NEC

SILICON TRANSISTOR
2SC5186

NPN EPITAXIAL SILICON TRANSISTOR IN ULTRA SUPER MINI-MOLD PACKAGE FOR LOW-NOISE MICROWAVE AMPLIFICATION

FEATURES

- Low Noise
  NF = 1.3 dB TYP. @ V_{CE} = 2 V, I_C = 3 mA, f = 2 GHz
  NF = 1.3 dB TYP. @ V_{CE} = 1 V, I_C = 3 mA, f = 2 GHz
- Ultra Super Mini-Mold package

ORDERING INFORMATION

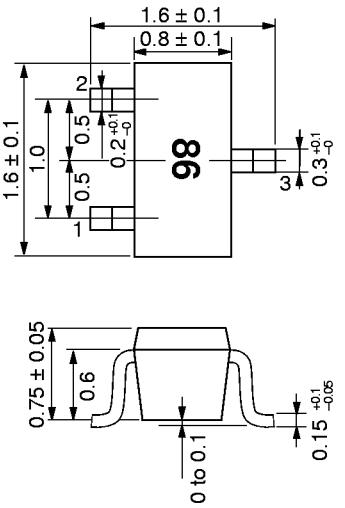
PART NUMBER	QUANTITY	ARRANGEMENT
2SC5186	50 units/box	Embossed tape, 8 mm wide, Pin 3 (Collector) facing the perforations.
2SC5186-T1	3 000 units/reel	

* Contact your NEC sales representatives to order samples for evaluation (available in batches of 50).

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C)

Collector to Base Voltage	V_{CBO}	5	V
Collector to Emitter Voltage	V_{CEO}	3	V
Emitter to Base Voltage	V_{EBO}	2	V
Collector Current	I_C	30	mA
Total Power Dissipation	P_T	90	mW
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	–65 to +150	°C

PACKAGE DIMENSIONS
(Units: mm)



PIN CONNECTIONS

1. Emitter
2. Base
3. Collector

Caution; This transistor uses high-frequency technology. Be careful not to allow excessive current to flow through the transistor, including static electricity.

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ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Collector Cutoff Current	I_{CBO}			100	nA	V_{CB} = 5 V, I_E = 0
Emitter Cutoff Current	I_{EBO}			100	nA	V_{EB} = 1 V, I_C = 0
DC Current Gain	h_{FE}	70		140		V_{CE} = 2 V, I_C = 20 mA*1
Insertion Power Gain (1)	$\|S_{21e}\|^2$	8.5	10		dB	V_{CE} = 2 V, I_C = 20 mA, f = 2 GHz
Insertion Power Gain (2)	$\|S_{21e}\|^2$	6.0	7.5		dB	V_{CE} = 1 V, I_C = 10 mA, f = 2 GHz
Noise Figure (1)	NF		1.3	2.0	dB	V_{CE} = 2 V, I_C = 3 mA, f = 2 GHz
Noise Figure (2)	NF		1.3	2.0	dB	V_{CE} = 1 V, I_C = 3 mA, f = 2 GHz
Gain Bandwidth Product (1)	f_T	9	11		GHz	V_{CE} = 2 V, I_C = 20 mA, f = 2 GHz
Gain Bandwidth Product (2)	f_T	7	9		GHz	V_{CE} = 1 V, I_C = 10 mA, f = 2 GHz
Feed-back Capacitance	C_{re}		0.4	0.8	pF	V_{CB} = 2 V, I_E = 0 mA, f = 1 MHz*2

***1** Measured with pulses: Pulse width ≤ 350 μs, duty clcye ≤ 2 %, pulsed.

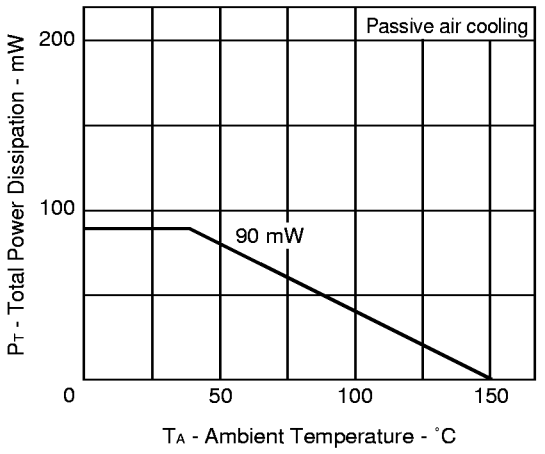
***2** Measured with a three-terminal bridge. The emitter and case terminal are connected to the guard terminal of the bridge.

h_{FE} Class

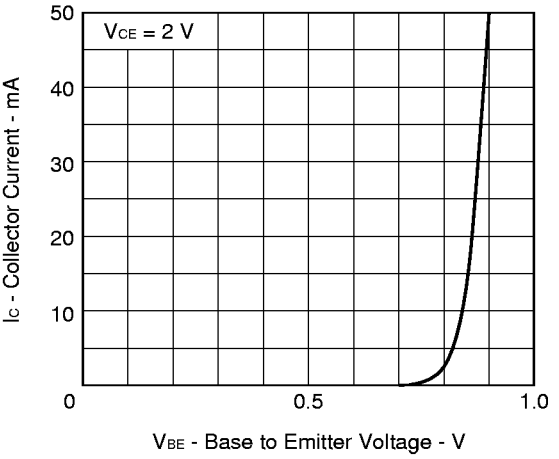
Class	FB
Marking	86
h_{FE}	70 to 140

CHARACTERISTICS CURVES (T_A = 25 °C)

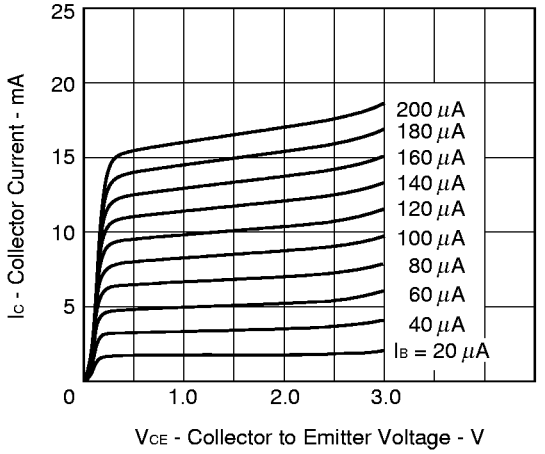
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



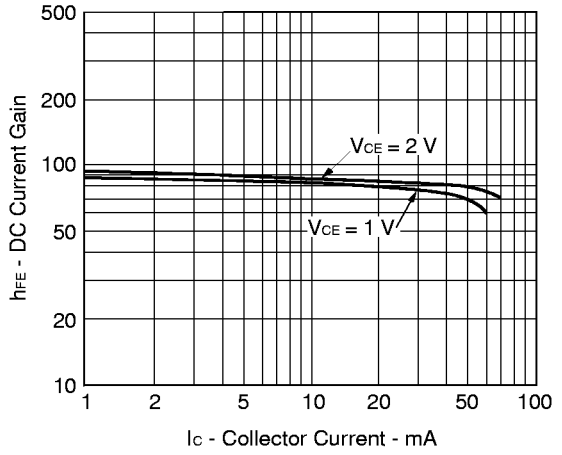
COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



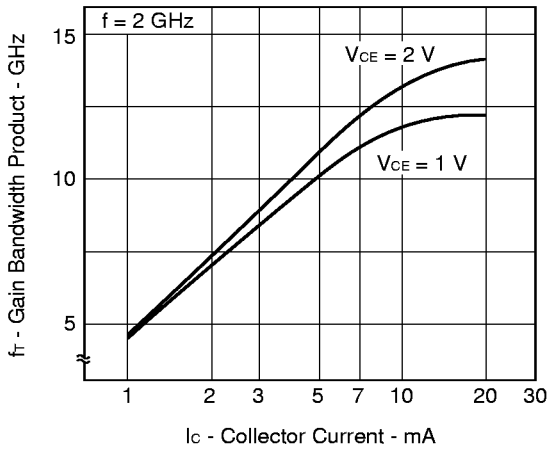
COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



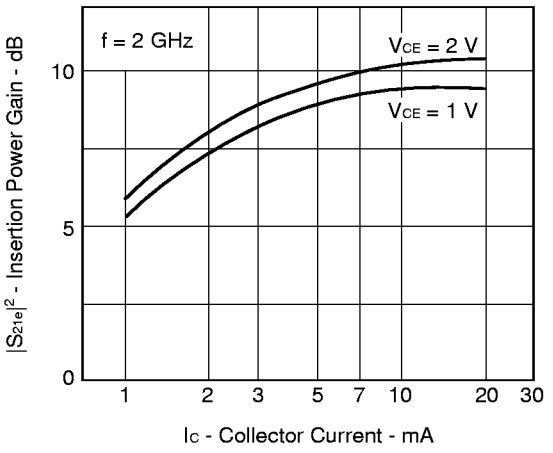
DC CURRENT GAIN vs. COLLECTOR CURRENT



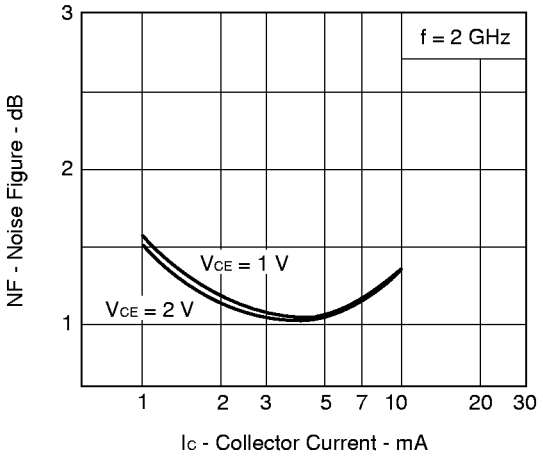
GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT



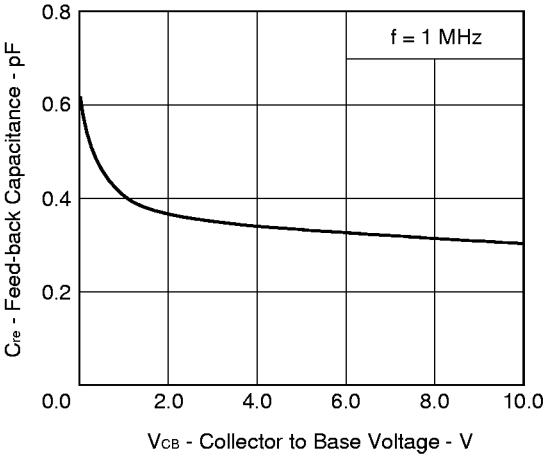
INSERTION POWER GAIN vs. COLLECTOR CURRENT



NOISE FIGURE
vs. COLLECTOR CURRENT



FEED-BACK CAPACITANCE
vs. COLLECTOR TO BASE VOLTAGE



S-PARAMETERS

V_{CE} = 1 V, I_C = 1 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.849	–51.2	3.157	134.7	0.121	55.5	0.898	–29.3
800.00	0.729	–67.5	2.868	121.5	0.162	47.2	0.797	–35.8
1000.00	0.661	–83.1	2.633	108.9	0.189	40.4	0.703	–43.2
1200.00	0.600	–96.6	2.501	99.1	0.202	35.1	0.664	–50.1
1400.00	0.546	–110.6	2.334	91.2	0.217	30.5	0.617	–55.0
1600.00	0.503	–125.3	2.147	82.3	0.231	27.5	0.567	–59.2
1800.00	0.479	–137.9	2.038	74.1	0.225	27.3	0.515	–63.8
2000.00	0.432	–151.1	1.862	68.4	0.222	24.8	0.481	–68.2
2200.00	0.408	–166.1	1.687	61.1	0.218	21.0	0.452	–72.9

V_{CE} = 1 V, I_C = 3 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.587	–77.1	6.278	117.3	0.094	47.5	0.675	–45.1
800.00	0.475	–96.8	5.167	104.5	0.120	44.7	0.544	–51.6
1000.00	0.402	–112.4	4.424	93.6	0.136	43.1	0.453	–58.0
1200.00	0.351	–127.9	3.969	86.1	0.151	42.8	0.409	–63.0
1400.00	0.319	–144.1	3.480	79.7	0.164	41.2	0.361	–66.8
1600.00	0.313	–158.2	3.106	72.4	0.179	41.7	0.325	–71.1
1800.00	0.305	–169.6	2.884	66.8	0.187	42.7	0.289	–76.7
2000.00	0.297	176.3	2.586	62.7	0.195	42.1	0.263	–80.5
2200.00	0.310	162.4	2.313	56.7	0.203	39.5	0.244	–87.2

V_{CE} = 1 V, I_C = 5 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.449	–91.8	7.506	109.0	0.081	47.3	0.545	–52.2
800.00	0.362	–113.0	5.961	97.4	0.102	50.2	0.428	–57.6
1000.00	0.302	–128.0	5.003	87.8	0.122	47.4	0.350	–63.2
1200.00	0.271	–144.6	4.408	81.5	0.138	49.3	0.314	–66.8
1400.00	0.257	–161.3	3.813	75.6	0.157	48.8	0.272	–71.0
1600.00	0.261	–173.5	3.389	69.1	0.172	48.1	0.243	–75.8
1800.00	0.266	176.1	3.125	64.3	0.186	48.7	0.216	–82.6
2000.00	0.272	163.7	2.795	60.7	0.196	48.4	0.196	–86.9
2200.00	0.293	151.0	2.492	55.2	0.206	45.3	0.181	–95.5

V_{CE} = 1 V, I_C = 7 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.363	–103.5	8.197	103.6	0.073	50.7	0.457	–56.6
800.00	0.305	–125.6	6.389	93.1	0.093	51.1	0.355	–61.0
1000.00	0.246	–140.7	5.312	84.4	0.116	52.8	0.286	–65.9
1200.00	0.233	–157.3	4.636	78.7	0.134	53.4	0.253	–68.6
1400.00	0.230	–174.1	3.987	73.3	0.154	53.2	0.223	–73.6
1600.00	0.242	176.0	3.540	67.1	0.174	51.5	0.195	–80.4
1800.00	0.248	166.7	3.255	62.8	0.188	52.0	0.174	–88.2
2000.00	0.262	154.8	2.904	59.5	0.199	51.7	0.158	–92.6
2200.00	0.287	144.5	2.584	54.3	0.210	48.4	0.146	–103.6

V_{CE} = 1 V, I_C = 10 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.299	–115.1	8.638	99.5	0.063	55.2	0.386	–60.1
800.00	0.259	–136.8	6.657	90.0	0.088	55.8	0.299	–63.7
1000.00	0.216	–153.1	5.505	81.9	0.114	54.9	0.239	–67.4
1200.00	0.211	–169.2	4.774	76.8	0.135	56.2	0.209	–70.6
1400.00	0.220	175.5	4.093	71.6	0.155	56.1	0.183	–75.3
1600.00	0.234	167.5	3.633	65.7	0.174	54.6	0.162	–83.7
1800.00	0.242	159.6	3.334	61.7	0.191	54.0	0.143	–93.4
2000.00	0.258	148.9	2.967	58.6	0.203	53.7	0.132	–99.4
2200.00	0.286	139.9	2.638	53.6	0.215	50.1	0.124	–112.4

V_{CE} = 1 V, I_C = 20 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.232	–144.0	8.936	93.2	0.061	59.1	0.267	–67.1
800.00	0.226	–160.4	6.790	85.0	0.087	61.6	0.206	–69.5
1000.00	0.204	–177.5	5.587	77.9	0.112	60.3	0.163	–73.6
1200.00	0.210	169.4	4.809	73.5	0.136	61.4	0.142	–77.2
1400.00	0.230	159.6	4.105	68.6	0.159	59.2	0.123	–85.0
1600.00	0.251	154.6	3.648	63.0	0.179	58.5	0.109	–96.4
1800.00	0.256	148.1	3.336	59.5	0.196	57.0	0.100	–110.7
2000.00	0.278	139.7	2.965	56.7	0.209	55.9	0.094	–118.8
2200.00	0.305	133.0	2.629	51.8	0.222	51.8	0.098	–136.9

V_{CE} = 1 V, I_C = 30 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.240	–159.0	8.660	90.9	0.060	66.5	0.224	–69.0
800.00	0.241	–171.1	6.559	83.1	0.085	63.7	0.171	–72.7
1000.00	0.228	172.8	5.394	76.1	0.113	61.7	0.135	–78.8
1200.00	0.239	161.7	4.631	71.9	0.138	62.9	0.116	–80.5
1400.00	0.261	154.0	3.951	67.0	0.159	61.0	0.098	–91.1
1600.00	0.280	149.7	3.513	61.4	0.181	58.8	0.090	–107.9
1800.00	0.284	144.2	3.208	58.0	0.200	57.9	0.087	–122.8
2000.00	0.307	136.9	2.848	55.2	0.210	56.5	0.083	–132.8
2200.00	0.334	130.5	2.522	50.3	0.225	52.1	0.093	–150.5

V_{CE} = 2 V, I_C = 1 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.867	–47.1	3.217	137.6	0.103	55.4	0.913	–25.8
800.00	0.751	–62.5	2.947	124.9	0.138	49.1	0.829	–31.4
1000.00	0.680	–77.2	2.722	112.8	0.165	42.2	0.740	–38.1
1200.00	0.619	–90.3	2.597	103.0	0.180	38.7	0.705	–44.4
1400.00	0.560	–102.9	2.449	95.4	0.195	34.2	0.665	–49.0
1600.00	0.508	–116.7	2.254	86.8	0.205	31.6	0.618	–52.3
1800.00	0.480	–129.2	2.144	78.8	0.204	31.2	0.568	–56.4
2000.00	0.435	–142.2	1.980	73.0	0.204	28.7	0.532	–60.8
2200.00	0.403	–157.1	1.809	65.6	0.201	25.3	0.505	–65.1

V_{CE} = 2 V, I_C = 3 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.611	–69.3	6.591	120.5	0.081	51.1	0.721	–39.2
800.00	0.489	–86.9	5.496	107.8	0.107	46.9	0.595	–44.7
1000.00	0.410	–102.1	4.728	97.0	0.127	45.4	0.507	–49.9
1200.00	0.346	–115.4	4.259	89.5	0.136	46.1	0.463	–54.1
1400.00	0.307	–130.9	3.769	83.3	0.151	45.0	0.419	–56.7
1600.00	0.286	–146.1	3.365	76.0	0.165	44.8	0.382	–59.5
1800.00	0.273	–158.2	3.120	70.1	0.173	46.4	0.346	–63.6
2000.00	0.255	–173.1	2.802	66.1	0.180	45.6	0.321	–67.3
2200.00	0.260	172.1	2.511	60.3	0.187	43.4	0.303	–72.0

V_{CE} = 2 V, I_C = 5 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.465	–81.0	8.012	112.0	0.068	50.5	0.599	–44.8
800.00	0.364	–99.5	6.426	100.5	0.093	51.8	0.483	–49.0
1000.00	0.295	–114.2	5.408	90.8	0.111	50.5	0.403	–53.0
1200.00	0.250	–128.7	4.784	84.5	0.127	52.0	0.368	–56.0
1400.00	0.226	–146.1	4.169	78.9	0.143	51.9	0.332	–57.9
1600.00	0.220	–161.2	3.704	72.3	0.160	51.7	0.302	–60.7
1800.00	0.214	–173.2	3.414	67.2	0.170	51.7	0.272	–65.2
2000.00	0.211	172.1	3.049	63.8	0.182	51.7	0.253	–68.5
2200.00	0.229	158.4	2.717	58.5	0.193	48.6	0.239	–74.5

V_{CE} = 2 V, I_C = 7 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.369	–90.4	8.842	106.4	0.064	53.1	0.517	–47.9
800.00	0.289	–109.7	6.950	96.0	0.086	54.5	0.412	–50.5
1000.00	0.224	–123.7	5.784	87.2	0.105	53.3	0.339	–53.7
1200.00	0.194	–139.8	5.068	81.5	0.125	56.1	0.309	–56.0
1400.00	0.183	–159.0	4.383	76.4	0.143	55.6	0.280	–58.1
1600.00	0.185	–173.1	3.887	70.2	0.159	55.2	0.256	–60.9
1800.00	0.188	175.2	3.574	65.7	0.176	55.3	0.229	–65.7
2000.00	0.194	161.5	3.182	62.4	0.184	54.2	0.213	–69.4
2200.00	0.215	149.9	2.834	57.5	0.196	51.3	0.202	–76.2

V_{CE} = 2 V, I_C = 10 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.294	–98.0	9.407	102.2	0.057	55.6	0.445	–49.5
800.00	0.234	–119.0	7.292	92.7	0.081	55.5	0.358	–51.8
1000.00	0.180	–134.2	6.034	84.5	0.104	56.6	0.294	–53.7
1200.00	0.158	–151.6	5.254	79.5	0.123	59.2	0.268	–55.1
1400.00	0.158	–170.0	4.520	74.5	0.142	58.9	0.243	–57.7
1600.00	0.168	176.2	4.010	68.6	0.161	57.5	0.220	–60.5
1800.00	0.174	166.0	3.682	64.4	0.177	57.3	0.200	–66.2
2000.00	0.185	153.4	3.271	61.5	0.187	56.7	0.184	–70.2
2200.00	0.208	144.0	2.905	56.7	0.200	53.1	0.176	–77.7

V_{CE} = 2 V, I_C = 20 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.187	–121.6	10.000	95.8	0.050	65.0	0.337	–50.7
800.00	0.163	–140.5	7.630	87.7	0.078	62.2	0.276	–49.8
1000.00	0.127	–161.0	6.268	80.6	0.100	61.3	0.227	–51.8
1200.00	0.130	–177.8	5.419	76.3	0.121	63.1	0.211	–52.7
1400.00	0.145	166.3	4.642	71.7	0.145	62.9	0.192	–55.1
1600.00	0.163	157.9	4.116	66.1	0.164	61.3	0.172	–59.9
1800.00	0.170	150.5	3.771	62.5	0.181	60.4	0.154	–66.1
2000.00	0.189	141.5	3.345	59.8	0.192	58.9	0.144	–72.1
2200.00	0.211	134.5	2.966	55.3	0.205	55.3	0.137	–81.8

V_{CE} = 2 V, I_C = 30 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.163	–135.8	9.983	93.5	0.050	65.2	0.306	–50.2
800.00	0.157	–154.9	7.591	85.9	0.075	63.9	0.254	–49.2
1000.00	0.130	–174.3	6.228	79.1	0.100	63.1	0.210	–48.9
1200.00	0.139	170.5	5.367	75.0	0.124	65.6	0.196	–50.0
1400.00	0.157	158.6	4.592	70.5	0.144	63.9	0.180	–52.8
1600.00	0.177	152.4	4.074	65.0	0.164	62.1	0.161	–57.3
1800.00	0.183	145.6	3.728	61.6	0.181	61.3	0.146	–64.2
2000.00	0.202	137.6	3.306	58.9	0.192	59.8	0.133	–70.5
2200.00	0.228	131.8	2.932	54.5	0.206	55.9	0.126	-80.6