

Home remedies for tv

Here are the official tricks from the Federal Communications Commission you can use to clear away CB and ham transmitter interference from tv, fm and stereo.

During the past few years tremendous advances have been made in the field of radio and television communications. Communications by radio and television from any point on the earth, and sometimes from points beyond the earth, have now become commonplace.

In recent years, the growth of two-way radio, permitting personal communications from motor vehicles and homes, has been explosive. These

advances in communication technology are not without problems.

The radio frequency *spectrum* is becoming crowded and interference problems, due to lack of compatibility between the different radio systems, are becoming widespread. This is evidenced by the thousands of complaints of interference to home electronic entertainment equipment (television, stereo, electronic organ, telephone, tape recorder and other audio equipment)

received by the Federal Communications Commission (FCC) each year.

Most of these interference problems can be traced to one or more of the following factors:

■ Characteristics of the receiving system, such as the system design and installation.

■ Environment of the receiving system, including the distance from television transmitter, intervening terrain, or the presence of nearby radio transmitter.



Electrical interference—This is what your television picture looks like when your set is reacting to any of the following devices operated in or near your home: Hair dryers, electric shavers, mixers, blenders, power saws, vehicle ignition systems, and other similar devices. When this type of interference is occurring, you may also hear a sizzling or buzzing sound along with the sound of the tv program. Do not confuse this interference with poor tv signal.



Poor tv signal—This is the type of television picture you will be receiving if you are far away from the tv transmitter site or if there is a building or mountain between you and the tv station. Defective antenna, improper antenna orientation, or disconnected or broken lead-in wire may also cause this problem. The sound of your tv usually will not be affected unless the tv signal is extremely weak. You can improve the quality of the signal by installing a higher antenna, using a directional antenna, a signal amplifier, or repairing the lead-in wire. Check with your tv sales and service representative on antenna systems available.

interference



■ Characteristics of radio frequency generating devices, such as citizens band (CB) and other radio transmitters.

■ Practices of the radio transmitter operator. For example, a CB user operating an illegal overpower transmitter or amplifier.

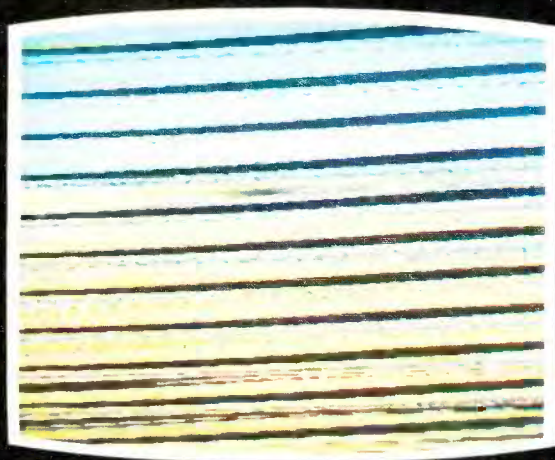
The FCC has jurisdiction over some of these factors. For example, the Commission has technical standards for transmitting devices such as CB trans-

mitters. These technical standards were recently strengthened by the the Commission. In addition, the Commission has rules concerning the way in which radio transmitters may be operated.

Obviously, control of some of the factors is not within the jurisdiction of the Commission. The quality of the television signal received at your home, for example, is most often influenced by the distance you live from the television station and the intervening terrain.

The commission has no standards for the design and installation of television receivers and associated antenna systems. However, many interference problems can be corrected by modifying and improving the television receiving systems.

As you begin to identify the type of interference you are experiencing, keep in mind that not only must your equipment be able to receive and amplify the desired signal, but it also must reject all



Horizontal control problem—When your set requires adjustment of the horizontal hold control or replacement of a bad tube or component, the above pattern will appear on your tv picture. The sound, if affected, may contain a high pitch tone. To eliminate, simply adjust your horizontal hold control or call your service representative to replace the bad tube or component.



Radio transmitter interference—This is what your picture looks like when it is picking up the transmission of CB, Amateur, Police or other radio transmitters. It will normally affect vhf channels only. You may notice that the interference pattern changes or moves as the radio transmitter operator talks. Do not confuse this interference with horizontal control problem.



unwanted signals and noise. This means that, even if the equipment you think is causing the interference is being properly operated, it is still possible to experience interference.

Purchasing a filter

There are no set procedures for eliminating television interference—it's a matter of eliminating the most likely sources of interference a step at a time. The first step is to install an inexpensive *high-pass filter* on the back of your tv set. In making this installation, follow these procedures:

- Determine the type of antenna wire that is connected to your tv set. Coaxial cable is a round lead-in wire which requires a filter impedance of 75 ohms. Twin lead is a flat wire which requires a filter impedance of 300 ohms.

- Purchase the filter which matches the type of antenna wire going to your tv set. The impedance information mentioned above will be on the filter label. Do not use a combination of twin-lead and coaxial cable without proper matching transformers, often called baluns. Filters are available in most stores that sell or repair television sets, and in electronics stores such as Radio Shack and Lafayette.

- Carefully read the instructions that are provided with the filter. You should be installing the filter on the back of your tv set, as near to the antenna terminal as possible.

- If you are on a cable system, you may still install the filter at the antenna terminal. However, if the interference continues, contact the cable company repair service for assistance. Do not attempt to modify the cable system yourself.

Installing a filter

The following is a guide to installing the filter. You may have to modify some steps to suit your particular installation.

- Disconnect the antenna wire (twin-lead or coaxial) from the television set antenna terminals.

- Connect the wire from the antenna to the input terminals of the filter.

- For twin-lead wire, connect a very

short (1" to 2") "jumper" wire from the antenna input terminals of the set to the filter. For coaxial cable, it will be necessary to obtain a jumper cable that has the proper connectors already installed. This can be purchased at the time you buy the coaxial filter.

- Be sure that in the case of twin lead wire, the actual wires are making contact with the terminals. For coaxial cable, be sure the connector plugs are properly installed on the coaxial cable.

- If you have an amplifier in your antenna system, you should have a filter installed ahead of the amplifier and another filter ahead of the tv receiver input terminals. If the amplifier is located close to the receiver, then install the filter before the amplifier only.

Booster amplifiers usually are located near the back of the tv set. Mast mounted outdoor amplifiers are usually located on the antenna. Distribution amplifiers usually are located somewhere in the distribution system. If a distribution amplifier is in your antenna system, then be sure to trace the entire length of the antenna system, because amplifiers are usually in out-of-the-way places.

- The connecting wires between the filter and amplifier, and between the amplifier and antenna terminal, should be as short as possible.



FM interference—Interference from a nearby fm broadcast station will cause this type pattern to appear on your tv screen. Although it normally will affect tv channel 6 only, one additional channel in the channel 2-13 series may occasionally be affected. It sometimes affects both the picture and sound of your set. Note that the interference pattern may change or vary with the sound of the fm broadcast station program, *not* the sound of the tv program. Do not confuse this interference with fine tuning problem.



Fine tuning problem—This is the type of pattern which will appear on your screen if the fine tuner of the tv set is not properly adjusted. Although it looks similar to fm interference, you will note that the pattern changes with the sound of the tv program. Readjust the fine tuning control of the tv set to eliminate the problem.

■ The instructions provided with the filter you bought may call for a ground connection. The wire should be as short as possible and connected between the high-pass filter ground terminal and a metallic cold water pipe or a ground rod. Use bell wire, which can be obtained in most variety stores, for this connection.

■ If installation of the filter at the tv antenna terminals does not entirely eliminate the interference, contact your service representative to install a high-pass filter inside the tv set at the tuner input terminals. Internal modification to your set should be done only by a service representative.

Resolution of interference

Although some interference problems can be attributed to television receiver, many problems can also be traced on CB radio transmitters. Therefore, upon receipt of an interference complaint from your neighbor, you should take all steps possible to insure that your radio transmitter is not causing the interference.

Voluntary installation of a low-pass filter, or other steps as outlined below, may eliminate the interference, and may prevent you from receiving an order from the Commission to implement these measures. You are not, however,

required to service or add filtering to the complainant's television, and should not take any such action without the full cooperation of your neighbors.

CB interference to channel 2

You are cautioned that the use of an amateur transmitter on the Citizens Band is illegal. Further, the use of external rf power amplifiers with CB transceivers is illegal. Both actions may subject you to Commission actions or criminal penalties.

Second harmonic interference from a CB transmitter to channel 2 may exist even though the transmitter meets FCC specifications for harmonic radiation. In these cases, a tuned filter across the antenna terminals of the television should help. An open circuit, quarter-wave, tuned stub across the antenna terminals can also be used. The stub should be made of the same type of wire as that connected to the antenna input terminals of the television.

The initial stub length should be 37 inches for RG-59/U coax; and 48 inches for 300 ohm twin lead. After connecting the stub, cut the unterminated end of the stub off in one-quarter inch sections until the interference is eliminated.

For harmonics falling on other tv channels, such as channel 5, 6, or 9, the

length of the stub can be calculated using the formula:

$$\text{Length in inches} = \frac{2952V}{f}$$

where V = velocity factor of line
and f = frequency in megahertz

Amateur interference to channel 2

One additional type of interference from a nearby transmitter is unique to the amateur 6 meter band—50-54 MHz. Since 6 meters is immediately adjacent to channel 2 (54-60 MHz), interference to channel 2 may occur.

In most cases, installation of an open circuit, quarterwave, tuned stub at the antenna terminals of the television set should be effective.

If RG-59/U is used as the tv lead-in wire, the initial length of the stub should be 42 inches. If 300 ohm twin lead is used, the initial length should be 53 inches.

After the stub is attached to the television, begin cutting off the unterminated end of the stub one-quarter inch at a time until the interference is eliminated. If the interference is reduced, but not eliminated by this method, add a second



Co-channel interference—This is the type of pattern which will appear on your screen when your set is simultaneously receiving two tv signals. Note that the two images are different, as though one picture has been placed on top of the other. Co-channel interference is due to either atmospheric conditions or the location of your home in relation to the location of the tv stations. If the problem is from atmospheric conditions, little can be done to correct the problem. However, the problem is usually temporary. If it is caused by the location of your home in relation to the location of the tv stations, use of a highly directional antenna may help eliminate the problem. Do not confuse this interference with ghosting.



Ghosting—This is the type of picture you will see when the tv signal is reflected, or the tv antenna or antenna lead-in wire are in poor condition. When ghosting occurs, it means the tv signal is being reflected off a mountain, building or other man-made structure, with the signals being sent over different paths to your tv set and arriving at slightly different times. With ghosting, note that the two images are the same. Rotation of your tv antenna to a new position, or installation of shielded lead-in wire may resolve this problem. If rotation of the antenna does not resolve the problem, have a service representative check the condition and/or placement of the antenna and antenna lead-in wire.



stub directly to the input terminals of the tuner.

Electrical interference is caused by either vehicle ignition systems or electrical devices. The first step in attempting to resolve electrical interference problems is to locate the source of interference.

Interference from vehicle ignition

Ignition interference sounds like a "popping" noise in the sound system of your tv that rises in intensity. This can be caused by any vehicle ignition system, including gasoline operated lawn mowers, snowmobiles, and automobiles. If the interference is to television receivers, you may hear the popping noise and also see dancing dots in the picture. In some case, you may only see the interference, and not hear the popping noise in the sound.

If your own vehicle is causing interference, you may wish to install a commercially manufactured kit in your vehicle to reduce the ignition noise. Other remedial measures include relocating your antenna, raising the antenna, and using shielded lead-in antenna wire.

Interference from electrical devices

The interference you are experiencing on your television set or am/fm radio may be caused by an electric razor, vacuum cleaner, fan, drill, electric blankets, bake ovens, fluorescent lights, arc

lights, light dimmer controls, relays, static from machinery, lightning arrestors, adding machine.

Cash register, circuit breakers, ultra-violet lamps, germicidal lamps, defective wiring, loose fuse, arc welder, switch contacts (such as on dishwashers and other home appliances), refrigerator, water pump, sewing machine, light blinkers (including Christmas tree lightblinker), electric heating pads, aquarium warmers.

Neon signs, door bell circuits/transformers, toys (such as electric trains), sign flashers, antifriction bearings, printing press static eliminators, calculator, insulators, incandescent lamp (new or old), sun lamps, electrical pole (ground wire cut or poor contact), loose electrical connection, electric fence unit, furnace controls, power company transformers, and smoke precipitators.

If you have a portable radio that is affected by the interference, use it as a detection device to assist in locating the source of interference. With the portable radio, move from room to room and determine in which room the interference appears to be the loudest. Then look for one of the devices listed above and unplug it to see if the interference disappears. If several devices are in the room, unplug them, one at a time, until the interference disappears.

If a portable radio is not affected, you can go to the main fuse or circuit breaker box in your home, remove one fuse at a time, or shut off one breaker at a time, and see if the interference goes away.

If it does not go away when the first fuse or circuit breaker is off, replace the fuse or turn the circuit breaker back on and continue on until the interference does disappear. When the circuit that supplies the power to the tv or radio is turned off, it will be necessary to plug that device into some other circuit.

When the interference disappears with a fuse removed or circuit breaker off, go to the room supplied by that cir-

cuit and look for any of the suspect devices. If any are in the room, replace the fuse or turn the circuit breaker back on. Then unplug the device suspected of causing the interference. If several devices are in the room, unplug them, one at a time.

If you are unable to locate within your own home the device that is causing the problem, the interference may be coming from a device located in your neighbor's home. With the cooperation of your neighbor, follow the same procedures described above.

If your investigation leads you to suspect that a power line or power company equipment is the source of interference, contact the power company.

To resolve electrical interference, modifications must be made to the interfering device. This should only be done by a qualified service representative. Short duration interference, such as that from electric drills and saws, may be very costly to attempt to eliminate; you may just want to "live with it".

Resolving electrical interference

Before proceeding with the following steps to modify the device located as the source of interference, you should check the local electrical codes to determine if the device may be modified, and whether a licensed electrician must modify the device.

Caution: all bypassing of devices with capacitors should be done with extreme care to insure that the capacitors do not short out the ac line. Dangerous voltages exist which can cause electrocution if mishandled. Avoid power wiring which can cause the full ac line voltage to appear on the case of the device.

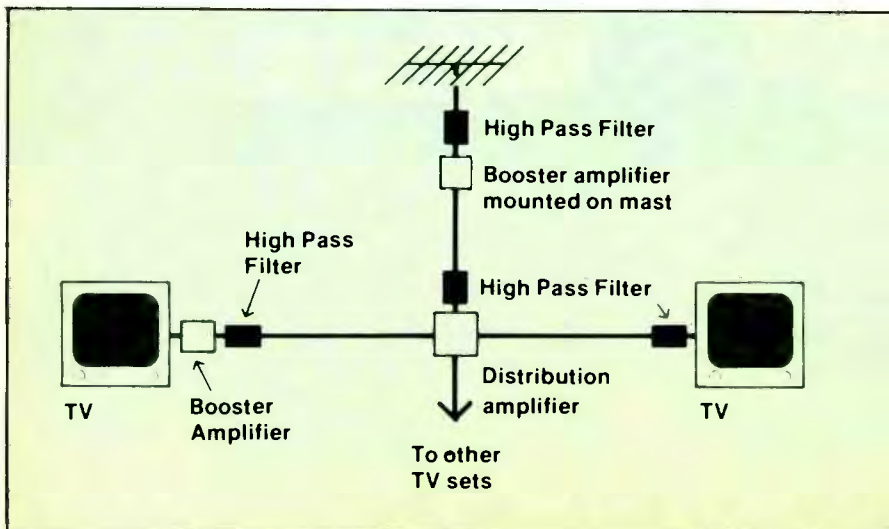
Since interference from an electric drill or saw may be of short duration, we suggest no modifications be made to the device. If, however, interference is of long duration, and you wish to take on this task, proceed as follows:

- Interference from a drill or saw is actually caused by arcing between the brushes and commutator. The interference then is transmitted through the power cord. Bypassing each side of the line to ground each side to the other, and the switch with capacitors may be helpful. The bypassing should be done inside the device in question.

- Electric blankets, fish tank heaters, and other thermostatically controlled appliances, with worn and pitted contacts, cause interference because of contact arcing of the breaker points. This can be eliminated by bypassing the contacts with a .001 mfd capacitor or replacing the worn or pitted contacts.

- Defective devices such as doorbell transformers should be replaced.

- Dimmer switches that utilize an SCR or triac can produce tremendous interference and it is very difficult to eliminate. This is due to the approximate





square wave output that is produced by the switching at the SCR or triac. However, bypassing may be helpful.

■ Since resolving electrical interference has to proceed on a case-by-case basis, you should always consider adequately bypassing with ceramic capacitors any component of the circuit that arcs or distorts the ac sine wave.

Identification of audio

Interference to audio devices, such as tape recorders, record players, electronic organs, telephones, and hi-fi amplifiers, is caused by the equipment responding to the transmission of a nearby radio transmitter. Audio interference, often called audio rectification, may also affect the sound portion of your tv and am/fm radio.

When this type of interference is occurring, you will hear the voice transmissions of the radio transmitter and/or the volume level of the audio device you are using may decrease. If you have determined that this is the type of interference you are receiving, these suggested methods for eliminating audio interference may help.

Audio interference is a condition that usually requires internal modification of your equipment. For safety reasons, we recommend that any modifications be made by a qualified service technician.

In the case of telephone interference, contact your local telephone company. They can install a 1542A or similar inductor in the telephone instrument to resolve the problem. Bell System personnel can obtain additional data in Section 500-150-100 of the "Bell System Practices—Plant Series" manual.

For all other audio devices, you may find the following suggestions helpful:

■ Replace unshielded wire between the amplifier and speakers with shielded wire.

■ Ground the affected equipment to a metallic cold water pipe or ground rod. A ground connection can be made with a short piece of bell wire, which can be obtained at most variety stores. Do not ground ac-dc type devices. Normally devices which may safely be grounded will provide a grounding terminal. If no terminal is provided, consult a qualified service representative for advice.

■ If the interference is not eliminated after taking these steps, call a qualified

service representative. You may also wish to discuss the matter with the operator of the radio transmitter.

Resolving audio interference

Audio interference is defined as reception of rf energy by an audio amplifier. The rf energy is then rectified, or more properly detected, by an electron tube, transistor, diode, poor solder joint or ground, or integrated circuit. The detected signal is then treated identically as a normal audio signal appearing at the amplifier input terminals.

The effects of audio interference vary with the type of modulation employed by the transmitter. The following chart shows expected effects:

■ AM—The voice or music will be heard as any normal audio signal applied to the amplifier. The voice or music may be extremely loud and slightly distorted.

■ SSB—single sideband—the voice will sound practically unintelligible and garbled.

■ FM—Usually no sound will be heard; however, a decrease in the volume of the amplifier will be noted when the radio transmitter is on. Clicks may be heard when a two-way radio transmitter is keyed and unkeyed. A "frying" noise that sounds like bacon sizzling may also be heard.

■ TV—Audio rectification of a tv signal will sound like a buzz. The buzz will change its sound as the television picture changes.

Rectification before volume

In attempting to isolate where in the audio chain the rectification is taking place, check to determine if the volume control has any effect on the interference. If the volume of the interfering signal changes with a change in the volume control, then the rectification is occurring before the volume control. If the volume control has minimal or no effect, the rectification is occurring after the volume control.

A multiple input audio amplifier may be susceptible to audio interference on only one or some of the available inputs. Generally, low-level, high-impedance inputs, such as those in turn-tables, cartridges, tape heads, or microphones, are the most susceptible.

Grounding

If, for example, the only input affected is from a turn-table, then disconnect the turn-table cartridge from the amplifier at the input terminals of the amplifier. If the interference is eliminated, then the cartridge, or wire between the cartridge and amplifier, is sensing the rf.

Proper grounding, connections, shielding, and rf bypassing are keys

to solving audio rectification. Often, a "process of elimination" approach must be used.

All grounding should be to a good earth ground such as a metallic cold water pipe or 8' ground rod. Ground leads should be as short as possible. Remember, a dc ground may appear as an open circuit to rf energy.

Ground leads should be of as large a diameter wire as practicable. Finally, grounding of the chassis, shields of speaker leads, and other external connections should be made to a common point to avoid ground loops. Ground loops are circuits that form a dc ground, but contain rf circulating currents. *Caution:* Some equipment chassis are at line voltage potential and cannot be connected directly to ground.

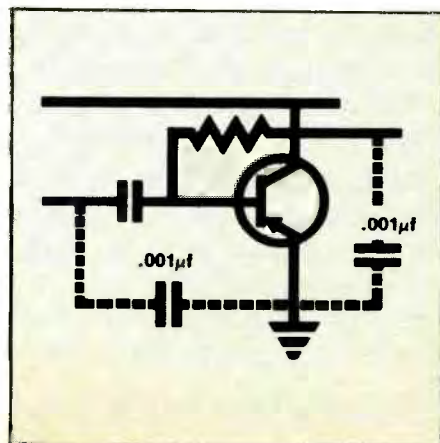
In these circumstances, a ceramic capacitor of 0.001 mfd at 1Kv should be placed in the ground lead. This capacitor appears as a short to rf, but an open circuit to ac.

■ Shielding—all speaker leads from audio equipment should be made of two conductor shielded wires. The shield should be grounded only at the amplifier end, and should not be used as an audio conductor. The two internal wires should be connected to the speaker.

■ Power line filter—rf may be entering the audio device through the ac power line. Several power line filters are commercially available. If necessary, a power line filter can be constructed. Place the filter as close as possible to the point where the ac cord enters the amplifier.

■ Poor electrical connections—poor solder connections or old electrolytic capacitors may be the cause of the audio rectification problem. If tests to this point have failed, try resoldering all connections in the amplifier and replacing electrolytic capacitors. Before actually replacing the electrolytic capacitor, try paralleling the capacitor with another one of like value. This should reveal the presence of a bad capacitor.

When the volume control is in its minimum position, and the interference is still heard, an rf filter is required in the



This article is a condensation of the helpful tv tips in *How To Identify and Solve Radio-Television Interference Problems*, a complete report by the Federal Communications Commission, published by Cowan Publishing Corp., 14 Vanderver Ave., Port Washington, NY 11050. Copies of the complete FCC tv book are available by mail from Cowan Publishing for \$1 plus 25c postage and handling.

audio amplifier. It's very important that the filter does not affect the audio response of the amplifier.

Tube type equipment

Interference in tube type equipment can be avoided by connecting an rf choke, ranging in value from 2 millihenry to 5 millihenry, in the upper end of the cathode circuit. The choke coil must not be bypassed by a capacitor. The dc resistance of such coil is generally quite low and the bias voltage is not greatly affected. However, if the dc resistance does affect the bias voltage, the value of the bias resistor should be decreased to compensate for the dc resistance of the choke.

A grid-stopping or "swamping" resistor can also be employed. The resistor, ranging in value from 1000 to 75,000 ohms, is connected in series with the grid.

Capacitors, rf chokes and resistors can be used in combinations to make filters to eliminate the interference. Use a choke of two to six microhenries and a capacitor of about 10 picafarads.

Transistor equipment

Interference in transistor equipment can usually be eliminated with the use of a shunt capacitor. A resistor/capacitor combination can also be used. It's important that the filter network does not affect the biasing of the transistor or the frequency response of the amplifier. The values of the capacitors used are not critical, but there are some pitfalls to look out for in using capacitors.

For example, ceramic caps are the best choice. Paper caps should be avoided, however, because they do not work at radio frequencies. Leads should be kept as short as possible. Grounds should be made directly to the emitter and not to the chassis or other grounds. If the signal increases, then a ground loop has been created, and the inductor method should be tried.

In areas of high rf energy, the inductor approach is more effective than the shunt capacitor. An rf choke should be used in series with both the input and output leads of the amplifier stage since the rf can enter a stage through either.

Organ circuits can be isolated by the use of the Swell Pedal, band box vol-

ume, or tabs (draw bars). By adjusting each one of these different controls, the effect on the interference can be noted.

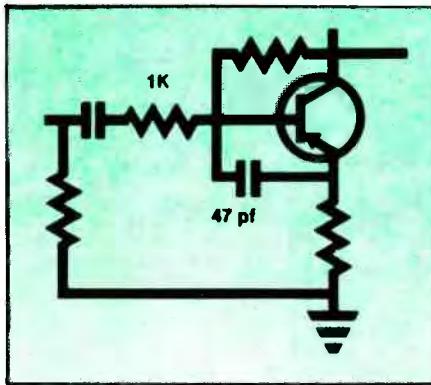
If the volume of the interference changes, the rf is being detected by the amplifier at a point before that particular control. If the volume of the interference does not change, then the interference is being detected after that control. Using this method, the point at which the rf is entering the organ can be determined, and the appropriate filter inserted into the circuit.

Telephones

Telephone rf interference can be eliminated by the use of a 1542A or similar inductor. This inductor must be installed inside the phone and not at the baseboard.

To install the inductor inside the phone, the corners of the plastic container will have to be removed. If the phone is too small for the inductor, such as the "Princess" telephone, then a pair of 2.5 MH chokes (75 ma or higher) can be substituted for the 1542A filter. Install one on each side of the line and as close to the 211A equalizing network as possible. *Note:* The information provided here applies primarily to privately owned equipment and should not be applied to equipment owned by the telephone company.

Telephone company owned equipment should be modified only by tele-

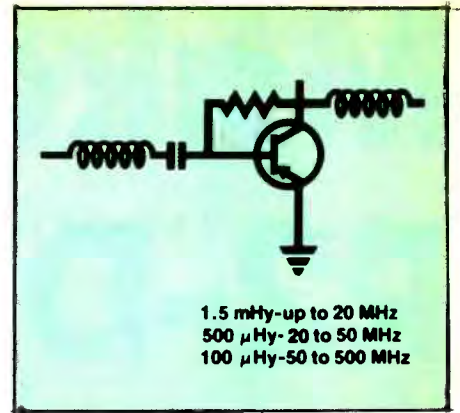


phone company personnel. Bell System personnel can obtain additional data in Section 500-150-100 of the "Bell System Practices—Plant Series" manual.

Resolving fm interference

The installation of an inexpensive *fm band rejection filter* is the first step to take in resolving fm interference. In making this installation, follow the steps outlined for purchasing and installing a high-pass filter.

There are no set procedures for eliminating fm interference. It's a matter of eliminating the most likely sources of interference a step at a time. You may be required to take several steps before the interference problem is resolved. Once you've installed the filter called for, or made the required adjustment, leave the



modifications in place and proceed to the next step.

To begin, check to see that an fm band rejection filter has been installed on the tv set at the antenna terminals. If the installation of an fm band rejection filter is not effective, then a tuned stub trap should be constructed.

The trap should be placed on and parallel to the lead-in and tuned for minimum interference. Then slide the trap along the line to further reduce interference. Finally, tape the trap to the lead-in in the most effective position.

Another type of stub, called an open circuit quarter-wave type, can be made from the same type of wire as the antenna lead-in wire. The initial length of the stub should be 24 inches for RG-59/U coaxial cable or 29 inches for 300 ohm twin-lead wire. If connecting the stub to the antenna terminals is not completely effective, connect a second stub of the same length directly to the input terminals of the tuner, inside the television set. This should eliminate the interference.

Amateur transmitter operators

If you have a linear amplifier on your amateur transmitting equipment, use two low-pass filters. One filter should be installed between the actual transmitter (exciter) and the input to the linear amplifier. This prevents harmonics generated in the exciter from reaching the linear amplifier. The second filter should be installed at the output of the linear amplifier to reduce harmonic and spurious content. One unique interference problem to tv channel 2 is from an amateur transmitter operating on the 6 meter band. This is due to the close proximity of the frequencies involved.

If the transmitter is not grounded, connect the chassis to a good earth ground with large diameter wire or copper strap. This should assist in elimination radiation of energy from the cabinet.

Local Television Interference (TVI) Committees are available to assist you in resolving interference problems. Contact the nearest FCC district office or the American Radio Relay League, Newington, Connecticut, for assistance in locating a TVI committee in your area. 