VHF/UHF ANTENNAS
FEDERAL FTR-29C ANTENNA SYSTEM
MAINTENANCE

CONTENTS PAGE

1. GENERAL

1.01 This section describes the alignment and routine maintenance of the Federal FTR-29C Radio Frequency Antenna Systems including the FLU-5108 Antenna Duplexing Filter.

2. ALIGNMENT TESTS

(A) Antennas

2.01 At the time the antenna is installed the antenna parabola can be set to within 0.5 degrees of optimum, if carefully done. Optimum alignment of the antenna, including a test for dipole polarization and focal point setting can be made when the radio system is being aligned.

(B) Antenna Duplexing Filter FLU-5108

2.02 The antenna duplexing filter is adjusted at the factory for optimum performance at the transmitter and receiver frequencies. The alignment procedure outlined in Paragraph 2.04 may be used in the field, when the operating frequencies of a radio system are to be changed, or when the factory adjustment is to be checked during initial installation or during periodic maintenance.

2.03 Apparatus:

1 Frequency Meter Panel, FLU-5005
1 Oscilloscope, Federal, FLU-5092
1 Pulse Source; a Pulse Generator FLU-5019, a Pulse Restorer FLU-5047 or a commercial pulse generator, similar to the Kay Electric Micropulser
1 Receiver, Radio, Federal, FLU-5107
1 Signal Generator, Hewlett-Packard 612A, 450-1200 megacycles
1 Transmitter, Radio, Federal, FLU-5106

*45 db of Lossy Line, RG-21/U (2-10 db, 1-20 db and 1-5 db) with a UG-18/U plug at one end and a UG-20/U jack at the other end.

*Note: This loss may have to be varied in order to obtain a suitable reading on the FLU-5005 Frequency Meter Panel.

2.04 Procedure:

(1) Connect the output jack, J7 of the radio transmitter double stub tuner through 45 db of lossy line to the FLU-5005 Frequency Meter Panel. Set the FLU-5005 panel switch to the "FREQ" position.

(2) Apply power and a pulse source to the radio transmitter and tune it carefully to the transmitting frequency assigned to the antenna duplexing filter.

(3) Remove the power from the radio transmitter. Disconnect the lossy line from J7 on the double stub tuner. Restore the normal radio transmitter output coaxial cable connection from J7 on the double stub tuner to J2 on the antenna duplexing filter. A

(4) Apply power to the radio receiver and tune it to the receiving frequency assigned to the duplexing filter.

(5) After completing the receiver adjustment, remove the signal generator and restore the input coaxial cable connection from J3

on the antenna duplexing filter to J1, the receiver input jack.

(6) Connect the Hewlett-Packard 612A Signal Generator to J1 on the antenna duplexing filter.

(7) Align the receiver preselector in the antenna duplexing filter.

(8) Connect the RG-58/U cable, provided with the FLU-5005 Frequency Meter Panel between the wavemeter cavity input connector J1 (on FLU-5005), and J5 on the antenna duplexing filter. Set the FLU-5005 panel switch to the "FREQ" position.

(9) Remove the Hewlett-Packard 612A Signal Generator from J1 on the antenna duplexing filter.

(10) Apply power to the radio transmitter and allow it to come up to operating temperature.

(11) Adjust the length of each one of the snort stubs, one at a time, in small steps, until a peak reading is obtained on the meter. The short stubs should be adjusted to this peak reading on the wavemeter to obtain a suitable signal source for the adjustments that follow. As the alignment proceeds the radio transmitter output power should be monitored on the FLU-5005 Frequency Meter Panel, readjusting the output power of the radio transmitter to insure that a readable signal is being supplied.

(12) Disable the radio transmitter by removing V1, the 6AC7 video amplifier tube.

(13) Connect the FLU-5005 Frequency Meter Panel through a 20 db section of RG-21/U lossy line to J1 on the antenna duplexing filter.

(14) Replace V1, the 6AC7 video amplifier tube in the radio transmitter panel.

(15) Measure the radio transmitter frequency. Readjust it to the transmitting frequency of the antenna duplexing filter, if any drift has occurred.

(16) Connect the Federal FLU-5092 Oscilloscope to test point E2 on the radio receiver panel. Synchronize the oscilloscope with the synchronizing output voltage from the pulse source feeding the radio transmitter. If a pulse generator is used for this purpose, connect the 8 kc or pulse input jack on the oscilloscope to J1 on the pulse generator panel. Set the oscilloscope controls as follows:

SYNC SEL	to	PTM
TRIG-RECUR	to	TRIG
SYNC	to	8 KCS
SWEEP MULT	to	1 or 10
PHASING	to	Vertical index line (12 o'clock)
VERT ATT and GAIN	to	the position where pulse breakthrough is displayed on the oscilloscope screen. If the long stubs of the antenna duplexing filter are not set to the correct length, this pulse breakthrough will be displayed.
SYNC GAIN	to	the position where the pulse breakthrough display is synchronized (stationary).

(17) While monitoring the frequency of the radio transmitter, adjust one of the long stubs until the pulse breakthrough visible on the oscilloscope screen is reduced to a minimum level. Mark the setting with a pencil and detune the stub about one inch.

(18) Continuing with the monitoring of the radio transmitter frequency adjust another long stub for minimum pulse breakthrough. Mark this setting, and detune the stub about one inch.

(19) Adjust the last long stub following the same procedure outlined in Steps (17) and (18). Lock this long stub in the position where minimum pulse breakthrough occurs. Reset and lock the first two long stubs to the marked settings.

(20) Recheck the pattern on the oscilloscope screen. The oscilloscope will show traces of noise when the vertical gain is set at maximum. The pulses, if any appear, should be at a level below or equal to that of the noise peaks.

(21) Recheck the radio transmitter frequency.

(22) Recheck the pattern on the oscilloscope screen. If it was necessary to readjust the radio transmitter frequency in Step (21), the pulse breakthrough amplitude might increase. If this occurs, the long stubs should

be readjusted following the procedure outlined in Steps (17) through (19). This procedure may have to be repeated several times, before the pulse breakthrough is at a minimum at the correct transmitter frequency.

(23) Turn off the radio transmitter by setting switch S1 on the FLU-5003 power supply to the "OFF" position.

(24) Disconnect the coaxial cable from J7 on the radio transmitter double stub tuner and J2 on the antenna duplexing filter. Connect in its place a 10 db section of RG-21/U lossy line. Leave the 20 db section of RG-21/U lossy line connected to J1 on the antenna duplexing filter. The 10 db lossy line is employed to isolate the radio transmitter from the antenna duplexing filter.

(25) Connect the RG-58/U cable provided with the FLU-5005 Frequency Meter Panel between the wavemeter cavity input connector J1 (on FLU-5005) to J5 on the antenna duplexing filter.

(26) Apply power to the radio transmitter. Allow it to come up to operating temperature and then measure the frequency. If the frequency has changed, readjust it exactly to the transmitting frequency of the antenna duplexing filter.

(27) Carefully adjust each one of the short stubs, one at a time in the direction which produces an increase in FLU-5005 panel meter reading. Absolute power output is obtained when further adjustment of the stubs fails to increase the reading on the FLU-5005 panel meter. When this condition is obtained, lock each stub.

(28) Turn off the radio transmitter by setting switch S1, on the FLU-5003 power supply to the "OFF" position.

(29) Remove the 10 db section of RG-21/U lossy line from J7 on the radio transmitter double stub tuner and J2 on the antenna duplexing filter.

(30) Replace the coaxial cable that connects J7 on the radio transmitter double stub tuner to J2 on the antenna duplexing filter.

(31) Apply power to the radio transmitter. Allow it to come up to operating temperature and then measure the frequency.

(32) Recheck the oscilloscope for any pulse breakthrough. Whatever breakthrough there is, it should be equal to or less than the level of the noise visible on the oscilloscope screen.

(33) Turn off the radio transmitter by setting switch S1 on the FLU-5003 power supply to the "OFF" position.

(34) Disconnect the 20 db section of RG-21/U lossy line from J1 on the antenna duplexing filter.

(35) Connect the antenna transmission line to J1 on the antenna duplexing filter.

(36) Turn on the radio transmitter and measure the frequency. If the radio transmitter frequency has shifted appreciably after the antenna system has been connected in place of the 20 db lossy line, a fault in the antenna system is indicated. A complete check of the antenna system following the procedure outlined in Part 4 of this section is indicated.

3. ROUTINE MAINTENANCE TESTS

(A) General

3.01 In order to be certain that the Federal FTR-29C Radio Frequency Antenna System is operating efficiently, certain tests should be made on a routine basis. Inasmuch as a repairman will be visiting the radio station at regular intervals for the purpose of performing equipment routines, it would be desirable to have him read and record the antenna system gas pressures and voltage standing wave ratios on these occasions. If either of these readings vary from normal a trouble is indicated and remedial action as discussed in Paragraphs 4.01 to 4.08 should be followed.

(B) Gas Pressure Test

3.02 Gas pressure readings are furnished by the gauge that is installed with the coaxial transmission line. The readings should be taken and recorded at the intervals prescribed in Section 402-300-330. A pressure of 5 lbs in the transmission line will prevent any moisture from entering the line. If the pressure drops to zero, the line should be examined for cuts, bruises, chafing or breaks.

(C) Voltage Standing Wave Ratio Test

3.03 To read the VSWR on a coaxial transmission line a M.C. Jones MM702 Micromatch is connected in series with the coaxial transmission line at the radio transmitter output. This instrument provides the means for reading the Forward and Backward (Reflected) Power in the coaxial transmission line. In cases where the transmission line develops trouble, causing

the characteristic impedance of the line to change, a high backward power reading will be indicated.

3.04 Requirement: The VSWR should be less than 1.7:1.

(D) Duplexing Filter Alignment Test

3.05 The alignment of the duplexing filter should only be checked if it is suspected that the adjustment has changed. Too frequent adjustment of the duplexing filter will result in the locking clamps scoring the stubs, preventing an exact adjustment.

3.06 Procedure for testing long stub adjustment:

(1) Connect the Federal FLU-5092 Oscilloscope to E2, the monitoring jack at the radio receiver output. Connect the 8 kc or Pulse Input jack of the oscilloscope to J1 on the Pulse Generator Panel or to J3 on the D and I Common Equipment Panel if at a repeater station. Set the oscilloscope Vert Gain and Vert Mult for maximum gain.

(2) Turn off the radio transmitter associated with the radio receiver and filter by operating switch J1 on the FLU-5003 rf power supply to the "OFF" position.

(3) Disconnect the antenna from J1 on the duplexing filter and in its place, connect about 20 db of RG-21/U lossy line.

(4) Connect the FLU-5005 Frequency Meter Panel to J5 on the duplexing filter. Set the FLU-5005 panel switch to the "FREQ" position.

(5) Turn on the radio transmitter, allow it time to heat and then read the frequency. If the frequency is not correct, retune the radio transmitter to the exact operating frequency.

(6) Examine the oscilloscope display for traces of pulse breakthrough. With the oscilloscope operating at maximum vertical gain there will be some noise apparent on the oscilloscope screen.

Requirement: If there is any pulse breakthrough, the amplitude of the pulses should not exceed that of the noise. If the pulse amplitude exceeds the noise level a readjustment of the long stubs as outlined in 2(B) is indicated.

3.07 Procedure for testing short stub adjustment:

(1) Remove B+ power from the radio transmitter by operating switch S1, on the FLU-5003 rf power supply to the "OFF" position.

(2) Disconnect the coaxial cable that connects J7, the radio transmitter output jack to J2, the input jack on the duplexing filter.

(3) Disconnect the antenna coaxial transmission line from J1 on the duplexing filter.

(4) Connect about 35 db of RG-21/U lossy line to J7, the radio transmitter output jack.

(5) Connect the other end of the RG-21/U lossy line to the FLU-5005 Frequency Meter Panel. Set the switch on the FLU-5005 Frequency Meter Panel to the "FREQ" position. It may be necessary to adjust the amount of the attenuation offered by the lossy line in order to obtain a convenient on-scale meter reading.

(6) Apply power to the radio transmitter by operating the switch S1 on the FLU-5003 rf power supply to the "ON" position. Allow the radio transmitter to reach operating temperature and then check the frequency, adjusting it if necessary. Record the meter reading.

(7) Remove power from the radio transmitter as described in Step (1).

(8) Remove the RG-21/U lossy line from J7, the radio transmitter output jack and connect it to J1, the duplexing filter antenna jack.

(9) Restore the normal coaxial cable connection from J2 on the duplexing filter to J7, the radio transmitter output jack.

(10) Apply power to the radio transmitter by operating the switch S1 on the FLU-5003 rf power supply to the "ON" position.

(11) Read the FLU-5005 Frequency Meter Panel meter reading.

Requirement: The meter reading taken in Step (11) shall be the same as that taken in Step (6). The duplexing filter when properly aligned presents very little loss.

4. TROUBLE LOCATION PROCEDURES

(A) General

4.01 Because there is a wide variation in the antenna arrangements at individual installations, it is impracticable to prescribe

fixed procedures for clearing antenna troubles, except for a few of the more common types of troubles which are discussed in general terms in the following paragraphs. Since the majority of installations employ the 7/8 and 1-5/8 inch rigid type coaxial type transmission line, this discussion will be concerned chiefly with that type of installation.

4.02 While the immediate causes of antenna troubles may arise from a number of factors, all such troubles may be summarized into two general categories: (1) insulation faults and (2) continuity faults.

(B) Insulation Faults

4.03 Insulation faults cause loss of radiated power in transmitting antennas and a reduction of signal voltage from a receiving antenna. In the case of transmitting antennas, such faults are manifested by a marked change in the back power reading on a Jones Micromatch. With receiving antennas this condition will be indicated by lowered AVC voltage. On both antennas the gas pressure would likely be, but not necessarily, subnormal.

4.04 Where an observation shows abnormally high back power (Paragraph 4.03) with no gas pressure, an inspection of the coaxial transmission line should be made. This inspection should begin at the transmitter end and continue towards the radiating end. In some instances the faults will be discovered without the necessity of climbing to high elevations. Upon locating the leak, suitable repairs should be made and the line recharged with gas. With the transmitter operating another reading of the back power should be taken. If trouble persists proceed to Paragraph 4.05.

4.05 Where the rise in back power is not due to lack of gas pressure, an insulation resistance test should be made. This will require disconnection of the transmission line from both the dipole assembly and the radio transmitter. With both ends of the transmission line clear, check the insulation resistance with a megger. If a megger is not immediately available, a dc ohmmeter test may confirm quickly that there is an insulation fault, however, a negative test by an ohmmeter is not conclusive that there is no trouble. If the insulation resistance of the transmission line is satisfactory, the dipole assembly should be examined for presence of moisture or other defects.

(C) Continuity Faults

4.06 Continuity faults may range from an open circuit in the coaxial transmission line inner conductor to a high resistance in the transmission line. With radio transmitters, this will result in no radiation or in lowered radiation. This may or may not produce an abnormal reading of back power depending upon the location of the fault. When there is a complete break in the line, this will result in no signal voltage at the radio receiver, and in the case of a high resistance in the transmission line the signal voltage at the receiver input will be low. Complete opens are caused by mechanical damage which has also caused breaks in the sheath and loss of gas pressure. Considerations discussed in Paragraph 4.04 apply.

4.07 High resistance faults are usually the result of poor installation. These troubles are caused by either misalignment of the inner conductor connecting sleeves or by poor contact of the connecting sleeves with the inner surfaces of the center coaxial conductor. Beginning with the flexible coaxial cable connections at each end of the transmission line and continuing to all of the rigid coaxial transmission threaded joints, examine each connection in this order until the trouble is found and remedied.

4.08 Another continuity trouble that has evidenced itself as intermittent circuit noise is caused by poor installation of the inner conductor connecting sleeves. This condition may be confirmed by connecting a Wheatstone bridge to the radio transmitter end of the coaxial transmission line. The bridge will read near zero resistance (0.03 to 0.05 ohms for a 200 ft 7/8 in. coaxial cable run) because of the low resistance of the dipole assembly. Movement of the coaxial transmission line will cause a variation in the bridge reading if this condition exists. To correct this condition, the coaxial transmission line will have to be disassembled, section by section, inspecting the connecting sleeves at each joint and expanding them to provide a tighter connection.