ANNEX 1 PROCESSING GAIN OF DIRECT SEQUENCE SPREAD SPECTRUM MEASUREMENT

1. LIMITS OF PROCESSING GAIN OF A DIRECT SEQUENCE SPREAD SPECTRUM MEASUREMENT

The limit of processing gain is 10dB

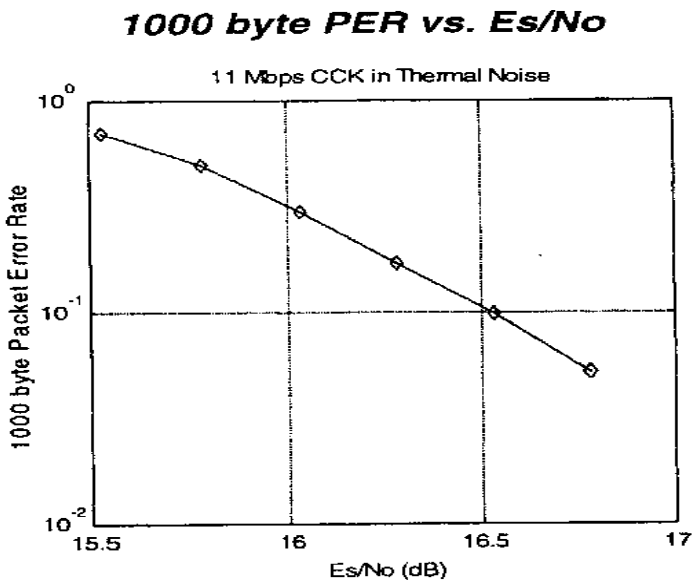
1.1 TEST INSTRUMENTS & SUPPORT UNIT

Description & Manufacturer	Model No.	Serial No.
Anritsu Spectrum Analyzer, 9kHz to 30GHz	MS2667C	M10281
Anritsu Signal Generator, 10kHz to 20GHz	68247B	984703
Hewlett Packard Power Meter,	HP438A	2743A04416
Hewlett Packard Power Sensor, -30 to 20dBm	8485A	2942A08387
Hewlett Packard Step Attenuator, 10dB steps	HP8496B	3247A18505
Mini-Circuits Power Splitter	ZN2PD-9G	NA
DELL Laptop Computer	Inspiron 5000e	NA
Campaq Laptop Computer	PPX	99125

1.2 METHOD OF MEASUREMENT

The processing gain may be measured using the CW jamming margin method. Section 4.7.4 shows the test configuration. The test consists of stepping a signal generator in 50 kHz increments across the passband of the system. At each point, the generator level required to produce the recommended Bit Error Rate (BER) is recorded. This level is jammer level. The output power of the transmitting unit is measured at the same point. The jammer to Signal (J/S) ratio is then calculated. Discard the worst 20% of the J/S data points. The lowest remaining J/S ratio is used when calculating the Process Gain.

The reference PER is specified as 8%. The corresponding Es/No (signal to noise ratio per symbol) is 16.4 dB. The curve is attached as below.



This value and the measured J/S ratio are used in the following equation to calculate the Process Gain (Gp) of the system.

$$Gp = (S/N)_o + Mj + Lsys$$

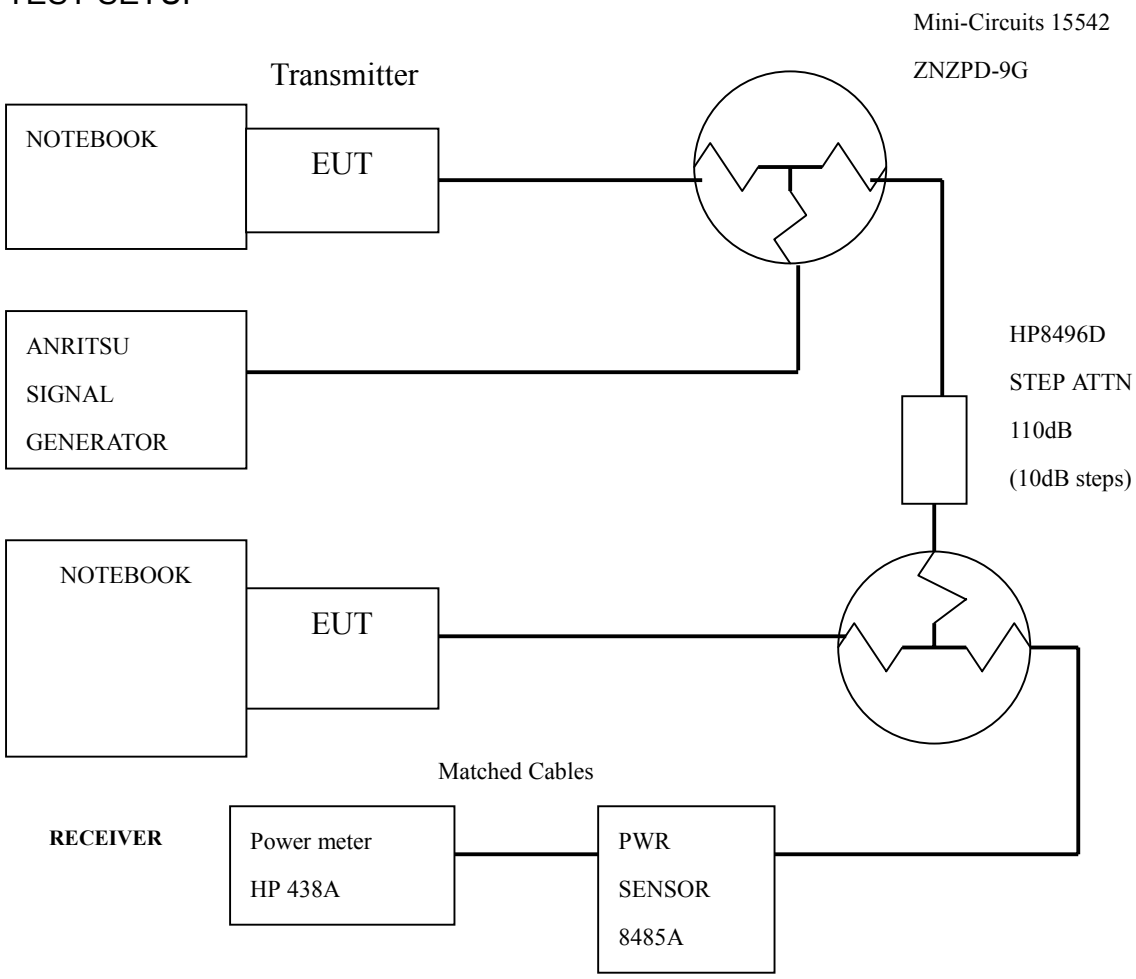
Where:

$(S/N)_o$: Signal to noise ratio for the chosen BER.

Mj : Maximum jammer to Signal Ratio recorded at the detected BER.

Lsys : System losses . For the purpose of this processing gain calculation, we assume Lsys at its minimum value of 2 dB.

TEST SETUP



1.3 TEST PROCEDURES

Obtain the simplex link shown. Perform all independent instrumentation calibrations prior to this procedure. Set operating power levels using fixed and variable attenuators in system to meet the following objectives:

Signal Power at receiver approximately –55dBm (above thermal sensitivity such that thermal noise does not cause bit errors.

Signal Power at power meter between –20 and –30dBm for optimal linearity.

Use spectrum analyzer to monitor test.

Ensure that CW Jammer generator RF output is disabled and measure the power at the power meter port using the power meter. This is the relative signal power, Sr.

Disable Transmitter, and set CW Jammer generator RF output frequency equal to the carrier frequency and enable generator output. Set reference CW Jammer power level at power meter port 8.4dB below Sr (minimum J/S, or 10dB processing gain reference level). Note the power level setting on the generator, this is the reference CW Jammer power setting, Jr.

Disable CW Jammer, re-establish link. PER test should be operating essentially error -free.

Enable CW Jammer at the reference power level and verify that the PER test indicates a PER of less than 8%.

Alternatively, adjust the CW Jammer level to that which causes 8% PER and verify that the S/J is less than 8.4dB.

Repeat step 7 for uniform steps in frequency increments of 50 kHz across the receiver passband with the CW Jammer. In this case the receiver passband is +/- 8.5 MHz.

The numerical data associated with the following radio channel is tabulated and presented for Channel 1,6, and 11.

Note:Since the jamming signal will be blocked by the IF filter if the jamming frequency is far form the center of the carrier frequency. So, only those frequencies around carrier frequency are shown here.

1.4 EUT OPERATING CONDITION

The software provided by client to set the EUT to transmit at lowest, middle and highest channel.

1.5 TEST RESULTS

EUT	PCMCIA 11M Wireless LAN Card	**Model**	WPC11 V2.5
Environmental Conditions	20℃,65%RH	**Tested By**	Gary Chang

Although the theoretical processing gain is lower than 10 dB, but the CCK coding provides an extra coding gain of 2.2dB.

11Mbps CHANNEL 1 Processing Gain				
Gp = (S/N)+ Mj + Lsys				
Freq.	**Gp**	**(S/N)**	**Mj = J/S**	**Lsys**
(GHz)	**(dB)**	**(dB)**	**(dB)**	**(dB)**
2.4095	11.5	16.4	-6.9	2
2.40955	11.2	16.4	-7.2	2
2.4096	11.3	16.4	-7.1	2
2.40965	11.6	16.4	-6.8	2
2.4097	10.8	16.4	-7.6	2
2.40975	11	16.4	-7.4	2
2.4098	11.4	16.4	-7	2
2.40985	11.1	16.4	-7.3	2
2.4099	10.8	16.4	-7.6	2
2.40995	11	16.4	-7.4	2
2.41	11.1	16.4	-7.3	2
2.41005	11.1	16.4	-7.3	2
2.4101	10.7	16.4	-7.7	2
2.41015	11.4	16.4	-7	2
2.4102	11.5	16.4	-6.9	2
2.41025	11.6	16.4	-6.8	2
2.4103	11.8	16.4	-6.6	2
2.41035	11.2	16.4	-7.2	2
2.4104	11.1	16.4	-7.3	2
2.41045	10.9	16.4	-7.5	2
2.4105	10.8	16.4	-7.6	2
2.41055	11.4	16.4	-7	2
2.4106	11.7	16.4	-6.7	2
2.41065	11.2	16.4	-7.2	2
2.4107	11.6	16.4	-6.8	2
2.41075	11.5	16.4	-6.9	2
2.4108	11.6	16.4	-6.8	2

11Mbps CHANNEL 1 Processing Gain				
Gp = (S/N)+ Mj + Lsys				
Freq. (GHz)	Gp (dB)	(S/N) (dB)	Mj = J/S (dB)	Lsys (dB)
2.41085	11.2	16.4	-7.2	2
2.4109	11.4	16.4	-7	2
2.41095	11.2	16.4	-7.2	2
2.411	11.1	16.4	-7.3	2
2.41105	11.2	16.4	-7.2	2
2.4111	11.1	16.4	-7.3	2
2.41115	11.9	16.4	-6.5	2
2.4112	11.8	16.4	-6.6	2
2.41125	11.9	16.4	-6.5	2
2.4113	12	16.4	-6.4	2
2.41135	11.6	16.4	-6.8	2
2.4114	11.2	16.4	-7.2	2
2.41145	11.1	16.4	-7.3	2
2.4115	11	16.4	-7.4	2
2.41155	11.6	16.4	-6.8	2
2.4116	11.4	16.4	-7	2
2.41165	11.1	16.4	-7.3	2
2.4117	11.2	16.4	-7.2	2
2.41175	11.4	16.4	-7	2
2.4118	11.3	16.4	-7.1	2
2.41185	10.8	16.4	-7.6	2
2.4119	10.7	16.4	-7.7	2
2.41195	10.5	16.4	-7.9	2
2.412	10.4	16.4	-8	2
2.41205	11.2	16.4	-7.2	2
2.4121	10.6	16.4	-7.8	2
2.41215	11.6	16.4	-6.8	2
2.4122	11.1	16.4	-7.3	2
2.41225	11.9	16.4	-6.5	2
2.4123	11.8	16.4	-6.6	2
2.41235	11.9	16.4	-6.5	2
2.4124	11.4	16.4	-7	2
2.41245	11.1	16.4	-7.3	2
2.4125	11.9	16.4	-6.5	2
2.41255	11.9	16.4	-6.5	2
2.4126	11.2	16.4	-7.2	2
2.41265	11.1	16.4	-7.3	2
2.4127	11.4	16.4	-7	2
2.41275	11.9	16.4	-6.5	2
2.4128	12.1	16.4	-6.3	2
2.41285	12	16.4	-6.4	2

11Mbps CHANNEL 1 Processing Gain				
Gp = (S/N)+ Mj + Lsys				
Freq. (GHz)	Gp (dB)	(S/N) (dB)	Mj = J/S (dB)	Lsys (dB)
2.4129	12.3	16.4	-6.1	2
2.41295	11.6	16.4	-6.8	2
2.413	12.1	16.4	-6.3	2
2.41305	11.4	16.4	-7	2
2.4131	11.3	16.4	-7.1	2
2.41315	11.8	16.4	-6.6	2
2.4132	11.4	16.4	-7	2
2.41325	11.3	16.4	-7.1	2
2.4133	11.6	16.4	-6.8	2
2.41335	11.9	16.4	-6.5	2
2.4134	12	16.4	-6.4	2
2.41345	12	16.4	-6.4	2
2.4135	11.2	16.4	-7.2	2
2.41355	11.1	16.4	-7.3	2
2.4136	11.4	16.4	-7	2
2.41365	11.2	16.4	-7.2	2
2.4137	11.9	16.4	-6.5	2
2.41375	11.9	16.4	-6.5	2
2.4138	11.1	16.4	-7.3	2
2.41385	11.2	16.4	-7.2	2
2.4139	11.2	16.4	-7.2	2
2.41395	11.1	16.4	-7.3	2
2.414	11.4	16.4	-7	2
2.41405	11.4	16.4	-7	2
2.4141	11	16.4	-7.4	2
2.41415	10.8	16.4	-7.6	2
2.4142	10.9	16.4	-7.5	2
2.41425	11.6	16.4	-6.8	2
2.4143	11.9	16.4	-6.5	2
2.41435	12	16.4	-6.4	2
2.4144	11.2	16.4	-7.2	2
2.41445	11.1	16.4	-7.3	2
2.4145	11.4	16.4	-7	2

11Mbps CHANNEL 6 Processing Gain				
Gp = (S/N)+ Mj + Lsys				
Freq. (GHz)	Gp (dB)	(S/N) (dB)	Mj = J/S (dB)	Lsys (dB)
2.4345	10.9	16.4	-7.5	2
2.43455	10.9	16.4	-7.5	2
2.4346	11.4	16.4	-7	2
2.43465	10.8	16.4	-7.6	2
2.4347	11.3	16.4	-7.1	2
2.43475	11.6	16.4	-6.8	2
2.4348	11.4	16.4	-7	2
2.43485	10.8	16.4	-7.6	2
2.4349	11.4	16.4	-7	2
2.43495	10.7	16.4	-7.7	2
2.435	10.5	16.4	-7.9	2
2.43505	11.1	16.4	-7.3	2
2.4351	11.4	16.4	-7	2
2.43515	11.6	16.4	-6.8	2
2.4352	11.5	16.4	-6.9	2
2.43525	11.5	16.4	-6.9	2
2.4353	10.9	16.4	-7.5	2
2.43535	11	16.4	-7.4	2
2.4354	10.8	16.4	-7.6	2
2.43545	11	16.4	-7.4	2
2.4355	11.4	16.4	-7	2
2.43555	11.4	16.4	-7	2
2.4356	11	16.4	-7.4	2
2.43565	11.1	16.4	-7.3	2
2.4357	10.9	16.4	-7.5	2
2.43575	11.5	16.4	-6.9	2
2.4358	11.6	16.4	-6.8	2
2.43585	11.2	16.4	-7.2	2
2.4359	11.2	16.4	-7.2	2
2.43595	10.6	16.4	-7.8	2
2.436	10.6	16.4	-7.8	2
2.43605	11.6	16.4	-6.8	2
2.4361	11.2	16.4	-7.2	2
2.43615	11.1	16.4	-7.3	2

11Mbps CHANNEL 6 Processing Gain				
Gp = (S/N)+ Mj + Lsys				
Freq. (GHz)	Gp (dB)	(S/N) (dB)	Mj = J/S (dB)	Lsys (dB)
2.4362	11.9	16.4	-6.5	2
2.43625	11.8	16.4	-6.6	2
2.4363	11.7	16.4	-6.7	2
2.43635	11.2	16.4	-7.2	2
2.4364	10.9	16.4	-7.5	2
2.43645	11	16.4	-7.4	2
2.4365	11	16.4	-7.4	2
2.43655	11.6	16.4	-6.8	2
2.4366	11.8	16.4	-6.6	2
2.43665	11.8	16.4	-6.6	2
2.4367	12	16.4	-6.4	2
2.43675	11.2	16.4	-7.2	2
2.4368	11	16.4	-7.4	2
2.43685	11.4	16.4	-7	2
2.4369	10.7	16.4	-7.7	2
2.43695	10.6	16.4	-7.8	2
2.437	10.4	16.4	-8	2
2.43705	10.8	16.4	-7.6	2
2.4371	10.6	16.4	-7.8	2
2.43715	11.4	16.4	-7	2
2.4372	11.6	16.4	-6.8	2
2.43725	11.8	16.4	-6.6	2
2.4373	11.9	16.4	-6.5	2
2.43735	12	16.4	-6.4	2
2.4374	12.1	16.4	-6.3	2
2.43745	11.4	16.4	-7	2
2.4375	11.2	16.4	-7.2	2
2.43755	11.1	16.4	-7.3	2
2.4376	11.2	16.4	-7.2	2
2.43765	10.9	16.4	-7.5	2
2.4377	10.9	16.4	-7.5	2
2.43775	11.9	16.4	-6.5	2
2.4378	12.1	16.4	-6.3	2
2.43785	12	16.4	-6.4	2

11Mbps CHANNEL 6 Processing Gain				
Gp = (S/N)+ Mj + Lsys				
Freq. (GHz)	Gp (dB)	(S/N) (dB)	Mj = J/S (dB)	Lsys (dB)
2.4379	12.3	16.4	-6.1	2
2.43795	12.2	16.4	-6.2	2
2.438	11.5	16.4	-6.9	2
2.43805	11.2	16.4	-7.2	2
2.4381	11.1	16.4	-7.3	2
2.43815	11.4	16.4	-7	2
2.4382	11.4	16.4	-7	2
2.43825	11.2	16.4	-7.2	2
2.4383	11.1	16.4	-7.3	2
2.43835	11	16.4	-7.4	2
2.4384	10.9	16.4	-7.5	2
2.43845	11	16.4	-7.4	2
2.4385	10.9	16.4	-7.5	2
2.43855	11.7	16.4	-6.7	2
2.4386	11.2	16.4	-7.2	2
2.43865	11.1	16.4	-7.3	2
2.4387	11.1	16.4	-7.3	2
2.43875	11.6	16.4	-6.8	2
2.4388	10.9	16.4	-7.5	2
2.43885	10.9	16.4	-7.5	2
2.4389	10.8	16.4	-7.6	2
2.4895	11.3	16.4	-7.1	2
2.439	11.4	16.4	-7	2
2.43905	11.5	16.4	-6.9	2
2.4391	11.5	16.4	-6.9	2
2.43915	11.6	16.4	-6.8	2
2.4392	10.7	16.4	-7.7	2
2.43925	11.4	16.4	-7	2
2.4393	10.9	16.4	-7.5	2
2.43935	11.3	16.4	-7.1	2
2.4394	11.6	16.4	-6.8	2
2.43945	11.6	16.4	-6.8	2
2.4395	11.4	16.4	-7	2

11Mbps CHANNEL 11 Processing Gain				
Gp = (S/N)+ Mj + Lsys				
Freq. (GHz)	Gp (dB)	(S/N) (dB)	Mj = J/S (dB)	Lsys (dB)
2.4595	11.9	16.4	-6.5	2
2.45955	11.6	16.4	-6.8	2
5.4596	11.4	16.4	-7	2
2.45965	11.3	16.4	-7.1	2
2.4597	11.3	16.4	-7.1	2
2.45975	11.5	16.4	-6.9	2
2.4598	11.9	16.4	-6.5	2
2.45985	11.1	16.4	-7.3	2
2.4599	11.4	16.4	-7	2
2.45995	11.1	16.4	-7.3	2
2.46	11.2	16.4	-7.2	2
2.46005	11.6	16.4	-6.8	2
2.4601	11.4	16.4	-7	2
2.46015	11.2	16.4	-7.2	2
2.4602	11.1	16.4	-7.3	2
2.46025	11.3	16.4	-7.1	2
2.4603	11.5	16.4	-6.9	2
2.46035	11.8	16.4	-6.6	2
2.4604	11.1	16.4	-7.3	2
2.46045	12	16.4	-6.4	2
2.4605	12	16.4	-6.4	2
2.46055	10.8	16.4	-7.6	2
2.4606	10.9	16.4	-7.5	2
2.46065	11.1	16.4	-7.3	2
2.4607	11.1	16.4	-7.3	2
2.46075	11.4	16.4	-7	2
2.4608	11.9	16.4	-6.5	2
2.46085	12.1	16.4	-6.3	2
2.4609	12.3	16.4	-6.1	2
2.46095	12.1	16.4	-6.3	2
2.461	12.1	16.4	-6.3	2
2.46105	11.4	16.4	-7	2
2.4611	11.8	16.4	-6.6	2
2.46115	11.9	16.4	-6.5	2

11Mbps CHANNEL 11 Processing Gain				
Gp = (S/N)+ Mj + Lsys				
Freq. (GHz)	Gp (dB)	(S/N) (dB)	Mj = J/S (dB)	Lsys (dB)
2.4612	12.4	16.4	-6	2
2.46125	11.8	16.4	-6.6	2
2.4613	11.9	16.4	-6.5	2
2.46135	12.4	16.4	-6	2
2.4614	11.8	16.4	-6.6	2
2.46145	11.8	16.4	-6.6	2
2.4615	11.7	16.4	-6.7	2
2.46155	12.5	16.4	-5.9	2
2.4616	12.5	16.4	-5.9	2
2.46165	12.5	16.4	-5.9	2
2.4617	12.6	16.4	-5.8	2
2.46175	12.1	16.4	-6.3	2
2.4618	12	16.4	-6.4	2
2.46185	11.8	16.4	-6.6	2
2.4619	12.3	16.4	-6.1	2
2.46195	12.3	16.4	-6.1	2
2.462	11.6	16.4	-6.8	2
2.46205	12	16.4	-6.4	2
2.4621	12.4	16.4	-6	2
2.46215	11.9	16.4	-6.5	2
2.4622	12.4	16.4	-6	2
2.46225	12.6	16.4	-5.8	2
2.4623	12.8	16.4	-5.6	2
2.46235	12.5	16.4	-5.9	2
2.4624	12.5	16.4	-5.9	2
2.46245	12	16.4	-6.4	2
2.4625	12	16.4	-6.4	2
2.46255	12.1	16.4	-6.3	2
2.4626	12.2	16.4	-6.2	2
2.46265	12.4	16.4	-6	2
2.4627	11.9	16.4	-6.5	2
2.46275	12.1	16.4	-6.3	2
2.4628	12	16.4	-6.4	2
2.46285	12	16.4	-6.4	2

11Mbps CHANNEL 11 Processing Gain				
Gp = (S/N)+ Mj + Lsys				
Freq. (GHz)	Gp (dB)	(S/N) (dB)	Mj = J/S (dB)	Lsys (dB)
2.4629	12.4	16.4	-6	2
2.46295	11.9	16.4	-6.5	2
2.463	12	16.4	-6.4	2
2.46305	11.8	16.4	-6.6	2
2.4631	11.7	16.4	-6.7	2
2.46315	11.6	16.4	-6.8	2
2.4632	11.6	16.4	-6.8	2
2.46325	12.1	16.4	-6.3	2
2.4633	12	16.4	-6.4	2
2.46335	11.4	16.4	-7	2
2.4634	11.9	16.4	-6.5	2
2.46345	11.9	16.4	-6.5	2
2.4635	12	16.4	-6.4	2
2.46355	12.1	16.4	-6.3	2
2.4636	11.6	16.4	-6.8	2
2.46365	11.6	16.4	-6.8	2
2.4637	11.8	16.4	-6.6	2
2.46375	11.8	16.4	-6.6	2
2.4638	11.7	16.4	-6.7	2
2.46385	11.6	16.4	-6.8	2
2.4639	11.6	16.4	-6.8	2
2.46395	11.5	16.4	-6.9	2
2.464	11.4	16.4	-7	2
2.46405	11.3	16.4	-7.1	2
2.4641	11.6	16.4	-6.8	2
2.46415	11.6	16.4	-6.8	2
2.4642	11.5	16.4	-6.9	2
2.46425	12.4	16.4	-6	2
2.4643	12.4	16.4	-6	2
2.46435	12	16.4	-6.4	2
4.4644	11.9	16.4	-6.5	2
2.46445	12.4	16.4	-6	2
2.4645	12.1	16.4	-6.3	2