Ordering number:ENN6179

NPN Epitaxial Planar Silicon Composite Transistor

FH203

VCO OSC Circuit Applications

Features

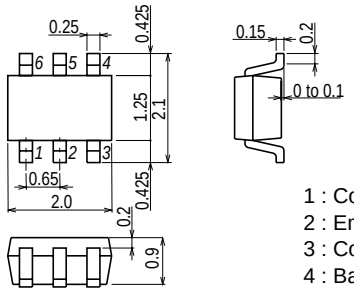
- Composite type with a buffer transistor (2SC5245) and a oscillator transistors (2SC5415) contained in the currently provided MCP package as a VCO oscillator, improving the mounting efficiency greatly.
- The FH203 is formed with two chips, being equivalent to the 2SC5245 and 2SC5415, placed in one package.
- Optimal for use in UHF band oscillator circuit.

Package Dimensions

unit:mm

2160

[FH203]



1 : Collector1
2 : Emitter1
3 : Collector2
4 : Base2
5 : Emitter2
6 : Base1
SANYO : MCP6

Specifications

Absolute Maximum Ratings at Ta = 25˚C

Parameter	Symbol	Conditions	Ratings	Unit
Tr1 [2SC5245]				
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		30	mA
Collector Dissipation	P_C		150	mW
Tr2 [2SC5415]				
Collector-to-Base Voltage	V_{CBO}		20	V
Collector-to-Emitter Voltage	V_{CEO}		10	V
Emitter-to-Base Voltage	V_{EBO}		2	V
Collector Current	I_C		100	mA
Collector Dissipation	P_C		150	mW
[Common specifications]				
Total Dissipation	P_T		200	mW
Junction Temperature	Tj		150	˚C
Storage Temperature	Tstg		–55 to +150	˚C

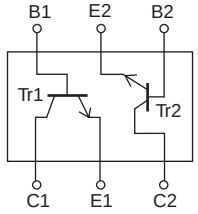
SANYO Electric Co.,Ltd. Semiconductor Company
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

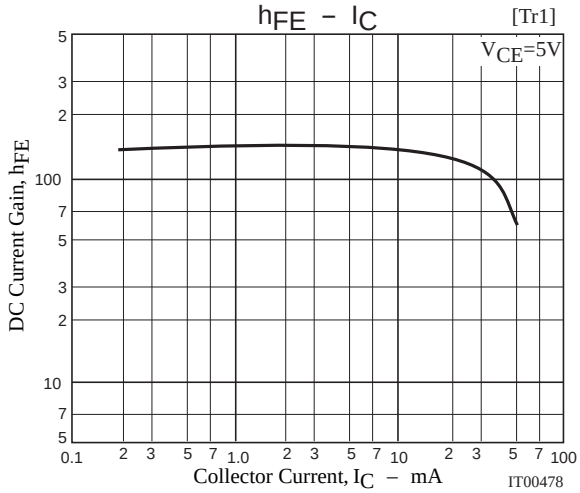
Electrical Characteristics at Ta = 25˚C

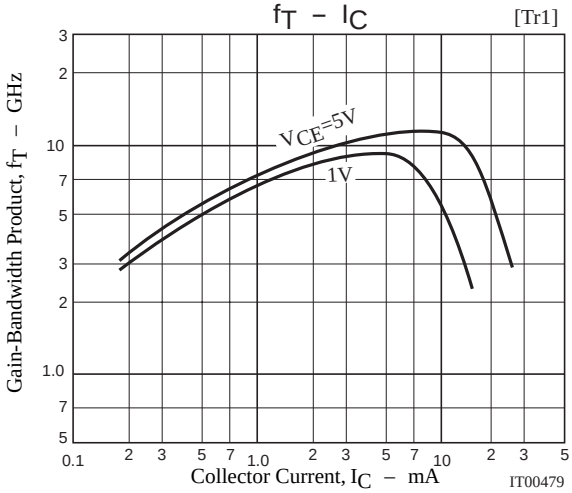
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Tr1 [2SC5245]						
Collector Cutoff Current	I_{CBO}	V_{CB}=10V, I_E=0			1.0	μA
Emitter Cutoff Current	I_{EBO}	V_{EB}=1V, I_C=0			10	μA
DC Current Gain	h_{FE}	V_{CE}=5V, I_C=10mA	90		200	
Gain-Bandwidth Product	f_T	V_{CE}=5V, I_C=10mA	8	11		GHz
Output Capacitance	Cob	V_{CB}=10V, f=1MHz		0.45	0.7	pF
Forward Transfer Gain	$\|S21e\|^2$	V_{CE}=5V, I_C=10mA, f=1.5GHz	8	10		dB
Noise Figure	NF	V_{CE}=5V, I_C=5mA, f=1.5GHz		1.4	3.0	dB
Tr2 [2SC5415]						
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}	V_{CE}=5V, I_C=30mA	90		200	
Gain-Bandwidth Product	f_T	V_{CE}=5V, I_C=30mA	6	7.5		GHz
Output Capacitance	Cob	V_{CB}=10V, f=1MHz		0.9	1.4	pF
Forward Transfer Gain	$\|S21e\|^2$	V_{CE}=5V, I_C=30mA, f=1GHz	10	12		dB
Noise Figure	NF	V_{CE}=5V, I_C=7mA, f=1GHz		1.1	2.0	dB

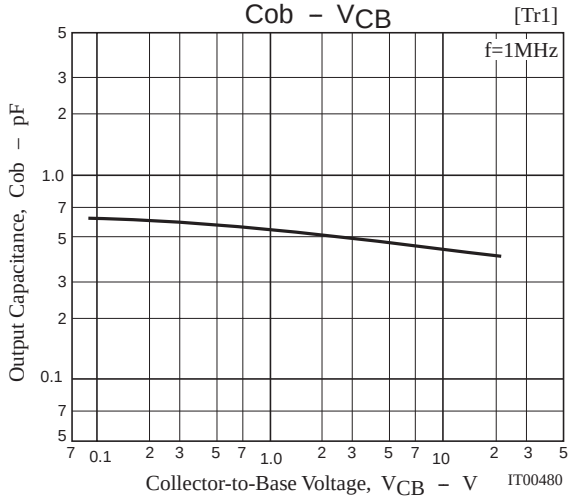
Marking : 203

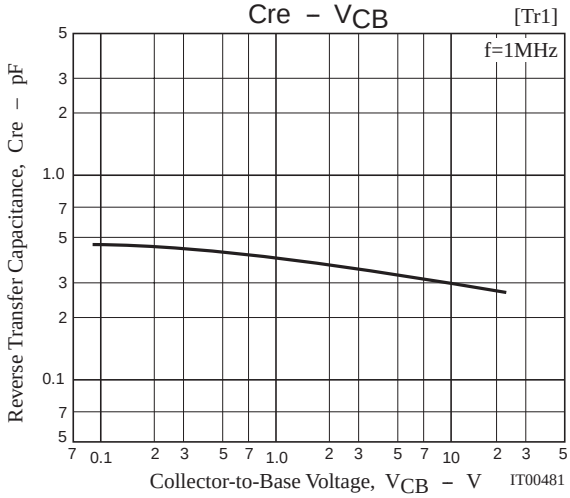
Electrical Connection

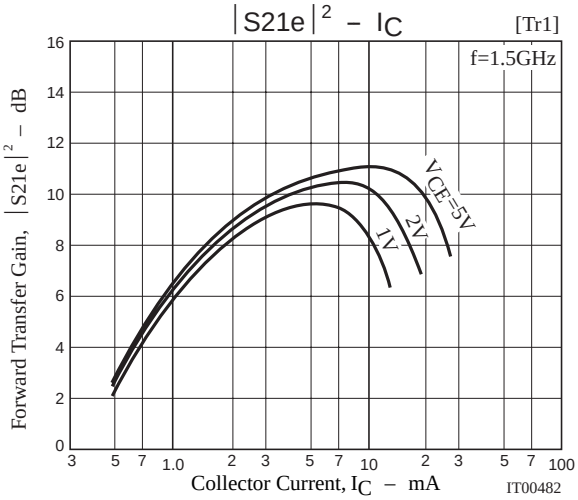


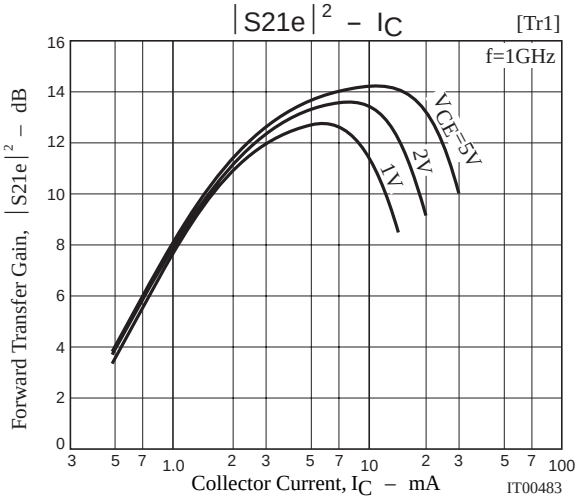


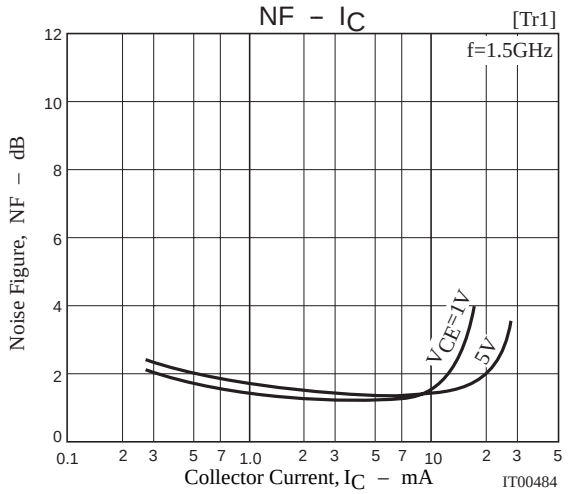


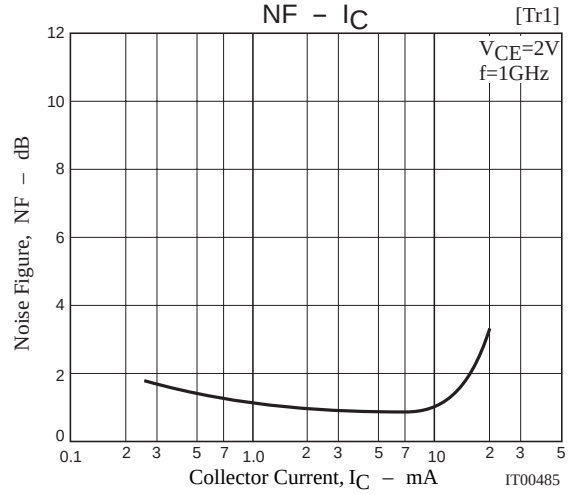


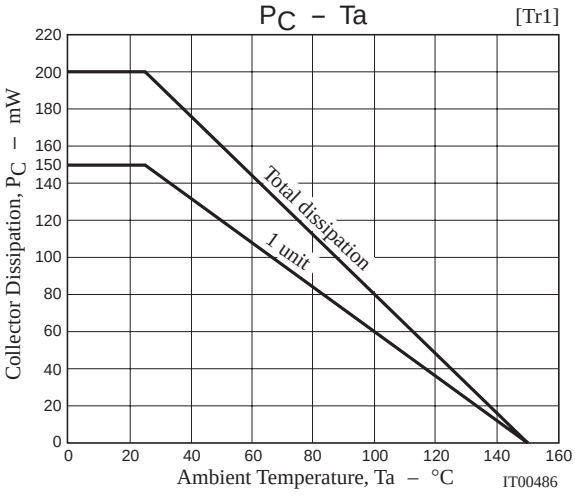



|S21e|² – IC
[Tr1]
f=1.5GHz
VCE=5V
2V
1V
Forward Transfer Gain, |S21e|² – dB
Collector Current, IC – mA
IT00482


|S21e|² – IC
[Tr1]
f=1GHz
VCE=5V
2V
1V
Forward Transfer Gain, |S21e|² – dB
Collector Current, IC – mA
IT00483


NF – IC
[Tr1]
f=1.5GHz
VCE=1V
5V
Noise Figure, NF – dB
Collector Current, IC – mA
IT00484


NF – IC
[Tr1]
VCE=2V
f=1GHz
Noise Figure, NF – dB
Collector Current, IC – mA
IT00485


PC – Ta
[Tr1]
Total dissipation
1 unit
Collector Dissipation, PC – mW
Ambient Temperature, Ta – °C
IT00486

S Parameters (Common emitter) [Tr1]

V_{CE}=5V, I_C=5mA, Z_O=50Ω

Freq (MHz)	$\|S_{11}\|$	$\angle S_{11}$	$\|S_{21}\|$	$\angle S_{21}$	$\|S_{12}\|$	$\angle S_{12}$	$\|S_{22}\|$	$\angle S_{22}$
200	0.763	–37.5	11.926	146.9	0.036	70.7	0.892	–19.1
400	0.590	–65.4	9.202	124.3	0.058	60.9	0.740	–29.1
600	0.456	–85.5	7.173	109.4	0.073	57.4	0.631	–33.7
800	0.374	–102.0	5.743	98.7	0.086	56.7	0.566	–35.8
1000	0.323	–115.0	4.785	90.5	0.098	56.7	0.528	–37.2
1200	0.288	–127.5	4.105	83.6	0.110	57.2	0.505	–38.4
1400	0.264	–137.7	3.599	77.5	0.123	57.7	0.488	–39.6
1600	0.248	–147.4	3.213	71.3	0.136	57.6	0.476	–41.2
1800	0.239	–156.9	2.905	66.4	0.150	57.6	0.466	–43.3
2000	0.235	–165.7	2.651	61.3	0.165	57.2	0.462	–45.4

V_{CE}=5V, I_C=10mA, Z_O=50Ω

Freq (MHz)	$\|S_{11}\|$	$\angle S_{11}$	$\|S_{21}\|$	$\angle S_{21}$	$\|S_{12}\|$	$\angle S_{12}$	$\|S_{22}\|$	$\angle S_{22}$
200	0.605	–52.6	16.354	136.2	0.031	67.5	0.804	–23.9
400	0.417	–84.6	11.011	113.3	0.048	62.4	0.622	–30.5
600	0.319	–106.3	8.026	100.5	0.062	62.2	0.533	–32.0
800	0.266	–124.6	6.250	91.3	0.076	63.4	0.491	–32.4
1000	0.238	–136.5	5.115	84.7	0.090	64.3	0.469	–33.2
1200	0.225	–148.9	4.336	78.8	0.104	64.4	0.458	–34.6
1400	0.215	–158.3	3.813	73.4	0.119	64.5	0.449	–35.8
1600	0.213	–167.3	3.365	68.1	0.135	63.8	0.443	–37.7
1800	0.212	–175.6	3.030	63.5	0.150	63.1	0.436	–39.6
2000	0.216	–177.5	2.754	58.9	0.166	62.5	0.438	–41.9

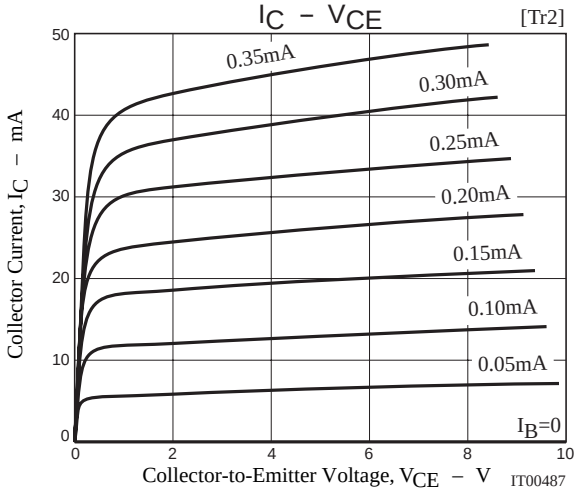
V_{CE}=2V, I_C=3mA, Z_O=50Ω

Freq (MHz)	$\|S_{11}\|$	$\angle S_{11}$	$\|S_{21}\|$	$\angle S_{21}$	$\|S_{12}\|$	$\angle S_{12}$	$\|S_{22}\|$	$\angle S_{22}$
200	0.842	–30.7	8.491	153.0	0.044	72.5	0.931	–17.1
400	0.704	–56.3	7.161	131.9	0.075	60.9	0.808	–28.8
600	0.579	–76.1	5.879	116.3	0.095	54.1	0.696	–36.2
800	0.480	–93.1	4.882	104.2	0.109	51.0	0.615	–40.6
1000	0.417	–106.3	4.154	95.0	0.121	49.3	0.564	–43.5
1200	0.376	–119.6	3.597	87.1	0.132	48.7	0.526	–45.8
1400	0.343	–130.2	3.212	80.2	0.143	48.6	0.469	–47.5
1600	0.319	–140.5	2.875	73.4	0.154	48.7	0.475	–49.6
1800	0.303	–150.0	2.604	67.7	0.166	48.6	0.461	–51.6
2000	0.298	–160.0	2.383	62.1	0.179	48.9	0.451	–52.9

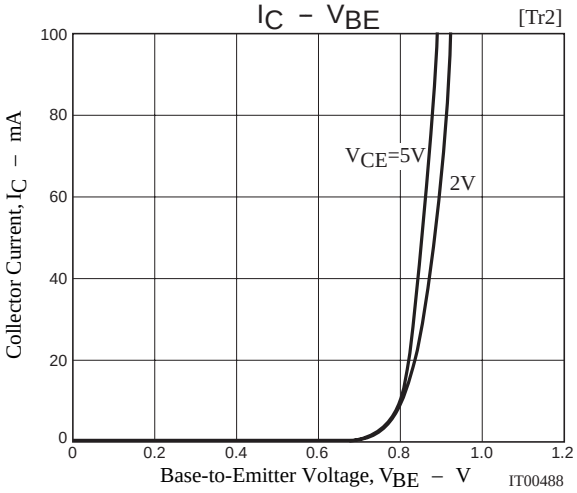
V_{CE}=1V, I_C=1mA, Z_O=50Ω

Freq (MHz)	$\|S_{11}\|$	$\angle S_{11}$	$\|S_{21}\|$	$\angle S_{21}$	$\|S_{12}\|$	$\angle S_{12}$	$\|S_{22}\|$	$\angle S_{22}$
200	0.945	–18.9	3.296	162.5	0.054	77.2	0.980	–11.0
400	0.884	–37.3	3.206	145.9	0.102	65.9	0.934	–20.5
600	0.810	–53.6	2.942	131.2	0.139	56.3	0.870	–29.0
800	0.728	–69.4	2.711	117.8	0.166	48.6	0.811	–35.5
1000	0.667	–82.5	2.449	107.0	0.187	42.5	0.763	–40.9
1200	0.605	–95.8	2.252	96.9	0.199	37.3	0.715	–45.7
1400	0.561	–106.1	2.061	88.1	0.207	33.5	0.673	–49.4
1600	0.518	–117.2	1.909	79.5	0.212	30.6	0.638	–53.4
1800	0.492	–127.5	1.766	72.2	0.215	28.6	0.611	–56.5
2000	0.465	–137.9	1.658	65.2	0.217	27.6	0.592	–59.9

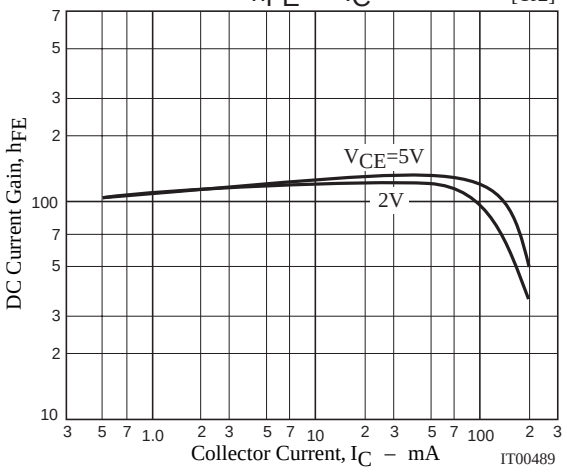
I_C – V_{CE} [Tr2]



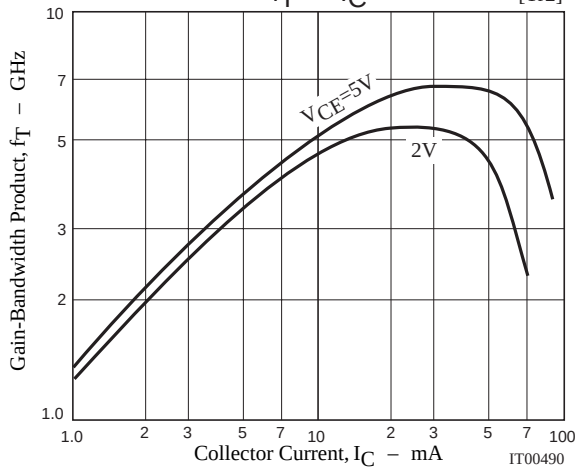
I_C – V_{BE} [Tr2]



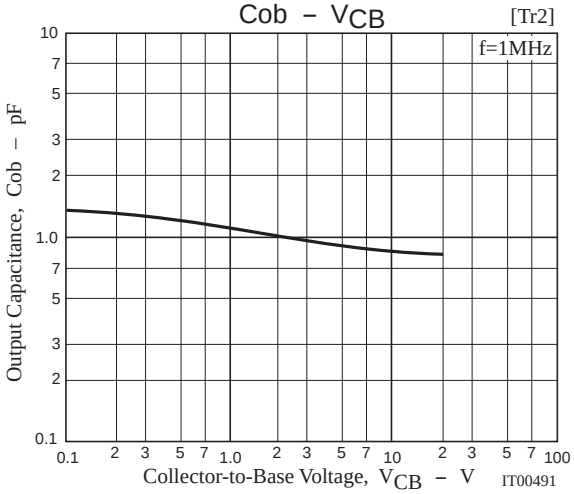
h_{FE} – I_C [Tr2]



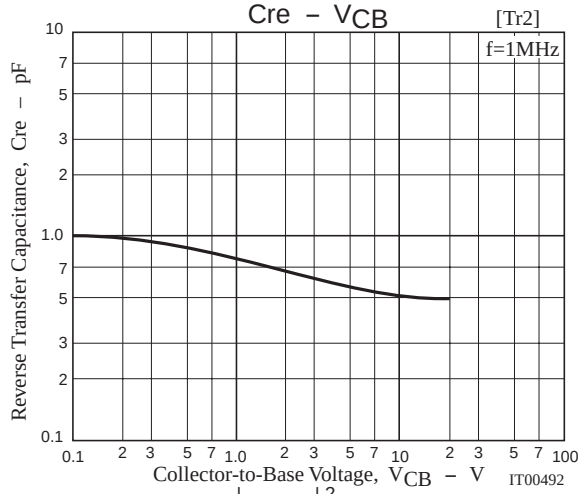
f_T – I_C [Tr2]



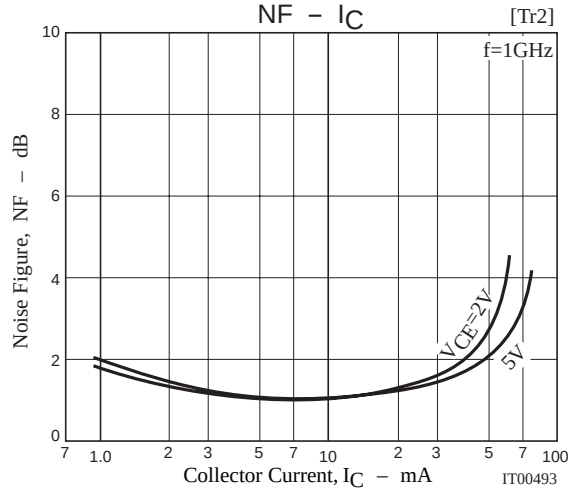
Cob – V_{CB} [Tr2]



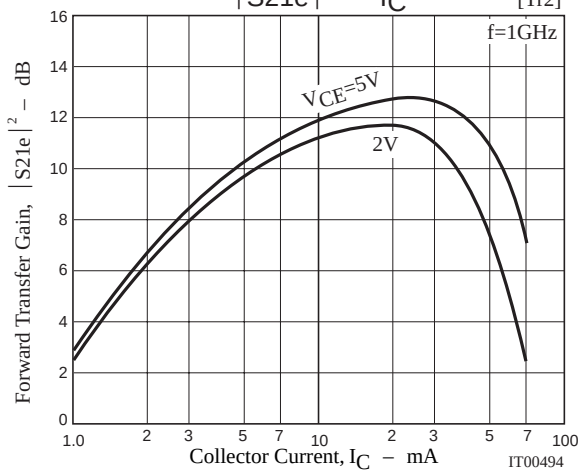
Cre – V_{CB} [Tr2]

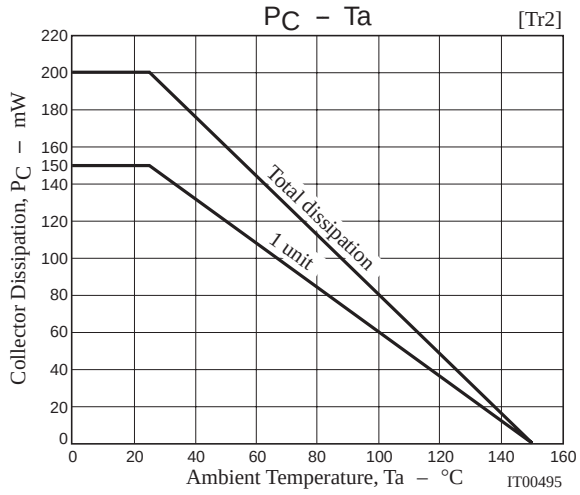


NF – I_C [Tr2]



$|S21e|^2$ – I_C [Tr2]





S Parameters (Common emitter) [Tr2]

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	0.849	–40.1	9.957	151.0	0.039	67.0	0.887	–22.9
200	0.772	–74.0	8.916	131.5	0.061	51.0	0.711	–36.9
400	0.670	–120.2	6.255	107.5	0.079	39.3	0.503	–47.1
600	0.626	–145.2	4.746	92.7	0.085	38.6	0.424	–49.5
800	0.614	–158.6	3.652	83.9	0.093	39.6	0.369	–52.6
1000	0.608	–168.4	3.001	76.2	0.099	42.3	0.345	–55.5
1200	0.607	–175.8	2.518	69.4	0.107	44.9	0.332	–58.8
1400	0.608	178.5	2.185	63.5	0.116	47.5	0.329	–62.4
1600	0.606	172.4	1.911	57.9	0.124	49.7	0.325	–66.7
1800	0.605	167.5	1.717	53.0	0.137	52.8	0.331	–70.7
2000	0.605	162.6	1.580	48.3	0.152	55.0	0.345	–74.5

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	0.743	–57.3	17.164	142.7	0.034	60.5	0.797	–32.6
200	0.655	–99.5	13.461	120.8	0.049	48.5	0.570	–48.8
400	0.589	–140.3	8.090	100.0	0.061	44.8	0.363	–58.8
600	0.572	–158.3	5.662	88.7	0.073	48.1	0.289	–61.2
800	0.569	–169.0	4.311	81.5	0.085	51.2	0.250	–63.7
1000	0.567	–176.5	3.506	74.9	0.098	54.1	0.233	–66.5
1200	0.568	177.4	2.945	68.9	0.111	55.8	0.225	–69.7
1400	0.566	172.3	2.561	63.6	0.125	56.8	0.223	–73.3
1600	0.567	167.2	2.255	58.7	0.140	57.9	0.224	–77.7
1800	0.567	163.1	2.028	54.4	0.155	58.6	0.228	–81.4
2000	0.569	159.0	1.848	49.8	0.171	58.0	0.236	–85.0

S Parameters (Common emitter) [Tr2]

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	0.625	–84.7	24.593	132.0	0.028	56.0	0.685	–43.4
200	0.576	–125.3	16.266	111.2	0.039	49.5	0.442	–59.3
400	0.554	–155.3	8.969	94.8	0.052	52.2	0.265	–68.5
600	0.551	–168.4	6.117	85.7	0.067	57.3	0.205	–72.0
800	0.552	–176.6	4.632	79.5	0.083	60.1	0.179	–74.9
1000	0.551	177.4	3.752	73.6	0.098	62.1	0.169	–78.2
1200	0.553	172.4	3.143	68.2	0.115	62.6	0.164	–81.7
1400	0.553	167.9	2.725	63.3	0.132	62.1	0.165	–85.1
1600	0.554	163.7	2.410	58.7	0.148	61.9	0.168	–89.7
1800	0.555	159.9	2.169	54.6	0.166	61.3	0.174	–92.8
2000	0.556	156.2	1.972	50.2	0.183	60.1	0.180	–96.5

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	0.587	–105.4	25.998	124.3	0.026	53.7	0.607	–48.2
200	0.572	–139.6	16.084	106.4	0.034	50.7	0.373	–62.2
400	0.564	–162.6	8.697	92.1	0.048	56.4	0.224	–69.1
600	0.563	–173.3	5.919	83.8	0.064	61.5	0.176	–72.2
800	0.564	179.6	4.493	77.9	0.081	63.5	0.157	–74.6
1000	0.566	174.2	3.630	72.2	0.097	65.2	0.151	–78.0
1200	0.568	169.7	3.045	66.9	0.115	65.2	0.151	–81.8
1400	0.567	165.7	2.635	62.2	0.132	64.7	0.154	–85.5
1600	0.569	161.6	2.332	57.6	0.150	64.1	0.158	–90.1
1800	0.568	158.1	2.100	53.4	0.168	63.0	0.165	–93.5
2000	0.570	154.5	1.906	49.3	0.187	61.8	0.171	–97.7

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	0.868	–35.6	10.432	152.9	0.030	68.8	0.917	–16.7
200	0.777	–68.9	8.971	135.0	0.049	53.9	0.777	–27.4
400	0.668	–113.6	6.913	109.9	0.064	42.4	0.595	–35.1
600	0.626	–137.4	5.027	95.9	0.071	40.1	0.501	–37.4
800	0.600	–153.7	3.883	86.8	0.078	41.7	0.460	–38.9
1000	0.588	–164.5	3.228	78.7	0.083	45.0	0.443	–41.0
1200	0.585	–172.6	2.775	71.8	0.090	50.0	0.442	–43.4
1400	0.581	–179.1	2.407	66.0	0.097	53.0	0.435	–46.5
1600	0.581	174.8	2.134	60.5	0.106	56.1	0.430	–50.1
1800	0.581	169.8	1.914	55.5	0.118	59.1	0.433	–53.8
2000	0.587	165.2	1.741	50.7	0.130	60.9	0.433	–57.6

S Parameters (Common emitter) [Tr2]

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	0.762	–50.3	17.603	145.9	0.027	64.2	0.846	–24.5
200	0.664	–89.3	14.157	124.8	0.040	52.5	0.647	–36.3
400	0.573	–131.9	8.865	102.9	0.053	47.4	0.453	–41.5
600	0.544	–152.3	6.246	91.1	0.062	49.9	0.381	–41.8
800	0.537	–164.1	4.783	83.6	0.072	53.9	0.349	–42.5
1000	0.533	–172.3	3.910	76.9	0.082	56.9	0.334	–44.1
1200	0.536	–178.7	3.292	71.1	0.095	59.6	0.327	–46.5
1400	0.533	175.7	2.843	65.8	0.107	61.1	0.322	–49.3
1600	0.535	170.4	2.510	61.0	0.119	62.0	0.324	–52.9
1800	0.535	166.1	2.254	56.3	0.134	63.2	0.326	–56.3
2000	0.537	161.7	2.043	51.8	0.148	63.4	0.330	–60.0

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	0.589	–84.0	29.588	131.2	0.021	59.1	0.699	–35.5
200	0.530	–123.9	18.896	111.2	0.030	53.4	0.471	–44.4
400	0.506	–153.8	10.319	95.1	0.042	58.1	0.318	–44.4
600	0.502	–167.0	7.012	86.5	0.055	62.7	0.270	–43.2
800	0.502	–175.2	5.310	80.4	0.070	65.3	0.252	–43.5
1000	0.503	178.6	4.303	74.7	0.084	66.7	0.244	–45.3
1200	0.505	173.7	3.602	69.5	0.100	67.2	0.241	–48.1
1400	0.505	169.3	3.117	64.8	0.114	67.1	0.243	–51.2
1600	0.507	165.2	2.753	60.3	0.130	67.0	0.243	–55.2
1800	0.508	161.5	2.479	56.3	0.146	66.5	0.248	–58.6
2000	0.510	157.9	2.245	52.0	0.163	65.7	0.251	–62.6

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	0.569	–109.2	27.869	122.4	0.019	53.8	0.603	–35.3
200	0.558	–142.4	16.434	105.1	0.025	52.5	0.416	–37.5
400	0.554	–164.6	8.680	91.6	0.037	60.7	0.321	–34.0
600	0.556	–174.9	5.895	83.7	0.050	66.4	0.295	–34.0
800	0.557	178.4	4.465	78.0	0.065	69.3	0.286	–36.2
1000	0.559	173.3	3.616	72.4	0.079	70.3	0.282	–39.6
1200	0.560	169.0	3.032	67.4	0.096	71.0	0.283	–43.5
1400	0.560	164.9	2.627	62.5	0.111	70.9	0.283	–47.4
1600	0.560	161.2	2.319	58.0	0.127	70.6	0.285	–52.3
1800	0.561	157.8	2.087	53.7	0.144	70.3	0.289	–56.4
2000	0.563	154.2	1.900	49.5	0.161	69.4	0.293	–61.1