

RQG1003UQAQF

NPN Silicon Germanium Transistor High Frequency Low Noise Amplifier

REJ03G1538-0100

Rev.1.00

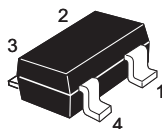
Jul 20, 2007

Features

- Ideal for LNA applications. e.g. Tuner, Wireless LAN Cordless phone and etc.
- High gain and low noise.
 - MSG = 26 dB typ., NF = 0.55 dB typ. at $V_{CE} = 2\text{ V}$, $I_C = 10\text{ mA}$, $f = 0.9\text{ GHz}$
 - MSG = 22 dB typ., NF = 0.65 dB typ. at $V_{CE} = 2\text{ V}$, $I_C = 10\text{ mA}$, $f = 1.8\text{ GHz}$
 - MSG = 20 dB typ., NF = 0.75 dB typ. at $V_{CE} = 2\text{ V}$, $I_C = 10\text{ mA}$, $f = 2.4\text{ GHz}$
 - MSG = 14 dB typ., NF = 1.2 dB typ. at $V_{CE} = 2\text{ V}$, $I_C = 10\text{ mA}$, $f = 5.8\text{ GHz}$
- High transition frequency
 - $f_T = 36\text{ GHz}$ typ.
- CMPAK-4 (2.0 x 1.25 x 1.1(max) mm)

Outline

RENESAS Package code: PTSP0004ZA-A
(Package name: CMPAK-4)



1. Emitter
2. Collector
3. Emitter
4. Base

Note: Marking is "UQ-".

Absolute Maximum Ratings

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

Item	Symbol	Ratings	Unit
Collector to base voltage	V_{CBO}	8	V
Collector to emitter voltage	V_{CEO}	3.5	V
Emitter to base voltage	V_{EBO}	1.2	V
Collector current	I_C	35	mA
Collector power dissipation	P_C	100	mW
	P_C	250 ^{note1}	mW
Junction temperature	T_j	150	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Notes: 1. Value on PCB (FR-4 : 40 x 40 x 1.6mm double side)

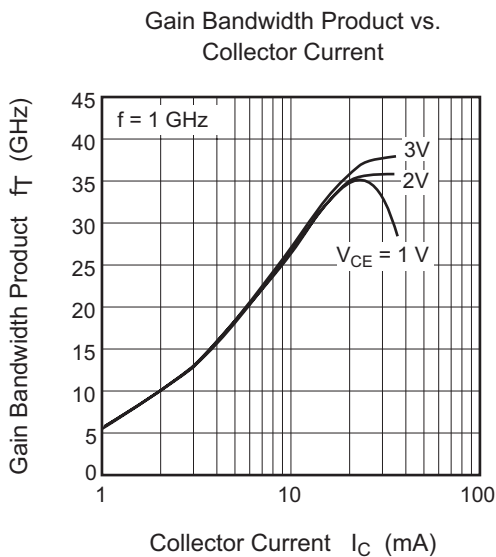
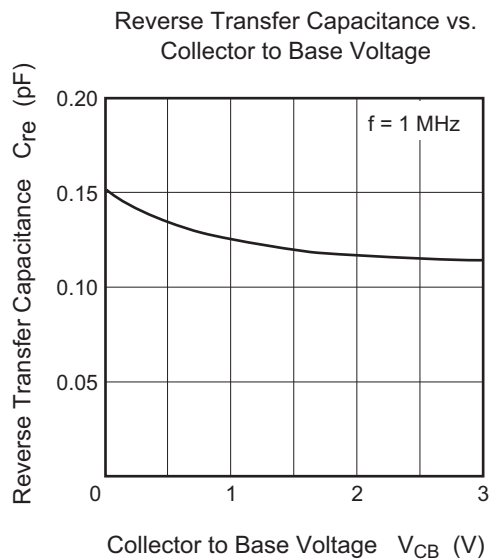
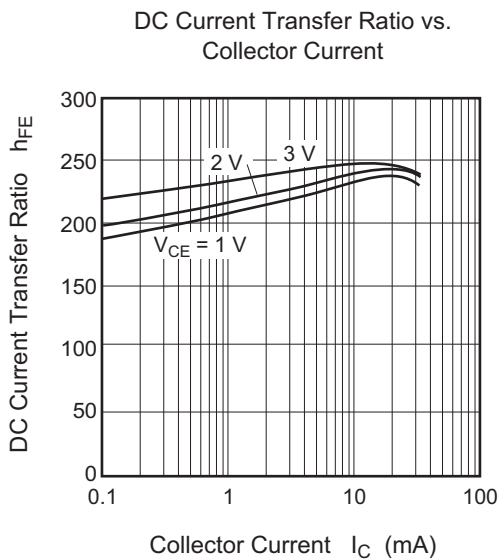
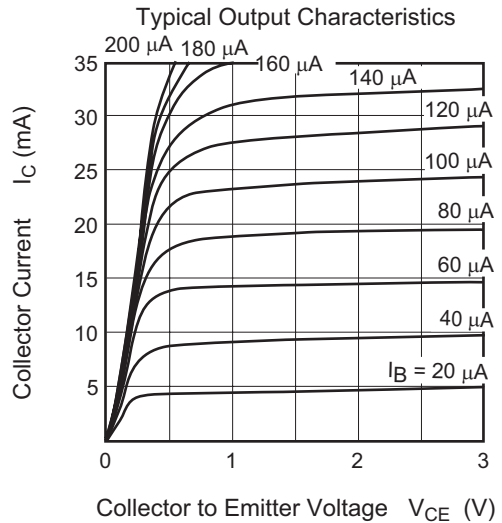
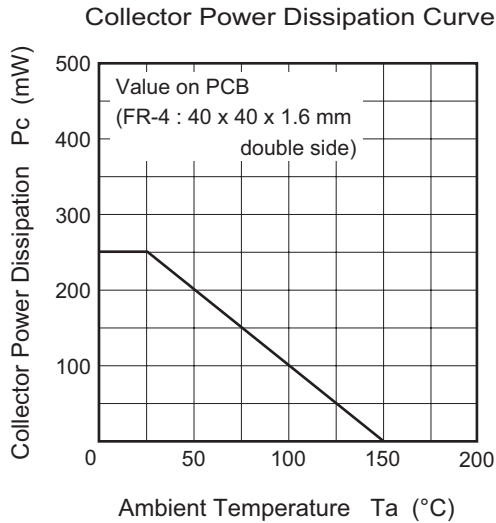
Electrical Characteristics

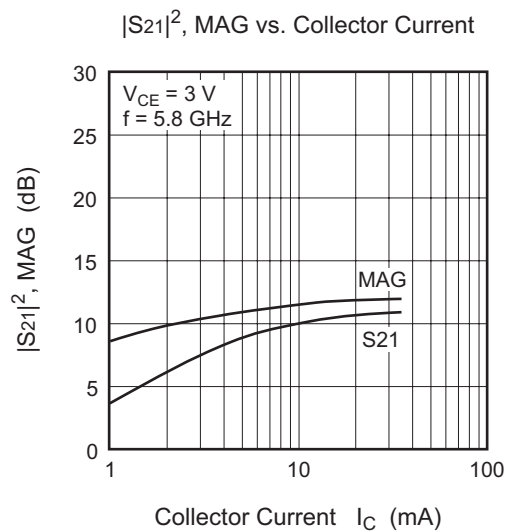
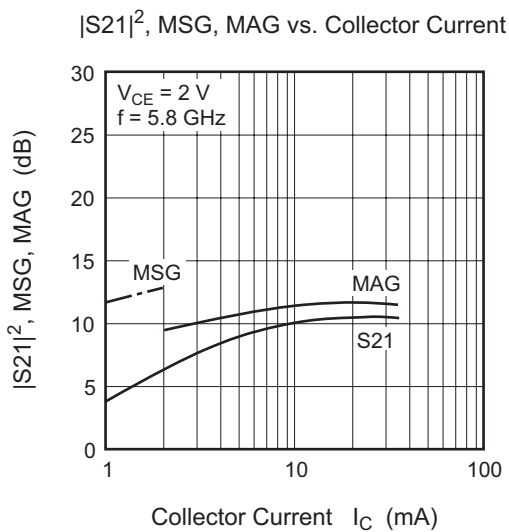
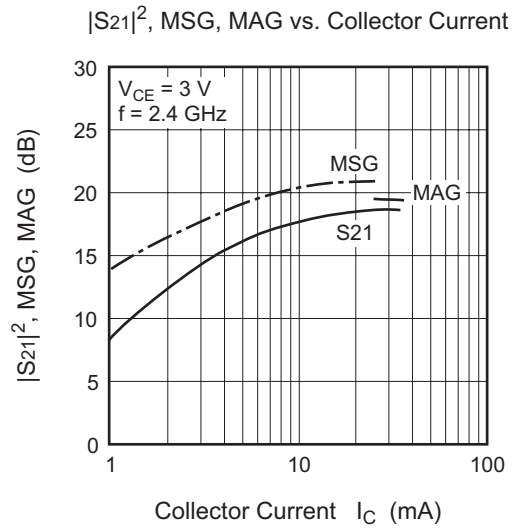
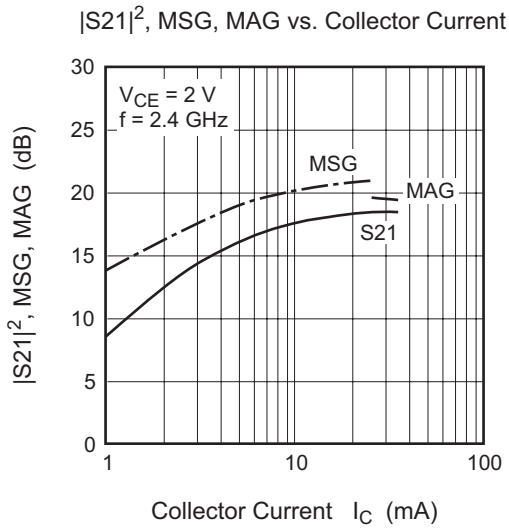
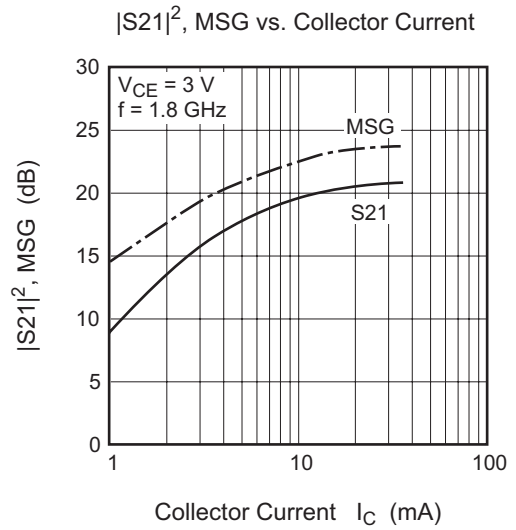
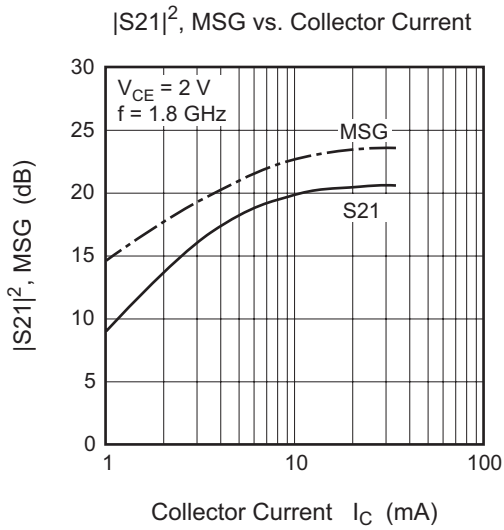
(Ta = 25°C)

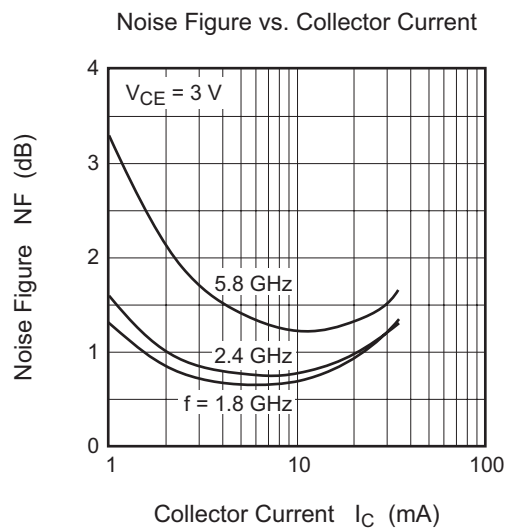
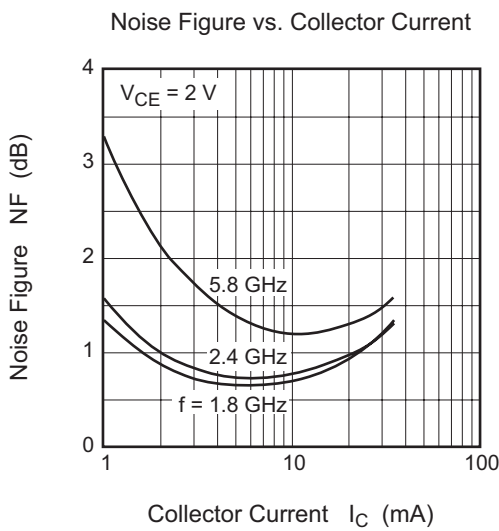
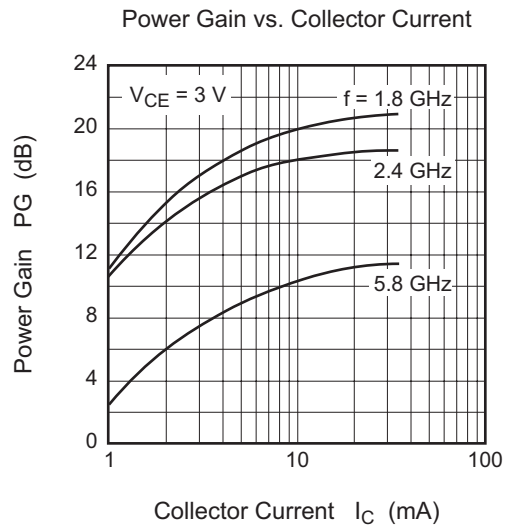
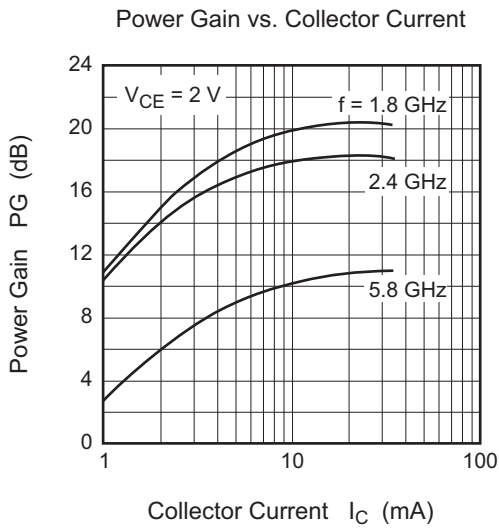
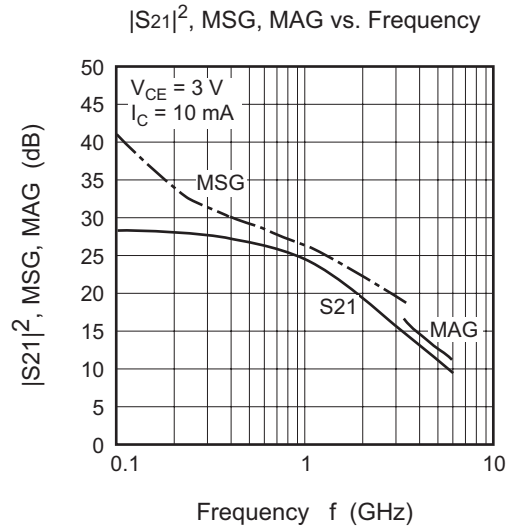
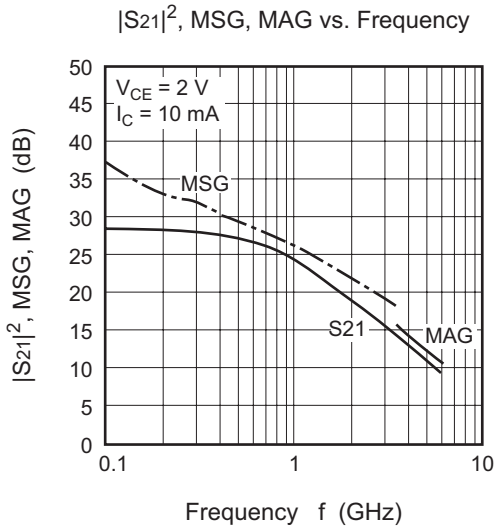
Item	Symbol	Min.	Typ	Max.	Unit	Test Conditions	
DC current transfer ratio	h_{FE}	100	200	300	—	$V_{CE} = 2\text{ V}$, $I_C = 5\text{ mA}$	
Reverse Transfer Capacitance	C_{re}	—	0.12	—	pF	$V_{CB} = 2\text{ V}$, $I_E = 0$, $f = 1\text{ MHz}$	
Transition Frequency	f_T	—	36	—	GHz	$V_{CE} = 2\text{ V}$, $I_C = f_T\text{ peak}$, $f = 1\text{ GHz}$	
Forward Transfer Coefficient	0.9 GHz	$ S_{21} ^2$	—	24	—	dB	$V_{CE} = 2\text{ V}$, $I_C = 10\text{ mA}$
	1.8 GHz		—	20	—		
	2.4 GHz		—	17	—		
	5.8 GHz		—	10	—		
Maximum Stable Gain <small>note1</small>	0.9 GHz	MSG	—	26	—	dB	$V_{CE} = 2\text{ V}$, $I_C = 10\text{ mA}$
	1.8 GHz		—	22	—		
	2.4 GHz		—	20	—		
	5.8 GHz		—	14	—		
Maximum Available Gain <small>note2</small>	5.8 GHz	MAG	—	11	—	dB	$V_{CE} = 2\text{ V}$, $I_C = 10\text{ mA}$
Power Gain	0.9 GHz	PG	—	23	—	dB	$V_{CE} = 2\text{ V}$, $I_C = 10\text{ mA}$
	1.8 GHz		—	20	—		
	2.4 GHz		—	18	—		
	5.8 GHz		—	10	—		
Noise figure	0.9 GHz	NF	—	0.55	—	dB	$V_{CE} = 2\text{ V}$, $I_C = 10\text{ mA}$
	1.8 GHz		—	0.65	—		
	2.4 GHz		—	0.75	—		
	5.8 GHz		—	1.2	—		

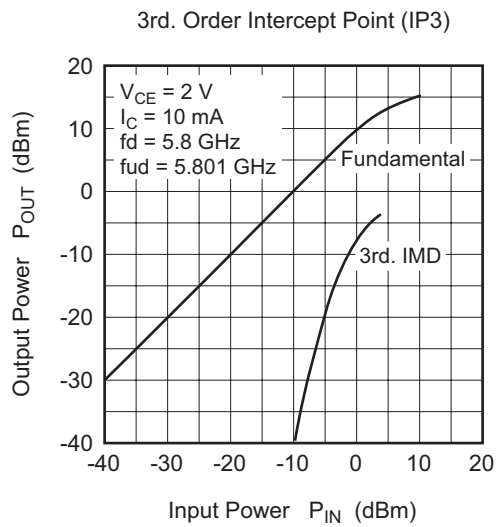
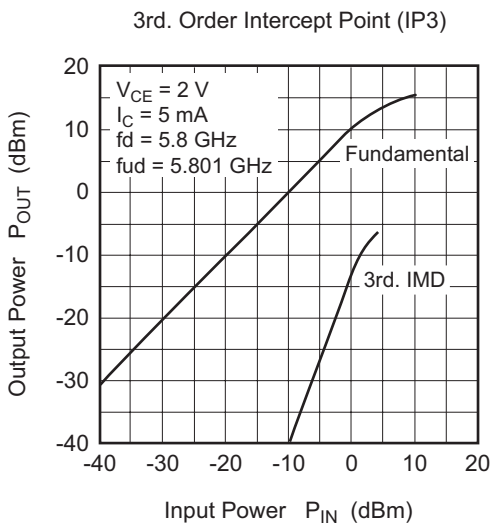
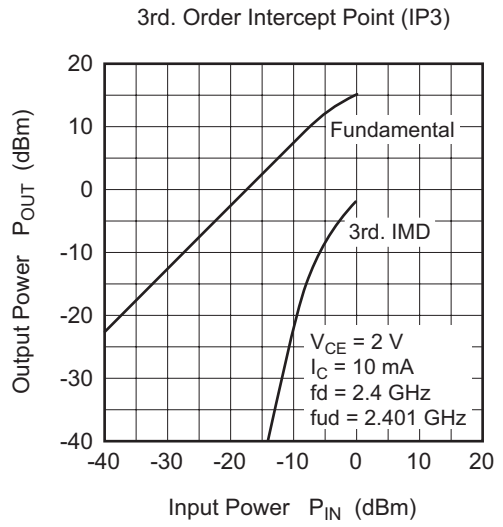
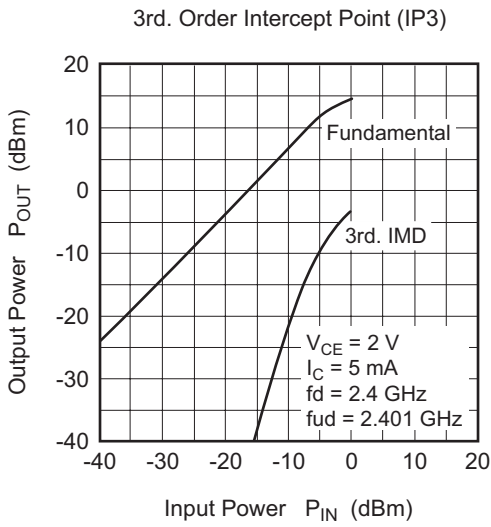
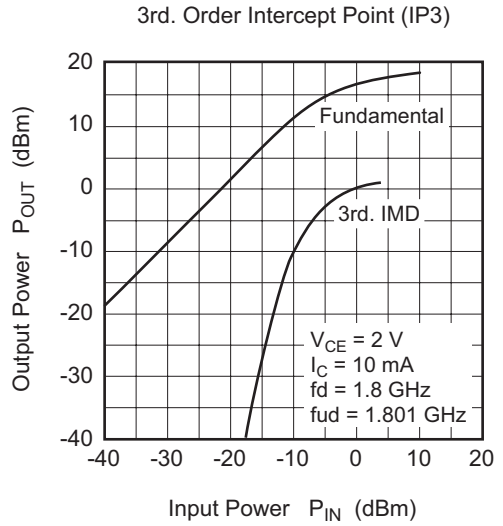
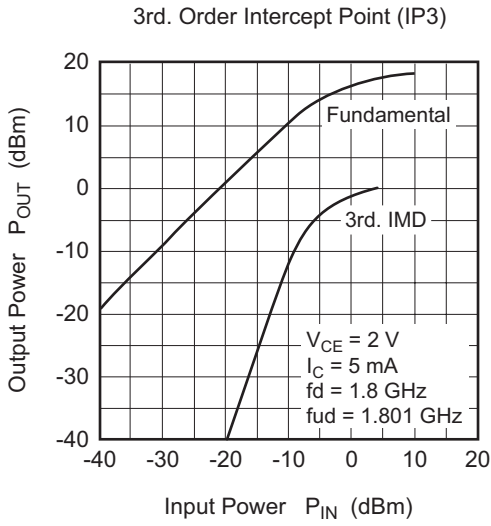
Notes: 1. $MSG = |S_{21}| / |S_{12}|$ 2. $MAG = |S_{21}| / |S_{12}|(K - (K^2 - 1)^{1/2})$

Main Characteristics

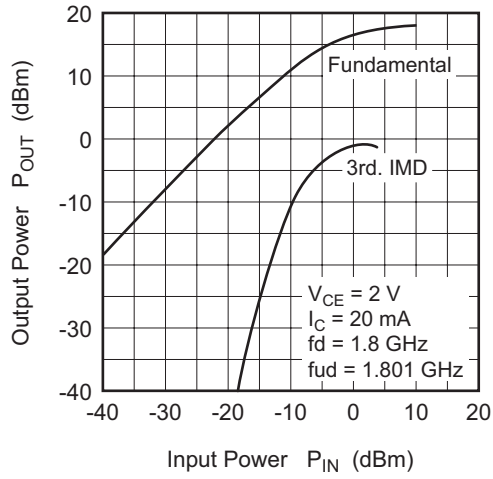




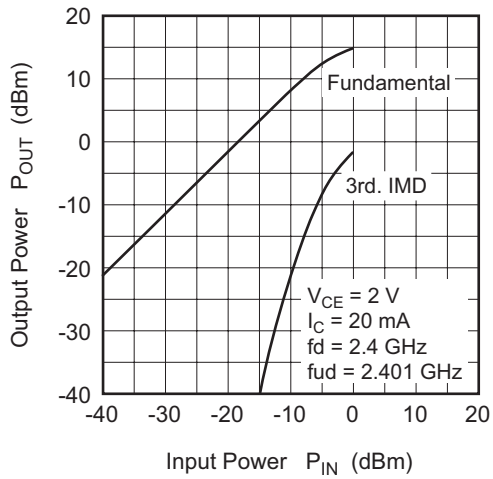




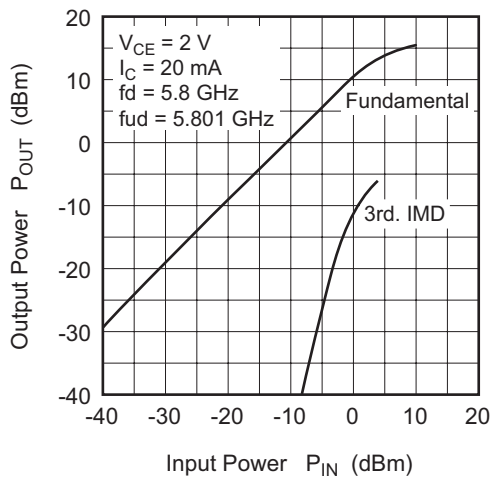
3rd. Order Intercept Point (IP3)



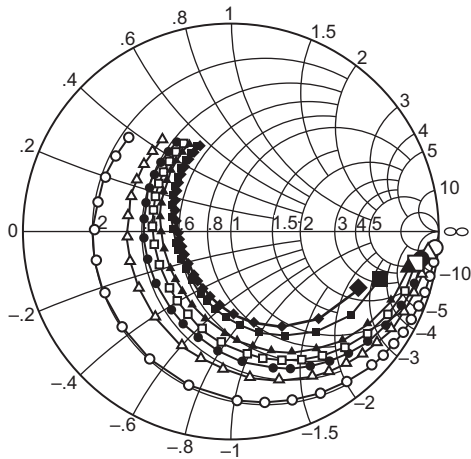
3rd. Order Intercept Point (IP3)



3rd. Order Intercept Point (IP3)



S₁₁ Parameter vs. Frequency

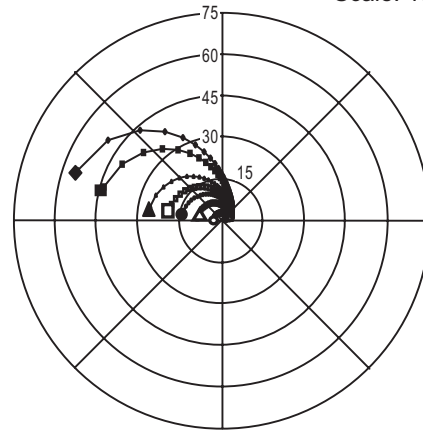


Condition: $V_{CE} = 2\text{ V}$, $Z_o = 50\ \Omega$
 100 to 1000 MHz (100 MHz step)
 1000 to 2000 MHz (200 MHz step)
 2000 to 6000 MHz (400 MHz step)



S₂₁ Parameter vs. Frequency

Scale: 15 / div.

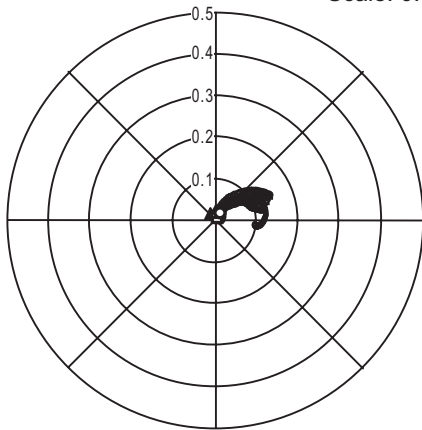


Condition: $V_{CE} = 2\text{ V}$, $Z_o = 50\ \Omega$
 100 to 6000 MHz (100 MHz step)

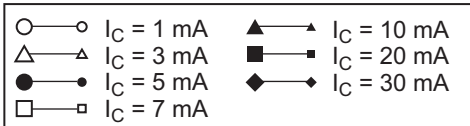


S₁₂ Parameter vs. Frequency

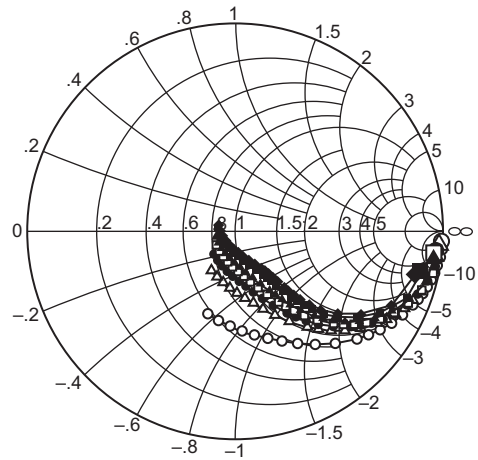
Scale: 0.1 / div.



Condition: $V_{CE} = 2\text{ V}$, $Z_o = 50\ \Omega$
 100 to 6000 MHz (100 MHz step)



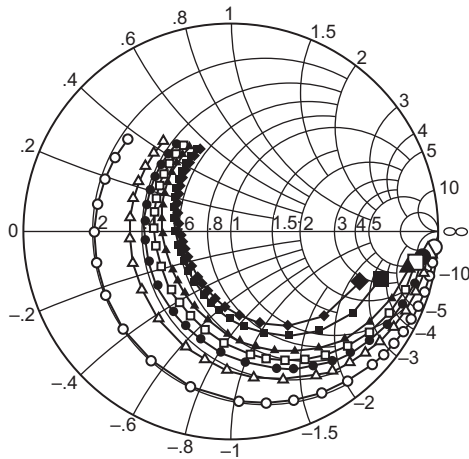
S₂₂ Parameter vs. Frequency



Condition: $V_{CE} = 2\text{ V}$, $Z_o = 50\ \Omega$
 100 to 1000 MHz (100 MHz step)
 1000 to 2000 MHz (200 MHz step)
 2000 to 6000 MHz (400 MHz step)



S₁₁ Parameter vs. Frequency

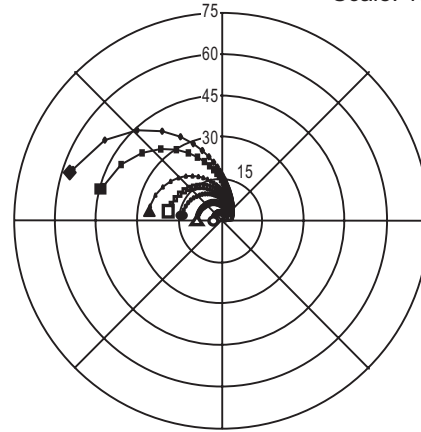


Condition: $V_{CE} = 3\text{ V}$, $Z_o = 50\ \Omega$
 100 to 1000 MHz (100 MHz step)
 1000 to 2000 MHz (200 MHz step)
 2000 to 6000 MHz (400 MHz step)



S₂₁ Parameter vs. Frequency

Scale: 15 / div.

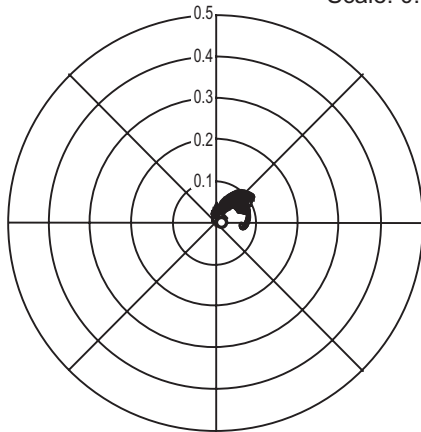


Condition: $V_{CE} = 3\text{ V}$, $Z_o = 50\ \Omega$
 100 to 6000 MHz (100 MHz step)

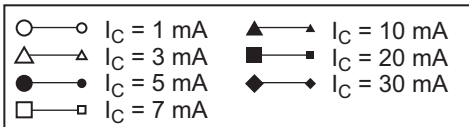


S₁₂ Parameter vs. Frequency

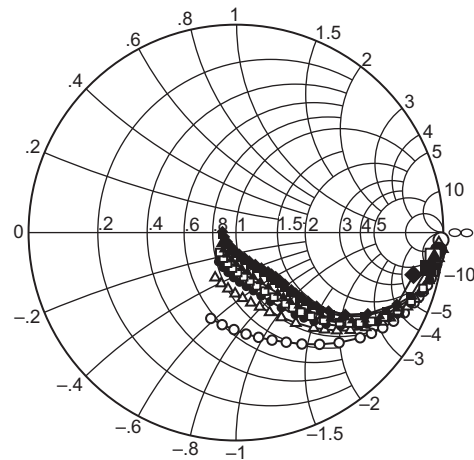
Scale: 0.1 / div.



Condition: $V_{CE} = 3\text{ V}$, $Z_o = 50\ \Omega$
 100 to 6000 MHz (100 MHz step)



S₂₂ Parameter vs. Frequency



Condition: $V_{CE} = 3\text{ V}$, $Z_o = 50\ \Omega$
 100 to 1000 MHz (100 MHz step)
 1000 to 2000 MHz (200 MHz step)
 2000 to 6000 MHz (400 MHz step)



S Parameter

 $(V_{CE} = 2\text{ V}, I_C = 5\text{ mA}, Z_O = 50\ \Omega)$

f (MHz)	S11		S21		S12		S22	
	MAG	ANG(deg.)	MAG	ANG(deg.)	MAG	ANG(deg.)	MAG	ANG(deg.)
100	0.924	-8.2	14.62	172.4	0.0099	95.9	0.974	-5.4
200	0.914	-15.8	14.43	165.5	0.0130	75.7	0.980	-9.9
300	0.891	-23.5	14.11	159.0	0.0191	79.3	0.959	-14.4
400	0.869	-31.3	13.76	152.9	0.0260	72.2	0.932	-18.9
500	0.841	-38.8	13.40	147.2	0.0304	66.8	0.901	-23.1
600	0.812	-46.1	12.99	141.7	0.0359	62.2	0.867	-26.9
700	0.782	-52.8	12.44	136.6	0.0401	59.6	0.831	-30.6
800	0.750	-59.6	12.00	131.6	0.0438	55.7	0.794	-33.8
900	0.718	-66.7	11.63	127.1	0.0465	55.1	0.758	-36.6
1000	0.686	-73.0	11.14	122.5	0.0499	52.2	0.723	-39.3
1100	0.657	-79.0	10.66	118.4	0.0521	48.3	0.692	-41.7
1200	0.626	-85.3	10.25	114.2	0.0552	46.8	0.659	-44.0
1300	0.600	-91.0	9.79	110.4	0.0572	45.4	0.630	-46.0
1400	0.577	-96.5	9.36	106.9	0.0596	44.0	0.603	-48.0
1500	0.555	-102.0	8.98	103.6	0.0606	42.4	0.576	-49.8
1600	0.534	-107.4	8.61	100.3	0.0624	41.6	0.551	-51.3
1700	0.516	-112.6	8.25	97.3	0.0644	39.9	0.527	-52.9
1800	0.501	-117.6	7.91	94.4	0.0661	38.9	0.506	-54.3
1900	0.487	-122.6	7.60	91.6	0.0664	37.9	0.486	-55.8
2000	0.474	-127.4	7.31	88.9	0.0684	36.9	0.467	-57.2
2200	0.455	-136.6	6.77	83.8	0.0711	35.6	0.432	-59.8
2400	0.441	-145.5	6.29	79.0	0.0732	34.7	0.402	-62.3
2600	0.430	-153.9	5.88	74.5	0.0753	33.4	0.374	-64.9
2800	0.424	-161.7	5.51	70.3	0.0783	32.9	0.349	-67.4
3000	0.422	-169.0	5.17	66.2	0.0802	31.6	0.326	-70.0
3200	0.422	-175.9	4.87	62.2	0.0825	30.7	0.306	-72.8
3400	0.423	177.7	4.60	58.4	0.0853	30.1	0.286	-75.7
3600	0.424	171.7	4.35	54.7	0.0875	29.6	0.269	-78.2
3800	0.427	166.5	4.13	51.3	0.0892	29.2	0.253	-81.2
4000	0.434	161.3	3.93	47.8	0.0927	28.5	0.241	-84.6
4200	0.440	156.4	3.75	44.4	0.0957	27.7	0.228	-88.4
4400	0.446	151.9	3.58	41.0	0.0985	26.9	0.216	-92.3
4600	0.454	147.6	3.43	37.7	0.1015	25.8	0.205	-96.1
4800	0.460	143.5	3.29	34.4	0.1047	24.6	0.195	-100.3
5000	0.467	139.3	3.16	31.2	0.1073	23.6	0.185	-104.8
5200	0.475	135.6	3.04	28.0	0.1102	22.8	0.176	-109.6
5400	0.481	131.9	2.93	24.8	0.1138	21.3	0.168	-114.9
5600	0.489	128.3	2.82	21.7	0.1171	20.5	0.161	-120.1
5800	0.497	124.7	2.72	18.5	0.1201	18.8	0.154	-125.8
6000	0.504	121.4	2.63	15.4	0.1242	17.9	0.148	-132.1

S Parameter

(V_{CE} = 2 V, I_C = 10 mA, Z_O = 50 Ω)

f (MHz)	S11		S21		S12		S22	
	MAG	ANG(deg.)	MAG	ANG(deg.)	MAG	ANG(deg.)	MAG	ANG(deg.)
100	0.871	-11.8	26.57	169.1	0.0044	49.5	0.961	-7.8
200	0.837	-23.4	25.71	159.4	0.0127	77.4	0.953	-14.8
300	0.793	-34.2	24.48	150.6	0.0170	74.2	0.906	-21.3
400	0.749	-44.4	23.16	142.8	0.0219	67.3	0.850	-27.0
500	0.698	-54.1	21.80	135.6	0.0265	63.8	0.797	-31.9
600	0.650	-63.4	20.39	129.1	0.0297	59.2	0.743	-35.9
700	0.607	-71.5	18.95	123.4	0.0333	56.8	0.689	-39.5
800	0.564	-79.4	17.66	118.1	0.0359	54.1	0.642	-42.3
900	0.527	-86.9	16.50	113.5	0.0373	52.8	0.600	-44.7
1000	0.494	-93.6	15.39	109.2	0.0405	51.4	0.563	-46.9
1100	0.467	-100.2	14.38	105.4	0.0416	50.1	0.529	-48.6
1200	0.441	-106.5	13.49	101.8	0.0433	49.7	0.498	-50.2
1300	0.419	-112.2	12.66	98.5	0.0452	48.3	0.470	-51.7
1400	0.402	-117.9	11.92	95.5	0.0483	48.4	0.446	-52.9
1500	0.386	-123.6	11.26	92.7	0.0497	48.8	0.423	-54.2
1600	0.374	-129.0	10.66	90.0	0.0514	48.6	0.402	-55.2
1700	0.364	-133.8	10.11	87.5	0.0530	47.3	0.384	-56.3
1800	0.356	-138.9	9.61	85.0	0.0546	47.2	0.366	-57.2
1900	0.348	-143.6	9.16	82.7	0.0569	46.8	0.350	-58.4
2000	0.343	-148.3	8.74	80.5	0.0582	46.7	0.335	-59.4
2200	0.337	-157.0	8.01	76.3	0.0617	45.8	0.308	-61.5
2400	0.334	-165.1	7.38	72.3	0.0652	45.9	0.285	-63.7
2600	0.335	-172.4	6.84	68.5	0.0698	44.1	0.262	-66.2
2800	0.338	-179.4	6.37	64.9	0.0730	43.6	0.242	-68.7
3000	0.342	174.5	5.96	61.3	0.0772	42.9	0.225	-71.3
3200	0.349	168.6	5.59	57.9	0.0801	42.0	0.209	-74.6
3400	0.354	163.2	5.27	54.5	0.0840	41.1	0.192	-77.9
3600	0.361	158.2	4.97	51.3	0.0885	39.4	0.177	-81.0
3800	0.367	153.9	4.71	48.3	0.0918	38.7	0.167	-84.4
4000	0.377	149.7	4.48	45.2	0.0962	37.8	0.155	-89.2
4200	0.386	145.7	4.27	42.1	0.1007	36.1	0.144	-93.9
4400	0.394	141.9	4.08	39.0	0.1038	34.8	0.134	-99.2
4600	0.404	138.3	3.90	36.0	0.1081	33.1	0.126	-104.9
4800	0.411	134.8	3.74	33.1	0.1119	31.5	0.118	-111.4
5000	0.420	131.3	3.59	30.1	0.1163	30.4	0.111	-117.9
5200	0.429	128.1	3.45	27.1	0.1196	28.7	0.105	-125.8
5400	0.437	125.0	3.32	24.1	0.1237	26.9	0.100	-134.2
5600	0.446	121.8	3.20	21.2	0.1275	25.5	0.096	-142.6
5800	0.454	118.8	3.09	18.3	0.1307	23.7	0.094	-151.2
6000	0.462	115.8	2.98	15.4	0.1353	21.8	0.093	-161.0

S Parameter

 $(V_{CE} = 3\text{ V}, I_C = 5\text{ mA}, Z_O = 50\ \Omega)$

f (MHz)	S11		S21		S12		S22	
	MAG	ANG(deg.)	MAG	ANG(deg.)	MAG	ANG(deg.)	MAG	ANG(deg.)
100	0.932	-7.5	14.49	172.5	0.0014	85.0	0.978	-5.0
200	0.919	-15.7	14.33	165.7	0.0097	82.5	0.979	-9.5
300	0.896	-22.9	14.03	159.3	0.0184	73.4	0.959	-13.7
400	0.875	-30.7	13.71	153.3	0.0248	71.7	0.934	-18.0
500	0.847	-38.2	13.37	147.6	0.0295	69.0	0.905	-22.0
600	0.817	-45.4	12.98	142.3	0.0337	63.4	0.873	-25.6
700	0.789	-51.9	12.45	137.2	0.0379	60.3	0.839	-29.2
800	0.756	-58.6	12.02	132.2	0.0422	56.7	0.803	-32.3
900	0.724	-65.6	11.67	127.7	0.0441	53.0	0.768	-35.0
1000	0.693	-71.7	11.19	123.1	0.0479	51.4	0.735	-37.5
1100	0.663	-77.8	10.72	119.0	0.0506	50.1	0.704	-39.8
1200	0.632	-83.9	10.32	114.8	0.0523	47.7	0.673	-41.9
1300	0.605	-89.5	9.86	111.0	0.0548	45.5	0.643	-43.9
1400	0.582	-95.0	9.44	107.6	0.0569	44.5	0.617	-45.7
1500	0.558	-100.6	9.06	104.2	0.0582	43.1	0.591	-47.4
1600	0.537	-106.0	8.69	100.9	0.0605	41.7	0.567	-48.8
1700	0.518	-111.1	8.33	97.8	0.0610	40.2	0.545	-50.4
1800	0.502	-116.0	8.00	94.9	0.0634	39.5	0.523	-51.8
1900	0.487	-121.0	7.68	92.1	0.0642	38.9	0.503	-53.2
2000	0.475	-126.0	7.39	89.4	0.0655	38.0	0.485	-54.4
2200	0.454	-135.0	6.85	84.3	0.0683	36.6	0.451	-56.9
2400	0.438	-144.0	6.37	79.6	0.0704	35.6	0.421	-59.2
2600	0.428	-152.3	5.95	75.1	0.0731	34.1	0.393	-61.5
2800	0.421	-160.2	5.58	70.8	0.0749	33.7	0.369	-63.9
3000	0.418	-167.5	5.24	66.7	0.0780	32.5	0.348	-66.3
3200	0.417	-174.5	4.93	62.7	0.0789	31.6	0.327	-68.8
3400	0.418	179.0	4.66	58.9	0.0819	31.3	0.309	-71.4
3600	0.418	172.9	4.41	55.3	0.0834	30.6	0.291	-73.9
3800	0.422	167.6	4.19	51.9	0.0864	30.3	0.275	-76.6
4000	0.428	162.3	3.99	48.4	0.0892	29.7	0.263	-79.8
4200	0.433	157.5	3.81	44.9	0.0921	28.2	0.250	-83.0
4400	0.439	152.8	3.64	41.5	0.0950	27.8	0.238	-86.6
4600	0.447	148.5	3.49	38.3	0.0980	26.9	0.227	-90.1
4800	0.453	144.2	3.34	35.0	0.1014	25.9	0.217	-93.9
5000	0.461	140.2	3.21	31.8	0.1041	25.4	0.206	-97.8
5200	0.468	136.3	3.09	28.6	0.1072	24.2	0.196	-102.2
5400	0.475	132.7	2.98	25.4	0.1099	23.0	0.188	-106.9
5600	0.483	129.1	2.87	22.2	0.1131	21.9	0.179	-111.4
5800	0.489	125.5	2.77	19.1	0.1161	20.5	0.172	-116.5
6000	0.497	122.1	2.68	16.0	0.1207	19.5	0.164	-121.9

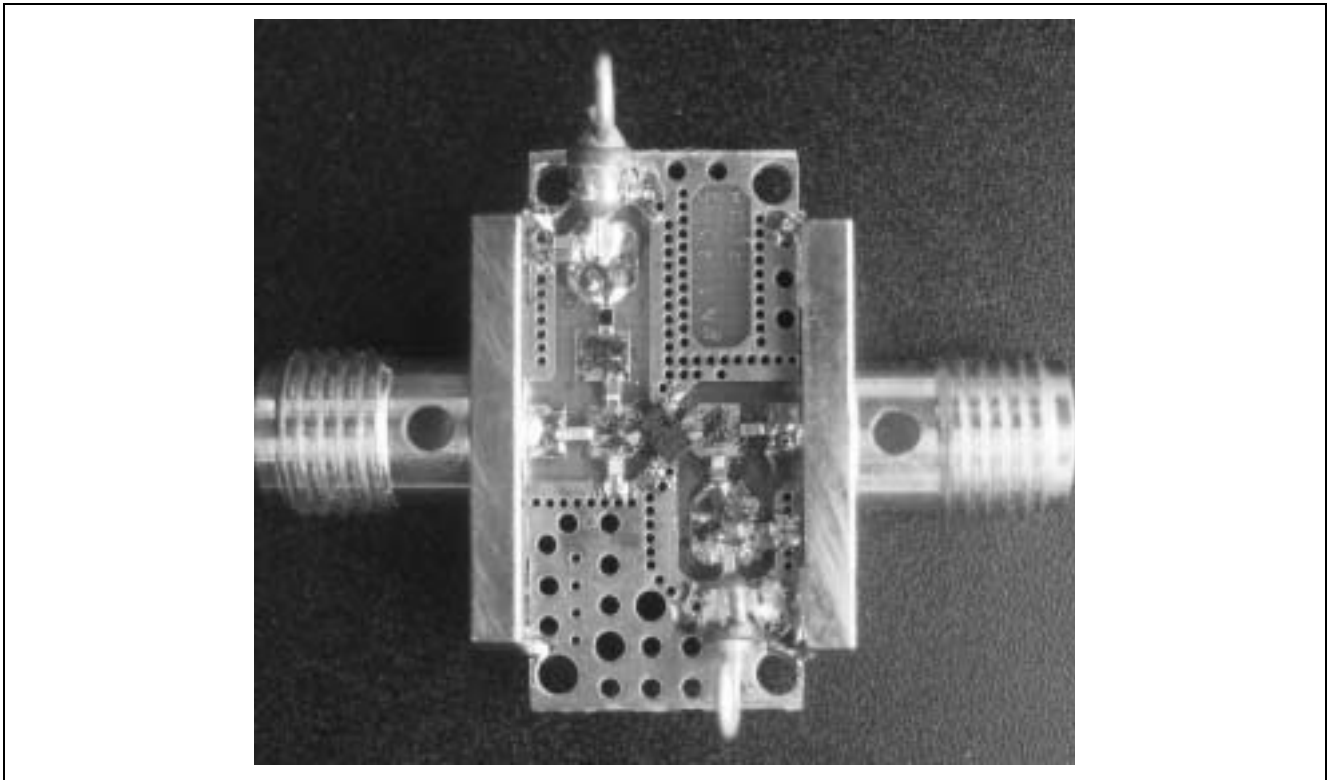
S Parameter

(V_{CE} = 3 V, I_C = 10 mA, Z_O = 50 Ω)

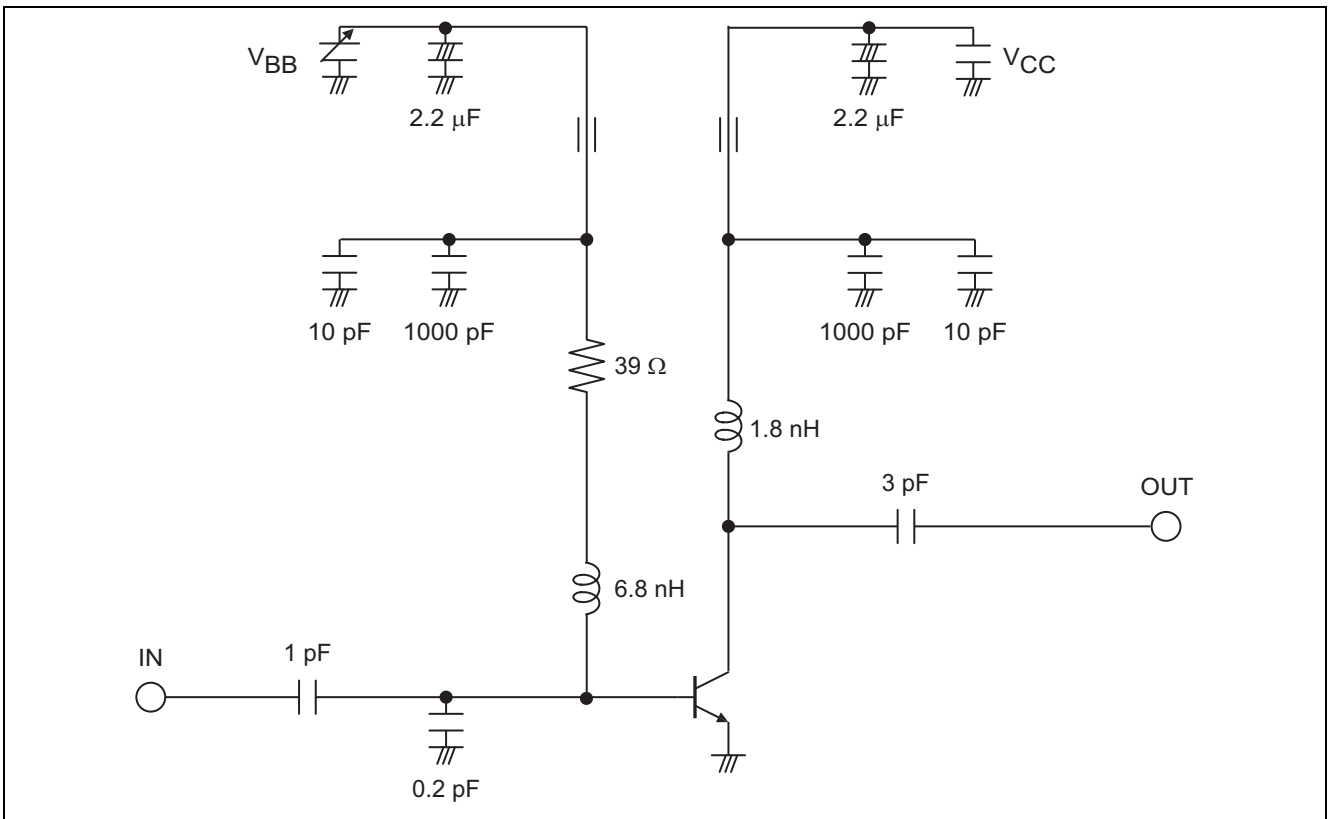
f (MHz)	S11		S21		S12		S22	
	MAG	ANG(deg.)	MAG	ANG(deg.)	MAG	ANG(deg.)	MAG	ANG(deg.)
100	0.869	-11.8	26.56	169.2	0.0022	69.6	0.963	-7.5
200	0.841	-22.8	25.72	159.7	0.0116	75.7	0.951	-14.1
300	0.799	-33.3	24.52	151.0	0.0173	70.7	0.907	-20.2
400	0.755	-43.5	23.24	143.3	0.0235	70.7	0.857	-25.6
500	0.704	-53.1	21.90	136.1	0.0256	63.7	0.804	-30.4
600	0.655	-62.0	20.51	129.7	0.0297	60.4	0.751	-34.2
700	0.612	-70.0	19.10	124.0	0.0318	57.3	0.701	-37.5
800	0.569	-77.9	17.81	118.7	0.0340	54.8	0.654	-40.2
900	0.530	-85.4	16.66	114.1	0.0361	51.3	0.614	-42.6
1000	0.497	-91.9	15.56	109.8	0.0390	52.3	0.577	-44.5
1100	0.469	-98.4	14.54	106.0	0.0410	50.0	0.543	-46.1
1200	0.442	-104.7	13.66	102.3	0.0426	50.7	0.514	-47.6
1300	0.420	-110.3	12.82	99.1	0.0445	49.3	0.487	-48.9
1400	0.402	-116.0	12.08	96.1	0.0462	49.0	0.464	-50.1
1500	0.386	-121.6	11.41	93.2	0.0473	48.7	0.441	-51.2
1600	0.372	-126.9	10.80	90.5	0.0497	48.4	0.421	-52.0
1700	0.361	-132.0	10.25	88.0	0.0514	48.3	0.402	-53.1
1800	0.352	-137.0	9.75	85.5	0.0526	47.6	0.386	-54.0
1900	0.345	-141.6	9.29	83.2	0.0545	47.3	0.370	-55.0
2000	0.338	-146.4	8.87	81.0	0.0559	47.1	0.355	-55.9
2200	0.331	-155.2	8.13	76.8	0.0600	46.3	0.329	-57.8
2400	0.328	-163.3	7.49	72.8	0.0634	45.6	0.305	-59.7
2600	0.327	-171.0	6.95	69.0	0.0670	44.7	0.284	-62.0
2800	0.330	-177.8	6.48	65.3	0.0703	44.2	0.264	-64.2
3000	0.335	175.8	6.06	61.8	0.0751	43.9	0.246	-66.5
3200	0.340	169.9	5.69	58.4	0.0783	42.9	0.230	-69.5
3400	0.347	164.2	5.36	55.0	0.0810	41.4	0.215	-72.1
3600	0.352	159.2	5.05	51.9	0.0845	40.3	0.199	-74.7
3800	0.358	154.8	4.79	48.8	0.0884	39.3	0.188	-77.9
4000	0.368	150.6	4.56	45.7	0.0937	38.7	0.177	-81.9
4200	0.376	146.6	4.35	42.6	0.0974	37.2	0.165	-85.8
4400	0.385	142.7	4.15	39.6	0.1011	36.0	0.154	-90.4
4600	0.394	139.0	3.97	36.6	0.1050	34.3	0.145	-95.0
4800	0.402	135.5	3.81	33.6	0.1087	32.8	0.136	-100.1
5000	0.411	132.1	3.65	30.6	0.1125	31.6	0.127	-105.6
5200	0.420	128.7	3.51	27.7	0.1171	29.7	0.119	-112.1
5400	0.428	125.6	3.38	24.7	0.1206	28.2	0.112	-118.8
5600	0.437	122.5	3.26	21.8	0.1242	26.8	0.106	-126.1
5800	0.444	119.5	3.15	18.9	0.1280	24.7	0.102	-134.1
6000	0.453	116.4	3.04	15.9	0.1322	23.1	0.097	-142.1

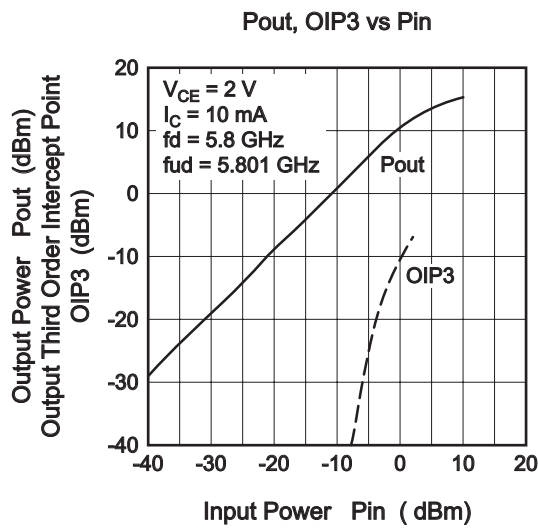
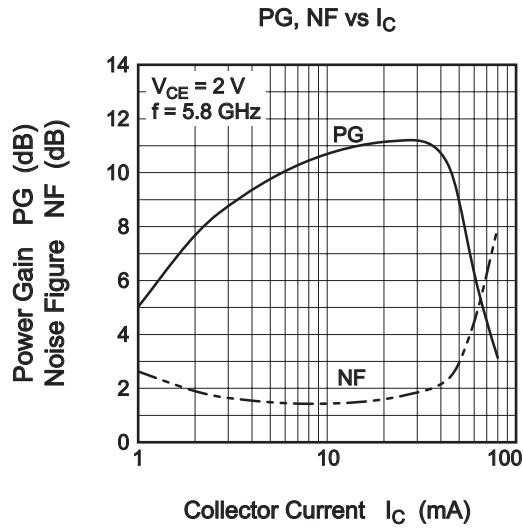
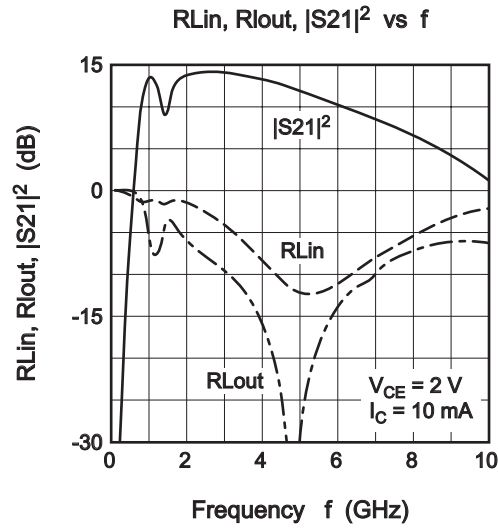
RQG1003 5.8 GHz Evaluation Board

Evaluation Board Pattern Layout

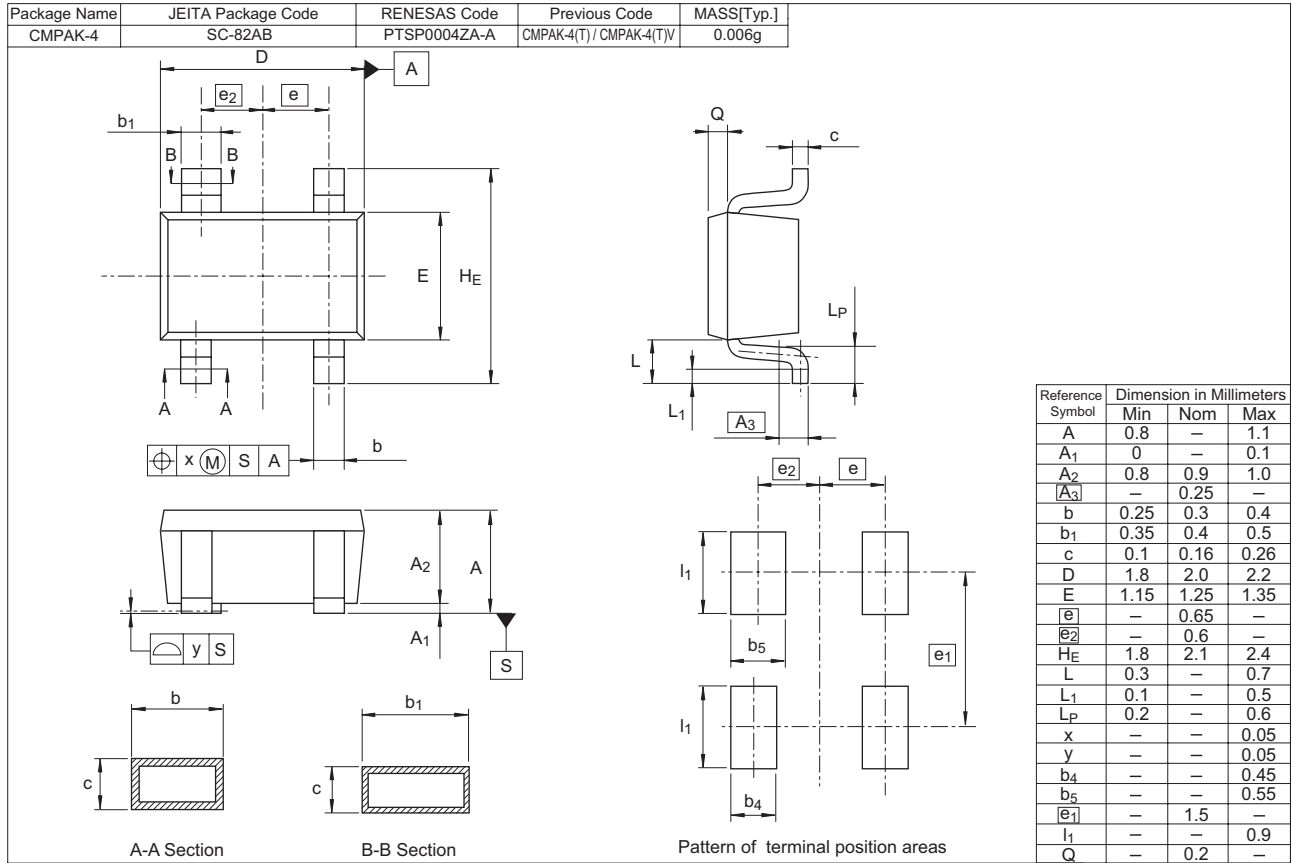


Circuit





Package Dimensions



Ordering Information

Part No.	Quantity	Shipping Container
RQG1003UQ-TL-E	3000 pcs	φ178 mm reel, 8 mm emboss taping

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1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001

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Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

Renesas Technology Malaysia Sdn. Bhd
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jalan Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510