NSF2250WT1

NPN Silicon Oscillator and Mixer Transistor

The NSF2250WT1 NPN silicon epitaxial bipolar transistor is intended for use in general purpose UHF oscillator and mixer applications. It is suitable for automovtive keyless entry and TV tuner designs.

The device features stable oscillation and small frequency drift during changes in the supply voltage and over the ambient temperature range.

Features

- High Gain Bandwidth Product: f_T = 2000 MHz Minimum
- Tightly Controlled h_{FE} Range: h_{FE} = 120 to 250
- Low Feedback Capacitance: C_{RE} = 0.45 pF Typical

MAXIMUM RATINGS

Parameters	Symbol	Units	Ratings
Collector to Base Voltage	V_{CBO}	V	30
Collector to Emitter Voltage	V_{CEO}	V	15
Emitter to Base Voltage	VE_{BO}	V	3.0
Collector Current	I_C	mA	50
Electrostatic Discharge	ESD	HBM – Class 1C MM – Class A	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation T_A = 25°C Derate above 25°C	P_D	202 (Note 1) 310 (Note 2) 1.6 (Note 1) 2.5 (Note 2)	mW mW/°C
Thermal Resistance – Junction-to-Ambient	$R_{\theta JA}$	618 (Note 1) 403 (Note 2)	°C/W
Thermal Resistance – Junction-to-Lead	$R_{\theta JL}$	280 (Note 1) 332 (Note 2)	°C/W
Junction and Storage Temperature Range	T_J, T_{stg}	–55 to +150	°C

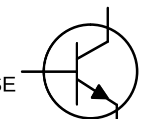
1. FR–4 @ Minimum Pad
2. FR–4 @ 1.0 x 1.0 inch Pad

ON Semiconductor™

http://onsemi.com

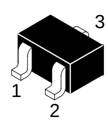
COLLECTOR
3

1
BASE

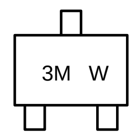


2
EMITTER

MARKING DIAGRAM



SOT–323/SC–70
CASE 419
STYLE 3



3M = Specific Device Code
W = Date Code

ORDERING INFORMATION

Device	Package	Shipping
NSF2250WT1	SOT–323	3000/Tape & Reel

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

Characteristic	Symbol	Min	Typ	Max	Unit
Collector Cutoff Current, V_{CB} = 12 V, I_E = 0	I_{CBO}	–	–	0.1	μA
DC Current Gain, V_{CE} = 10 V, I_C = 5.0 mA	h_{FE}	120	–	250	–
Collector Saturation Voltage, I_C = 10 mA, I_B = 1.0 mA	$V_{CE(sat)}$	–	–	0.5	V
Gain Bandwidth Product, V_{CE} = 3 V, I_E = –5.0 mA	f_T	2.0	2.3	–	GHz
Output Capacitance, V_{CB} = 3 V, I_E = 0 mA, f = 1.0 MHz	C_{OB}	–	0.7	1.2	pF
Collector to Base Time Constant, V_{CE} = 3 V, I_E = –5.0 mA, f = 31.9 MHz	$C_C \bullet r_{b'b}$	–	3.5	8.0	ps
Feedback Capacitance, V_{CB} = 10 V, I_E = 0 mA, f = 1.0 MHz	C_{RE}	–	0.45	–	pF

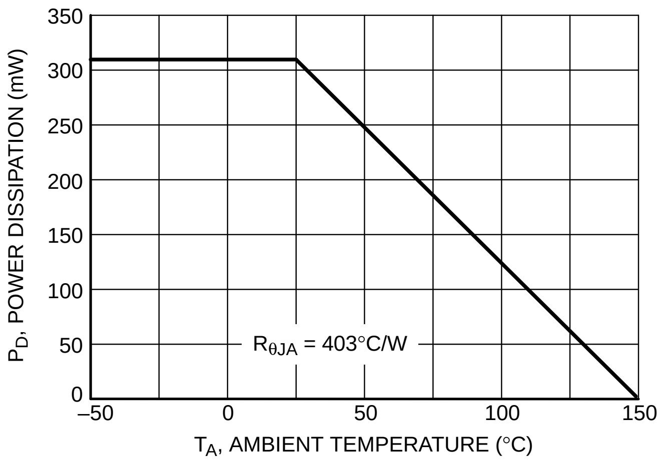


Figure 1. Derating Curve

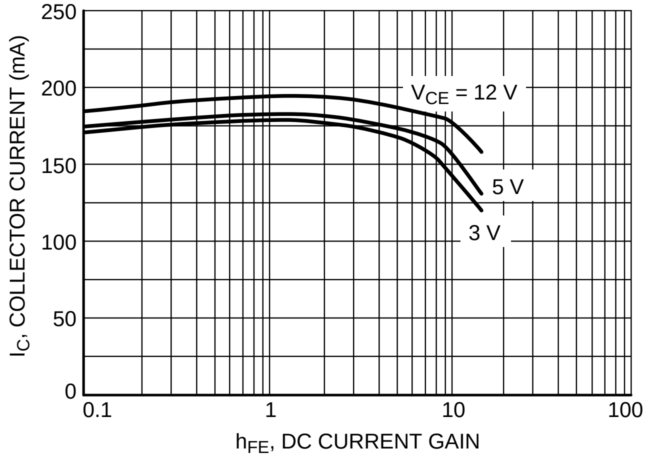


Figure 2. DC Current Gain versus Collector Current

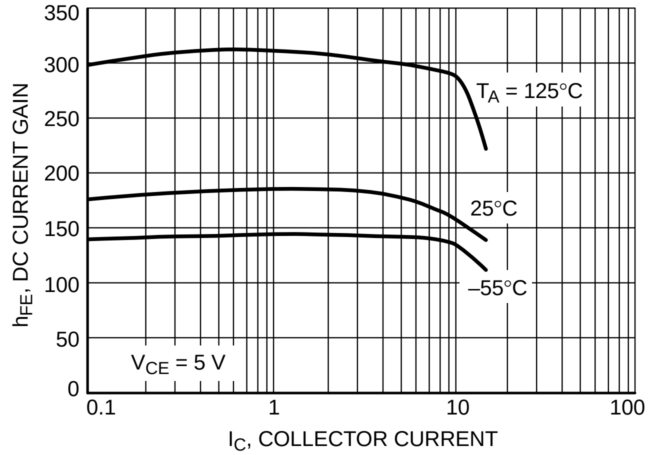


Figure 3. DC Current Gain versus Collector Current

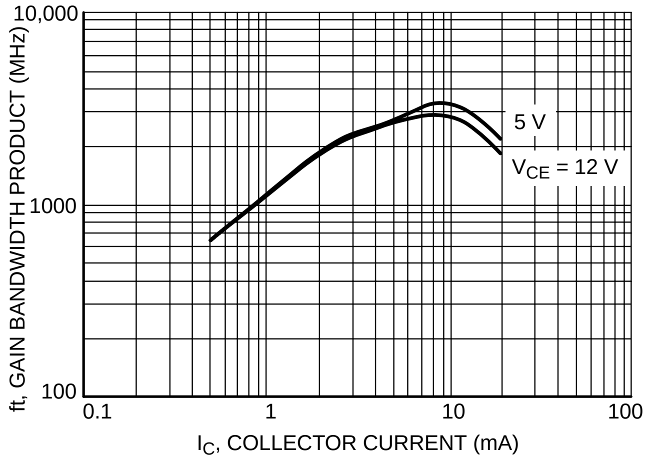


Figure 4. Gain Bandwidth Product versus Collector Current

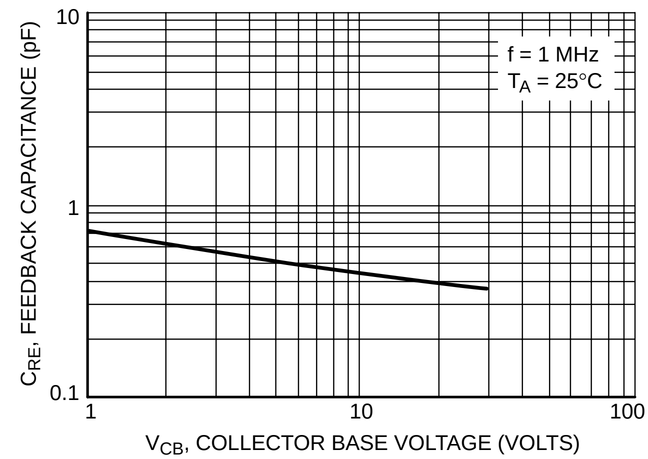


Figure 5. Device Capacitance versus Collector Base Voltage

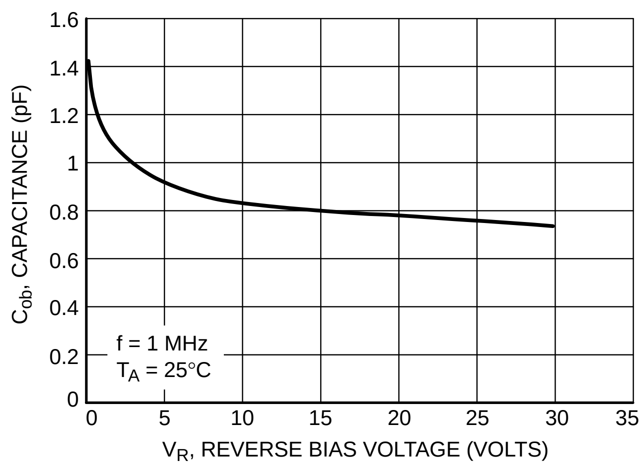


Figure 6. Output Capacitance

TYPICAL COMMON EMITTER SCATTERING PARAMETER (T_A = 25°C)

Freq	S11		S21		S12		S22	
MHz	Mag	Ang	Mag	Ang	Mag	Ang	Mag	Ang
V_{CE} = 2.5 V, I_C = 2.5 mA								
50	0.926	–14.124	6.803	162.639	0.018	82.792	0.973	–7.062
100	0.855	–26.794	6.224	148.649	0.034	73.296	0.921	–12.818
200	0.667	–47.287	5.033	126.317	0.058	62.292	0.807	–19.210
300	0.513	–60.931	4.072	110.981	0.074	58.641	0.736	–21.979
400	0.411	–70.342	3.326	100.524	0.090	57.333	0.694	–23.695
500	0.342	–77.461	2.831	92.771	0.104	56.067	0.670	–25.311
600	0.297	–84.335	2.445	86.222	0.117	55.166	0.651	–27.095
700	0.261	–90.986	2.154	80.493	0.131	53.800	0.637	–29.095
800	0.236	–97.798	1.935	75.382	0.144	52.087	0.627	–31.026
900	0.218	–104.905	1.755	70.672	0.155	50.745	0.617	–33.167
1000	0.205	–112.449	1.617	66.258	0.168	49.386	0.608	–35.352
1500	0.190	–147.224	1.200	48.079	0.219	42.418	0.575	–46.016
2000	0.215	–171.677	1.011	33.299	0.258	35.910	0.544	–58.267
2500	0.230	–172.291	0.889	20.271	0.294	31.024	0.510	–68.713
3000	0.236	–155.125	0.866	10.984	0.340	28.868	0.450	–81.517

TYPICAL COMMON EMITTER SCATTERING PARAMETER (T_A = 25°C)

Freq	S11		S21		S12		S22	
MHz	Mag	Ang	Mag	Ang	Mag	Ang	Mag	Ang
V_{CE} = 3 V, I_C = 5 mA								
50	0.858	–20.126	12.065	156.269	0.017	78.802	0.945	–10.278
100	0.733	–36.552	10.452	139.116	0.029	69.100	0.850	–16.656
200	0.493	–58.358	7.472	115.678	0.047	62.893	0.712	–20.497
300	0.362	–69.976	5.544	103.053	0.062	62.188	0.653	–21.545
400	0.288	–78.272	4.337	94.866	0.075	61.876	0.621	–22.551
500	0.242	–85.666	3.582	88.592	0.090	61.259	0.603	–23.975
600	0.212	–93.237	3.048	83.504	0.103	59.861	0.590	–25.526
700	0.190	–101.308	2.656	78.785	0.116	58.802	0.580	–27.405
800	0.177	–109.656	2.375	74.561	0.128	57.017	0.573	–29.334
900	0.167	–118.336	2.145	70.348	0.141	55.629	0.563	–31.402
1000	0.163	–127.188	1.968	66.700	0.153	53.851	0.555	–33.301
1500	0.176	–164.287	1.435	50.083	0.203	47.574	0.528	–43.164
2000	0.210	–174.155	1.187	35.998	0.246	41.767	0.501	–54.213
2500	0.226	–159.754	1.034	23.227	0.288	36.614	0.469	–63.689
3000	0.239	–144.224	0.995	14.088	0.340	34.458	0.413	–74.387

TYPICAL COMMON EMITTER SCATTERING PARAMETER (T_A = 25°C)

Freq	S11		S21		S12		S22	
MHz	Mag	Ang	Mag	Ang	Mag	Ang	Mag	Ang
V_{CE} = 3 V, I_C = 10 mA								
50	0.643	–35.313	15.384	140.063	0.015	69.823	0.864	–14.048
100	0.459	–53.013	11.650	121.580	0.024	63.636	0.738	–17.013
200	0.289	–70.035	7.214	104.714	0.040	65.531	0.647	–17.265
300	0.225	–80.644	5.260	96.934	0.053	66.205	0.618	–18.444
400	0.192	–91.607	4.122	91.266	0.068	66.344	0.598	–20.216
500	0.172	–102.488	3.419	86.447	0.082	64.574	0.584	–22.273
600	0.161	–113.748	2.929	82.212	0.096	63.206	0.572	–24.418
700	0.156	–125.151	2.575	78.231	0.107	61.822	0.561	–26.828
800	0.155	–135.549	2.313	74.282	0.119	60.606	0.553	–28.821
900	0.156	–145.469	2.099	70.461	0.131	59.154	0.543	–31.132
1000	0.163	–153.718	1.925	67.004	0.141	57.409	0.536	–33.247
1500	0.201	–175.526	1.415	50.535	0.193	52.024	0.505	–43.365
2000	0.237	–159.398	1.173	36.726	0.240	46.396	0.477	–54.652
2500	0.247	–147.097	1.021	24.113	0.289	41.529	0.444	–64.094
3000	0.259	–133.925	0.982	15.023	0.346	38.491	0.382	–75.243

TYPICAL COMMON EMITTER SCATTERING PARAMETER (T_A = 25°C)

Freq	S11		S21		S12		S22	
MHz	Mag	Ang	Mag	Ang	Mag	Ang	Mag	Ang
V_{CE} = 10 V, I_C = 5 mA								
50	0.877	–17.278	11.972	157.707	0.012	81.580	0.972	–7.268
100	0.765	–31.274	10.386	140.944	0.022	72.099	0.900	–12.126
200	0.539	–49.213	7.575	118.277	0.037	66.849	0.803	–14.944
300	0.406	–57.758	5.678	105.478	0.049	66.104	0.757	–16.182
400	0.334	–63.347	4.464	97.467	0.062	65.473	0.729	–17.508
500	0.286	–68.461	3.698	91.347	0.073	64.460	0.717	–19.007
600	0.252	–73.828	3.159	86.264	0.085	63.014	0.706	–20.874
700	0.227	–79.612	2.766	81.745	0.095	62.100	0.697	–22.551
800	0.208	–86.135	2.474	77.803	0.106	60.785	0.690	–24.442
900	0.190	–93.121	2.237	73.571	0.116	59.532	0.682	–26.405
1000	0.179	–100.507	2.047	70.150	0.125	57.905	0.674	–28.385
1500	0.162	–139.494	1.495	53.949	0.169	52.604	0.652	–37.411
2000	0.185	–167.453	1.242	40.156	0.207	47.697	0.631	–47.834
2500	0.200	–175.534	1.082	27.306	0.247	44.045	0.609	–55.962
3000	0.208	–159.130	1.050	18.234	0.296	42.716	0.557	–65.696

V_{CE} = 2.5 V, I_C = 2.5 mA

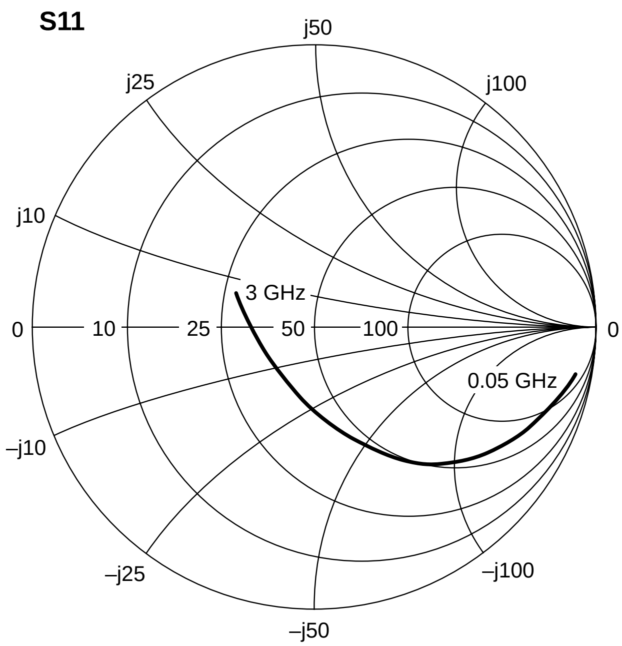


Figure 7. Input Reflection Coefficient

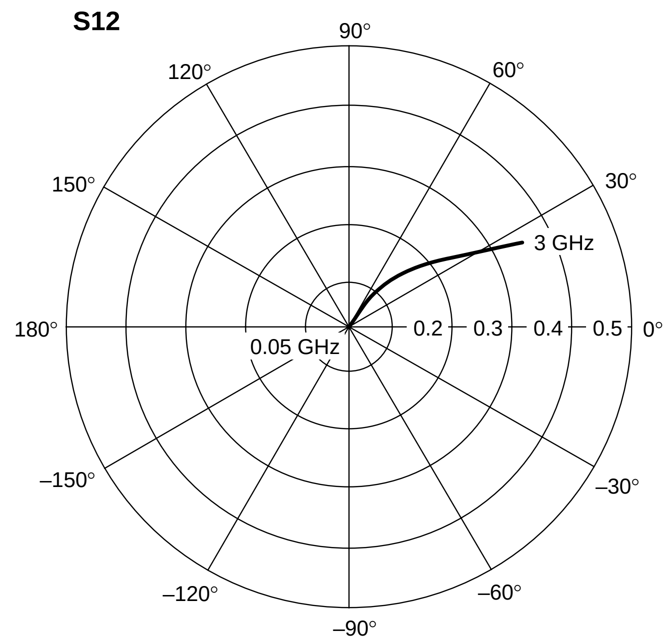


Figure 8. Reverse Transmission Coefficient

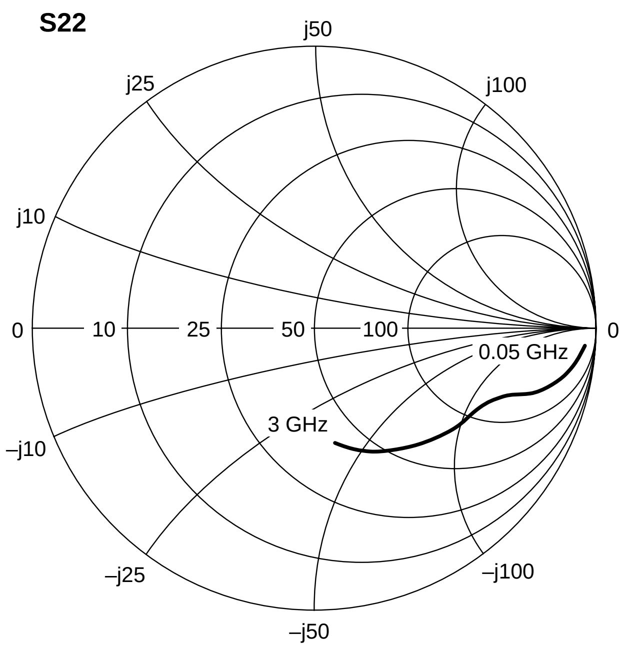


Figure 9. Output Reflection Coefficient

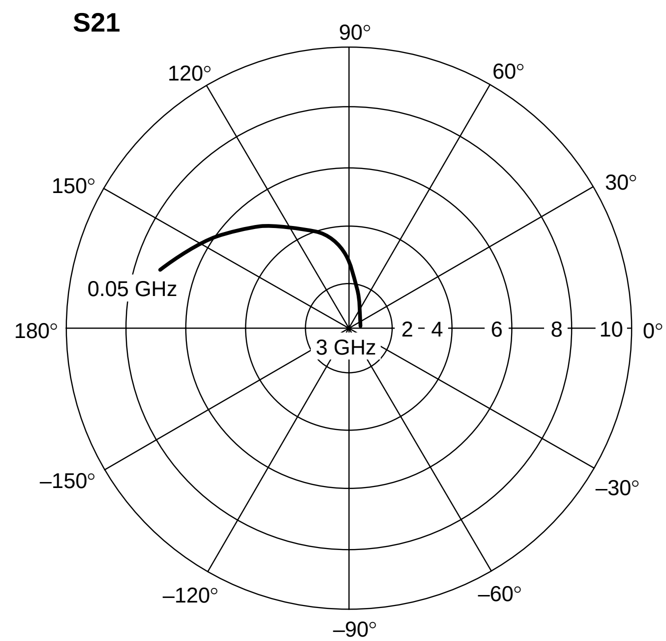


Figure 10. Forward Transmission Coefficient

V_{CE} = 3.0 V, I_C = 10 mA

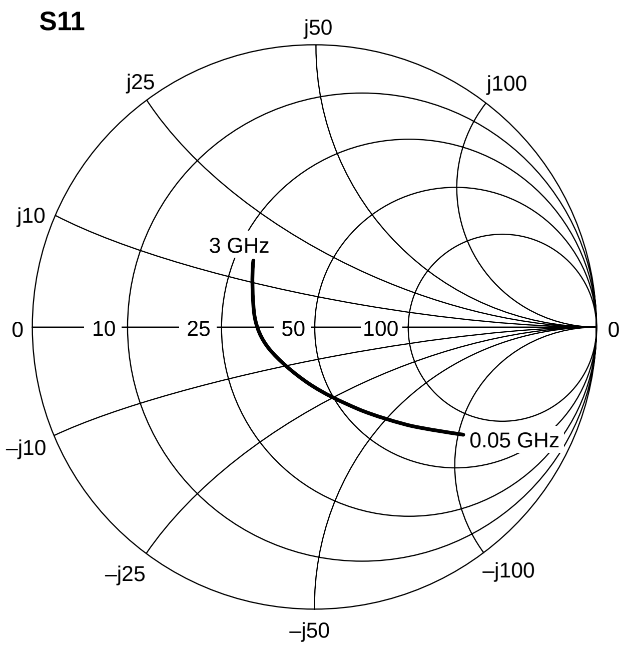


Figure 11. Input Reflection Coefficient

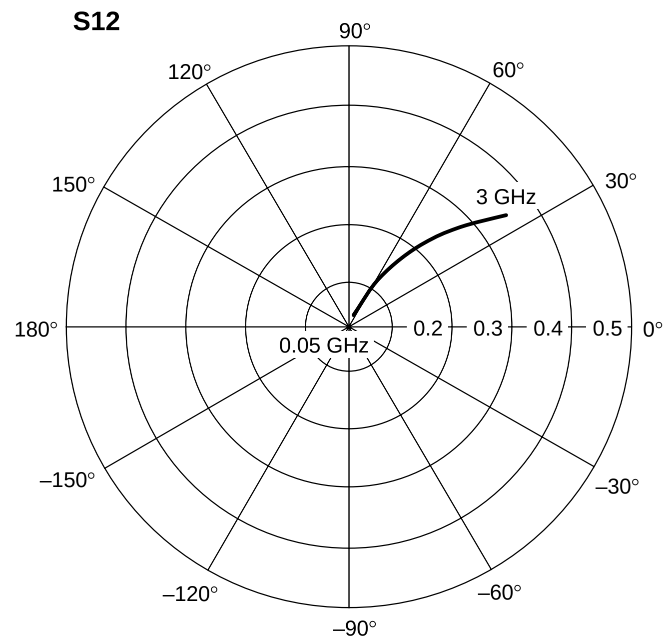


Figure 12. Reverse Transmission Coefficient

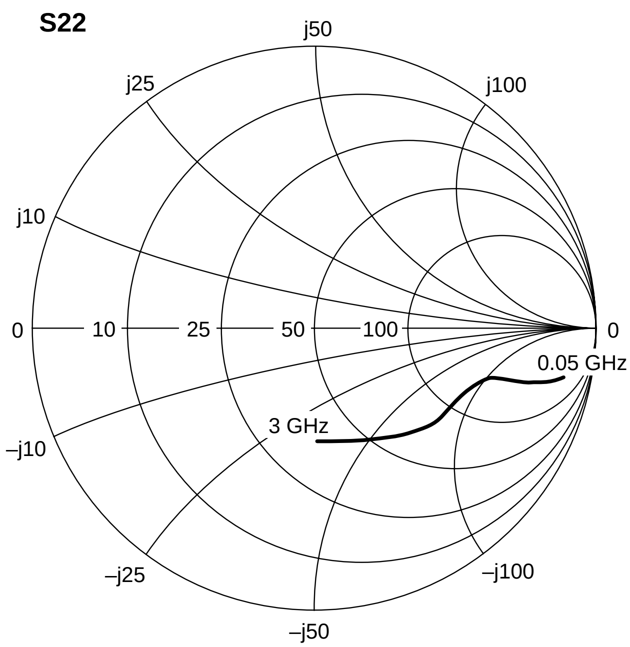


Figure 13. Output Reflection Coefficient

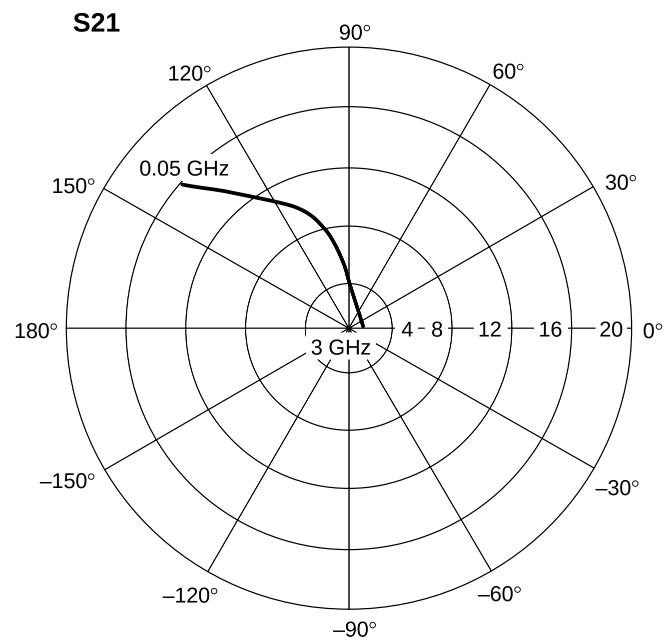


Figure 14. Forward Transmission Coefficient

TYPICAL COMMON BASE SCATTERING PARAMETER (T_A = 25°C)

V_{CE} = 2.5 V, I_C = 2.5 mA

Freq	S11		S21		S12		S22	
MHz	Mag	Ang	Mag	Ang	Mag	Ang	Mag	Ang
50	0.627	176.455	1.6218	–3.3808	0.003	81.692	1.006	–1.7455
100	0.626	172.821	1.6153	–6.8404	0.008	87.954	1.002	–3.5734
200	0.622	165.583	1.6042	–13.205	0.014	92.620	1.005	–6.7806
400	0.608	151.867	1.5630	–26.289	0.031	96.834	1.006	–13.779
600	0.589	138.455	1.5099	–39.579	0.052	96.285	1.016	–21.141
800	0.566	126.103	1.4461	–52.382	0.076	94.675	1.022	–28.553
1000	0.541	114.811	1.3613	–65.315	0.102	90.577	1.026	–36.519
1500	0.476	89.445	1.1404	–98.892	0.170	78.774	1.014	–57.448
2000	0.397	68.206	0.8928	–133.58	0.233	68.003	0.922	–77.708

TYPICAL COMMON BASE SCATTERING PARAMETER (T_A = 25°C)

V_{CE} = 3 V, I_C = 5 mA

Freq	S11		S21		S12		S22	
MHz	Mag	Ang	Mag	Ang	Mag	Ang	Mag	Ang
50	0.781	176.95	1.7732	–3.0425	0.004	85.472	1.006	–1.6658
100	0.780	174.093	1.7625	–5.9870	0.006	88.871	1.002	–3.5604
200	0.776	168.012	1.7622	–11.733	0.013	94.408	1.004	–6.7723
400	0.759	156.688	1.7285	–23.541	0.029	100.70	1.006	–13.627
600	0.743	145.893	1.6911	–35.161	0.047	100.93	1.015	–20.799
800	0.725	135.660	1.6441	–46.886	0.071	98.938	1.024	–28.057
1000	0.709	126.241	1.5817	–58.697	0.095	95.803	1.031	–35.921
1500	0.674	103.465	1.4275	–90.316	0.172	85.633	1.037	–56.915
2000	0.620	81.3686	1.1968	–123.89	0.249	73.589	0.957	–77.953

TYPICAL COMMON BASE SCATTERING PARAMETER (T_A = 25°C)

V_{CE} = 3 V, I_C = 10 mA

Freq	S11		S21		S12		S22	
MHz	Mag	Ang	Mag	Ang	Mag	Ang	Mag	Ang
50	0.867	176.898	1.8601	–3.2938	0.004	88.195	1.006	–1.7132
100	0.863	173.941	1.8432	–6.3479	0.007	90.044	1.001	–3.6916
200	0.851	167.942	1.8370	–12.359	0.014	91.598	1.003	–6.9503
400	0.821	157.527	1.7814	–23.95	0.029	96.128	1.003	–13.909
600	0.795	148.933	1.7303	–34.993	0.045	97.955	1.011	–21.082
800	0.782	139.487	1.6831	–46.443	0.067	98.521	1.018	–28.456
1000	0.773	131.501	1.6327	–57.916	0.091	96.532	1.024	–36.296
1500	0.765	110.253	1.4975	–89.11	0.169	88.005	1.031	–57.462
2000	0.730	87.937	1.2711	–123.21	0.253	76.070	0.950	–78.777

V_{CE} = 2.5 V, I_C = 2.5 mA

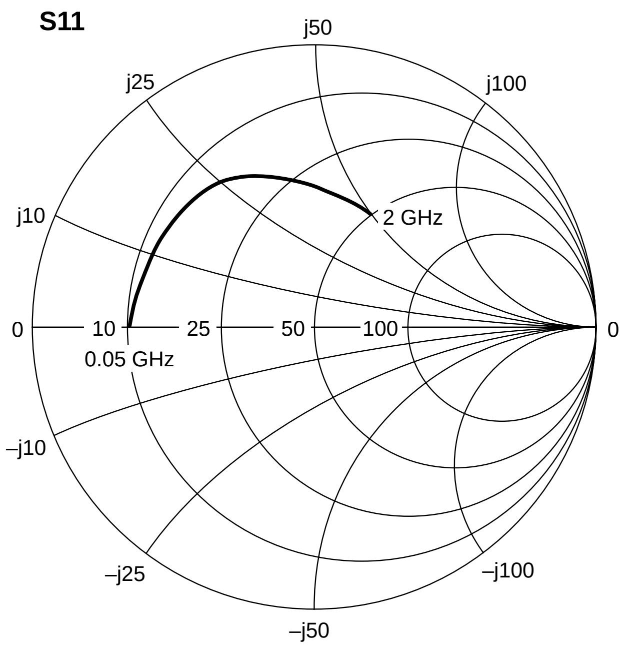


Figure 15. Input Reflection Coefficient

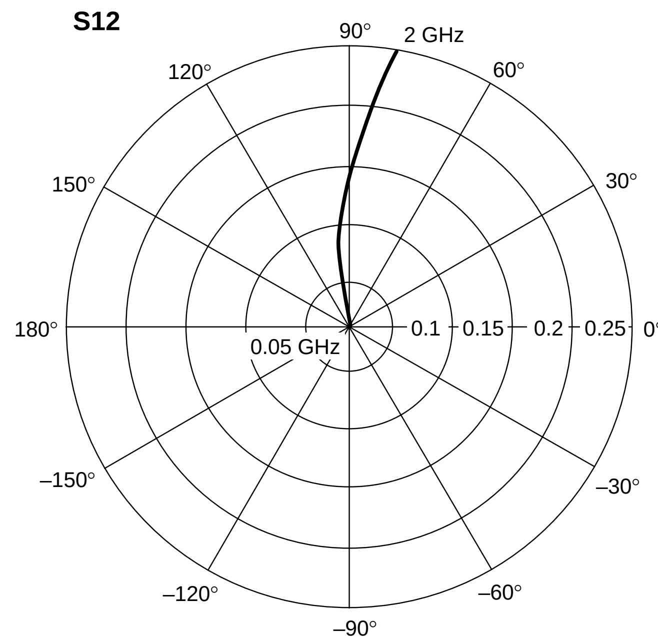


Figure 16. Reverse Transmission Coefficient

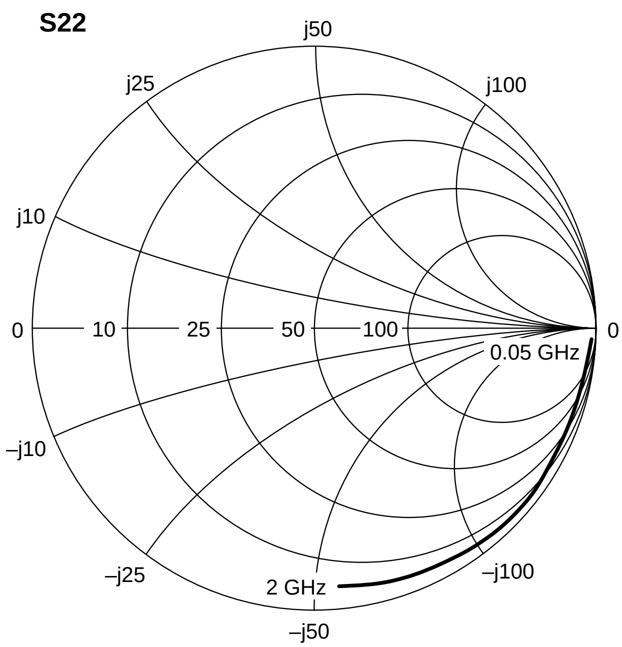


Figure 17. Output Reflection Coefficient

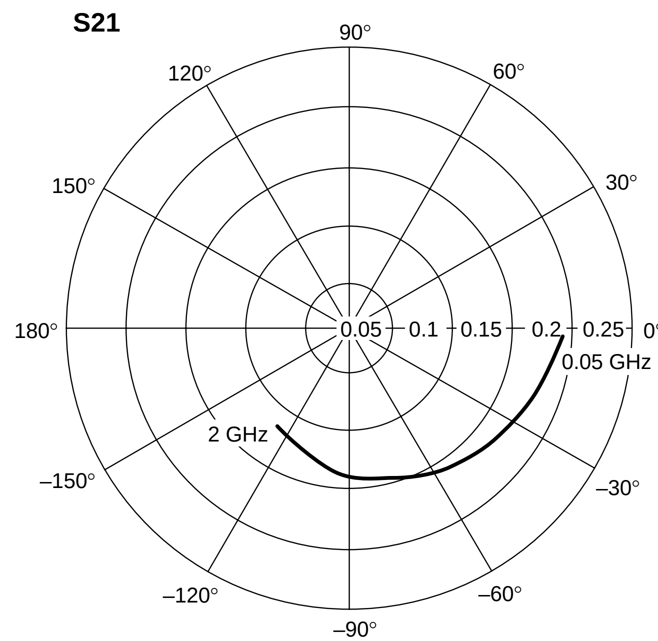
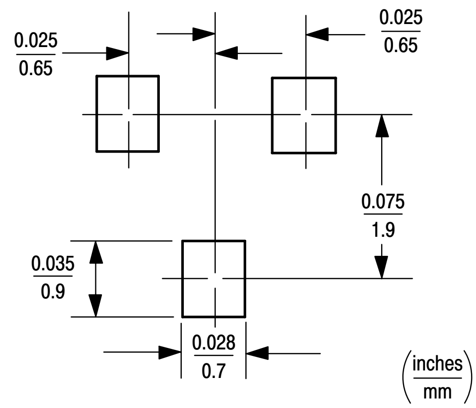


Figure 18. Forward Transmission Coefficient

INFORMATION FOR USING THE SC–70/SOT–323 SURFACE MOUNT PACKAGE

MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to insure proper solder connection interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.



SC–70/SOT–323 POWER DISSIPATION

The power dissipation of the SC–70/SOT–323 is a function of the pad size. This can vary from the minimum pad size for soldering to the pad size given for maximum power dissipation. Power dissipation for a surface mount device is determined by $T_{J(max)}$, the maximum rated junction temperature of the die, $R\theta_{JA}$, the thermal resistance from the device junction to ambient; and the operating temperature, T_A. Using the values provided on the data sheet, P_D can be calculated as follows.

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

The values for the equation are found in the maximum ratings table on the data sheet. Substituting these values into the equation for an ambient temperature T_A of 25°C, one can calculate the power dissipation of the device which in this case is 200 milliwatts.

$$P_D = \frac{150°C - 25°C}{0.625°C/W} = 200 \text{ milliwatts}$$

The 0.625°C/W assumes the use of the recommended footprint on a glass epoxy printed circuit board to achieve a power dissipation of 200 milliwatts. Another alternative would be to use a ceramic substrate or an aluminum core board such as Thermal Clad®. Using a board material such as Thermal Clad, a higher power dissipation of 300 milliwatts can be achieved using the same footprint.

SOLDERING PRECAUTIONS

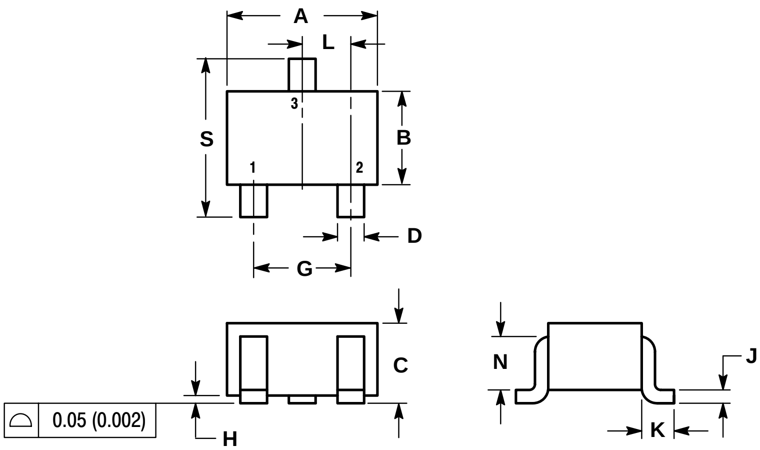
The melting temperature of solder is higher than the rated temperature of the device. When the entire device is heated to a high temperature, failure to complete soldering within a short time could result in device failure. Therefore, the following items should always be observed in order to minimize the thermal stress to which the devices are subjected.

- Always preheat the device.
- The delta temperature between the preheat and soldering should be 100°C or less.*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the reflow soldering method, the difference should be a maximum of 10°C.
- The soldering temperature and time should not exceed 260°C for more than 10 seconds.
- When shifting from preheating to soldering, the maximum temperature gradient should be 5°C or less.
- After soldering has been completed, the device should be allowed to cool naturally for at least three minutes. Gradual cooling should be used as the use of forced cooling will increase the temperature gradient and result in latent failure due to mechanical stress.
- Mechanical stress or shock should not be applied during cooling

* Soldering a device without preheating can cause excessive thermal shock and stress which can result in damage to the device.

PACKAGE DIMENSIONS

SC–70 (SOT–323)
CASE 419–04
ISSUE L



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.071	0.087	1.80	2.20
B	0.045	0.053	1.15	1.35
C	0.032	0.040	0.80	1.00
D	0.012	0.016	0.30	0.40
G	0.047	0.055	1.20	1.40
H	0.000	0.004	0.00	0.10
J	0.004	0.010	0.10	0.25
K	0.017 REF		0.425 REF	
L	0.026 BSC		0.650 BSC	
N	0.028 REF		0.700 REF	
S	0.079	0.095	2.00	2.40

STYLE 3:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

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