

## Nonlinear effects on antennas

by Igor Grigorov/RK3ZK

TVI and RFI appeared suddenly when my transceiver worked on amateur ranges of 10-20 meters. Earlier the transceiver worked everywhere without TV and FM radio interferences. I did not do anything either to the transceiver or the antennas.

For search of the cause of interferences the transceiver was switched off from the outside antenna and loaded to a dummy load. No interferences! The transceiver was switched on to the indoor magnetic loop. Again, no interferences! Interferences appeared when the transceiver was switched on to the outside antenna. An additional low-pass filter at transceiver output did not influence the level of arising interferences. **So, located on a roof antenna was the source of interferences.**

But how can the antenna create TV and FM radio interferences? Why did the interferences disappear some days later and the antenna worked well again?

### The heart of the effect

These interferences are caused by a nonlinear conductivity (like a semi-conductor) at an oxide film covered metal parts, which comprise the antenna or are located near the antenna. For example, a copper oxide is a good semi-conductor. The oxides of many other metals are good semi-conductors too. A pressing junction of one metal to another, especially if a galvanic couple is formed there, often has a semiconductor's effect.

Let's examine the things that take place if a transmitting antenna or metal objects which are placed near this antenna have parts causing the nonlinear effect. When the antenna works at transmitting mode, RF currents flow through these semi-conductor sites, and these RF currents can be significant. The antenna or metal objects placed near an antenna, that have sites keeping nonlinear conductivity through which RF currents flow, will work like a mixer or a multiplier of radio signals. In this case, radio signals emitted by a ham's transceiver, can be mixed in different combinations with radio signals from a television center or from VHF broadcast or service stations, with main buzz of 50 (60) Hz, or multiplied by each other.

The secondary signals, obtained as a result of it, with frequencies formed by different linear combinations of frequencies of original signals, can be radiated back in the ether. It will cause different electronic equipment interferences at the activity of a ham transmitter.

The nonlinear effect of mixing signals can appear at a power going to an antenna starting from several watts.

Everything depends on the location of these nonlinear sites. At placing them directly on the antenna, on the antenna mast, on guys, a small power will be enough for forming secondary signals. At removing the nonlinear sites from the antenna, a considerable power going to the antenna will be needed for forming secondary signals.

If the nonlinear sites are placed on the metal objects that have resonances at the operating frequencies of a ham's transmitter, a small power going to the antenna will be enough for creating secondary signals. If the metal objects keeping the nonlinear sites have resonances on the frequencies of the secondary signals, the radiation of the secondary signals will be especially great.

### The causes of sudden occurrence of the nonlinear effect

Let's examine the effects that can cause sudden occurrence of the effect of nonlinear conductivity. I think that acid rains and dust containing particles of metals can cause these effects.

Acid rains cause a strengthened corrosion of metal, and, hence, occurrence of an oxide film keeping the effect of nonlinear conductivity. Many hams observed that sometimes after rains the transceiver that worked before without interferences suddenly started to create interferences. The dust, containing particles of metal and suddenly brought with a strong wind, can create sites keeping the effect of nonlinear conductivity.

Metal dust covers the metal objects placed on and near the antenna, acid rains cause some chemical reactions between the metal dust and metal that this dust covers. As a result of it, after a strong wind which contains particles of the metal dust and acid rains, a transceiver starts to create TV and FM radio interferences.

As a rule, suddenly created sites, keeping the effect of nonlinear conductivity, suddenly disappear. Some time after the rain and dusty storm, the sun dries up the oxidized surfaces, and (in my opinion) destroys the film of oxide formed by acid rains. The effect of nonlinear conductivity disappears, and a ham's transceiver does not create interferences in its work.

### **Dangerous nonlinear sites**

The sites, keeping the effect of nonlinear conductivity, that are created for a long time, are the most dangerous, because, as a rule, they do not lose the properties under effect of the sun. The sites, keeping the effect of nonlinear conductivity, that are created for a long time, at first create weak interferences. In the course of time the sites produce still stronger interferences.

For example, if a drop of water gets under paint cover of an antenna, the drop can create a site keeping the effect of nonlinear conductivity. To find the site is rather difficult! Copper and brass antenna parts, and copper and brass objects placed near the antenna, which are unprotected by paint, in the course of time are oxidized. Aluminum antenna parts with scratches are also subjected to oxidation. This oxide can have the effect of nonlinear conductivity.

It was noticed by me, the sites, keeping the effect of nonlinear conductivity, which were created during long time, demand some "additional charging" so as not to lose the nonlinear effect. That is, if an antenna, that has the sites, keeping the effect of nonlinear conductivity, is not used to transfer, the sites lose the qualities. But as soon as the antenna starts to work to transfer, the sites, keeping the effect of nonlinear conductivity, restore the nonlinear qualities for a short while. Thus, external atmospheric conditions influence a little the restoration of these nonlinear qualities, work of the antenna to transfer influences much. Nonlinear qualities can be restored both in dry and rainy weather, both in heat in the summer, and in a frost in the winter.

### **Searching of sites keeping the effect of nonlinear conductivity**

Let's examine how it is possible to find out the sites keeping the effect of nonlinear conductivity.

I used two methods for search of the sites. The first method is a visual method, the second one is a tool method.

The visual method consists of a visual inspection of the antenna design and places located near the antenna. By using this method we visually find suspicious oxidized places and suspicious pressing junctions of one metal to another. We also find metal objects located near the antenna that should have resonances within the antenna operation ranges.

After that a tool method is used. This method confirms or denies whether the visually found places can create interferences, or, that is the same, they have the effect of nonlinear conductivity or not.

### **Nonlinear effects in resonant objects**

Using the tool method we can measure resonances of metal objects that are near the antenna or used in the design of the antenna (for example, masts, guys, etc.). It is possible to find resonances with the help of a GDO. This method of measuring resonances of masts and guys with the help of a GDO is described in reference [1].

If metal objects have resonances within operational ranges of a ham's transceiver, significant RF currents can flow on surfaces of these metal objects when the transceiver works to transfer. When significant RF currents flow on surfaces of objects that have sites keeping nonlinear conductivity, these objects will work like a mixer or a multiplier of radio signals. In this case, radio signals emitted by ham's transceiver, can be in different combinations mixed with radio signals from a television center or from VHF broadcast or service stations, with main buzz of 50 (60) Hz, or multiplied by each other. My experience shows that a pressing junction of such resonance objects produces a very high level of interferences.

**Photo: Finding of resonance of the mast with help a GDO**





Photo: Finding of resonance of the guys with help a GDO

For example, a metal mast with television antennas was near my transmitting antenna. There were strong TV interferences when my transceiver worked to transfer at a range of 30-M. As it appeared, this mast had a resonance frequency 10100 kHz, or on the amateur range of 30 30-M. When a ferrite ring from a deflection system of an old TV was installed at the base of the mast, the resonance frequency of the mast became equal to 9800 kHz. TV interferences disappeared when my transceiver worked on the 30-M range.

Photo: Finding of resonance of the antenna mast with the ferrite core at its base with help a GDO



If to change the resonance frequencies of these objects, a level of the RF currents, caused by work of the antenna to transfer, will be sharply decreased. In this case the level of the interferences will be considerably decreased too, or the interferences will disappear entirely. It is possible to change a resonance frequency of a metal mast (to shift it downwards), if at its base to install a ferrite ring from a deflection system of a TV.

Photo: Ferrite core installed at the antenna mast base

Unfortunately, when the ferrite ring was installed, a resonance on a range of 15-M appeared at the mast. TV interferences appeared too. For elimination of this resonance I used a magnetic tape from an old videocassette. When I wound the centre of the mast with the tape, my GDO did not fix any resonance on amateur ranges. By means of an old magnetic tape from old videocassettes it is possible to eliminate easily parasitic resonances of masts and guys on high-frequency amateur ranges of 15-6 meters



There is one more way of eliminating parasitic resonances of metal objects. It consists in painting these objects in graphite paint. This way, and also manufacturing of the graphite or coal paint, is described in reference [2]. It is the most effective way of struggle against this phenomenon.

**Direct detection of sites keeping the effect of nonlinear conductivity**

When the parasitic resonances of metal objects placed near the antenna are eliminated, start a further search of the places creating interferences. For that a transceiver is turned on to a small RF power, when the effect of nonlinear conductivity begins only to appear in the antenna system and objects placed near the antenna.

Try to find places where the interferences are formed by an indicator of interferences.

**Photo: Wrapping the antenna mast by magnetic tape**



**Indicator of interferences**

It is possible to use either a portable TV-set or a hand-held receiver working on a wide range of frequencies as an indicator of interferences. A TV - set quickly and reliably helps to find a place where interferences are formed and shows the influence of TV interferences. It is very simple to find interferences with the help of a broadband receiver. The receiver hisses and rattles and receives imaginary stations near the places keeping the effect of nonlinear conductivity.

I prefer to use a broadband receiver for finding places keeping the effect of nonlinear conductivity. A hand – held receiver has smaller sizes than a portable TV, but a receiver, as well as a portable TV, allows quickly to find interferences and places where the interferences are formed. For example, for a long time I have used a broadband radio receiver “Tecsun-R1012” for finding interferences. This receiver works at MW, SW (5-22 MHz), VHF- FM (60-110 MHz) and VHF – TV (1 - 12 TV channels).

This receiver allows to search for the interferences on a wide range of frequencies.

**Finding the interferences**

Smoothly moving a TV set or a receiver around an antenna, try to find places where the level of interferences is maximum (see Fig. 1). Try to find the interferences near the already visually found oxidized sites, places of pressing junctions of metals, near metal parts that have parasitic resonances. Usually in this case the pattern of interferences is very spread. It is clear, combination frequencies are created on small nonlinear segments, where there are conditions for their appearance, and they are radiated through sizable parts - guys, metal enclosure of a roof, antenna, etc. However, the maximum of intensity of interferences will be near the places where they are created.

**Photo: Finding of the interferences**

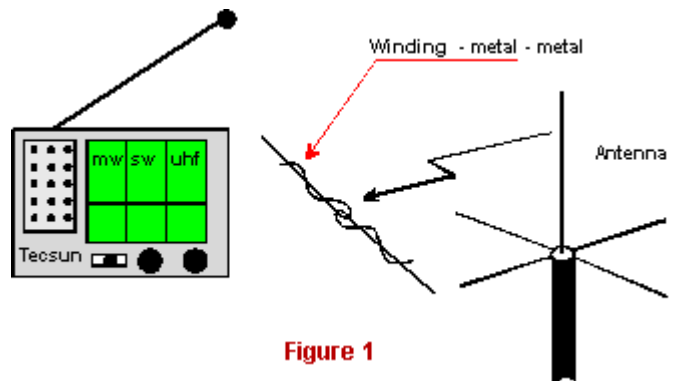


After that proceed with searching of the exact places where interferences are formed.

**Localization of the interferences**

To determine the placement of a site keeping the effect of nonlinear conductivity the suspicious place is irradiated by RF energy.

**Figure 1** Search of sites keeping the effect of nonlinear conductivity



**Figure 1**

An RF Lantern is used for this purpose. The design of the RF Lantern is simple.

**RF Lantern**

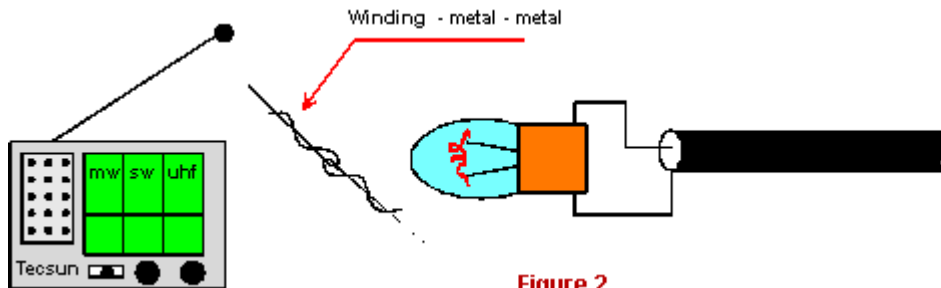
A dummy load that is connected to the end of the feeder going from a ham’s transceiver can serve as a RF Lantern. The dummy load must be unscreened. 10- 40 watt going to the dummy load will be enough for the RF Lantern to work. It is possible to use an incandescent bulb that has a resistance equal to the wave resistance of the feeder and a proper power as a dummy load.

A dummy load has a small field of radiation at immediate proximity near it. It allows to irradiate a suspicious site placed near the dummy load and check the site to keeping the effect of nonlinear conductivity. **Fig. 2** shows the method. A TV set or a radio receiver should be near that place where occurrence of nonlinear effect is supposed to be.

**Photo:** Localization of a suspicious place



**Figure 2** Localization of a suspicious place



**Figure 2**

"Shining" by the radio field of the RF Lantern the suspicious places, such as the oxidized surfaces of metals and pressing junctions of metals, it is possible very precisely to define whether interferences are created there. The coaxial cable that feed the RF Lantern should provide free moving around the places that are suspected of keeping the effect of nonlinear conductivity. RF Lantern on the base of an incandescent bulb is especially convenient to search for such places. In this case, "shining" a suspicious place by the light of the bulb, we check this place on the creation of secondary frequencies.

Metal guys are broken by insulators, a touching place of a metal guy to a metal mast is broken by an insulator plate or tape.

However, in some cases it is not possible to eliminate the touch of metals to an antenna mast or an antenna guy. Some samples of antenna metal masts have designed pressure junctions of metals among themselves, that is why the elimination of these pressing junctions of metals will entail alteration of the mast.

When the places keeping the effect of nonlinear conductivity are found, start to eliminate the effect of nonlinear conductivity. Ways of liquidating nonlinear effects depend on the reasons for their occurrence. Let's examine the ways of eliminating interferences arising at a place of pressing junction of metals.

For elimination of the effect of nonlinear conductivity arising at places of pressing junctions of metals that are impossible to break by insulators, use food foil or graphite paint. For this wrap up this place in a food foil or paint it in graphite or coal paint.

**Touching metals**

The effect of nonlinear conductivity arising at places of pressing junctions of metal, for example, at places of winding of metal guys or at a touch of a metal guy to a metal mast, could be eliminated by isolating metals from each other.

**Graphite paint**

The universal way of eliminating the effect of nonlinear conductivity consists in covering the places keeping the nonlinear effect with graphite or coal paint. The way of manufacturing graphite or coal paint is described in reference [2].

**Photo:** Wrapping a suspicious place by aluminum foil



It is possible to rub the places with graphite or coal if a ham has no graphite or coal paint. What is the effect of rubbing metal objects or parts of these objects, keeping the effect of nonlinear conductivity, with graphite or coal paint?

**Firstly**, by covering metal objects or parts of these objects with graphite paint we will essentially reduce Q- factor of these objects on high frequencies that results in significant decrease of a level of high-frequency currents which are induced at work of a closely located transmitting antenna. Elimination of resonances in the field of frequencies of work of the transmitter considerably will lower the efficiency to create secondary frequencies. Elimination of resonances in the field of the secondary frequencies, produced at places keeping the effect of nonlinear conductivity, will lower the efficiency to radiate the interferences.

**Secondly**, the layer of graphite, located atop of a site keeping the effect of nonlinear conductivity, provides additional absorption of a high-frequency energy in a wide spectrum of radio frequencies. The graphite layer provides absorption of the signal radiated by the ham's transmitter, affecting the site keeping the effect of nonlinear conductivity and being the reason for creating secondary frequencies. The same graphite layer provides additional absorption of the secondary frequencies created on sites keeping the effect of nonlinear conductivity. It will considerably reduce an overall performance of the sites keeping the effect of nonlinear conductivity to create secondary frequencies.

**Thirdly**, the layer of graphite located atop of a film of oxide or atop of pressing junctions of metals creates an equalized effect of an RF- potential on the surface where this graphite layer is allocated. It considerably lowers an overall performance of sites keeping the effect of nonlinear conductivity as a mixer of radio signals.

It was repeatedly noticed by me that painting of pressing junctions of metals or oxidized places of metals usually reduces to full elimination nonlinear effects arising on these sites.

### **Panoramic Spectrum Analyser in search of nonlinear sites**

If a ham has a possibility to use a **Panoramic Spectrum Analyser**, he is capable not only of finding interferences, radiated from the sites keeping the effect of nonlinear conductivity, but also in defining parameters of the interferences. Hence, it will be possible to assume what equipment will be affected by the interferences. A Panoramic Spectrum Analyser allows to see the effect of painting in graphitic paint the places, where there are nonlinear phenomena or to see the effect from separation pressing junctions of metals from each other.

A source of nonlinear effects can be most unexpected. In one of my cases, a bay of a bimetallic wire (copper cover above iron wire) placed on a roof near my transmitting antenna caused TV interferences. After the bay was removed to the other side of the roof, the interferences were stopped.

I wish successes in struggle against nonlinear effects!

#### References:

1. Grigorov I.N.: Antenna Tuning @ Adjustments. – Published by antennex Online Magazine, Corpus Christi, Texas, USA.  
ISBN: 1-877992-39-9
2. Grigorov I.N.: Antenna Toolkits. Part-I: Wires and Parts // [www.antennex.com/library/archive](http://www.antennex.com/library/archive) V



Multi- Range Vertical Antenna UA1DZ

by Igor Grigorov, RK3ZK

**Antenna history:** Antenna UA1DZ is a very interesting multi- range vertical antenna designed by known Russian radio amateur UA1DZ. The antenna was very popular in use in the former USSR. Russian radio amateurs widely use the antenna at present days also. The antenna works with a low SWR on 40-m, 20-m and 15m. Firstly UA1DZ told about his antenna in the ether, and after that, lots Russian radio amateurs have did the antenna and Antenna UA1DZ became very popularity. First printing papers about antenna UA1DZ appeared in reference [1]. This antenna has gain 3,67 dBi at 40-m, gain 4 dBi at 20-m, gain 7,6 dBi at 15m (reportedly to VA3TTT, reference [2]).

**Antenna construction:** Figure 1 shows the construction and matching device of multi-range vertical antenna UA1DZ (based on reference [1]). The vibrator of the antenna has the length in 9.3 meters and four counterpoises of the antenna have length in 9.4 meters. Why has the antenna such sizes? Well, for his multi range antenna UA1DZ used an old military vertical antenna and this one had such sizes.

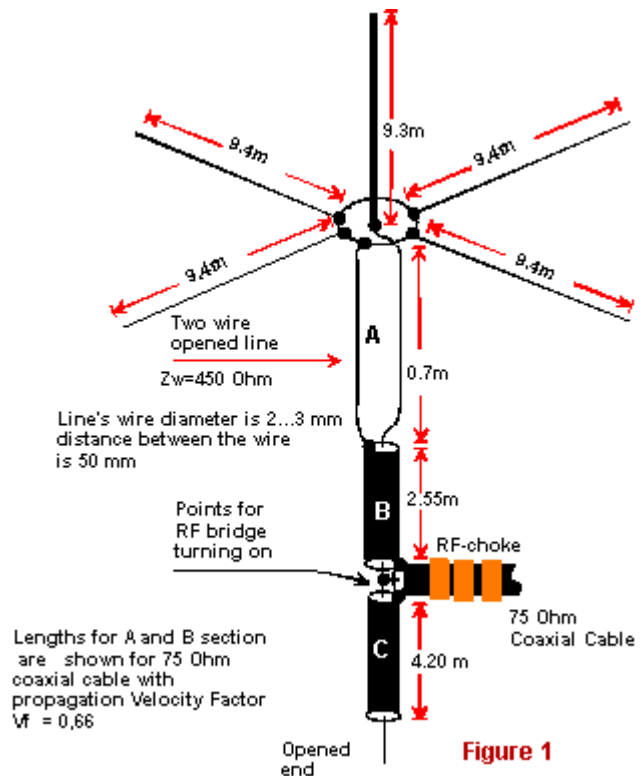
If you have not such old military vertical antenna, of course, it is possible to do home made vibrator and counterpoises! The vibrator and counterpoises must be made from copper or aluminum stuff. Do not use iron wire for HF antenna at all! Iron does not work properly in HF transmitting antennas, especially at upper amateur HF ranges.

Guys must be used with the antenna for providing wind strength. Use acryl cord or iron wire "broken" by insulators to one - meter lengths. Base insulator should have high mechanical and electrical strength because antenna vibrator has a large weight and there is high RF- voltage across the base insulator in transmitting period.

**Matching device:** It is made on one length of two – wire opened line and two lengths of a 75- Ohms coaxial cable. With the matching device the antenna can work on ranges 40-m, 20-m and 15m with a SWR in coaxial cable no more than 2:1. Two wire opened line "A" does initial matching the antenna input impedance with feeding coaxial cable. The line has characteristic impedance of 450 Ohm and one meter initial length. As usual, the line has ended length about 0.7- meter.

Coaxial cable "B" with characteristic impedance of 75- Ohm and with length 2.5 meters makes further matching for input impedance of the antenna system with feeding coaxial cable. An opened on the end length of coaxial cable "C" makes compensation of a reactive part of the input impedance of the antenna system.

Two wire line (part A) and the matching parts B and C must be placed not less the 50 centimeters above the roof. Parts A and B should be placed in straight line. It is possible to coil the part C in a bay.



**Antenna tuning:** The antenna UA1DZ is tuned as follow.

- An RF bridge is turned to input terminal of antenna matching device (see Figure 1).
- Shift antenna resonance frequencies in amateur 40- and 15-m bands by gradually diminishing the length of matching section A. Five centimeters truncation the length of matching section A does frequency shift up to 200 kHz on 21 MHz, and up to 60 kHz on 7 MHz.

It is quite possible to tune the length of matching section A so, that antenna UA1DZ will have the resonance frequencies inside ranges 21 and 7 MHz. If the antenna UA1DZ has resonances on these ranges (40- and 15-m), it will have a resonance frequency inside 20-m range.

**Two-wire opened line:** It is possible to use either commercial made two-wire opened line either homebrew one. Remind, that two-wire transmission line with aerial dielectric and 450 Ohm characteristic

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impedance has relation between the diameter of its wires and the distance between these wires nearly 20 (see [Figure 2](#)).

**RF – choke should be used:** An RF-choke should be installed on the coaxial cable at the antenna terminal. This RF-choke precludes leaking of RF currents on the outer braid of the coaxial cable.

Without such RF-choke the outer braid of the coaxial cable will serve as a radiating part of the vertical antenna. It causes big level of RF interferences when the antenna works on transmission. 10 -30 ferrite rings, hardly dressed on the coaxial cable at the antenna terminal, make the most simple an RF-choke. The place for a RF choke is shown in [Figure 1](#).

## Hula- Hoop magnetic Loop

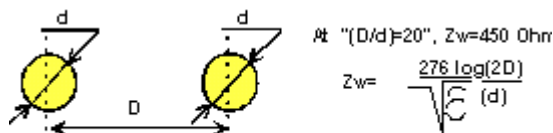


Figure 2

### References:

1. RB5IM.: Ground plane UA1DZ. Bulletin UC 1993, C.27.
2. A. Barskiy, VA3TTT: About antenna L [www.krasnodar.online.ru/hamradio](http://www.krasnodar.online.ru/hamradio)

## Hula- Hoop magnetic Loop

by [Yuri Kazakevich](#), EW6BN, , [ew6bn@tut.by](mailto:ew6bn@tut.by)



After long QRT (birth of my daughter, changing my QTH) I was going again QRV!!!

So, I needed an antenna! But where can I install it? It was not possible to install any antenna on the roof of my house. I had only place for installation of an antenna, the place was my balcony of my house. Well, it was very place. What an antenna can install at the place? I thought, it was only a Magnetic Loop Antenna.

I remembered, when I still went to school, I used a Magnetic Loop Antenna made from old coaxial cable for my work on CB - range 27 MHz. The antenna worked very well. Well, I decided to use a Magnetic Loop Antenna for my very restricted area for a work at 14 MHz.

Lots information about Magnetic Loop Antennas I found in the Internet, in particular in reference [1], it is a free e- book on antennas (in Russian).

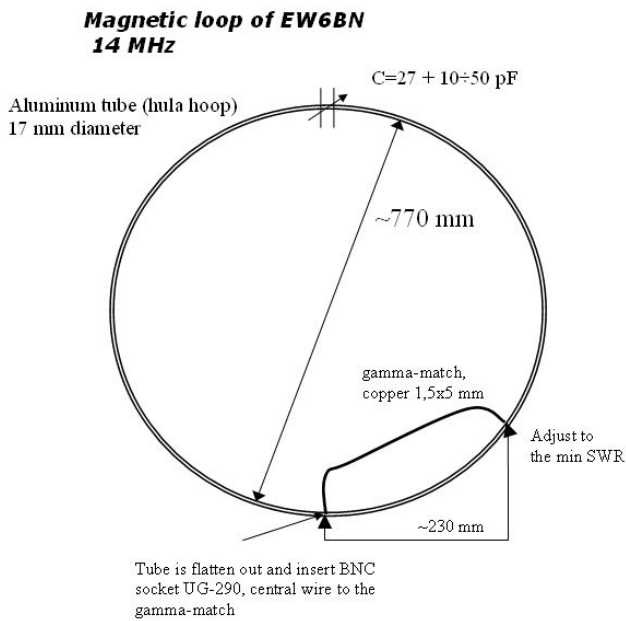
I decided to make my Magnetic Loop Antenna on the basis of an aluminum hula - hoop. Hula – hoops in diameter of 77 centimeters and with 17 mm tube

diameter were on sale in my local shop. The hula – hoop tuned at 14 MHz with two capacitor- one variable capacitor 10- 50 pF, and other, bridged to the variable capacitor, a fixed capacitor in 27 pF. The capacitors placed at the top the hoop. For my loop I used gamma feeding, because it has very high efficiency. [Figure 1](#) shows my Magnetic Loop Antenna. I have got 1:1.3 SWR with the gamma match.

The Magnetic Loop Antenna was installed on the third floor of a brick five-floor house. A wooden stick hold the antenna almost in one meter aside from the balcony. It was impossible to do a rotary design of the antenna for my conditions, so I just fixed the antenna on the line West – East. My house is situated at outskirts of the city, so, the West is opened, only one imperfection, a high-voltage power electric line on 110 kV is in 50 meters from my antenna....

**On reception** the antenna worked perfectly. But, unfortunately, there was a small handicap from the high-voltage power electric line.

**Figure 1 Magnetic Loop Antenna**



The antenna had very good results at transmission mode. See my first QSOs, that I have made straight away after installation of the antenna.

**18:50 UTC, 13 July 2003:**

I heard "CQ de G3KXV". I pressed on key – "G3KXV de EW6BN/QRP..."  
And ... "EW6BN/QRP de G3KXV" op Vic.  
YES, the QSO is made!  
I gave RST 579 QSB.  
He gave me 569, also QSB, 100-w and a dipole, your mag loop 77 cm doing very well!

**19:25, UTC, 13 July 2003:**

HB9DRK/QRP stayed on CQ, he received my call, gave me 329, I gave him the info about my mag loop, and HB9DRK/QRP gave me a new rpt 559, he used 5-w and a delta.

Perfectly... My soul was singing, but I had to do QRT for a while...

So, my balcony Magnetic Loop Antenna allows me to be in the ether again and to do interesting QSOs over the World!

**Reference:**

1. Igor Grigorov: "Antennas for radio amateurs - 1998, Majkop, e-book, Available free at [http:// hamradio.online.ru/ftp/rk3zk/zip](http://hamradio.online.ru/ftp/rk3zk/zip)

**EW6BN:A Field Operation**



Once again about a magnetic loop ...

by Igor Grigorov, RK3ZK

I made probably hundreds various magnetic loops (and on basis of hula- hoops, of course!) for work in ranges of frequencies from 136 kHz up to 148 MHz. And always I have got rather quite good results, as at work of these antennas on reception, and at their work on transfer. And I am certainly glad, that Jury too has engaged in magnetic loops antennas!

For those hams who want to engage in experiments with magnetic loops on basis of hula-hoops, I have made calculations of magnetic loops antennas made on basis of

hula-hoops with diameter 77 cm and 100 cm. KI6GD **Magnetic Loop Antenna Calculator V.1.3** was used for this calculations. This program rather well counts parameters of magnetic loops antennas, and I recommend for all hams to use it.

I also calculated sizes for gamma matching and **Table 1** shows it. The sizes, of course, need to be corrected at a real antenna design.

*I wish you good luck in experiments with magnetic loops antennas!*

**Table 1**

Band, m	80	40	30	20	17	15
Hula- Hoop 100 cm OD	500	300	250	200	180	200
Hula- Hoop 77 cm OD	600	350	300	250	200	180

**The Gamma Match consists of from 1-mm OD (#18 AWG) placed at 50 mm above the Hula- Hoop**

**Magnetic Loop Antenna, 77 cm OD, 17 mm aluminum tube**

**Magnetic Loop Antenna, 77 cm OD, 17 mm aluminum tube**

**K16GD - Magnetic Loop Antenna Calculator v1.3 (c)2001**

Antenna Specifications		Units
Loop Circumference	<input type="text" value="2.418"/> meters	<input type="radio"/> Standard
Conductor Diameter	<input type="text" value="17"/> mm	<input checked="" type="radio"/> Metric
Operating Frequency	<input type="text" value="10.1"/> MHz	Shape
Operating Power	<input type="text" value="5"/> watts	<input type="radio"/> Octagon
Bandwidth	14.8 kHz	<input checked="" type="radio"/> Circle
Capacitor Value	101.2 pF	<input type="radio"/> Square
Capacitor Voltage	0.7 kV	Material
Conductor Wavelength	0.086 lambda	<input type="radio"/> Copper
Efficiency	8.3 %	<input checked="" type="radio"/> Aluminum
Inductance	2.282 μH	<input type="button" value="Calculate"/>
Inductive Reactance	144.8 ohms	<input type="button" value="Save"/>
Loop Area	1.5 metersl	<input type="button" value="Help"/>
Loop Diameter	0.8 meters	<input type="button" value="Exit"/>
Loop Q Value	680.7 Qres	
Radiation Resistance	0.009 ohms	
Resistance Loss	0.098 ohms	

**K16GD - Magnetic Loop Antenna Calculator v1.3 (c)2001**

Antenna Specifications		Units
Loop Circumference	<input type="text" value="2.418"/> meters	<input type="radio"/> Standard
Conductor Diameter	<input type="text" value="17"/> mm	<input checked="" type="radio"/> Metric
Operating Frequency	<input type="text" value="14.06"/> MHz	Shape
Operating Power	<input type="text" value="5"/> watts	<input type="radio"/> Octagon
Bandwidth	20.7 kHz	<input checked="" type="radio"/> Circle
Capacitor Value	48.6 pF	<input type="radio"/> Square
Capacitor Voltage	0.8 kV	Material
Conductor Wavelength	0.119 lambda	<input type="radio"/> Copper
Efficiency	22.4 %	<input checked="" type="radio"/> Aluminum
Inductance	2.282 μH	<input type="button" value="Calculate"/>
Inductive Reactance	201.6 ohms	<input type="button" value="Save"/>
Loop Area	1.5 metersl	<input type="button" value="Help"/>
Loop Diameter	0.8 meters	<input type="button" value="Exit"/>
Loop Q Value	680.0 Qres	
Radiation Resistance	0.033 ohms	
Resistance Loss	0.115 ohms	

**K16GD - Magnetic Loop Antenna Calculator v1.3 (c)2001**

Antenna Specifications		Units
Loop Circumference	<input type="text" value="2.418"/> meters	<input type="radio"/> Standard
Conductor Diameter	<input type="text" value="17"/> mm	<input checked="" type="radio"/> Metric
Operating Frequency	<input type="text" value="18.1"/> MHz	Shape
Operating Power	<input type="text" value="5"/> watts	<input type="radio"/> Octagon
Bandwidth	30.9 kHz	<input checked="" type="radio"/> Circle
Capacitor Value	26.3 pF	<input type="radio"/> Square
Capacitor Voltage	0.9 kV	Material
Conductor Wavelength	0.153 lambda	<input type="radio"/> Copper
Efficiency	41.1 %	<input checked="" type="radio"/> Aluminum
Inductance	2.282 μH	<input type="button" value="Calculate"/>
Inductive Reactance	259.5 ohms	<input type="button" value="Save"/>
Loop Area	1.5 metersl	<input type="button" value="Help"/>
Loop Diameter	0.8 meters	<input type="button" value="Exit"/>
Loop Q Value	585.6 Qres	
Radiation Resistance	0.091 ohms	
Resistance Loss	0.131 ohms	

**K16GD - Magnetic Loop Antenna Calculator v1.3 (c)2001**

Antenna Specifications		Units
Loop Circumference	<input type="text" value="2.418"/> meters	<input type="radio"/> Standard
Conductor Diameter	<input type="text" value="17"/> mm	<input checked="" type="radio"/> Metric
Operating Frequency	<input type="text" value="21.1"/> MHz	Shape
Operating Power	<input type="text" value="5"/> watts	<input type="radio"/> Octagon
Bandwidth	43.1 kHz	<input checked="" type="radio"/> Circle
Capacitor Value	17.4 pF	<input type="radio"/> Square
Capacitor Voltage	0.9 kV	Material
Conductor Wavelength	0.179 lambda	<input type="radio"/> Copper
Efficiency	54.4 %	<input checked="" type="radio"/> Aluminum
Inductance	2.282 μH	<input type="button" value="Calculate"/>
Inductive Reactance	302.5 ohms	<input type="button" value="Save"/>
Loop Area	1.5 metersl	<input type="button" value="Help"/>
Loop Diameter	0.8 meters	<input type="button" value="Exit"/>
Loop Q Value	489.5 Qres	
Radiation Resistance	0.168 ohms	
Resistance Loss	0.141 ohms	

*Magnetic Loop Antenna, 100 cm OD, 17 mm aluminum tube*

K16GD - Magnetic Loop Antenna Calculator v1.3 (c)2001

Antenna Specifications		Units
Loop Circumference	3.14 meters	<input type="radio"/> Standard
Conductor Diameter	17 mm	<input checked="" type="radio"/> Metric
Operating Frequency	3.6 MHz	Shape
Operating Power	5 watts	<input type="radio"/> Octagon
Bandwidth	8.4 kHz	<input checked="" type="radio"/> Circle
Capacitor Value	671.7 pF	<input type="radio"/> Square
Capacitor Voltage	0.4 kV	Material
Conductor Wavelength	0.040 lambda	<input type="radio"/> Copper
Efficiency	0.5 %	<input checked="" type="radio"/> Aluminum
Inductance	2.870 uH	<input type="button" value="Calculate"/>
Inductive Reactance	64.9 ohms	<input type="button" value="Save"/>
Loop Area	2.6 metersl	<input type="button" value="Help"/>
Loop Diameter	1.0 meters	<input type="button" value="Exit"/>
Loop Q Value	427.0 Qres	
Radiation Resistance	0.000 ohms	
Resistance Loss	0.076 ohms	

K16GD - Magnetic Loop Antenna Calculator v1.3 (c)2001

Antenna Specifications		Units
Loop Circumference	3.14 meters	<input type="radio"/> Standard
Conductor Diameter	17 mm	<input checked="" type="radio"/> Metric
Operating Frequency	7.03 MHz	Shape
Operating Power	5 watts	<input type="radio"/> Octagon
Bandwidth	12.4 kHz	<input checked="" type="radio"/> Circle
Capacitor Value	169.4 pF	<input type="radio"/> Square
Capacitor Voltage	0.6 kV	Material
Conductor Wavelength	0.077 lambda	<input type="radio"/> Copper
Efficiency	5.3 %	<input checked="" type="radio"/> Aluminum
Inductance	2.870 uH	<input type="button" value="Calculate"/>
Inductive Reactance	126.8 ohms	<input type="button" value="Save"/>
Loop Area	2.6 metersl	<input type="button" value="Help"/>
Loop Diameter	1.0 meters	<input type="button" value="Exit"/>
Loop Q Value	568.2 Qres	
Radiation Resistance	0.006 ohms	
Resistance Loss	0.106 ohms	

K16GD - Magnetic Loop Antenna Calculator v1.3 (c)2001

Antenna Specifications		Units
Loop Circumference	3.14 meters	<input type="radio"/> Standard
Conductor Diameter	17 mm	<input checked="" type="radio"/> Metric
Operating Frequency	10.1 MHz	Shape
Operating Power	5 watts	<input type="radio"/> Octagon
Bandwidth	16.8 kHz	<input checked="" type="radio"/> Circle
Capacitor Value	77.3 pF	<input type="radio"/> Square
Capacitor Voltage	0.7 kV	Material
Conductor Wavelength	0.111 lambda	<input type="radio"/> Copper
Efficiency	16.5 %	<input checked="" type="radio"/> Aluminum
Inductance	2.870 uH	<input type="button" value="Calculate"/>
Inductive Reactance	182.2 ohms	<input type="button" value="Save"/>
Loop Area	2.6 metersl	<input type="button" value="Help"/>
Loop Diameter	1.0 meters	<input type="button" value="Exit"/>
Loop Q Value	600.2 Qres	
Radiation Resistance	0.025 ohms	
Resistance Loss	0.127 ohms	

K16GD - Magnetic Loop Antenna Calculator v1.3 (c)2001

Antenna Specifications		Units
Loop Circumference	3.14 meters	<input type="radio"/> Standard
Conductor Diameter	17 mm	<input checked="" type="radio"/> Metric
Operating Frequency	14.06 MHz	Shape
Operating Power	5 watts	<input type="radio"/> Octagon
Bandwidth	27.0 kHz	<input checked="" type="radio"/> Circle
Capacitor Value	35.4 pF	<input type="radio"/> Square
Capacitor Voltage	0.8 kV	Material
Conductor Wavelength	0.155 lambda	<input type="radio"/> Copper
Efficiency	38.7 %	<input checked="" type="radio"/> Aluminum
Inductance	2.870 uH	<input type="button" value="Calculate"/>
Inductive Reactance	253.6 ohms	<input type="button" value="Save"/>
Loop Area	2.6 metersl	<input type="button" value="Help"/>
Loop Diameter	1.0 meters	<input type="button" value="Exit"/>
Loop Q Value	520.3 Qres	
Radiation Resistance	0.094 ohms	
Resistance Loss	0.149 ohms	

Magnetic Loop Antenna, 100 cm OD, 17 mm aluminum tube

KI6GD - Magnetic Loop Antenna Calculator		v1.3 (c)2001	
Antenna Specifications		Units	
Loop Circumference	<input type="text" value="3.14"/> meters	<input type="radio"/> Standard	
Conductor Diameter	<input type="text" value="17"/> mm	<input checked="" type="radio"/> Metric	
Operating Frequency	<input type="text" value="18.1"/> MHz	Shape	
Operating Power	<input type="text" value="5"/> watts	<input type="radio"/> Octagon	
Bandwidth	47.5 kHz	<input checked="" type="radio"/> Circle	
Capacitor Value	17.7 pF	<input type="radio"/> Square	
Capacitor Voltage	0.8 kV	Material	
Conductor Wavelength	0.199 lambda	<input type="radio"/> Copper	
Efficiency	60.4 %	<input checked="" type="radio"/> Aluminum	
Inductance	2.870 uH	<input type="button" value="Calculate"/>	
Inductive Reactance	326.4 ohms	<input type="button" value="Save"/>	
Loop Area	2.6 metersl	<input type="button" value="Help"/>	
Loop Diameter	1.0 meters	<input type="button" value="Exit"/>	
Loop Q Value	381.1 Qres		
Radiation Resistance	0.259 ohms		
Resistance Loss	0.170 ohms		

KI6GD - Magnetic Loop Antenna Calculator		v1.3 (c)2001	
Antenna Specifications		Units	
Loop Circumference	<input type="text" value="3.14"/> meters	<input type="radio"/> Standard	
Conductor Diameter	<input type="text" value="17"/> mm	<input checked="" type="radio"/> Metric	
Operating Frequency	<input type="text" value="21.1"/> MHz	Shape	
Operating Power	<input type="text" value="5"/> watts	<input type="radio"/> Octagon	
Bandwidth	73.3 kHz	<input checked="" type="radio"/> Circle	
Capacitor Value	10.6 pF	<input type="radio"/> Square	
Capacitor Voltage	0.7 kV	Material	
Conductor Wavelength	0.232 lambda	<input type="radio"/> Copper	
Efficiency	72.3 %	<input checked="" type="radio"/> Aluminum	
Inductance	2.870 uH	<input type="button" value="Calculate"/>	
Inductive Reactance	380.6 ohms	<input type="button" value="Save"/>	
Loop Area	2.6 metersl	<input type="button" value="Help"/>	
Loop Diameter	1.0 meters	<input type="button" value="Exit"/>	
Loop Q Value	287.9 Qres		
Radiation Resistance	0.478 ohms		
Resistance Loss	0.183 ohms		

Twins Delta Loop for 145 MHz



US8AR



Specification:

- **Directional diagram:** "Eight" with low-altitude beam to horizon;

by **Nick V. Derenko**, US8AR  
 ex **UB5AEO, UB4AR** <mailto:us8ar@qsl.net>  
<http://www.qsl.net/us8ar>  
<http://us8ar.narod.ru>

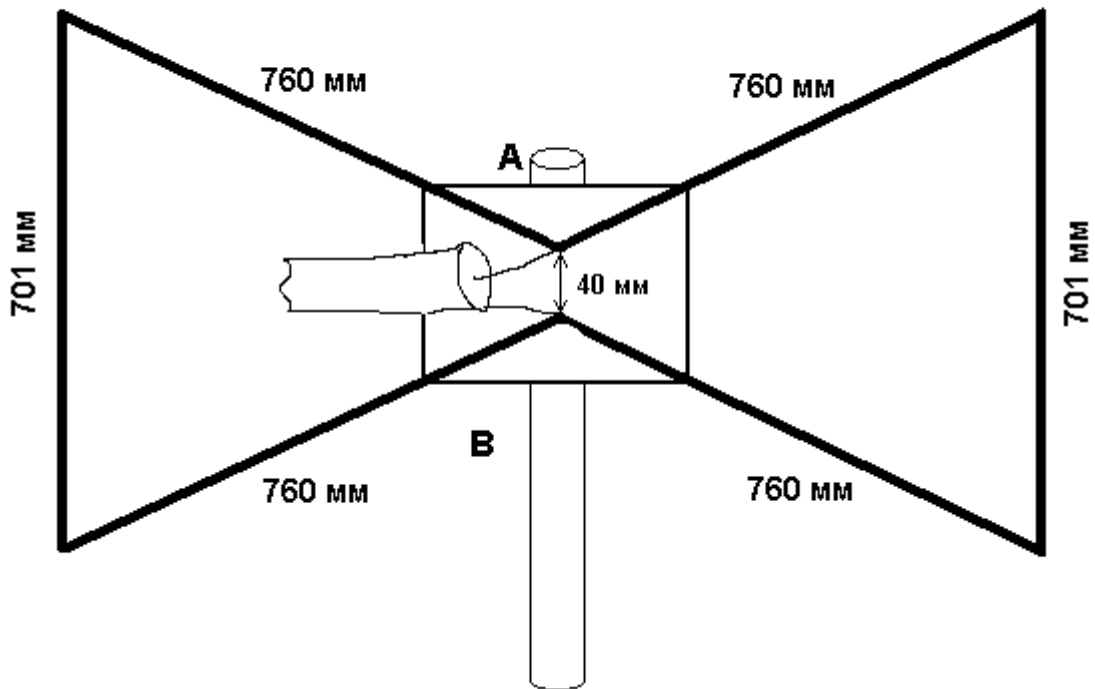
SOMEWORDS ABOUTE MYSELF

Hello ! If it's interesting I'll tell some aboute myself. I was born 25 may 1957 y. in Snesznoe town of Donetsk obl. of Ukraine. After finishing Primorsko-Akhtarsk's school in 1974 I worked a locksmith and a turner. In 1975 I entered in Taganrog radiotechnical institute and finished it in 1980. After it I living and working in Romny town of Sumy oblast of Ukraine. I worked an engineer in Romny's branch of Leningrad NPO "Krasnaja Zaria" and seniorengeener in Special Design Bureau "Poisk". Since 1997 I working a foreman of powerenergetics of "Akhtyrkaneftegaz". I am married and have daughter and son.

- **Input resistance:** 50 Ohm;
- **Polarization -** Vertical;
- **Gain** 6 dB;
- **SWR** 1,01:1.

Figure 1 shows the antenna.

Figure 1



The antenna is made from a copper or aluminum wire in diameter of 4 mm. A copper or brass tube also will do well. The wires fastened by collars to a dielectric plate in 4 mm thickness. I use a plate from PC stuff. The plate fastened by collars to the antenna metal mast.

A coaxial cable is connected to points "A" and "B" (the central core to "A", the braid to "B").

Below, there is a file of the antenna in [MMANA](#).

(MMANA available FREE at [www.qsl.net](http://www.qsl.net))

Twins Delta For 145\_50 MHz

```

*
145.5
* wire *
7
0.0, 0.6845, -0.3505, 0.0, 0.6845, 0.3505, 0.002, -1
0.0, 0.6845, -0.3505, 0.0, 0.0, -0.02, 0.002, -1
0.0, 0.6845, 0.3505, 0.0, 0.0, 0.02, 0.002, -1
0.0, 0.0, -0.02, 0.0, -0.6845, -0.3505, 0.002, -1
0.0, 0.0, 0.02, 0.0, -0.6845, 0.3505, 0.002, -1
0.0, -0.6845, -0.3505, 0.0, -0.6845, 0.3505, 0.002, -1
0.0, 0.0, -0.02, 0.0, 0.0, 0.02, 8.000e-04, -1
*** sources ***
1, 1
w7c, 0.0, 1.0
*** load ***
0, 1
*** Autosegment ***
400, 40, 2.0, 1
*G/H/M/R/AzEl/X*
0, 5.0, 0, 50.0, 0, 0, 0
    
```

Enjoy!

Keys for QRP- expeditions

Igor Grigorov, RK3ZK,  
G-QRP-C # 6363



The two articles, putting below, were published at SPRAT, the journal of the G- QRP – C # 114 and 115 accordingly. However, I think, the keys will be interesting for all amateurs.

Telegraph key for a QRP-expedition

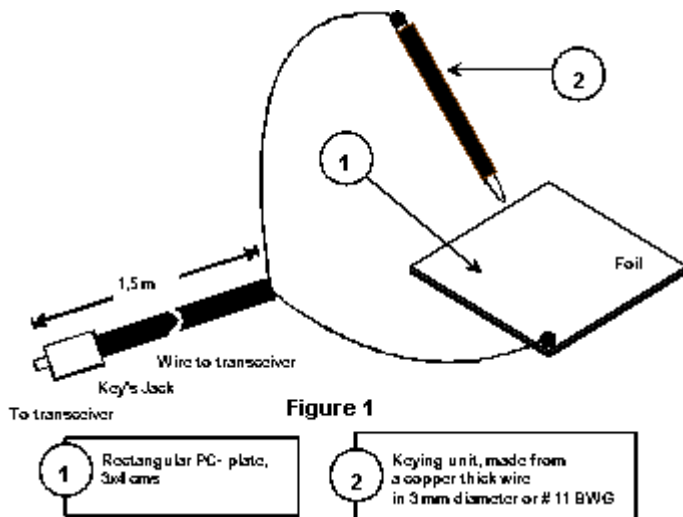
It is a problem what a key to use in a QRP-expedition, hand or electronic. An electronic key does not provide a good operation at a QRP-expedition for the following reason. At first, it need in an external feeding for it, at second, as rule an electronic key made on the CMOS (Complementary Metal Oxide Semiconductor) chips is undergo of dampness. From dampness it would leave out of operation in the most improper moment. A standard telegraph key, usual for routine radio amateur activity, is complicated in application in field conditions because the key should be reliably fixed to any fixed base. The matter is not always possible in a field QRP-expedition. Often expedition key is keeping in one hand (or even on a knee) and by other hand working on it. Certainly, it is very inconveniently for job in the ether and rate of transmission is very low in that case.

Photo: My QRP transceiver with a Solar battery and such simple key



My special self-made a hand telegraph key has no the defects. Fig. 1 shows drawing for the key.

It consists of from a rectangular part of PC- board (item 1), which is connected to “ground” of a transceiver and a keying unit (item 2), made from a copper thick wire in 3 mm diameter or #11 BWG, or # 9 AWG.



At operating in the ether the rectangular part places in a hand, on a knee or on any fixed basis. The other arm does keying. Ever it is possible to paste this slice of PC – board with help of an adhesive tape to a transceiver case or to floor of a tent. This key was used at operation from any possible most inconvenient positions. For example, laying in a tent, and even laying in a sleeping bag. Certainly, the keying rate is not so high, up to 60 symbols per one minute. But it is quite sufficient for operation from a QRP expedition, where the high speed do not use usually.

Electronic keying for an electronic key

When I used an electronic telegraph key made on CMOS chips during my QRP- expedition, I found out that the key is very sensitive to dampness. Even when I covered a PC- board of the key by paraffin (it is possible easily to delete paraffin with the help of hot water and after that with petrol, if a repair is necessary), the failures in activity of the key continued.

Also I found out that small drops of water influenced on key operation, i.e. the drops covered contacts of the key's manipulator and go to false operation.

Only reed relays (magnetically operated with hermetically sealed contacts) helped me to solve that problem and make reliable work of the electronic key in field operation.

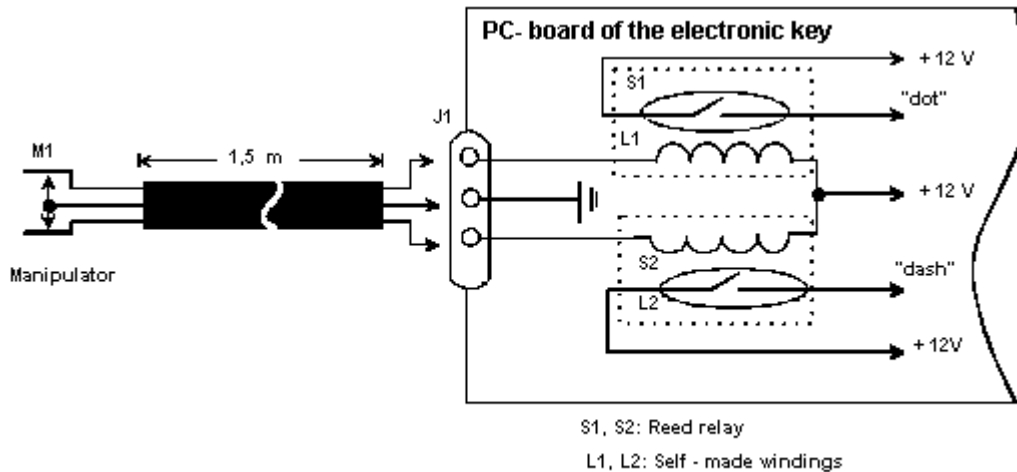


Figure 1

The reed relays were placed on the PC- board of the automatic electronic key, near keying “dot” – “dash” chip. I used old reed relays, taken from burned old relay of a telephone station. Fig. 1 shows the scheme of the unit. The PC- board of the automatic electronic key with the reed relays was covered with paraffin. Manipulator of the key was placed outside the key’s body. The reed relays had a self- made windings. Each winding contained several thousands turns, coiled by copper wire 0.1 mm in diameter or #36 BWG.

Winding of reed relay consumed current near 3- 4 mA at 12 volts of key power voltage. Such small current did not load much key battery.

The electronic telegraph key, consisted of such electronic keying unit and PC- board covered with paraffin, reliably works even while raining. Also the key was serviceable in the morning when both key PC- board and manipulator were covered with dew.

QRP beyond belief

Igor Grigorov / RK3ZK

G-QRP-C # 6363



The article, putting below, was published at SPRAT, the journal of the G- QRP – C # 114. However, I think, the keys will be interesting for all amateurs.

*Work on QRP is wonderful when with only several watts of power to do a DX QSO. But the surprise is especially great if a radio amateur does not know that he works on QRP... later he looks into his log and does not believe it! About such improbable work on QRP I want to tell.*

It took place on the 10<sup>th</sup> of December 2001, during the QRP expedition on Ai - Petri plateau. This expedition was held in honour of the centenary of Marconi’s First Transoceanic radio contact. The UR-QRP Club arranged the expedition. The call EN100GM was used. We used an old military Russian made radio R - 143. It provided 8 watts RF- power at 1.8 to 18 MHz. An ATU (Antenna Tuning Unit) was used with the military transceiver. Fig. 1 shows the scheme for the ATU.

By mistake, one of the operators connected our

Photo: December 10, 2002



transmitting antenna to jack J4 instead of jack J2. In other words, our antenna was connected to R4,



## Old computer's PSU gives useful parts for antennas

Igor Grigorov, RK3ZK

Photo: Old PSU

*A personal computer has become an ordinary thing in the recent time. Nearly every radio amateur has his own personal computer. With the course of time some computer's blocks fail and are replaced by new ones. Soon the old computer is replaced by a new one. Finally, a radio amateur accumulates faulty computers as well as faulty and unnecessary computer's pieces.*

*But do not throw away the faulty pieces! It is possible to find useful applications for them in a ham practice. This article is a chat about the practical usage of an output transformer from a faulty old Power Supply Unit (PSU).*



Photo: Opened PSU

### An output transformer is the most useful part of a PSU

I believe an output transformer is the most useful part of a PSU and this detail can find its useful application in antennas. An output transformer has a large ferrite core and works on high frequencies (60- 200 kHz). In addition an output transformer has a qualitative electrical isolation between its primary and secondary windings. The isolation withstands 300 volts across the windings.

It is to be mentioned that there is a good deal of different models of computers' PSUs. However a PSU's output transformer has practically identical data for all PSUs having the same power. I had a faulty ATX PSU. **Fig. 1** (see next page) illustrates the circuit of the ATX PSU. The output transformer from the ATX PSU had a mark "ATX-33T". The transformer was soldered out accurately, and I started to experiment with it.



ATX- 33T transformer

### ATX- 33T transformer as an RF ammeter

**Fig. 2** shows ATX-33T transformer's circuit cut out from the circuit of the ATX PSU. ATX-33T transformer has the primary winding connected to output transistors of a DC/DC converter, and the secondary tapped winding providing several low voltages necessary to feed a computer. The secondary winding has fewer turns than the primary one. I supposed the ATX-33T transformer could transform a low RF voltage to high with low losses.

In this Part – I We will discuss using AT-33T transformer as an RF transformer.

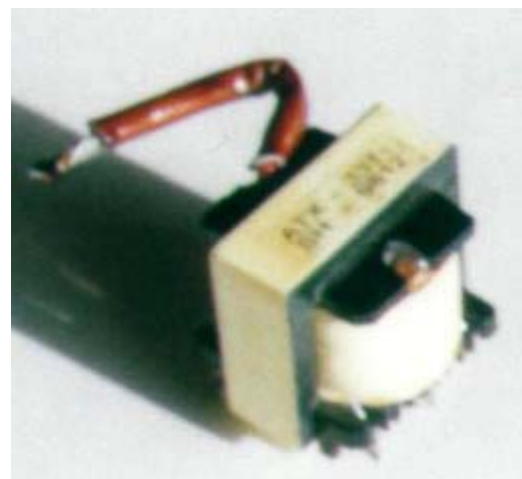
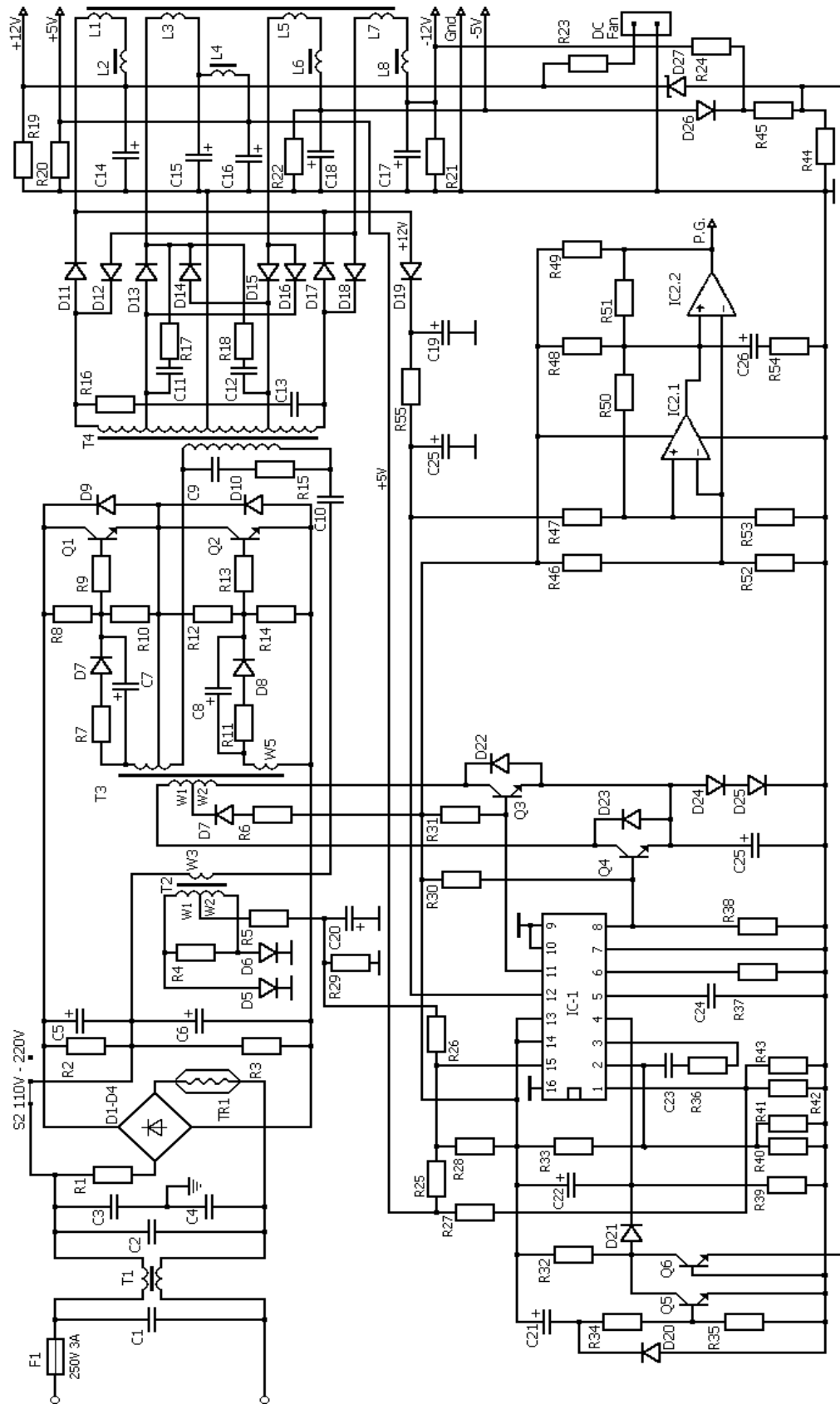
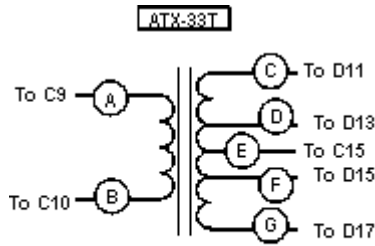


Figure 1 ATX PSU



**ATX- 33T transformer**



**Figure 2**

**An RF ammeter**

I found useful application for AT-33T transformer. This one was turned to **a current transform for an RF ammeter**. You need to add only a current loop to AT-33T transformer and this one will be a current transformer for an RF ammeter. The current loop (or a current winding) contains only one turn of a wire placed on a cheek of transformer's core (see **Fig. 3**). There was used a copper wire of 0.8 mm in diameter/# 20 AWG.

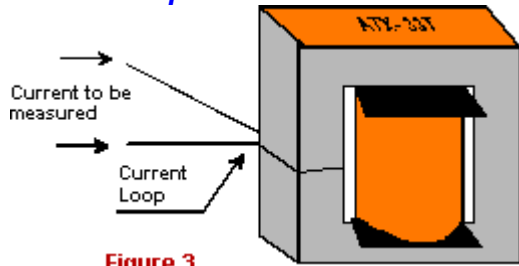
I found that the 24 volt winding (**Fig. 4A**) as well as the inverter's winding (**Fig. 4B**) works as well as the meter's winding. A germanium diode was used in an RF detector at the meter's winding. A d.c. meter had a 1mA full scale deflection and

140-Ohm resistance. To verify the work of the RF ammeter made on the base of AT-33T transformer I connected it in serial with a control ammeter. **Fig. 5** shows the circuit.

**Note:** A control ammeter was a home brew RF ammeter designed by reference [1]. The RF ammeter was calibrated with the help of a standard measuring equipment.

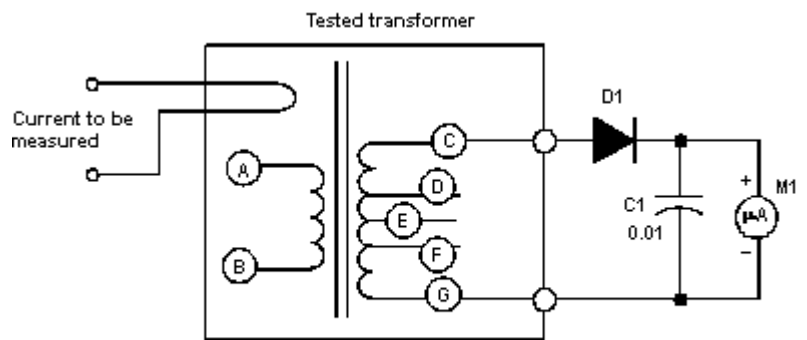
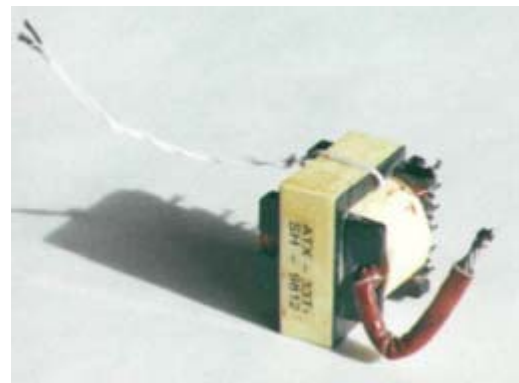
**Tab. 1** contains testing data for the RF ammeter shown in **Fig. 4**. Using data from **Tab. 1** I made diagrams "meter reading vs. frequency" to the 24 volt winding and to the inverter's winding (see **Fig. 6**). The curve shows that the inverter's winding (**A- B**) is the optimal winding for application in the RF ammeter made on the base of AT-33T transformer.

**Current loop on the transformer side**



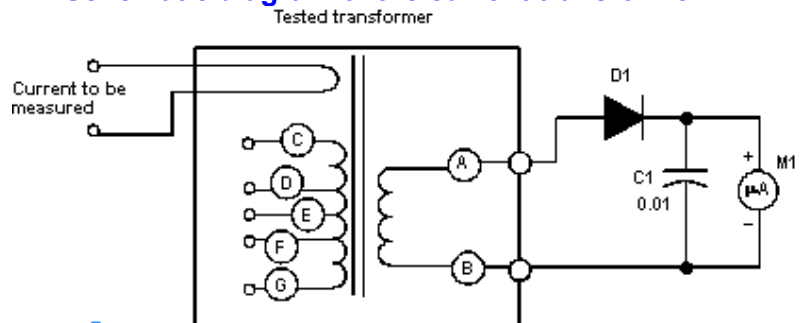
**Figure 3**

**Current loop on the transformer side**



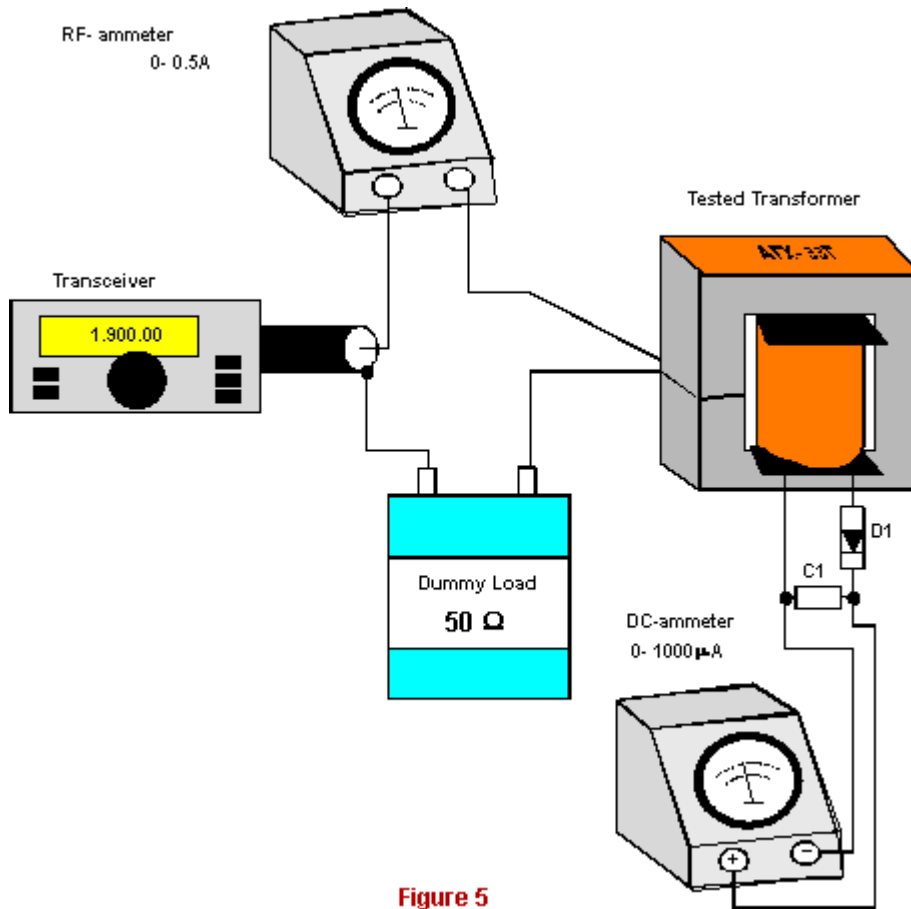
**A** **Figure 4** D1- RF - diode, germanium, 1N34A, 1N82A  
M1- DC -  $\mu$  ammeter, 0-1000  $\mu$ A

**Schematic diagram of the current transformer**



**B** **Figure 4** D1- RF - diode, germanium, 1N34A, 1N82A  
M1- DC -  $\mu$  ammeter, 0-1000  $\mu$ A

*Circuit for testing of the RF ammeter*



**Figure 5**

**Table 1** Data for the 24 volts winding and for inverter's winding

Frequency, MHz	1.9	2.0	2.3	2.5	2.8	3.0	3.4	3.7	4.2	5.0	6.2	7.1	10.0	14.2
24-V winding, Meter reading, $\mu\text{A}$	1000	900	750	700	660	580	500	410	250	160	80	80	60	15
Inverter's winding, Meter reading, $\mu\text{A}$	700	680	660	650	630	600	550	520	500	420	380	380	280	120

Meter reading vs. frequency

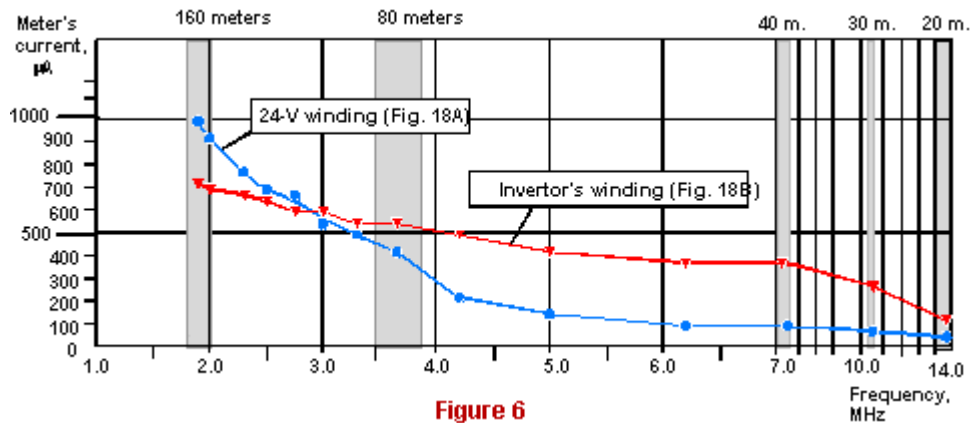


Figure 6

Note: The RF current through a current loop is constant on all frequencies and equals to 0.26A

The RF ammeter has two drawbacks. Firstly, it works on a limited frequency range, to 7 MHz for my test. Secondly, the RF ammeter is too frequency dependent. I eliminated these defects to a certain extent. A low-resistance resistor R1 bridged to the meter's winding reduces the frequency dependence and extends the frequency range. Fig. 7 shows the circuit for the "linear" RF ammeter. A germanium diode was used in the RF detector of the "linear" RF ammeter. A d.c. meter had a 100µA full scale deflection and 320-Ohm resistance.

Linear RF ammeter

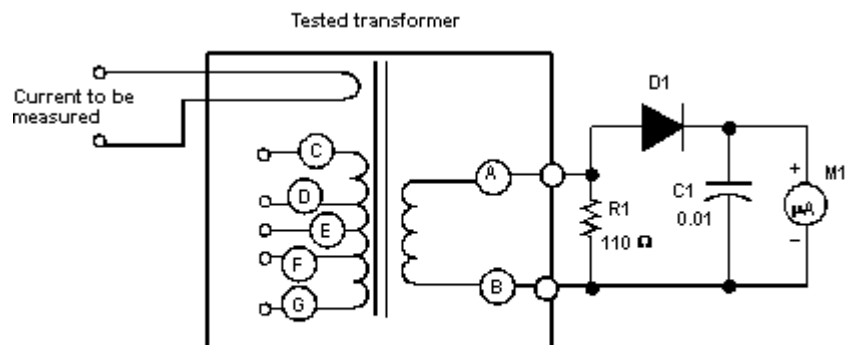


Figure 7

D1- RF - diode, germanium, 1N34A, 1N82A  
M1- DC - µA ammeter, 0-100 µA

I picked up a value of the R1 that while at 1.5 MHz the control RF ammeter showed the RF current of 0.1A the detector's meter had a full-scale deflection of 100µA. R1 had 110 Ohms in

this case. All other measurements were made at RF current of 0.1A and R1 of 110 Ohms. Data for the measurements are shown in Tab. 2. Using data from this table I

constructed diagrams "meter reading vs. frequency" (see Fig. 8), the measurements are shown in Tab. 2. Using data from this table I constructed diagrams "meter reading vs. frequency" (see Fig. 8).

Table 2 Linear RF ammeter

Frequency, MHz	1.5	3.0	3.6	7.0	10.0	14.2
Meter reading, µA	100	95	93	90	90	50

Note: The RF current through a current loop is constant on all frequencies and equals to 0.1A

Meter reading vs. frequency

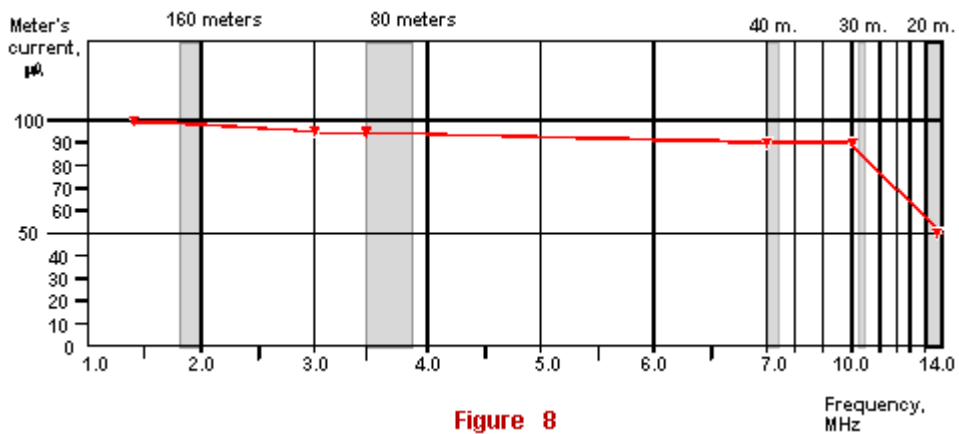


Figure 8

Fig. 8 shows that the RF ammeter (Fig. 7) provides almost linear measurement of the RF current on ranges of 160- 30 meters. It is possible to expand the

measuring range of the RF ammeter with the help of a variable resistor connected in serial with the d.c. meter. Fig. 9 shows such a RF ammeter with an expanded scale.

RF ammeter with an expanded scale

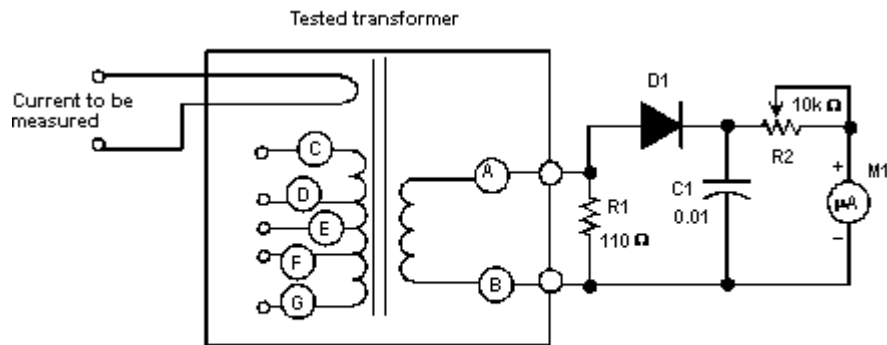


Figure 9

D1- RF - diode, germanium, 1N34A, 1N82A  
 M1- DC - µA ammeter, 0-100 µA

**Conclusion:** It is possible to use AT-33T transformer in design of an RF ammeter. However, large dimensions of AT-33T transformer and the limited frequency range of an RF ammeter made on its base are the drawbacks of its application.

If you need an RF ammeter for only one amateur range of 160, 80 or 40 meters, or you do not need linearity from your RF ammeter while this one is working on these ranges, use the circuit given in Fig. 4. In this case an inexpensive micro-ammeter with a 1000µA full- scale deflection will do well.

If you want the RF ammeter to work linearly on 160 - 30 meters use circuits given in Fig. 8 and 9. The drawback of these circuits is that an expensive d.c. micro - ammeter of a 100µA full- scale deflection is used there.

Reference:

1. Grigorov I.N.: Antenna Tuning @ Adjustments. – Published by antennex Online Magazine, Corpus Christi, Texas USA. ISBN: 1-877992-39-9

To be continued....