



SCARS Tech License Course – Week 5

Amateur Radio Practices and Station Setup

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Technician License Course

Chapter 5

Lesson Plan Module – 5b Transmitters, Receivers and Transceivers



Generalized Transceiver Categories

- Mobile VHF/UHF FM
- Single Band VHF or UHF FM
- Dual Band VHF/UHF FM
- All Band HF and VHF/UHF
- Multimode VHF/UHF CW/SSB/FM
- Handheld (HT)



Single-Band Mobile

- Single-band, 2 meter is a good starter radio.
- Operates from 13.8 volts dc, requires external power supply or car battery.
- Requires an external antenna.
- Can be operated mobile or as a base station.
- Limited to frequency modulation (FM) and usually either 2 meters or 70 cm bands.
- Up to approximately 50 watts output.

Dual-Band Mobile

- Same as the single-band transceiver but includes additional band(s).
- Most common are 2 meter and 70 cm bands.
- Could add 6 meters, 222 MHz or 1.2 GHz.
- Might have separate antenna connections for each band or a single connection for a dual-band antenna



Multimode Transceiver

- Nearly all HF rigs are multimode.
- VHF multimode operates on FM plus AM/SSB/CW modes.
- Required for “weak-signal” operation on VHF/UHF.
- More features add complexity and cost.
- More flexibility will allow you to explore new modes as you gain experience.



Multiband Transceiver

- Covers many bands – usually refers to coverage of HF + VHF/UHF.
- Also covers all modes.
- Frequently 100 watts on HF, some power limitations on high bands (25–50 watts).
- Larger units have internal power supplies, smaller units need external power supply.



Handheld (HT) Transceiver

- Small handheld FM units.
- Can be single band or dual band.
- Limited power (usually 5 watts or less).
- Includes power (battery) and antenna in one package.
- Often purchased as a starter rig but low power limits range.



Handheld (HT) Transceiver

- Single, dual and multiband versions (with increasing cost and complexity).
- Some can receive outside the ham bands, such as aircraft, commercial FM broadcast, etc.
- Very portable and self-contained.
- Internal microphone and speaker.
- Rubber duck antenna.
- Battery powered.



Handheld (HT) Transceiver

- Extra battery packs
 - AA cell pack useful in emergencies
- Drop-in, fast charger
- Extended antenna
- External microphone and speaker
- Headset

Side-by-Side

	Single Band	Dual Band	Multi-mode	Multi-band	Hand-held
Freq Agility	Limited	Medium	Medium	Full	Limited
Functionality	Limited	Limited	Full	Full	Limited
Ease of Use	Easy	Medium	Medium	Difficult	Easy
Programming	Easy	Easy	Medium	Challenging	Easy/ Medium
Power	Low	Low	Medium	High	Low
Cost	Low	Modest	High	High	Low



Rig Vocabulary

- We will now go through some jargon and vocabulary specific to the receive and transmit functions and controls of a transceiver.



Band and Frequency Selection

- Fundamental to all amateur transceivers
- Can set by VFO (continuously variable) or by keypad “direct” entry
- Memories can generally store:
 - Frequency
 - Mode
 - Filter and similar settings
 - Alphanumeric labels



Transmitter Controls and Functions

- Main tuning display (both TX and RX):
 - Controls the frequency selection via the variable frequency oscillator (VFO).
 - Frequency can be set with a knob or keypad or programmed channels.
 - Variable frequency step size (tuning rate, resolution).
 - Rigs can usually store the information for two operating frequencies (VFO A and VFO B).



Transmitter Controls and Functions

- Mode selector (both TX and RX for multimode rigs).
 - AM/FM/SSB (LSB or USB)
 - CW
 - Data (RTTY or PSK)
- Could be automatic based on recognized band plan.



Transmitter Controls and Functions

- Microphone controls
 - Gain
 - Controls transmitter sensitivity to your voice
 - Speech Compressor or Speech Processor
 - Increases microphone gain at lower sound levels to increase overall signal strength or “punch”.



Transmitter Controls and Functions

- Too much gain or compression can cause problems
 - Splatter
 - Over-deviation
 - Over-modulation



Transmitter Controls and Functions

- Automatic Level Control (ALC)
 - Automatically limits speech modulation, reducing transmitter over-drive
 - Causes some speech distortion
 - Do NOT use for data modes like PSK
- Also prevents overdrive to external power amplifier



Microphones and Keys

- Microphones (mic)
 - Hand mics
 - Desk mics
 - Pre-amplified desk mics
 - Speaker-mics
 - Headsets or boom-sets
 - Internal mics
- Speak *across* the mic, not into the mic



Microphones and Keys

- Transmitter ON/OFF or “keying”
 - Push-to-Talk (PTT)
 - Voice-Operated Transmission (VOX)
 - VOX Gain
 - VOX Delay
 - Anti-VOX



Microphones and Keys

- Key jack
- Manually-Operating Transmission (MOX or SEND - varies with manufacturer)
- Morse code
 - Straight key
 - Electronic keyer and paddle
 - Semi-automatic (Bug)



Receiver Controls and Functions

- AF Gain or Volume
 - Controls the audio level to the speaker or headphones
- RF Gain
 - Controls the gain of the receiver's input amplifiers
- Attenuator
 - Reduces signal at the receiver input



Receiver Controls and Functions

- Receive Incremental Tuning (RIT)
 - “Fine tuning”
 - Adjusts receive frequency independent of main VFO
 - Doesn't vary the transmitted frequency
 - Transmitters have a similar function (XIT)



Receiver Controls and Functions

- Automatic Gain Control (AGC)
 - Automatically limits the incoming signals during signal (voice) peaks to maintain even volume
 - Keeps strong signals from blasting the listener
 - Different time response settings:
 - Fast setting for CW
 - Slow settings for SSB and AM
 - Not used in FM because amplitude is constant



Receiver Controls and Functions

- Squelch
 - Mutes audio to speaker when signal is not present
- Used in FM primarily
 - Open – allows very weak signals to pass through (along with noise)
 - Tight – allows only the strongest signals to pass



Receiver Controls and Functions

- Advance the squelch control until the noise just disappears
 - Also opened by MON (Monitor) control on handhelds



Receiver Controls and Functions

- Filters (can be electronic modules or DSP)
 - IF filter
 - Used to narrow the width of signal that is passed.
 - Can attenuate adjacent signals.
 - Notch filter
 - Very narrow filter that can be moved over an interfering signal to attenuate it.



Receiver Controls and Functions

- Noise blanker (NB)
 - Removes signal pulses that are frequently associated with random naturally generated noise
 - Can cause problems if strong signals are present
- Noise reduction (NR)
 - DSP function to remove noise from signal
- Noise limiter (NL)
 - Simply limits maximum volume of a noise pulse



Receiver Controls and Functions

- Preamplifier
 - Increases sensitivity but can cause overload
- Reception and Transmission Meter
 - In transmit, indicates output power or ALC or other functions as selected by switch setting
 - In receive, indicates signal strength
 - In “S” units S1 through S9 – S9 is strongest
 - Above S9, meter is calibrated in dB (i.e. S9+10 dB)



Receiver Controls and Functions

- Receivers can be limited to ham bands or can cover other parts of the spectrum.
- General coverage receivers cover a wide area of the spectrum and can be used for shortwave listening (SWL).



Data Modes

- Computer-to-computer communication
- Specialized modems
 - Terminal Node Controller (TNC)
 - Multiple Protocol Controller (MPC)
- Computer sound card software
 - Requires radio interface



Popular Digital Modes & Systems

- Radioteletype (RTTY)
- PSK31
- MFSK
- Packet Radio and PACTOR
- CW (International Morse)
- Automatic Packet Reporting System (APRS)
- FT8 & related digital modes of communication
- Winlink System

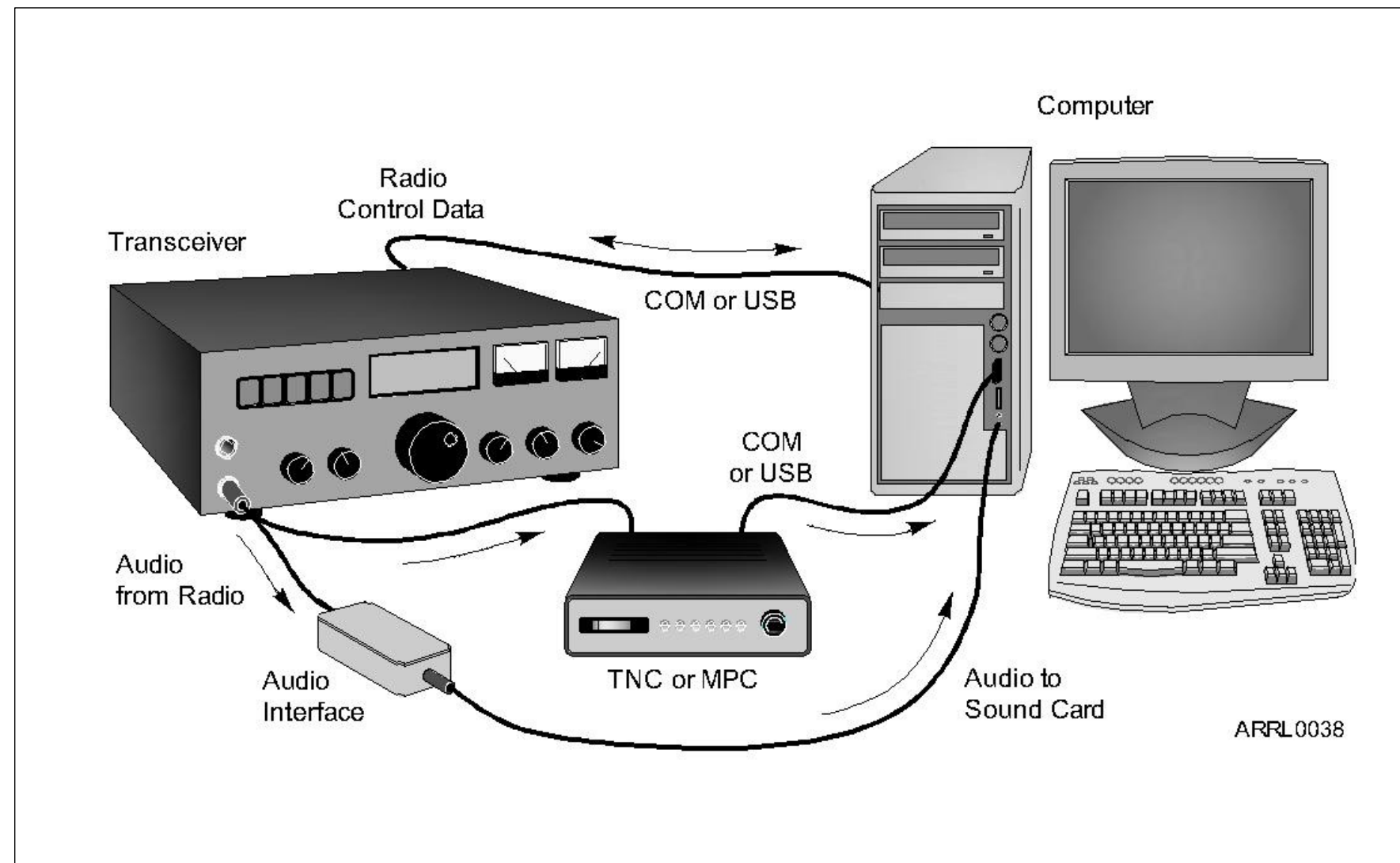


Popular Digital Modes & Systems

- Error detection
 - Yes: Packet radio, MFSK
 - No: RTTY, PSK31
- Error correction
 - MFSK (forward error correction or FEC)
 - Packet radio
 - Checksums and call signs
 - Retransmission or ARQ

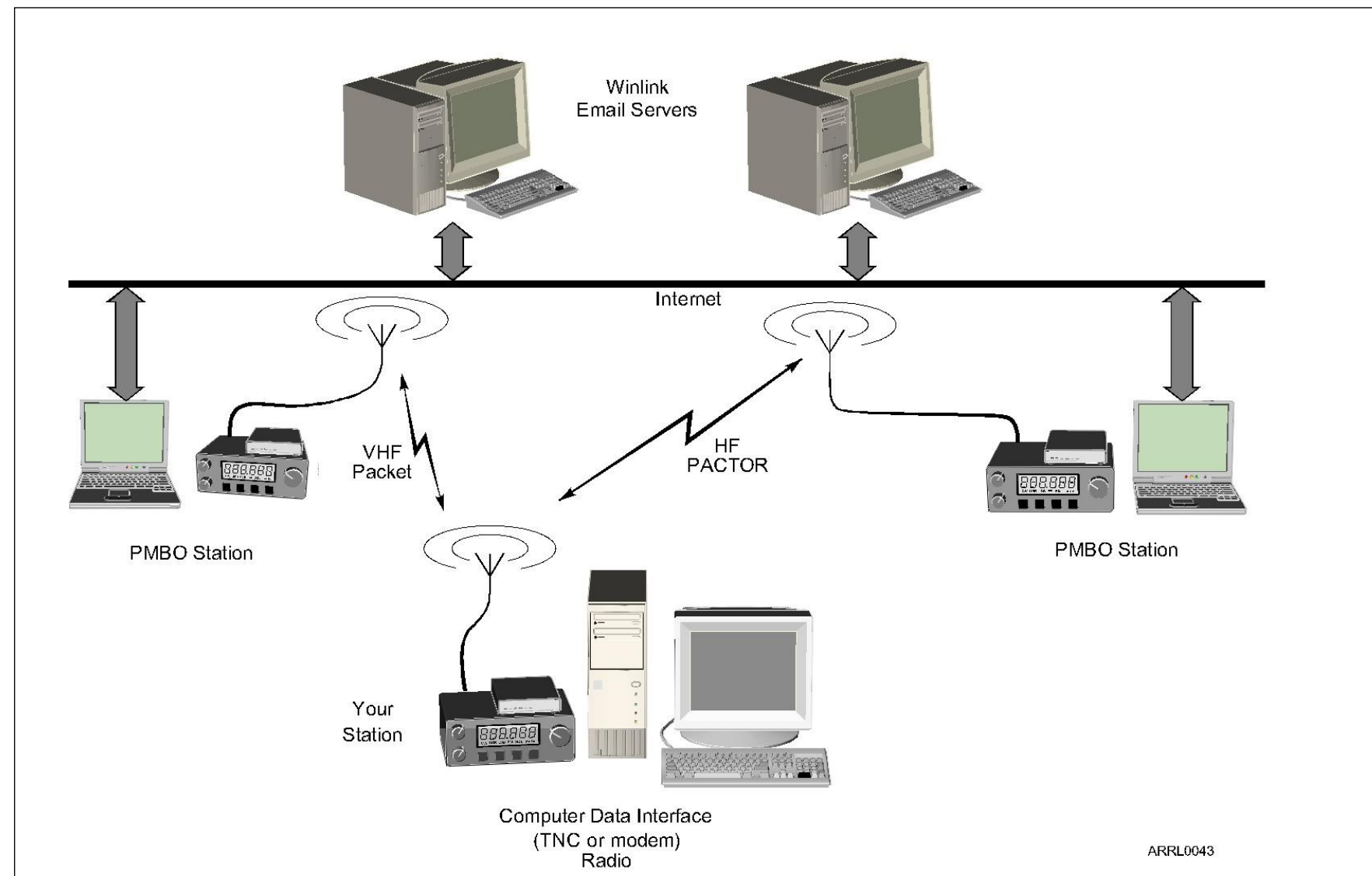


Data Station Setup



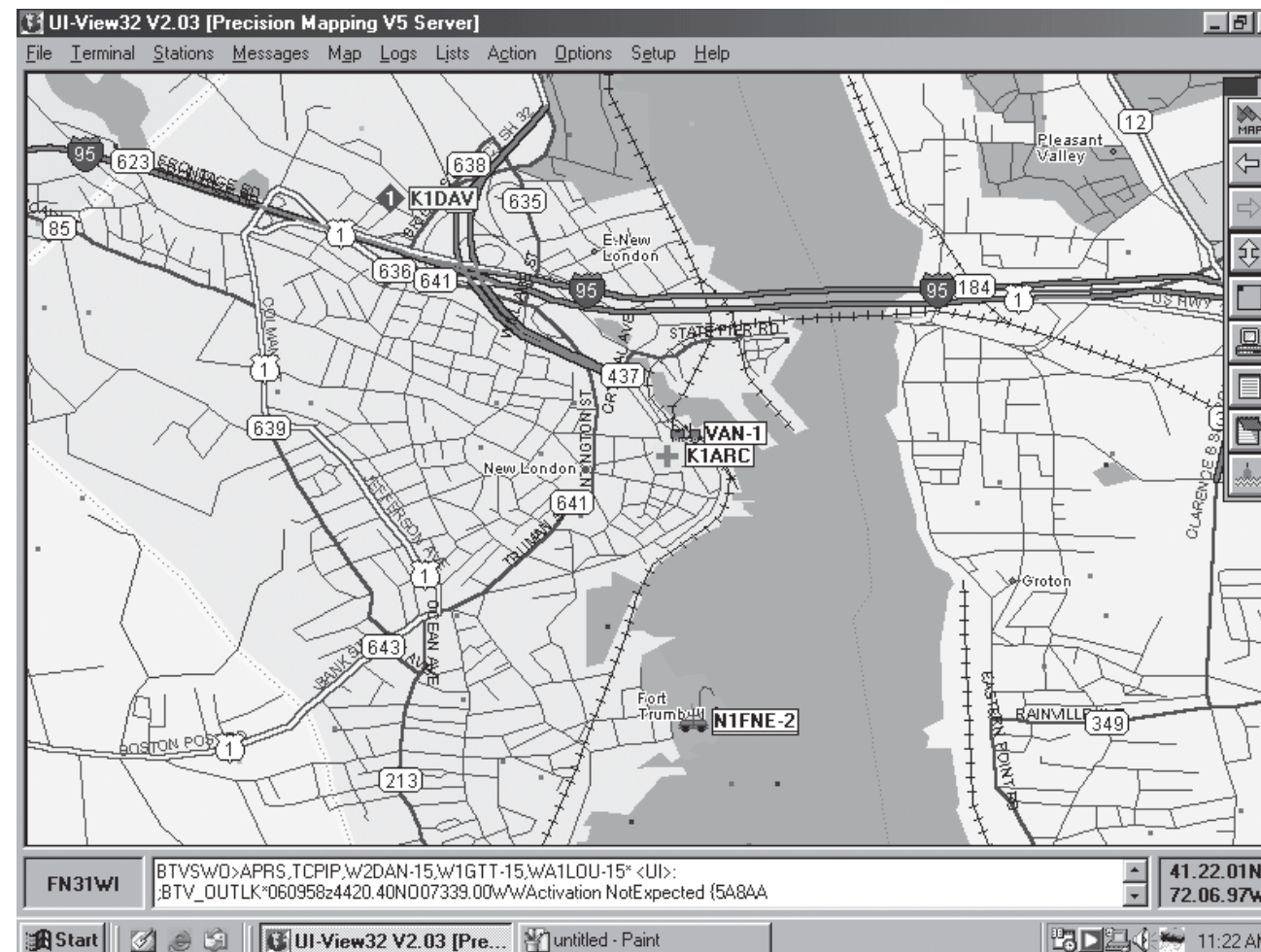


Internet Gateway





Automatic Position Reporting System (APRS)





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Chapter 5

Lesson Plan Module – 5c Power Sources



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.



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.
 - 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



Batteries

- Energy capabilities rated in Ampere-hours
 - Amps X time (at a constant voltage)



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.



Battery Charging

- Lead-acid batteries release explosive hydrogen during charging or rapid discharge so adequate ventilation is required.
- 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



Battery Charging

- 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).



End of Week 5

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