A guide to coaxial cables and their losses when used on the 934 MHz Personal Radio Band.

NEVADA COMMUNICATIONS

This information sheet will lead to a better understanding of the losses involved in some of the popular coaxial cables when used on the 934-935 MHz Personal Radio Band. The tables produced should help you to directly relate to your situation in a simple manner so that you may calculate your own system losses.

Introduction

Power losses at radio frequencies effect both transmission and reception. As the frequency increases so does the dielectric loss of most materials. At 934 MHz much greater dielectric heating of RF components is to be expected than would occur at lower frequencies such as 27 MHz. When this occurs transmission loss increases and the result is an inefficient transfer of energy. To keep the power losses to a minimum it is therefore very important to select the correct type and quality of coaxial cable and to keep it as short as possible.

Coaxial Cable Selection for 934 MHz

Table 1 shows 4 popular coaxial cables with the respective losses from 1 to 30 mtrs. Of the 4 cables shown the H-100 comes out on top. The H-100 cable is of semi-rigid design which means in practice that it is rather stiff and harder to work with than normal cables. It is however well worth the effort. (note SSE technical information sheet No. 2A for information about fitting of plugs etc).

One of the major problems in selecting say RG213 or RG58 type cables is that there are many manufacturers producing such cable to sub-standard quality although they print RG213 or RG58 on the cable. Unfortunately many of them are of the lowest quality with very poor braid density etc. I can only suggest therefore if possible ONLY buy cable for 934 MHz from a well known Brand manufacturer such as, BICC, POPE, PIRELLI etc. Low cost 27 MHz CB type cable is a complete waste of money and watts for 934 MHz. There is little point in optimizing your antenna system etc only to be losing most of your power in poor quality cable.

Cable Losses in Decibels

Decibel measurements seem to be a problem for many people. Therefore I have tried to arrange matters so that those people who regard the maths involved in using their calculator or logarithm tables as rather complicated, need only refer to table 1 to find the respective loss for the cable type they wish to use, and then refer this figure to graph 1 which simply shows you the power lost for a specific (db) loss, as a percentage %.

For those people who would like to use the Power decibel data, then it is shown below:-

The decibel (db) is a measurement term which logarithmically expresses the ratio between two power voltage or current values. In our case we are using Power values as follows:-

Decibels (db) $= 10 \log_{10} \frac{P1}{P2}$ Where P1 and P2 are the two power levels. (Table 4)

Below are some simple examples which I hope will illustrate the use of tables 1, 2, 4 etc.

Example 1

Situation: You decide to buy some good quality RG213 cable. The length required is 8 mtrs.
Solution: Referring to table 1 shows that RG213 cable with a length of 8 mtrs. loss = 2db.

We now have a figure of 2db which may be used in various ways. 1. We can find out what this 2db means as a percentage of power lost. 2. If the TX output power is known then we can find out exactly how much power is lost and therefore how much power is left to work with.
Graph 1 is very useful for quick approximate percentage (%) readings. To use the graph follow this simple procedure. Find the 2db position on the left hand vertical scale (marked loss in db). From this point make a straight line to the right, until this line crosses the sloping line. Go from this point, straight down to the bottom horizontal line (marked power loss %). It should show a reading of approximately 37%, which would be your power loss for 2db.

We can now work out this problem using a practical example of known transmitter output power.
Situation: You have the same 2db loss as above. The transmitter output power is 7 watts.
Solution: We know from above that 2db loss is equal to a 37% loss, now we can find out what this means in relation to 7 watts as follows:

$\frac{37 \times 7}{100} = \frac{259}{100} = 2.59$ watts lost. Power left therefore is 7w − 2.59w = 4.41 watts.

Summary: We have now found out that of the 7 watts produced from the transmitter, we will only have 4.41 watts left to work with, as there will be a loss of 2.59 watts. As the (db) losses increase so does the power loss and therefore we will have less power available to use.

Another solution: If we refer to table 2 we will find that the power down ratio for 2db is 0.631. Therefore to find the power available you proceed as follows:
TX power x ratio power down = 7w x 0.631 = 4.41 watts available power. Which is as you can see the same answer as above ! !. If you wish to double check this figure with table 4 to find the (db) loss which we know was 2db proceed as follows:

Decibels (db) $= 10 \log_{10} \frac{P1}{P2} = \frac{4.41}{7} = 10 \log 0.63$ which is 2.00db.

Example 2

Situation: This time we will see what happens if you had used good quality RG/58. The length is the same 8 mtrs. The transmitter output power is the same 7 watts.
Solution: Referring to table 1 shows that RG/58 cable with a length of 8 mtrs has a loss of 4.4db. A quick check on graph 1 shows a 4.4db loss to be apx 64% power loss which is:

$\frac{64 \times 7}{100} = \frac{448}{100} = 4.48$ watts lost.

Power left therefore is 7w − 4.48 = 2.52 watts.

Using table 2 we find that 4.4db loss is the same as a power ratio down of apx 0.360. Therefore power available is TX power x ratio power down = 7 x 0.360 = 2.52 watts. Which as you can see is the same answer as above. If you wish to double check using table 4 then:

Decibels (db) $= 10 \log_{10} \frac{P1}{P2} = \frac{2.52}{7}\ 10 \log 0.36 =$ 4.4db which was the original loss.

Summary: We see now by using RG/58 cable we have only 2.52 watts to work with out of the 7w. This means that RG/58 cable is not very suitable at this length at 934MHz.

Summary

To obtain a quick simple check on losses use graph 1 which will show percentage power loss. If power output from transmitter is known, then after obtaining (db) loss from table 1, find the Power ratio down from table 2. Then your power available is: TX power x ratio down figure. When you have this answer subtract it from the TX power and then you will have the power loss in watts. Remember that these losses are minimum losses as no consideration has been taken into account of VSWR mismatch conditions, or coaxial relay switch over units etc.

As mentioned earlier these cable losses etc will also effect reception ie, the sensitivity, noise figure etc of your receiver. This is why any receiver pre-amplifier at 934 MHz must be placed as near

GRAPH 1 Ratio: Percentage Power Loss to Loss in Decibels