

**NEC**<sup>®</sup>**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

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

SYMBOLS	PARAMETERS	UNITS	RATINGS
$V_{CB0}$	Collector to Base Voltage	V	25
$V_{CE0}$	Collector to Emitter Voltage	V	12 <sup>1</sup>
$V_{EB0}$	Emitter to Base Voltage	V	3
$I_C$	Collector Current	mA	70
$T_J$	Junction Temperature	$^\circ\text{C}$	200 <sup>2</sup>
$T_{STG}$	Storage Temperature	$^\circ\text{C}$	-65 to +200 <sup>3</sup>

**Notes:**

1. Typical  $BV_{CE0} = 25\text{ V}$  for  $R \leq 300\ \Omega$ .
2. Maximum  $T_J$  for the NE02132, NE02133, NE02136, and NE02137 is  $+150^\circ\text{C}$ .
3. Maximum storage temperature for the NE02132, NE02135, NE02136 and NE02137 is  $-65$  to  $+150^\circ\text{C}$ . Maximum storage temperature for the NE02133 is  $-55$  to  $+150^\circ\text{C}$ .

**NE02135 TYPICAL NOISE PARAMETERS** $V_{CE} = 10\text{ V}, I_C = 5\text{ mA}$ 

FREQUENCY (MHz)	NFmin (dB)	GA	OPT SOURCE	$R_N/50\ \Omega$
500	1.2	18.6	.36 $\angle 69^\circ$	.14
1000	1.5	13.9	.31 $\angle 124^\circ$	.12
1500	2.0	12.1	.50 $\angle 165^\circ$	.05
2000	2.4	9.6	.44 $\angle -175^\circ$	.06
2500	2.6	8.9	.62 $\angle -161^\circ$	.10
3000	3.6	8.6	.68 $\angle -141^\circ$	.14
3500	3.7	6.9	.71 $\angle -139^\circ$	.21

 $V_{CE} = 10\text{ V}, I_C = 20\text{ mA}$ 

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

PERFORMANCE SPECIFICATIONS ( $T_A = 25^\circ\text{C}$ )

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	
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
$f_r$	Gain Bandwidth Product at $V_{CE} = 10\text{ V}$ , $I_C = 20\text{ mA}$	GHz		4.5			4.5			4.5			4.5			4.5	
$ S_{21} ^2$	Insertion Power Gain at $V_{CE} = 10\text{ V}$ , $I_C = 20\text{ mA}$ , $f = 0.5\text{ GHz}$ $f = 1\text{ GHz}$ $f = 2\text{ GHz}$	dB dB dB		18.5 13 6.5			18.5 13 6.5			15 10 4			18.5 13 5.7			9 11	
NF <sub>MIN</sub>	Minimum Noise Figure <sup>2</sup> at $V_{CE} = 10\text{ V}$ , $I_C = 3\text{ mA}$ , $f = 0.5\text{ GHz}$ $V_{CE} = 10\text{ V}$ , $I_C = 5\text{ mA}$ , $f = 1\text{ GHz}$ $f = 2\text{ GHz}$	dB dB dB		1.5 2.7 4.5			1.5 2.7 4.5			1.5 3			1.5 3			1.8 3	
MAG	Maximum Available Gain <sup>3</sup> at $V_{CE} = 10\text{ V}$ , $I_C = 20\text{ mA}$ , $f = 0.5\text{ GHz}$ $f = 1\text{ GHz}$ $f = 2\text{ GHz}$	dB dB dB		22 18 12			22 18 12			11.5			22 18 11			14	

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

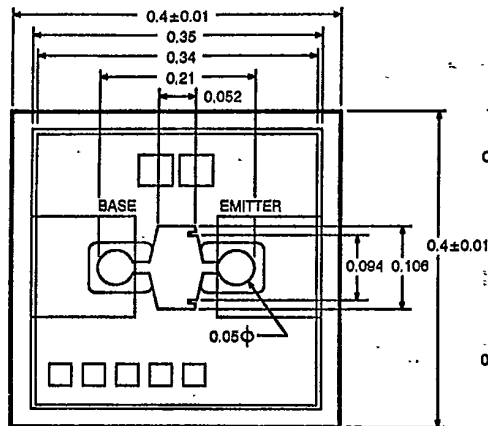
EIAJ <sup>1</sup> REGISTERED NUMBER PACKAGE OUTLINE		NE02100 00 (CHIP)		NE02103 2SC1560(C) 03		NE02107 07		NE02112 2SC1988 12		NE02132 2SC2570 32		NE02133 2SC2351 33		NE02135 2SC2149 35		NE02137 2SC2369 37	
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
$I_{CBO}$	Collector Cutoff Current at $V_{CB} = 15\text{ V}$ , $I_E = 0$	$\mu\text{A}$		1.0			1.0			1.0			1.0			1.0	
$I_{EBO}$	Emitter Cutoff Current at $V_{EB} = 2\text{ V}$ , $I_C = 0$	$\mu\text{A}$		1.0			1.0			1.0			1.0			1.0	
$h_{FE}$	Forward Current Gain at $V_{CE} = 10\text{ V}$ , $I_C = 20\text{ mA}$		20	70	250	20	70	250	20	70	250	20	70	250	20	70	250
$C_{CB}$	Collector to Base Capacitance <sup>2</sup> at $V_{CB} = 10\text{ V}$ , $I_E = 0$ , $f = 1\text{ MHz}$	pF		0.6	1.0		0.6	1.0		0.7	0.9		0.75	1.0		.75	1.0
$R_{TH}$	Thermal Resistance ( $\mu\text{-C}$ )	$^\circ\text{C/W}$		70			90			90			120			500	
$R_{TH}$	Thermal Resistance ( $\mu\text{-A}$ )			300			500			500			666			600	
$P_T^3$	Total Power Dissipation	mW	580	700	700	350	700	700	350	250	250	150	290	500	500	250	250

Notes:

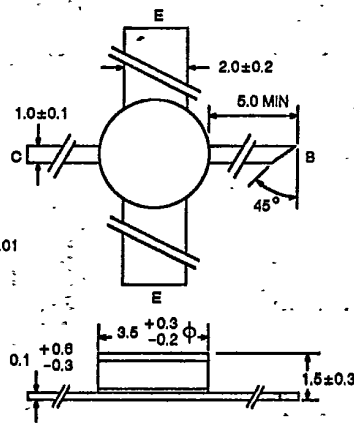
- Electronic Industrial Association of Japan.
- $C_{CB}$  measurement employs a three-terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal.
- Minimum dissipation based on  $R_{TH}(\mu\text{-A})$  for applications without effective heatsink, maximum dissipation based on  $R_{TH}(\mu\text{-C})$  for applications with effective heatsink.

OUTLINE DIMENSIONS (Units in mm)

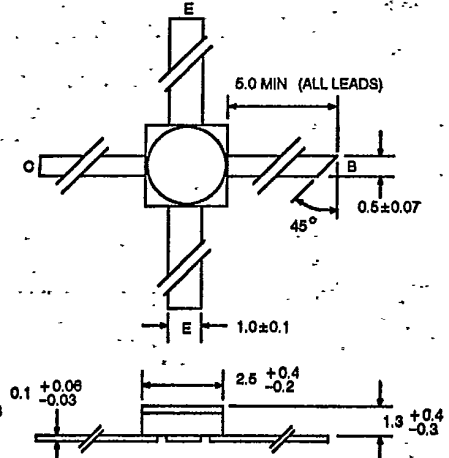
NE02100 (CHIP)  
(Chip Thickness: 140  $\mu$ m)



OUTLINE 03

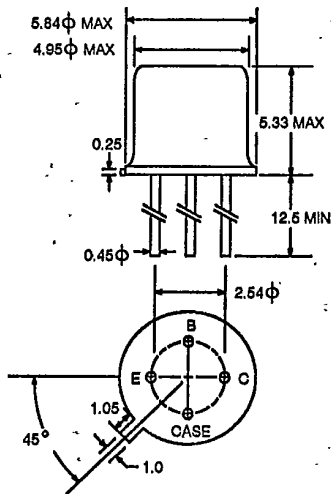


OUTLINE 07

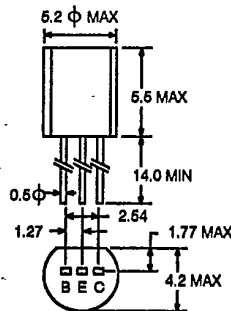


\*07B has emitter and base reversed.

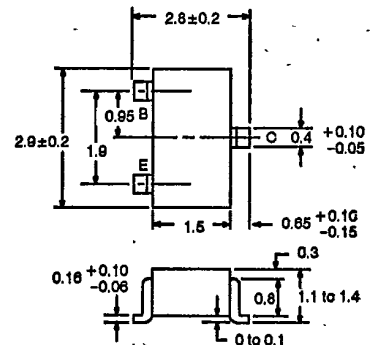
OUTLINE 12  
(TO-72)



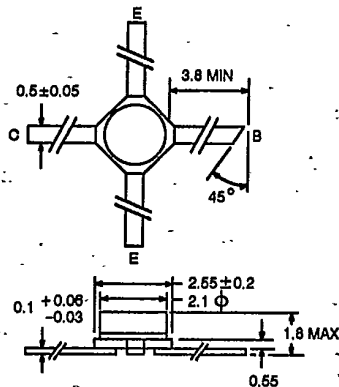
OUTLINE 32  
(TO-92)



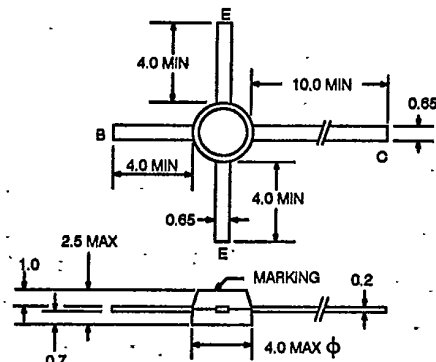
OUTLINE 33  
(SOT-23)



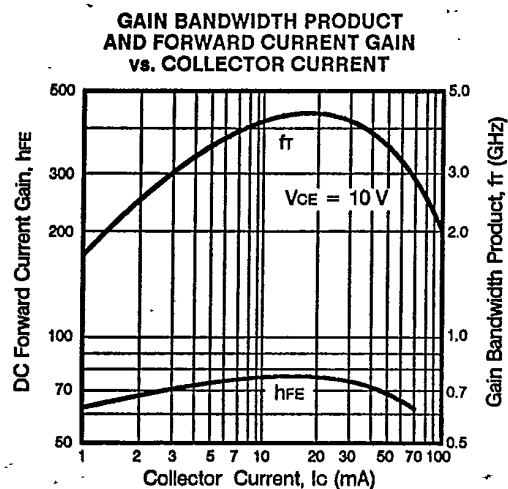
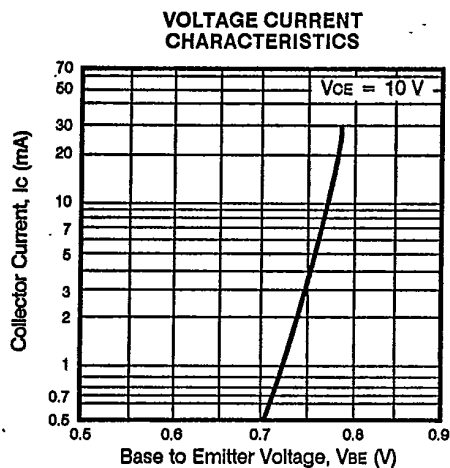
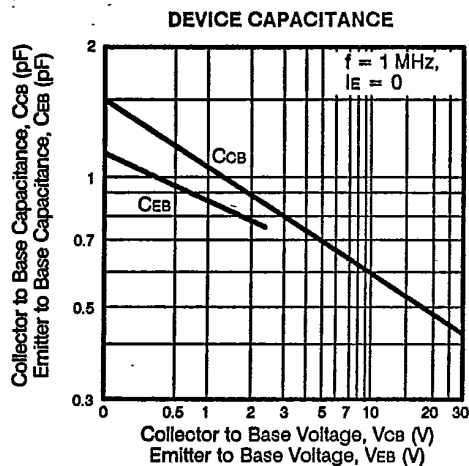
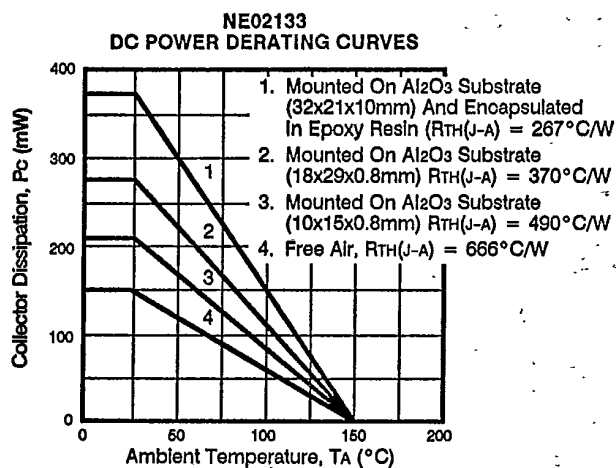
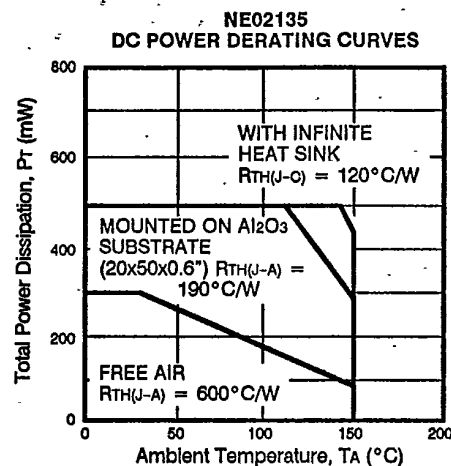
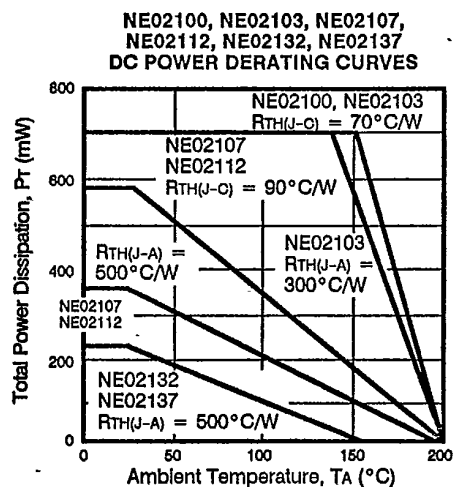
OUTLINE 35  
(MICRO-X)



OUTLINE 37

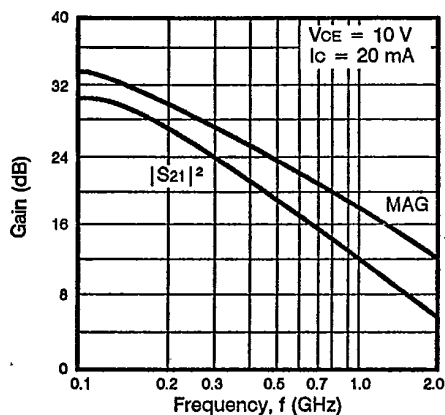


\*The NE02136 is available with only the bottom emitter lead.

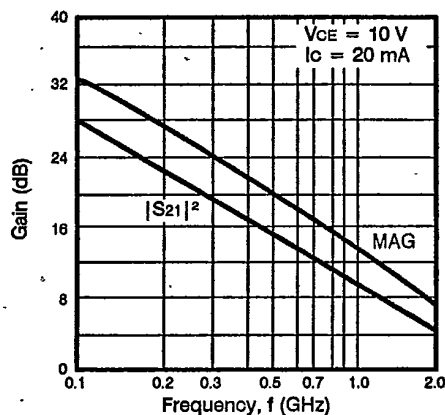
TYPICAL DEVICE CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ )T-31-17  
T-31-19

TYPICAL PERFORMANCE CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ )

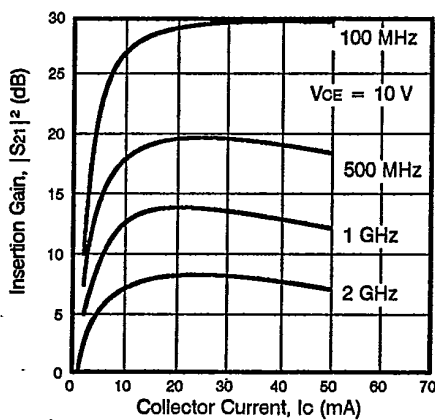
NE02103, NE02107, NE02135  
GAIN vs. FREQUENCY



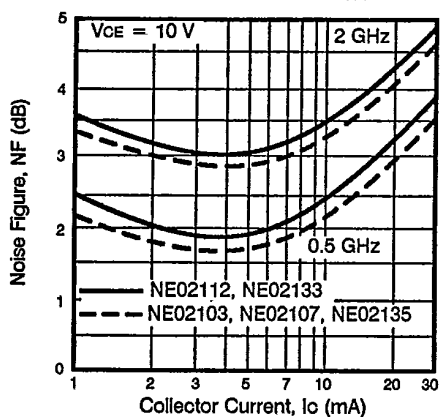
NE02112, NE02133  
GAIN vs. FREQUENCY



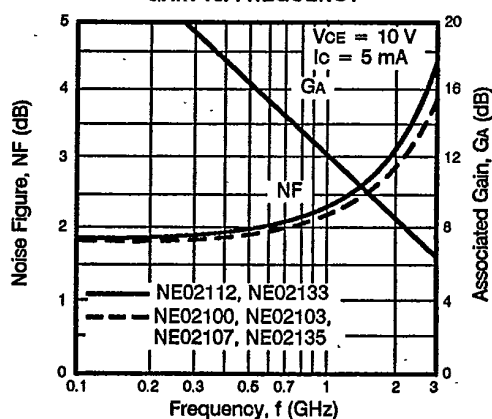
NE02103, NE02107  
INSERTION GAIN vs. COLLECTOR CURRENT



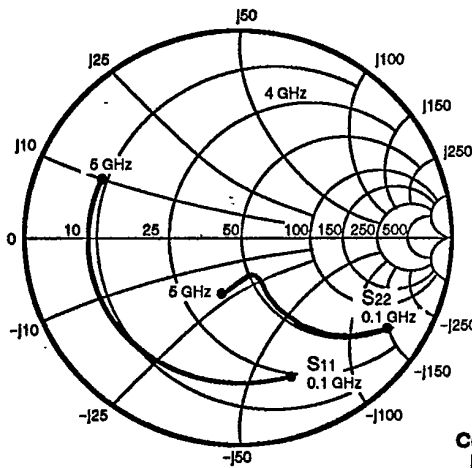
NOISE FIGURE vs.  
COLLECTOR CURRENT



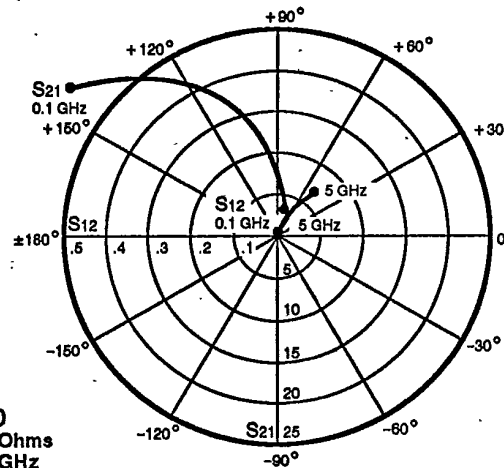
NOISE FIGURE AND ASSOCIATED  
GAIN vs. FREQUENCY



## TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE02100  
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	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

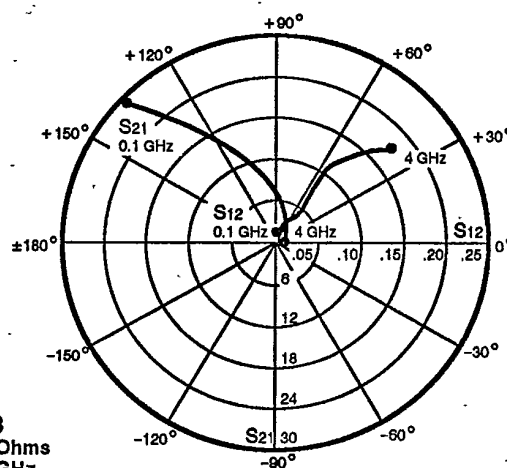
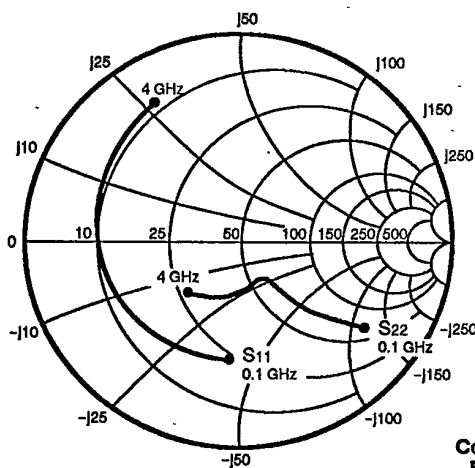
	S11	S21	S12	S22	k	GMA dB
100	.75 -47	20.04 153	.02 65	.89 -24	.11	29.2
500	.72 -137	9.40 105	.05 34	.41 -57	.39	22.5
1000	.72 -162	4.97 86	.06 34	.27 -62	.69	19.0
1500	.71 -173	3.37 75	.07 38	.23 -66	.92	16.8
2000	.71 -179	2.56 66	.08 41	.22 -71	1.09	13.2
2500	.71 176	2.05 58	.09 43	.23 -76	1.19	10.9
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

	S11	S21	S12	S22	k	GMA dB
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

	S11		S21		S12		S22	
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

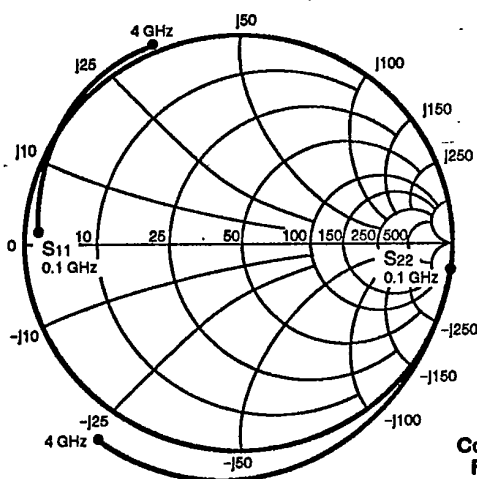
VCE = 10 V, IC = 20 mA

	S11		S21		S12		S22	
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

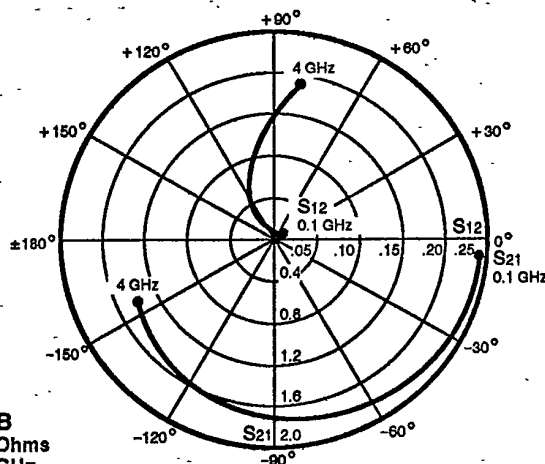
VCE = 10 V, IC = 40 mA

	S11		S21		S12		S22	
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

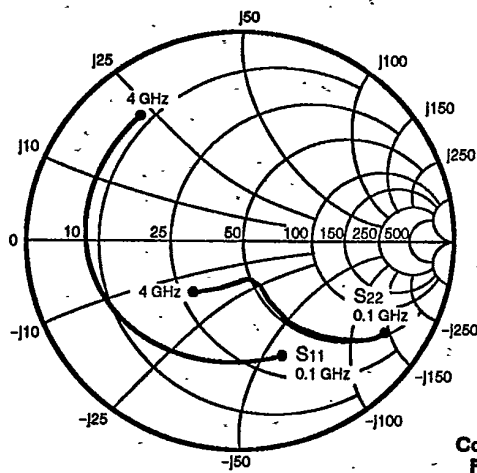
100	.92	176	1.90	-6	.01	56	1.02	-6
500	.93	171	1.89	-19	.01	139	1.01	-18
1000	.92	164	1.89	-37	.01	129	1.05	-36
1500	.96	159	1.88	-55	.03	126	1.09	-53
2000	.97	152	1.81	-75	.06	119	1.10	-69
2500	1.01	142	1.75	-90	.09	110	1.09	-80
3000	1.02	132	1.67	-110	.12	100	1.13	-95
3500	1.03	121	1.55	-132	.15	89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

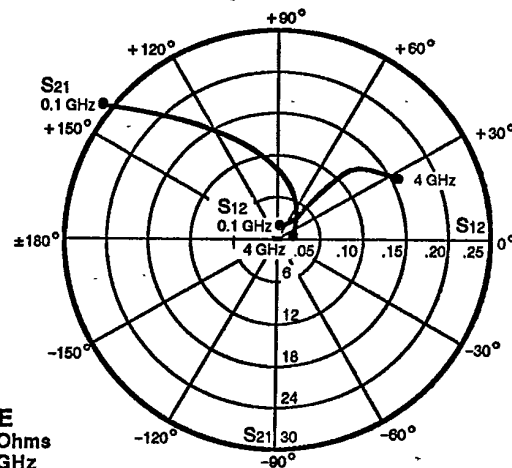
100	.95	176	1.93	-7	.01	-74	1.02	-7
500	.94	171	1.91	-20	.01	116	1.01	-19
1000	.94	163	1.91	-38	.01	133	1.05	-36
1500	.98	158	1.90	-57	.03	126	1.09	-53
2000	.99	151	1.83	-77	.06	119	1.10	-69
2500	1.04	141	1.81	-92	.09	111	1.09	-81
3000	1.05	132	1.72	-115	.12	100	1.13	-97
3500	1.05	120	1.58	-136	.15	88	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  
( $V_{CE} = 10\text{ V}$ ,  $I_C = 20\text{ mA}$ )



## S-MAGN AND ANGLES:

 $V_{CE} = 10\text{ V}$ ,  $I_C = 5\text{ mA}$ 

FREQUENCY (MHz)

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

 $V_{CE} = 10\text{ V}$ ,  $I_C = 10\text{ mA}$ 

	S11		S21		S12		S22
100	.69	-54	22.57	150	.01	69	.89
500	.67	-145	9.37	100	.05	36	.39
1000	.67	-172	5.00	79	.06	36	.27
1500	.67	175	3.40	65	.08	37	.26
2000	.67	165	2.57	53	.09	40	.25
2500	.67	154	2.07	41	.11	35	.28
3000	.67	146	1.80	30	.12	34	.31
3500	.67	137	1.53	20	.14	30	.34
4000	.67	130	1.41	8	.15	23	.36

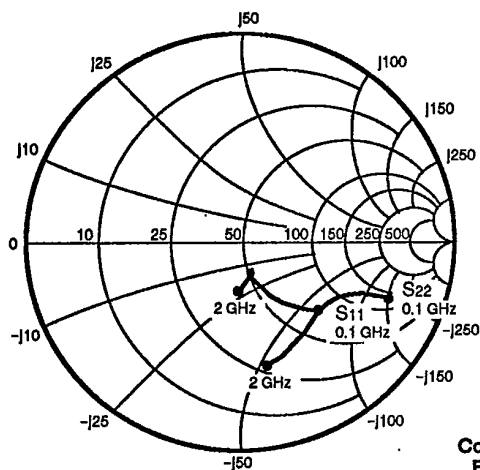
 $V_{CE} = 10\text{ V}$ ,  $I_C = 20\text{ mA}$ 

	S11		S21		S12		S22
100	.58	-79	31.63	142	.01	65	.81
500	.67	-161	10.57	95	.03	45	.28
1000	.67	179	5.47	77	.04	46	.19
1500	.67	168	3.70	64	.07	46	.19
2000	.67	159	2.78	53	.09	48	.20
2500	.67	150	2.26	42	.11	44	.23
3000	.68	142	1.96	31	.12	39	.25
3500	.67	134	1.68	21	.14	36	.28
4000	.68	127	1.53	9	.16	27	.31

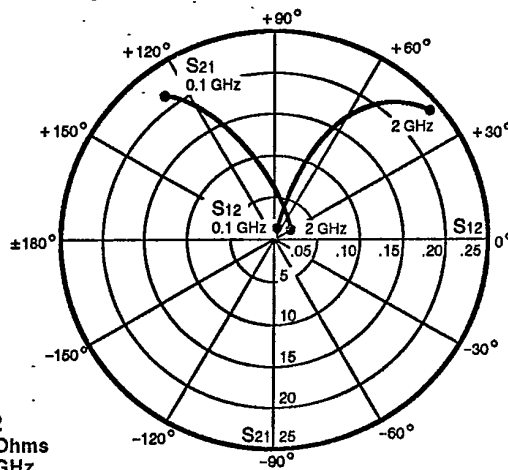
 $V_{CE} = 10\text{ V}$ ,  $I_C = 30\text{ mA}$ 

	S11		S21		S12		S22
100	.55	-96	35.99	137	.01	63	.75
500	.67	-167	10.79	93	.02	48	.24
1000	.68	176	5.52	75	.04	53	.17
1500	.68	166	3.75	63	.07	52	.17
2000	.68	158	2.81	52	.09	53	.18
2500	.68	148	2.26	41	.11	46	.21
3000	.68	141	1.96	30	.13	42	.24
3500	.68	133	1.66	20	.14	38	.27
4000	.68	126	1.51	9	.16	29	.30

## 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

	S11	S21	S12	S22
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

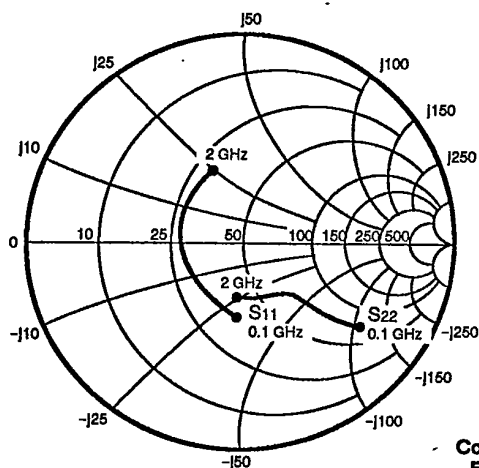
	S11	S21	S12	S22
100	.47 -41	21.28 127	.01 76	.73 -21
200	.33 -56	13.15 108	.03 71	.62 -25
500	.18 -76	5.87 85	.09 70	.51 -32
1000	.11 -81	3.12 64	.16 64	.49 -43
1500	.14 -80	2.18 46	.22 53	.53 -61
2000	.23 -91	1.66 26	.24 38	.60 -80

VCE = 10 V, IC = 40 mA

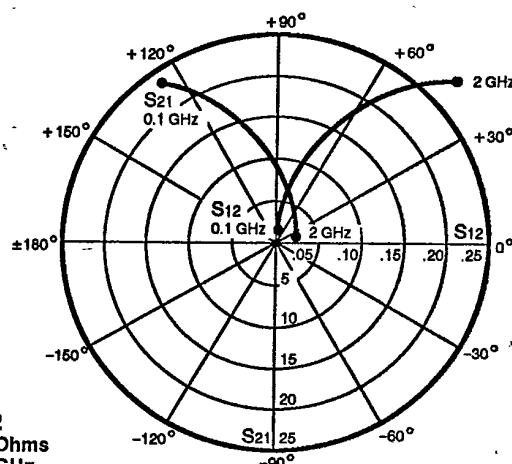
	S11	S21	S12	S22
100	.37 -49	21.89 119	.01 71	.68 -19
200	.25 -64	12.81 103	.02 71	.60 -21
500	.13 -89	5.52 82	.09 71	.53 -28
1000	.07 -99	2.93 62	.16 65	.52 -41
1500	.10 -87	2.06 44	.21 53	.55 -59
2000	.18 -94	1.56 24	.23 39	.62 -79

T-31-17

## TYPICAL COMMON EMITTER SCATTERING PARAMETERS



**NE02132**  
Coordinates in Ohms  
Frequency in GHz  
( $V_{CE} = 10\text{ V}$ ,  $I_C = 20\text{ mA}$ )

**S-MAGN AND ANGLES:** $V_{CE} = 10\text{ V}$ ,  $I_C = 5\text{ mA}$ 

FREQUENCY (MHz)

	$S_{11}$	$S_{21}$	$S_{12}$	$S_{22}$
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

 $V_{CE} = 10\text{ V}$ ,  $I_C = 10\text{ mA}$ 

	$S_{11}$	$S_{21}$	$S_{12}$	$S_{22}$
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

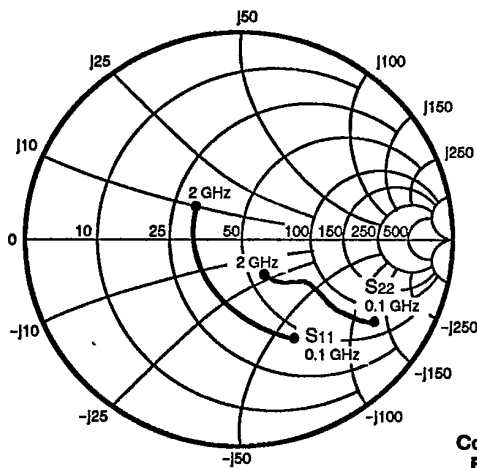
 $V_{CE} = 10\text{ V}$ ,  $I_C = 20\text{ mA}$ 

	$S_{11}$	$S_{21}$	$S_{12}$	$S_{22}$
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

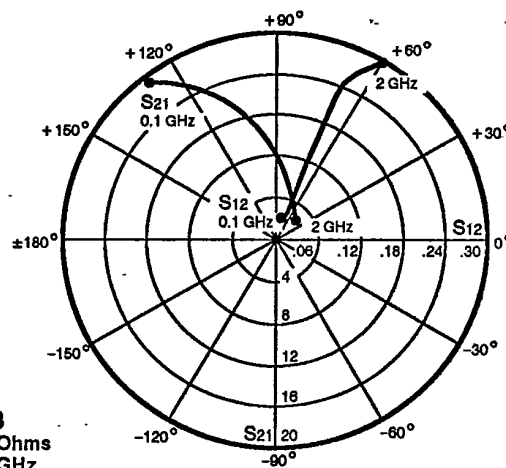
 $V_{CE} = 10\text{ V}$ ,  $I_C = 40\text{ mA}$ 

	$S_{11}$	$S_{21}$	$S_{12}$	$S_{22}$
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

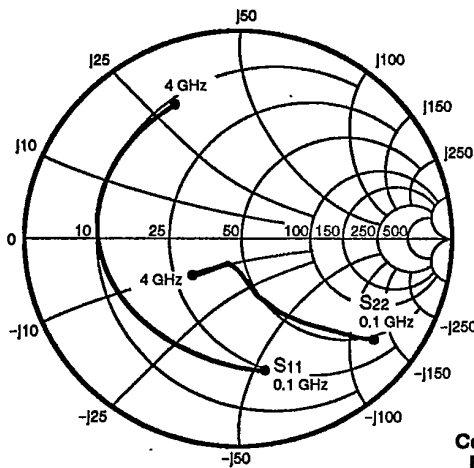
	S11	S21	S12	S22
100	.66 -48	19.53 139	.02 79	.81 -27
200	.46 -78	13.52 118	.03 58	.58 -35
500	.27 -129	6.29 93	.09 67	.38 -36
1000	.21 -169	3.31 74	.16 66	.34 -40
1500	.23 165	2.35 62	.23 64	.29 -47
2000	.26 146	1.87 50	.29 59	.26 -62

VCE = 10 V, IC = 20 mA

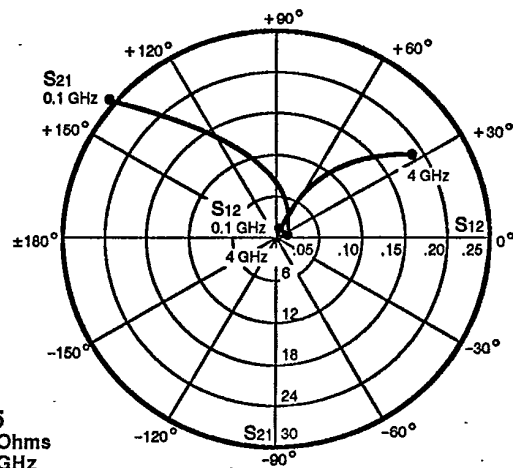
	S11	S21	S12	S22
100	.51 -61	19.37 129	.02 79	.70 -32
200	.33 -91	15.04 109	.03 64	.48 -35
500	.21 -143	6.57 89	.08 71	.33 -32
1000	.19 -177	3.41 72	.16 69	.32 -37
1500	.21 160	2.41 61	.24 67	.26 -45
2000	.24 142	1.92 49	.30 59	.23 -59

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## TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE02135  
Coordinates in Ohms  
Frequency in GHz  
(VCE = 10 V, IC = 20 mA)



## S-MAGN AND ANGLES:

VCE = 10 V, IC = 5 mA

FREQUENCY (MHz)

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

VCE = 10 V, IC = 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

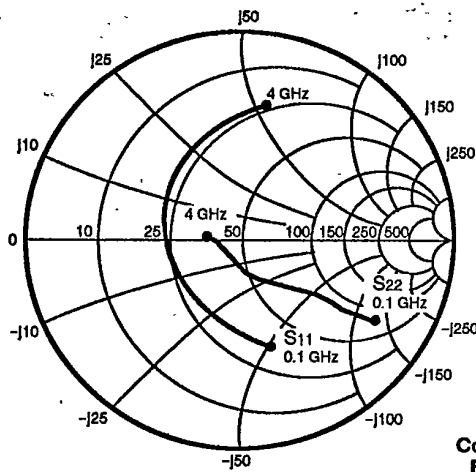
VCE = 10 V, IC = 20 mA

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

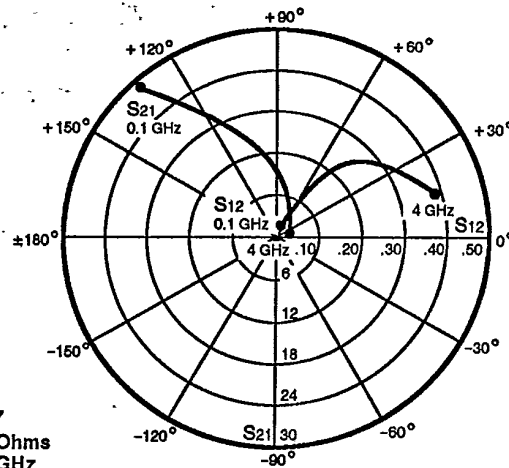
VCE = 10 V, IC = 30 mA

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



NE02137  
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	.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

	S11	S21	S12	S22
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

	S11	S21	S12	S22
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

	S11	S21	S12	S22
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