

# HSG2002

## SiGe HBT High Frequency Medium Power Amplifier

REJ03G0444-0300

Rev.3.00

Jun 21, 2006

### Features

- High Transition Frequency  
 $f_T = 28.5$  GHz typ.
- Low Distortion and Excellent Linearity  
P1dB at output = +25 dBm typ.  $f = 5.8$  GHz
- High Collector to Emitter Voltage  
 $V_{CEO} = 5$  V
- Ideal for 2 GHz, 5 GHz Band applications. e.g WLAN, Digital cordless phone.

### Outline

Renesas Package code: PWQN0008ZA-A  
(Package name: HWQFN-8 <TNP-8TV>)



1. Collector
2. Collector
3. Collector
4. Emitter
5. Emitter
6. Base
7. Emitter
8. Emitter
9. Emitter

Note: Marking is "2002".

### Absolute Maximum Ratings

( $T_a = 25^\circ\text{C}$ )

Item	Symbol	Ratings	Unit
Collector to base voltage	$V_{CBO}$	12	V
Collector to emitter voltage	$V_{CEO}$	5	V
Emitter to base voltage	$V_{EBO}$	1.5	V
Collector current	$I_C$	500	mA
Collector power dissipation	$P_C$	1.4 <sup>Note</sup>	W
Junction temperature	$T_j$	150	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-55 to +150	$^\circ\text{C}$

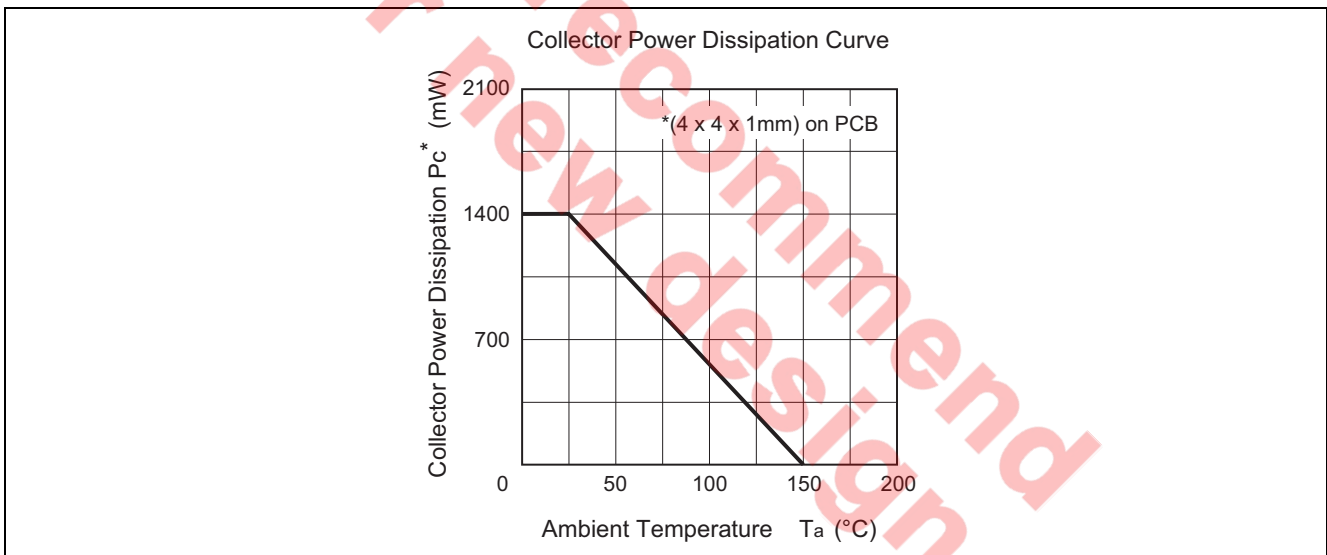
Note: Value on PCB (40 x 40 x 1.0mm)

## Electrical Characteristics

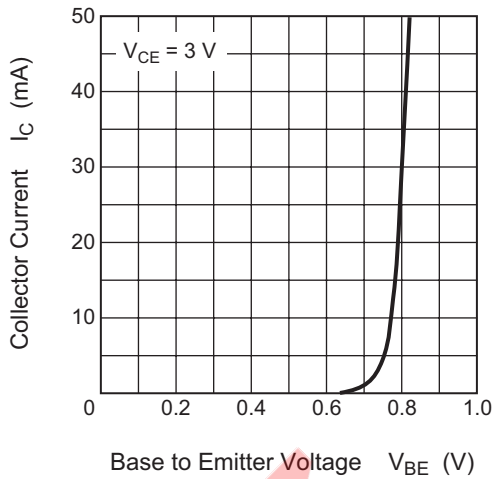
(Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
DC current transfer ratio	$h_{FE}$	170	240	320	—	$V_{CE} = 3\text{ V}$ , $I_C = 100\text{ mA}$
Reverse Transfer Capacitance	$C_{re}$	—	—	1.0	pF	$V_{CB} = 3\text{ V}$ , $I_E = 0$ , $f = 1\text{ MHz}$ emitter grounded
Transition Frequency	$f_T$	—	28.5	—	GHz	$V_{CE} = 3\text{ V}$ , $I_C = 250\text{ mA}$ $f = 1\text{ GHz}$
Maximum Stable Gain	MSG	9.0	10.5	—	dB	$V_{CE} = 3\text{ V}$ , $I_C = 250\text{ mA}$ , $f = 5.8\text{ GHz}$ ,
Maximum Available Gain	MAG	—	15	—	dB	$V_{CE} = 3\text{ V}$ , $I_C = 250\text{ mA}$ , $f = 2.4\text{ GHz}$ ,
Maximum Available Gain	MAG	—	7	—	dB	$V_{CE} = 3\text{ V}$ , $I_C = 250\text{ mA}$ , $f = 5.8\text{ GHz}$ ,
Power Gain	PG	—	5.5	—	dB	$V_{CE} = 3.6\text{ V}$ , $I_{Cq} = 100\text{ mA}$ , $f = 5.8\text{ GHz}$ , $P_{in} = +20\text{ dBm}$
1dB Compression Point at output	P1dB	—	+25	—	dBm	$V_{CE} = 3.6\text{ V}$ , $I_{Cq} = 100\text{ mA}$ , $f = 5.8\text{ GHz}$
Saturation Output Power	Po(sat)	—	+27	—	dBm	$V_{CE} = 3.6\text{ V}$ , $I_{Cq} = 100\text{ mA}$ $f = 5.8\text{ GHz}$ , $P_{in} = +25\text{ dBm}$

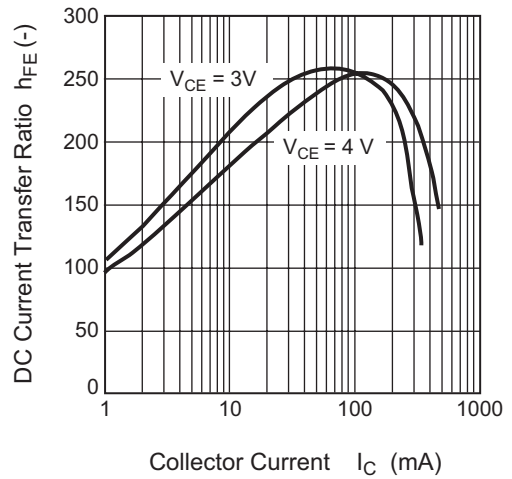
## Main Characteristics



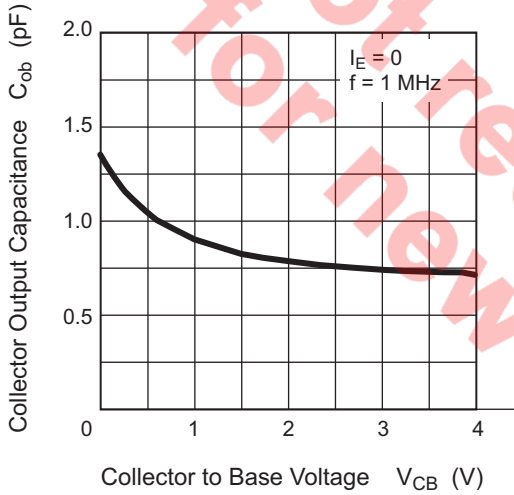
Typical Transfer Characteristics



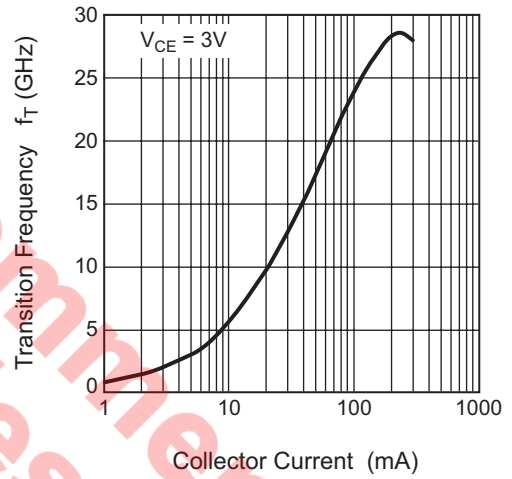
DC Current Transfer Ratio vs. Collector Current



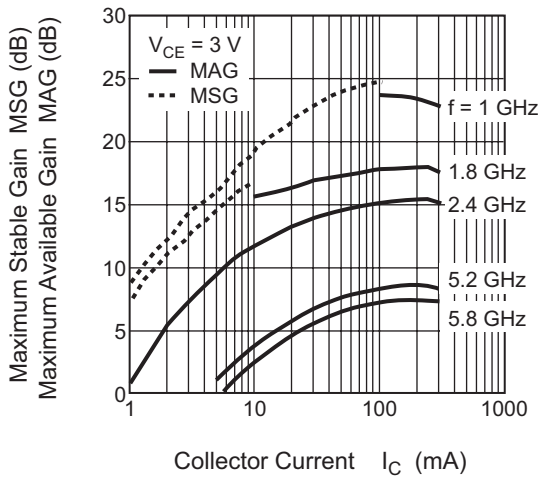
Collector Output Capacitance vs. Collector to Base Voltage



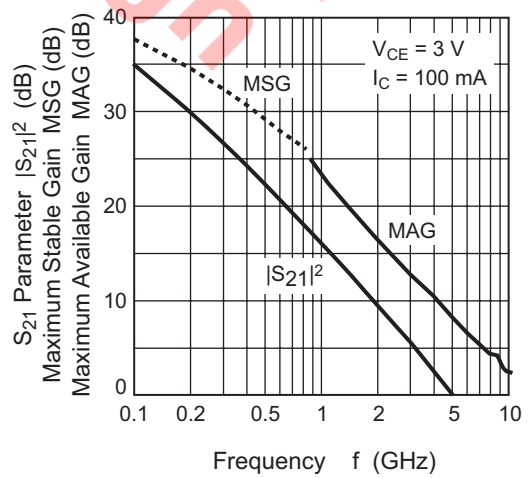
Transition Frequency vs. Collector Current



Maximum Stable Gain, Maximum Available Gain vs. Collector Current

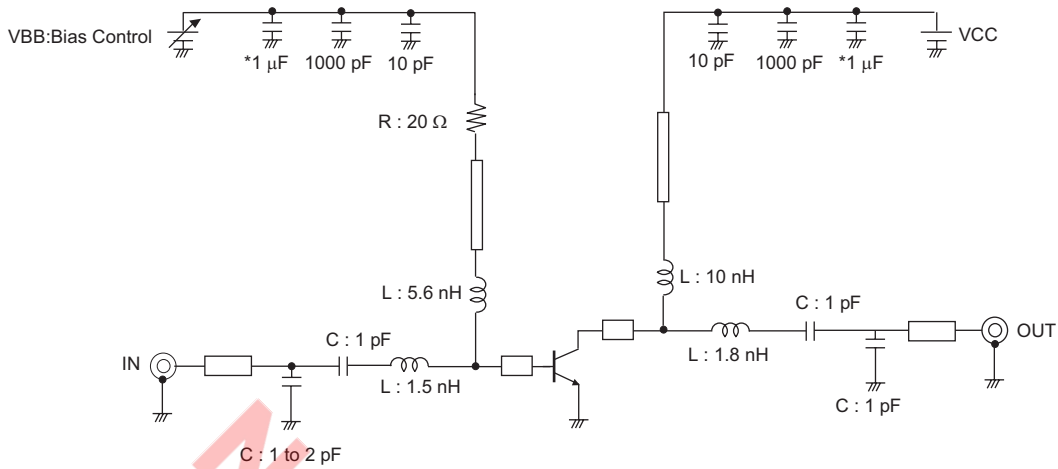


S<sub>21</sub> Parameter, Maximum Stable Gain, Maximum Available Gain vs. Frequency

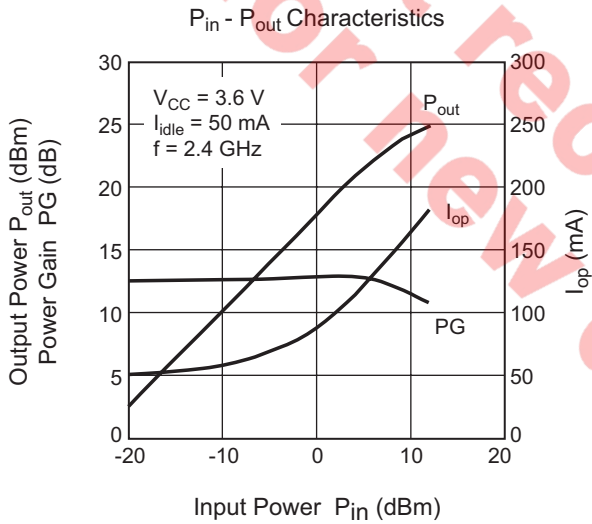


2.4GHz Characteristics

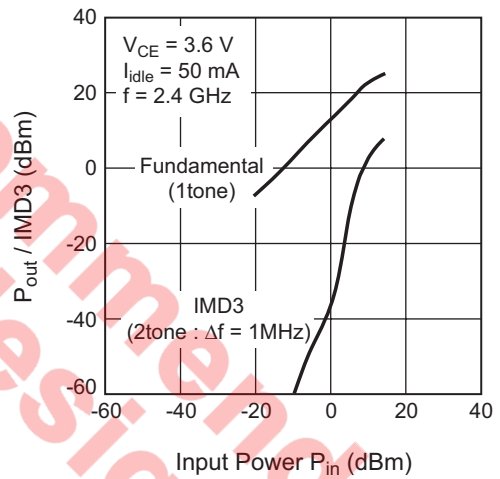
Evaluation Board Circuit



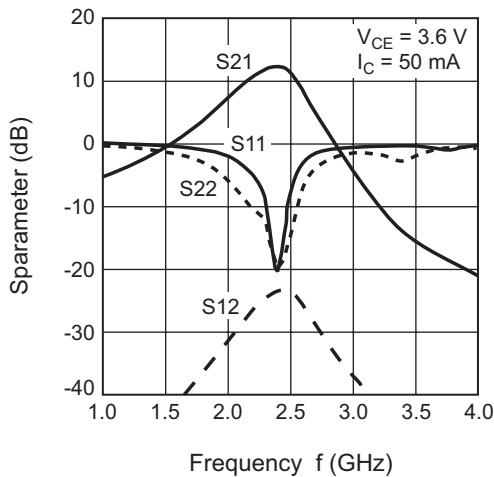
Pin - Pout Characteristics



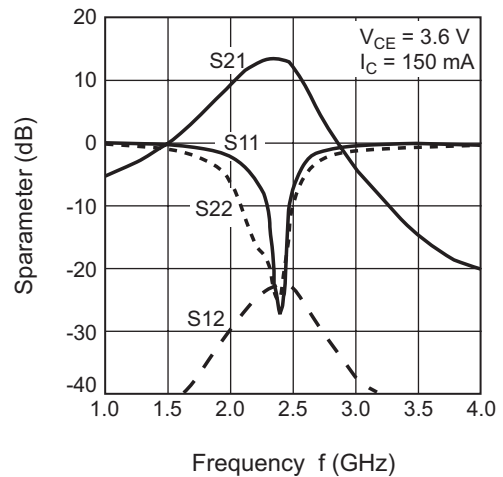
3rd. Order Intermodulation Distortion (IMD3)



Sparameter vs. Frequency

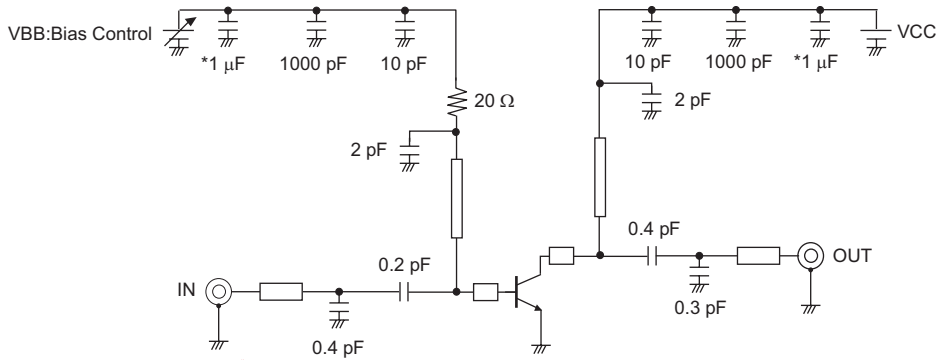


Sparameter vs. Frequency

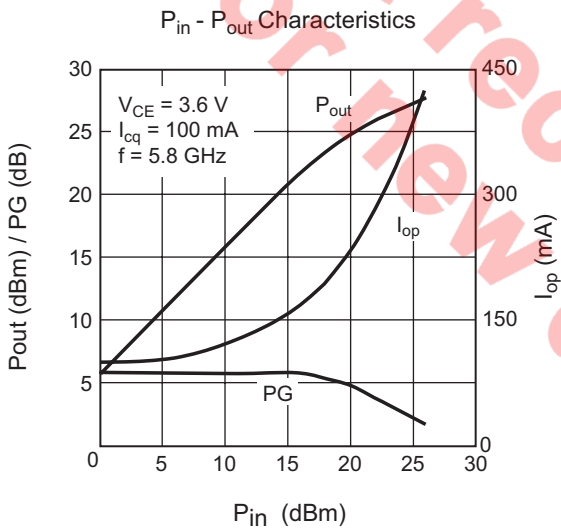


### 5.8GHz Characteristics

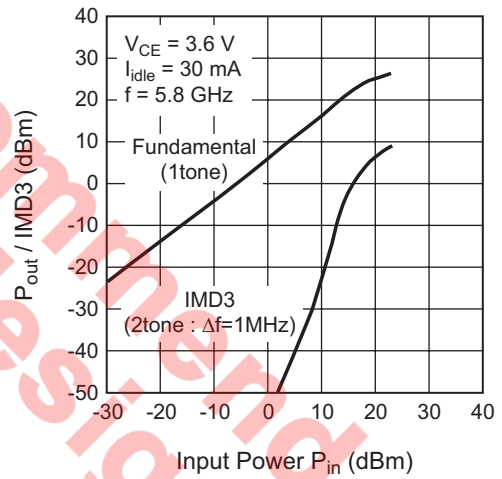
Evaluation Board Circuit



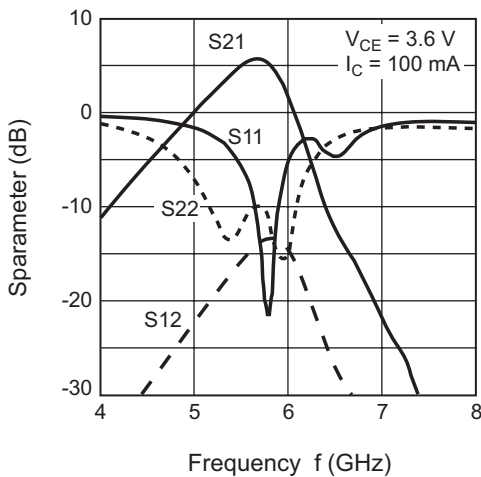
Pin - Pout Characteristics



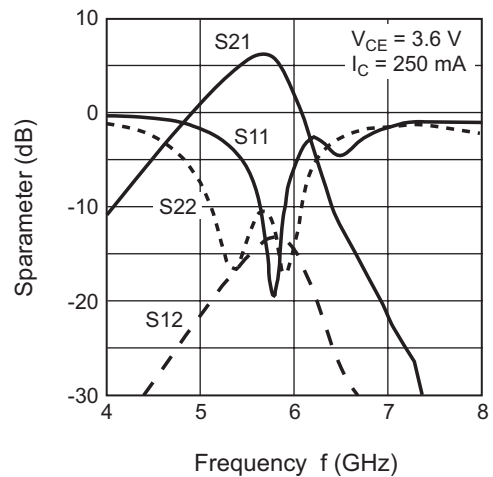
3rd. Order Intermodulation Distortion (IMD3)



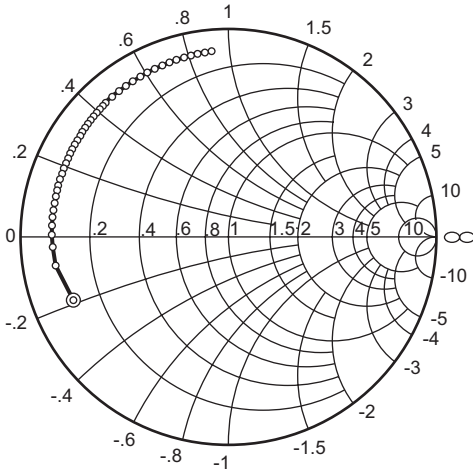
Sparameter vs. Frequency



Sparameter vs. Frequency

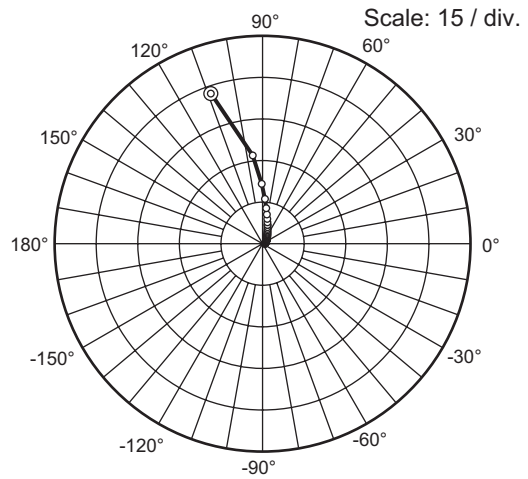


S<sub>11</sub> Parameter vs. Frequency



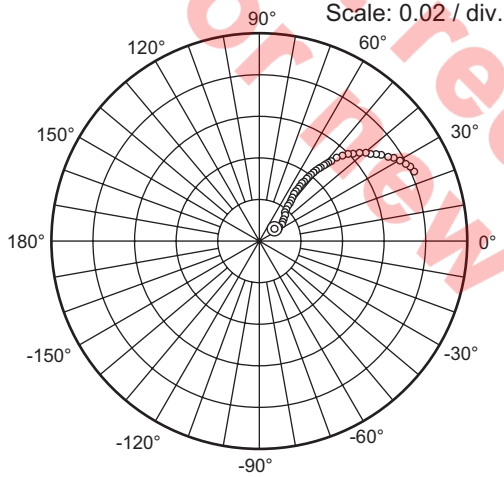
Condition:  $V_{CE} = 3\text{ V}$ ,  $I_C = 100\text{ mA}$ ,  $Z_o = 50\ \Omega$   
 100 to 3000 MHz (100 MHz Step)  
 3200 to 6000 MHz (200 MHz Step)

S<sub>21</sub> Parameter vs. Frequency



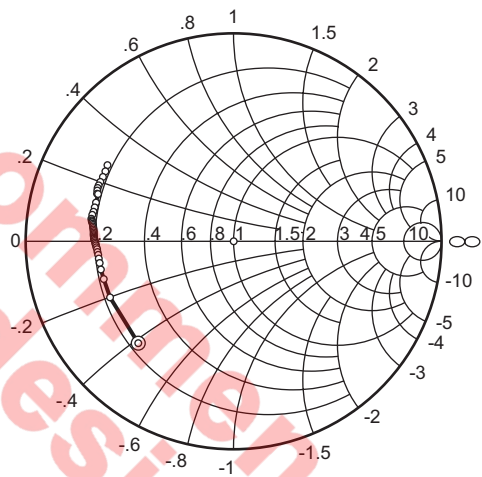
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S<sub>12</sub> Parameter vs. Frequency



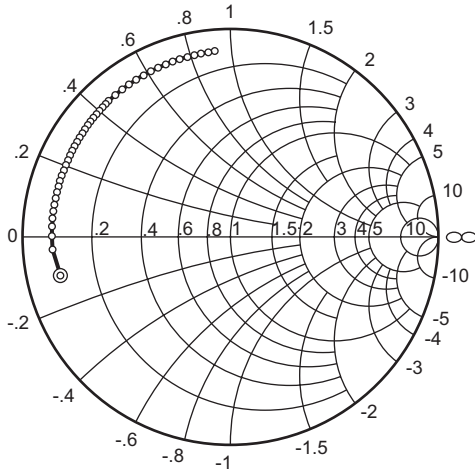
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S<sub>22</sub> Parameter vs. Frequency



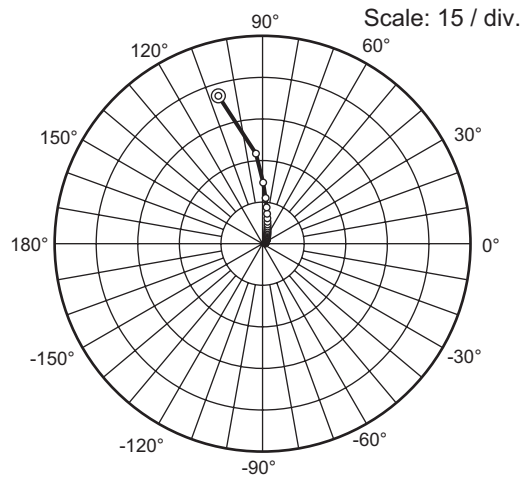
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S<sub>11</sub> Parameter vs. Frequency



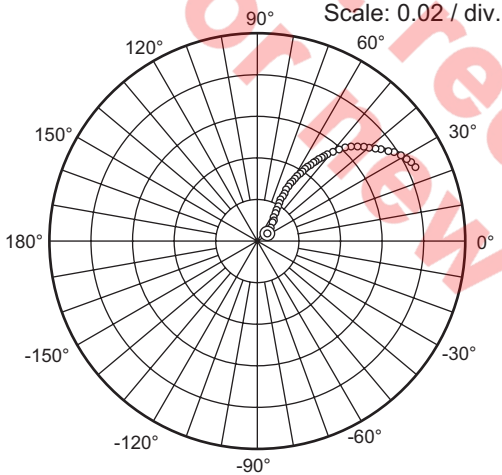
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S<sub>21</sub> Parameter vs. Frequency



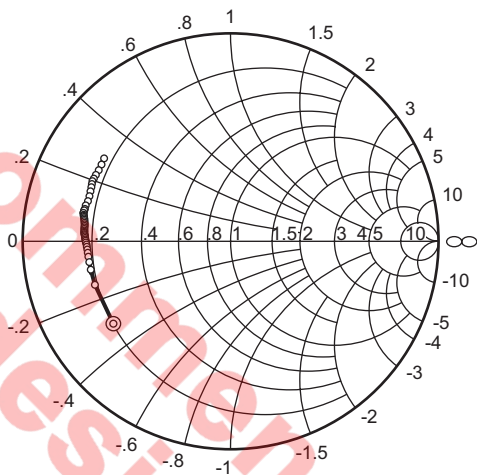
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S<sub>12</sub> Parameter vs. Frequency



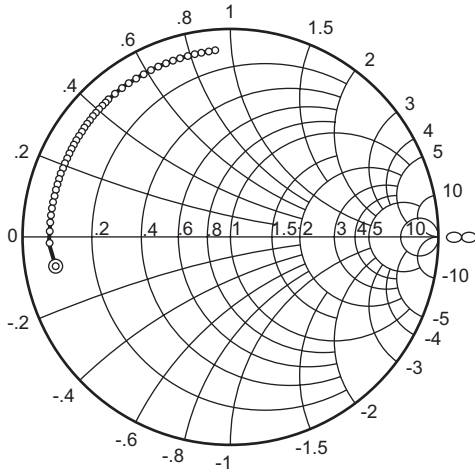
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S<sub>22</sub> Parameter vs. Frequency



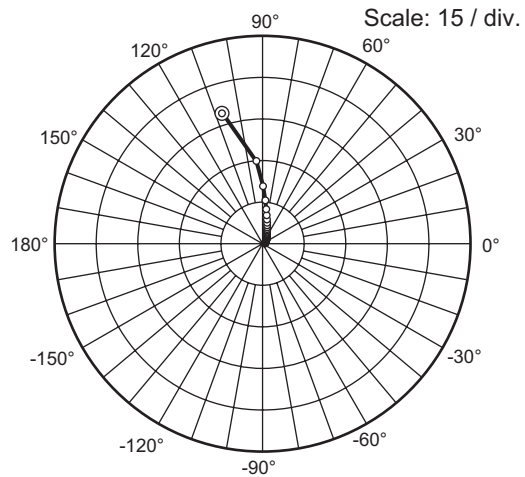
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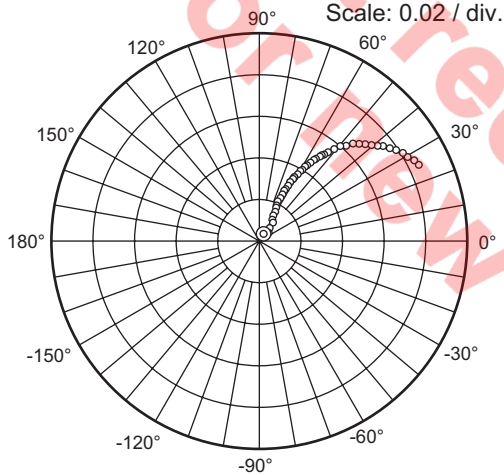
Condition:  $V_{CE} = 3\text{ V}$ ,  $I_C = 300\text{ mA}$ ,  $Z_o = 50\ \Omega$   
 100 to 3000 MHz (100 MHz Step)  
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S<sub>21</sub> Parameter vs. Frequency



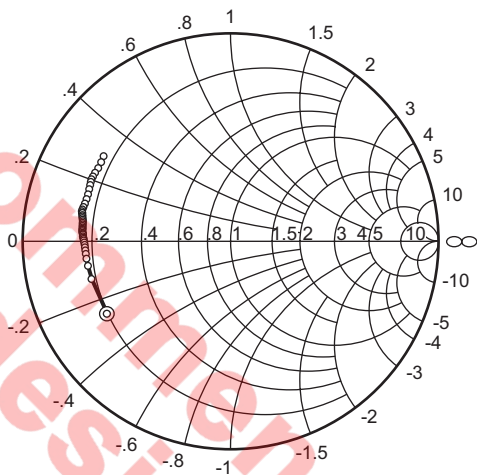
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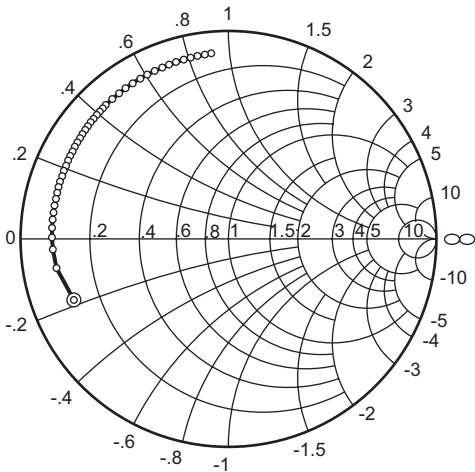
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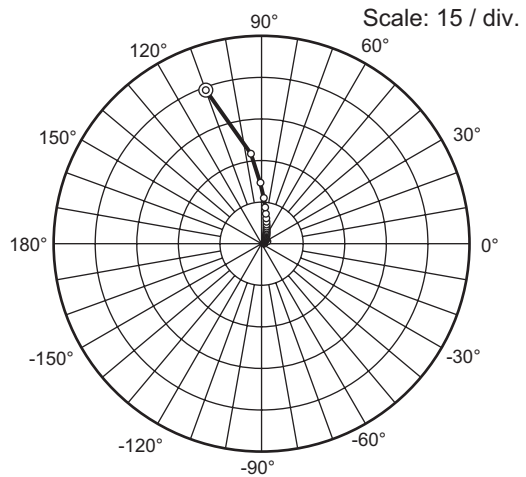


S<sub>11</sub> Parameter vs. Frequency



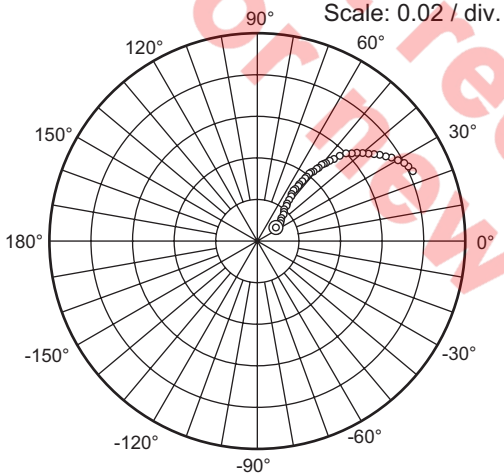
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S<sub>21</sub> Parameter vs. Frequency



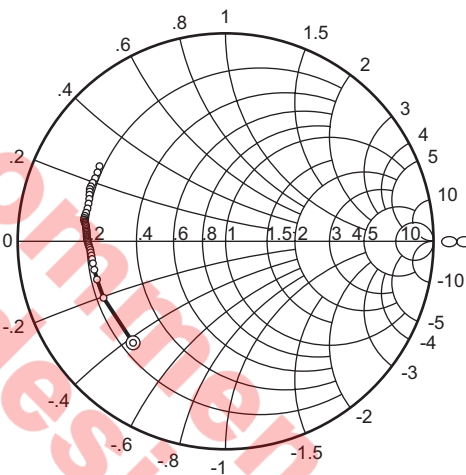
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S<sub>12</sub> Parameter vs. Frequency



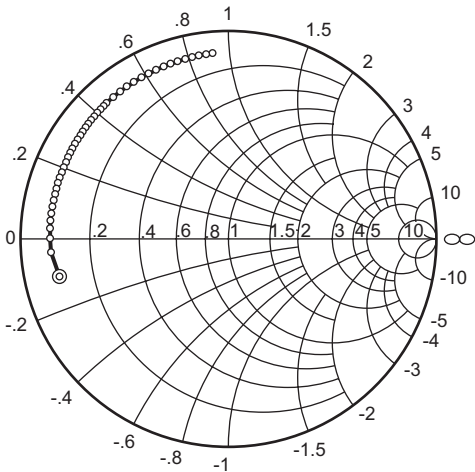
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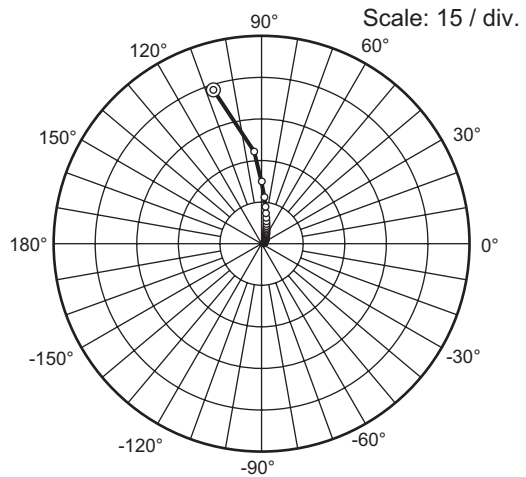
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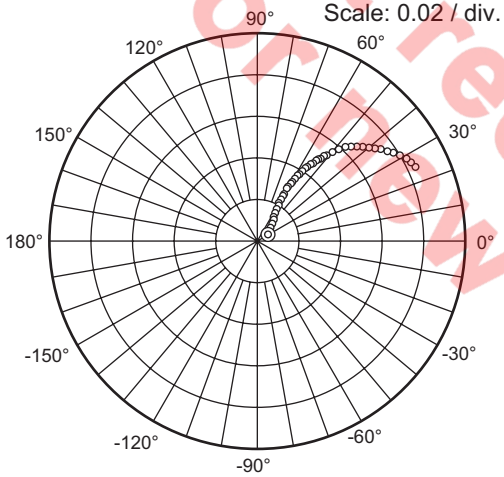
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S<sub>21</sub> Parameter vs. Frequency



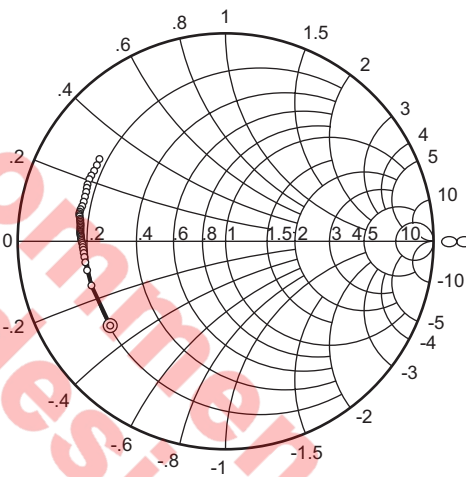
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S<sub>12</sub> Parameter vs. Frequency



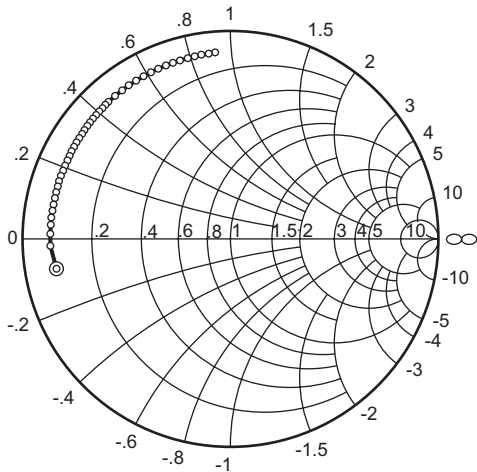
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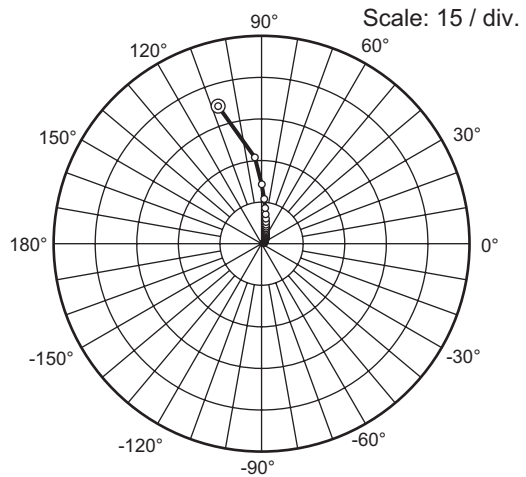
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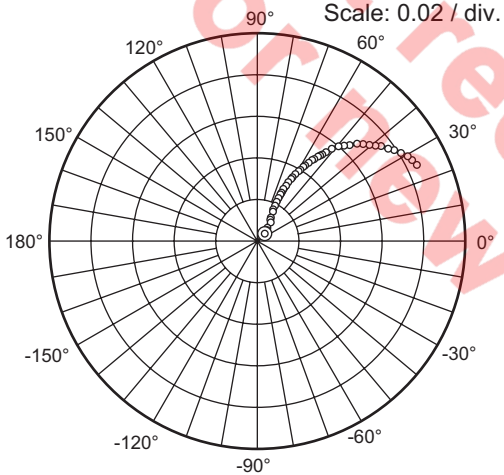
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S<sub>21</sub> Parameter vs. Frequency



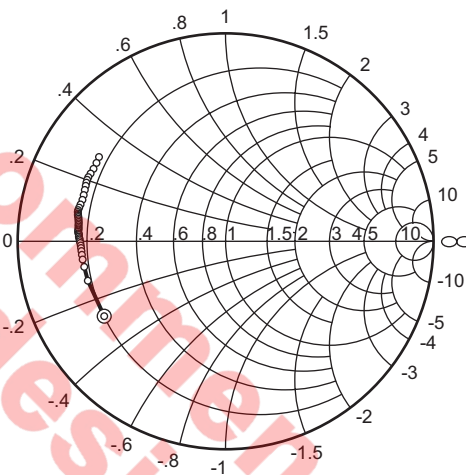
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S<sub>12</sub> Parameter vs. Frequency



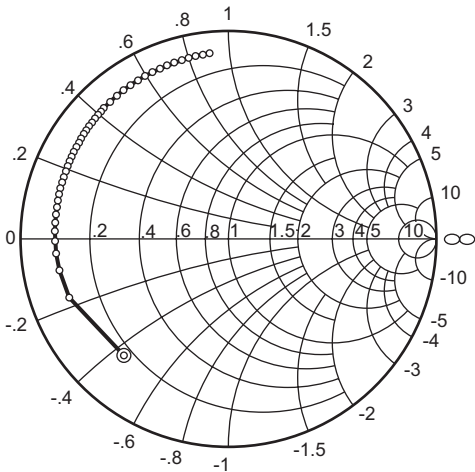
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S<sub>22</sub> Parameter vs. Frequency



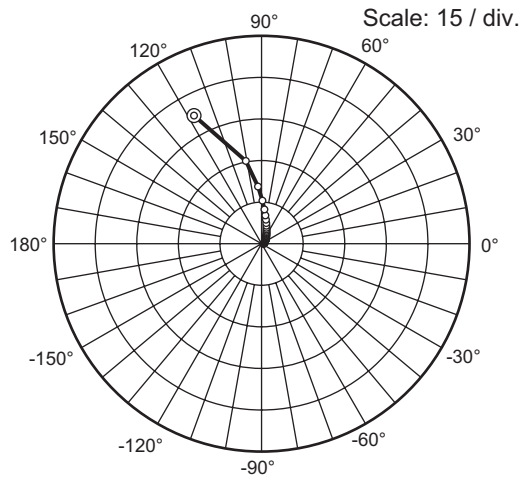
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S<sub>11</sub> Parameter vs. Frequency



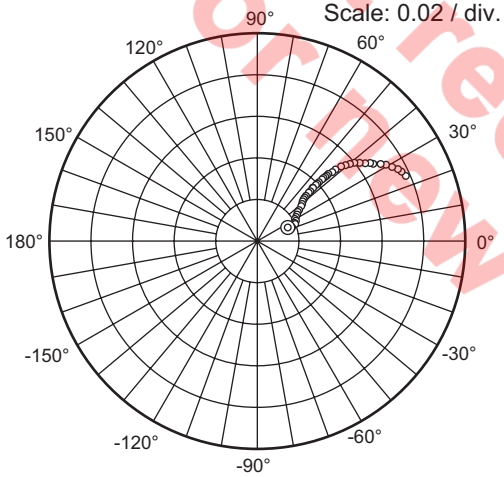
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S<sub>21</sub> Parameter vs. Frequency



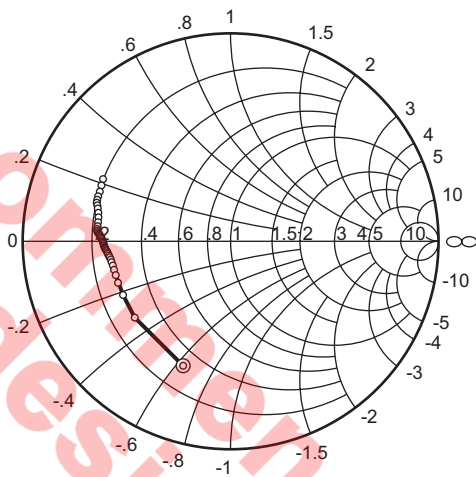
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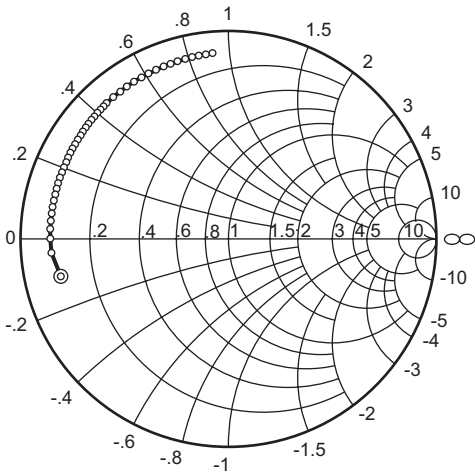
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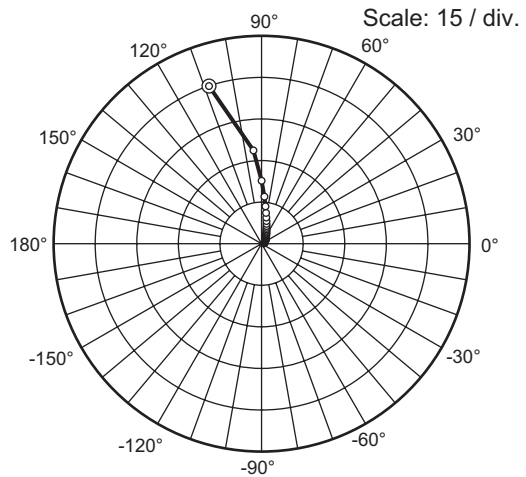
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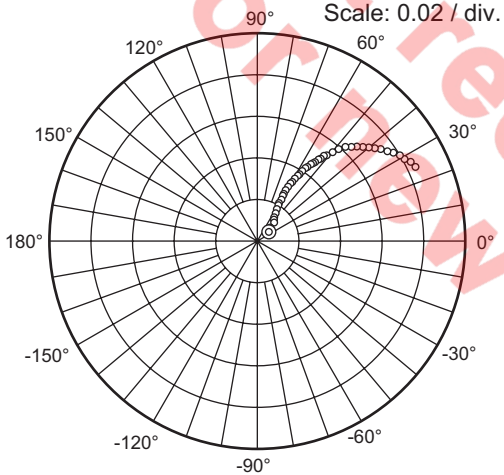
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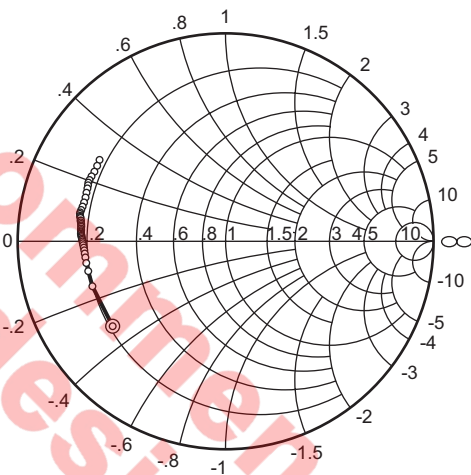
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S<sub>12</sub> Parameter vs. Frequency



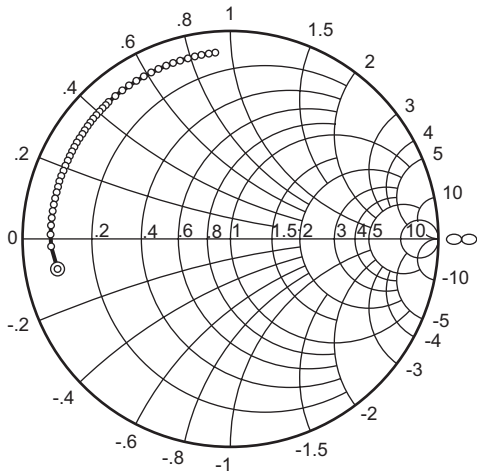
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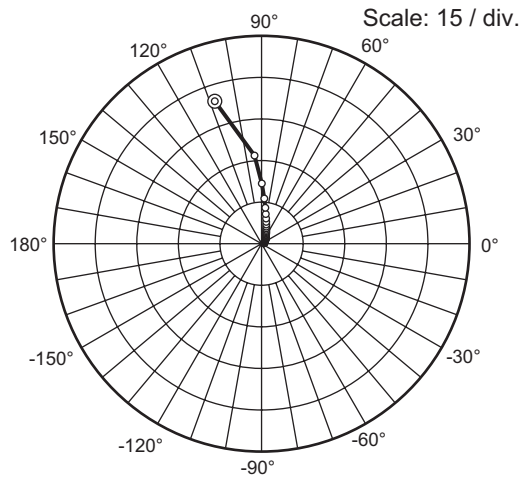
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S<sub>11</sub> Parameter vs. Frequency



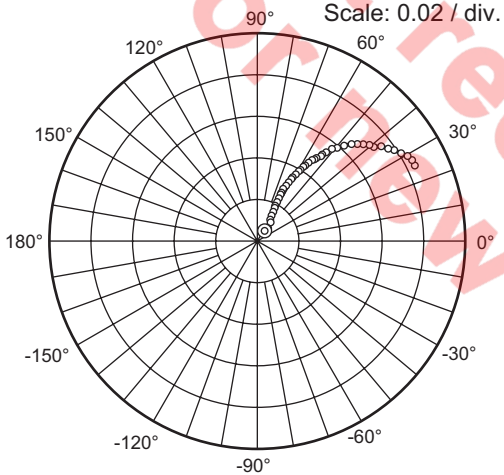
Condition:  $V_{CE} = 3.6\text{ V}$ ,  $I_C = 300\text{ mA}$ ,  $Z_o = 50\ \Omega$   
 100 to 3000 MHz (100 MHz Step)  
 3200 to 6000 MHz (200 MHz Step)

S<sub>21</sub> Parameter vs. Frequency



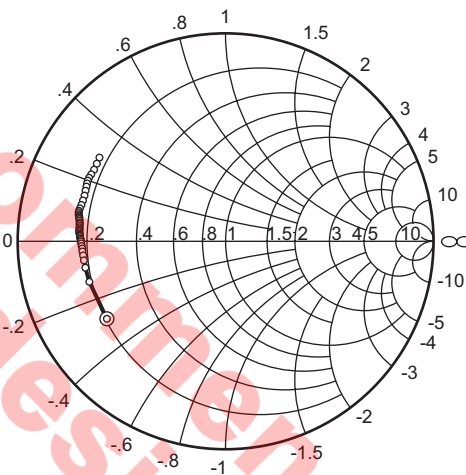
Condition:  $V_{CE} = 3.6\text{ V}$ ,  $I_C = 300\text{ mA}$ ,  $Z_o = 50\ \Omega$   
 100 to 3000 MHz (100 MHz Step)  
 3200 to 6000 MHz (200 MHz Step)

S<sub>12</sub> Parameter vs. Frequency



Condition:  $V_{CE} = 3.6\text{ V}$ ,  $I_C = 300\text{ mA}$ ,  $Z_o = 50\ \Omega$   
 100 to 3000 MHz (100 MHz Step)  
 3200 to 6000 MHz (200 MHz Step)

S<sub>22</sub> Parameter vs. Frequency



Condition:  $V_{CE} = 3.6\text{ V}$ ,  $I_C = 300\text{ mA}$ ,  $Z_o = 50\ \Omega$   
 100 to 3000 MHz (100 MHz Step)  
 3200 to 6000 MHz (200 MHz Step)



## S Parameter

 $(V_{CE} = 3 \text{ V}, I_C = 100 \text{ mA}, Z_O = 50 \Omega)$ 

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.808	-158.0	57.02	109.1	0.0093	38.0	0.671	-133.2
200	0.843	-170.6	32.12	96.4	0.0107	31.2	0.653	-155.6
300	0.847	-176.7	21.69	90.9	0.0118	35.0	0.651	-163.8
400	0.850	179.3	16.26	87.1	0.0136	36.4	0.653	-168.0
500	0.851	176.3	12.96	84.3	0.0146	39.5	0.653	-170.8
600	0.852	173.6	10.75	81.9	0.0158	41.9	0.654	-172.7
700	0.852	171.3	9.18	79.6	0.0177	45.2	0.655	-174.3
800	0.852	169.0	7.98	77.6	0.0186	48.5	0.657	-175.5
900	0.853	166.8	7.05	75.7	0.0201	49.7	0.658	-176.7
1000	0.854	164.8	6.31	73.9	0.0220	51.0	0.661	-177.5
1100	0.856	163.0	5.71	72.1	0.0234	51.2	0.663	-178.3
1200	0.857	161.1	5.21	70.4	0.0249	52.0	0.665	-178.9
1300	0.856	159.2	4.78	68.7	0.0264	52.8	0.666	-179.5
1400	0.858	157.4	4.42	67.1	0.0283	53.8	0.668	179.9
1500	0.858	155.6	4.10	65.4	0.0298	53.8	0.670	179.4
1600	0.859	153.9	3.83	63.9	0.0315	53.5	0.672	178.9
1700	0.861	152.2	3.59	62.4	0.0329	53.6	0.672	178.5
1800	0.862	150.7	3.37	60.9	0.0347	53.7	0.673	178.0
1900	0.863	149.0	3.18	59.3	0.0359	53.1	0.674	177.5
2000	0.863	147.4	3.01	57.7	0.0378	52.8	0.674	177.0
2100	0.863	145.7	2.86	56.2	0.0390	52.5	0.675	176.4
2200	0.866	144.3	2.71	54.7	0.0405	52.1	0.675	175.8
2300	0.867	142.7	2.59	53.2	0.0421	51.7	0.677	175.2
2400	0.868	141.2	2.46	51.8	0.0436	51.3	0.678	174.6
2500	0.869	139.7	2.36	50.2	0.0452	50.7	0.680	174.0
2600	0.870	138.2	2.25	48.8	0.0462	50.2	0.681	173.4
2700	0.871	136.7	2.16	47.3	0.0480	49.5	0.684	172.9
2800	0.872	135.2	2.07	45.8	0.0491	49.1	0.686	172.3
2900	0.873	133.8	1.99	44.5	0.0503	48.7	0.689	172.0
3000	0.875	132.5	1.91	43.2	0.0518	48.0	0.690	171.6
3200	0.876	129.7	1.78	40.4	0.0548	47.2	0.693	171.0
3400	0.877	126.9	1.66	37.7	0.0574	45.8	0.693	170.3
3600	0.878	124.2	1.56	35.0	0.0599	44.5	0.692	169.4
3800	0.879	121.6	1.46	32.2	0.0617	43.0	0.689	168.1
4000	0.880	118.8	1.38	29.3	0.0643	41.4	0.688	166.3
4200	0.882	116.3	1.30	26.4	0.0666	39.7	0.688	164.3
4400	0.883	113.7	1.22	23.7	0.0680	38.1	0.691	162.4
4600	0.884	111.1	1.15	21.0	0.0701	36.7	0.696	160.8
4800	0.886	108.7	1.09	18.6	0.0719	35.3	0.700	159.6
5000	0.888	106.4	1.04	16.1	0.0741	33.2	0.703	158.6
5200	0.889	103.9	0.99	13.6	0.0761	31.8	0.703	157.5
5400	0.891	101.7	0.94	11.0	0.0780	29.8	0.702	156.0
5600	0.893	99.6	0.89	8.4	0.0797	27.8	0.701	153.8
5800	0.894	97.3	0.85	5.7	0.0810	26.3	0.703	151.4
6000	0.897	95.2	0.81	3.3	0.0817	24.2	0.709	148.9

## S Parameter

 $(V_{CE} = 3 \text{ V}, I_C = 200 \text{ mA}, Z_O = 50 \Omega)$ 

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.840	-167.2	55.66	106.6	0.0060	37.6	0.689	-145.0
200	0.859	-176.0	32.64	94.3	0.0071	42.3	0.685	-162.3
300	0.860	179.7	22.09	89.6	0.0091	45.5	0.686	-168.6
400	0.861	176.6	16.56	86.4	0.0116	51.2	0.687	-171.7
500	0.862	174.0	13.20	83.9	0.0127	51.6	0.688	-173.9
600	0.862	171.7	10.95	81.7	0.0139	56.1	0.689	-175.5
700	0.862	169.6	9.35	79.7	0.0160	57.3	0.690	-176.8
800	0.862	167.5	8.14	77.8	0.0176	58.7	0.692	-177.9
900	0.863	165.5	7.20	76.1	0.0195	59.3	0.693	-178.8
1000	0.863	163.6	6.45	74.4	0.0212	60.3	0.696	-179.6
1100	0.865	161.8	5.83	72.8	0.0229	61.2	0.697	179.7
1200	0.865	160.0	5.32	71.2	0.0248	60.5	0.699	179.2
1300	0.864	158.2	4.89	69.6	0.0264	60.4	0.700	178.6
1400	0.865	156.4	4.52	68.1	0.0284	61.1	0.701	178.0
1500	0.865	154.7	4.20	66.5	0.0302	60.5	0.702	177.5
1600	0.867	153.0	3.92	65.1	0.0320	60.4	0.704	177.1
1700	0.868	151.4	3.68	63.7	0.0333	59.6	0.705	176.6
1800	0.869	149.8	3.46	62.2	0.0350	59.1	0.705	176.2
1900	0.869	148.2	3.27	60.7	0.0367	58.7	0.705	175.7
2000	0.870	146.6	3.09	59.2	0.0384	57.7	0.706	175.1
2100	0.870	145.0	2.94	57.7	0.0399	57.1	0.706	174.5
2200	0.872	143.5	2.79	56.3	0.0416	56.7	0.706	173.9
2300	0.873	141.9	2.66	54.9	0.0431	56.1	0.707	173.3
2400	0.874	140.5	2.54	53.5	0.0446	55.1	0.708	172.7
2500	0.875	139.0	2.42	52.1	0.0464	54.5	0.710	172.1
2600	0.875	137.5	2.32	50.7	0.0475	53.9	0.711	171.5
2700	0.876	136.1	2.22	49.2	0.0492	53.3	0.713	171.0
2800	0.877	134.6	2.13	47.9	0.0507	52.4	0.715	170.5
2900	0.878	133.2	2.05	46.6	0.0519	51.9	0.717	170.1
3000	0.880	131.9	1.98	45.3	0.0536	51.2	0.718	169.7
3200	0.880	129.1	1.84	42.7	0.0562	49.8	0.721	169.0
3400	0.881	126.3	1.71	40.1	0.0590	48.3	0.720	168.3
3600	0.882	123.7	1.61	37.5	0.0617	46.9	0.718	167.4
3800	0.883	121.0	1.52	34.8	0.0640	45.3	0.715	166.0
4000	0.883	118.3	1.43	31.9	0.0662	43.4	0.713	164.2
4200	0.885	115.7	1.35	29.2	0.0684	41.6	0.713	162.2
4400	0.886	113.2	1.27	26.6	0.0700	39.9	0.716	160.3
4600	0.887	110.6	1.20	23.9	0.0721	38.1	0.719	158.7
4800	0.889	108.3	1.13	21.6	0.0740	36.7	0.722	157.5
5000	0.890	106.0	1.08	19.2	0.0764	34.5	0.725	156.4
5200	0.890	103.5	1.03	16.8	0.0784	33.1	0.724	155.3
5400	0.892	101.3	0.98	14.2	0.0804	30.9	0.723	153.7
5600	0.894	99.2	0.94	11.7	0.0819	28.8	0.721	151.6
5800	0.895	96.9	0.89	9.1	0.0831	27.2	0.723	149.2
6000	0.898	94.9	0.85	6.7	0.0839	25.1	0.728	146.7



## S Parameter

 $(V_{CE} = 3 \text{ V}, I_C = 300 \text{ mA}, Z_O = 50 \Omega)$ 

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.853	-170.5	49.25	107.2	0.004	60.4	0.690	-149.7
200	0.871	-178.1	29.97	94.3	0.006	40.8	0.693	-164.9
300	0.870	178.2	20.77	89.6	0.008	51.2	0.696	-170.3
400	0.870	175.4	15.70	86.4	0.011	53.2	0.698	-173.2
500	0.870	173.1	12.55	84.0	0.012	58.4	0.699	-175.1
600	0.870	170.9	10.43	81.9	0.014	61.2	0.700	-176.5
700	0.870	168.9	8.91	79.9	0.016	61.3	0.701	-177.7
800	0.869	166.9	7.76	78.0	0.018	63.2	0.702	-178.7
900	0.870	164.9	6.87	76.4	0.019	64.0	0.704	-179.6
1000	0.870	163.1	6.16	74.7	0.021	65.0	0.706	179.6
1100	0.871	161.3	5.57	73.1	0.023	63.8	0.707	179.0
1200	0.872	159.5	5.09	71.5	0.025	63.5	0.709	178.5
1300	0.871	157.7	4.67	70.0	0.027	63.7	0.711	178.0
1400	0.872	156.0	4.33	68.4	0.028	62.9	0.711	177.3
1500	0.872	154.3	4.02	66.9	0.030	62.4	0.711	176.9
1600	0.873	152.6	3.76	65.5	0.032	62.3	0.714	176.6
1700	0.874	151.0	3.52	64.1	0.034	61.4	0.715	176.0
1800	0.875	149.5	3.31	62.6	0.035	61.2	0.715	175.5
1900	0.876	147.9	3.13	61.1	0.037	60.4	0.715	175.1
2000	0.876	146.3	2.97	59.7	0.039	59.6	0.715	174.6
2100	0.876	144.7	2.82	58.2	0.040	58.8	0.716	174.0
2200	0.878	143.2	2.67	56.7	0.042	58.4	0.716	173.4
2300	0.879	141.7	2.55	55.4	0.043	57.7	0.717	172.8
2400	0.879	140.3	2.43	54.0	0.045	56.8	0.717	172.2
2500	0.881	138.7	2.33	52.6	0.047	56.0	0.719	171.6
2600	0.881	137.3	2.22	51.1	0.048	55.4	0.721	171.0
2700	0.882	135.8	2.13	49.7	0.050	54.3	0.723	170.4
2800	0.882	134.3	2.05	48.4	0.051	53.9	0.724	169.9
2900	0.883	132.9	1.97	47.1	0.052	53.1	0.726	169.6
3000	0.885	131.6	1.90	45.9	0.054	52.2	0.728	169.1
3200	0.885	128.9	1.76	43.3	0.057	50.8	0.730	168.5
3400	0.886	126.1	1.65	40.7	0.060	49.5	0.729	167.8
3600	0.887	123.5	1.55	38.1	0.062	47.6	0.727	166.8
3800	0.887	120.8	1.46	35.4	0.065	46.1	0.724	165.4
4000	0.887	118.1	1.37	32.6	0.067	44.2	0.722	163.6
4200	0.889	115.5	1.30	29.9	0.069	42.4	0.722	161.7
4400	0.890	113.0	1.22	27.3	0.071	40.5	0.725	159.7
4600	0.891	110.4	1.15	24.7	0.073	38.8	0.728	158.1
4800	0.892	108.1	1.09	22.4	0.075	37.5	0.731	156.9
5000	0.893	105.8	1.04	20.1	0.077	35.4	0.733	155.9
5200	0.894	103.3	0.99	17.7	0.079	33.6	0.732	154.7
5400	0.896	101.1	0.94	15.2	0.081	31.5	0.731	153.1
5600	0.897	99.0	0.90	12.7	0.082	29.5	0.728	151.0
5800	0.898	96.7	0.86	10.1	0.084	27.5	0.730	148.5
6000	0.901	94.7	0.82	7.7	0.085	25.5	0.736	146.1

## S Parameter

 $(V_{CE} = 3.3 \text{ V}, I_C = 100 \text{ mA}, Z_0 = 50 \Omega)$ 

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.800	-158.5	58.96	110.0	0.011	36.5	0.661	-132.4
200	0.839	-170.4	32.67	96.8	0.011	27.3	0.647	-155.2
300	0.846	-176.6	22.02	91.1	0.012	30.4	0.645	-163.5
400	0.849	179.5	16.50	87.3	0.014	37.9	0.646	-167.8
500	0.850	176.4	13.15	84.5	0.015	41.2	0.647	-170.6
600	0.851	173.7	10.90	82.0	0.016	43.8	0.648	-172.5
700	0.851	171.4	9.30	79.7	0.018	45.5	0.649	-174.0
800	0.852	169.1	8.09	77.6	0.019	47.7	0.651	-175.3
900	0.852	166.9	7.15	75.7	0.020	49.9	0.652	-176.4
1000	0.853	164.9	6.40	73.9	0.022	50.4	0.655	-177.3
1100	0.855	163.0	5.79	72.1	0.023	51.7	0.657	-178.0
1200	0.856	161.2	5.28	70.4	0.025	52.4	0.660	-178.7
1300	0.855	159.3	4.84	68.7	0.027	52.9	0.661	-179.3
1400	0.857	157.5	4.48	67.0	0.028	54.0	0.663	-179.9
1500	0.857	155.7	4.16	65.4	0.030	54.5	0.665	179.6
1600	0.859	153.9	3.88	63.8	0.031	53.9	0.666	179.1
1700	0.860	152.3	3.63	62.4	0.033	53.4	0.666	178.7
1800	0.860	150.7	3.42	60.8	0.034	53.6	0.668	178.2
1900	0.862	149.0	3.23	59.2	0.036	53.1	0.668	177.8
2000	0.863	147.4	3.05	57.6	0.038	52.8	0.669	177.2
2100	0.863	145.8	2.89	56.1	0.039	52.6	0.669	176.6
2200	0.865	144.3	2.75	54.5	0.041	52.5	0.671	176.0
2300	0.866	142.7	2.62	53.1	0.042	52.0	0.671	175.5
2400	0.867	141.3	2.50	51.6	0.043	51.1	0.673	174.9
2500	0.869	139.7	2.39	50.1	0.045	50.6	0.675	174.2
2600	0.869	138.3	2.28	48.6	0.046	50.1	0.676	173.6
2700	0.870	136.7	2.19	47.1	0.048	49.9	0.679	173.1
2800	0.871	135.3	2.10	45.7	0.049	49.3	0.681	172.6
2900	0.872	133.9	2.01	44.3	0.050	48.7	0.684	172.3
3000	0.874	132.5	1.94	43.0	0.052	48.0	0.685	171.9
3200	0.875	129.7	1.80	40.2	0.054	47.0	0.689	171.3
3400	0.876	126.9	1.68	37.5	0.057	46.0	0.689	170.6
3600	0.878	124.3	1.57	34.8	0.060	44.7	0.688	169.7
3800	0.879	121.6	1.48	32.0	0.062	42.9	0.685	168.4
4000	0.880	118.8	1.39	29.0	0.064	41.6	0.683	166.6
4200	0.882	116.3	1.31	26.2	0.066	39.9	0.684	164.6
4400	0.883	113.7	1.24	23.5	0.068	38.2	0.687	162.7
4600	0.884	111.1	1.17	20.7	0.070	36.7	0.692	161.1
4800	0.886	108.8	1.10	18.3	0.072	35.2	0.696	159.9
5000	0.888	106.5	1.05	15.8	0.074	33.4	0.700	158.9
5200	0.889	104.0	1.00	13.4	0.076	31.9	0.700	157.8
5400	0.891	101.8	0.95	10.7	0.078	29.9	0.699	156.2
5600	0.893	99.6	0.90	8.1	0.080	28.0	0.697	154.2
5800	0.894	97.3	0.86	5.5	0.081	26.3	0.700	151.7
6000	0.897	95.3	0.82	3.0	0.082	24.2	0.706	149.2

## S Parameter

 $(V_{CE} = 3.3 \text{ V}, I_C = 200 \text{ mA}, Z_O = 50 \Omega)$ 

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.833	-167.5	58.17	107.4	0.006	32.3	0.687	-143.9
200	0.856	-175.7	33.32	94.6	0.007	33.4	0.680	-161.8
300	0.858	179.8	22.45	89.8	0.009	45.3	0.681	-168.2
400	0.860	176.6	16.81	86.5	0.011	49.3	0.683	-171.5
500	0.861	174.1	13.40	84.0	0.013	52.5	0.684	-173.7
600	0.861	171.8	11.11	81.8	0.014	56.0	0.685	-175.3
700	0.861	169.6	9.48	79.7	0.016	57.6	0.686	-176.6
800	0.861	167.5	8.25	77.8	0.018	58.9	0.688	-177.7
900	0.861	165.5	7.30	76.1	0.020	59.0	0.688	-178.7
1000	0.862	163.7	6.54	74.4	0.021	60.7	0.691	-179.4
1100	0.864	161.8	5.91	72.8	0.023	60.3	0.693	179.9
1200	0.864	160.0	5.40	71.2	0.025	60.4	0.695	179.3
1300	0.863	158.2	4.95	69.6	0.026	60.3	0.696	178.7
1400	0.864	156.5	4.59	68.0	0.029	60.8	0.697	178.1
1500	0.864	154.7	4.26	66.5	0.030	60.6	0.698	177.7
1600	0.866	153.0	3.98	65.0	0.032	59.7	0.700	177.2
1700	0.867	151.4	3.73	63.6	0.033	59.4	0.700	176.8
1800	0.868	149.9	3.51	62.2	0.035	58.9	0.701	176.3
1900	0.869	148.2	3.31	60.7	0.037	58.5	0.701	175.9
2000	0.869	146.6	3.14	59.1	0.038	57.7	0.701	175.3
2100	0.869	145.0	2.98	57.7	0.040	57.2	0.702	174.7
2200	0.871	143.6	2.83	56.2	0.042	56.6	0.702	174.1
2300	0.872	142.0	2.70	54.8	0.043	56.0	0.703	173.5
2400	0.873	140.6	2.57	53.4	0.045	55.2	0.704	172.9
2500	0.874	139.1	2.46	52.0	0.046	54.3	0.706	172.3
2600	0.874	137.6	2.35	50.6	0.048	53.8	0.707	171.7
2700	0.876	136.1	2.25	49.1	0.049	53.3	0.709	171.2
2800	0.876	134.6	2.16	47.7	0.050	52.4	0.711	170.6
2900	0.877	133.2	2.08	46.4	0.052	51.9	0.713	170.3
3000	0.879	131.9	2.00	45.2	0.053	51.0	0.715	169.8
3200	0.879	129.1	1.86	42.5	0.056	49.8	0.717	169.2
3400	0.880	126.3	1.74	39.9	0.059	48.4	0.716	168.5
3600	0.882	123.7	1.63	37.3	0.062	46.9	0.715	167.5
3800	0.882	121.1	1.54	34.6	0.064	45.2	0.711	166.2
4000	0.883	118.3	1.45	31.8	0.066	43.5	0.709	164.4
4200	0.884	115.8	1.36	29.0	0.068	41.8	0.710	162.4
4400	0.885	113.2	1.29	26.4	0.070	39.9	0.712	160.5
4600	0.886	110.6	1.21	23.7	0.072	38.2	0.716	158.9
4800	0.888	108.3	1.15	21.4	0.074	36.7	0.719	157.6
5000	0.889	106.0	1.09	19.0	0.076	34.6	0.721	156.6
5200	0.890	103.5	1.04	16.6	0.078	33.0	0.721	155.5
5400	0.892	101.3	0.99	14.0	0.080	31.0	0.720	153.9
5600	0.894	99.2	0.95	11.5	0.082	28.9	0.718	151.8
5800	0.895	96.9	0.90	8.9	0.083	27.1	0.720	149.4
6000	0.897	94.9	0.86	6.4	0.084	25.1	0.725	146.9

## S Parameter

 $(V_{CE} = 3.3 \text{ V}, I_C = 300 \text{ mA}, Z_O = 50 \Omega)$ 

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.849	-170.3	52.00	107.5	0.005	44.8	0.686	-148.4
200	0.867	-177.8	31.15	94.4	0.007	48.3	0.689	-164.1
300	0.867	178.4	21.36	89.7	0.008	52.9	0.691	-169.8
400	0.867	175.5	16.08	86.5	0.011	54.2	0.693	-172.8
500	0.868	173.2	12.84	84.1	0.012	58.7	0.694	-174.7
600	0.867	171.0	10.66	81.9	0.013	60.1	0.695	-176.2
700	0.867	169.0	9.11	79.9	0.016	62.0	0.696	-177.4
800	0.867	166.9	7.93	78.1	0.017	63.4	0.697	-178.4
900	0.868	165.0	7.02	76.4	0.019	63.4	0.699	-179.4
1000	0.868	163.1	6.29	74.7	0.021	63.8	0.701	179.9
1100	0.870	161.4	5.69	73.1	0.023	63.9	0.702	179.2
1200	0.870	159.6	5.20	71.5	0.025	63.7	0.704	178.7
1300	0.869	157.8	4.77	69.9	0.026	63.5	0.706	178.1
1400	0.870	156.1	4.42	68.4	0.028	63.5	0.706	177.5
1500	0.870	154.3	4.11	66.9	0.030	62.5	0.707	177.1
1600	0.871	152.7	3.84	65.5	0.032	62.3	0.709	176.8
1700	0.873	151.1	3.60	64.0	0.034	61.4	0.711	176.2
1800	0.873	149.5	3.38	62.6	0.035	61.1	0.710	175.7
1900	0.874	147.9	3.20	61.1	0.037	60.4	0.710	175.3
2000	0.874	146.3	3.03	59.6	0.039	59.4	0.710	174.8
2100	0.874	144.7	2.87	58.1	0.040	58.8	0.711	174.2
2200	0.876	143.3	2.73	56.7	0.042	58.2	0.712	173.6
2300	0.877	141.7	2.60	55.3	0.043	57.7	0.712	173.0
2400	0.878	140.3	2.48	53.9	0.045	56.7	0.713	172.4
2500	0.879	138.8	2.37	52.5	0.047	55.9	0.715	171.8
2600	0.879	137.3	2.27	51.1	0.048	55.2	0.716	171.2
2700	0.880	135.8	2.18	49.6	0.050	54.3	0.718	170.6
2800	0.880	134.4	2.09	48.3	0.051	53.7	0.720	170.1
2900	0.882	133.0	2.01	47.0	0.052	53.1	0.722	169.8
3000	0.883	131.7	1.94	45.7	0.054	52.3	0.723	169.3
3200	0.884	128.9	1.80	43.1	0.057	51.1	0.725	168.7
3400	0.884	126.1	1.68	40.5	0.060	49.4	0.725	168.0
3600	0.886	123.5	1.58	37.9	0.062	47.7	0.723	167.0
3800	0.886	120.8	1.49	35.3	0.064	46.1	0.720	165.7
4000	0.887	118.1	1.40	32.4	0.067	44.3	0.717	163.8
4200	0.888	115.5	1.32	29.7	0.069	42.5	0.718	161.9
4400	0.889	113.0	1.25	27.1	0.071	40.6	0.721	159.9
4600	0.890	110.4	1.18	24.5	0.073	38.9	0.724	158.3
4800	0.891	108.1	1.11	22.2	0.075	37.5	0.727	157.1
5000	0.892	105.8	1.06	19.8	0.077	35.2	0.729	156.0
5200	0.893	103.3	1.01	17.5	0.079	33.6	0.729	154.9
5400	0.895	101.1	0.96	14.9	0.081	31.5	0.727	153.3
5600	0.897	99.0	0.92	12.4	0.083	29.4	0.725	151.2
5800	0.897	96.7	0.87	9.8	0.084	27.6	0.727	148.7
6000	0.900	94.7	0.83	7.4	0.085	25.5	0.732	146.3

## S Parameter

 $(V_{CE} = 3.6 \text{ V}, I_C = 100 \text{ mA}, Z_O = 50 \Omega)$ 

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.753	-131.9	52.27	117.8	0.016	24.0	0.640	-110.9
200	0.816	-159.8	30.38	100.8	0.017	21.5	0.589	-141.5
300	0.827	-169.5	20.65	93.6	0.018	21.7	0.578	-153.5
400	0.832	-175.2	15.52	88.9	0.020	24.3	0.577	-159.8
500	0.834	-179.3	12.38	85.3	0.020	25.9	0.576	-163.6
600	0.836	177.4	10.27	82.4	0.021	27.8	0.577	-166.3
700	0.837	174.6	8.77	79.7	0.021	30.5	0.578	-168.4
800	0.838	171.9	7.62	77.2	0.022	32.0	0.581	-170.1
900	0.839	169.5	6.72	75.0	0.023	33.7	0.583	-171.4
1000	0.841	167.3	6.01	72.9	0.024	35.9	0.587	-172.5
1100	0.843	165.2	5.44	70.9	0.025	36.6	0.589	-173.3
1200	0.845	163.2	4.96	68.9	0.027	38.5	0.593	-174.1
1300	0.845	161.2	4.54	67.0	0.028	39.7	0.594	-174.7
1400	0.846	159.4	4.20	65.2	0.029	41.2	0.597	-175.4
1500	0.847	157.4	3.89	63.3	0.030	42.1	0.600	-175.9
1600	0.849	155.6	3.63	61.6	0.031	42.6	0.603	-176.4
1700	0.851	153.9	3.39	59.9	0.032	42.9	0.605	-176.8
1800	0.852	152.3	3.19	58.2	0.034	43.3	0.606	-177.2
1900	0.854	150.6	3.00	56.5	0.035	43.2	0.608	-177.6
2000	0.855	148.8	2.84	54.7	0.037	43.6	0.610	-178.2
2100	0.855	147.2	2.69	53.0	0.037	44.0	0.611	-178.8
2200	0.858	145.7	2.55	51.4	0.039	43.8	0.613	-179.4
2300	0.860	144.0	2.43	49.8	0.040	43.7	0.615	-179.9
2400	0.861	142.6	2.31	48.2	0.041	43.7	0.617	179.5
2500	0.863	141.0	2.21	46.5	0.043	43.6	0.620	178.9
2600	0.863	139.5	2.11	44.9	0.044	43.6	0.623	178.3
2700	0.865	137.9	2.02	43.3	0.045	43.4	0.626	177.8
2800	0.866	136.4	1.93	41.7	0.046	43.3	0.630	177.4
2900	0.867	135.0	1.85	40.3	0.047	43.4	0.633	177.0
3000	0.870	133.6	1.78	38.8	0.049	42.6	0.636	176.6
3200	0.871	130.8	1.65	35.8	0.051	42.5	0.641	176.1
3400	0.873	127.9	1.54	32.9	0.054	41.7	0.644	175.5
3600	0.876	125.2	1.44	30.0	0.056	40.7	0.645	174.7
3800	0.877	122.5	1.35	27.0	0.058	39.8	0.644	173.5
4000	0.878	119.7	1.26	24.0	0.060	38.9	0.644	171.8
4200	0.881	117.1	1.19	20.9	0.062	37.4	0.646	169.7
4400	0.882	114.5	1.12	18.1	0.064	35.8	0.651	167.8
4600	0.883	111.9	1.05	15.2	0.066	34.7	0.658	166.1
4800	0.886	109.5	0.99	12.6	0.067	33.7	0.664	164.9
5000	0.888	107.1	0.94	10.1	0.070	32.0	0.670	163.9
5200	0.889	104.6	0.89	7.5	0.072	30.7	0.672	162.7
5400	0.892	102.4	0.84	4.8	0.074	28.8	0.673	161.2
5600	0.894	100.2	0.80	2.1	0.076	27.1	0.673	159.2
5800	0.895	97.9	0.76	-0.6	0.077	25.7	0.677	156.6
6000	0.898	95.8	0.72	-3.2	0.078	23.7	0.683	154.0

## S Parameter

 $(V_{CE} = 3.6 \text{ V}, I_C = 200 \text{ mA}, Z_O = 50 \Omega)$ 

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.826	-167.4	59.94	108.5	0.007	38.7	0.680	-143.1
200	0.854	-175.5	33.77	95.0	0.008	37.1	0.676	-161.4
300	0.857	179.9	22.69	90.0	0.009	45.9	0.676	-167.8
400	0.859	176.8	16.99	86.6	0.012	47.7	0.678	-171.2
500	0.859	174.2	13.53	84.1	0.013	52.1	0.679	-173.5
600	0.859	171.8	11.22	81.8	0.014	54.6	0.680	-175.1
700	0.860	169.7	9.58	79.8	0.016	56.6	0.681	-176.4
800	0.860	167.6	8.34	77.9	0.018	58.6	0.683	-177.5
900	0.860	165.6	7.37	76.1	0.020	59.6	0.685	-178.5
1000	0.861	163.7	6.60	74.4	0.021	60.3	0.687	-179.3
1100	0.862	161.9	5.97	72.8	0.023	59.8	0.688	-180.0
1200	0.863	160.0	5.45	71.2	0.025	60.6	0.690	179.4
1300	0.862	158.2	5.00	69.6	0.026	60.7	0.691	178.9
1400	0.863	156.5	4.63	68.0	0.028	60.9	0.693	178.3
1500	0.863	154.7	4.30	66.4	0.030	60.5	0.694	177.8
1600	0.865	153.1	4.02	65.0	0.032	60.1	0.695	177.4
1700	0.866	151.4	3.77	63.6	0.033	59.4	0.697	176.9
1800	0.867	149.9	3.54	62.1	0.035	59.0	0.697	176.4
1900	0.867	148.3	3.34	60.6	0.037	58.2	0.697	176.0
2000	0.868	146.6	3.17	59.1	0.038	57.7	0.697	175.5
2100	0.868	145.0	3.00	57.6	0.040	57.3	0.698	174.9
2200	0.870	143.6	2.86	56.1	0.042	56.6	0.698	174.2
2300	0.871	142.0	2.72	54.7	0.043	55.9	0.699	173.7
2400	0.872	140.6	2.59	53.3	0.045	55.1	0.700	173.1
2500	0.873	139.0	2.48	51.9	0.046	54.4	0.702	172.5
2600	0.873	137.6	2.37	50.4	0.047	53.8	0.703	171.8
2700	0.875	136.1	2.27	49.0	0.049	53.1	0.705	171.3
2800	0.875	134.7	2.18	47.6	0.050	52.4	0.707	170.8
2900	0.876	133.3	2.10	46.3	0.052	52.0	0.709	170.4
3000	0.878	131.9	2.02	45.0	0.053	51.0	0.711	170.0
3200	0.879	129.1	1.88	42.4	0.056	49.7	0.713	169.3
3400	0.879	126.3	1.75	39.7	0.059	48.5	0.713	168.7
3600	0.881	123.7	1.65	37.1	0.062	46.9	0.711	167.7
3800	0.882	121.0	1.55	34.4	0.064	45.0	0.708	166.3
4000	0.882	118.3	1.46	31.6	0.066	43.5	0.706	164.6
4200	0.884	115.8	1.38	28.8	0.068	41.7	0.706	162.6
4400	0.885	113.2	1.30	26.2	0.070	40.0	0.709	160.7
4600	0.886	110.6	1.22	23.5	0.072	38.3	0.712	159.0
4800	0.887	108.3	1.16	21.2	0.074	36.7	0.715	157.8
5000	0.889	106.0	1.10	18.8	0.076	34.6	0.718	156.8
5200	0.890	103.5	1.05	16.3	0.078	33.0	0.718	155.7
5400	0.892	101.3	1.00	13.8	0.080	31.0	0.717	154.1
5600	0.893	99.2	0.95	11.2	0.081	29.1	0.715	152.0
5800	0.894	97.0	0.91	8.6	0.083	27.3	0.717	149.5
6000	0.897	94.9	0.86	6.2	0.084	25.1	0.722	147.1

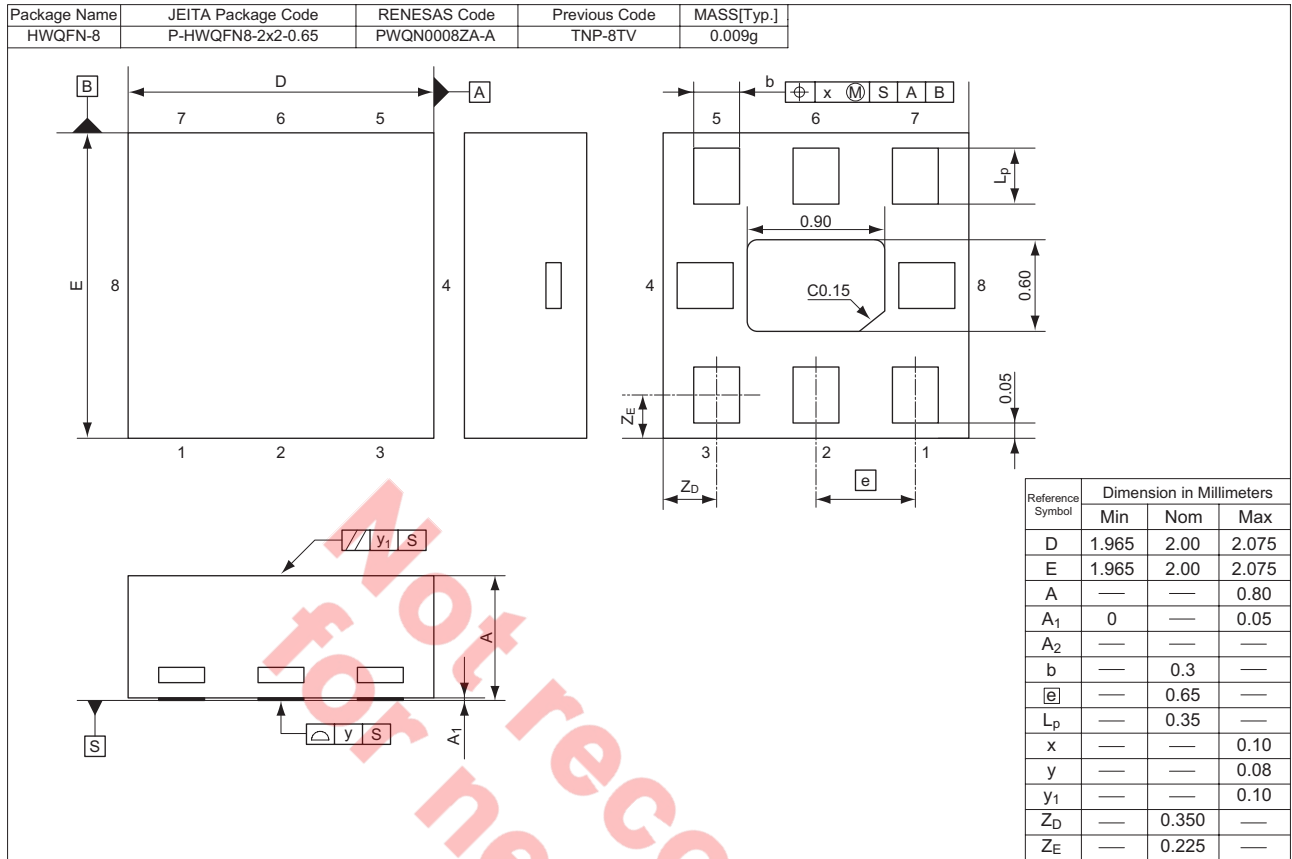
## S Parameter

 $(V_{CE} = 3.6 \text{ V}, I_C = 300 \text{ mA}, Z_O = 50 \Omega)$ 

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.844	-170.2	54.08	108.2	0.006	54.3	0.682	-146.9
200	0.864	-177.6	31.88	94.6	0.006	44.2	0.684	-163.5
300	0.866	178.6	21.72	89.8	0.008	49.7	0.687	-169.4
400	0.866	175.7	16.32	86.6	0.011	54.5	0.688	-172.4
500	0.866	173.3	13.01	84.1	0.012	58.9	0.689	-174.4
600	0.866	171.1	10.81	82.0	0.014	60.8	0.691	-176.0
700	0.866	169.0	9.23	79.9	0.016	61.4	0.691	-177.2
800	0.866	167.0	8.04	78.1	0.018	62.4	0.693	-178.2
900	0.866	165.0	7.11	76.4	0.019	63.2	0.695	-179.2
1000	0.867	163.2	6.37	74.7	0.021	63.1	0.696	-180.0
1100	0.869	161.4	5.77	73.1	0.023	63.3	0.697	179.4
1200	0.869	159.6	5.26	71.5	0.025	63.5	0.699	178.9
1300	0.868	157.8	4.84	69.9	0.026	63.5	0.701	178.3
1400	0.869	156.1	4.48	68.3	0.028	63.7	0.701	177.7
1500	0.869	154.3	4.16	66.8	0.030	62.5	0.702	177.3
1600	0.870	152.7	3.89	65.4	0.032	61.9	0.704	177.0
1700	0.871	151.1	3.65	64.0	0.034	61.2	0.706	176.4
1800	0.872	149.5	3.43	62.5	0.035	61.0	0.706	175.9
1900	0.873	147.9	3.24	61.0	0.037	60.0	0.705	175.5
2000	0.873	146.3	3.07	59.5	0.039	59.3	0.706	174.9
2100	0.873	144.7	2.91	58.0	0.040	58.7	0.706	174.4
2200	0.875	143.3	2.77	56.6	0.042	58.2	0.707	173.7
2300	0.876	141.7	2.64	55.2	0.043	57.6	0.708	173.1
2400	0.877	140.3	2.51	53.8	0.045	56.8	0.708	172.6
2500	0.878	138.8	2.41	52.3	0.047	55.9	0.710	171.9
2600	0.878	137.3	2.30	50.9	0.048	55.0	0.712	171.3
2700	0.879	135.8	2.21	49.5	0.049	54.5	0.714	170.8
2800	0.880	134.4	2.12	48.1	0.051	53.5	0.715	170.3
2900	0.880	133.0	2.03	46.9	0.052	53.1	0.718	169.9
3000	0.882	131.7	1.96	45.6	0.054	52.2	0.719	169.5
3200	0.883	128.9	1.82	43.0	0.057	51.0	0.721	168.8
3400	0.884	126.1	1.70	40.4	0.059	49.4	0.721	168.2
3600	0.885	123.5	1.60	37.7	0.062	47.7	0.719	167.2
3800	0.885	120.8	1.50	35.1	0.065	45.8	0.716	165.8
4000	0.886	118.1	1.42	32.2	0.067	44.1	0.714	164.0
4200	0.887	115.5	1.34	29.5	0.069	42.4	0.714	162.0
4400	0.888	113.0	1.26	26.9	0.071	40.6	0.717	160.1
4600	0.889	110.4	1.19	24.2	0.072	38.9	0.720	158.5
4800	0.890	108.1	1.12	21.9	0.075	37.4	0.723	157.3
5000	0.891	105.8	1.07	19.6	0.077	35.2	0.725	156.2
5200	0.892	103.3	1.02	17.2	0.079	33.6	0.725	155.0
5400	0.894	101.1	0.97	14.7	0.081	31.4	0.723	153.5
5600	0.896	99.0	0.93	12.1	0.083	29.5	0.721	151.4
5800	0.897	96.7	0.88	9.5	0.084	27.6	0.724	148.9
6000	0.899	94.7	0.84	7.1	0.084	25.6	0.729	146.4



### Package Dimensions



### Ordering Information

Part Name	Quantity	Shipping Container
HSG2002TB-E	2000 pcs.	φ178 mm Reel, 8 mm Emboss Taping

Note: Therefore especially small contact area of terminal, miss contact may occur if inadequate soldering condition is applied.

Contact Renesas sales office for any question regarding recommended soldering condition of Renesas.



Keep safety first in your circuit designs!

1. Renesas Technology Corp. puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

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