NEC

MICROWAVE TRANSISTOR SERIES

NE889

FEATURES

- **PNP COMPLEMENT TO NE327**
- **HIGH GAIN BANDWIDTH PRODUCT**
  f_T = 4.0 GHz
- **HIGH GAIN**
  18 dB at 500 MHz
- **LOW NOISE**
  2.5 dB at 500 MHz
- **RELIABLE**
  Gold Metallization and Rugged Packages

DESCRIPTION AND APPLICATIONS

The NE889 Series of PNP silicon transistors is designed for ultra high speed current mode switching applications and microwave amplifiers up to 2 GHz. The NE889 is available in several package styles and in chip form (NE88900). The NE88935 is an economical metal ceramic stripline version which features low parasitic elements and is ideal for low cost hybrid circuits. Reliability is assured by NEC's stringent production controls, which are patterned after MIL-S-19500 and Pt-Si/Ti/Pt/Au metallization. The NE32702 (2SC1090) is the NPN complement to the NE88902 (2SA801).

PERFORMANCE SPECIFICATIONS (T_a=25°C)

NE PART NUMBER EIAJ[1] REGISTERED NUMBER PACKAGE CODE			NE88902 2SA801 02			NE88912 12 (TO-72)			NE88935 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}=-5V, I_C=15mA	GHz		4.0			4.0			4.0	
$\|S_{21E}\|^2$	Insertion Power Gain at V_{CE}=-10V, I_C=20mA, f=0.5GHz	dB		16.0			13.0			16.0	
	f=1.0GHz	dB	8	10.2			7.2			10.2	
	f=2.0GHz	dB		4.2			2.0			4.2	
NF_{min}	Minimum Noise Figure[2] at V_{CE}=-10V, I_C=3mA, f=0.2GHz	dB		1.8			2.0			1.8	
	f=0.5GHz	dB		2.7			3.0			2.5	3.5
	f=1.0GHz	dB		4.2			4.5			4.2	
MAG	Maximum Available Gain[3] at V_{CE}=-10V, I_C=20mA, f=0.5GHz	dB		18.0			14.5			18.0	
	f=1.0GHz	dB		12.0			9.0			12.0	
	f=2.0GHz	dB		7.0			3.0			7.0	

SEE NOTES ON BACK PAGE

ELECTRICAL CHARACTERISTICS (T_a=25°C)

NE PART NUMBER EIAJ[1] REGISTERED NUMBER PACKAGE CODE			NE88902 2SA801 02			NE88912 12 (TO-72)			NE88935 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}=−10V, I_E=0	μA			0.1			0.1			0.1
I_{EBO}	Emitter Cutoff Current at V_{EB}=−2.0V, I_C=0	μA			0.1			0.1			0.1
h_{FE}	Forward Current Gain at V_{CE}=-10V, I_C=15mA		20	90	200	20	90	200	20	90	200
C_{CB}	Collector-Base Capacitance[4] at V_{CB}=−5V, I_E=0mA, f=1.0MHz	pF		1.2	1.5		1.2	1.5		1.2	1.5
R_{th}	Thermal Resistance (J-C)	°C/W			60			80			130
P_T	Total Power Dissipation	mW			300			300			250[5]

SEE NOTES ON BACK PAGE

ALL DC TESTS PERFORMED PER MIL-STD-750

ABSOLUTE MAXIMUM RATINGS (T_a=25°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	50	mA
Operating Junction Temperature	T_j	200	°C
Storage Temperature	T_{stg}	−65~+200[5]	°C

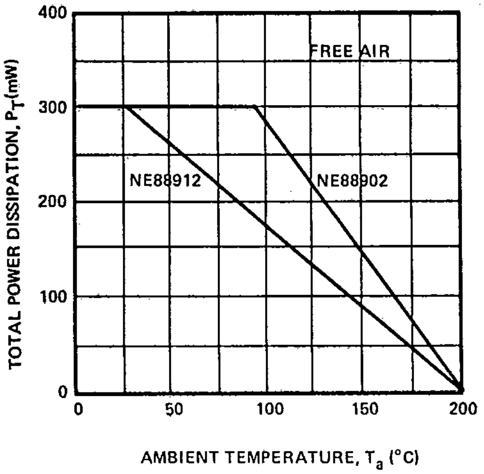
SEE NOTES ON BACK PAGE

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

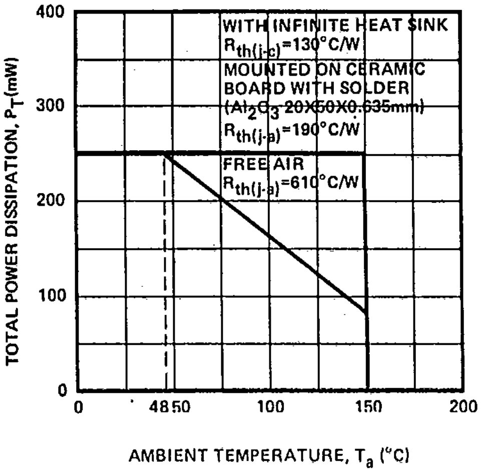
GRADE D (Industrial) 200-1200 Failures in 10^9 Device Hours (FIT)	GRADE C (Military) 50-300 Failures in 10^9 Device Hours (FIT)
400°C Wafer Bake 100% DC Wafer Probe 100% Visual Inspection (Chip) Pre-cap Inspection (sample basis) 100% High Temperature Storage (200°C-48Hrs) 100% Gross Leak Tests 100% Mechanical Shock Tests 100% Group A Test (Tests may vary depending upon package style.)	400°C Wafer Bake 100% DC Wafer Probe 100% Visual Inspection (Chip) 100% Pre-cap Inspection 100% Vacuum Bake (300°C-2Hrs) 100% High Temperature Storage (200°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°C or $T_j$max 100% Group A Test

DEVICE CHARACTERISTICS (T_a=25°C)

DC POWER DERATING CURVES

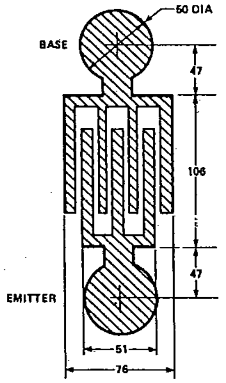


DC POWER DERATING CURVES FOR THE NE88935 GRADE D (INDUSTRIAL)

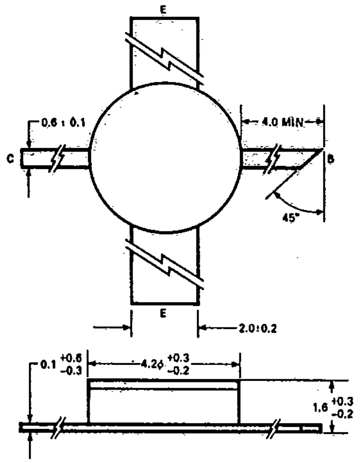


PHYSICAL DIMENSIONS *(Units in mm)*

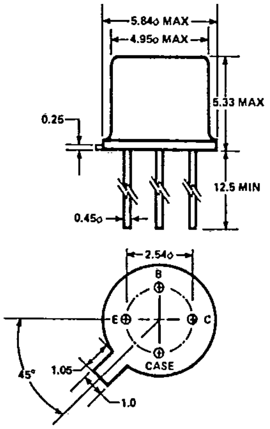
NE88900 (CHIP)
(Chip Size: 400x400μm)



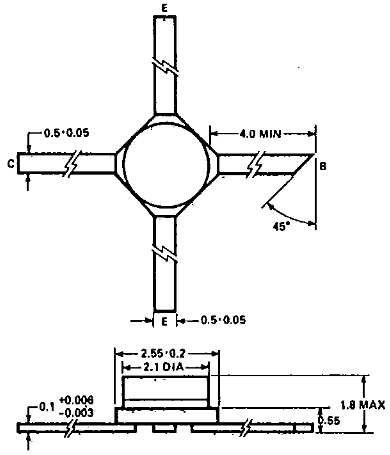
NE88902



NE88912 (TO-72)

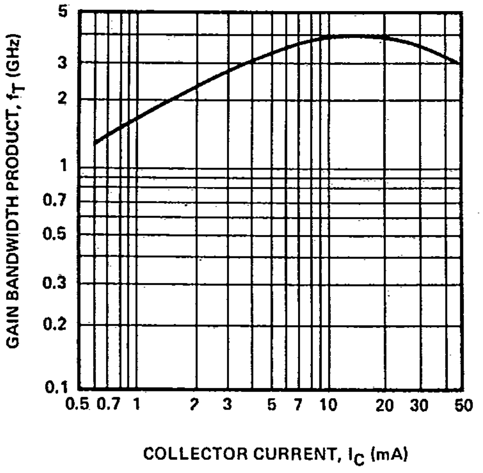


NE88935 (μ-x)

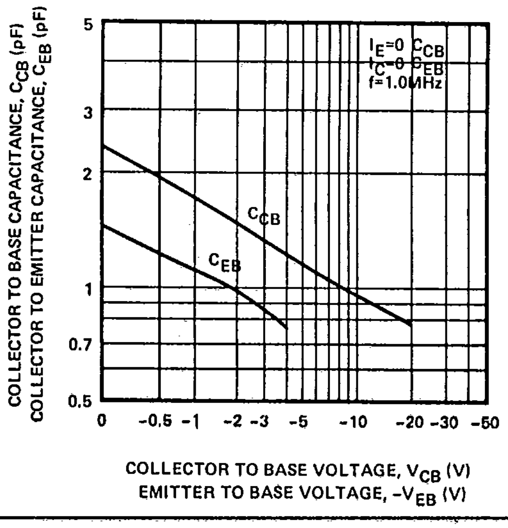


PERFORMANCE CHARACTERISTICS (T_a=25°C)

GAIN BANDWIDTH
VS. COLLECTOR CURRENT
(V_{CE}=−5V, I_C=15mA)

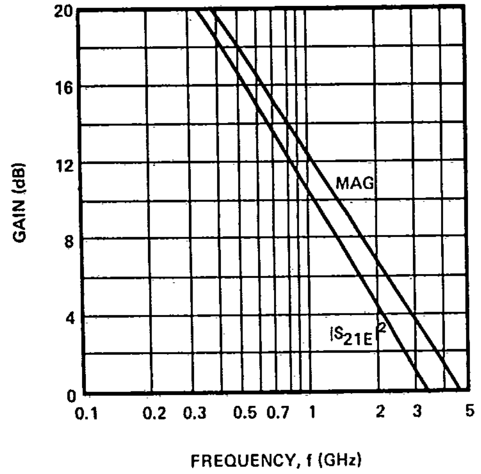


DEVICE CAPACITANCE

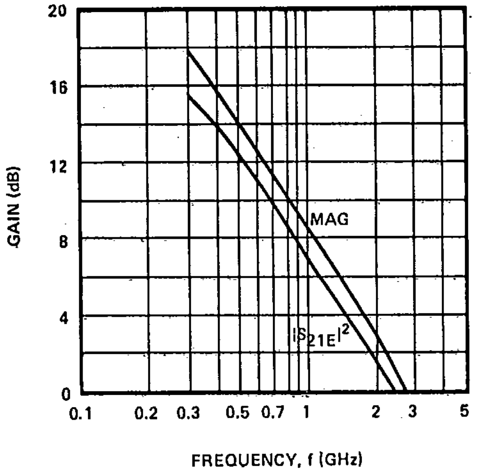


PERFORMANCE CHARACTERISTICS *Cont'd.*

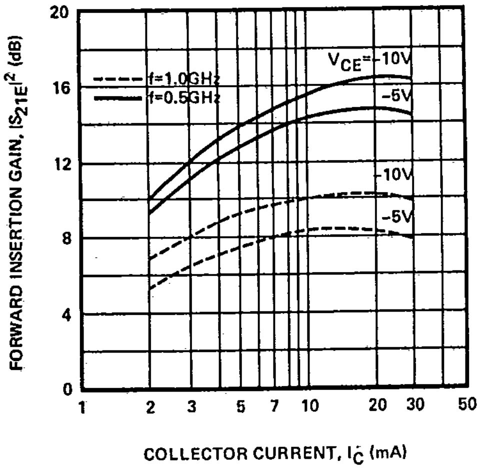
TYPICAL GAIN
VS. FREQUENCY PERFORMANCE
FOR THE NE88902 AND NE88935
(V_{CE} = -10V, I_C = 20mA)



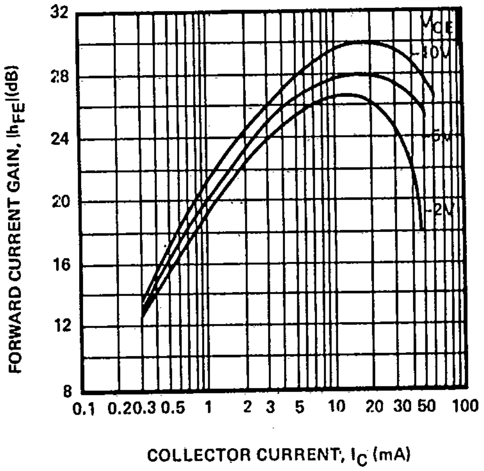
TYPICAL GAIN
VS. FREQUENCY PERFORMANCE
FOR THE NE88912
(V_{CE} = -10V, I_C = 20mA)



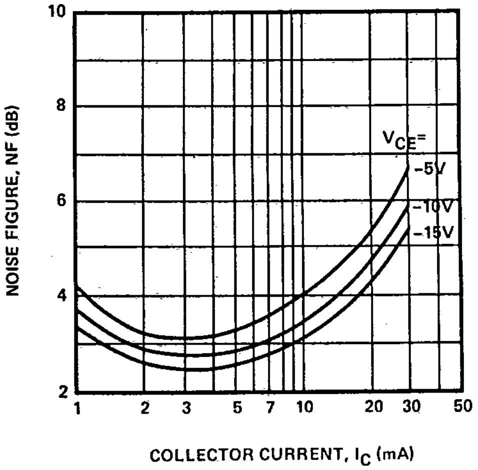
TYPICAL INSERTION GAIN
VS. COLLECTOR CURRENT
FOR THE NE88902 AND NE88935



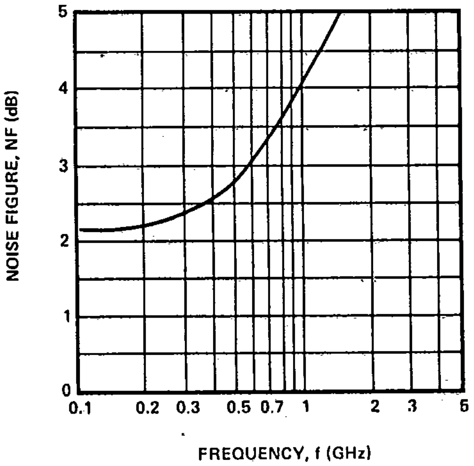
TYPICAL CURRENT GAIN
VS. COLLECTOR CURRENT
(f = 100MHz)



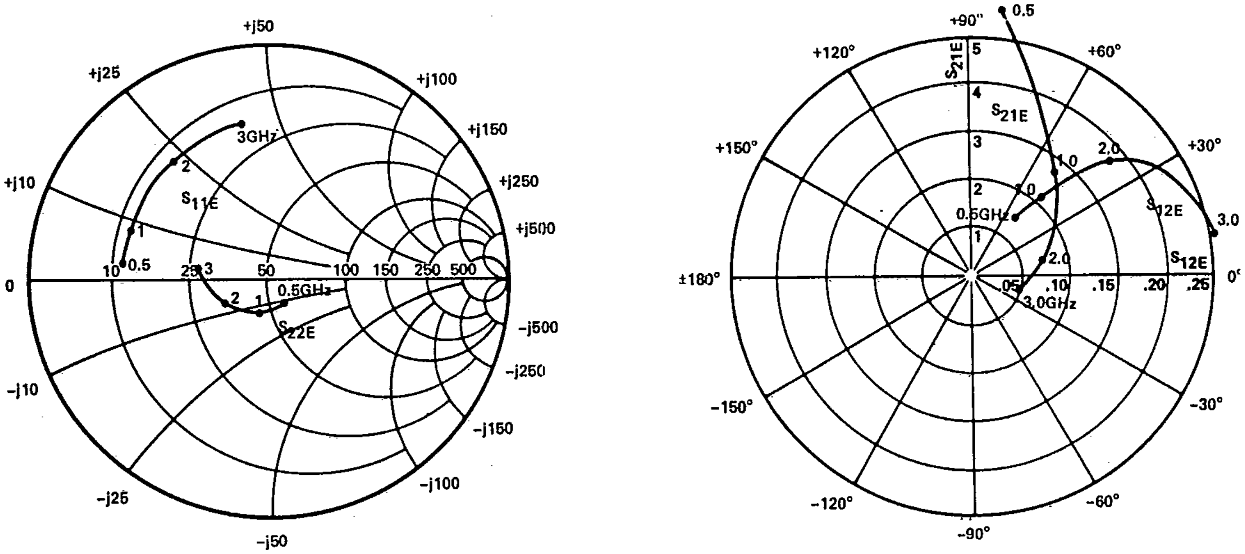
TYPICAL NOISE FIGURE
VS. COLLECTOR CURRENT
FOR THE NE88902 AND NE88935
(f = 500MHz)



TYPICAL NOISE FIGURE
VS. FREQUENCY
FOR THE NE88912 AND NE88935
(V_{CE} = -10V, I_C = 3mA)



NE88902 COMMON EMITTER SCATTERING PARAMETERS



Coordinates in Ohms
Frequency in GHz
(V_{CE}=-10V, I_C=20mA, Z_O=50Ω)

S—MAGN AND ANGLES:

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

FREQUENCY (MHz)	S11		S21		S12		S22	
500	.50	-152	4.79	95	.10	38	.28	-54
1000	.57	173	2.57	60	.14	28	.26	-94
2000	.61	131	1.39	18	.20	17	.23	-141
3000	.65	101	.96	-14	.25	1	.32	172

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

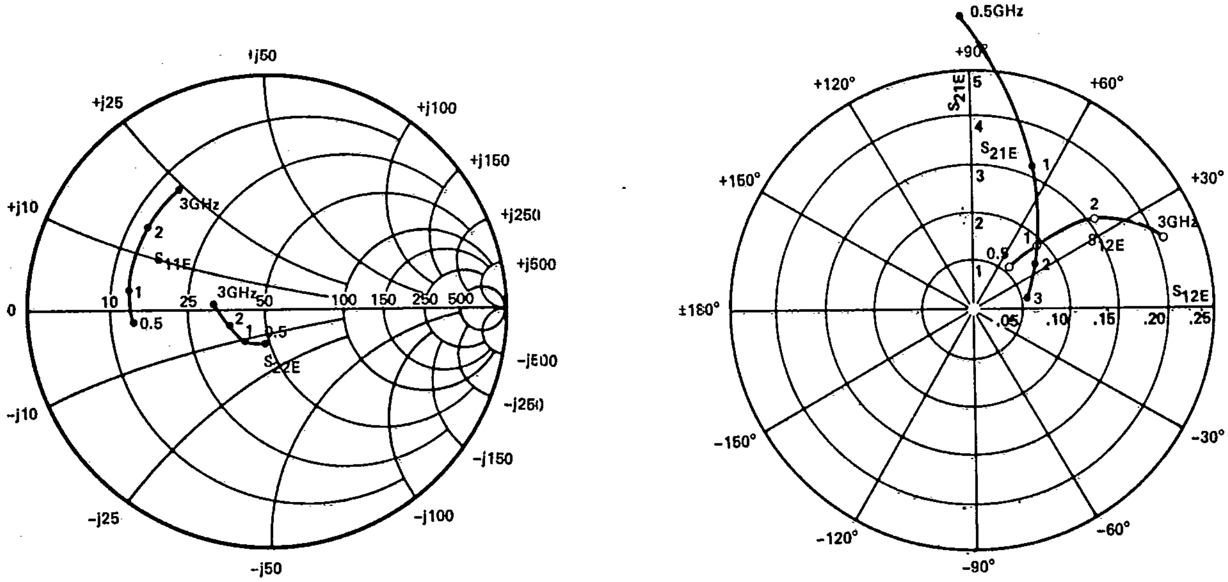
500	.55	-174	5.63	88	.08	45	.16	-62
1000	.58	163	2.81	58	.12	39	.18	-106
2000	.63	127	1.48	19	.19	25	.19	-154
3000	.67	99	1.01	-13	.26	6	.30	164

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

500	.60	171	5.89	83	.07	54	.08	-56
1000	.60	157	2.84	56	.11	48	.15	-106
2000	.65	124	1.48	17	.19	31	.18	-154
3000	.69	97	1.00	-13	.26	10	.29	164

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

500	.63	167	5.74	81	.06	58	.07	-36
1000	.61	155	2.74	54	.10	51	.14	-97
2000	.66	123	1.42	16	.19	33	.18	-145
3000	.70	96	.95	-15	.26	12	.30	169



Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10V, I_C = 20mA, Z_O = 50Ω)

S–MAGN AND ANGLES:

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

FREQUENCY (MHz)	S11		S21		S12		S22	
500	.46	-133	5.08	104	.11	40	.30	-56
1000	.54	-170	2.82	72	.14	29	.25	-96
2000	.56	153	1.51	38	.19	22	.19	-133
3000	.59	130	1.05	12	.24	10	.23	-168

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

FREQUENCY (MHz)	S11		S21		S12		S22	
500	.50	-160	6.11	97	.08	43	.18	-76
1000	.57	177	3.12	70	.11	38	.19	-117
2000	.59	147	1.63	38	.17	31	.16	-156
3000	.62	126	1.12	14	.22	18	.22	175

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

FREQUENCY (MHz)	S11		S21		S12		S22	
500	.56	-176	6.53	93	.06	50	.10	-95
1000	.59	170	3.19	68	.09	47	.15	-128
2000	.62	144	1.65	38	.16	38	.15	-163
3000	.65	125	1.12	13	.21	24	.21	172

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

FREQUENCY (MHz)	S11		S21		S12		S22	
500	.59	178	6.44	91	.06	54	.07	-94
1000	.60	168	3.10	67	.09	51	.14	-122
2000	.63	143	1.59	37	.16	40	.14	-157
3000	.66	124	1.07	12	.21	26	.21	178

NOTES:

1. Electronic Industries Association – Japan.
2. Output and Input are tuned for minimum noise figure.
3. Maximum Available Gain (MAG) is calculated from the device S-Parameters using the following equation,

$$\text{MAG} = |S_{21E}|^2 \cdot \frac{1}{1-|S_{11E}|^2} \cdot \frac{1}{1-|S_{22E}|^2}$$

4. Capacitance is measured with emitter and case connected to the guard terminal at the bridge.
5. The NE88935 Grade D (Industrial) version has a T_{stg} of –65°C~+150°C.

EXCLUSIVE SALES AGENT FOR **NEC Corporation** MICROWAVE SEMICONDUCTORS PRODUCTS — U.S. & CANADA

CALIFORNIA EASTERN LABORATORIES, INC. • Headquarters • 3260 Jay Street • Santa Clara, CA 95054 • (408) 988-3500 • Telex 34-6393 or 171197

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