

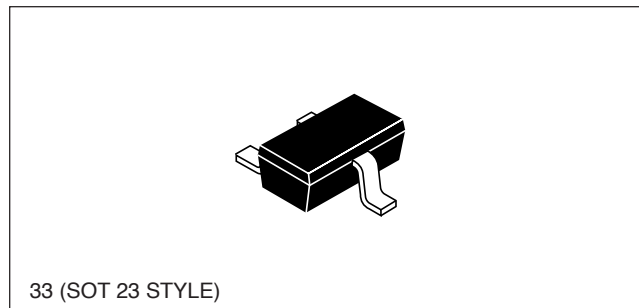


# PNP SILICON HIGH FREQUENCY TRANSISTOR

## NE97733

### FEATURES

- **HIGH GAIN BANDWIDTH PRODUCT:**  
 $f_T = 8.5 \text{ GHz TYP}$
- **HIGH SPEED SWITCHING CHARACTERISTICS**
- **NPN COMPLIMENT AVAILABLE:** NE68133
- **HIGH INSERTION POWER GAIN:**  
 $IS_{21EI}^2 = 12 \text{ dB at } 1 \text{ GHz}$



### DESCRIPTION

NEC's NE97733 PNP silicon transistor is designed for ultrahigh speed current mode switching applications and microwave amplifiers up to 3.5 GHz. The NE97733 offers excellent performance and reliability at low cost.

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

PART NUMBER EIAJ <sup>1</sup> REGISTERED NUMBER PACKAGE OUTLINE			NE97733 2SA1977 33		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
$f_T$	Gain Bandwidth Product at $V_{CE} = -8 \text{ V}$ , $I_C = -20 \text{ mA}$	GHz	6.0	8.5	
NF	Noise Figure at $V_{CE} = -8 \text{ V}$ , $I_C = -3 \text{ mA}$	dB		1.5	3.0
$IS_{21EI}^2$	Insertion Power Gain at $V_{CE} = -8 \text{ V}$ , $I_C = -20 \text{ mA}$ , $f = 1 \text{ GHz}$	dB	8.0	12.0	
$h_{FE}$	Forward Current Gain Ratio at $V_{CE} = -8 \text{ V}$ , $I_C = -20 \text{ mA}$		20	40	100
$I_{CBO}$	Collector Cutoff Current at $V_{CB} = -10 \text{ V}$ , $I_E = 0$	$\mu\text{A}$			-0.1
$I_{EBO}$	Emitter Cutoff Current at $V_{BE} = -1 \text{ V}$ , $I_C = 0$	$\mu\text{A}$			-0.1
$CR_{E2}$	Feedback Capacitance at $V_{CB} = -10 \text{ V}$ , $I_E = 0 \text{ mA}$ , $f = 1 \text{ MHz}$	pF		0.5	0.1
$P_T$	Total Power Dissipation	mW			200

Notes:

1. Electronic Industrial Association of Japan.
2. Capacitance is measured with emitter and case connected to the guard terminal at the bridge.

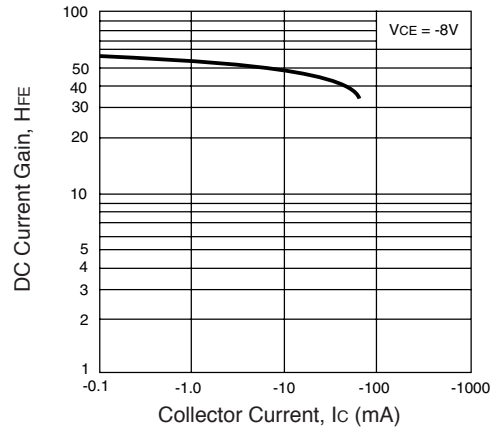
**ABSOLUTE MAXIMUM RATINGS<sup>1</sup>** ( $T_A = 25^\circ\text{C}$ )

SYMBOLS	PARAMETERS	UNITS	RATINGS
V <sub>CBO</sub>	Collector to Base Voltage	V	-20
V <sub>CEO</sub>	Collector to Emitter Voltage	V	-12
V <sub>EBO</sub>	Emitter to Base Voltage	V	-3
I <sub>C</sub>	Collector Current	mA	-50
T <sub>J</sub>	Junction Temperature	°C	150
T <sub>STG</sub>	Storage Temperature	°C	-65 to +200

Note:

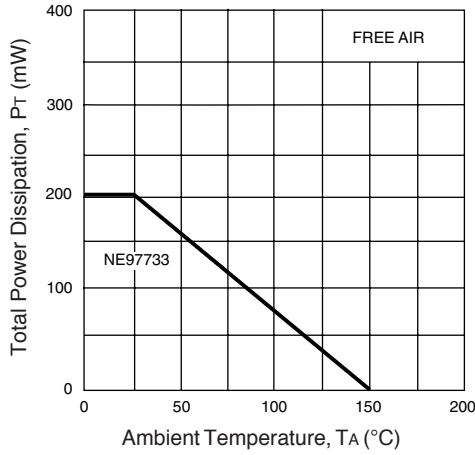
1. Operation in excess of any one of these parameters may result in permanent damage.

**DC CURRENT GAIN vs. COLLECTOR CURRENT**

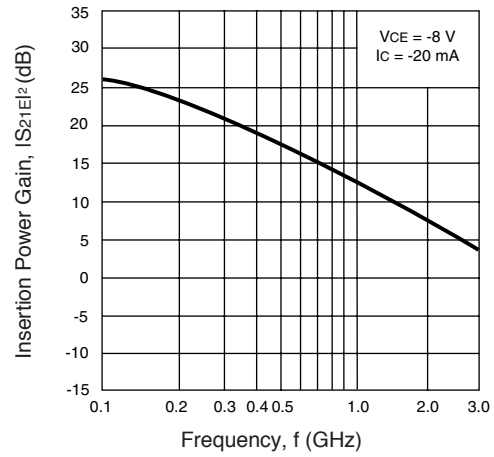


**TYPICAL PERFORMANCE CURVES** ( $T_A = 25^\circ\text{C}$ )

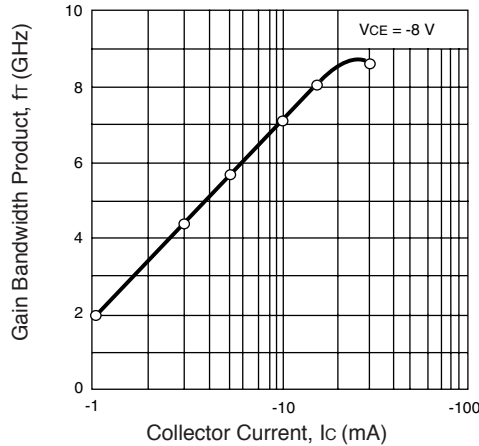
**DC POWER DERATING CURVES**



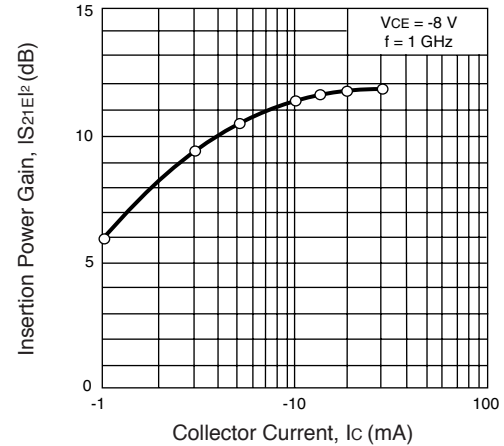
**INSERTION GAIN vs. FREQUENCY**



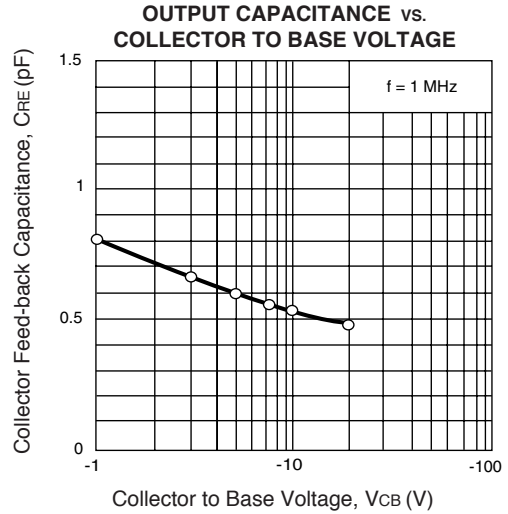
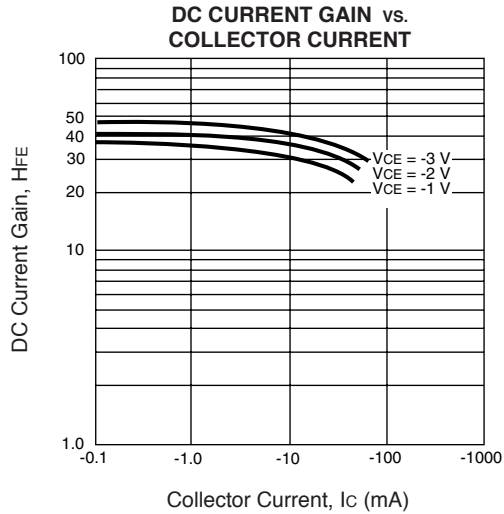
**GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT**



**INSERTION GAIN vs. COLLECTOR CURRENT**



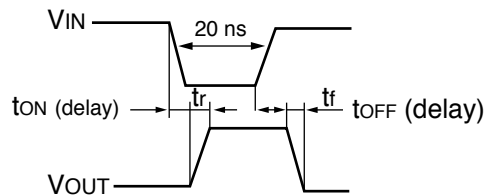
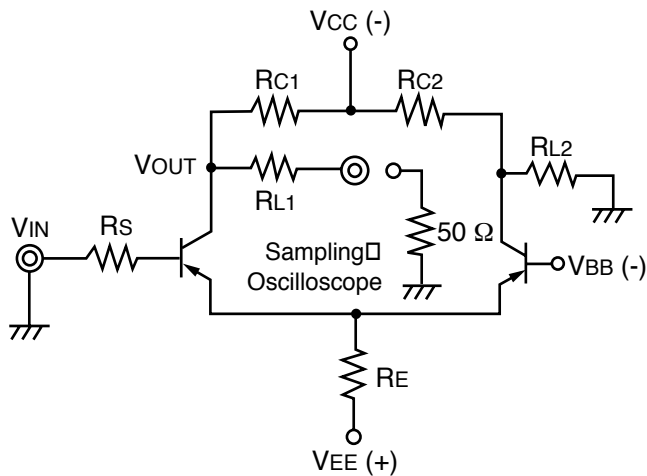
**TYPICAL PERFORMANCE CURVES** ( $T_A = 25^\circ\text{C}$ )



**SWITCHING CHARACTERISTICS**

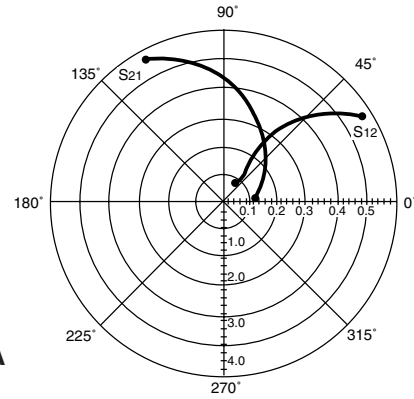
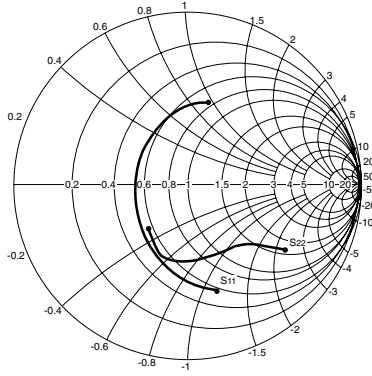
Parameter	Symbol	$V_{in} = 1\text{ V}$	Unit
		TYP	
Turn-on Delay Time	$t_{ON}$ (delay)	1.08	ns
Rise Time	$t_r$	0.66	ns
Turn-off Delay Time	$t_{OFF}$ (delay)	0.32	ns
Fall Time	$t_f$	0.78	ns

**SWITCHING TIME MEASUREMENT CIRCUIT**



$V_{in} = 1\text{ V}, V_{BB} = -0.5\text{ V}, R_{c1} = R_{c2}$						
$R_s$ ( $\Omega$ )	$R_c$ ( $\Omega$ )	$R_{L1}$ ( $\Omega$ )	$R_{L2}$ ( $\Omega$ )	$R_E$ ( $\Omega$ )	$V_{EE}$ (V)	$V_{CC}$ (V)
160	1 K	200	250	2.7 K	27	26.3

TYPICAL SCATTERING PARAMETERS (TA = 25°C)



97733  
VCE = -8 V, IC = -3 mA

VCE = -1 V, IC = -5 mA

FREQUENCY (GHz)	S11		S21		S12		S22		K	MAG <sup>1</sup> (dB)
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		
0.50	0.428	-126.3	4.899	100.7	0.101	52.7	0.417	-54.0	0.77	16.8
0.80	0.382	-160.6	3.398	82.8	0.132	54.1	0.309	-60.2	0.97	14.1
1.00	0.374	-175.9	2.813	74.1	0.154	55.0	0.272	-64.5	1.04	11.5
1.50	0.387	155.1	2.002	56.8	0.213	54.6	0.230	-80.1	1.09	7.9
2.00	0.419	132.6	1.583	42.6	0.274	51.3	0.226	-100.1	1.07	6.0
2.50	0.461	114.5	1.323	30.6	0.336	46.5	0.247	-119.0	1.04	4.8
3.00	0.502	100.2	1.148	21.0	0.393	40.9	0.270	-133.8	1.01	4.1
4.00	0.552	82.6	0.948	7.0	0.501	29.4	0.267	-159.3	0.98	2.8
5.00	0.574	74.2	0.859	-4.4	0.599	16.0	0.218	155.9	0.98	1.6

VCE = -5 V, IC = -10 mA

0.50	0.251	-126.4	7.121	99.1	0.072	67.8	0.426	-38.9	0.91	19.9
0.80	0.213	-159.9	4.739	84.5	0.107	68.2	0.350	-39.9	1.00	16.0
1.00	0.207	-176.4	3.878	77.3	0.131	67.6	0.324	-41.9	1.03	13.7
1.50	0.225	151.5	2.708	62.5	0.191	64.2	0.288	-52.1	1.04	10.3
2.00	0.265	127.7	2.116	49.8	0.252	59.4	0.272	-67.9	1.03	8.2
2.50	0.316	109.8	1.754	38.6	0.310	53.5	0.275	-85.3	1.00	7.2
3.00	0.365	96.8	1.511	28.8	0.364	47.5	0.284	-100.1	0.98	6.2
4.00	0.428	82.3	1.218	13.5	0.467	36.4	0.269	-121.5	0.95	4.2
5.00	0.462	77.7	1.074	0.8	0.566	24.3	0.171	-148.4	0.94	2.8

VCE = -8 V, IC = -3 mA

0.50	0.626	-74.0	4.205	119.4	0.088	54.6	0.673	-32.7	0.56	16.8
0.80	0.447	-111.0	3.520	97.8	0.109	51.8	0.558	-38.2	0.79	15.1
1.00	0.374	-131.4	3.075	87.0	0.122	52.6	0.512	-41.0	0.91	14.0
1.50	0.302	-174.7	2.293	67.2	0.157	56.0	0.451	-49.9	1.05	10.2
2.00	0.310	151.1	1.824	51.9	0.202	57.8	0.427	-62.0	1.06	8.0
2.50	0.355	125.4	1.516	39.0	0.256	56.7	0.425	-76.0	1.01	7.0
3.00	0.407	106.9	1.301	28.4	0.314	53.7	0.433	-89.1	0.96	6.2
4.00	0.428	85.0	1.038	13.9	0.438	44.7	0.425	-110.2	0.90	3.7
5.00	0.503	74.6	0.930	3.7	0.573	32.3	0.328	-133.5	0.91	2.1

VCE = -8 V, IC = -20 mA

0.50	0.151	-140.9	8.095	95.5	0.067	74.7	0.389	-34.1	0.98	20.8
0.80	0.140	-172.1	5.268	83.1	0.105	73.5	0.334	-34.1	1.02	16.2
1.00	0.142	172.1	4.288	76.7	0.129	72.2	0.315	-36.1	1.03	14.1
1.50	0.170	141.7	2.974	63.2	0.191	66.9	0.285	-46.2	1.03	10.9
2.00	0.215	119.7	2.317	51.4	0.252	60.8	0.269	-61.6	1.02	8.9
2.50	0.268	104.0	1.918	40.7	0.309	54.6	0.268	-79.2	1.00	7.9
3.00	0.318	92.5	1.652	31.2	0.362	48.4	0.274	-94.3	0.98	6.6
4.00	0.379	80.9	1.332	15.8	0.459	36.9	0.257	-114.2	0.95	4.6
5.00	0.416	79.2	1.169	2.6	0.552	25.3	0.154	-134.6	0.94	3.3

Note:

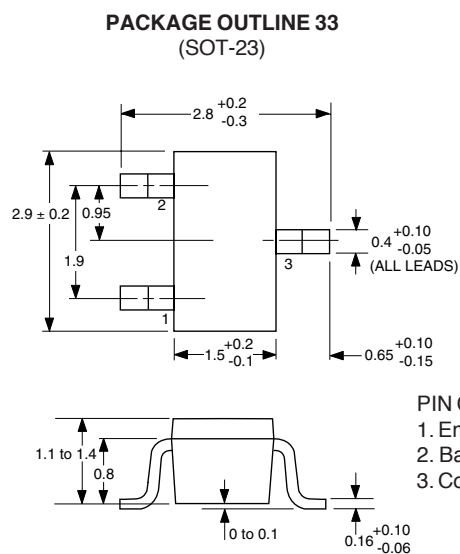
1. Gain Calculation:

$$MAG = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1}). \text{ When } K \leq 1, \text{ MAG is undefined and MSG values are used. } MSG = \frac{|S_{21}|}{|S_{12}|}, K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12}| |S_{21}|}, \Delta = S_{11} S_{22} - S_{21} S_{12}$$

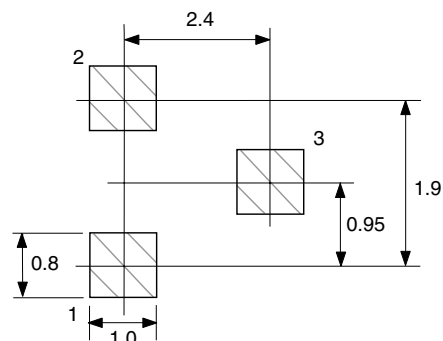
MAG = Maximum Available Gain

MSG = Maximum Stable Gain

## OUTLINE DIMENSIONS (Units in mm)



## OUTLINE 33 RECOMMENDED P.C.B. LAYOUT



## ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKAGING
NE97733-T1B-A	3000	Tape & Reel

### Life Support Applications

These NEC products are not intended for use in life support devices, appliances, or systems where the malfunction of these products can reasonably be expected to result in personal injury. The customers of CEL using or selling these products for use in such applications do so at their own risk and agree to fully indemnify CEL for all damages resulting from such improper use or sale.

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Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (\*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL’s understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

Restricted Substance per RoHS	Concentration Limit per RoHS (values are not yet fixed)	Concentration contained in CEL devices	
		-A	-AZ
Lead (Pb)	< 1000 PPM	Not Detected	(*)
Mercury	< 1000 PPM	Not Detected	
Cadmium	< 100 PPM	Not Detected	
Hexavalent Chromium	< 1000 PPM	Not Detected	
PBB	< 1000 PPM	Not Detected	
PBDE	< 1000 PPM	Not Detected	

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