



NPN Epitaxial Planar Silicon Transistor

2SC5646

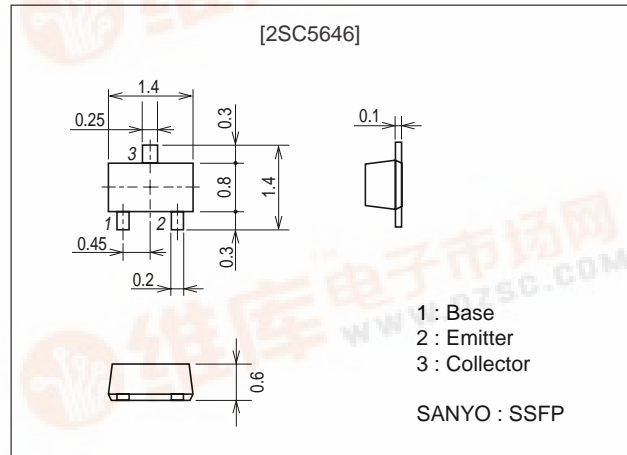
UHF to S Band Low-Noise Amplifier and OSC Applications

Features

- Low-noise use : NF=1.5dB typ (f=2GHz).
- High cut-off frequency : $f_T=10\text{GHz}$ typ ($V_{CE}=1\text{V}$).
: $f_T=12.5\text{GHz}$ typ ($V_{CE}=3\text{V}$).
- Low operating voltage.
- High gain : $|S_{21e}|^2=9.5\text{dB}$ typ (f=2GHz).
- Ultraminiature and thin flat leadless package (1.4mmX0.8mmX0.6mm).

Package Dimensions

unit : mm
2159



Specifications

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Collector-to-Base Voltage	V_{CBO}		9	V
Collector-to-Emitter Voltage	V_{CEO}		4	V
Emitter-to-Base Voltage	V_{EBO}		2	V
Collector Current	I_C		30	mA
Collector Dissipation	P_C		100	mW
Junction Temperature	T_j		150	$^\circ\text{C}$
Storage Temperature	T_{stg}		-55 to +150	$^\circ\text{C}$

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

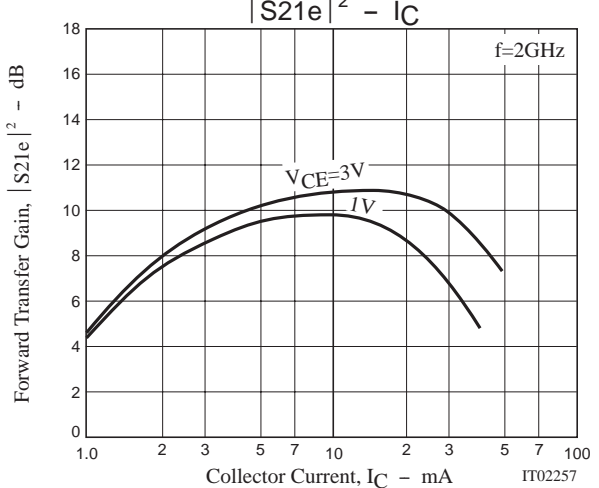
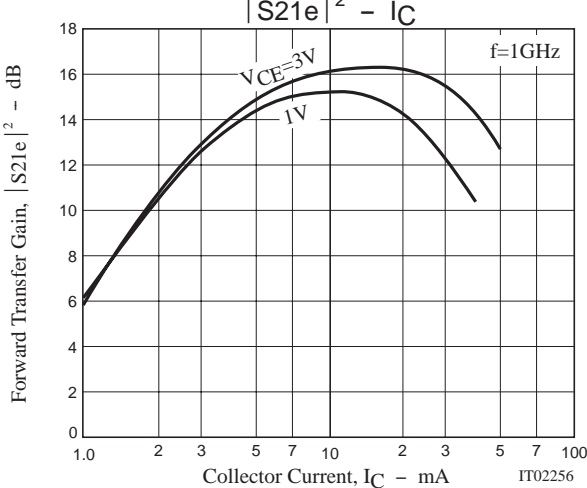
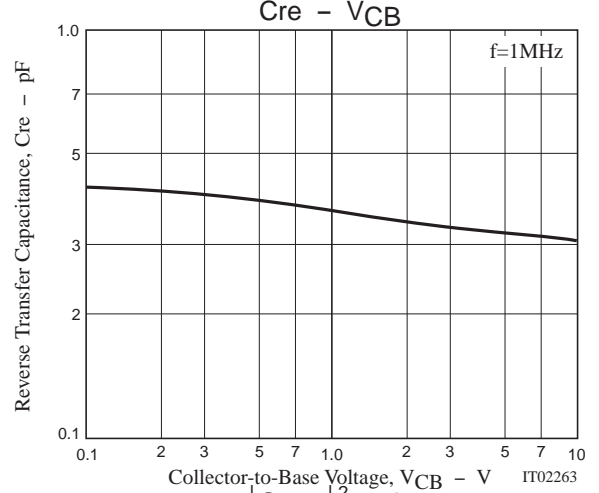
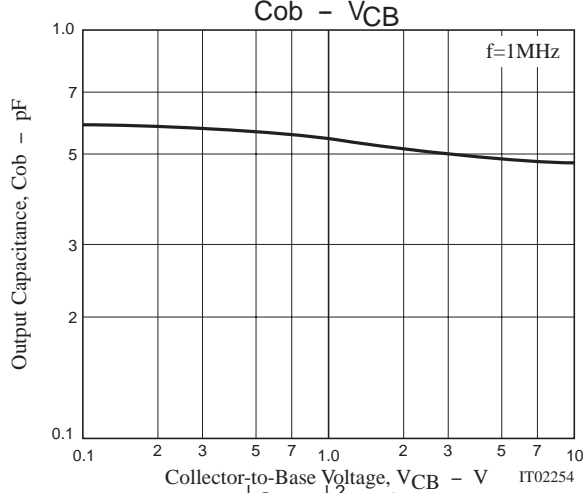
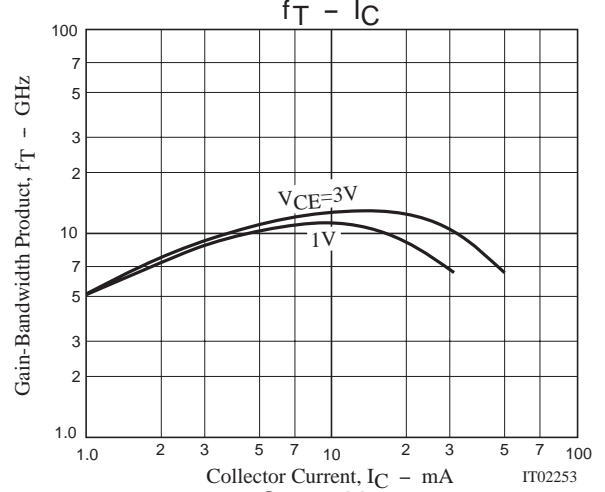
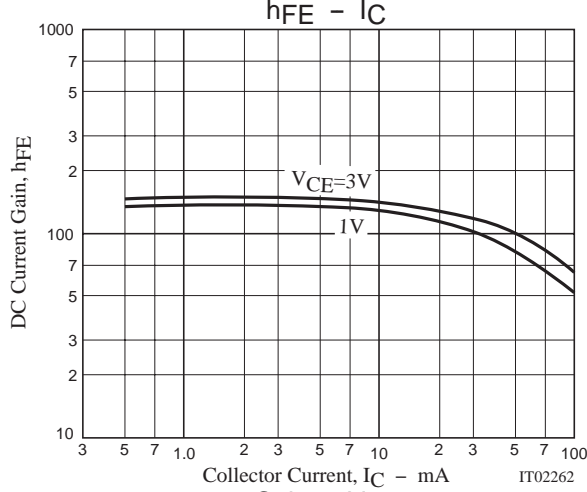
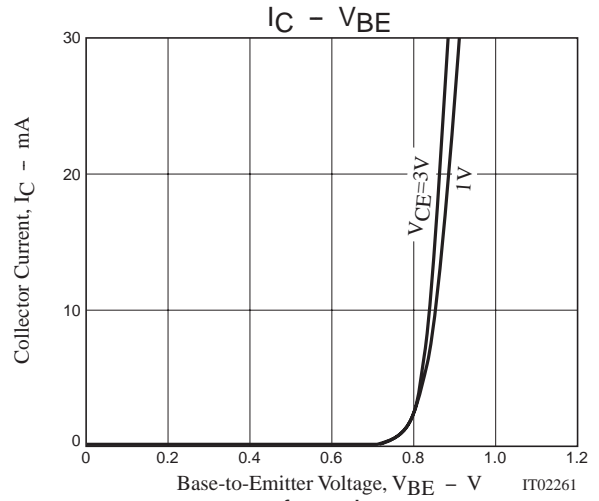
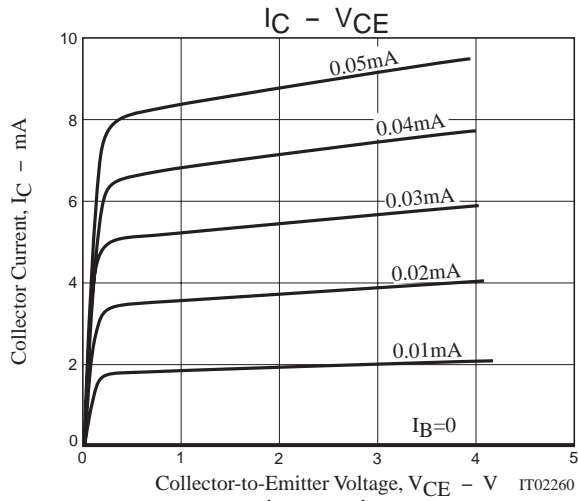
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Collector Cutoff Current	I_{CBO}	$V_{CB}=5\text{V}, I_E=0$			1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=1\text{V}, I_C=0$			10	μA
DC Current Gain	h_{FE}	$V_{CE}=1\text{V}, I_C=5\text{mA}$	100		160	
Gain-Bandwidth Product	f_{T1}	$V_{CE}=1\text{V}, I_C=5\text{mA}$	8	10		GHz
	f_{T2}	$V_{CE}=3\text{V}, I_C=15\text{mA}$		12.5		GHz
Output Capacitance	C_{ob}	$V_{CB}=1\text{V}, f=1\text{MHz}$		0.55	0.7	pF
Reverse Transfer Capacitance	C_{re}	$V_{CB}=1\text{V}, f=1\text{MHz}$		0.4		pF
Forward Transfer Gain	$ S_{21e} ^2_1$	$V_{CE}=1\text{V}, I_C=5\text{mA}, f=2\text{GHz}$	8	9.5		dB
	$ S_{21e} ^2_2$	$V_{CE}=3\text{V}, I_C=15\text{mA}, f=2\text{GHz}$		10.5		dB
Noise Figure	NF	$V_{CE}=1\text{V}, I_C=3\text{mA}, f=2\text{GHz}$		1.5	2.3	dB

Marking : NF

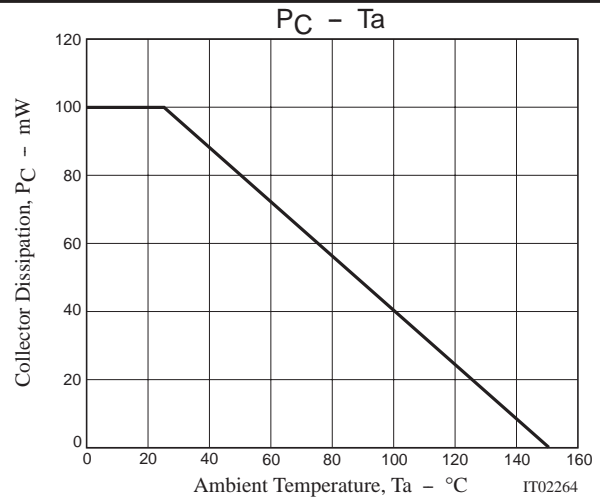
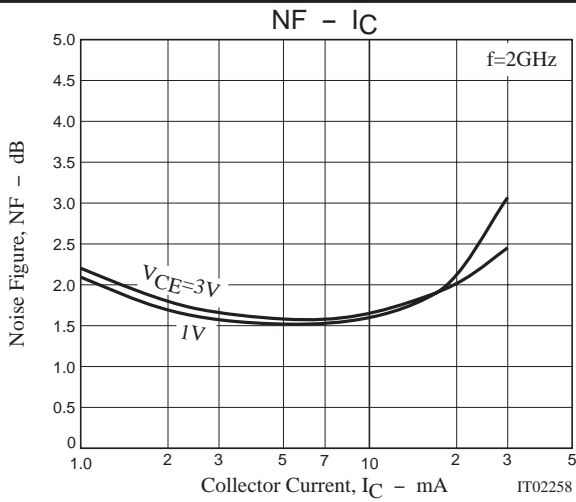
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S Parameters (Common emitter)

$V_{CE}=1\text{V}, I_C=1\text{mA}, Z_0=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.966	-14.5	3.235	165.4	0.052	78.9	0.980	-11.5
400	0.929	-28.6	3.081	152.3	0.099	68.9	0.943	-22.3
600	0.874	-41.4	2.825	140.1	0.137	59.4	0.889	-32.3
800	0.820	-53.1	2.657	129.4	0.168	51.9	0.835	-40.7
1000	0.778	-63.3	2.504	118.4	0.189	45.8	0.796	-47.7
1200	0.713	-72.3	2.281	110.8	0.207	40.4	0.743	-54.0
1400	0.674	-80.2	2.155	102.8	0.216	36.0	0.717	-58.9
1600	0.636	-87.8	2.005	94.8	0.225	32.8	0.693	-63.8
1800	0.599	-94.8	1.853	88.3	0.232	29.8	0.660	-68.6
2000	0.568	-101.0	1.732	82.6	0.236	27.4	0.640	-72.7
2200	0.542	-107.1	1.630	77.2	0.240	25.6	0.624	-76.3
2400	0.522	-113.2	1.553	72.0	0.243	23.5	0.616	-80.5
2600	0.511	-121.0	1.488	67.3	0.238	21.9	0.589	-83.7
2800	0.470	-127.1	1.403	62.6	0.237	21.3	0.573	-86.1
3000	0.448	-132.7	1.340	58.9	0.235	21.4	0.561	-87.8

$V_{CE}=1\text{V}, I_C=5\text{mA}, Z_0=50\Omega$

Freq(MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
200	0.832	-34.2	11.473	151.5	0.044	70.2	0.891	-24.8
400	0.696	-60.9	9.543	130.5	0.072	57.2	0.738	-42.0
600	0.558	-79.8	7.440	117.4	0.088	48.9	0.598	-51.8
800	0.488	-96.6	6.103	107.7	0.099	45.7	0.520	-59.7
1000	0.455	-109.2	5.244	97.8	0.109	45.0	0.464	-66.3
1200	0.415	-120.0	4.520	90.8	0.117	45.0	0.427	-70.0
1400	0.390	-129.5	3.950	85.1	0.124	45.2	0.405	-73.4
1600	0.375	-136.9	3.524	80.2	0.132	45.8	0.384	-76.2
1800	0.358	-143.7	3.145	75.7	0.140	46.2	0.371	-78.3
2000	0.351	-149.1	2.896	71.2	0.149	46.4	0.365	-80.8
2200	0.344	-154.9	2.649	66.9	0.158	47.0	0.364	-82.2
2400	0.340	-159.4	2.468	63.0	0.166	47.1	0.366	-86.0
2600	0.339	-163.9	2.299	59.1	0.174	48.1	0.350	-85.7
2800	0.335	-167.8	2.162	55.5	0.185	48.5	0.361	-85.0
3000	0.339	-171.6	2.043	52.0	0.196	49.1	0.388	-84.0

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V_{CE}=1V, I_C=10mA, Z_O=50Ω

Freq(MHz)	S ₁₁	∠S ₁₁	S ₂₁	∠S ₂₁	S ₁₂	∠S ₁₂	S ₂₂	∠S ₂₂
200	0.712	-50.0	16.218	141.2	0.040	64.6	0.796	-33.0
400	0.556	-82.8	11.575	119.9	0.060	54.0	0.594	-50.6
600	0.444	-104.0	8.470	108.8	0.071	49.9	0.465	-58.3
800	0.401	-120.1	6.729	99.1	0.082	49.9	0.394	-64.8
1000	0.385	-132.9	5.619	90.8	0.091	51.3	0.357	-69.7
1200	0.367	-141.8	4.775	85.2	0.100	52.4	0.330	-72.6
1400	0.357	-149.8	4.137	80.1	0.112	53.3	0.313	-75.4
1600	0.351	-156.4	3.674	75.5	0.121	54.1	0.305	-77.5
1800	0.344	-161.7	3.283	71.7	0.132	54.2	0.300	-79.7
2000	0.341	-166.5	2.985	67.9	0.142	54.5	0.300	-81.0
2200	0.339	-170.7	2.740	63.8	0.153	54.8	0.306	-83.0
2400	0.339	-174.6	2.532	60.2	0.165	54.8	0.308	-86.3
2600	0.338	-178.0	2.365	56.7	0.176	54.8	0.302	-86.2
2800	0.340	178.6	2.214	53.3	0.187	54.9	0.310	-84.5
3000	0.340	175.5	2.090	50.0	0.201	54.8	0.347	-83.5

V_{CE}=1V, I_C=20mA, Z_O=50Ω

Freq(MHz)	S ₁₁	∠S ₁₁	S ₂₁	∠S ₂₁	S ₁₂	∠S ₁₂	S ₂₂	∠S ₂₂
200	0.566	-75.5	17.073	129.2	0.036	57.9	0.632	-41.0
400	0.459	-113.6	10.744	108.8	0.050	52.6	0.433	-55.0
600	0.406	-134.0	7.486	100.0	0.061	51.6	0.342	-59.3
800	0.392	-147.0	5.766	91.5	0.072	54.2	0.298	-63.8
1000	0.395	-156.6	4.755	84.1	0.082	57.0	0.280	-67.4
1200	0.390	-163.3	4.019	78.9	0.093	58.6	0.270	-69.8
1400	0.389	-169.0	3.464	74.2	0.104	59.4	0.266	-72.5
1600	0.389	-173.9	3.058	69.9	0.115	60.2	0.268	-75.0
1800	0.385	-177.8	2.731	66.3	0.128	60.0	0.272	-77.6
2000	0.386	178.7	2.481	62.5	0.140	60.0	0.277	-79.6
2200	0.386	175.4	2.274	58.7	0.152	60.4	0.288	-82.0
2400	0.387	172.3	2.103	55.1	0.164	59.8	0.296	-85.7
2600	0.386	169.5	1.958	51.7	0.177	60.1	0.293	-86.1
2800	0.388	166.9	1.837	48.3	0.190	59.5	0.305	-85.2
3000	0.389	164.3	1.730	45.1	0.206	59.0	0.342	-84.3

V_{CE}=3V, I_C=1mA, Z_O=50Ω

Freq(MHz)	S ₁₁	∠S ₁₁	S ₂₁	∠S ₂₁	S ₁₂	∠S ₁₂	S ₂₂	∠S ₂₂
200	0.970	-13.3	3.318	166.5	0.046	79.3	0.983	-10.3
400	0.938	-26.2	3.140	154.1	0.087	70.0	0.952	-20.1
600	0.885	-37.8	2.901	142.4	0.122	61.6	0.905	-29.2
800	0.838	-48.6	2.719	132.2	0.150	54.5	0.859	-37.0
1000	0.793	-58.7	2.557	121.9	0.171	48.5	0.820	-43.9
1200	0.736	-66.7	2.320	114.2	0.188	43.6	0.774	-49.6
1400	0.703	-74.4	2.242	106.3	0.199	39.0	0.747	-54.4
1600	0.658	-81.8	2.115	98.4	0.208	35.7	0.719	-59.4
1800	0.614	-89.0	1.938	91.7	0.213	32.8	0.694	-63.8
2000	0.580	-94.8	1.813	86.0	0.217	30.7	0.672	-67.8
2200	0.551	-100.5	1.707	80.6	0.220	29.1	0.655	-71.4
2400	0.531	-106.5	1.630	75.4	0.225	27.1	0.647	-75.5
2600	0.518	-114.0	1.563	70.7	0.222	25.6	0.618	-78.6
2800	0.476	-119.8	1.473	65.8	0.222	25.1	0.603	-81.1
3000	0.452	-125.2	1.408	62.1	0.221	25.3	0.590	-82.7

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V_{CE}=3V, I_C=5mA, Z_O=50Ω

Freq(MHz)	S ₁₁	∠S ₁₁	S ₂₁	∠S ₂₁	S ₁₂	∠S ₁₂	S ₂₂	∠S ₂₂
200	0.854	-29.8	11.793	153.4	0.039	71.9	0.907	-22.1
400	0.719	-55.0	9.801	133.9	0.066	59.9	0.770	-37.9
600	0.574	-72.8	7.799	121.1	0.082	51.9	0.641	-47.3
800	0.514	-86.9	6.563	110.0	0.093	48.3	0.557	-54.1
1000	0.458	-100.6	5.612	100.8	0.103	47.3	0.501	-60.5
1200	0.421	-110.4	4.876	93.8	0.111	47.0	0.461	-64.3
1400	0.388	-119.5	4.298	87.7	0.119	47.0	0.433	-67.7
1600	0.364	-127.4	3.841	82.7	0.125	47.6	0.415	-69.8
1800	0.346	-134.9	3.440	78.5	0.134	47.6	0.399	-72.2
2000	0.335	-139.3	3.148	73.7	0.142	48.0	0.390	-73.9
2200	0.328	-146.3	2.889	69.9	0.150	48.8	0.390	-76.0
2400	0.319	-150.3	2.694	65.4	0.158	49.0	0.386	-79.2
2600	0.319	-155.7	2.500	62.0	0.166	49.9	0.376	-79.1
2800	0.313	-159.5	2.365	58.2	0.175	50.1	0.381	-78.3
3000	0.314	-163.8	2.218	54.8	0.187	51.2	0.417	-77.8

V_{CE}=3V, I_C=10mA, Z_O=50Ω

Freq(MHz)	S ₁₁	∠S ₁₁	S ₂₁	∠S ₂₁	S ₁₂	∠S ₁₂	S ₂₂	∠S ₂₂
200	0.746	-42.4	16.884	145.0	0.036	67.2	0.837	-28.8
400	0.584	-72.2	12.609	123.6	0.056	57.1	0.649	-45.4
600	0.460	-91.8	9.390	112.1	0.068	52.3	0.515	-53.0
800	0.398	-107.4	7.534	102.6	0.078	51.9	0.437	-59.3
1000	0.371	-120.9	6.340	94.0	0.087	53.1	0.394	-64.0
1200	0.346	-130.4	5.393	88.2	0.097	53.8	0.365	-66.5
1400	0.331	-138.4	4.681	83.2	0.106	54.5	0.344	-69.1
1600	0.320	-145.5	4.166	78.7	0.116	55.3	0.331	-71.0
1800	0.310	-151.6	3.720	74.9	0.126	55.3	0.325	-73.0
2000	0.307	-157.1	3.388	71.0	0.136	55.9	0.323	-74.2
2200	0.301	-161.7	3.110	67.1	0.146	56.2	0.326	-76.1
2400	0.302	-165.9	2.877	63.5	0.157	55.9	0.326	-79.2
2600	0.299	-169.6	2.684	60.0	0.167	56.3	0.318	-78.8
2800	0.300	-173.1	2.513	56.8	0.178	56.5	0.329	-77.3
3000	0.300	-176.5	2.374	53.5	0.192	56.4	0.367	-76.7

V_{CE}=3V, I_C=20mA, Z_O=50Ω

Freq(MHz)	S ₁₁	∠S ₁₁	S ₂₁	∠S ₂₁	S ₁₂	∠S ₁₂	S ₂₂	∠S ₂₂
200	0.621	-57.1	20.374	136.5	0.032	63.7	0.744	-34.4
400	0.471	-91.2	13.710	115.3	0.047	56.4	0.537	-49.1
600	0.379	-111.9	9.792	105.5	0.058	54.8	0.422	-54.1
800	0.350	-127.4	7.674	97.1	0.068	56.5	0.363	-58.3
1000	0.338	-139.0	6.356	89.3	0.079	58.5	0.331	-61.6
1200	0.327	-147.7	5.374	84.0	0.089	59.8	0.312	-63.6
1400	0.321	-154.9	4.646	79.4	0.100	60.5	0.302	-65.6
1600	0.317	-160.5	4.119	75.4	0.110	61.1	0.296	-67.5
1800	0.313	-165.4	3.670	71.8	0.122	60.8	0.295	-69.4
2000	0.311	-169.9	3.336	68.1	0.133	61.1	0.298	-70.9
2200	0.311	-173.6	3.060	64.5	0.144	61.2	0.305	-72.8
2400	0.312	-177.3	2.826	61.0	0.156	60.7	0.308	-76.3
2600	0.312	-179.9	2.633	57.7	0.168	60.6	0.303	-75.8
2800	0.313	176.7	2.464	54.5	0.180	60.6	0.318	-74.6
3000	0.315	174.3	2.325	51.4	0.193	60.1	0.357	-74.3

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