Technician License Course
Chapter 5
Amateur Radio Equipment

Lesson Plan Module 12:

Power Supplies and Batteries,

RF Interference (RFI)

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Power Supplies

Most modern amateur radio equipment is designed to use an external DC power source similar to the battery voltage for motorized vehicles.

- A power supply is required to convert 120 volts AC to 13.6 Volts DC. 12 Volts is a nominal value.
- A 100 Watt SSB transceiver may need 240 Watts which is about 20 Amps DC.
- A 50 Watt FM transceiver may only need 12 Amps.

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Linear Power Supplies

Linear – Conventional supply with transistor regulators:

- Uses a transformer to reduce voltage.
- Heavy weight and large size – 18 lbs for 20 Amps.
- Regulation circuits waste energy – less than 75% efficient
- Repair and troubleshooting relatively easy
- Higher cost compared to switching supplies

Switch Mode Power Supplies

Switching – Modern supply with active regulation, solid state components replace heavy transformers

- Light weight and small size – 5 lbs. for 30 Amps.
- Regulation circuits are efficient – greater than 85%
- Poor designs can make RF noise.
- Not as robust and can be difficult to repair
- Less expensive than linear supplies

Power Supply Ratings

- Continuous duty – how much current can be supplied over the long term.
- Intermittent duty – how much current can be supplied over the short term.
- Regulation – the ability to maintain a constant voltage when the load current changes.
- Protection – what happens if overloaded or in case of a fault.

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Mobile Power Wiring Safety

Car batteries hold lots of energy – shorting a battery could cause a fire. Follow requirements for safe car wiring:

- Use wire of appropriate size and insulation.
- Fuse both positive and negative leads near the battery.
- Connect radio's negative lead to where the battery ground connection is made.
- Use grommets or protective sleeves to prevent wire chafing.
- Don't assume all metal in the car is connected together – modern cars have many non-metal pieces.

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Mobile Power Side Effects

- Alternator whine and Ignition noise.
- Voltage difference between engine running and stopped.
- Voltage spikes due to *Load Dumps* when starting engine.
- Radio interference with control computers.
- Sneak power paths through radio if not properly grounded.
- Running down the battery.

Batteries

Batteries create current through a chemical reaction.

- Made up of individual cells connected in series.
- Cell voltage depends on chemistry. 1.2 V to 3.6 V.

Battery types.

- Disposable.
- Rechargeable.

Energy capabilities rated in Ampere-hours.

- Amps X time, but only under stated conditions.
- i.e. , 1500 mAH, 5 AH, 100 AH

Battery Charging

There are many myths about charging batteries. Check with the manufacturer. Some batteries can be recharged, some cannot. It can be dangerous to charge batteries not meant for recharging.

Use the proper charger for the battery being charged.

- NiCad and NiMH overheat if charged too long.
- Lithium Ion can ignite if charging too fast.

Batteries will lose capability to recharge over time.

Batteries should be maintained fully charged.

Over-charging will cause heating and could damage the battery.

Lead-acid batteries can release gasses during charging so you must provide ventilation.

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Handheld Transceiver Batteries

Battery packs – packages of several rechargeable cells connected together.

- NiCd (nickel-cadmium)
- NiMH (nickel-metal hydride)
- Li-ion (lithium-ion)

For emergencies, have a battery holder that can use disposable batteries (AA size)

Radio Frequency Interference (RFI)

Unwanted, unintentional signals from some electronic device that interferes with radio reception by your station or your neighbors equipment.

RFI caused by your station can be avoided by operating your transmitting equipment properly.

RFI to your receiving equipment can come from your residence or from your neighbors.

- Light dimmers
- Computers and TV
- Motor controllers

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RFI Mitigation

Filters attenuate interfering signals and keep you from interfering.

- High-pass – generally on the receive side.
- Low-pass – generally on the transmit side.
- Band-Reject – generally at the receiver.
- Band-pass – used within most radio equipment.

Shielding and Grounding

Ferrite chokes and Baluns

Causes of RFI

Direct detection – offending signals get into the electronics circuits to cause interference.

Fundamental Overload – strong signal that overwhelms the weaker, wanted signal or causes changes in the biasing of transistor circuits.

Harmonics – multiples of the transmitter frequency that are close to the frequency of the desired signal.

Products – Mixtures of several frequencies that occur when the outputs of two or more transmitters mix in a non-linear circuit.

Cable TV Interference

Usually the result of broken shielding somewhere in the cable.

- Loose, broken, or corroded connections.
- Unterminated or illegal connections.
- Usually solved by proper cable maintenance by cable supplier.

If the cable can interfere with you, you can possibly interfere with the cable. Some CATV channels use Amateur frequencies

Sources of Radio Noise

Electrical arcs (motors, thermostats, electric fences, neon signs).

Fluorescent lamps and dimmers

Power lines.

Motor vehicle ignitions or alternators.

Switching power supplies.

Computers and networks

TV sets.

Dealing with RFI Complaints

Take interference complaints seriously.

Make sure you operate your equipment properly.

Eliminate interference in your own home first.

Make sure that you're really not the cause

- Does the interference occur when you are not transmitting?
- Enlist a third party to perform tests.
- Try to maintain a civil and friendly relationship with the complainant.
- Offer to help eliminate the RFI, even if you are not at fault.

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Dealing with Part 15 Interference

FCC Part 15 includes wireless phones, intercomms, routers, door openers, lighting controls, etc., which use radio frequencies. RFI from and to unlicensed devices is the responsibility of the users of such devices.

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

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Electrical Grounding in your house

Make sure your home is “up to code.” Codes have changed a lot over years. Bringing up to code can be expensive.

Most ham equipment does not require special wiring or circuits.

- Use 3-wire power cords for safety.
- 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.

Basics of Grounding in the Station

The AC Power Ground lead is not an RF ground. An Earth connection may not be necessary but all equipments should be bonded together. This will avoid shock hazards when touching equipments and may reduce damage due to lightning.

Each equipment is bonded to a common ground bar with a separate large conductor.

- Solid flat copper strap is best.
- Make connections with clamps or screws.
- Long wires may be useless at RF.

The ground bar may be connected to an Earth Ground rod but the ground rod must be bonded to the AC Power Ground.

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RF Effects of Grounding Problems

You might receive reports of “RF Feedback” while operating on HF Voice – a distortion which occurs on voice peaks or totally distorted voice signals.

- RF currents in the Microphone cable.
- Signal Hum from AC in common ground.
- RF Burns from touching Mike or Transceiver.

Sometimes a Balun or feedline choke at the antenna is necessary to keep RF current off the feedline shield.

Shield currents can also be a reason for TV or telephone interference.

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