

FEATURES

- HIGH GAIN BANDWIDTH PRODUCT
- IDEAL FOR LINEAR CLASS A AMPLIFIERS

DESCRIPTION AND APPLICATIONS

The NE567 Series of NPN Silicon Bipolar Transistors is designed for general purpose and ultra linear small signal amplifier applications up to 4 GHz and oscillator applications up into X-Band. The NE567 is available in a variety of packages and in chip form.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V _{CB0}	Collector to Base Voltage	V	25
V _{CE0}	Collector to Emitter Voltage	V	12
V _{EB0}	Emitter to Base Voltage	V	2
I _C	Collector Current	mA	60
T _J	Junction Temperature	°C	200
T _{STG}	Storage Temperature	°C	-65 to +200

PERFORMANCE SPECIFICATIONS (T_A = 25°C)

PART NUMBER EIAJ ¹ REGISTERED NUMBER PACKAGE OUTLINE			NE56700 CHIP			NE56708 2SC2338 08			NE56787 87		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
f _s	Frequency where S ₂₁ ² = 0 dB	GHz	7.5	8		7.5	8		7.5	8	
I _{CBO}	Collector Cutoff Current at V _{CB} = 10 V, I _E = 0	μA			1			1			1
I _{EB0}	Emitter Cutoff Current at V _{EB} = 1 V, I _C = 0	μA			1			1			1
h _{FE}	Forward Current Gain ² at V _{CE} = 10 V, I _C = 30 mA		30	100	200	30	100	200	30	100	200
C _{OB}	Output Capacitance ³ at V _{CB} = 10 V, I _E = 0, f = 1 MHz	pF		0.18	0.25		0.18	0.25		0.18	0.25
S _{21E} ²	Insertion Gain at V _{CE} = 10 V, I _C = 30 mA, f = 4 GHz	dB	5.5	6		5.5	6				
MAG	Maximum Available Gain ⁴ at V _{CE} = 10 V, I _C = 30 mA, f = 4 GHz	dB		11			10.5				
R _{TH}	Thermal Resistance ⁵ (Junction-to-Case)	°C/W			40			50			40
P _T	Total Power Dissipation	W			0.6			0.6			0.6

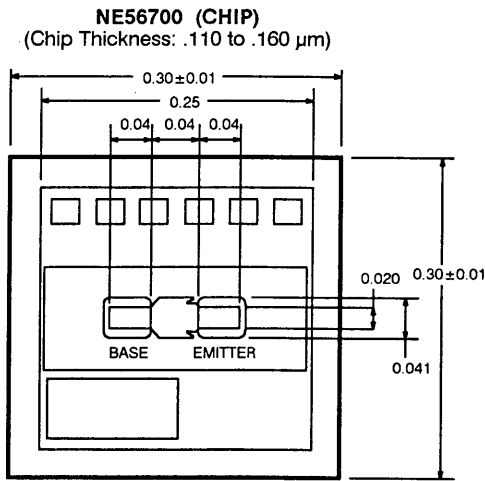
Notes:

1. Electronic Industrial Association of Japan.
2. PW ≤ 350 ms, duty cycle ≤ 2%/pulsed.
3. Emitter is grounded.
4. Maximum Available Gain (MAG) is calculated from the device S-Parameters using the equation,

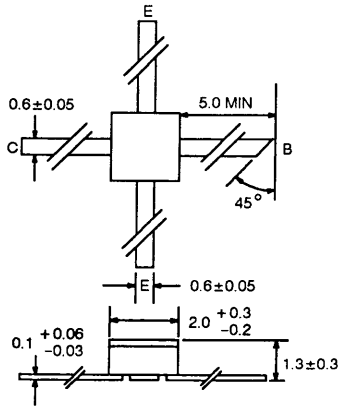
$$MAG = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1}) \quad K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{21}| |S_{12}|} \quad \Delta = S_{11} S_{22} - S_{21} S_{12}$$

5. R_{TH} (Junction-to-Ambient) for the NE56708 is 420°C/W.

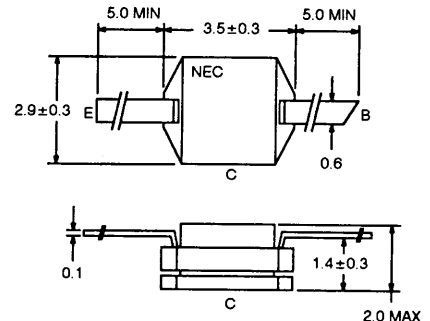
OUTLINE DIMENSIONS (Units in mm)



OUTLINE 08



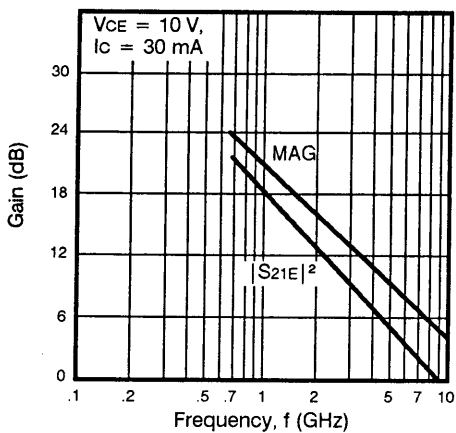
OUTLINE 87



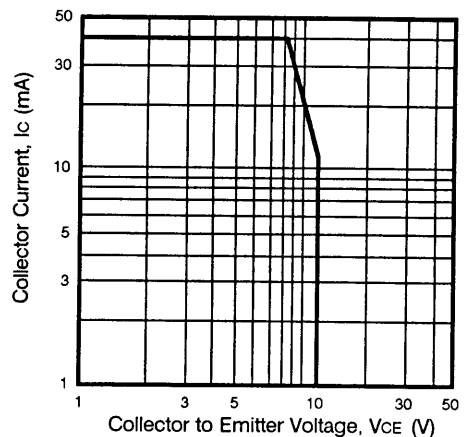
*All dimensions typical unless noted.

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

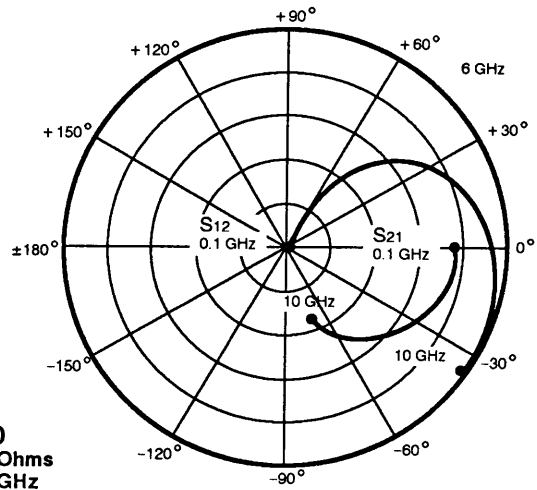
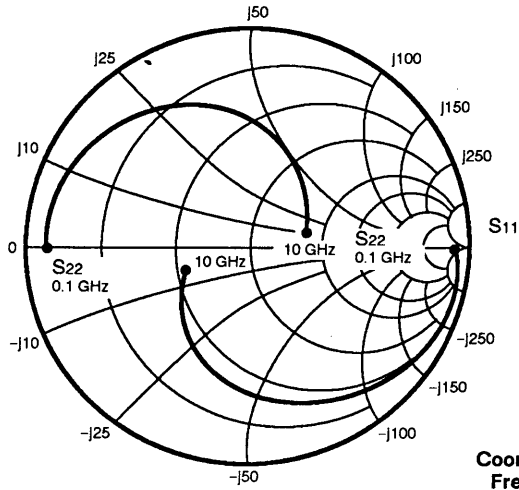
NE56708
INSERTION GAIN AND MAXIMUM AVAILABLE GAIN vs. FREQUENCY



NE567 SERIES
SAFE OPERATING AREA



TYPICAL COMMON COLLECTOR SCATTERING PARAMETERS



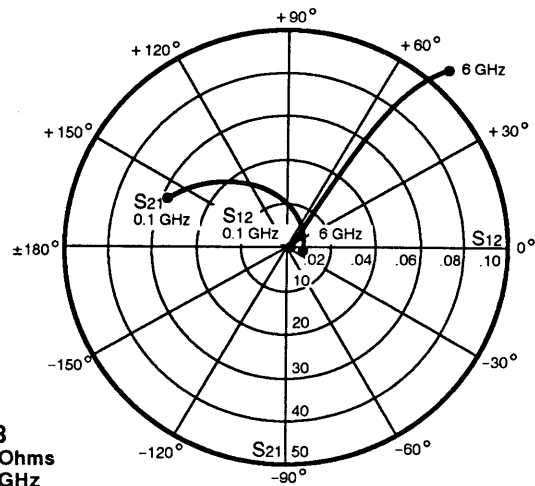
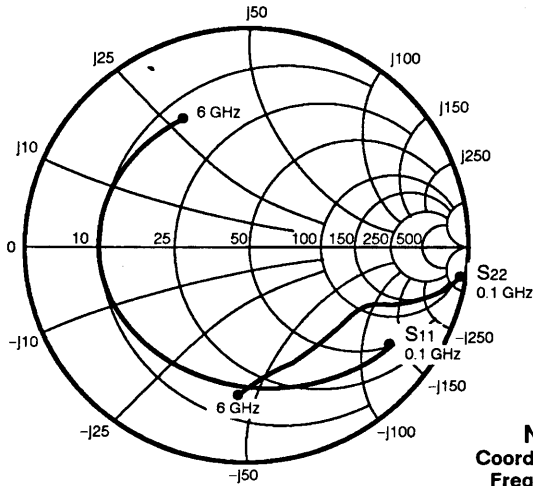
NE56700
Coordinates in Ohms
Frequency in GHz
(VCE = 9.5 V, IC = 24 mA)

S-MAGN AND ANGLES:

VCE = 9.5 V, IC = 24 mA

FREQUENCY (GHz)	S11		S21		S12		S22	
0.10	0.97	0.60	1.86	-0.80	0.05	34.20	0.89	178.00
0.50	0.96	-9.0	1.89	-6.40	0.12	65.40	0.89	170.00
1.00	0.95	-18.20	1.87	-13.20	0.23	65.40	0.88	160.00
1.50	0.93	-28.00	1.83	-18.95	0.32	59.60	0.85	150.90
2.00	0.91	-38.00	1.78	-24.45	0.42	53.60	0.82	141.90
2.50	0.88	-46.20	1.72	-28.60	0.50	48.50	0.79	134.25
3.00	0.84	-54.20	1.66	-32.60	0.58	43.50	0.75	126.75
3.50	0.81	-62.20	1.60	-37.20	0.64	37.60	0.72	118.80
4.00	0.78	-70.20	1.53	-41.60	0.70	31.60	0.67	110.80
4.50	0.74	-77.40	1.45	-45.60	0.75	26.60	0.65	103.80
5.00	0.70	-84.30	1.39	-49.60	0.79	20.60	0.61	96.70
5.50	0.67	-90.40	1.32	-52.70	0.83	15.95	0.59	90.60
6.00	0.64	-96.40	1.26	-55.70	0.86	11.45	0.56	84.60
6.50	0.60	-103.30	1.21	-58.70	0.89	6.50	0.52	78.60
7.00	0.57	-107.60	1.15	-59.00	0.91	3.30	0.50	73.50
7.50	0.54	-113.40	1.11	-61.25	0.93	-1.05	0.47	68.05
8.00	0.51	-119.40	1.06	-63.75	0.95	-5.55	0.45	62.55
8.50	0.48	-124.05	1.02	-65.35	0.96	-9.60	0.43	57.05
9.00	0.44	-128.55	0.97	-66.85	0.98	-13.60	0.41	51.55
9.50	0.42	-133.50	0.94	-68.35	0.99	-17.60	0.39	45.60
10.00	0.40	-138.50	0.92	-69.85	0.99	-21.60	0.36	39.60

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE56708
Coordinates in Ohms
Frequency in GHz
(VCE = 10 V, IC = 30 mA)

S-MAGN AND ANGLES:

VCE = 10 V, IC = 10 mA

FREQUENCY (MHz)

	S11		S21		S12		S22	
100	.81	-25	18.47	163	.00	76	.98	-7
500	.70	-101	12.12	120	.02	47	.76	-23
1000	.65	-142	7.33	96	.03	36	.63	-32
1500	.64	-161	5.13	80	.03	32	.63	-36
2000	.62	-173	3.88	69	.04	40	.63	-42
2500	.63	174	3.16	58	.05	31	.59	-49
3000	.64	165	2.74	51	.05	42	.59	-59
3500	.64	157	2.31	41	.06	48	.62	-65
4000	.65	148	2.13	33	.06	48	.60	-72
4500	.65	143	1.83	18	.07	45	.63	-81
5000	.62	134	1.65	13	.07	43	.62	-85
5500	.63	130	1.55	4	.09	47	.68	-91
6000	.62	119	1.41	-1	.10	45	.71	-96

VCE = 10 V, IC = 20 mA

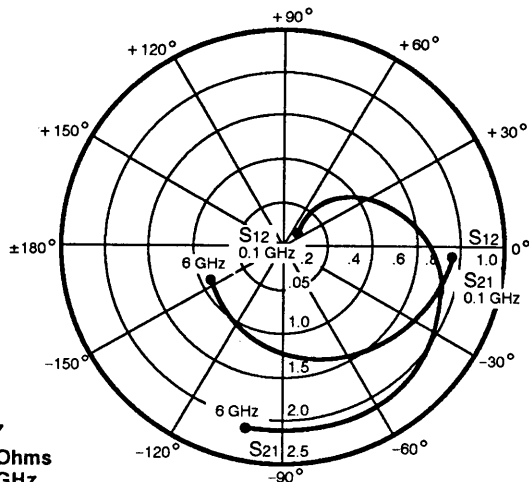
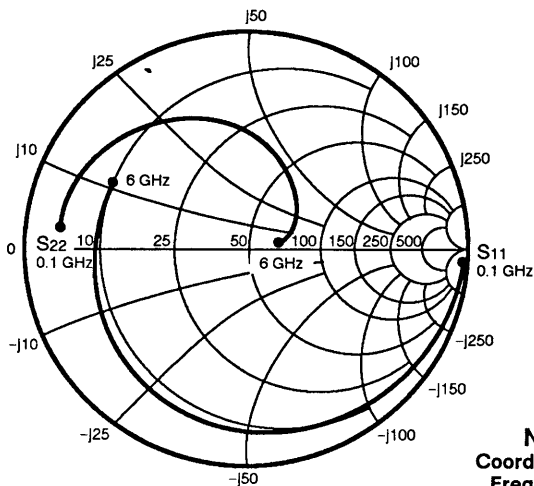
100	.77	-32	25.71	159	.00	77	.96	-9
500	.66	-115	14.56	113	.01	45	.69	-24
1000	.63	-151	8.32	92	.02	39	.58	-31
1500	.63	-167	5.77	78	.02	36	.58	-36
2000	.61	-178	4.33	68	.03	49	.59	-41
2500	.62	168	3.52	57	.05	45	.55	-48
3000	.63	160	3.06	50	.05	52	.55	-59
3500	.63	152	2.59	41	.06	52	.57	-64
4000	.65	144	2.36	31	.07	51	.56	-71
4500	.61	141	2.01	19	.07	47	.59	-80
5000	.62	132	1.84	12	.08	45	.62	-84
5500	.63	127	1.70	4	.09	48	.63	-93
6000	.62	117	1.54	-1	.10	47	.67	-95

VCE = 10 V, IC = 30 mA

100	.75	-36	29.82	157	.00	71	.96	-10
500	.65	-123	15.33	110	.01	45	.66	-23
1000	.63	-157	8.51	90	.01	43	.56	-30
1500	.63	-172	5.86	76	.02	43	.57	-35
2000	.61	178	4.40	67	.03	53	.58	-40
2500	.64	166	3.58	56	.05	51	.55	-47
3000	.64	159	3.10	49	.05	50	.55	-58
3500	.63	152	2.59	40	.06	55	.57	-63
4000	.65	143	2.39	31	.07	55	.57	-70
4500	.63	139	2.05	17	.08	50	.59	-80
5000	.62	131	1.88	13	.08	49	.57	-83
5500	.62	126	1.72	3	.10	51	.65	-90
6000	.62	116	1.58	-1	.11	47	.68	-95



TYPICAL COMMON COLLECTOR SCATTERING PARAMETERS



NE56787
Coordinates in Ohms
Frequency in GHz
(VCE = 10 V, IC = 30 mA)

S-MAGN AND ANGLES:

VCE = 10 V, IC = 10 mA

FREQUENCY (MHz)

	S11		S21		S12		S22	
100	.94	-6	1.76	-7	.09	52	.79	170
500	.90	-35	1.66	-24	.33	52	.73	147
1000	.84	-62	1.49	-38	.57	28	.60	121
1500	.74	-89	1.33	-52	.68	8	.46	104
2000	.67	-109	1.20	-66	.77	-9	.36	88
2500	.62	-135	1.14	-72	.84	-19	.30	81
3000	.58	-153	1.07	-83	.88	-34	.23	67
3500	.56	-170	1.00	-91	.90	-46	.16	53
4000	.57	173	.97	-100	.92	-59	.11	53
4500	.56	157	.91	-111	.93	-72	.08	57
5000	.55	140	.88	-120	.94	-85	.05	64
5500	.54	127	.83	-133	.92	-99	.03	123
6000	.55	116	.78	-142	.90	-112	.09	143

VCE = 10 V, IC = 20 mA

100	.94	-5	1.80	-7	.06	44	.83	172
500	.93	-30	1.74	-21	.24	56	.80	154
1000	.92	-53	1.64	-35	.43	38	.71	134
1500	.85	-79	1.51	-50	.55	19	.61	118
2000	.80	-100	1.40	-65	.66	2	.53	102
2500	.74	-116	1.29	-75	.72	-10	.48	90
3000	.70	-133	1.20	-87	.78	-25	.42	77
3500	.68	-148	1.12	-97	.81	-37	.35	63
4000	.67	-164	1.06	-107	.85	-52	.29	57
4500	.64	-178	.99	-118	.88	-65	.26	49
5000	.62	166	.95	-129	.90	-79	.23	41
5500	.61	154	.90	-141	.90	-93	.18	34
6000	.62	141	.82	-152	.89	-106	.13	43

VCE = 10 V, IC = 30 mA

100	.94	-5	1.81	-6	.05	42	.85	173
500	.94	-27	1.78	-20	.20	56	.83	157
1000	.94	-50	1.68	-33	.37	41	.75	139
1500	.89	-75	1.58	-48	.49	24	.67	123
2000	.85	-96	1.49	-64	.59	8	.60	109
2500	.80	-108	1.35	-76	.68	-5	.55	98
3000	.76	-123	1.25	-88	.75	-21	.48	83
3500	.75	-137	1.17	-98	.79	-34	.40	67
4000	.73	-152	1.12	-108	.82	-49	.32	57
4500	.70	-166	1.04	-121	.84	-62	.28	45
5000	.68	-180	1.00	-131	.84	-76	.23	31
5500	.67	167	.95	-145	.84	-91	.17	18
6000	.67	154	.87	-156	.83	-104	.09	14

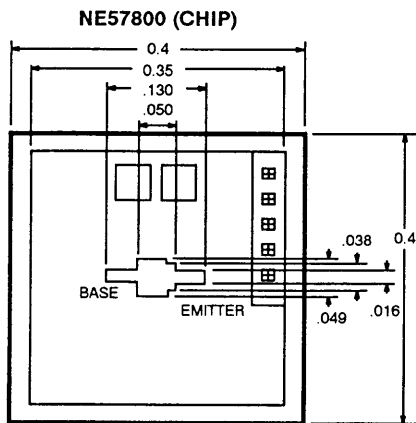
FEATURES

- **HIGH GAIN BANDWIDTH PRODUCT:** $f_T = 6$ GHz
- **LOW NOISE FIGURE:** 2.5 dB at 2 GHz
- **HIGH GAIN:** 13 dB at 2 GHz
- **RELIABILITY PROVEN IN SPACE:**
Platinum-Gold Metallization
Hermetic Stripline Packages
Space Qualified

DESCRIPTION AND APPLICATIONS

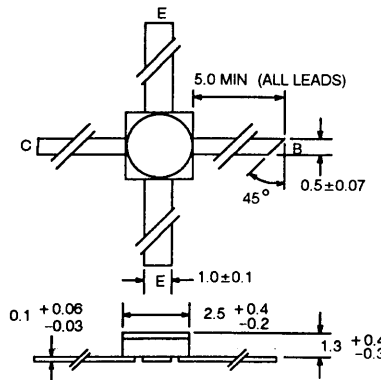
The NE578 series of NPN silicon transistors is designed for use in low noise amplifiers up to 5 GHz. The series features NEC's hi-rel metallization system, using platinum-silicide, titanium, platinum, and gold. NEC's metallization technique provides for high-temperature (100°C) operation at rated dissipation. NEC's stringent quality control standards (patterned after MIL-S-19500), made the NE578 one of the first microwave transistors to be qualified and flown in space.

CHIP DIMENSIONS (Units in μm)

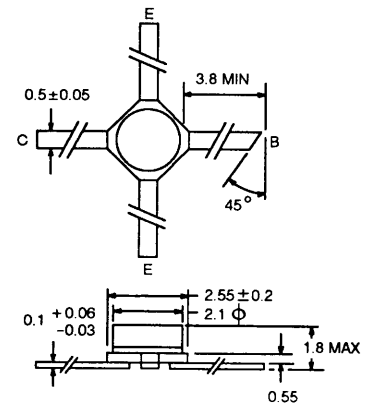


(Chip Thickness: 140 μm typ.)

OUTLINE 07



OUTLINE 35



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

PART NUMBER EIAJ ¹ REGISTERED NUMBER PACKAGE OUTLINE			NE57800 00 (CHIP)			NE57807 07			NE57835 2SC2150 35 (MICRO-X)		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
f_T	Gain Bandwidth Product at $V_{CE} = 8$ V, $I_C = 10$ mA	GHz	4	6		4	6		4	6	
$ S_{21E} ^2$	Insertion Power Gain at $V_{CE} = 8$ V, $I_C = 10$ mA, $f = 1$ GHz $f = 2$ GHz $f = 4$ GHz	dB dB dB	1.5	15 9 2.7		2	15 9 2.7		1.5	15 9 2.7	
NF _{MIN}	Minimum Noise Figure ² at $V_{CE} = 8$ V, $I_C = 3$ mA, $f = 2$ GHz $f = 3$ GHz $f = 4$ GHz	dB dB dB		2.5			2.7 3.8 5	5.5		2.4 3.4 4.3	5.5
MAG	Maximum Available Gain ³ at $V_{CE} = 8$ V, $I_C = 10$ mA $f = 2$ GHz $f = 3$ GHz $f = 4$ GHz	dB dB dB		7.4		6	13 9.5 7.4			12 9 6.5	

Notes:

1. Electronic Industrial Association of Japan.
2. Input and output are tuned for optimum noise figure.
3. Maximum Available Gain (MAG) is calculated from the device S-Parameters using the equation,

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

NE57800, NE57807, NE57835

ELECTRICAL CHARACTERISTICS (TA = 25°C)

PART NUMBER EIAJ ¹ REGISTERED NUMBER PACKAGE OUTLINE			NE57800 00 (CHIP)			NE57807 07			NE57835 2SC2150 35 (MICRO-X)		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
IcBO	Collector Cutoff Current at Vcb = 8 V, Ie = 0	μA			0.1			0.1			0.1
IeBO	Emitter Cutoff Current at Veb = 2 V, Ic = 0	μA			0.1			0.1			0.1
hFE	Forward Current Gain at Vce = 8 V, Ic = 10 mA		30	100	200	30	100	200	30	100	200
Ccb	Collector to Base Capacitance ² at Vcb = 8 V, Ie = 0 mA, f = 1 MHz	pF		0.4			0.4	0.6		0.3	0.6
Rth	Thermal Resistance (Junction-to-Case)	°C/W		110				110			140
Pt	Total Power Dissipation	mW			250			250			250 ³

Notes:

1. Electronic Industrial Association of Japan.
2. Ccb measurement employs a three-terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal.
3. Maximum case temperature for the NE57835 Grd D (Industrial) is -65°C to +150°C.

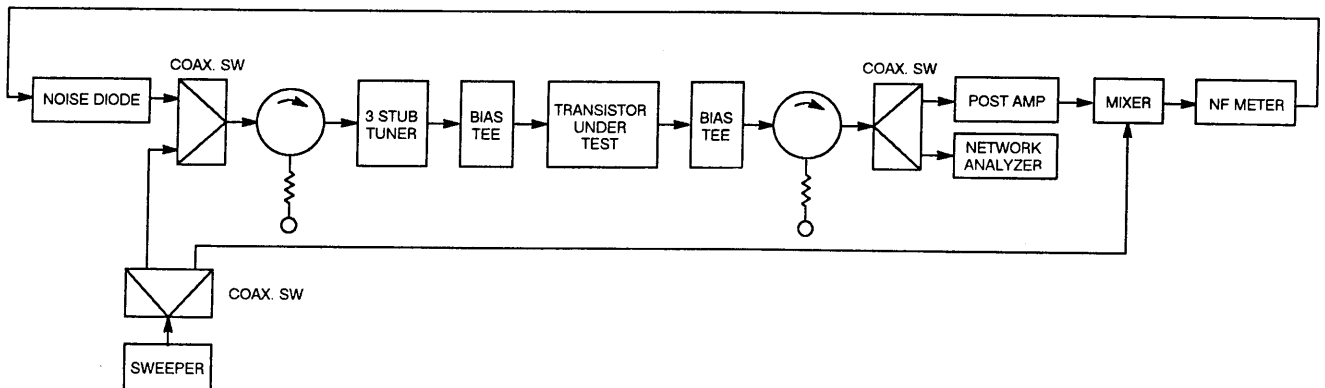
ABSOLUTE MAXIMUM RATINGS (TA = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
VcBO	Collector to Base Voltage	V	25
VceO	Collector to Emitter Voltage	V	11
VeBO	Emitter to Base Voltage	V	3
Ic	Collector Current	mA	30
Tj	Junction Temperature	°C	200*
Tstg	Storage Temperature	°C	-65 to +200*

*Maximum case temperature for the NE57835 Grd D (Industrial) is -65°C to +150°C.

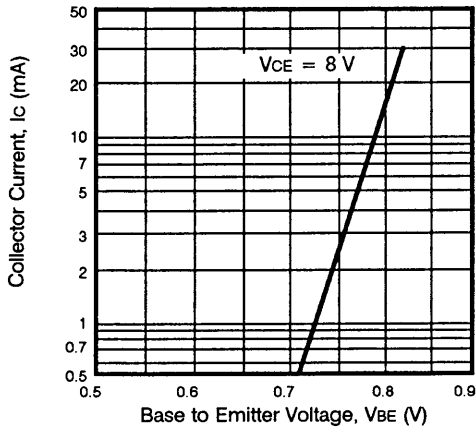
TEST CIRCUIT DIAGRAM

NOISE FIGURE AND GAIN MEASUREMENT CIRCUIT

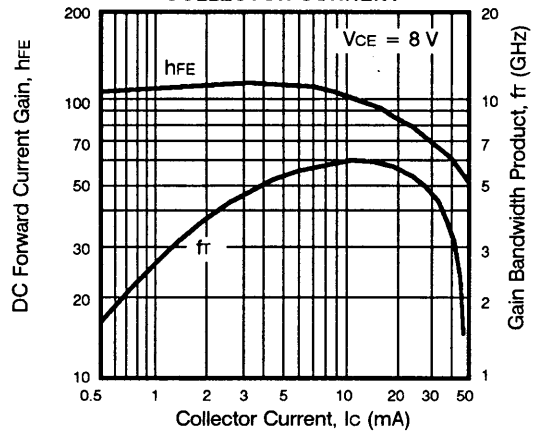


TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

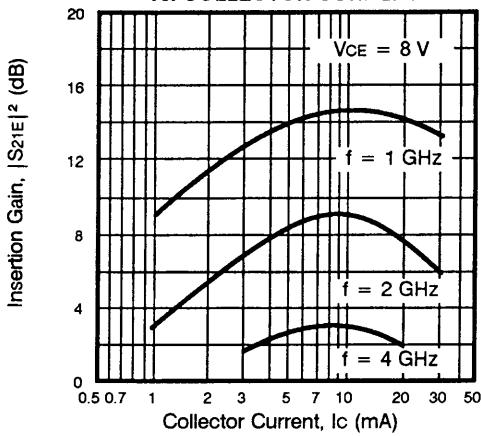
COLLECTOR CURRENT vs. BASE EMITTER VOLTAGE



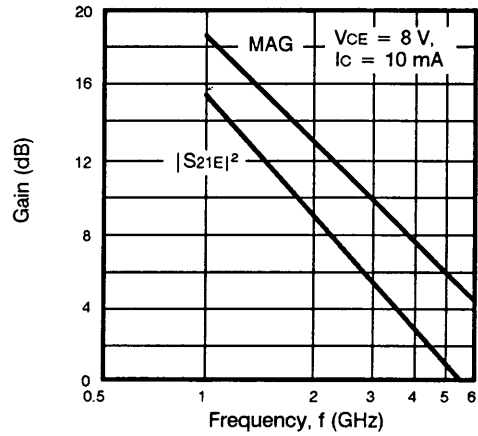
GAIN BANDWIDTH PRODUCT AND FORWARD CURRENT GAIN vs. COLLECTOR CURRENT



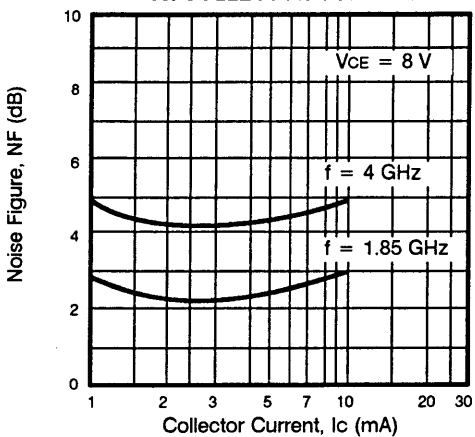
INSERTION GAIN vs. COLLECTOR CURRENT



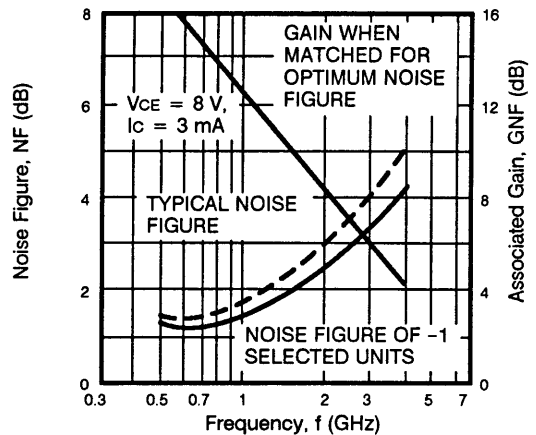
GAIN vs. FREQUENCY



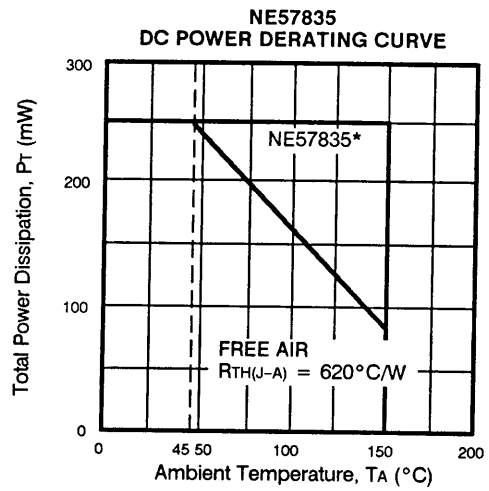
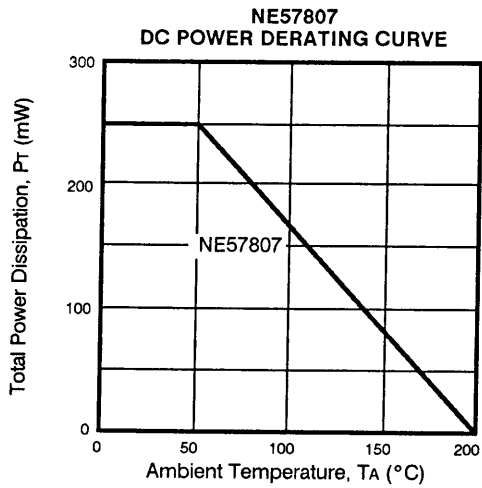
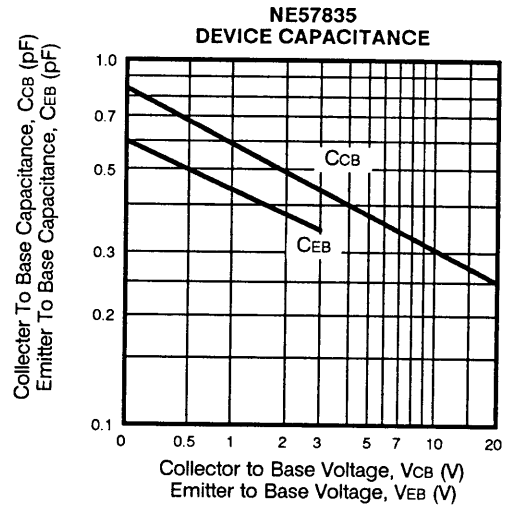
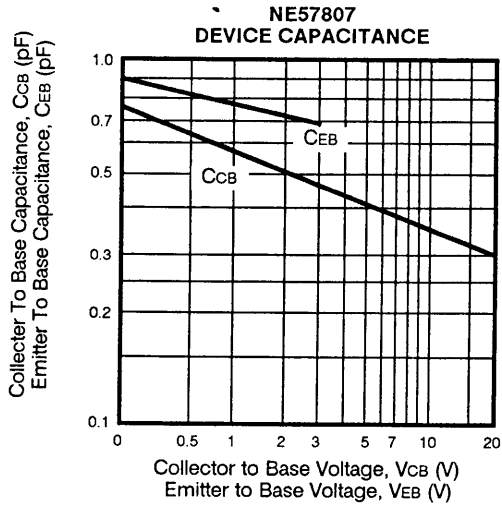
NOISE FIGURE vs. COLLECTOR CURRENT



NOISE FIGURE AND ASSOCIATED GAIN vs. FREQUENCY

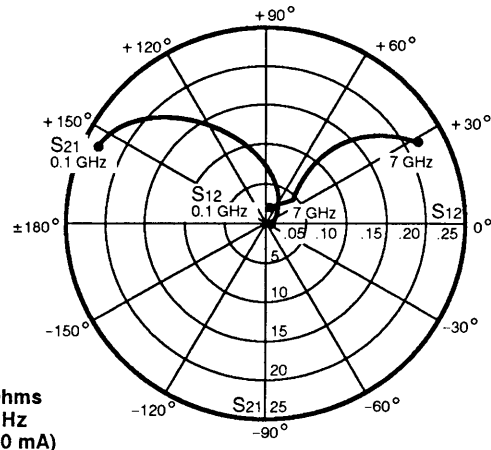
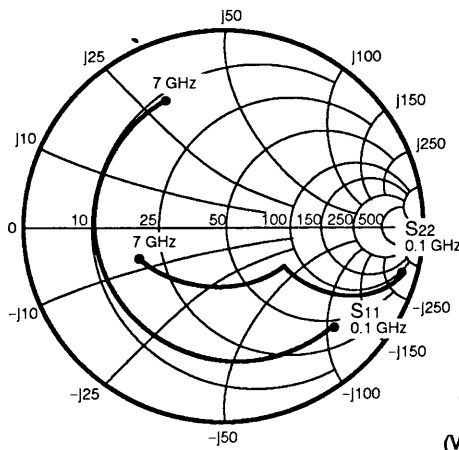


TYPICAL DEVICE CHARACTERISTICS (TA = 25°C)



*WITH INFINITE HEAT SINK,
R_{TH(J-C)} = 140°C/W MOUNTING ON
CERAMIC BOARD WITH SOLDER
(20 x 50 x 0.635 mm Al₂O₃)
R_{TH(J-A)} = 200°C/W

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE57800
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 8 V, I_C = 10 mA)

S-MAGN AND ANGLES:

V_{CE} = 8 V, I_C = 3 mA

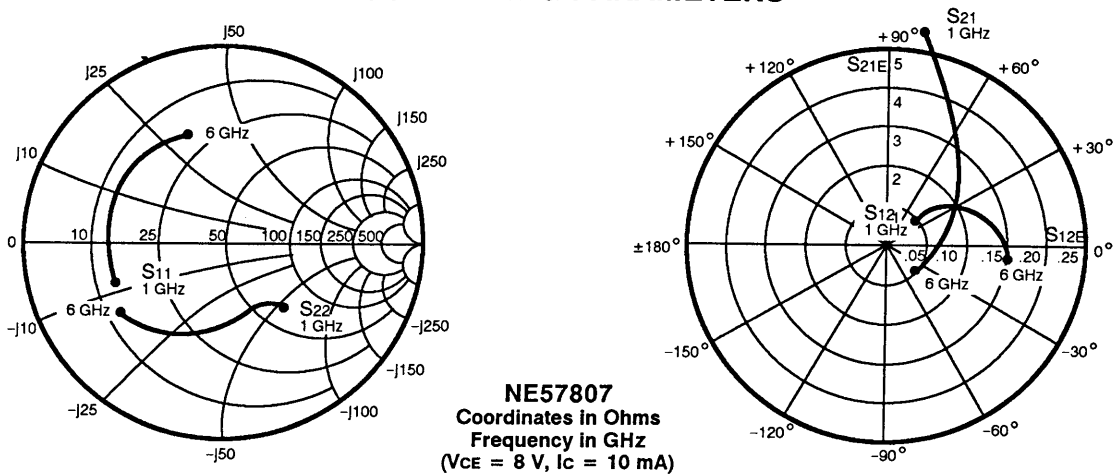
FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	.95	-19	9.17	167	.02	80	.98	-7
200	.89	-37	9.02	155	.04	70	.94	-15
300	.82	-54	8.37	145	.05	62	.89	-20
400	.80	-69	7.68	136	.06	55	.83	-25
500	.77	-82	6.97	128	.07	49	.78	-28
600	.74	-94	6.45	121	.08	46	.72	-32
700	.75	-101	5.66	115	.09	41	.68	-33
800	.70	-111	5.33	110	.09	39	.65	-35
900	.69	-119	4.91	105	.09	36	.60	-36
1000	.67	-127	4.66	101	.09	35	.57	-38
2000	.63	-166	2.55	72	.11	30	.46	-47
3000	.62	174	1.75	52	.13	28	.42	-60
4000	.63	157	1.39	35	.14	29	.40	-80
5000	.63	143	1.12	16	.16	27	.41	-104
6000	.64	131	.92	2	.18	23	.45	-131
7000	.66	119	.77	-12	.20	18	.52	-155

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

100	.74	-44	23.15	155	.02	71	.92	-15
200	.69	-79	19.53	136	.03	56	.79	-27
300	.66	-104	15.76	123	.03	49	.67	-33
400	.66	-120	12.87	114	.04	43	.58	-35
500	.65	-132	10.84	108	.04	41	.53	-35
600	.64	-141	9.31	102	.04	42	.47	-35
700	.64	-147	8.07	97	.05	40	.45	-36
800	.64	-153	7.20	94	.05	40	.42	-36
900	.64	-157	6.44	91	.05	43	.40	-34
1000	.64	-162	5.93	88	.05	44	.40	-35
2000	.64	175	3.04	66	.07	50	.34	-43
3000	.66	161	2.07	50	.10	50	.31	-58
4000	.66	148	1.59	34	.13	48	.31	-79
5000	.67	136	1.30	16	.16	43	.31	-105
6000	.69	126	1.06	4	.19	36	.37	-133
7000	.71	115	.90	-11	.21	29	.44	-157

Note: S-parameters include bond wires.
 Base: Total 1 wire (s), 1 per bond pad, 0.0245" (623 μm) long each wire.
 Collector: Total 1 wire (s), 1 per bond pad, 0.0179" (454 μm) long each wire.
 Emitter: Total 2 wire (s), 1 per side, 0.0493" (1251 μm) long each wire.
 Wire: 0.0007" (17.7 μm) Dia., gold.

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



S-MAGN AND ANGLES:

V_{CE} = 8 V, I_C = 2 mA

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
1000	.68	-111	3.57	98	.12	30	.70	-47
2000	.56	-153	2.01	58	.13	12	.56	-65
3000	.54	-178	1.43	31	.14	0	.55	-86
4000	.54	164	1.15	5	.15	-10	.59	-107
5000	.53	147	.95	-18	.15	-18	.63	-126
6000	.51	130	.81	-39	.16	-27	.69	-144

V_{CE} = 8 V, I_C = 3 mA

1000	.64	-123	4.22	93	.10	29	.62	-49
2000	.55	-162	2.29	56	.11	16	.50	-65
3000	.54	174	1.60	31	.13	5	.50	-86
4000	.54	158	1.28	5	.14	-3	.55	-107
5000	.52	142	1.06	-17	.15	-11	.60	-125
6000	.50	125	.90	-38	.16	-21	.66	-143

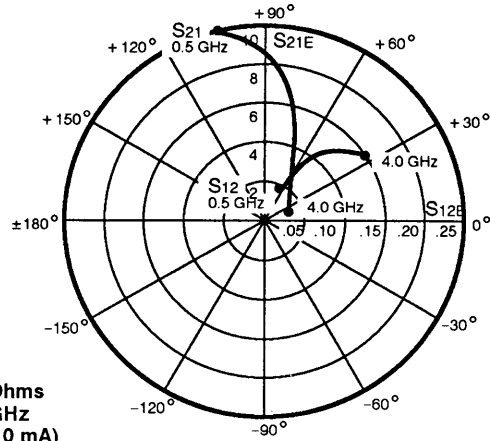
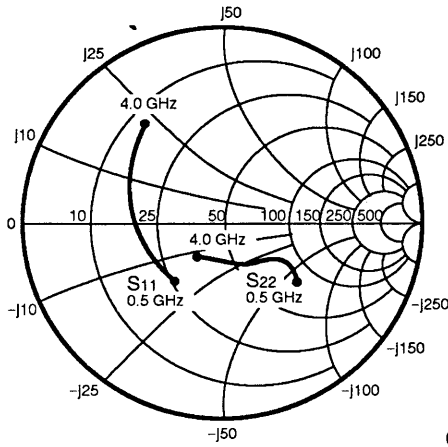
V_{CE} = 8 V, I_C = 5 mA

1000	.60	-139	4.92	88	.08	31	.53	-50
2000	.54	-174	2.59	54	.10	23	.44	-64
3000	.54	166	1.80	30	.12	13	.45	-85
4000	.54	151	1.42	5	.14	4	.51	-106
5000	.53	135	1.17	-17	.15	-4	.56	-125
6000	.51	118	.99	-38	.16	-14	.64	-142

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

1000	.58	-158	5.49	81	.06	37	.44	-48
2000	.56	174	2.83	51	.08	34	.39	-60
3000	.58	158	1.95	28	.11	23	.42	-82
4000	.58	144	1.53	4	.13	14	.49	-104
5000	.58	128	1.25	-18	.14	4	.54	-123
6000	.56	110	1.05	-39	.16	-5	.62	-142

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE57835
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 8 V, I_C = 10 mA)

S-MAGN AND ANGLES:

V_{CE} = 8 V, I_C = 3 mA

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	.89	-15	8.70	165	.02	80	.90	-15
200	.81	-32	8.10	153	.04	70	.90	-14
500	.60	-77	6.50	120	.08	52	.72	-32
1000	.47	-117	4.30	93	.10	45	.55	-37
2000	.43	178	2.50	60	.13	38	.37	-60
4000	.57	134	1.18	16	.19	20	.33	-118

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

100	.65	-32	19.20	152	.02	72	.90	-15
200	.55	-63	15.20	138	.03	63	.78	-24
500	.40	-127	9.80	102	.05	52	.50	-38
1000	.40	-160	7.70	82	.07	52	.35	-33
2000	.50	158	3.00	57	.11	52	.24	-60
4000	.63	128	1.34	18	.16	33	.22	-128