T-31-21

NEC®

NPN SILICON HIGH SPEED SWITCHING TRANSISTOR

NE98200
NE98203
NE98208
NE98241

FEATURES

- **WIDE DYNAMIC RANGE**
- **HIGH GAIN BANDWIDTH PRODUCT:** fr = 7 GHz
- **400 PICO SECOND SWITCHING TIME**
- **HIGH RELIABILITY GOLD METALLIZATION**
- **USEFUL AS AN OSCILLATOR UP TO 6 GHz**

DESCRIPTION AND APPLICATIONS

The NE982 series of NPN silicon transistors features a high gain bandwidth product, and wide dynamic range. The series is designed for medium level microwave amplifier and oscillator applications up to 6 GHz and ultrahigh speed switching applications. The NE98203 and NE98208 are single transistors packaged in rugged metal ceramic stripline packages while the NE98241 dual chip version is designed for differential amplifiers and CML circuit applications. Reliability is assured by NEC's high reliability gold metallization system and quality control procedures patterned after MIL-S-19500.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{CBO}	Collector to Base Voltage	V	20
V_{CEO}	Collector to Emitter Voltage	V	8
V_{EBO}	Emitter to Base Voltage	V	3
I_C	Collector Current	mA	80*
T_J	Junction Temperature	°C	200
T_{STG}	Storage Temperature	°C	-65 to +200

*I_C = 200 mA max; PW ≤ 5 µs, duty cycle ≤ 10%.

PERFORMANCE SPECIFICATIONS (T_A = 25°C)

PART NUMBER EIAJ[1] REGISTERED PART NUMBER PACKAGE OUTLINE			NE98203 2SC1660 (Grd C) 03			NE98208 08			NE98241 2SC1662 (Grd C) 41		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
fr	Gain Bandwidth Product at V_{CE} = 6 V, I_C = 30 mA	GHz	6	7		6	7		6	7	
$\|S_{21E}\|^2$	Insertion Power Gain at V_{CE} = 6 V, I_C = 30 mA, f = 1 GHz f = 2 GHz f = 3 GHz	 dB dB dB	12	 13 7.5 4		12	 13 7.5 4				
Tx	Switching Time[2] at V_{CE} = 6 V, I_C = 20 mA	ηs		0.4			0.4			0.4	
MAG	Maximum Available Gain[3] at V_{CE} = 6 V, I_C = 30 mA, f = 1 GHz f = 2 GHz f = 3 GHz	 dB dB dB		 15 9.5 6			 15 9.5 6			 15 9.5 6	
Posc	Oscillator Power Output at V_{CE} = 6 V, I_C = 20 mA, f = 6 GHz	mW		20			20				

Notes:

1. Electronic Industrial Association of Japan.
2. In an ECL circuit.
3. Maximum Available Gain (MAG) is calculated from the device S-Parameters using the equation, $MAG = |S_{21E}|^2 \cdot \frac{1}{1-|S_{11E}|^2} \cdot \frac{1}{1-|S_{22E}|^2}$

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

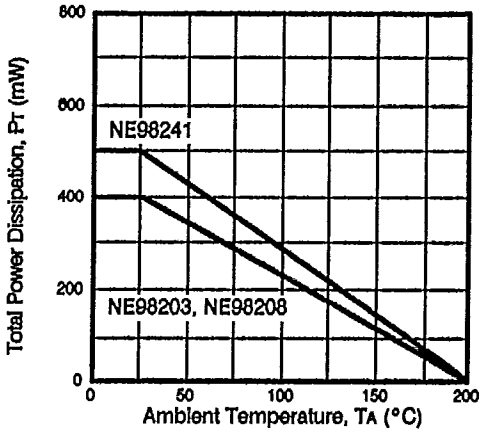
PART NUMBER EIAJ[1] REGISTERED NUMBER PACKAGE OUTLINE			NE98203 2SC1660 (Grd C) 03			NE98208 08			NE98241 2SC1662 (Grd C) 41		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
I_{CBO}	Collector Cutoff Current at V_{CB} = 6 V, I_E = 0	µA			0.1			0.1			0.1
I_{EBO}	Emitter Cutoff Current at V_{EB} = 2 V, I_C = 0	µA			0.1			0.1			0.1
h_{FE}	Forward Current Gain[2] at V_{CE} = 5 V, I_C = 30 mA		30	100	300	30	100	300	30	100	300
h_{FE1} h_{FE2}	Forward Current Gain Delta[3] at V_{CE} = 5 V, I_C = 30 mA								0.6		1
V_{BE}	Base to Emitter Voltage, V_{CE} = 5 V, I_C = 30 mA	V									0.9
ΔV_{BE}	Base to Emitter Voltage Delta, V_{CE} = 5 V, I_C = 30 mA	mV									20
C_{CB}	Collector to Base Capacitance[4] at V_{CB} = 6 V, I_E = 0, f = 1 MHz	pF		0.6	1		0.6	1		0.6	1
R_{TH}	Thermal Resistance (Juntion-to-Case)	°C/W			70			70			90
P_T	Total Power Dissipation Per Device	mW/Unit									350
P_T	Total Power Dissipation	mW			500			500			400

Notes:

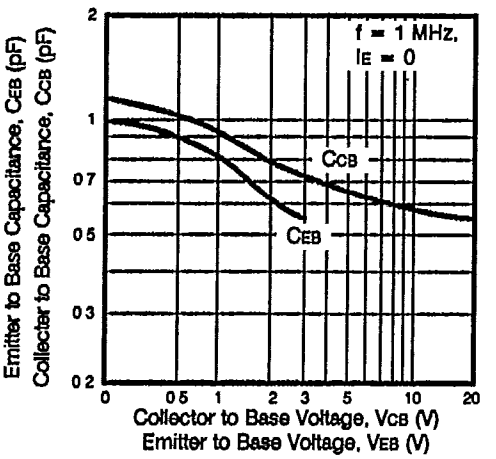
1. Electronic Industrial Association of Japan.
2. Pulse Width ≤ 350 µs, Duty Cycle ≤ 2%/pulsed.
3. h_{FE2} is smallest of the two.
4. C_{CB} measurement employs a three-terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal.

TYPICAL DEVICE CHARACTERISTICS (T_A = 25°C)

DC POWER DERATING CURVES

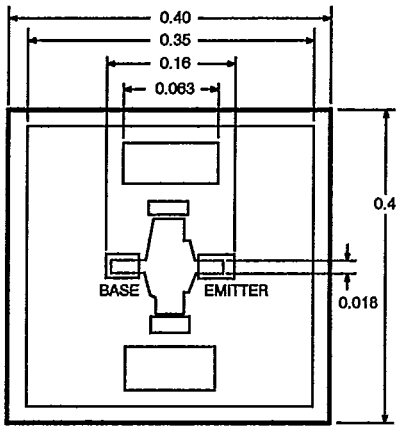


DEVICE CAPACITANCE

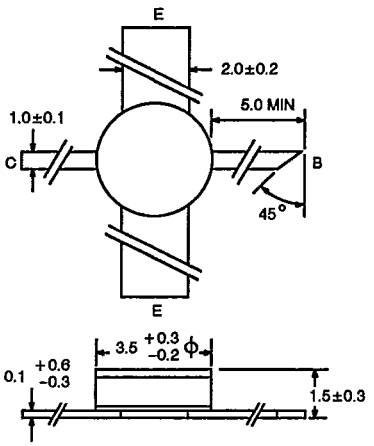


OUTLINE DIMENSIONS (Units in mm)

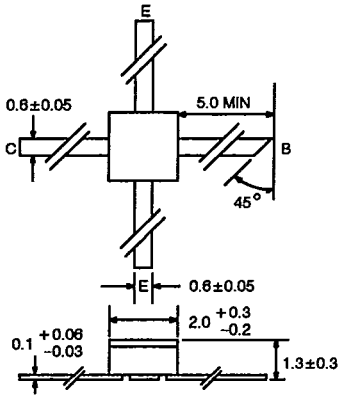
NE98200 (CHIP)
(Chip Thickness: 140 to 160 µm)



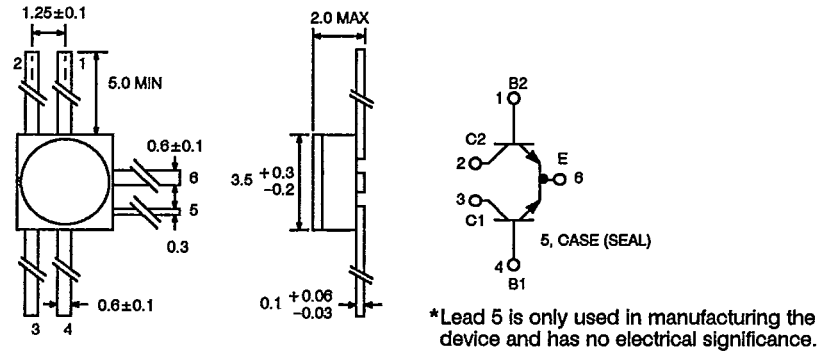
OUTLINE 03



OUTLINE 08



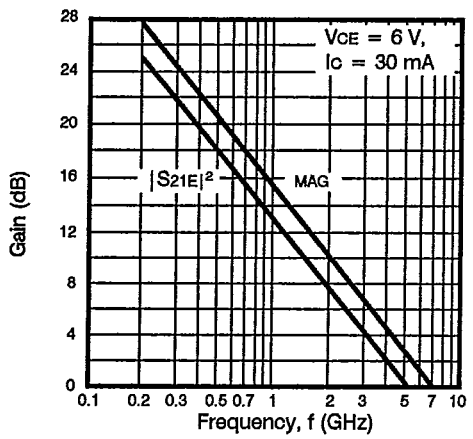
OUTLINE 41



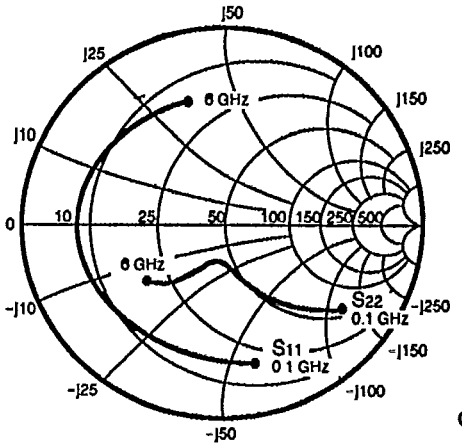
*Lead 5 is only used in manufacturing the device and has no electrical significance.

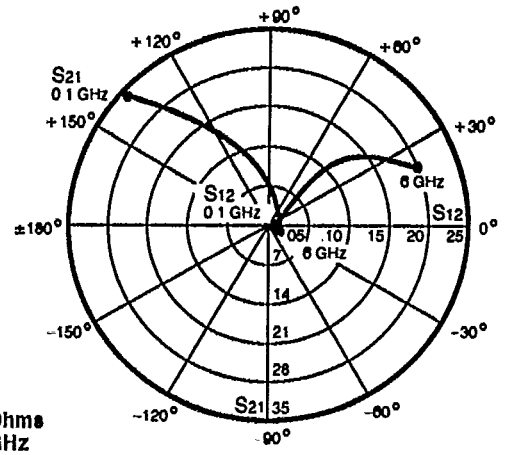
TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

GAIN CHARACTERISTICS vs. FREQUENCY



TYPICAL COMMON EMITTER SCATTERING PARAMETERS





NE98208
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 6 V, I_C = 20 mA)

S-MAGN AND ANGLES:

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
V_{CE} = 6 V, I_C = 5 mA								
100	.88	-33	14.49	158	.02	75	.95	-18
500	.70	-119	7.68	110	.08	36	.52	-57
1000	.68	-154	4.43	87	.10	26	.36	-74
2000	.66	178	2.31	61	.11	26	.33	-90
3000	.64	158	1.61	39	.13	23	.37	-107
4000	.65	142	1.26	19	.15	20	.42	-120
5000	.62	128	1.04	4	.17	15	.48	-131
6000	.59	112	.86	-12	.20	10	.53	-141
V_{CE} = 6 V, I_C = 10 mA								
100	.80	-52	23.62	149	.02	65	.88	-27
500	.68	-143	9.30	101	.06	35	.37	-69
1000	.69	-169	5.02	82	.07	34	.25	-84
2000	.67	170	2.56	59	.10	40	.25	-98
3000	.66	151	1.78	39	.12	36	.31	-113
4000	.67	137	1.39	21	.15	31	.37	-124
5000	.64	123	1.16	5	.18	23	.43	-135
6000	.61	108	.97	-10	.20	17	.48	-142
V_{CE} = 6 V, I_C = 20 mA								
100	.72	-77	33.16	138	.01	58	.78	-36
500	.70	-159	10.11	95	.04	39	.26	-78
1000	.70	-177	5.28	79	.05	45	.18	-92
2000	.69	166	2.67	58	.09	50	.21	-102
3000	.69	148	1.85	39	.12	42	.28	-115
4000	.69	134	1.44	20	.15	37	.34	-125
5000	.66	120	1.19	5	.18	27	.40	-134
6000	.64	106	.98	-10	.21	21	.46	-141
V_{CE} = 6 V, I_C = 30 mA								
100	.69	-94	36.89	132	.01	56	.71	-40
500	.70	-165	10.15	92	.03	44	.22	-77
1000	.71	179	5.24	77	.04	51	.16	-88
2000	.70	164	2.65	57	.09	53	.20	-98
3000	.69	148	1.83	37	.12	46	.27	-112
4000	.70	134	1.42	19	.15	40	.34	-123
5000	.67	120	1.18	3	.18	30	.41	-133
6000	.65	106	.96	-12	.21	23	.47	-140