# DATA SHEET

# SILICON TRANSISTOR

# HIGH FREQUENCY LOW NOISE AMPLIFIER NPN SILICON EPITAXIAL TRANSISTOR 4 PINS SUPER MINI MOLD

# FEATURES

NEC

- Small Package
- High Gain Bandwidth Product (fT = 12 GHz TYP.)
- Low Noise, High Gain
- Low Voltage Operation

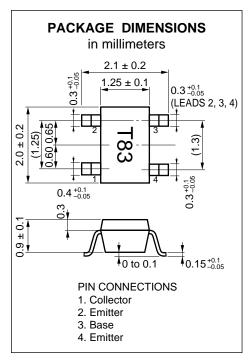
## ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKING STYLE
2SC5015-T1	3 Kpcs/Reel.	Embossed tape 8 mm wide. Pin3 (Base), Pin4 (Emitter) face to perforation side of the tape.
2SC5015-T2	3 Kpcs/Reel.	Embossed tape 8 mm wide. Pin1 (Collector), Pin2 (Emitter) face to perforation side of the tape.

\* Please contact with responsible NEC person, if you require evaluation sample. Unit sample quantity shall be 50 pcs. (Part No.: 2SC5014)

# ABSOLUTE MAXIMUM RATINGS (TA = 25 °C)

	•		
Collector to Base Voltage	Vсво	9	V
Collector to Emitter Voltage	Vceo	6	V
Emitter to Base Voltage	Vево	2	V
Collector Current	Ic	30	mA
Total Power Dissipation	Рт	150	mW
Junction Temperature	Ti	150	°C
Storage Temperature	Tstg	-65 to + 150	°C



#### Caution: Electrostatic Sensitive Device

# ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Collector Cutoff Current	Ісво			0.1	μA	$V_{CB} = 5 V, I_E = 0$
Emitter Cutoff Current	Іево			0.1	μA	VEB = 1 V, Ic = 0
DC Current Gain	hfe	75		150		Vce = 3 V, Ic = 10 mA*1
Gain Bandwidth Product	fт		12		GHz	Vce = 3 V, Ic = 10 mA
Feed-back Capacitance	Cre		0.3	0.5	pF	Vсв = 3 V, IE = 0, f = 1 MHz <sup>*2</sup>
Insertion Power Gain	S <sub>21e</sub>   <sup>2</sup>	9	11		dB	V <sub>CE</sub> = 3 V, Ic = 10 mA, f = 2.0 GHz
Noise Figure	NF		1.5	2.5	dB	V <sub>CE</sub> = 3 V, Ic = 3 mA, f = 2.0 GHz

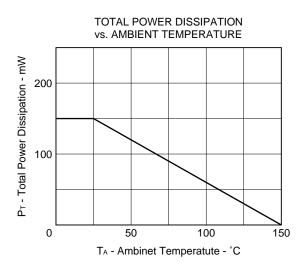
\*1 Pulse Measurement; PW  $\leq$  350  $\mu s,$  Duty Cycle  $\leq$  2 % Pulsed.

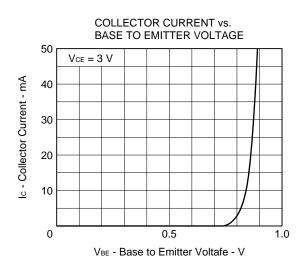
\*2 Measured with 3 terminals bridge, Emitter and Case should be grounded.

## hFE Classification

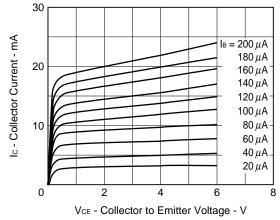
Rank	KB
Marking	T83
hfe	75 to 150

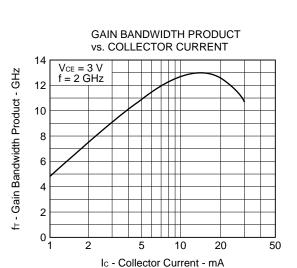




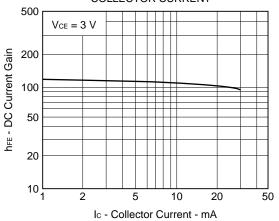


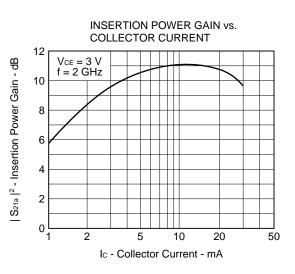
COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE

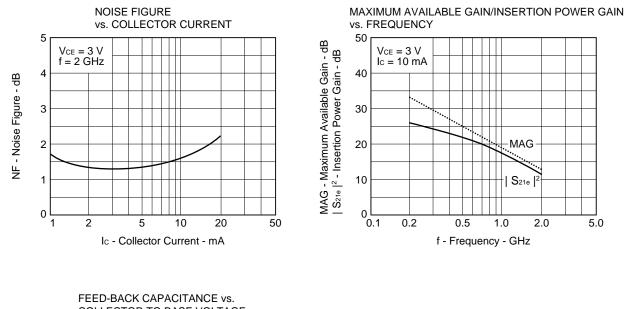


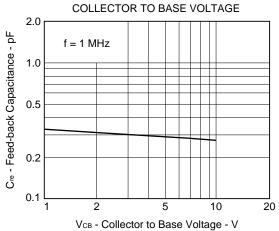


DC CURRENT GAIN vs. COLLECTOR CURRENT









## S-PARAMETER

FREQUENCY S11	S <sub>2</sub>					
		1	S	12	S	22
f (MHz) MAG ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00 .727 –22.0	22.084	159.4	.011	87.5	.934	-13.1
200.00 .640 -42.3	19.220	142.1	.029	70.7	.832	-24.3
300.00 .537 -57.8	16.333	129.2	.041	69.4	.735	-31.7
400.00 .452 -70.0	13.716	119.6	.046	60.9	.642	-35.6
500.00 .374 -82.3	11.834	111.2	.051	59.6	.562	-39.2
600.00 .332 -91.0	10.355	105.6	.060	61.7	.520	-40.7
700.00 .293 -101.5	9.190	100.2	.066	61.0	.479	-42.0
800.00 .255 -109.0	8.182	95.6	.072	61.3	.443	-44.4
900.00 .231 -119.1	7.376	91.9	.076	60.5	.413	-44.0
1000.00 .211 –128.8	6.751	87.9	.086	61.2	.394	-43.9
1100.00 .200 –136.1	6.171	84.9	.095	62.6	.376	-45.7
1200.00 .184 -143.4	5.658	81.7	.099	58.8	.363	-47.1
1300.00 .184 –154.3	5.286	79.0	.103	60.1	.342	-48.3
1400.00 .180 -162.4	4.932	76.2	.111	54.6	.332	-48.3
1500.00 .174 –171.5	4.630	73.3	.115	56.8	.310	-51.6
1600.00 .180 -178.4	4.347	70.9	.123	58.2	.303	-53.2
1700.00 .192 176.8	4.128	68.7	.131	54.1	.292	-51.8
1800.00 .193 169.1	3.914	66.0	.132	55.6	.292	-54.2
1900.00 .191 165.2	3.734	64.0	.139	51.7	.285	-55.3
2000.00 .209 161.0	3.561	61.1	.151	53.8	.281	-60.1
2100.00 .212 154.0	3.386	59.3	.154	51.9	.268	-61.0
2200.00 .219 148.1	3.242	56.7	.165	50.8	.267	-64.1
2300.00 .230 147.0	3.117	54.9	.169	49.2	.259	-63.5
2400.00 .230 141.3	2.986	53.0	.172	51.0	.240	-66.9
2500.00 .243 140.6	2.891	50.2	.186	48.5	.239	-68.9
2600.00 .254 135.8	2.790	48.6	.188	47.7	.249	-67.8
2700.00 .247 135.4	2.703	47.4	.193	47.9	.242	-73.3
2800.00 .251 132.3	2.610	44.0	.203	45.5	.237	-75.5
2900.00 .254 131.9	2.525	42.6	.207	44.0	.232	-77.9
3000.00 .269 123.9	2.435	40.5	.213	42.1	.236	-82.2

Vce = 3 V, Ic = 5 mA								
FREQUENCY		S11	S	21	S	12	S	22
f (MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.854	-15.0	13.962	166.0	.014	83.0	.966	-9.2
200.00	.795	-29.7	13.063	152.7	.033	76.1	.917	-17.9
300.00	.724	-41.9	11.975	141.5	.046	71.1	.856	-25.0
400.00	.648	-53.1	10.690	132.1	.054	65.0	.785	-30.0
500.00	.569	-63.9	9.702	123.1	.063	62.7	.711	-34.8
600.00	.516	-72.9	8.789	116.6	.070	58.8	.656	-38.4
700.00	.457	-81.9	8.009	110.2	.078	55.8	.611	-40.8
800.00	.411	-88.9	7.240	104.7	.085	54.3	.562	-44.1
900.00	.374	-96.5	6.634	100.2	.094	55.3	.525	-45.7
1000.00	.331	-105.0	6.145	95.6	.095	52.9	.500	-46.6
1100.00	.310	-111.5	5.664	91.9	.102	53.3	.468	-48.0
1200.00	.277	-118.1	5.207	88.1	.108	50.6	.453	-50.0
1300.00	.260	-126.8	4.898	84.8	.112	51.5	.425	-51.2
1400.00	.249	-134.2	4.595	81.6	.119	52.3	.411	-52.6
1500.00	.232	-143.5	4.329	78.3	.121	50.2	.386	-54.8
1600.00	.232	-150.4	4.085	75.4	.133	48.7	.378	-55.2
1700.00	.234	-158.5	3.892	72.7	.134	46.4	.360	-57.5
1800.00	.216	-164.6	3.678	69.8	.140	47.9	.359	-58.6
1900.00	.211	-171.3	3.514	67.6	.145	45.5	.343	-60.4
2000.00	.230	-176.6	3.368	64.5	.151	46.0	.336	-63.1
2100.00	.224	174.1	3.207	62.2	.161	46.4	.319	-64.7
2200.00	.227	168.9	3.064	59.2	.166	45.9	.317	-66.7
2300.00	.229	165.3	2.942	57.3	.168	44.3	.314	-67.4
2400.00	.230	158.8	2.838	55.3	.174	44.3	.291	-68.4
2500.00	.253	156.1	2.742	52.5	.181	42.8	.290	-71.4
2600.00	.250	150.1	2.656	50.7	.184	44.0	.289	-69.8
2700.00	.248	149.2	2.558	49.0	.189	43.8	.281	-74.2
2800.00	.254	145.7	2.484	45.9	.195	40.9	.283	-77.3
2900.00	.262	143.7	2.405	44.2	.203	39.8	.276	-77.7
3000.00	.264	135.7	2.317	41.7	.208	39.4	.294	-83.9

## S-PARAMETER

5-PARAMETER								
Vce = 3 V, Ic = 3 mA								
		-						
FREQUENCY		S11	S			12		22
f (MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.908	-11.7	9.519	169.3	.020	77.7	.984	-7.3
200.00	.872	-22.9	9.147	158.9	.036	74.3	.951	-13.7
300.00	.825	-33.1	8.721	149.4	.050	68.7	.920	-19.7
400.00	.767	-42.7	8.085	141.0	.061	66.4	.866	-24.9
500.00	.701	-52.2	7.623	132.2	.073	61.0	.813	-30.0
600.00	.656	-61.0	7.104	125.7	.082	57.4	.764	-33.9
700.00	.598	-69.4	6.670	119.0	.088	54.9	.721	-37.3
800.00	.551	-76.2	6.145	113.1	.097	52.4	.671	-41.2
900.00	.494	-84.0	5.719	108.0	.101	51.7	.631	-42.9
1000.00	.458	-90.7	5.371	102.9	.111	49.3	.602	-45.0
1100.00	.422	-97.4	5.005	98.6	.117	47.6	.570	-47.0
1200.00	.388	-104.1	4.642	94.3	.118	46.3	.538	-49.4
1300.00	.356	-110.7	4.396	90.5	.124	45.3	.512	-51.3
1400.00	.341	-117.6	4.148	86.8	.129	42.6	.491	-52.7
1500.00	.318	-124.9	3.933	83.0	.135	44.0	.463	-55.2
1600.00	.305	-132.3	3.713	79.8	.140	43.7	.445	-56.4
1700.00	.291	-140.3	3.563	77.0	.141	42.0	.430	-57.1
1800.00	.282	-145.0	3.382	73.6	.149	42.2	.424	-59.1
1900.00	.269	-151.9	3.234	71.2	.149	41.8	.413	-60.7
2000.00								
	.277	-160.1	3.108	67.7	.155	41.4	.401	-64.2
2100.00	.262	-167.5	2.956	65.1	.162	40.4	.386	-65.3
2200.00	.255	-172.8	2.838	61.9	.169	38.9	.377	-66.8
2300.00	.260	-177.4	2.722	60.0	.169	38.1	.373	-68.2
2400.00	.249	175.5	2.635	57.5	.173	37.9	.352	-68.1
2500.00	.266	171.8	2.553	54.5	.182	38.2	.351	-71.9
2600.00	.263	164.2	2.459	52.0	.183	36.7	.347	-70.9
2700.00	.270	164.0	2.383	50.6	.192	36.7	.341	-75.1
2800.00	.272	159.9	2.323	47.5	.195	36.4	.337	-79.8
2900.00	.278	155.5	2.241	45.6	.193	34.5	.316	-78.4
3000.00	.272	150.5	2.147	42.7	.200	35.0	.324	-82.3
Vce = 3 V, Ic = 1 mA								22
Vce = 3 V, Ic = 1 mA FREQUENCY	S	S11	S	21	S	12	S	22 ANG
Vce = 3 V, Ic = 1 mA FREQUENCY f (MHz)	MAG	S11 ANG	S: MAG	ANG	S MAG	12 ANG	S MAG	ANG
Vce = 3 V, Ic = 1 mA FREQUENCY f (MHz) 100.00	MAG .973	S11 ANG -6.3	S: MAG 3.521	ANG 173.9	S MAG .015	<sup>12</sup> ANG 82.1	S MAG .991	ANG -3.5
Vce = 3 V, Ic = 1 mA FREQUENCY f (MHz) 100.00 200.00	MAG .973 .959	S11 ANG -6.3 -13.5	S: MAG 3.521 3.484	ANG 173.9 167.3	S MAG .015 .033	<sup>12</sup> ANG 82.1 83.0	S MAG .991 .985	ANG -3.5 -7.6
Vce = 3 V, Ic = 1 mA FREQUENCY f (MHz) 100.00 200.00 300.00	MAG .973 .959 .947	S11 ANG -6.3 -13.5 -19.7	S: MAG 3.521 3.484 3.458	ANG 173.9 167.3 161.2	S MAG .015 .033 .055	<sup>12</sup> ANG 82.1 83.0 79.6	S MAG .991 .985 .981	ANG -3.5 -7.6 -11.3
Vce = 3 V, Ic = 1 mA FREQUENCY f (MHz) 100.00 200.00	MAG .973 .959 .947 .922	S11 ANG -6.3 -13.5	S: MAG 3.521 3.484	ANG 173.9 167.3	S MAG .015 .033	<sup>12</sup> ANG 82.1 83.0	S MAG .991 .985	ANG -3.5 -7.6
Vce = 3 V, Ic = 1 mA FREQUENCY f (MHz) 100.00 200.00 300.00 400.00	MAG .973 .959 .947 .922	S11 ANG -6.3 -13.5 -19.7	S: MAG 3.521 3.484 3.458 3.360	ANG 173.9 167.3 161.2 155.2	S MAG .015 .033 .055 .065	<sup>12</sup> ANG 82.1 83.0 79.6 72.2	S MAG .991 .985 .981	ANG -3.5 -7.6 -11.3 -14.8
Vce = 3 V, Ic = 1 mA FREQUENCY f (MHz) 100.00 200.00 300.00 400.00 500.00	MAG .973 .959 .947 .922 .898	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8	S: MAG 3.521 3.484 3.458 3.360 3.348	ANG 173.9 167.3 161.2 155.2 148.3	S MAG .015 .033 .055 .065 .084	<sup>12</sup> ANG 82.1 83.0 79.6 72.2 69.4	S MAG .991 .985 .981 .962 .946	ANG -3.5 -7.6 -11.3 -14.8 -18.9
$\begin{array}{l} V_{CE} = 3 \ V, \ I_{C} = 1 \ mA \\ FREQUENCY \\ f \ (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287	ANG 173.9 167.3 161.2 155.2 148.3 143.3	S MAG .015 .033 .055 .065 .084 .100	<sup>12</sup> ANG 82.1 83.0 79.6 72.2 69.4 63.5	S MAG .991 .985 .981 .962 .946 .925	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5
$\begin{array}{l} V_{CE} = 3 \ V, \ I_{C} = 1 \ mA \\ FREQUENCY \\ f \ (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3	S MAG .015 .033 .055 .065 .084 .100 .109	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2	S MAG .991 .985 .981 .962 .946 .925 .909	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5
$V_{CE} = 3 \text{ V}, \text{ Ic} = 1 \text{ mA} \\ FREQUENCY} \\ f (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .848 .822	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4	S MAG .015 .033 .055 .065 .084 .100 .109 .126	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6	S MAG .991 .985 .981 .962 .946 .925 .909 .875	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5
$V_{CE} = 3 V, I_C = 1 mA$ FREQUENCY f (MHz) 100.00 200.00 300.00 400.00 500.00 600.00 700.00 800.00 900.00	MAG .973 .959 .947 .922 .898 .878 .848 .848 .822 .772	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1	S MAG .015 .033 .055 .065 .065 .100 .109 .126 .134	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -25.5 -29.5 -32.4
$V_{CE} = 3 V, I_C = 1 mA$ FREQUENCY f (MHz) 100.00 200.00 300.00 400.00 500.00 600.00 700.00 800.00 900.00 1000.00	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0	S: MAG 3.521 3.484 3.360 3.348 3.287 3.248 3.136 3.040 2.980	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -25.5 -29.5 -32.4 -34.6
$V_{CE} = 3 V, I_C = 1 mA$ FREQUENCY f (MHz) 100.00 200.00 300.00 400.00 500.00 600.00 700.00 800.00 900.00 1000.00 1100.00	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -29.5 -32.4 -34.6 -38.1
$V_{CE} = 3 V, I_C = 1 mA$ FREQUENCY f (MHz) 100.00 200.00 300.00 400.00 500.00 600.00 700.00 800.00 900.00 1000.00	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0	S: MAG 3.521 3.484 3.360 3.348 3.287 3.248 3.136 3.040 2.980	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -25.5 -29.5 -32.4 -34.6
$\begin{array}{l} V_{CE}=3 \; V, \; I_{C}=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1100.00 \\ 1200.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .878 .878 .848 .822 .772 .752 .708 .676	S <sub>11</sub> ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 110.5	S MAG .015 .033 .055 .065 .084 .100 .126 .134 .150 .158 .163	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -25.5 -25.5 -32.4 -34.6 -38.1 -40.7
$\begin{array}{l} V_{CE}=3 \; V, \; I_{C}=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1100.00 \\ 1200.00 \\ 1300.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644	S <sub>11</sub> ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 110.5 106.0	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776 .745	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -29.5 -32.4 -34.6 -38.1 -40.7 -43.5
$\begin{array}{l} V_{CE}=3 \; V, \; Ic=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1100.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .848 .848 .848 .842 .772 .752 .708 .676 .644 .617	S <sub>11</sub> ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2	S: MAG 3.521 3.484 3.458 3.360 3.348 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 110.5 106.0 101.4	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172 .176	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776 .745 .724	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -32.4 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8
$\begin{array}{l} V_{CE}=3 \; V, \; Ic=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1100.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579	$\begin{array}{c} \text{ANG} \\ -6.3 \\ -13.5 \\ -19.7 \\ -26.2 \\ -32.8 \\ -39.1 \\ -45.9 \\ -51.7 \\ -58.0 \\ -64.0 \\ -70.1 \\ -76.4 \\ -82.4 \\ -82.4 \\ -88.2 \\ -94.1 \end{array}$	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.879 2.749 2.690 2.588 2.514	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 110.5 106.0 101.4 96.8	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172 .176 .181	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 55.0 55.0 46.1 43.5 44.1 38.2 36.3	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776 .745 .724 .696	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2
$\begin{array}{l} V_{CE}=3 \; V, \; Ic=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1000.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1600.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .559	$\begin{array}{c} \text{ANG} \\ -6.3 \\ -13.5 \\ -19.7 \\ -26.2 \\ -32.8 \\ -39.1 \\ -45.9 \\ -51.7 \\ -58.0 \\ -64.0 \\ -70.1 \\ -76.4 \\ -82.4 \\ -82.4 \\ -88.2 \\ -94.1 \\ -100.2 \end{array}$	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.879 2.749 2.690 2.588 2.514 2.407	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 110.5 106.0 101.4 96.8 92.4	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172 .176 .181 .186	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776 .745 .724 .696 .680	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2
$\begin{array}{l} V_{CE}=3 \; V, \; Ic=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1000.00 \\ 1100.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1600.00 \\ 1700.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .559 .536	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2 -94.1 -100.2 -106.6	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588 2.514 2.407 2.369	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 110.5 106.0 101.4 96.8 92.4 89.1	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172 .176 .181 .186 .188	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2 31.7	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776 .745 .745 .724 .696 .680 .651	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2 -52.6
$\begin{array}{l} V_{CE}=3 \; V, \; I_{C}=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1100.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1600.00 \\ 1700.00 \\ 1800.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .559 .536 .509	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2 -94.1 -100.2 -106.6 -111.4	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588 2.514 2.407 2.369 2.278	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 110.5 106.0 101.4 96.8 92.4 89.1 84.9	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172 .176 .181 .181 .186 .188 .191	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2 31.7 30.5	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776 .745 .724 .696 .680 .651 .642	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -29.5 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2 -52.6 -54.9
$\begin{array}{l} V_{CE}=3 \; V, \; Ic=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1000.00 \\ 1100.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1600.00 \\ 1700.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .559 .536	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2 -94.1 -100.2 -106.6	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588 2.514 2.407 2.369	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 110.5 106.0 101.4 96.8 92.4 89.1	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172 .176 .181 .186 .188	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2 31.7	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776 .745 .745 .724 .696 .680 .651	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2 -52.6
$\begin{array}{l} V_{CE}=3 \; V, \; I_{C}=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1100.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1600.00 \\ 1700.00 \\ 1800.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .559 .536 .509	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2 -94.1 -100.2 -106.6 -111.4	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588 2.514 2.407 2.369 2.278	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 110.5 106.0 101.4 96.8 92.4 89.1 84.9	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172 .176 .181 .181 .186 .188 .191	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2 31.7 30.5	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776 .745 .724 .696 .680 .651 .642	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -29.5 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2 -52.6 -54.9
$\begin{array}{l} V_{CE}=3 \; V, \; I_{C}=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1000.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1600.00 \\ 1700.00 \\ 1800.00 \\ 1900.00 \\ 2000.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .559 .536 .509 .490 .478	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2 -94.1 -100.2 -106.6 -111.4 -117.1 -124.8	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588 2.514 2.407 2.369 2.278 2.201 2.151	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 120.9 116.1 110.5 106.0 101.4 96.8 92.4 89.1 84.9 81.5 77.0	S MAG .015 .033 .055 .065 .084 .100 .126 .134 .150 .158 .163 .172 .176 .181 .186 .181 .186 .188 .191 .192 .195	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2 31.7 30.5 28.4 27.2	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776 .745 .724 .696 .680 .651 .642 .624 .624 .611	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -29.5 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2 -52.6 -54.9 -57.0 -59.7
$\begin{array}{l} V_{CE}=3 \; V, \; I_{C}=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1000.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1600.00 \\ 1700.00 \\ 1800.00 \\ 1900.00 \\ 2000.00 \\ 2100.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .559 .559 .559 .559 .509 .490 .478 .442	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2 -94.1 -100.2 -106.6 -111.4 -117.1 -124.8 -129.6	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588 2.514 2.407 2.369 2.278 2.201 2.151 2.071	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 120.9 116.1 120.9 116.1 105.0 101.4 96.8 92.4 89.1 89.1 89.1 84.9 81.5 77.0 73.5	S MAG .015 .033 .055 .065 .084 .100 .126 .134 .150 .158 .163 .172 .176 .181 .186 .181 .186 .188 .191 .192 .195 .198	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2 31.7 30.5 28.4 27.2 25.4	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776 .745 .724 .696 .680 .651 .642 .624 .611 .593	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -29.5 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2 -52.6 -54.9 -57.0 -59.7 -62.2
$\begin{array}{l} V_{CE}=3 \; V, \; I_{C}=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1000.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1600.00 \\ 1700.00 \\ 1800.00 \\ 1900.00 \\ 2000.00 \\ 2100.00 \\ 2200.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .559 .536 .509 .490 .478 .442 .423	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2 -94.1 -100.2 -106.6 -111.4 -117.1 -124.8 -129.6 -136.7	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588 2.514 2.407 2.369 2.278 2.201 2.151 2.071 2.001	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 120.9 116.1 120.9 116.1 110.5 106.0 101.4 96.8 92.4 89.1 84.9 81.5 77.0 73.5 69.4	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172 .176 .181 .186 .188 .191 .192 .195 .198 .201	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2 31.7 30.5 28.4 27.2 25.4 25.8	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .745 .724 .696 .680 .651 .642 .624 .611 .593 .575	ANG -3.5 -7.6 -11.3 -14.8 -22.5 -25.5 -25.5 -25.5 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2 -52.6 -54.9 -54.9 -54.9 -55.7 -59.7 -62.2 -63.7
$\begin{array}{l} V_{CE}=3 \; V, \; I_{C}=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1000.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1600.00 \\ 1700.00 \\ 1800.00 \\ 1900.00 \\ 2000.00 \\ 2100.00 \\ 2300.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .536 .509 .490 .478 .442 .423 .429	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2 -94.1 -100.2 -106.6 -111.4 -117.1 -124.8 -129.6 -136.7 -140.8	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588 2.514 2.407 2.369 2.278 2.271 2.2691 2.151 2.071 2.001 1.938	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 120.9 116.1 120.9 116.1 110.5 106.0 101.4 96.8 92.4 89.1 84.9 81.5 77.0 73.5 69.4 67.1	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172 .176 .181 .186 .188 .191 .192 .195 .198 .201 .203	ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2 31.7 30.5 28.4 27.2 25.4 25.8 23.5	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .745 .724 .696 .680 .651 .642 .624 .611 .593 .575 .565	ANG -3.5 -7.6 -11.3 -14.8 -22.5 -25.5 -29.5 -29.5 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2 -52.6 -54.9 -57.0 -59.7 -62.2 -63.7 -65.5
$\begin{array}{l} V_{CE}=3 \; V, \; I_{C}=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1000.00 \\ 1200.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1600.00 \\ 1900.00 \\ 2000.00 \\ 2100.00 \\ 2300.00 \\ 2400.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .536 .509 .490 .478 .442 .423 .429 .401	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2 -94.1 -100.2 -106.6 -111.4 -117.1 -124.8 -129.6 -136.7 -140.8 -145.8	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588 2.514 2.407 2.369 2.278 2.201 2.151 2.071 2.001 1.938 1.873	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 120.9 116.1 120.9 116.1 120.9 116.1 120.9 116.1 106.0 101.4 96.8 92.4 89.1 84.9 81.5 77.0 73.5 69.4 67.1 63.8	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172 .176 .181 .188 .191 .192 .195 .198 .201 .203 .202	<sup>12</sup> ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2 31.7 30.5 28.4 27.2 25.4 25.8 23.5 21.3	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .745 .724 .696 .680 .651 .642 .624 .611 .593 .575 .565 .536	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2 -52.6 -54.9 -57.0 -57.0 -59.7 -62.2 -63.7 -65.5 -66.3
$\begin{array}{l} V_{CE}=3 \; V, \; I_{C}=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1000.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1500.00 \\ 1600.00 \\ 1700.00 \\ 1900.00 \\ 2000.00 \\ 2100.00 \\ 2200.00 \\ 2300.00 \\ 2400.00 \\ 2500.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .559 .536 .509 .490 .478 .442 .423 .429 .401 .406	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2 -94.1 -100.2 -106.6 -111.4 -117.1 -124.8 -129.6 -136.7 -140.8 -145.8 -152.3	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588 2.514 2.407 2.369 2.278 2.201 2.151 2.071 2.001 1.938 1.873 1.839	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 120.9 116.1 110.5 106.0 101.4 96.8 92.4 89.1 84.9 81.5 77.0 73.5 69.4 67.1 63.8 60.3	S MAG .015 .033 .055 .065 .084 .100 .126 .134 .150 .158 .163 .172 .176 .181 .181 .186 .188 .191 .192 .195 .198 .201 .203 .202 .204	<sup>12</sup> ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2 31.7 30.5 28.4 27.2 25.4 25.8 23.5 21.3 20.3	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776 .745 .724 .696 .680 .651 .642 .624 .611 .593 .575 .565 .536 .540	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -29.5 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2 -52.6 -54.9 -57.0 -59.7 -65.5 -66.3 -69.0
$\begin{array}{l} V_{CE}=3 \; V, \; I_{C}=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1000.00 \\ 1200.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1600.00 \\ 1900.00 \\ 2000.00 \\ 2100.00 \\ 2300.00 \\ 2400.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .536 .509 .536 .509 .490 .478 .442 .423 .429 .401	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2 -94.1 -100.2 -106.6 -111.4 -117.1 -124.8 -129.6 -136.7 -140.8 -145.8	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588 2.514 2.407 2.369 2.278 2.201 2.151 2.071 2.001 1.938 1.873	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 120.9 116.1 120.9 116.1 120.9 116.1 120.9 116.1 106.0 101.4 96.8 92.4 89.1 84.9 81.5 77.0 73.5 69.4 67.1 63.8	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172 .176 .181 .188 .191 .192 .195 .198 .201 .203 .202	<sup>12</sup> ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2 31.7 30.5 28.4 27.2 25.4 25.8 23.5 21.3	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .745 .724 .696 .680 .651 .642 .624 .611 .593 .575 .565 .536	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2 -52.6 -54.9 -57.0 -57.0 -59.7 -62.2 -63.7 -65.5 -66.3
$\begin{array}{l} V_{CE}=3 \; V, \; I_{C}=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1000.00 \\ 1200.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1600.00 \\ 1700.00 \\ 1800.00 \\ 2000.00 \\ 2100.00 \\ 2200.00 \\ 2300.00 \\ 2500.00 \\ 2600.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .559 .536 .509 .490 .478 .442 .423 .429 .401 .406	S <sub>11</sub> ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2 -94.1 -100.2 -106.6 -111.4 -117.1 -124.8 -129.6 -136.7 -140.8 -145.8 -152.3 -158.3	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588 2.514 2.407 2.369 2.278 2.201 2.151 2.071 2.001 1.938 1.873 1.839	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 120.9 116.1 110.5 106.0 101.4 96.8 92.4 89.1 84.9 81.5 77.0 73.5 69.4 67.1 63.8 60.3	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172 .176 .181 .186 .181 .192 .195 .198 .201 .203 .202 .204 .201	<sup>12</sup> ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2 31.7 30.5 28.4 27.2 25.4 25.8 23.5 21.3 20.3 20.6	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776 .745 .724 .696 .680 .651 .642 .624 .611 .593 .575 .565 .536 .540 .528	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -29.5 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2 -52.6 -54.9 -57.0 -59.7 -65.5 -66.3 -69.0
$\begin{array}{l} V_{CE}=3 \; V, \; I_{C}=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1000.00 \\ 1000.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1500.00 \\ 1900.00 \\ 2000.00 \\ 2100.00 \\ 2200.00 \\ 2300.00 \\ 2500.00 \\ 2600.00 \\ 2700.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .559 .536 .509 .490 .478 .442 .423 .429 .401 .406 .388 .400	S11 ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2 -94.1 -100.2 -106.6 -111.4 -117.1 -124.8 -129.6 -136.7 -140.8 -145.8 -152.3 -158.3 -158.3 -161.7	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588 2.514 2.407 2.369 2.278 2.201 2.151 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.788 2.201 2.151 2.071 2.788 2.201 2.151 2.071 2.788 2.201 2.151 2.071 2.788 2.201 2.151 2.071 2.788 2.201 2.151 2.071 2.788 2.201 2.151 2.071	ANG 173.9 167.3 161.2 155.2 148.3 143.3 137.3 131.4 126.1 120.9 116.1 120.9 116.1 110.5 106.0 101.4 96.8 92.4 89.1 84.9 81.5 77.0 73.5 69.4 67.1 63.8 60.3 57.3 55.3	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172 .176 .181 .172 .176 .181 .186 .188 .191 .192 .195 .198 .201 .203 .202 .204 .201 .204	<sup>12</sup> ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2 31.7 30.5 28.4 27.2 25.4 25.8 23.5 21.3 20.3 20.6 20.6	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776 .745 .745 .745 .745 .745 .696 .680 .651 .642 .624 .611 .593 .575 .565 .536 .536 .528 .521	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -32.4 -32.4 -34.6 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2 -52.6 -54.9 -57.0 -59.7 -62.2 -63.7 -62.5 -66.3 -69.0 -68.7 -72.7
$\begin{array}{l} V_{CE}=3 \; V, \; I_{C}=1 \; mA \\ FREQUENCY \\ f \; (MHz) \\ 100.00 \\ 200.00 \\ 300.00 \\ 400.00 \\ 500.00 \\ 600.00 \\ 700.00 \\ 800.00 \\ 900.00 \\ 1000.00 \\ 1000.00 \\ 1200.00 \\ 1200.00 \\ 1300.00 \\ 1400.00 \\ 1500.00 \\ 1600.00 \\ 1700.00 \\ 1800.00 \\ 2000.00 \\ 2100.00 \\ 2200.00 \\ 2300.00 \\ 2500.00 \\ 2600.00 \end{array}$	MAG .973 .959 .947 .922 .898 .878 .848 .822 .772 .752 .708 .676 .644 .617 .579 .559 .536 .509 .490 .478 .423 .429 .401 .406 .388	S <sub>11</sub> ANG -6.3 -13.5 -19.7 -26.2 -32.8 -39.1 -45.9 -51.7 -58.0 -64.0 -70.1 -76.4 -82.4 -88.2 -94.1 -100.2 -106.6 -111.4 -117.1 -124.8 -129.6 -136.7 -140.8 -145.8 -152.3 -158.3	S: MAG 3.521 3.484 3.458 3.360 3.348 3.287 3.248 3.136 3.040 2.980 2.879 2.749 2.690 2.588 2.514 2.407 2.369 2.278 2.201 2.151 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.071 2.788 2.201 2.151 2.071 2.788 2.201 2.151 2.071 2.788 2.201 2.788 2.201 2.788 2.201 2.788 2.201 2.788 2.201 2.788 2.201 2.788 2.201 2.788 2.201 2.788 2.201 2.778 2.201 2.751 2.071	ANG 173.9 167.3 161.2 155.2 148.3 143.3 143.3 137.3 131.4 126.1 120.9 116.1 120.9 116.1 120.9 116.1 110.5 106.0 101.4 96.8 92.4 89.1 84.9 81.5 77.0 73.5 69.4 67.1 63.8 60.3 57.3	S MAG .015 .033 .055 .065 .084 .100 .109 .126 .134 .150 .158 .163 .172 .176 .181 .186 .181 .192 .195 .198 .201 .203 .202 .204 .201	<sup>12</sup> ANG 82.1 83.0 79.6 72.2 69.4 63.5 60.2 56.6 55.0 50.0 46.1 43.5 44.1 38.2 36.3 33.2 31.7 30.5 28.4 27.2 25.4 25.8 23.5 21.3 20.3 20.6	S MAG .991 .985 .981 .962 .946 .925 .909 .875 .847 .830 .801 .776 .745 .724 .696 .680 .651 .642 .624 .611 .593 .575 .565 .536 .540 .528	ANG -3.5 -7.6 -11.3 -14.8 -18.9 -22.5 -25.5 -29.5 -32.4 -32.4 -32.4 -38.1 -40.7 -43.5 -46.8 -49.2 -50.2 -52.6 -54.9 -57.0 -59.7 -62.2 -63.7 -65.5 -66.3 -68.7

3000.00

.368

-177.7

1.590

46.0

.209

17.2

.495

-80.4

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