Title: DC 713 Technician License Exam Prep
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Overview

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- Technician License
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- SDR
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- Resources

Introduction

- Software developer
  - ~20 years professionally
  - Security software developer
  - Design and implement secure APIs
- InfoSec
  - Software vulnerability assessment
  - Auditing
  - CISSP 2005+
  - US Army
- IT Background
  - IT Admin
  - ISP (dial-up land)
  - DevOps

Introduction

- Amateur Radio
  - First ham license, Novice in late 70s
    - 5 wpm CW (w00t!)
  - Technician at DefCon22
  - General Class 2 weeks later
  - Working on Amateur Extra
- Founding member, Houston dc713
- Founding member, Houston Area Hackers Anonymous
- OpenBSD user
- Electronics hobbyist

About You

- Who has their Technician Class License?

About You

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- Who has their General Class License?

About You

- Who has their Technician Class License?
- Who has their General Class License?
- Who has the Amateur Extra Class License?

What is Amateur Radio?

- Radio service operated by amateurs, *i.e.* non-professional
  - Not for monetary gain
  - Typically a real person
  - Clubs can organize for amateurs to work together
- Amateur Radio Service
- Established by the International Telecommunications Union
- Regulated by international agreement
  - Regulations implemented through harmonizing of laws by national governments
- Three regions:
  - Region 1 (Europe, Middle East, CIS, Africa)
  - Region 2 (Americas)
  - Region 3 (South and East Asia, Pacific Ocean)
- Hobby

What is Amateur Radio?

- License to experiment with radio:
  - Somewhat dependent on region and country
  - US, very open and mostly hands off due to internal “policing” by hams
  - Many innovations from amateur sphere

When Did Amateur Radio Start?

- Officially, early 1900s
- However, amateurs have operated since the beginning of radio

Why “Ham”?

- Believed to have begun as pejorative because amateurs were “ham fisted” on their key (Morse Code)
- Adopted by amateurs as badge of honor

Notable Accomplishments by Amateur Radio

- One of the oldest radio associations in the world, American Radio Relay League (ARRL)
  - Begun in 1914 by Hiram Percy Maxim
- Numerous satellite launches
- Led development of packet radio
- Long-distance transmitting around the world using various
  - Skip propagation
  - Moonbounce (Earth-Moon-Earth EME)
  - Meteor scatter
- Development of Slow-Scan and Fast-Scan Television
  - Shortwave radio equipment to send television images using normal voice bandwidth
  - Amateur radio operators were online in many cities before commercial stations came on the air
- Local, regional, national and international relay networks

Notable Accomplishments by Amateur Radio

- Quick mobilization during disaster
  - Supplementing and often replacing local phone systems (wired and wireless)
  - Work to send gear and people around the world during major disasters

Privileges – What Can a Ham Do?

- Transmit in numerous bands
  - Depends on license class
- Transmit using various modes of communication
  - Voice
  - Image
  - Text and Data
    - Continuous Wave (CW) – Morse Code
    - Packet Radio
    - Phase-Shift Keying
    - Spread Spectrum
    - Digital
- Operate stations in other countries
  - If reciprocal licensing in place
  - Limited by country laws, not US
- Build and use unlicensed equipment
  - Within regulation
  - It's the operator who's licensed in amateur, not the equipment!!!

Privileges – What Can a Ham Do?

- Help license other hams!
  - Volunteer Examiner
- Help enforce FCC regulations and volunteer band plans ARRL - Band Plan

License Requirements

- 3 License classes in US:
  - Technician
  - General
  - Amateur Extra
- Technician
  - 35-multiple-guess-question exam
  - No Morse code required
  - Voice privileges
  - Various modes allowed
  - Limited in high-frequency bands
- General
  - 35-multiple-guess-question exam
  - All privileges of Technician
  - Access to 83% of all amateur HF bands
- Amateur Extra
  - 50-multiple-guess-question exam
  - All privileges allowed to amateurs

Costs and Duration

- License good for 10 years
  - Renewal fee, no additional testing

Getting Licensed

- Shoot for Technician class license first
  - Learn some basic electronics
  - Learn how to use Ohm's Law
  - Memorize some band-plan information
- Get a study guide
  - ARRL books very good helpful
    - Kindle - The ARRL Ham Radio License Manual
  - Numerous online resources
  - `http://hamexam.org`
- Start making contacts
- Study for the next license

Technician License

- Four knowledge areas to study:
  - Statutes and international agreements
  - Convention and agreements
  - A wee-bit of physics
  - Basic electronics

Statutory / International Agreements

- Many uses of amateur radio frequencies are governed by international agreement through the ITU
- All such agreements are encoded in FCC regulations
- The exam **has** questions about these rules and regulations
- Must be memorized . . . can't be guessed or derived

Convention

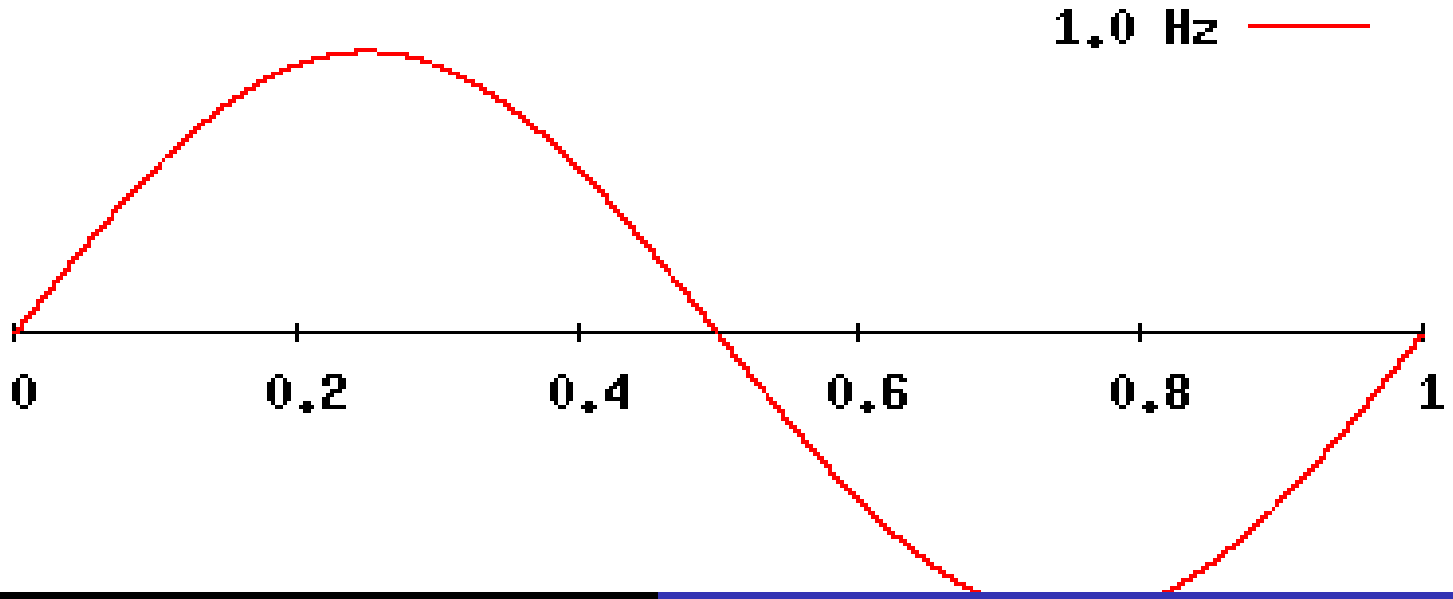
- Many aspects of amateur radio are based on agreements and convetion among amateurs
  - Frequencies for code/cw
  - Frequencies for digital modes
  - Whether voice is upper or lower sideband
- The exam **has** questions about these conventions
- Must be memorized . . . can't be guessed or derived

A Wee-Bit of Physics

- Radio is a term to describe a specific band of electromagnetic waves
- It's also the aggregating term we use to describe the practical use of EM to wirelessly communicate point to point
- You don't need a PhD in physics to communicate
- But you do need to understand a few concepts from physics to communicate effectively
- And to get your license

Relationship Between Megahertz and Wavelength

- Speed of light . . . in meters/second
  - ~300M m/s <— very important
  - English units won't help you much unless you like gratuitous math
  - Wikipedia - Speed of Light
- Megahertz is the number of cycles per second of a wave
  - Wikipedia - Hertz
- Wavelength . . . the length of the wave



Converting Between Megahertz and Wavelength

- Electromagnetic waves travel at the speed of light
  - Regardless of their length
- Very short wave complete more cycles per second than very long waves
- To determine the wavelength of a signal at a give frequency, divide it's cycle (frequency) into the speed of light

Example:

- 300,000,000 m/s / 150,000,000 hertz (cycles/second)
- == ~2 meters

Notice something?

- When dealing with frequency in the Megahertz range, drop the millions
- ~300 m/s / 150 hertz (cycles/second) == ~2 meters

Basic Electronics

- Just as you don't need to a PhD to communicate as an amateur, you don't need a EE
- But you do need to know some basic electronics
- And again, in part to get your license

Ohm's Law

- "Ohm's law states that the current through a conductor between two points is directly proportional to the voltage across the two points."
  - Wikipedia - Ohm's Law

$$I = \frac{V}{R},$$

Figure 1: Ohma's Law

Where:

- **I** is the current through the conductor in units of amperes
- **V** is the voltage measured across the conductor in units of volts
- **R** is the resistance of the conductor in units of ohms

Ohm's Law

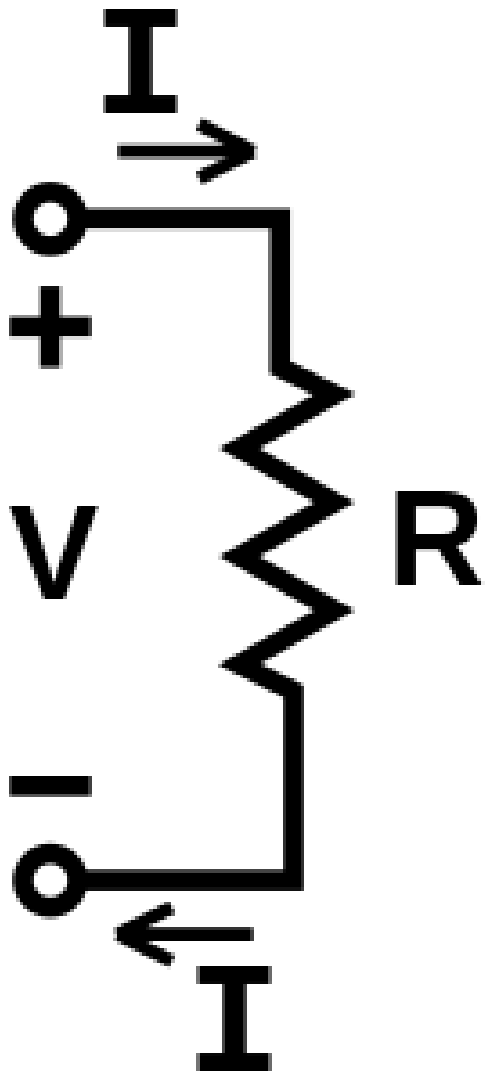


Figure 2: IVR Relationship

Ohm's Law

- Exam questions will give you 2 terms and ask for the missing value
- Matter of re-arranging the original equation:
  - V = I x R (Voltage = Current multiplied by Resistance)
  - R = V / I (Resistance = Voltage divided by Current)
  - I = V / R (Current = Voltage Divided by Resistance)

Example:

- A circuit has a current of 5 amperes, and a resistance of 2 ohm:
- How many volts is the circuit?
- V = I x R
- 5 amperes x 2 ohm = 10 volts

Hardware – What Do I Need?

- Technically, nothing. . . but that's no fun
- A receiver, better than nothing, but still no fun
- A transceiver. . . ahh
  - A handy talkie like the BaoFeng
  - A mobile rig – not (!!!!) a CB
  - A portable rig
  - A beast
- Handy Talkies
  - Battery powered
  - Typically 1 to 3 bands (70 cm, 2 m, 6 m)
  - 1 to 5 watts
  - 100+ memories for favorite frequencies
  - DTMF keypad
  - "Rubber-ducky" antenna

Hardware – What Do I Need?

- Mobile and portable
  - Dual band to all band
  - Voice modes to all mode
  - Microphone
  - Serial or other computer interface
  - 13.8 VDC, sometimes internal batteries
  - Antenna connected by feed line
  - Perhaps an antenna tuner
    - Internal or add-on
- Beast
  - Require AC or perhaps converter
  - Usually all band, not always
    - Some purpose-built rigs, especially DXing
  - Serial or other computer interface
  - Antenna connected by feed line
  - Often an antenna tuner
    - Internal or add-on

Hardware – What Do I Need?

- Antenna
- Antenna tuner
- Computer
- Sky's the limit

SDR

- Software-Defined Radio
- Replaces purpose-specific circuits with general purpose computing and software algorithms

Once You Pass

- Get an inexpensive radio
  - No easier way to lose interest than to not have a radio
  - BaoFeng handy talkies are cheap (~$35.00 on Amazon)
- Look for a club
- Join ARRL
  - QST Magazine has tons of info and articles

SDR

- Get an RTL SDR
  - About $20.00
- Get a HackRF, BladeRF or AirSpy
- Get the software
  - rtl-sdr
  - gqrx
  - GNU Radio

Questions

- Questions - You have them, I may have answers

Contact Details

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- `http://akpoff.com`
- @akpoff
- This presentation, look for blog post on `http://akpoff.com` or Github
- KG5DQJ

Ham Radio Clubs and License Info

- FCC
- ARRL
- ARRL Club Finder
- Gordon West
- HamExam
- QST

Radio Gear

- BaoFeng
- Houston Amateur Radio Supply
- Icom
- Kenwood
- Motorola
- Yaesu

SDR People and Resources

- rtl-sdr
- Great Scott Gadgets
  - Michael Ossmann
  - HackRF
  - YardStick
- BladeRF
- AirSpy

License and Credits