

NPN EPITAXIAL SILICON TRANSISTOR IN 4-PIN MINI-MOLD PACKAGE
FOR LOW-NOISE MICROWAVE AMPLIFICATION

FEATURES

- Low current consumption and high gain
 $|S_{21e}|^2 = 11.5 \text{ dB TYP. @ } V_{CE} = 2 \text{ V, } I_c = 7 \text{ mA, } f = 2 \text{ GHz}$
 $|S_{21e}|^2 = 10.5 \text{ dB TYP. @ } V_{CE} = 1 \text{ V, } I_c = 5 \text{ mA, } f = 2 \text{ GHz}$
- 4-pin Mini-Mold package
 EIAJ: SC-61

ORDERING INFORMATION

PART NUMBER	QUANTITY	ARRANGEMENT
2SC5178-T1	3000 units/reel	Embossed tape, 8 mm wide, pins No. 3 (base) and No. 4 (emitter) facing the perforations
2SC5178-T2	3000 units/reel	Embossed tape, 8 mm wide, pins No. 1 (collector) and No. 2 (emitter) facing the perforations

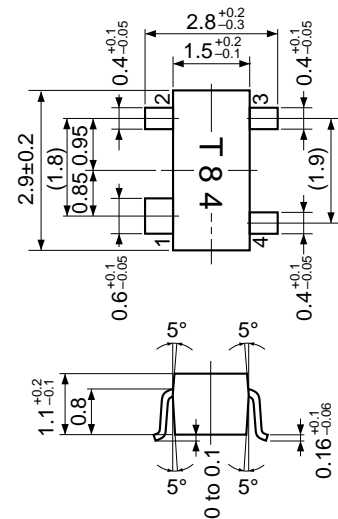
* Contact your NEC sales representatives to order samples for evaluation (available in batches of 50).

ABSOLUTE MAXIMUM RATINGS ($T_A = 25 \text{ }^\circ\text{C}$)

Collector to Base Voltage	V_{CBO}	5	V
Collector to Emitter Voltage	V_{CEO}	3	V
Emitter to Base Voltage	V_{EBO}	2	V
Collector Current	I_c	10	mA
Total Power Dissipation	P_T	30	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-65 to +150	$^\circ\text{C}$

PACKAGE DIMENSIONS

(Units: mm)



PIN CONNECTIONS

1. Collector
2. Emitter
3. Base
4. Emitter

CAUTION; This transistor uses high-frequency technology. Be careful not to allow excessive current to flow through the transistor, including static electricity.

ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

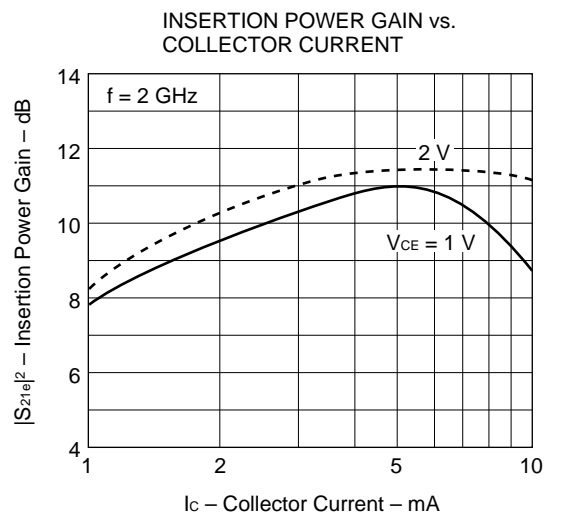
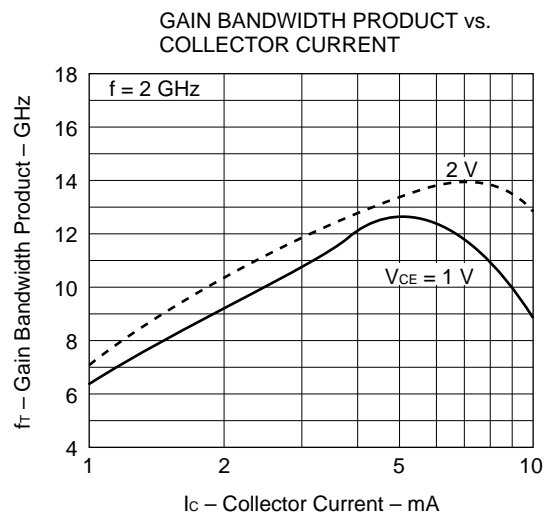
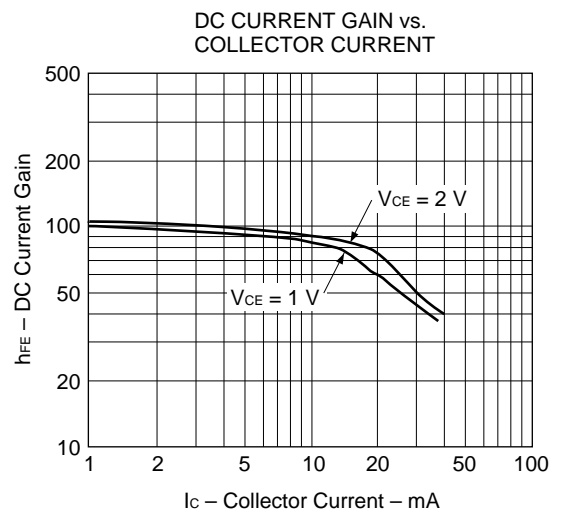
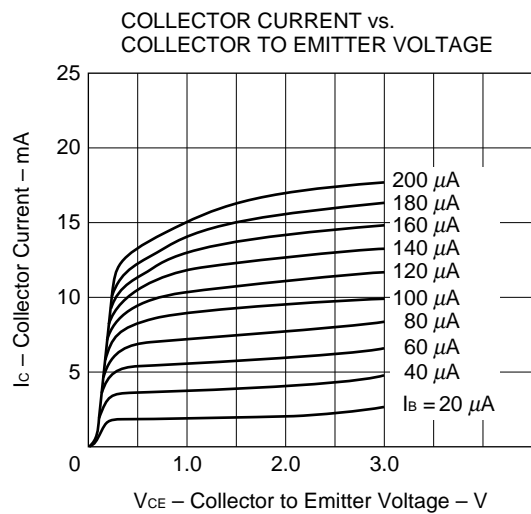
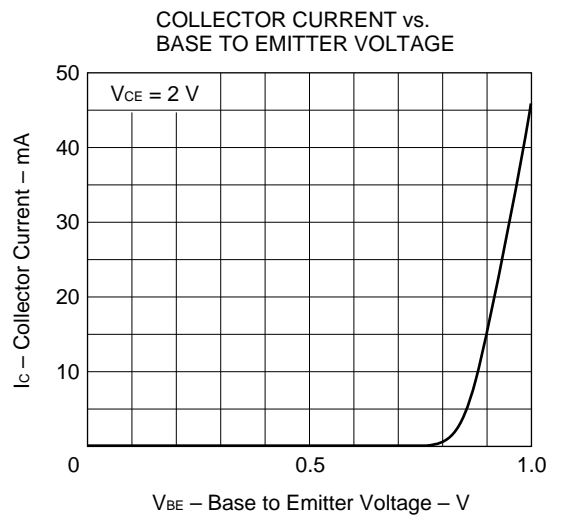
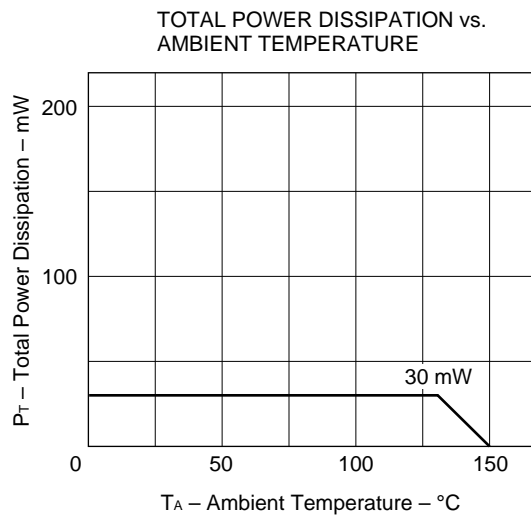
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Collector Cutoff Current	I _{CBO}			100	nA	V _{CB} = 5 V, I _E = 0
Emitter Cutoff Current	I _{EBO}			100	nA	V _{EB} = 1 V, I _C = 0
DC Current Gain	h _{FE}	70		140		V _{CE} = 2 V, I _C = 7 mA*1
Insertion Power Gain (1)	S _{21e} ²	9.5	11.5		dB	V _{CE} = 2 V, I _C = 7 mA, f = 2 GHz
Insertion Power Gain (2)	S _{21e} ²	7.5	10.5		dB	V _{CE} = 1 V, I _C = 5 mA, f = 2 GHz
Noise Figure (1)	NF		1.5	2.0	dB	V _{CE} = 2 V, I _C = 3 mA, f = 2 GHz
Noise Figure (2)	NF		1.5	2.0	dB	V _{CE} = 1 V, I _C = 3 mA, f = 2 GHz
Gain Bandwidth Product (1)	f _T	10.5	13.5		GHz	V _{CE} = 2 V, I _C = 7 mA, f = 2 GHz
Gain Bandwidth Product (2)	f _T	8.5	12		GHz	V _{CE} = 1 V, I _C = 5 mA, f = 2 GHz
Feedback Capacitance	C _{re}		0.3	0.5	pF	V _{CB} = 2 V, I _E = 0 mA, f = 1 MHz*2

- *1. Measured with pulses: Pulse width ≤ 350 μs, duty cycle ≤ 2 %, pulsed
- *2. Measured with a three-terminal bridge. The emitter and case terminal are connected to the guard terminal of the bridge.

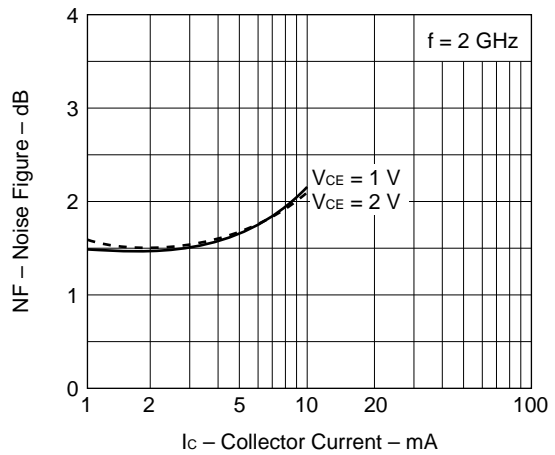
h_{FE} Class

Class	FB
Marking	T84
h _{FE}	70 to 140

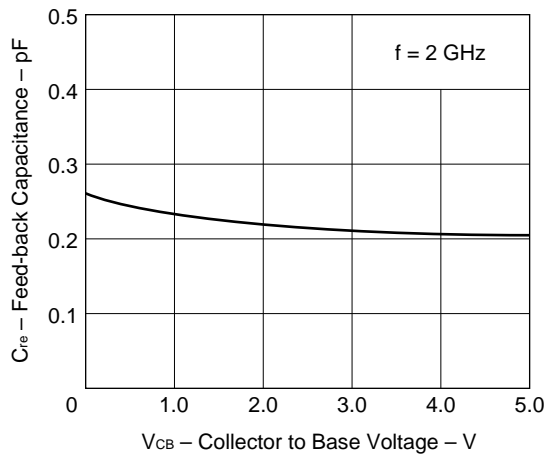
CHARACTERISTICS CURVES (T_A = 25 °C)



NOISE FIGURE vs.
COLLECTOR CURRENT



FEED-BACK CAPACITANCE vs.
COLLECTOR TO BASE VOLTAGE



S-PARAMETER

V_{CE} = 1 V, I_c = 1 mA, Z_o = 50 Ω

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.954	-9.5	3.362	168.9	0.026	77.0	0.989	-6.9
400.00	0.933	-19.1	3.305	158.2	0.061	76.5	0.972	-13.5
600.00	0.902	-28.3	3.251	148.3	0.084	68.1	0.941	-20.5
800.00	0.855	-38.2	3.204	137.6	0.106	63.3	0.917	-27.6
1000.00	0.798	-48.3	3.113	126.9	0.150	54.1	0.890	-34.5
1200.00	0.739	-59.2	3.032	116.5	0.170	53.5	0.842	-40.8
1400.00	0.667	-69.1	2.892	107.3	0.178	45.2	0.769	-47.5
1600.00	0.597	-77.4	2.719	96.6	0.195	37.7	0.729	-52.4
1800.00	0.519	-87.9	2.626	88.5	0.213	31.8	0.675	-60.3
2000.00	0.472	-97.7	2.484	80.5	0.223	31.7	0.634	-64.6
2200.00	0.413	-110.8	2.345	72.8	0.233	24.9	0.582	-70.9
2400.00	0.365	-123.4	2.255	64.6	0.238	18.9	0.530	-77.0
2600.00	0.306	-135.0	2.169	58.1	0.249	14.2	0.496	-83.0
2800.00	0.280	-154.3	2.015	51.3	0.254	14.6	0.452	-88.0
3000.00	0.259	-174.4	1.982	44.3	0.239	10.0	0.461	-99.2

V_{CE} = 1 V, I_c = 3 mA, Z_o = 50 Ω

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.878	-16.5	8.193	161.7	0.030	68.5	0.968	-11.6
400.00	0.789	-31.1	7.559	145.1	0.054	72.2	0.899	-22.2
600.00	0.694	-45.0	6.833	130.9	0.075	64.4	0.816	-30.8
800.00	0.589	-56.7	6.147	118.1	0.095	53.7	0.727	-38.1
1000.00	0.501	-69.1	5.496	106.8	0.115	53.5	0.673	-45.4
1200.00	0.423	-80.2	4.936	96.9	0.120	52.5	0.600	-49.8
1400.00	0.340	-90.7	4.427	88.7	0.140	47.1	0.537	-54.3
1600.00	0.280	-100.1	3.975	80.0	0.141	41.7	0.496	-60.1
1800.00	0.221	-114.0	3.672	73.1	0.163	40.1	0.437	-66.0
2000.00	0.196	-125.8	3.347	66.4	0.181	34.6	0.419	-69.6
2200.00	0.157	-142.7	3.066	60.4	0.176	33.4	0.374	-75.8
2400.00	0.160	-168.6	2.893	53.8	0.199	30.6	0.333	-76.7
2600.00	0.135	162.2	2.715	48.4	0.202	28.2	0.304	-85.6
2800.00	0.181	148.5	2.530	42.5	0.214	29.8	0.284	-92.0
3000.00	0.204	127.6	2.438	36.8	0.218	24.2	0.287	-99.7

$V_{CE} = 1\text{ V}$, $I_c = 5\text{ mA}$, $Z_o = 50\ \Omega$

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.801	-21.6	11.278	156.4	0.030	69.6	0.935	-14.8
400.00	0.677	-39.6	9.808	136.7	0.049	71.2	0.833	-26.4
600.00	0.557	-53.2	8.302	121.4	0.063	58.9	0.717	-35.2
800.00	0.451	-66.4	7.123	108.9	0.091	56.5	0.628	-40.7
1000.00	0.358	-76.9	6.140	98.1	0.095	51.6	0.577	-45.8
1200.00	0.277	-90.1	5.377	89.3	0.107	49.9	0.503	-50.4
1400.00	0.222	-100.7	4.737	81.6	0.122	47.7	0.454	-52.6
1600.00	0.172	-113.7	4.198	74.0	0.144	44.3	0.419	-55.7
1800.00	0.115	-135.4	3.838	67.7	0.153	44.1	0.376	-61.9
2000.00	0.111	-151.0	3.476	61.8	0.159	43.0	0.346	-66.5
2200.00	0.118	-173.9	3.178	56.1	0.182	35.9	0.308	-71.1
2400.00	0.121	159.2	2.982	50.4	0.195	38.3	0.280	-79.3
2600.00	0.142	137.2	2.795	45.1	0.191	36.9	0.264	-83.8
2800.00	0.181	128.6	2.589	39.5	0.226	28.0	0.242	-87.0
3000.00	0.210	108.6	2.489	34.1	0.237	28.0	0.239	-100.8

$V_{CE} = 1\text{ V}$, $I_c = 7\text{ mA}$, $Z_o = 50\ \Omega$

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.732	-26.3	13.376	152.5	0.024	74.3	0.900	-16.6
400.00	0.593	-44.8	10.989	130.9	0.047	67.6	0.782	-28.3
600.00	0.453	-59.2	8.954	115.8	0.060	67.1	0.664	-35.6
800.00	0.341	-71.0	7.441	103.6	0.075	60.2	0.585	-40.4
1000.00	0.254	-83.3	6.267	93.7	0.094	58.6	0.530	-43.6
1200.00	0.193	-95.5	5.441	85.6	0.103	56.9	0.476	-47.5
1400.00	0.144	-112.2	4.757	78.5	0.120	51.4	0.434	-50.8
1600.00	0.118	-136.4	4.207	71.4	0.129	50.9	0.405	-53.5
1800.00	0.088	-159.6	3.814	65.8	0.140	46.9	0.363	-58.7
2000.00	0.084	-178.8	3.464	60.2	0.155	45.9	0.334	-64.2
2200.00	0.099	148.2	3.167	54.8	0.174	41.3	0.315	-67.2
2400.00	0.134	127.4	2.939	49.3	0.180	40.2	0.290	-73.0
2600.00	0.175	117.8	2.771	44.7	0.187	38.8	0.274	-79.0
2800.00	0.212	112.4	2.578	39.6	0.206	32.0	0.266	-82.0
3000.00	0.265	109.7	2.476	33.9	0.229	31.0	0.264	-90.8

$V_{CE} = 2\text{ V}$, $I_C = 1\text{ mA}$, $Z_o = 50\ \Omega$

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.955	-8.7	3.382	169.5	0.029	81.7	0.997	-6.3
400.00	0.941	-17.7	3.329	159.3	0.054	77.2	0.976	-12.6
600.00	0.899	-25.9	3.274	149.7	0.075	71.5	0.953	-19.0
800.00	0.864	-35.3	3.246	139.5	0.102	65.9	0.927	-25.7
1000.00	0.824	-45.2	3.188	129.4	0.121	60.3	0.901	-31.9
1200.00	0.757	-54.2	3.101	119.3	0.143	54.1	0.860	-37.5
1400.00	0.695	-63.4	2.976	110.2	0.168	43.6	0.800	-44.8
1600.00	0.623	-73.6	2.797	99.8	0.177	40.5	0.760	-50.0
1800.00	0.548	-81.4	2.721	91.7	0.198	37.2	0.717	-56.2
2000.00	0.503	-92.5	2.601	83.9	0.198	32.3	0.670	-61.8
2200.00	0.429	-102.0	2.430	76.0	0.201	28.3	0.616	-66.6
2400.00	0.392	-112.4	2.376	68.4	0.228	23.9	0.561	-72.4
2600.00	0.310	-127.2	2.269	61.2	0.221	20.4	0.524	-77.6
2800.00	0.289	-140.6	2.134	54.4	0.224	13.3	0.509	-82.8
3000.00	0.248	-159.0	2.112	48.0	0.228	10.6	0.498	-90.5

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

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.877	-14.6	8.210	162.6	0.026	74.3	0.971	-10.2
400.00	0.807	-28.4	7.644	147.0	0.049	78.5	0.924	-19.7
600.00	0.723	-40.8	6.973	133.6	0.070	67.8	0.850	-28.0
800.00	0.624	-52.1	6.331	120.8	0.087	56.4	0.771	-34.5
1000.00	0.531	-61.9	5.727	109.6	0.101	54.9	0.703	-40.6
1200.00	0.442	-72.6	5.160	100.0	0.116	49.8	0.651	-45.6
1400.00	0.380	-80.4	4.647	91.6	0.122	47.8	0.589	-50.6
1600.00	0.292	-88.6	4.192	83.0	0.138	44.6	0.525	-54.8
1800.00	0.249	-98.4	3.880	76.1	0.153	40.2	0.487	-60.1
2000.00	0.208	-112.1	3.553	69.5	0.161	42.0	0.461	-63.6
2200.00	0.167	-122.0	3.276	63.0	0.172	37.5	0.427	-68.2
2400.00	0.142	-144.3	3.074	56.9	0.191	36.8	0.392	-72.2
2600.00	0.115	-170.2	2.915	51.4	0.180	33.3	0.359	-80.1
2800.00	0.140	165.8	2.697	45.6	0.192	28.3	0.332	-85.2
3000.00	0.154	134.5	2.606	40.2	0.203	26.6	0.330	-91.8

$V_{CE} = 2\text{ V}$, $I_c = 5\text{ mA}$, $Z_o = 50\ \Omega$

FREQUENCY		S ₁₁		S ₂₁		S ₁₂		S ₂₂	
(MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG	
200.00	0.802	-18.8	11.437	157.7	0.026	89.7	0.945	-12.9	
400.00	0.700	-35.7	10.038	138.7	0.044	66.9	0.862	-23.3	
600.00	0.588	-47.4	8.649	124.1	0.061	68.2	0.760	-31.0	
800.00	0.483	-59.2	7.480	111.5	0.082	58.5	0.673	-37.1	
1000.00	0.387	-68.4	6.479	100.9	0.102	56.1	0.612	-42.0	
1200.00	0.308	-78.3	5.695	92.0	0.101	52.1	0.559	-46.1	
1400.00	0.258	-86.5	5.044	84.5	0.119	53.7	0.496	-48.7	
1600.00	0.193	-94.3	4.494	76.8	0.134	48.5	0.460	-52.0	
1800.00	0.139	-110.4	4.112	70.8	0.147	49.4	0.417	-55.2	
2000.00	0.116	-120.7	3.746	64.7	0.145	43.7	0.403	-60.2	
2200.00	0.075	-143.0	3.429	59.1	0.168	40.5	0.368	-64.4	
2400.00	0.094	-174.9	3.204	53.1	0.186	40.7	0.329	-69.5	
2600.00	0.086	149.7	3.040	48.0	0.196	35.9	0.307	-76.1	
2800.00	0.131	125.6	2.805	42.8	0.201	37.7	0.296	-77.7	
3000.00	0.164	116.1	2.701	37.2	0.237	32.4	0.276	-86.6	

$V_{CE} = 2\text{ V}$, $I_c = 7\text{ mA}$, $Z_o = 50\ \Omega$

FREQUENCY		S ₁₁		S ₂₁		S ₁₂		S ₂₂	
(MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG	
200.00	0.754	-22.1	13.572	154.1	0.025	79.8	0.925	-14.3	
400.00	0.620	-39.0	11.414	133.6	0.042	66.8	0.823	-24.8	
600.00	0.501	-50.8	9.431	118.7	0.060	64.8	0.714	-31.5	
800.00	0.376	-61.0	7.926	106.6	0.068	57.5	0.639	-37.0	
1000.00	0.298	-70.4	6.730	96.7	0.086	58.3	0.587	-40.7	
1200.00	0.224	-78.7	5.860	88.5	0.100	60.1	0.528	-43.5	
1400.00	0.177	-87.7	5.137	81.7	0.106	57.2	0.487	-45.0	
1600.00	0.132	-96.9	4.552	74.4	0.118	53.2	0.448	-48.8	
1800.00	0.080	-108.7	4.145	69.0	0.131	53.1	0.421	-51.4	
2000.00	0.058	-128.1	3.769	63.3	0.143	48.0	0.397	-57.7	
2200.00	0.036	-178.5	3.425	57.9	0.166	45.1	0.378	-60.3	
2400.00	0.067	145.7	3.217	52.8	0.161	46.8	0.341	-66.6	
2600.00	0.104	122.4	3.026	48.0	0.183	39.2	0.321	-72.3	
2800.00	0.141	118.8	2.819	43.2	0.197	36.6	0.310	-74.1	
3000.00	0.205	107.8	2.735	37.7	0.193	33.2	0.321	-78.8	

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Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

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