

SILICON TRANSISTOR 2SC5180

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

FEATURES

- Low current consumption and high gain
 |S_{21e}|² = 12 dB TYP. @ VcE = 2 V, Ic = 7 mA, f = 2 GHz
 |S_{21e}|² = 11 dB TYP. @ VcE = 1 V, Ic = 5 mA, f = 2 GHz
- Supper Mini-Mold package

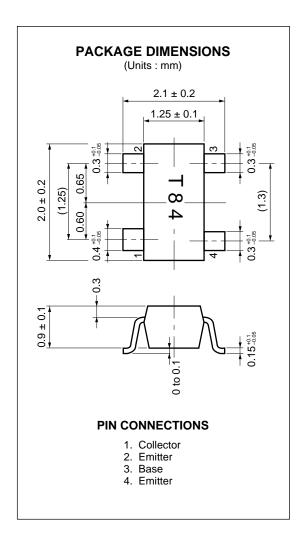
ORDERING INFORMATION

PART NUMBER	QUANTITY	ARRANGEMENT
2SC5180-T1	3 000 units/reel	Embossed tape, 8 mm wide, pins No. 3 (base) and No. 4 (emitter) facing the perforations
2SC5180-T2	3 000 units/leel	Embossed tape, 8 mm wide, pins No. 1 (collector) and No. 2 (emitter) facing the perforations

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

ABSOLUTE MAXIMUM RATINGS (TA = 25 $^{\circ}$ C)

Collector to Base Voltage	Vсво	5	V
Collector to Emitter Voltage	VCEO	3	V
Emitter to Base Voltage	VEBO	2	V
Collector Current	Ic	10	mA
Total Power Dissipation	Рт	30	mW
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-65 to +150	°C



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



ELECTRICAL CHARACTERISTICS (TA = 25 $^{\circ}$ C)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Collector Cutoff Current	Ісво			100	nA	Vcb = 5 V, IE = 0
Emitter Cutoff Current	ІЕВО			100	nA	VEB = 1 V, IC = 0
DC Current Gain	hfe	70		140		VcE = 2 V, Ic = 7 mA*1
Insertion Power Gain (1)	S _{21e} ²	10	12		dB	VcE = 2 V, Ic = 7 mA, f = 2 GHz
Insertion Power Gain (2)	S _{21e} ²	8.5	11		dB	VcE = 1 V, Ic = 5 mA, f = 2 GHz
Noise Figure (1)	NF		1.5	2.0	dB	VcE = 2 V, Ic = 3 mA, f = 2 GHz
Noise Figure (2)	NF		1.5	2.0	dB	VcE = 1 V, Ic = 3 mA, f = 2 GHz
Gain Bandwidth Product (1)	fт	12	15.5		GHz	VcE = 2 V, Ic = 7 mA, f = 2 GHz
Gain Bandwidth Product (2)	fт	10	13		GHz	VcE = 1 V, Ic = 5 mA, f = 2 GHz
Feedback Capacitance	Cre		0.3	0.5	pF	VcB = 2 V, IE = 0 mA, f = 1 MHz*2

^{* 1 :} Measured with pulses : Pulse width \leq 350 μ s, duty cycle \leq 2 %, pulsed

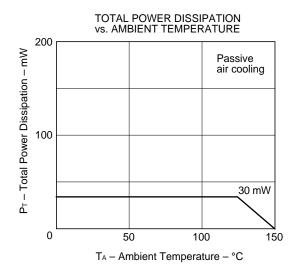
hee class

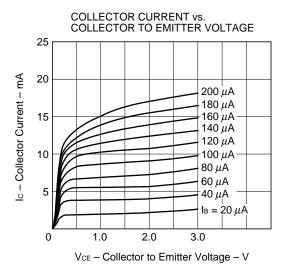
Class	FB
Marking	T84
hfE	70 to 140

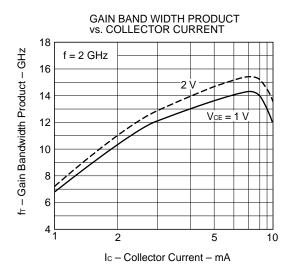
2

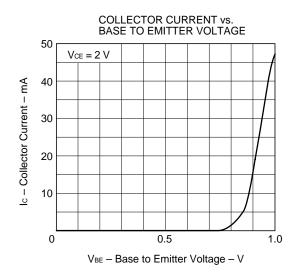
^{* 2 :} Measured with a three-terminal bridge. The emitter and case terminal are connected to the guard terminal of the bridge.

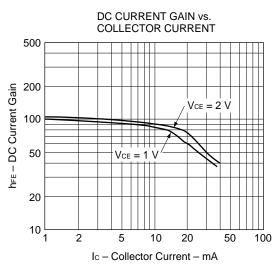
CHARACTERISTICS CURVES (TA = 25 °C)

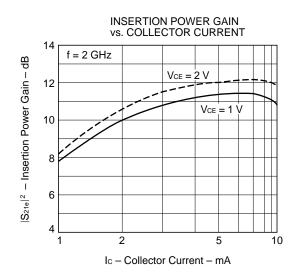


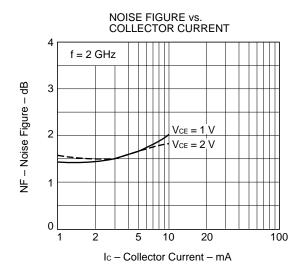


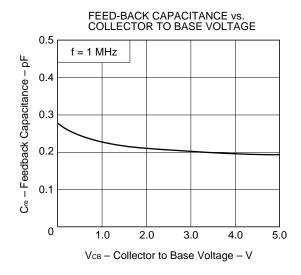














S-PARAMETER

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VCE = 1 V, IC = 1 m/s	A, $Z_0 = 50 \ \Omega$	2						
FREQUENCY		S11	S	21	S	12	S	22
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.916	-28.0	3.247	147.1	0.074	65.6	0.960	-21.2
800.00	0.816	-36.9	3.092	136.2	0.111	58.6	0.887	-26.2
1000.00	0.741	-47.1	2.929	125.5	0.140	54.4	0.810	-32.8
1200.00	0.691	-55.8	2.864	116.5	0.158	52.2	0.788	-39.3
1400.00	0.628	-63.3	2.762	109.6	0.179	48.2	0.744	-44.5
1600.00	0.558	-72.3	2.590	100.9	0.195	44.8	0.692	-49.2
1800.00	0.508	-80.9	2.505	93.4	0.199	43.7	0.647	-54.7
2000.00	0.444	-87.8	2.293	88.1	0.196	39.5	0.602	-58.2
2200.00	0.386	-94.3	2.111	81.8	0.201	35.8	0.575	-61.2
VCE = 1 V, IC = 3 m/	A, Zo = 50 <u>c</u>	2						
FREQUENCY		S11	S	21	S	12	S	22
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.694	-43.6	6.614	129.7	0.063	57.9	0.819	-30.4
800.00	0.557	-54.5	5.730	117.1	0.090	54.4	0.707	-35.6
1000.00	0.463	-63.1	5.054	106.4	0.113	52.6	0.609	-41.1
1200.00	0.394	-70.7	4.628	99.0	0.115	54.2	0.575	-45.5
1400.00	0.325	-78.9	4.123	92.2	0.123	52.5	0.526	-48.8
1600.00	0.269	-88.2	3.744	84.3	0.157	51.5	0.478	-52.5
1800.00	0.226	-96.9	3.488	79.4	0.160	52.5	0.441	-57.0
2000.00	0.220	-103.5	3.085	75.5	0.166	50.8	0.412	-57.0 -57.9
2200.00	0.146	-103.3 -111.9	2.776	73.5 70.5	0.174	48.1	0.412	-60.0
			2.770	70.5	0.174	40.1	0.401	-00.0
VCE = 1 V, $IC = 5 m$	A, $Z_0 = 50 \ \Omega$	2						
FREQUENCY	;	S11	S	21	S	12	S	22
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00				120.8	0.055	57.5		-33.5
	0.556	- 51.5	7.925	120.0	0.055		0.729	
800.00	0.430	-61.6	6.573	108.7	0.083	55.0	0.614	-37.4
800.00 1000.00	0.430 0.338	-61.6 -68.2	6.573 5.644	108.7 98.8	0.083 0.102	55.0 54.0	0.614 0.527	-37.4 -41.0
800.00 1000.00 1200.00	0.430 0.338 0.271	-61.6 -68.2 -75.3	6.573 5.644 5.047	108.7 98.8 92.4	0.083	55.0 54.0 57.7	0.614 0.527 0.498	-37.4 -41.0 -44.6
800.00 1000.00 1200.00 1400.00	0.430 0.338 0.271 0.217	-61.6 -68.2 -75.3 -84.1	6.573 5.644 5.047 4.409	108.7 98.8 92.4 86.0	0.083 0.102 0.117 0.133	55.0 54.0 57.7 56.5	0.614 0.527 0.498 0.451	-37.4 -41.0 -44.6 -47.5
800.00 1000.00 1200.00 1400.00 1600.00	0.430 0.338 0.271 0.217 0.171	-61.6 -68.2 -75.3 -84.1 -94.6	6.573 5.644 5.047 4.409 3.985	108.7 98.8 92.4 86.0 78.8	0.083 0.102 0.117 0.133 0.148	55.0 54.0 57.7 56.5 55.9	0.614 0.527 0.498 0.451 0.414	-37.4 -41.0 -44.6 -47.5 -50.0
800.00 1000.00 1200.00 1400.00 1600.00	0.430 0.338 0.271 0.217	-61.6 -68.2 -75.3 -84.1 -94.6 -104.4	6.573 5.644 5.047 4.409 3.985 3.674	108.7 98.8 92.4 86.0 78.8 74.9	0.083 0.102 0.117 0.133 0.148 0.155	55.0 54.0 57.7 56.5 55.9 57.4	0.614 0.527 0.498 0.451 0.414 0.382	-37.4 -41.0 -44.6 -47.5 -50.0 -53.9
800.00 1000.00 1200.00 1400.00 1600.00	0.430 0.338 0.271 0.217 0.171 0.137	-61.6 -68.2 -75.3 -84.1 -94.6	6.573 5.644 5.047 4.409 3.985	108.7 98.8 92.4 86.0 78.8	0.083 0.102 0.117 0.133 0.148	55.0 54.0 57.7 56.5 55.9	0.614 0.527 0.498 0.451 0.414	-37.4 -41.0 -44.6 -47.5 -50.0
800.00 1000.00 1200.00 1400.00 1600.00 1800.00 2000.00 2200.00	0.430 0.338 0.271 0.217 0.171 0.137 0.100 0.079	-61.6 -68.2 -75.3 -84.1 -94.6 -104.4 -114.7 -125.3	6.573 5.644 5.047 4.409 3.985 3.674 3.229	108.7 98.8 92.4 86.0 78.8 74.9 71.4	0.083 0.102 0.117 0.133 0.148 0.155 0.162	55.0 54.0 57.7 56.5 55.9 57.4 55.7	0.614 0.527 0.498 0.451 0.414 0.382 0.361	-37.4 -41.0 -44.6 -47.5 -50.0 -53.9 -55.0
800.00 1000.00 1200.00 1400.00 1600.00 1800.00 2000.00	0.430 0.338 0.271 0.217 0.171 0.137 0.100 0.079	-61.6 -68.2 -75.3 -84.1 -94.6 -104.4 -114.7 -125.3	6.573 5.644 5.047 4.409 3.985 3.674 3.229 2.897	108.7 98.8 92.4 86.0 78.8 74.9 71.4	0.083 0.102 0.117 0.133 0.148 0.155 0.162	55.0 54.0 57.7 56.5 55.9 57.4 55.7 53.0	0.614 0.527 0.498 0.451 0.414 0.382 0.361 0.357	-37.4 -41.0 -44.6 -47.5 -50.0 -53.9 -55.0
800.00 1000.00 1200.00 1400.00 1600.00 1800.00 2000.00 2200.00 VCE = 1 V, IC = 7 mA	0.430 0.338 0.271 0.217 0.171 0.137 0.100 0.079	-61.6 -68.2 -75.3 -84.1 -94.6 -104.4 -114.7 -125.3	6.573 5.644 5.047 4.409 3.985 3.674 3.229 2.897	108.7 98.8 92.4 86.0 78.8 74.9 71.4 66.9	0.083 0.102 0.117 0.133 0.148 0.155 0.162 0.173	55.0 54.0 57.7 56.5 55.9 57.4 55.7 53.0	0.614 0.527 0.498 0.451 0.414 0.382 0.361 0.357	-37.4 -41.0 -44.6 -47.5 -50.0 -53.9 -55.0 -57.2
800.00 1000.00 1200.00 1400.00 1600.00 1800.00 2000.00 2200.00 VCE = 1 V, IC = 7 m/s	0.430 0.338 0.271 0.217 0.171 0.137 0.100 0.079 A, Zo = 50 S	-61.6 -68.2 -75.3 -84.1 -94.6 -104.4 -114.7 -125.3	6.573 5.644 5.047 4.409 3.985 3.674 3.229 2.897	108.7 98.8 92.4 86.0 78.8 74.9 71.4 66.9	0.083 0.102 0.117 0.133 0.148 0.155 0.162 0.173	55.0 54.0 57.7 56.5 55.9 57.4 55.7 53.0	0.614 0.527 0.498 0.451 0.414 0.382 0.361 0.357	-37.4 -41.0 -44.6 -47.5 -50.0 -53.9 -55.0 -57.2
800.00 1000.00 1200.00 1400.00 1600.00 2000.00 2200.00 VCE = 1 V, IC = 7 mA FREQUENCY	0.430 0.338 0.271 0.217 0.171 0.137 0.100 0.079 A, Zo = 50 Q	-61.6 -68.2 -75.3 -84.1 -94.6 -104.4 -114.7 -125.3	6.573 5.644 5.047 4.409 3.985 3.674 3.229 2.897	108.7 98.8 92.4 86.0 78.8 74.9 71.4 66.9	0.083 0.102 0.117 0.133 0.148 0.155 0.162 0.173	55.0 54.0 57.7 56.5 55.9 57.4 55.7 53.0	0.614 0.527 0.498 0.451 0.414 0.382 0.361 0.357	-37.4 -41.0 -44.6 -47.5 -50.0 -53.9 -55.0 -57.2
800.00 1000.00 1200.00 1400.00 1600.00 2000.00 2200.00 VCE = 1 V, IC = 7 mA FREQUENCY MHz 600.00	0.430 0.338 0.271 0.217 0.171 0.137 0.100 0.079 A, Zo = 50 S MAG 0.455	-61.6 -68.2 -75.3 -84.1 -94.6 -104.4 -114.7 -125.3 2 S11 ANG -57.2	6.573 5.644 5.047 4.409 3.985 3.674 3.229 2.897	108.7 98.8 92.4 86.0 78.8 74.9 71.4 66.9	0.083 0.102 0.117 0.133 0.148 0.155 0.162 0.173	55.0 54.0 57.7 56.5 55.9 57.4 55.7 53.0	0.614 0.527 0.498 0.451 0.414 0.382 0.361 0.357	-37.4 -41.0 -44.6 -47.5 -50.0 -53.9 -55.0 -57.2 22 ANG -34.1
800.00 1000.00 1200.00 1400.00 1600.00 2000.00 2200.00 VCE = 1 V, IC = 7 mA FREQUENCY MHz 600.00 800.00	0.430 0.338 0.271 0.217 0.171 0.137 0.100 0.079 A, Zo = 50 S MAG 0.455 0.335	-61.6 -68.2 -75.3 -84.1 -94.6 -104.4 -114.7 -125.3 2 611 ANG -57.2 -67.4	6.573 5.644 5.047 4.409 3.985 3.674 3.229 2.897 S MAG 8.518 6.873	108.7 98.8 92.4 86.0 78.8 74.9 71.4 66.9	0.083 0.102 0.117 0.133 0.148 0.155 0.162 0.173 SAMAG 0.051 0.075	55.0 54.0 57.7 56.5 55.9 57.4 55.7 53.0	0.614 0.527 0.498 0.451 0.414 0.382 0.361 0.357 S MAG 0.657 0.557	-37.4 -41.0 -44.6 -47.5 -50.0 -53.9 -55.0 -57.2 22 ANG -34.1 -36.6
800.00 1000.00 1200.00 1400.00 1600.00 1800.00 2000.00 2200.00 VCE = 1 V, IC = 7 m/s FREQUENCY MHz 600.00 800.00 1000.00	0.430 0.338 0.271 0.217 0.171 0.137 0.100 0.079 A, Zo = 50 G MAG 0.455 0.335 0.252	-61.6 -68.2 -75.3 -84.1 -94.6 -104.4 -114.7 -125.3 2 611 ANG -57.2 -67.4 -73.2	6.573 5.644 5.047 4.409 3.985 3.674 3.229 2.897 S MAG 8.518 6.873 5.825	108.7 98.8 92.4 86.0 78.8 74.9 71.4 66.9 21 ANG 114.4 103.1 93.9	0.083 0.102 0.117 0.133 0.148 0.155 0.162 0.173 SAMAG 0.051 0.075 0.095	55.0 54.0 57.7 56.5 55.9 57.4 55.7 53.0 12 ANG 56.0 55.1 56.7	0.614 0.527 0.498 0.451 0.414 0.382 0.361 0.357 S MAG 0.657 0.557 0.480	-37.4 -41.0 -44.6 -47.5 -50.0 -53.9 -55.0 -57.2 22 ANG -34.1 -36.6 -39.2
800.00 1000.00 1200.00 1400.00 1600.00 1800.00 2000.00 2200.00 VCE = 1 V, IC = 7 mA FREQUENCY MHz 600.00 800.00 1000.00 1200.00	0.430 0.338 0.271 0.217 0.171 0.137 0.100 0.079 A, Zo = 50 Q MAG 0.455 0.335 0.252 0.194	-61.6 -68.2 -75.3 -84.1 -94.6 -104.4 -114.7 -125.3 2 611 ANG -57.2 -67.4 -73.2 -80.5	6.573 5.644 5.047 4.409 3.985 3.674 3.229 2.897 S MAG 8.518 6.873 5.825 5.131	108.7 98.8 92.4 86.0 78.8 74.9 71.4 66.9 21 ANG 114.4 103.1 93.9 88.3	0.083 0.102 0.117 0.133 0.148 0.155 0.162 0.173 SAMAG 0.051 0.075 0.095 0.113	55.0 54.0 57.7 56.5 55.9 57.4 55.7 53.0 12 ANG 56.0 55.1 56.7 59.7	0.614 0.527 0.498 0.451 0.414 0.382 0.361 0.357 S MAG 0.657 0.557 0.480 0.453	-37.4 -41.0 -44.6 -47.5 -50.0 -53.9 -55.0 -57.2 22 ANG -34.1 -36.6 -39.2 -41.8
800.00 1000.00 1200.00 1400.00 1600.00 1800.00 2000.00 2200.00 VCE = 1 V, IC = 7 mA FREQUENCY MHz 600.00 800.00 1000.00 1200.00 1400.00	0.430 0.338 0.271 0.217 0.171 0.137 0.100 0.079 A, Zo = 50 G MAG 0.455 0.335 0.252 0.194 0.148	-61.6 -68.2 -75.3 -84.1 -94.6 -104.4 -114.7 -125.3 2 611 ANG -57.2 -67.4 -73.2 -80.5 -91.1	6.573 5.644 5.047 4.409 3.985 3.674 3.229 2.897 S MAG 8.518 6.873 5.825 5.131 4.447	108.7 98.8 92.4 86.0 78.8 74.9 71.4 66.9 21 ANG 114.4 103.1 93.9 88.3 82.0	0.083 0.102 0.117 0.133 0.148 0.155 0.162 0.173 SAMAG 0.051 0.075 0.095 0.113 0.129	55.0 54.0 57.7 56.5 55.9 57.4 55.7 53.0 12 ANG 56.0 55.1 56.7 59.7 58.7	0.614 0.527 0.498 0.451 0.414 0.382 0.361 0.357 S MAG 0.657 0.557 0.480 0.453 0.417	-37.4 -41.0 -44.6 -47.5 -50.0 -53.9 -55.0 -57.2 22 ANG -34.1 -36.6 -39.2 -41.8 -44.6
800.00 1000.00 1200.00 1400.00 1600.00 1800.00 2000.00 2200.00 VCE = 1 V, IC = 7 mA FREQUENCY MHz 600.00 800.00 1000.00 1200.00 1400.00 1600.00	0.430 0.338 0.271 0.217 0.171 0.137 0.100 0.079 A, Zo = 50 § MAG 0.455 0.335 0.252 0.194 0.148 0.114	-61.6 -68.2 -75.3 -84.1 -94.6 -104.4 -114.7 -125.3 S11 ANG -57.2 -67.4 -73.2 -80.5 -91.1 -105.9	6.573 5.644 5.047 4.409 3.985 3.674 3.229 2.897 S MAG 8.518 6.873 5.825 5.131 4.447 4.018	108.7 98.8 92.4 86.0 78.8 74.9 71.4 66.9 21 ANG 114.4 103.1 93.9 88.3 82.0 75.3	0.083 0.102 0.117 0.133 0.148 0.155 0.162 0.173 SAMAG 0.051 0.075 0.095 0.113 0.129 0.145	55.0 54.0 57.7 56.5 55.9 57.4 55.7 53.0 12 ANG 56.0 55.1 56.7 59.7 58.7 58.7	0.614 0.527 0.498 0.451 0.414 0.382 0.361 0.357 S MAG 0.657 0.557 0.480 0.453 0.417 0.385	-37.4 -41.0 -44.6 -47.5 -50.0 -53.9 -55.0 -57.2 22 ANG -34.1 -36.6 -39.2 -41.8 -44.6 -46.8
800.00 1000.00 1200.00 1400.00 1600.00 1800.00 2000.00 2200.00 VCE = 1 V, Ic = 7 mA FREQUENCY MHz 600.00 800.00 1000.00 1200.00 1400.00 1600.00 1800.00	0.430 0.338 0.271 0.217 0.171 0.137 0.100 0.079 A, Zo = 50 <u>G</u> MAG 0.455 0.335 0.252 0.194 0.148 0.114 0.087	-61.6 -68.2 -75.3 -84.1 -94.6 -104.4 -114.7 -125.3 S11 ANG -57.2 -67.4 -73.2 -80.5 -91.1 -105.9 -119.5	6.573 5.644 5.047 4.409 3.985 3.674 3.229 2.897 S MAG 8.518 6.873 5.825 5.131 4.447 4.018 3.682	108.7 98.8 92.4 86.0 78.8 74.9 71.4 66.9 21 ANG 114.4 103.1 93.9 88.3 82.0 75.3 71.9	0.083 0.102 0.117 0.133 0.148 0.155 0.162 0.173 SAMAG 0.051 0.075 0.095 0.113 0.129 0.145 0.152	55.0 54.0 57.7 56.5 55.9 57.4 55.7 53.0 12 ANG 56.0 55.1 56.7 59.7 58.7 58.7 60.6	0.614 0.527 0.498 0.451 0.414 0.382 0.361 0.357 MAG 0.657 0.480 0.453 0.417 0.385 0.357	-37.4 -41.0 -44.6 -47.5 -50.0 -53.9 -55.0 -57.2 22 ANG -34.1 -36.6 -39.2 -41.8 -44.6 -46.8 -50.6



Vce = 1 V, Ic = 10 m	A, $Z_0 = 50$	Ω						
FREQUENCY	S	511	S	21	S	12	S	22
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.359	-65.9	8.500	108.9	0.048	54.8	0.603	-33.1
800.00	0.255	-78.2	6.731	98.1	0.071	56.3	0.516	-34.4
1000.00	0.177	-83.8	5.648	89.6	0.090	56.8	0.449	-35.9
1200.00	0.127	-96.6	4.927	84.4	0.109	61.7	0.431	-38.2
1400.00	0.098	-115.6	4.251	78.2	0.125	61.4	0.400	-40.5
1600.00	0.081	-141.9	3.839	71.9	0.143	61.2	0.377	-42.8
1800.00	0.072	-162.7	3.504	68.8	0.150	62.1	0.351	-46.1
2000.00	0.070	170.9	3.072	65.8	0.157	60.3	0.338	-47.5
2200.00	0.074	157.1	2.748	61.5	0.167	57.2	0.342	-50.4
Vce = 2 V, Ic = 1 mA	, Zo = 50 Ω	2						
FREQUENCY	S	511	S	21	S	12	S	22
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.927	-26.3	3.263	148.6	0.065	64.5	0.968	-19.5
800.00	0.827	-34.2	3.122	138.1	0.101	59.7	0.903	-24.1
1000.00	0.758	-43.7	2.962	127.7	0.129	54.9	0.828	-30.3
1200.00	0.712	-52.2	2.910	118.9	0.146	54.2	0.808	-36.5
1400.00	0.653	-59.1	2.825	112.3	0.165	50.6	0.769	-41.3
1600.00	0.581	-67.5	2.657	103.8	0.181	47.3	0.723	-46.0
1800.00	0.530	-75.7	2.578	96.3	0.185	46.0	0.673	-51.3
2000.00	0.469	-82.1	2.368	91.0	0.184	41.5	0.630	-54.7
2200.00	0.410	-87.5	2.184	84.7	0.188	38.2	0.607	-57.4
Vce = 2 V, Ic = 3 mA	, Zo = 50 Ω	2						
FREQUENCY	S	511	S	21	S	12	S	22
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
MHz 600.00	MAG 0.727	ANG -39.7	MAG 6.761	ANG 131.7	MAG 0.057	ANG 58.1	MAG 0.841	ANG -27.8
600.00	0.727	-39.7	6.761	131.7	0.057	58.1	0.841	-27.8
600.00 800.00 1000.00	0.727 0.587	-39.7 -49.7	6.761 5.910	131.7 119.4	0.057 0.084	58.1 55.8	0.841 0.737	-27.8 -32.4
600.00 800.00	0.727 0.587 0.490	-39.7 -49.7 -57.4	6.761 5.910 5.229	131.7 119.4 108.8	0.057 0.084 0.104	58.1 55.8 54.2	0.841 0.737 0.645	-27.8 -32.4 -37.5
600.00 800.00 1000.00 1200.00	0.727 0.587 0.490 0.425	-39.7 -49.7 -57.4 -64.5	6.761 5.910 5.229 4.812	131.7 119.4 108.8 101.3	0.057 0.084 0.104 0.120	58.1 55.8 54.2 55.7	0.841 0.737 0.645 0.608	-27.8 -32.4 -37.5 -41.8 -45.1
600.00 800.00 1000.00 1200.00 1400.00	0.727 0.587 0.490 0.425 0.354	-39.7 -49.7 -57.4 -64.5 -70.8	6.761 5.910 5.229 4.812 4.314	131.7 119.4 108.8 101.3 94.8	0.057 0.084 0.104 0.120 0.135	58.1 55.8 54.2 55.7 55.3	0.841 0.737 0.645 0.608 0.562	-27.8 -32.4 -37.5 -41.8
600.00 800.00 1000.00 1200.00 1400.00	0.727 0.587 0.490 0.425 0.354 0.295	-39.7 -49.7 -57.4 -64.5 -70.8 -78.5	6.761 5.910 5.229 4.812 4.314 3.919	131.7 119.4 108.8 101.3 94.8 86.9	0.057 0.084 0.104 0.120 0.135 0.148	58.1 55.8 54.2 55.7 55.3 54.1	0.841 0.737 0.645 0.608 0.562 0.517	-27.8 -32.4 -37.5 -41.8 -45.1 -48.3
600.00 800.00 1000.00 1200.00 1400.00 1600.00	0.727 0.587 0.490 0.425 0.354 0.295 0.251	-39.7 -49.7 -57.4 -64.5 -70.8 -78.5 -85.1	6.761 5.910 5.229 4.812 4.314 3.919 3.662	131.7 119.4 108.8 101.3 94.8 86.9 81.8	0.057 0.084 0.104 0.120 0.135 0.148 0.151	58.1 55.8 54.2 55.7 55.3 54.1 54.8	0.841 0.737 0.645 0.608 0.562 0.517 0.478	-27.8 -32.4 -37.5 -41.8 -45.1 -48.3 -52.4
600.00 800.00 1000.00 1200.00 1400.00 1600.00 1800.00 2000.00	0.727 0.587 0.490 0.425 0.354 0.295 0.251 0.203 0.167	-39.7 -49.7 -57.4 -64.5 -70.8 -78.5 -85.1 -89.4 -93.9	6.761 5.910 5.229 4.812 4.314 3.919 3.662 3.243	131.7 119.4 108.8 101.3 94.8 86.9 81.8 77.9	0.057 0.084 0.104 0.120 0.135 0.148 0.151 0.156	58.1 55.8 54.2 55.7 55.3 54.1 54.8 52.9	0.841 0.737 0.645 0.608 0.562 0.517 0.478 0.449	-27.8 -32.4 -37.5 -41.8 -45.1 -48.3 -52.4 -53.6
600.00 800.00 1000.00 1200.00 1400.00 1600.00 1800.00 2000.00	0.727 0.587 0.490 0.425 0.354 0.295 0.251 0.203 0.167	-39.7 -49.7 -57.4 -64.5 -70.8 -78.5 -85.1 -89.4 -93.9	6.761 5.910 5.229 4.812 4.314 3.919 3.662 3.243 2.924	131.7 119.4 108.8 101.3 94.8 86.9 81.8 77.9	0.057 0.084 0.104 0.120 0.135 0.148 0.151 0.156	58.1 55.8 54.2 55.7 55.3 54.1 54.8 52.9 50.9	0.841 0.737 0.645 0.608 0.562 0.517 0.478 0.449	-27.8 -32.4 -37.5 -41.8 -45.1 -48.3 -52.4 -53.6
600.00 800.00 1000.00 1200.00 1400.00 1600.00 1800.00 2000.00 2200.00 VCE = 2 V, IC = 5 mA	0.727 0.587 0.490 0.425 0.354 0.295 0.251 0.203 0.167	-39.7 -49.7 -57.4 -64.5 -70.8 -78.5 -85.1 -89.4 -93.9	6.761 5.910 5.229 4.812 4.314 3.919 3.662 3.243 2.924	131.7 119.4 108.8 101.3 94.8 86.9 81.8 77.9 73.0	0.057 0.084 0.104 0.120 0.135 0.148 0.151 0.156 0.164	58.1 55.8 54.2 55.7 55.3 54.1 54.8 52.9 50.9	0.841 0.737 0.645 0.608 0.562 0.517 0.478 0.449	-27.8 -32.4 -37.5 -41.8 -45.1 -48.3 -52.4 -53.6 -55.6
600.00 800.00 1000.00 1200.00 1400.00 1600.00 1800.00 2000.00 2200.00 VCE = 2 V, IC = 5 mA FREQUENCY	0.727 0.587 0.490 0.425 0.354 0.295 0.251 0.203 0.167	-39.7 -49.7 -57.4 -64.5 -70.8 -78.5 -85.1 -89.4 -93.9	6.761 5.910 5.229 4.812 4.314 3.919 3.662 3.243 2.924	131.7 119.4 108.8 101.3 94.8 86.9 81.8 77.9 73.0	0.057 0.084 0.104 0.120 0.135 0.148 0.151 0.156 0.164	58.1 55.8 54.2 55.7 55.3 54.1 54.8 52.9 50.9	0.841 0.737 0.645 0.608 0.562 0.517 0.478 0.449	-27.8 -32.4 -37.5 -41.8 -45.1 -48.3 -52.4 -53.6 -55.6
600.00 800.00 1000.00 1200.00 1400.00 1600.00 2000.00 2200.00 VCE = 2 V, IC = 5 mA FREQUENCY	0.727 0.587 0.490 0.425 0.354 0.295 0.251 0.203 0.167 A, Zo = 50 Ω	-39.7 -49.7 -57.4 -64.5 -70.8 -78.5 -85.1 -89.4 -93.9	6.761 5.910 5.229 4.812 4.314 3.919 3.662 3.243 2.924	131.7 119.4 108.8 101.3 94.8 86.9 81.8 77.9 73.0	0.057 0.084 0.104 0.120 0.135 0.148 0.151 0.156 0.164	58.1 55.8 54.2 55.7 55.3 54.1 54.8 52.9 50.9	0.841 0.737 0.645 0.608 0.562 0.517 0.478 0.449 0.441	-27.8 -32.4 -37.5 -41.8 -45.1 -48.3 -52.4 -53.6 -55.6
600.00 800.00 1000.00 1200.00 1400.00 1600.00 2000.00 2200.00 VCE = 2 V, IC = 5 mA FREQUENCY MHz 600.00	0.727 0.587 0.490 0.425 0.354 0.295 0.251 0.203 0.167 ., Zo = 50 Ω MAG 0.592	-39.7 -49.7 -57.4 -64.5 -70.8 -78.5 -85.1 -89.4 -93.9 2 111 ANG -46.3	6.761 5.910 5.229 4.812 4.314 3.919 3.662 3.243 2.924	131.7 119.4 108.8 101.3 94.8 86.9 81.8 77.9 73.0	0.057 0.084 0.104 0.120 0.135 0.148 0.151 0.156 0.164 S1	58.1 55.8 54.2 55.7 55.3 54.1 54.8 52.9 50.9	0.841 0.737 0.645 0.608 0.562 0.517 0.478 0.449 0.441	-27.8 -32.4 -37.5 -41.8 -45.1 -48.3 -52.4 -53.6 -55.6
600.00 800.00 1000.00 1200.00 1400.00 1600.00 2000.00 2200.00 VCE = 2 V, IC = 5 mA FREQUENCY MHz 600.00 800.00	0.727 0.587 0.490 0.425 0.354 0.295 0.251 0.203 0.167 ., Zo = 50 Ω S MAG 0.592 0.457	-39.7 -49.7 -57.4 -64.5 -70.8 -78.5 -85.1 -89.4 -93.9 2 -11 ANG -46.3 -55.1	6.761 5.910 5.229 4.812 4.314 3.919 3.662 3.243 2.924 S MAG 8.189 6.849	131.7 119.4 108.8 101.3 94.8 86.9 81.8 77.9 73.0	0.057 0.084 0.104 0.120 0.135 0.148 0.151 0.156 0.164 S1 MAG 0.052 0.074	58.1 55.8 54.2 55.7 55.3 54.1 54.8 52.9 50.9	0.841 0.737 0.645 0.608 0.562 0.517 0.478 0.449 0.441 S MAG 0.763 0.655	-27.8 -32.4 -37.5 -41.8 -45.1 -48.3 -52.4 -53.6 -55.6 222 ANG -30.6 -33.8
600.00 800.00 1000.00 1200.00 1400.00 1600.00 2000.00 2200.00 VCE = 2 V, IC = 5 mA FREQUENCY MHz 600.00 800.00 1000.00	0.727 0.587 0.490 0.425 0.354 0.295 0.251 0.203 0.167 ., Zo = 50 Ω MAG 0.592 0.457 0.369	-39.7 -49.7 -57.4 -64.5 -70.8 -78.5 -85.1 -89.4 -93.9 2 111 ANG -46.3 -55.1 -60.0	6.761 5.910 5.229 4.812 4.314 3.919 3.662 3.243 2.924 S MAG 8.189 6.849 5.900	131.7 119.4 108.8 101.3 94.8 86.9 81.8 77.9 73.0 21 ANG 122.9 110.9 101.1	0.057 0.084 0.104 0.120 0.135 0.148 0.151 0.156 0.164 S1 MAG 0.052 0.074 0.096	58.1 55.8 54.2 55.7 55.3 54.1 54.8 52.9 50.9	0.841 0.737 0.645 0.608 0.562 0.517 0.478 0.449 0.441 S MAG 0.763 0.655 0.564	-27.8 -32.4 -37.5 -41.8 -45.1 -48.3 -52.4 -53.6 -55.6 222 ANG -30.6 -33.8 -37.6
600.00 800.00 1000.00 1200.00 1400.00 1600.00 2000.00 2200.00 VCE = 2 V, IC = 5 mA FREQUENCY MHz 600.00 800.00 1000.00 1200.00	0.727 0.587 0.490 0.425 0.354 0.295 0.251 0.203 0.167 ., Zo = 50 Ω MAG 0.592 0.457 0.369 0.305	-39.7 -49.7 -57.4 -64.5 -70.8 -78.5 -85.1 -89.4 -93.9 2 111 ANG -46.3 -55.1 -60.0 -66.2	6.761 5.910 5.229 4.812 4.314 3.919 3.662 3.243 2.924 S MAG 8.189 6.849 5.900 5.303	131.7 119.4 108.8 101.3 94.8 86.9 81.8 77.9 73.0 21 ANG 122.9 110.9 101.1 94.7	0.057 0.084 0.104 0.120 0.135 0.148 0.151 0.156 0.164 S1 MAG 0.052 0.074 0.096 0.111	58.1 55.8 54.2 55.7 55.3 54.1 54.8 52.9 50.9 50.9	0.841 0.737 0.645 0.608 0.562 0.517 0.478 0.449 0.441 S MAG 0.763 0.655 0.564 0.533	-27.8 -32.4 -37.5 -41.8 -45.1 -48.3 -52.4 -53.6 -55.6 22 ANG -30.6 -33.8 -37.6 -40.7
600.00 800.00 1000.00 1200.00 1400.00 1600.00 2000.00 2200.00 VCE = 2 V, IC = 5 mA FREQUENCY MHz 600.00 800.00 1000.00 1200.00 1400.00	0.727 0.587 0.490 0.425 0.354 0.295 0.251 0.203 0.167 MAG 0.592 0.457 0.369 0.305 0.249	-39.7 -49.7 -57.4 -64.5 -70.8 -78.5 -85.1 -89.4 -93.9 2.11 ANG -46.3 -55.1 -60.0 -66.2 -72.3	6.761 5.910 5.229 4.812 4.314 3.919 3.662 3.243 2.924 S MAG 8.189 6.849 5.900 5.303 4.651	131.7 119.4 108.8 101.3 94.8 86.9 81.8 77.9 73.0 21 ANG 122.9 110.9 101.1 94.7 88.4	0.057 0.084 0.104 0.120 0.135 0.148 0.151 0.156 0.164 S1 MAG 0.052 0.074 0.096 0.111 0.126	58.1 55.8 54.2 55.7 55.3 54.1 54.8 52.9 50.9 4 59.4 56.6 54.1 58.0 58.2	0.841 0.737 0.645 0.608 0.562 0.517 0.478 0.449 0.441 S MAG 0.763 0.655 0.564 0.533 0.495	-27.8 -32.4 -37.5 -41.8 -45.1 -48.3 -52.4 -53.6 -55.6 22 ANG -30.6 -33.8 -37.6 -40.7 -43.3
600.00 800.00 1000.00 1200.00 1400.00 1600.00 2000.00 2200.00 VCE = 2 V, IC = 5 mA FREQUENCY MHz 600.00 800.00 1000.00 1200.00 1400.00 1600.00	0.727 0.587 0.490 0.425 0.354 0.295 0.251 0.203 0.167 MAG 0.592 0.457 0.369 0.305 0.249 0.198	-39.7 -49.7 -57.4 -64.5 -70.8 -78.5 -85.1 -89.4 -93.9 -11 ANG -46.3 -55.1 -60.0 -66.2 -72.3 -79.2	6.761 5.910 5.229 4.812 4.314 3.919 3.662 3.243 2.924 S MAG 8.189 6.849 5.900 5.303 4.651 4.202	131.7 119.4 108.8 101.3 94.8 86.9 81.8 77.9 73.0 21 ANG 122.9 110.9 101.1 94.7 88.4 81.2	0.057 0.084 0.104 0.120 0.135 0.148 0.151 0.156 0.164 S1 MAG 0.052 0.074 0.096 0.111 0.126 0.139	58.1 55.8 54.2 55.7 55.3 54.1 54.8 52.9 50.9 50.9	0.841 0.737 0.645 0.608 0.562 0.517 0.478 0.449 0.441 S MAG 0.763 0.655 0.564 0.533 0.495 0.460	-27.8 -32.4 -37.5 -41.8 -45.1 -48.3 -52.4 -53.6 -55.6 22 ANG -30.6 -33.8 -37.6 -40.7 -43.3 -45.6
600.00 800.00 1000.00 1200.00 1400.00 1600.00 2000.00 2200.00 VCE = 2 V, IC = 5 mA FREQUENCY MHz 600.00 800.00 1000.00 1200.00 1400.00 1600.00 1800.00	0.727 0.587 0.490 0.425 0.354 0.295 0.251 0.203 0.167 MAG 0.592 0.457 0.369 0.305 0.249 0.198 0.160	-39.7 -49.7 -57.4 -64.5 -70.8 -78.5 -85.1 -89.4 -93.9 -111 ANG -46.3 -55.1 -60.0 -66.2 -72.3 -79.2 -85.2	6.761 5.910 5.229 4.812 4.314 3.919 3.662 3.243 2.924 S MAG 8.189 6.849 5.900 5.303 4.651 4.202 3.888	131.7 119.4 108.8 101.3 94.8 86.9 81.8 77.9 73.0 21 ANG 122.9 110.9 101.1 94.7 88.4 81.2 77.2	0.057 0.084 0.104 0.120 0.135 0.148 0.151 0.156 0.164 S1 MAG 0.052 0.074 0.096 0.111 0.126 0.139 0.146	58.1 55.8 54.2 55.7 55.3 54.1 54.8 52.9 50.9 50.9	0.841 0.737 0.645 0.608 0.562 0.517 0.478 0.449 0.441 S MAG 0.763 0.655 0.564 0.533 0.495 0.460 0.425	-27.8 -32.4 -37.5 -41.8 -45.1 -48.3 -52.4 -53.6 -55.6 22 ANG -30.6 -33.8 -37.6 -40.7 -43.3 -45.6 -59.3



VCE = 2 V, $IC = 7 m$	$A, Zo = 50 \Omega$	2						
FREQUENCY	5	S11	S	21	S	12	S	22
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.489	-50.8	8.917	116.7	0.045	58.5	0.701	-31.1
800.00	0.371	-58.8	7.266	105.4	0.070	57.0	0.601	-33.3
1000.00	0.287	-62.3	6.166	96.2	0.090	57.4	0.523	-35.7
1200.00	0.233	-67.2	5.456	90.6	0.106	61.2	0.501	-38.3
1400.00	0.181	-72.6	4.743	84.5	0.122	62.0	0.465	-40.4
1600.00	0.138	-80.1	4.283	77.7	0.137	61.2	0.436	-42.7
1800.00	0.105	-86.5	3.937	74.2	0.143	62.8	0.404	-45.9
2000.00	0.072	-91.2	3.456	71.1	0.149	60.2	0.389	-47.1
2200.00	0.052	-93.0	3.097	66.9	0.159	57.3	0.391	-49.2
VCE = 2 V, IC = 10	mA, Zo = 50	Ω						
Vce = 2 V, Ic = 10 FREQUENCY	,	Ω S11	S	21	S	12	S	22
•	,		S MAG	21 ANG	S ² MAG	12 ANG	S: MAG	22 ANG
FREQUENCY	,	S11						
FREQUENCY MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
FREQUENCY MHz 600.00	MAG 0.404	ANG -55.4	MAG 9.236	ANG 111.8	MAG 0.039	ANG 55.3	MAG 0.660	ANG -30.2
FREQUENCY MHz 600.00 800.00	MAG 0.404 0.298	ANG -55.4 -62.9	MAG 9.236 7.374	ANG 111.8 101.0	MAG 0.039 0.064	ANG 55.3 57.2	MAG 0.660 0.569	ANG -30.2 -31.4
FREQUENCY MHz 600.00 800.00 1000.00	MAG 0.404 0.298 0.221	ANG -55.4 -62.9 -65.2	MAG 9.236 7.374 6.206	ANG 111.8 101.0 92.5	MAG 0.039 0.064 0.087	ANG 55.3 57.2 60.1	MAG 0.660 0.569 0.501	ANG -30.2 -31.4 -33.0
FREQUENCY MHz 600.00 800.00 1000.00 1200.00	MAG 0.404 0.298 0.221 0.169	ANG -55.4 -62.9 -65.2 -69.5	MAG 9.236 7.374 6.206 5.441	ANG 111.8 101.0 92.5 87.4	MAG 0.039 0.064 0.087 0.102	ANG 55.3 57.2 60.1 63.5	MAG 0.660 0.569 0.501 0.483	ANG -30.2 -31.4 -33.0 -35.3
FREQUENCY MHz 600.00 800.00 1000.00 1200.00 1400.00	MAG 0.404 0.298 0.221 0.169 0.128	ANG -55.4 -62.9 -65.2 -69.5 -76.3	MAG 9.236 7.374 6.206 5.441 4.701	ANG 111.8 101.0 92.5 87.4 81.4	MAG 0.039 0.064 0.087 0.102 0.119	ANG 55.3 57.2 60.1 63.5 63.3	MAG 0.660 0.569 0.501 0.483 0.456	ANG -30.2 -31.4 -33.0 -35.3 -37.4
FREQUENCY MHz 600.00 800.00 1000.00 1200.00 1400.00 1600.00	MAG 0.404 0.298 0.221 0.169 0.128 0.089	ANG -55.4 -62.9 -65.2 -69.5 -76.3 -86.1	MAG 9.236 7.374 6.206 5.441 4.701 4.244	ANG 111.8 101.0 92.5 87.4 81.4 75.0	MAG 0.039 0.064 0.087 0.102 0.119 0.134	ANG 55.3 57.2 60.1 63.5 63.3	MAG 0.660 0.569 0.501 0.483 0.456 0.430	ANG -30.2 -31.4 -33.0 -35.3 -37.4 -39.5

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