NEC®

T-31-17

NPN SILICON HIGH SPEED SWITCHING TRANSISTOR

NE98100
NE98108
NE98141

FEATURES

- **HIGH GAIN BANDWIDTH PRODUCT:** f_T = 7 GHz
- **LOW OUTPUT CAPACITANCE:** C_{CB} = 0.35 pF
- **ULTRA HIGH SPEED SWITCHING:** T_X = 0.4 ηs
- **AVAILABLE IN BOTH SINGLE AND DUAL CHIP CONFIGURATIONS**
- **HIGHLY RELIABLE METALLIZATION AND RUGGED METAL-CERAMIC STRIPLINE PACKAGES**

DESCRIPTION AND APPLICATIONS

The NE981 series of NPN silicon transistors is designed for microwave amplifiers up to 6 GHz and ultrahigh speed switching applications. The series is available in chip form and two packaged versions. The NE98108 is a single chip packaged in a metal-ceramic stripline, and the NE98141 is a dual chip package designed for differential amplifiers and CML circuit applications. Both configurations are screened to NEC's Grade C level of reliability which is patterned after MIL-S-19500, and meets or exceeds most of the QC requirements for military applications. The series employs NEC's unique Pt/Si-Ti-Pt-Au hi-rel metallization system which yields the utmost in performance consistency and reliability.

PERFORMANCE SPECIFICATIONS (T_A = 25°C)

PART NUMBER EIAJ[1] REGISTERED NUMBER PACKAGE OUTLINE			NE98108 2SC1656 (Grd C) 08			NE98141 2SC1658 (Grd C) 41		
SYMBOLS	**PARAMETERS AND CONDITIONS**	**UNITS**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**
f_T	Gain Bandwidth Product at V_{CE} = 5 V, I_C = 20 mA	GHz	6	7		6	7	
$\lvert S_{21E}\rvert^2$	Insertion Power Gain at V_{CE} = 6 V, I_C = 10 mA, f = 0.5 GHz f = 1 GHz f = 2 GHz	 dB dB dB		 19 14 9			 19 14 9	
NF_{MIN}	Minimum Noise Figure at V_{CE} = 6 V, I_C = 5 mA, f = 0.5 GHz	dB		3			3	
T_X	Switching Time[2] at V_{CE} = 6 V, I_C = 10 mA	ηs		0.4			0.4	
MAG	Maximum Available Gain[3] at V_{CE} = 6 V, I_C = 10 mA, f = 0.5 GHz f = 1 GHz f = 2 GHz	 dB dB dB		 21 16 10			 21 16 10	
P_{OSC}	Oscillator Power Output at V_{CE} = 6 V, I_C = 20 mA, f = 7 GHz	mW		10				

Notes:

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

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PART NUMBER EIAJ[1] REGISTERED NUMBER PACKAGE OUTLINE			NE98108 2SC1656 (Grd C) 08			NE98141 2SC1658 (Grd C) 41		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX
I_{CBO}	Collector Cutoff Current at V_{CB} = 10 V, I_E = 0	µA			0.1			0.1
I_{EBO}	Emitter Cutoff Current at V_{EB} = 2 V, I_C = 0	µA			0.1			0.1
h_{FE}	Forward Current Gain[2] at V_{CE} = 3 V, I_C = 10 mA		30	100	300	30	100	300
$\frac{h_{FE1}}{h_{FE2}}$	Forward Current Gain Delta[3] at V_{CE} = 3 V, I_C = 10 mA					0.6		1
V_{BE}	Base to Emitter Voltage V_{CE} = 3 V, I_C = 10 mA	V			0.95			0.95
ΔV_{BE}	Base to Emitter Voltage Delta V_{CE} = 3 V, I_C = 10 mA	mV						20
C_{CB}	Collector to Base Capacitance[4] at V_{CB} = 6 V, I_E = 0, f = 1 MHz	pF		0.35	0.5		0.35	0.5
R_{TH}	Thermal Resistance (Junction-to-Case)	°C/W			110			110
P_T	Total Power Dissipation Per Device	mW/Unit						150
P_T	Total Device Dissipation	mW			150			300

Notes:

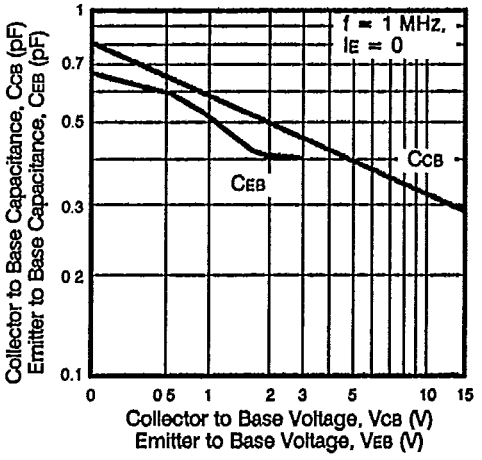
1. Electronic Industrial Association of Japan.
2. Pulse Width ≤ 350 µs, Duty Cycle ≤ 2%/pulsed.
3. h_{FE2} is the smallest of the two.
4. C_{CB} measurement employs a three-terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

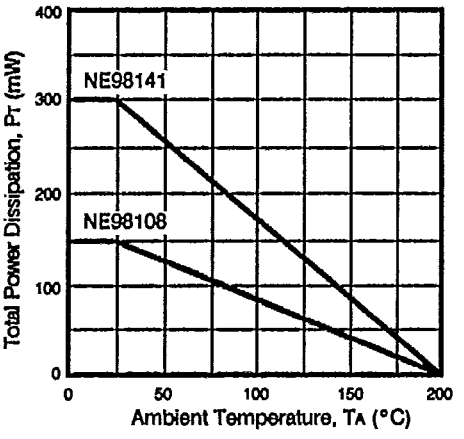
SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{CBO}	Collector to Base Voltage	V	10
V_{CEO}	Collector to Emitter Voltage	V	6
V_{EBO}	Emitter to Base Voltage	V	3
I_C	Collector Current	mA	30
T_J	Junction Temperature	°C	200
T_{STG}	Storage Temperature	°C	-65 to +200

TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

DEVICE CAPACITANCE

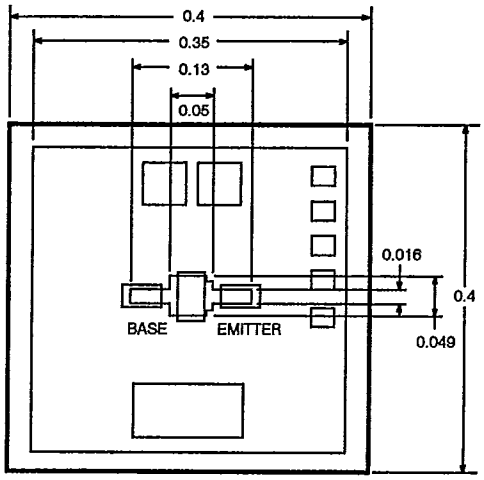


DC POWER DERATING CURVES

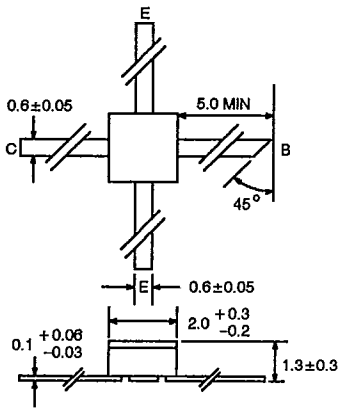


OUTLINE DIMENSIONS (Units in mm)

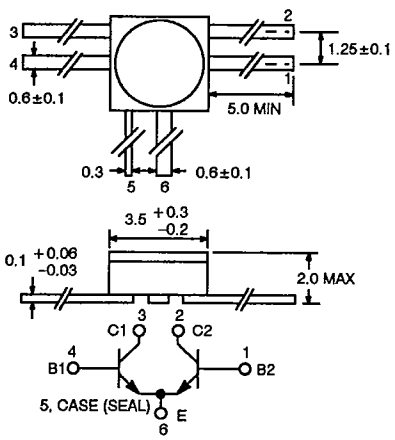
NE98100 (CHIP)
(Chip Thickness: 140 to 160 µm)



OUTLINE 08



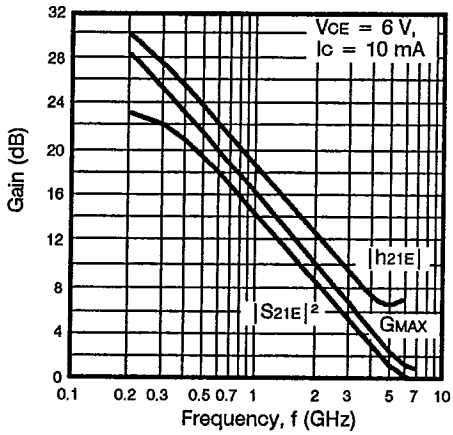
OUTLINE 41



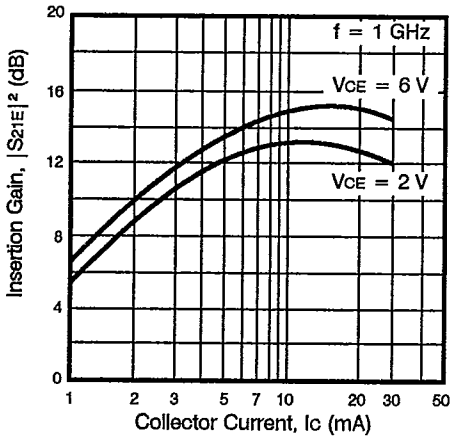
*Lead 5 is only used in manufacturing the device and has no electrical significance.

TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

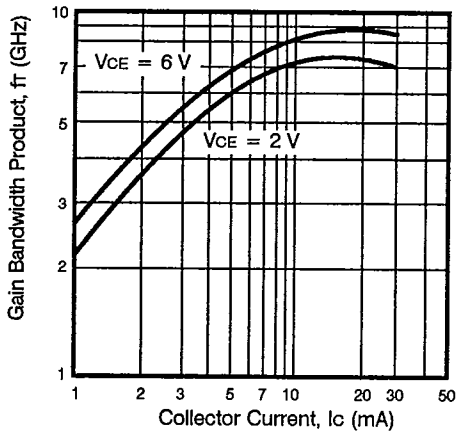
GAIN CHARACTERISTICS vs. FREQUENCY



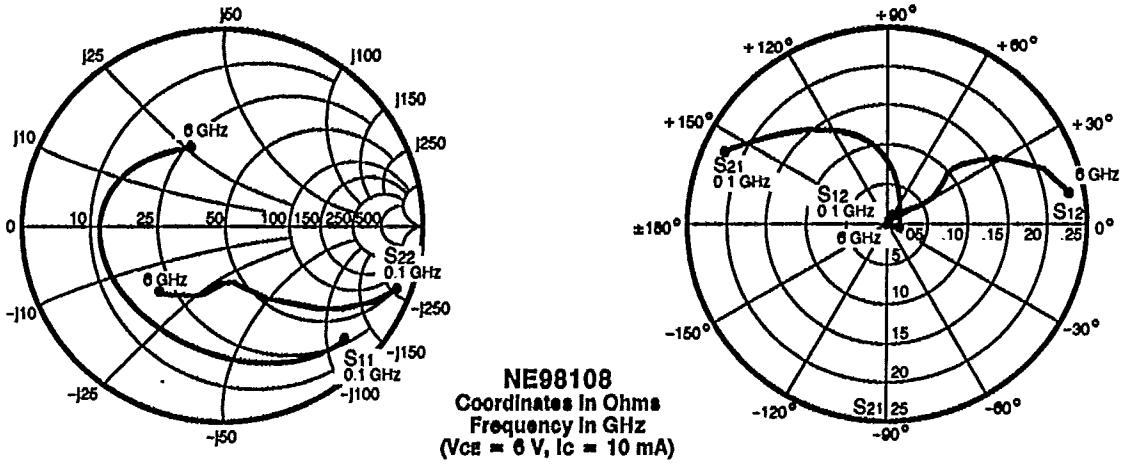
INSERTION GAIN vs. COLLECTOR CURRENT



GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT



TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE98108
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 6 V, I_C = 10 mA)

S-MAGN AND ANGLES:

V_{CE} = 6 V, I_C = 5 mA

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
100	.90	-25	14.10	161	.01	77	.96	-13
500	.67	-101	8.58	116	.08	43	.60	-47
1000	.60	-141	5.17	92	.09	33	.41	-62
2000	.55	-175	2.73	65	.12	32	.35	-75
3000	.52	163	1.93	43	.14	27	.35	-93
4000	.50	145	1.53	24	.17	21	.39	-107
5000	.47	129	1.27	7	.20	13	.44	-118
6000	.43	112	1.07	-8	.22	6	.48	-128

V_{CE} = 6 V, I_C = 10 mA

100	.82	-39	22.93	154	.01	71	.91	-20
500	.61	-127	10.55	106	.06	41	.44	-56
1000	.58	-160	5.83	86	.07	40	.29	-67
2000	.56	174	3.01	62	.10	43	.27	-78
3000	.54	157	2.12	42	.14	36	.29	-95
4000	.52	141	1.67	24	.17	30	.33	-109
5000	.49	126	1.40	7	.21	20	.38	-120
6000	.43	109	1.17	-7	.23	12	.43	-130

V_{CE} = 6 V, I_C = 15 mA

100	.76	-50	28.59	149	.01	70	.87	-24
500	.59	-141	11.23	101	.04	43	.37	-59
1000	.59	-168	6.03	83	.06	46	.25	-67
2000	.56	170	3.08	61	.10	49	.24	-77
3000	.55	153	2.17	42	.13	40	.28	-94
4000	.54	137	1.70	23	.17	32	.32	-107
5000	.50	122	1.42	6	.20	22	.38	-117
6000	.46	105	1.19	-8	.23	14	.43	-126

V_{CE} = 6 V, I_C = 20 mA

100	.71	-59	32.32	145	.01	64	.83	-27
500	.59	-148	11.49	99	.04	45	.32	-58
1000	.59	-172	6.05	81	.05	49	.22	-65
2000	.57	168	3.09	60	.10	52	.23	-75
3000	.55	151	2.17	41	.13	43	.27	-93
4000	.54	135	1.70	22	.17	34	.32	-105
5000	.51	119	1.41	5	.20	24	.38	-116
6000	.47	103	1.16	-9	.23	16	.44	-125