NEWSLETTER ARCHIVES

How Short Is Short? Coax Connections At VHF/UHF

As part of the on-going ATV activity in the Club, interest was expressed recently by several members in a home-constructed 24 element yagii for 23cm ATV as a potential home station antenna. A test model was built by Jim Middleton G6MGZ for evaluation and initially tested at the G3GRO shack for VSWR where it was found to be fairly poor at around 2:1 at the nominal design frequency of 1250Mhz and worse at 1296Mhz. Adjusting the folded dipole driven for length seemed make very little difference to the VSWR which suggested that there was some significant mismatch in the feeder connection. Examination of the feeder connection to the pads on the small printed circuit board inside the sealed junction box containing the balun arrangement, showed that the the flattened braid tail formed by teasing back the outer screening braid of the UR67 feeder and also the centre conductor projecting beyond the outer screen were each about 10mm long which although apparently in line with the drawing, were in my opinion far too long for 23cm. The feeder connections to the pads on the circuit board were therefore modified to reduce the excess length of the centre wire of the coax to about 5mm (still a bit too long!) and make the braid connection virtually directly on to the copper connection pad on the balun arrangement with a minimum length of braid tail.

These changes made a dramatic effect on the overall VSWR bringing it down to 1.2 at 1250Mhz (the ATV repeater input frequency) and still only 1.3:1 near the top end of the band at around 1296Mhz. During subsequent discussions at the Club regarding these results, some surprise was expressed by some members that the length of the coax connections was so critical. Everyone I think realised that leads had to be kept short at UHF and microwave frequencies but there does not seem to be much published quantative data available on the effect of different lead lengths on VSWR at different frequencies - hence the question, how short is short . As a result I decided to carry out some measurements at different frequencies on the effect of varying the length of the connecting tails of a short piece of UR67 feeding a 50 ohm dummy load via a panel mount N connector as as a test jig typical of a cable connection as seen in the photograph at Figure 1 over page. The results should also be typical of connections to a pair of solder pads on a PCB as in the case of the printed circuit carrying the balun in the example of the 23cm yagi described above (See Fig 2.)

Measurement Set-Up

The centre conductor of the feeder was soldered to the solder-spill rear connection pin of a square flanged version of a panel-mount Type N female connector and the braid connection made to a solder tag bolted to the flange of the connector via one of the 4 mounting holes. The measurements were conducted with a high quality dummy load plugged into the N connector. The other end of the piece of UR67 was terminated in an N connector connected to the measurement system. The VSWR was then measured at 144, 432, and 1296Mhz with three different lengths of connecting tails for the centre conductor and a single braid tail of 3mm, 6mm and 10mm; a length of 3mm being probably as short as it is practical to make it with a cable as thick as UR67 (10.2mm diameter). The centre conductor wire was wrapped around the solder pin of the N connector and soldered as close to the base of the pin as possible in order to achieve the minimum lead length of 3mm. Note that the solder spill has a clearance hole drilled in it intended to take the connecting wire but since the length of the pin is already 7mm, feeding the wire in endwise would prevent achieving a centre conductor connection as short as 3mm.

The VSWR tests were then repeated with the coax outer braid split into two separate 6mm screening braid earth connections to the N connector .

Measurement Method

The VSWR was measured with a wide-band directional coupler by measuring the forward and reverse power with a HP 435A power meter and then calculating VSWR by taking the ratio of the forward and reverse powers. The drive source was a Yaesu FT736 multi-band transceiver with about 1 watt RF output into the 10dB attenuator pad feeding the directional coupler. The 10db pad served to isolate the tranceiver from mismatch effects from the test piece.

The test results are shown in the graph

at Fig.3 on page 12.

Results

(1) It will be seen from the graphs in Fig.3 that for tails of as short as 3mm in length, the VSWR is very low and virtually flat varying only between 1.1 and 1.05 from 144Mhz to 1296Mhz. The apparent fall at 1296Mhz is probably due to imperfections in the measurement gear due to small reflection from the dummy load and the directional coupler etc. which at some frequencies tend to cancel and hence make the indicated VSWR look somewhat better than it really is in practice.

(2) Increasing the length of the braid tail and exposed centre conductor to 6mm has a dramatic effect on the VSWR increasing it to 1.3 at 432Mhz and over 1.6 at 1296Mhz. Note that this value of VSWR is only for the cable connection only and when a load such as an antenna is added it will tend to raise the overall mismatch still further.

(3) Increasing the length of the connections to 10mm each raises the VSWR still further to 1.35 at 432Mhz and to 1.75 at 1296Mhz. The latter measurement is consistent with the 2.0 :1 measured initially on the yagi antenna under test which had 10mm tails.

(4) Doubling up the screening braid ground connections to the N connector significantly reduces the mismatch at 432 and 1296Mhz as shown in the graph at Fig3 plotted with two 6mm screening braid tails to ground.

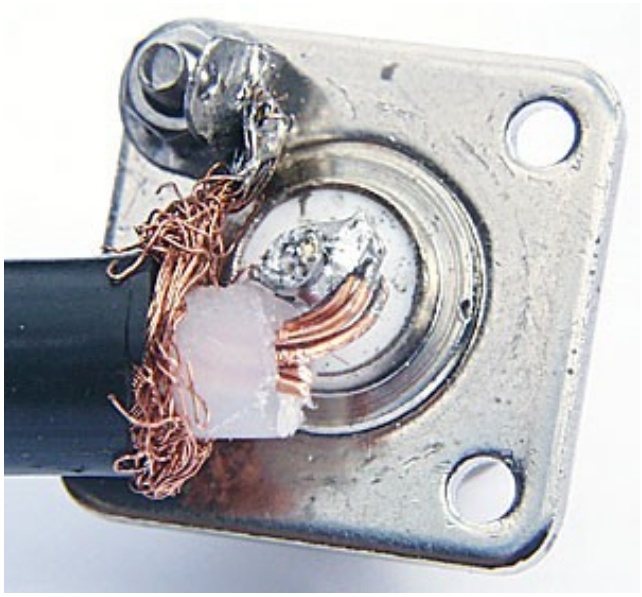

fIg 1

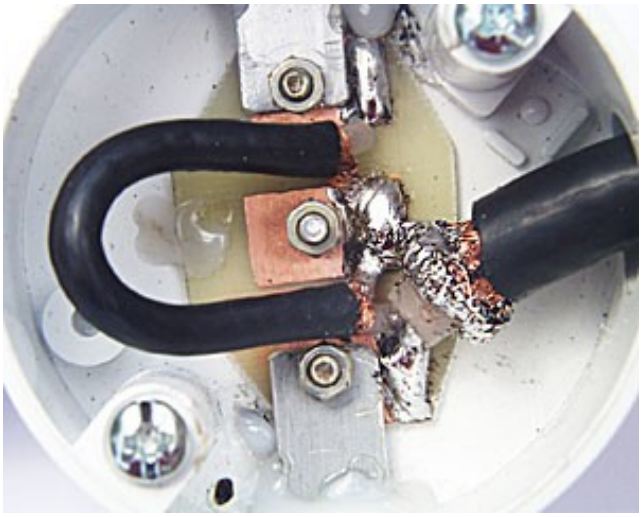

fIg 2

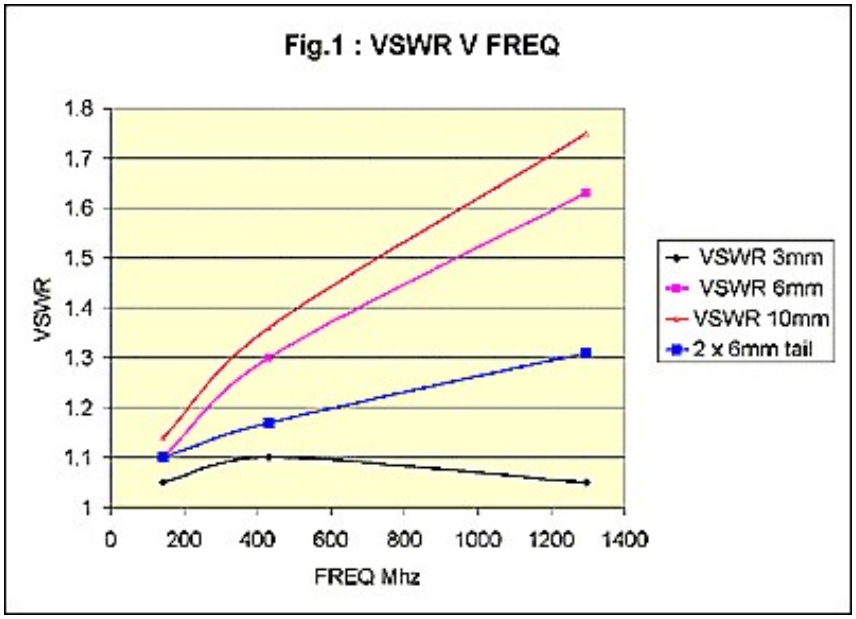
Fig.1 : VSWR V FREQ
VSWR
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0
200
400
600
800
1000
1200
1400
FREQ Mhz
VSWR 3mm
VSWR 6mm
VSWR 10mm
2 x 6mm tail

fIg 3

Conclusions and Recommendations

(a) At 144Mhz and below, cable tails up to about 10mm long do not have a significant effect on VSWR but it is good practice to keep them short anyway.

(b) Above 144Mhz, increasing the length of connecting tails has a very dramatic adverse effect on SWR keep them down to not more than 3mm in length

(c) If you are making the ground connections by means of teasing out the screening braid into tails, keep them as short as possible and preferably double them up.

(d) Rather than use braid earth tails, it is often better and neater to remove a short section of the outer covering and trim the braid so as to leave only a very short exposed length of dielectric and tin the end of the braid to avoid it fraying and then wrap a piece of tinned copper wire around the tinned section and solder it to the braid and make a very short earth connection via the tinned wire. A second earth connection can be made by the same means.

(e) These tests have showed that when considering rear connections to chassis mounting connectors such as Type N etc. rather than to solder pads, it is possible to get a very good VSWR with open backed connectors even at 1296Mz providing that leads are kept very short, however, we have only been considering the VSWR aspect above and if you are concerned about leakage and signal cross-talk from cables etc, it would be advisable to use the full back-shell type connector which although more expensive, do maintain continuous screening contact to the screening braid of the cable.

de Derek G3GRO

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