Ordering number:ENN5910

NPN Epitaxial Planar Silicon Transistor

2SC5414

High-Frequency Low-Noise Amplifier Applications

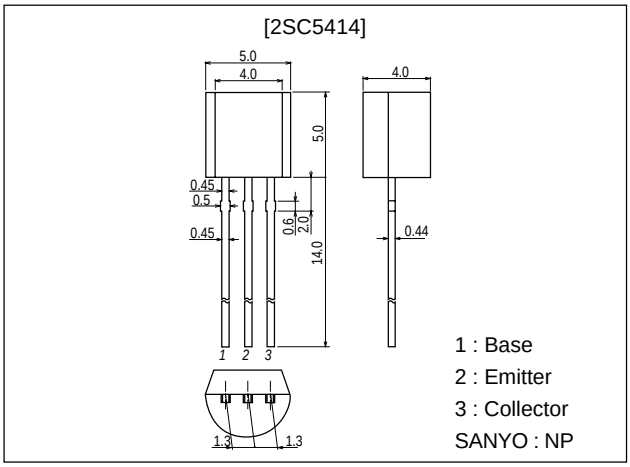
Features

- High gain : $|S21e|^2$=9.5dB typ (f=1GHz).
- High cutoff frequency : f_T=6.7GHz typ.

Package Dimensions

unit:mm

2004B



Specifications

Absolute Maximum Ratings at Ta = 25˚C

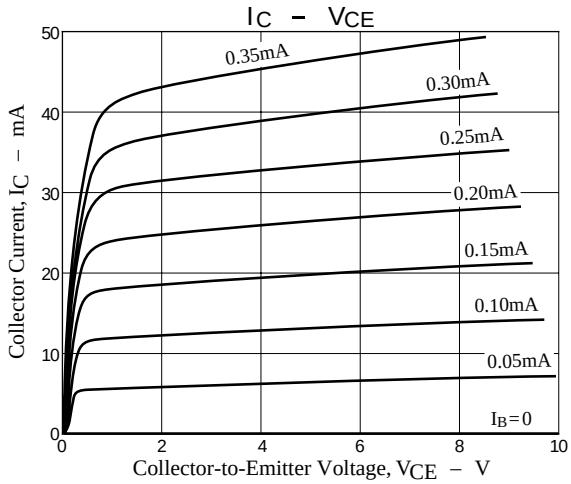
Parameter	Symbol	Conditions	Ratings	Unit
Collector-to-Base Voltage	V_{CBO}		20	V
Collector-to-Emitter Voltage	V_{CEO}		12	V
Emitter-to-Base Voltage	V_{EBO}		2	V
Collector Current	I_C		100	mA
Collector Dissipation	P_C		400	mW
Junction Temperature	Tj		150	˚C
Storage Temperature	Tstg		–55 to +150	˚C

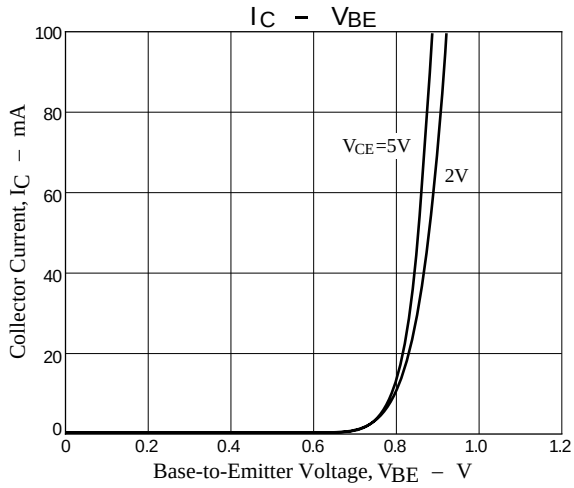
Electrical Characteristics at Ta = 25˚C

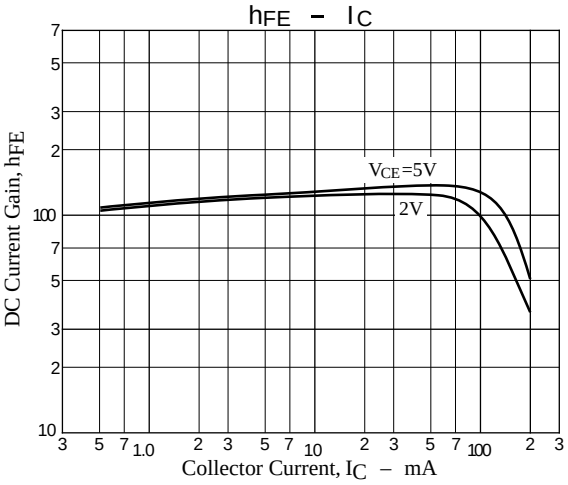
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Collector Cutoff Current	I_{CBO}	V_{CB}=10V, I_E=0			1.0	μA
Emitter Cutoff Current	I_{EBO}	V_{EB}=1V, I_C=0			10	μA
DC Current Gain	$h_{FE}1$	V_{CE}=5V, I_C=30mA	90*		270*	
	$h_{FE}2$	V_{CE}=5V, I_C=70mA	70			
Gain-Bandwidth Product	f_T	V_{CE}=5V, I_C=30mA	5	6.7		GHz
Output Capacitance	Cob	V_{CB}=5V, f=1MHz		1.0	1.5	pF
Reverse Transfer Capacitance	Cre	V_{CB}=5V, f=1MHz		0.6		pF
Forward Transfer Gain	$\|S21e\|^2$	V_{CE}=5V, I_C=30mA, f=1GHz	8	9.5		dB
Noise Figure	NF	V_{CE}=5V, I_C=7mA, f=1GHz		1.1	2.0	dB

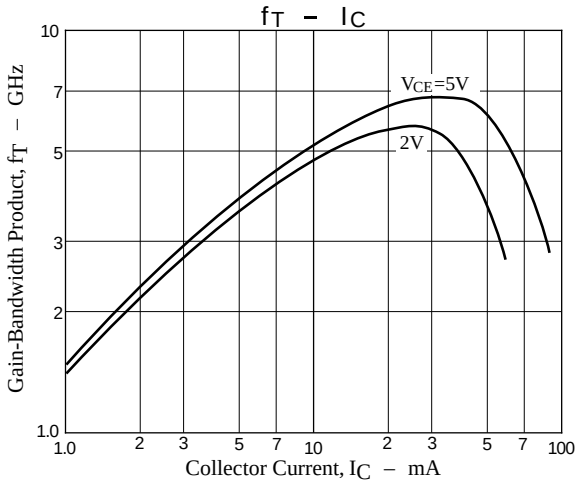
* The 2SC5414 is classified by 30mA h_{FE} as follows :

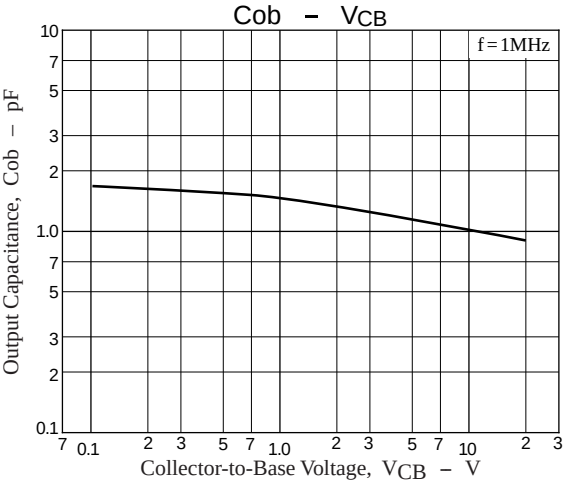
90	E	180	135	F	270

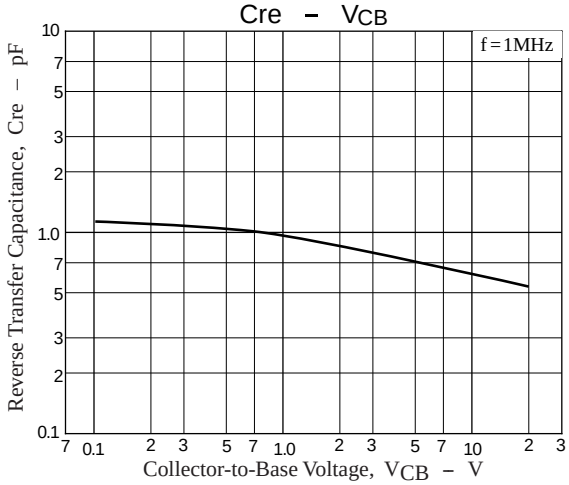

IC – VCE
Collector Current, IC – mA
Collector-to-Emitter Voltage, VCE – V
0.35mA
0.30mA
0.25mA
0.20mA
0.15mA
0.10mA
0.05mA
IB=0

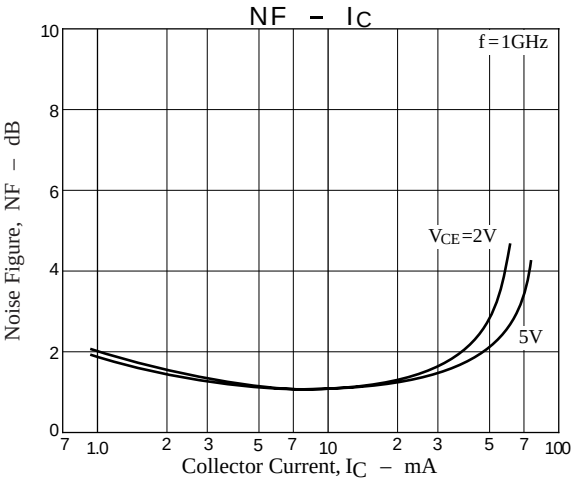

IC – VBE
Collector Current, IC – mA
Base-to-Emitter Voltage, VBE – V
VCE=5V
2V

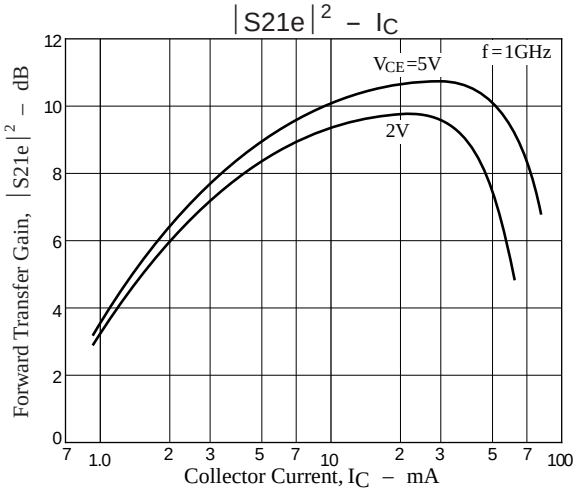

hFE – IC
DC Current Gain, hFE
Collector Current, IC – mA
VCE=5V
2V

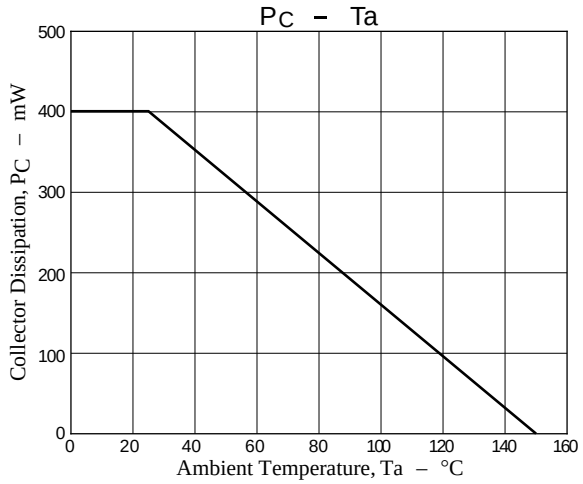

fT – IC
Gain-Bandwidth Product, fT – GHz
Collector Current, IC – mA
VCE=5V
2V


Cob – VCB
Output Capacitance, Cob – pF
Collector-to-Base Voltage, VCB – V
f=1MHz


Cre – VCB
Reverse Transfer Capacitance, Cre – pF
Collector-to-Base Voltage, VCB – V
f=1MHz


NF – IC
Noise Figure, NF – dB
Collector Current, IC – mA
f=1GHz
VCE=2V
5V


|S21e|2 – IC
Forward Transfer Gain, |S21e|2 – dB
Collector Current, IC – mA
f=1GHz
VCE=5V
2V



S Parameters (Common emitter)

V_{CE}=2V, I_C=5mA, Z_O=50Ω

Freq (MHz)	$\lvert S_{11} \rvert$	$\angle S_{11}$	$\lvert S_{21} \rvert$	$\angle S_{21}$	$\lvert S_{12} \rvert$	$\angle S_{12}$	$\lvert S_{22} \rvert$	$\angle S_{22}$
100	0.789	–46.1	12.790	142.7	0.041	66.1	0.870	–25.4
200	0.604	–80.1	9.631	117.8	0.063	53.1	0.691	–39.5
400	0.404	–123.7	5.802	90.2	0.090	44.6	0.510	–51.7
600	0.331	–153.8	4.101	72.4	0.112	42.2	0.444	–58.8
800	0.297	–177.9	3.180	58.0	0.137	39.3	0.419	–66.4
1000	0.281	160.9	2.642	45.5	0.163	35.7	0.413	–74.1
1200	0.275	140.4	2.254	32.7	0.190	31.0	0.410	–82.5
1400	0.277	122.6	1.983	21.5	0.218	26.0	0.405	–90.9
1600	0.281	103.9	1.787	10.3	0.247	20.5	0.395	–99.8
1800	0.295	89.0	1.626	–0.1	0.278	14.4	0.390	–108.3
2000	0.314	73.5	1.511	–10.3	0.311	7.7	0.380	–117.5

V_{CE}=2V, I_C=10mA, Z_O=50Ω

Freq (MHz)	$\lvert S_{11} \rvert$	$\angle S_{11}$	$\lvert S_{21} \rvert$	$\angle S_{21}$	$\lvert S_{12} \rvert$	$\angle S_{12}$	$\lvert S_{22} \rvert$	$\angle S_{22}$
100	0.638	–60.1	18.641	131.8	0.036	63.1	0.754	–33.9
200	0.438	–95.8	12.165	107.7	0.054	55.5	0.549	–45.7
400	0.289	–138.8	6.728	84.2	0.083	53.2	0.392	–53.9
600	0.245	–168.0	4.654	69.1	0.113	50.5	0.348	–59.7
800	0.227	170.3	3.575	56.2	0.146	45.7	0.336	–67.3
1000	0.221	150.3	2.950	44.5	0.177	40.1	0.335	–75.3
1200	0.215	130.3	2.520	32.5	0.221	30.9	0.332	–86.7
1400	0.218	113.3	2.203	21.6	0.240	27.0	0.331	–92.3
1600	0.231	96.2	1.978	11.2	0.272	20.1	0.320	–101.1
1800	0.243	80.8	1.805	1.2	0.304	13.0	0.314	–109.7
2000	0.267	66.9	1.668	–8.9	0.336	5.5	0.306	–118.6

V_{CE}=2V, I_C=20mA, Z_O=50Ω

Freq (MHz)	$\|S_{11}\|$	$\angle S_{11}$	$\|S_{21}\|$	$\angle S_{21}$	$\|S_{12}\|$	$\angle S_{12}$	$\|S_{22}\|$	$\angle S_{22}$
100	0.476	–75.8	22.939	121.7	0.031	62.9	0.633	–40.4
200	0.317	–113.1	13.544	100.3	0.047	61.2	0.427	–48.3
400	0.227	–155.0	7.193	80.3	0.081	59.5	0.319	–53.3
600	0.206	178.6	4.913	66.5	0.116	55.1	0.293	–59.0
800	0.195	158.2	3.764	54.3	0.151	49.1	0.289	–67.1
1000	0.194	139.7	3.091	43.4	0.186	42.4	0.291	–75.4
1200	0.198	121.4	2.632	32.0	0.220	34.9	0.294	–84.4
1400	0.204	105.8	2.305	21.3	0.253	27.5	0.290	–93.3
1600	0.213	89.2	2.066	11.2	0.285	20.1	0.281	–102.3
1800	0.230	75.2	1.881	1.5	0.318	12.5	0.275	–111.0
2000	0.252	62.9	1.742	–8.4	0.350	4.6	0.264	–120.0

V_{CE}=2V, I_C=30mA, Z_O=50Ω

Freq (MHz)	$\|S_{11}\|$	$\angle S_{11}$	$\|S_{21}\|$	$\angle S_{21}$	$\|S_{12}\|$	$\angle S_{12}$	$\|S_{22}\|$	$\angle S_{22}$
100	0.403	–88.7	23.847	116.6	0.028	63.5	0.561	–42.5
200	0.284	–126.8	13.541	96.9	0.045	63.7	0.380	–47.5
400	0.228	–167.6	7.074	78.2	0.081	61.5	0.295	–51.3
600	0.217	169.3	4.827	65.0	0.116	56.8	0.275	–57.2
800	0.213	151.0	3.687	52.8	0.153	50.3	0.276	–66.0
1000	0.211	134.3	3.034	42.2	0.188	43.2	0.281	–74.9
1200	0.216	117.8	2.579	30.8	0.223	35.5	0.283	–84.2
1400	0.222	103.1	2.262	20.4	0.256	27.9	0.280	–93.2
1600	0.238	87.6	2.029	10.3	0.289	20.3	0.271	–102.4
1800	0.248	74.2	1.840	0.3	0.321	12.6	0.265	–111.2
2000	0.271	61.6	1.706	–9.7	0.354	4.5	0.254	–120.5

V_{CE}=5V, I_C=5mA, Z_O=50Ω

Freq (MHz)	$\|S_{11}\|$	$\angle S_{11}$	$\|S_{21}\|$	$\angle S_{21}$	$\|S_{12}\|$	$\angle S_{12}$	$\|S_{22}\|$	$\angle S_{22}$
100	0.807	–41.4	12.983	145.1	0.032	68.1	0.899	–20.6
200	0.627	–72.5	10.034	120.7	0.052	55.7	0.748	–32.3
400	0.399	–114.4	6.208	92.5	0.074	47.6	0.590	–42.7
600	0.314	–144.0	4.422	74.9	0.093	54.2	0.532	–49.4
800	0.266	–169.8	3.425	60.3	0.115	42.9	0.514	–56.8
1000	0.242	168.7	2.831	47.9	0.137	39.8	0.512	–64.6
1200	0.230	146.1	2.422	35.3	0.161	35.8	0.510	–72.6
1400	0.227	125.8	2.121	24.0	0.186	31.3	0.508	–80.8
1600	0.237	105.7	1.902	13.1	0.212	26.4	0.504	–89.1
1800	0.249	88.5	1.725	3.1	0.240	21.0	0.501	–97.2
2000	0.273	72.7	1.595	–7.2	0.271	14.8	0.497	–106.0

V_{CE}=5V, I_C=10mA, Z_O=50Ω

Freq (MHz)	$\|S_{11}\|$	$\angle S_{11}$	$\|S_{21}\|$	$\angle S_{21}$	$\|S_{12}\|$	$\angle S_{12}$	$\|S_{22}\|$	$\angle S_{22}$
100	0.664	–52.5	19.156	134.9	0.029	65.7	0.807	–26.7
200	0.450	–85.2	13.004	110.4	0.044	58.6	0.621	–36.3
400	0.264	–124.5	7.320	86.3	0.069	55.5	0.490	–42.7
600	0.206	–153.2	5.075	70.9	0.095	53.3	0.450	–48.6
800	0.175	–178.9	3.884	58.1	0.122	48.7	0.444	–56.0
1000	0.163	159.7	3.190	46.8	0.150	43.8	0.446	–64.0
1200	0.156	135.8	2.715	35.0	0.178	37.8	0.446	–72.4
1400	0.158	115.9	2.376	24.3	0.204	31.8	0.448	–80.6
1600	0.174	95.5	2.127	14.0	0.233	25.5	0.439	–88.9
1800	0.188	77.7	1.938	4.1	0.262	19.0	0.434	–96.9
2000	0.212	62.7	1.788	–5.6	0.292	12.0	0.431	–105.3

V_{CE}=5V, I_C=30mA, Z_O=50Ω

Freq (MHz)	$\|S_{11}\|$	$\angle S_{11}$	$\|S_{21}\|$	$\angle S_{21}$	$\|S_{12}\|$	$\angle S_{12}$	$\|S_{22}\|$	$\angle S_{22}$
100	0.423	–71.0	26.259	120.2	0.024	66.3	0.647	–32.7
200	0.258	–103.4	15.300	99.6	0.038	65.6	0.482	–36.2
400	0.155	–145.0	8.070	80.5	0.068	63.8	0.405	–39.6
600	0.129	173.2	5.493	67.5	0.098	59.1	0.388	–45.9
800	0.119	161.6	4.203	55.9	0.129	53.1	0.390	–54.2
1000	0.116	140.1	3.436	45.4	0.160	46.5	0.396	–62.7
1200	0.119	117.4	2.914	34.2	0.190	39.4	0.401	–71.8
1400	0.129	98.0	2.545	24.3	0.219	32.5	0.398	–80.2
1600	0.146	79.7	2.284	14.2	0.249	25.3	0.393	–88.6
1800	0.160	65.1	2.064	4.9	0.278	18.2	0.389	–96.9
2000	0.187	54.4	1.913	–4.9	0.308	10.7	0.386	–105.3

V_{CE}=5V, I_C=50mA, Z_O=50Ω

Freq (MHz)	$\|S_{11}\|$	$\angle S_{11}$	$\|S_{21}\|$	$\angle S_{21}$	$\|S_{12}\|$	$\angle S_{12}$	$\|S_{22}\|$	$\angle S_{22}$
100	0.381	–82.7	25.958	114.6	0.023	65.6	0.611	–32.2
200	0.251	–120.2	14.443	95.9	0.037	65.8	0.465	–34.5
400	0.185	–164.6	7.561	78.0	0.067	64.0	0.405	–38.7
600	0.174	170.5	5.153	64.8	0.096	59.6	0.396	–46.0
800	0.163	149.4	3.904	52.8	0.127	53.5	0.401	–54.9
1000	0.167	130.7	3.194	41.9	0.157	47.1	0.406	–63.5
1200	0.176	112.8	2.696	31.0	0.187	39.8	0.410	–72.9
1400	0.184	96.6	2.358	20.5	0.216	32.9	0.409	–81.5
1600	0.197	80.7	2.115	10.1	0.246	25.9	0.404	–90.3
1800	0.214	68.1	1.908	0.1	0.275	18.8	0.400	–98.2
2000	0.243	55.0	1.766	–9.6	0.305	11.1	0.392	–106.2