

NEC**MICROWAVE TRANSISTOR SERIES****NE593****FEATURES**

- HIGH GAIN BANDWIDTH PRODUCT
 $f_T = 2\text{GHz}$
- HIGH INSERTION GAIN
5.5 dB typically at 1 GHz
- PNP COMPLEMENT TO THE NE734

DESCRIPTION AND APPLICATIONS

The NE593 Series of PNP silicon general purpose UHF transistors provide the designer with a wide selection of reliable transistors for high speed logic and wide-band low noise amplifier applications. The series uses NEC's highly reliable platinum-silicide, titanium, platinum, and gold metallization system to assure uniform performance and reliability. Besides the chip form (NE59300), several package styles are available. While the series is designed for industrial applications, the NE59312 (2SA800) is screened to NEC's Grade C level of reliability which is patterned after MIL-STD-19500 for applications such as military that require higher than normal MTF values. The NE59335 is in an economical metal-ceramic stripline package and is ideal for hybrid integrated circuits. The NE59333 is in the plastic Mini-Mold package (23A3) designed for high speed automated assembly operations for large volume hybrid I.C.'s. Detailed handling procedures are available upon request. The NE734 Series is the NPN complement.

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

NE PART NUMBER EIAJ ¹ REGISTERED NUMBER PACKAGE CODE			NE59312 2SA800 12 (TO-72)			NE59333 33 (MINI-MOLD)			NE59335 35 (MICRO-X)		
SYMBOL	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
f_T	Gain Bandwidth Product at $V_{CE} = -10\text{V}$, $I_C = 10\text{mA}$	GHz	1.5	2.0		1.5	2.0		1.5	2.0	
$ S_{21E} ^2$	Insertion Power Gain at $V_{CE} = -10\text{V}$, $I_C = 10\text{mA}$, $f = 0.5\text{GHz}$ $f = 1.0\text{GHz}$	dB dB		10.5 5.5			10.5 5.5			10.5 5.5	
NF_{min}	Minimum Noise Figure at $V_{CE} = -10\text{V}$, $I_C = 3\text{mA}$, $f = 0.5\text{GHz}$	dB		3.0			3.0			3.0	
MAG	Maximum Available Gain at $V_{CE} = -10\text{V}$, $I_C = 10\text{mA}$ $f = 0.5\text{GHz}$ $f = 1.0\text{GHz}$	dB dB		12.5 7.0			12.5 7.0			12.5 7.0	

SEE NOTES ON BACK PAGE

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

NE PART NUMBER EIAJ ¹ REGISTERED NUMBER PACKAGE CODE			NE59312 2SA800 12 (TO-72)			NE59333 33 (MINI-MOLD)			NE59335 35 (MICRO-X)		
SYMBOL	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
I_{CBO}	Collector Cutoff Current at $V_{CB} = -15\text{V}$, $I_E = 0$	μA			0.1			0.1			0.1
I_{EBO}	Emitter Cutoff Current at $V_{DB} = -2.0\text{V}$, $I_C = 0$	μA			0.1			0.1			0.1
h_{FE}	Forward Current Gain at $V_{CE} = -10\text{V}$, $I_C = 10\text{mA}$		20	60	200	20	60	200	20	60	200
C_{CB}	Collector-Base Capacitance ² at $V_{CB} = -10\text{V}$, $I_E = 0\text{mA}$, $f = 1.0\text{MHz}$	pF		0.9	1.1		1.0	1.5		0.9	1.1
R_{th}	Thermal Resistance (J-C)	$^\circ\text{C/W}$			300			267 ⁴			130
P_T	Total Power Dissipation	mW			250			275 ³			250 ³

SEE NOTES ON BACK PAGE

ALL DC TESTS PERFORMED PER MIL-STD-750

NE593, L-BAND PNP AMPLIFIER SERIES

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

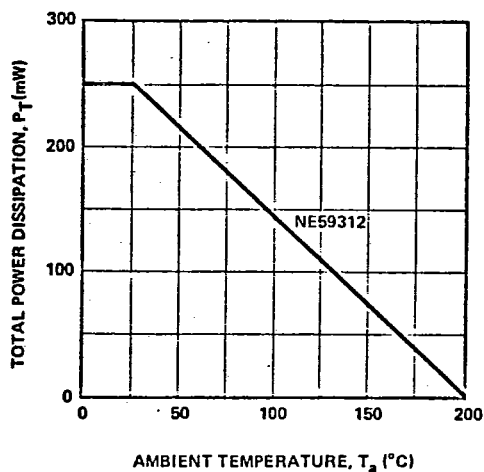
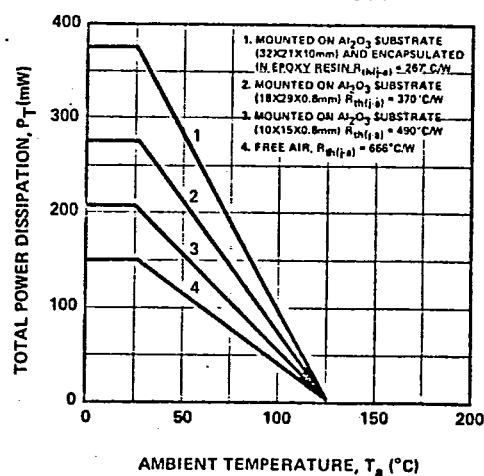
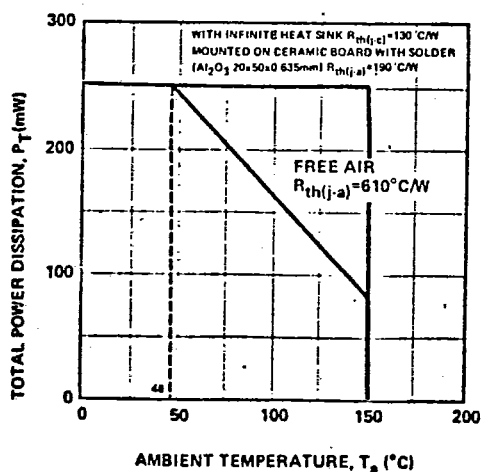
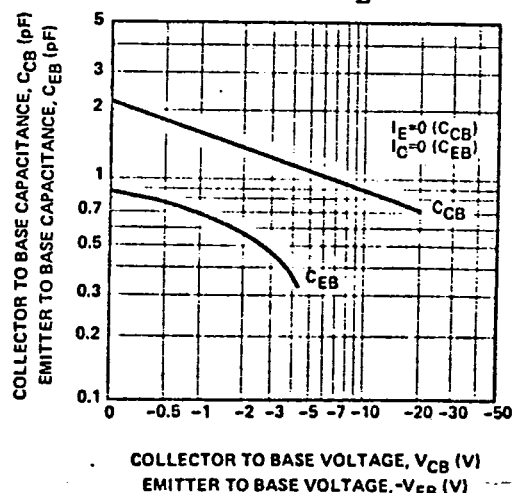
PARAMETERS	SYMBOL	RATINGS	UNIT
Collector-Base Voltage	V_{CBO}	-20	V
Collector-Emitter Voltage	V_{CEO}	-12	V
Emitter-Base Voltage	V_{EBO}	-3.0	V
Collector Current	I_C	30	mA
Operating Junction Temperature	T_j	200 ³	$^\circ\text{C}$
Storage Temperature	T_{stg}	-65~+200 ³	$^\circ\text{C}$

SEE NOTES ON BACK PAGE

RELIABILITY SCREENING (HES-32200; MIL-STD-750)

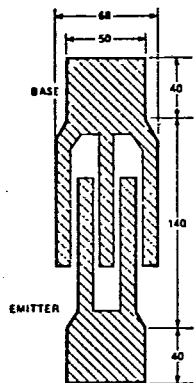
GRADE D (Industrial) 200-1200 Failures in 10 ³ Device Hours (FIT)	GRADE C (Military) 50-300 Failures in 10 ³ Device Hours (FIT)
400 $^\circ\text{C}$ Wafer Bake 100% DC Wafer Probe 100% Visual Inspection (Chip) Pre-cap Inspection (sample basis) 100% High Temperature Storage (200 $^\circ\text{C}$ -48Hrs) 100% Gross Leak Tests 100% Mechanical Shock Tests 100% Group A Test	400 $^\circ\text{C}$ Wafer Bake 100% DC Wafer Probe 100% Visual Inspection (Chip) 100% Pre-cap Inspection 100% Vacuum Bake (300 $^\circ\text{C}$ -2Hrs) 100% High Temperature Storage (200 $^\circ\text{C}$ -48Hrs) 100% Environmental Tests (Heat Cycle, Gross and Fine Leak, Centrifuge, Shock) 100% 168 Hour Power Burn-in at $P_{C,max}$ and $T_a = 25^\circ\text{C}$ or $T_{j,max}$ 100% Group A Test
(Tests may vary depending upon package style.)	

DEVICE CHARACTERISTICS

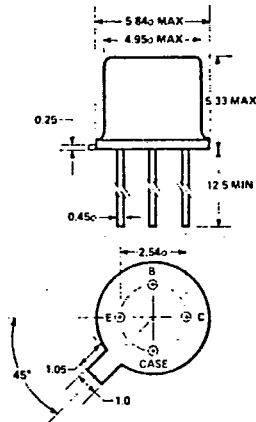
DC POWER DERATING CURVES
FOR THE NE59312DC POWER DERATING CURVES
FOR THE NE59333DC POWER DERATING CURVES
FOR THE NE59335TYPICAL DEVICE CAPACITANCE
FOR THE NE59312 AND NE59335
($f = 1.0\text{MHz}$, $I_E = 0$)

NE593, L-BAND PNP AMPLIFIER SERIES

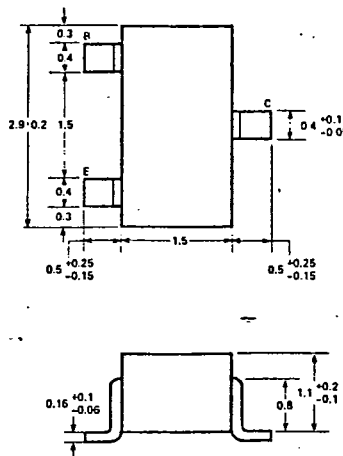
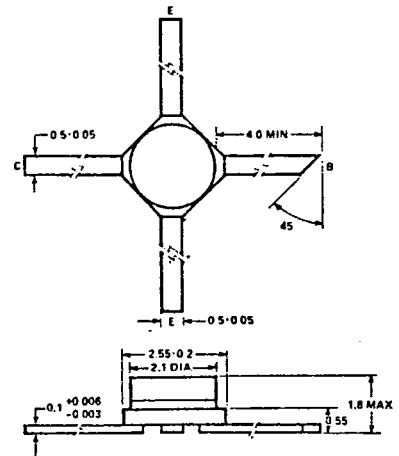
PHYSICAL DIMENSIONS (Units in mm)

NE59300 (CHIP)
(Chip Size: 400x400 μ m)

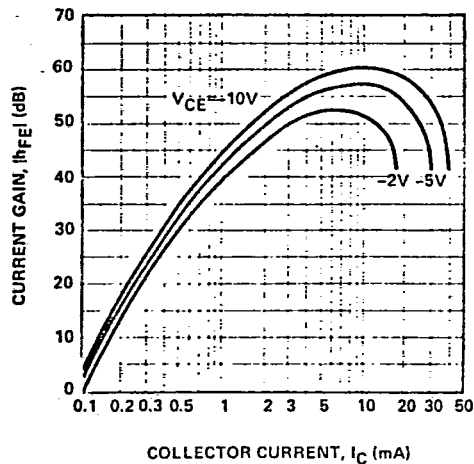
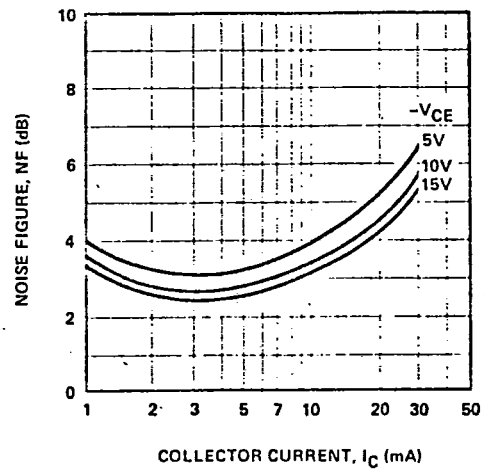
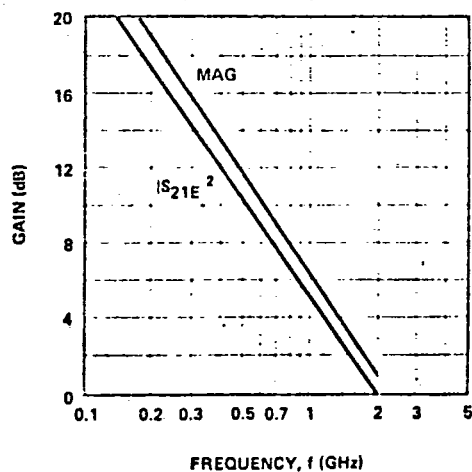
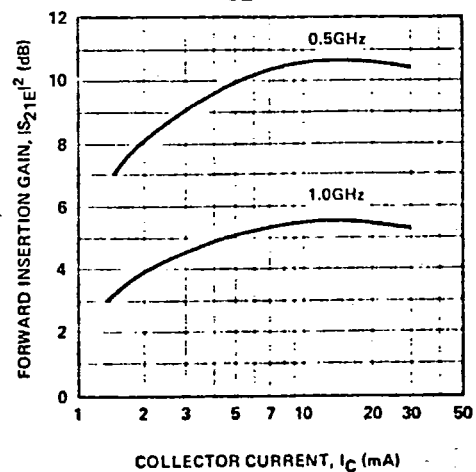
NE59312 (TO-72)



NE59333 (23A3)

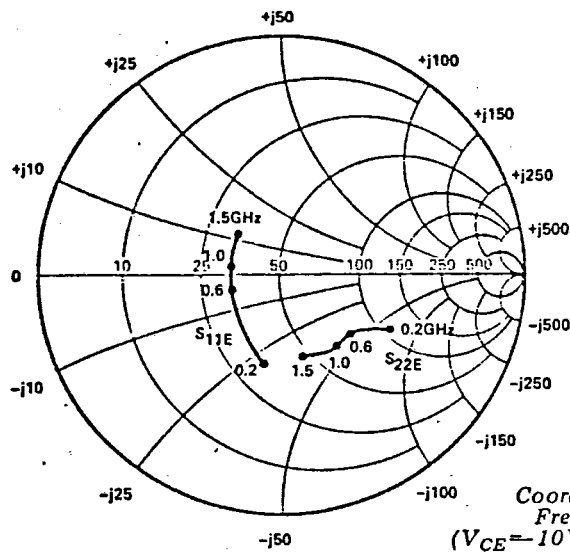
NE59335 (μ -x)

PERFORMANCE CHARACTERISTICS

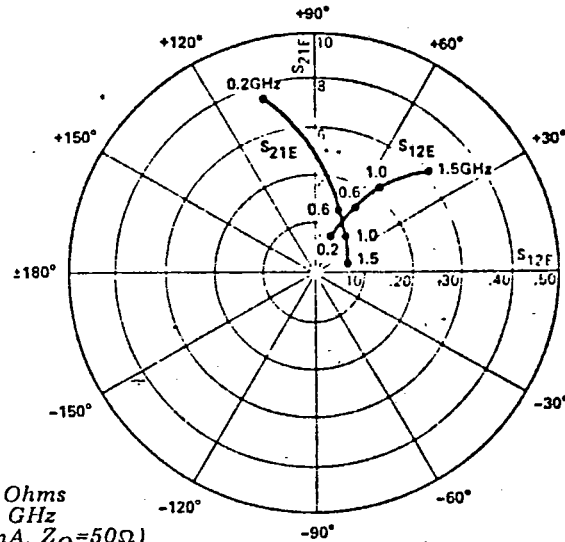
TYPICAL CURRENT GAIN
VS. COLLECTOR CURRENT
($f=100\text{MHz}$)TYPICAL NOISE FIGURE
VS. COLLECTOR CURRENT
($f=500\text{MHz}$)TYPICAL INSERTION GAIN
AND MAXIMUM AVAILABLE GAIN
VS. FREQUENCY
($V_{CE}=-10\text{V}$, $I_C=10\text{mA}$)TYPICAL INSERTION GAIN
VS. COLLECTOR CURRENT
($V_{CE}=-10\text{V}$)

NE593, L-BAND PNP AMPLIFIER SERIES

NE59312 COMMON EMITTER SCATTERING PARAMETERS



Coordinates in Ohms
Frequency in GHz
($V_{CE} = -10V$, $I_C = 10mA$, $Z_0 = 50\Omega$)



S-MAGN AND ANGLES:

 $V_{CE} = -10V$, $I_C = 2mA$

FREQUENCY (MHz)	S11		S21		S12		S22	
200	.72	-59	4.44	129	.10	59	.71	-20
400	.39	-95	2.89	97	.13	47	.57	-38
600	.32	-123	2.18	79	.16	43	.51	-46
800	.29	-148	1.79	64	.19	44	.47	-54
1000	.24	-163	1.54	52	.22	44	.46	-58
1200	.25	176	1.36	41	.25	41	.44	-71
1400	.27	158	1.22	31	.28	39	.41	-83
1500	.26	149	1.18	25	.29	39	.41	-80

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

200	.50	-81	6.61	114	.08	58	.56	-22
400	.24	-123	3.76	88	.11	55	.44	-35
600	.21	-148	2.65	73	.15	52	.41	-42
800	.22	-170	2.10	60	.19	53	.38	-49
1000	.18	177	1.78	49	.23	51	.40	-52
1200	.21	161	1.56	39	.26	47	.38	-66
1400	.24	146	1.39	30	.30	42	.35	-78
1500	.23	137	1.32	25	.31	41	.36	-74

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

200	.36	-99	7.61	105	.07	62	.50	-26
400	.18	-149	4.09	83	.11	61	.39	-30
600	.18	-168	2.82	69	.15	58	.37	-37
800	.21	176	2.21	58	.19	57	.35	-45
1000	.18	164	1.86	47	.23	54	.37	-48
1200	.21	152	1.62	38	.27	49	.36	-63
1400	.25	139	1.44	29	.30	44	.33	-74
1500	.24	131	1.37	24	.32	42	.35	-71

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

200	.28	-119	7.67	99	.06	66	.50	-28
400	.19	-171	4.03	79	.10	65	.38	-25
600	.20	176	2.74	66	.15	60	.37	-33
800	.23	165	2.13	55	.19	59	.36	-41
1000	.21	154	1.79	44	.23	56	.39	-46
1200	.25	144	1.56	35	.26	51	.37	-61
1400	.29	132	1.38	26	.30	46	.34	-73
1500	.28	124	1.32	21	.32	45	.36	-70

NOTES TO TABLES ON PAGE1:

- Electronic Industries Association - Japan.
- C_{CB} measurement employs a three-terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal.
- The maximum case temperature for the NE59335 is $-65^\circ \sim 150^\circ$ and $-55^\circ C \sim +125^\circ C$ for the NE59333.
- R_{th} (junction to ambient) for the NE59333.



EXCLUSIVE SALES AGENT FOR Nippon Electric Co. Ltd MICROWAVE SEMICONDUCTORS. USA • CANADA • EUROPE

CALIFORNIA EASTERN LABORATORIES, INC. • Headquarters and Warehouse • 3005 Democracy Way • Santa Clara CA 95050 • (408) 988-3500 • Telex 34-6393

CALIFORNIA EASTERN LABORATORIES, INTERNATIONAL BV • European Sales Office and Warehouse • Havenstraat 8a • Zaandam Nederland • (975) 169740 • Telex 844-13463