



NPN SILICON HIGH FREQUENCY TRANSISTOR

NE856 SERIES

FEATURES

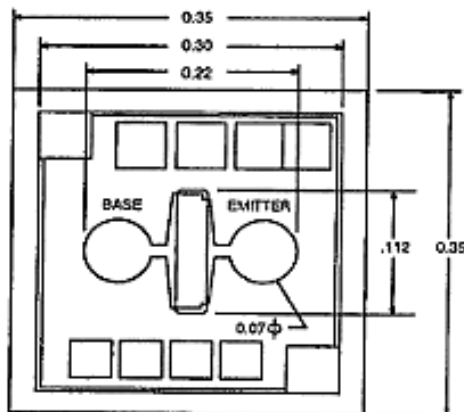
- **HIGH GAIN BANDWIDTH PRODUCT:** $f_r = 7 \text{ GHz}$
- **LOW NOISE FIGURE:** 1.1 dB at 1 GHz
- **HIGH COLLECTOR CURRENT:** 100 mA
- **LOW COST**

DESCRIPTION AND APPLICATIONS

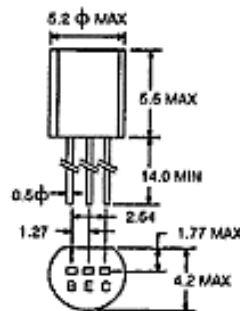
The NE856 series of NPN epitaxial silicon transistors is designed for low noise, high gain amplifiers. Low noise figures, high gain, and high current capability achieve wide dynamic range and excellent linearity. The NE856 series offers excellent performance and reliability at low cost. This is achieved by NEC's titanium, platinum, gold and direct nitride passivated base surface process. The NE856 series is available in chip form and in five low cost package styles.

OUTLINE DIMENSIONS (Units in mm)

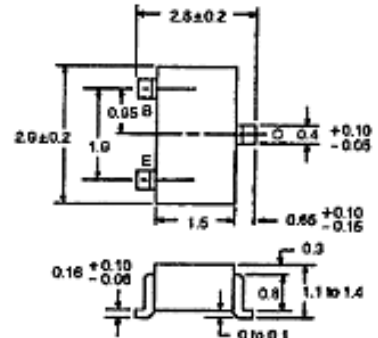
NE85600 (CHIP)
(Chip Thickness: 140 to 160 μm)



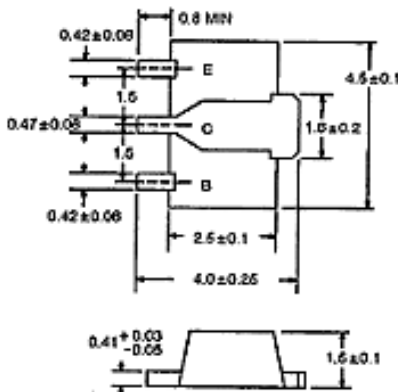
OUTLINE 32 (TO-92)



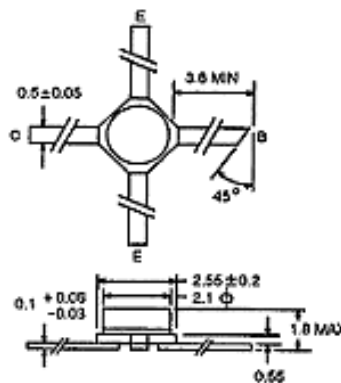
OUTLINE 33 (SOT-23)



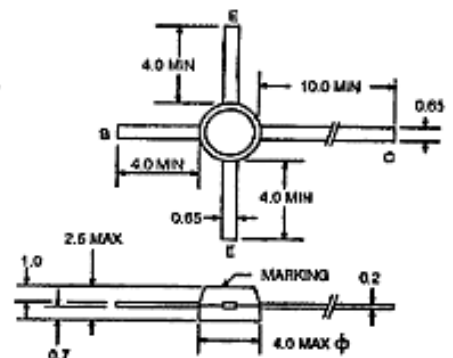
OUTLINE 34 (SOT-89)



OUTLINE 35 (MICRO-X)



OUTLINE 37 (DISK-MOLD)



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

SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	NE85600		NE85602		NE85633		NE85634		NE85635		NE85637		
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
f _r	Gain Bandwidth Product at V _{CE} = 10 V, I _C = 20 mA	GHz	7.0												
S ₂₁ ¹	Insertion Power Gain at V _{CE} = 10 V, I _C = 20 mA, f = 1 GHz V _{CE} = 10 V, I _C = 20 mA, f = 2 GHz	dB dB	7.0	9.0			11.5		9.0			7.0		13.0	
MAG	Maximum Available Gain at V _{CE} = 10 V, I _C = 20 mA, f = 1 GHz V _{CE} = 10 V, I _C = 20 mA, f = 2 GHz	dB dB	10.0	12.0			13.0					10.0	12.0		
NF	Noise Figure at V _{CE} = 10 V, I _C = 7 mA, f = 1 GHz V _{CE} = 10 V, I _C = 7 mA, f = 2 GHz V _{CE} = 10 V, I _C = 40 mA, f = 1 GHz	dB dB dB	2.1	3.4			1.1	2.0	1.1	1.8	3.0	2.1	3.4	1.1	2.0
GA	Associated Gain at V _{CE} = 10 V, I _C = 7 mA, f = 1 GHz V _{CE} = 10 V, I _C = 7 mA, f = 2 GHz V _{CE} = 10 V, I _C = 40 mA, f = 1 GHz	dB dB dB		10.0			9.0		11.0			10.0		12.0	

Note:

1. Electronic Industrial Association of Japan.

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

SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	NE85600		NE85632		NE85633		NE85634		NE85635		NE85637	
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
I _{CEO}	Collector Cutoff Current at V _{CE} = 10 V, I _B = 0	μA		1.0										
I _{CEO}	Emitter Cutoff Current at V _{BE} = 1 V, I _C = 0	μA		1.0										
I _{ES}	Forward Current Gain at V _{CE} = 10 V, I _C = 20 mA		50	120	300	50	120	300	50	120	300	50	120	300
C _{out}	Output Capacitance at V _{CE} = 10 V, I _C = 0, f = 1 MHz	pF		0.5	1.0	0.65	1.0	0.65	1.0	1.0	1.5	0.5	1.0	0.65
R _{th}	Thermal Resistance (junction-to-ambient)	°C/W				25.0		625		62.5*		650		625
P _T	Total Power Dissipation	W		70		60		20		2*		58		20

Notes:

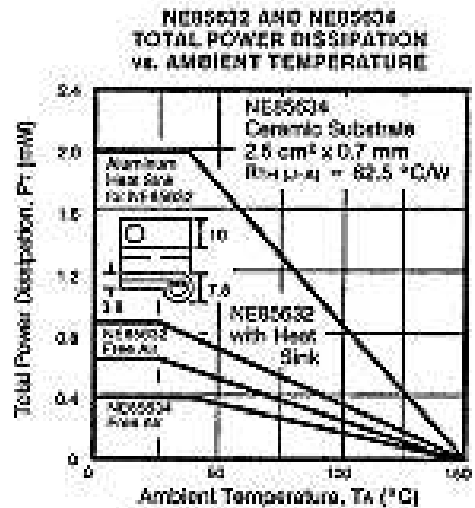
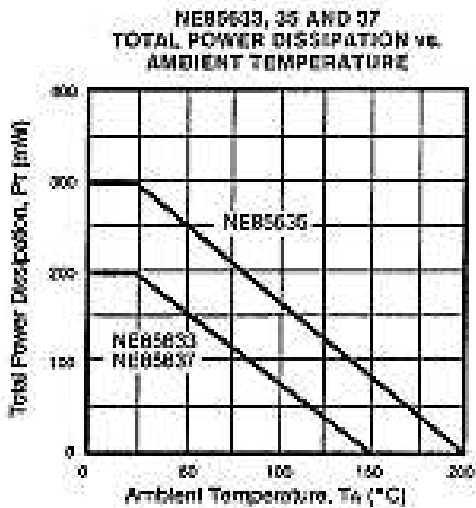
1. Electronic Industrial Association of Japan.
2. Pulse width ≤ 350 μs, duty cycle ≤ 2% pulsed.
3. C_{out} measurement employs a three terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal.
4. * With 2.5 cm² x 0.7 mm ceramic substrate.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

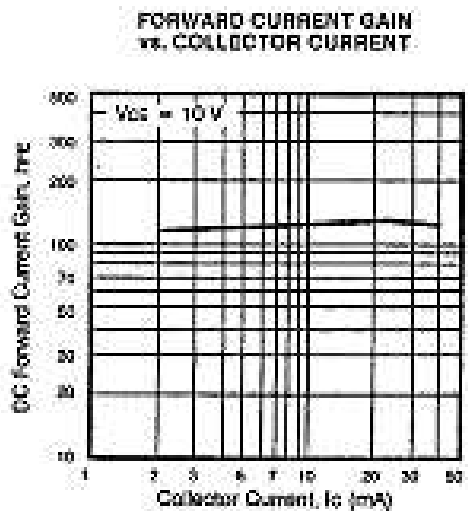
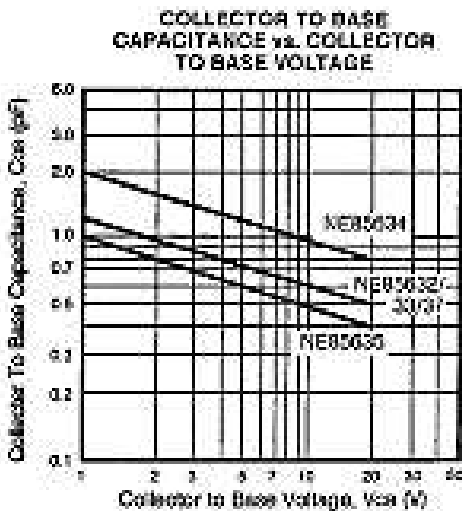
SYMBOLS	PARAMETERS	UNITS	RATINGS
V _{CE0}	Collector to Base Voltage	V	20
V _{CEB}	Collector to Emitter Voltage	V	12
V _{EB0}	Emitter to Base Voltage	V	3.0
I _C	Collector Current	mA	100
T _J	Junction Temperature	°C	200*
T _{stg}	Storage Temperature	°C	-65 to +150

*Maximum T_J for the NE85632/33/34 & 37 is +160°C

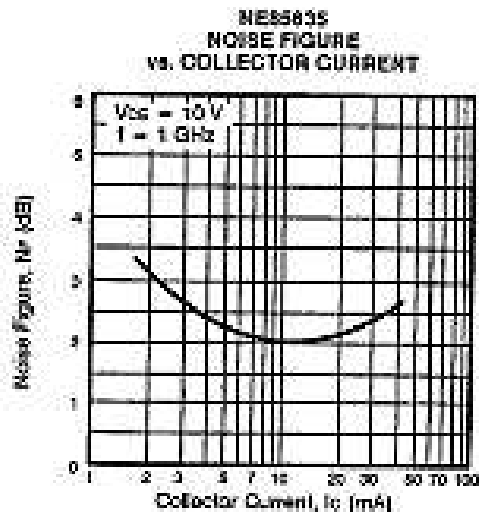
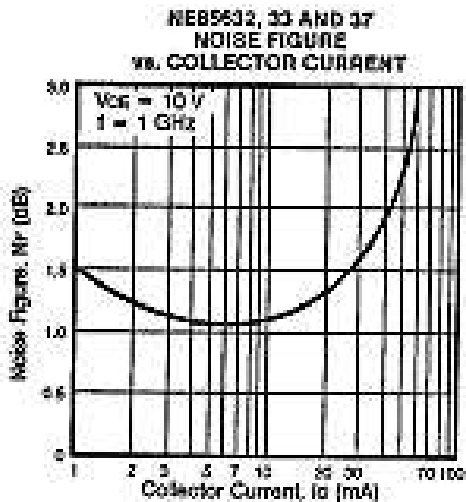
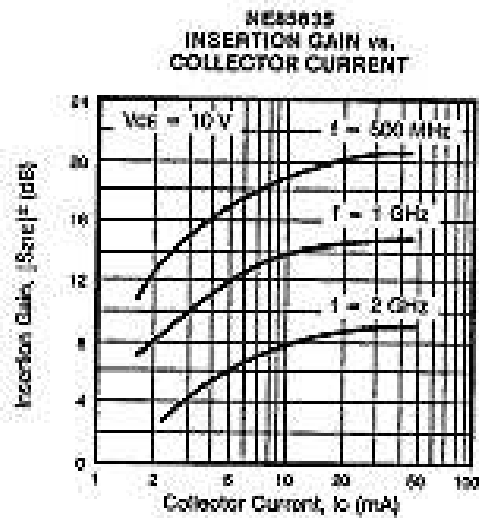
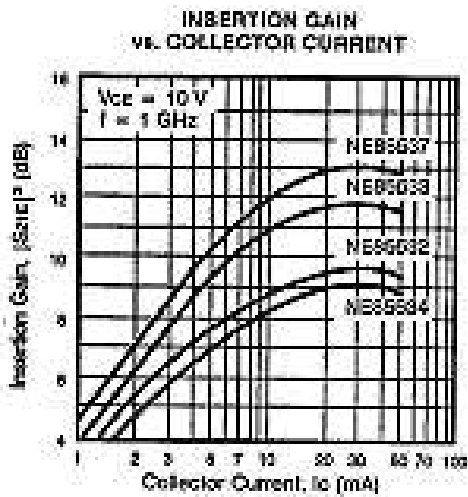
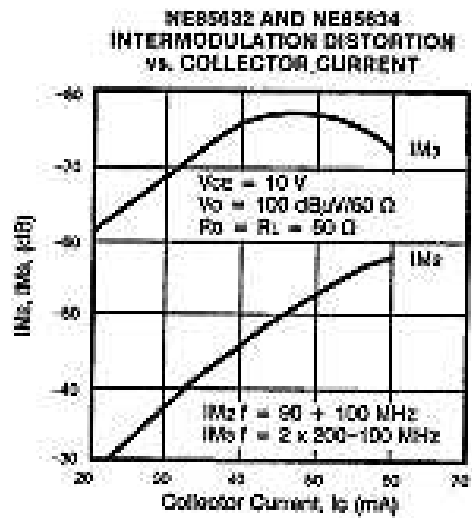
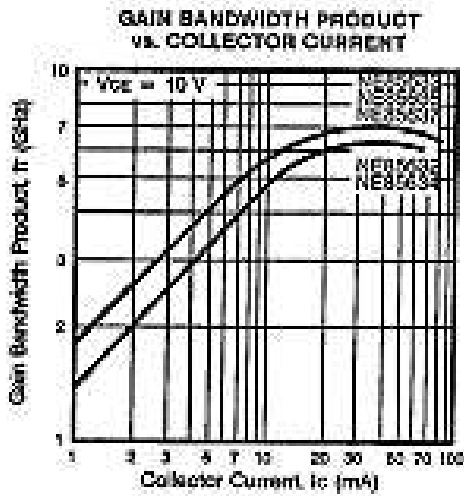
TYPICAL DEVICE CHARACTERISTICS (T_A = 25°C)



TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

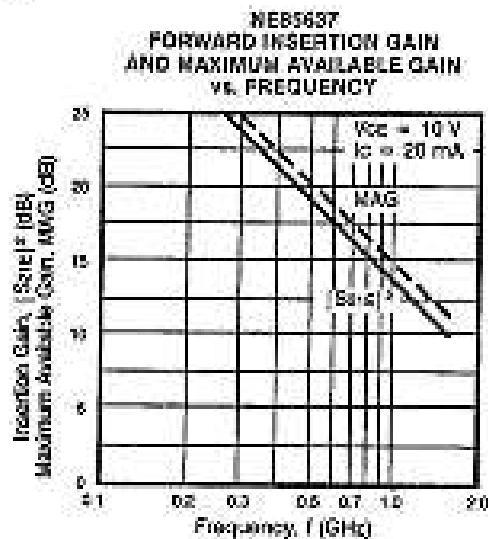
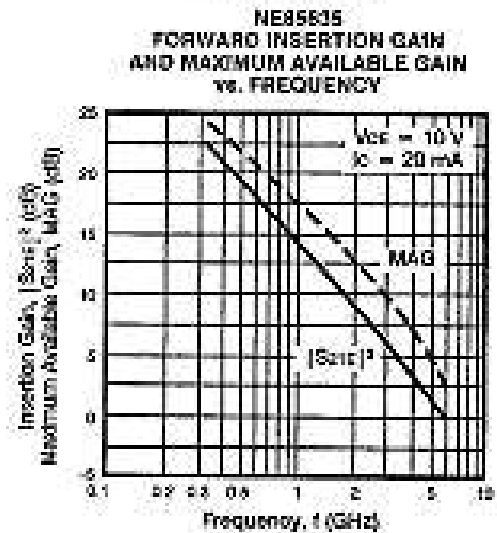
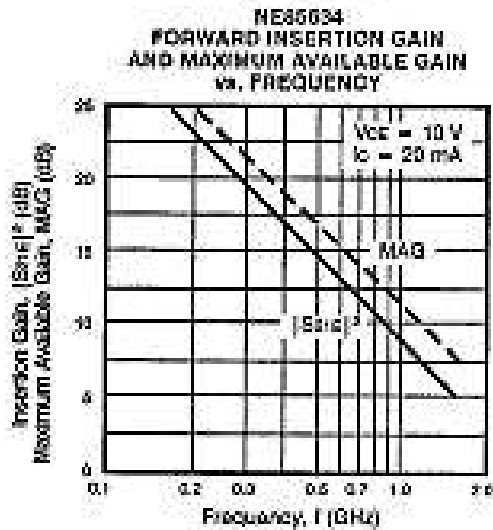
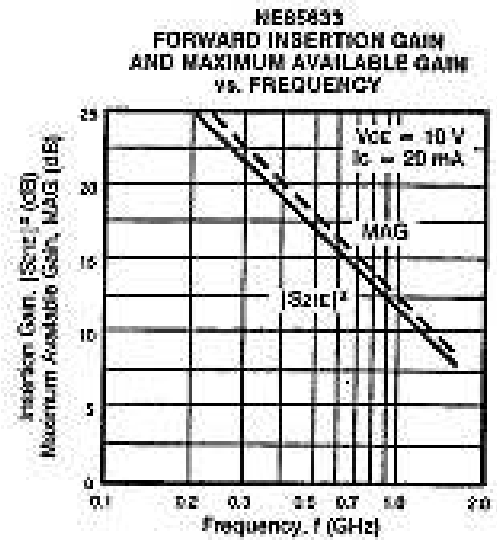
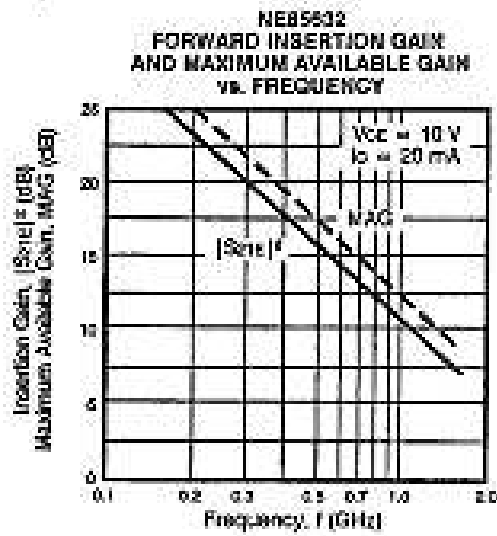


TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

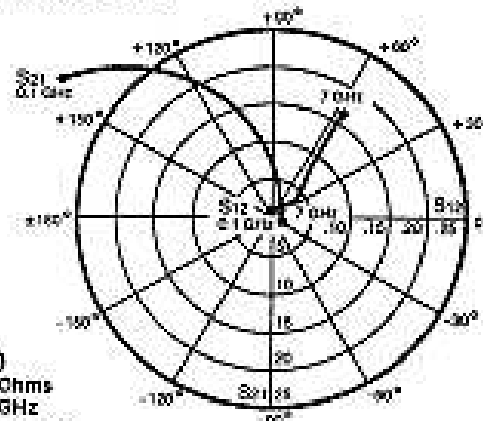
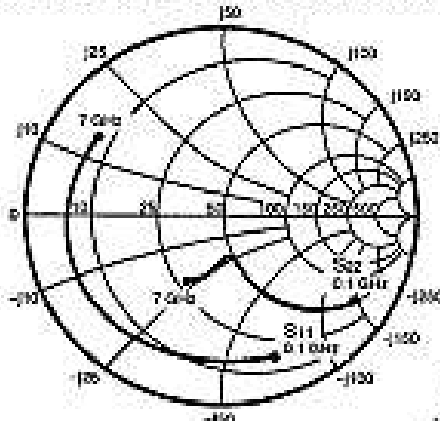


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TYPICAL PERFORMANCE CHARACTERISTICS ($T_A = 25^\circ\text{C}$)



TYPICAL COMMON EMITTER SCATTERING PARAMETERS



S-MAGN AND ANGLES:

VCE = 10 V, IC = 7 mA

FREQUENCY (MHz)	S ₁₁	S ₁₂	S ₂₁	S ₂₂
100	.67	-37	15.42	157
200	.84	-70	13.92	140
300	.81	-88	11.87	127
400	.80	-113	10.14	117
500	.80	-125	8.83	111
600	.78	-135	7.57	105
700	.78	-141	6.52	100
800	.78	-140	5.58	97
900	.78	-152	6.29	94
1000	.75	-158	4.88	91
2000	.75	-176	2.91	72
3000	.75	175	1.67	57
4000	.77	167	1.30	45
5000	.77	160	1.05	33
6000	.77	153	.87	23
7000	.77	147	.75	15

VCE = 10 V, IC = 20 mA

100	.78	-60	32.67	145
200	.75	-107	23.04	125
300	.75	-120	17.83	113
400	.77	-141	14.01	105
500	.76	-148	11.40	101
600	.76	-155	9.73	97
700	.76	-159	8.38	94
800	.76	-163	7.40	91
900	.77	-165	6.60	89
1000	.76	-165	5.97	87
2000	.70	178	3.03	72
3000	.76	171	2.05	69
4000	.78	164	1.58	45
5000	.76	157	1.29	37
6000	.75	151	1.08	27
7000	.76	146	.89	18

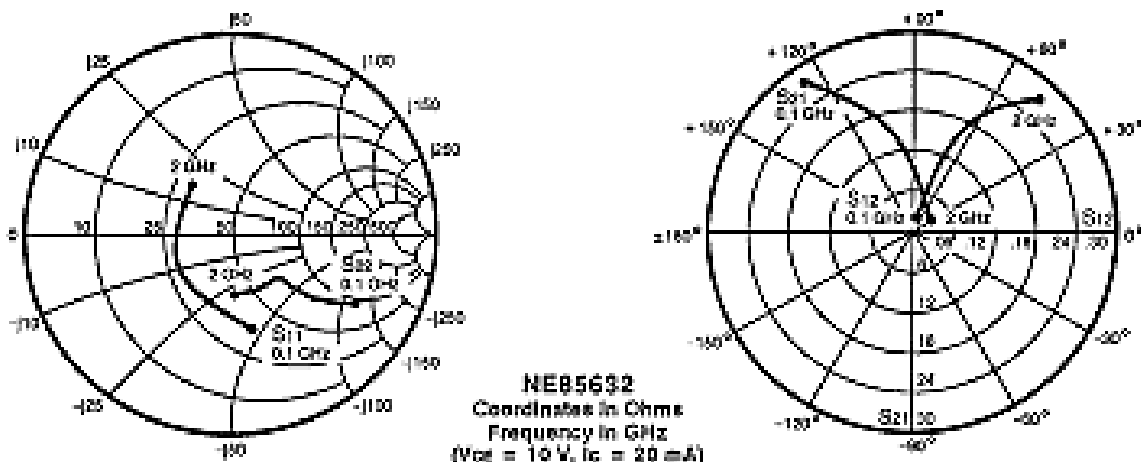
VCE = 10 V, IC = 30 mA

100	.73	-78	37.25	140
200	.75	-118	25.60	120
300	.75	-128	18.54	109
400	.76	-148	14.43	103
500	.76	-155	11.77	98
600	.76	-160	9.89	95
700	.76	-164	8.53	92
800	.76	-167	7.60	90
900	.76	-169	6.93	87
1000	.76	-171	6.04	85
2000	.70	178	3.08	71
3000	.78	170	2.07	69
4000	.75	153	1.50	48
5000	.78	158	1.30	37
6000	.75	151	1.10	27
7000	.75	145	.95	18

Note: S-parameters include bond wires.
 Base: Total 1 wire (x), 1 per bond pad, 0.0093" (238 μm) long each wire.
 Collector: Total 1 wire (x), 1 per bond pad, 0.0093" (210 μm) long each wire.
 Emitter: Total 2 wire (x), 1 per side, 0.0304" (772 μm) long each wire.
 Wire: 0.0007" (17.7 μm) Dia., gold.



TYPICAL COMMON EMITTER SCATTERING PARAMETERS



S-MAGN AND ANGLES:

VCE = 10 V, IC = 7 mA

FREQUENCY (MHz)

	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	.71	-50	16.63	141	.02	70	.85	-32
200	.54	-54	11.97	119	.04	55	.66	-34
500	.40	-134	6.98	91	.08	58	.44	-43
1000	.34	-173	3.38	68	.13	58	.40	-52
1500	.34	163	2.33	48	.18	57	.38	-70
2000	.37	140	1.94	29	.24	47	.39	-88

VCE = 10 V, IC = 10 mA

100	.62	-58	20.35	136	.02	70	.80	-26
200	.45	-95	13.62	113	.03	55	.59	-38
500	.35	-141	8.44	89	.07	63	.39	-42
1000	.31	-177	3.46	63	.13	60	.35	-51
1500	.31	160	2.46	48	.19	57	.35	-70
2000	.34	138	2.04	30	.25	48	.35	-88

VCE = 10 V, IC = 20 mA

100	.45	-78	26.73	126	.01	69	.68	-31
200	.32	-116	15.88	106	.02	62	.47	-37
500	.28	-154	7.03	86	.07	70	.32	-40
1000	.27	-175	3.72	64	.14	63	.32	-50
1500	.28	165	2.63	47	.20	58	.31	-70
2000	.30	134	2.17	30	.28	45	.31	-88

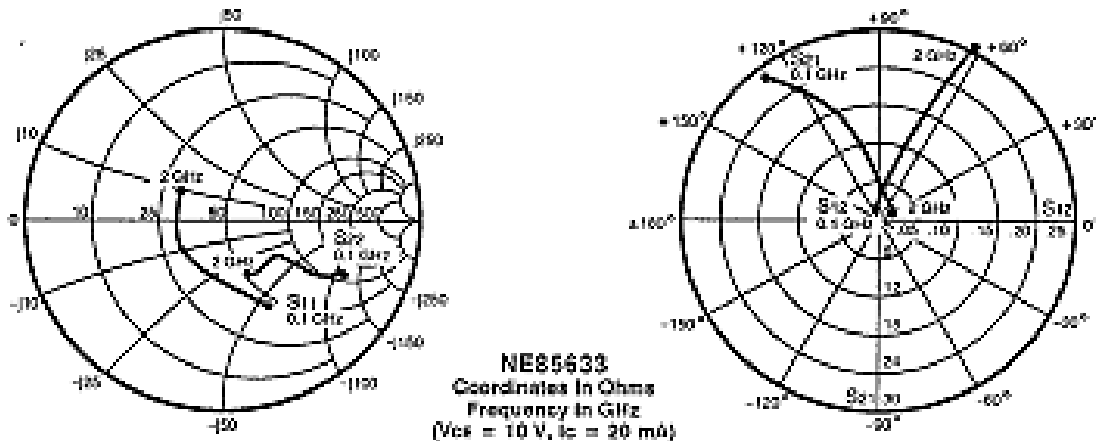
VCE = 10 V, IC = 30 mA

100	.37	-90	29.24	120	.01	71	.62	-33
200	.28	-128	16.64	101	.02	64	.42	-36
500	.27	-160	7.19	83	.07	72	.30	-37
1000	.26	-172	3.79	63	.14	64	.30	-48
1500	.27	153	2.67	47	.21	58	.29	-69
2000	.30	133	2.20	30	.27	46	.30	-88

VCE = 10 V, IC = 50 mA

100	.30	-102	29.24	115	.01	75	.58	-31
200	.23	-144	16.12	89	.01	69	.41	-32
500	.24	-170	6.80	83	.07	73	.31	-33
1000	.28	-152	3.63	65	.14	65	.28	-39
1500	.29	132	2.53	51	.18	59	.24	-41
2000	.33	110	2.01	37	.24	49	.23	-49

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



S-MAGN AND ANGLES:

VCE = 10 V, IC = 7 mA

FREQUENCY (MHz)

	S ₁₁	S ₂₁	S ₁₂	S ₂₂
100	.37 -43	16.55 145	.01 71	.88 -18
200	.57 -74	12.28 123	.04 58	.70 -25
500	.35 -126	6.20 95	.08 61	.69 -34
1000	.29 -163	3.38 78	.12 64	.44 -41
1500	.27 171	2.35 62	.18 69	.45 -52
2000	.30 135	1.80 49	.23 62	.43 -64

VCE = 10 V, IC = 10 mA

100	.69 -50	20.27 129	.01 74	.83 -22
200	.48 -82	14.10 117	.03 59	.64 -31
500	.30 -134	6.67 93	.07 66	.44 -39
1000	.25 -168	3.59 75	.13 66	.41 -41
1500	.23 168	2.50 62	.19 66	.41 -52
2000	.28 152	2.00 50	.25 62	.42 -64

VCE = 10 V, IC = 20 mA

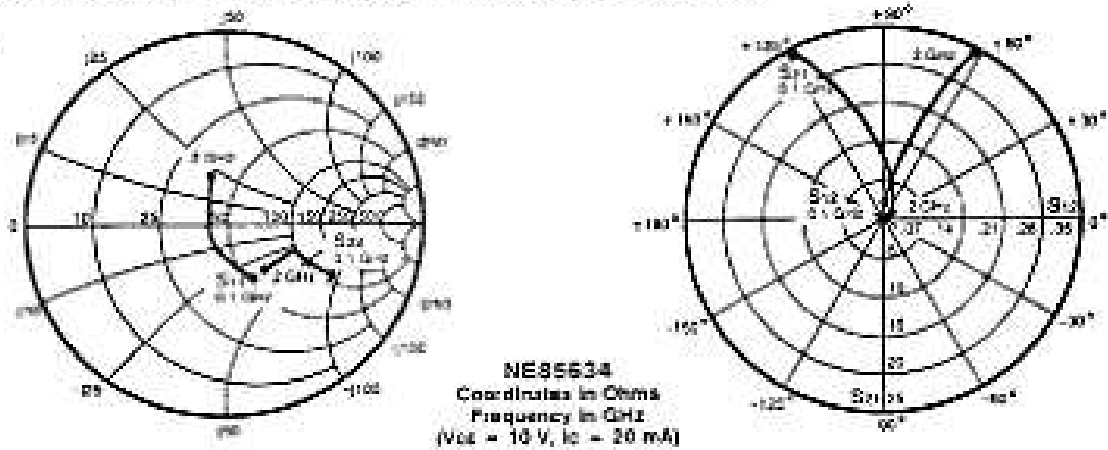
100	.58 -64	26.42 129	.01 69	.72 -27
200	.35 -95	15.90 109	.02 64	.63 -32
500	.24 -147	7.22 89	.07 71	.38 -31
1000	.21 -175	3.01 73	.13 69	.37 -40
1500	.20 162	2.04 62	.20 67	.35 -53
2000	.23 149	2.10 49	.28 61	.37 -65

VCE = 10 V, IC = 30 mA

100	.49 -72	28.53 124	.01 68	.67 -27
200	.30 -104	15.78 105	.02 66	.49 -30
500	.23 -154	7.25 85	.07 73	.37 -29
1000	.21 -179	3.03 72	.13 70	.36 -39
1500	.20 160	2.04 61	.20 67	.37 -62
2000	.23 147	2.11 49	.28 61	.37 -65

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TYPICAL COMMON EMITTER SCATTERING PARAMETERS



S-MAGN AND ANGLES:

VCE = 10 V, IC = 7 mA

FREQUENCY (MHz)	S ₁₁		S ₂₂		S ₁₂		S ₂₁	
100	.64	-50	15.48	136	.03	70	.81	-23
200	.41	-81	10.42	114	.04	65	.61	-30
500	.21	-133	4.50	60	.10	69	.43	-39
1000	.10	-165	2.67	70	.17	69	.39	-34
1500	.23	-125	1.90	58	.25	63	.37	-46
2000	.31	-119	1.52	48	.32	63	.37	-59

VCE = 10 V, IC = 10 mA

100	.56	-58	15.40	130	.02	64	.74	-28
200	.32	-89	11.55	100	.04	63	.54	-32
500	.17	-143	5.22	68	.10	72	.38	-30
1000	.10	-156	2.80	70	.18	70	.37	-30
1500	.20	-127	2.02	59	.26	64	.34	-45
2000	.28	-114	1.50	46	.33	62	.34	-58

VCE = 10 V, IC = 20 mA

100	.36	-72	21.01	118	.02	72	.61	-29
200	.19	-105	13.04	101	.04	72	.44	-39
500	.11	-163	6.00	65	.10	78	.34	-35
1000	.14	-137	3.01	68	.19	71	.33	-42
1500	.18	-115	2.15	58	.28	67	.30	-47
2000	.25	-105	1.70	47	.34	61	.30	-60

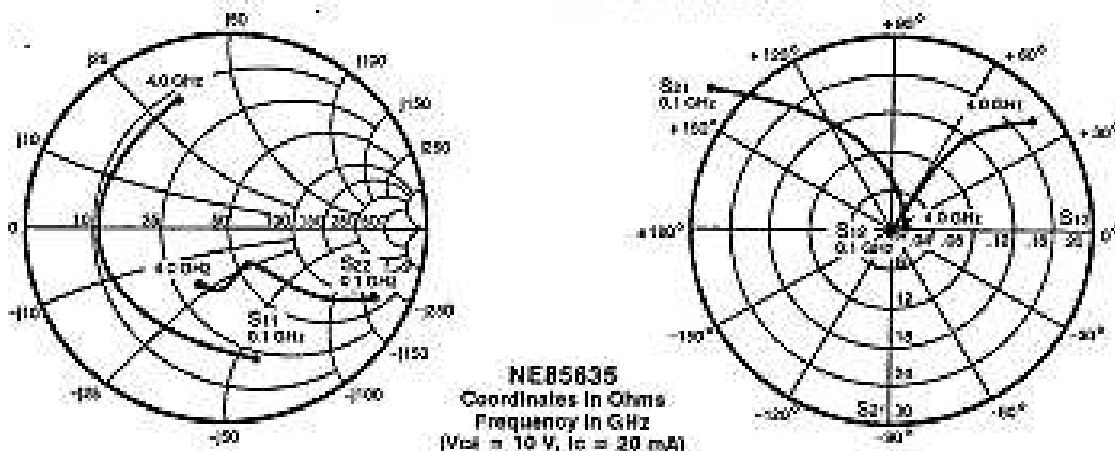
VCE = 10 V, IC = 30 mA

100	.28	-81	24.62	113	.01	72	.55	-28
200	.14	-118	13.40	98	.09	76	.41	-35
500	.11	-176	6.69	64	.11	79	.30	-32
1000	.14	-131	3.65	68	.19	72	.32	-31
1500	.19	-112	2.15	58	.28	65	.30	-47
2000	.25	-104	1.81	47	.35	60	.30	-60

VCE = 10 V, IC = 50 mA

100	.21	-97	24.92	109	.01	80	.55	-28
200	.13	-141	13.24	96	.03	79	.39	-32
500	.13	-173	6.56	63	.10	80	.33	-30
1000	.17	-134	2.98	67	.19	72	.33	-30
1500	.21	-114	2.11	67	.28	68	.31	-45
2000	.26	-107	1.77	48	.35	62	.31	-59

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



S-MAGN AND ANGLES:

VCE = 10 V, IC = 7 mA

FREQUENCY (MHz)

	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	.82	-47	18.05	154	.00	35	91	-16
500	.68	-141	6.12	50	.02	34	45	-41
1000	.66	-160	4.29	77	.03	34	36	-48
1500	.66	174	2.94	64	.04	39	38	63
2000	.65	160	2.23	50	.05	42	34	-61
2500	.67	145	1.81	37	.10	44	38	-75
3000	.60	134	1.57	24	.12	46	40	-69
3500	.69	123	1.31	11	.15	39	41	-100
4000	.71	112	1.20	1	.18	39	43	-111

VCE = 10 V, IC = 20 mA

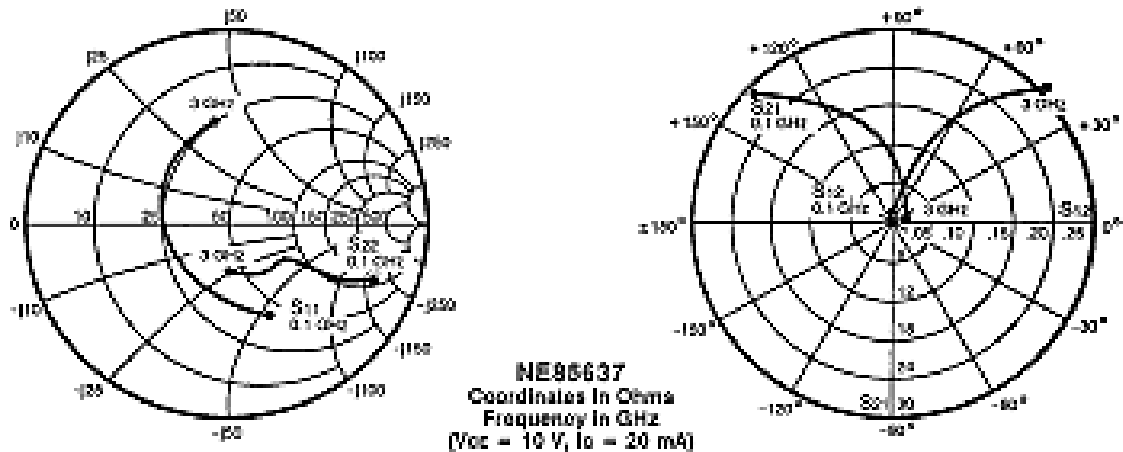
100	.65	-78	34.20	141	.00	9	79	-27
500	.64	-162	10.38	81	.00	49	26	-49
1000	.62	179	5.02	75	.02	62	21	-60
1500	.62	167	3.62	63	.04	63	23	-68
2000	.62	153	2.80	50	.08	64	19	-63
2500	.64	140	2.22	39	.11	60	25	-62
3000	.66	131	1.92	26	.14	48	27	-64
3500	.67	120	1.62	14	.16	38	28	-105
4000	.68	110	1.43	4	.17	38	30	-115

VCE = 10 V, IC = 30 mA

100	.61	-91	38.48	135	.00	7	71	-31
500	.63	-188	10.75	81	.00	48	23	-48
1000	.62	176	5.47	74	.02	57	19	-68
1500	.62	161	3.71	62	.04	68	21	-65
2000	.62	152	2.88	50	.06	67	17	-61
2500	.63	139	2.28	39	.12	62	22	-83
3000	.65	130	1.98	27	.14	46	22	-94
3500	.67	120	1.66	16	.18	40	25	-105
4000	.68	110	1.51	5	.18	38	27	-118



TYPICAL COMMON EMITTER SCATTERING PARAMETERS



S-MAGN AND ANGLES:

VCE = 10 V, IC = 7 mA

FREQUENCY (MHz)

	S ₁₁	S ₂₁	S ₁₂	S ₂₂
100	.77 -42	17.35 149	.01 72	.01 -16
500	.45 -135	7.22 97	.05 50	.03 -31
1000	.44 -179	3.50 73	.08 50	.04 -36
1500	.44 158	2.69 57	.12 55	.03 -44
2000	.47 139	2.05 43	.16 57	.03 -55
2500	.51 121	1.68 28	.19 51	.03 -71
3000	.55 103	1.45 15	.23 48	.03 -80

VCE = 10 V, IC = 10 mA

100	.69 -50	21.85 144	.01 69	.07 -10
500	.41 -143	7.99 93	.05 69	.07 -31
1000	.40 176	4.19 72	.09 61	.07 -35
1500	.41 150	2.95 58	.12 55	.05 -44
2000	.44 135	2.18 43	.16 57	.04 -54
2500	.48 118	1.69 29	.21 50	.04 -60
3000	.52 107	1.51 16	.24 44	.04 -68

VCE = 10 V, IC = 20 mA

100	.55 -68	29.93 134	.01 70	.06 -25
500	.35 -160	8.79 89	.05 64	.06 -29
1000	.37 168	4.52 70	.09 67	.05 -33
1500	.38 150	3.12 58	.13 61	.04 -42
2000	.41 134	2.37 43	.18 58	.03 -50
2500	.45 117	1.80 30	.22 50	.03 -60
3000	.49 106	1.60 17	.26 43	.03 -67

VCE = 10 V, IC = 30 mA

100	.48 -80	33.45 129	.01 69	.07 -25
500	.34 -167	9.04 87	.05 65	.06 -28
1000	.37 165	4.60 69	.09 69	.04 -31
1500	.37 148	3.15 56	.13 62	.03 -41
2000	.40 133	2.40 43	.18 59	.03 -52
2500	.45 119	1.88 29	.22 50	.03 -60
3000	.48 108	1.70 16	.25 43	.03 -68

VCE = 10 V, IC = 40 mA

100	.45 -89	34.26 125	.01 70	.06 -26
500	.35 -171	8.79 85	.05 71	.06 -24
1000	.37 163	4.61 68	.09 70	.04 -30
1500	.38 147	3.09 55	.13 63	.04 -39
2000	.41 131	2.37 42	.18 60	.04 -52
2500	.45 116	1.95 28	.22 49	.03 -60
3000	.49 105	1.68 15	.26 42	.03 -68