NEC

SILICON TRANSISTOR

2SC5012

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

FEATURES

• Small Package

• High Gain Bandwidth Product (f_T = 9 GHz TYP.)

• Low Noise, High Gain
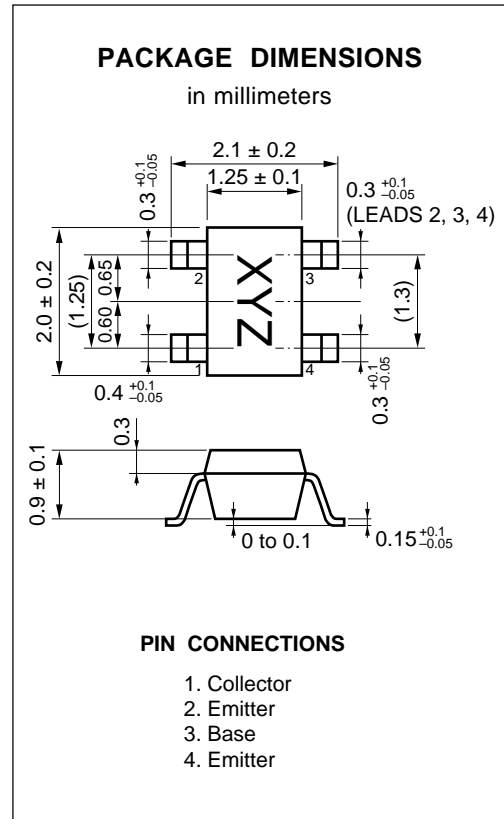
• Low Voltage Operation

ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKING STYLE
2SC5012-T1	3 Kpcs/Reel.	Embossed tape 8 mm wide. Pin 3 (Base), Pin 4 (Emitter) face to perforation side of the tape.
2SC5012-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.: 2SC5012)

ABSOLUTE MAXIMUM RATINGS (T$_A$ = 25 ˚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	65	mA
Total Power Dissipation	P_T	150	mW
Junction Temperature	T_j	150	˚C
Storage Temperature	T_{stg}	−65 to +150	˚C

PACKAGE DIMENSIONS
in millimeters

2.1 ± 0.2
1.25 ± 0.1
$0.3^{+0.1}_{-0.05}$
$0.3^{+0.1}_{-0.05}$ (LEADS 2, 3, 4)
2.0 ± 0.2
(1.25)
0.65
0.60
(1.3)
$0.4^{+0.1}_{-0.05}$
$0.3^{+0.1}_{-0.05}$
0.9 ± 0.1
0.3
0 to 0.1
$0.15^{+0.1}_{-0.05}$
XYZ

PIN CONNECTIONS

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

Caution; Electrostatic Sensitive Device.

ELECTRICAL CHARACTERISTICS (T$_A$ = 25 ˚C)

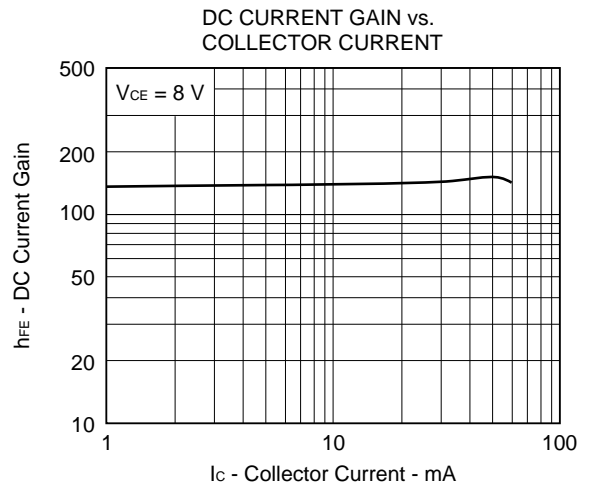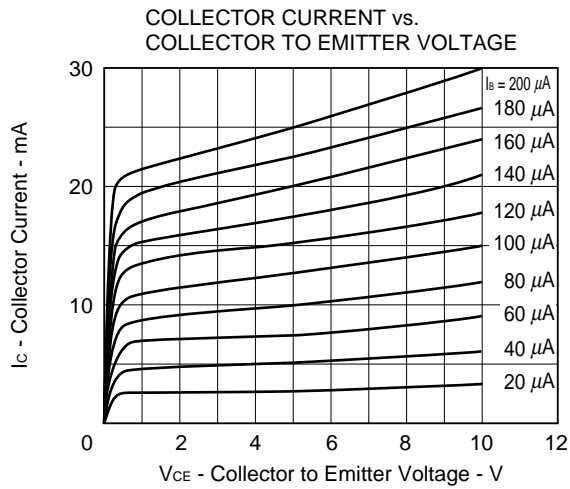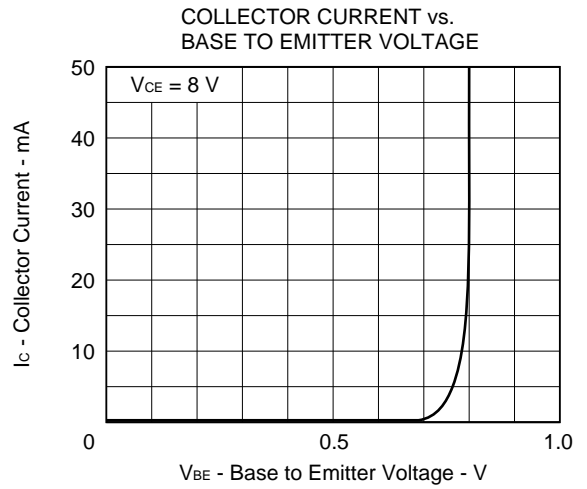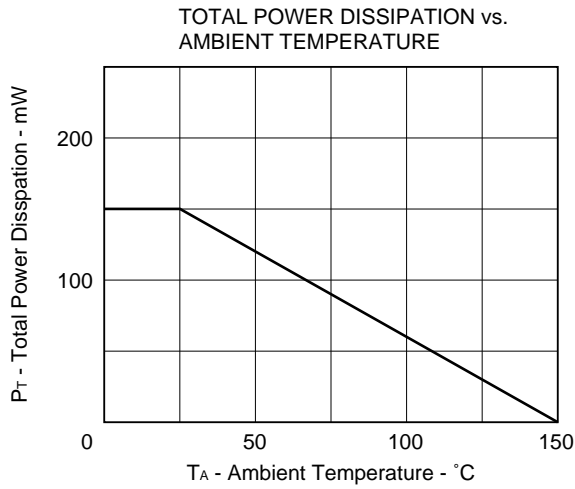| CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Collector Cutoff Current	I$_{CBO}$			1.0	μA	V$_{CB}$ = 10 V, I$_E$ = 0
Emitter Cutoff Current	I$_{EBO}$			1.0	μA	V$_{EB}$ = 1 V, I$_C$ = 0
DC Current Gain	h$_{FE}$	50	100	250		V$_{CE}$ = 8 V, I$_C$ = 20 mA*1
Gain Bandwidth Product	f$_T$		9.0		GHz	V$_{CE}$ = 8 V, I$_C$ = 20 mA
Feed-back Capacitance	C$_{re}$		0.25	0.8	pF	V$_{CB}$ = 10 V, I$_E$ = 0, f = 1 MHz*2
Insertion Power Gain	|S$_{21e}$|^2	13	15		dB	V$_{CE}$ = 8 V, I$_C$ = 20 mA, f = 1.0 GHz
Noise Figure	NF		1.2	2.5	dB	V$_{CE}$ = 8 V, I$_C$ = 7 mA, f = 1.0 GHz

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

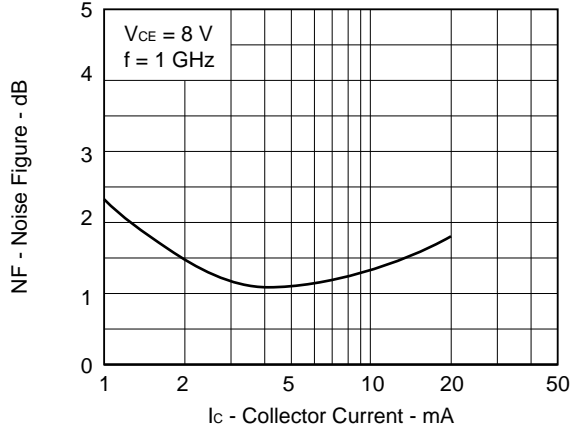*2 Measured with 3 terminals bridge, Emitter and Case should be grounded.

h$_{FE}$ Classification

Rank	EB	FB	GB
Marking	R36	R37	R38
h$_{FE}$	50 to 100	80 to 160	125 to 250

TYPICAL CHARACTERISTICS (T$_A$ = 25 ˚C)

TOTAL POWER DISSIPATION vs.
AMBIENT TEMPERATURE

P$_T$ - Total Power Disspation - mW

T$_A$ - Ambient Temperature - ˚C

COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE

V$_{CE}$ = 8 V

I$_C$ - Collector Current - mA

V$_{BE}$ - Base to Emitter Voltage - V

COLLECTOR CURRENT vs.
COLLECTOR TO EMITTER VOLTAGE

I$_C$ - Collector Current - mA

I$_B$ = 200 μA
180 μA
160 μA
140 μA
120 μA
100 μA
80 μA
60 μA
40 μA
20 μA

V$_{CE}$ - Collector to Emitter Voltage - V

DC CURRENT GAIN vs.
COLLECTOR CURRENT

V$_{CE}$ = 8 V

h$_{FE}$ - DC Current Gain

I$_C$ - Collector Current - mA

GAIN BANDWIDTH PRODUCT vs.
COLLECTOR CURRENT

V$_{CE}$ = 8 V
f = 1 GHz

f$_T$ - Gain Bandwidth Product - GHz

I$_C$ - Collector Current - mA

INSERTION POWER GAIN vs.
COLLECTOR CURRENT

V$_{CE}$ = 8 V
f = 1 GHz

$|S_{21e}|^2$ - Insertion Power Gain - dB

I$_C$ - Collector Current - mA

3

NOISE FIGURE vs.
COLLECTOR CURRENT

$V_{CE} = 8$ V
$f = 1$ GHz

NF - Noise Figure - dB

I_C - Collector Current - mA

MAXIMUM AVAILABLE GAIN/INSERTION
POWER GAIN vs. FREQUENCY

$V_{CE} = 8$ V
$I_C = 20$ mA

MAG - Maximum Available Gain - dB
$|S_{21e}|^2$ - Insertion Power Gain - dB

MAG

$|S_{21e}|^2$
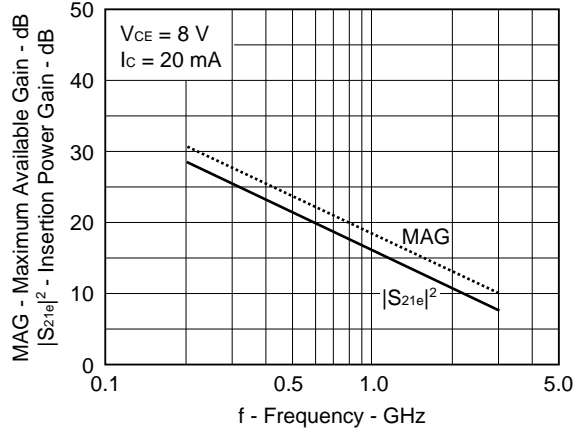
f - Frequency - GHz

FEED-BACK CAPACITANCE vs.
COLLECTOR TO BASE VOLTAGE

$f = 1$ MHz

C_{re} - Feed-back Capacitance - pF

V_{CB} - Collector to Base Voltage - V
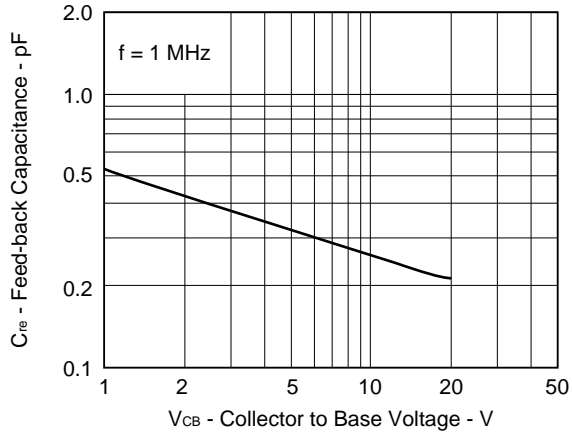
S-PARAMETER

V_{CE} = 8 V, I_C = 20 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
f (MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.589	−57.8	34.077	143.4	.016	60.0	.826	−22.7
200.00	.486	−95.2	24.310	121.8	.022	56.3	.644	−30.4
300.00	.436	−119.1	18.108	109.7	.028	59.4	.543	−32.3
400.00	.411	−137.1	14.077	101.8	.031	48.4	.470	−31.9
500.00	.395	−149.6	11.600	95.5	.037	56.9	.430	−32.1
600.00	.398	−158.1	9.826	91.1	.040	60.9	.412	−31.9
700.00	.395	−166.5	8.540	86.9	.045	63.1	.388	−30.4
800.00	.397	−172.9	7.482	83.1	.051	57.9	.372	−31.3
900.00	.401	−179.1	6.693	80.0	.057	66.1	.360	−32.8
1000.00	.407	175.4	6.069	76.6	.061	61.4	.358	−31.8
1100.00	.407	170.1	5.483	73.9	.066	59.3	.342	−33.2
1200.00	.407	167.6	5.019	71.3	.069	59.3	.334	−34.8
1300.00	.420	162.3	4.644	68.9	.076	61.8	.317	−36.0
1400.00	.412	160.0	4.338	66.1	.077	61.2	.330	−37.3
1500.00	.433	156.2	4.052	63.4	.083	58.7	.313	−39.0
1600.00	.432	153.4	3.777	61.2	.088	61.4	.310	−41.4
1700.00	.455	151.2	3.579	58.8	.096	60.0	.297	−41.7
1800.00	.456	146.7	3.373	56.5	.099	59.3	.296	−42.1
1900.00	.453	145.9	3.208	54.8	.101	60.4	.311	−44.8
2000.00	.463	143.2	3.061	52.5	.106	59.9	.298	−49.9
2100.00	.475	141.0	2.917	49.8	.116	56.0	.287	−49.5
2200.00	.486	138.6	2.801	47.2	.119	59.9	.303	−53.3
2300.00	.481	136.8	2.676	45.2	.125	55.2	.290	−58.2
2400.00	.497	133.4	2.573	43.4	.125	55.8	.268	−56.8
2500.00	.502	132.5	2.469	40.7	.132	54.0	.273	−59.7
2600.00	.511	130.8	2.403	38.9	.147	52.8	.290	−59.6
2700.00	.508	129.1	2.306	37.2	.146	54.3	.269	−67.5
2800.00	.504	126.7	2.228	33.8	.147	50.0	.271	−71.7
2900.00	.509	125.7	2.146	32.5	.159	51.0	.273	−66.7
3000.00	.514	123.0	2.068	29.6	.161	46.5	.289	−73.2

V_{CE} = 3 V, I_C = 5 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
f (MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.826	−29.5	14.854	160.0	.024	78.6	.953	−13.4
200.00	.752	−56.0	13.074	142.7	.039	62.0	.850	−24.2
300.00	.682	−77.7	11.233	129.3	.051	54.3	.754	−31.9
400.00	.627	−95.2	9.484	119.1	.059	48.6	.664	−36.2
500.00	.575	−111.1	8.193	110.4	.066	45.3	.586	−39.3
600.00	.555	−122.6	7.199	104.1	.071	41.2	.531	−41.7
700.00	.536	−134.3	6.411	98.1	.075	40.8	.492	−42.3
800.00	.524	−142.8	5.683	92.9	.078	39.9	.452	−45.0
900.00	.517	−150.5	5.136	88.9	.083	41.8	.425	−45.4
1000.00	.512	−158.6	4.702	84.5	.083	43.4	.411	−45.3
1100.00	.504	−164.5	4.293	80.9	.086	41.0	.395	−47.5
1200.00	.501	−169.3	3.925	77.7	.093	41.8	.382	−47.8
1300.00	.501	−175.3	3.661	74.4	.096	42.2	.361	−49.4
1400.00	.505	−178.9	3.424	71.3	.093	43.2	.351	−50.2
1500.00	.504	175.0	3.204	68.1	.099	42.0	.331	−52.6
1600.00	.512	171.4	3.009	65.2	.103	41.1	.330	−53.0
1700.00	.530	167.9	2.858	62.6	.110	44.3	.319	−54.7
1800.00	.529	164.3	2.698	60.0	.110	43.8	.332	−56.5
1900.00	.529	161.1	2.579	57.7	.113	43.5	.315	−58.4
2000.00	.543	158.3	2.455	54.6	.118	43.8	.318	−61.3
2100.00	.536	153.8	2.325	51.0	.122	45.0	.313	−64.0
2200.00	.552	151.0	2.217	48.0	.128	42.4	.300	−67.8
2300.00	.552	149.3	2.119	46.0	.130	41.5	.294	−67.7
2400.00	.548	145.6	2.057	44.4	.135	42.6	.288	−69.6
2500.00	.560	143.8	1.969	41.0	.137	44.7	.290	−74.7
2600.00	.572	140.8	1.913	38.9	.140	41.9	.279	−75.0
2700.00	.572	138.3	1.832	37.3	.149	40.6	.291	−78.0
2800.00	.562	136.4	1.775	34.4	.153	42.9	.290	−82.7
2900.00	.571	135.0	1.728	32.8	.158	40.1	.295	−82.1
3000.00	.588	132.8	1.651	30.1	.164	39.5	.287	−86.4

S-PARAMETER

V_{CE} = 3 V, I_C = 3 mA

FREQUENCY	S11		S21		S12		S22	
f (MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.887	−22.8	9.939	164.2	.024	78.7	.973	−9.8
200.00	.836	−44.6	9.201	149.5	.044	67.2	.912	−18.1
300.00	.782	−63.0	8.316	137.2	.060	57.2	.847	−25.2
400.00	.724	−79.7	7.309	127.1	.068	52.2	.772	−29.6
500.00	.666	−95.1	6.543	117.6	.078	47.5	.697	−34.0
600.00	.642	−107.2	5.870	110.6	.086	40.1	.640	−36.8
700.00	.610	−119.1	5.313	104.0	.091	36.8	.607	−38.3
800.00	.592	−128.2	4.760	98.2	.092	36.4	.563	−40.8
900.00	.579	−137.4	4.349	93.5	.094	34.7	.535	−42.0
1000.00	.563	−145.9	4.007	88.5	.096	32.8	.510	−42.4
1100.00	.556	−153.1	3.677	84.4	.100	32.5	.488	−43.9
1200.00	.546	−158.5	3.364	80.6	.099	32.1	.475	−46.0
1300.00	.545	−165.0	3.157	76.9	.103	33.0	.452	−47.0
1400.00	.544	−169.5	2.960	73.6	.100	32.3	.449	−49.1
1500.00	.543	−176.2	2.775	69.9	.103	30.6	.427	−50.0
1600.00	.552	−179.9	2.605	66.8	.104	32.8	.424	−51.1
1700.00	.561	175.7	2.487	63.7	.105	32.6	.414	−52.3
1800.00	.561	171.1	2.349	60.9	.113	32.6	.411	−55.0
1900.00	.561	168.6	2.237	58.4	.111	32.9	.406	−57.3
2000.00	.580	164.0	2.138	55.0	.120	33.7	.397	−60.1
2100.00	.569	159.2	2.032	51.3	.114	33.3	.403	−62.3
2200.00	.572	156.0	1.936	48.1	.119	34.7	.395	−64.7
2300.00	.574	152.8	1.860	46.0	.121	34.6	.386	−66.2
2400.00	.580	150.6	1.797	43.5	.117	37.4	.382	−67.8
2500.00	.594	147.6	1.727	40.2	.126	35.5	.382	−71.4
2600.00	.596	144.7	1.668	38.4	.132	36.2	.371	−71.6
2700.00	.604	142.5	1.612	36.6	.129	38.1	.373	−76.4
2800.00	.584	140.3	1.567	33.1	.137	38.3	.378	−78.8
2900.00	.603	138.6	1.506	31.9	.135	36.4	.379	−79.6
3000.00	.594	135.0	1.432	28.6	.147	37.3	.380	−84.5

V_{CE} = 3 V, I_C = 1 mA

FREQUENCY	S11		S21		S12		S22	
f (MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.00	.968	−14.4	3.598	169.7	.025	77.5	.987	−4.9
200.00	.942	−29.1	3.497	159.2	.047	75.0	.971	−9.9
300.00	.918	−42.4	3.370	149.6	.072	65.0	.952	−14.3
400.00	.882	−55.8	3.169	140.6	.085	57.8	.918	−18.4
500.00	.838	−68.1	3.015	131.3	.101	51.5	.882	−22.2
600.00	.825	−79.9	2.850	124.0	.114	46.3	.848	−25.2
700.00	.789	−90.8	2.702	116.6	.122	41.6	.823	−28.0
800.00	.770	−100.8	2.505	109.4	.132	35.5	.788	−31.1
900.00	.740	−109.9	2.352	103.7	.138	31.4	.757	−32.8
1000.00	.722	−119.0	2.225	97.6	.138	26.9	.747	−34.8
1100.00	.703	−127.3	2.077	92.5	.139	25.8	.720	−37.2
1200.00	.692	−134.3	1.930	87.2	.144	23.0	.703	−39.2
1300.00	.678	−142.1	1.831	82.6	.146	18.7	.682	−40.6
1400.00	.674	−147.6	1.740	78.2	.141	17.1	.681	−43.0
1500.00	.662	−154.5	1.644	73.7	.137	15.1	.655	−45.1
1600.00	.665	−160.7	1.552	69.6	.136	13.0	.644	−46.6
1700.00	.673	−166.6	1.502	66.0	.137	12.0	.640	−48.4
1800.00	.666	−171.6	1.420	61.9	.136	10.0	.641	−51.1
1900.00	.667	−175.3	1.360	59.0	.128	10.0	.629	−53.3
2000.00	.677	179.3	1.301	55.1	.124	8.6	.626	−55.5
2100.00	.671	173.9	1.245	50.8	.122	9.4	.616	−58.8
2200.00	.673	169.5	1.182	46.7	.116	7.5	.618	−60.9
2300.00	.673	166.2	1.145	44.5	.118	11.5	.613	−63.4
2400.00	.669	162.5	1.098	42.0	.107	8.2	.607	−65.8
2500.00	.683	159.6	1.057	38.1	.106	13.2	.603	−69.0
2600.00	.689	155.6	1.030	35.7	.106	14.1	.596	−69.5
2700.00	.695	152.4	.986	33.7	.108	18.2	.599	−72.9
2800.00	.675	149.7	.965	29.9	.101	16.0	.613	−77.4
2900.00	.687	146.9	.929	28.8	.099	16.1	.600	−77.8
3000.00	.674	143.3	.884	24.9	.109	18.0	.600	−81.9