Amateur Radio License

FM Handheld Radios, Simplex, and Repeaters
Today's Topics

- FM, Frequencies
- FM Radios
- VHF/UHF Propagation
- Simplex
- Repeaters
Frequency Modulation

- Information encoded in frequency of carrier
- Wider bandwidth than AM Voice 5-15 kHz
- More resistant to propagation effects
- Common for VHF/UHF handhelds and mobiles
- Also digital packet, voice
Line-of-Sight

- At VHF and UHF radio waves effectively travel in straight lines
- Limited by radio horizon
- Slightly refracted by the atmosphere
  - Effective earth radius 4/3 the true radius
  - From a radio perspective, the earth is slightly flatter
Packard EE to Cory Hall, UCB

LOS coverage from Packard

Propagation Path
Multipath

- Radio waves often travel by multiple paths, which can constructively or destructively interfere

- Small changes in location can result in large changes in signal: “picket fencing”
Tropospheric Ducting

- Temperature and humidity inversions can cause the atmosphere to act as a wave guide
- Frequently in August VHF (like FM radio) is ducted from California as far as Hawaii
Knife-Edge Diffraction

- Radio waves will diffract from sharp edges, some power will be delivered behind the obstruction.
Handheld Radios

- VHF and/or UHF
  sometimes 220 MHz, 1.2 GHz
- 5 Watts
- Always has FM, may have digital
  voice and data
- Can be complex to operate
  Every button does three things
  Programmed with a PC, software
Connection Methods

- Simplex:
  - You and your contact talk on the same frequency alternately
  - Limited in range (great if you have LOS!)
  - Calling frequencies

- Repeaters:
  - You talk to a powerful radio high on a mountain, it rebroadcasts on a different frequency
  - You can talk to anyone who can see the same repeater (a very long way)
  - Usually need to know an access frequency
Receivers relay signals from radios that normally can’t reach each other

- Receives on one frequency, transmits on another
- Repeater split
  - +/- 600 kHz on 2 m
  - +/- 5 MHz on 70 cm
- Your radio knows!
Access Tones

- Repeaters don’t want to retransmit any signal they hear! If repeaters can hear each other the result could be unstable.

- Repeaters look for an additional tone

  - CTCSS : continuous tone coded squelch
  - PL : Motorola “Private Line”
  - Bursts of codes or tones
  - DCS : Digitally coded squelch
Repeaters

- Listed in repeater directories, iPhone apps:
  - Repeater output frequency
  - Repeater shift
  - Access frequency (PL = 100, for example)
- Many, many open repeaters out there
- Program local repeaters into your radio
Band Plans

• FCC doesn’t specify what you can do in some part of the amateur bands

• Voluntary agreements define “Band Plans”

• Recommends frequencies for

  • DX
  • Digital modes
  • Beacons
  • Weak Signals
  • Satellites
  • Simplex
  • Repeater inputs and outputs
  • Control links
Northern California
2 m Band Plan

20 kHz channel spacing in 144.0 - 146.0 MHz
15 kHz channel spacing in 146.0 - 148.0 MHz
In the ARRL plan all channels are 20 kHz.

2 meter Band Plan for Northern California
144.0 - 148.0 MHz

EME exclusive
145.80 International Space Station

1st ch. in the segment
1st ch. in the segment
1st ch. in the segment
1st ch. in the segment

All Mode and Experimental
Repeater Input
Beacon
Repeater Output
CW
SSB
Digital
SSB
Earth-Moon-Earth (EME)
Weak Signal
FM Simplex
Differs from ARRL plan

For general Amateur Radio, see ARRL (www.arrl.org)
For repeaters, see NARCC (www.narcc.org)
For satellites, see AMSAT (www.amsat.org)

Northern California Packet Association
May 20, 2011
www.n0ary.org/ncpa
Northern California 70 cm Band Plan

25 kHz channel spacing 440.0 - 450.0 MHz
Links, Auxiliary, and digital are 20 kHz wide channels except as noted
ATV is a single 6 MHz wide simplex channel
Weak Signal, Satellite, and All Mode segments are not channelized

For general Amateur Radio, see ARRL (www.arrl.org)
For repeaters, link, and auxiliary see NARCC (www.narcc.org)
For satellites, see AMSAT (www.amsat.org)

Northern California Packet Association
May 20, 2011
The digital organization of Northern California.
www.n0ary.org/ncpa
A few Bay Area 2 m Repeaters

<table>
<thead>
<tr>
<th>Frequency MHz/Offset</th>
<th>PL Hz</th>
<th>Call Sign</th>
<th>Location</th>
<th>Repeater Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>145.130</td>
<td>127.30</td>
<td>K6EAG</td>
<td>Hayward</td>
<td>Hayward Radio Club</td>
</tr>
<tr>
<td>145.150</td>
<td>114.80</td>
<td>W6PW</td>
<td>San Francisco</td>
<td>San Francisco ARC</td>
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<tr>
<td>145.170</td>
<td>127.30</td>
<td>K6EAG</td>
<td>Sunnyvale</td>
<td>Hayward Radio Club</td>
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<tr>
<td>145.230</td>
<td>100.00</td>
<td>N6NFI</td>
<td>Palo Alto</td>
<td>South Peninsula Amateur Radio Klub S.P.A.R.K.</td>
</tr>
<tr>
<td>145.270</td>
<td>100.00</td>
<td>W6ASH</td>
<td>Mountain View</td>
<td>Southern Peninsula Emergency Communication System S.P.E.C.S.</td>
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<tr>
<td>145.310</td>
<td>127.30</td>
<td>KE6ZOY</td>
<td>Santa Clara</td>
<td>IRLP Enabled Node 3488</td>
</tr>
<tr>
<td>145.310</td>
<td>88.50</td>
<td>WZ6L</td>
<td>Vallejo</td>
<td>IRLP Enabled Node 3545</td>
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<tr>
<td>145.350</td>
<td>100.00</td>
<td>AB6CR</td>
<td>Livermore</td>
<td>Livermore RACES Wide Area</td>
</tr>
<tr>
<td>145.390</td>
<td>100.00</td>
<td>W6DYL</td>
<td>San Jose</td>
<td>South Bay Radio Group</td>
</tr>
<tr>
<td>145.430</td>
<td>127.30</td>
<td>AD6D</td>
<td>Livermore</td>
<td>Livermore RACES</td>
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<tr>
<td>145.450</td>
<td>127.30</td>
<td>K6FB</td>
<td>Los Gatos</td>
<td>Las Cumbres ARC</td>
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<tr>
<td>146.115</td>
<td>100.00</td>
<td>AA6BT</td>
<td>San Jose</td>
<td>Silicon Valley Emergency Communications System S.V.E.C.S. Old Call Sign WB6ADZ</td>
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<tr>
<td>146.205</td>
<td>103.50</td>
<td>KC6LLI</td>
<td>San Jose</td>
<td></td>
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<tr>
<td>146.385</td>
<td>114.8</td>
<td>W6UU</td>
<td>San Jose</td>
<td>Santa Clara ARA</td>
</tr>
</tbody>
</table>
### Carla Network

- About 40 networked repeaters across California
- One PL is Local
- Another PL activates the entire networks

<table>
<thead>
<tr>
<th>System</th>
<th>Freq</th>
<th>Link</th>
<th>Local</th>
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<tbody>
<tr>
<td>2  San Francisco</td>
<td>442.075+</td>
<td>162.2</td>
<td>100.0</td>
</tr>
<tr>
<td>3  Pt. Arena</td>
<td>443.075+</td>
<td>173.8</td>
<td>100.0</td>
</tr>
<tr>
<td>4  Greenfield</td>
<td>442.075+</td>
<td>167.9</td>
<td>114.8</td>
</tr>
<tr>
<td>5  Oakland</td>
<td>443.050+</td>
<td>173.8</td>
<td>114.8</td>
</tr>
<tr>
<td>6  Stonyford/Willows</td>
<td>443.075+</td>
<td>167.9</td>
<td>114.8</td>
</tr>
<tr>
<td>7  San Jose</td>
<td>443.075+</td>
<td>162.2</td>
<td>123.0</td>
</tr>
<tr>
<td>8  Tahoe</td>
<td>442.075+</td>
<td>151.4</td>
<td>127.3</td>
</tr>
<tr>
<td>9  Modesto</td>
<td>442.075+</td>
<td>173.8</td>
<td>123.0</td>
</tr>
<tr>
<td>10 Santa Cruz/Monterey</td>
<td>443.475+</td>
<td>173.8</td>
<td>123.0</td>
</tr>
<tr>
<td>11 Walnut Creek</td>
<td>443.475+</td>
<td>162.2</td>
<td>114.8</td>
</tr>
<tr>
<td>12 Pleasanton</td>
<td>442.075+</td>
<td>156.7</td>
<td>103.5</td>
</tr>
<tr>
<td>13 Shasta Lake</td>
<td>442.075+</td>
<td>167.9</td>
<td>114.8</td>
</tr>
<tr>
<td>14 Cisco Grove</td>
<td>443.475+</td>
<td>156.7</td>
<td>100.0</td>
</tr>
<tr>
<td>15 Coalinga/Fresno</td>
<td>440.750+</td>
<td>162.2</td>
<td>114.8</td>
</tr>
<tr>
<td>16 Vacaville/Sacramento</td>
<td>440.750+</td>
<td>173.8</td>
<td>100.0</td>
</tr>
<tr>
<td>17 Sonora</td>
<td>443.475+</td>
<td>151.4</td>
<td>103.5</td>
</tr>
<tr>
<td>18 Topaz Lake</td>
<td>443.475+</td>
<td>167.9</td>
<td>110.9</td>
</tr>
</tbody>
</table>
Call Signs

• 1-2 letters, a digit, followed by 1-3 letters
  • Tells a little about your license class
• For the US, the first letter is K, W, or N, or A.
• Digit tells where in the US your call sign originated
• Last 1-3 letters identify you
Phonetics

<table>
<thead>
<tr>
<th>Letter</th>
<th>Word</th>
<th>Letter</th>
<th>Word</th>
<th>Letter</th>
<th>Word</th>
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<tbody>
<tr>
<td>A</td>
<td>Alpha</td>
<td>J</td>
<td>Juliet</td>
<td>S</td>
<td>Sierra</td>
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<tr>
<td>B</td>
<td>Bravo</td>
<td>K</td>
<td>Kilo</td>
<td>T</td>
<td>Tango</td>
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<tr>
<td>C</td>
<td>Charlie</td>
<td>L</td>
<td>Lima</td>
<td>U</td>
<td>Uniform</td>
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<tr>
<td>D</td>
<td>Delta</td>
<td>M</td>
<td>Mike</td>
<td>V</td>
<td>Victor</td>
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<tr>
<td>E</td>
<td>Echo</td>
<td>N</td>
<td>November</td>
<td>W</td>
<td>Whisky</td>
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<tr>
<td>F</td>
<td>Foxtrot</td>
<td>O</td>
<td>Oscar</td>
<td>X</td>
<td>X-Ray</td>
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<tr>
<td>G</td>
<td>Golf</td>
<td>P</td>
<td>Papa</td>
<td>Y</td>
<td>Yankee</td>
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<tr>
<td>H</td>
<td>Hotel</td>
<td>Q</td>
<td>Quebec</td>
<td>Z</td>
<td>Zulu</td>
</tr>
<tr>
<td>I</td>
<td>India</td>
<td>R</td>
<td>Romeo</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AG6WH : Alpha Golf Six Whiskey Hotel
Typical Call Signs

- Recent Technician class (2x3, Group D)
  - KK6GAF

- Recent Extra class (2x2, Group A)
  - AG6WH

- Vanity call signs
  - Many 2x2’s (Group B) and 1x3’s (Group C) available
  - 1x2’s and 2x1’s are harder to come by

- Special events have 1x1’s
Call Signs

Middle digit tells you where the call sign was issued
Which of the following is a valid call sign for a Technician class amateur radio station? (T1C05)

A. K1XXX
B. KA1X
C. W1XX
D. All of the above
Which of the following is a valid call sign for a Technician class amateur radio station?  (T1C05)

A.  K1XXX

B.  KA1X

C.  W1XX

D.  All of the above
Vanity Call Signs

• You can make up your own call sign
  • Must have the right number for your district
  • Web sites to help you find one that is free
• Apply on the FCC web site, for free
• My wife is Kim B Pauly, so she has KB6PAU
• My friend Miki works in MRI, so he is KK6MRI
Signal Report

- Verbal: “you are just barely getting into the repeater…”
- RST: Three numbers
  - Readability 1-5
  - Signal Strength: 1-9
  - Tone: 1-9 (for CW)
  - Best is 599
- “Q” System
  - Barely understandable (1) to perfectly readable (5)
Calling Protocol

• Listen first to see if the frequency is free. Press the small, lower button (mon) to do this.

• Push the PTT button (big middle button), the red light goes on, wait a second, and talk into the microphone

• Identify with your call sign every ten minutes, and when signing off. I’m AG6WH, or alpha-golf-6-whisky-hotel

• If you are looking for someone to talk to say something like “CQ CQ CQ this is AG6WH”, or “AG6WH Monitoring”

• When you are done, tell everyone that the frequency is open by saying “AG6WH Clear”, or “AG6WH 73”
Your Turn!

• Make up a call sign KN6XXX, where XXX is replaced by your initials (two or three). Use your region for the digit if you’d like.

• Call CQ with your call sign, first letters then phonetics

• Wait for an caller

• Ask for a signal report

• Thank your caller, and sign off