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The 40m wire antenna for 80m, 40m and 20m operation.

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The 40m wire antenna used with the 9:1 balun, has been widely talked about for many years, with many articles on how such an antenna, and how they function.

However, I would like to introduce another viewpoint on the 40m wire antenna, which I hope would bring a different approach of understanding.

The wire itself.

First what is the 40m wire, yes a long wire, but even a length of wire has its D.C. resistance, but with an AC signal, the 40m wire would have both an inductance and hence a reactance.

To measure the AC reactance, the inductance value for the 40m wire must be determined. Fortunately, there is a simplified answer to this question, which is to use the equation relating to the characteristic impedance for a coax cable.

Impedance ohms = SQR(inductance / capacitance)

However, for a coax cable, the coax line capacitance is indicated as a per metre of value, quoted as a 101pF / m or (30.8pF / ft) in value for a 50ohms coax cable, reference to RG58c cable.

From this, the inductance per metre can be determined, as follows:

Impedance ^ 2 * capacitance per metre = inductance per metre

Equates to as 50^2 * 101pF = 253nH per metre.

Capacitance per metre proof = (30.8pF / ft) / 12 * (100 / 2.54) = 101pF / m

Thus, the inductance for the 40m wire can be found by the following :

Inductance of 40m wire = 40 * 253nH / m = 10uH

The 40m wire reactance at the 40m band can now be determined, which equates the value of :

XL (40m wire) = 2* PI * 7.1MHz * 10uH

XL = 445 ohms.

A 40m wire is fed through a 9:1 balun, which would turn down the 40m wire reactance to a lower value, hence :

antenna terminal impedance = 445 / 9 = 49.5 ohms

The 40m wire with a 9:1 balun, is thus then a direct 50ohms coax and radio terminal impedance match.

The question is now, if the 40wire antenna was operated upon the 20m band or the 80m band, what would be the working characteristics.

The 40m wire inductance would remain the same as before, the 10uH in value, but the reactance of the 40m wire operating on either the 20m or the 80m bands, would be different.

The 40m wire working the 20m band, the reactance equates to as follows:

XL (40m wire) = 2* PI * 14.2MHz * 10uH

XL = 891 ohms.

Through the 9:1 balun, the terminal impedance equates as :

antenna terminal impedance = 891 / 9 = 99 ohms.

While operating upon the 80 band,

XL (40m wire) = 2* PI * 3.7MHz * 10uH

XL = 232 ohms.

Through the 9:1 balun, the terminal impedance equates as :

antenna terminal impedance = 232 / 9 = 26 ohms.

Clearly, to work the 40m wire on three different bands, from the 80m to the 40m and onto the 20m band, requires the introduction of a 1:2 balun, also a 2:1 balun, which would allow the 40m wire antenna operation without an antenna matching unit, in essence a direct 50ohm match on all three bands, the 80m, the 40m and also the 20m band.

In essence though, the use of a 2:1 balun operated as a step up also connected as a step down, would correct the difference between the various terminal impedances of the 80m and 20m band operations.

The 20m band operation, the balun would act as an impedance step down towards the radio, while for the 80m band operation, the balun would act as a step up towards the radio.

For the 40m band operation, the 40m wire antenna would be a direct connection to the radio, unless the antenna installation for the 40m wire on the 40m band, uses a 1:1 isolation balun.

For the different band operations, a combination use of switching relays could be used to switch in or out the various baluns for each of the three band conditions of operation.

The 40m wire usually comes packaged in a loop, by following the principle that a medium wave ferrite rod antenna is a tuned circuit, the wire ferrite cored inductance as an antenna, using the 40m wire still left as a wire loop as packaged, the 40m wire antenna could then be installed in the loft or attic of a house, leaving then the metal box containing the switching relays for the baluns, the baluns operated remotely by just simply switching a DC supply voltage, each relay combination, input and a output relay, for the three different band operation of use.

Using the FT240-31 core, impedance ratio of 1:2, equates to a turns ratio of 1:1.4, which equates to as a 2 turns primary, and 3 turns secondary.