

NEC[®]**NPN SILICON HIGH
FREQUENCY TRANSISTOR**

NE68100
NE68132
NE68133
NE68135
NE68137

T-31-15
T-31-17
T-31-21

FEATURES

- **HIGH GAIN BANDWIDTH PRODUCT:** $f_T = 8 \text{ GHz}$
- **LOW NOISE FIGURE**
1.2 dB at 1 GHz
1.6 dB at 2 GHz
- **HIGH ASSOCIATED GAIN**
15 dB at 1 GHz
12 dB at 2 GHz

DESCRIPTION AND APPLICATIONS

The NE681 series of NPN silicon transistors are designed for low noise and high gain amplifier applications. They offer excellent performance and reliability at low cost. The NE681 in 32, 33 and 37 packages can be used in VHF, UHF and CATV band amplifiers while the NE68135 can be used in amplifiers from 1 to 4 GHz. The series is also available in chip form. High performance is achieved by NEC's titanium, platinum, gold and direct nitride deposit passivation process. Low cost is achieved by NEC's high volume production capabilities.

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

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{CB0}	Collector to Base Voltage	V	20
V_{CE0}	Collector to Emitter Voltage	V	10
V_{EB0}	Emitter to Base Voltage	V	1.5
I_C	Collector Current	mA	65
T_J	Operating Junction Temperature	$^\circ\text{C}$	150*
T_{STG}	Storage Temperature	$^\circ\text{C}$	-55 to +150**

*200 $^\circ\text{C}$ for NE68135 and NE68100.

**-65 to +150 for NE68135.

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

PART NUMBER EIAJ* REGISTERED NUMBER PACKAGE OUTLINE			NE68100 00 (CHIP)			NE68132 2SC3582 32			NE68133 2SC3583 33			NE68135 2SC3604 35			NE68137 2SC3584 37		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
f_T	Gain Bandwidth Product at $V_{CE} = 8 \text{ V}$, $I_C = 20 \text{ mA}$	GHz		9.0			8.0			9.0			9.0			9.0	
$ S_{21E} ^2$	Insertion Power Gain at $V_{CE} = 8 \text{ V}$, $I_C = 20 \text{ mA}$, $f = 1 \text{ GHz}$ $f = 2 \text{ GHz}$	dB dB	9.0	11.0		9.0	11.0		11.0	13.0		9.0	11.0		13.0	15.0	
MAG	Maximum Available Gain at $V_{CE} = 8 \text{ V}$, $I_C = 20 \text{ mA}$, $f = 1 \text{ GHz}$ $f = 2 \text{ GHz}$	dB dB		14.0			13.0			15.5			14.0			17.0	
NF	Noise Figure at $V_{CE} = 8 \text{ V}$, $I_C = 7 \text{ mA}$, $f = 1 \text{ GHz}$ $f = 2 \text{ GHz}$	dB dB		1.6	2.3		1.2	2.5		1.2	2.5		1.6	2.3		1.2	2.5
GNF	Associated Gain at Noise Figure at $V_{CE} = 8 \text{ V}$, $I_C = 7 \text{ mA}$, $f = 1 \text{ GHz}$ $f = 2 \text{ GHz}$	dB dB		12.0			12.0			13.0			12.0			15.0	

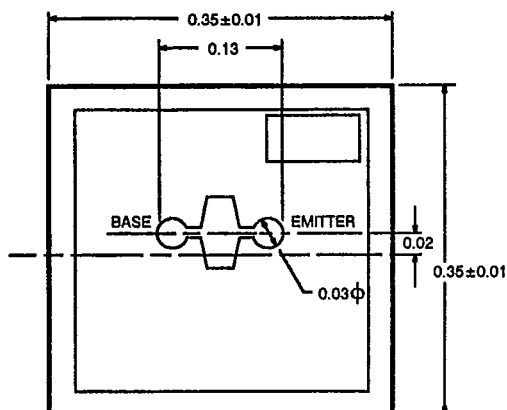
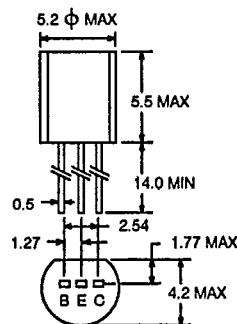
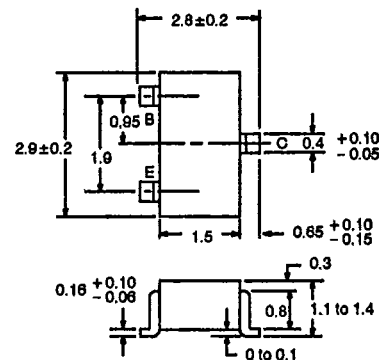
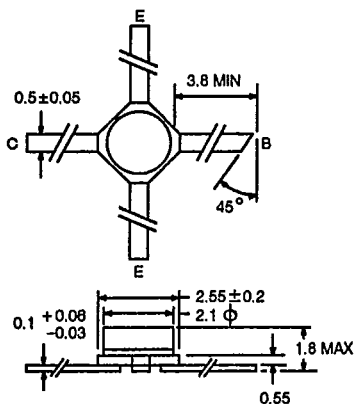
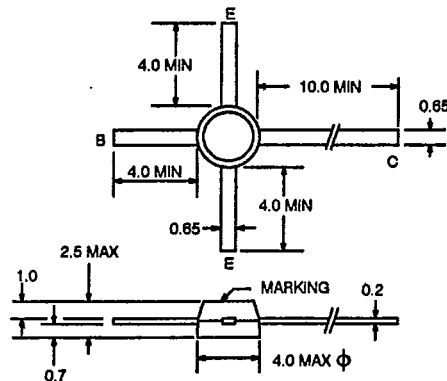
*Electronic Industrial Association of Japan.

T-31-17
T-31-21**ELECTRICAL CHARACTERISTICS** ($T_A = 25^\circ\text{C}$)

PART NUMBER EIAJ ¹ REGISTERED NUMBER PACKAGE OUTLINE			NE68100 00 (CHIP)			NE68132 2SC3582 32			NE68133 2SC3583 33			NE68135 2SC3604 35			NE68137 2SC3584 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 $V_{CB} = 10\text{ V}$, $I_E = 0$	μA			1.0			1.0			1.0			1.0			1.0
I_{EBO}	Emitter Cutoff Current at $V_{EB} = 1\text{ V}$, $I_C = 0$	μA			1.0			1.0			1.0			1.0			1.0
h_{FE}^2	Forward Current Gain at $V_{CE} = 8\text{ V}$, $I_C = 20\text{ mA}$		50	100	250	50	100	250	50	100	250	50	100	250	50	100	250
C_{OB}	Output Capacitance at $V_{CB} = 10\text{ V}$, $I_E = 0$, $f = 1\text{ MHz}$	pF		0.2	0.7		0.4	0.9		0.35	0.9		0.2	0.7		0.25	0.8
R_{TH}	Thermal Resistance (Junction-to-Ambient)	$^\circ\text{C/W}$			80 ³			500			625			590			500
P_T	Total Power Dissipation	mW			600			250			200			295			250

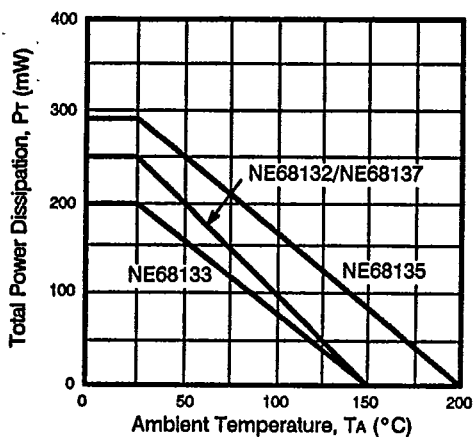
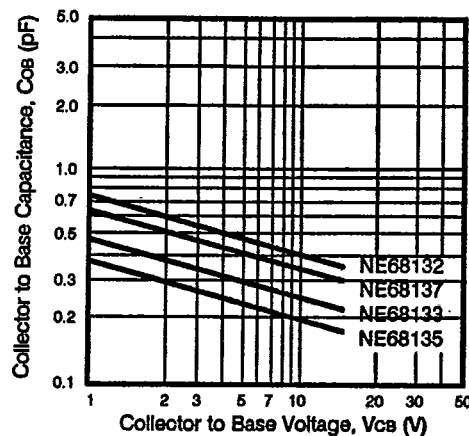
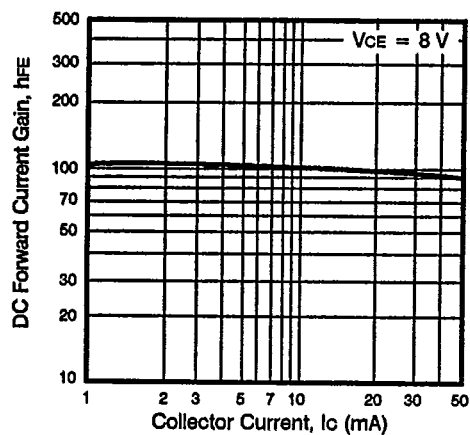
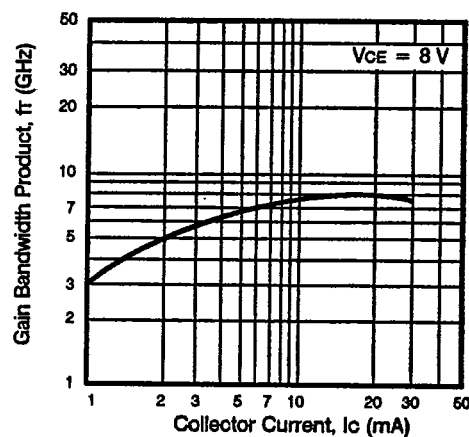
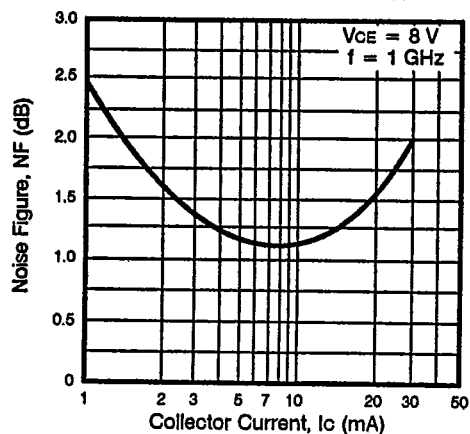
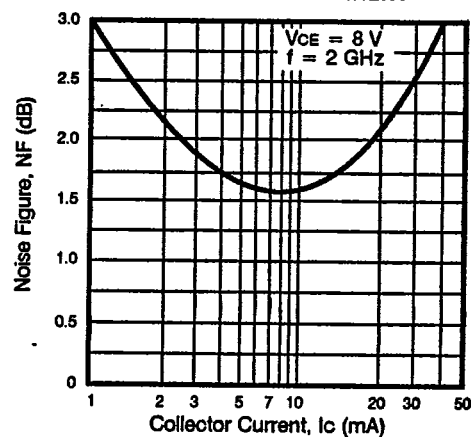
Notes:

- Electronic Industrial Association of Japan.
- Pulsed ($PW \leq 350\text{ }\mu\text{s}$, duty cycle $\leq 2\%$)
- R_{TH} (Junction-to-Channel) when mounted on an infinite heat sink.

OUTLINE DIMENSIONS (Units in mm)**NE68100 (CHIP)**
(Chip Thickness: 160 μm)**OUTLINE 32**
(TO-92)**OUTLINE 33**
(SOT-23)**OUTLINE 35**
(MICRO-X)**OUTLINE 37**
(DISK-MOLD)

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

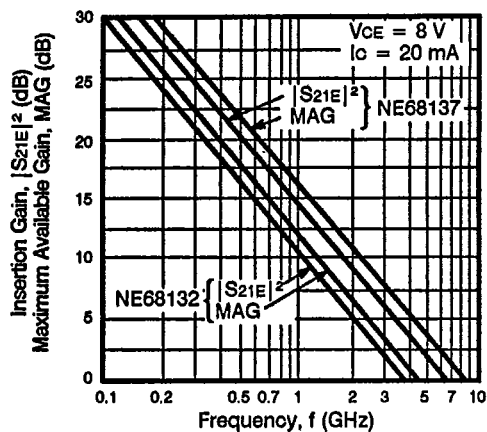
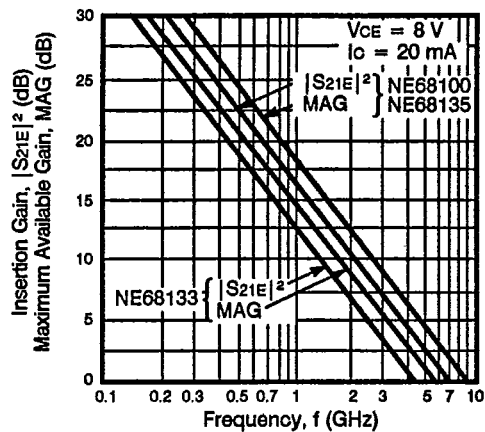
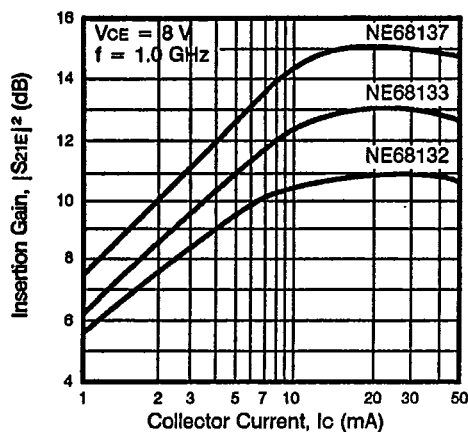
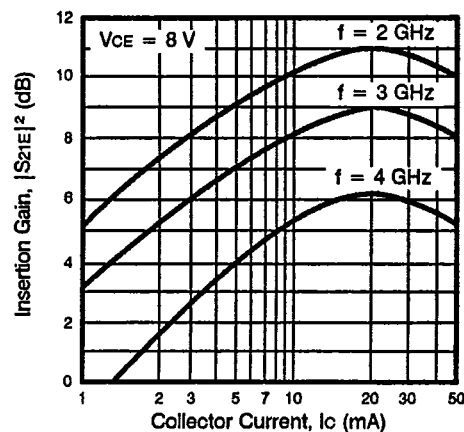
DC POWER DERATING CURVES

COLLECTOR TO BASE CAPACITANCE
vs. COLLECTOR TO BASE VOLTAGEFORWARD CURRENT GAIN
vs. COLLECTOR CURRENTGAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENTNE68132, 33 & 37
NOISE FIGURE
vs. COLLECTOR CURRENTNE68100, NE68135
NOISE FIGURE
vs. COLLECTOR CURRENT

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

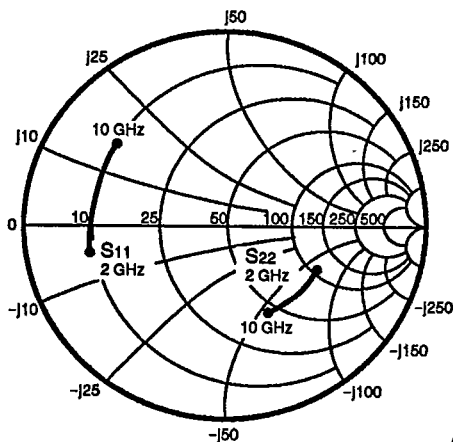
T-31-17

T-31-21

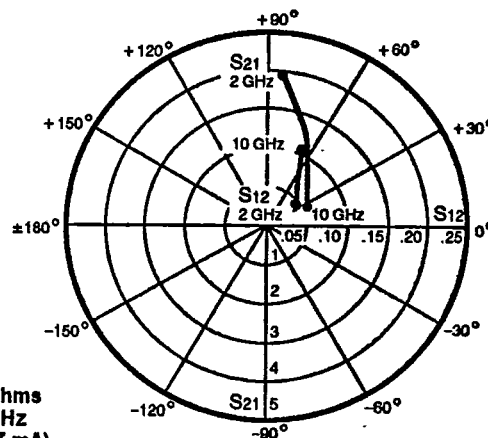
FORWARD INSERTION GAIN
AND MAXIMUM AVAILABLE GAIN
vs. FREQUENCYFORWARD INSERTION GAIN
AND MAXIMUM AVAILABLE GAIN
vs. FREQUENCYNE68132, 33 & 37
INSERTION GAIN vs.
COLLECTOR CURRENTNE68100, NE68135
INSERTION GAIN vs.
COLLECTOR CURRENT

2

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE68100
Coordinates in Ohms
Frequency in GHz
(VCE = 8 V, IC = 7 mA)



S-MAGN AND ANGLES:

VCE = 8 V, IC = 7 mA

FREQUENCY (GHz)

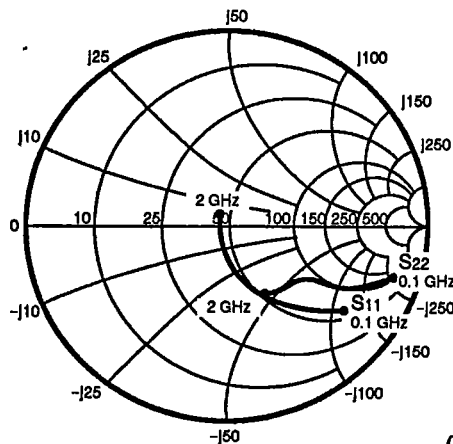
	S11		S21		S12		S22	
2.0	.70	-167	3.96	84	0.05	37	.50	-29
2.5	.70	-173	3.35	78	0.05	38	.49	-30
3.0	.69	-178	2.98	74	0.05	42	.48	-31
3.5	.69	177	2.69	70	0.06	46	.48	-33
4.0	.69	174	2.40	66	0.06	47	.48	-34
4.5	.70	170	2.19	62	0.06	50	.47	-37
5.0	.69	167	2.01	59	0.07	54	.48	-38
5.5	.70	164	1.87	55	0.07	55	.48	-41
6.0	.70	162	1.73	52	0.08	58	.49	-43
6.5	.70	159	1.64	49	0.08	58	.47	-46
7.0	.70	156	1.52	46	0.09	59	.48	-49
7.5	.70	154	1.44	43	0.09	59	.48	-51
8.0	.70	151	1.36	39	0.10	61	.48	-54
8.5	.71	149	1.30	37	0.10	62	.48	-57
9.0	.71	147	1.23	34	0.11	63	.49	-59
9.5	.71	144	1.18	31	0.11	63	.48	-63
10.0	.71	142	1.14	29	0.12	64	.49	-66

VCE = 8 V, IC = 20 mA

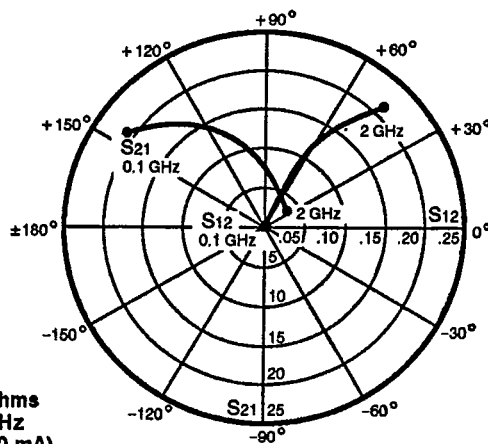
	S11		S21		S12		S22	
2.0	.68	-180	4.78	80	0.04	55	.40	-27
2.5	.68	176	4.06	75	0.04	58	.39	-27
3.0	.68	173	3.53	72	0.05	61	.40	-29
3.5	.68	170	3.14	68	0.05	63	.39	-30
4.0	.68	167	2.80	65	0.06	65	.39	-33
4.5	.69	164	2.57	61	0.06	66	.40	-34
5.0	.68	162	2.34	58	0.07	67	.39	-36
5.5	.69	159	2.18	55	0.07	68	.41	-38
6.0	.69	157	2.02	52	0.08	68	.39	-41
6.5	.69	155	1.90	49	0.09	68	.41	-44
7.0	.69	153	1.76	46	0.09	67	.39	-46
7.5	.69	151	1.68	43	0.10	67	.41	-49
8.0	.70	149	1.57	40	0.10	67	.39	-52
8.5	.70	146	1.52	38	0.11	68	.41	-53
9.0	.70	144	1.42	35	0.11	68	.39	-57
9.5	.71	142	1.38	32	0.12	68	.41	-59
10.0	.71	140	1.32	29	0.12	68	.40	-62

Note: S-parameters include bond wires.
Base: Total 1 wire (s), 1 per bond pad, 0.0180" (457 μ m) long each wire.
Collector: Total 1 wire (s), 1 per bond pad, 0.0085" (215 μ m) long each wire.
Emitter: Total 2 wire (s), 2 per bond pad, 0.0220" (559 μ m) long each wire.
Wire: 0.0008" (20 μ m) Dia., gold.

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE68132
Coordinates in Ohms
Frequency in GHz
(VCE = 8 V, IC = 10 mA)



S-MAGN AND ANGLES:

VCE = 8 V, IC = 7 mA

FREQUENCY (MHz)

	S11	S21	S12	S22
100	.79 -31	16.63 151	.00 112	.90 -15
200	.57 -52	13.27 127	.01 63	.76 -26
400	.35 -81	8.56 105	.04 60	.57 -33
600	.25 -95	6.19 91	.06 60	.51 -35
800	.18 -108	4.81 81	.09 59	.47 -39
1000	.15 -125	3.96 72	.11 58	.45 -39
1200	.10 -133	3.37 65	.13 56	.46 -45
1400	.04 -151	2.95 58	.15 53	.44 -46
1600	.06 140	2.66 51	.17 51	.45 -52
1800	.09 137	2.43 44	.19 47	.42 -58
2000	.07 116	2.23 38	.20 46	.42 -63

VCE = 8 V, IC = 10 mA

	S11	S21	S12	S22
100	.71 -36	20.62 146	.00 95	.86 -17
200	.47 -58	15.37 122	.01 65	.70 -28
400	.27 -83	9.34 101	.03 65	.52 -32
600	.19 -95	6.59 88	.06 63	.47 -33
800	.13 -108	5.09 78	.08 62	.44 -37
1000	.10 -124	4.17 71	.11 60	.42 -37
1200	.05 -132	3.53 63	.13 59	.43 -44
1400	.01 161	3.10 57	.15 54	.42 -45
1600	.05 137	2.77 50	.17 52	.43 -52
1800	.08 131	2.52 44	.19 48	.40 -58
2000	.07 107	2.33 38	.21 46	.40 -62

VCE = 8 V, IC = 20 mA

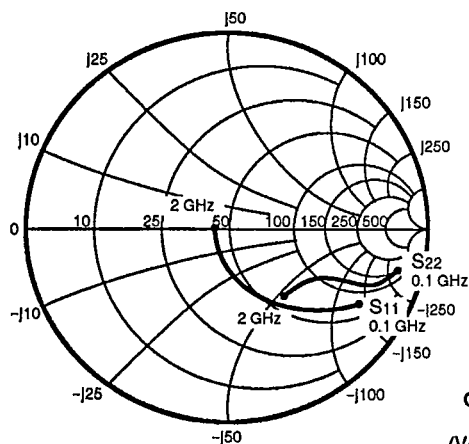
	S11	S21	S12	S22
100	.54 -46	27.69 136	.00 148	.78 -21
200	.29 -66	18.19 113	.00 61	.60 -28
400	.15 -90	10.14 94	.03 70	.46 -29
600	.09 -95	7.01 84	.06 69	.43 -29
800	.05 -107	5.36 75	.09 66	.41 -33
1000	.04 -129	4.37 68	.11 63	.40 -35
1200	.01 165	3.70 62	.14 61	.41 -42
1400	.01 133	3.21 56	.16 57	.41 -43
1600	.04 95	2.87 49	.18 53	.41 -50
1800	.06 104	2.62 43	.20 49	.38 -56
2000	.07 78	2.40 37	.22 46	.39 -61

VCE = 8 V, IC = 30 mA

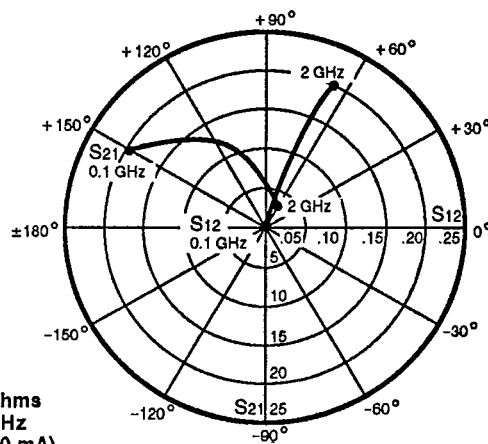
	S11	S21	S12	S22
100	.45 -52	30.19 131	.00 161	.73 -22
200	.22 -72	18.75 109	.00 64	.57 -27
400	.11 -98	10.25 92	.03 73	.44 -27
600	.06 -104	7.01 82	.06 72	.42 -27
800	.02 -128	5.37 74	.09 67	.41 -32
1000	.02 -148	4.37 67	.11 65	.40 -33
1200	.01 164	3.68 61	.14 62	.42 -41
1400	.01 131	3.21 55	.16 57	.41 -42
1600	.05 93	2.85 48	.18 54	.42 -49
1800	.07 96	2.61 42	.20 50	.38 -55
2000	.08 76	2.40 37	.22 47	.40 -60

NE68100, NE68132, NE68133, NE68135, NE68137

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE68133
Coordinates in Ohms
Frequency in GHz
(VCE = 8 V, IC = 10 mA)



S-MAGN AND ANGLES:

VCE = 8 V, IC = 7 mA

FREQUENCY (MHz)

	S11		S21		S12		S22	
100	.81	-26	15.96	155	.00	96	.92	-12
200	.62	-46	13.19	132	.01	73	.80	-21
400	.39	-71	8.70	110	.03	65	.63	-27
600	.29	-86	6.46	98	.05	64	.56	-29
800	.22	-102	5.05	89	.07	64	.52	-31
1000	.18	-123	4.15	82	.10	65	.51	-35
1200	.14	-136	3.52	75	.12	65	.48	-38
1400	.12	-145	3.07	71	.14	65	.49	-40
1600	.11	-155	2.75	66	.16	64	.50	-44
1800	.09	-156	2.47	62	.18	65	.50	-48
2000	.10	-179	2.28	57	.20	63	.47	-52

VCE = 8 V, IC = 10 mA

	S11		S21		S12		S22	
100	.75	-31	19.70	150	.00	94	.89	-14
200	.53	-51	15.30	127	.01	73	.75	-22
400	.32	-73	9.52	106	.03	67	.58	-27
600	.23	-86	6.88	95	.05	67	.52	-28
800	.17	-102	5.34	86	.07	67	.49	-30
1000	.14	-124	4.35	80	.10	67	.48	-35
1200	.10	-138	3.70	74	.12	67	.46	-38
1400	.08	-145	3.20	70	.14	67	.47	-40
1600	.07	-153	2.87	65	.16	66	.48	-44
1800	.06	-156	2.57	61	.18	65	.48	-48
2000	.06	180	2.39	56	.20	63	.45	-52

VCE = 8 V, IC = 20 mA

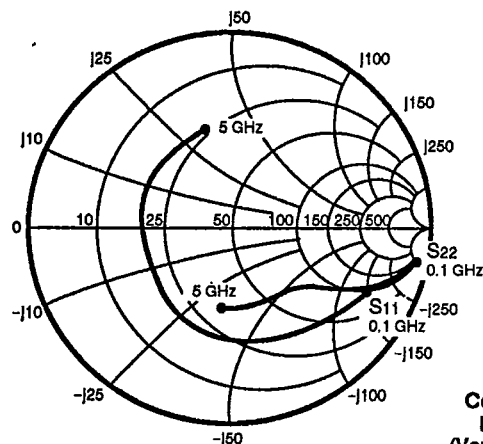
	S11		S21		S12		S22	
100	.64	-39	25.97	142	.00	94	.83	-17
200	.38	-59	18.08	118	.00	76	.67	-23
400	.21	-77	10.34	100	.03	72	.52	-24
600	.14	-87	7.23	91	.05	72	.48	-26
800	.10	-104	5.56	83	.07	71	.46	-26
1000	.09	-132	4.53	78	.10	70	.46	-32
1200	.05	-151	3.83	72	.12	69	.44	-36
1400	.04	-157	3.32	68	.14	69	.45	-38
1600	.03	-154	2.97	64	.17	68	.47	-43
1800	.02	174	2.64	60	.19	67	.46	-47
2000	.03	173	2.45	56	.21	63	.44	-50

VCE = 8 V, IC = 30 mA

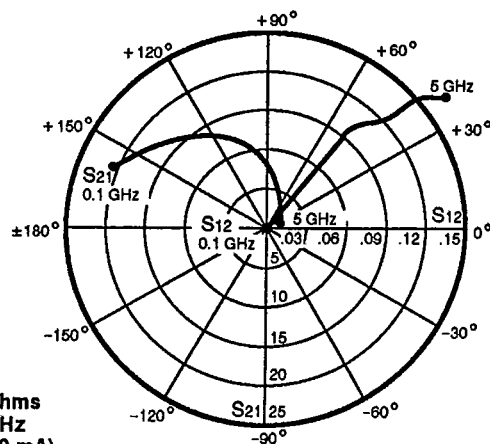
	S11		S21		S12		S22	
100	.57	-45	28.06	137	.00	97	.79	-17
200	.32	-65	18.40	114	.00	78	.64	-22
400	.17	-85	10.22	97	.02	73	.51	-22
600	.11	-96	7.10	89	.05	73	.49	-23
800	.08	-119	5.43	82	.07	73	.46	-25
1000	.09	-147	4.41	76	.10	71	.46	-31
1200	.06	-170	3.73	71	.12	70	.45	-34
1400	.05	-176	3.24	67	.14	70	.46	-37
1600	.04	-179	2.89	63	.17	68	.48	-42
1800	.03	154	2.58	59	.19	67	.47	-46
2000	.05	158	2.40	55	.21	64	.44	-50

NE68100, NE68132, NE68133, NE68135, NE68137

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE68135
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 8 V, I_C = 10 mA)



S-MAGN AND ANGLES:

V_{CE} = 8 V, I_C = 7 mA

FREQUENCY (MHz)

	S ₁₁	S ₂₁	S ₁₂	S ₂₂
100	.81 -23	16.36 165	.00 152	.96 -8
500	.61 -99	11.02 118	.02 49	.66 -31
1000	.51 -141	6.44 91	.03 42	.51 -37
1500	.46 -165	4.43 76	.04 43	.52 -41
2000	.45 177	3.45 64	.05 43	.48 -44
2500	.49 157	2.74 52	.09 43	.44 -51
3000	.50 146	2.35 43	.10 43	.46 -60
3500	.51 134	2.01 31	.11 41	.46 -67
4000	.53 124	1.82 23	.13 40	.45 -78
4500	.54 114	1.59 15	.14 40	.47 -85
5000	.55 105	1.47 5	.16 36	.48 -94

V_{CE} = 8 V, I_C = 10 mA

	S ₁₁	S ₂₁	S ₁₂	S ₂₂
100	.75 -27	20.42 162	.00 153	.96 -10
500	.56 -109	12.44 114	.01 51	.60 -33
1000	.48 -149	7.00 89	.02 46	.47 -37
1500	.44 -171	4.78 75	.04 48	.48 -40
2000	.43 171	3.71 63	.05 47	.44 -44
2500	.46 154	2.96 52	.09 47	.42 -52
3000	.47 143	2.52 43	.10 48	.42 -59
3500	.49 131	2.17 32	.12 43	.42 -67
4000	.51 122	1.95 24	.13 43	.42 -78
4500	.52 112	1.70 16	.15 41	.43 -85
5000	.53 104	1.57 6	.17 36	.43 -95

V_{CE} = 8 V, I_C = 20 mA

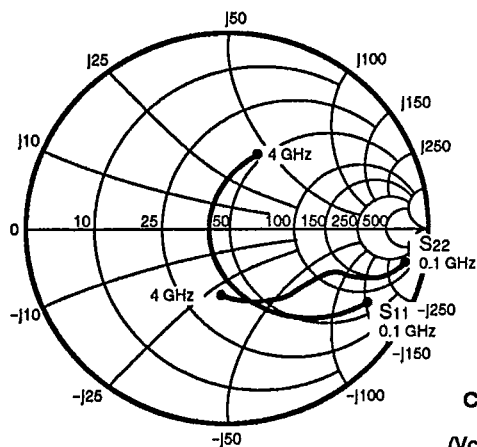
	S ₁₁	S ₂₁	S ₁₂	S ₂₂
100	.65 -37	28.32 157	.00 154	.93 -13
500	.49 -127	14.25 107	.01 56	.52 -34
1000	.44 -161	7.66 86	.01 56	.41 -36
1500	.42 -180	5.15 73	.03 56	.43 -39
2000	.41 164	3.99 61	.05 54	.40 -42
2500	.46 147	3.16 53	.09 53	.38 -50
3000	.46 138	2.70 42	.11 51	.38 -58
3500	.48 127	2.31 31	.12 46	.39 -66
4000	.50 118	2.07 24	.14 44	.39 -77
4500	.51 109	1.81 17	.16 42	.39 -82
5000	.53 101	1.68 7	.17 37	.41 -93

V_{CE} = 8 V, I_C = 30 mA

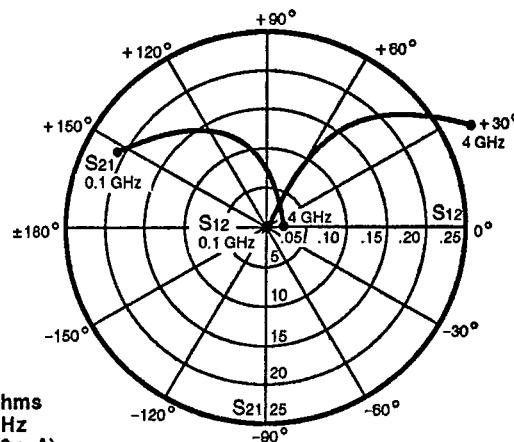
	S ₁₁	S ₂₁	S ₁₂	S ₂₂
100	.60 -44	31.85 154	.00 153	.91 -14
500	.47 -137	14.38 104	.00 62	.49 -31
1000	.45 -167	7.60 84	.01 61	.41 -33
1500	.43 176	5.09 72	.03 59	.43 -37
2000	.42 161	3.94 61	.05 57	.41 -41
2500	.46 146	3.12 52	.09 56	.39 -49
3000	.48 137	2.67 42	.11 54	.39 -58
3500	.49 126	2.29 31	.12 49	.39 -66
4000	.51 117	2.05 24	.14 46	.40 -76
4500	.52 108	1.80 17	.16 44	.40 -84
5000	.53 100	1.66 7	.17 39	.41 -93

NE68100, NE68132, NE68133, NE68135, NE68137

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE68137
Coordinates in Ohms
Frequency in GHz
(VCE = 8 V, IC = 10 mA)



S-MAGN AND ANGLES:

VCE = 8 V, IC = 7 mA

FREQUENCY (MHz)

	S11		S21		S12		S22	
100	.84	-24	16.89	158	.00	152	.94	-10
500	.38	-91	9.04	105	.03	60	.60	-26
1000	.19	-134	4.97	78	.06	59	.51	-31
1500	.12	-179	3.42	62	.11	57	.54	-37
2000	.14	128	2.65	47	.14	50	.49	-44
2500	.23	109	2.17	35	.18	45	.45	-55
3000	.29	96	1.89	21	.21	39	.43	-67
3500	.34	82	1.65	8	.25	31	.40	-78
4000	.40	73	1.49	-3	.28	27	.38	-92

VCE = 8 V, IC = 10 mA

	S11		S21		S12		S22	
100	.78	-29	21.33	153	.00	153	.91	-12
500	.30	-95	9.82	101	.02	64	.56	-26
1000	.14	-140	5.26	76	.06	62	.49	-30
1500	.08	-165	3.59	61	.11	59	.52	-37
2000	.12	116	2.77	47	.15	52	.46	-43
2500	.22	101	2.27	35	.18	45	.44	-53
3000	.28	89	1.95	21	.22	40	.41	-66
3500	.33	78	1.71	9	.26	31	.39	-78
4000	.39	69	1.54	-2	.29	26	.36	-93

VCE = 8 V, IC = 20 mA

	S11		S21		S12		S22	
100	.65	-38	29.39	145	.00	150	.86	-14
500	.19	-107	10.58	94	.02	69	.51	-23
1000	.08	-159	5.50	74	.07	67	.46	-28
1500	.06	138	3.73	60	.11	62	.50	-35
2000	.12	102	2.87	46	.15	55	.45	-41
2500	.22	92	2.33	35	.20	47	.41	-54
3000	.27	84	2.02	22	.23	41	.39	-65
3500	.32	74	1.76	10	.27	32	.35	-78
4000	.38	67	1.59	-1	.30	26	.33	-94

VCE = 8 V, IC = 30 mA

	S11		S21		S12		S22	
100	.59	-44	32.29	140	.00	154	.83	-15
500	.16	-120	10.49	92	.02	72	.50	-20
1000	.08	-178	5.40	72	.06	68	.47	-26
1500	.08	130	3.65	59	.11	62	.50	-34
2000	.14	100	2.82	45	.15	55	.46	-41
2500	.24	93	2.28	33	.19	47	.41	-53
3000	.28	84	1.96	21	.23	41	.40	-65
3500	.32	73	1.72	10	.26	32	.37	-78
4000	.37	67	1.57	-1	.29	26	.34	-94