Ordering number:ENN5911

NPN Epitaxial Planar Silicon Transistor

2SC5415

High-Frequency Low-Noise Amplifier Applications

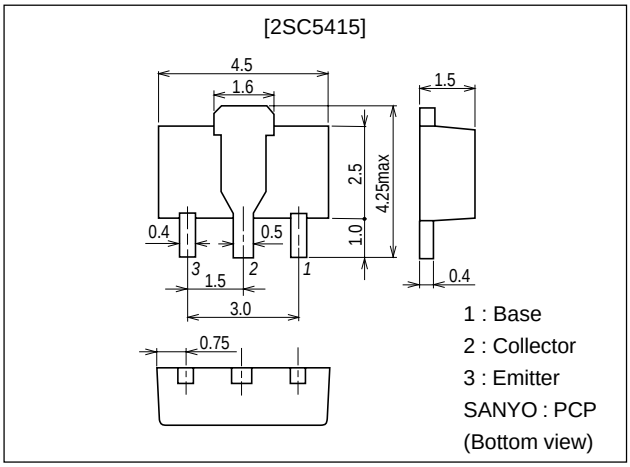
Features

- High gain : $|S21e|^2$=9dB typ (f=1GHz).
- High cutoff frequency : f_T=6.7GHz typ.

Package Dimensions

unit:mm

2038A



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	Mounted on a ceramic board (250mm²×0.8mm)	800	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		1.2	1.8	pF
Reverse Transfer Capacitance	Cre	V_{CB}=5V, f=1MHz		0.65		pF
Forward Transfer Gain	$\|S21e\|^2$	V_{CE}=5V, I_C=30mA, f=1GHz	7.5	9		dB
Noise Figure	NF	V_{CE}=5V, I_C=7mA, f=1GHz		1.1	2.0	dB

* The 2SC5415 is classified by 30mA h_{FE} as follows :

90	E	180	135	F	270

Marking : EA

h_{FE} rank : E, F

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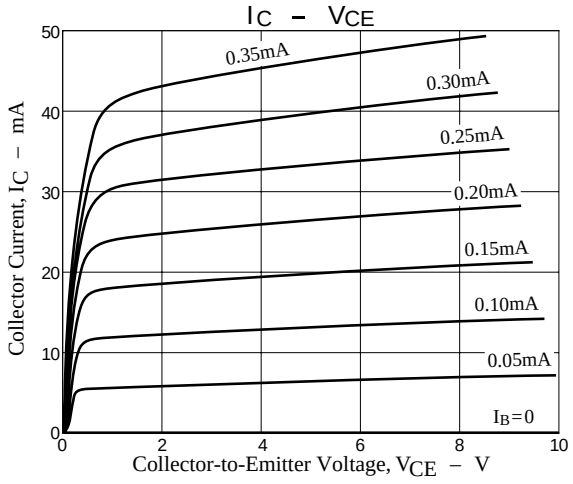
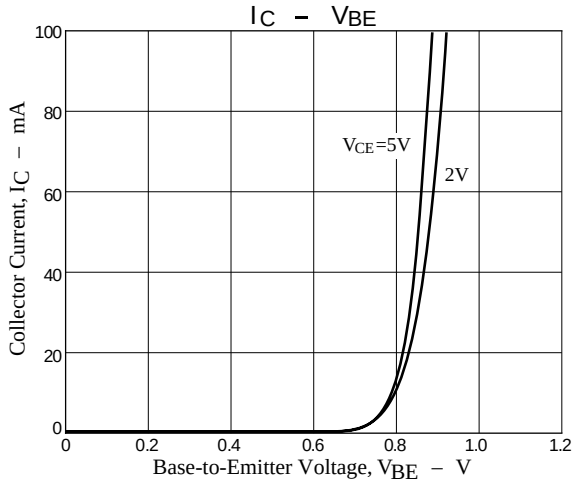
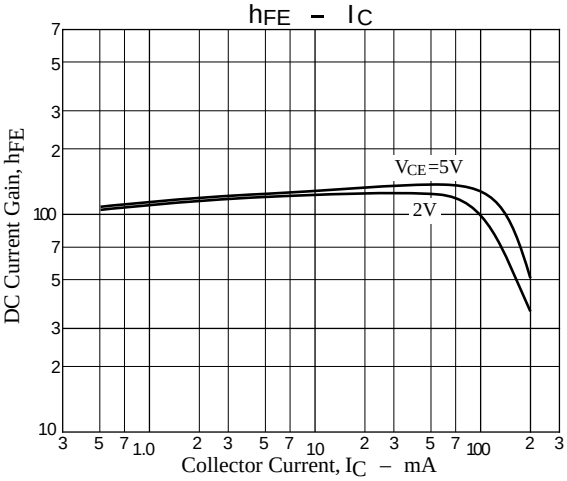
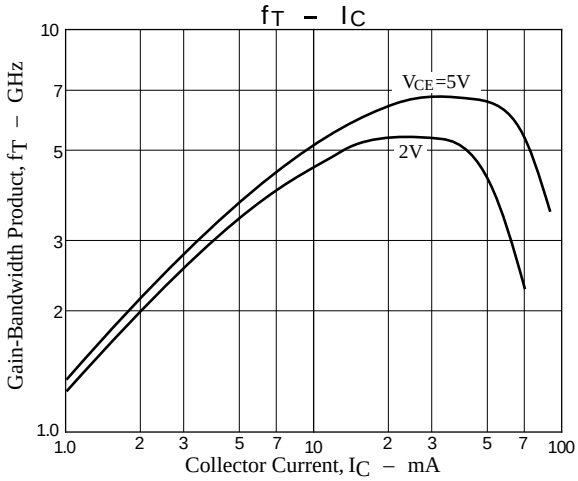
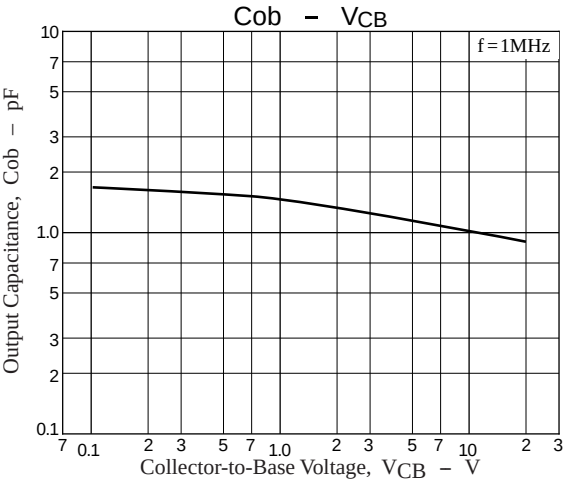
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

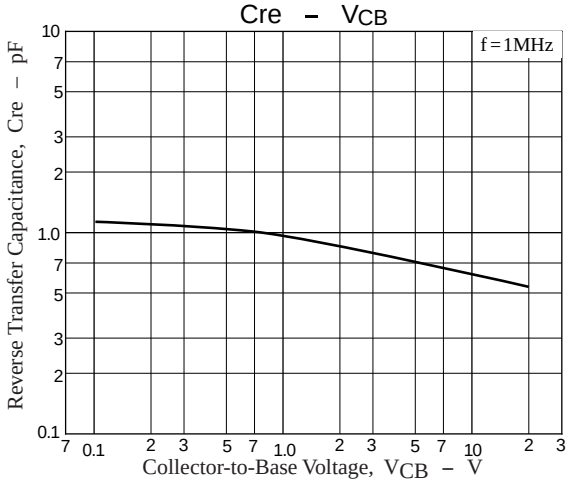

IC – VCE
Collector Current, IC – mA
Collector-to-Emitter Voltage, VCE – V
0.35mA
0.30mA
0.25mA
0.20mA
0.15mA
0.10mA
0.05mA
IB=0

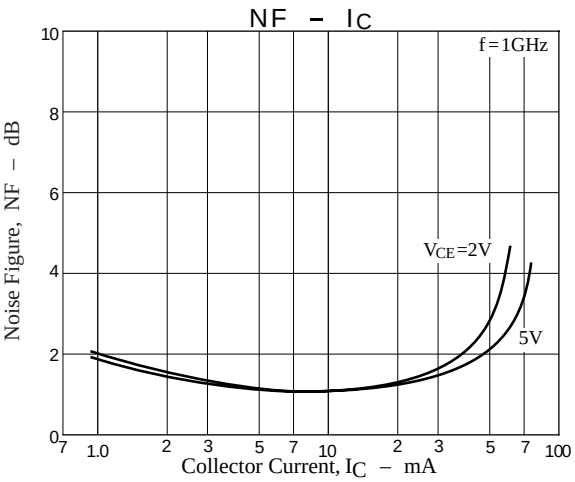

IC – VBE
Collector Current, IC – mA
Base-to-Emitter Voltage, VBE – V
VCE=5V
2V

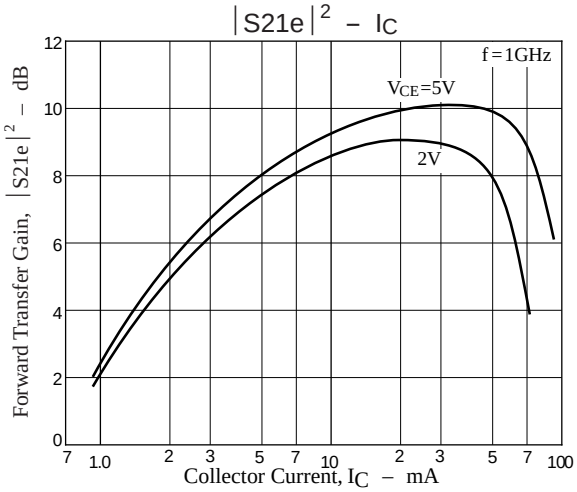

hFE – IC
DC Current Gain, hFE
Collector Current, IC – mA
VCE=5V
2V

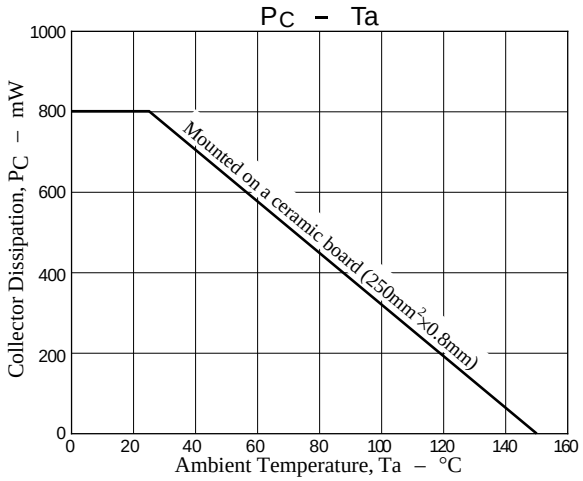

fT – IC
Gain-Bandwidth Product, fT – GHz
Collector Current, IC – mA
VCE=5V
2V


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)	| S_{11} |	∠ S_{11}	| S_{21} |	∠ S_{21}	| S_{12} |	∠ S_{12}	| S_{22} |	∠ S_{22}
100	0.737	–51.3	11.929	142.2	0.046	65.0	0.836	–27.1
200	0.564	–86.8	8.854	118.5	0.070	54.3	0.649	–39.5
400	0.408	–129.5	5.231	95.2	0.097	51.5	0.454	–48.4
600	0.366	–155.0	3.667	82.0	0.121	53.7	0.394	–52.3
800	0.348	–175.8	2.811	70.0	0.147	55.3	0.370	–56.6
1000	0.338	169.4	2.332	62.6	0.175	56.2	0.368	–60.5
1200	0.346	156.6	2.000	54.2	0.205	55.7	0.361	–66.7
1400	0.350	145.7	1.739	47.3	0.235	54.9	0.363	–72.7
1600	0.360	136.1	1.557	40.6	0.267	53.7	0.371	–77.7
1800	0.365	126.2	1.428	34.4	0.300	51.7	0.383	–83.4
2000	0.369	116.9	1.306	29.3	0.334	49.2	0.385	–89.5

V_{CE}=2V, I_C=10mA, Z_O=50Ω

Freq (MHz)	| S_{11} |	∠ S_{11}	| S_{21} |	∠ S_{21}	| S_{12} |	∠ S_{12}	| S_{22} |	∠ S_{22}
100	0.580	–67.4	17.590	130.8	0.040	62.8	0.715	–36.9
200	0.414	–104.9	11.116	109.3	0.059	58.5	0.490	–48.3
400	0.311	–145.7	6.099	90.2	0.091	60.9	0.338	–53.5
600	0.291	–168.2	4.213	79.2	0.125	62.4	0.294	–56.9
800	0.286	172.9	3.212	69.7	0.159	61.8	0.279	–61.6
1000	0.281	159.6	2.634	62.4	0.194	60.3	0.277	–65.9
1200	0.292	148.3	2.248	54.9	0.228	57.7	0.281	–71.7
1400	0.297	138.5	1.973	48.5	0.261	55.2	0.284	–77.2
1600	0.305	129.7	1.767	42.4	0.295	52.6	0.290	–82.7
1800	0.311	120.5	1.605	36.4	0.328	49.6	0.297	–88.5
2000	0.313	111.7	1.473	31.2	0.362	46.3	0.303	–93.9

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	0.432	–85.5	21.435	121.4	0.034	63.6	0.585	–45.4
200	0.313	–123.5	12.390	102.7	0.052	64.6	0.375	–54.0
400	0.263	–160.5	6.547	87.0	0.090	67.4	0.260	–57.1
600	0.257	–179.7	4.481	77.4	0.129	67.0	0.231	–60.9
800	0.260	163.3	3.408	68.8	0.168	64.8	0.224	–66.3
1000	0.258	151.6	2.792	62.1	0.206	62.3	0.224	–70.9
1200	0.271	141.6	2.378	55.1	0.243	58.7	0.231	–77.2
1400	0.270	133.1	2.085	49.1	0.278	55.4	0.236	–82.9
1600	0.282	124.5	1.867	43.2	0.313	52.2	0.242	–88.4
1800	0.288	115.4	1.697	37.5	0.346	48.7	0.249	–94.2
2000	0.290	107.0	1.558	32.3	0.380	45.0	0.256	–99.4

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	0.370	–97.4	22.555	117.0	0.031	65.1	0.518	–49.0
200	0.288	–135.1	12.614	99.9	0.051	67.4	0.326	–55.8
400	0.260	–168.5	6.590	85.5	0.090	69.9	0.229	–58.1
600	0.259	174.8	4.499	76.4	0.131	68.6	0.207	–62.3
800	0.263	159.3	3.419	68.1	0.172	66.0	0.204	–68.3
1000	0.262	148.2	2.796	61.7	0.211	62.8	0.206	–73.2
1200	0.275	138.9	2.382	54.7	0.248	59.1	0.215	–79.6
1400	0.279	130.4	2.089	48.8	0.284	55.6	0.220	–85.4
1600	0.286	122.5	1.869	43.0	0.320	52.1	0.227	–91.1
1800	0.291	113.8	1.700	37.3	0.353	48.4	0.235	–97.0
2000	0.293	105.4	1.562	32.2	0.387	44.7	0.242	–102.2

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	0.752	–45.7	12.674	144.1	0.037	67.6	0.871	–21.6
200	0.575	–78.6	9.416	121.5	0.058	57.3	0.697	–32.2
400	0.391	–119.9	5.688	97.7	0.082	54.4	0.532	–38.3
600	0.334	–146.4	4.015	84.3	0.103	56.8	0.472	–41.5
800	0.307	–169.1	3.085	73.2	0.126	58.9	0.450	–45.4
1000	0.292	174.7	2.534	65.1	0.151	60.2	0.444	–49.5
1200	0.303	160.6	2.164	56.8	0.177	60.0	0.449	–54.6
1400	0.305	148.6	1.896	49.9	0.204	59.7	0.453	–59.6
1600	0.314	137.9	1.693	43.2	0.235	58.9	0.454	–65.0
1800	0.321	127.3	1.530	36.9	0.267	57.1	0.460	–70.0
2000	0.328	117.7	1.394	31.5	0.299	55.1	0.470	–76.4

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	0.601	–58.4	18.468	133.9	0.033	65.7	0.765	–25.1
200	0.413	–92.4	12.043	112.1	0.049	61.0	0.603	–30.7
400	0.275	–132.7	6.703	92.4	0.078	63.3	0.509	–36.8
600	0.240	–157.9	4.641	81.3	0.107	64.8	0.470	–45.9
800	0.228	–179.9	3.536	71.9	0.137	64.6	0.438	–56.8
1000	0.221	164.7	2.889	64.8	0.168	63.6	0.408	–69.3
1200	0.232	151.6	2.462	57.2	0.199	61.5	0.371	–83.9
1400	0.238	140.6	2.154	51.0	0.229	59.5	0.334	–100.6
1600	0.249	131.1	1.924	44.8	0.259	57.3	0.298	–120.1
1800	0.257	120.9	1.740	38.8	0.290	54.6	0.265	–143.5
2000	0.262	111.5	1.589	33.6	0.322	51.6	0.246	–170.6

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	0.373	–79.4	24.799	120.4	0.026	67.6	0.598	–36.8
200	0.245	–114.8	14.190	102.5	0.043	69.5	0.418	–39.2
400	0.183	–154.3	7.472	87.6	0.077	71.8	0.331	–38.5
600	0.174	–175.8	5.102	78.5	0.112	70.9	0.310	–41.3
800	0.177	163.8	3.872	70.4	0.147	68.7	0.305	–46.3
1000	0.177	150.2	3.158	64.1	0.181	66.1	0.308	–51.0
1200	0.190	139.3	2.681	57.4	0.215	62.8	0.313	–57.0
1400	0.197	129.5	2.343	51.6	0.247	59.6	0.317	–62.4
1600	0.209	121.2	2.090	45.9	0.279	56.7	0.321	–67.8
1800	0.217	111.6	1.892	40.3	0.309	53.3	0.327	–73.6
2000	0.222	102.6	1.727	35.2	0.340	49.9	0.333	–78.9

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	0.308	–92.8	25.470	116.0	0.024	69.2	0.543	–36.8
200	0.221	–129.7	14.126	99.7	0.041	72.1	0.389	–36.4
400	0.190	–165.7	7.357	85.9	0.076	73.8	0.324	–35.3
600	0.189	176.0	5.012	77.4	0.111	72.5	0.309	–38.8
800	0.195	158.6	3.800	69.4	0.146	69.9	0.307	–44.2
1000	0.195	146.5	3.097	63.2	0.180	67.2	0.311	–49.3
1200	0.209	136.8	2.630	56.5	0.214	63.7	0.317	–55.6
1400	0.216	127.8	2.300	50.8	0.246	60.5	0.321	–61.3
1600	0.227	119.9	2.050	45.1	0.279	57.5	0.325	–66.9
1800	0.237	111.0	1.857	39.4	0.310	54.1	0.331	–72.8
2000	0.241	102.2	1.695	34.5	0.341	50.5	0.337	–78.3