

NPN MEDIUM POWER MICROWAVE TRANSISTOR

NE33300
NE33353E
NE33353B
NE33387

FEATURES

- 450 mW LINEAR POWER OUTPUT at 2 GHz (Common-Emitter)
- 1.25 W CLASS C POWER OUTPUT with 8.0 dB Gain at 3 GHz (Common-Base)
- 0.35 W OSCILLATOR POWER OUTPUT at 5 GHz (Common-Collector)
- RUGGED HERMETIC STRIPLINE PACKAGES

DESCRIPTION AND APPLICATIONS

The NE333 series of NPN silicon transistors is designed for L and S-Band medium power applications. The series is available in either chip form or in a variety of metal-ceramic packages. The series employs silicon nitride (Si₃N₄) passivation, silicon dioxide (SiO₂) glassivation and NEC's proprietary fabrication technique which uses arsenic doped polysilicon (AsDOPOS). The NE33353 is available in common-emitter and common-base configurations. The NE33387 in a common-collector configuration is ideally suited for oscillator applications. Reliability is assured by NEC's titanium-platinum-gold metallization system and stringent production controls patterned after MIL-S-19500.

PERFORMANCE SPECIFICATIONS (T_A = 25°C)

PART NUMBER PACKAGE OUTLINE			NE33300 00 (CHIP)			NE33353B 53B			NE33353E 53E			NE33387 87		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
f _r	Gain Bandwidth Product at at V _{CE} = 10 V, I _c = 100 mA	GHz	3.0	4.5		3.0	4.5		3.0	4.5		3.0	4.5	
S _{21E} ²	Insertion Power Gain at V _{CE} = 10 V, I _c = 100 mA, f = 2 GHz	dB		5.0						5.0				
MAG	Maximum Available Power Gain* at V _{CE} = 10 V, I _c = 100 mA, f = 1 GHz f = 2 GHz f = 4 GHz	dB dB dB		16.0 10.5 4.0						16.0 10.5 4.0				
P _{OUT}	Class C Power Output at V _{CC} = 11 V, P _{IN} = 22 dBm, R _E = 0.7 Ω, f = 3 GHz	W					1.25							
P _{osc}	Power Output as an Oscillator at V _{CE} = 11 V, I _c = 140 mA, f = 5 GHz	mW											355	
P _{1dB}	Power Output at 1 dB Compression, V _{CE} = 10 V, I _c = 100 mA, f = 2 GHz	mW		450						450				

*Maximum Available Gain (MAG) is calculated from the device S-Parameters using the equation,

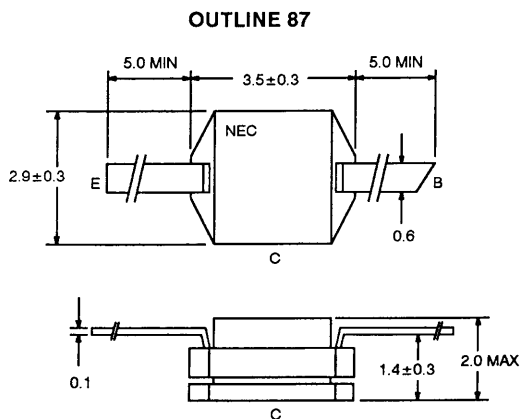
$$MAG = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1}) \quad K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{21}| |S_{12}|} \quad \Delta = S_{11} S_{22} - S_{21} S_{12}$$

ELECTRICAL CHARACTERISTICS (TA = 25°C)

PART NUMBER PACKAGE OUTLINE			NE33300 00 (CHIP)			NE33353B 53B			NE33353E 53E			NE33387 87		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
ICBO	Collector Cutoff Current at VCB = 10 V, IE = 0	μA			0.5			0.5			0.5			0.5
IEBO	Emitter Cutoff Current at VEB = 2 V	μA			0.5			0.5			0.5			0.5
hFE	Forward Current Gain at VCE = 6 V, IC = 100 mA (pulsed)		20	40	200	20	40	200	20	40	200	20	40	200
CCB*	Collector to Base Capacitance at VCB = 10 V, IE = 0, f = 1 MHz	pF		1.0	1.5		2.6	3.5		1.0	1.5		1.4	2.0
RTH	Thermal Resistance (Junction-to-Case)	°C/W			35			35			35			35
PT	Total Power Dissipation	W			5.0			5.0			5.0			5.0

*CCB measurement employs a three-terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal.

OUTLINE DIMENSIONS (Units in mm)

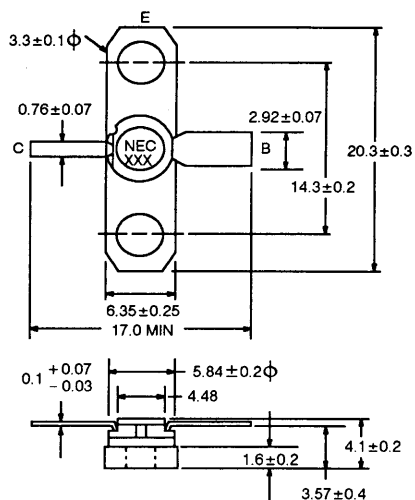


ABSOLUTE MAXIMUM RATINGS (TA = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
VCBO	Collector to Base Voltage	V	28
VCEO	Collector to Emitter Voltage	V	14*
VEBO	Emitter to Base Voltage	V	3.0
IC	Collector Current	mA	200
TJ	Junction Temperature	°C	200
TSTG	Storage Temperature	°C	-65 to +200

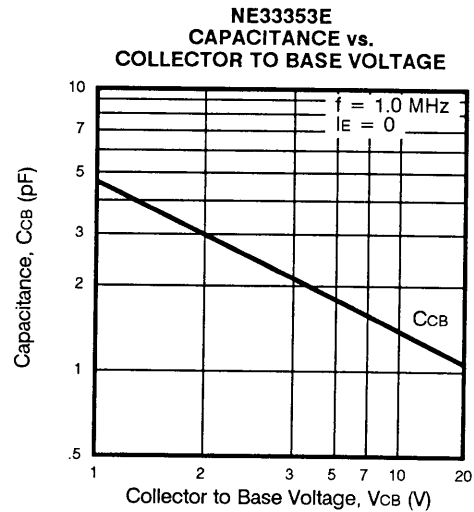
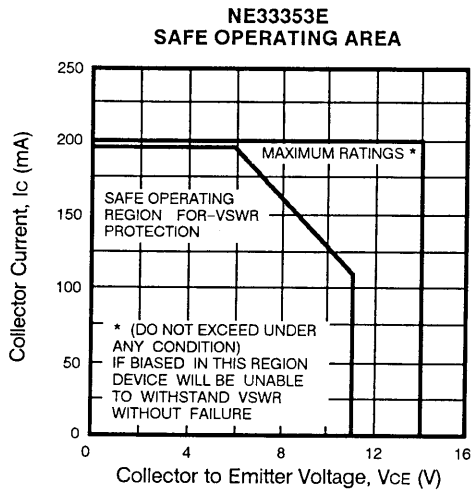
*Typical VCEr = 30 V for R ≤ 300 Ω

OUTLINE 53 E/B*

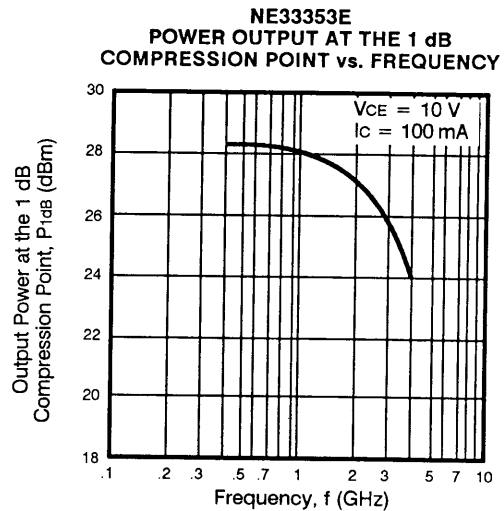
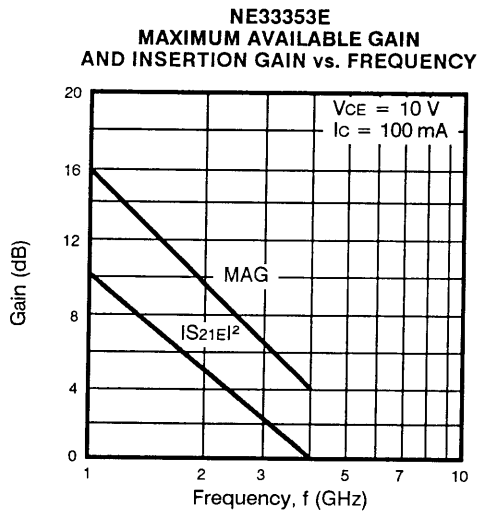


*53B has emitter and base reversed.

TYPICAL DEVICE CHARACTERISTICS (T_A = 25°C)



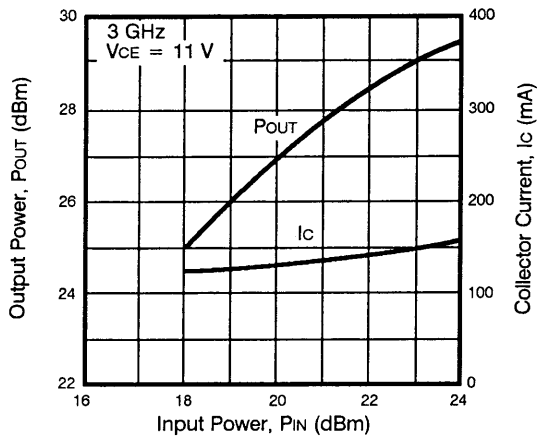
TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)



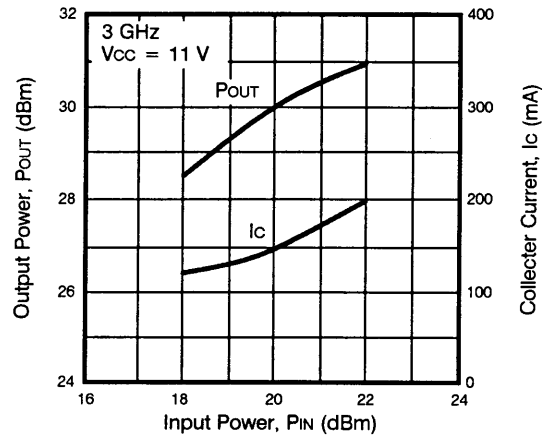
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TYPICAL PERFORMANCE CHARACTERISTICS (TA = 25°C)

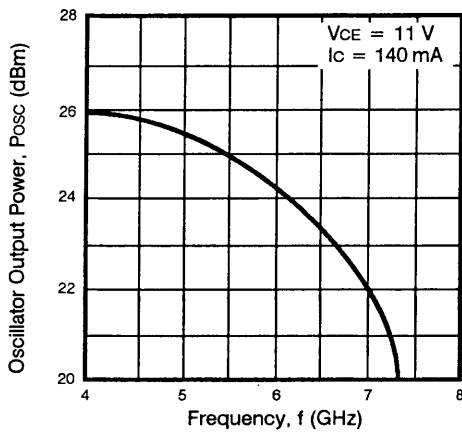
NE33353E
OUTPUT POWER AND
COLLECTOR CURRENT vs. INPUT POWER



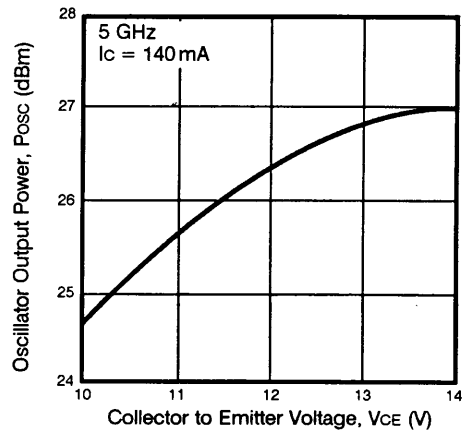
NE33353B
CLASS C OUTPUT POWER
AND COLLECTOR CURRENT
vs. INPUT POWER



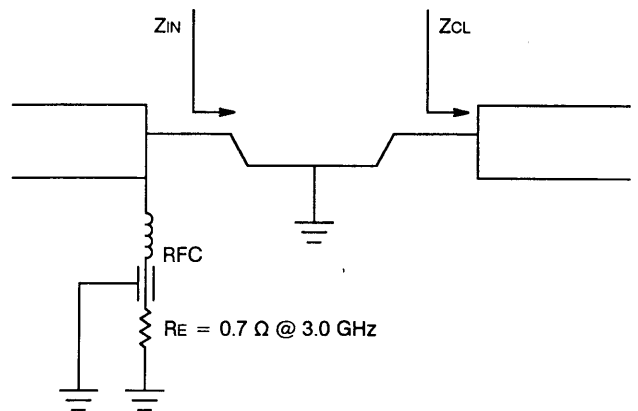
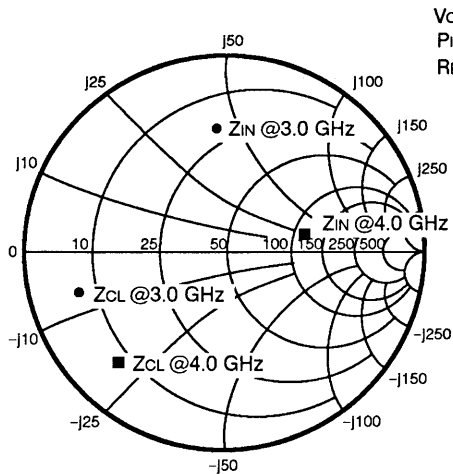
NE33387
OSCILLATOR OUTPUT POWER
vs. FREQUENCY



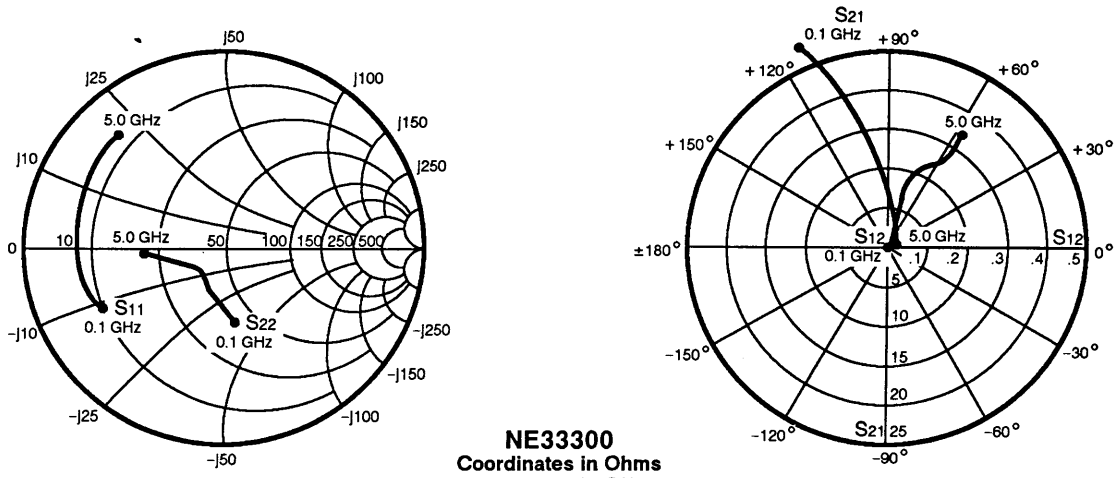
NE33387
OSCILLATOR OUTPUT POWER vs.
COLLECTOR TO EMITTER VOLTAGE



NE33353B IMPEDANCE CHARACTERISTICS



TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE33300
Coordinates in Ohms
Frequency in GHz
(VCE = 10 V, IC = 100 mA)

S-MAGN AND ANGLES:

VCE = 10 V, IC = 50 mA

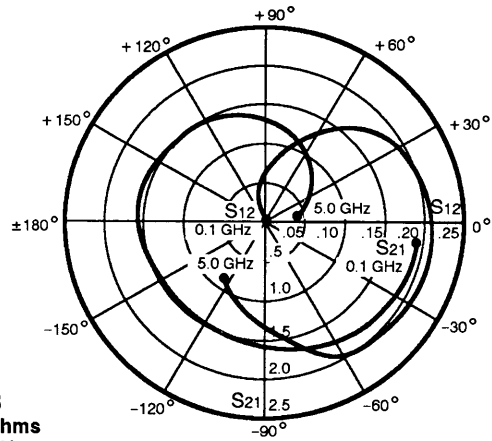
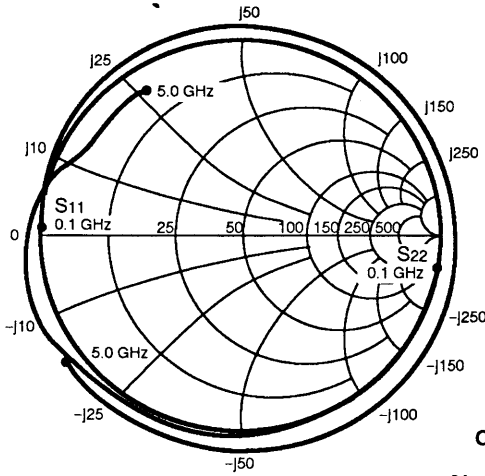
FREQUENCY (MHz)	S11		S21		S12		S22	
100	0.65	-146	26.98	118	0.01	66	0.47	-70
200	0.70	-164	14.87	103	0.01	43	0.30	-92
300	0.72	-171	10.15	96	0.02	57	0.23	-108
400	0.73	-175	7.62	91	0.03	62	0.21	-122
500	0.74	-178	6.14	88	0.04	62	0.20	-129
600	0.73	180	5.14	85	0.04	66	0.19	-137
700	0.73	176	4.43	82	0.05	68	0.18	-137
800	0.73	176	3.80	80	0.06	70	0.20	-137
900	0.75	175	3.41	78	0.07	68	0.20	-143
1000	0.74	172	3.07	76	0.07	72	0.19	-144
2000	0.74	161	1.57	59	0.13	73	0.24	-150
3000	0.78	151	1.11	47	0.21	69	0.32	-168
4000	0.79	134	0.90	30	0.28	58	0.40	-173
5000	0.77	133	0.74	30	0.34	58	0.39	-177

VCE = 10 V, IC = 100 mA

100	0.67	-154	28.19	113	0.01	65	0.41	-79
200	0.71	-168	15.05	100	0.01	48	0.26	-101
300	0.72	-173	10.19	93	0.02	62	0.21	-118
400	0.73	-177	7.62	89	0.03	66	0.19	-131
500	0.74	-179	6.13	87	0.04	66	0.18	-136
600	0.73	178	5.12	84	0.04	68	0.18	-145
700	0.74	177	4.41	81	0.05	71	0.18	-142
800	0.73	175	3.77	79	0.06	73	0.19	-141
900	0.75	174	3.39	78	0.07	72	0.19	-148
1000	0.74	171	3.06	75	0.07	74	0.19	-149
2000	0.74	161	1.57	58	0.14	74	0.24	-153
3000	0.78	150	1.13	47	0.22	68	0.32	-173
4000	0.80	134	0.91	30	0.29	57	0.39	-177
5000	0.77	133	0.75	29	0.34	57	0.38	-180



TYPICAL COMMON BASE SCATTERING PARAMETERS



NE33353B
Coordinates in Ohms
Frequency in GHz
(V_{CB} = 11 V, I_C = 100 mA)

S-MAGN AND ANGLES:

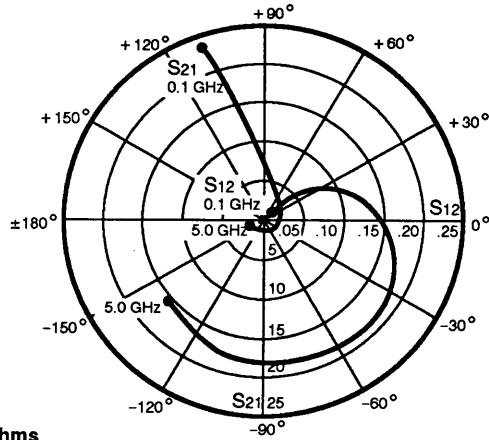
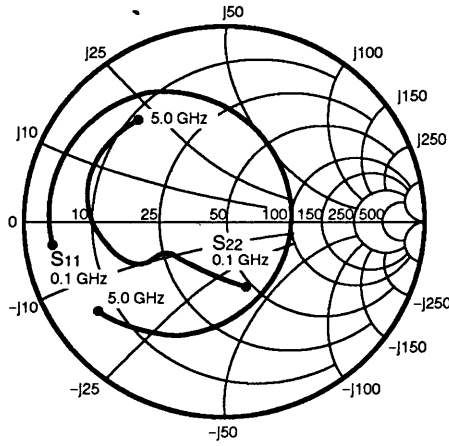
V_{CB} = 11 V, I_C = 100 mA

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	0.98	178	1.93	-8	0.01	122	1.01	-9
200	0.98	176	1.92	-13	0.01	147	0.99	-18
300	1.00	174	1.87	-22	0.01	129	1.02	-26
400	0.99	172	1.90	-28	0.01	137	1.00	-34
500	1.00	170	1.87	-35	0.01	106	1.01	-45
600	1.00	167	1.81	-41	0.02	128	1.02	-52
700	1.00	165	1.81	-49	0.01	115	1.02	-59
800	0.99	164	1.78	-51	0.02	133	1.03	-68
900	1.00	162	1.73	-59	0.02	115	1.04	-74
1000	1.01	159	1.69	-65	0.02	124	1.03	-82
2000	1.07	130	1.50	-120	0.09	81	1.06	-133
3000	1.12	68	1.63	178	0.19	37	1.10	-169
4000	1.18	-58	1.25	81	0.21	-52	0.85	151
5000	1.09	-142	0.43	5	0.08	-127	0.87	123

V_{CB} = 11 V, I_C = 150 mA

100	0.97	177	1.82	-11	0.01	65	0.98	-11
200	0.97	175	1.77	-18	0.01	60	0.96	-20
300	0.99	173	1.68	-28	0.01	74	0.99	-29
400	0.97	171	1.68	-34	0.01	81	0.95	-37
500	0.98	170	1.64	-41	0.01	89	0.96	-48
600	0.97	167	1.56	-47	0.02	78	0.97	-56
700	0.99	165	1.55	-56	0.01	97	0.98	-62
800	0.98	163	1.51	-60	0.02	105	0.98	-71
900	0.99	160	1.44	-67	0.02	99	0.99	-77
1000	0.98	158	1.39	-74	0.02	101	0.98	-85
2000	0.99	129	1.13	-133	0.07	76	0.99	-133
3000	0.97	65	1.16	158	0.17	28	0.99	-172
4000	1.01	-62	0.82	61	0.17	-53	0.80	156
5000	1.03	-144	0.26	-16	0.09	-135	0.85	124

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE33353E
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10 V, I_C = 150 mA)

S-MAGN AND ANGLES:
V_{CE} = 10 V, I_C = 50 mA

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	.76	-154	27.04	115	.02	50	.48	-83
500	.85	176	6.58	78	.02	40	.29	-141
1000	.84	164	3.41	57	.03	51	.30	-148
1500	.81	153	2.40	38	.05	44	.35	-147
2000	.74	135	1.96	19	.08	33	.37	-147
2500	.67	118	1.75	-2	.11	19	.42	-151
3000	.54	91	1.64	-26	.14	-0	.49	-158
3500	.36	43	1.51	-56	.16	-26	.54	-167
4000	.34	-48	1.32	-91	.18	-61	.64	175
4500	.57	-111	.99	-129	.17	-101	.70	152
5000	.75	-147	.66	-161	.16	-139	.68	129

V_{CE} = 10 V, I_C = 100 mA

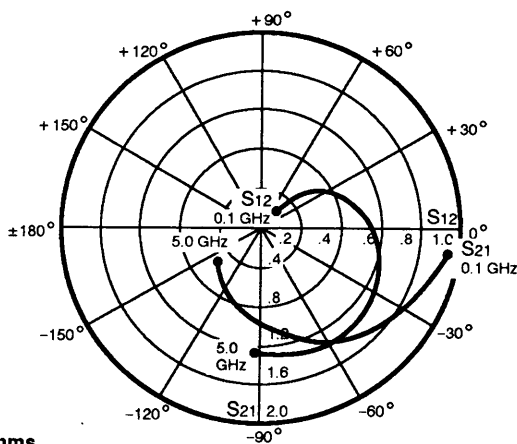
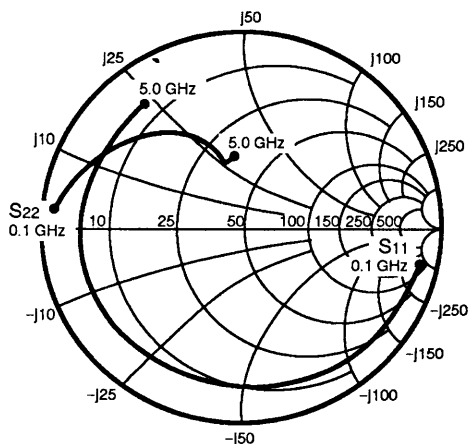
100	.80	-163	26.94	111	.02	57	.44	-94
500	.85	174	6.83	77	.02	53	.30	-149
1000	.83	162	3.55	57	.03	57	.30	-155
1500	.81	152	2.51	39	.06	44	.33	-153
2000	.73	134	2.05	20	.09	35	.35	-151
2500	.66	116	1.84	-1	.12	21	.39	-153
3000	.53	90	1.72	-27	.15	0	.45	-156
3500	.35	41	1.58	-55	.18	-27	.55	-166
4000	.34	-51	1.38	-92	.19	-62	.63	175
4500	.57	-112	1.03	-129	.17	-103	.68	152
5000	.75	-148	.69	-161	.16	-140	.66	128

V_{CE} = 10 V, I_C = 150 mA

100	.82	-169	23.07	109	.02	52	.35	-71
500	.85	173	5.47	80	.02	55	.28	-122
1000	.84	162	2.94	58	.03	56	.33	-136
1500	.82	151	2.09	39	.05	41	.38	-142
2000	.75	134	1.75	19	.09	37	.39	-146
2500	.69	116	1.56	-3	.11	22	.44	-151
3000	.56	89	1.46	-28	.14	1	.49	-156
3500	.39	40	1.35	-57	.17	-24	.58	-167
4000	.38	-47	1.18	-94	.18	-60	.65	174
4500	.59	-109	.89	-132	.17	-102	.69	152
5000	.76	-146	.59	-165	.15	-140	.67	129

2

TYPICAL COMMON COLLECTOR SCATTERING PARAMETERS



NE33387
Coordinates in Ohms
Frequency in GHz
(VEC = -11 V, IC = 140 mA)

S-MAGN AND ANGLES:

VEC = -11 V, IC = 50 mA

FREQUENCY (MHz)	S11		S21		S12		S22	
100	.96	-7	1.90	-5	.02	46	.94	176
500	.95	-36	1.82	-23	.19	58	.94	161
1000	.96	-69	1.70	-41	.34	38	.86	146
1500	.91	-97	1.52	-61	.44	21	.70	131
2000	.89	-124	1.37	-73	.52	2	.61	118
2500	.86	-146	1.17	-89	.56	-11	.54	109
3000	.87	-165	1.07	-100	.60	-28	.48	103
3500	.86	176	.94	-114	.61	-43	.43	96
4000	.87	160	.86	-123	.62	-56	.39	92
4500	.85	144	.74	-136	.61	-69	.37	89
5000	.86	128	.68	-145	.60	-82	.37	87

VEC = -11 V, IC = 100 mA

100	.97	-7	1.91	-5	.02	47	.95	176
500	.96	-36	1.83	-24	.19	58	.95	161
1000	.96	-70	1.71	-42	.34	38	.87	145
1500	.91	-98	1.52	-62	.45	22	.70	129
2000	.89	-123	1.36	-73	.52	3	.63	116
2500	.87	-145	1.16	-89	.56	-11	.54	107
3000	.87	-164	1.05	-100	.60	-28	.48	101
3500	.86	178	.92	-114	.62	-42	.43	93
4000	.87	161	.84	-123	.63	-56	.39	90
4500	.85	146	.73	-136	.61	-69	.37	87
5000	.85	131	.66	-145	.61	-82	.37	85

VEC = -11 V, IC = 140 mA

100	.92	-11	1.85	-8	.11	48	.90	173
500	.84	-43	1.68	-26	.30	38	.82	156
1000	.83	-79	1.51	-44	.44	21	.71	141
1500	.77	-107	1.31	-63	.54	6	.55	127
2000	.79	-132	1.19	-73	.58	-9	.49	117
2500	.76	-154	1.00	-87	.62	-22	.42	110
3000	.77	-172	.91	-98	.64	-38	.38	108
3500	.77	171	.80	-110	.65	-52	.34	104
4000	.78	155	.74	-118	.65	-64	.33	103
4500	.77	141	.65	-129	.63	-77	.34	102
5000	.77	126	.59	-138	.63	-90	.36	99

FEATURES

- **LOW NOISE FIGURE:** 1 dB at 70 MHz
- **HIGH RELIABILITY METALLIZATION**
- **LINEAR POWER OUTPUT:** 200 mW at 2 GHz
- **LOW COST**

DESCRIPTION AND APPLICATIONS

The NE416 series of NPN silicon transistors is one of the most versatile and widely used of NEC's microwave transistors. The series provides economical solutions to a wide range of amplifier and oscillator problems. Low noise figures, high gain and high current capability achieve wide dynamic range and excellent linearity. The NE416 series is available in a wide selection of package styles and in chip form for thin and thick film circuits. Most package styles are available with Grade C (JANTXV equivalent) and Grade CX (JANTX equivalent) screening. The NE41615 and NE41603 have been space qualified. The series is volume produced, using the latest techniques and production controls patterned after MIL-S-19500. Of special importance is the use of NEC's high reliability metallization system (Pt-Si-Ti-Pt-Au) which offers the utmost in performance, reliability, and permits high temperature operation (100°C) at rated dissipation. The NE416 series offers superior performance and reliability at prices usually lower than less reliable moly-gold or aluminum transistors.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V _{CB0}	Collector to Base Voltage	V	35
V _{CE0}	Collector to Emitter Voltage	V	18
V _{EB0}	Emitter to Base Voltage	V	3
I _c	Collector Current	mA	100
T _J	Junction Temperature	°C	200*
T _{STG}	Storage Temperature	°C	-65 to +200**

*Maximum Junction Temperature for NE41632 is 150°C.

**Maximum Storage Temperature (T_{STG}) for the NE41632 and NE41635 is -65°C to 150°C. The leads of the NE41635 are Sn plated and may tarnish above 150°C. Once soldered into a circuit, the unit can be stored at 200°C.

NE41635 TYPICAL NOISE PARAMETERS

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

FREQUENCY (MHz)	NF min (dB)	G _A /dB	OPT SOURCE	RN/50 Ω
500	1.8	15.3	.40 ∠ 128°	.17
1000	3.0	11.1	.58 ∠ 171°	.10
1500	4.2	8.3	.69 ∠ -174°	.14
2000	4.8	6.7	.68 ∠ -162°	.26

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

500	2.4	17.5	.42 ∠ 159°	.13
1000	3.6	12.7	.59 ∠ 180°	.10
1500	4.9	9.8	.67 ∠ -169°	.15
2000	5.6	8.8	.73 ∠ -159°	.50

PERFORMANCE SPECIFICATIONS (TA = 25°C)

NE PART NUMBER		NE41603		NE41607		NE41612-12		NE41615		NE41620		NE41632-1		NE41635			
EIAJ ¹ REGISTERED NUMBER		2SC1949 (Grd C)				2SC2025 (Grd D) NC921 (Grd D)		2SC1426 (Grd Cx)		2SC1255 (Grd C) 2SC1592 (Grd D)		NE41632-1 NE41632-2 2SC24073 (Grd D) 2SC24083 (Grd D)		NE41635			
PACKAGE OUTLINE		03		07		12 (TO-72)		15 (TO-33)		20		32 (TO-92)		35 (MICRO-X)			
SYMBOLS	PARAMETERS AND CONDITIONS	MIN	TYP	MAX	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
ICBO	Collector Cutoff Current at VCB = 20 V, IE = 0			0.1	μA			0.1			0.1			0.1			0.1
IEBO	Emitter Current Gain at VEB = 2 V, IC = 0			0.1	μA			0.1			0.1			0.1			0.1
hFE	Forward Current Gain ⁴ at VCB = 5 V, IC = 25 mA VCB = 10 V, IC = 50 mA	30	100	200		30	100	200	30	100	200	30	100	200	30	100	200
CCB	Collector to Base Capacitance ⁵ at VCB = 5 V, IE = 0, f = 1 MHz VCB = 10 V, IE = 0, f = 1 MHz		1	1.5	PF		1	2		1	2		1	2		1	2
RTH	Thermal Resistance (Junction-to-Case)			50	°C/W			50			50			50			50
PT	Total Power Dissipation (TA = 25°C)			.58	W			.58			3.5			3.5			.29

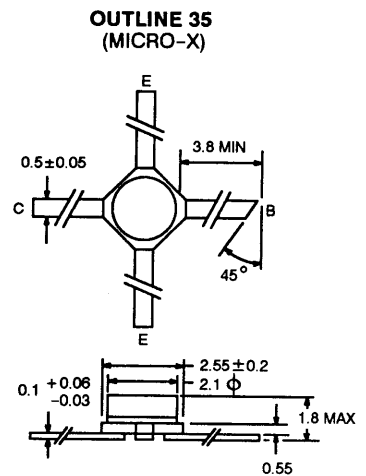
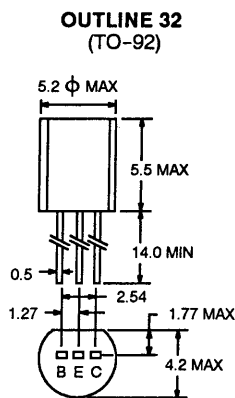
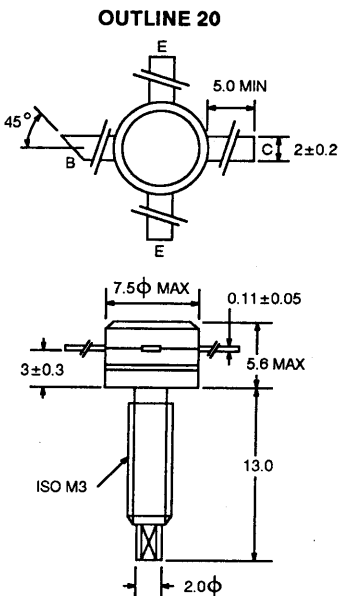
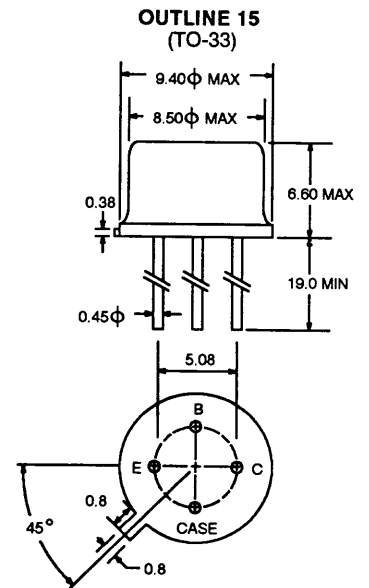
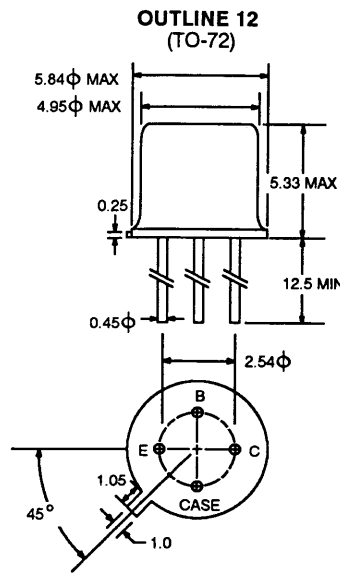
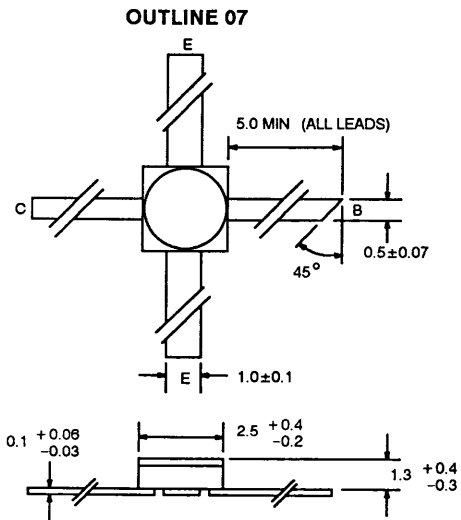
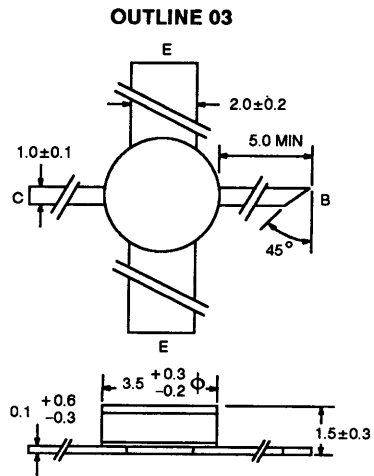
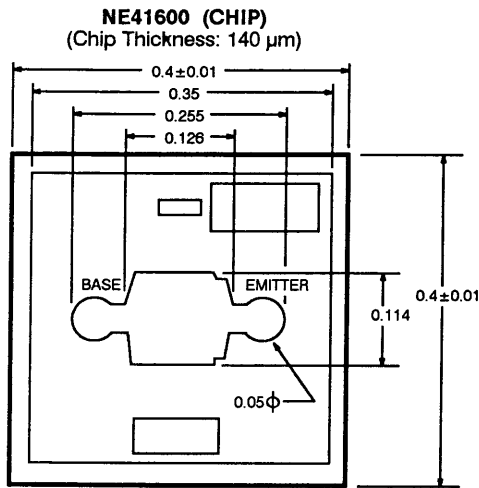
ELECTRICAL CHARACTERISTICS (TA = 25°C)

NE PART NUMBER		NE41603		NE41607		NE41612-12		NE41615		NE41620		NE41632-1		NE41635			
EIAJ ¹ REGISTERED NUMBER		2SC1949 (Grd C)				2SC2025 (Grd D) NC921 (Grd D)		2SC1426 (Grd Cx)		2SC1255 (Grd C) 2SC1592 (Grd D)		NE41632-1 NE41632-2 2SC24073 (Grd D) 2SC24083 (Grd D)		NE41635			
PACKAGE OUTLINE		03		07		12 (TO-72)		15 (TO-33)		20		32 (TO-92)		35 (MICRO-X)			
SYMBOLS	PARAMETERS AND CONDITIONS	MIN	TYP	MAX	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
f _T	Gain Bandwidth Product at VCE = 10 V, IC = 25 mA VCE = 10 V, IC = 50 mA	2	3.5		GHz	1.5	2.7		2	3.5		2	3.5		2	3.5	
S _{21E} ²	Insertion Power Gain at VCE = 10 V, IC = 30 mA, f = 0.5 GHz f = 1 GHz VCE = 10 V, IC = 50 mA, f = 0.2 GHz f = 0.5 GHz	7	16 9.5		dB		13 8			15 8.5		18 21 19		16 9.5		7	
NFMIN	Minimum Noise Figure at VCE = 10 V, IC = 5 mA, RG = 50 Ω f = 0.2 GHz f = 0.5 GHz f = 1 GHz VCE = 5 V, IC = 2 mA, RG = 200 Ω f = 70 MHz (NE41612-1)		1.2 1.5 3.5		dB		2.3 2.8 5			1.4 1.5 3.7				1.5 3.5			
MAG	Maximum Available Gain ⁶ at VCE = 10 V, IC = 30 mA, f = 0.5 GHz VCE = 10 V, IC = 50 mA, f = 0.2 GHz f = 0.5 GHz		20 14		dB		15.5 10			17 12		22.5 15		21 14			
GP	Power Gain at VCE = 15 V, IC = 50 mA, PIN = 10 dBm, f = 2 GHz				dB					9 10				12			
POUT	Power Output at VCE = 15 V, IC = 50 mA, PIN = 15 dBm, f = 2 GHz VCE = 12.6 V, PIN = 7 dBm, f = 0.5 GHz				dBm					22 23		20 22 ³					

Notes:

- Electronic Industrial Association of Japan.
- NE41612-1 (NC921) is selected for low noise.
- NE41632-1 (2SC2407) is selected for power and the NE41632-2 (2SC2408) is selected for small signal applications.
- Pulse measurement Duty Cycle ≤ 2%, PW ≤ 30 ns.
- CCB measurement employs a three-terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal.
- MAG = $|S_{21E}|^2 \cdot \frac{1}{1 - |S_{11E}|^2} \cdot \frac{1}{1 - |S_{22E}|^2}$

OUTLINE DIMENSIONS (Units in mm)

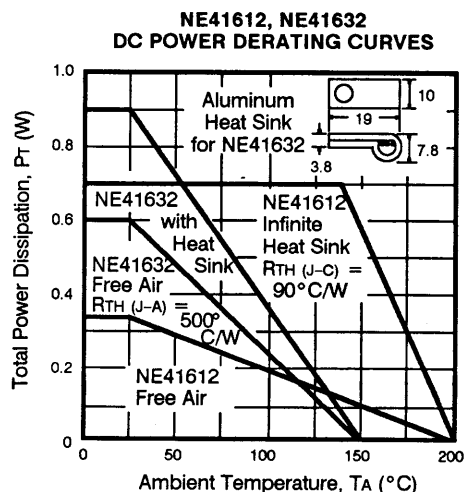
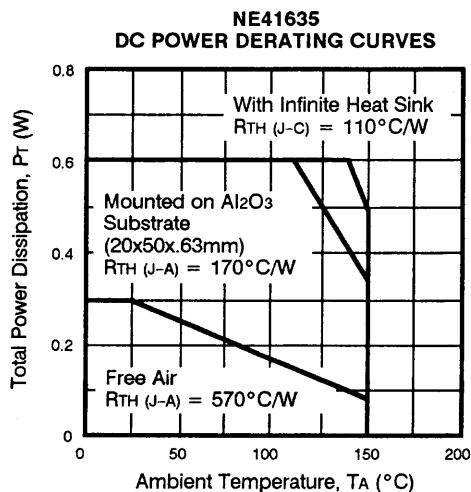
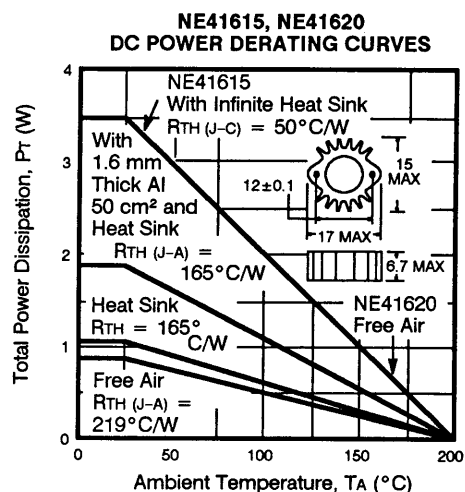
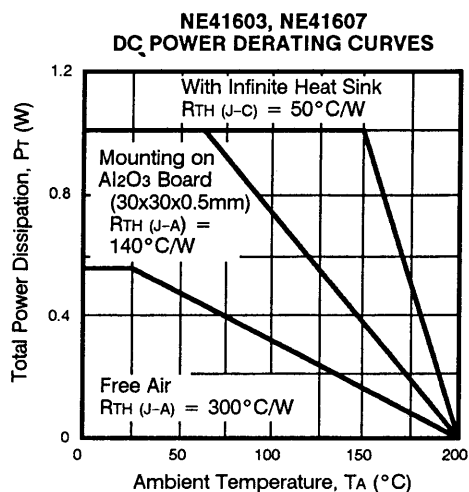


32B is available with center lead the base.

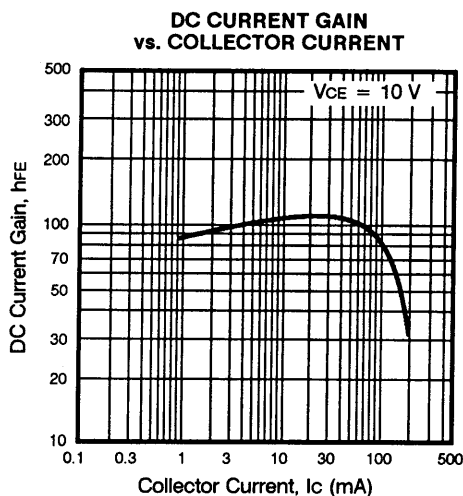
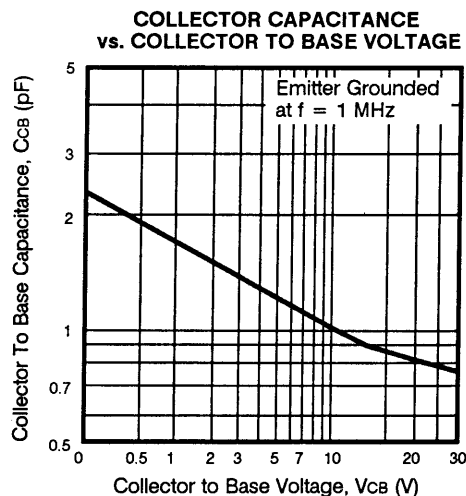
2

NE416 SERIES

TYPICAL DEVICE CHARACTERISTICS (TA = 25°C)

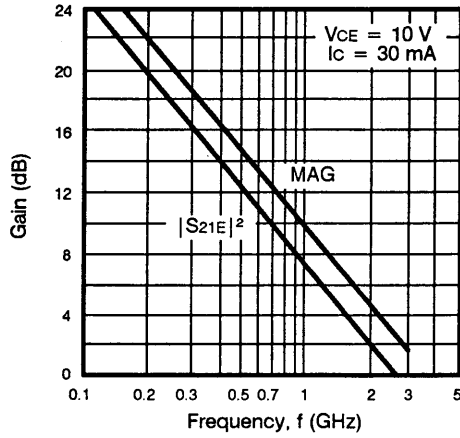


TYPICAL PERFORMANCE CHARACTERISTICS (TA = 25°C)

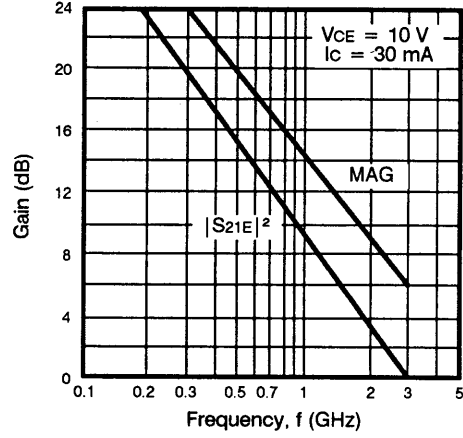


TYPICAL PERFORMANCE CHARACTERISTICS ($T_A = 25^\circ\text{C}$)

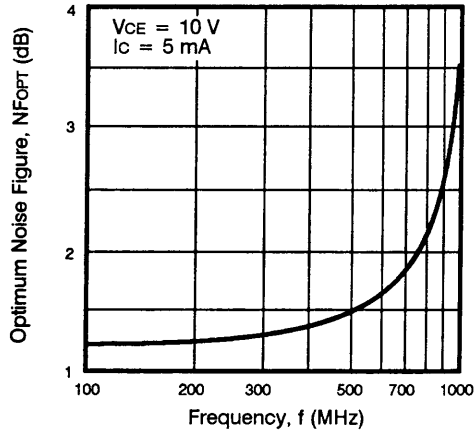
NE41612, NE41615 AND NE41632-2
FORWARD INSERTION GAIN
AND MAXIMUM AVAILABLE GAIN
vs. FREQUENCY



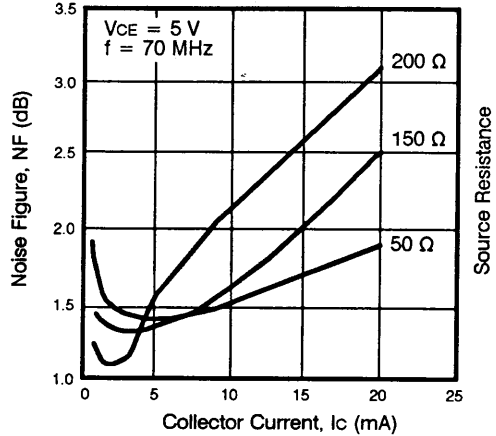
NE41603 AND NE41607
FORWARD INSERTION GAIN
AND MAXIMUM AVAILABLE GAIN
vs. FREQUENCY



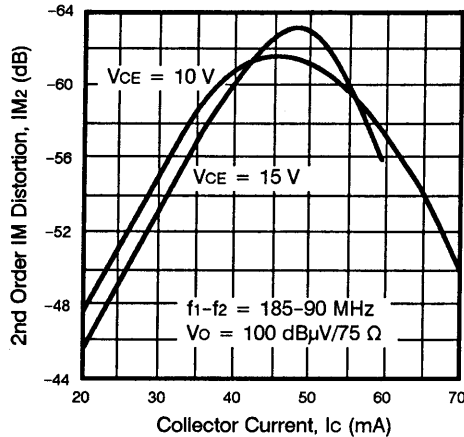
NE41603, NE41607 AND NE41632-2
NOISE FIGURE vs. FREQUENCY



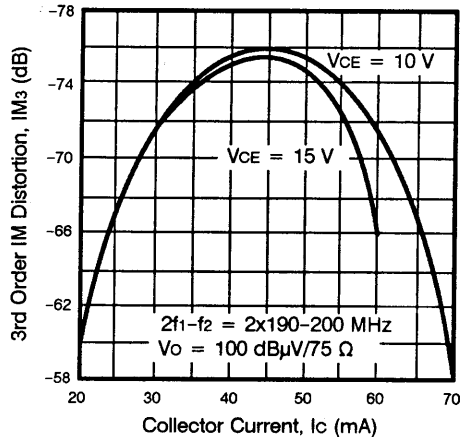
NE41612-1
NOISE FIGURE vs.
COLLECTOR CURRENT AND
SOURCE RESISTANCE



NE41615
SECOND ORDER IM DISTORTION
vs. COLLECTOR CURRENT



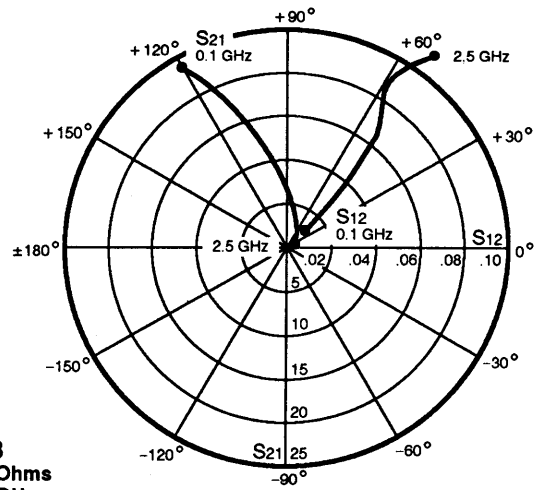
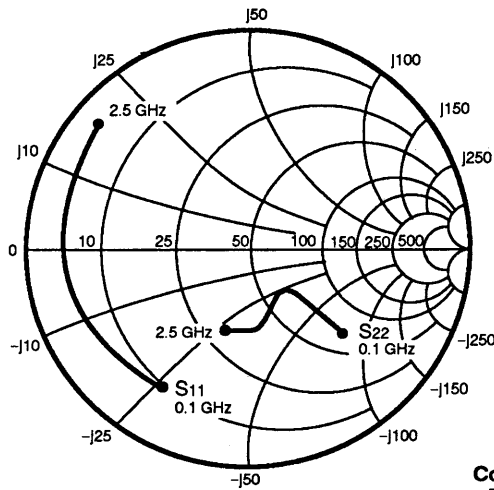
NE41615
THIRD ORDER IM DISTORTION
vs. COLLECTOR CURRENT



2

NE416 SERIES

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE41603
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	-73	12.33	139	.03	57	.84	-24
500	.79	-160	4.01	87	.07	24	.47	-36
1000	.78	178	2.08	63	.06	24	.44	-49
1500	.79	166	1.40	45	.07	30	.49	-65
2000	.80	155	1.03	31	.08	40	.52	-81
2500	.81	143	.80	16	.10	42	.53	-100

VCE = 10 V, IC = 10 mA

100	.75	-99	18.56	129	.02	50	.72	-32
500	.77	-171	4.95	84	.04	32	.35	-38
1000	.77	172	2.51	63	.05	39	.31	-51
1500	.78	162	1.69	46	.07	42	.38	-67
2000	.79	152	1.25	32	.09	49	.43	-81
2500	.81	142	.97	19	.10	48	.43	-101

VCE = 10 V, IC = 20 mA

100	.72	-125	23.98	119	.01	46	.57	-41
500	.78	-177	5.62	82	.03	44	.24	-42
1000	.78	169	2.83	63	.05	52	.23	-54
1500	.79	160	1.90	47	.07	52	.28	-69
2000	.80	152	1.40	34	.09	55	.34	-83
2500	.82	142	1.10	21	.11	53	.36	-101

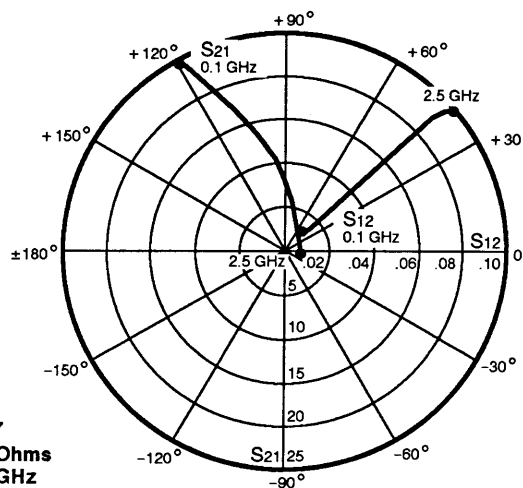
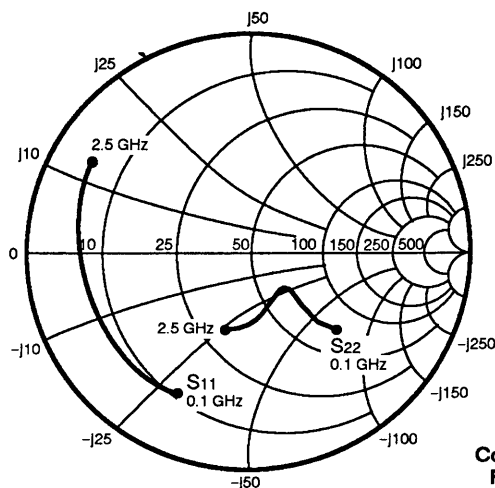
VCE = 10 V, IC = 30 mA

100	.72	-137	26.27	115	.01	47	.51	-45
500	.78	-180	5.87	81	.03	52	.20	-44
1000	.78	169	2.95	62	.05	55	.20	-55
1500	.79	160	1.97	48	.07	55	.25	-70
2000	.81	152	1.46	35	.09	58	.31	-84
2500	.82	140	1.14	20	.11	55	.33	-101

VCE = 10 V, IC = 50 mA

100	.72	-150	27.80	110	.01	49	.44	-47
500	.79	178	5.96	80	.02	60	.18	-42
1000	.79	168	2.98	62	.05	61	.19	-54
1500	.80	159	1.99	47	.07	59	.24	-68
2000	.81	151	1.47	35	.09	61	.30	-83
2500	.83	141	1.14	22	.11	58	.32	-103

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE41607
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	.86	-68	12.47	139	.03	59	.84	-25
500	.76	-154	4.15	87	.07	24	.44	-41
1000	.76	-175	2.16	62	.08	20	.42	-57
1500	.76	175	1.46	43	.09	22	.47	-73
2000	.77	167	1.08	27	.09	22	.51	-91
2500	.78	157	.83	11	.10	22	.55	-106

VCE = 10 V, IC = 10 mA

100	.79	-92	18.90	129	.02	51	.71	-35
500	.76	-165	5.11	84	.05	31	.30	-46
1000	.76	179	2.60	62	.06	34	.30	-59
1500	.76	171	1.76	44	.08	32	.35	-75
2000	.77	164	1.30	29	.09	34	.40	-91
2500	.78	155	1.01	14	.10	30	.46	-106

VCE = 10 V, IC = 20 mA

100	.75	-117	24.58	119	.01	45	.57	-45
500	.76	-172	5.80	81	.03	40	.20	-51
1000	.77	176	2.92	62	.06	44	.21	-63
1500	.77	169	1.97	46	.08	42	.27	-77
2000	.78	162	1.45	31	.09	43	.32	-94
2500	.79	151	1.13	16	.10	36	.39	-107

VCE = 10 V, IC = 30 mA

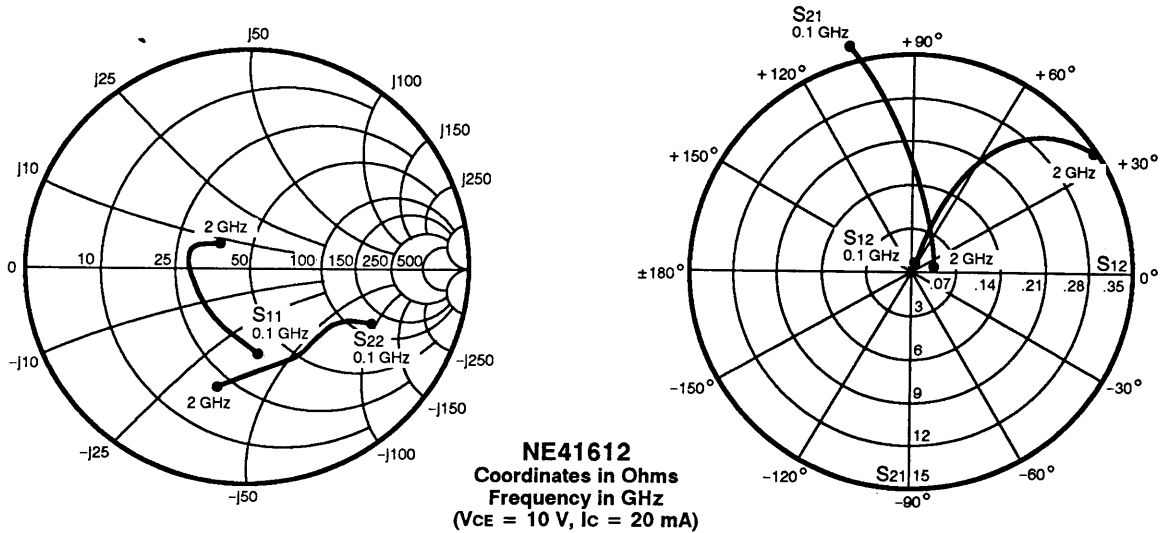
100	.73	-130	26.90	114	.01	47	.50	-49
500	.76	-175	6.05	80	.03	45	.17	-53
1000	.77	175	3.02	62	.05	48	.18	-64
1500	.78	168	2.03	46	.07	44	.25	-78
2000	.79	162	1.50	32	.09	45	.30	-95
2500	.79	150	1.16	17	.10	40	.37	-109

VCE = 10 V, IC = 50 mA

100	.73	-142	27.99	110	.01	43	.43	-50
500	.78	-178	6.03	79	.02	53	.16	-49
1000	.78	173	3.00	61	.05	51	.18	-62
1500	.79	167	2.01	46	.07	49	.24	-77
2000	.81	160	1.49	32	.08	50	.30	-94
2500	.81	151	1.16	19	.10	45	.36	-110

NE416 SERIES

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



S-MAGN AND ANGLES:

VCE = 5 V, IC = 2 mA

FREQUENCY (MHz)

	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	.83	-52	6.06	141	.05	58	.89	-20
200	.69	-87	4.45	118	.09	49	.76	-31
500	.52	-143	2.25	81	.12	39	.59	-46
1000	.49	172	1.31	49	.16	54	.55	-69
1500	.44	139	.97	28	.25	59	.59	-92
2000	.35	108	.82	12	.36	48	.60	-115

VCE = 10 V, IC = 5 mA

100	.68	-60	10.41	132	.03	62	.80	-22
200	.51	-95	6.94	110	.06	54	.65	-30
500	.37	-148	3.24	79	.10	57	.53	-40
1000	.34	170	1.79	52	.17	61	.51	-59
1500	.30	145	1.32	30	.25	58	.55	-82
2000	.22	122	1.05	9	.32	46	.60	-104

VCE = 10 V, IC = 10 mA

100	.52	-73	13.86	122	.02	62	.69	-25
200	.38	-105	8.38	102	.05	59	.56	-31
500	.29	-155	3.71	77	.11	63	.46	-39
1000	.27	169	2.02	51	.19	61	.45	-57
1500	.24	149	1.48	30	.26	53	.50	-80
2000	.17	135	1.18	9	.32	41	.56	-100

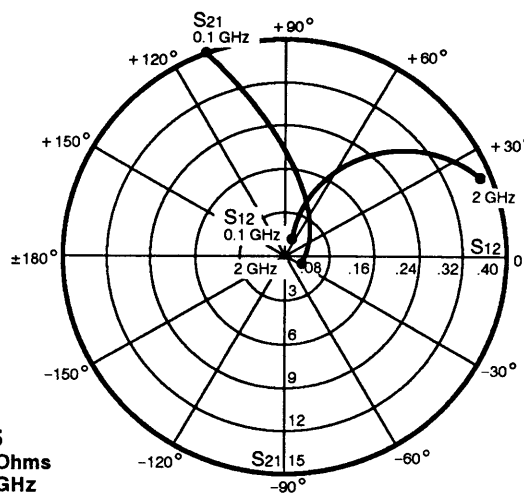
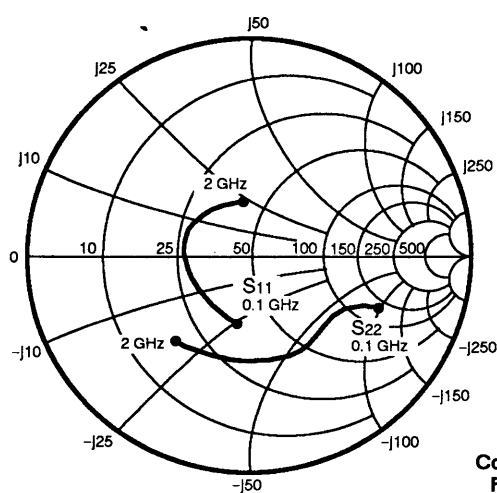
VCE = 10 V, IC = 20 mA

100	.39	-83	16.25	114	.02	62	.60	-27
200	.29	-114	9.23	98	.04	65	.49	-30
500	.25	-159	3.97	75	.11	67	.42	-38
1000	.24	168	2.15	51	.20	60	.41	-56
1500	.20	152	1.57	30	.28	51	.46	-78
2000	.14	145	1.24	9	.33	37	.53	-98

VCE = 10 V, IC = 30 mA

100	.34	-89	16.82	111	.02	65	.56	-27
200	.26	-119	9.37	96	.04	66	.47	-28
500	.24	-162	4.00	74	.11	68	.41	-37
1000	.23	167	2.16	51	.20	61	.41	-56
1500	.20	152	1.57	30	.28	51	.45	-78
2000	.14	145	1.24	8	.33	36	.52	-98

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE41615
Coordinates in Ohms
Frequency in GHz
(VCE = 10 V, IC = 20 mA)

S-MAGN AND ANGLES:

VCE = 10 V, IC = 5 mA

FREQUENCY (MHz)

	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	.59	-74	9.98	126	.03	58	.78	-22
200	.46	-112	6.28	103	.05	52	.66	-30
500	.39	-160	2.91	72	.09	57	.59	-46
1000	.37	164	1.71	39	.17	57	.62	-78
1500	.36	133	1.30	10	.27	46	.62	-109
2000	.31	91	1.07	-16	.38	31	.59	-136

VCE = 10 V, IC = 10 mA

100	.42	-89	13.14	116	.02	60	.68	-25
200	.33	-124	7.57	97	.04	61	.57	-29
500	.31	-165	3.33	70	.10	65	.53	-46
1000	.31	164	1.93	39	.19	55	.56	-78
1500	.31	135	1.47	10	.28	41	.56	-107
2000	.26	96	1.20	-16	.38	27	.54	-133

VCE = 10 V, IC = 20 mA

100	.29	-104	15.31	110	.02	63	.59	-26
200	.25	-135	8.44	93	.04	68	.51	-18
500	.27	-167	3.64	69	.11	67	.48	-46
1000	.28	165	2.09	39	.20	53	.51	-78
1500	.27	138	1.57	11	.29	39	.52	-106
2000	.22	98	1.29	-16	.38	23	.50	-131

VCE = 10 V, IC = 30 mA

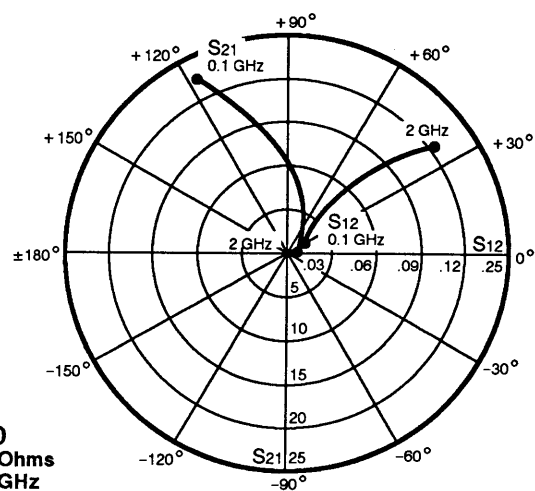
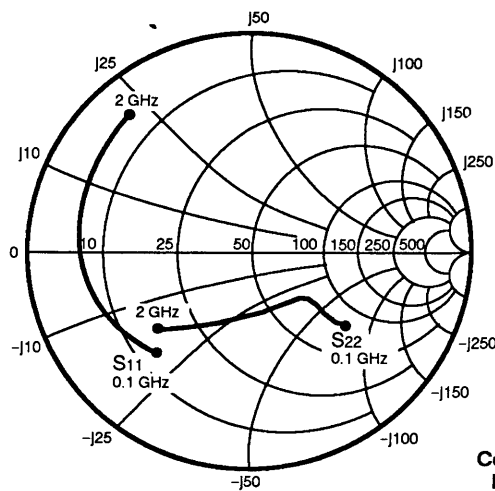
100	.24	-112	16.22	107	.01	69	.56	-25
200	.22	-140	8.77	92	.04	73	.49	-28
500	.25	-168	3.76	69	.11	67	.46	-46
1000	.26	167	2.14	39	.21	53	.49	-78
1500	.26	139	1.61	11	.30	38	.50	-106
2000	.21	100	1.32	-15	.38	22	.48	-130

VCE = 10 V, IC = 50 mA

100	.19	-126	16.89	104	.01	72	.53	-25
200	.20	-148	8.99	90	.04	73	.47	-27
500	.24	-170	3.83	68	.11	68	.45	-46
1000	.26	166	2.18	39	.21	52	.48	-78
1500	.26	139	1.63	11	.30	37	.48	-106
2000	.20	99	1.34	-16	.38	21	.47	-129

NE416 SERIES

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE41620
Coordinates in Ohms
Frequency in GHz
(VCE = 10 V, IC = 20 mA)

S-MAGN AND ANGLES:

VCE = 10 V, IC = 10 mA

FREQUENCY (MHz)

	S11		S21		S12		S22	
100	.71	-104	17.66	125	.03	51	.69	-36
200	.72	-142	10.59	103	.03	33	.49	-41
500	.75	-177	4.49	74	.04	32	.37	-52
1000	.75	159	2.29	45	.05	40	.38	-79
1500	.78	143	1.50	21	.08	36	.44	-106
2000	.78	130	1.10	-1	.12	35	.53	-132

VCE = 10 V, IC = 20 mA

100	.66	-130	22.48	116	.02	42	.56	-43
200	.72	-158	12.57	97	.02	30	.38	-45
500	.75	176	5.11	72	.04	47	.28	-53
1000	.75	156	2.60	45	.06	49	.31	-81
1500	.77	142	1.70	22	.09	42	.37	-108
2000	.78	129	1.27	0	.12	38	.46	-132

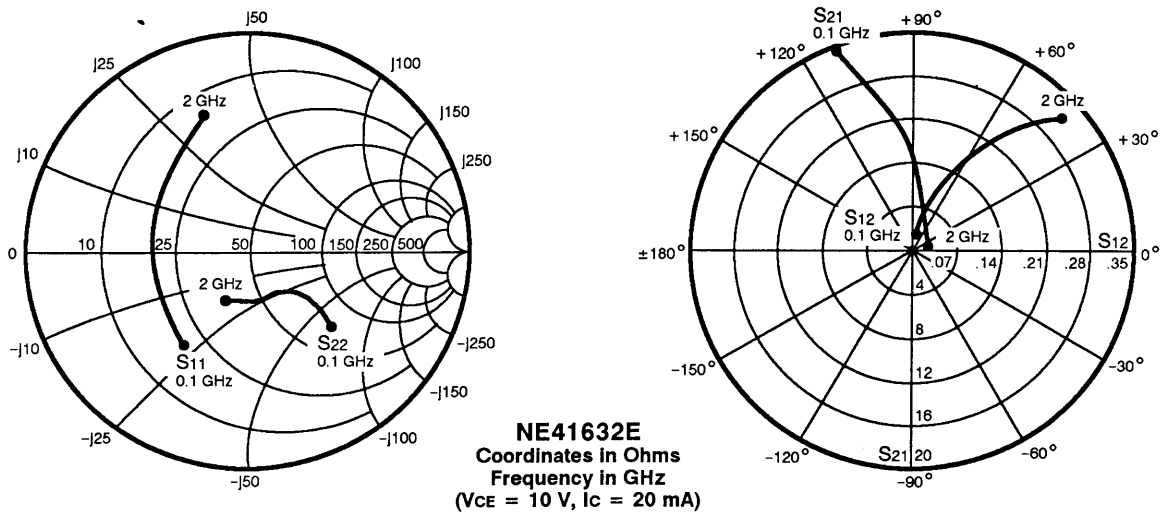
VCE = 10 V, IC = 30 mA

100	.67	-143	24.33	112	.02	58	.49	-46
200	.71	-165	13.33	95	.02	49	.33	-46
500	.75	174	5.36	71	.04	53	.25	-55
1000	.75	155	2.72	45	.06	52	.27	-81
1500	.77	141	1.78	22	.08	44	.34	-108
2000	.78	129	1.31	2	.12	39	.43	-132

VCE = 10 V, IC = 50 mA

100	.67	-153	25.61	108	.02	64	.43	-47
200	.72	-171	13.75	92	.02	47	.29	-46
500	.76	172	5.46	70	.03	54	.23	-52
1000	.76	154	2.76	45	.06	56	.26	-80
1500	.78	141	1.80	22	.09	47	.33	-108
2000	.79	128	1.34	1	.12	40	.42	-131

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



S-MAGN AND ANGLES:

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

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	.72	-73	11.39	132	.04	59	.78	-28
200	.58	-117	7.45	109	.06	43	.58	-38
500	.54	-167	3.51	79	.09	48	.40	-48
1000	.57	156	1.90	49	.14	55	.37	-65
1500	.62	130	1.37	27	.21	56	.36	-89
2000	.70	108	1.11	8	.30	47	.36	-117

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

100	.59	-97	15.52	121	.03	57	.64	-35
200	.50	-139	9.01	101	.04	49	.44	-41
500	.50	-178	4.00	76	.09	59	.32	-48
1000	.54	151	2.14	49	.16	58	.30	-64
1500	.60	127	1.54	28	.23	54	.28	-89
2000	.66	107	1.25	8	.31	45	.30	-118

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

100	.49	-125	18.93	111	.02	60	.50	-40
200	.46	-159	10.20	95	.03	58	.34	-41
500	.48	173	4.35	74	.09	67	.25	-47
1000	.52	147	2.31	49	.17	60	.24	-63
1500	.58	126	1.66	28	.24	54	.23	-89
2000	.65	107	1.35	9	.32	43	.24	-118

V_{CE} = 10 V, I_C = 30 mA

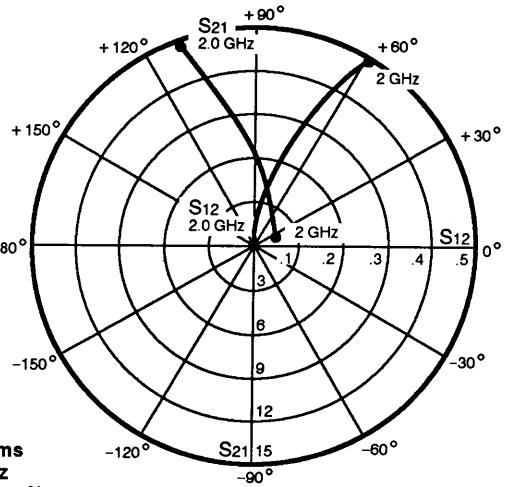
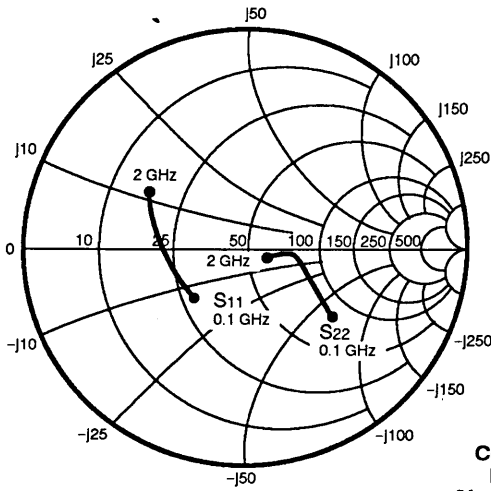
100	.46	-139	20.01	107	.01	66	.45	-40
200	.46	-166	10.52	93	.02	63	.30	-40
500	.48	171	4.45	73	.09	70	.23	-46
1000	.51	146	2.34	49	.17	62	.23	-63
1500	.56	126	1.67	29	.25	55	.22	-91
2000	.64	107	1.36	10	.33	44	.24	-118

V_{CE} = 10 V, I_C = 50 mA

100	.45	-152	20.48	104	.01	68	.40	-38
200	.46	-173	10.53	90	.03	69	.28	-36
500	.48	169	4.44	72	.09	72	.23	-43
1000	.52	145	2.33	48	.17	63	.23	-61
1500	.57	125	1.66	28	.25	56	.22	-88
2000	.65	107	1.34	9	.33	45	.24	-116

NE416 SERIES

TYPICAL COMMON BASE SCATTERING PARAMETERS



NE41632B
Coordinates in Ohms
Frequency in GHz
(V_{CB} = 10 V, I_C = 20 mA)

S-MAGN AND ANGLES:

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

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	.55	-81	9.59	128	.04	59	.74	-28
200	.47	-122	6.03	106	.06	52	.55	-33
500	.45	-160	2.83	80	.12	68	.38	-29
1000	.45	176	1.64	55	.22	75	.30	-31
1500	.48	160	1.29	40	.35	73	.20	-40
2000	.51	146	1.17	27	.49	65	.13	-57

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

100	.41	-109	12.53	118	.03	66	.61	-32
200	.38	-144	7.12	100	.05	64	.44	-32
500	.40	-168	3.18	77	.13	75	.31	-23
1000	.41	172	1.81	55	.24	74	.26	-20
1500	.44	160	1.42	39	.36	69	.20	-23
2000	.48	148	1.27	26	.49	62	.14	-33

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

100	.33	-136	14.61	111	.02	72	.51	-34
200	.34	-160	7.85	95	.05	74	.36	-30
500	.36	-173	3.41	76	.13	78	.27	-17
1000	.38	171	1.93	55	.26	73	.24	-11
1500	.42	161	1.50	40	.37	67	.20	-11
2000	.46	150	1.34	26	.48	60	.15	-18

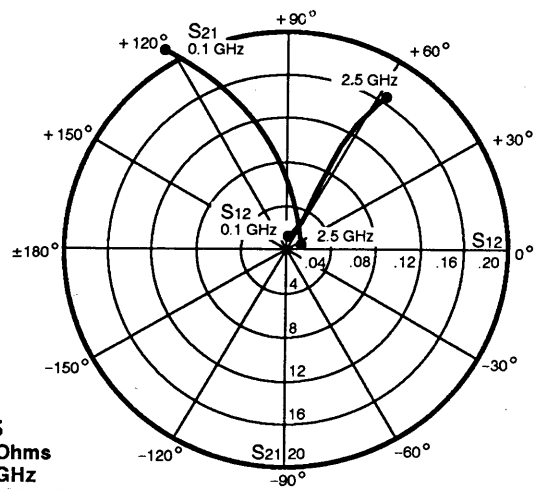
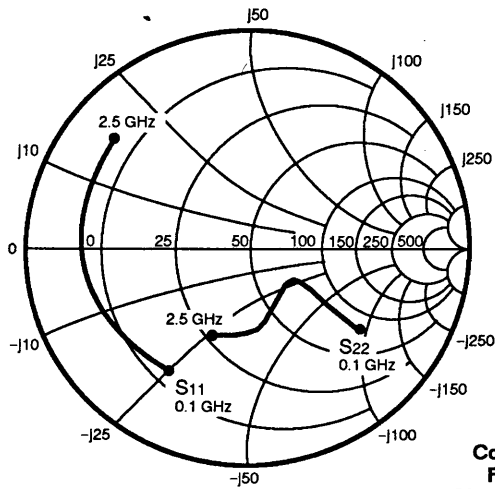
V_{CB} = 10 V, I_C = 30 mA

100	.31	-151	15.38	108	.02	78	.46	-34
200	.33	-168	8.10	94	.05	78	.33	-29
500	.35	-176	3.50	75	.14	79	.25	-14
1000	.37	170	1.98	55	.26	73	.24	-7
1500	.41	161	1.53	40	.37	66	.20	-6
2000	.46	151	1.37	25	.48	60	.16	-14

V_{CB} = 10 V, I_C = 50 mA

100	.32	-163	15.78	105	.02	79	.43	-33
200	.34	-175	8.21	92	.05	80	.32	-27
500	.35	-178	3.52	75	.14	80	.25	-11
1000	.37	169	1.99	54	.26	73	.24	-4
1500	.41	161	1.54	39	.37	66	.21	-4
2000	.46	150	1.37	25	.48	59	.16	-13

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE41635
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	.76	-72	11.56	140	.03	59	.85	-23
500	.75	-161	3.86	88	.06	27	.48	-38
1000	.75	176	2.00	62	.07	33	.45	-54
1500	.76	162	1.36	44	.08	44	.48	-72
2000	.77	151	1.01	31	.10	54	.52	-87
2500	.79	138	.80	17	.15	56	.51	-110

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

100	.70	-102	17.26	129	.02	53	.73	-32
500	.76	-171	4.68	85	.04	36	.36	-41
1000	.76	171	2.39	63	.06	45	.35	-56
1500	.76	161	1.61	47	.08	52	.39	-73
2000	.78	151	1.21	33	.11	58	.43	-89
2500	.78	137	.96	18	.23	63	.42	-110

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

100	.65	-125	21.75	120	.01	51	.62	-37
500	.73	-178	5.24	82	.03	52	.28	-42
1000	.73	167	2.65	61	.06	60	.26	-57
1500	.75	157	1.80	45	.09	60	.30	-74
2000	.76	147	1.35	33	.12	62	.35	-88
2500	.77	135	1.07	18	.16	58	.37	-110

V_{CE} = 10 V, I_C = 30 mA

100	.65	-137	23.60	117	.01	53	.55	-41
500	.73	179	5.45	81	.04	57	.24	-42
1000	.73	166	2.75	61	.07	63	.24	-57
1500	.74	156	1.86	45	.10	62	.28	-74
2000	.76	147	1.39	33	.13	62	.32	-88
2500	.78	136	1.10	19	.17	58	.34	-110

