Technician License Course
Chapter 5

Lesson Plan Module 12 –

Power Sources and RF Interference (RFI)

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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

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.

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.

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

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).

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.

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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

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.

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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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

Practice Questions

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

A. Cool the battery in ice for several hours

B. Add acid to the battery

C. Connect the battery in parallel with a vehicle's battery and run the engine

D. All of these choices are correct

T2C02 HRLM (5-18)

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T2C02 HRLM (5-18)

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

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

T4A03 HRLM (5-15)

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T4A03 HRLM (5-15)

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Where must a filter be installed to reduce harmonic emissions from your station?

A. Between the transmitter and the antenna

B. Between the receiver and the transmitter

C. At the station power supply

D. At the microphone

T4A04 HRLM (5-21)

Where must a filter be installed to reduce harmonic emissions from your station?

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T4A04 HRLM (5-21)

ARRL The national association for AMATEUR RADIO

Which type of conductor is best to use for RF grounding?

A. Round stranded wire

B. Round copper-clad steel wire

C. Twisted-pair cable

D. Flat strap

T4A08 HRLM (5-25)

ARRL The national association for AMATEUR RADIO

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T4A08 HRLM (5-25)

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Which of the following could you use to cure distorted audio caused by RF current flowing on the shield of a microphone cable?

A. Band-pass filter

B. Low-pass filter

C. Preamplifier

D. Ferrite choke

T4A09 HRLM (5-20)

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T4A09 HRLM (5-20)

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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?

A. The ignition system

B. The alternator

C. The electric fuel pump

D. Anti-lock braking system controllers

T4A10 HRLM (5-16)

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T4A10 HRLM (5-16)

ARRL The national association for AMATEUR RADIO

Where should the negative return connection of a mobile transceiver's power cable be connected?

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

T4A11 HRLM (5-15)

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T4A11 HRLM (5-15)

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What could be happening if another operator reports a variable high-pitched whine on the audio from your mobile transmitter?

A. Your microphone is picking up noise from an open window

B. You have the volume on your receiver set too high

C. You need to adjust your squelch control

D. Noise on the vehicle's electrical system is being transmitted along with your speech audio

T4A12 HRLM (5-16)

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T4A12 HRLM (5-16)

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How much voltage does a mobile transceiver usually require?

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

T5A06 HRLM (5-15)

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T5A06 HRLM (5-15)

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Which of the following battery types is rechargeable?

A. Nickel-metal hydride

B. Lithium-ion

C. Lead-acid gel-cell

D. All of these choices are correct

T6A10 HRLM (5-17)

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T6A10 HRLM (5-17)

ARRL The national association for AMATEUR RADIO

Which of the following battery types is not rechargeable?

A. Nickel-cadmium

B. Carbon-zinc

C. Lead-acid

D. Lithium-ion

T6A11 HRLM (5-17)

Which of the following battery types is not rechargeable?

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T6A11 HRLM (5-17)

ARRL The national association for AMATEUR RADIO

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

A. Regulator

B. Oscillator

C. Filter

D. Phase inverter

T6D05 HRLM (5-15)

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T6D05 HRLM (5-15)

Which is of the following is a common reason to use shielded wire?

A. To decrease the resistance of DC power connections

B. To increase the current carrying capability of the wire

C. To prevent coupling of unwanted signals to or from the wire

D. To couple the wire to other signals

T6D12 HRLM (5-22)

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T6D12 HRLM (5-22)

ARRL The national association for AMATEUR RADIO

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)

ARRL The national association for AMATEUR RADIO

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

A. Fundamental overload

B. Harmonics

C. Spurious emissions

D. All of these choices are correct

T7B03 HRLM (5-19)

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T7B03 HRLM (5-19)

ARRL The national association for AMATEUR RADIO

Which of the following is a way to reduce or eliminate interference by an amateur transmitter to a nearby telephone?

A. Put a filter on the amateur transmitter

B. Reduce the microphone gain

C. Reduce the SWR on the transmitter transmission line

D. Put a RF filter on the telephone

T7B04 HRLM (5-21)

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T7B04 HRLM (5-21)

ARRL The national association for AMATEUR RADIO

How can overload of a non-amateur radio or TV receiver by an amateur signal be reduced or eliminated?

A. Block the amateur signal with a filter at the antenna input of the affected receiver

B. Block the interfering signal with a filter on the amateur transmitter

C. Switch the transmitter from FM to SSB

D. Switch the transmitter to a narrow-band mode

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T7B05 HRLM (5-21)

ARRL The national association for AMATEUR RADIO

Which of the following actions should you take if a neighbor tells you that your station's transmissions are interfering with their radio or TV reception?

A. Make sure that your station is functioning properly and that it does not cause interference to your own radio or television when it is tuned to the same channel

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. Install a harmonic doubler on the output of your transmitter and tune it until the interference is eliminated

T7B06 HRLM (5-22)

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T7B06 HRLM (5-22)

ARRL The national association for AMATEUR RADIO

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

A. Snap-on ferrite chokes

B. Low-pass and high-pass filters

C. Band-reject and band-pass filters

D. All of these choices are correct

T7B07 HRLM (5-19)

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T7B07 HRLM (5-19)

What should you do if something in a neighbor's home is causing harmful interference to your amateur station?

A. Work with your neighbor to identify the offending device

B. Politely inform your neighbor about the rules that prohibit the use of devices which cause interference

C. Check your station and make sure it meets the standards of good amateur practice

D. All of these choices are correct

T7B08 HRLM (5-23)

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T7B08 HRLM (5-23)

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What is a Part 15 device?

A. An unlicensed device that may emit low powered radio signals on frequencies used by a licensed service

B. A type of amateur radio that can legally be used in the citizen's band

C. A device for long distance communications using special codes sanctioned by the International Amateur Radio Union

D. A type of test set used to determine whether a transmitter is in compliance with FCC regulation 91.15

T7B09 HRLM (5-23)

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T7B09 HRLM (5-23)

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

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

T7B11 HRLM (5-24)

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T7B11 HRLM (5-24)

ARRL The national association for AMATEUR RADIO

What might be the first step to resolve cable TV interference from your ham radio transmission?

A. Add a low pass filter to the TV antenna input

B. Add a high pass filter to the TV antenna input

C. Add a preamplifier to the TV antenna input

D. Be sure all TV coaxial connectors are installed properly

T7B12 HRLM (5-21)

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T7B12 HRLM (5-21)

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

A. It emits ozone which can be harmful to the atmosphere

B. Shock hazard due to high voltage

C. Explosive gas can collect if not properly vented

D. All of these choices are correct

T0A09 HRLM (5-18)

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T0A09 HRLM (5-18)

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What can happen if a lead-acid storage battery is charged or discharged too quickly?

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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