USERS MANUAL
for the

FB5 Antenna

a personal non-commercial project of the Florida Boys

AB4ET Dec.2003

The FB5 Antenna
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ILLUSTRATIONS

The FB5 Antenna

1.0 INTRODUCTION

The FB5 antenna (Fig. 1.0) is a group design and construction project by the "Florida Boys" for personal use. It is not a commercial venture, but simply a project to keep the Florida Boys busy and out of mischief.

The Florida Boys is a highly disorganized group of amateur radio operators who are mainly members of the Platinum Coast Amateur Radio Society. Collectively they are interested in all aspects of the hobby especially home brewing (radio equipment), Operating, DX and Contesting.

The Master of Ceremonies gave the title -*The Florida Boys* - to them at an awards dinner, at the Dayton Hamfest several years ago. It occurred when they were presented with a winner's plaque for yet another win in one of the national or international contests that they had entered.

2.0 DESIGN

The FB5 antenna is a short; center loaded vertical dipole similar closely resembling a commercial unit produced by Force 12 Antennas Inc. known as the Sigma 5. (The "5" indicates the number of bands on which it will operate). The general concept of inductively loading a dipole in order to reduce its physical dimensions and switching out coil sections to change bands is not new and the Florida Boys considered it a good basis for a home brew project for personal use while making some worthwhile improvements over the design of the commercial product.

Since this antenna is a mere 9 feet long its performance cannot be expected to equal or surpass that of a full size unit of one half wavelength long on the band of interest. However it does work well and initial reports of long haul DX worked have justified the design and construction effort.

The basic design is of a short dipole with loading coils for each band in each of the two legs of the dipole. The coils are connected in series and additional coils are added incrementally as more inductance is required for lower frequency ranges.

On the higher bands the unwanted coils are shorted by relay contacts. This can be seen diagrammatically on the Conceptual Circuit Diagram Fig 2.0 and Fig 2.1.

The initial design included a four turn matching coil directly across the terminals of the coaxial feed line. However, in cases this has been found to be unnecessary and has been removed, but in other cases adding a turn or two improved the match.

3.0 CONSTRUCTION

Construction is straightforward and due to group participation very little final assembly is required. Since this is fairly obvious no detailed instructions are included. However care should be taken with the Antenna Loading Unit wiring to ensure compatibility. See the wiring diagrams. Some of the group members have elected to use split tubing method of joining the main sections of tubing together instead of the stainless bolts and wing nuts. Splitting the tubing and using stainless hose clamps will make the antenna sturdier, provide a more solid connection, and allow more adjustment on individual bands. This will allow moving the antenna from the SSB section of the bands to the CW section without readjusting the coils. It should be noted that any adjustment of the tubing lengths after tuning would affect all bands. It should also be noted that on almost all bands the antenna will operate across the entire band without any adjustment.

To use the split tubing method carefully cut two slots in the larger diameter tubing approximately two to three inches long using a fine-toothed hacksaw. Preferably cut the slots so that they do not pass through the pre-drilled holes used by the wing nut hardware. Hose clamps are required but not supplied. The pre-drilled holes can be used as a guide, and a black permanent marker can be used to mark preferred settings.

4.0 ELECTRICAL

Band switching is accomplished by eight relays, four for each leg of the dipole (Fig.2.0. and 2.1.). Switching is carried out remotely via a small control unit (Fig.4.0.) and a multi-conductor control cable (Fig.3.0 and 4.0).

The relay control box contains a six position rotary switch, an LED to indicate DC power and the connectors for the DC and the control cable. Some Florida Boys have installed LED indicators for each band. See figure 8 for this modification. The 20-meter band position appears in positions 1 and 6. On 20 meters all relays are de-energized and all coils are in circuit. Hence, with no power applied to the unit, it defaults to the 20-meter band.

The relay control box requires a 12-volt DC supply (not provided). Common wall-wart power supplies work well if capable of providing adequate current. Many just connect to the 12-volt DC power supply for their rig.

Refer to Fig.2.0. - The loading coil system consists of five coils per element. ALL coils are in circuit to achieve resonance on 20 meters and sections are incrementally short circuited by the appropriate relay as the switch is changed to higher frequency bands. i.e.

The following example shows operation for one element as illustrated in Fig. 2.0.

Band	Relays energized	Coils in circuit.	Coils shorted
20	None	All	None
17	K1, K5	17,15,12,10	20
15	K2, K6	15, 12, 10	20,17
12	K3 , K7	12,10	20,17,15
10	K4, K8	10	20,17,15,12

5.0 ADJUSTMENT - GENERAL

Set up the antenna, with the 4-inch PVC center housing cover removed, in an open area away from metallic obstructions. Ten to fifteen feet clearance should be adequate. The antenna is relatively immune to nearby metal as long as it is not too close, (as far as effects on tuning are concerned, although it may affect the radiation pattern during operation!). However note the comments regarding cables below

Check the dimensions of the tubing per Fig.1.0.

Connect the coaxial feed line and the control cable.

It is absolutely imperative that the feed line and control cable be brought away from the antenna at right angles to the plane of the tubing. If this is not observed and a cable hangs down near the antenna element, false readings will be obtained.

If the Antenna Analyzer adjustment method is used as in Sect. 4.2 one person can adequately perform the adjustment and tuning. If the station transmitter is used as in Sect. 4.3 then two persons will make the task infinitely easier.

5.1. Adjustment using an Antenna Analyzer.

- Connect the analyzer to the antenna using a short piece of 50-ohm coax. (a length of about 18 inches or less).
- Select the 10-meter position on the control box.
- Stand as far away from the antenna as possible while still being able to hold and operate the analyzer.
- Place the control cable so that it is not in the proximity of the antenna tubing. Placing it over ones shoulder works well.

- With the analyzer, find the resonance of the antenna in or near the 10-meter band. If the resonant point is below the lower band edge or too low in the band for the anticipated mode of operation spread the turns of the two, ten meter loading coils and re- check the resonance. Care should be taken to try and spread the coil turns equally for the two coils. If reasonable spreading of the turns does not move the resonance in band it may be necessary to shorten the element lengths. This should be done in equal increments at both sides of the antenna.
- Check the SWR at the lower band edge and at suitable points through the band, up to the highest anticipated frequency of interest. If the SWR at resonance is unsatisfactory try checking the coil adjustments to ensure they have been adjusted equally. The matching coil can be installed and the effect checked for an improvement. A satisfactorily low SWR should be achievable from 28.0 to at about 28.8 or 29 MHz.
- If the 10-meter SWR is satisfactory, switch the control box to the 12-meter position and repeat the checks except that no adjustment to element lengths should be made.
- Adjustment for 12 meters should be made on the 4 turn coils nearest to the 10-meter coils at the feed point end. When the resonance is moved into the band the SWR should be adequate throughout the band 24.890 - 28.990 MHz.
- Switch to the 15-meter band and repeat. Adjust the two coils next to the coils previously adjusted for 12 meters. A resonance in the band center should be adequately low throughout the band, 21.0 - 21.450 MHz.
- Switch to the 17-meter band. Adjust the two five-turn coils next outboard of the 15-meter coils. When resonance is in band the SWR should be similar throughout the band, 18.068 - 18.168 MHz.
- Switch to the 20-meter position and check the resonance. Adjust the six turn coils at the outer ends of the PC board for resonance in the appropriate area of the band. The SWR should be satisfactorily low throughout most of the band 14.0 - 14.35 MHz. Most have found that the 20-meter band has the most narrow bandwidth and have set the center frequency between 14.150 and 14.200 to get coverage for areas the individual operator prefers. However, once connected to a radio with an internal antenna tuner, it can be tuned to cover the band.
- After the 20-meter band has been set, recheck the other bands again starting at 10 meters.
- If all bands are OK install the PVC housing and recheck all bands again.

5.2. Adjustment using the station transceiver and an SWR meter.

- Connect the antenna to the station transceiver via an SWR meter using 50 ohm coaxial cable e.g. RG-58U or similar. Ideally the SWR meter should be as close to the antenna as possible to eliminate any errors due to the transmission line characteristics.
- Ensure that the coaxial cable and control cable leave the loading coil housing at right angles to the elements for a distance of six feet or more to avoid erroneous measurements.
- Carry out the test procedure as for Para 4.2, except that measurements are made at the transceiver. Spot-check the SWR throughout the bands using the SWR meter choosing unoccupied spot frequencies to avoid causing interference.
- Carry out adjustments to the antenna loading coils as shown in Para. 4.2.

6.0 Modifications and accessories.

6.1 The initial two ten meter coils caused the ten-meter resonance to be too high (about 29MHz). New coils with four turns about 5/8 inch in diameter will correct this problem. This modification has been already incorporated in most FB5's.

6.2 The four-turn heavy gauge matching coil mounted directly across the feed point has been found by some to be unnecessary. However, others have found that more inductance was required for a satisfactory match, and have replaced the coil with a five-turn coil. Most everyone noted that when the tuning was checked with the analyzer through the full length of 50 or 100 feet of coax, the SWR was better than measured directly at the antenna.

6.3 In order to prevent the control and RF feed cables from drooping near the antenna and potentially effecting performance a modification can be incorporated as shown in Fig. 6. This modification also provides strain relief to the connectors. This requires the addition of a length of PVC pipe and a Tee piece. Details are not provided as this modification can be implemented in many ways given the range of PVC components available from most hardware stores. The cables can be secured to the boom with rubber bands, cable ties or even string.

6.4 A useful accessory is a carrying case and the one shown in Fig 7. This one was found by Bob Adamitis K9MDO and looks like a very satisfactory solution. It consists simply of a Plano 26" plastic toolbox Model No. 682, which he purchased at a hardware store in Illinois. However they are not available locally.

They can be purchased direct from the factory for $12.00 each plus UPS shipping at $7.68 i.e. $19.68 delivered. This is almost exactly what Bob paid at his local hardware store. They can be ordered at 1-800-226-9868 using a credit card. They ship in 72 hrs max and shipping takes four days. Other info can be found at their web page, www.planomolding.com. If you decide to use this case you will need to shorten the PVC ground mount slightly and take a couple inches of extra tubing off the top of the one-inch tube on the center loading unit.

6.5 Some users have added an extra LED for each band position on the band selector switch to indicate the switch position selected. A suggested circuit is shown in Fig. 8.0.

6.6 Jan-K4QD, with antenna modeling and coil design help from Al-K3VN, and construction help and advice form other Florida Boys used the same center PC board and two relays to build a 16 foot tall 30 and 40-meter version of the antenna. This antenna was tested successfully at 500 watts on CW and performed well in San Andres where it was used to make over 1500 contacts on the two bands.

7.0 Power requirements

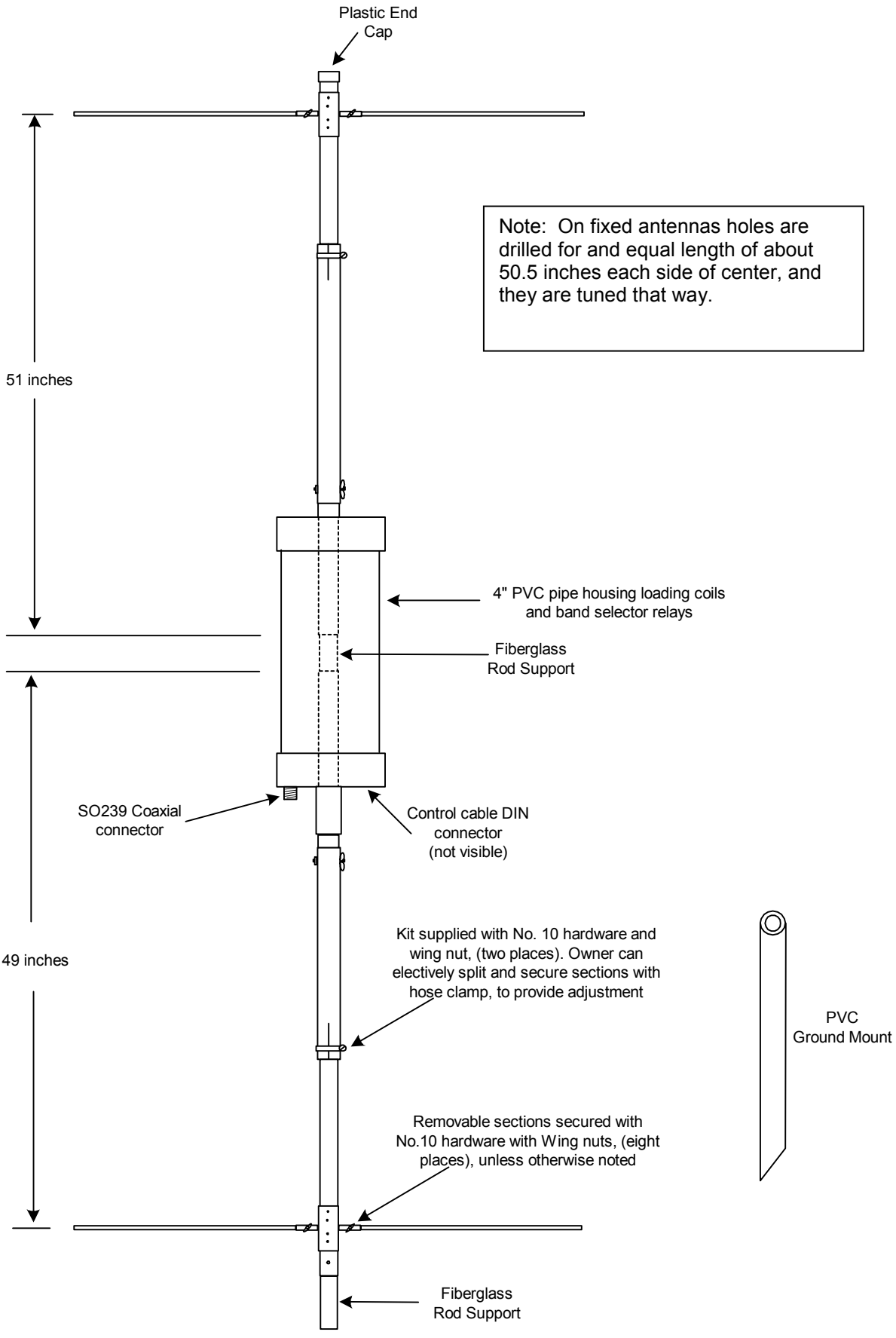
The Unit operates from a nominal 12 volt Dc power supply which must be provided by the owner. Satisfactory operation will occur over a range of at least 10 to 18 volts DC.

Current requirements for a nominal 12.8 volts DC supply are :

20 meter band 10 ma/s (LED only)

All other bands 130 ma/s (Two relays at 60 ma/s each plus 10 ma/s for the LED)

If additional LED's are added to highlight the selected band the additional LED current should be added to the max. current drain. For a typical LED a current limiting resistor of 1200 ohms at 1/2 watt should suffice.



Drawn. 15 Nov 03 AB4ET

Fig.1.0.
FB5 ANTENNA
General View