



# NPN SILICON HIGH FREQUENCY TRANSISTOR

# NE021 SERIES

## FEATURES

- HIGH INSERTION GAIN: 18.5 dB at 500 MHz
- LOW NOISE FIGURE: 1.5 dB at 500 MHz
- HIGH POWER GAIN: 12 dB at 2 GHz
- LARGE DYNAMIC RANGE: 19 dBm at 1 dB 2 GHz Gain Compression

## DESCRIPTION AND APPLICATIONS

The NE021 series of NPN silicon transistors provides economical solutions to wide ranges of amplifier and oscillator problems. Low noise and high current capability provide wide dynamic ranges; the excellent linearity of  $S_{21}$  with collector current assures low intermodulation distortion. The NE021 series is available as a chip or in several package styles. The series uses the NEC gold, platinum, titanium, and platinum-silicide metallization system to provide the utmost in reliability. Most package options are available with Grade C (JANTXV equivalent) and Grade CX (JANTX equivalent) reliability screening. Some packages are available in both common-base and common-emitter configurations. The NE02103 and the NE02107 have been qualified for high-reliability space applications.

## ABSOLUTE MAXIMUM RATINGS (TA = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V <sub>CEO</sub>	Collector to Base Voltage	V	25
V <sub>CE0</sub>	Collector to Emitter Voltage	V	12 <sup>1</sup>
V <sub>EB0</sub>	Emitter to Base Voltage	V	3
I <sub>C</sub>	Collector Current	mA	70
T <sub>J</sub>	Junction Temperature	°C	200 <sup>2</sup>
T <sub>STG</sub>	Storage Temperature	°C	-65 to +200 <sup>3</sup>

Notes:

1. Typical  $BV_{CE0} = 25$  V for  $R \leq 300 \Omega$ .
2. Maximum T<sub>J</sub> for the NE02132, NE02133, NE02136, and NE02137 is +150°C.
3. Maximum storage temperature for the NE02132, NE02135, NE02136 and NE02137 is -65 to +150°C. Maximum storage temperature for the NE02133 is -55 to +150°C.

## NE02135 TYPICAL NOISE PARAMETERS

V<sub>CE</sub> = 10 V, I<sub>C</sub> = 5 mA

FREQUENCY (MHz)	NF <sub>min</sub> (dB)	GA	OPT SOURCE	R <sub>N</sub> /50 Ω
500	1.2	18.6	.36 ∠ 69°	.14
1000	1.5	13.9	.31 ∠ 124°	.12
1500	2.0	12.1	.50 ∠ 165°	.05
2000	2.4	9.6	.44 ∠ -175°	.06
2500	2.6	8.9	.52 ∠ -161°	.10
3000	3.6	8.6	.68 ∠ -141°	.14
3500	3.7	6.9	.71 ∠ -139°	.21

V<sub>CE</sub> = 10 V, I<sub>C</sub> = 20 mA

500	1.8	20.6	.16 ∠ 149°	.15
1000	1.9	16.1	.33 ∠ 169°	.13
1500	2.4	13.5	.46 ∠ -179°	.09
2000	2.9	11.5	.53 ∠ -167°	.08
2500	3.2	9.8	.57 ∠ -154°	.14
3000	3.9	9.7	.62 ∠ -139°	.27
3500	4.3	7.6	.67 ∠ -134°	.42

**PERFORMANCE SPECIFICATIONS (TA = 25°C)**

SYMBOLS	PART NUMBER EIAJ <sup>1</sup> REGISTERED NUMBER PACKAGE OUTLINE	NE02100 00 (CHIP)			NE02103 2SC1560(C) 03			NE02107 07			NE02112 2SC1988 12			NE02132 2SC2570 32			NE02133 2SC2351 33			NE02135 2SC2149 35			NE02137 2SC2369 37			
		PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX		
f <sub>r</sub>	Gain Bandwidth Product at V <sub>CE</sub> = 10 V, I <sub>c</sub> = 20 mA	GHz	4.5			4.5			4.5			4.5			4.5			4.5			4.5			4.5		
S <sub>21</sub>   <sup>2</sup>	Insertion Power Gain at V <sub>CE</sub> = 10 V, I <sub>c</sub> = 20 mA, f = 0.5 GHz f = 1 GHz f = 2 GHz	dB	18.5	13	6.5	18.5	13	6.5	18.5	13	6.5	15	10	4	15	10	4	15	10	4	18.5	13	5.7	18.5	13	5.7
NF <sub>MIN</sub>	Minimum Noise Figure <sup>2</sup> at V <sub>CE</sub> = 10 V, I <sub>c</sub> = 3 mA, f = 0.5 GHz V <sub>CE</sub> = 10 V, I <sub>c</sub> = 5 mA, f = 1 GHz f = 2 GHz	dB	1.5			1.5			1.5			1.5	2.5		1.5	2.5		1.5	3		1.5			1.5		
MAG	Maximum Available Gain <sup>3</sup> at V <sub>CE</sub> = 10 V, I <sub>c</sub> = 20 mA, f = 0.5 GHz f = 1 GHz f = 2 GHz	dB	22	18	12	22	18	12	22	18	12	17.5	12.5	7.5	11.5			14			22	18	11	22	18	11

Notes:

- Electronic Industrial Association of Japan.
- Input and output are tuned for optimum noise figures.
- Maximum Available Gain (MAG) is calculated for the device S-Parameters using the equation,  $MAG = |S_{21}|^2 \cdot \frac{1}{1 - |S_{11}|^2} \cdot \frac{1}{1 - |S_{22}|^2}$

**ELECTRICAL SPECIFICATIONS (TA = 25°C)**

SYMBOLS	PART NUMBER EIAJ <sup>1</sup> REGISTERED NUMBER PACKAGE OUTLINE	NE02100 00 (CHIP)			NE02103 2SC1560(C) 03			NE02107 07			NE02112 2SC1988 12			NE02132 2SC2570 32			NE02133 2SC2351 33			NE02135 2SC2149 35			NE02137 2SC2369 37		
		PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
I <sub>CO</sub>	Collector Cutoff Current at V <sub>CB</sub> = 15 V, I <sub>E</sub> = 0	μA			1.0			1.0			1.0			1.0			1.0			1.0			1.0		
I <sub>EO</sub>	Emitter Cutoff Current at V <sub>EB</sub> = 2 V, I <sub>C</sub> = 0	μA			1.0			1.0			1.0			1.0			1.0			1.0			1.0		
I <sub>FE</sub>	Forward Current Gain at V <sub>CE</sub> = 10 V, I <sub>c</sub> = 20 mA		20	70	250	20	70	250	20	70	250	20	70	250	20	70	250	20	70	250	20	70	250	20	70
C <sub>CB</sub>	Collector to Base Capacitance <sup>2</sup> at V <sub>CB</sub> = 10 V, I <sub>E</sub> = 0, f = 1 MHz	pF			0.6	1.0	0.6	1.0	0.6	1.0	0.6	1.0	0.6	1.0	0.7	0.9	0.75	1.0	0.6	1.0	0.6	1.0	0.75	1.0	0.75
R <sub>TH</sub>	Thermal Resistance (μ-C)	°C/W			70			90			90			90			666			600			600		
R <sub>TH</sub>	Thermal Resistance (J-A)	mW			300			500			500			500			150			290			500		
P <sub>T</sub> <sup>3</sup>	Total Power Dissipation	mW	580		700	580		700	350		700	350		250			200			250			250		

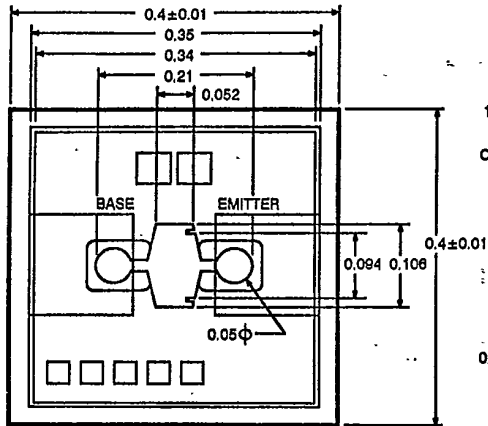
Notes:

- Electronic Industrial Association of Japan.
- C<sub>CB</sub> measurement employs a three-terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal.
- Minimum dissipation based on R<sub>TH(μ-A)</sub> for applications without effective heatsink, maximum dissipation based on R<sub>TH(μ-C)</sub> for applications with effective heatsink.

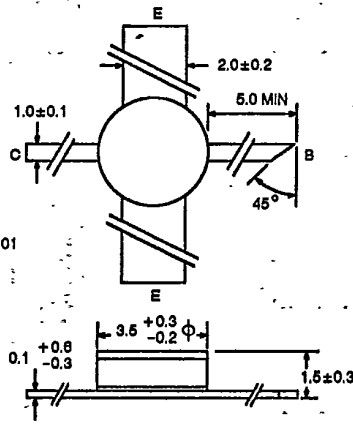


OUTLINE DIMENSIONS (Units in mm)

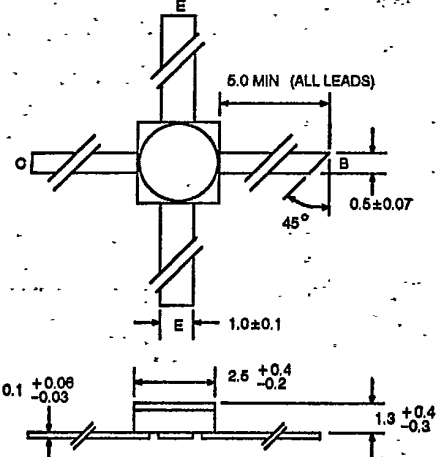
NE02100 (CHIP)  
(Chip Thickness: 140 μm)



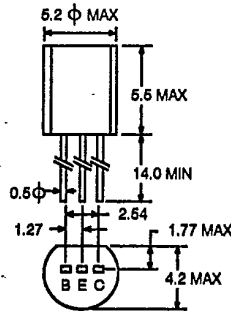
OUTLINE 03



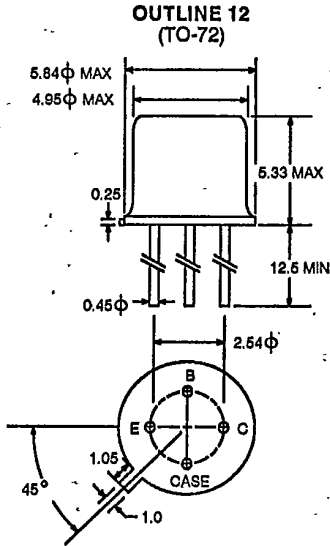
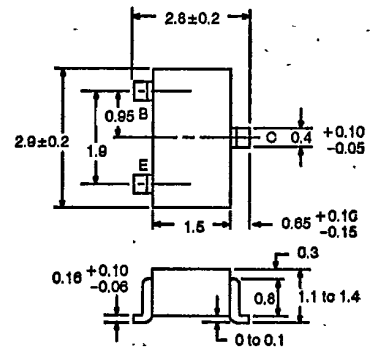
OUTLINE 07



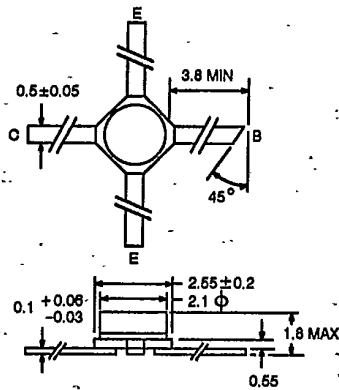
OUTLINE 32  
(TO-92)



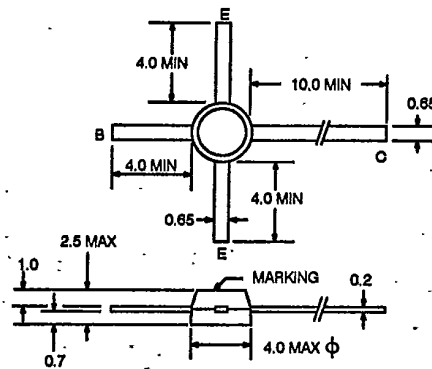
OUTLINE 33  
(SOT-23)



OUTLINE 35  
(MICRO-X)



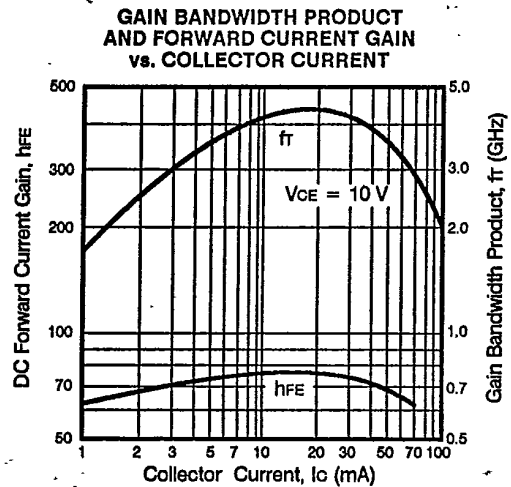
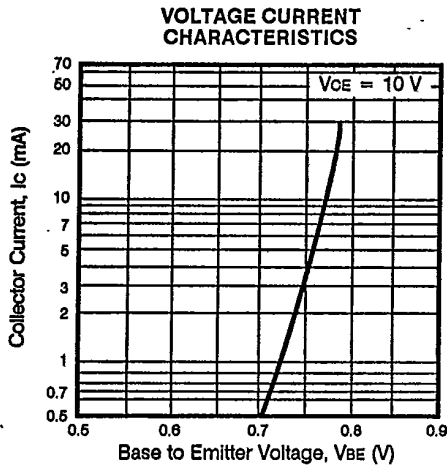
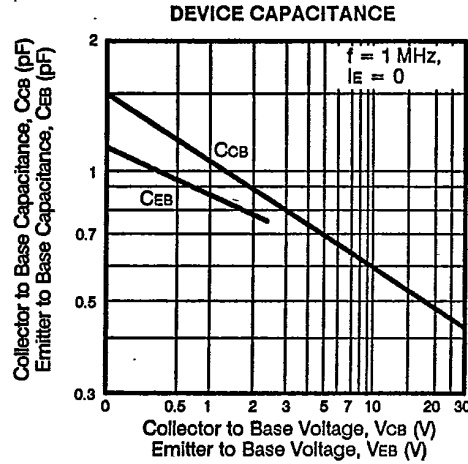
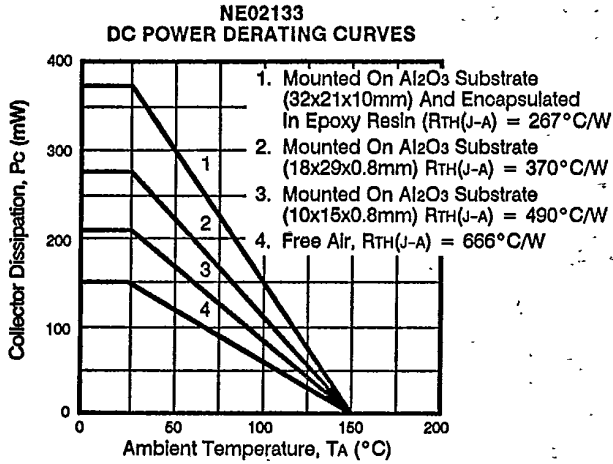
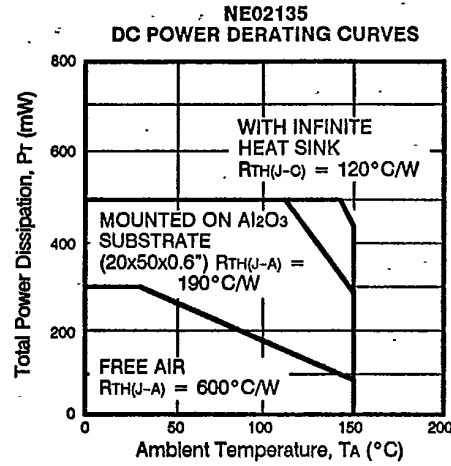
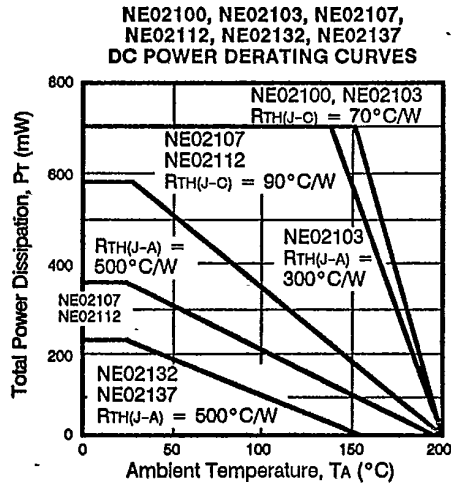
OUTLINE 37



\*The NE02136 is available with only the bottom emitter lead.

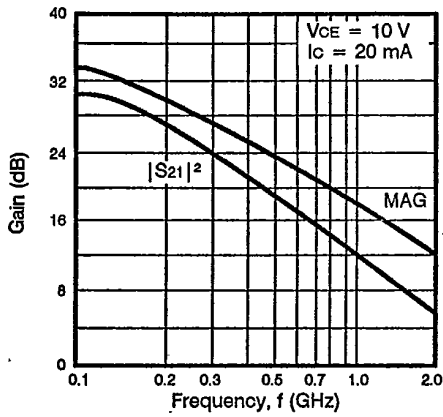
T-31-17  
T-31-19

TYPICAL DEVICE CHARACTERISTICS (TA = 25°C)

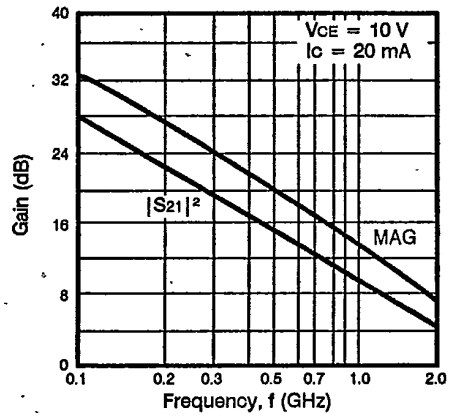


TYPICAL PERFORMANCE CHARACTERISTICS (TA = 25°C)

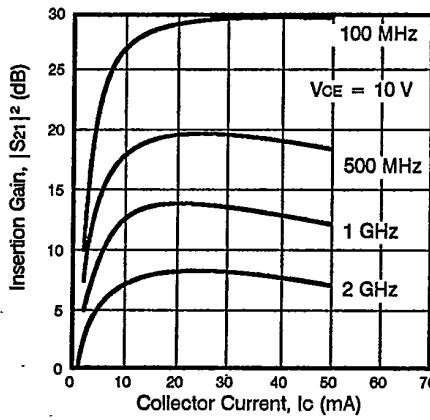
NE02103, NE02107, NE02135  
GAIN vs. FREQUENCY



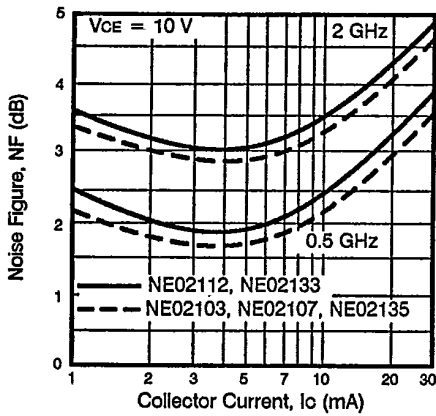
NE02112, NE02133  
GAIN vs. FREQUENCY



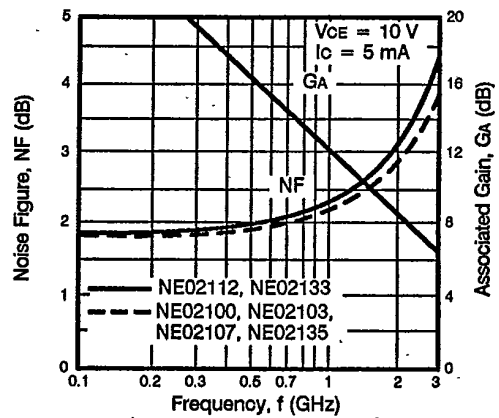
NE02103, NE02107  
INSERTION GAIN vs. COLLECTOR CURRENT



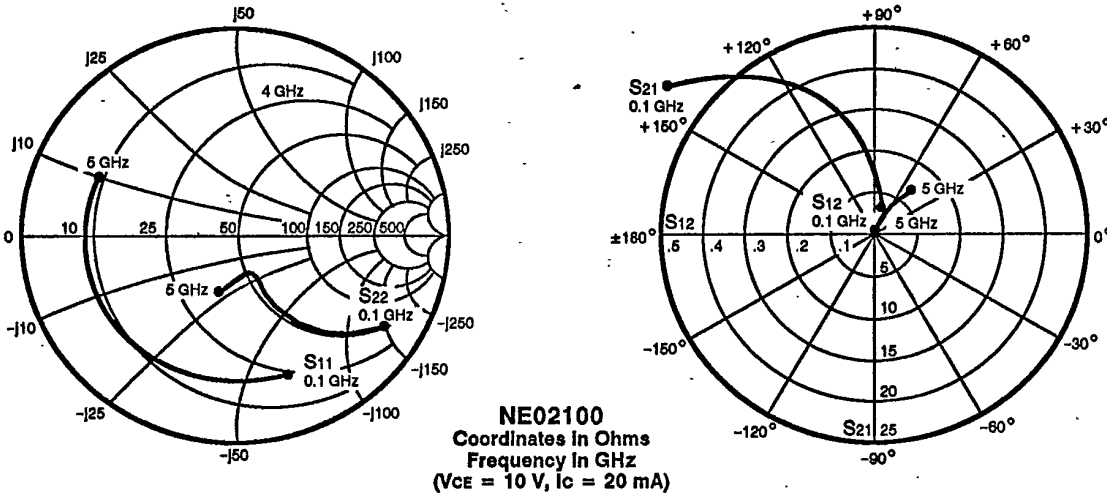
NOISE FIGURE vs. COLLECTOR CURRENT



NOISE FIGURE AND ASSOCIATED GAIN vs. FREQUENCY



**TYPICAL COMMON EMITTER SCATTERING PARAMETERS**



**S-MAGN AND ANGLES:**

VCE = 10 V, IC = 5 mA

FREQUENCY (MHz)	S11	S21	S12	S22	k	GMA dB
100	.84 -32	11.83 160	.03 70	.94 -16	.11	26.4
500	.75 -114	7.22 113	.07 36	.56 -45	.29	19.9
1000	.73 -150	4.13 89	.09 27	.39 -61	.54	16.9
1500	.71 -164	2.85 76	.09 27	.35 -66	.77	15.0
2000	.71 -173	2.16 66	.10 28	.33 -61	.97	13.5
2500	.71 -179	1.75 57	.10 30	.33 -67	1.14	10.1
3000	.70 176	1.49 49	.11 32	.34 -73	1.25	8.3
3500	.70 172	1.28 42	.12 33	.35 -80	1.35	6.9
4000	.70 168	1.13 34	.12 34	.37 -88	1.41	5.9
4500	.70 165	1.02 27	.13 34	.39 -94	1.47	4.9
5000	.70 161	.92 20	.14 35	.41 -100	1.49	4.2

VCE = 10 V, IC = 10 mA

100	.75 -47	20.04 153	.02 65	.89 -24	.11	29.2
500	.72 -137	9.40 105	.05 34	.41 -57	.39	22.5
1000	.72 -162	4.97 86	.06 34	.27 -62	.69	19.0
1500	.71 -173	3.37 75	.07 38	.23 -66	.92	16.8
2000	.71 -179	2.56 66	.08 41	.22 -71	1.09	13.2
2500	.71 176	2.05 58	.09 43	.23 -76	1.19	10.9
3000	.71 172	1.74 51	.10 44	.24 -82	1.27	9.2
3500	.71 168	1.50 44	.11 44	.25 -88	1.31	7.9
4000	.70 165	1.33 37	.12 44	.27 -95	1.36	6.8
4500	.70 162	1.19 30	.13 44	.29 -100	1.39	5.9
5000	.70 159	1.08 24	.14 43	.31 -106	1.39	5.1

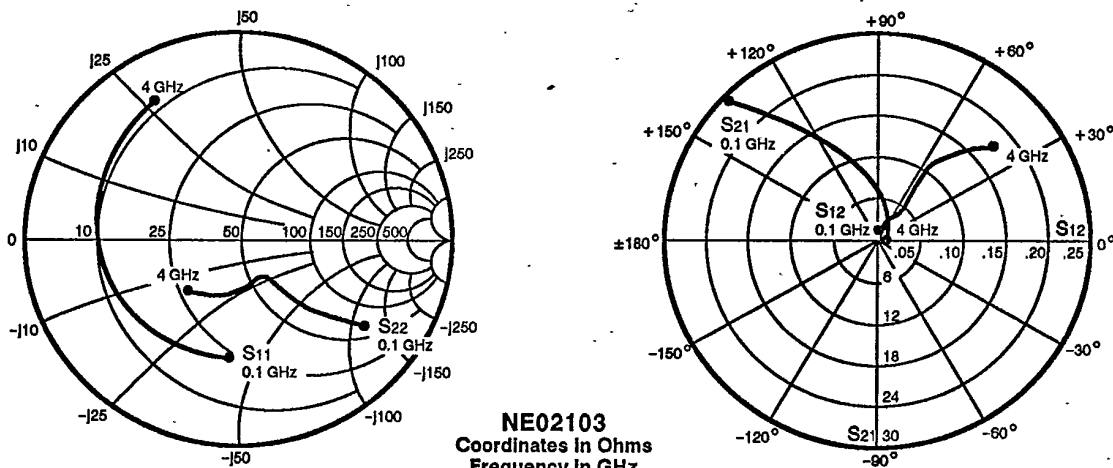
VCE = 10 V, IC = 20 mA

100	.68 -70	29.75 145	.02 59	.81 -33	.14	31.6
500	.72 -152	10.58 99	.04 37	.30 -65	.53	24.3
1000	.72 -170	5.42 84	.05 43	.19 -69	.87	20.4
1500	.72 -178	3.65 74	.06 48	.17 -73	1.05	16.4
2000	.72 177	2.74 66	.07 50	.17 -78	1.17	13.2
2500	.72 172	2.21 58	.09 51	.17 -83	1.23	11.3
3000	.71 169	1.86 51	.10 52	.19 -87	1.27	9.7
3500	.71 166	1.61 44	.11 51	.20 -93	1.30	8.4
4000	.71 162	1.42 38	.12 51	.22 -99	1.34	7.3
4500	.71 160	1.28 31	.13 49	.24 -105	1.33	6.4
5000	.71 157	1.15 25	.14 48	.27 -109	1.34	5.6

NOTE: S-Parameters include bond wires.  
 BASE: Total 1 wire (s), 1 per bond pad, 0.0115" (291 μm) long each wire.  
 COLLECTOR: Total 1 wire (s), 1 per bond pad, 0.0072" (182 μm) long each wire.  
 EMITTER: Total 2 wire (s), 1 per side, 0.015" (393 μm) long each wire.  
 WIRE: 0.0007" (17.7 μm) dia., gold.



TYPICAL COMMON EMITTER SCATTERING PARAMETERS



**NE02103**  
Coordinates in Ohms  
Frequency in GHz  
(VCE = 10 V, IC = 20 mA)

**S-MAGN AND ANGLES:**

VCE = 10 V, IC = 5 mA

FREQUENCY (MHz)	S11		S21		S12		S22	
100	.82	-41	13.67	154	.02	72	.92	-17
500	.67	-133	6.53	103	.07	34	.51	-43
1000	.66	-167	3.58	79	.08	31	.38	-51
1500	.65	175	2.45	63	.10	32	.37	-61
2000	.66	163	1.85	51	.11	36	.37	-71
2500	.67	151	1.49	38	.12	34	.36	-83
3000	.68	141	1.29	26	.14	35	.38	-98
3500	.69	132	1.09	16	.16	32	.40	-110
4000	.71	124	.96	5	.16	29	.43	-121

VCE = 10 V, IC = 10 mA

100	.69	-62	21.74	145	.01	68	.84	-25
500	.65	-154	7.92	96	.05	39	.36	-49
1000	.65	-179	4.15	76	.07	43	.27	-55
1500	.65	168	2.81	62	.08	47	.27	-63
2000	.66	158	2.12	51	.11	49	.28	-74
2500	.68	146	1.70	39	.12	44	.28	-88
3000	.69	138	1.46	28	.14	43	.30	-102
3500	.71	129	1.23	17	.17	40	.33	-115
4000	.72	121	1.09	7	.17	34	.35	-126

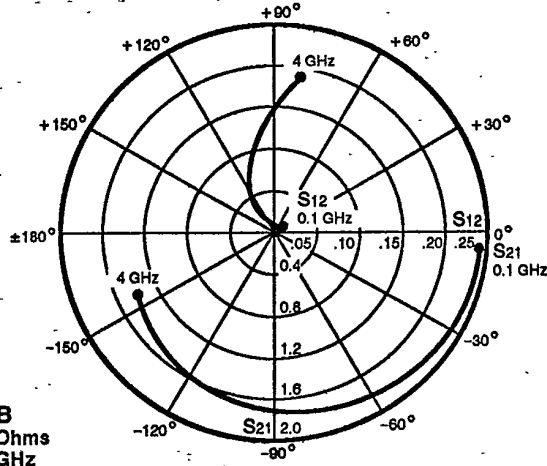
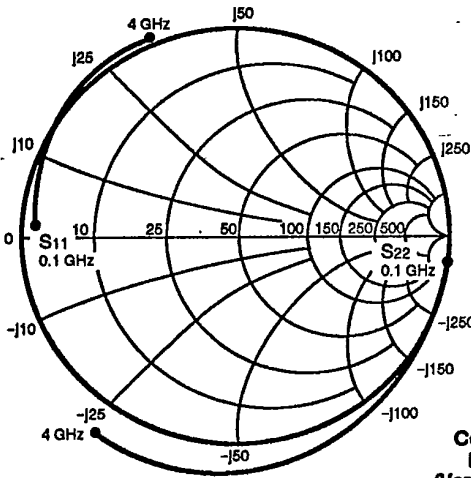
VCE = 10 V, IC = 20 mA

100	.57	-91	29.51	136	.01	65	.74	-33
500	.65	-167	8.77	91	.04	48	.27	-54
1000	.66	175	4.49	74	.06	54	.20	-60
1500	.66	164	3.05	61	.08	54	.21	-68
2000	.68	154	2.27	51	.10	55	.22	-78
2500	.69	144	1.83	39	.13	50	.23	-93
3000	.70	136	1.56	29	.14	45	.25	-107
3500	.72	127	1.30	19	.16	42	.28	-118
4000	.74	120	1.18	9	.18	39	.31	-130

VCE = 10 V, IC = 40 mA

100	.53	-121	34.50	128	.01	66	.66	-38
500	.66	-175	9.00	88	.03	61	.23	-50
1000	.67	171	4.56	72	.05	63	.17	-55
1500	.68	161	3.07	60	.08	59	.19	-64
2000	.69	152	2.30	50	.10	60	.21	-75
2500	.71	142	1.85	39	.13	54	.21	-92
3000	.72	135	1.59	29	.14	47	.24	-108
3500	.74	126	1.33	19	.16	45	.26	-119
4000	.75	119	1.18	8	.17	42	.30	-131

**TYPICAL COMMON BASE SCATTERING PARAMETERS**



**NE02107B**  
Coordinates in Ohms  
Frequency in GHz  
(V<sub>CB</sub> = 10 V, I<sub>C</sub> = 20 mA)

**S-MAGN AND ANGLES:**

V<sub>CB</sub> = 10 V, I<sub>C</sub> = 5 mA

FREQUENCY (MHz)

	S <sub>11</sub>	S <sub>21</sub>	S <sub>12</sub>	S <sub>22</sub>
100	.79 175	1.77 -10	.01 106	1.01 -9
500	.79 170	1.78 -24	.01 111	1.02 -22
1000	.79 163	1.72 -44	.01 117	1.05 -40
1500	.83 157	1.71 -64	.03 109	1.09 -58
2000	.83 149	1.57 -87	.06 106	1.09 -75
2500	.87 145	1.53 -99	.08 103	1.08 -81
3000	.87 136	1.40 -122	.11 95	1.11 -96
3500	.87 126	1.21 -140	.13 86	1.10 -111
4000	.86 117	1.12 -164	.17 76	1.08 -125

V<sub>CB</sub> = 10 V, I<sub>C</sub> = 10 mA

100	.88 177	1.84 -6	.01 -31	1.01 -6
500	.88 171	1.84 -19	.01 112	1.00 -18
1000	.87 164	1.83 -38	.01 132	1.05 -36
1500	.90 169	1.82 -57	.03 118	1.08 -53
2000	.92 152	1.72 -76	.06 117	1.10 -69
2500	.95 144	1.68 -92	.08 108	1.09 -81
3000	.96 135	1.57 -113	.12 98	1.13 -96
3500	.96 126	1.45 -135	.15 88	1.12 -111
4000	.95 116	1.33 -156	.18 77	1.10 -126

V<sub>CB</sub> = 10 V, I<sub>C</sub> = 20 mA

100	.92 176	1.90 -6	.01 56	1.02 -6
500	.93 171	1.89 -19	.01 139	1.01 -18
1000	.92 164	1.89 -37	.01 129	1.05 -36
1500	.96 159	1.88 -55	.03 126	1.09 -53
2000	.97 152	1.81 -75	.06 119	1.10 -69
2500	1.01 142	1.75 -90	.09 110	1.09 -80
3000	1.02 132	1.67 -110	.12 100	1.13 -95
3500	1.03 121	1.55 -132	.15 89	1.13 -110
4000	1.02 112	1.42 -154	.18 79	1.12 -125

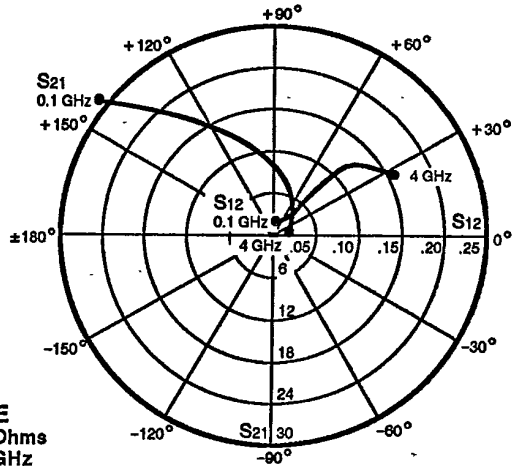
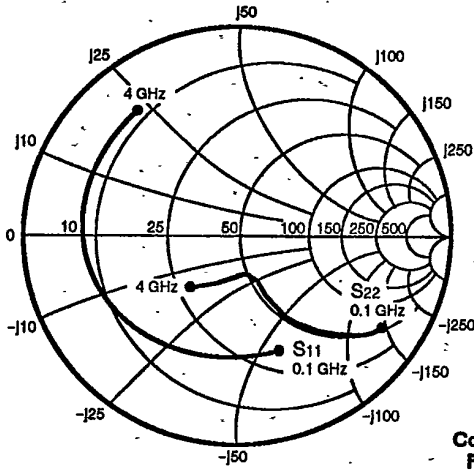
V<sub>CB</sub> = 10 V, I<sub>C</sub> = 40 mA

100	.95 176	1.93 -7	.01 -74	1.02 -7
500	.94 171	1.91 -20	.01 116	1.01 -19
1000	.94 163	1.91 -38	.01 133	1.05 -36
1500	.98 158	1.90 -57	.03 126	1.09 -53
2000	.99 151	1.83 -77	.06 119	1.10 -69
2500	1.04 141	1.81 -92	.09 111	1.09 -81
3000	1.05 132	1.72 -115	.12 100	1.13 -97
3500	1.05 120	1.58 -136	.15 88	1.13 -113
4000	1.03 111	1.46 -157	.18 77	1.10 -127





TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE02107E  
Coordinates in Ohms  
Frequency in GHz  
(VCE = 10 V, IC = 20 mA)

S-MAGN AND ANGLES:

VCE = 10 V, IC = 5 mA

FREQUENCY (MHz)

	S11	S21	S12	S22
100	.82 -36	13.90 157	.01 73	.95 -16
500	.70 -125	7.38 107	.07 35	.54 -47
1000	.68 -161	4.17 82	.08 25	.39 -59
1500	.68 -178	2.87 66	.09 24	.38 -68
2000	.68 170	2.18 53	.10 26	.37 -78
2500	.67 159	1.73 40	.11 22	.38 -90
3000	.67 151	1.49 28	.12 23	.40 -102
3500	.68 142	1.27 17	.13 19	.43 -112
4000	.68 134	1.16 6	.14 17	.45 -122

VCE = 10 V, IC = 10 mA

100	.69 -54	22.57 150	.01 69	.89 -23
500	.67 -145	9.37 100	.05 36	.39 -58
1000	.67 -172	5.00 79	.06 36	.27 -70
1500	.67 175	3.40 65	.08 37	.26 -77
2000	.67 165	2.57 53	.09 40	.25 -87
2500	.67 154	2.07 41	.11 35	.28 -97
3000	.67 146	1.80 30	.12 34	.31 -108
3500	.67 137	1.53 20	.14 30	.34 -116
4000	.67 130	1.41 8	.15 23	.36 -125

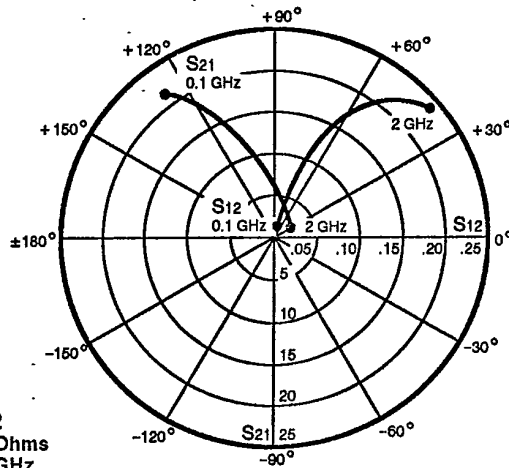
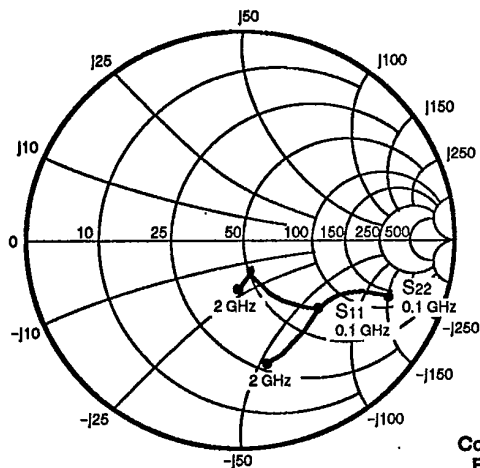
VCE = 10 V, IC = 20 mA

100	.58 -79	31.63 142	.01 65	.81 -32
500	.67 -161	10.57 95	.03 45	.28 -68
1000	.67 179	5.47 77	.04 46	.19 -78
1500	.67 168	3.70 64	.07 46	.19 -84
2000	.67 159	2.78 53	.09 48	.20 -96
2500	.67 150	2.26 42	.11 44	.23 -105
3000	.68 142	1.96 31	.12 39	.25 -114
3500	.67 134	1.68 21	.14 36	.28 -122
4000	.68 127	1.53 9	.16 27	.31 -128

VCE = 10 V, IC = 30 mA

100	.55 -96	35.99 137	.01 63	.75 -37
500	.67 -167	10.79 93	.02 48	.24 -69
1000	.68 176	5.52 75	.04 53	.17 -77
1500	.68 166	3.75 63	.07 52	.17 -83
2000	.68 158	2.81 52	.09 53	.18 -96
2500	.68 148	2.26 41	.11 46	.21 -106
3000	.68 141	1.96 30	.13 42	.24 -115
3500	.68 133	1.66 20	.14 38	.27 -123
4000	.68 126	1.51 9	.16 29	.30 -131

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE02112  
Coordinates in Ohms  
Frequency in GHz  
(VCE = 10 V, IC = 20 mA)



S-MAGN AND ANGLES:

VCE = 10 V, IC = 5 mA

FREQUENCY (MHz)

	S11		S21		S12		S22	
100	.76	-31	12.27	147	.01	69	.89	-16
200	.61	-52	9.59	126	.04	64	.78	-25
500	.33	-87	5.07	94	.09	61	.61	-36
1000	.17	-113	2.80	68	.15	60	.55	-47
1500	.14	-112	1.99	48	.20	53	.57	-63
2000	.18	-107	1.52	28	.22	40	.63	-82

VCE = 10 V, IC = 10 mA

100	.61	-37	17.41	136	.01	69	.81	-20
200	.45	-56	11.92	116	.03	69	.68	-26
500	.23	-82	5.64	88	.09	68	.54	-34
1000	.13	-94	3.03	66	.16	63	.51	-45
1500	.14	-90	2.13	47	.21	52	.53	-62
2000	.22	-96	1.62	27	.24	38	.60	-80

VCE = 10 V, IC = 20 mA

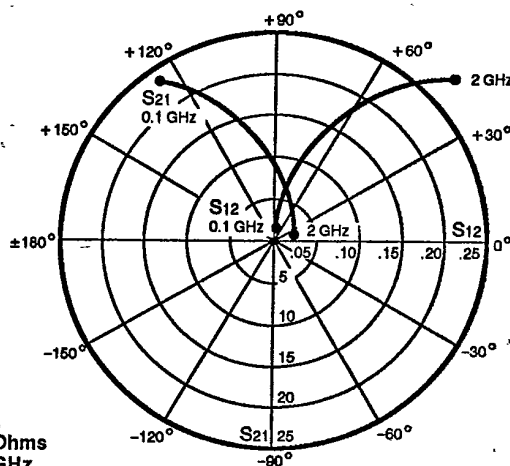
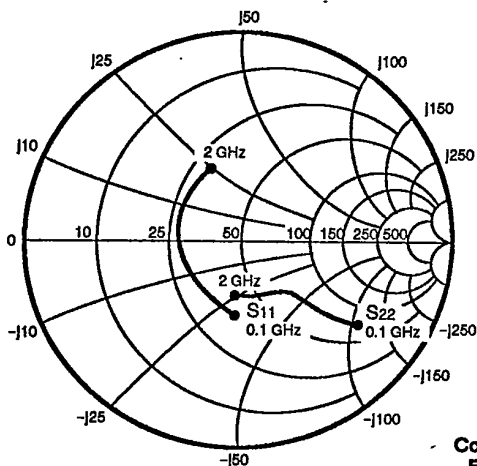
100	.47	-41	21.28	127	.01	76	.73	-21
200	.33	-56	13.15	108	.03	71	.62	-25
500	.18	-76	5.87	85	.09	70	.51	-32
1000	.11	-81	3.12	64	.16	64	.49	-43
1500	.14	-80	2.18	46	.22	53	.53	-61
2000	.23	-91	1.66	26	.24	38	.60	-80

VCE = 10 V, IC = 40 mA

100	.37	-49	21.89	119	.01	71	.68	-19
200	.25	-64	12.81	103	.02	71	.60	-21
500	.13	-89	5.52	82	.09	71	.53	-28
1000	.07	-99	2.93	62	.16	65	.52	-41
1500	.10	-87	2.06	44	.21	53	.55	-59
2000	.18	-94	1.56	24	.23	39	.62	-79

T-31-17

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE02132  
Coordinates in Ohms  
Frequency in GHz  
(VCE = 10 V, IC = 20 mA)

S-MAGN AND ANGLES:

VCE = 10 V, IC = 5 mA

FREQUENCY (MHz)

	S11		S21		S12		S22	
100	.70	-45	12.65	145	.03	71	.88	-21
200	.54	-80	9.63	123	.05	55	.70	-34
500	.39	-136	5.06	92	.09	53	.46	-47
1000	.35	176	2.77	63	.14	52	.40	-57
1500	.36	145	1.97	44	.20	51	.37	-72
2000	.41	120	1.62	25	.26	43	.36	-88

VCE = 10 V, IC = 10 mA

100	.50	-64	18.88	135	.02	69	.78	-29
200	.37	-105	12.46	113	.03	57	.56	-40
500	.31	-155	5.84	86	.09	64	.35	-48
1000	.30	163	3.12	62	.15	58	.32	-57
1500	.32	136	2.20	44	.22	53	.30	-73
2000	.37	114	1.80	26	.28	42	.29	-89

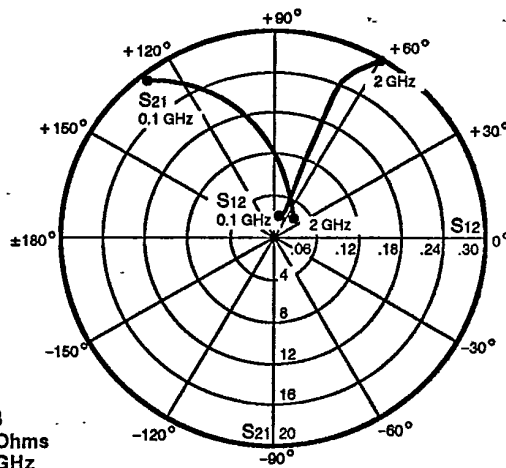
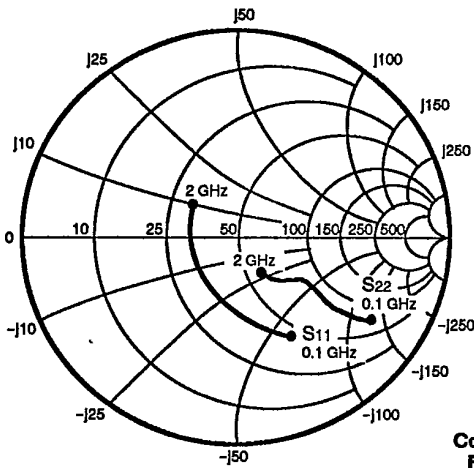
VCE = 10 V, IC = 20 mA

100	.34	-90	23.82	125	.01	71	.67	-34
200	.27	-133	14.23	105	.03	66	.45	-42
500	.27	-171	6.24	83	.09	70	.29	-46
1000	.29	155	3.31	60	.16	62	.28	-55
1500	.30	131	2.32	43	.23	54	.26	-74
2000	.35	111	1.88	26	.29	42	.26	-90

VCE = 10 V, IC = 40 mA

100	.27	-118	26.55	117	.01	73	.57	-36
200	.26	-156	14.82	100	.02	75	.38	-39
500	.27	179	6.32	81	.09	74	.27	-41
1000	.29	151	3.33	59	.16	63	.27	-53
1500	.31	128	2.34	43	.23	55	.26	-71
2000	.36	109	1.89	25	.29	42	.25	-88

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE02133  
Coordinates in Ohms  
Frequency in GHz  
(VCE = 10 V, IC = 20 mA)



S-MAGN AND ANGLES:

VCE = 10 V, IC = 5 mA

FREQUENCY (MHz)

	S11	S21	S12	S22
100	.80 -37	13.53 150	.03 73	.91 -18
200	.63 -63	10.48 129	.04 59	.72 -29
500	.37 -114	5.56 99	.09 61	.48 -38
1000	.27 -158	3.02 76	.15 60	.40 -41
1500	.27 172	2.16 63	.21 63	.34 -49
2000	.29 151	1.74 49	.27 58	.31 -62

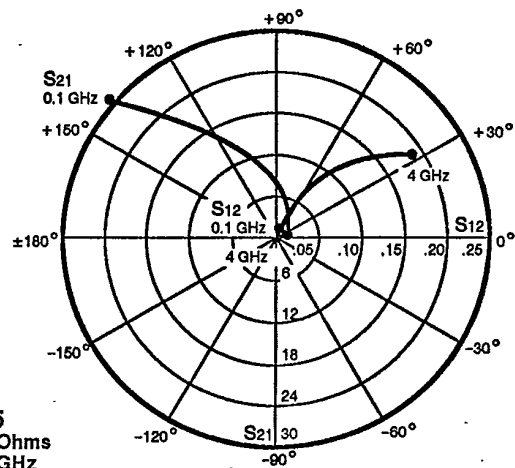
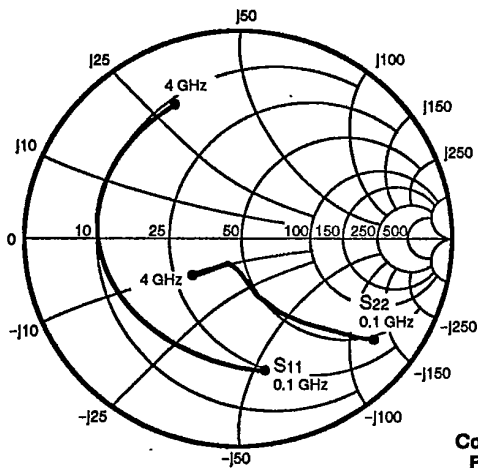
VCE = 10 V, IC = 10 mA

100	.66 -48	19.53 139	.02 79	.81 -27
200	.46 -78	13.52 118	.03 58	.58 -35
500	.27 -129	6.29 93	.09 67	.38 -36
1000	.21 -169	3.31 74	.16 66	.34 -40
1500	.23 165	2.35 62	.23 64	.29 -47
2000	.26 146	1.87 50	.29 59	.26 -62

VCE = 10 V, IC = 20 mA

100	.51 -61	19.37 129	.02 79	.70 -32
200	.33 -91	15.04 109	.03 64	.48 -35
500	.21 -143	6.57 89	.08 71	.33 -32
1000	.19 -177	3.41 72	.16 69	.32 -37
1500	.21 160	2.41 61	.24 67	.26 -45
2000	.24 142	1.92 49	.30 59	.23 -59

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE02135  
Coordinates in Ohms  
Frequency in GHz  
(V<sub>CE</sub> = 10 V, I<sub>C</sub> = 20 mA)

S-MAGN AND ANGLES:

V<sub>CE</sub> = 10 V, I<sub>C</sub> = 5 mA

FREQUENCY (MHz)

	S <sub>11</sub>	S <sub>21</sub>	S <sub>12</sub>	S <sub>22</sub>
100	.84 -36	13.82 156	.02 73	.94 -18
500	.68 -126	7.18 106	.08 35	.51 -53
1000	.66 -163	4.02 81	.09 27	.34 -66
1500	.65 178	2.75 64	.10 27	.31 -74
2000	.65 163	2.10 52	.12 30	.31 -83
2500	.66 151	1.68 39	.13 26	.31 -95
3000	.66 141	1.46 27	.14 26	.33 -106
3500	.67 129	1.24 17	.16 26	.36 -116
4000	.68 121	1.14 5	.17 23	.38 -127

V<sub>CE</sub> = 10 V, I<sub>C</sub> = 10 mA

100	.73 -55	22.55 148	.02 65	.87 -27
500	.64 -148	8.90 98	.06 37	.36 -66
1000	.64 -176	4.71 77	.07 39	.23 -82
1500	.64 169	3.19 63	.09 40	.21 -87
2000	.65 156	2.42 52	.11 42	.21 -97
2500	.65 145	1.95 40	.13 37	.22 -108
3000	.66 135	1.69 29	.15 35	.25 -118
3500	.66 125	1.43 19	.17 32	.27 -127
4000	.68 117	1.34 8	.19 28	.29 -137

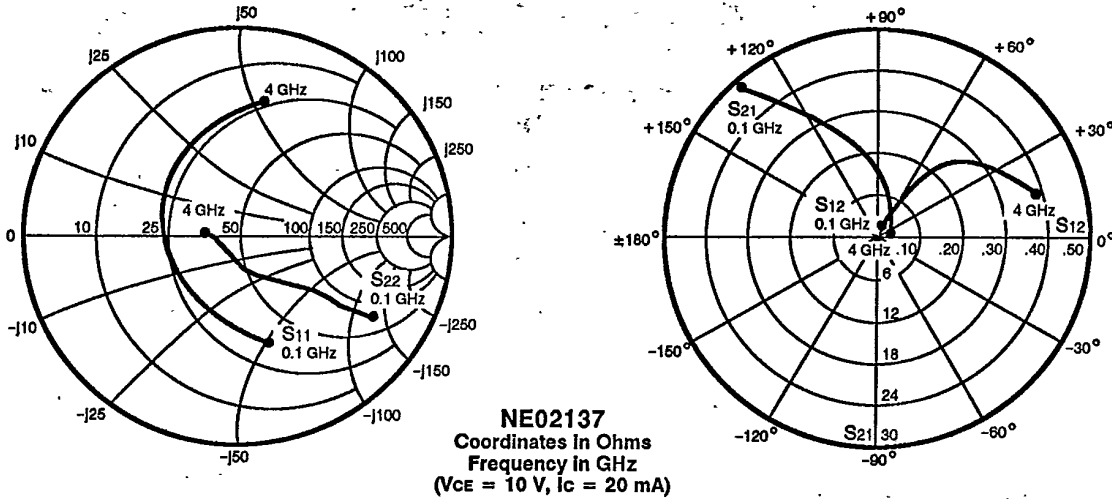
V<sub>CE</sub> = 10 V, I<sub>C</sub> = 20 mA

100	.62 -80	31.13 139	.01 60	.77 -37
500	.64 -163	9.88 93	.04 46	.26 -79
1000	.65 176	5.07 75	.06 49	.16 -95
1500	.64 164	3.45 63	.08 50	.15 -101
2000	.65 154	2.60 52	.11 51	.16 -111
2500	.66 142	2.10 40	.13 43	.18 -121
3000	.66 133	1.81 30	.15 40	.20 -129
3500	.66 122	1.55 20	.17 36	.22 -136
4000	.68 115	1.43 8	.19 31	.25 -144

V<sub>CE</sub> = 10 V, I<sub>C</sub> = 30 mA

100	.58 -95	35.35 134	.01 59	.72 -40
500	.64 -169	10.11 91	.03 50	.22 -82
1000	.65 173	5.15 74	.06 55	.14 -97
1500	.65 162	3.49 62	.08 53	.14 -103
2000	.66 152	2.63 52	.11 54	.15 -112
2500	.66 141	2.10 39	.13 46	.17 -122
3000	.66 132	1.82 29	.15 42	.19 -129
3500	.67 122	1.54 20	.17 38	.22 -137
4000	.68 115	1.44 9	.20 31	.24 -146

**TYPICAL COMMON EMITTER SCATTERING PARAMETERS**



**S-MAGN AND ANGLES:**

VCE = 10 V, IC = 5 mA

FREQUENCY (MHz)

	S11		S21		S12		S22	
100	.81	-36	13.62	152	.02	72	.92	-17
500	.46	-127	6.36	98	.08	48	.50	-39
1000	.42	-176	3.51	72	.11	48	.38	-46
1500	.43	154	2.43	53	.15	46	.35	-54
2000	.46	133	1.87	39	.19	44	.33	-65
2500	.53	113	1.54	23	.23	37	.24	-86
3000	.58	100	1.33	9	.27	31	.23	-112
3500	.61	88	1.15	-1	.31	23	.21	-144
4000	.65	79	1.04	-16	.35	16	.26	-155

VCE = 10 V, IC = 10 mA

100	.66	-52	21.54	142	.02	72	.83	-24
500	.37	-149	7.49	91	.07	56	.38	-39
1000	.37	170	3.96	69	.11	57	.29	-45
1500	.39	146	2.71	53	.16	52	.27	-53
2000	.43	128	2.08	39	.21	47	.24	-67
2500	.51	109	1.70	24	.25	38	.17	-91
3000	.56	97	1.46	10	.29	30	.15	-123
3500	.60	86	1.25	-0	.32	22	.15	-159
4000	.63	77	1.15	-14	.36	14	.19	-171

VCE = 10 V, IC = 20 mA

100	.51	-73	28.85	131	.01	69	.72	-30
500	.34	-167	8.09	87	.06	64	.31	-36
1000	.36	161	4.18	67	.11	63	.24	-42
1500	.38	140	2.85	52	.17	54	.22	-52
2000	.41	124	2.19	38	.22	50	.20	-66
2500	.50	107	1.78	24	.26	39	.12	-94
3000	.55	96	1.52	11	.30	30	.12	-133
3500	.58	84	1.31	0	.32	22	.12	177
4000	.62	77	1.20	-13	.37	14	.17	179

VCE = 10 V, IC = 30 mA

100	.45	-88	31.67	125	.01	70	.66	-32
500	.33	-174	8.10	85	.06	67	.29	-33
1000	.36	158	4.16	66	.11	64	.24	-40
1500	.39	139	2.84	51	.16	56	.22	-50
2000	.42	123	2.18	38	.22	50	.20	-63
2500	.50	106	1.77	23	.26	39	.12	-91
3000	.55	95	1.51	9	.30	30	.11	-130
3500	.58	85	1.29	0	.32	24	.07	-163
4000	.62	76	1.20	-12	.36	14	.16	-180



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Datasheets for electronic components.