Universal Beverage Antenna

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Beverage Antennas are widely used at commercial and military radio communication. In commercial communication Beverage Antenna as usual is used as a receiving antenna. However, in military communication Beverage Antenna is used for both purposes- for receiving and transmitting applications. Transmitting/receiving Beverage Antenna was used in DX- Pedition EK1NWB on to Kizhy island (the antenna described at: http://www.antentop.org/008/ua3znw008.htm) where the antenna (against skepticism of some persons) illuminated its good job.

So when again in Toronto I have changed my QTH and the QTH allowed me install Beverage Antenna, I did not hesitated.

Beverage Antenna has lots advantages that attractive me. ***First***, it is low noise receiving antenna. At all my previously settled QTHs I had so devastated noise level that 160 and 80 meter Bands were closed for me. ***Second***, Beverage Antenna is lighting safety antenna because the antenna wire grounded from both sides and the antenna wire is placed at small height above the ground. ***Third***, Beverage Antenna is sustained at strong winds and ice rain- it is very important for Canadian winter.

Forth, Beverage Antenna is (at proper installation) practically invisible. That is very important in the place where some antennas may be restricted. ***Fifth***, Beverage Antenna is very broadband antenna. Without any ATU the antenna may have good SWR on all amateurs HF Bands from 160 to 6 meter. ***Sixth***, Beverage Antenna has single lobe diagram directivity. It is possible count again and again the advantages of the Beverage Antenna.

But we begin count disadvantages. ***First and the main*** lack of the antenna is the low efficiency on to transmission. However, the lack may be easy improved with PA- but if you do not hear anything (usual matter in modern city overloaded by electromagnetic smog) you do not need PA…

Figure 1 shows a Classical Beverage Antenna. Beverage Antenna consists of a horizontal wire with length L. The length may be from one-half to tens wavelengths long. The wire suspended above the ground at height H. For real receiving antennas the height may be from 1.5 up to 5.0 meter. For military transmitting Beverage Antennas the height may be from 0.5 up to 1.5 meter.

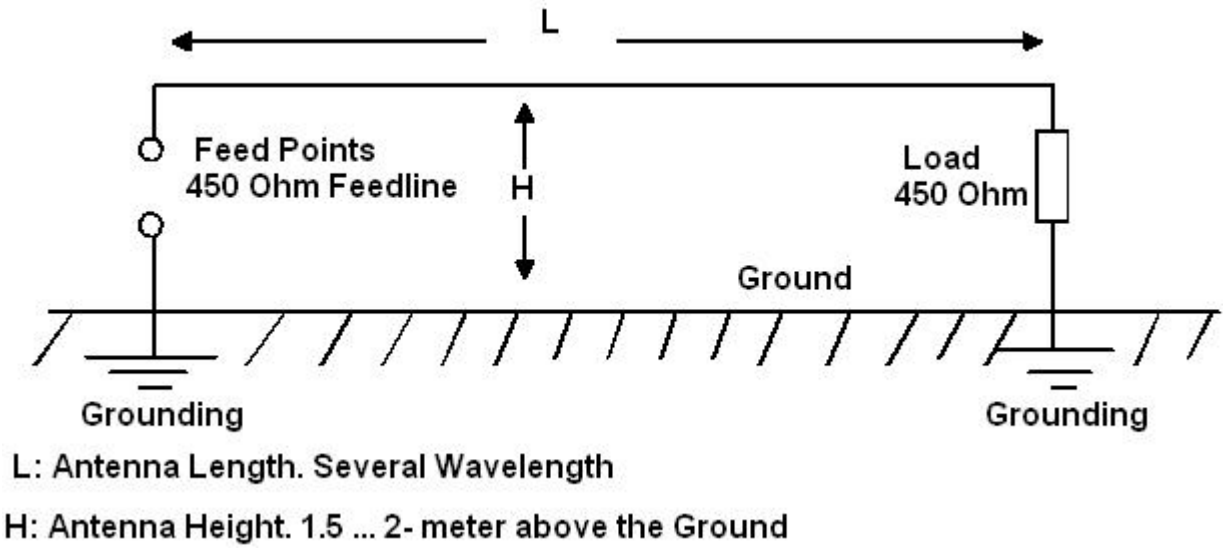

Figure 1 Classical Beverage Antenna

Receiver/transmitter with the feedline is attached to one end and the other terminated through a resistor (300- 600 Ohm) to ground. The value of the resistor should be equal to the wave impedance of the transmission line that created by the antenna wire and the ground under the wire. So, optimum value of the resistor depends on the height the wire above the ground and diameter of the wire. Beverage Antenna has SWR close to 1.0:1.0 in a wide spectrum of the radio frequency band when the optimum value resistor is used and the antenna fed through line with impedance that is equal to the wave impedance of the antenna.

Beverage Antenna has practically unidirectional radiation pattern (small back lobe of course is present) with the main lobe directed to the resistor-terminated end. The wide of the lobe depends on to ratio "used frequency: antenna length." I believe that the paragraph gave enough theoretical knowledge to build a Beverage Antenna.

Figure 2 shows Beverage Antenna that I have installed at my backyard. Length of my Beverage antenna was equal to 20- meters. The length was fixed by the length of the fence. Antenna wire was stapled to the fence. I used to a 16- AWG (1.3- mm) wire in strong black plastic insulation. The wire was bought at sale at Home Depot- 22 cent/meter. The wire used to in electrical job. The antenna wire was placed at height 1.8- meter above the ground. Height of the fence defines it. Theoretical value of the wave impedance of my antenna was close to 500- Ohm. It is allowed me use 450- Ohm terminated resistor and transformer 1:9 to feed the antenna through coaxial cable RG8X 50- Ohm. At my case the cable had length in 50 feet. At both end sides the Beverage Antenna had RF and electrical grounding.

Below we discuss all parts of the Beverage Antenna.

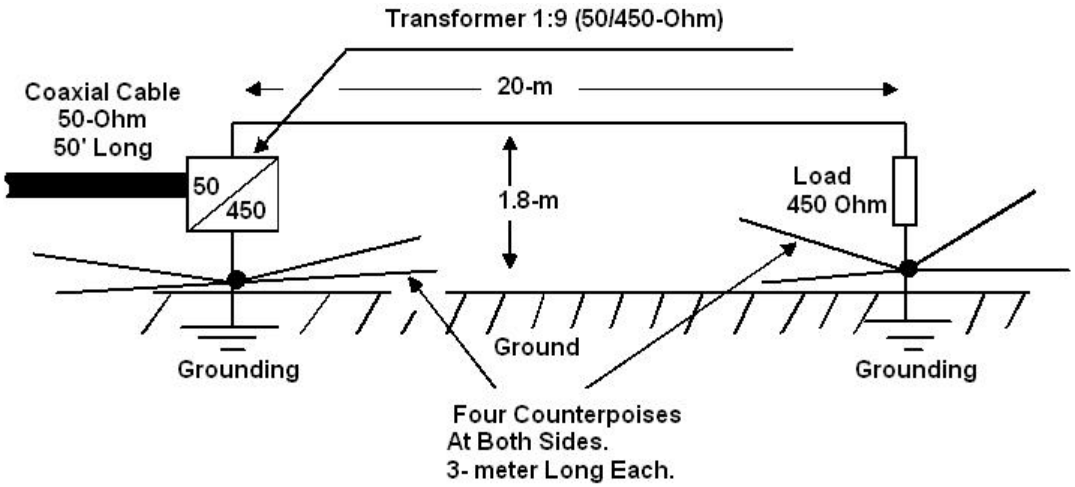

Figure 2 Practical Design of my Beverage Antenna

Terminated resistor of the Beverage Antenna

I need termination resistor for my Beverage Antenna. It should be 450- Ohm, non-inductive, 20… 50- Wtts Broadband termination resistor. Power of the resistor depends on output power of used transmitter. The resistor may dissipate up to 50% of the RF power going to the antenna. It is not a problem to buy such resistor online through internet. However, the chipper one costs $ 50.0 USD. I decided make the termination resistor by myself. I bought a kit with 25 e.a. usual 4.7-kOm/2.5-Wtt metal resistors for $ 5.0 on e-bay. Eleven such resistors switched to bridge have resistance 440- Ohm. **Figure 3** shows the home- brew termination resistor. Coin in 25- cents is placed beside the termination resistor. Dissipative power of the resistor should be 27.5- Wtts. However my experiments show that the resistor could stand at least 50- Wtts for a short time.

So, the Beverage antenna may work with transmitter with output power 100- Wtts with CW and SSB mode.

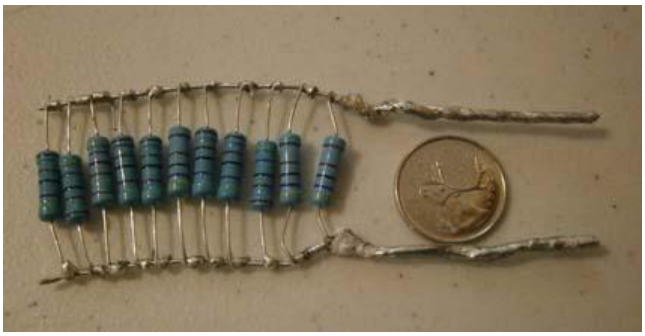

Figure 2 Practical Design of Home- Brew Termination Resistor

Transformer of the Beverage Antenna

Transformer of the Beverage Antenna is one of the important parts of the antenna. Transformer should work at all frequency range of the antenna. Transformer should stand power going to the antenna. It is preferably use to transformer with insulated windings for any Beverage Antenna. **Figure 4** shows Beverage Antenna with transformer with insulated windings. Such transformer provides electrical insulation the antenna from transceiver. It causes less noise from electrical interferences and provides additional protection of the transceiver from lightning discharge. However to make such transformer is not an easy task. Thereof I used unsymmetrical RF transformer 1:9.

Figure 5 shows schematic of classical unsymmetrical RF transformer 1:9. The transformer is winding by a triple wire onto a ferrite core. It may be a ferrite ring or ferrite rod. Transformer may contain 7-… 15 turns.

Quantity of turns depends onto size and permeability of the ferrite core and frequency range of the antenna.

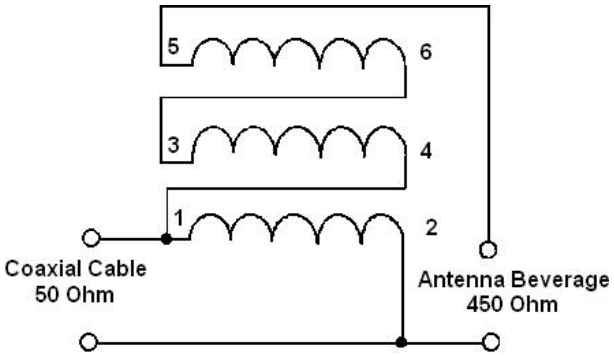

Figure 5 Schematic of Classical Unsymmetrical RF Transformer 1:9

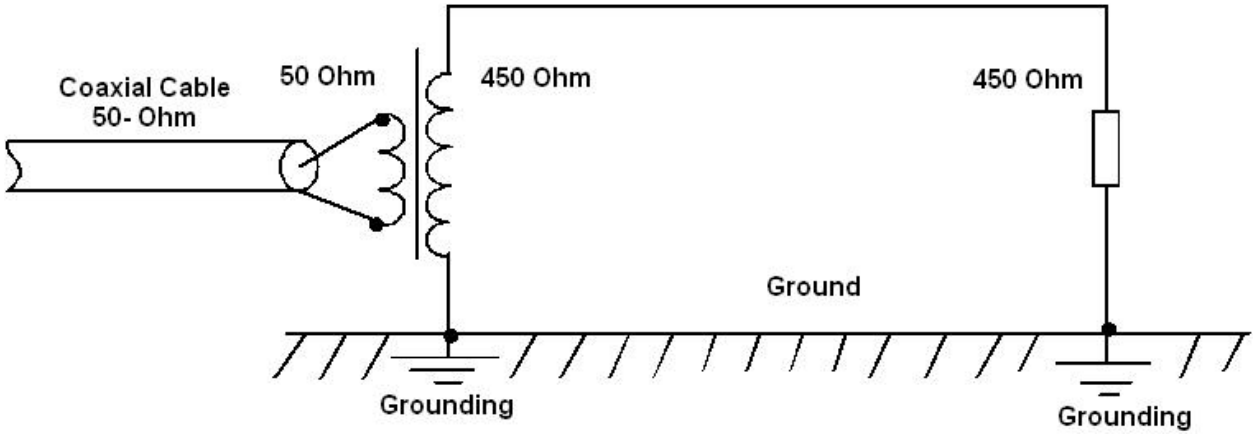

Figure 4 Beverage Antenna with Transformer with Insulated Windings

My first attempt to make RF transformer was use a TV Yoke's ferrite ring for the transformer 1:9. **Figure 6** shows the TV Yoke. I removed wires from the yoke. Then the ring was wrapped by black vinyl insulation tape. Unsymmetrical RF Transformer 1:9 was made according to the **Figure 5**. Transformer contained 8- turns of usual electrical wire. **Figure 7** shows ready Unsymmetrical RF Transformer 1:9 on TV Yoke. The transformer was tested. At the beginning the transformer was tested with usual metal resistor in resistance 440 Ohm. **Table 1** shows data for transformer made on Yoke Core loaded to Resistor 440 Ohm the measurements made by MFJ- 259B. **Table 2** shows data for the transformer made on Yoke Core loaded to home brew Resistor 440 Ohm (shown at **Figure 3**) the measurements made by MFJ- 259B. The home brew resistor has some reactance that clearly seen from the two tables. MFJ- 259B does not indicates the character of the reactance (capacitance or inductive) so I used sign "@" at the reactance.

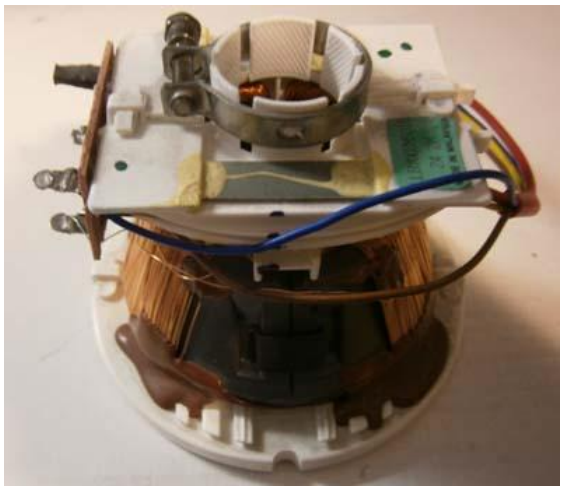

Figure 6 TV Yoke

Table 1 and Table 2 show that the transformer works well at 160- and 80- meter Bands, fair at 40- and 20- meter Bands and bad beginning from 17- meter Band. Of course it is possible play with quantity of the turns but anyway it should be difficult to make a real broadband transformer that covers 160- 10- meter Bands. So I gave up attempt to use RF transformer on TV Yoke core at my Beverage Antenna.

In my parts box there was a symmetrical Balun from LDG. Figure 8 shows the Balun. Some time ago I experimented with the Balun. However for that time it just took place in the box waiting for a new application. Time is come. The Balun had strong plastic cabinet with socket SO- 239 on it from one side and two terminals (for antenna and for ground) at another side.

Figure 7 Unsymmetrical RF Transformer 1:9 on TV Yoke

Table 1

Transformer made on Yoke Core. Loaded on to single resistor 440 Ohm. Measurement by MFJ- 259B

Band	160	80	40	30	20	17	15	12	10
Z	48@j5	45@j4	35@j1.4	27@j1	19@j11	13@j29	11@j40	9@j54	6@j69
SWR	1.1	1.1	1.4	1.8	2.5	4.3	6.7	9.1	12.4

Table 2

Transformer made on Yoke Core. Loaded on to eleven 4.7-kOm resistors switched to bridge (440 Ohm overall). Measurement by MFJ- 259B

Band	160	80	40	30	20	17	15	12	10
Z	49@j4	44@j6	31@j3	23@j2	15@j17	10@j33	10@j41	6@j61	5@j70
SWR	1.0	1.1	1.5	2.0	3.0	5.7	7.9	11.7	14.4

A ferrite ring was used on the Balun. The sizes of the ring were suite for transformer 1:9 that could work at 100- Wtts RF power going through. It was not hard reworked the Balun to unsymmetrical RF transformer 1:9. Additional wire in Teflon insulation was coiled between turns of the Balun. Then the wires were connected according to Figure 5. Figure 9 shows the unsymmetrical RF transformer 1:9. The transformer was tested. Table 3 shows data for the transformer loaded to Resistor 440 Ohm the measurements made by MFJ- 259B.

Figure 8 Balun RBA- 1:1 from LDG

Table 4 shows data for the transformer loaded to home brew Resistor 440 Ohm (shown at Figure 3) the measurements made by MFJ- 259B. As you can see the transformer works well from 160- to 10- meter band. It is possible play with quantity of the turns to move low SWR up or down inside the 160- 10- meter Band. However, I did not do it and leaved things like this.

Figure 9 Unsymmetrical RF transformer 1:9 on the Base of Balun RBA- 1:1

Table 3

Transformer made on LDG Balun Core. Loaded on to single resistor 440 Ohm. Measurement by MFJ- 259B

Band	160	80	40	30	20	17	15	12	10
Z	42@j17	48@j8	45@j3	40@j3	35@j3	31@j8	29@j12	29@j17	27@j29
SWR	1.5	1.1	1.1	1.1	1.4	1.6	1.8	2.0	2.4

Table 4

Transformer made on LDG Balun Core. Loaded on to eleven 4.7-kOm resistors switched to bridge (440 Ohm overall). Measurement by MFJ- 259B

Band	160	80	40	30	20	17	15	12	10
Z	43@j15	47@j7	42@j4	37Z@j4	31	27@j5	24@j10	23@j16	23@j21
SWR	1.4	1.1	1.2	1.3	1.6	1.8	2.1	2.5	2.8

Grounding of the Beverage Antenna

Right grounding of the each sides of Beverage Antenna is not a simple task. For example, at receiving centers of ex-USSR the grounding of Beverage Antenna was made by 10- 15 radial wires that were dig on to depth 20- 40- cm into the ground. It was good RF and electrical grounding. But it was not for me. I made simplified grounding. The grounding consisted of two parts (see **Figure 2**).

One part was ***RF grounding***. The grounding made suction of RF currents from the antenna wire. There were four wires in length 3- meter each. I used the same wire that for Beverage Antenna. The wires were dig on to depth 5- cm into the ground.

Another part of the grounding there was ***electrical grounding***. Electrical grounding allows static electricity flow from the antenna wire to the ground. As well the grounding increases the safety of the Beverage Antenna at lightning time. Antenna works quiet on to receiving with electrical grounding. **Figure 10** shows design of the electrical grounding. To make the grounding I used two copper strips (it was Copper Strapping from Home Depot) in length 3- feet and five copper tubes in length one foot each. The stuff was soldered according to the **Figure 10**.

I used compact Bernzomatic Butane Gas burner for soldering. **Figure 11** shows soldered grounding. **Figure 12** shows grounding at the antenna (feeding side). Ditch in depth near 5- cm was made in the place of the copper strip. The strips were placed into the ditches. Copper tubes were hammered into the ground. After that a batch of earth (with grass seed) was covered the electrical grounding. Grass already covers my grounding.

Design of the Beverage Antenna

Wire of the Beverage Antenna was stapled to the wooden fence. **Figure 13** shows stapled wire.

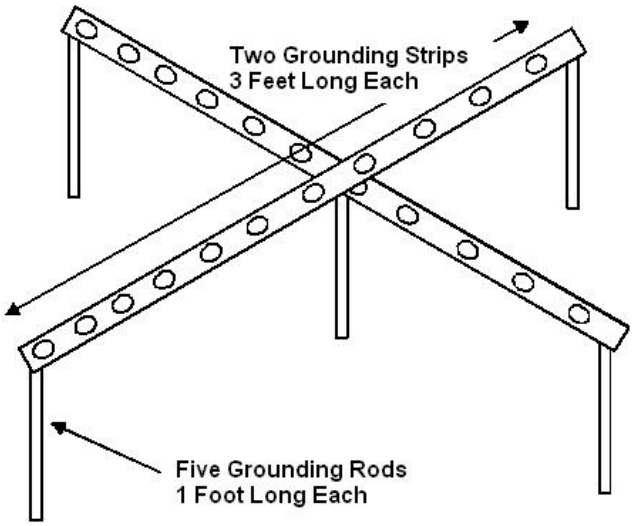

Figure 10 Design of the Electrical Grounding

Figure 11 Soldered Grounding

Termination resistor and transformer of Beverage Antenna were placed into food plastic boxes.

The boxes were chosen to fit the resistor assembly and transformer. **Figure 14** shows termination resistor in open plastic food box. **Figure 15** shows transformer in open plastic food box. Each box was closed by cover.

Then several turns of a vinyl plastic tape (I used electrical tape for outdoor application that should work at temperature range: – 20 C to + 60 C) were coiled above the cover. **Figure 16** shows termination resistor in closed plastic food box. **Figure 17** shows transformer in closed plastic food box. Coaxial cable is going to basement through a window with plastic insert. The insert made from soft foam. **Figure 18** shows the plastic insert on the window. Near entry of the cable to the plastic insert the coaxial cable was coiled in a small coil. The coil was an RF Choke that closed way for stray RF currents inducted to outer jacket of the coaxial cable to the transceiver. Also the choke gave additional protection from lightning. **Figure 19** shows the RF choke.

Figure 12 Grounding at the Antenna

Figure 13 Stapled Wire of Beverage Antenna

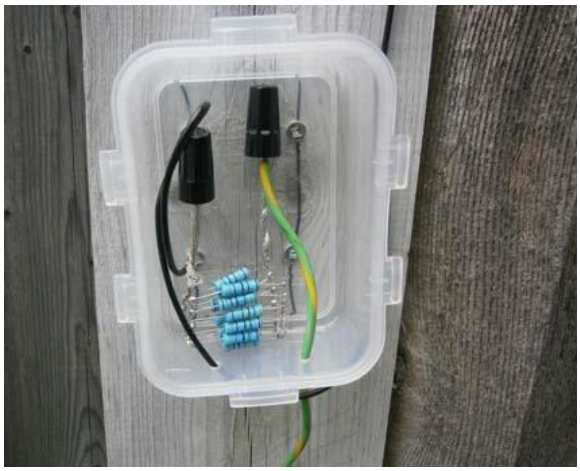

Figure 14 Termination Resistor of Beverage Antenna in Open Plastic Food Box

Figure 15 Transformer of Beverage Antenna in Open Plastic Food Box

Figure 16 Termination Resistor of Beverage Antenna in Closed Plastic Food Box

Figure 17 Transformer of Beverage Antenna in Closed Plastic Food Box

Test of the Beverage Antenna

At first I have measured SWR of the Beverage Antenna with help of MFJ-259B and with internal SWR- meter at IC-718. **Table 5** shows SWR of the Beverage Antenna measured with help of MFJ-259B. **Table 5** shows SWR of the Beverage Antenna measured with help of internal SWR- meter at IC-718. Data for MFJ- 259B a little differ from data obtained with internal SWR- meter at IC-718. It happened because at antenna wire there is some stray RF voltage receiving from different radio stations. The RF voltage add some errors to the reading SWR by MFJ-259B. In this case data obtained from the internal SWR-meter of IC-718 are close to the truth.

My Beverage Antenna has direction to Europe and East Cost of the USA. Antenna works perfect. Low bands 160 and 80- meter come to live. It was very good reception at all HF bands from 160- to 10 meter.

Figure 18 Plastic Insert on the Window

Figure 19 RF Choke near the Window

I could receive ham station from Europe and Asia from 160- to 10 meter. Of course, I cannot say that about transmitting operation on 160- 40- meter bands. It is noticeable that some power lost into the termination resistor. However, at good propagation the Beverage Antenna works perfect on transmission at all HF bands from 160- to 10 meter.

Table 5

Antenna Beverage with transformer made on LDG Balun Core. Load: 4.7-kOm x 11 Resistors (440 Ohm overall). Length of the 50- Ohm Coaxial Cable to antenna is 50 Feet. Measurement by MFJ- 259

Band	160	80	40	30	20	17	15	12	10
Z	75@j8	57@j4	42@j11	43@j19	50@j21	39@j28	24@j35	24@j12	97@j65
SWR	1.5	1.1	1.1	1.5	1.5	1.9	1.9	2.1	2.8

Table 6

Antenna Beverage with transformer made on LDG Balun Core. Load: 4.7-kOm x 11 Resistors (440 Ohm overall). Length of the 50- Ohm Coaxial Cable to antenna is 50 Feet. Measurement by SWR –meter of ICOM- 718

Band	160	80	40	30	20	17	15	12	10
SWR	1.7	1.0	1.0	1.5	1.1	1.8	1.8	2.0	2.9