BRAZOS VALLEY AMATEUR RADIO CLUB

AMATEUR RADIO FOR SOUTHWEST HOUSTON AND FORT BEND COUNTY

MARCH 2003 VOLUME 27 ISSUE 3

Good turnout of sellers and buyers for the Mix-n-Match

Stealth Antennas Topic of March Meeting

Kevin Foto, KD5O and Ross Lawler, W5HFF presented a program on stealth antennas at the BVARC membership meeting.

Public Service Net

Doug Woodruff, KC5VYZ - Coordinator

The Public Service Net meets every Monday night on 145.47 (123 PL) at 9:00 p.m. Everyone is welcome. Check-ins and that night's net control:

3/3 - 27 - Cam, K5CAM 3/10 - 28 - Kevin, KD5O
3/17 -28- Joe, K5JWM 3/25 - 31 - Doug, KC5VYZ

Net Control Operators Needed

If you are interested in helping with the Monday night net, then let me know. We have a prepared script that can get you going with a general format. If you have ideas to make the net more interesting and useful, then let me know your thoughts. To be a net control operator you must be a paid up club member and have at least a technician radio license and the desire to step out into the net world. The ARRL Audio News is a special treat of the net, but if you cannot go this part of the net, then you might find someone else to help with the Audio News piece. It is a great deal of fun and gives you experience handling traffic, which could be valuable during times of emergencies. Contact Doug at, KC5VYZ@arrl.net for more information.

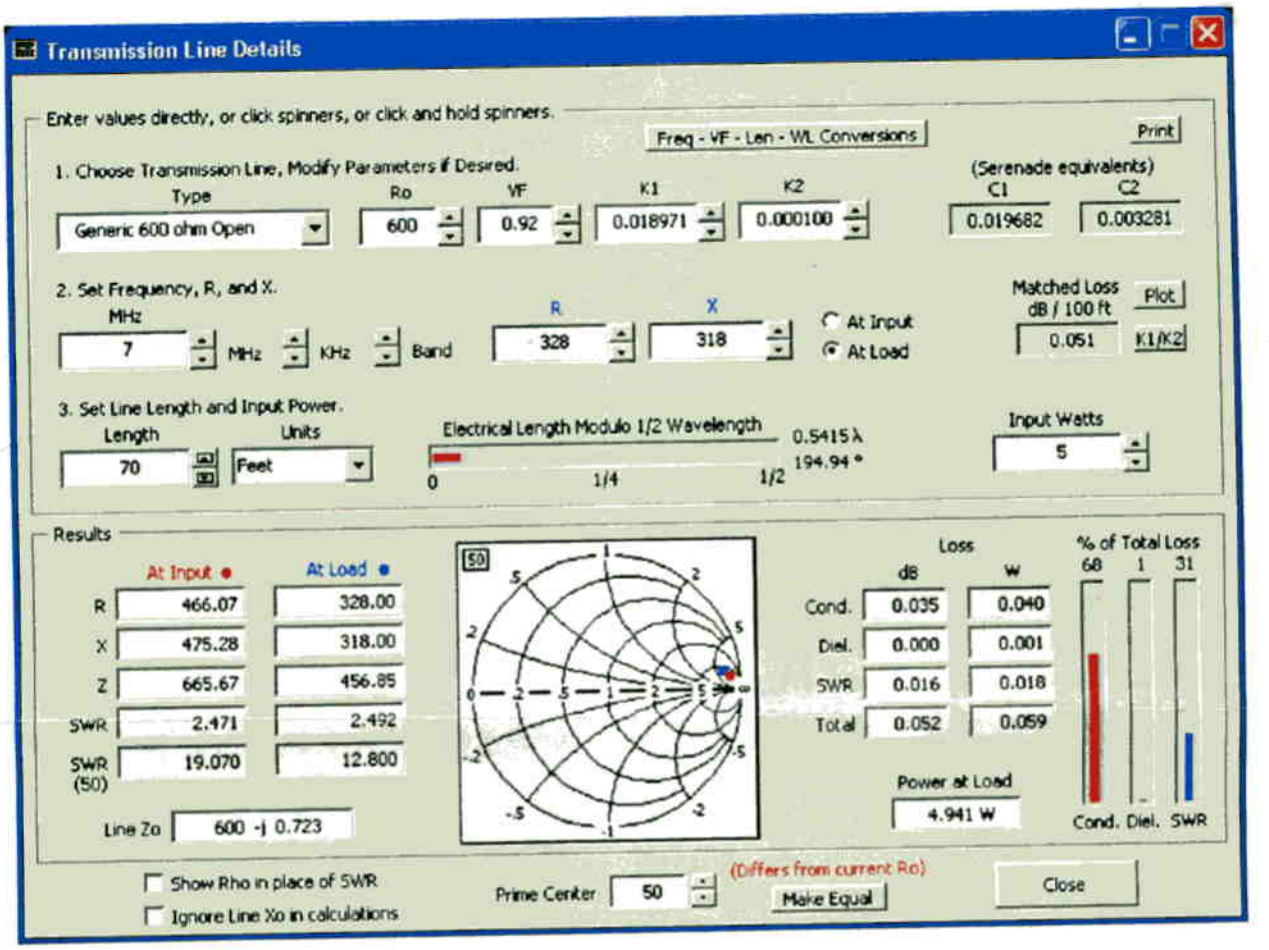
Scanner Jack, KB5TMY says farewell to the club and thanked the club for "a good ten years".

A little bit of History

In May of 1898, 24 year old GUGLIELMO MARCONI registered Patent 7777 since which the world of radio communications has not looked back. This breakthrough added tuning circuits to guarantee the independence of simultaneous communications between more than one station.

A Detailed Look at Transmission Line Operation Via the PC

by Rick Hiller, W5RH



The Smith Chart has been and still is a wonderful tool when dealing with transmission line issues. However, with my introduction to TLDetails, it might be more proper to say that the Smith Chart "was" a wonderful tool. The "manually operated" Smith Chart has been replaced, at least in my world of rudimentary transmission line work.

What is it?

TLDetails is a freeware Windows application written by Dan McGuire, AC6LA. It is downloadable from Dan's web site at www.qsl.net/ac6la/TLDetails.html.

The program is very intuitive, although a tip is in order before you start to use the program. If you are not familiar with the nomenclature of the transmission line world, I suggest that you take some time and read through the transmission line portion of one of the antenna handbooks that are readily available You might also want to obtain a copy of the QST article, " A Beginners Guide to Transmission Line and Antenna Tuner Modeling" too. (see references)

What input parameters do I need to provide?

Reference the picture of the TLDetails GUI, or better yet, download the program and run it. I will lead you through it.

1. **Choose Transmission Line, Modify Parameters**...Select a coaxial or open wire feed line type. The characteristics for all of the standard types of feed lines are stored within the program, so you don't have to enter them. You can, however, modify them if you wish.

2. **Set Frequency, R and X**...pick the frequency where you intend to operate. Also, select the Z value that has been measured or modeled (more on this later) and select that it is the value at the input or at the load...this will vary depending on your set of conditions. For example: a measured Z at the shack end of a cable would be an input, as the antenna would be the load, or a feed Z from an EZNEC modeled antenna would be an input too, with the receiver end as the load. **Input** is the source of the power and **load** is the sink of the power.

3) **Set Line Length and Input Power**... select the physical line length that you have in feet, meters, wavelength, etc. **The Electrical Length** is figured automatically, based on the velocity factor for the particular transmission line. It is represented in Modulo ½ Wavelength format, as the properties of a transmission line repeat every ½ wavelength. **Input power** is important, so select your input level, QRP, QRO or anywhere in between.

What does the program give me?

A nice feature of TLDetails is that you don't have to wait for a 'computational result'. As soon as you add or change one of the required input parameters, the program immediately produces the results. This is very beneficial, because you can instantly see how the Z or loss characteristics change as you vary any of the input parameters.

By providing the type of cable, it's length, the power level and the Z at one end, TLDetails will calculate all losses (conductor, dielectric and SWR), the power delivered to the load and the Z at the opposite end of the feed line–Essentially, everything you need to know.

All of these answers are shown in the bottom half of the GUI in the **Results** box. The two most important areas are **At Input/At Load** on the left and the **Loss** area on the right. In the middle is a rudimentary Smith Chart, so you can see the result graphically, if you are familiar with the Smith Chart's layout and meaning.

What can TLDetails do for me?

First, it can provide you an insight into the performance of your antenna system in an area that was, in the past, typically ignored with a cursory glance, a nod and a wink. This insight is most important, for example, when you are trying to determine why your coaxial fed 80 meter dipole doesn't perform very well on 20 meters.

Second, it can help you select the best feed line for that new antenna system, whether it be a single band or multiple band design in the HF, VHF or UHF range.

Third, TLDetails can be used as a tool to complete your antenna system modeling functionality. It complements EZNEC, AO Wires or other modeling programs very well.

Fourth, it can be used as a marvelous demonstration tool during self-learning or license class instruction of transmission line theory. It provides that always needed 'Elmer' when you are trying to understand transmission line theory articles and books.

Some practical examples

The primary function of the transmission line is to transfer the maximum amount of power output from the transmitter to the antenna. A very obvious no-brainer, but a totally loss less transmission line does not exist. Loss is relative, in that some transmission lines are more lossy or less lossy than others, depending on many factors. You could certainly purchase extremely low loss 1 inch hardline and use it for a transmission line in any antenna system. This would be perfectly fine except for the fact that you would be paying $5.50 per foot. At that rate your transmission line cost would be equal to that of Yagi and the rotator–not too cost effective. But what coax can you use and still get good performance for your situation? That is what TLDetails will tell you.

Multi-element Yagi

If your Cushcraft/Hy-Gain/Force 12 (pick one) 20 meter Yagi at 45 feet gives you an approximate 50 ohm feed Z, then select a coax with 50 ohm 'Ro'. RG-58, RG8X, RG-213 are good starting points. Set up TLDetails for one of these coaxes, say (58); set the Frequency at *(14.05)*; set the length of the coax, say (*120* feet).

-Since the antenna feed Z is close to that of the coaxial cable the 'impedance transformation' is minimal but the loss factor is the critical parameter. As you can see, if you are running 5 watt QRP levels, the loss will be 1.625 watts. If you are running 100 watts the loss will be 32.493 watts. Now change the coax type to RG-213 and look at the results: much lower loss, 18.541 watts and more power out, 81.459 watts, to the antenna. The choice is obvious, performance-wise, but now it is in the realm of your pocketbook–spend 30 cents a foot or 70 cents a foot. Keep in mind that this loss happens both ways (transmit AND receive).

Multi-band 80 meter Dipole Example

The feed Z of a modeled 80 meter antenna is 65 ohms -j025 (load). Let's feed it with a 75 foot piece of RG-8 coax. TLDetails shows Z at the input of the coax (shack end) and the losses involved. Now, take the coax length and vary it a few feet plus or a few feet minus. Notice how the Z changes. In certain situations you will be able to vary the Z enough that your antenna tuner can match to the mismatch. Although the losses will remain, you will be able to at least match it and send the antenna the maximum power that the transmitter has to offer.

This demonstrates a well know antenna system tuning trick. If, for example, you are unable to match to your system with your tuner, simply lengthen or shorten the coax by a few feet (easiest is to add a jumper) and it will change the input Z. This alternate input Z might be just what your tuner needs to provide you a match. KK5NU's college buddy, W5DXP (see references) authored an article that uses switched, stepped transmission line length variations to match his antenna on multiple bands.

Now let's use this 80 meter antenna on 20 meters. The model predicts that it will have a feed point Z of about 1250 -j49 ohms–not close to 50 ohms at all but let's see what TLDetails tell us. Enter 1250 for R and -49 for X and select **At Load**. Look at the 'solved for' Z at the feedline

input, 11.47 +j80.36. Also, and more importantly, look at the losses incurred, 2.499 dB or 43.75 watts. With 5 watts in only 2.813 watts arrive at the antenna. These high SWR caused losses occur with RG-213, a fairly low loss coax at HF frequencies.

Let's change the transmission line type and see what happens. We've all heard that open wire lines are less lossy, so lets trade out the 213 for 600 ohm open wire. This still has the impedance excursions at the input, 305.25 +j249.85, but more importantly, look at the losses. They are way down, .047 dB, which is similar to losses expected of a transmission line that is being utilized near its characteristic Z. With the 600 ohm line 98.918% of the power input to the feedline arrives at the antenna versus 56.4% with 50 ohm RG-213.

From this, one can see that in a situation where an antenna is being used away from the designed frequency, it is advantageous to go for low loss open wire types. You might have to provide additional tools, such as 4:1 baluns, etc. to bring the match in to the tuner range, but your losses will be far less. For many years, one of the more popular multi-band antennas has been a 102 foot flat top fed with open wire line. Now you can see why it is such a good over-all performer. *(Note that in recent years, W4RNL has investigated the best performer for multi-banding and provides an alternate and higher performance multi-band solution. (see references))*

Determining your antenna's feed point Z from inside your shack.

If you have one of the marvelous MFJ 259B, or similar Z bridges, you are one lucky antenna dude or dudette. With these empirical measuring devices and TLDetails, you have the world by the tail.

For example, say you have a 40 meter, apex up, delta loop. The feed point is 1/4 wavelength down from the apex (feeding for maximum low angle, vertically polarized radiation); however, the feed point just happens to be 25 feet in the air and the only test point that you have access to is the end of the coax in the shack. Lucky you, you have TLDetails and with it you can determine the feed point Z of your antenna.

Simply measure the Z at the coax's shack end with your bridge, place this Z value within TLDetails, note the transmission line type and length and you have an immediate number for the feed Z of your antenna. Plus you will know the losses occurring within the coax.

This "remote measurement" is quite helpful when you are trying to "tune in" a Yagi's gamma match or other network at the antenna feed point, especially if the antenna is not within easy reach. You can see the Z variations and take the correct tuning action. Even better, you can figure the Z value needed with a correctly adjusted gamma match and simply vary the gamma match (both L and C) until the remote measurement is what it should be.

Summary

A simple rule in antenna design and implementation is that the more information you have concerning your antenna system, the better off you are. TLDetails helps you compile all of this information and formulate it into constructive data for your analysis.

There are many other ways to utilize TLDetails than the few samples I have shown. For a free piece of software it is fantastic in that it will help you make decisions on coax versus open wire, RG-58 versus 213 or it will even allow you to determine the efficiency of your antenna 'system'. For QRP'ers, it will show you just how much of that "QRP Gallon" is reaching the ether.

One final point; if you have a situation where you have multiple types of coax or transmission lines in a system, you will have to model each section separately, saving the results for each on paper and then going to the next section with a different type of transmission line. It works fine like this, but keep track of what you are doing.

I hope this article provided you with a detailed look at TLDetails and its capabilities. TLDetails is a great program and the price is definitely right. BTW, if you like the program or have any questions about it, send Dan McGuire an email He's a really great ham and would sincerely enjoy hearing from you. Let him know how his program helped you improve your antenna system.

Thanks go out to Dan for giving me permission to highlight his TLDetails program and utilize a picture from his web site. Thanks also go to Rod, K5BGB, whose professional editing expertise was heavily utilized and greatly appreciated.

In closing, when we improve our antenna systems, we attain better communication with our fellow hams. Better communication means more fun, and fun is what Amateur Radio is all about.

Enjoy.... 72,73 Rick W5RH Questions or comments to rhiller@sdicgm.com

References and additional reading:

- **TLDetails Software** Dan McGuire, AC6LA – www.qsl.net/ac6la/index.html
- **A Beginners Guide to Transmission Line and Antenna Tuner Modeling** – Dean Straw, N6BV available in PDF at www.arrl.org (Membership required) or QST Jan 2001
- **W5DXP's No-Tuner, All-HF-Band, Horizontal, Center Fed Antenna** – Cecile Moor,e W5DXP www.qsl.net/w5dxp/notuner.htm
- **TLW Transmission Line Modeling Software** ARRL Antenna Handbook 19th edition
- **Reflections II Book** – Walt Maxwell via World Radio Press
- **My Feedline Tunes My Antenna** – Byron Goodman, W1DXB
- Available in PDF at www.arrl.org (Membership required) or QST Nov. 1991
- **Suppose I Could Have Only One Wire**– web article – L. B. Cebik,W4RNL – www.cebik.com/aledz.htm
- **Many additional transmission line references** – www2.arrl.org/tis/info/reflections.html