Technician License Course
Chapter 5

Lesson Plan Module 12 –
Power Sources and RF Interference (RFI)

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Stuff To Bring

- Red/black power wire
- Piece of coax
- Relay
- Mag mount antenna
- HT with alkaline battery pack
- Duck Lamp and battery

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Power Supplies

- Most modern radio equipment runs from 12 volts dc.
  - Actual preferred voltage is 13.8 volts.
- Household ac power is 120 volts ac.
- Power supplies convert 120 volts ac to regulated, filtered dc.
  - If you use a lab-type 12 volt power supply, be sure it is adjustable to 13.8 volts.

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Types of Power Supplies

- Linear:
  - Use iron transformers
  - Heavy (physically)
  - Do not emit RF, generally immune to strong RF
- Switching:
  - Electronics instead of transformers
  - Lightweight and small
  - Can emit RF if not properly filtered
    - Check product reviews

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Power Supply Ratings
Voltage and Current

- Continuous duty – how much current can be supplied continuously.
- Intermittent duty – how much current can be supplied for short surges, such as on voice peaks.
- Regulation – how well the power supply maintains a constant output voltage.

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Mobile Power Wiring Safety

- Car batteries hold lots of energy – shorting a battery could cause a fire.
- Special requirements for safe car wiring:
  - Fuse both positive and negative leads.
  - Connect radio's negative lead to negative terminal or engine block ground strap.
  - Use grommets or protective sleeves to protect wires.
  - Don't assume all metal in the car is grounded; modern cars are as much plastic as metal.

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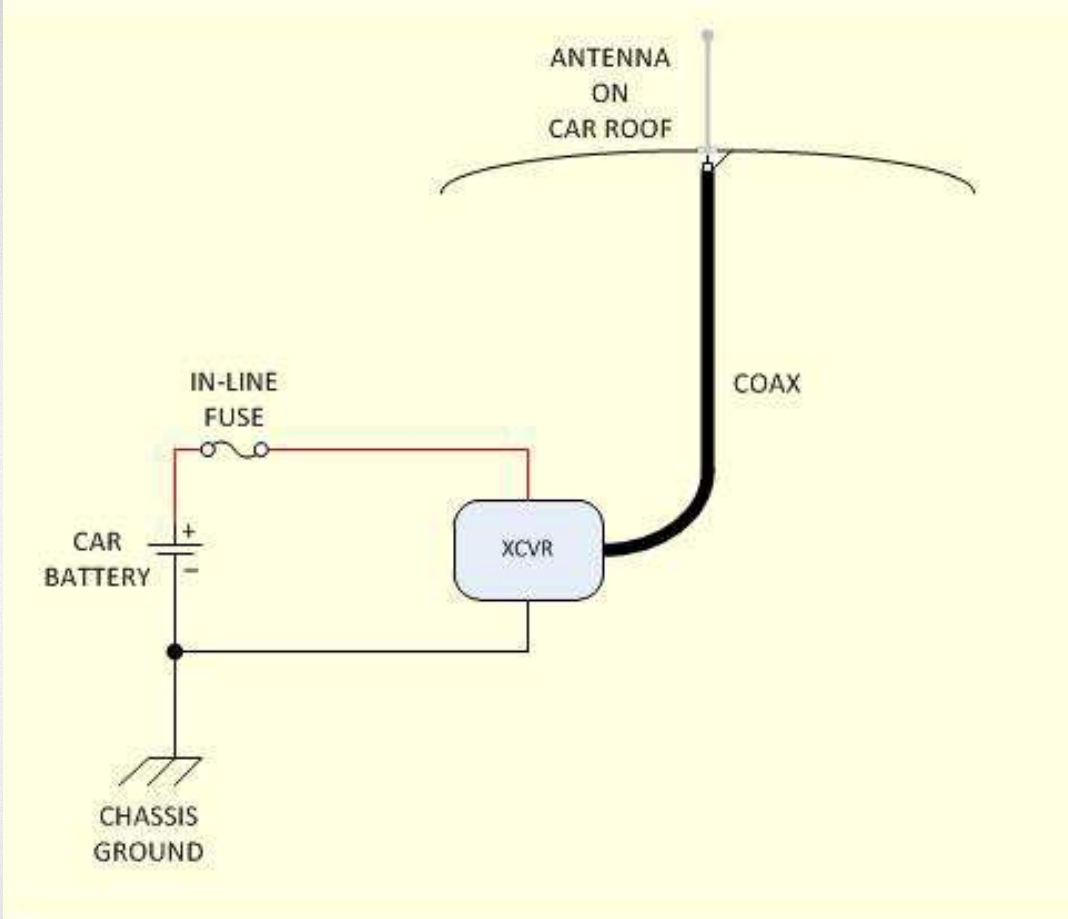
Mobile Power Wiring Safety



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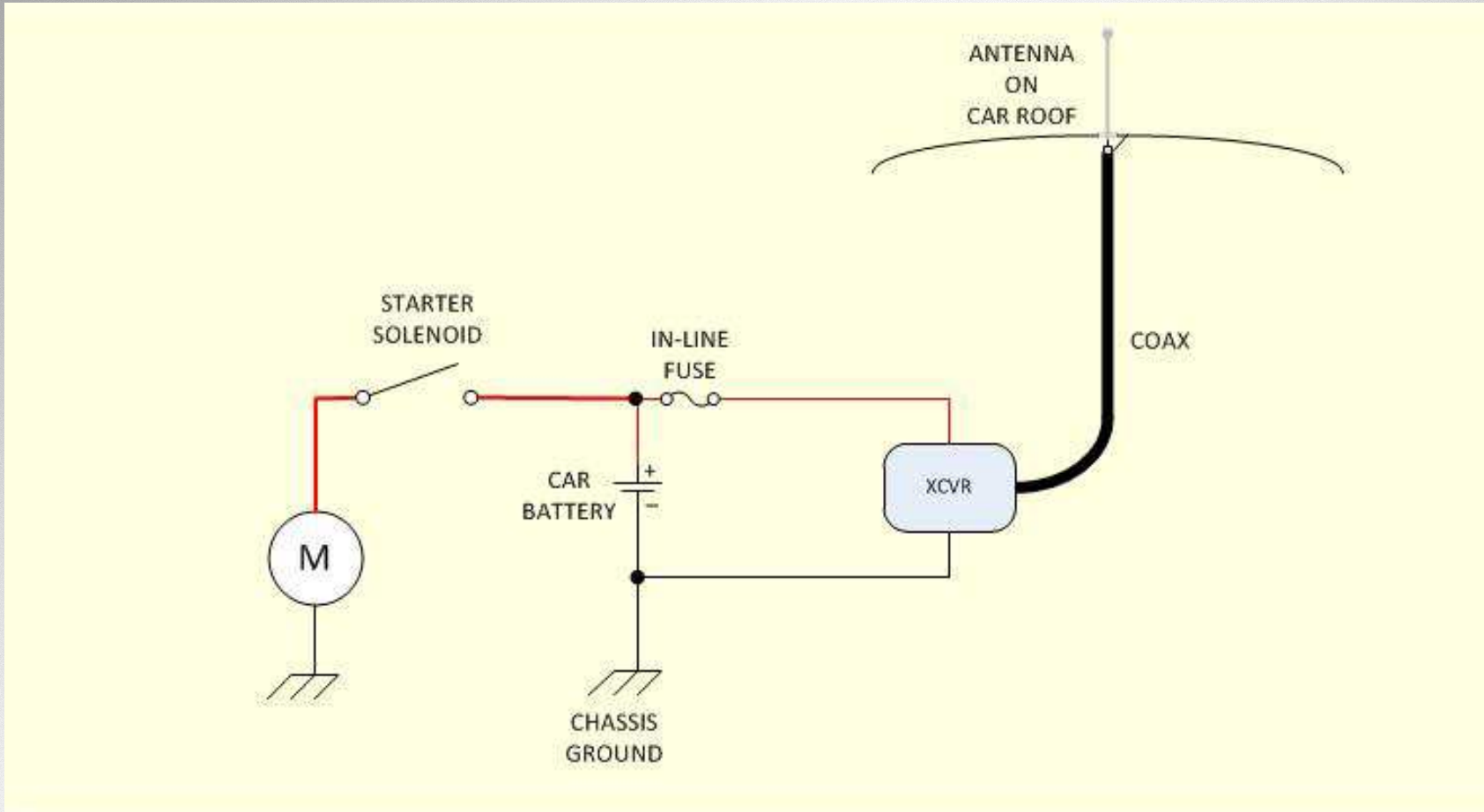

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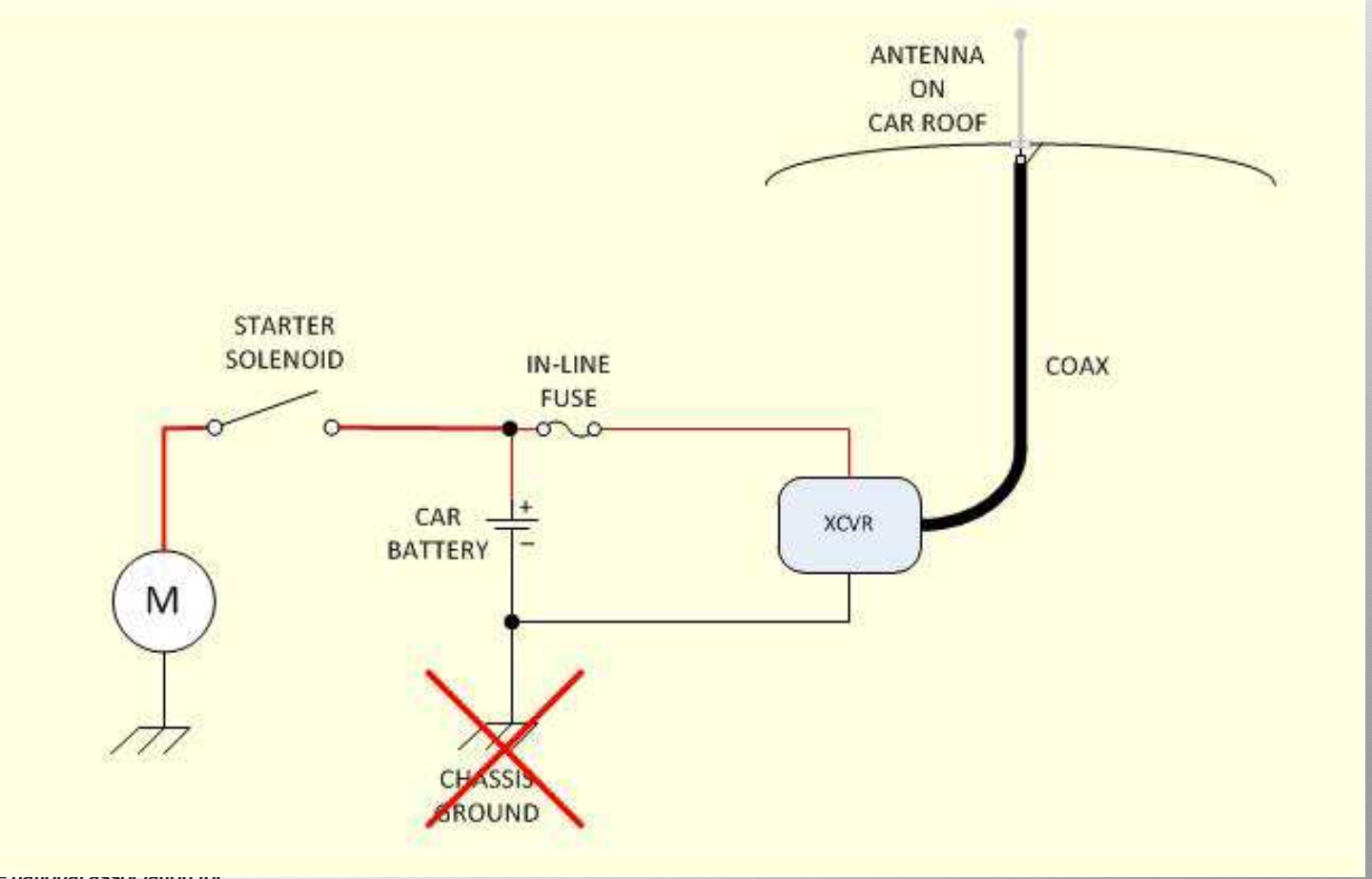

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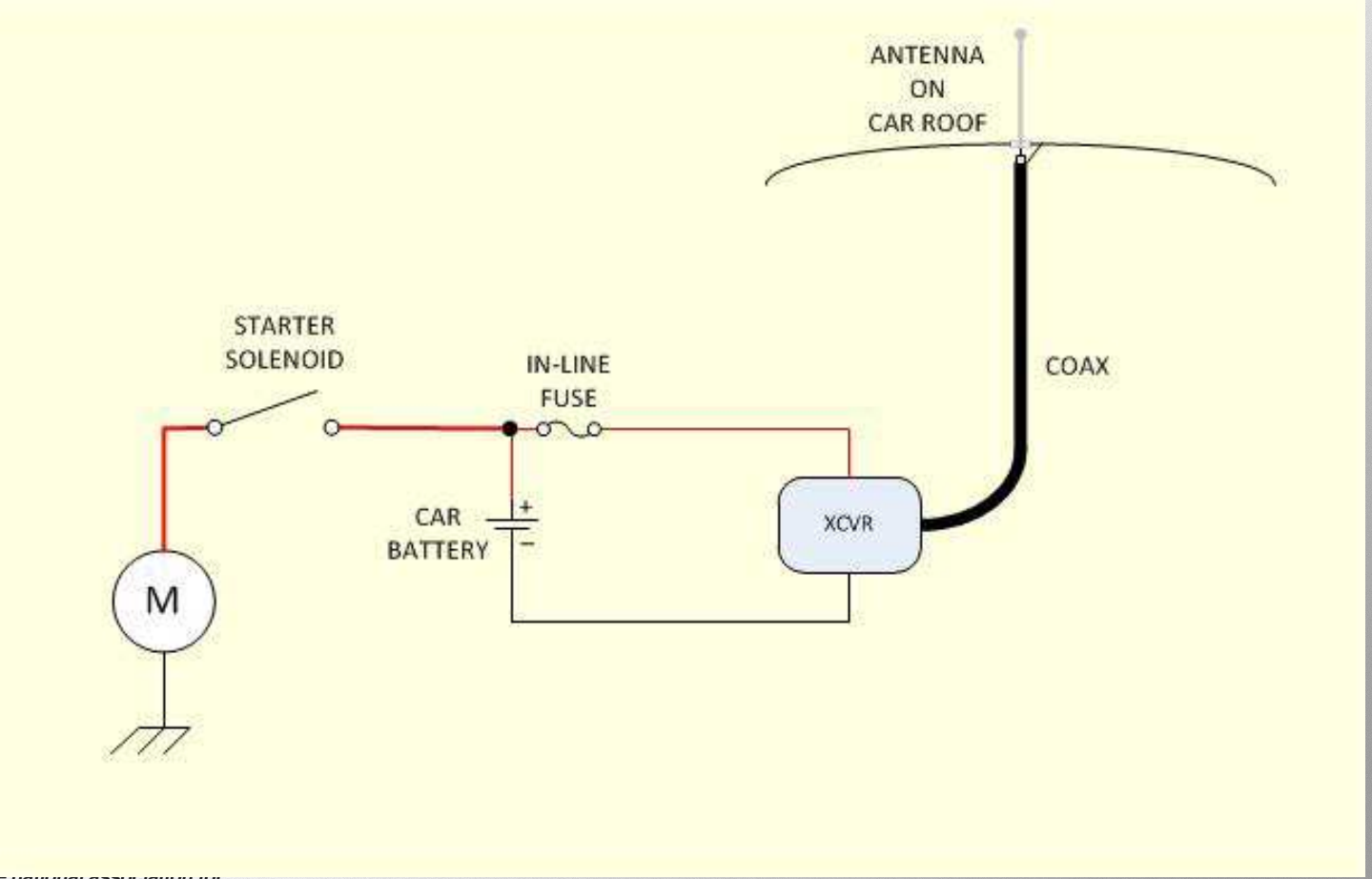

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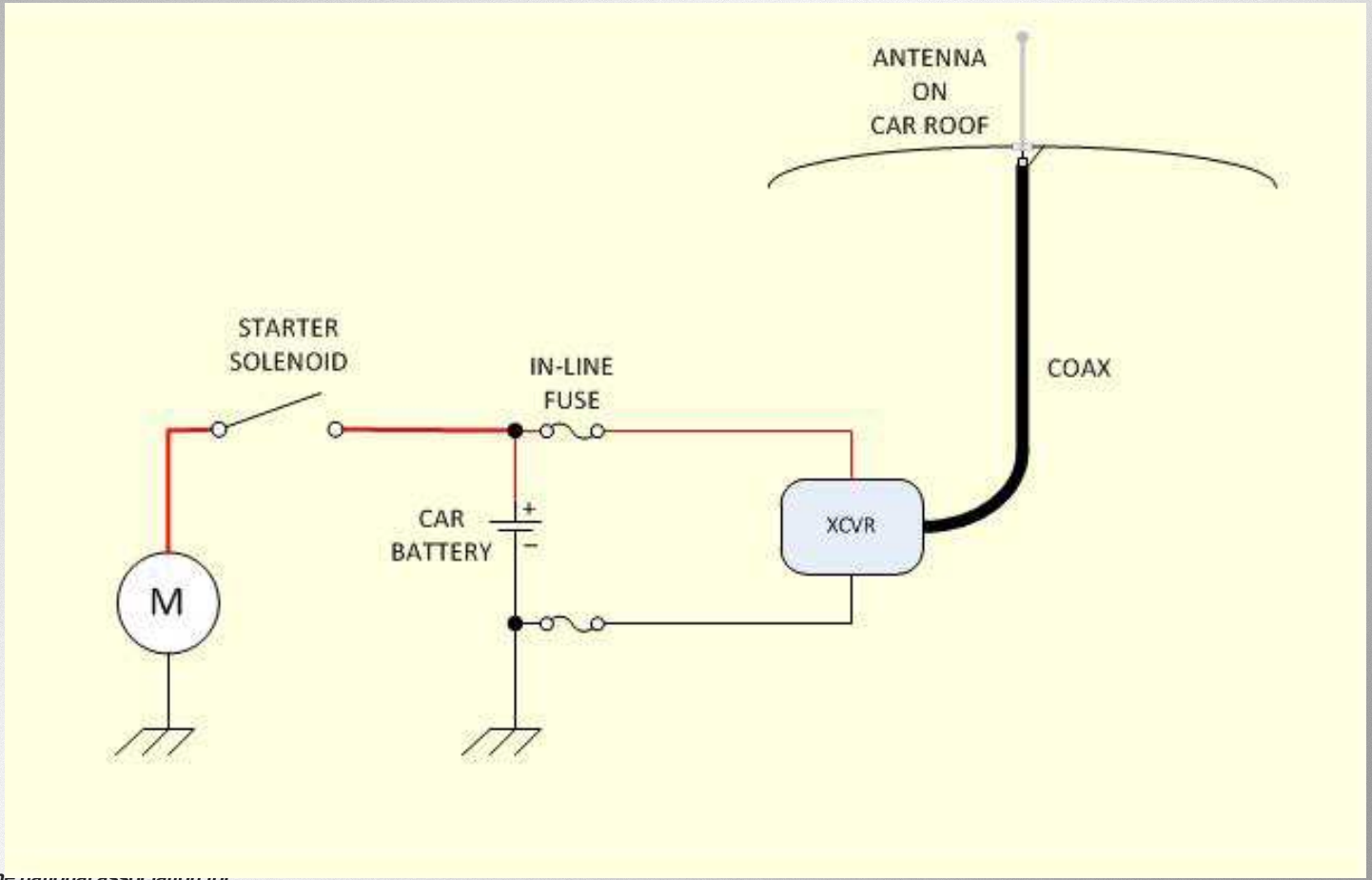

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Batteries

- Create current through a chemical reaction
  - Individual cells connected in series or parallel
  - Cell chemistry determines voltage per cell
- Battery types
  - Disposable (primary batteries)
  - Rechargeable (secondary batteries)
  - Storage
- Energy capabilities rated in Ampere-hours
  - Amps X time (at a constant voltage)

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Battery Charging

- Some batteries can be recharged, some cannot.
- Use the proper charger for the battery being charged.
- Batteries will lose capacity with each cycle.
- Best if batteries are maintained fully charged.
  - Over-charging will cause heating and could damage the battery.
- Lead-acid batteries release explosive hydrogen during charging or rapid discharge so adequate ventilation is required.

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Battery Charging

- Automobiles can be a good emergency power source by recharging batteries
- A 12-volt lead-acid station battery can be recharged by connecting it to an automobile's electrical system
  - Monitor battery temperature
  - Make sure battery is well-ventilated
  - Use jumper cables, not cigarette lighter plug
  - Caution: initial current will be high

Handheld Transceivers

- Battery packs – packages of several individual rechargeable batteries connected together.
  - NiCd (nickel-cadmium)
  - NiMH (nickel-metal hydride)
  - Li-ion (lithium-ion)
- For emergencies, have a battery pack that can use disposable batteries (AA size).

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Which is a good reason to use a regulated power supply for communications equipment? (T4A03)

- A. It prevents voltage fluctuations from reaching sensitive circuits
- B. A regulated power supply has FCC approval
- C. A fuse or circuit breaker regulates the power
- D. Power consumption is independent of load

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Where should a mobile transceiver's power negative connection be made? (T4A11)

- A. At the battery or engine block ground strap
- B. At the antenna mount
- C. To any metal part of the vehicle
- D. Through the transceiver's mounting bracket

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How much voltage does a mobile transceiver usually require? (T5A06)

- A. About 12 volts
- B. About 30 volts
- C. About 120 volts
- D. About 240 volts

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What is the nominal voltage of a fully charged nickel-cadmium cell? (T6A10)

- A. 1.0 volts
- B. 1.2 volts
- C. 1.5 volts
- D. 2.2 volts

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Which battery type is not rechargeable? (T6A11)

- A. Nickel-cadmium
- B. Carbon-zinc
- C. Lead-acid
- D. Lithium-ion

Which battery type is not rechargeable? (T6A11)

- A. Nickel-cadmium X (used in radios and cordless phones – but now largely supplanted by nickel-metal hydride)
- **B. Carbon-zinc** (carbon-zinc are the original throw-away drugstore batteries, now mostly supplanted by alkaline batteries)
- C. Lead-acid X (used in cars)
- D. Lithium-ion X (used in laptops and cellphones)

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What type of circuit controls the amount of voltage from a power supply? (T6D05)

- A. Regulator
- B. Oscillator
- C. Filter
- D. Phase inverter

What type of circuit controls the amount of voltage from a power supply? (T6D05)

- **A. Regulator** **(regulate = control)**
- B. Oscillator
- C. Filter
- D. Phase inverter

What is one way to recharge a 12-volt lead-acid station battery if the commercial power is out? (T0A08)

- A. Cool the battery in ice for several hours
- B. Add acid to the battery
- C. Connect the battery to a car's battery and run the engine
- D. All of these choices are correct

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What kind of hazard is presented by a conventional 12-volt storage battery? (T0A09)

- A. It emits ozone which can be harmful to the atmosphere
- B. Shock hazard due to high voltage
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What can happen if a lead-acid storage battery is charged or discharged too quickly? (T0A10)

- A. The battery could overheat and give off flammable gas or explode
- B. The voltage can become reversed
- C. The “memory effect” will reduce the capacity of the battery
- D. All of these choices are correct

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Radio Frequency Interference (RFI)

- Signals that interfere with radio reception.
- Interference can be FROM your station or TO your station.
- Solving the problem might take a little detective work!

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Types of RFI

- Direct detection – offending signals get into the electronic circuits to cause interference.
- Overload – strong signal that overwhelms the ability of the receiver to reject it.
- RF Current – can be picked up by cables of consumer equipment.
- Transmitted harmonics – must be filtered out at the transmitter.

Filters

- Filters attenuate (reduce) signals
- High-pass – reduce low-frequency signals
- Low-pass – reduce high-frequency signals
- Band-pass – only pass a range of signals
- Notch – reduces a narrow range of signals
- Selecting correct filter requires understanding the source of the interference

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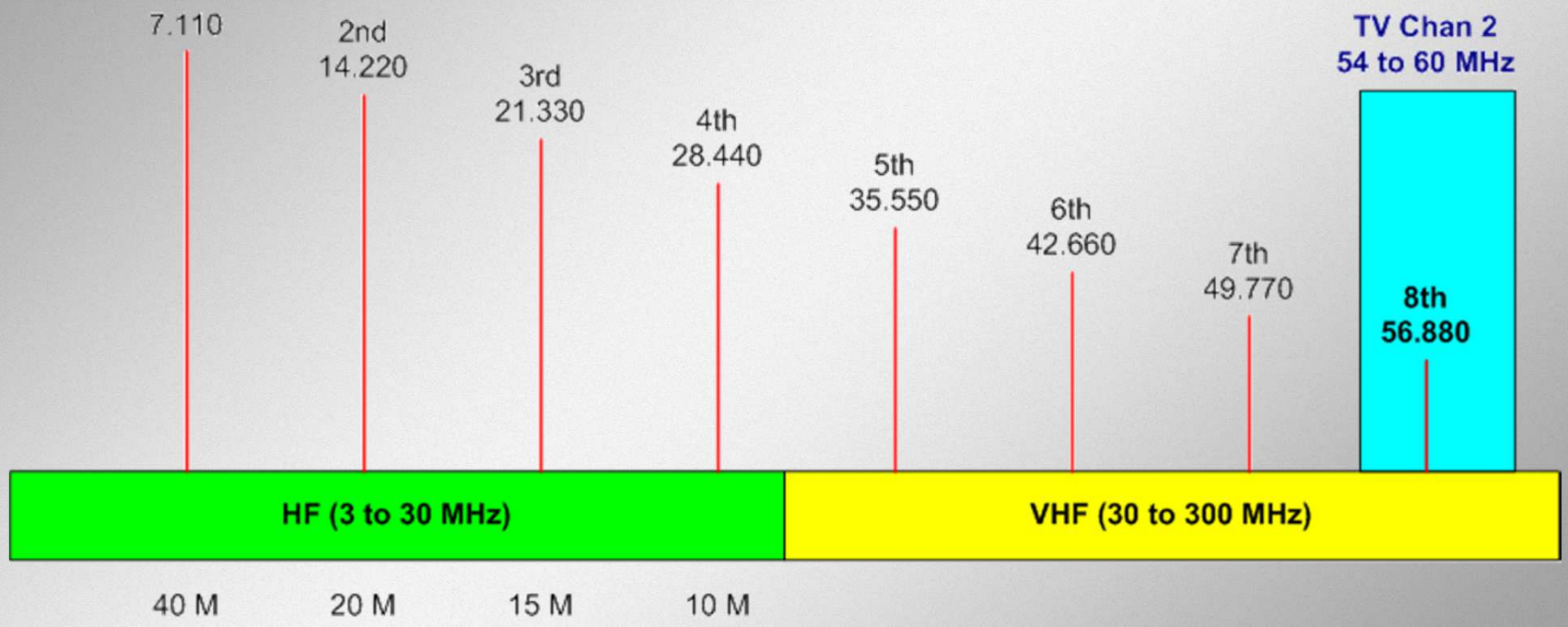
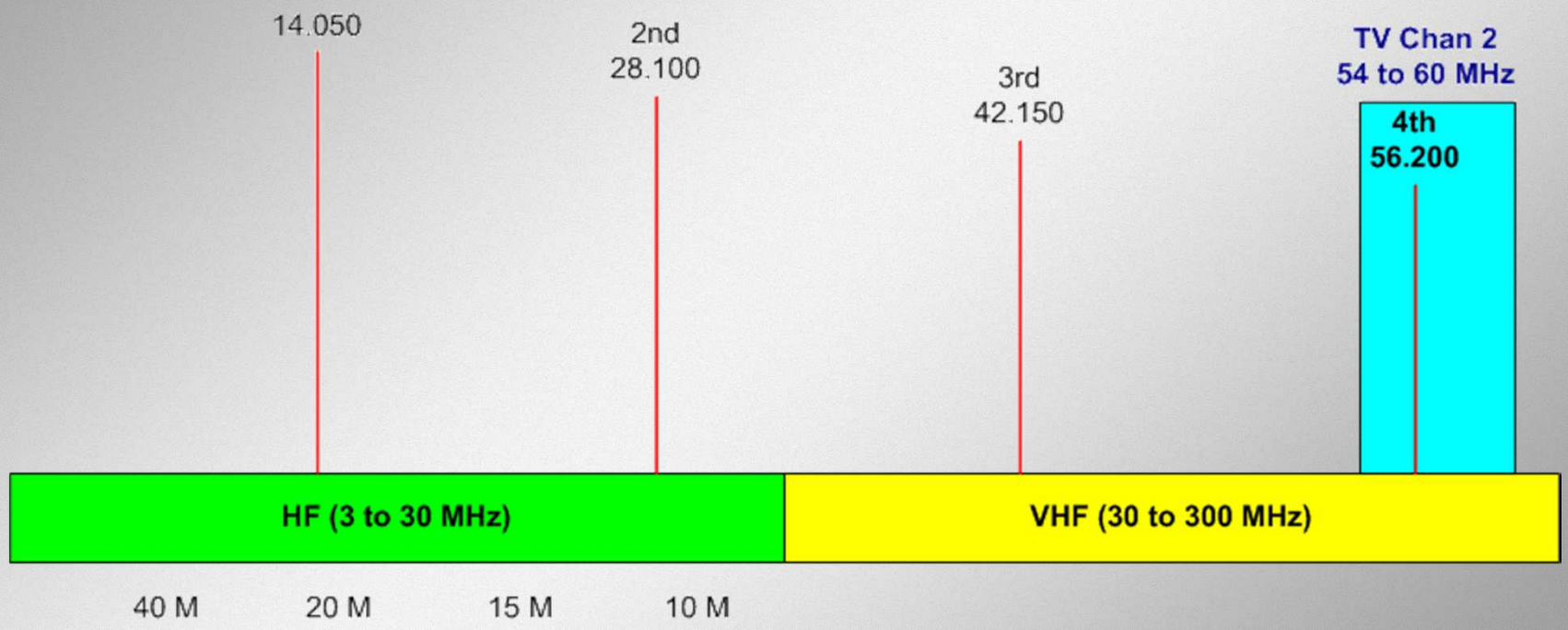
Harmonics of a 40 M signal



Harmonics of a 20 M signal



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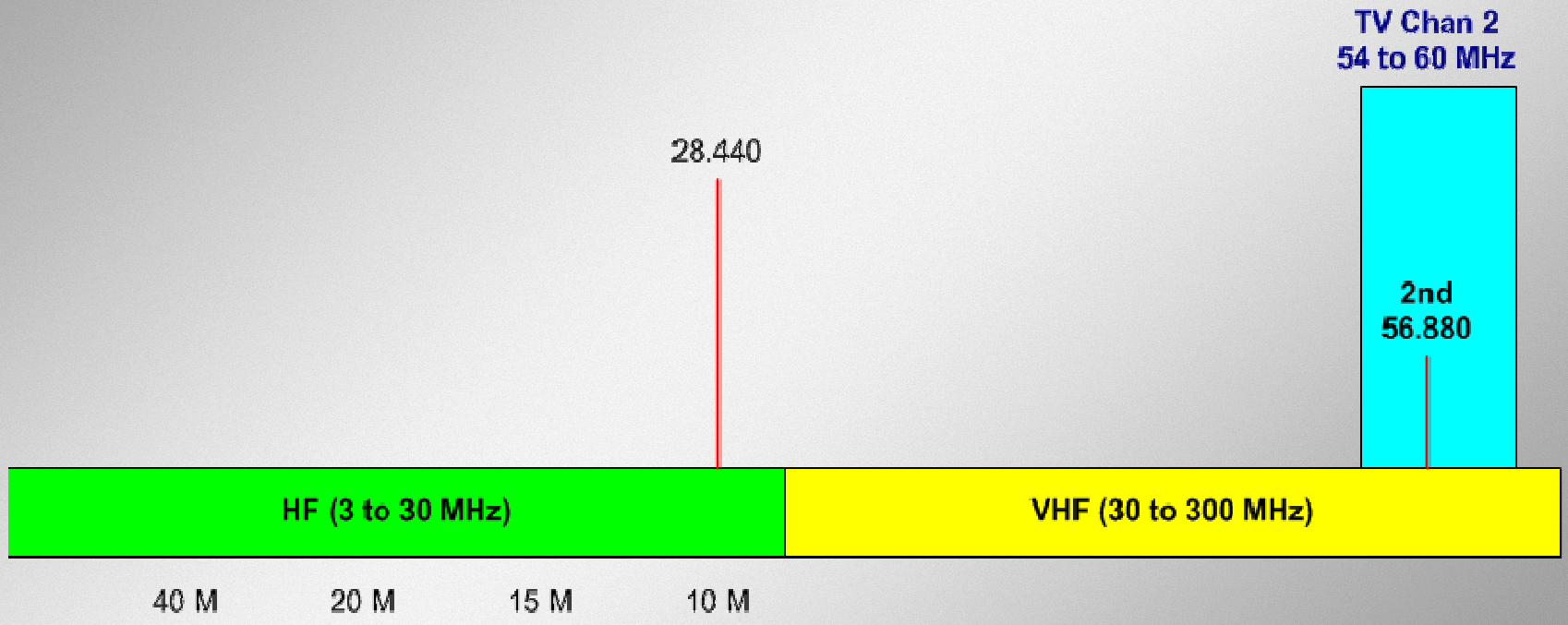
Harmonics of a 10 M signal



Ferrite Chokes

- Creates impedance (opposition to ac) on cables and wires.
- Can be used to block RF current that causes interference to entertainment equipment, microphones, monitors, amplifiers, etc.
- Wind cable through ferrite core to create blocking impedance.

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Cable TV Interference

- Usually the result of broken shielding somewhere in the cable.
  - Loose connections
  - Broken connections
  - Corroded connections
- Usually solved by proper cable maintenance by cable supplier.

Noise Sources

- Electrical arcs (motors, thermostats, electric fences, neon signs)
- Power lines
- Motor vehicle ignitions or alternators
- Switching power supplies
- Computers, networks and TV sets

RFI Guidelines

- Operate your equipment properly.
- Eliminate interference in your own home.
- Use good station building practices to eliminate unwanted signals.
  - Shielded wire and cables
  - Shielded equipment
  - Good connections and filters

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Dealing with RFI

- Take interference complaints seriously.
- Make sure that you're really not the cause (demonstrate that you don't interfere within your own home).
- Offer to help eliminate the RFI, even if you are not at fault.
- Consult ARRL RFI Resources for help and assistance.

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Part 15 Rules

- Applies only to unlicensed devices
- Unlicensed devices may not interfere with licensed services, such as amateur radio
- Unlicensed devices must accept any interference they receive from licensed services
- RFI from and to unlicensed devices is the responsibility of the users of such devices

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What the Rules Say

- Bottom line – If your station is operating properly, you are protected against interference complaints
- BUT – Be a good neighbor because they are probably not familiar with Part 15 rules and regulations

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Where must a filter be installed to reduce harmonic emissions? (T4A04)

- A. Between the transmitter and the antenna
- B. Between the receiver and the transmitter
- C. At the station power supply
- D. At the microphone

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What type of filter should be connected to a TV receiver as the first step in trying to prevent RF overload from a nearby 2 meter transmitter? (T4A05)

- A. Low-pass filter
- B. High-pass filter
- C. Band-pass filter
- D. Band-reject filter

What is RF overload anyway?

- Fundamentally different from harmonic interference
- Remember that receivers are designed to deal with microvolt-level signals from distant transmitters
- Now imagine that your transmitting a kilowatt into an antenna on your roof that is 30 feet away from your neighbor’s TV antenna

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What is meant by fundamental overload in reference to a receiver? (T7B02)

- A. To much voltage from the power supply
- B. Too much current from the power supply
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- D. Interference caused by turning the volume up too high

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What would cause a broadcast AM or FM radio to receive an amateur radio transmission unintentionally?

A. The receiver is susceptible to strong signals outside the AM or FM band

B. The microphone gain of the transmitter is turned up too high

C. The audio amplifier of the transmitter is overloaded

D. The deviation of an FM transmitter is set too low

T7B02 HRLM (5-21)

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T7B02 HRLM (5-21)

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Which would you use to reduce RF current flowing on the shield of an audio cable? (T4A09)

- A. Band-pass filter
- B. Low-pass filter
- C. Preamplifier
- D. Ferrite choke

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Which of the following may be a cause of radio frequency interference? (T7B03)

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- B. Harmonics
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What is the most likely cause of interference to a non-cordless telephone from a nearby transmitter? (T7B04)

- A. Harmonics from the transmitter
- B. The telephone is inadvertently acting as a radio receiver
- C. Poor station grounding
- D. Improper transmitter adjustment

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What is a logical first step when attempting to cure a radio frequency interference problem in a nearby telephone? (T7B05)

- A. Install a low-pass filter at the transmitter
- B. Install a high-pass filter at the transmitter
- C. Install an RF filter at the telephone
- D. Improve station grounding

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What should you do first if someone tells you that your station's transmissions are interfering with their radio or TV reception? (T7B06)

- A. Make sure that your station is functioning properly and that it does not cause interference to your own television
- B. Immediately turn off your transmitter and contact the nearest FCC office for assistance
- C. Tell them that your license gives you the right to transmit and nothing can be done to reduce the interference
- D. Continue operating normally because your equipment cannot possibly cause any interference

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Which of the following may be useful in correcting a radio frequency interference problem? (T7B07)

- A. Snap-on ferrite chokes
- B. Low-pass and high-pass filters
- C. Band-reject and band-pass filters
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What should you do if a “Part 15” device in your neighbor’s home is causing harmful interference to your amateur station? (T7B08)

- A. Work with you neighbor to identify the offending device
- B. Politely inform your neighbor about the rules that require him to stop using the device if it causes interference
- C. Check your station and make sure it meets the standards of good amateur practice
- D. All of these choices are correct

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Electrical Safety Grounding and Circuit Protection (in the Home)

- Make sure your home is “up to code.”
- Most ham equipment does not require special wiring or circuits.
  - Use 3-wire power cords.
  - Use circuit breakers, circuit breaker outlets, or Ground Fault Interrupter (GFI) circuit breakers.
  - Use proper fuse or circuit breaker size.
  - Don’t overload single outlets.

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RF “Grounding”

- Not the same as ac safety grounding
- “Bonding” is more accurate
- Keep all equipment at the same RF voltage
  - Current will not flow between pieces of equipment which can cause RF feedback
  - Minimizes RF “hot spots” (RF burns)
  - Use solid strap or wire for best RF connection

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What is a symptom of RF feedback in a transmitter or transceiver? (T7B11)

- A. Excessive SWR at the antenna connection
- B. The transmitter will not stay on the desired frequency
- C. Reports of garbled, distorted, or unintelligible transmissions
- D. Frequent blowing of power supply fuses

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What type of conductor is best to use for RF grounding? (T4A08)

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- B. Round copper-clad steel wire
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What is the source of a high-pitched whine that varies with engine speed in a mobile transceiver's receive audio? (T4A10)

- A. The ignition system
- B. The alternator
- C. The electric fuel pump
- D Anti-lock braking system controllers

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(Ignition system would make popping noises. Fuel pump and ABS are unaffected by engine speed)

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