NEC

NPN MEDIUM POWER MICROWAVE TRANSISTOR

NE57500 NE57510

FEATURES

- **HIGH OSCILLATOR OUTPUT POWER :** 700 mW at 1.7 GHz
- **GOLD METALLIZATION FOR HIGH RELIABILITY**
- **HIGH POWER GAIN:** 4 dB AT 2 GHz (V_{CC} = 18 V)
- **HIGH POWER OUTPUT:** 1.6 W at 2 GHz (V_{CC} = 18 V)

DESCRIPTION

The NE575 series of NPN silicon medium power transistors is designed to operate in amplifiers and oscillators up to 2 GHz with supply voltages up to 18 volts. Transistors in this series are available in either a low-inductance can (TO-46) or in chip form. The NE575 series employs NEC's titanium-platinum-gold metallization system. This unique metallization system, with NEC's stringent quality control procedures, yields the utmost in reliability and uniformity and eliminates many of the problems associated with aluminum and moly-gold metallization. This feature also allows for high temperature (100°C) operation at rated dissipation.

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ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PART NUMBER EIAJ[1] REGISTERED NUMBER PACKAGE OUTLINE			NE57500 00(CHIP)			NE57510 2SC1600-Grd D 10 (TO-46)		
SYMBOLS	**PARAMETERS AND CONDITIONS**	**UNITS**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**
f_T	Gain Bandwidth Product (T_C = 25°C) at V_{CE} = 10 V, I_C = 100 mA	GHz	1.6	2		1.6	2	
MAG	Maximum Available Gain at V_{CE} = 10 V, I_C = 100 mA, f = 1 GHz	dB		11.0		8.0		
$\|S_{21E}\|^2$	Insertion Power Gain at V_{CE} = 10 V, I_C = 100 mA, f = 1 GHz	dB		3.5			3.5	
P_{OUT}	Power Output at V_{CC} = 18 V, I_C = 125 mA, f = 2 GHz, P_{IN} = 28 dBm	W	1.4	1.6		1.4	1.6	
P_{OSC}	Oscillator Output Power at V_{CC} = 18 V, I_C = 150 mA, f = 1.7 GHz	mW		700			700	
G_P	Power Gain at V_{CC} = 18 V, I_C = 100 mA, P_{IN} = 28 dBm, f = 2 GHz	dB	3.5	4		3.5	4	
h_{FE}	Forward Current Gain at V_{CB} = 10 V, I_C = 100 mA[2]		15	80	200	15	80	200
I_{CBO}	Collector Cutoff Current at V_{CB} = 20 V, I_E = 0	μA			100			100
I_{EBO}	Emitter Cutoff Current at V_{EB} = 2 V, I_C = 0	μA			100			100
C_{CB}	Collector to Base Capacitance[4] at V_{CB} = 10 V, I_E = 0, f = 1 MHz	pF		3			3	4.5
$R_{TH\ (J\text{-}C)}$	Thermal Resistance (Junction to Case)	°C/W			23			40
P_T	Total Power Dissipation (T_A = 25°C)	W			7.5			4.4

Notes:
1. Electronic Industrial Association of Japan.
2. PW ≤ 350 μs, duty cycle ≤ 2% pulsed.
3. Typical V_{CER} = 30 V for R ≤ 300 Ω.
4. Emitter is grounded.

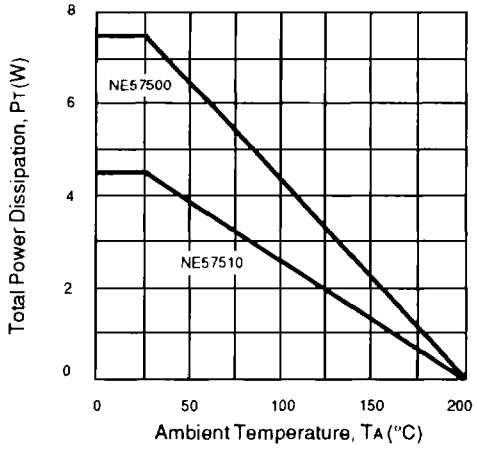
ABSOLUTE MAXIMUM RATINGS[1] (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{CBO}	Collector to Base Voltage	V	40
V_{CEO}	Collector to Emitter Voltage	V	20
V_{EBO}	Emitter to Base Voltage	V	3
$I_{C(DC)}$	Collector Current (DC)	mA	250
$I_{C(PEAK)}$	Collector Current (Peak)	mA	750
T_J	Junction Temperature	°C	200
T_{STG}	Storage Temperature	°C	-65 to +200

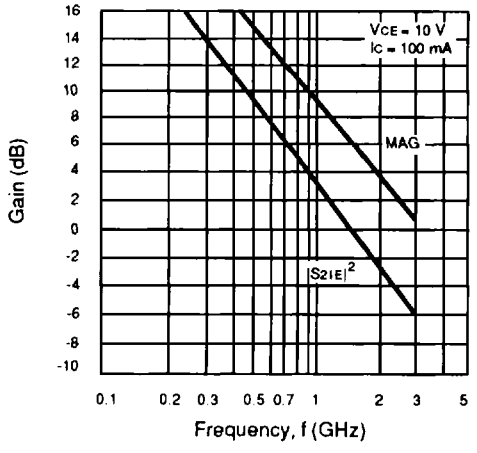
Notes:
1. Operation in excess of any one of these parameters may result in permanent damage.

TYPICAL PERFORMANCE CURVES (T_A = 25°C)

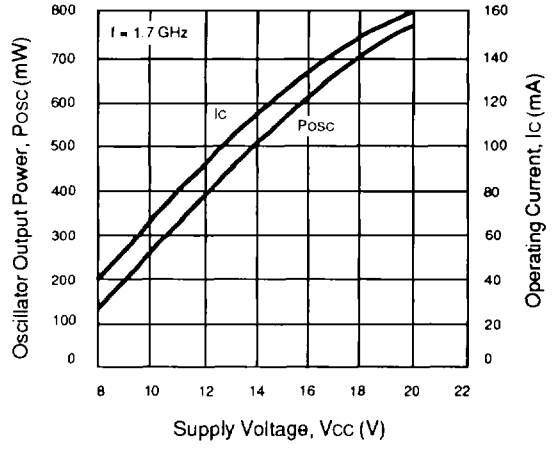
POWER DERATING CURVES



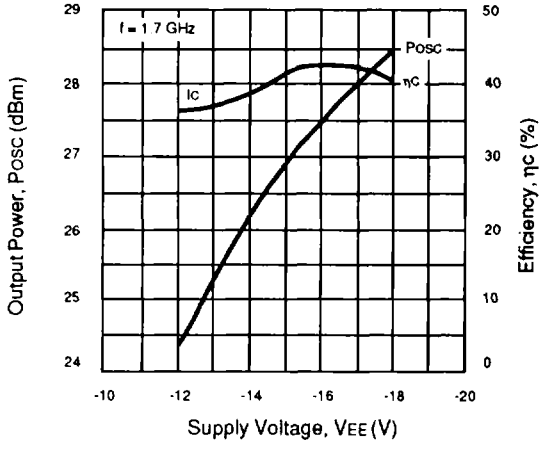
INSERTION GAIN AND MAXIMUM AVAILABLE GAIN vs. FREQUENCY



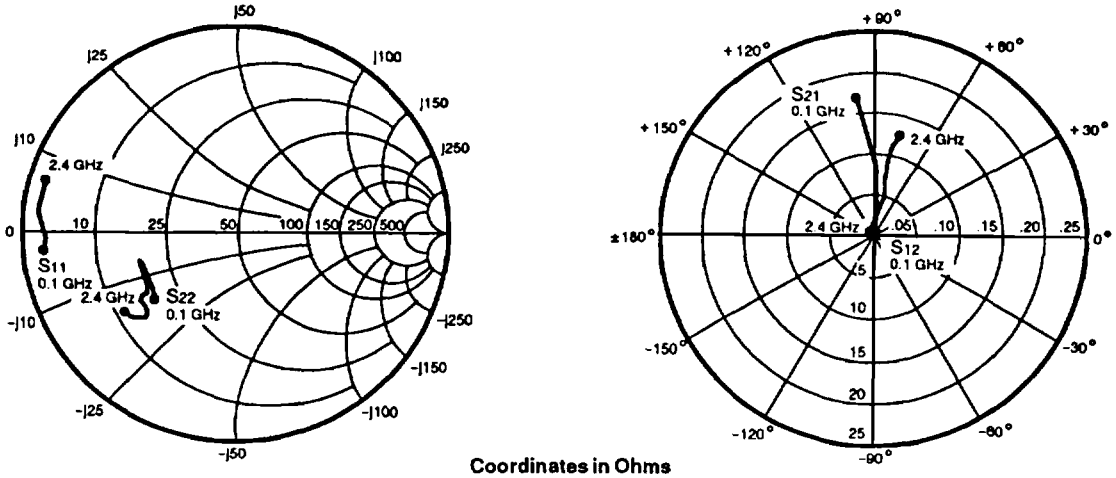
NE57510 OSCILLATOR OUTPUT POWER vs. COLLECTOR VOLTAGE AND COLLECTOR CURRENT



NE57510 OSCILLATOR POWER AND COLLECTOR EFFICIENCY vs. SUPPLY VOLTAGE



TYPICAL COMMON EMITTER SCATTERING PARAMETERS (T_A = 25 °C)



Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10 V, I_C = 100 mA)

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NE57500

V_{CE} = 10 V, I_C = 50 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K	MAG[1]
(MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
100	.88	-167	15.65	98	.004	9	.29	-124	1.64	31.5
200	.87	-174	7.98	91	.006	34	.25	-142	2.27	24.8
400	.89	-178	3.97	81	.020	59	.26	-151	1.40	19.2
600	.88	179	2.68	75	.031	64	.26	-152	1.39	15.6
800	.87	177	1.97	69	.035	66	.29	-141	1.68	12.7
1000	.88	176	1.60	63	.049	70	.30	-141	1.41	11.3
1200	.88	175	1.35	58	.064	74	.29	-139	1.28	10.0
1400	.87	173	1.16	54	.076	74	.33	-136	1.25	8.8
1600	.87	172	1.03	48	.088	76	.35	-137	1.20	8.0
1800	.87	170	.89	45	.098	77	.39	-137	1.23	6.7
2000	.87	167	.83	38	.108	77	.39	-137	1.15	6.5
2200	.90	165	.75	36	.117	74	.41	-140	.94	8.1
2400	.89	164	.66	32	.130	75	.43	-143	1.03	5.9

V_{CE} = 10 V, I_C = 100 mA

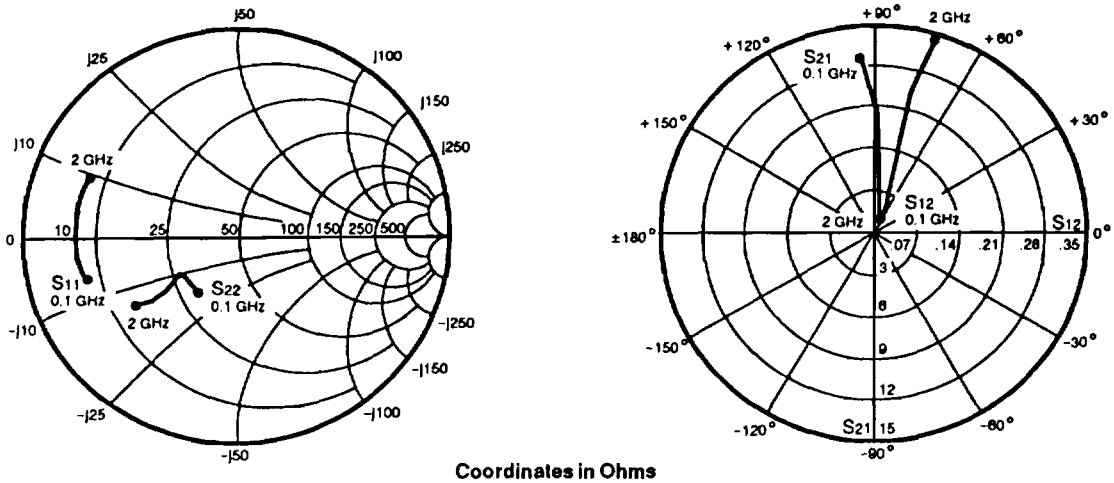
100	.88	-171	16.02	96	.004	13	.29	-138	1.66	31.7
200	.88	-176	8.13	90	.006	45	.26	-152	2.39	24.9
400	.89	-179	4.05	81	.013	69	.28	-158	1.95	19.2
600	.88	178	2.73	75	.029	71	.27	-160	1.49	15.5
800	.88	176	2.01	69	.042	72	.28	-148	1.43	13.0
1000	.87	176	1.64	64	.054	75	.29	-148	1.43	11.2
1200	.88	175	1.37	59	.068	75	.28	-145	1.19	10.4
1400	.88	173	1.19	55	.077	77	.31	141	1.24	8.9
1600	.87	171	1.05	48	.089	77	.33	-141	1.21	7.9
1800	.87	170	.92	45	.100	77	.36	-140	1.24	6.7
2000	.87	167	.85	38	.109	77	.37	-139	1.15	6.6
2200	.90	165	.76	36	.119	74	.38	-142	.93	8.1
2400	.89	164	.68	31	.131	75	.41	-144	1.06	5.6

Note:
Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$. When $K \le 1$, MAG = MSG. $$MSG = \frac{|S_{21}|}{|S_{12}|}$$, $$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

TYPICAL COMMON EMITTER SCATTERING PARAMETERS (T_A = 25°C)



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

NE57510

V_{CE} = 10 V, I_C = 25 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K	MAG[1]
(MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		
100	.73	-157	11.48	98	.03	43	.32	-107	0.62	25.8
200	.74	-169	5.93	88	.04	50	.28	-127	0.94	21.7
400	.74	-178	3.05	78	.07	66	.28	-133	1.10	14.4
600	.75	177	2.08	69	.11	67	.32	-135	0.99	12.8
800	.75	174	1.58	62	.14	71	.37	-135	0.98	10.5
1000	.76	171	1.32	54	.17	74	.41	-136	0.91	8.9
1200	.74	167	1.13	50	.20	75	.45	-136	0.93	7.5
1400	.75	165	.99	47	.24	75	.50	-137	0.84	6.1
1600	.75	162	.89	42	.27	75	.55	-139	0.78	5.2
1800	.74	159	.81	40	.29	74	.59	-142	0.80	4.5
2000	.74	157	.76	40	.33	74	.61	-144	0.78	3.6

V_{CE} = 10 V, I_C = 50 mA

100	.72	-163	12.32	96	.03	46	.32	-125	0.69	26.1
200	.72	-173	6.35	87	.04	58	.30	-142	1.03	21.0
400	.73	-179	3.26	78	.08	67	.31	-148	1.03	15.1
600	.74	176	2.22	70	.11	71	.33	-148	1.04	11.8
800	.74	172	1.70	63	.15	72	.36	-147	0.99	10.5
1000	.74	169	1.43	56	.18	72	.39	-145	0.94	9.0
1200	.73	167	1.25	52	.22	74	.42	-143	0.90	7.5
1400	.73	164	1.09	48	.25	73	.46	-142	0.86	6.4
1600	.73	162	.98	43	.28	73	.50	-143	0.82	5.4
1800	.72	160	.90	40	.30	72	.54	-144	0.81	4.8
2000	.71	157	.84	40	.33	72	.56	-145	0.82	4.1

V_{CE} = 10 V, I_C = 100 mA

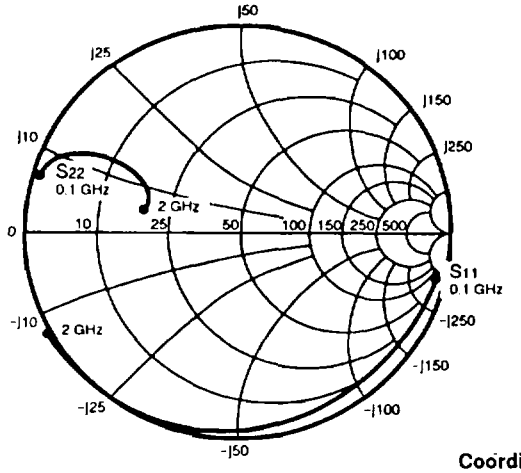
100	.73	-166	12.22	94	.02	52	.31	-133	0.97	27.9
200	.73	-174	6.28	86	.03	62	.30	-147	1.29	20.0
400	.73	180	3.23	77	.08	71	.30	-152	1.06	14.6
600	.74	175	2.20	69	.12	72	.31	-151	1.01	12.0
800	.74	172	1.70	63	.15	73	.35	-149	1.01	10.0
1000	.74	169	1.41	55	.18	73	.37	-147	0.97	8.9
1200	.73	166	1.23	51	.22	72	.40	-144	0.91	7.5
1400	.72	164	1.08	46	.25	73	.44	-142	0.89	6.4
1600	.72	162	.96	42	.28	73	.48	-143	0.86	5.3
1800	.73	160	.88	38	.30	72	.53	-144	0.80	4.7
2000	.71	156	.83	37	.33	71	.55	-144	0.81	4.0

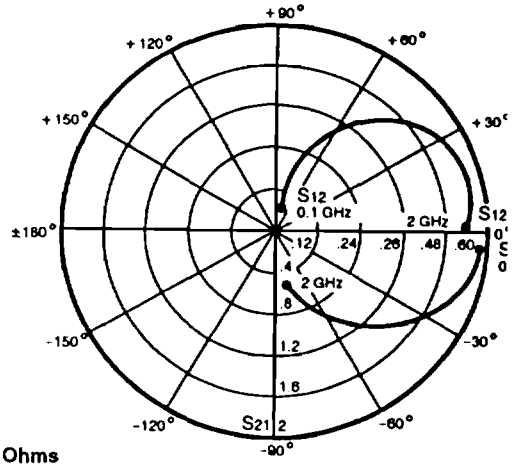
Note:
Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$. When $K \le 1$, MAG = MSG. $$MSG = \frac{|S_{21}|}{|S_{12}|}$$, $$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}S_{21}|}$$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

TYPICAL COMMON COLLECTOR SCATTERING PARAMETERS (TA = 25°C)





Coordinates in Ohms
Frequency in GHz
(VCE = 10 V, IC = 50 mA)

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NE57510

VCE = 10 V, IC = 25 mA

FREQUENCY	S11		S21		S12		S22		K	MAG[1]
(MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		
100	.98	-15	1.87	-7	.08	68	.92	173	0.21	13.7
200	.97	-31	1.80	-17	.19	68	.90	167	0.11	9.8
400	.97	-58	1.60	-30	.35	56	.81	158	0.08	6.6
600	.95	-79	1.41	-41	.46	44	.70	151	0.12	4.9
800	.94	-97	1.21	-50	.52	33	.60	148	0.16	3.7
1000	.94	-111	1.03	-56	.56	24	.51	151	0.22	2.6
1200	.97	-120	.89	-60	.59	16	.43	155	0.23	1.8
1400	.99	-130	.76	-66	.58	10	.40	165	0.25	1.2
1600	.99	-137	.68	-71	.57	3	.38	175	0.32	0.8
1800	.98	-144	.56	-77	.55	-6	.40	-178	0.41	0.1
2000	1.00	-150	.47	-78	.53	-8	.45	-175	0.29	-0.5

VCE = 10 V, IC = 50 mA

100	.99	-14	1.90	-7	.06	68	.94	174	0.21	15.0
200	.97	-30	1.82	-16	.15	70	.93	169	0.07	10.8
400	.98	-55	1.65	-29	.29	60	.87	162	0.04	7.6
600	.97	-76	1.46	-40	.34	50	.78	155	0.13	6.3
800	.96	-94	1.28	-50	.46	41	.70	151	0.06	4.4
1000	.97	-109	1.09	-56	.51	31	.61	150	0.07	3.3
1200	1.00	-119	.94	-61	.55	24	.53	151	0.07	2.3
1400	1.01	-129	.80	-68	.55	18	.47	156	0.08	1.6
1600	1.02	-137	.71	-74	.56	11	.42	162	0.14	1.0
1800	1.01	-144	.59	-79	.55	2	.41	169	0.23	0.2
2000	1.02	-150	.49	-81	.54	1	.44	173	0.17	-0.4

VCE = 10 V, IC = 100 mA

100	.99	-15	1.90	-7	.06	70	.95	175	0.18	15.0
200	.97	-30	1.83	-16	.15	71	.95	170	0.07	10.9
400	.98	-57	1.65	-29	.28	62	.89	162	0.04	7.7
600	.97	-78	1.46	-41	.39	51	.81	156	0.01	5.7
800	.96	-96	1.26	-51	.47	42	.73	151	0.02	4.3
1000	.97	-111	1.08	-57	.52	33	.65	150	0.03	3.2
1200	1.01	-120	.91	-62	.56	25	.55	149	0.02	2.1
1400	1.02	-131	.78	-69	.56	19	.49	154	0.04	1.4
1600	1.01	-139	.68	-74	.57	12	.43	158	0.11	0.8
1800	1.00	-145	.56	-80	.56	2	.40	166	0.17	0.1
2000	1.00	-152	.46	-81	.56	-0	.43	171	0.20	-0.8

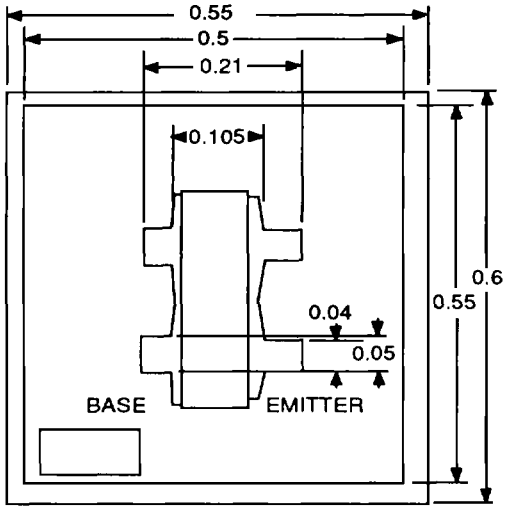
Note:
Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$. When $K \le 1$, MAG = MSG. $$MSG = \frac{|S_{21}|}{|S_{12}|}$$, $$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain, MSG = Maximum Stable Gain

OUTLINE DIMENSIONS (Units in mm)

NE57500 (CHIP)
(Chip Thickness: 160±20 μm)



PACKAGE OUTLINE 10
(TO-46)