RADIO FREQUENCY DEMODULATION SUPPRESSORS FOR TELEPHONE SETS

1. GENERAL

1.01 This practice provides information on how to *identify, select,* and *install* devices for the reduction of radio frequency interference (RFI) and covers both *inside* and *outside* plant conditions of radio frequency interference.

1.02 This practice replaces CTSP 410-600-404.

2. DESCRIPTION

2.01 Radio interference on customer's telephone set is generally caused by a radio station being too close to the customer's telephone facility or telephone instrument.

2.02 Some of the major causes of RFI has been found to be:

a. Corroded connections.

b. Loose wire terminations.

c. Abandoned drop wire still connected to the line.

d. Inside wire connected but not used.

e. Foreign attachments.

2.03 The following telephone set components may also act as effective demodulators:

a. Speech equalization varistors in networks.

b. Transistors in amplifiers of some networks or handsets.

c. Varistors and transistors such as in Touch-Tone dials.

d. Diodes in polarity guards.

e. Click suppression varistors across the receiver units.

f. Bad carbon transmitters.

2.04 In some cases, *high frequency potentials* of appreciable magnitude to ground may be present on cables or wires. It is possible for high frequency induction to cause arcing to ground across open space protectors, resulting in a sputtering or crackling noise in the receiver. Should it appear that an abnormal level of high frequency energy is present on a customer's line, refer the matter to your supervisor.

3. TEST PROCEDURE

3.01 A hand test telephone, with the transmitter shunted out, is required for the following test procedure. If the transmitter is not shunted out, it may demodulate the radio signal and render the test invalid. The following procedure is used to determine whether the source of RFI is within the telephone set, in a component, or in a line connection external to the set. The same procedure should also be used for interference testing on electronic equipment.

a. Place all telephone sets in the circuit to be tested on hook.

b. Bridge the modified (*transmitter shunted out*) hand test telephone across the line.

c. If radio interference is heard, it indicates that the source of the RFI is external to the telephone sets. In this case, perform corrective action as described in paragraph 4.

d. If radio interference is not heard, it indicates that the source of RFI is internal to one or more of the telephone sets. In this case, perform corrective action as described in paragraph 5.

3.02 Because of the numerous possible sources of such interference and the unpredictable level of RFI energy which might prevail, it is impossible to prescribe a specific series of instructions which may be uniformly applied in correcting all RFI trouble. Each case of RFI trouble must be investigated and a solution determined based on those conditions which are peculiar to the location involved. Therefore, one or more of the following corrective measures may be required to correct a given case of RFI.

3.03 If the methods outlined in this practice do not eliminate RFI, refer the problem to your supervisor.

4. RFI CORRECTIVE MEASURES–*EXTERNAL*

4.01 In those instances where RFI is determined to be external to the telephone set, it will first be necessary to check all line connections between the cable terminal and the telephone set connecting block. This check should also include an inspection of station protector and protected cable terminal carbons, where found. All corroded connections should be cleaned and defective carbon blocks should be replaced. If RFI problem is still evident, proceed as outlined in the following paragraphs.

NOTE: RFI energy may go to ground and be demodulated through the carbon in a protector with no apparent damage being done to the carbon. If this condition exists, remove the carbons and make proper tests.

4.02 Small ceramic disk type capacitors of ±20 percent tolerance and a 500 volt rating installed at the station protector should alleviate RFI. Capacitors of the following values should be obtained for RFI application:

$0.01\mu f$ $0.02\mu f$ $0.03\mu f$

4.03 Two capacitors are required for RFI suppression at the station protector (see Figure 1). It may be necessary to substitute capacitors of various values until interference is eliminated. It is desirable to employ the minimum capacitance necessary to eliminate the trouble. Thus, $0.03\mu f$ units would not be used if $0.01\mu f$ capacitors would clear the line and in no event would $0.01\mu f$ and $0.02\mu f$ or similar unequal combinations be employed. Install capacitors as follows:

a. Insulate capacitor leads with standard tubing. Keep leads as short as possible. See Figure 2a.

b. Terminate the other lead of each capacitor on the ground post of the protector. See Figure 2b.

c. Terminate one lead of the first capacitor on the tip and one lead of the second capacitor on the ring terminal on the station side of the protector. See Figure 2c.

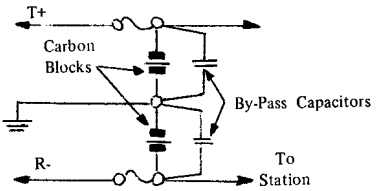


FIGURE 1. Capacitor Installation on Station Protector

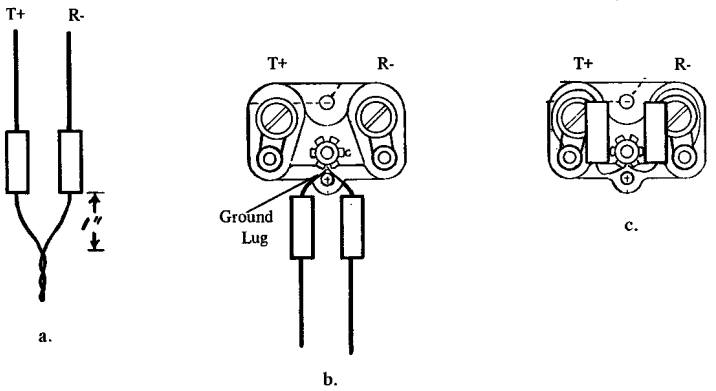


FIGURE 2. Capacitors Mounted on Station Protector

4.04 In some severe cases of RFI, it may be necessary to place bypass capacitors at the serving terminal in addition to those placed within the telephone set or protector. These additional capacitors shall be mounted outside the terminal in a one pair line arrestor (either cable or open wire type is acceptable). Mount the arrestor as close to the terminal as possible, keeping in mind the need to *avoid climbing area infractions* while maintaining easy access to the cable terminal. Remove carbon blocks before installing capacitors. Carbon blocks are not to be used in this application of the line arrestor. Refer to Figure 3 and proceed as follows:

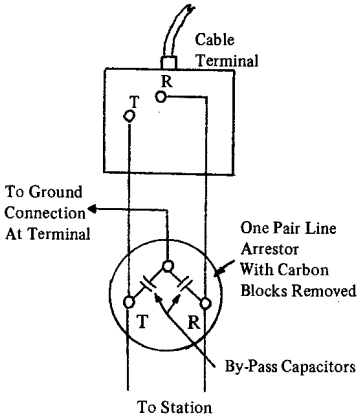


FIGURE 3. Capacitor Installation at Cable Terminal

a. Insulate capacitor leads with standard tubing. Keep leads as short as possible.

b. Terminate one lead of the first capacitor on the *tip* and one lead of the second capacitor on the *ring* terminal of the arrestor.

c. Terminate the other lead of each capacitor on the *ground* terminal of the line arrestor.

d. Connect short lengths of drop wire between tip terminals and between ring terminals of cable terminal and line arrestor.

e. Place a short length of wire between a dependable ground connection on the cable terminal and the ground terminal of the line arrestor.

5. RFI CORRECTIVE MEASURES–*INTERNAL SUPPRESSION DEVICES*

5.01 In those instances where RFI is determined to be internal to the telephone sets, it will first be necessary to check for *loose* or *corroded* line connections. This check should also include an inspection for defective *telephone cord sets.* Sometimes replacement of the *transmitter* and *receiver capsules* will eliminate an RFI problem. If the RFI problem is still evident after the above inspections and appropriate corrective measures, install drainage capacitors.

5.02 A CAC1542A *inductor* can be effectively used as a radio frequency suppression coil. The *inductor* should be installed as close as possible to the telephone set. The mounting block is designed to be mounted on a wall in place of the usual telephone connecting block. Inductor mounting block installation procedures are similar to connecting block installation procedures (see Figures 4 and 5). If the inductor is used with an instrument that does not require a connecting block, the inductor should be connected across the line as close as possible to the subset of the instrument.

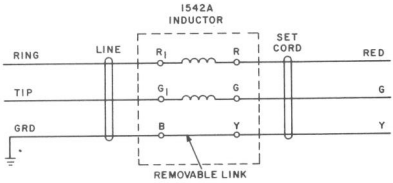


FIGURE 4. 1542A Inductor Schematic

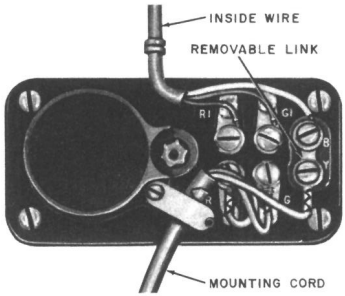
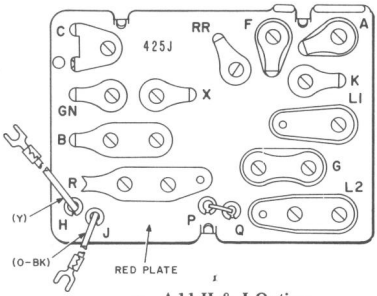
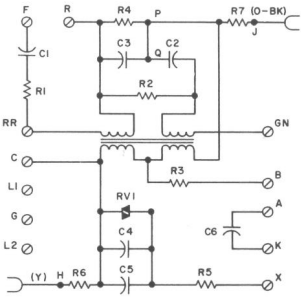


FIGURE 5. Cording Diagram, 1542A Inductor

5.03 A W.E. Co. 425J *network* eliminates the speech equalization varistors and adds *resistors* to remove radio interference (see Figures 6a. and b.). The 425J can be used for rotary or Touch-Tone dial applications. The 425J also contains an equalization network for Touch-Tone dials by using the X terminal (see Figure 6a.).



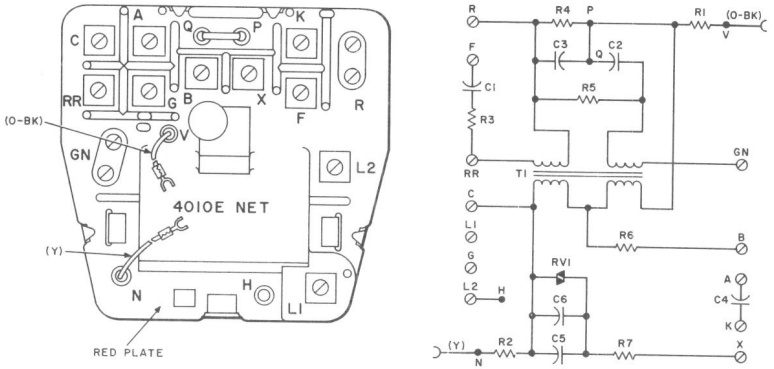
a. Add H & J Option



b. Add H & J Wiring Option

FIGURE 6. 425J Network and Schematic

5.04 The W.E. Co. 4010E *network* operates the same way as the 425 except that there is a difference in wiring options (see Figures 7a. and 7b.).

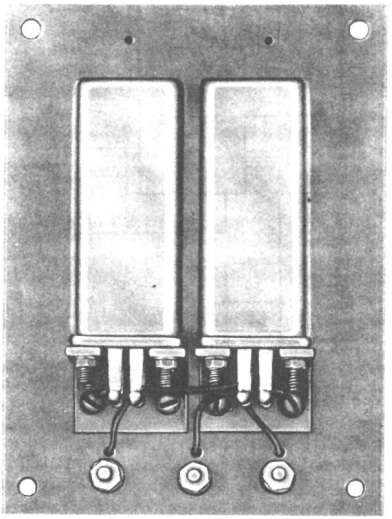


a. "N" and "V" Option

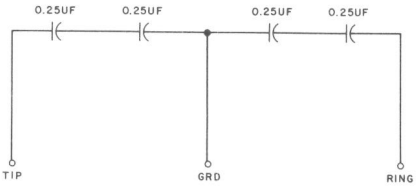
b. Add "N" and "V" Wiring Option

FIGURE 7. 4010E Network and Schematic

5.05 The W.E. Co. 40BA *capacitor* should be located at the protector to bypass radio frequency signals to ground. Bypass capacitors should be installed across all other components of the telephone set that may act as a demodulator, such as a *transmitter* unit, *receiver* unit, *transistors* in *amplifiers, polarity guards,* etc. (see Figures 8a. and b.).



a. Capacitor



b. Schematic

FIGURE 8. 40BA Capacitor and Schematic

6. INSTALLATION OF A PROTECTOR WITH THE 40BA *CAPACITOR*

6.01 The 40BA *capacitor* should be installed near and connected to the protector with as short a piece of inside wire as possible (see Figure 9).

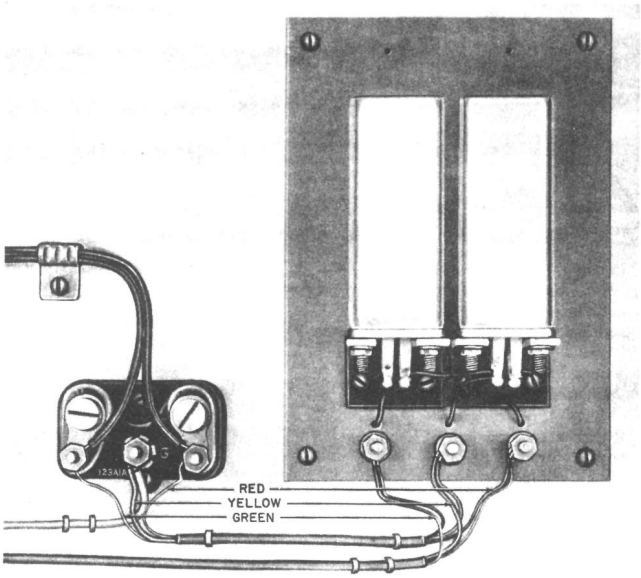


FIGURE 9. 123A1A Protector with 40BA Capacitor Installed

7. W.E. CO. KS-13814, LIST 7 *CAPACITOR*

7.01 The W.E. Co. KS-13814, List 7 capacitor or equivalent may be the most effective device for eliminating radio interference in 500 and 700 type telephone sets (see Figure 10).

FIGURE 10. KS-13814, List 7 Capacitor

7.02 The KS-13814, List 7 *capacitor* is installed in the 500 type telephone sets as shown in Figure 11. It is connected across the L and RW terminals of the 311A equalizers. Place the capacitor against the equalizer as shown. Cover the exposed portions of the leads with tubular insulation.

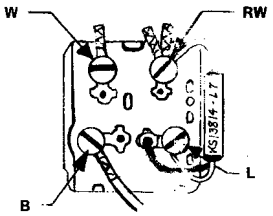


FIGURE 11. 500A, B or 501A, B Telephone Set, KS-13814, List 7 Capacitor Installed

7.03 The KS-13814, List 7 *capacitor* is installed in the 500 and 554 telephone sets as shown in Figure 12. It is connected across the F and L2 terminals of the 425 network. If the set is used as the tip station on two party message rate service, the capacitor should be connected across L1 and L2 of the 425 network. Cover the exposed portions of the capacitor leads with tubular insulation. For low frequency interference, another KS-13814, List 7 capacitor may be needed across terminals R and RR on the 425 network.

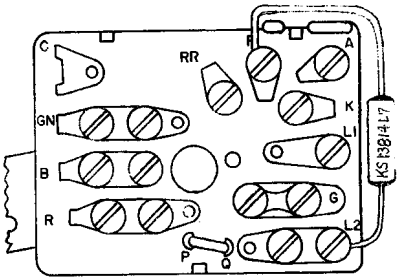


FIGURE 12. 500 and 554 Telephone Set, KS-13814, List 7 Capacitor Installed

7.04 The KS-13814, List 7 *capacitor* is installed in the 500 and 554 type telephone sets as shown in Figure 13. It is connected across the L2 and GN terminals of the 425 network as shown. Place the capacitor against the side of the network nearest the ringer. Cover the exposed portions of the capacitor leads with tubular insulation.

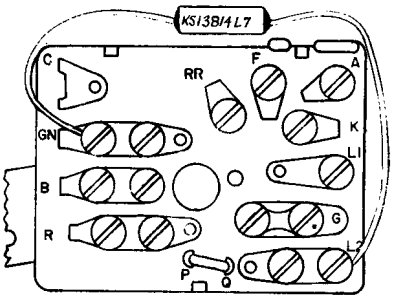


FIGURE 13. 500 and 554 Type Telephone Set, KS-13814, List 7 Capacitor Installed

7.05 The KS-13814, List 7 *capacitor* is installed in the 701 type telephone sets as shown in Figure 14. It is connected between the F and C terminals of the 495 network. Cover the exposed portions of the capacitor leads with tubular insulation.

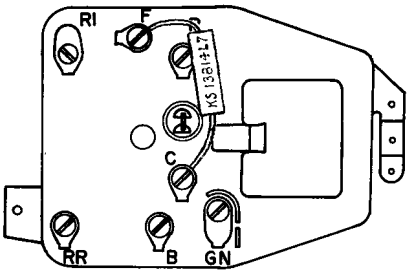


FIGURE 14. 701 Telephone Set, KS-13814, List 7 Capacitor Installed. Dial Removed for Clarity

7.06 The KS-13814, List 7 *capacitor* may be placed inside the G type handset to bypass the transmitter unit as shown in Figure 15. Place the capacitor against the transmitter cup, keeping the capacitor leads as short as possible.

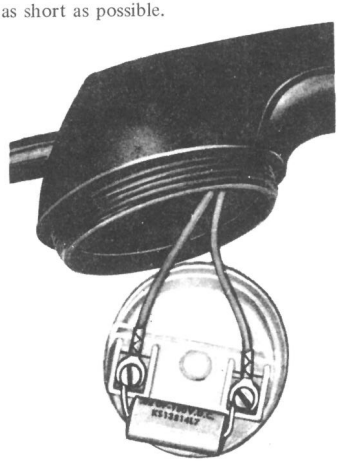


FIGURE 15. KS-13814, List 7 Capacitor, Handset Transmitter Cup

7.07 The KS-13814, List 7 *capacitor* may be used to bypass the 44A varistor on a U1 receiver unit as shown in Figure 16. Place the capacitor against the varistor, keeping the capacitor leads as short as possible.

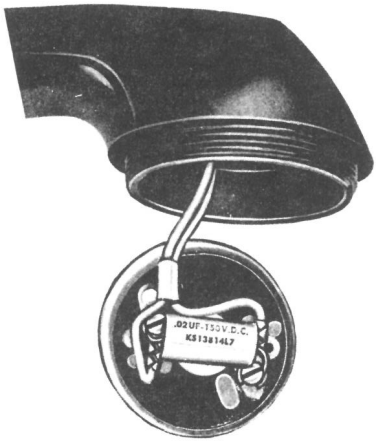


FIGURE 16. KS-13814, List 7 Capacitor, Handset Receiver Unit