

NEC

SILICON TRANSISTOR  
2SC5013HIGH FREQUENCY LOW NOISE AMPLIFIER  
NPN SILICON EPITAXIAL TRANSISTOR  
4 PINS SUPER MINI MOLD

## FEATURES

- Small Package
- High Gain Bandwidth Product ( $f_T = 10$  GHz TYP.)
- Low Noise, High Gain
- Low Voltage Operation

## ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKING STYLE
2SC5013-T1	3 Kpcs/Reel.	Embossed tape 8 mm wide. Pin3 (Base), Pin4 (Emitter) face to perforation side of the tape.
2SC5013-T2	3 Kpcs/Reel.	Embossed tape 8 mm wide. Pin1 (Collector), Pin2 (Emitter) face to perforation side of the tape.

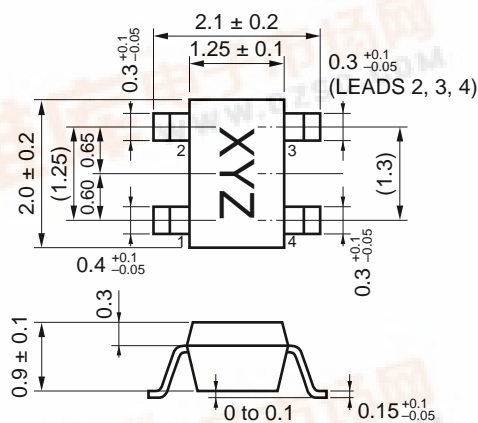
\* Please contact with responsible NEC person, If you require evaluation sample. Unit sample quantity shall be 50 pcs.  
(Part No.: 2SC5013)

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

Collector to Base Voltage	$V_{CBO}$	20	V
Collector to Emitter Voltage	$V_{CEO}$	10	V
Emitter to Base Voltage	$V_{EBO}$	1.5	V
Collector Current	$I_C$	35	mA
Total Power Dissipation	$P_T$	150	mW
Junction Temperature	$T_j$	150	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-65 to +150	$^\circ\text{C}$

## PACKAGE DIMENSIONS

in millimeters



## PIN CONNECTIONS

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

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

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Collector Cutoff Current	I <sub>CBO</sub>			1.0	μA	V <sub>CB</sub> = 10 V, I <sub>E</sub> = 0
Emitter Cutoff Current	I <sub>EBO</sub>			1.0	μA	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0
DC Current Gain	h <sub>FE</sub>	50	100	250		V <sub>CE</sub> = 6 V, I <sub>C</sub> = 10 mA* <sup>1</sup>
Gain Bandwidth Product	f <sub>T</sub>		10		GHz	V <sub>CE</sub> = 6 V, I <sub>C</sub> = 10 mA
Feed back Capacitance	C <sub>re</sub>		0.25	0.8	pF	V <sub>CB</sub> = 10 V, I <sub>E</sub> = 0, f = 1 MHz* <sup>2</sup>
Insertion Power Gain	S <sub>21e</sub>   <sup>2</sup>	7.5	9.5		dB	V <sub>CE</sub> = 6 V, I <sub>C</sub> = 10 mA, f = 2.0 GHz
Noise Figure	NF		1.8	3.0	dB	V <sub>CE</sub> = 6 V, I <sub>C</sub> = 5 mA, f = 2.0 GHz

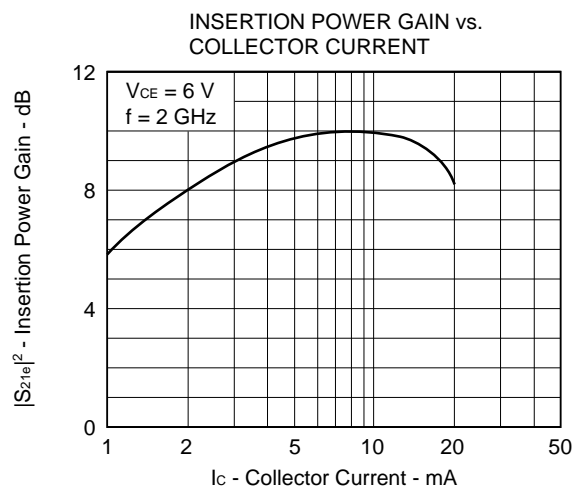
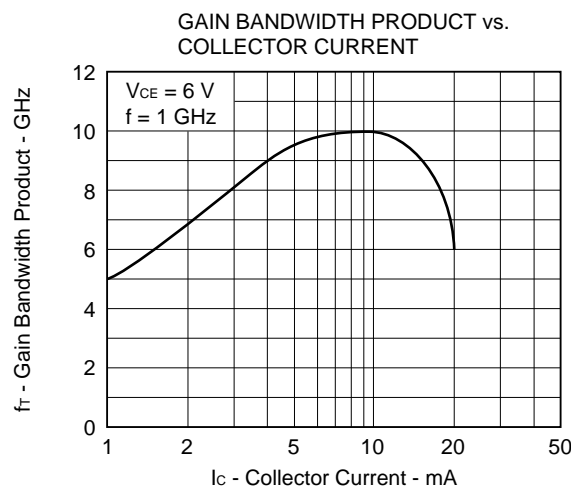
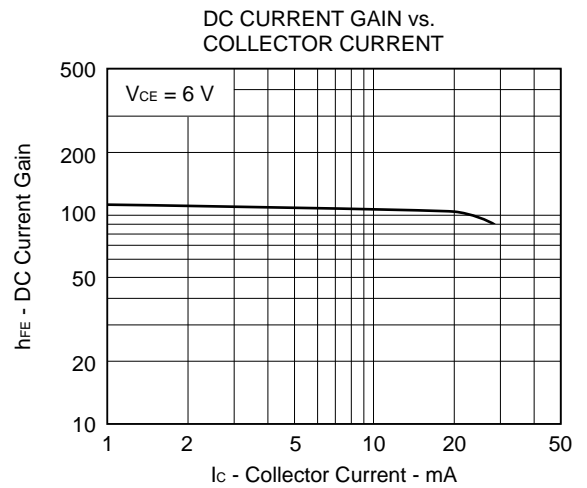
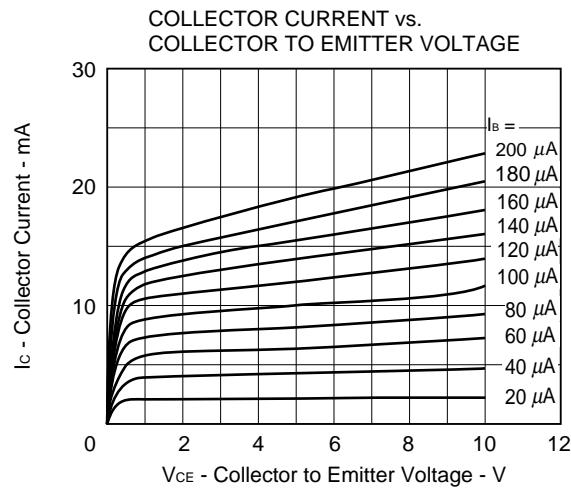
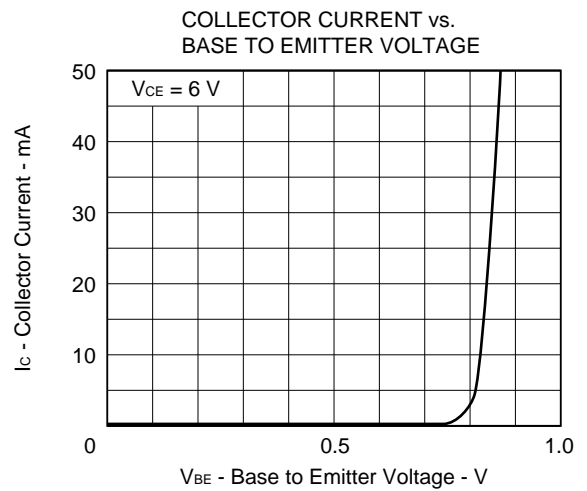
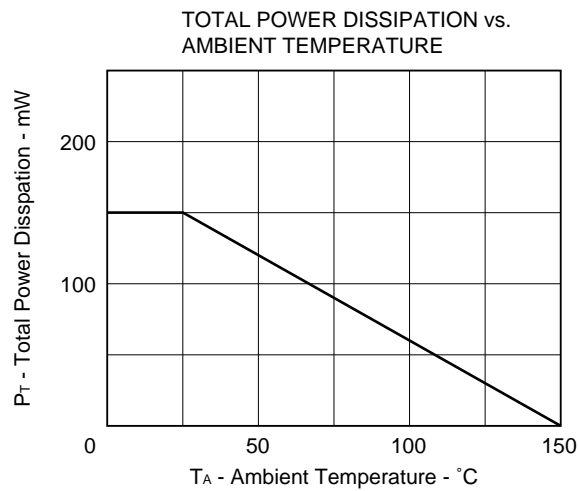
\*1 Pulse Measurement; PW ≤ 350 μs, Duty Cycle ≤ 2 % Pulsed.

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

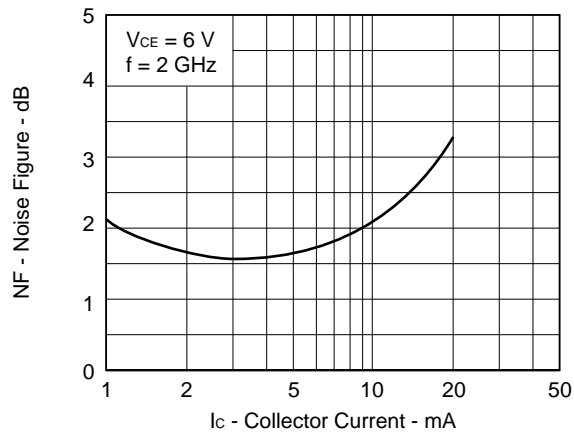
**h<sub>FE</sub> Classification**

Rank	EB	FB	GB
Marking	R46	R47	R48
h <sub>FE</sub>	50 to 100	80 to 160	125 to 250

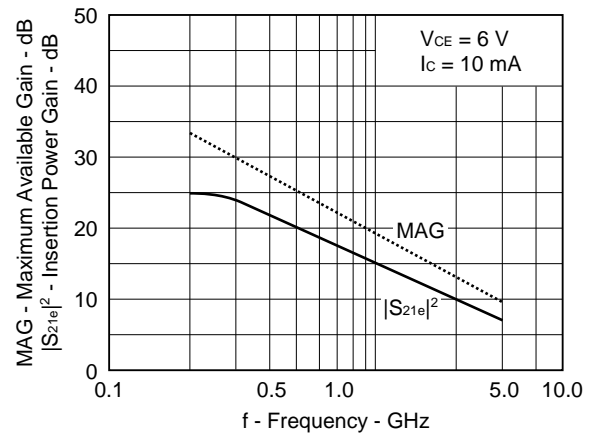
TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ )



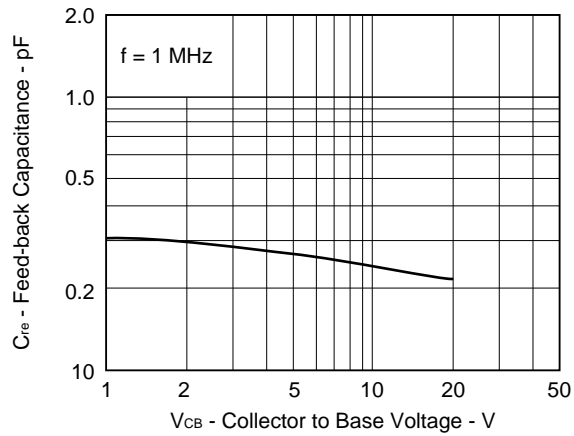
NOISE FIGURE vs.  
COLLECTOR CURRENT



MAXIMUM AVAILABLE GAIN/INSERTION  
POWER GAIN vs. FREQUENCY



FEED-BACK CAPACITANCE vs.  
COLLECTOR TO BASE VOLTAGE



**S-PARAMETER**V<sub>CE</sub> = 6 V, I<sub>c</sub> = 10 mA

FREQUENCY f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.728	-26.9	21.563	157.7	.013	86.3	.946	-11.0
200.00	.616	-50.1	18.401	139.3	.023	69.9	.851	-18.5
300.00	.522	-68.0	15.357	126.0	.029	57.4	.766	-23.2
400.00	.441	-83.2	12.718	116.3	.037	58.4	.694	-24.8
500.00	.376	-96.2	10.893	108.2	.039	62.0	.637	-26.0
600.00	.341	-107.8	9.466	102.5	.047	63.0	.602	-27.0
700.00	.310	-118.1	8.396	97.2	.049	60.6	.579	-27.3
800.00	.286	-127.0	7.434	92.5	.054	60.1	.556	-28.3
900.00	.266	-138.1	6.707	88.7	.056	58.1	.541	-28.3
1000.00	.261	-146.1	6.128	84.7	.065	59.9	.529	-29.2
1100.00	.252	-154.5	5.578	81.6	.067	63.0	.516	-29.5
1200.00	.249	-160.1	5.111	78.4	.073	60.2	.506	-31.0
1300.00	.243	-168.7	4.769	75.6	.073	57.3	.494	-31.7
1400.00	.241	-173.0	4.467	72.5	.082	56.5	.488	-33.7
1500.00	.253	-179.5	4.183	69.6	.085	59.6	.474	-34.3
1600.00	.251	174.3	3.932	67.1	.094	56.7	.471	-36.3
1700.00	.269	170.9	3.731	64.7	.093	58.2	.464	-36.5
1800.00	.266	164.5	3.536	62.0	.098	59.3	.466	-38.0
1900.00	.269	161.6	3.372	60.0	.100	56.7	.457	-40.0
2000.00	.285	158.2	3.233	57.1	.116	56.2	.451	-42.0
2100.00	.289	154.8	3.071	55.4	.117	57.0	.449	-44.3
2200.00	.300	150.6	2.935	52.3	.120	58.5	.445	-46.0
2300.00	.298	149.3	2.812	50.8	.128	57.4	.440	-47.1
2400.00	.293	144.6	2.720	48.4	.127	57.1	.432	-47.0
2500.00	.315	143.0	2.623	45.8	.137	55.1	.425	-52.2
2600.00	.326	138.8	2.542	43.9	.144	54.7	.419	-50.4
2700.00	.327	137.8	2.435	42.4	.151	50.4	.419	-54.7
2800.00	.320	136.4	2.376	39.4	.158	53.9	.427	-57.6
2900.00	.327	135.1	2.285	37.9	.161	48.7	.425	-60.2
3000.00	.337	129.1	2.218	34.6	.160	50.1	.419	-61.9

V<sub>CE</sub> = 3 V, I<sub>c</sub> = 5 mA

FREQUENCY f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.836	-17.9	13.996	164.7	.015	73.5	.971	-8.3
200.00	.768	-34.4	12.918	150.7	.025	72.7	.918	-15.1
300.00	.692	-48.4	11.709	138.9	.038	66.8	.862	-20.5
400.00	.614	-61.2	10.317	129.2	.044	60.2	.793	-23.9
500.00	.535	-72.4	9.260	120.2	.051	55.8	.731	-27.1
600.00	.490	-82.3	8.326	113.8	.056	55.6	.684	-29.1
700.00	.435	-92.9	7.553	107.6	.063	55.6	.658	-30.6
800.00	.398	-100.8	6.791	102.1	.065	58.1	.614	-32.6
900.00	.362	-110.0	6.194	97.7	.070	54.7	.591	-32.8
1000.00	.333	-118.3	5.724	93.2	.074	54.2	.567	-33.4
1100.00	.318	-126.0	5.263	89.6	.079	55.3	.548	-34.7
1200.00	.297	-133.4	4.837	85.7	.084	53.9	.542	-35.6
1300.00	.281	-141.4	4.538	82.5	.085	53.3	.516	-36.7
1400.00	.275	-147.5	4.256	79.4	.090	52.0	.509	-37.9
1500.00	.263	-155.9	4.004	76.0	.099	50.6	.488	-38.2
1600.00	.268	-162.3	3.770	73.3	.099	49.4	.491	-39.3
1700.00	.277	-169.6	3.597	70.7	.105	49.9	.484	-40.0
1800.00	.267	-174.9	3.407	67.7	.109	51.2	.475	-41.7
1900.00	.262	-179.5	3.244	65.6	.112	50.2	.468	-43.4
2000.00	.276	175.7	3.118	62.3	.119	51.9	.460	-46.6
2100.00	.273	169.3	2.967	59.5	.120	50.4	.453	-47.4
2200.00	.283	164.4	2.837	56.5	.127	47.6	.446	-49.3
2300.00	.291	161.1	2.726	54.5	.129	49.7	.441	-50.5
2400.00	.283	155.3	2.635	52.3	.135	50.6	.431	-51.1
2500.00	.302	153.1	2.538	49.3	.138	50.0	.429	-53.9
2600.00	.304	148.2	2.458	47.3	.143	49.1	.426	-53.3
2700.00	.313	145.8	2.365	45.9	.147	47.8	.418	-57.4
2800.00	.304	143.9	2.296	42.6	.156	45.9	.436	-60.7
2900.00	.320	143.1	2.209	41.0	.157	44.9	.417	-60.2
3000.00	.311	136.6	2.122	37.9	.166	46.4	.426	-64.2

**S-PARAMETER** $V_{CE} = 3\text{ V}$ ,  $I_c = 3\text{ mA}$ 

FREQUENCY f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.902	-13.0	9.558	168.7	.014	84.4	.979	-6.1
200.00	.851	-26.2	9.143	157.3	.028	74.3	.954	-11.7
300.00	.802	-37.4	8.623	147.3	.039	69.7	.919	-16.7
400.00	.740	-48.4	7.924	138.3	.047	62.4	.870	-20.8
500.00	.673	-58.7	7.396	129.6	.059	58.6	.820	-24.6
600.00	.628	-68.1	6.856	122.9	.064	56.0	.777	-27.4
700.00	.570	-77.1	6.376	116.2	.069	53.7	.741	-29.3
800.00	.525	-85.5	5.838	110.2	.075	52.2	.698	-32.1
900.00	.476	-94.0	5.406	105.2	.079	51.0	.671	-33.0
1000.00	.444	-101.0	5.065	100.2	.086	48.3	.650	-34.5
1100.00	.414	-108.1	4.698	96.0	.088	48.0	.621	-35.7
1200.00	.382	-115.4	4.347	91.6	.095	47.4	.606	-37.3
1300.00	.362	-123.1	4.108	88.0	.097	47.5	.584	-38.4
1400.00	.347	-129.7	3.874	84.3	.098	45.7	.570	-39.5
1500.00	.331	-136.8	3.663	80.7	.100	45.9	.543	-40.5
1600.00	.323	-144.1	3.457	77.5	.103	44.4	.540	-41.8
1700.00	.325	-151.0	3.312	74.7	.107	46.4	.525	-42.7
1800.00	.311	-156.6	3.143	71.5	.113	44.2	.523	-44.8
1900.00	.299	-161.8	3.009	68.8	.114	46.4	.515	-46.4
2000.00	.316	-169.4	2.883	65.2	.118	44.7	.504	-47.9
2100.00	.303	-176.8	2.746	62.4	.123	45.6	.492	-50.0
2200.00	.311	179.4	2.636	59.0	.125	43.0	.488	-51.8
2300.00	.308	173.8	2.539	57.0	.128	44.0	.486	-52.1
2400.00	.298	169.7	2.446	54.5	.137	45.1	.470	-53.4
2500.00	.319	164.0	2.371	51.4	.141	42.7	.468	-55.8
2600.00	.323	161.0	2.291	49.2	.139	43.4	.463	-56.2
2700.00	.320	158.3	2.203	47.5	.143	42.6	.462	-58.9
2800.00	.318	155.2	2.146	44.2	.149	42.2	.469	-62.4
2900.00	.339	152.9	2.066	42.5	.150	42.5	.457	-63.6
3000.00	.322	146.3	1.987	39.1	.162	41.3	.458	-66.6

 $V_{CE} = 3\text{ V}$ ,  $I_c = 1\text{ mA}$ 

FREQUENCY f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.971	-7.4	3.546	173.5	.019	84.5	.998	-3.3
200.00	.950	-15.4	3.498	166.3	.031	75.8	.986	-6.9
300.00	.937	-22.4	3.464	159.7	.045	76.2	.983	-9.9
400.00	.910	-29.7	3.348	153.4	.058	67.5	.962	-13.2
500.00	.877	-36.9	3.321	146.0	.071	67.2	.946	-16.6
600.00	.858	-44.0	3.232	140.7	.082	62.3	.928	-19.3
700.00	.822	-51.3	3.187	134.4	.090	58.1	.909	-21.9
800.00	.792	-58.1	3.054	128.3	.102	56.1	.884	-25.5
900.00	.751	-65.0	2.949	122.9	.110	50.7	.852	-27.2
1000.00	.718	-71.4	2.867	117.5	.116	48.6	.845	-29.7
1100.00	.686	-78.2	2.750	112.7	.122	45.0	.813	-32.3
1200.00	.649	-84.4	2.620	107.1	.131	42.7	.793	-34.2
1300.00	.623	-91.2	2.543	102.7	.128	42.4	.767	-36.0
1400.00	.592	-97.1	2.449	98.2	.137	37.2	.758	-38.7
1500.00	.565	-104.0	2.362	93.5	.136	33.7	.729	-40.0
1600.00	.542	-110.2	2.259	89.2	.140	32.8	.715	-41.5
1700.00	.524	-117.6	2.219	85.9	.147	29.5	.703	-43.2
1800.00	.508	-122.9	2.117	81.6	.148	28.3	.692	-45.5
1900.00	.483	-127.9	2.043	78.3	.140	30.1	.674	-47.2
2000.00	.481	-135.3	1.989	74.0	.147	28.4	.667	-49.0
2100.00	.453	-141.6	1.901	70.1	.145	25.9	.652	-51.0
2200.00	.445	-147.4	1.850	65.9	.145	25.6	.642	-52.6
2300.00	.445	-152.3	1.791	63.4	.154	24.4	.636	-54.4
2400.00	.425	-157.1	1.722	60.3	.145	25.6	.630	-56.3
2500.00	.436	-163.5	1.691	56.6	.148	25.9	.619	-58.8
2600.00	.419	-169.2	1.642	53.7	.148	22.1	.609	-58.5
2700.00	.430	-172.0	1.577	51.8	.143	22.3	.610	-61.9
2800.00	.416	-176.9	1.552	47.7	.146	22.6	.606	-64.8
2900.00	.433	178.9	1.488	45.5	.145	23.0	.596	-64.8
3000.00	.408	173.9	1.450	42.1	.155	22.8	.597	-67.4

[MEMO]

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NEC devices are classified into the following three quality grades:

"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.

Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

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Anti-radioactive design is not implemented in this product.