NEC

SILICON TRANSISTOR
2SC5181

NPN EPITAXIAL SILICON TRANSISTOR IN ULTRA SUPER MINI-MOLD PACKAGE FOR LOW-NOISE MICROWAVE AMPLIFICATION

FEATURES

- Low current consumption and high gain
  $|S_{21e}|^2$ = 10.5 dB TYP. @ V_{CE} = 2 V, I_C = 7 mA, f = 2 GHz
  $|S_{21e}|^2$ = 9.0 dB TYP. @ V_{CE} = 1 V, I_C = 5 mA, f = 2 GHz
- Ultra Super Mini-Mold package

ORDERING INFORMATION

PART NUMBER	QUANTITY	ARRANGEMENT
2SC5181	50 units/box	Embossed tape, 8 mm wide, pin No. 3 (collector) facing the perforation
2SC5181-T1	3 000 units/reel	

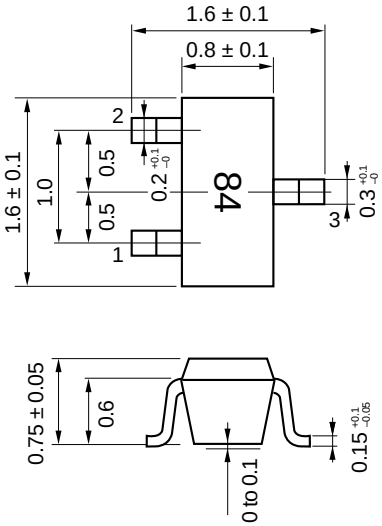
* Contact your NEC sales representatives to order samples for evaluation (available in batches of 50).

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C)

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	10	mA
Total Power Dissipation	P_T	30	mW
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	–65 to +150	°C

PACKAGE DIMENSIONS

(Units: mm)



PIN CONNECTIONS

1. Emitter
2. Base
3. Collector

Caution; This transistor uses high-frequency technology. Be careful not to allow excessive current to flow through the transistor, including static electricity.

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ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Collector Cutoff Current	I_{CBO}			100	nA	V_{CB} = 5 V, I_E = 0
Emitter Cutoff Current	I_{EBO}			100	nA	V_{EB} = 1 V, I_C = 0
DC Current Gain	h_{FE}	70		140		V_{CE} = 2 V, I_C = 7 mA***1**
Insertion Power Gain (1)	$\|S_{21e}\|^2$	8.0	10.5		dB	V_{CE} = 2 V, I_C = 7 mA, f = 2 GHz
Insertion Power Gain (2)	$\|S_{21e}\|^2$	7.0	9.0		dB	V_{CE} = 1 V, I_C = 5 mA, f = 2 GHz
Noise Figure (1)	NF		1.5	2.0	dB	V_{CE} = 2 V, I_C = 3 mA, f = 2 GHz
Noise Figure (2)	NF		1.5	2.0	dB	V_{CE} = 1 V, I_C = 3 mA, f = 2 GHz
Gain Bandwidth Product (1)	f_T	10	13		GHz	V_{CE} = 2 V, I_C = 7 mA, f = 2 GHz
Gain Bandwidth Product (2)	f_T	8.5	12		GHz	V_{CE} = 1 V, I_C = 5 mA, f = 2 GHz
Feedback Capacitance	C_{re}		0.4	0.6	pF	V_{CB} = 2 V, I_E = 0 mA, f = 1 MHz***2**

***1.** Measured with pulses: Pulse width ≤ 350 μs, duty cycle ≤ 2 %, pulsed

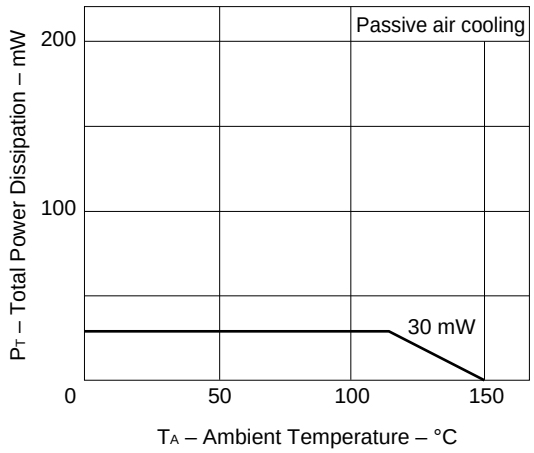
***2.** Measured with a three-terminal bridge. The emitter and case terminal are connected to the guard terminal of the bridge.

h_{FE} Class

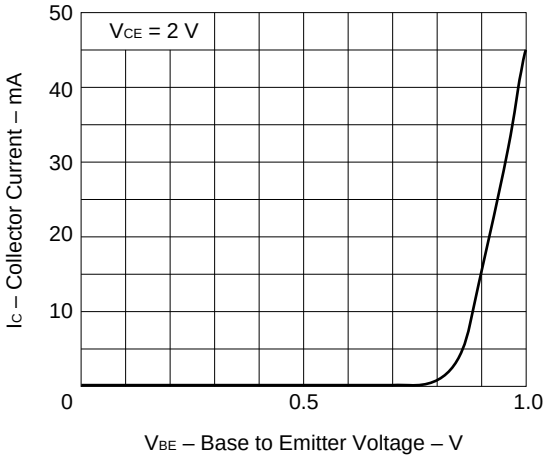
Class	FB
Marking	84
h_{FE}	70 to 140

CHARACTERISTICS CURVES (T_A = 25 °C)

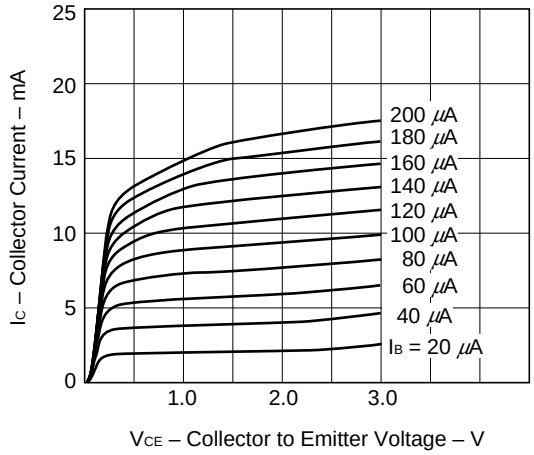
TOTAL POWER DISSIPATION vs.
AMBIENT TEMPERATURE



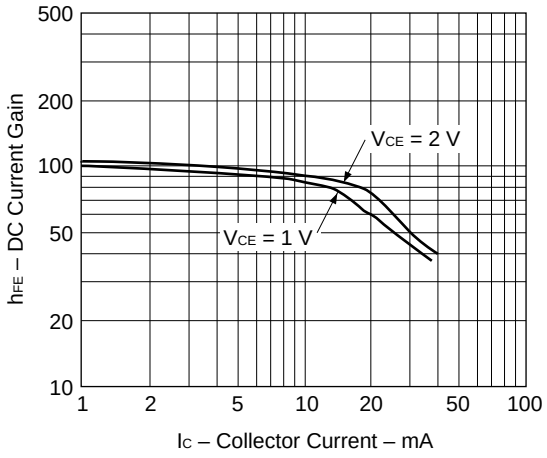
COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE



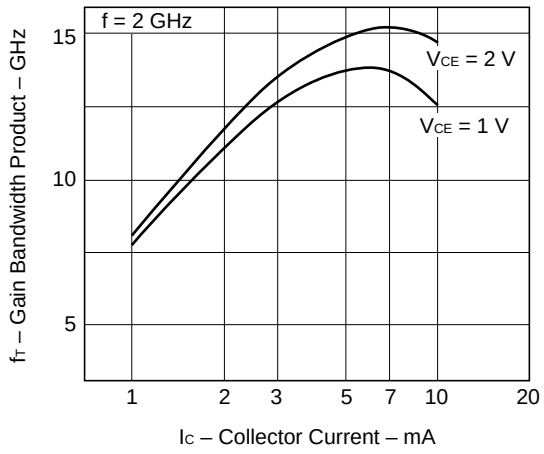
COLLECTOR CURRENT vs.
COLLECTOR TO EMITTER



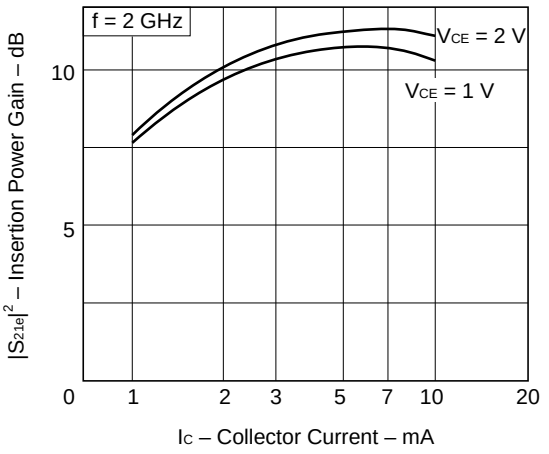
DC CURRENT GAIN vs.
COLLECTOR CURRENT



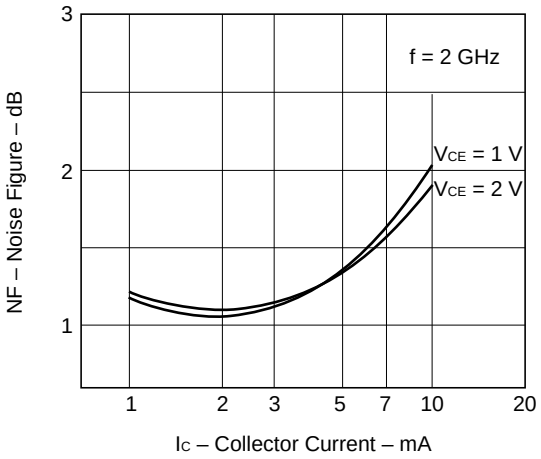
GAIN BANDWIDTH PRODUCT vs.
COLLECTOR CURRENT



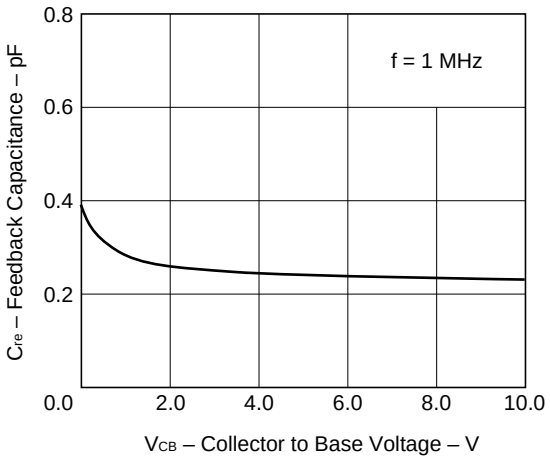
INSERTION POWER GAIN vs.
COLLECTOR CURRENT



NOISE FIGURE vs.
COLLECTOR CURRENT



FEED-BACK CAPACITANCE vs.
COLLECTOR TO BASE VOLTAGE



S-PARAMETERS

V_{CE} = 1 V, I_C = 1 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.892	–31.5	3.159	142.3	0.113	64.7	0.934	–25.9
800.00	0.795	–40.9	2.964	130.8	0.152	58.9	0.847	–32.1
1000.00	0.704	–50.9	2.762	119.7	0.180	53.0	0.759	–39.9
1200.00	0.653	–60.1	2.674	110.1	0.204	49.8	0.726	–47.4
1400.00	0.598	–66.6	2.590	103.0	0.228	45.9	0.688	–53.1
1600.00	0.524	–73.7	2.409	94.9	0.253	42.5	0.636	–58.2
1800.00	0.464	–80.6	2.285	87.2	0.265	41.3	0.575	–64.2
2000.00	0.415	–88.8	2.182	81.7	0.270	39.6	0.530	–68.9
2200.00	0.355	–97.7	2.032	74.6	0.278	35.7	0.495	–74.6

V_{CE} = 1 V, I_C = 3 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.653	–48.4	6.121	124.0	0.095	59.6	0.754	–37.3
800.00	0.517	–59.5	5.199	111.4	0.123	55.7	0.629	–43.1
1000.00	0.422	–68.5	4.502	100.6	0.143	53.0	0.533	–49.5
1200.00	0.362	–76.1	4.084	92.8	0.165	53.5	0.493	–54.2
1400.00	0.301	–81.4	3.661	86.8	0.183	51.6	0.448	–57.6
1600.00	0.245	–88.0	3.279	79.5	0.204	50.1	0.411	–61.1
1800.00	0.209	–92.7	3.024	74.1	0.220	49.7	0.369	–66.7
2000.00	0.175	–105.8	2.796	70.4	0.230	50.0	0.334	–69.5
2200.00	0.132	–121.6	2.535	64.5	0.244	46.8	0.311	–75.0

V_{CE} = 1 V, I_C = 3 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.514	–56.3	7.156	115.3	0.082	57.8	0.648	–40.3
800.00	0.389	–66.9	5.830	103.5	0.109	57.0	0.530	–44.6
1000.00	0.307	–73.5	4.939	93.6	0.131	56.4	0.446	–48.9
1200.00	0.253	–79.7	4.391	86.9	0.151	56.4	0.414	–52.5
1400.00	0.202	–85.5	3.865	81.4	0.175	55.2	0.379	–55.2
1600.00	0.157	–91.8	3.440	74.7	0.196	53.8	0.347	–58.4
1800.00	0.130	–96.2	3.155	70.1	0.213	53.5	0.313	–63.6
2000.00	0.108	–116.1	2.900	67.0	0.227	53.3	0.283	–65.6
2200.00	0.077	–142.5	2.614	61.5	0.241	50.7	0.268	–71.7

V_{CE} = 1 V, I_C = 7 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.405	–61.9	7.590	109.4	0.077	59.1	0.570	–40.5
800.00	0.305	–72.5	6.043	98.4	0.101	59.0	0.469	–43.6
1000.00	0.229	–78.2	5.059	89.2	0.124	57.9	0.399	–46.6
1200.00	0.184	–84.9	4.454	83.2	0.145	59.2	0.374	–49.4
1400.00	0.141	–91.4	3.886	78.0	0.169	57.6	0.347	–51.8
1600.00	0.106	–98.8	3.455	71.6	0.191	56.2	0.322	–54.5
1800.00	0.086	–104.3	3.162	67.6	0.210	55.3	0.290	–59.5
2000.00	0.071	–136.6	2.898	64.6	0.224	55.9	0.264	–61.4
2200.00	0.060	–174.6	2.606	59.4	0.237	52.7	0.249	–67.2

V_{CE} = 1 V, I_C = 10 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.324	–71.3	7.550	104.5	0.069	62.8	0.526	–39.4
800.00	0.232	–82.5	5.924	94.2	0.096	61.0	0.434	–40.5
1000.00	0.167	–89.5	4.927	85.5	0.119	59.7	0.375	–42.1
1200.00	0.128	–98.6	4.307	80.0	0.141	61.4	0.355	–44.8
1400.00	0.094	–110.3	3.740	74.9	0.165	60.6	0.335	–47.0
1600.00	0.067	–127.3	3.326	68.7	0.187	58.2	0.314	–49.2
1800.00	0.055	–140.2	3.041	64.9	0.207	57.6	0.283	–54.0
2000.00	0.068	–176.6	2.781	62.2	0.219	57.4	0.262	–56.1
2200.00	0.083	153.2	2.498	56.9	0.235	54.8	0.247	–62.0

V_{CE} = 2 V, I_C = 1 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.901	–29.6	3.172	143.7	0.106	66.0	0.940	–24.4
800.00	0.811	–38.5	2.995	132.6	0.143	59.6	0.861	–30.3
1000.00	0.719	–47.8	2.797	121.7	0.172	55.0	0.778	–37.6
1200.00	0.671	–56.7	2.715	112.2	0.196	51.4	0.745	–45.0
1400.00	0.621	–62.9	2.646	105.3	0.220	47.9	0.712	–50.5
1600.00	0.549	–69.2	2.467	97.5	0.240	44.4	0.659	–55.0
1800.00	0.488	–75.6	2.343	89.8	0.255	43.6	0.601	–60.8
2000.00	0.438	–83.6	2.243	84.3	0.261	41.6	0.556	–65.6
2200.00	0.380	–91.1	2.095	77.3	0.268	37.8	0.522	–70.9

V_{CE} = 2 V, I_C = 3 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.678	–44.9	6.256	125.7	0.088	60.5	0.778	–34.8
800.00	0.543	–55.3	5.350	113.4	0.114	56.1	0.656	–40.4
1000.00	0.447	–63.1	4.650	102.7	0.137	54.8	0.563	–46.1
1200.00	0.388	–69.9	4.225	94.8	0.157	54.2	0.519	–50.7
1400.00	0.325	–74.0	3.809	88.9	0.176	53.1	0.481	–54.5
1600.00	0.270	–78.9	3.408	81.8	0.195	51.3	0.441	–57.3
1800.00	0.231	–82.5	3.144	76.3	0.214	51.5	0.397	–62.3
2000.00	0.193	–93.2	2.918	72.7	0.223	51.1	0.363	–65.0
2200.00	0.148	–103.1	2.647	66.8	0.236	48.8	0.343	–70.0

V_{CE} = 2 V, I_C = 5 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.539	–51.7	7.390	117.1	0.080	61.7	0.676	–37.8
800.00	0.415	–61.1	6.057	105.3	0.103	58.5	0.560	–41.6
1000.00	0.332	–66.2	5.136	95.5	0.125	57.5	0.478	–45.6
1200.00	0.280	–71.9	4.579	88.7	0.146	58.5	0.445	–49.2
1400.00	0.228	–74.8	4.043	83.3	0.168	57.3	0.413	–51.6
1600.00	0.183	–78.2	3.597	76.8	0.187	55.4	0.383	–54.0
1800.00	0.157	–80.9	3.298	72.2	0.207	55.4	0.345	–58.9
2000.00	0.123	–95.6	3.042	69.1	0.218	55.5	0.317	–61.2
2200.00	0.084	–108.3	2.746	63.7	0.232	52.6	0.301	–66.0

V_{CE} = 2 V, I_C = 7 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.442	–56.3	7.920	111.3	0.070	63.0	0.610	–38.1
800.00	0.331	–65.1	6.345	100.3	0.097	59.0	0.507	–40.7
1000.00	0.257	–67.8	5.311	91.1	0.118	57.7	0.434	–43.4
1200.00	0.213	–73.1	4.689	85.1	0.141	60.4	0.407	–45.9
1400.00	0.168	–74.5	4.103	80.1	0.162	59.5	0.386	–48.0
1600.00	0.132	–77.3	3.643	73.8	0.184	58.3	0.359	–50.5
1800.00	0.110	–79.7	3.335	69.8	0.204	57.4	0.323	–54.8
2000.00	0.081	–99.2	3.065	66.9	0.214	57.5	0.301	–56.9
2200.00	0.048	–123.7	2.760	61.7	0.231	54.8	0.286	–62.3

V_{CE} = 2 V, I_C = 10 mA, Z_O = 50 Ω

FREQUENCY	S11		S21		S12		S22	
MHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
600.00	0.358	–60.7	8.135	106.8	0.068	61.8	0.565	–36.5
800.00	0.264	–68.8	6.411	96.5	0.090	62.0	0.475	–38.3
1000.00	0.199	–70.8	5.335	87.8	0.113	61.6	0.414	–40.1
1200.00	0.158	–75.7	4.674	82.4	0.139	62.5	0.392	–42.2
1400.00	0.121	–77.9	4.068	77.5	0.157	61.1	0.377	–44.8
1600.00	0.089	–80.4	3.610	71.4	0.180	59.7	0.352	–46.6
1800.00	0.073	–82.4	3.301	67.8	0.198	59.3	0.321	–50.6
2000.00	0.052	–114.2	3.027	65.1	0.211	58.9	0.298	–52.5
2200.00	0.030	–166.0	2.724	59.9	0.228	56.0	0.286	–58.0

M4 96.5