NPN 6 GHz wideband transistor

BFG91A

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DESCRIPTION

NPN transistor in a 4-lead dual-emitter plastic SOT103 envelope.

It is designed for application in wideband amplifiers, such as MATV and CATV systems.

PINNING

PIN	DESCRIPTION
1	emitter
2	collector
3	emitter
4	base

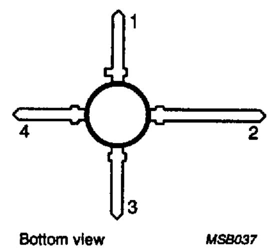


Fig.1 SOT103.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	–	12	V
I_C	DC collector current		–	–	35	mA
P_{tot}	total power dissipation	up to T_s = 158 °C (note 1)	–	–	300	mW
h_{FE}	DC current gain	I_C = 30 mA; V_{CE} = 5 V; T_j = 25 °C	40	90	–	
f_T	transition frequency	I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C	–	6	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 5 V; f = 1 MHz	–	0.5	–	pF
G_{UM}	maximum unilateral power gain	I_C = 30 mA; V_{CE} = 8 V; f = 800 MHz; T_{amb} = 25 °C	–	17.5	–	dB
F	noise figure	I_C = 30 mA; V_{CE} = 8 V; Z_S = opt.; f = 800 MHz; T_{amb} = 25 °C	–	2.3	–	dB
P_{L1}	output power at 1 dB gain compression	I_C = 30 mA; V_{CE} = 8 V; R_L = 75 Ω; f = 800 MHz; T_{amb} = 25 °C	–	17	–	dBm
ITO	third order intercept point	I_C = 30 mA; V_{CE} = 8 V; R_L = 75 Ω; f = 800 MHz; T_{amb} = 25 °C	–	36	–	dBm

Note

1. T_s is the temperature at the soldering point of the collector lead.

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	35	mA
I_{CM}	peak collector current	f > 1 MHz	–	50	mA
P_{tot}	total power dissipation	up to T_s = 158 °C (note 1)	–	300	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 158 °C (note 1)	55 K/W

Note

1. T_s is the temperature at the soldering point of the collector lead.

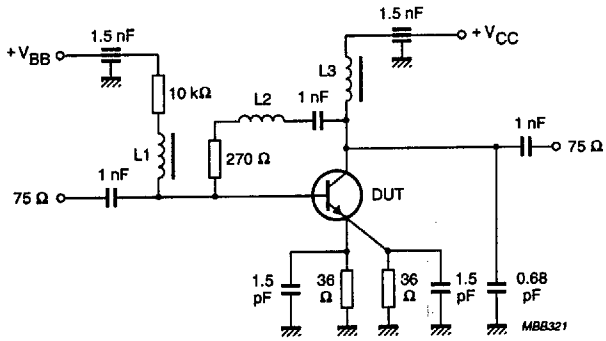
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 5$ V	–	–	50	nA
h_{FE}	DC current gain	$I_C = 30$ mA; $V_{CE} = 5$ V	40	90	–	
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 10$ V; f = 1 MHz	–	0.9	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 0.5$ V; f = 1 MHz	–	2.5	–	pF
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 5$ V; f = 1 MHz	–	0.5	–	pF
f_T	transition frequency	$I_C = 30$ mA; $V_{CE} = 5$ V; f = 500 MHz	–	6	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 30$ mA; $V_{CE} = 8$ V; f = 800 MHz; $T_{amb} = 25$ °C	–	17.5	–	dB
		$I_C = 30$ mA; $V_{CE} = 8$ V; f = 2 GHz; $T_{amb} = 25$ °C	–	9.5	–	dB
F	noise figure	$I_C = 4$ mA; $V_{CE} = 8$ V; Z_S = opt.; f = 800 MHz; $T_{amb} = 25$ °C	–	1.6	–	dB
		$I_C = 30$ mA; $V_{CE} = 8$ V; Z_S = opt.; f = 800 MHz; $T_{amb} = 25$ °C	–	2.3	–	dB
P_{L1}	output power at 1 dB gain compression	$V_{CE} = 8$ V; $I_C = 30$ mA; $R_L = 75\ \Omega$; f = 800 MHz; $T_{amb} = 25$ °C	–	17	–	dBm
ITO	third order intercept point (see Fig. 2)	note 2	–	36	–	dBm
V_O	output voltage	note 3	–	425	–	mV
d_2	second order intermodulation distortion (see Fig.2)	note 4	–	–50	–	dB

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$ dB.
2. $I_C = 30$ mA; $V_{CE} = 8$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C;
   P_p = ITO – 6 dB; $f_p = 800$ MHz;
   P_q = ITO – 6 dB; $f_q = 801$ MHz;
   measured at $f_{(2q-p)} = 802$ MHz and at $f_{(2p-q)} = 799$ MHz.
3. $d_{im} = -60$ dB; $I_C = 30$ mA; $V_{CE} = 8$ V; $R_L = 75\ \Omega$; $T_{amb} = 25$ °C;
   $V_p = V_O$ at $d_{im} = -60$ dB; $f_p = 795.25$ MHz;
   $V_q = V_O$ –6 dB; $f_q = 803.25$ MHz;
   $V_r = V_O$ –6 dB; $f_r = 805.25$ MHz;
   measured at $f_{(p+q-r)} = 793.25$ MHz.
4. $I_C = 30$ mA; $V_{CE} = 8$ V; $R_L = 75\ \Omega$; VSWR < 2; $T_{amb} = 25$ °C;
   $V_p = V_O = 200$ mV at $f_p = 250$ MHz;
   $V_q = V_O = 200$ mV at $f_q = 560$ MHz;
   measured at $f_{(p+q)} = 810$ MHz.



L1 = L3 = 5 μH Ferroxcube choke.

L2 = 3 turns 0.4 mm copper wire, internal diameter 3 mm, winding pitch 1 mm.

Fig.2 Intermodulation distortion and second order intermodulation distortion MATV test circuit.

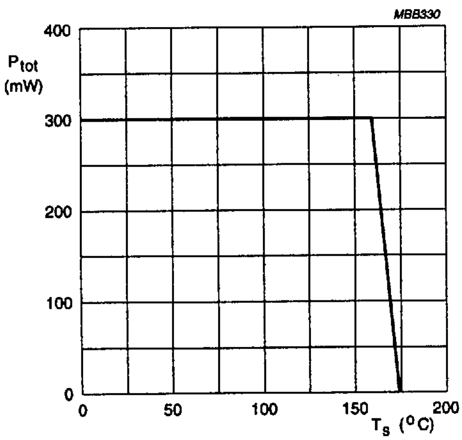
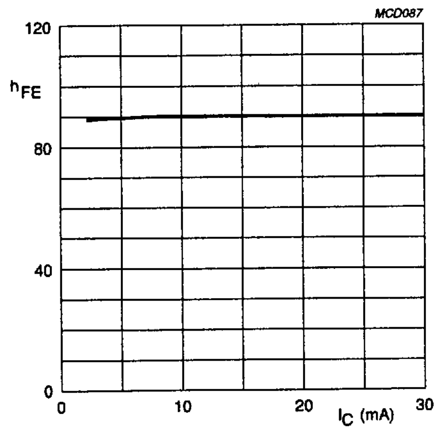
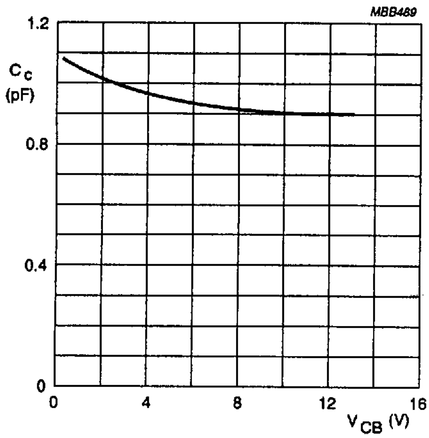


Fig.3 Power derating curve.



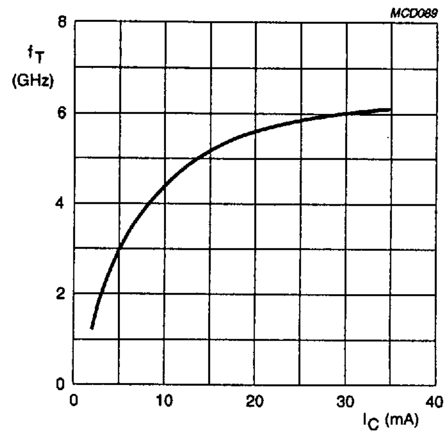
V_{CE} = 5 V; T_j = 25 °C.

Fig.4 DC current gain as a function of collector current.



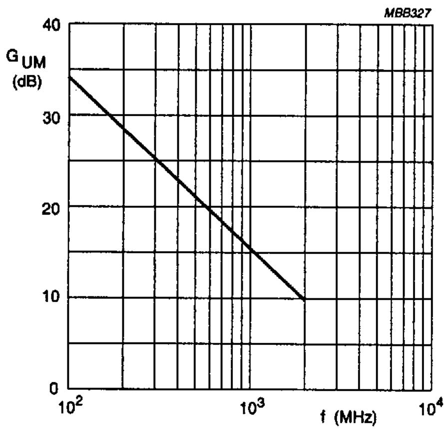
$I_E = i_e = 0$; f = 1 MHz; $T_j = 25$ °C.

Fig.5 Collector capacitance as a function of collector-base voltage.



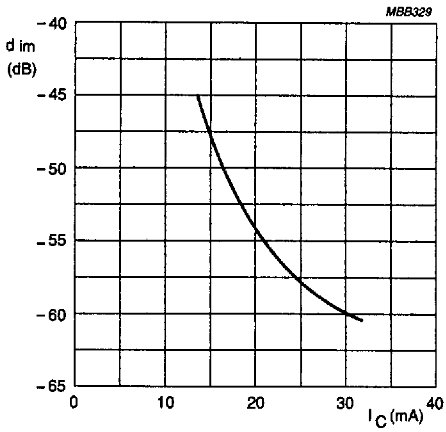
$V_{CE} = 8$ V; f = 500 MHz; $T_j = 25$ °C.

Fig.6 Transition frequency as a function of collector current.



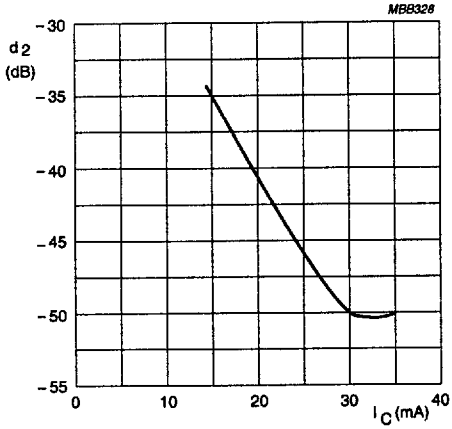
$I_C = 30$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C.

Fig.7 Maximum unilateral power gain as a function of frequency.



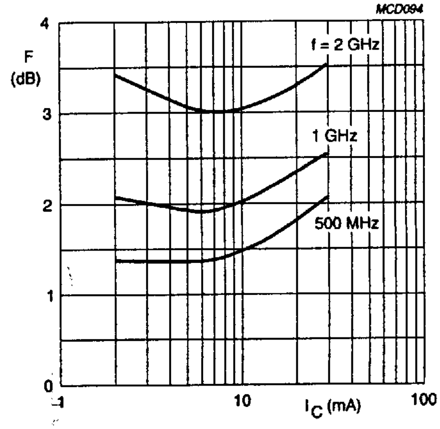
$V_{CE} = 8$ V; $V_O = 425$ mV; $f_{(p+q-r)} = 793.25$ MHz; $T_{amb} = 25$ °C.

Fig.8 Intermodulation distortion as a function of collector current.



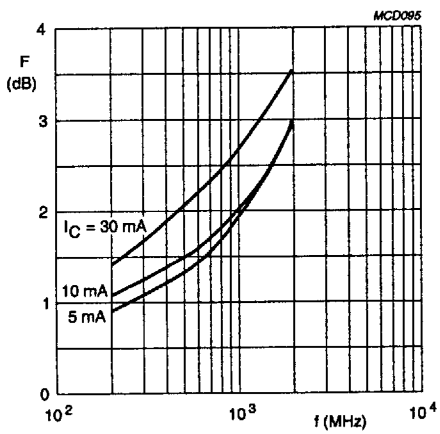
V_{CE} = 8 V; V_o = 200 dBmV; $f_{(p+q)}$ = 810 MHz; T_{amb} = 25 °C.

Fig.9 Second order intermodulation distortion as a function of collector current.



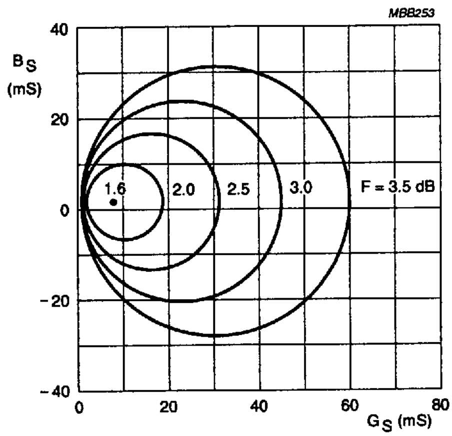
V_{CE} = 8 V; Z_S = opt.; T_{amb} = 25 °C.

Fig.10 Minimum noise figure as a function of collector current.



V_{CE} = 8 V; Z_S = opt.; T_{amb} = 25 °C.

Fig.11 Minimum noise figure as a function of frequency.



V_{CE} = 8 V; I_C = 4 mA; f = 800 MHz; T_{amb} = 25 °C.

Fig.12 Noise circle figure.

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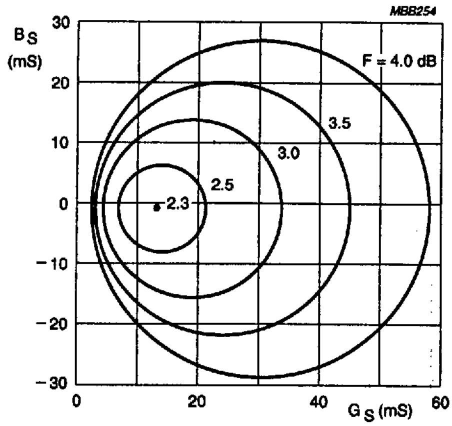
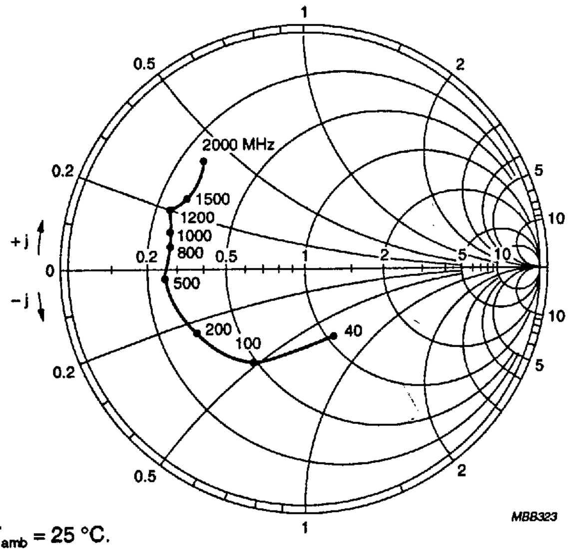


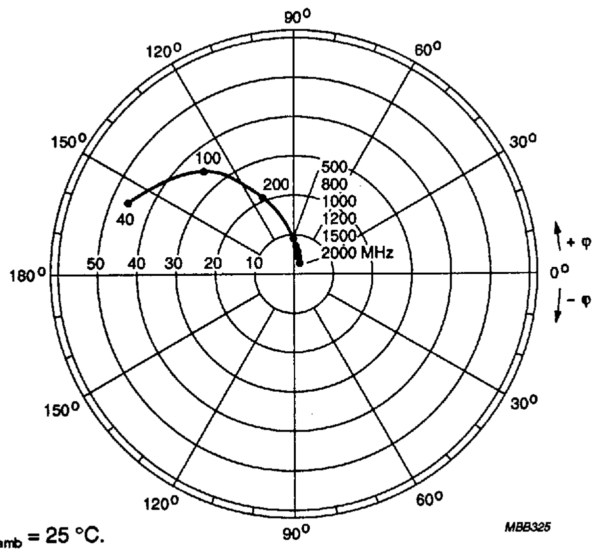
V_{CE} = 8 V; I_C = 30 mA; f = 800 MHz; T_{amb} = 25 °C.

Fig.13 Noise circle figure.



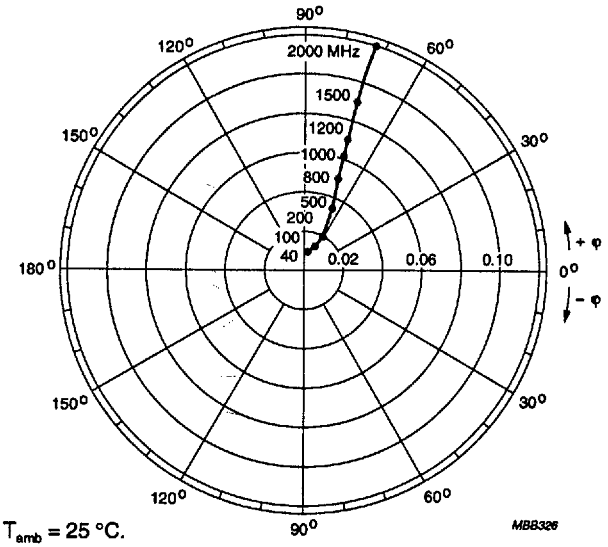
I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.14 Common emitter input reflection coefficient (S_{11}).



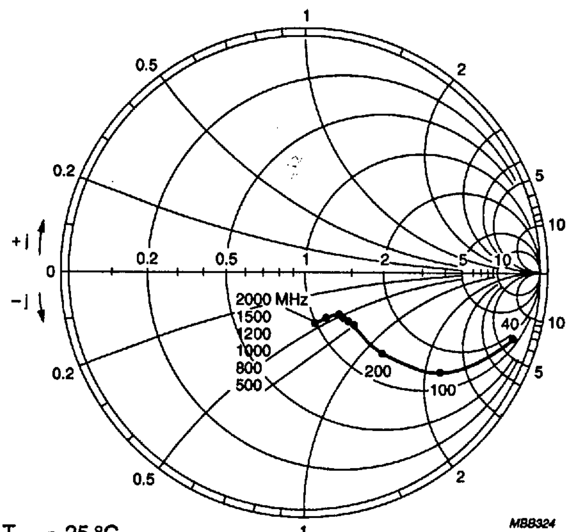
I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.15 Common emitter forward transmission coefficient (S_{21}).



I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.16 Common emitter reverse transmission coefficient (S_{12}).



I_C = 30 mA; V_{CE} = 8 V; T_{amb} = 25 °C.

Fig.17 Common emitter output reflection coefficient (S_{22}).

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Table 1 Common emitter scattering parameters, I_C = 10 mA; V_{CE} = 8 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.687	−29.3	25.578	163.6	0.009	84.2	0.960	−10.0	42.0
100	0.652	−66.0	21.764	143.8	0.021	63.3	0.847	−21.5	34.6
200	0.623	−106.0	15.792	123.8	0.030	48.9	0.665	−30.4	28.6
300	0.614	−129.5	11.802	111.9	0.035	42.7	0.553	−32.6	25.1
400	0.608	−142.9	9.275	104.4	0.038	41.5	0.489	−32.6	22.5
500	0.615	−152.2	7.658	99.2	0.041	41.2	0.453	−32.2	20.7
600	0.612	−159.2	6.491	94.9	0.044	44.2	0.429	−31.6	19.2
700	0.612	−164.5	5.641	91.4	0.045	45.5	0.412	−31.4	17.9
800	0.609	−169.4	4.996	88.1	0.049	46.7	0.402	−31.1	16.8
900	0.601	−173.5	4.461	85.3	0.051	48.4	0.393	−31.4	15.7
1000	0.606	−177.4	4.034	82.7	0.054	50.9	0.386	−31.6	14.8
1200	0.606	176.1	3.377	78.1	0.060	52.1	0.374	−32.7	13.2
1400	0.605	170.3	2.914	73.8	0.065	53.5	0.367	−34.5	11.9
1600	0.605	167.0	2.571	69.4	0.071	56.3	0.366	−36.5	10.8
1800	0.596	162.0	2.290	65.8	0.079	56.7	0.360	−38.3	9.7
2000	0.599	157.2	2.074	62.5	0.084	59.3	0.350	−40.1	8.8

Table 2 Common emitter scattering parameters, I_C = 30 mA; V_{CE} = 8 V

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		G_{UM} (dB)
	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	MAG. (RAT)	ANG. (DEG)	
40	0.475	−48.9	47.699	157.1	0.008	83.2	0.910	−18.1	42.3
100	0.507	−97.9	36.132	133.1	0.016	60.1	0.707	−35.9	35.4
200	0.545	−134.2	23.140	113.8	0.022	52.8	0.476	−46.7	29.9
300	0.568	−151.6	16.353	104.0	0.025	52.4	0.364	−48.9	26.6
400	0.574	−160.6	12.551	97.9	0.029	53.3	0.305	−48.5	24.1
500	0.580	−166.3	10.211	93.8	0.033	56.7	0.274	−47.6	22.3
600	0.582	−171.1	8.574	90.3	0.038	60.8	0.254	−46.5	20.8
700	0.584	−174.8	7.407	87.4	0.041	62.0	0.240	−46.3	19.5
800	0.578	−178.0	6.532	84.8	0.047	63.4	0.232	−45.5	18.3
900	0.580	178.8	5.822	82.4	0.052	64.1	0.226	−45.5	17.3
1000	0.584	175.8	5.263	80.3	0.057	66.1	0.221	−45.6	16.4
1200	0.587	170.4	4.393	76.4	0.065	65.8	0.213	−47.4	14.9
1400	0.586	166.3	3.775	72.7	0.074	67.1	0.210	−49.7	13.6
1600	0.588	163.1	3.335	68.7	0.083	66.6	0.212	−51.6	12.5
1800	0.580	159.6	2.974	65.4	0.093	66.3	0.210	−54.4	11.4
2000	0.585	154.4	2.700	62.3	0.102	66.7	0.202	−56.7	10.6