NEC

SILICON TRANSISTOR

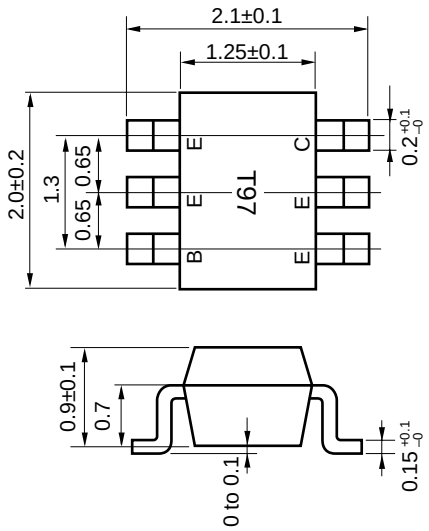
2SC5409

NPN EPITAXIAL SILICON TRANSISTOR FOR MICROWAVE HIGH-GAIN AMPLIFICATION

FEATURE

- High f_T
  16 GHz TYP.
- High gain
  $|S_{21e}|^2$ = 14 dB TYP.
  @f = 2 GHz, V_{CE} = 2 V, I_C = 20 mA
- NF = 1.1 dB, @f = 2 GHz V_{CE} = 2 V, I_C = 3 mA
- 6-pin Small Mini Mold Package

PACKAGE DIMENSIONS (in mm)



ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKING STYLE
2SC5409-T1	3 kpcs/reel	8-mm wide emboss taping, 6-pin (collector) feed hole direction

Remark To order evaluation samples, consult your NEC sales personnel (supported in 50-pcs units).

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
Collector to Base Voltage	V_{CBO}	5	V
Collector to Emitter Voltage	V_{CEO}	3	V
Emitter to Base Voltage	V_{EBO}	2	V
Collector Current	I_C	30	mA
Total Power Dissipation	P_T	90	mW
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	–65 to +150	°C

PIN CONNECTIONS

E: Emitter
C: Collector
B: Base

Because this product uses high-frequency process, avoid excessive input of static electricity, etc.

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ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 5 V, I_E = 0			0.1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 1 V, I_C = 0			0.1	μA
DC Current Gain	h_{FE}	V_{CE} = 2 V, I_C = 20 mA **Note 1**	70		140	
Gain Bandwidth Product	f_T	V_{CE} = 2 V, I_C = 20 mA, f = 2.0 GHz	13	16		GHz
Feed-back Capacitance	Cre	V_{CB} = 2 V, I_E = 0, f = 1 MHz **Note 2**		0.2	0.3	pF
Insertion Power Gain	$\|S_{21e}\|^2$	V_{CE} = 2 V, I_C = 20 mA, f = 2.0 GHz	12	14		dB
Noise Figure	NF	V_{CE} = 2 V, I_C = 3 mA, f = 2.0 GHz		1.1	1.8	dB

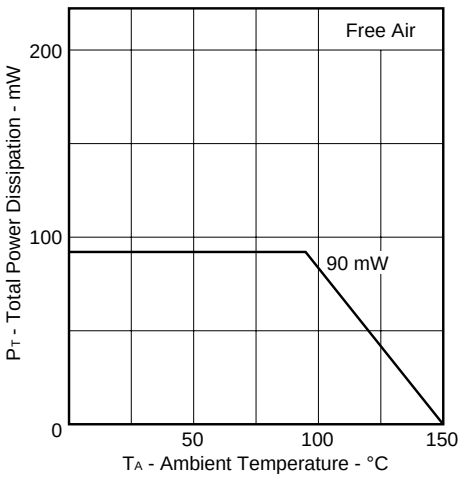
Rank	FB
Marking	T97
h_{FE}	70 to 140

Notes 1. Pulse measurement PW ≤ 350 μs, duty cycle ≤ 2 %, pulsed

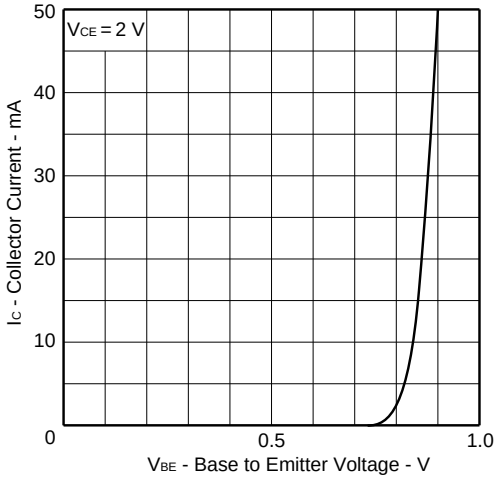
2. Measured with three-pin bridge, with emitter pin connected to the bridge guard.

TYPICAL CHARACTERISTICS (T_A = 25 °C)

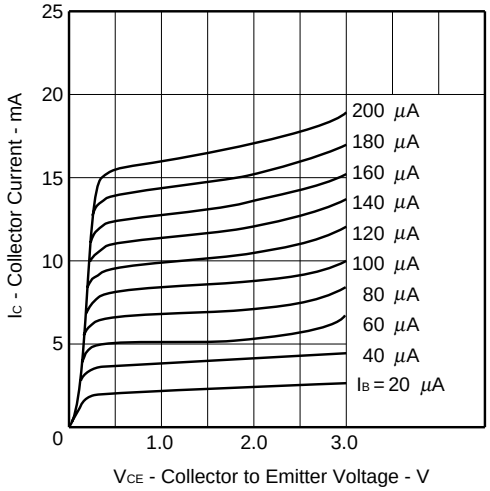
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



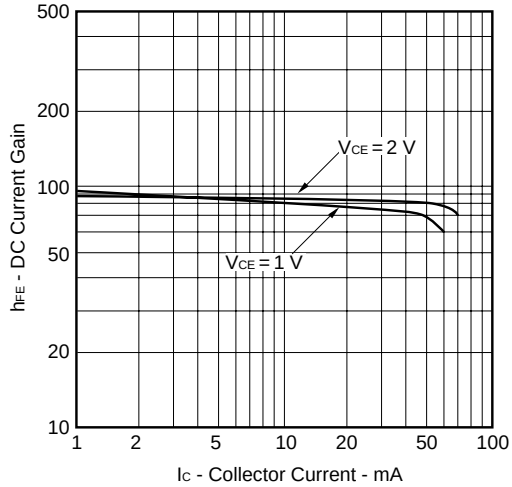
COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



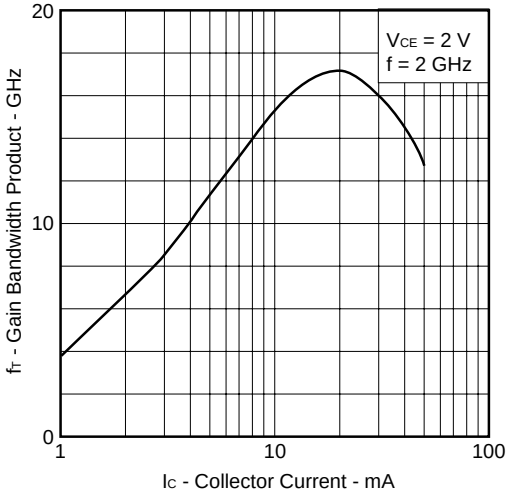
COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



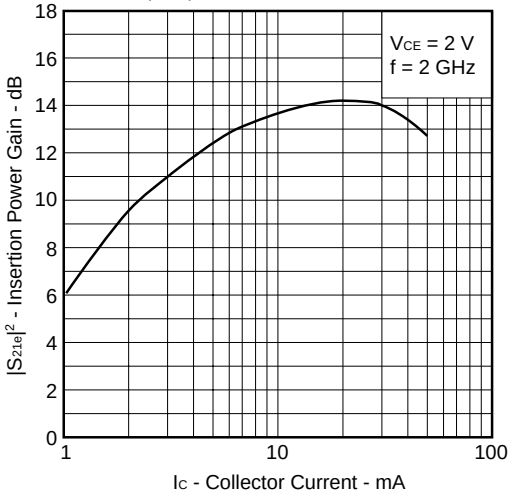
DC CURRENT GAIN vs. COLLECTOR CURRENT



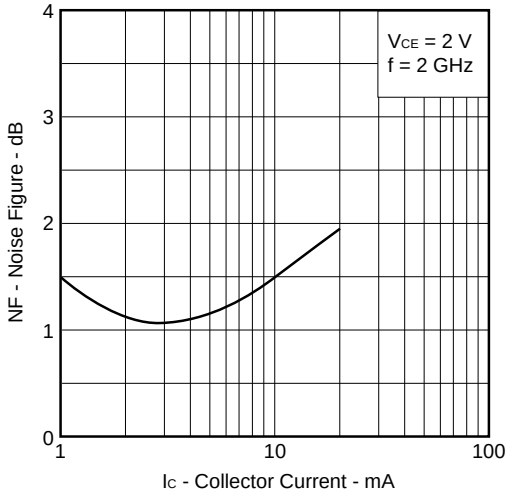
f_T vs. I_C characteristics



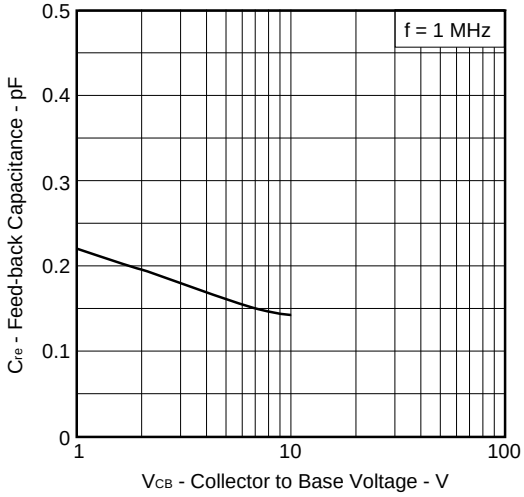
$|S_{21e}|^2$ vs. I_C characteristics



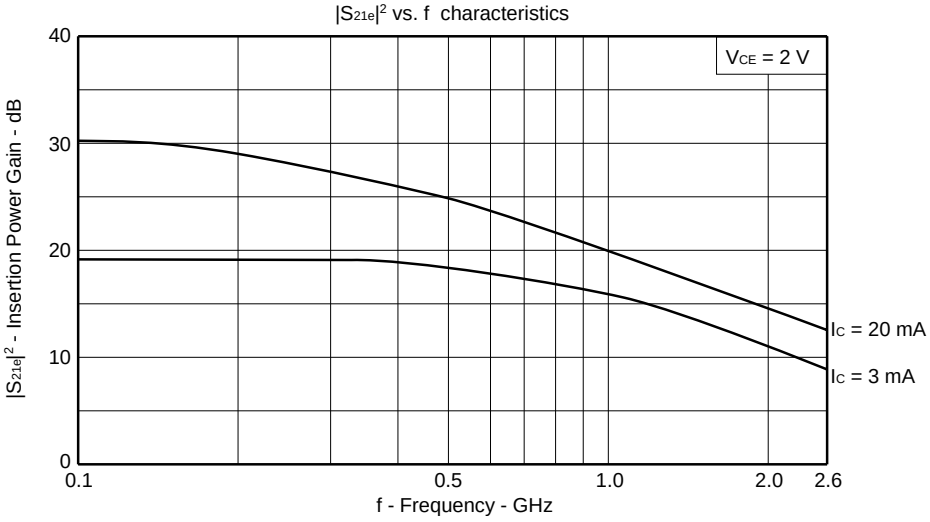
NF vs. I_C characteristics



C_{re} vs. V_{CB}



$|S_{21e}|^2$ vs. f characteristics



S PARAMETER

V_{CE} = 2 V I_C = 3 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.000	0.907	–11.3	7.343	170.3	0.013	81.4	0.977	–7.0
200.000	0.887	–22.7	7.221	161.1	0.026	73.9	0.960	–13.9
300.000	0.861	–33.6	6.963	152.8	0.034	66.4	0.929	–20.6
400.000	0.826	–45.1	6.563	143.9	0.045	62.4	0.894	–27.1
500.000	0.788	–54.5	6.506	134.8	0.053	55.1	0.860	–33.3
600.000	0.740	–65.4	6.264	128.6	0.062	50.1	0.815	–38.4
700.000	0.700	–75.2	5.775	120.4	0.067	44.8	0.772	–43.2
800.000	0.659	–84.6	5.644	113.8	0.073	41.1	0.734	–48.1
900.000	0.621	–94.5	5.314	108.4	0.076	35.9	0.691	–51.9
1 000.000	0.585	–103.3	4.924	101.7	0.078	33.6	0.658	–56.1
1 100.000	0.555	–112.1	4.705	95.6	0.080	29.9	0.621	–59.8
1 200.000	0.532	–121.0	4.442	90.9	0.083	27.3	0.592	–63.0
1 300.000	0.508	–129.0	4.230	85.7	0.083	24.7	0.565	–66.2
1 400.000	0.492	–137.3	3.978	81.1	0.083	23.6	0.545	–69.7
1 500.000	0.483	–145.3	3.795	76.4	0.083	21.8	0.522	–72.7
1 600.000	0.473	–153.1	3.615	72.9	0.083	19.9	0.504	–75.9
1 700.000	0.472	–160.0	3.372	69.1	0.083	19.7	0.490	–79.1
1 800.000	0.469	–167.1	3.237	63.7	0.084	17.4	0.476	–82.5
1 900.000	0.469	–173.9	3.106	60.8	0.082	16.3	0.461	–85.7
2 000.000	0.472	179.9	2.932	56.9	0.083	17.0	0.456	–89.2
2 100.000	0.479	173.9	2.825	52.9	0.084	16.1	0.446	–92.3
2 200.000	0.482	168.5	2.706	49.4	0.083	15.3	0.438	–96.1
2 300.000	0.495	163.1	2.607	46.0	0.082	14.5	0.435	–99.5
2 400.000	0.504	157.8	2.479	42.3	0.083	15.0	0.432	–103.7
2 500.000	0.512	153.7	2.403	37.4	0.080	14.7	0.429	–106.9
2 600.000	0.523	148.9	2.361	34.8	0.082	15.4	0.428	–110.8

V_{CE} = 2 V I_C = 20 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100.000	0.591	–30.8	33.233	157.5	0.010	76.4	0.877	–17.3
200.000	0.530	–58.2	28.692	139.8	0.018	65.2	0.773	–31.4
300.000	0.475	–80.8	24.362	126.3	0.024	59.7	0.666	–41.4
400.000	0.428	–100.1	20.644	115.9	0.028	54.2	0.573	–49.6
500.000	0.400	–115.3	17.561	107.9	0.032	51.9	0.504	–55.1
600.000	0.380	–128.9	15.258	101.2	0.035	51.0	0.446	–59.4
700.000	0.368	–140.5	13.430	95.6	0.038	50.1	0.403	–62.8
800.000	0.361	–150.7	11.977	90.7	0.040	49.1	0.369	–66.2
900.000	0.359	–159.9	10.742	86.1	0.043	49.4	0.339	–68.9
1 000.000	0.359	–167.9	9.780	82.1	0.046	49.5	0.319	–72.1
1 100.000	0.362	–174.9	8.924	78.4	0.049	48.7	0.297	–75.2
1 200.000	0.368	178.6	8.211	74.9	0.051	48.9	0.281	–77.9
1 300.000	0.373	172.9	7.608	71.4	0.054	48.8	0.268	–81.0
1 400.000	0.381	167.3	7.103	68.3	0.058	48.6	0.260	–84.7
1 500.000	0.392	162.4	6.621	65.1	0.060	48.1	0.248	–87.9
1 600.000	0.401	157.7	6.229	61.9	0.064	47.6	0.242	–91.9
1 700.000	0.410	153.9	5.884	59.2	0.067	47.2	0.239	–95.6
1 800.000	0.422	150.0	5.555	56.0	0.070	46.4	0.234	–99.9
1 900.000	0.431	146.1	5.256	53.0	0.073	45.9	0.230	–104.0
2 000.000	0.442	142.8	4.992	50.1	0.075	45.0	0.234	–108.7
2 100.000	0.455	139.7	4.755	47.3	0.078	44.3	0.232	–112.7
2 200.000	0.466	136.5	4.540	44.6	0.082	43.6	0.233	–118.4
2 300.000	0.480	134.0	4.335	41.7	0.084	42.8	0.238	–122.5
2 400.000	0.492	131.1	4.139	38.9	0.087	41.7	0.243	–128.0
2 500.000	0.502	128.6	3.972	36.1	0.090	40.6	0.244	–132.0
2 600.000	0.516	126.0	3.796	33.2	0.093	39.7	0.252	–136.4

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