



THE OHM TOWN NEWS

Voice of the Bridgerland Amateur Radio Club

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May 2017

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PRESIDENT'S MESSAGE

Many of us listen to WWV to get the time ticks to manually set our clocks. WWV is part of the [National Institute of Standards and Technology \(NIST\) Time and Frequency Division](#). WWV's primary purpose (and for most of its existence) is to disseminate the "official U.S. time" (provided by government entities such as NIST and USNO) to ensure that uniform time is maintained throughout the United States and around the world.

NIST also operates the very similar radio station WWVH in Kauai, Hawaii. Both WWV and WWVH announce the Coordinated Universal Time each minute, and make other recorded announcements of general interest on an hourly schedule, including the GPS satellite constellation status and severe oceanic weather warnings. Since they share frequencies, WWV uses a male voice to distinguish itself from WWVH, which uses a female voice. WWV time signals can also be accessed by telephone.

The time of day and propagation makes a difference on which frequency that you will be able to hear these stations. If you are able to hear both WWVH and WWV, the station identification for the time are made before the top of the minute. The WWVH announcement occurs first, at about 15 seconds before the minute. The WWV announcement follows at about 7.5 seconds before the minute. This separation in the announcement allows the listener to determine band conditions to the stations. WWV and WWVH transmits the following 44-second voice announcements (in lieu of the standard frequency tones) on an hourly schedule:

- a station identification at :00 and :30 past each hour;
- marine storm warnings, provided by the National Weather Service, for the Atlantic Ocean at :08 and :09 minutes past, and for the Pacific Ocean at :10 past;
- at :14 and :15 past, GPS satellite health reports from the Coast Guard Navigation Center;
- at :18 past, a special "geophysical alert" report from NOAA is transmitted, containing information on solar activity and shortwave radio propagation conditions.

Here is [WWV and WWVH Digital Time Code and Broadcast Format](#). WWV and WWVH continuously broadcast a binary coded decimal (BCD) time code on a 100-Hz subcarrier. The time code presents UTC information in serial fashion at a rate of 1 pulse per second. The information carried by the time code includes the current minute, hour, and day of year. The time code also contains the 100-Hz frequency from the subcarrier. The 100-Hz frequency may be used as a standard with the same accuracy as the audio frequencies.

WWV shares its site near Fort Collins with radio station WWVB which transmits carrier and time code (no voice) on 60 kHz in the LF ("longwave") band. The time signals generated by WWVB allow time-keeping devices such as radio-controlled clocks to automatically maintain accurate time without the need for manual adjustment. Depending upon signal strength they may require placement in a location with a relatively unobstructed path to the transmitter and need fair to good atmospheric conditions to successfully update the time. Inexpensive clocks keep track of the time between updates, or in their absence, with a non-disciplined quartz-crystal clock of similar accuracy to a non-radio-controlled quartz timepiece. Some clocks include an indicator to alert users to possible inaccuracy when synchronization has not been successful within the last 24 to 48 hours. Here is the [WWVB Time Code Format](#).

Then came the internet. And then GPS. The very industries that WWVB helped build suddenly threatened to make it obsolete. Today, stock traders rely on computerized trading algorithms that measure success in milliseconds, choosing to synchronize their servers with NIST's internet-based time service instead of WWVB. And since GPS satellites carry their own atomic clocks, nearly all of today's time and frequency needs are served from space. For proof, look no further than the phone in your pocket, delivering time beamed down from orbit.

WWVB's value might have a lot to do with the type of signal it broadcasts and its location. While most commercial radio waves measure only a few meters between peaks, WWVB's low frequency signal results in a five kilometer wavelength. On a clear night, a radio-controlled watch can pick up WWVB's 60 kHz signal as far away as Patagonia or New Zealand. As for what the future holds, WWVB has better reception in buildings than GPS, but only time will tell.

73,
Cordell
KE7IK

UPCOMING 2017 ACTIVITIES

- 10** May, 7:30 PM - **ARRL Rocky Mountain Division Net** 147.200/IRLP Node:9871
- 13** May, 10:00 AM - **BARC Club Mtg** - Cache County Sheriff's Office 3rd Floor
DMR, Fusion, D-Star, P25 Hot Spots and Dongles
- 16** May, 6:30-9:00—**Elmer Night** @ Cache County Sheriff's Office 3rd Floor
- 17** May, 7:00-9:00 PM — Cache County **ARES meeting** at the Sheriff's Office
- 20** May, 8:00 AM — **RACES HF Net** 3920 KHz
- 26-28** May, **2017 ARRL Rocky Mountain Division Convention**-Cody Wyoming ([Info](#))
- 01** June, 7:00 PM—**ARRL VEC License Test Session** @BATC room 806/808 ([Info](#))
- 2-3** June, **Wasatch Back Relay** - Lead Person for BARC: Tyler Griffiths ([More Info](#))
- 03** June, **Little Red Riding Hood** bicycle race — Lead Person: Russ Leikis ([Info](#))
- 14** June, 7:30 PM - **ARRL Rocky Mountain Division Net** 147.200/IRLP Node:9871
- 15** June, 8:00 PM **RACES VHF Net** 449.650 pl 100.0 Mt. Pisgha 147.180 Snowbird 147.20 IRLP
- 16-18** June, **WIMU Hamfest** in Garden City, UT ([Info](#))
- 21** June, 7:00 PM — Cache County **ARES meeting** at the Sheriff's Office
- 24-25** June, **Field Day** (in place of **BARC Club Meeting**) up Swan Flats road
in Logan Canyon ([More Info Here](#) for the BARC Club or [Here](#) from ARRL)

For more calendar information see the barconline.org/calendar

April Club Meeting:

In the April BARC club meeting a proposal was brought before the club asking if it was acceptable for the club to provide a donation of \$1000 to the Utah VHF Society to assist in the repair of the damaged Frisco Peak and Bear Lake repeater sites. Those two repeaters are managed by the VHF society and they were damaged over the winter by ice and the bad weather, some pictures were shown and discussed. A vote was taken and it was approved to make the donation. Also Ted McArthur AC7II gave a presentation on some of the handheld radios that are available, some of the good things to look for when buying a new radio, and also some of the things that are not as good to have for a handheld radio.

Report of ARRL-VEC Exam Sessions held in March and April

On Saturday, March 4, 2017 a license exam session was held at the USU Engineering Building. Here are the results of the exams given at this session.

The following individuals earned a Technician License:

Adam Black – KI7LQT
Daniel Halacy – KI7LQU
Christopher Heaps – KI7LQS
Kevin Lowder – KI7LQR

Here is a summary of the number of exams given and new licenses earned at this session:

Technician License Exams Given:	5	New Technician Licenses Earned:	4
General License Exams Given:	3	New General Licenses Earned:	0
Extra License Exams Given:	0	New Extra Licenses Earned:	0
Number of Exams Given:	8	Number of New Licenses Earned:	4

Number of People Served: 5

On Saturday, April 15, 2017 a license exam session was held at the USU Engineering Building. Here are the results of the exams given at this session.

The following individuals earned a Technician License:

Christopher Albano – KI7MXP
Nicholas Alder – KI7MXR
Aren Anderton – KI7MXS
John Arrowood – KI7MXU
Tyler Clair – KI7MXL
Paul Gritton – KI7MXN
Johnathan Hubert – KI7MXO
Benjamin Jensen – KI7MXQ
Ramona Lower – KI7MXM

The following upgraded to a General License:

Adam Black – KI7MXJ
Morgan Chelsey – KI7MXK
Tracy Shupe – KI7EZO

The following individual passed both the Technician and General Exams:

Morgan Davidson – KI7MXT

The following upgraded to an Amateur Extra:

William Frymire – KI7EPB

Here is a summary of the number of exams given and new licenses earned at this session:

Technician License Exams Given:	10	New Technician Licenses Earned:	9
General License Exams Given:	15	New General Licenses Earned:	4
Extra License Exams Given:	4	New Extra Licenses Earned:	1
Number of Exams Given:	29	Number of New Licenses Earned:	14

Number of People Served: 18

(Continued on page 5)

Welcome to the Bridgerland Amateur Radio Club to all those that earned their first Amateur Radio license on March 4th or April 15th.

A big thank you to all of the VEs that helped with these exam sessions.

Upcoming Exam Sessions – We are moving the location where exam are given to Bridgerland Applied Technology College (BATC) at 1301 North 600 West, Logan. We have two exam sessions scheduled in the coming months. The first one is Thursday, June 1 at 7:00 pm. in BATC room 806/808. The second is scheduled for Saturday, July 15 at 3:00 pm in BATC room 840. This session will follow a “One Day” Technician class that is being taught in the same location. More information is available on barconline.org/licensing.

Tell your family and friends about these opportunities to take an exam to get their license or upgrade.

Richard Elwood
KE7GYD

The ARRL Letter for April 20, 2017

Ham Astronauts Swap Places on International Space Station

With US Astronaut and ISS Expedition 50 Commander Shane Kimbrough, KE5HOD, now back on Earth, two more radio amateurs headed into space this week from Kazakhstan to join the ISS crew members that Kimbrough and Russian crewmates Sergey Ryzhikov and Andrey Borisenko left behind on the ISS. The returning trio touched down safely in Kazakhstan on April 10 after spending 173 days aboard the orbiting laboratory.

"Our crew landed safely in Kazakhstan!" Kimbrough tweeted shortly after arriving in Kazakhstan. "We are looking forward to time with family and friends."

During his time on the orbital complex, Kimbrough participated in several Amateur Radio on the International Space Station ([ARISS](#)) school contacts. In addition to his scientific research activities, he also ventured outside the confines of the space station for four spacewalks.

The Expedition 51/52 crew increment of NASA astronaut Jack Fischer, KG5FYH, and veteran cosmonaut Fyodor Yurchikhin, RN3FI, launched from Baikonur, Kazakhstan, today (April 20).

The pair will travel on board a Soyuz MS-04 vehicle on a fast-track, 6-hour course to the space station and dock to the Poisk module. Welcoming them aboard will be Expedition 51 Commander Peggy Whitson, ex-KC5ZTD, Oleg Novitskiy, and Thomas Pesquet, KG5FYG.



Fyodor Yurchikhin, RN3FI (left), and Jack Fischer, KG5FYH, at the Baikonur Cosmodrome in Kazakhstan, pose in front of their Soyuz MS-04 spacecraft during pre-launch preparations. [NASA photo]

Fischer, a first-time space flier, and Yurchikhin, a veteran of four spaceflights, will spend more than 4 months aboard the ISS, returning to Earth in early September.

Article Links Amateur Radio Growth to Emergency Communications

An April 11 [article](#), "Emergency Communications Driving Increase in Amateur Radio Operators" in *Emergency Management* magazine links the growth in Amateur Radio numbers to interest in emergency communications.

"There has been a tremendous amount of interest in emergency preparedness since 9/11 and Katrina, and this is true for the Amateur Radio community as well," ARRL Emergency Preparedness Manager Mike Corey, KI1U, told the publication. "Emergency communications is a gateway into Amateur Radio, and many join our ranks through an interest in being better prepared themselves and as a way to serve their community."

The article cites numbers from ARRL VEC Manager Maria Somma, AB1FM, who notes that 2016 was the third year in a row that the total number of new licenses exceeded 30,000. The article also cites ARRL Colorado Section Manager Jack Ciaccia, WMOG, who agreed with the premise that the uptick in new licenses is due to Amateur Radio's emergency capabilities.

"Interest really peaks after a large-scale event where ham radio has been utilized," Ciaccia said. Read [more](#).

The ARRL Letter for April 27, 2017 Armed Forces Day Crossband Communications Test Set for Saturday, May 13

US Army, Air Force, Navy, and Coast Guard stations will participate in the annual [Armed Forces Day Crossband Communications Test](#) on Saturday, May 13. This annual HF communication interoperability event, sponsored by the Department of Defense since 1934, challenges Amateur Radio operators to contact military stations across the US.

The event marks the 66th annual Armed Forces Day (AFD), officially on May 20. The AFD Crossband Military-Amateur Radio event takes place a week earlier in order to avoid schedule conflicts with those attending Hamvention.

Radio amateurs will transmit on Amateur Radio frequencies and listen on military frequencies, while military stations will transmit on military frequencies and listen on Amateur Radio frequencies. The annual event tests two-way communication between radio amateurs and military stations (authorized under §97.111 of the Amateur Service rules). It features traditional military-to-amateur crossband SSB voice, CW, practice using legacy interoperability waveforms, and the opportunity for participating hams to utilize more modern military modes, such as MIL-STD Serial PSK and Automatic Link Establishment (ALE). Military stations and Amateur Radio stations are authorized to communicate directly on certain 60-meter interoperability channels -- 5,330.5, 5346.5, and 5,371.5 kHz.

Select stations will transmit the Armed Forces Day message using Military Standard mode M188-110A. Amateur Radio operators may download [software](#) to receive the broadcast.

Shortwave listeners are welcome to participate. [Complete details](#), including stations, times, and operating modes are on the US Army MARS website. Read [more](#).

ISS Commander Peggy Whitson, ex-KC5ZTD, Sets New US Record for Time in Space

Current International Space Station (ISS) Commander [Peggy Whitson](#), ex-KC5ZTD, this week broke the record for cumulative time spent in space by a US astronaut. President Donald Trump -- with daughter Ivanka Trump and astronaut Kate Rubins, KG5FYJ, joining him in the Oval Office -- called Whitson on April 24 to congratulate her on her accomplishment. With Whitson for the call on board the ISS was astronaut Jack Fischer, KG5FYH, who arrived on April 20 for his first mission aboard ISS.

"Peggy is a phenomenal role model for young women, and all Americans, who are exploring or participating in STEM education programs and careers," President Trump said. "When I signed the INSPIRE Women Act in February, I did so to ensure more women have access to STEM education and careers, and to ensure America continues to benefit from the contributions of trailblazers like Peggy."

Whitson tweeted back, "Thank you, Mr. President, for the great opportunity to highlight the research we are doing up here aboard the space station and beyond!"



Peggy Whitson, ex-KC5ZTD, is joined by astronaut Jack Fischer, KG5FYH, as she speaks with President Donald Trump.

Last November, Whitson, 57, launched to the ISS on her current mission, with 377 days in space already under her belt, and broke the 534 cumulative-day record in space held by Jeff Williams, KD5TVQ. Whitson became the first woman to command the space station in 2008, and on April 9, she became the first woman to command it twice. She also holds the record for most spacewalks by a female astronaut.

"This is an inspirational record Peggy is setting today, and she would be the first to tell you this is a record that's absolutely made to be broken as we advance our knowledge and existence as both Americans and humans," said NASA acting Administrator Robert Lightfoot.

This is Whitson's third long-duration stay on board the space station, and her mission was recently extended for another 3 months. Instead of returning to Earth in June as originally planned, Whitson will remain on the ISS until September, returning home with Fischer and Russian cosmonaut Fyodor Yurchikhin, RN3FI.



Whitson first served aboard the ISS in 2002 as part of the Expedition 5 crew, was the Expedition 16 commander some 5 years later, and has conducted numerous Amateur Radio on the International Space Station (ARISS) contacts with students on Earth. Whitson has since let her Amateur Radio license lapse. -- *Thanks to NASA*

Ohio Columnist Alerts Locals to Upcoming Ham "Invasion"

Fairborn Daily Herald columnist Bill Taylor, N8YGS, is giving readers in the Fairborn, Ohio area a heads up regarding the thousands of radio amateurs soon to be descending upon Xenia, Ohio for Hamvention® -- being held there for the first time, May 19-21, at the Greene County Fairgrounds and Expo Center.

"It seems to me that folks hereabouts should be forewarned that in a few weeks we will be subjected to what might be called an 'invasion,'" Taylor [wrote](#). "Oh, it won't be by zombies, aliens from outer space, or locusts -- nope, it's going to be by very friendly 'hams,' known more formally as 'Amateur Radio operators.'"

A member of ARRL and of the Hamvention-sponsoring Dayton Amateur Radio Association (DARA), Taylor pointed out that past Hamvention attendance has been in the 25,000 range. "As for attendance this year, that's a bit of a question because of the change in venue," Taylor wrote, "but we can still expect thousands of folks visiting our county, many for the first time."



The Greene County Fairgrounds and Expo Center satellite view.

Taylor told ARRL that he's planning "at least a couple more columns about Hamvention and Amateur Radio, including one next week." He said his editor is "very supportive" of Hamvention and plans to devote as many column inches as possible to the event.

The ARRL Letter for May 4, 2017 Amateur Radio Volunteers Support 2017 Boston Marathon

On April 17, nearly 280 Amateur Radio communication volunteers participated in the 2017 Boston Marathon, the 121st running of the event organized by the Boston Athletic Association (BAA). Warmer-than-typical temperatures for the Patriots' Day race raised concern for increased medical issues, but lower humidity and some cloud cover later in the afternoon mitigated the potential for problems.

Amateur Radio's primary communication role involved logistics. Operations included relaying medical resupply requests, picking up runners via medical sweep buses, conveying medical statistics as required by the Red Cross and Massachusetts Department of Public Health, and providing situational awareness as needed along the entire 26-mile route. Amateur Radio also backed up EMS communications, and the team relayed several ambulance requests along the route. Brett Smith, AB1RL, one of the BAA Organizational Committee representatives, said Marathon organizers were very pleased with the efforts of Amateur Radio operators.

"Congratulations to everyone on a job very well done," Smith said afterward. "We were braced for a busy day, and our preparation helped see us through to make sure it was never anything we couldn't handle." Smith said that many volunteers enjoyed spending their day supporting the Marathon this year.

"We're already seeing e-mails from our volunteers thanking us for our work too. So the work was appreciated not only by organizers from the BAA, but the volunteers as well," he said.



Amateur Radio operators assisted in the State Emergency Operations Center (EOC). [Jim Palmer, KB1KQW, photo]

Course volunteer Matt Knowles, KC1AEI, was among them. "I feel like Amateur Radio plays an important role in the safety and security of the Boston Marathon," he said. "Our net operators were succinct, clear, and very patient as we took care of our individual responsibilities on the course. All of the communications volunteers put forth a unified effort on Monday, which made for another successful race."

Rob Macedo, KD1CY, the other BAA Organizational Committee representative, reported that state emergency managers were very pleased with the logistics and situational awareness support from Amateur Radio operators. He was stationed at the Multi-Agency Coordination Center (MACC), located at the State Emergency Operations Center (EOC) in Framingham.

"At one point mid-afternoon, one of the two finish line medical tents was filled to capacity," Macedo recounted. "The BAA and EMS representatives at the MACC were impressed at receiving the on- and off-diversion reports in a timely fashion from Finish Segment Coordinator Matt Brennan, NM1B."

Start Segment Coordinator Mark Richards, K1MGY, said all of the planning and setup at the race's starting point of Hopkinton paid off. "We provided BAA organizers at the start with an analysis that looks to correlate the planned and actual times of the start of the race very well," he said.

Course Field Operations/Course Net Control Segment Coordinator Jim Palmer, KB1KQW, said he was pleased with the performance of the Amateur Radio teams throughout the event. "Numerous course Amateur Radio volunteers have already expressed their appreciation for a well-run, highly organized event, and are already looking toward volunteering at the 2018 Marathon," he said. Course volunteers logged an estimated nearly 1,000 volunteer hours, and Palmer said their support was instrumental to the success of the communication support mission.



Nearly 280 Amateur Radio volunteers turned out to assist in Boston Marathon communications. [Jim Palmer, KB1KQW, photo]

At the Course Net Control Operations Center in Brookline, students from Dexter-Southfield School provided support to net control operators during the event. Numerous nets cover the Marathon course, and all are run from this single location. Students regularly updated status boards, informing both local net control operators and the other net control operations centers of each ham radio volunteer's location. Veteran net control operators dedicated some time to work with the students to teach them how marathon nets operate, providing a robust ham radio learning experience in an educational setting.



Amateur Radio is one of three radio communication systems used for the Boston Marathon. Eight Amateur Radio representatives, including segment coordinators, sit on the BAA Communications Committee with BAA officials and representatives of the Massachusetts State Police and a commercial communications contractor. Boston Marathon Medical Coordinator Chris Troyanos, who chairs the Communications Committee, has let the Amateur Radio community know that it is -- and will remain -- a vital component of Marathon communication support. -- *Thanks to Rob Macedo, KD1CY*

FCC Personal Radio Service Revisions Will Affect GMRS, FRS, CB, Other Part 95 Devices

Soon it will be legal for CBers to work DX on 11 meters. In a lengthy *Report and Order* ([R&O](#)) in a proceeding (WT Docket No. 10-119) dating back 7 years, the FCC has announced rule changes affecting the General Mobile Radio Service (GMRS), the Family Radio Service (FRS), the Citizens Band Radio Service (CBRS or "CB"), and other applications that fall under the FCC's Part 95 Personal Radio Services (PRS) rules and regulations. Part 95 devices typically are low-power units that communicate over shared spectrum and, with some exceptions, do not require a license.

"This draft *Report and Order* completes a thorough review of the PRS rules in order to modernize them, remove outdated requirements, and reorganize them to make it easier to find information," the FCC said in a summary attached to the *R&O*.

GMRS and FRS devices are used for personal communication over several miles; compact FRS handhelds, often sold in pairs, are widely available. While GMRS and FRS share spectrum, GMRS provides for greater communications range and requires an FCC license; FRS does not.

"The rules will increase the number of communications channels for both GMRS and FRS, expand digital capabilities to GMRS (currently allowed for FRS), and increase the power/range for certain FRS channels to meet consumer demands for longer range communications (while maintaining higher power capabilities for licensed GMRS)," the FCC explained.

The amended rules eventually will eliminate combination FRS/GMRS radios for the most part, but allow up to 2 W PEP output for FRS transceivers. "[M]any current users of GMRS/FRS combination radios do not obtain licenses to operate over the GMRS frequencies in those radios," the FCC said. "Much of this problem likely arises as a result of the mass consumer marketing of combination devices for sale to the public in large quantities to users who do not know about or do not understand the licensing requirements attached to such radios and obligations associated with operating in the GMRS."



Inexpensive Family Radio Service handhelds are widely available. [Rick Lindquist, WW1ME, photo]

The FCC said it no longer will certify FRS devices that incorporate GMRS capabilities or capabilities of other services. Existing GMRS/FRS combination radios that operate at power levels of less than 2 W ERP will be reclassified as FRS devices; existing GMRS/FRS radios that operate above that power level will be reclassified as GMRS devices, requiring an individual license. Radios that can transmit on GMRS repeater input channels will continue to be licensed individually and not by rule.

The FCC said changes to the decades-old Citizens Band (CB) rules will remove outdated requirements, including certain labeling requirements. DXing on Citizens Band will become legal too. Once the new rules are effective, CBers will be allowed to contact stations outside of the FCC-imposed -- but widely disregarded -- 155.3-mile distance limit. The revised CB rules further clarify how hands-free devices can be used with CB radios and will allow the use of wireless microphones with CB radios. The FCC left in place the current power limits for the CB Radio Service.

Most of the new Part 95 rules will become effective 30 days after their publication in *The Federal Register*. Read [more](#).

Questions for The Extra Class License

1. (E1C07) What is meant by local control?
 - A. Controlling a station through a local auxiliary link
 - B. Automatically manipulating local station controls
 - C. Direct manipulation of the transmitter by a control operator
 - D. Controlling a repeater using a portable handheld transceiver

2. (E2C04) What type of transmission is most often used for a ham radio mesh network?
 - A. Spread spectrum in the 2.4 GHz band
 - B. Multiple Frequency Shift Keying in the 10 GHz band
 - C. Store and forward on the 440 MHz band
 - D. Frequency division multiplex in the 24 GHz band

3. (E3B07) Which of the following could account for hearing an echo on the received signal of a distant station?
 - A. High D layer absorption
 - B. Meteor scatter
 - C. Transmit frequency is higher than the MUF
 - D. Receipt of a signal by more than one path

4. (E4C15) What is usually the primary source of noise that is heard from an HF receiver with an antenna connected?
 - A. Detector noise
 - B. Induction motor noise
 - C. Receiver front-end noise
 - D. Atmospheric noise

5. (E5C11) What do the two numbers that are used to define a point on a graph using rectangular coordinates represent?
 - A. The magnitude and phase of the point
 - B. The sine and cosine values
 - C. The coordinate values along the horizontal and vertical axes
 - D. The tangent and cotangent values

6. (E6A17) What are the names of the three terminals of a field-effect transistor?
 - A. Gate 1, gate 2, drain
 - B. Emitter, base, collector
 - C. Emitter, base 1, base 2
 - D. Gate, drain, source

7. (E7D04) Which of the following types of linear voltage regulator usually make the most efficient use of the primary power source?
 - A. A series current source
 - B. A series regulator
 - C. A shunt regulator
 - D. A shunt current source

8. (E8D04) What is the primary effect of extremely short rise or fall time on a CW signal?
 - A. More difficult to copy
 - B. The generation of RF harmonics
 - C. The generation of key clicks
 - D. Limits data speed

9. (E9C08) What is a folded dipole antenna?
 - A. A dipole one-quarter wavelength long
 - B. A type of ground-plane antenna
 - C. A dipole consisting of one wavelength of wire forming a very thin loop
 - D. A dipole configured to provide forward gain

10. (E0A01) What is the primary function of an external earth connection or ground rod?
 - A. Reduce received noise
 - B. Lightning protection
 - C. Reduce RF current flow between pieces of equipment
 - D. Reduce RFI to telephones and home entertainment systems

(For answers to test questions see bottom of page [12](#))

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Answers to questions on page [11](#): 1-C, 2-A, 3-D, 4-D, 5-C, 6-D, 7-B, 8-C, 9-C, 10-B

