Application Note 2

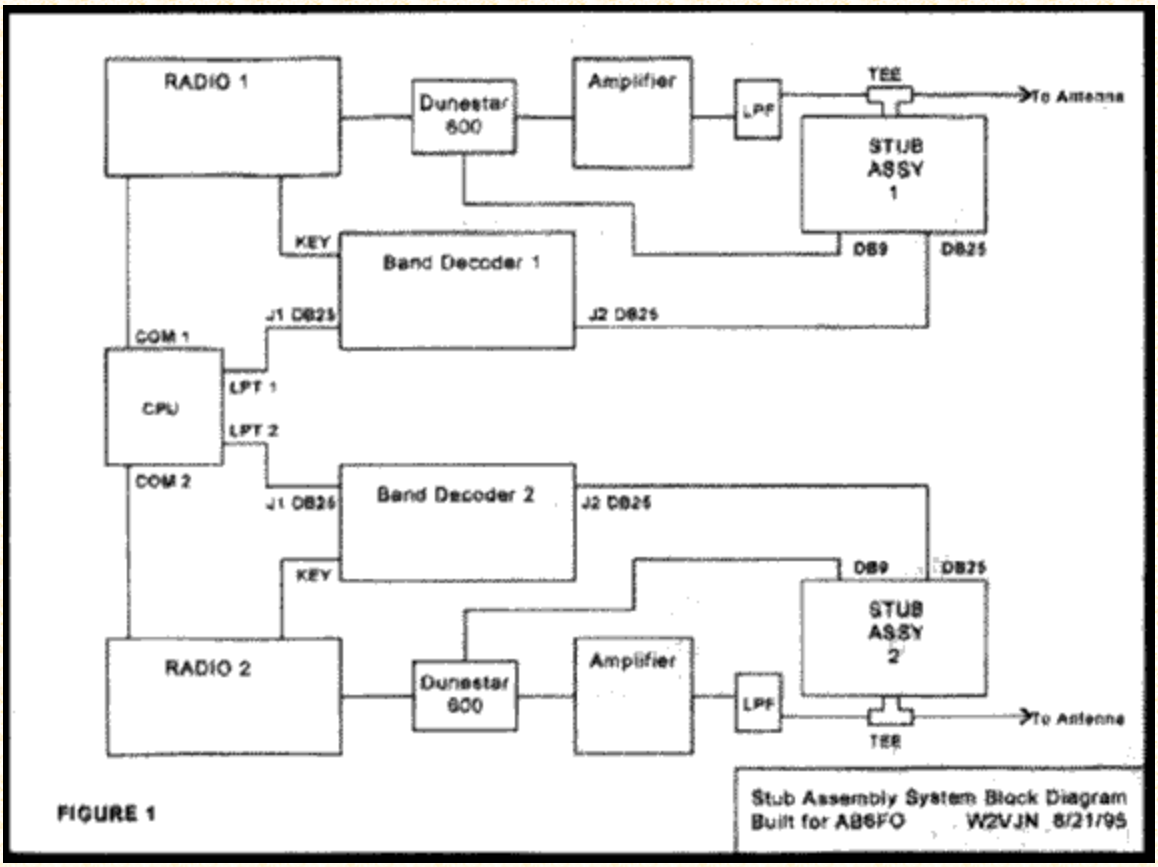
Subject: Band Reject Coaxial Stubs

(The following is a reprint of the September/October 1996 NCJ article on harmonic suppression using coaxial stubs written by Top Ten Devices' Chief Engineer, George Cutsogeorge, W2VJN.)

Band Switching Stubs for the Single-Op Two-Radio Station

Early last year Ken, AB6FO (now K6LA) put out a request on the CQ Contest reflector for help in constructing automatic band switching stubs for his newly designed single op two radio (SO2R) station. It looked like a perfect application for the band decoders and 6 way relay boxes available from Top Ten Devices, Inc. Single band stubs have been in use for many years by contesters to reduce inter-station interference, particularly in multi-op multi-radio stations. In this application, no band switching is required. For a single op, however, rapid band changing is a necessity to be competitive. Many of the top operators are using 2 radios which complicates it even further.

Figure 1 shows a block diagram of a portion of the SO2R station at K6LA. One computer controls two radios through Com 1 and Com 2. Each radio has a band switching filter in its RF drive line to an amplifier. These filters reduce the wide band noise produced by the transmitting radio so it is not audible in the receiving radio on another band. They also help prevent overload and damage of the receiving radio's front end.



Each amplifier has a TVI filter mounted very close to its output. A short run of double-shielded coax, RG-214, then connects to a tee fitting on the stub assembly. The length of this cable is not critical, but it should be well shielded. The tee output goes to the antenna selection relay. This article will not address the antenna switching or the key/mike controls.

The computer LPT ports control two band decoders which supply the relay driver signals to the stub assemblies. Simple diode logic is used to select the proper stubs and control signals are passed through to the band switching filters.

There are many ways the stubs could be arranged. These stub assemblies were designed to meet Ken's requirements. Each assembly contains 6 stubs arbitrarily designated as follows:

A= 1/4 wave shorted 80 meter.
B= 1/2 wave open 40 meter.
C= 1/4 wave shorted 40 meter, also acts as 3/4 wave shorted 15 meter.
F= 1/2 wave open 20 meter, also acts as 1 wave open 10 meter.
G= 1/4 wave shorted 20 meter.
J= 1/2 wave open 10 meter.

The switching logic is arranged to utilize these stubs on the following bands:

160= none
80= A, nulls 40,20,15,10
40= B&C, nulls 80&20,10
20= F&G, nulls 40,15&10
15= C, nulls 20,10
10= F&J, nulls 40,15&20

Figure 2 shows the wiring of the stub assemblies. The six way relay box has its shortest PC traces on outputs 3 and 4, so they are used for the shortest stubs. The longest stubs are connected to ports 1 and 6, which have the longer PC traces.

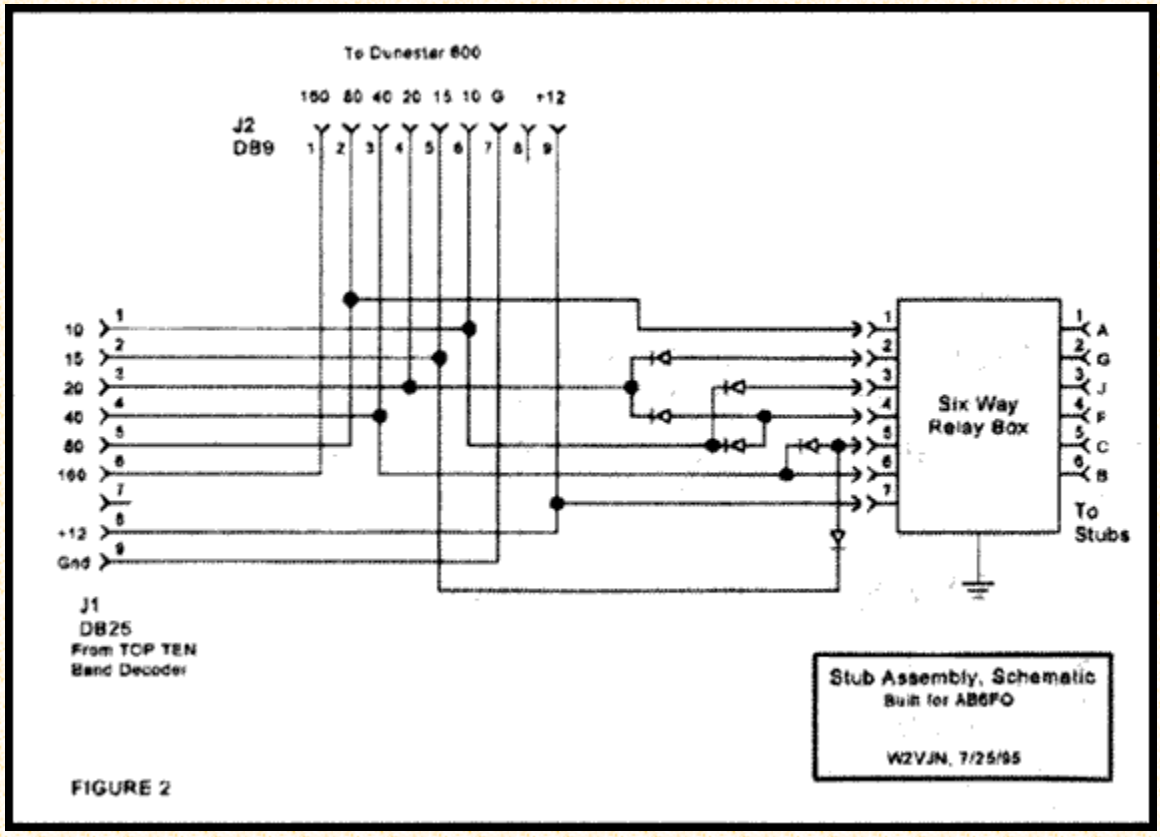
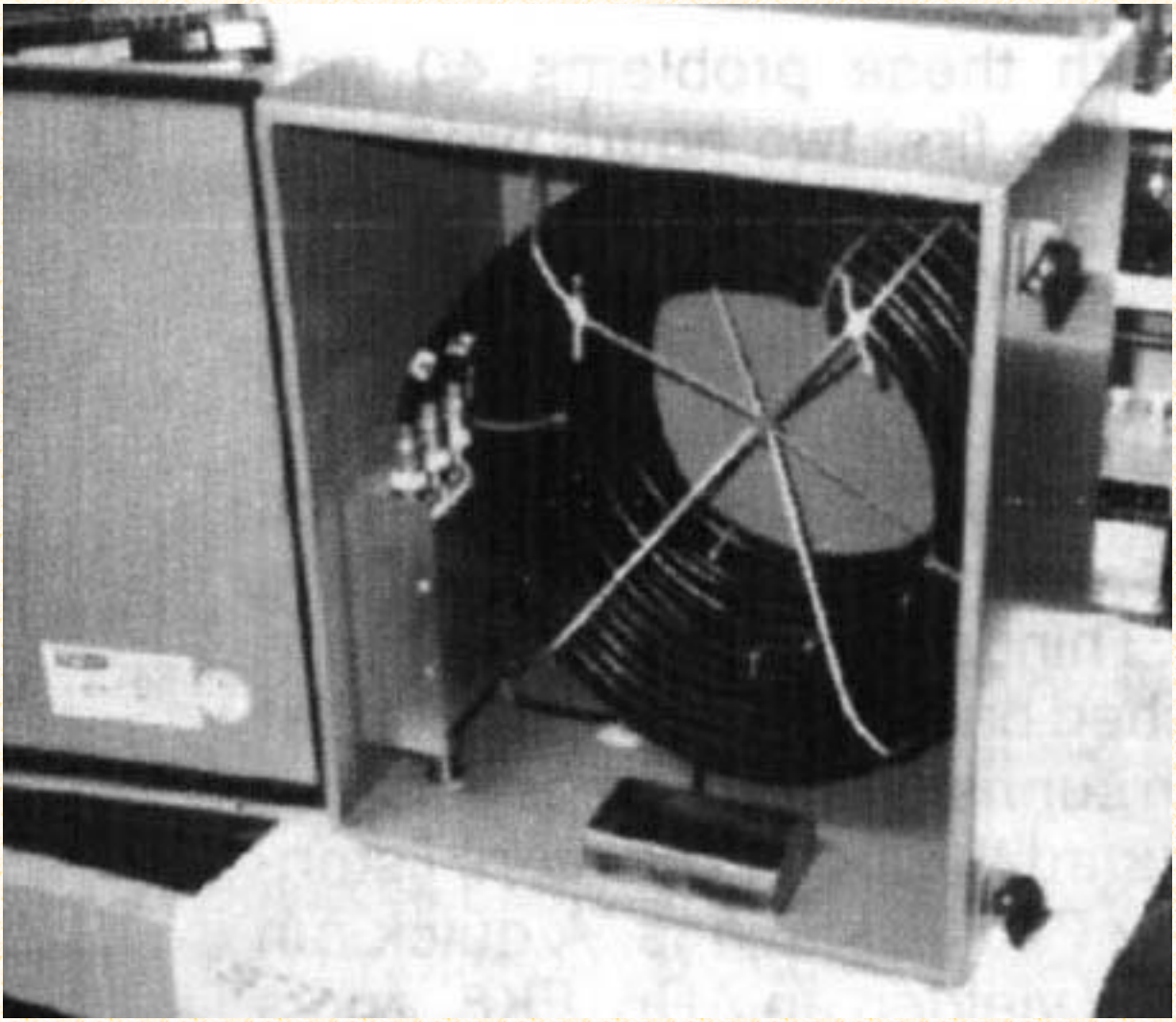


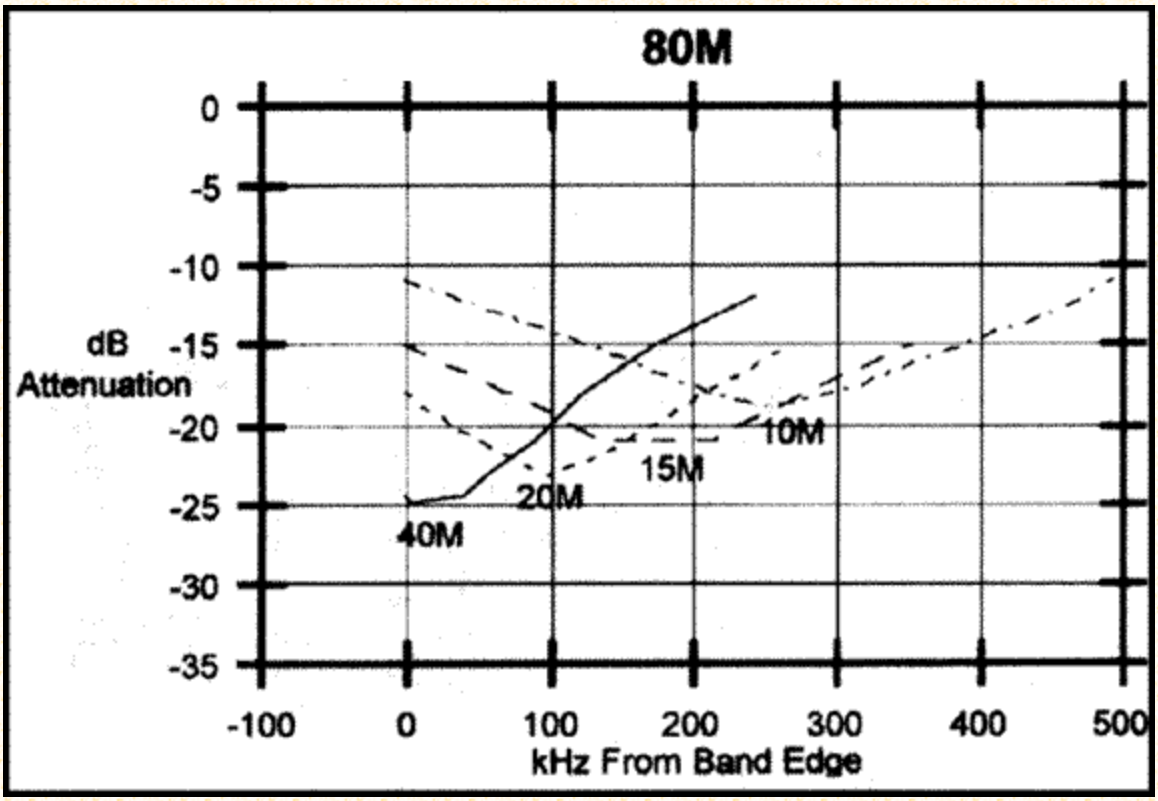
FIGURE 2

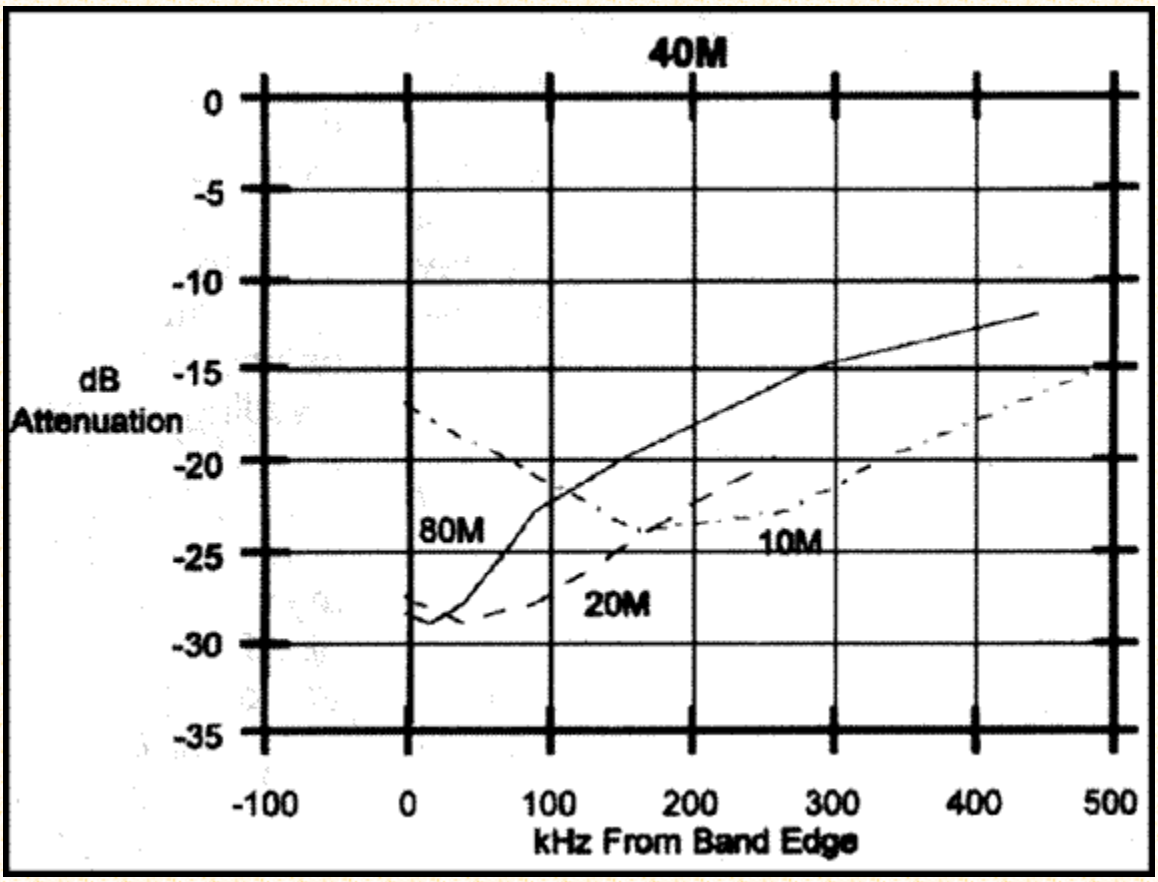
Figure 3 shows the construction. Two steel NEMA boxes are used to house the stubs. These are available at electrical supply houses. The six way relay box is mounted on the side of the NEMA enclosure and a UHF double male with a UHF barrel is used to extend the input fitting. All stubs are constructed with RG-213. Each stub has an SO239 connector on one end and is shorted or open on the other. The ends were coated with glyptol and

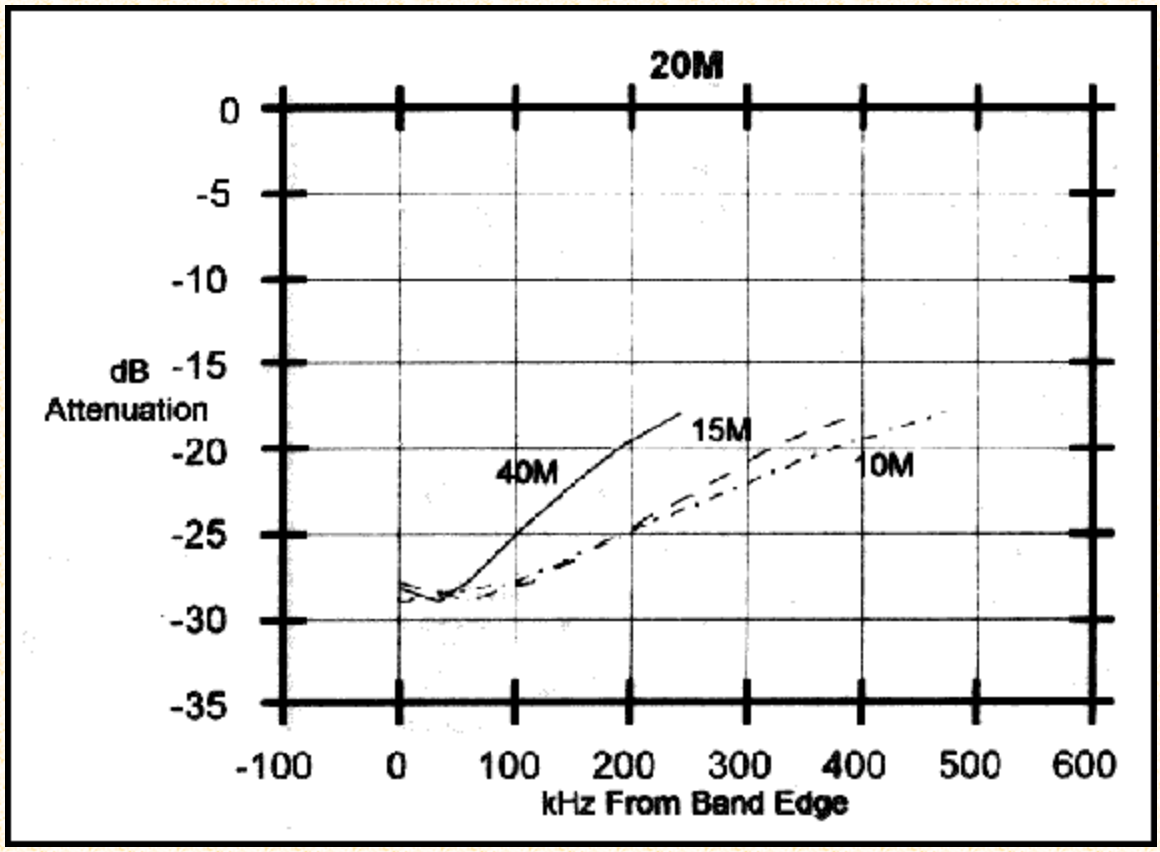
covered with shrink fit. For the open stubs the shield is cut back 1/4 inch before sealing. All stubs are tie wrapped individually and then tied in place with nylon cord. The diode logic and control connectors are mounted in a small die cast box.

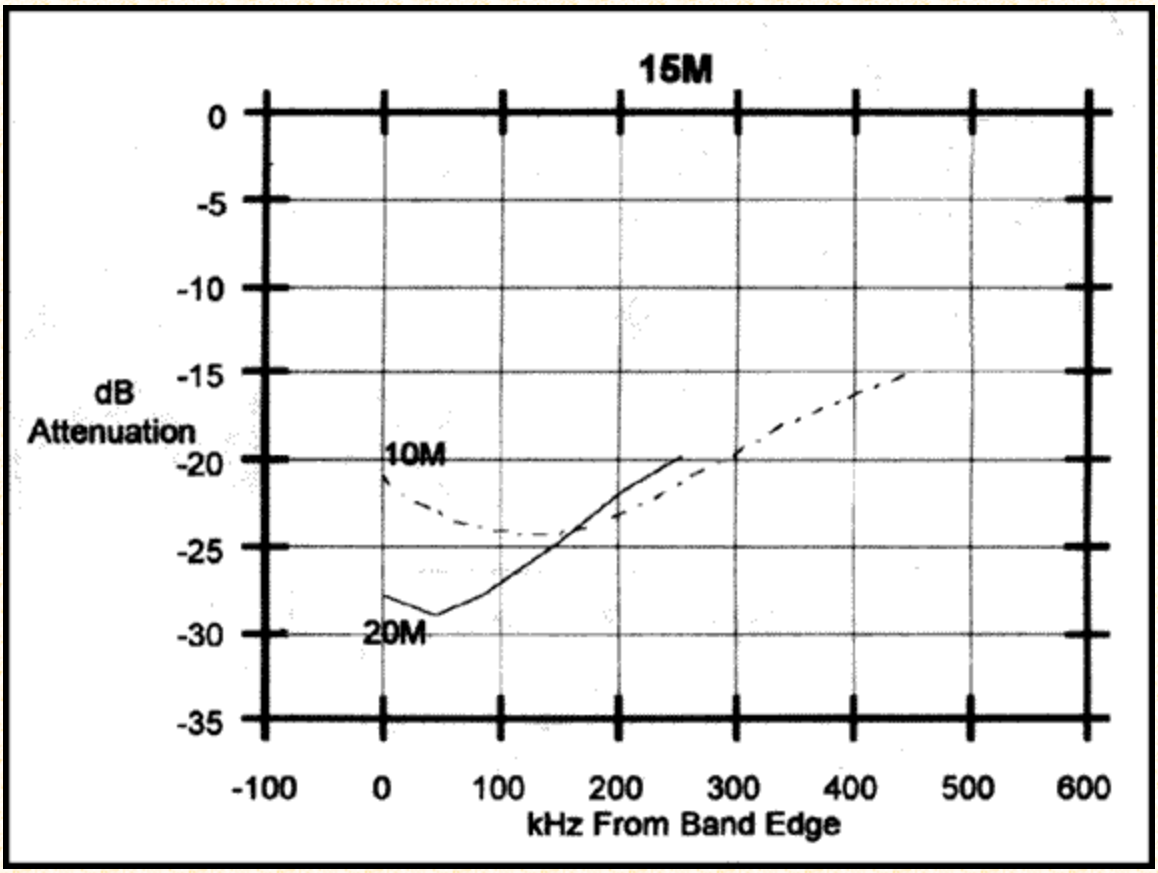


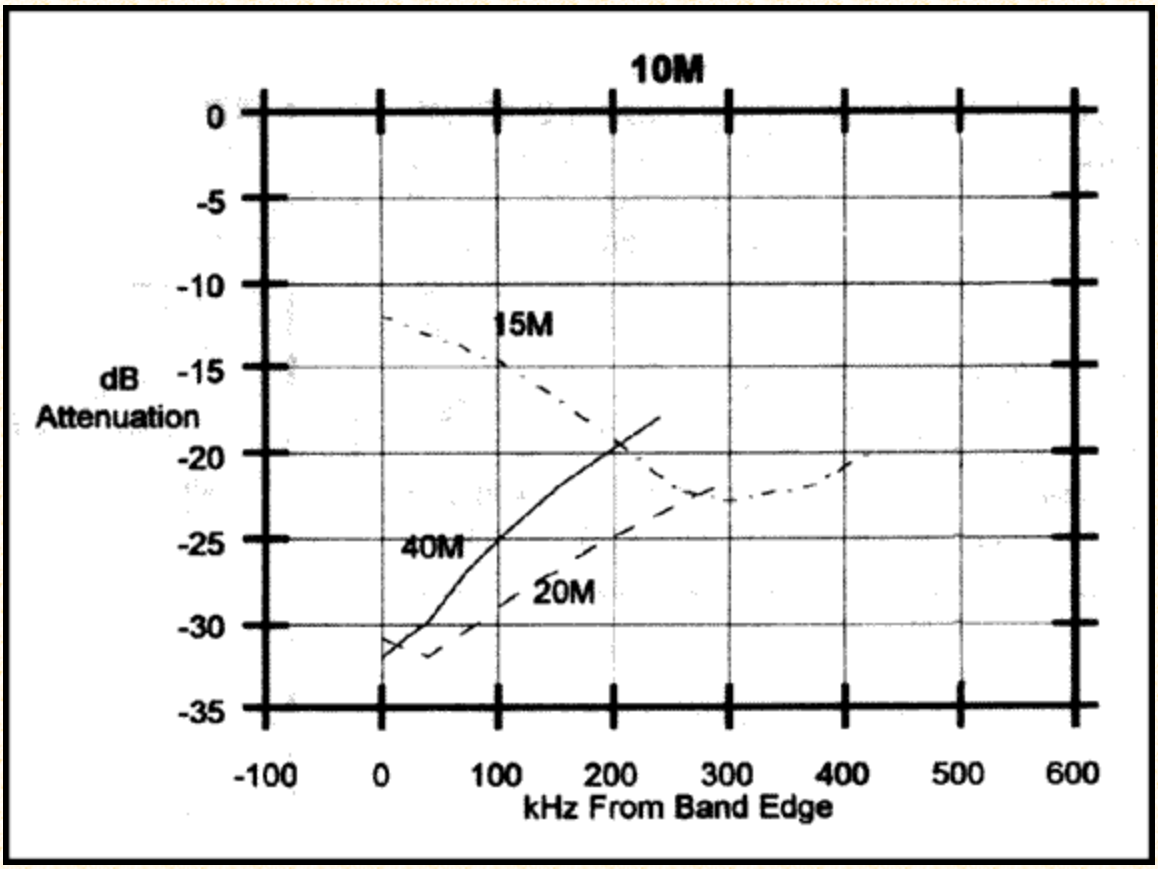
All stubs were cut for low CW operation and still provide some attenuation in the SSB bands. Figures 4, 5, 6, 7 and 8 show the attenuation on each band for signals coming from other bands or for transmitter harmonics. An MFJ 249 was used as the signal source and a scope or RF voltmeter as the detector. The meter on the MFJ did not have the resolution required to cut the stubs close enough. With the RF voltmeter arrangement they could be cut to 10 kHz or so.


80M
0
-5
-10
-15
-20
-25
-30
-35
dB
Attenuation
40M
20M
15M
10M
-100
0
100
200
300
400
500
kHz From Band Edge


40M
0
-5
-10
-15
-20
-25
-30
-35
dB
Attenuation
80M
20M
10M
-100
0
100
200
300
400
500
kHz From Band Edge


20M
0
-5
-10
dB -15
Attenuation
-20
-25
-30
-35
40M
15M
10M
-100
0
100
200
300
400
500
600
kHz From Band Edge


15M
0
-5
-10
-15
-20
-25
-30
-35
dB
Attenuation
10M
20M
-100
0
100
200
300
400
500
600
kHz From Band Edge



The stub lengths after trimming were as follows:

A 45’ 2”
B 45’ 0”
C 21’ 11”
F 21’ 10”
G 9’ 10.5”
J 10’ 2”

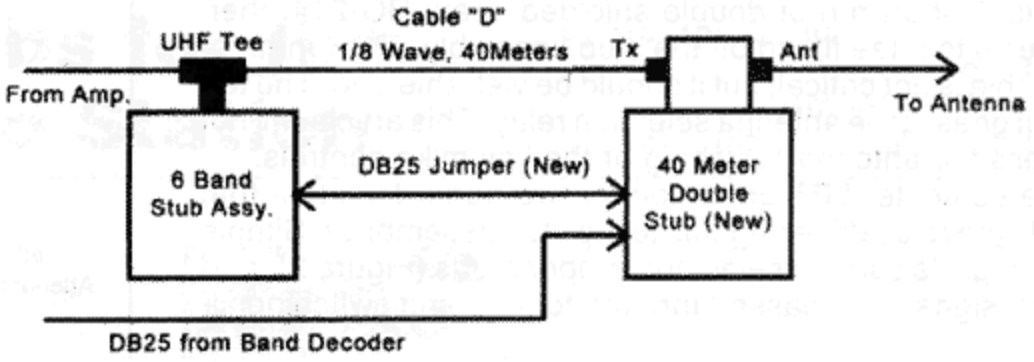
These numbers should be used as a guideline only for reproducing the stub assembly as there is some variation in velocity of propagation from cable to cable, even from the same lot. It’s advisable to start with it long and snip down as the null is approached.

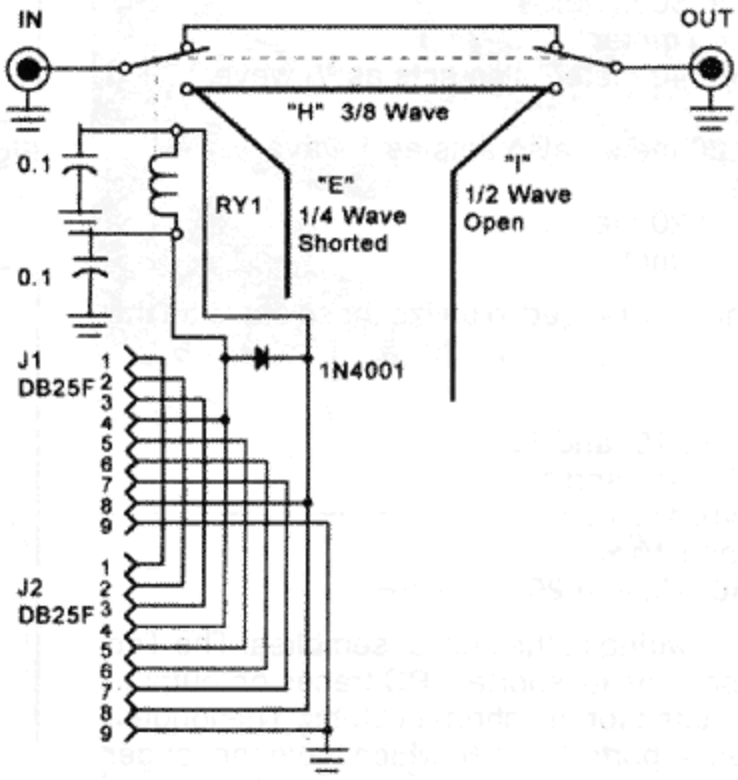
After Ken had the units installed and operating, he decided more attenuation was required when operating on 40 meters. A second assembly was constructed using two additional stubs. A 1/8 wave cable connects the two assemblies. A DPDT relay normally bypasses the 40 meter assembly except when 40 meters is in use. At the input is a 1/4 wave shorted stub

which nulls 20 and 10. The input is connected to the output with a 3/8 wave line and a 1/2 wave open stub nulls 80. Performance is shown below.

	Band		
Unit	80	20	10
Original	-28 dB	-28 dB	-24 dB
With 40 Assy	-64 dB	-65 dB	-41 dB

Figure 9 shows the 40 meter unit. They were built inside an aluminum chassis with a cover plate. The additional attenuation allows Ken to operate his second receiver very close in frequency to the transmitting harmonic.





Ry1 = P&B KA11DG-12V

Figure 9

Forty Meter Double Stub
Built for AB6FO

W2VJN 1/5/96