T-31-15
T-31-17
T-31-19

NEC®

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°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{CBO}	Collector to Base Voltage	V	25
V_{CEO}	Collector to Emitter Voltage	V	12[1]
V_{EBO}	Emitter to Base Voltage	V	3
I_C	Collector Current	mA	70
T_J	Junction Temperature	°C	200[2]
T_{STG}	Storage Temperature	°C	-65 to +200[3]

Notes:

1. Typical BV_{CER} = 25 V for R ≤ 300 Ω.
2. Maximum T_J 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.

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.

NE02135 TYPICAL NOISE PARAMETERS

V_{CE} = 10 V, I_C = 5 mA

FREQUENCY (MHz)	NFmin (dB)	G_A	OPT SOURCE	R_N/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_{CE} = 10 V, I_C = 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 (T_A = 25°C)

PART NUMBER EIAJ[1] 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	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
f_T	Gain Bandwidth Product at V_{CE} = 10 V, I_C = 20 mA	GHz		4.5			4.5			4.5			4.5			4.5			4.5			4.5			4.5	
$\|S_{21}\|^2$	Insertion Power Gain at V_{CE} = 10 V, I_C = 20 mA, f = 0.5 GHz	dB		18.5			18.5			18.5		13	15			15			15			18.5				
	f = 1 GHz	dB		13			13			13			10		8	10		9	10			13		9	11	
	f = 2 GHz	dB	5.5	6.5		5.5	6.5		5.5	6.5			4			4		5	4		5	5.7				
NF_{MIN}	Minimum Noise Figure[2] at V_{CE} = 10 V, I_C = 3 mA, f = 0.5 GHz	dB		1.5			1.5			1.5			1.5	2.5								1.5				
	V_{CE} = 10 V, I_C = 5 mA, f = 1 GHz	dB														1.5	3		1.5	3					1.8	3
	f = 2 GHz	dB		2.7	4.5		2.7	4.5		2.7	4.5		3									2.7	4.0			
MAG	Maximum Available Gain[3] at V_{CE} = 10 V, I_C = 20mA, f = 0.5 GHz	dB		22			22			22			17.5									22				
	f = 1 GHz	dB		18			18			18			12.5			11.5			14			18		14		
	f = 2 GHz	dB		12			12			12			7.5									11				

Notes:

1. Electronic Industrial Association of Japan.
2. Input and output are tuned for optimum noise figures.
3. 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°C)

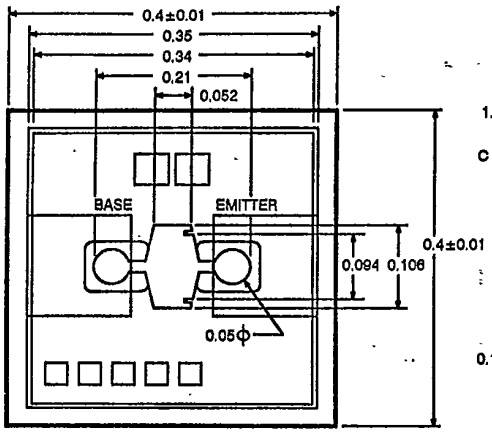
PART NUMBER EIAJ[1] REGISTERED NUMBER PACKAGE OUTLINE			NE02100 00 (CHIP)			NE02103 2SC1560(C) 03			NE02107 07			NE02112 2SC1988 12			NE02132 2SC2570 32			NE02133 2SC2351 33			NE02135 2SC2149 35			NE02137 2SC2369 37		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
I_{CBO}	Collector Cutoff Current at V_{CB} = 15 V, I_E = 0	µA			1.0			1.0			1.0			1.0			1.0			1.0			1.0			1.0
I_{EBO}	Emitter Cutoff Current at V_{EB} = 2 V, I_C = 0	µA			1.0			1.0			1.0			1.0			1.0			1.0			1.0			1.0
h_{FE}	Forward Current Gain at V_{CE} = 10 V, I_C = 20 mA		20	70	250	20	70	250	20	70	250	20	70	250	20	70	250	40	70	200	20	70	250	20	70	250
C_{CB}	Collector to Base Capacitance[2] at V_{CB} = 10 V, I_E = 0, f = 1 MHz	pF		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		.75	1.0
R_{TH}	Thermal Resistance (J-C)	°C/W			70			70			90			90									120			
R_{TH}	Thermal Resistance (J-A)							300			500			500			500			666			600			500
P_T[3]	Total Power Dissipation	mW	580		700	580		700	350		700	350		700			250			150	290		500			250

Notes:

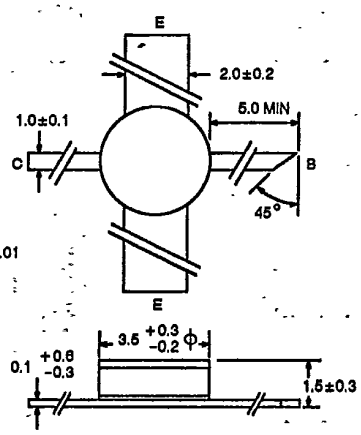
1. Electronic Industrial Association of Japan.
2. C_{CB} measurement employs a three-terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal..
3. Minimum dissipations based on $R_{TH(J-A)}$ for applications without effective heatsink, maximum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

OUTLINE DIMENSIONS (Units in mm)

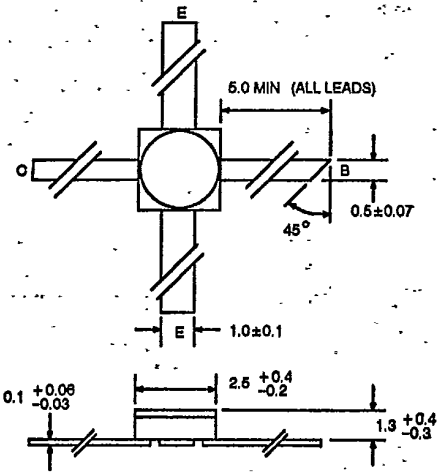
NE02100 (CHIP)
(Chip Thickness: 140 µm)



OUTLINE 03

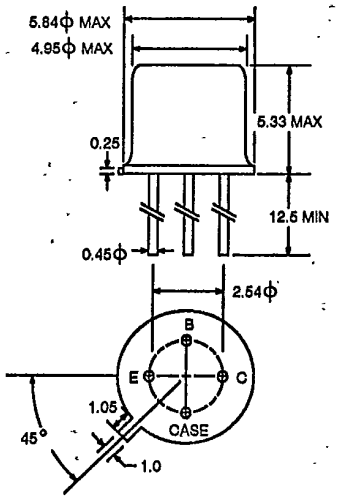


OUTLINE 07

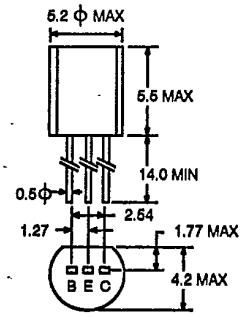


*07B has emitter and base reversed.

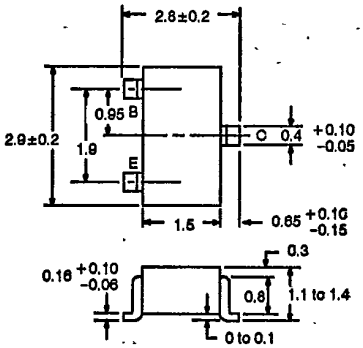
OUTLINE 12
(TO-72)



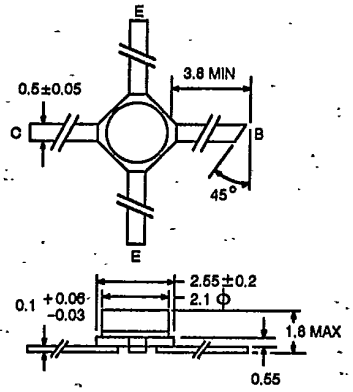
OUTLINE 32
(TO-92)



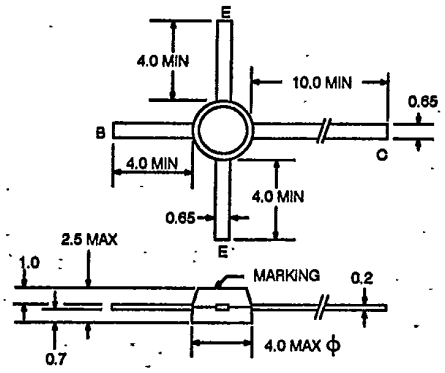
OUTLINE 33
(SOT-23)



OUTLINE 35
(MICRO-X)



OUTLINE 37

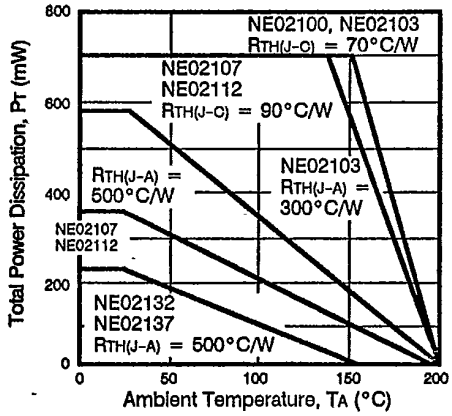


*The NE02136 is available with only the bottom emitter lead.

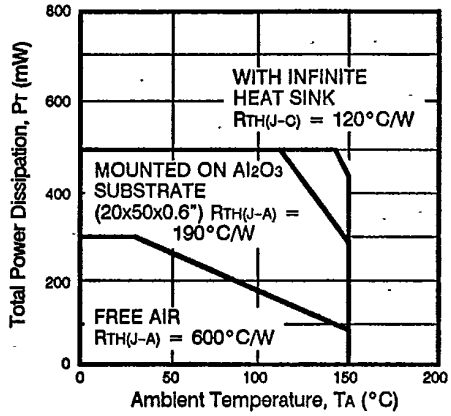
T-31-17
T-31-19

TYPICAL DEVICE CHARACTERISTICS (TA = 25°C)

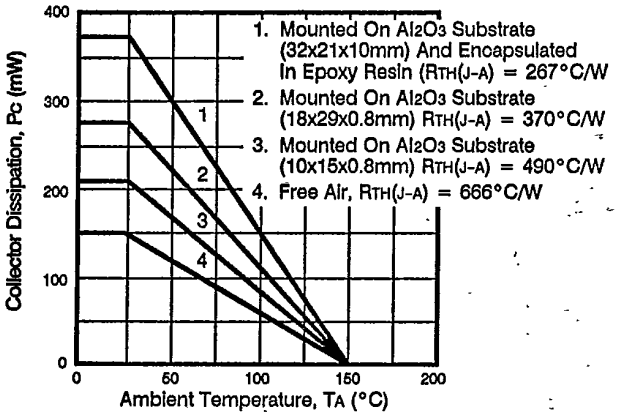
NE02100, NE02103, NE02107, NE02112, NE02132, NE02137
DC POWER DERATING CURVES



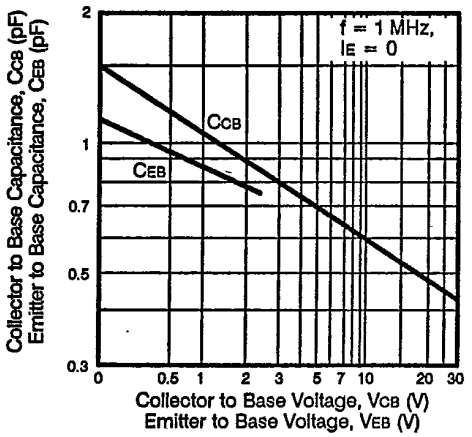
NE02135
DC POWER DERATING CURVES



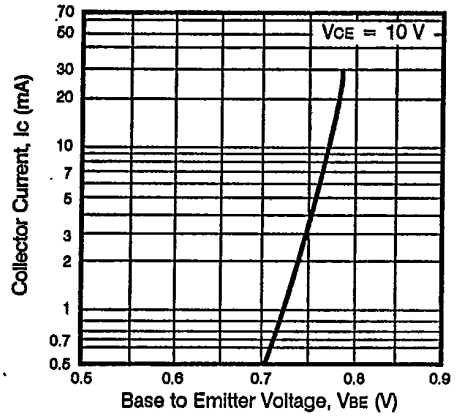
NE02133
DC POWER DERATING CURVES



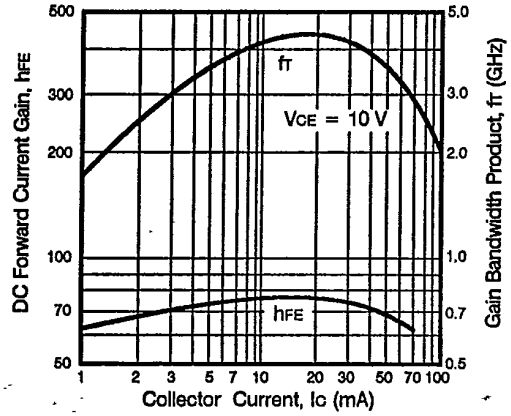
DEVICE CAPACITANCE



VOLTAGE CURRENT CHARACTERISTICS

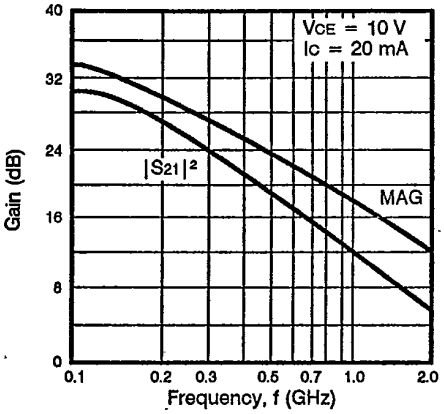


GAIN BANDWIDTH PRODUCT AND FORWARD CURRENT GAIN vs. COLLECTOR CURRENT

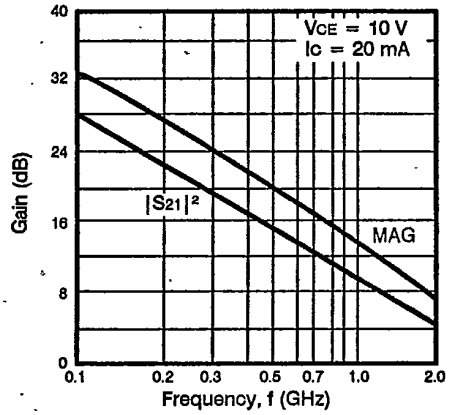


TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

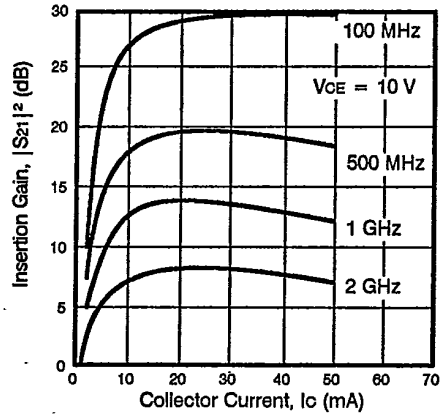
NE02103, NE02107, NE02135
GAIN vs. FREQUENCY



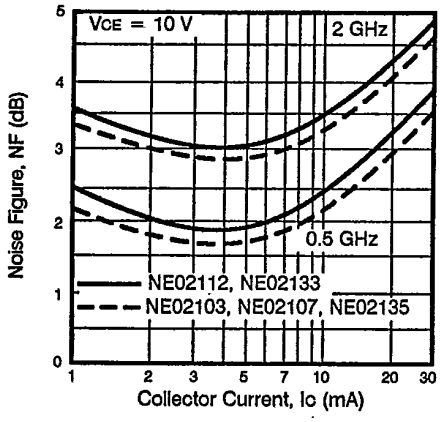
NE02112, NE02133
GAIN vs. FREQUENCY



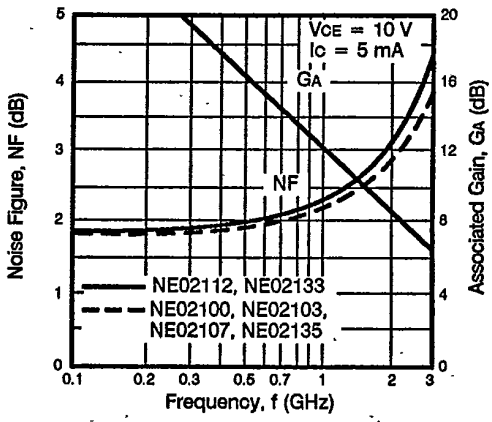
NE02103, NE02107
INSERTION GAIN vs. COLLECTOR CURRENT



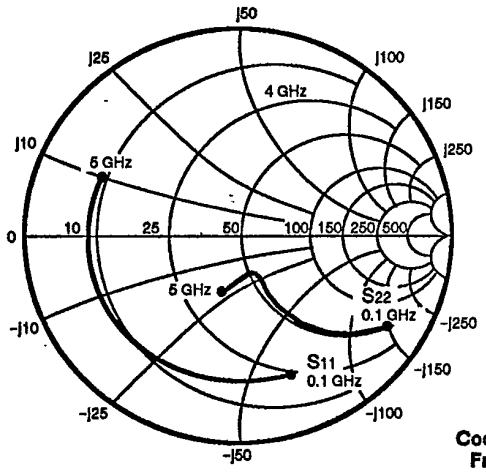
NOISE FIGURE vs.
COLLECTOR CURRENT

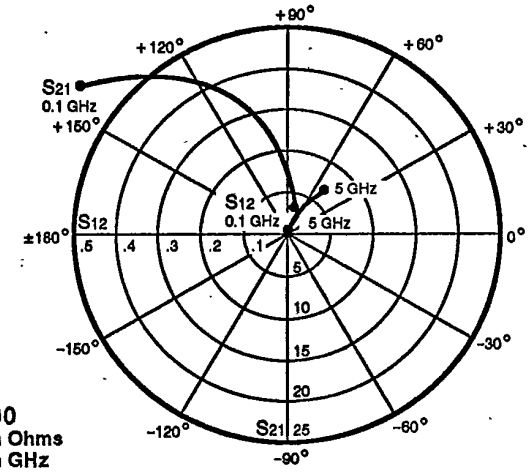


NOISE FIGURE AND ASSOCIATED
GAIN vs. FREQUENCY



TYPICAL COMMON EMITTER SCATTERING PARAMETERS





NE02100
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10 V, I_C = 20 mA)

S-MAGN AND ANGLES:

V_{CE} = 10 V, I_C = 5 mA

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		k	G_{MA} 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	-51	.54	16.9
1500	.71	-164	2.85	76	.09	27	.35	-56	.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

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

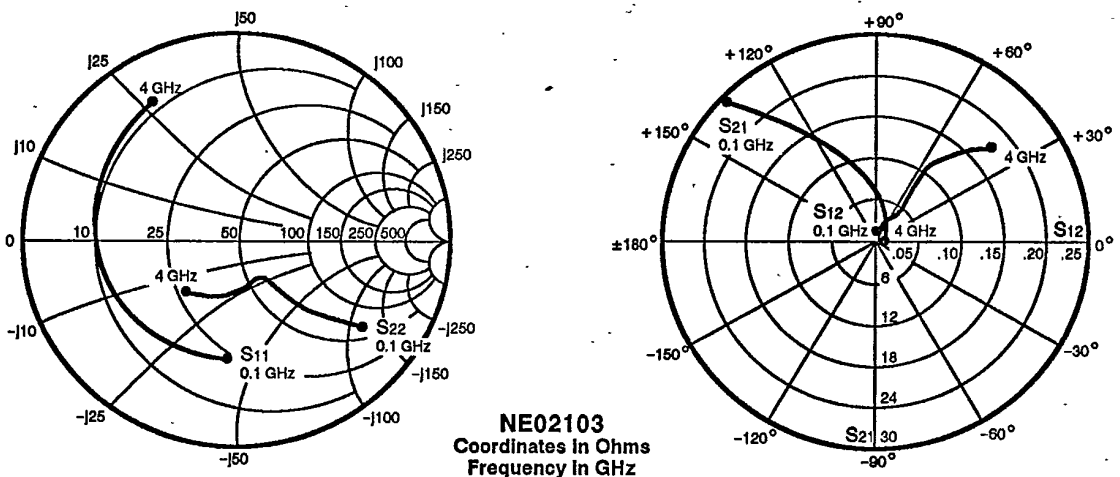
100	.75	-47	20.04	153	.02	65	.89	-24	.11	29.2
500	.72	-137	9.40	105	.05	34	.41	-57	.39	22.5
1000	.72	-162	4.97	86	.06	34	.27	-62	.69	19.0
1500	.71	-173	3.37	75	.07	38	.23	-66	.92	16.8
2000	.71	-179	2.56	66	.08	41	.22	-71	1.09	13.2
2500	.71	176	2.05	58	.09	43	.23	-76	1.19	10.9
3000	.71	172	1.74	51	.10	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

V_{CE} = 10 V, I_C = 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
(V_{CE} = 10 V, I_C = 20 mA)

S-MAGN AND ANGLES:

V_{CE} = 10 V, I_C = 5 mA

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
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

V_{CE} = 10 V, I_C = 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

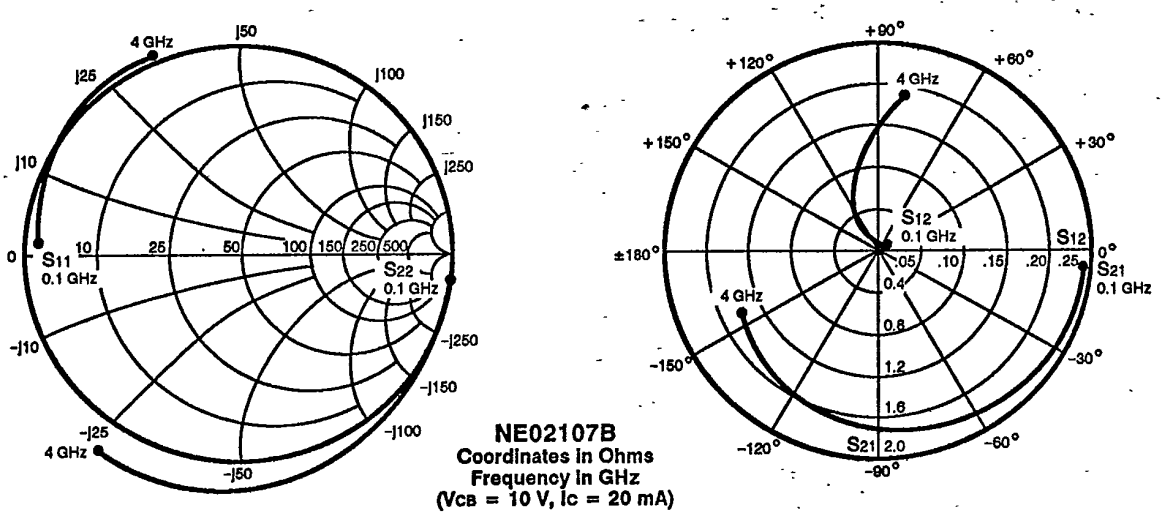
V_{CE} = 10 V, I_C = 20 mA

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

V_{CE} = 10 V, I_C = 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

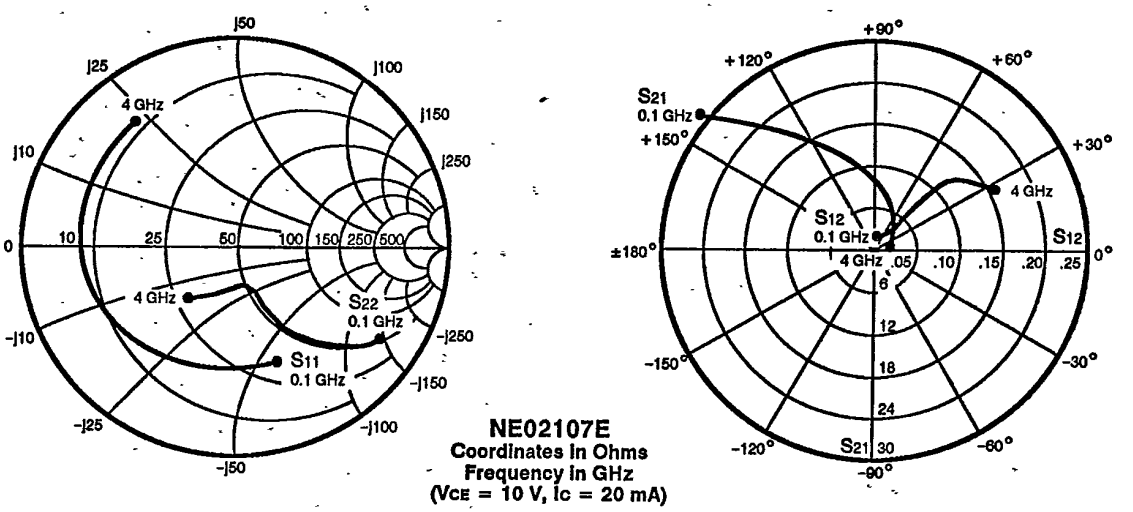


NE02107B
Coordinates in Ohms
Frequency in GHz
(V_{CB} = 10 V, I_C = 20 mA)

S-MAGN AND ANGLES:

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
V_{CB} = 10 V, I_C = 5 mA								
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_{CB} = 10 V, I_C = 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	159	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	125	1.45	-135	.15	88	1.12	-111
4000	.95	116	1.33	-156	.18	77	1.10	-126
V_{CB} = 10 V, I_C = 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_{CB} = 10 V, I_C = 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

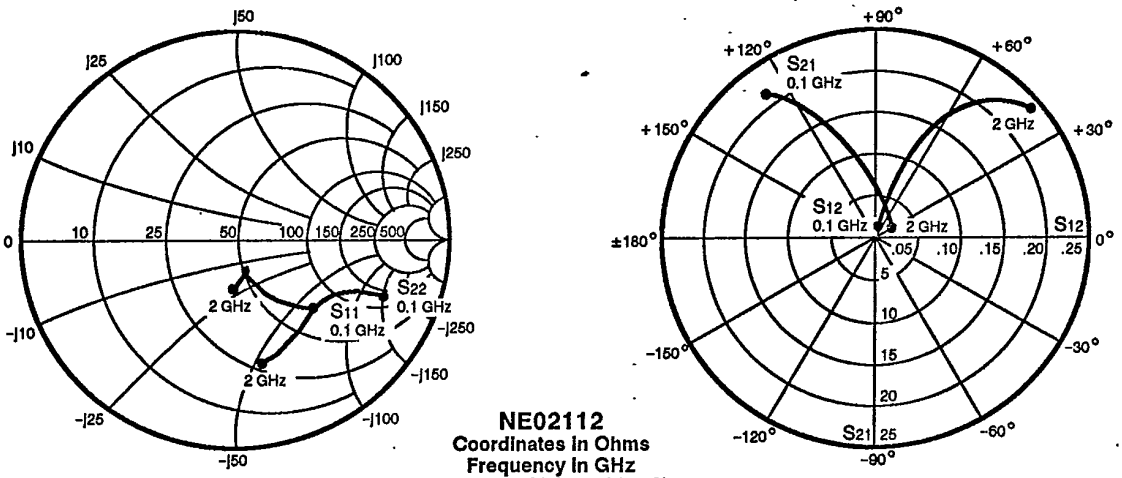


NE02107E
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10 V, I_C = 20 mA)

S-MAGN AND ANGLES:

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
V_{CE} = 10 V, I_C = 5 mA								
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
V_{CE} = 10 V, I_C = 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
V_{CE} = 10 V, I_C = 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
V_{CE} = 10 V, I_C = 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
(V_{CE} = 10 V, I_C = 20 mA)

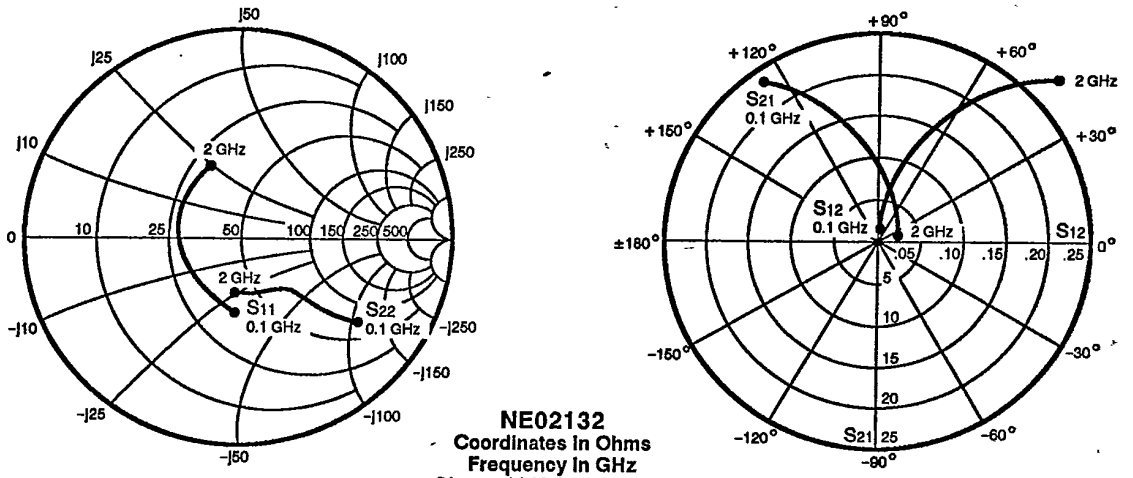
2

S-MAGN AND ANGLES:

FREQUENCY (MHz)	S11		S21		S12		S22	
V_{CE} = 10 V, I_C = 5 mA								
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
V_{CE} = 10 V, I_C = 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
V_{CE} = 10 V, I_C = 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
V_{CE} = 10 V, I_C = 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

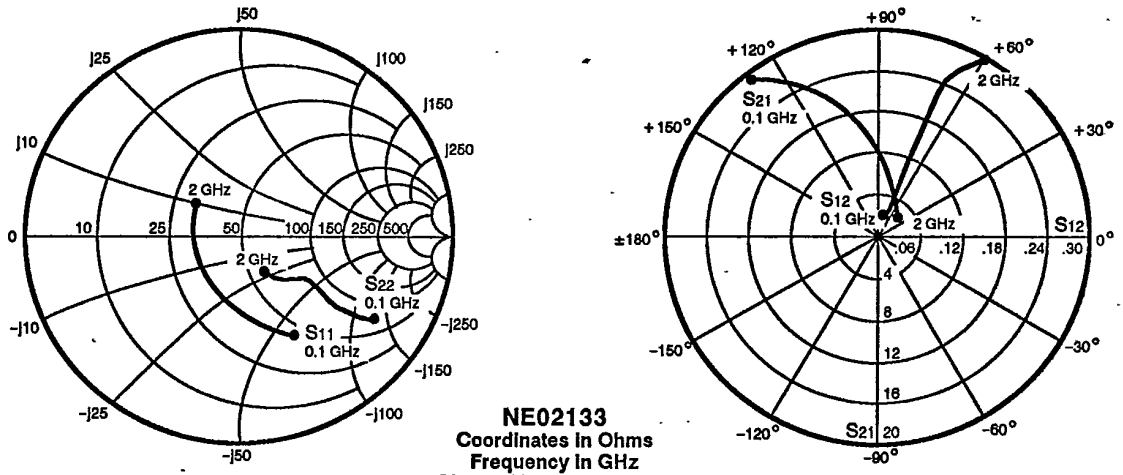


NE02132
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10 V, I_C = 20 mA)

S-MAGN AND ANGLES:

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
V_{CE} = 10 V, I_C = 5 mA								
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 V, I_C = 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
V_{CE} = 10 V, I_C = 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
V_{CE} = 10 V, I_C = 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
(V_{CE} = 10 V, I_C = 20 mA)

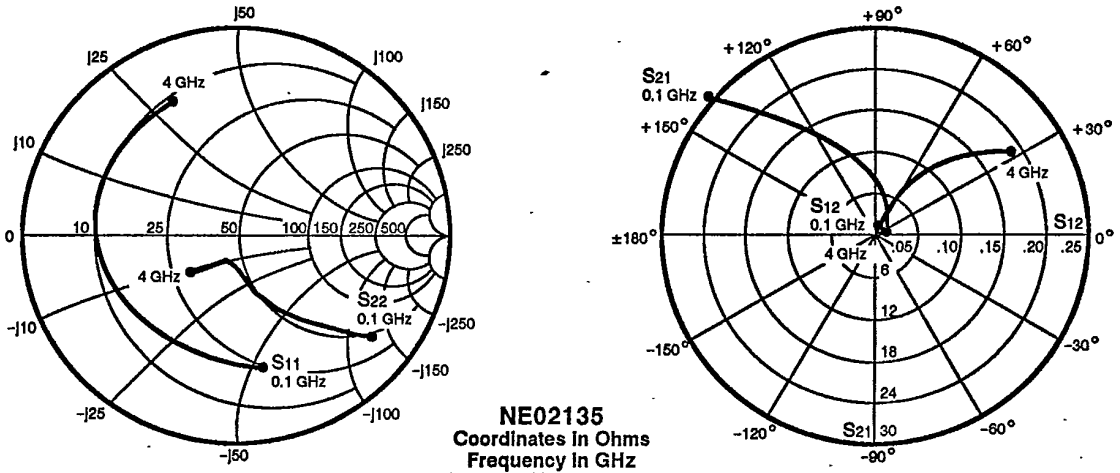
2

S-MAGN AND ANGLES:

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
V_{CE} = 10 V, I_C = 5 mA								
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
V_{CE} = 10 V, I_C = 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
V_{CE} = 10 V, I_C = 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

T-31-19

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE02135
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10 V, I_C = 20 mA)

S-MAGN AND ANGLES:

V_{CE} = 10 V, I_C = 5 mA

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
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_{CE} = 10 V, I_C = 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

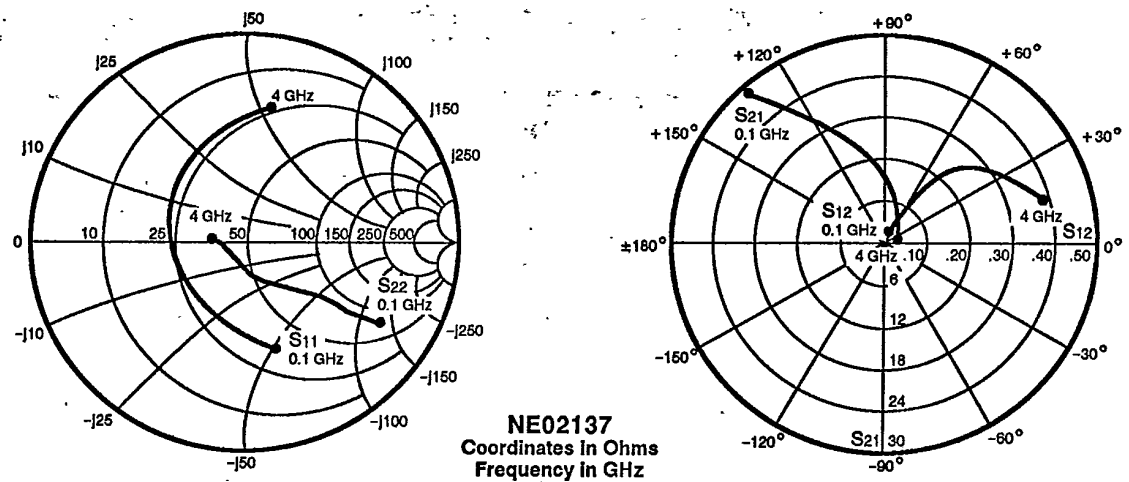
V_{CE} = 10 V, I_C = 20 mA

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_{CE} = 10 V, I_C = 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
(V_{CE} = 10 V, I_C = 20 mA)

S-MAGN AND ANGLES:

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
V_{CE} = 10 V, I_C = 5 mA								
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
V_{CE} = 10 V, I_C = 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
V_{CE} = 10 V, I_C = 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
V_{CE} = 10 V, I_C = 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