



**Radio Frequency
Interference!**

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RFI and EMI

- Radio Frequency Interference (RFI)
 - Interference to a receiver caused by actual signals, only one of which is desired.
 - Caused by harmonics, mixing, images, or poor design.
- Electro-Magnetic Interference (EMI)
 - RF Interference to a piece of equipment which is not normally a receiver.
 - RF gets into the equipment through inadequate shielding, filtering, grounding or design.
 - Affects all sorts of equipment – alarms, telephones, furnace controllers, smoke detectors, computers etc.

Two Issues for Hams...

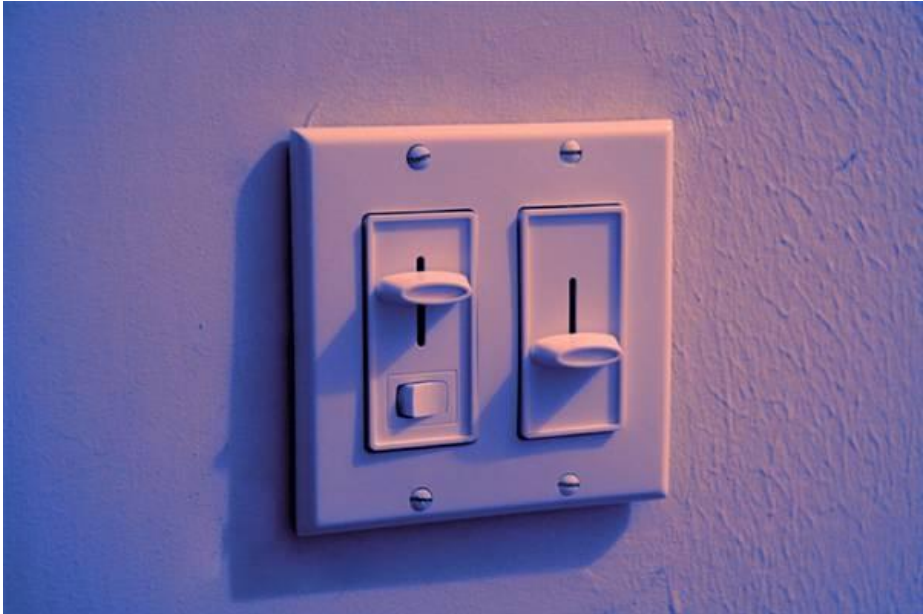
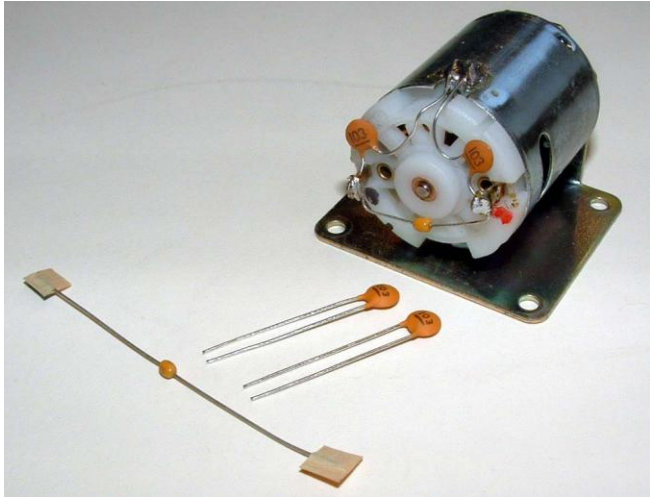
- Interference to others caused by your station;
and
- Interference to your station caused by other's equipment.

Interference

- Any unwanted interaction between electronic systems.
- Three main types:
 - Noise
 - Fundamental Overload
 - Spurious emissions

Noise

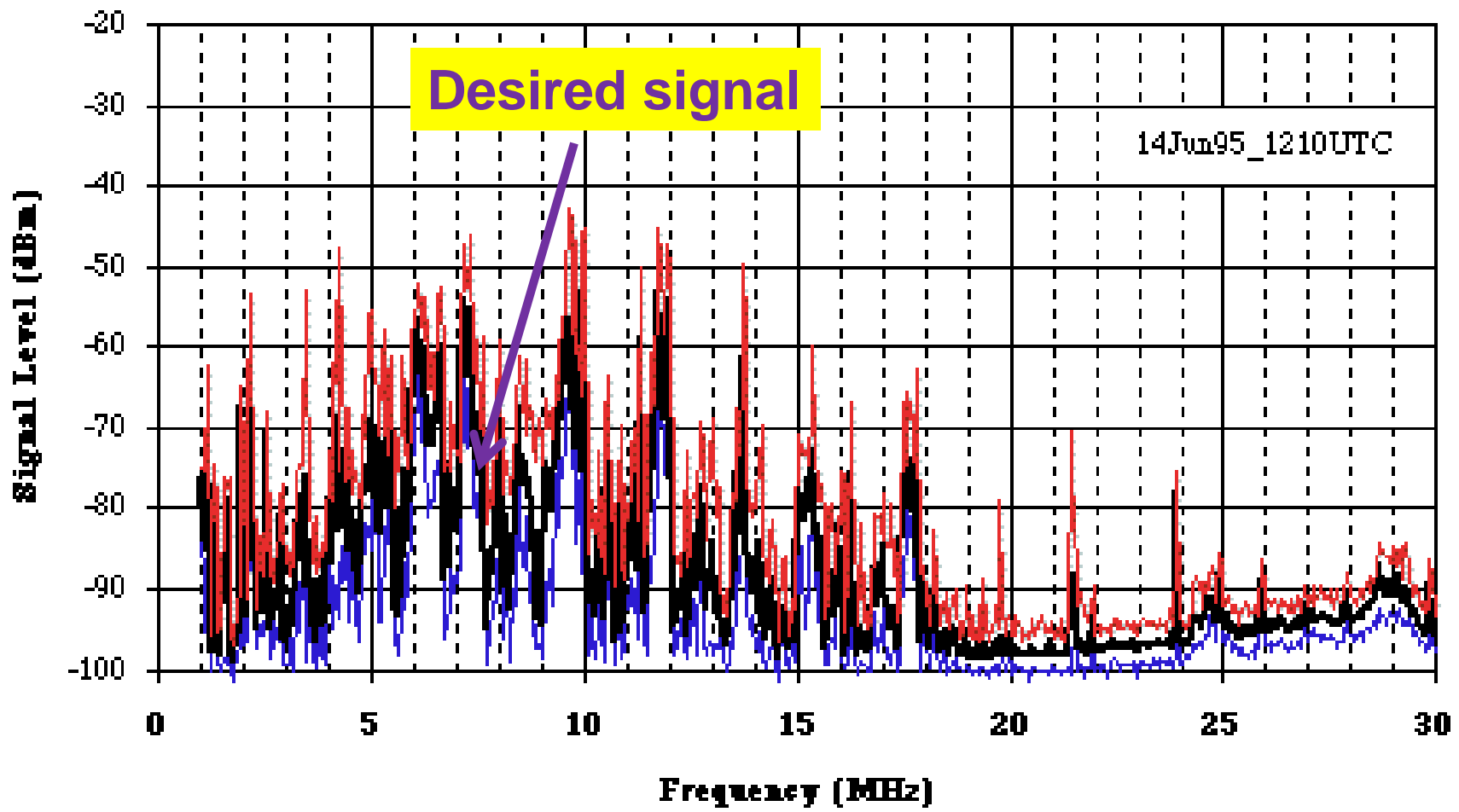
- Caused by an electromagnetic noise source:
 - Electric motors
 - Power line hardware
 - Defective florescent lights
 - Bug zappers
 - Light dimmers
 - Computer systems
 - Thermostats, etc, etc. etc.....
- Arcing could indicate a dangerous condition



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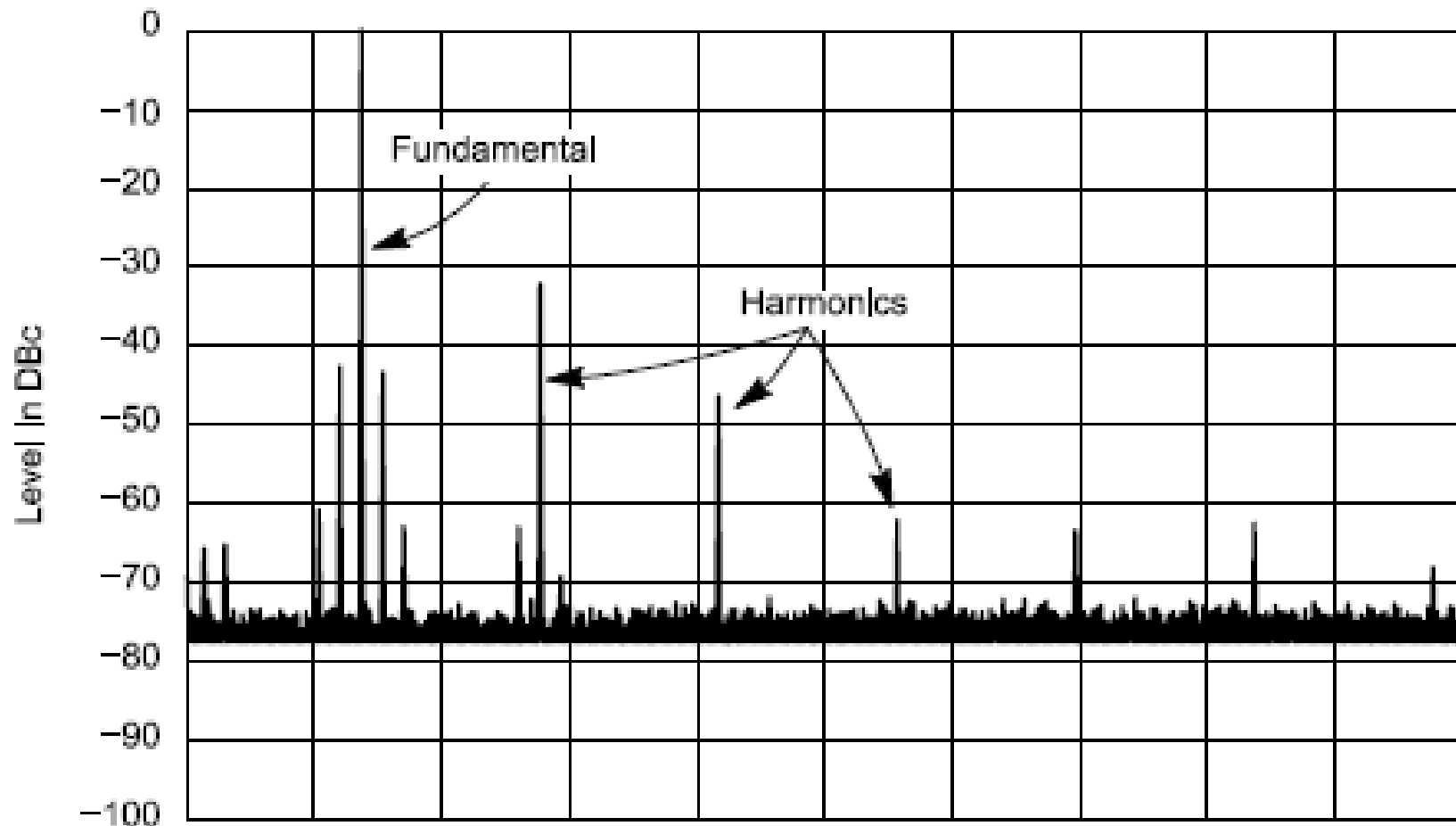
Fundamental Overload

- Caused by the inability of consumer equipment to reject strong signals.
- Even though your radio is transmitting legally, the filtering and shielding in the consumer equipment is inadequate.



Spurious Emissions

- Transmitter is inadvertently transmitting signals not assigned to it.
- Could be harmonics – multiples of the intended signal.
- Could be non-harmonic – signals generated by the peculiarities of the transmitter's design.
- Such problems are rare with modern transmitters.

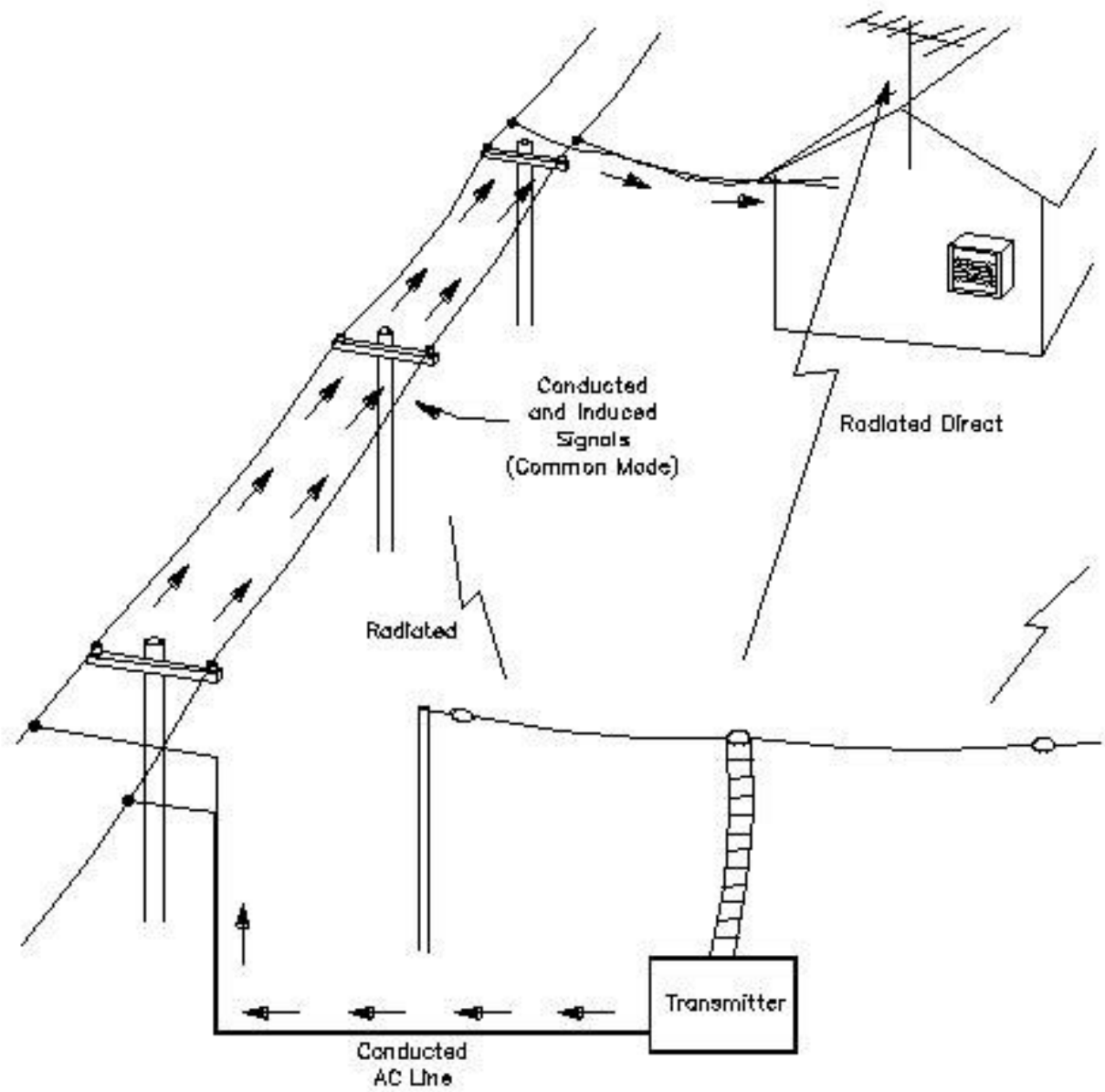


Sweep: 0 to 50 MHz (CF = 25 MHz, 5 MHz/div)

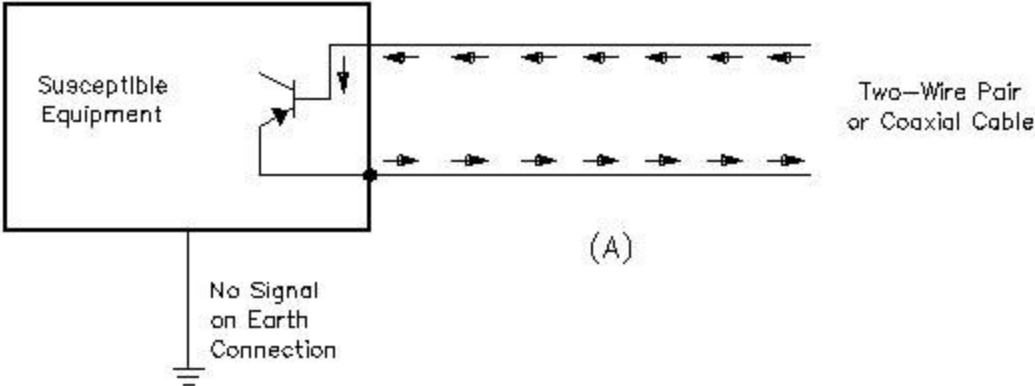
Res BW: 3 kHz Vid BW: 10 kHz

Sweep Time: 14 s

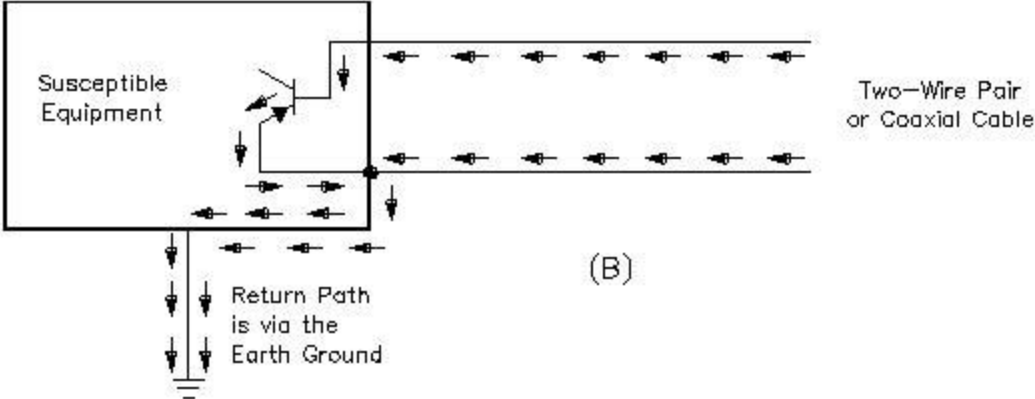
HBK05_13-002



Differential versus Common Mode



Differential Mode



Common Mode

What to do....

What to do....



When you receive a complaint!

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What to do....

- First.. REMAIN CALM!
- Express empathy and concern.
- Do not criticize their equipment.
- Try to explain the issue, and indicate that there are ways to correct the problem.
- Build a climate of cooperation.
- Do not automatically assume blame however.

What to do....

- Determine if it is actually you causing the interference:
 - It may be a fault with the consumer equipment unrelated to your transmissions;
 - Ensure the TV/radio can receive a good signal;
 - Compare dates and times against your logbook;
 - May only be specific bands, modes, power levels or antennas that cause interference;
 - Try to conduct tests if the neighbour agrees.

What to do....

- Under NO circumstances should you make internal modifications to someone else's equipment!
- You may void any warranty, and you will forever be responsible for repairing it!
- Only licensed technicians should do such work.
- Emphasize that you are ready to assist a qualified technician.

Solving RFI Problems

- First – clean up your own station!
 - Ensure all connections tight.
 - Ensure equipment is properly grounded.
 - Install Low-Pass or Band-Pass filters.
 - Have you made any recent changes that might cause problems?
 - Have a qualified technician confirm transmitter meets specifications for spurious signal attenuation.

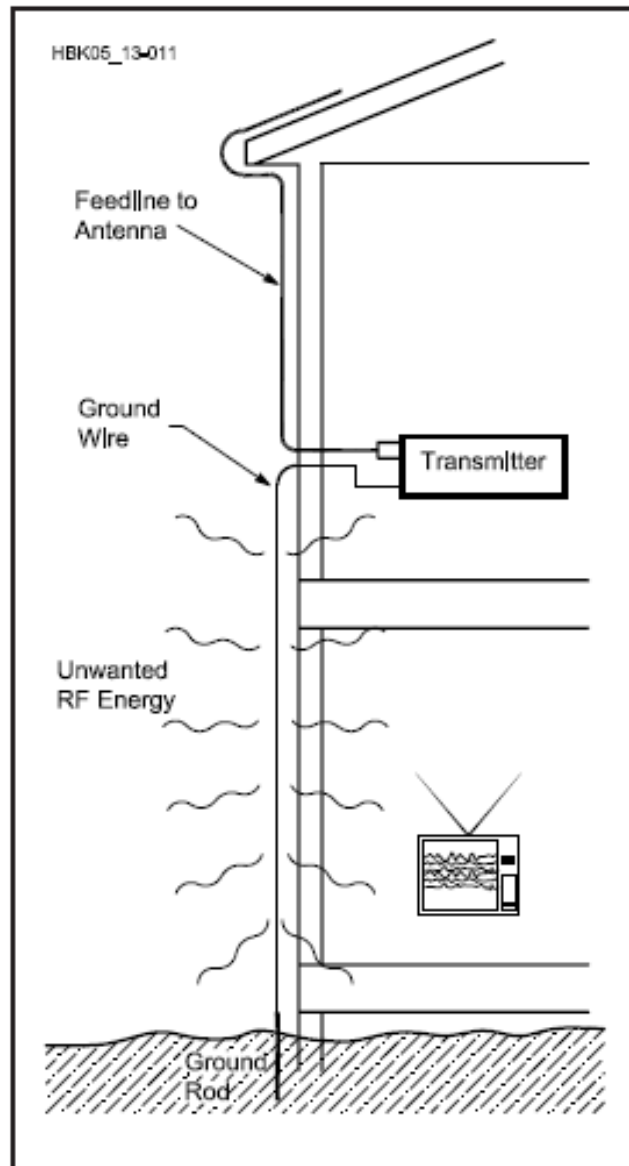


Fig 13.11 — When a transmitter is located on an upper floor, the ground lead may act as an antenna for VHF/ UHF energy. It may be better to not use a normal ground.

Solving RFI Problems

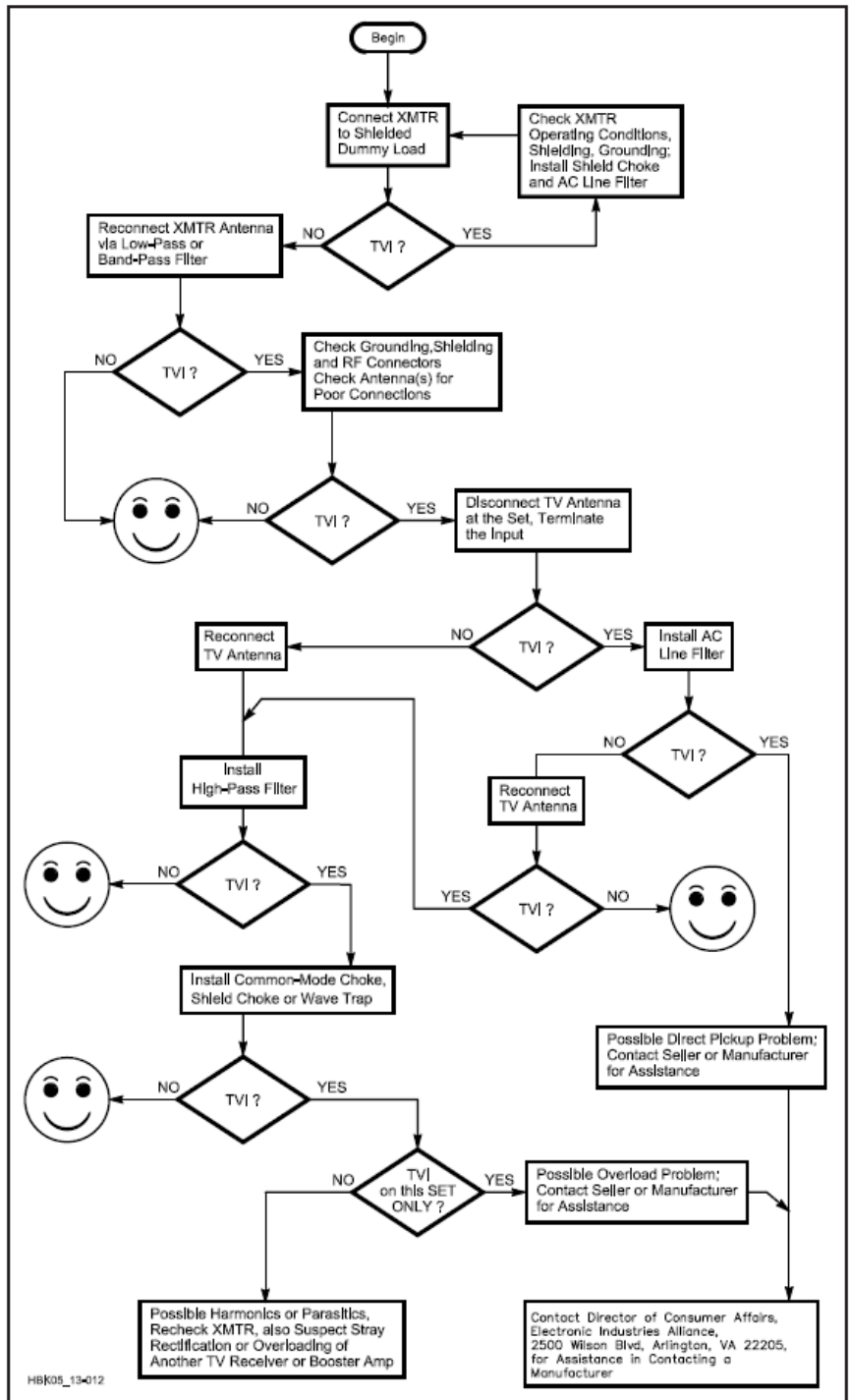
- Is interference similar on all bands?
 - If so, then it may be front end overload.
- Is your audio being received in addition to neighbour's favorite AM station?
 - If so, then it is Cross Modulation.
 - Your signal is being rectified in the receiver.

Steps to Take

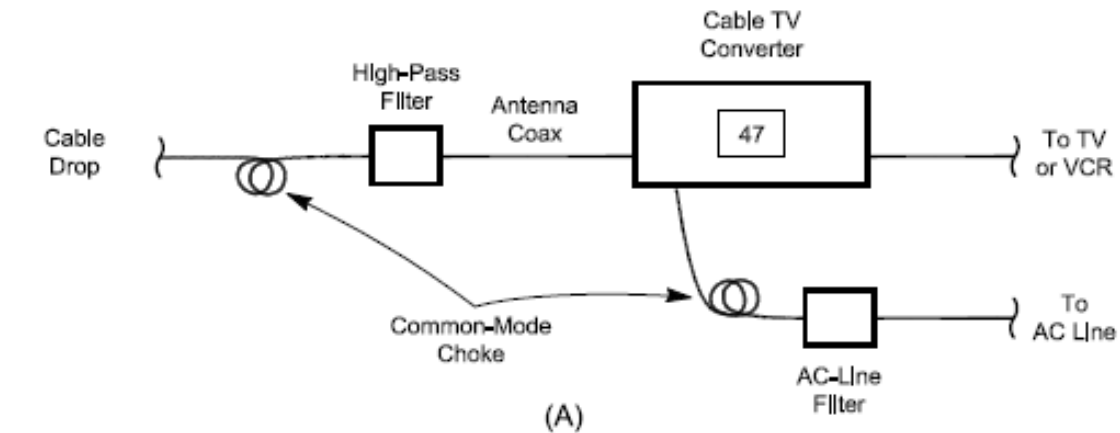
- Insure covers are secure and connected to chassis.
- Check power cord. Three prong? If not polarized, reverse the plug.
- Are cords or speaker leads multiples of $\frac{1}{4}$ wavelength of frequencies used?
- Are connectors proper? Is coax spliced?
- Disconnect pieces of equipment to track down where interference is entering system.

Steps to Take

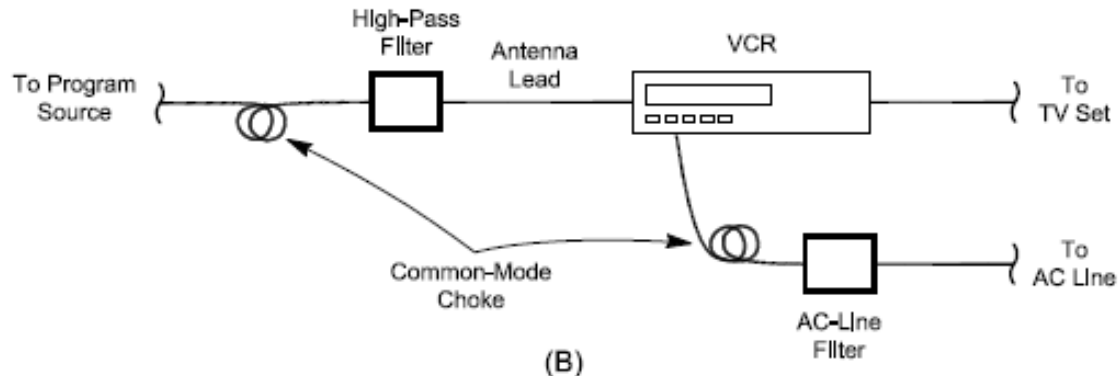
- For TV and cable systems, check for homemade splits instead of proper splitters.
- Also look for mixing 75 and 300 Ohm cable without proper baluns.
- Check for leakage by the cable system on 145.25 MHz. If signals are escaping, they can get in!



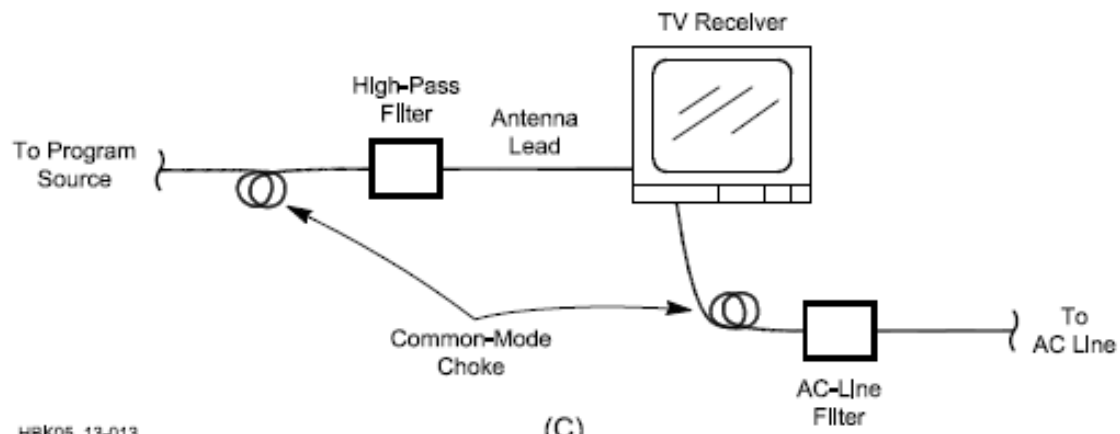
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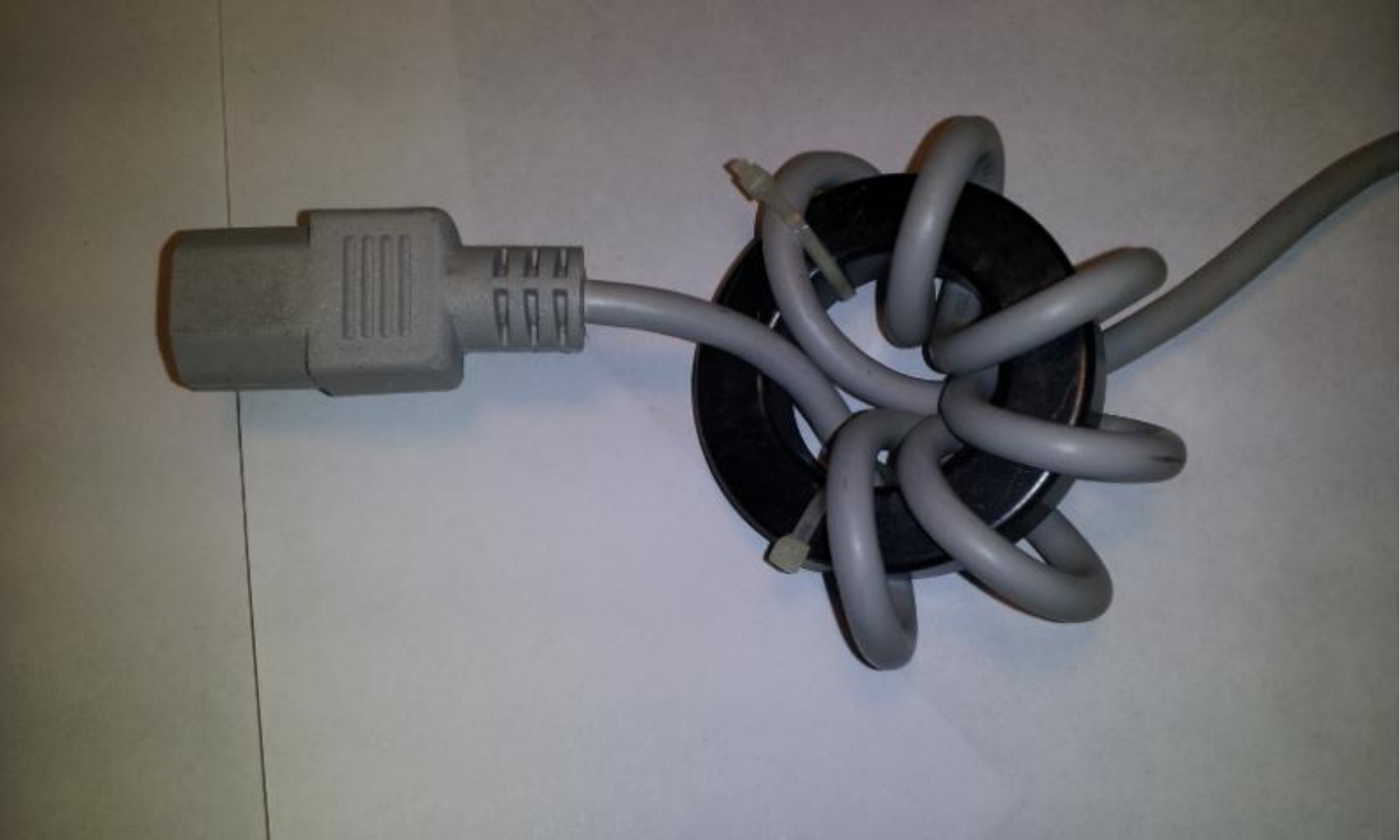
(A)



(B)



(C)



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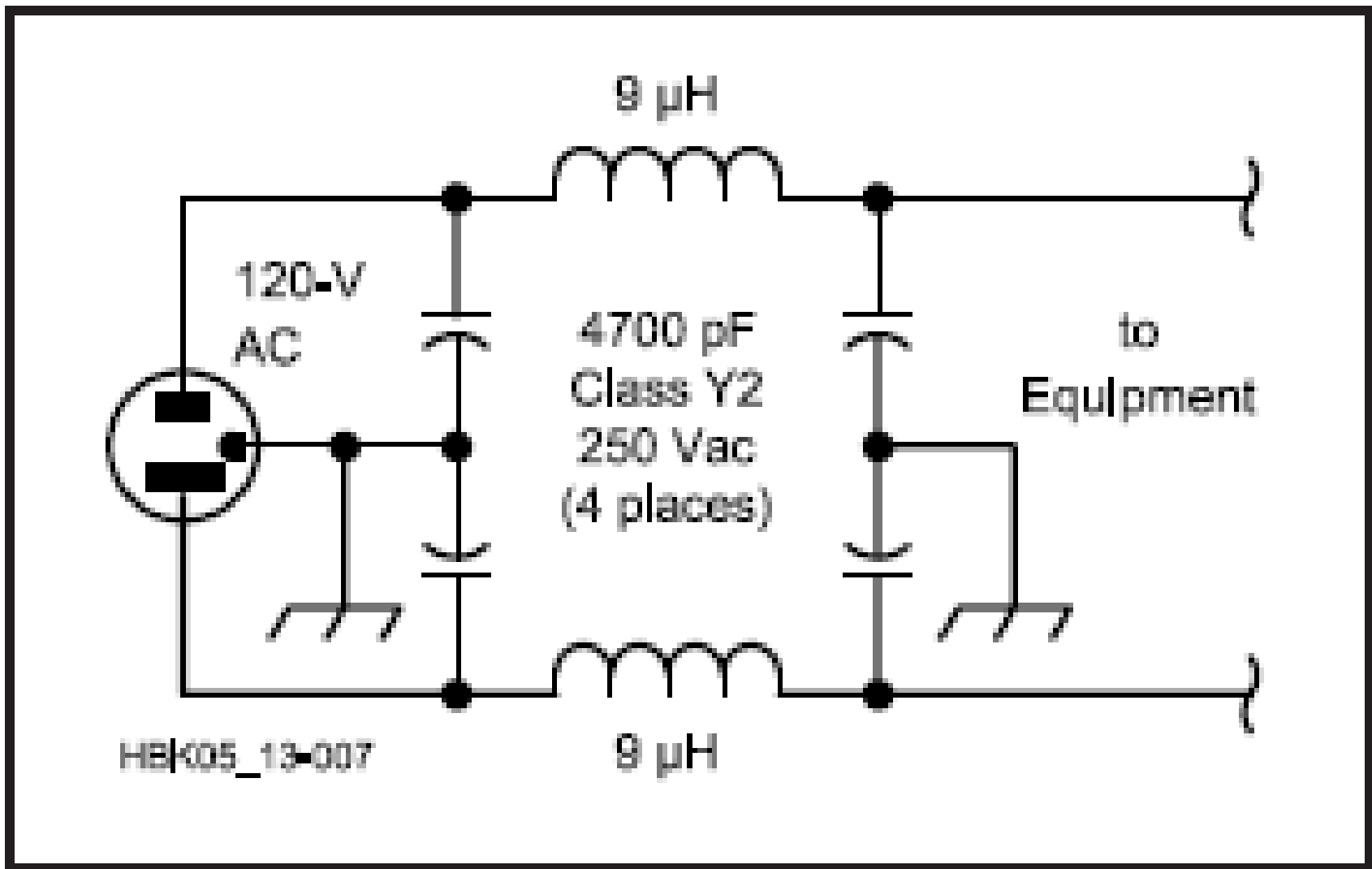


Fig 13.7 — A “brute-force” ac-line filter.



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Low Pass Filter – Used on Radio

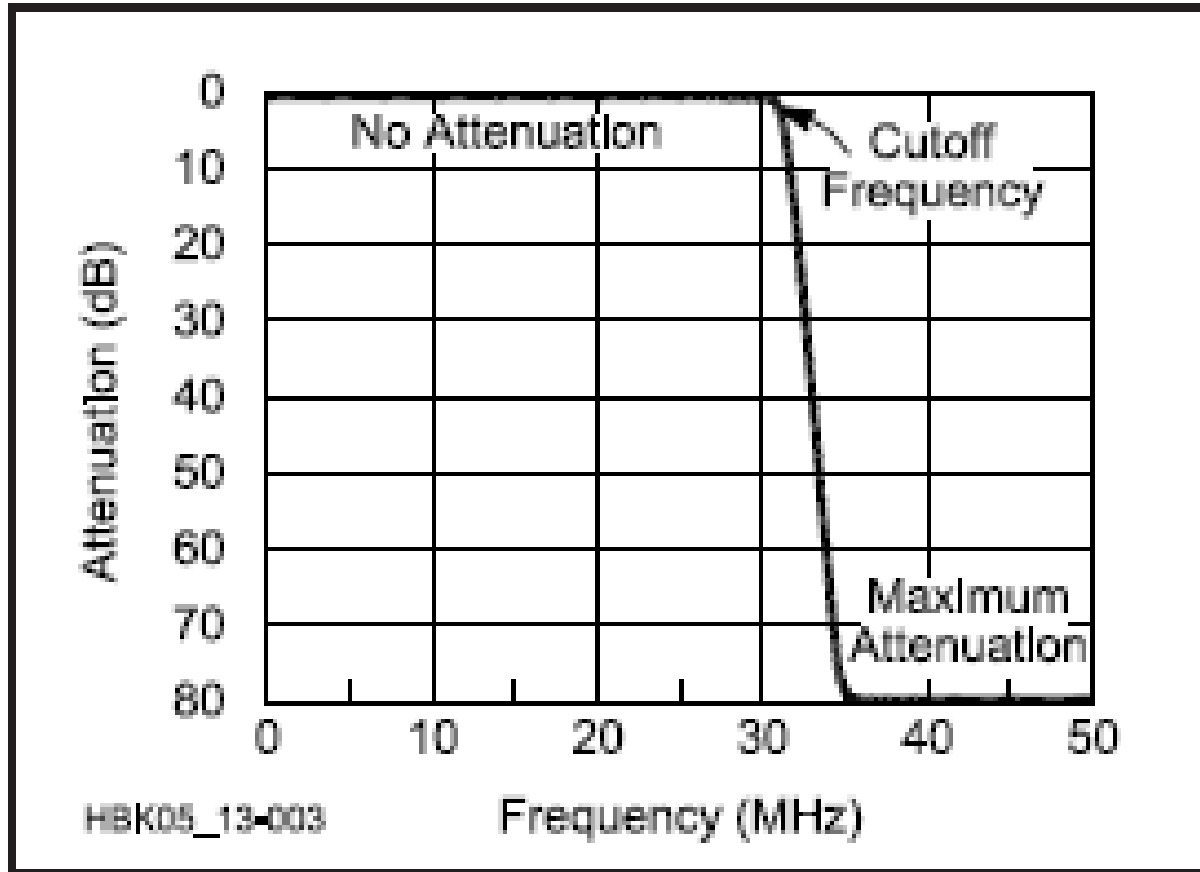


Fig 13.3 — An example of a low-pass filter-response curve.

High Pass Filter – Used on TV

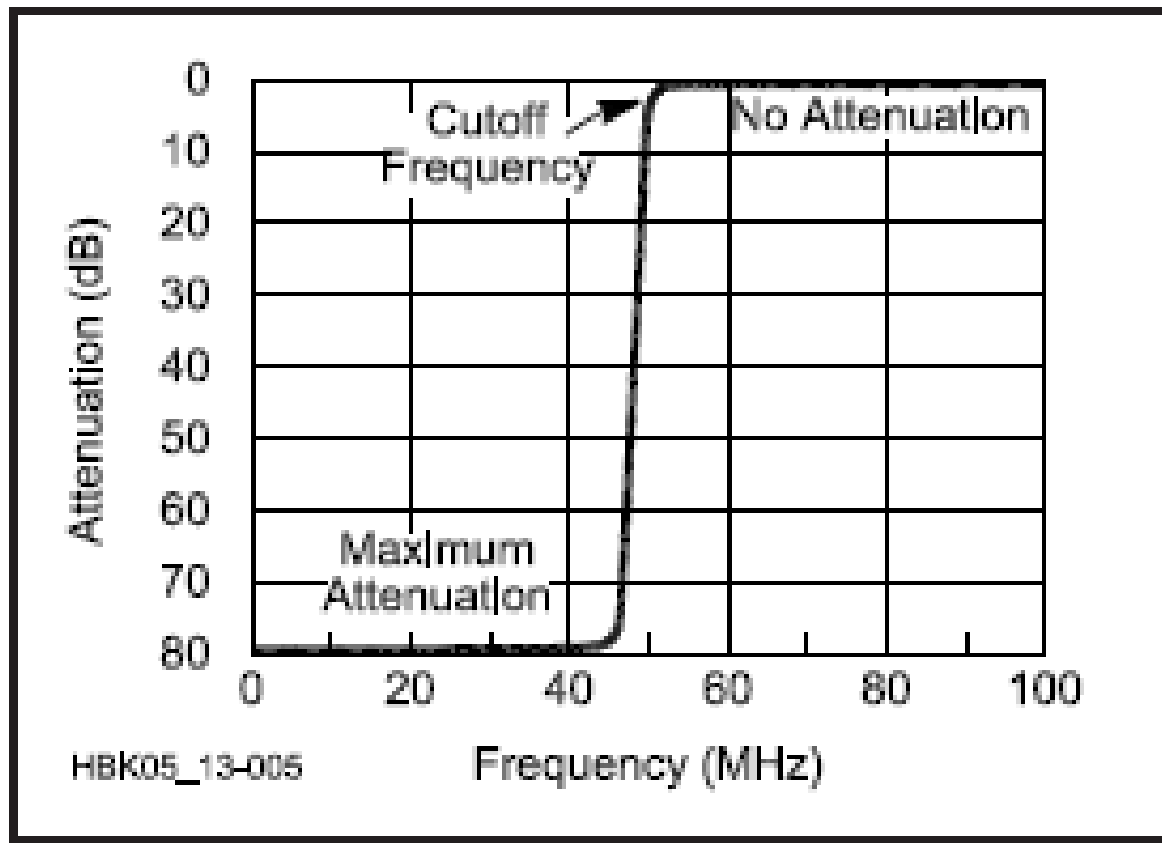
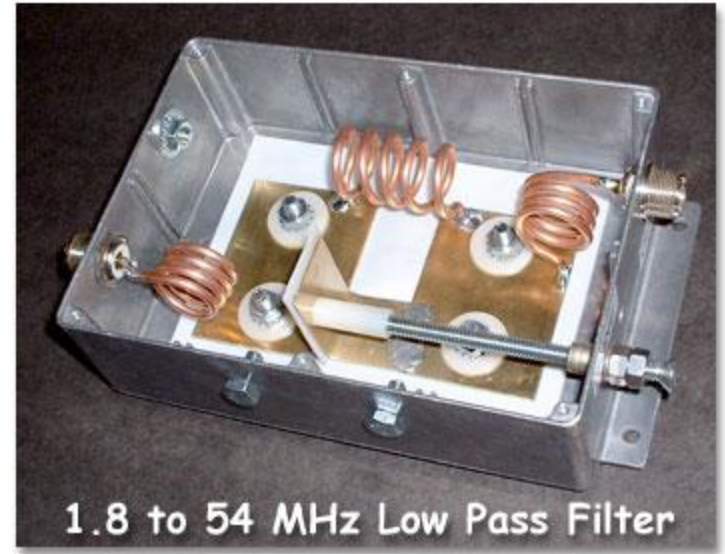
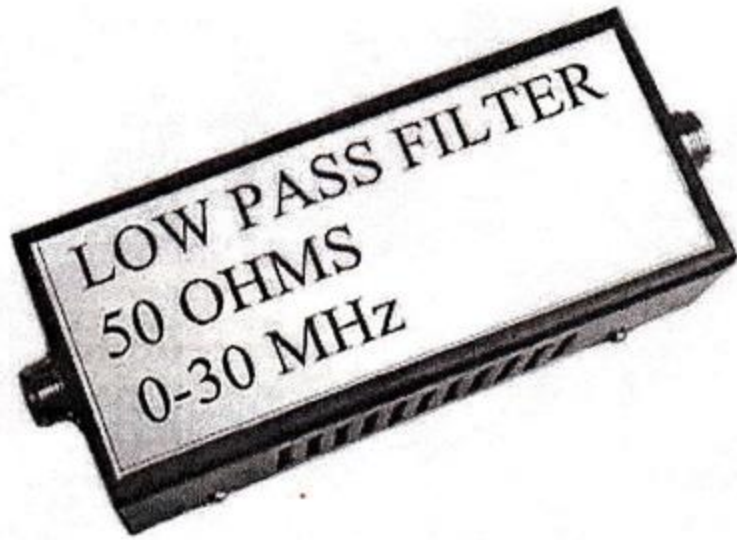
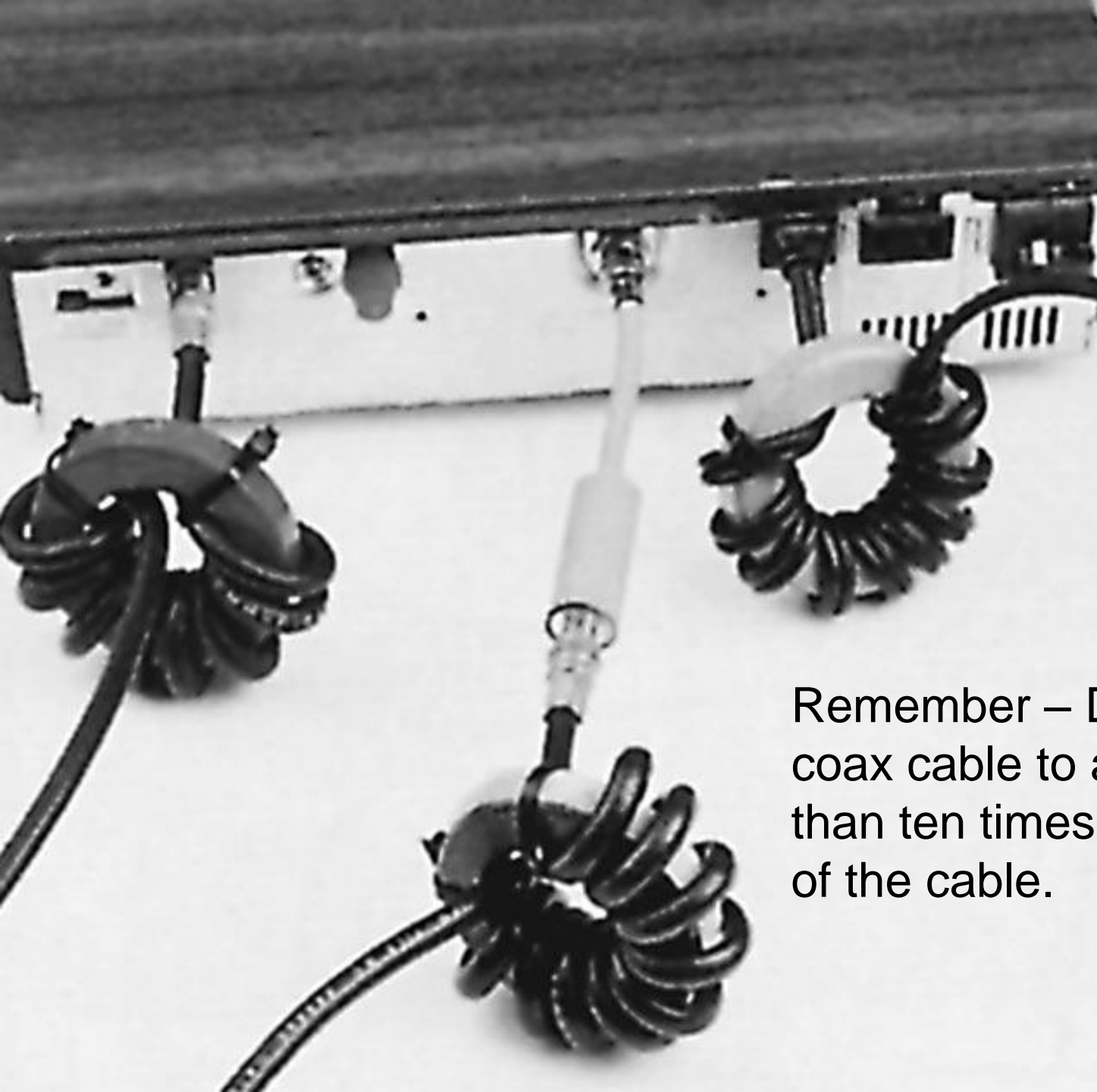


Fig 13.5 — An example of a high-pass filter response curve.





Remember – Do not bend coax cable to a radius less than ten times the diameter of the cable.



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Snap-On Ferrites



**Palomar Engineers Ameritron
Amp RFI Kit**

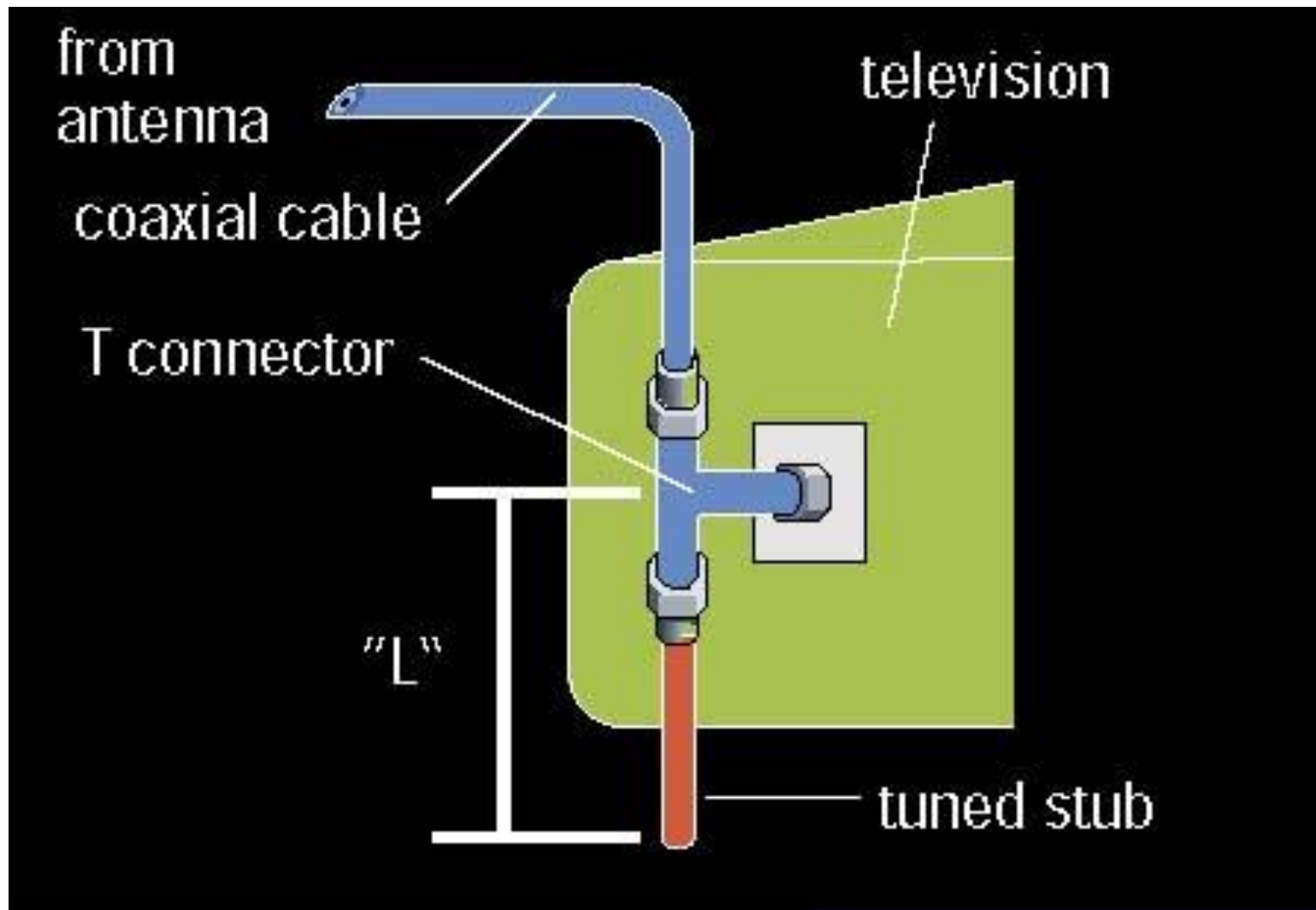
RF Input
Choke

Relay Cable
Choke

RF Out
Choke

AC Line
Choke

Quarter Wave Stub Trap



Grounding a Stereo System

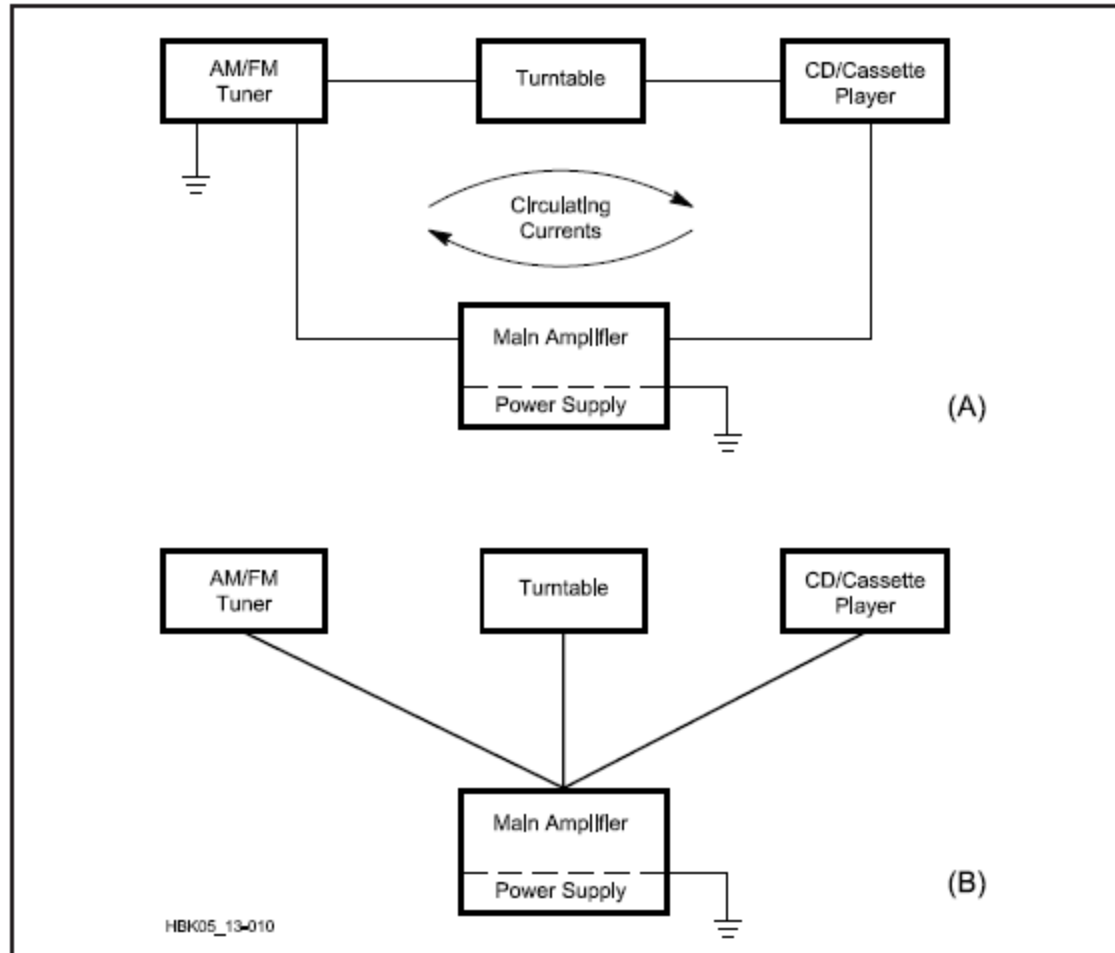


Fig 13.10 — A shows a stereo system grounded as an undesirable “ground loop.” B is the proper way to ground a multiple-component system.

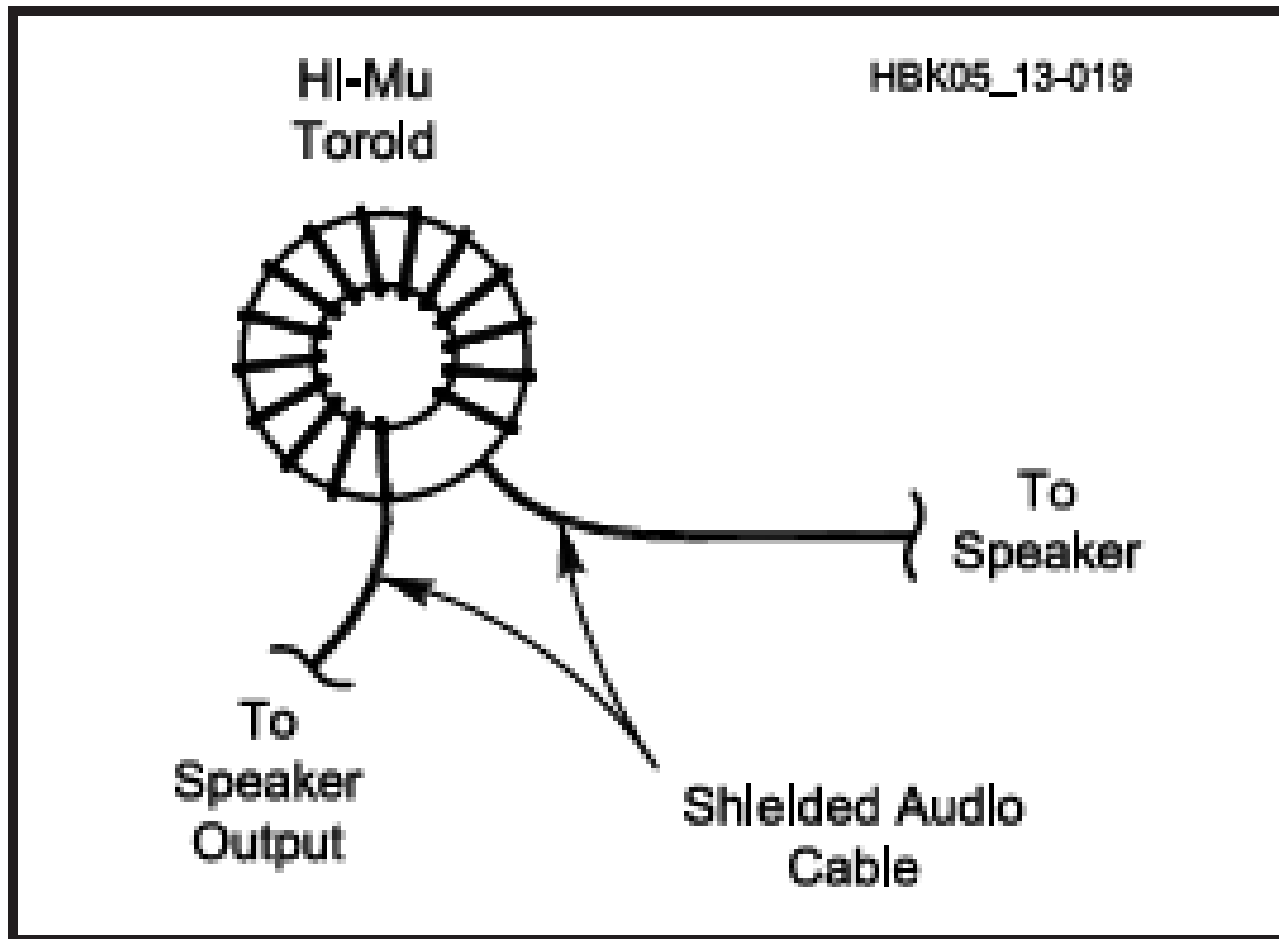


Fig 13.19 — This is how to make a speaker-lead common-mode choke. Be sure to use the correct ferrite material.

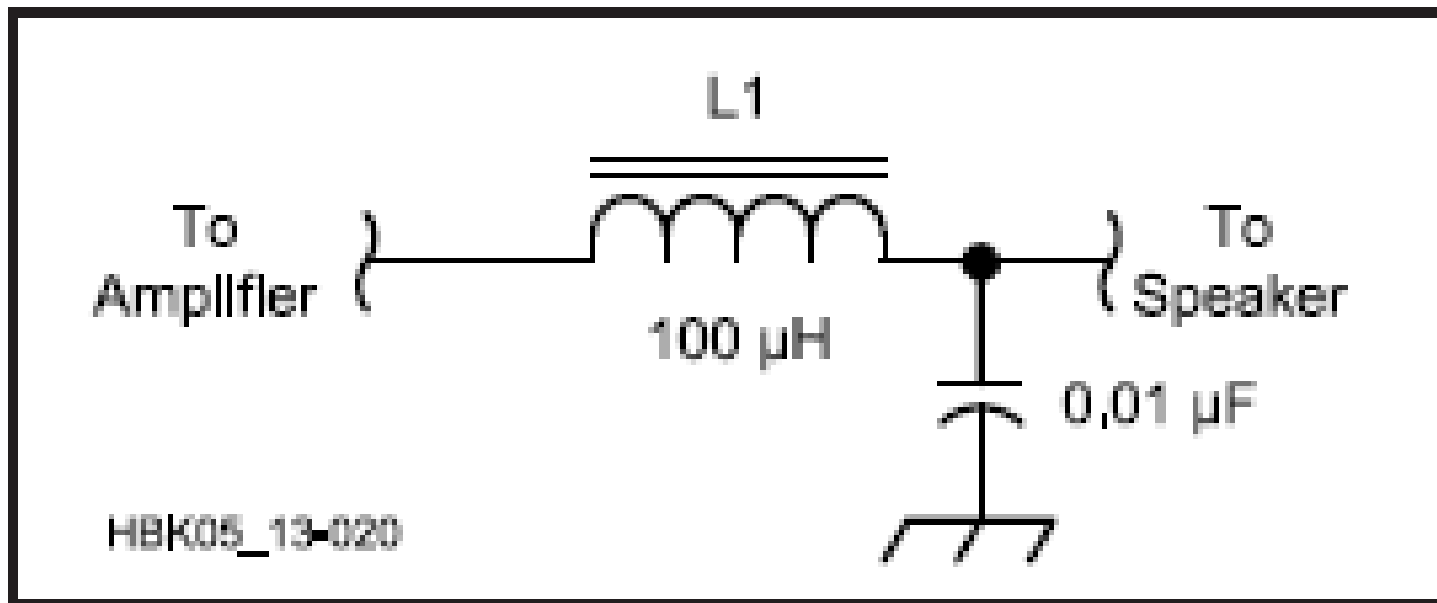


Fig 13.20 — An LC filter for speaker leads.

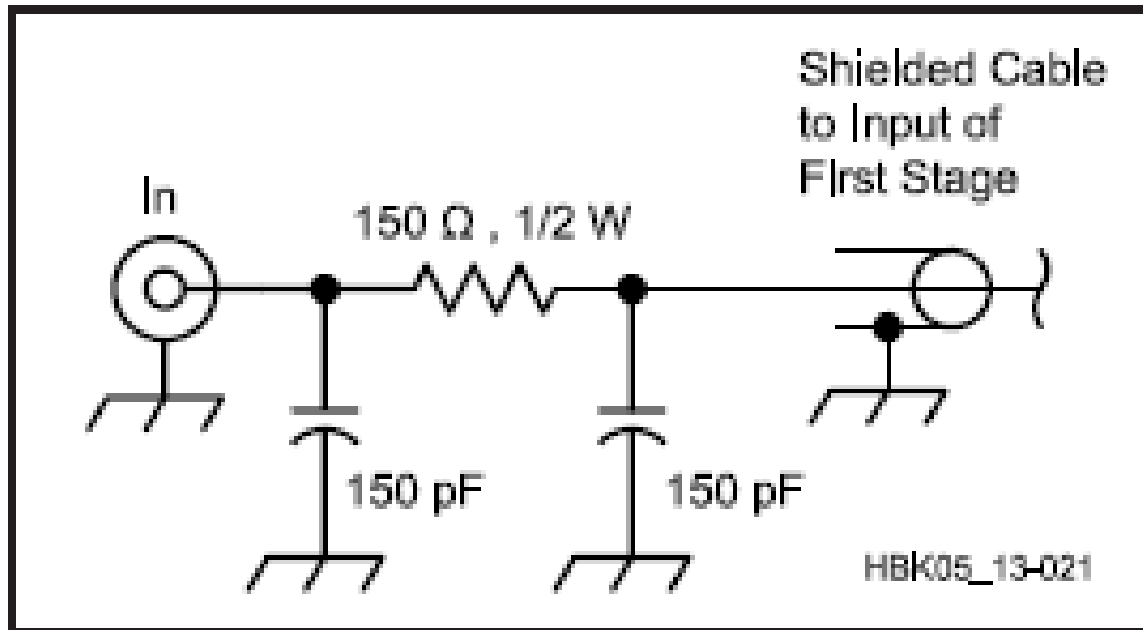
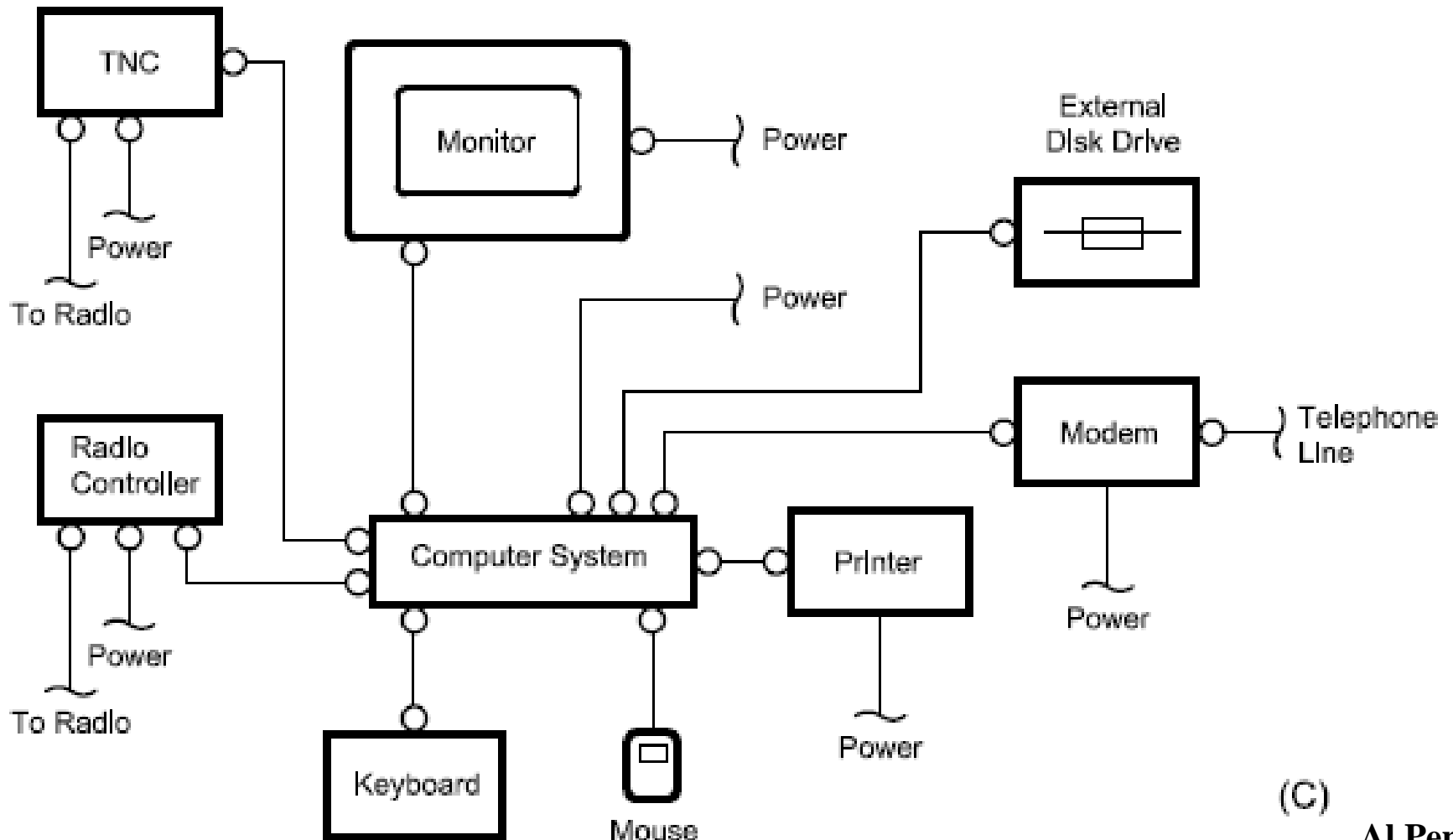


Fig 13.21 — A filter for use at the input of audio equipment. The components should be installed inside of the chassis at the connector by a qualified technician.

Warning: Bypassing Speaker Leads

Older amateur literature might tell you to put a 0.01- μ F capacitor across the speaker terminals to cure speaker-lead interference. *Don't do this!* Some modern solid-state amplifiers can break into a destructive, full-power, sometimes ultrasonic oscillation if they are connected to a highly capacitive load. If you do this to your neighbor's amplifier, you will have a whole new kind of personal diplomacy problem!
— Ed Hare, W1RFI, ARRL Laboratory Supervisor

Computer EMI



EMI can affect Anything!



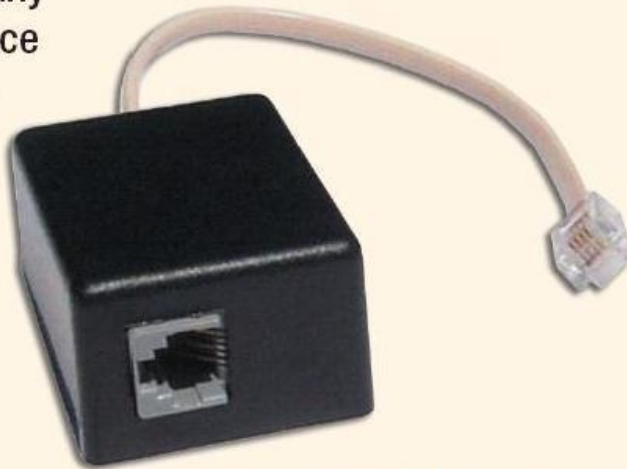
Telephone RFI

STOP

AM RADIO INTERFERENCE

with a plug-in modem/telephone RF filter from:

K-Y Filter Company
3010 Grinnel Place
Davis, CA 95618
(530) 757-6873



**CLICK
HERE!!**

www.ky-filters.com

Model AM-1 is for AM Broadcast Band radio interference.
Model RF-1 is for Short Wave, Ham Radio, CB etc.



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Industry Canada's Position

- Consumers should:
 - Insist manufacturer's design equipment to operate in a dense RF environment; and
 - Ensure equipment is set up and operated properly.
- Radio users should:
 - Accept the reality that high power radio transmitters, in urban areas, are likely to interfere with radio-sensitive devices; and
 - Consider methods of reducing the levels of RF energy, to which they expose their neighbours' electronic items

Industry Canada's Position

- Complainant must take a number of steps to resolve the issue:
 - Cooperate with Radio Operator;
 - Contact manufacturer of affected equipment to seek assistance;
 - Use self-help info offered by IC; and
 - Seek technical assistance if unable to help themselves.
- Only then will IC intervene.

Industry Canada's Position

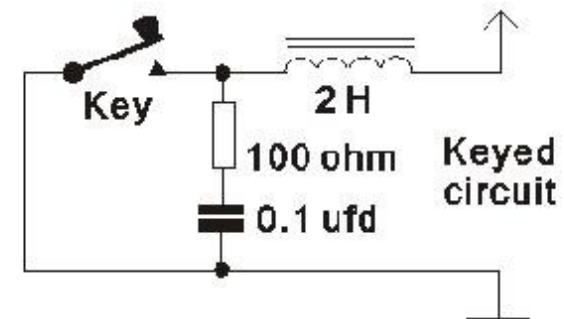
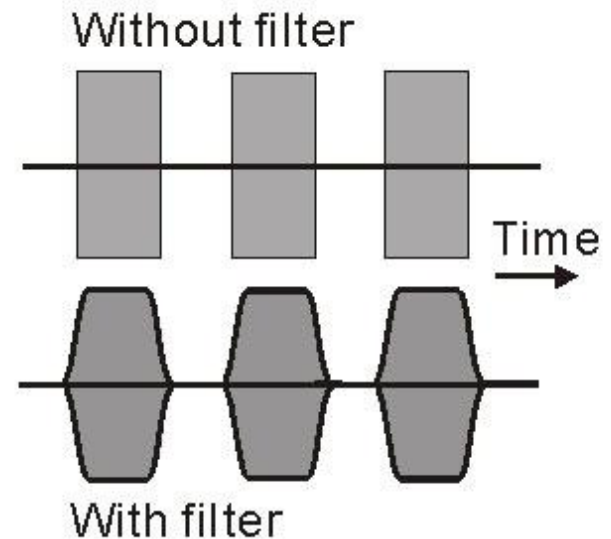
- Radio Operator:
 - Encouraged to work with complainants in resolving problems without recourse IC.
 - Failure to provide such cooperation may result in IC imposing additional terms and conditions upon the users' authorization to operate radio apparatus.

Interference to Other Hams

- Three primary issues:
 - Key Clicks: Transmitter turns on and off too rapidly during Morse transmissions, causing signal to occupy too wide a bandwidth.
 - Chirp: Voltage fluctuations when transmitter is keyed during Morse transmissions, cause VFO's frequency to vary, resulting in an audible chirp in received signal.
 - Splatter caused by setting microphone gain or amplifier drive too high.

Key Clicks

- Usually not a problem with modern radios.
- For older radios a key click filter can help.
- Indicated with addition of “K” to signal report i.e.: 599K



Chirp

- Cure is to use a power supply and cabling that can handle the load without voltage sag.
- Indicated by addition of a “C” to the signal report i.e.: 599C

DANGER

BLASTING AHEAD

**PLEASE TURN OFF
RADIO TRANSMITTER**



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www.protexplo.ca

Questions?