NEC®

NPN SILICON MICROWAVE TRANSISTOR

NE57800 NE57807 NE57835

T-31-17

FEATURES

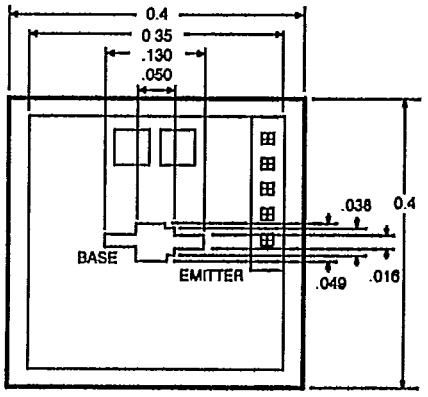
- **HIGH GAIN BANDWIDTH PRODUCT:** fT = 6 GHz
- **LOW NOISE FIGURE:** 2.5 dB at 2 GHz
- **HIGH GAIN:** 13 dB at 2 GHz
- **RELIABILITY PROVEN IN SPACE:**
  Platinum-Gold Metallization
  Hermetic Stripline Packages
  Space Qualified

DESCRIPTION AND APPLICATIONS

The NE578 series of NPN silicon transistors is designed for use in low noise amplifiers up to 5 GHz. The series features NEC's hi-rel metallization system, using platinum-silicide, titanium, platinum, and gold. NEC's metallization technique provides for high-temperature (100°C) operation at rated dissipation. NEC's stringent quality control standards (patterned after MIL-S-19500), made the NE578 one of the first microwave transistors to be qualified and flown in space.

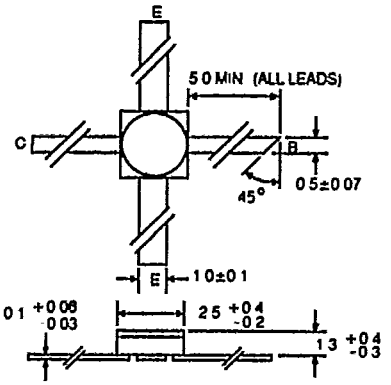
CHIP DIMENSIONS (Units in µm)

NE57800 (CHIP)

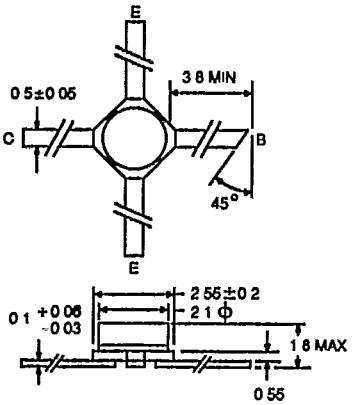


(Chip Thickness: 140 µm typ.)

OUTLINE 07



OUTLINE 35



PERFORMANCE SPECIFICATIONS (TA = 25°C)

PART NUMBER / EIAJ[1] REGISTERED NUMBER / PACKAGE OUTLINE			NE57800 00 (CHIP)			NE57807 07			NE57835 2SC2150 35 (MICRO-X)		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
fT	Gain Bandwidth Product at VCE = 8 V, IC = 10 mA	GHz	4	6		4	6		4	6	
$\|S_{21E}\|^2$	Insertion Power Gain at VCE = 8 V, IC = 10 mA,										
	f = 1 GHz	dB		15			15			15	
	f = 2 GHz	dB		9			9			9	
	f = 4 GHz	dB	1.5	2.7		2	2.7		1.5	2.7	
NFMIN	Minimum Noise Figure[2] at VCE = 8 V, IC = 3 mA,										
	f = 2 GHz	dB		2.5			2.7			2.4	
	f = 3 GHz	dB					3.8			3.4	
	f = 4 GHz	dB					5	5.5		4.3	5.5
MAG	Maximum Available Gain[3] at VCE = 8 V, IC = 10 mA										
	f = 2 GHz	dB					13			12	
	f = 3 GHz	dB					9.5			9	
	f = 4 GHz	dB		7.4		6	7.4			6.5	

Notes:

1. Electronic Industrial Association of Japan.
2. Input and output are tuned for optimum noise figure.
3. Maximum Available Gain (MAG) is calculated from the device S-Parameters using the equation,

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

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PART NUMBER EIAJ[1] REGISTERED NUMBER PACKAGE OUTLINE			NE57800 00 (CHIP)			NE57807 07			NE57835 2SC2150 35 (MICRO-X)		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
I_{CBO}	Collector Cutoff Current at V_{CB} = 8 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 at V_{CE} = 8 V, I_C = 10 mA		30	100	200	30	100	200	30	100	200
C_{CB}	Collector to Base Capacitance[2] at V_{CB} = 8 V, I_E = 0 mA, f = 1 MHz	pF		0.4			0.4	0.6		0.3	0.6
R_{TH}	Thermal Resistance (Junction-to-Case)	°C/W		110				110			140
P_T	Total Power Dissipation	mW			250			250			250[3]

Notes:
1. Electronic Industrial Association of Japan.
2. C_{CB} measurement employs a three-terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal.
3. Maximum case temperature for the NE57835 Grd D (Industrial) is -65°C to +150°C.

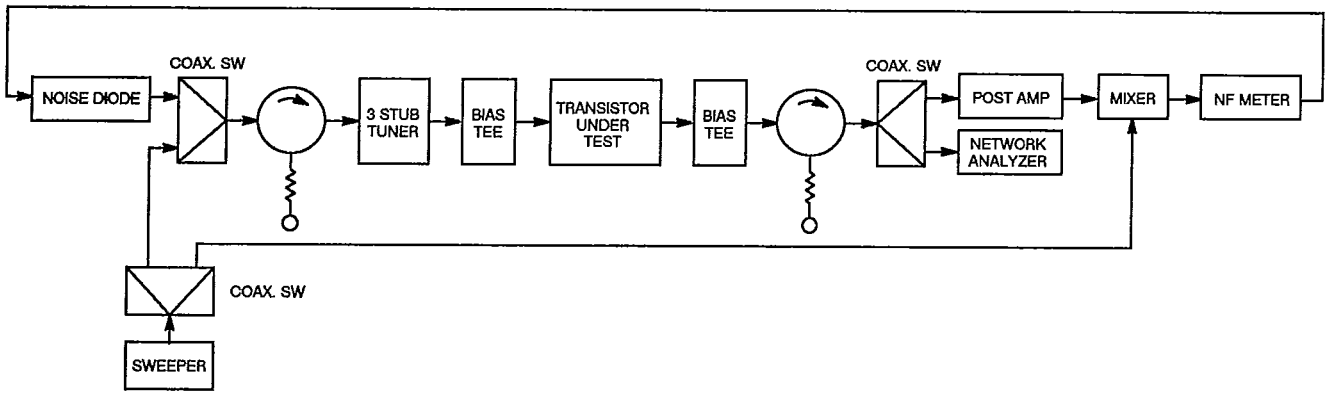
ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{CBO}	Collector to Base Voltage	V	25
V_{CEO}	Collector to Emitter Voltage	V	11
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*

*Maximum case temperature for the NE57835 Grd D (Industrial) is -65°C to +150°C.

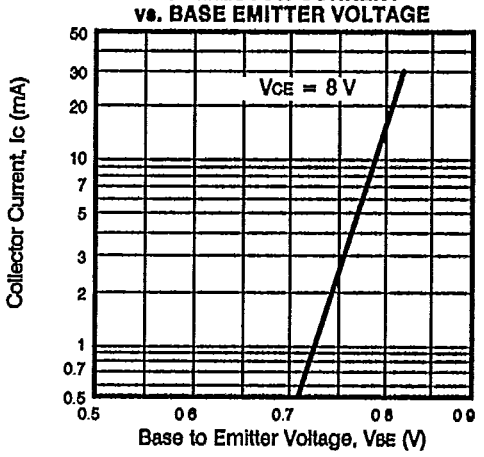
TEST CIRCUIT DIAGRAM

NOISE FIGURE AND GAIN MEASUREMENT CIRCUIT

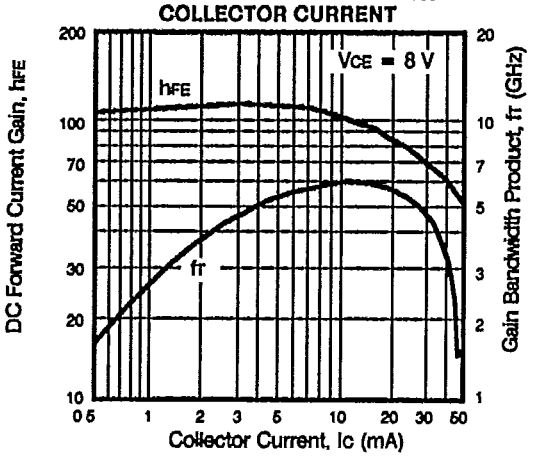


TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

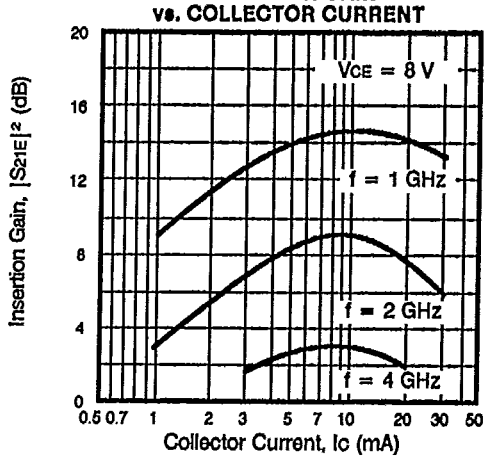
COLLECTOR CURRENT vs. BASE EMITTER VOLTAGE



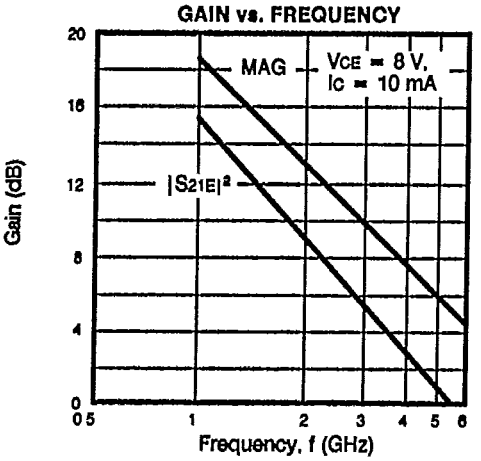
GAIN BANDWIDTH PRODUCT AND FORWARD CURRENT GAIN vs. COLLECTOR CURRENT



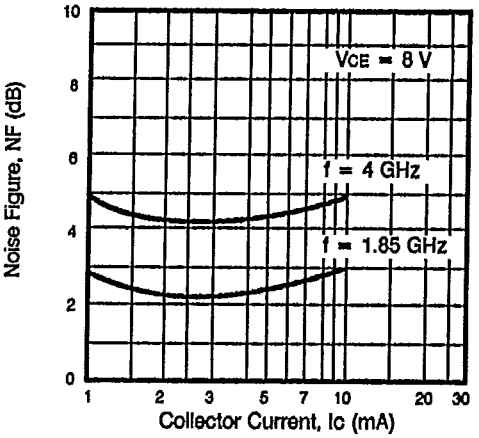
INSERTION GAIN vs. COLLECTOR CURRENT



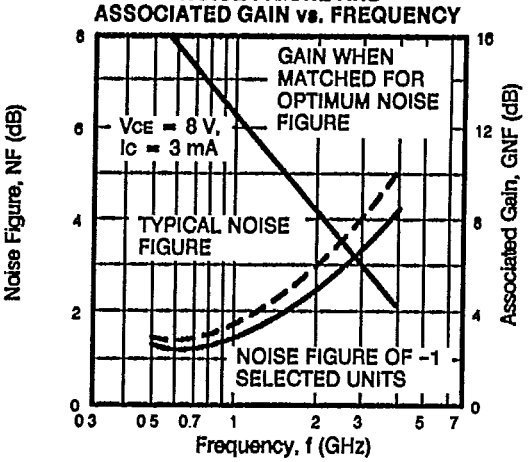
GAIN vs. FREQUENCY



NOISE FIGURE vs. COLLECTOR CURRENT

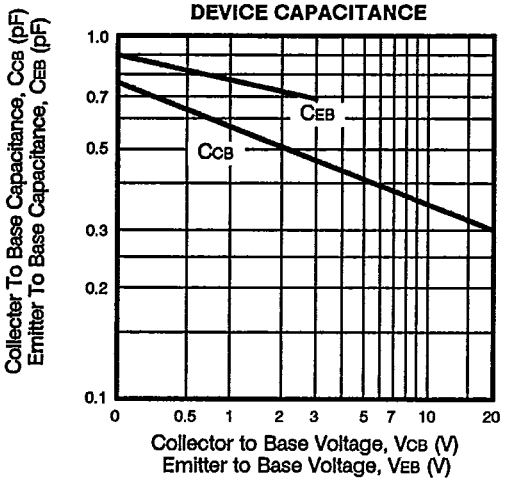


NOISE FIGURE AND ASSOCIATED GAIN vs. FREQUENCY

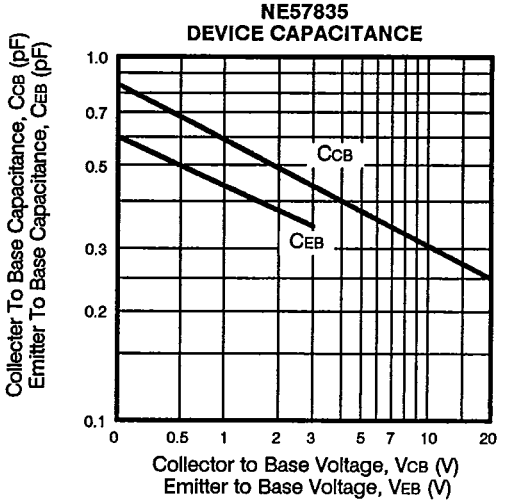


TYPICAL DEVICE CHARACTERISTICS (T_A = 25°C)

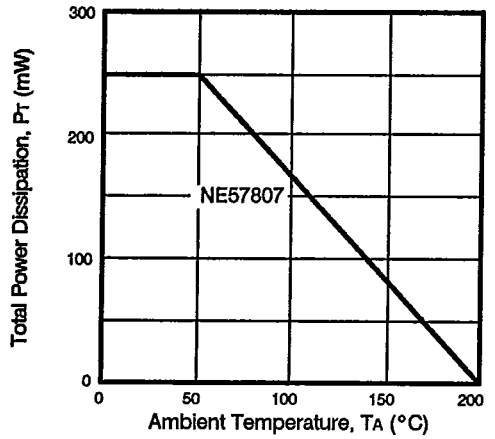
NE57807
DEVICE CAPACITANCE



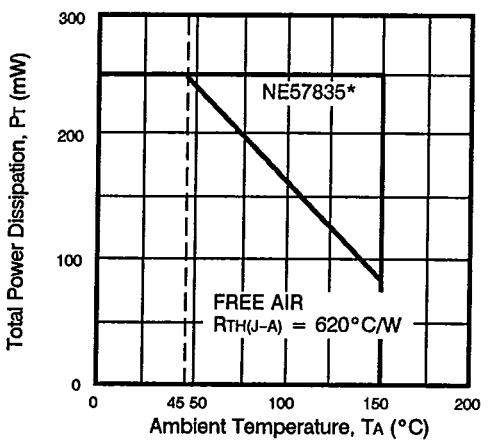
NE57835
DEVICE CAPACITANCE



NE57807
DC POWER DERATING CURVE

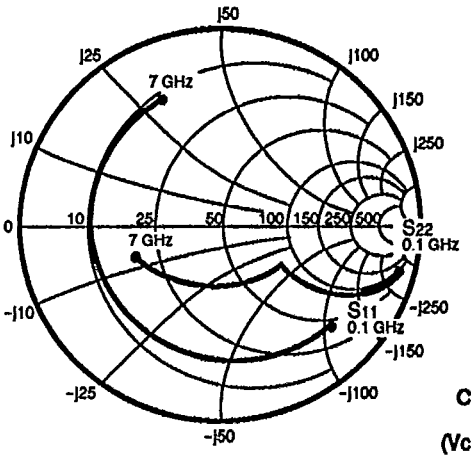


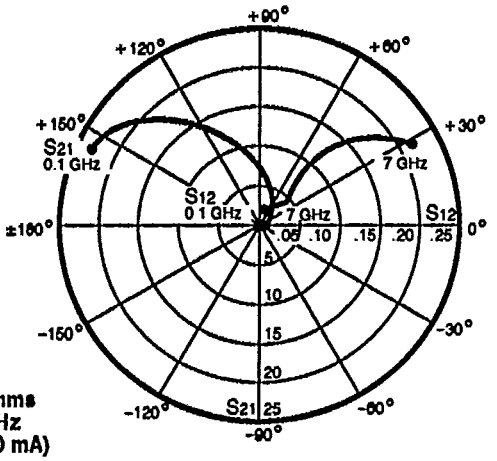
NE57835
DC POWER DERATING CURVE



*WITH INFINITE HEAT SINK,
$R_{TH(J-C)}$ = 140°C/W MOUNTING ON
CERAMIC BOARD WITH SOLDER
(20 x 50 x 0.635 mm Al_2O_3)
$R_{TH(J-A)}$ = 200°C/W

TYPICAL COMMON EMITTER SCATTERING PARAMETERS





NE57800
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 8 V, I_C = 10 mA)

S-MAGN AND ANGLES:

V_{CE} = 8 V, I_C = 3 mA

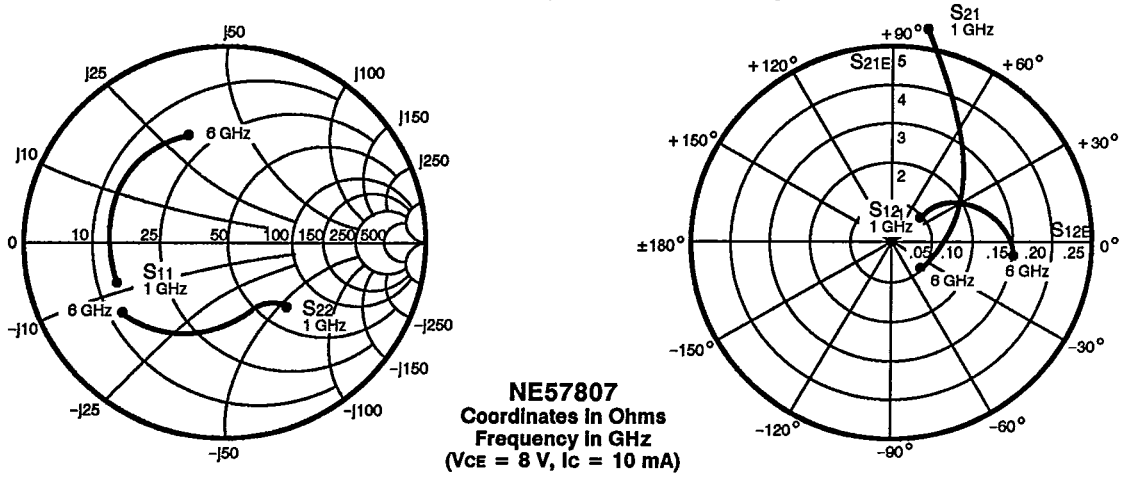
FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
100	.95	-19	9.17	167	.02	80	.98	-7
200	.89	-37	9.02	155	.04	70	.94	-15
300	.82	-54	8.37	145	.05	62	.89	-20
400	.80	-69	7.68	136	.06	55	.83	-25
500	.77	-82	6.97	128	.07	49	.78	-28
600	.74	-94	6.45	121	.08	46	.72	-32
700	.75	-101	5.66	115	.09	41	.68	-33
800	.70	-111	5.33	110	.09	39	.65	-35
900	.69	-119	4.91	105	.09	36	.60	-36
1000	.67	-127	4.66	101	.09	35	.57	-38
2000	.63	-166	2.55	72	.11	30	.46	-47
3000	.62	174	1.75	52	.13	28	.42	-60
4000	.63	157	1.39	35	.14	29	.40	-80
5000	.63	143	1.12	16	.16	27	.41	-104
6000	.64	131	.92	2	.18	23	.45	-131
7000	.66	119	.77	-12	.20	18	.52	-155

V_{CE} = 8 V, I_C = 10 mA

100	.74	-44	23.15	155	.02	71	.92	-15
200	.69	-79	19.53	136	.03	56	.79	-27
300	.66	-104	15.76	123	.03	49	.67	-33
400	.66	-120	12.87	114	.04	43	.58	-35
500	.65	-132	10.84	108	.04	41	.53	-35
600	.64	-141	9.31	102	.04	42	.47	-35
700	.64	-147	8.07	97	.05	40	.45	-36
800	.64	-153	7.20	94	.05	40	.42	-36
900	.64	-157	6.44	91	.05	43	.40	-34
1000	.64	-162	5.93	88	.05	44	.40	-35
2000	.64	175	3.04	66	.07	50	.34	-43
3000	.66	161	2.07	50	.10	50	.31	-58
4000	.66	148	1.59	34	.13	48	.31	-79
5000	.67	136	1.30	16	.16	43	.31	-105
6000	.69	126	1.06	4	.19	36	.37	-133
7000	.71	115	.90	-11	.21	29	.44	-157

Note: S-parameters include bond wires.
Base: Total 1 wire (s), 1 per bond pad, 0.0245" (623 µm) long each wire.
Collector: Total 1 wire (s), 1 per bond pad, 0.0179" (454 µm) long each wire.
Emitter: Total 2 wire (s), 1 per side, 0.0493" (1251 µm) long each wire.
Wire: 0.0007" (17.7 µm) Dia., gold.

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE57807
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 8 V, I_C = 10 mA)

S-MAGN AND ANGLES:

VCE = 8 V, IC = 2 mA

FREQUENCY (MHz)	S11		S21		S12		S22	
1000	.68	-111	3.57	98	.12	30	.70	-47
2000	.56	-153	2.01	58	.13	12	.56	-65
3000	.54	-178	1.43	31	.14	0	.55	-86
4000	.54	164	1.15	5	.15	-10	.59	-107
5000	.53	147	.95	-18	.15	-18	.63	-126
6000	.51	130	.81	-39	.16	-27	.69	-144

VCE = 8 V, IC = 3 mA

1000	.64	-123	4.22	93	.10	29	.62	-49
2000	.55	-162	2.29	56	.11	16	.50	-65
3000	.54	174	1.60	31	.13	5	.50	-86
4000	.54	158	1.28	5	.14	-3	.55	-107
5000	.52	142	1.06	-17	.15	-11	.60	-125
6000	.50	125	.90	-38	.16	-21	.66	-143

VCE = 8 V, IC = 5 mA

1000	.60	-139	4.92	88	.08	31	.53	-50
2000	.54	-174	2.59	54	.10	23	.44	-64
3000	.54	166	1.80	30	.12	13	.45	-85
4000	.54	151	1.42	5	.14	4	.51	-106
5000	.53	135	1.17	-17	.15	-4	.56	-125
6000	.51	118	.99	-38	.16	-14	.64	-142

VCE = 8 V, IC = 10 mA

1000	.58	-158	5.49	81	.06	37	.44	-48
2000	.56	174	2.83	51	.08	34	.39	-60
3000	.58	158	1.95	28	.11	23	.42	-82
4000	.58	144	1.53	4	.13	14	.49	-104
5000	.58	128	1.25	-18	.14	4	.54	-123
6000	.56	110	1.05	-39	.16	-5	.62	-142