–19.1	8.397	156.6	.021	75.5	.949	–11.9
200.00	.764	–34.1	8.259	139.2	.037	63.8	.866	–21.8
300.00	.681	–49.1	7.901	125.1	.051	54.8	.767	–28.2
400.00	.612	–63.6	7.397	113.1	.060	48.4	.689	–32.3
500.00	.534	–78.0	7.006	101.8	.068	42.2	.623	–35.2
600.00	.473	–89.5	6.297	91.7	.076	38.7	.573	–37.0
700.00	.414	–101.5	5.833	82.2	.082	35.3	.531	–38.1
800.00	.371	–112.1	5.352	73.6	.089	31.9	.499	–39.2
900.00	.339	–122.2	4.924	65.7	.095	28.7	.472	–39.9
1000.00	.314	–131.4	4.557	58.5	.103	25.6	.448	–40.9
1100.00	.295	–140.2	4.219	51.6	.109	22.8	.429	–41.2
1200.00	.283	–148.3	3.935	45.2	.115	20.1	.414	–42.2
1300.00	.275	–156.2	3.672	38.8	.122	16.9	.398	–42.8
1400.00	.270	–163.3	3.448	32.9	.129	13.8	.385	–44.0
1500.00	.267	–170.3	3.242	26.9	.136	10.7	.374	–45.0
1600.00	.268	–176.4	3.081	21.1	.143	7.5	.362	–46.4
1700.00	.273	177.8	2.927	15.4	.153	3.9	.353	–47.9
1800.00	.280	172.2	2.783	9.6	.160	–.1	.340	–49.5
1900.00	.288	165.8	2.663	3.9	.165	–3.8	.326	–51.1
2000.00	.294	160.1	2.540	–1.7	.171	–6.8	.316	–52.2
2100.00	.301	155.4	2.445	–7.0	.177	–10.1	.304	–53.7
2200.00	.307	151.6	2.347	–12.4	.186	–13.8	.293	–55.4
2300.00	.317	147.3	2.260	–17.8	.192	–17.2	.284	–57.0
2400.00	324	143.6	2.177	–23.0	.199	–20.8	.272	–58.9
2500.00	.334	140.2	2.105	–28.2	.207	–23.9	.261	–60.8
2600.00	.345	137.0	2.037	–33.5	.214	–27.8	.251	–63.7
2700.00	.354	134.0	1.977	–38.6	.221	–31.4	.241	–65.9
2800.00	.365	131.0	1.913	–43.8	.228	–35.3	.230	–68.6
2900.00	.377	128.2	1.856	–48.9	.235	–39.0	.220	–71.2
3000.00	.387	125.5	1.808	–53.8	.244	–42.9	.210	–74.5

PHASE-OUT

S-PARAMETER

V_{CE} = 1 V, I_C = 3 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.928	–11.2	5.570	160.2	.022	78.7	.974	–8.7
200.00	.876	–22.9	5.562	146.9	.040	67.5	.928	–16.9
300.00	.821	–34.2	5.509	134.3	.057	57.4	.859	–23.0
400.00	.758	–45.7	5.289	123.2	.070	49.7	.798	–28.0
500.00	.705	–56.7	5.198	113.1	.081	43.3	.738	–32.0
600.00	.652	–66.1	4.787	103.2	.089	37.0	.689	–35.2
700.00	.588	–76.8	4.617	93.6	.097	31.9	.640	–37.5
800.00	.535	–87.1	4.406	84.1	.103	27.6	.601	–39.4
900.00	.484	–97.1	4.187	75.5	.108	23.9	.565	–41.0
1000.00	.438	–107.0	3.986	67.1	.115	20.3	.533	–42.6
1100.00	.401	–116.3	3.771	59.1	.120	16.5	.508	–43.6
1200.00	.371	–125.4	3.566	51.8	.125	13.4	.486	–44.7
1300.00	.350	–133.4	3.362	44.8	.131	10.3	.468	–45.7
1400.00	.333	–141.3	3.177	38.3	.137	7.0	.449	–47.2
1500.00	.320	–148.7	3.015	31.8	.143	4.1	.436	–48.3
1600.00	.312	–156.1	2.872	25.8	.149	1.1	.421	–49.7
1700.00	.310	–162.9	2.745	19.5	.157	–2.5	.408	–51.4
1800.00	.310	–170.2	2.623	13.4	.162	–6.5	.391	–52.9
1900.00	.309	–177.5	2.514	7.3	.165	–9.7	.377	–54.2
2000.00	.310	175.4	2.407	1.4	.171	–12.7	.366	–55.5
2100.00	.313	169.8	2.318	–4.2	.177	–16.1	.351	–57.2
2200.00	.317	164.9	2.227	–9.8	.182	–19.1	.343	–58.5
2300.00	.324	159.5	2.157	–15.4	.188	–22.3	.330	–60.4
2400.00	.331	155.0	2.076	–20.8	.194	–25.6	.319	–62.2
2500.00	.338	150.6	2.012	–26.2	.200	–28.8	.307	–64.1
2600.00	.346	146.5	1.947	–31.7	.207	–32.4	.296	–66.8
2700.00	.356	142.6	1.894	–36.9	.213	–35.6	.285	–69.0
2800.00	.365	139.0	1.833	–42.3	.220	–39.1	.274	–71.8
2900.00	.375	135.7	1.782	–47.5	.226	–42.7	.265	–74.3
3000.00	.386	132.4	1.737	–52.7	.234	–46.1	.254	–77.2

V_{CE} = 1 V, I_C = 1 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.983	–6.8	1.986	166.5	.022	83.1	.993	–4.6
200.00	.968	–14.0	2.016	156.0	.044	73.1	.983	–9.3
300.00	.952	–21.0	2.067	145.7	.064	65.2	.959	–13.6
400.00	.925	–28.5	2.064	135.9	.083	56.7	.942	–17.7
500.00	.904	–35.3	2.096	127.1	.100	49.8	.913	–21.6
600.00	.878	–41.8	1.992	118.1	.116	42.7	.889	–25.2
700.00	.844	–48.6	1.971	109.4	.129	35.5	.859	–28.5
800.00	.816	–55.6	1.945	100.6	.141	28.7	.829	–31.7
900.00	.782	–62.3	1.900	92.3	.151	22.5	.795	–34.8
1000.00	.749	–69.9	1.926	84.3	.159	16.3	.765	–37.4
1100.00	.709	–77.8	1.940	76.0	.166	11.1	.736	–39.7
1200.00	.673	–85.8	1.952	68.2	.172	5.8	.709	–42.0
1300.00	.639	–92.8	1.904	60.4	.178	.8	.686	–44.2
1400.00	.606	–100.6	1.889	52.8	.182	–3.9	.661	–46.3
1500.00	.578	–107.5	1.837	45.2	.185	–8.9	.641	–48.2
1600.00	.551	–114.6	1.801	38.0	.189	–12.8	.621	–50.2
1700.00	.526	–122.6	1.782	30.7	.195	–17.6	.603	–52.2
1800.00	.509	–129.5	1.727	23.8	.196	–22.3	.582	–54.4
1900.00	.487	–137.3	1.702	16.9	.196	–26.3	.562	–56.1
2000.00	.466	–145.4	1.674	9.8	.198	–30.1	.548	–57.9
2100.00	.454	–152.5	1.637	3.4	.198	–33.7	.530	–59.6
2200.00	.446	–159.2	1.590	–3.1	.199	–36.9	.519	–61.7
2300.00	.437	–166.3	1.571	–9.5	.200	–40.5	.502	–63.5
2400.00	.433	–172.8	1.520	–15.7	.201	–43.8	.490	–65.7
2500.00	.430	–179.0	1.488	–21.7	.201	–46.5	.477	–67.7
2600.00	.429	174.8	1.459	–27.8	.203	–49.3	.466	–70.0
2700.00	.429	169.2	1.425	–33.7	.204	–52.3	.453	–72.4
2800.00	.433	163.8	1.390	–39.5	.206	–55.1	.443	–75.1
2900.00	.437	158.6	1.363	–45.3	.208	–57.9	.431	–77.5
3000.00	.443	153.5	1.336	–50.9	.211	–60.2	.421	–80.5

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