



# FH203

## VCO OSC Circuit Applications

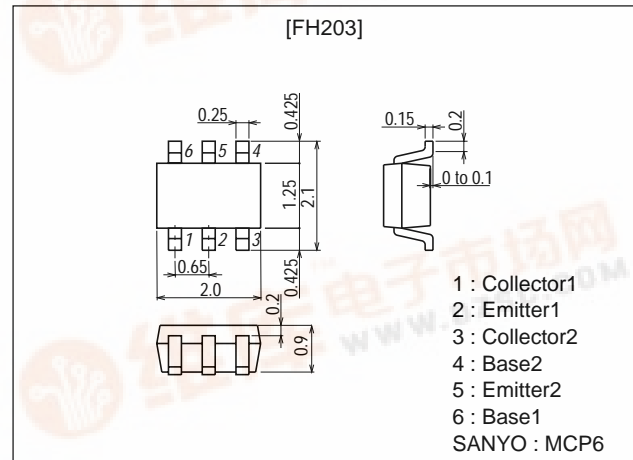
### Features

- 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



### Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Tr1 [2SC5245]				
Collector-to-Base Voltage	V <sub>CB0</sub>		20	V
Collector-to-Emitter Voltage	V <sub>CE0</sub>		10	V
Emitter-to-Base Voltage	V <sub>EB0</sub>		1.5	V
Collector Current	I <sub>C</sub>		30	mA
Collector Dissipation	P <sub>C</sub>		150	mW
Tr2 [2SC5415]				
Collector-to-Base Voltage	V <sub>CB0</sub>		20	V
Collector-to-Emitter Voltage	V <sub>CE0</sub>		10	V
Emitter-to-Base Voltage	V <sub>EB0</sub>		2	V
Collector Current	I <sub>C</sub>		100	mA
Collector Dissipation	P <sub>C</sub>		150	mW
[Common specifications]				
Total Dissipation	P <sub>T</sub>		200	mW
Junction Temperature	T <sub>j</sub>		150	°C
Storage Temperature	T <sub>stg</sub>		-55 to +150	°C

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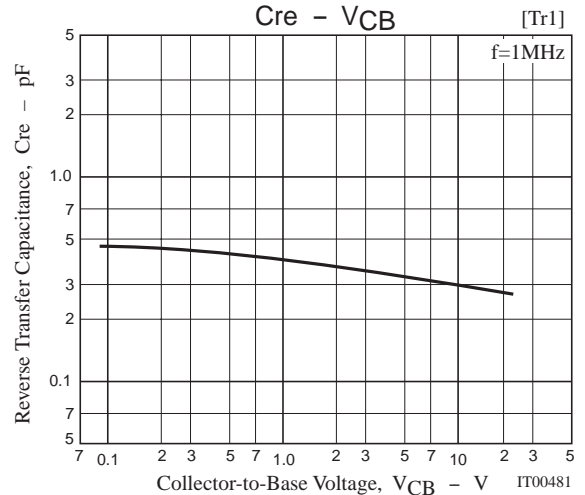
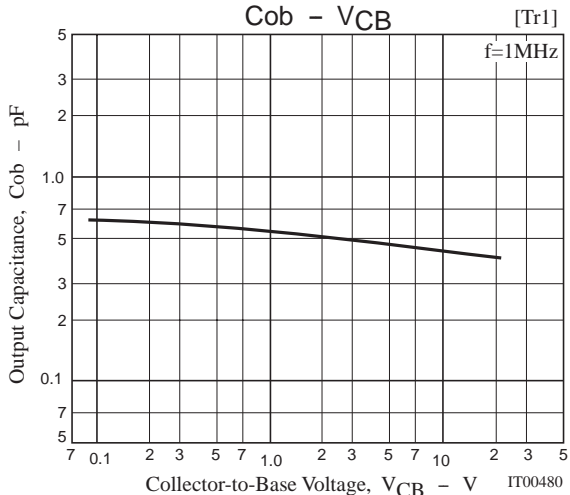
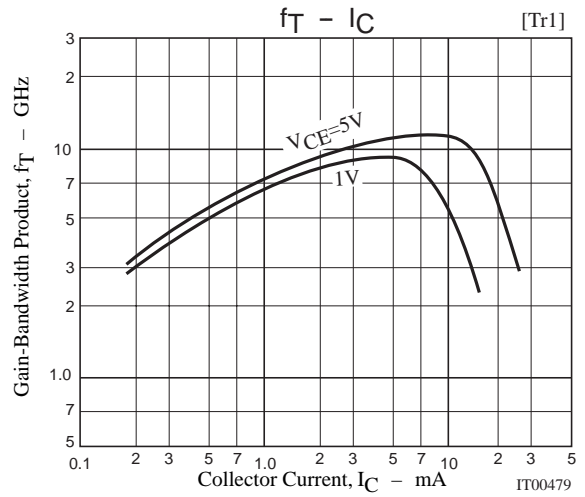
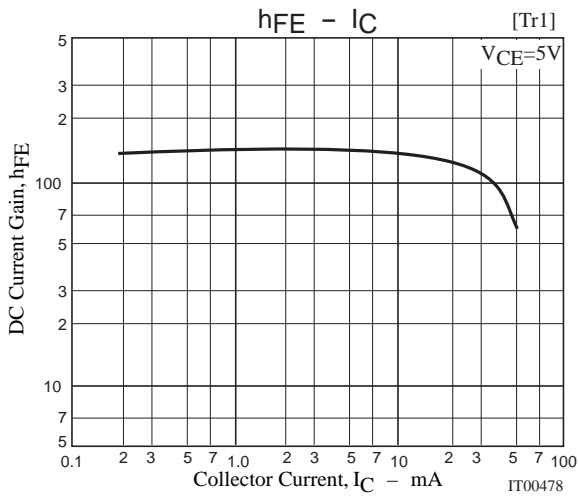
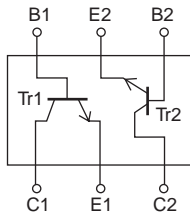
# FH203

## Electrical Characteristics at $T_a = 25^\circ\text{C}$

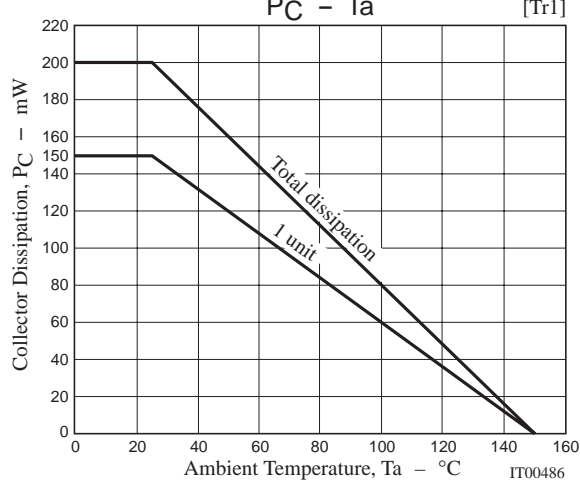
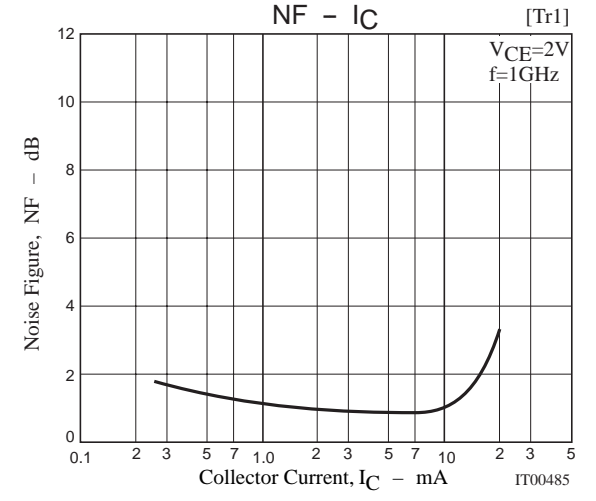
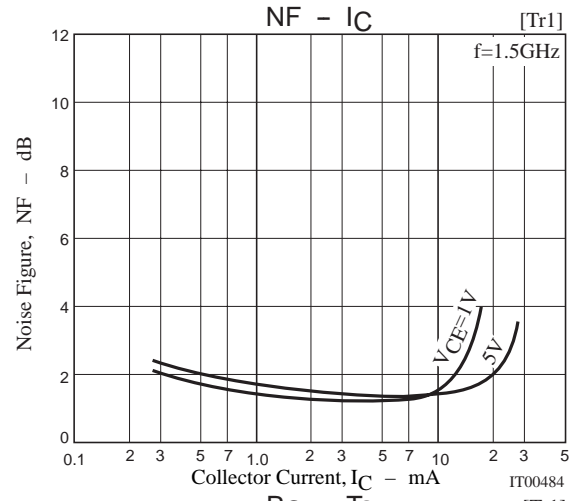
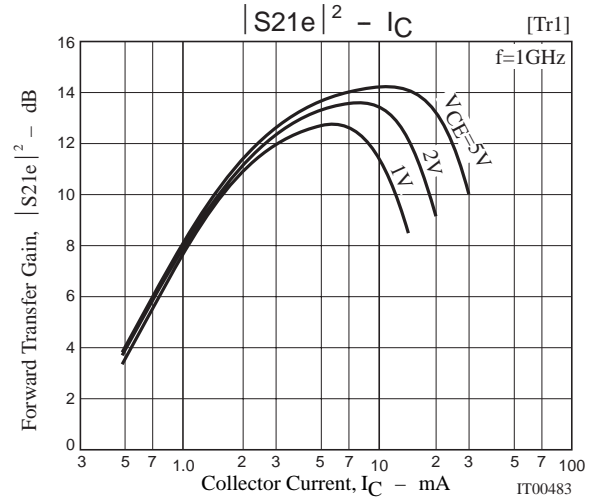
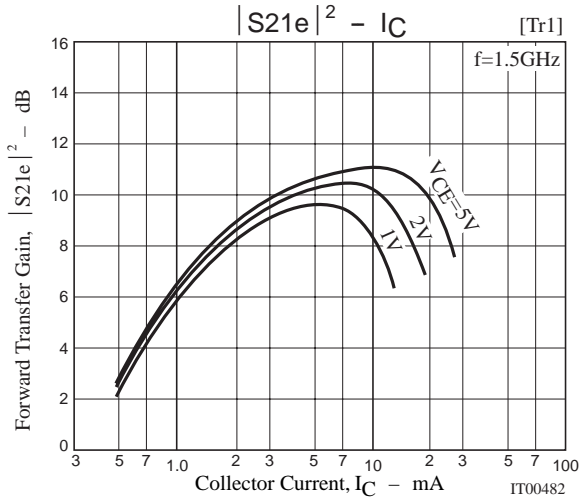
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
<b>Tr1 [2SC5245]</b>						
Collector Cutoff Current	$I_{CBO}$	$V_{CB}=10\text{V}, I_E=0$			1.0	$\mu\text{A}$
Emitter Cutoff Current	$I_{EBO}$	$V_{EB}=1\text{V}, I_C=0$			10	$\mu\text{A}$
DC Current Gain	$h_{FE}$	$V_{CE}=5\text{V}, I_C=10\text{mA}$	90		200	
Gain-Bandwidth Product	$f_T$	$V_{CE}=5\text{V}, I_C=10\text{mA}$	8	11		GHz
Output Capacitance	$C_{ob}$	$V_{CB}=10\text{V}, f=1\text{MHz}$		0.45	0.7	pF
Forward Transfer Gain	$ S_{21e} ^2$	$V_{CE}=5\text{V}, I_C=10\text{mA}, f=1.5\text{GHz}$	8	10		dB
Noise Figure	NF	$V_{CE}=5\text{V}, I_C=5\text{mA}, f=1.5\text{GHz}$		1.4	3.0	dB
<b>Tr2 [2SC5415]</b>						
Collector Cutoff Current	$I_{CBO}$	$V_{CB}=10\text{V}, I_E=0$			1.0	$\mu\text{A}$
Emitter Cutoff Current	$I_{EBO}$	$V_{EB}=1\text{V}, I_C=0$			10	$\mu\text{A}$
DC Current Gain	$h_{FE}$	$V_{CE}=5\text{V}, I_C=30\text{mA}$	90		200	
Gain-Bandwidth Product	$f_T$	$V_{CE}=5\text{V}, I_C=30\text{mA}$	6	7.5		GHz
Output Capacitance	$C_{ob}$	$V_{CB}=10\text{V}, f=1\text{MHz}$		0.9	1.4	pF
Forward Transfer Gain	$ S_{21e} ^2$	$V_{CE}=5\text{V}, I_C=30\text{mA}, f=1\text{GHz}$	10	12		dB
Noise Figure	NF	$V_{CE}=5\text{V}, I_C=7\text{mA}, f=1\text{GHz}$		1.1	2.0	dB

Marking : 203

## Electrical Connection



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### S Parameters (Common emitter) [Tr1]

$V_{CE}=5V, I_C=5mA, Z_O=50\Omega$

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

$V_{CE}=5V, I_C=10mA, Z_O=50\Omega$

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

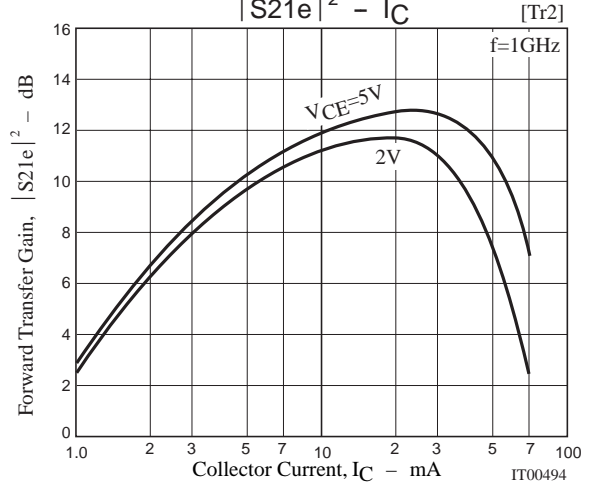
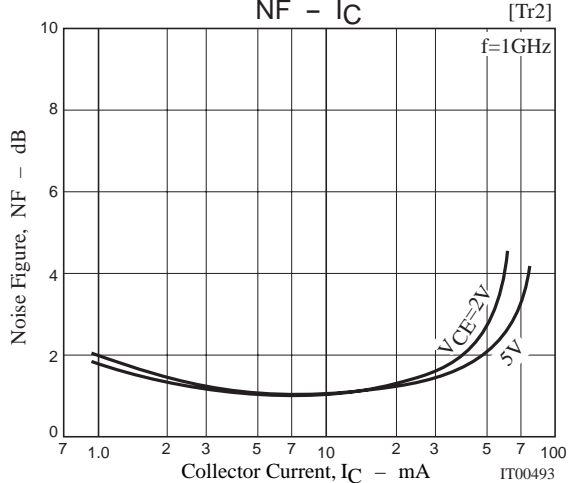
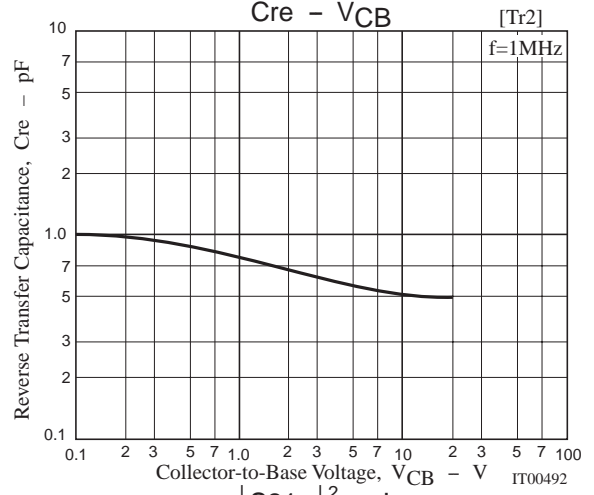
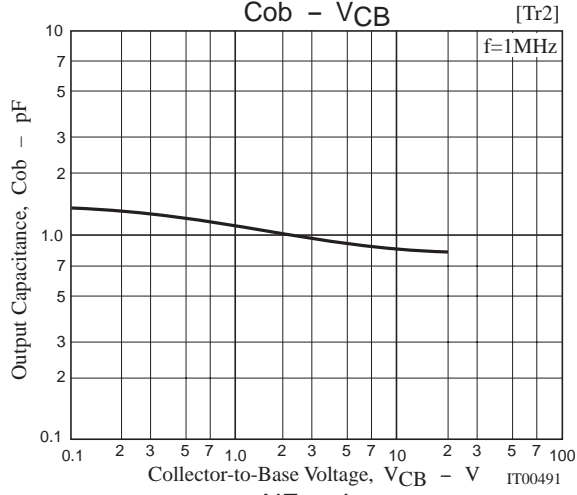
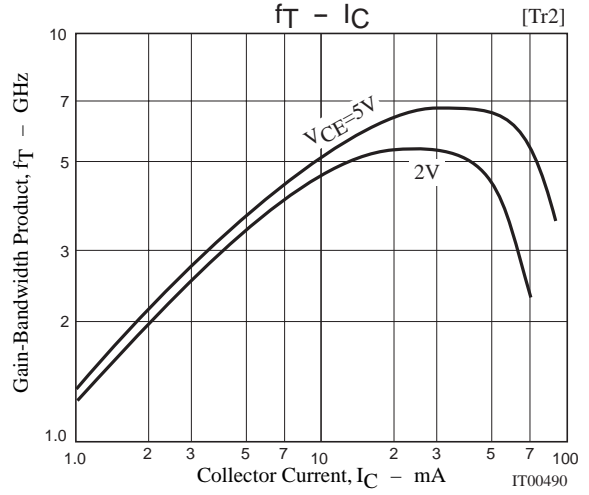
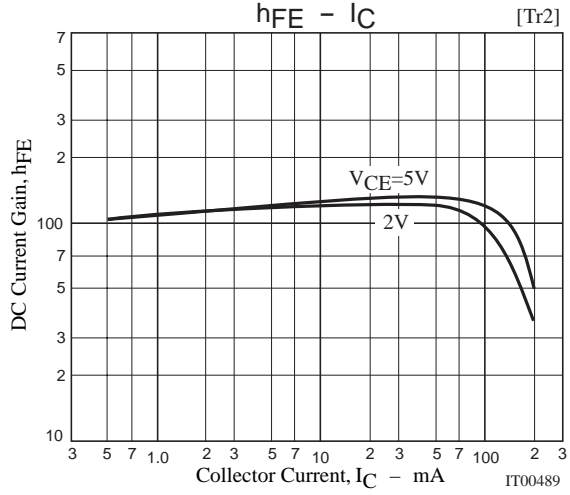
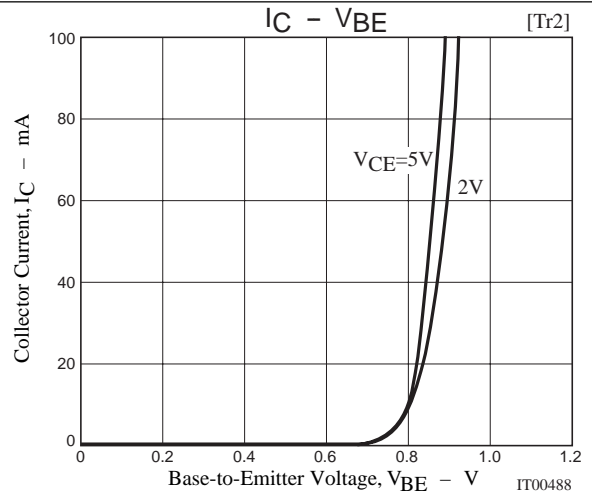
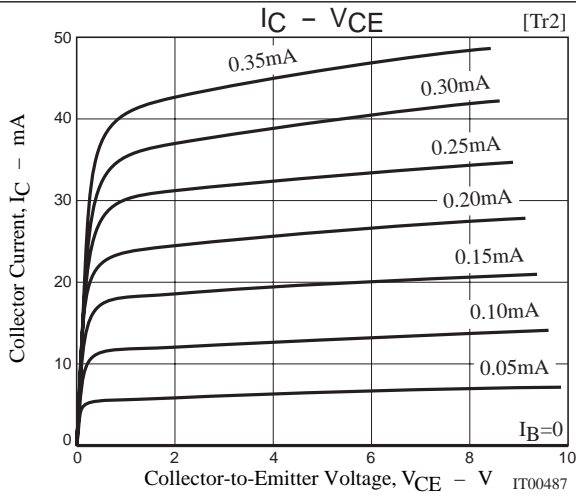
$V_{CE}=2V, I_C=3mA, Z_O=50\Omega$

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

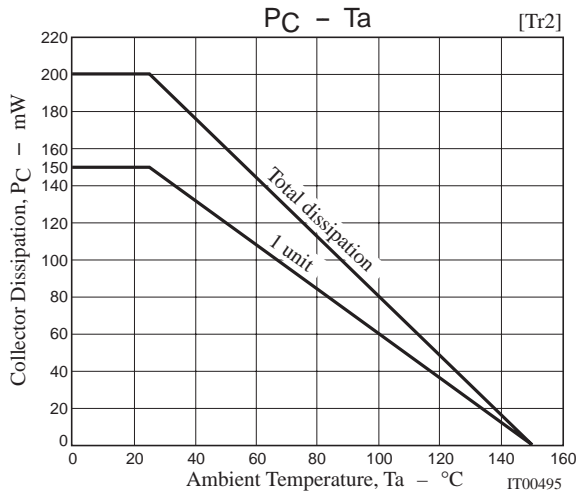
$V_{CE}=1V, I_C=1mA, Z_O=50\Omega$

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

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# FH203



## S Parameters (Common emitter) [Tr2]

$V_{CE}=2V, I_C=5mA, Z_O=50\Omega$

Freq (MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
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

$V_{CE}=2V, I_C=10mA, Z_O=50\Omega$

Freq (MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
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

## FH203

### S Parameters (Common emitter) [Tr2]

$V_{CE}=2V, I_C=20mA, Z_0=50\Omega$

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

$V_{CE}=2V, I_C=30mA, Z_0=50\Omega$

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

$V_{CE}=5V, I_C=5mA, Z_0=50\Omega$

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

## FH203

### S Parameters (Common emitter) [Tr2]

$V_{CE}=5V, I_C=10mA, Z_O=50\Omega$

Freq (MHz)	S <sub>11</sub>	∠S <sub>11</sub>	S <sub>21</sub>	∠S <sub>21</sub>	S <sub>12</sub>	∠S <sub>12</sub>	S <sub>22</sub>	∠S <sub>22</sub>
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

$V_{CE}=5V, I_C=30mA, Z_O=50\Omega$

Freq (MHz)	S <sub>11</sub>	∠S <sub>11</sub>	S <sub>21</sub>	∠S <sub>21</sub>	S <sub>12</sub>	∠S <sub>12</sub>	S <sub>22</sub>	∠S <sub>22</sub>
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

$V_{CE}=5V, I_C=50mA, Z_O=50\Omega$

Freq (MHz)	S <sub>11</sub>	∠S <sub>11</sub>	S <sub>21</sub>	∠S <sub>21</sub>	S <sub>12</sub>	∠S <sub>12</sub>	S <sub>22</sub>	∠S <sub>22</sub>
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



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