

2012 Amateur
Radio Special



Scanning - Shortwave - Ham Radio - Equipment
Internet Streaming - Computers - Antique Radio

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OSCAR AT 50

The Story of Amateur Radio's First Satellite

In this issue:

- QRP: Ham Radio's Economy Vehicle
- Amateur Radio Antenna Basics
- MT's Guide to 60 Meter Action
- The No-limits Technician Class Operator
- Creative HF Antenna Solutions



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Cover Story 8
Amateur Radio's Very First Satellite:

The Amazing Story of OSCAR-1
By Keith Baker KB1SF/VA3KSF

Amid Cold-War intrigue and suspicion, a dedicated group of amateur radio operators dreamed of something that had never been done before: a DIY satellite to join the space race. But, could a handful of true-believers build and launch a real satellite when space was dominated by government and military scientists with the backing of their respective national treasuries? In this month's cover story, Keith Baker KB1SF/VA3KSF, former AMSAT president, explains how they did it.

While their goal was to launch a simple transmit-only satellite, their mission would show that billion dollar budgets and expensive clean-rooms weren't necessary if you really believed you could do it. Nearly every step of the way was packed with doubt, but these well connected hams played their hand skillfully and launched not just one satellite but decades of space-related radio activities enjoyed by millions of hams around the world since.

On our cover:

A full size mockup of the CORONA upper stage is now displayed in the Smithsonian Institution. (Courtesy: Smithsonian Institution); OSCAR-1 was successfully launched as a secondary payload on Discoverer XXXVI (its unclassified CORONA cover name) on December 12, 1961 aboard a THOR-Agena rocket from Vandenberg AFB, California. (Courtesy: U.S.A.F.); An engineering model of OSCAR-1 sits today in the Smithsonian Institution. (Courtesy: AMSAT).

C O N T E N T S

QRP: The Economy Vehicle of Amateur Radio 13

By Bob Patterson K5DZE



With budgets tight and energy costs rising, Bob Patterson K5DZE takes a look at the plus side of QRP (low power operating). After many years as a QRO (high power) operator, Bob discovers what many old hands at QRP have known for decades: low power doesn't necessarily mean weak signal. But, operating QRP is more than just cranking down the power. When there's less power to throw into the ionosphere, QRP operators have to hone other skills to compete on the bands. Bob shows us all how it's done.

Antennas for Amateur Radio: Coping with space limitations and matching the mismatches 16

By Bob Grove W8JHD

Over the decades, *MT* founder and antenna guru Bob Grove W8JHD has found that the subject of antennas is foremost on most amateur operators' minds. And, with good reason; it's the main thing keeping most hams from getting the most out of their transceivers.



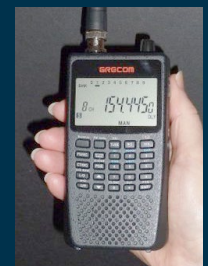
Without a good impedance match and a well designed and erected antenna, your transmitter may as well be hooked up to a dummy load. Bob takes a look at impedance matching; the differences between horizontal and vertical HF antennas; wire and tube designs and how you can update your older transceiver to help get the most out of your location, your antenna and your rig.

R E V I E W S

GRE PSR-120 Hand-held Scanner 70

By Bob Grove, W8JHD

Many locations across the U.S. don't use Project 25 or even trunked public service radio systems and may not for many years to come. This month Bob Grove looks at the GRE-PSR-120, a new scanner designed for just such locations. Find out how a scanner for basic systems is anything but basic.



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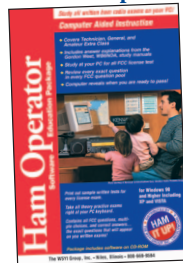
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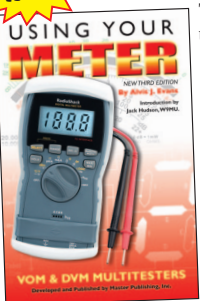


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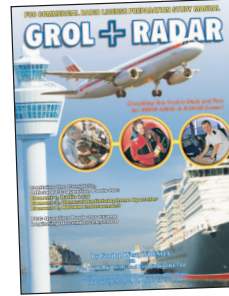
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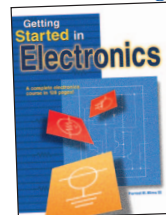
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COMMUNICATIONS

by Ken Reitz



AMATEUR RADIO/SHORTWAVE

New Law Seeks Amateur Radio Study

Part of the “Middle Class Tax Relief and Job Creation Act of 2012,” signed into law by President Obama February 22, asks the Department of Homeland Security to, “complete a study on the uses and capabilities of Amateur Radio Service communications in emergencies and disaster relief.” The study, which will recommend, “improved integration of amateur radio operators in the planning and furtherance of initiatives of the federal government...identification of impediments to enhanced amateur radio service communications, such as the effects of unreasonable or unnecessary private land use restrictions on residential antenna installations and recommendations regarding the removal of such impediments.” Look for this report to be out by the end of this summer.

BBG Sells Shortwave Short (Again)

The Board of Broadcasting Governors, the administrative body overseeing the Voice of America, Radio and TV Martí among other American international broadcast services, released their 161 page budget proposal for fiscal year 2013 in mid-February. “In these times of fiscal austerity, the BBG faces tough choices,” Board members said in a message to agency employees. “And we are not alone: Every branch and each element of the federal government has had to take a hard look at itself to achieve efficiencies without sacrificing its essential work on behalf of our country.”

The BBG asked for an overall 4.2 per cent decrease for international broadcasting over FY 2012. According to broadcast press reports, cuts will include transmission and staffing at VoA, Radio Free Europe/Radio Liberty, Radio Free Asia and the Middle East Broadcasting Network in addition to cuts at Radio and TV Martí.

The Committee for U.S. International Broadcasting (CUSIB), an independent New York-based non-governmental organization which supports the free-flow of uncensored news from the United States to countries without free media, was not impressed. CUSIB criticized BBG for its ambitious plans to “become the world’s leading international news agency” at the expense of Tibetan and Cantonese broadcast services it sees as vital to the region. In a press release CUSIB stated, “We oppose the BBG’s efforts to eviscerate core news services provided by the Voice of America and other broadcasters while using U.S. taxpayer resources to inflate the ranks of the BBG management.”



Andy Sennitt Closes Media Network Blog

Radio Netherlands Worldwide (RNW) blogger Andy Sennitt announced the closure of his popular blog on shortwave radio, *Media Network*, <http://blogs.rnw.nl/medianetwork/> on March 24 citing, “the new mandate of RNW effective 1 January 2013, it will no longer be possible for the organization to provide coverage of international media news. In April I shall be writing a series of articles reflecting on the changes in international broadcasting since I started appearing on the Media Network radio show in 1981 and looking ahead to the coming decade. The articles will be published on the RNW English website.”

AM/FM/TV BROADCASTING

TV Spectrum Auction Uncertainty

Also tucked away in the “Middle Class Tax Relief and Job Creation Act of 2012,” alluded to above, are the details for the upcoming, long running shift of what’s left of the TV broadcast band to make room for new wireless broadband entities.

A concise description of the proposed spectrum auction appeared in *TVNewsCheck*, the full article may be found here: www.tvnewscheck.com/article/2012/02/27/57705/heres-whats-next-for-the-spectrum-auction

Basically, the FCC will ask TV stations to vacate the top end of the UHF-TV band. This is most critical in the crowded metro areas of the east and west coasts, but “repacking,” as the process is called, will involve all stations and will likely mean channel reassignments, though, as with the DTV shift, stations will probably keep their legacy channel assignments even though they may not be anywhere near the channel actually assigned.

It’s a complicated process that will likely take the next eight years to fully implement and more questions have been raised by the process than professional spectrum analysts have been able to answer. For example, low-power TV stations and translators aren’t part of the auction and apparently have no protection in the repacking process, and the FCC may decide to modify non-participating stations’ licenses with potentially disastrous results for viewers. The FCC hasn’t done too well with previous auctions, so the law stipulates that it has only one chance to hold the auction and be done with it, and there could well be legal action against the plan from stations that believe they are hurt by it. Stay tuned.

TECHNOLOGY

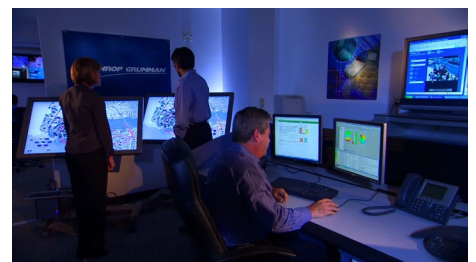
Antenna Design Resembles...Pasta

A scientific report in the *New Journal of Physics* noted the difficulty of crowding digital signals on narrow bands and keeping each separate. Researchers, one from Sweden and the other from Italy, found that twisting a wave on its axis in a clockwise or counter clockwise direction makes it so that it can carry more than one channel of information. According to the report, “In a three dimensional perspective, this phase twist looks like a fusilli pasta shaped beam. Each of these twisted beams can be independently generated, propagated and detected even in the very same frequency band, behaving as independent communications channels.” It could result in the proverbial “wet noodle” antenna!

PUBLIC SERVICE

NYC Tries to Sell Back \$549 Million System

An article in the *New York Daily News* found that a public safety wireless data network that cost the city over half a billion dollars three years ago and intended to be used by NYPD and NYFD agencies, hasn’t exactly panned out. According to the article, so far only half the police vehicles intended to use the system have had the necessary modems installed and only one quarter of fire vehicles have had the modems installed.



NYC Wireless System (Courtesy: Northrop Grumman)

In addition, of the system’s 1,000 planned solar-powered call boxes, that were to replace antique call boxes, only one has actually been installed. Another user of the system, the New York Department of Environmental Protection, uses the system to monitor 785,000 water meters, but the department had to shell out \$250 million to have the devices installed at each customer’s home.

As a result of departmental apathy, and in an effort to reduce costs, the Bloomberg administration tried without success to sell the system, which costs \$38 million per year to maintain, back to the manufacturer, Northrop Grumman, which the

city would then lease back. Apparently, Northrop Grumman wasn't buying.

SATELLITE

Solar Flare Predictor Aging

According to numerous media reports, NASA's main solar storm warning satellite, Advanced Composition Explorer (ACE) launched in 1997, could be on its last sip of hydrazine. That may not be terrible news, but it appears there's no replacement in the hangar except for a satellite that had been scheduled for launch in 2003 that has been in moth balls ever since.

Launch of the New Old Stock satellite named *Triana*, according to *MSNBC*, was put on hold by the Bush administration because of its backing by former Vice President Al Gore. Nonetheless, the satellite is undergoing preparation for launch with the U.S. Air Force. The "new" satellite has been renamed Deep Space Climate Observatory (DSCOVER), but it likely won't actually make it to space until June 2014, one year after the expected peak of the current solar cycle. Meanwhile, NASA will be hoping ACE can hang in there for another two years.

Politically-Tinged LightSquared Shambles

After a brief stint last year as a much-ballyhooed Future-of-Rural-Broadband scheme, LightSquared this year has found itself in a shambles. Unceremoniously skewered by the FCC, barred by the owners of the satellite it had contracted to use, and left adrift by its CEO, the last indignity was a public dog pile by anyone with a GPS unit and an email account, courtesy of the FCC.

The fall from FCC-grace for LightSquared came after pressure from the GPS industry forced the FCC to back away from its earlier blessing of the enterprise as part of its Rural Broadband Initiative. The resultant domino cascade triggered ripples in Congress, on Wall Street and with Inmarsat, the struggling UK-based satellite company on whose bird LightSquared had contracted to provide its service. Charges of cronyism regarding the service have been leveled from both political parties that have helped muddy the waters further, even holding up confirmation of two new FCC appointments.

Even now, it's not clear just how dead LightSquared is. With congressional investigations about to get underway (just in time to be politically expedient) and civil lawsuits threatened by various investors and the FCC still undecided on how it will treat the former darling of the Broadband Initiative, the whole mess could have the makings of a summer replacement reality show for insomniacs.

China on WX Sat Spree

According to *China Daily*, China will launch 12 meteorological satellites before 2020 as part of a ten year plan created by the China Meteorological Administration. "The launch of these satellites will dramatically boost China's weather monitoring capabilities, providing better services for a variety of industries," said an official of the country's top political advisory body. It's not clear if the new satellites will be able to tell the Chinese government if the haze over Beijing is really just fog, as they often claim.



Launch of Chinese weather satellite, but can it discern the difference between fog and smog? (Courtesy: Xinhua News Service)

FCC ENFORCEMENT

The Usual Suspects

Here's this month's installment from the FCC's Enforcement Bureau files:

A CB operator in Saginaw, Michigan was cited for transmitting music continuously for 20 minutes. A couple from Pennsylvania was cited for operating a radio jamming device designed to transmit in the 450-470 MHz band.

An FM pirate in Brooklyn, New York was cited for operating on 99.9 MHz with power measured at 6,454 microvolts per meter at 651 meters. Also in the modest pirate operator category were two from Eugene, Oregon who were caught operating on 98.5 with 3,866 microvolts/meter at 135 meters.

A pirate operator out of Boulder, Colorado was transmitting on 106.5 MHz with an output measured at 279,028 microvolts/meter at three meters. Just down the dial, he had competition from another pirate operating on 95.3 MHz at a whopping 457,083 microvolts/meter at three meters. Two other individuals were tagged in that operation.

But, the QRO (high power) FM pirate award goes to two people living at the same address in Olympia, Washington, who were operating on 98.5 MHz with power measured by FCC field agents at 710,143 microvolts/meter at three meters. The maximum allowed under Part 15 rules for unlicensed FM operation is 250 microvolts/meter at three meters. The FCC also tagged the owner of the property who lives in Shelton, Washington.

A San Jose, California man, earlier issued a Notice of Unlicensed Operation (NOUO) but who had not replied to the FCC citation, received a Forfeiture Order (FO) in the amount of \$25,000. Typically, a FO is \$10,000.

Sloppy AM Op Fined \$25,000

The licensee of WNFO-AM, Sun City, South Carolina, was slammed with a \$25,000 fine after agents, acting on a complaint, visited the station's transmitter site in July 2011 and found a variety of sloppy practices, including a collapsed fence

around the base of the tower, lack of perimeter fencing, and later the lack of properly functioning Emergency Alert System (EAS) equipment.

At the main studio they found only a single person operating the station under a local marketing agreement (LMA), no EAS gear, no EAS logs and an incomplete station public inspection file. The LMA operator told agents she was, "unfamiliar with EAS requirements and said that she had never observed EAS activity during her five years at the station." I guess a promotion is out of the question now.

In September the FCC issued a Letter of Inquiry asking for an explanation for what the agents found. The station owner replied with a shaggy dog story about vandalism at the transmitter site which was the cause of all his problems. The FCC was unimpressed. In the Notice of Apparent Liability for Forfeiture and Order they wrote, "...when agents arrived at the transmitter site on July 27, 2011, they found the outside door of the transmitter building locked with a padlock. It is difficult to believe that vandals would have disconnected, but otherwise left untouched, valuable EAS equipment at the transmitter site, removed the station's EAS logs, and then secured the transmitter site afterwards."

Communications is compiled by Ken Reitz KS4ZR (kenreitz@monitoringtimes.com) from clippings and links provided by our readers. Many thanks to this month's fine reporters: Anonymous, Rachel Baughn, Bob Grove, Norm Hill, Steve Karnes, and Larry Van Horn.

NASB

National Association of Shortwave Broadcasters

Representing the privately-owned shortwave stations in the USA

- Find links to all of our members at www.shortwave.org
- Take the NASB Shortwave Listener Survey and get a free subscription to the NASB Newsletter. www.surveymonkey.com/s/6LRVLJ7
- Listen to "The Voice of the NASB" on HCJB's DX Party Line on WRMI's 9955 kHz. Visit www.wrmi.net for schedule
- NASB is a member of the HFCC (High Frequency Coordination Conference) and the DRM (Digital Radio Mondiale) Consortium

Amateur Radio's Very First Satellite

The Amazing Story of OSCAR-1

By Keith Baker KB1SF/VA3KSF

Pivate groups of amateur radio operators around the globe have built and sent dozens of amateur radio communications and science satellites into orbit since the first, OSCAR-1, was launched on December 12, 1961.

That date already held a special place in radio history as it was the 60th anniversary of the first radio transmission across the Atlantic Ocean. Indeed, on December 12, 1901, Guglielmo Marconi completed his now-famous transmission and reception of Morse code for the letter S – three dots – from England to Newfoundland.

However, the story of the first amateur radio satellite actually began much earlier, in April, 1959, less than two years after what was then the Soviet Union had orbited the very first artificial satellite (*Sputnik 1*).

About that time, the author of the Semiconductor Column for *CQ Magazine*, Don Stoner W6TNS, published a design for a 50 milliwatt, 2 meter transistorized transmitter that he had

successfully tested across the San Bernardino Mountains of California, a distance of some 120 miles. Needless to say, he was absolutely amazed that such a tiny transmitter could be heard over that great a distance at that frequency and soon realized that it probably would work just as well if it were 120 miles overhead in a satellite.

So, while discussing the details of his latest brainchild in his *CQ Magazine* column, he casually asked his readers, “Does anyone have a spare rocket for orbiting purposes?”...never dreaming that his flip comment would ever amount to much.

As it turned out, one of the radio amateurs employed by Lockheed at the time, Fred Hicks W6EJU, read Don’s article and began to think that, indeed, it just might be possible to find a launch for such a satellite through his association with Lockheed and the U.S. Air Force. Remember, at the time, the U.S. military was the only organization in the United States that was launching payloads into orbit.

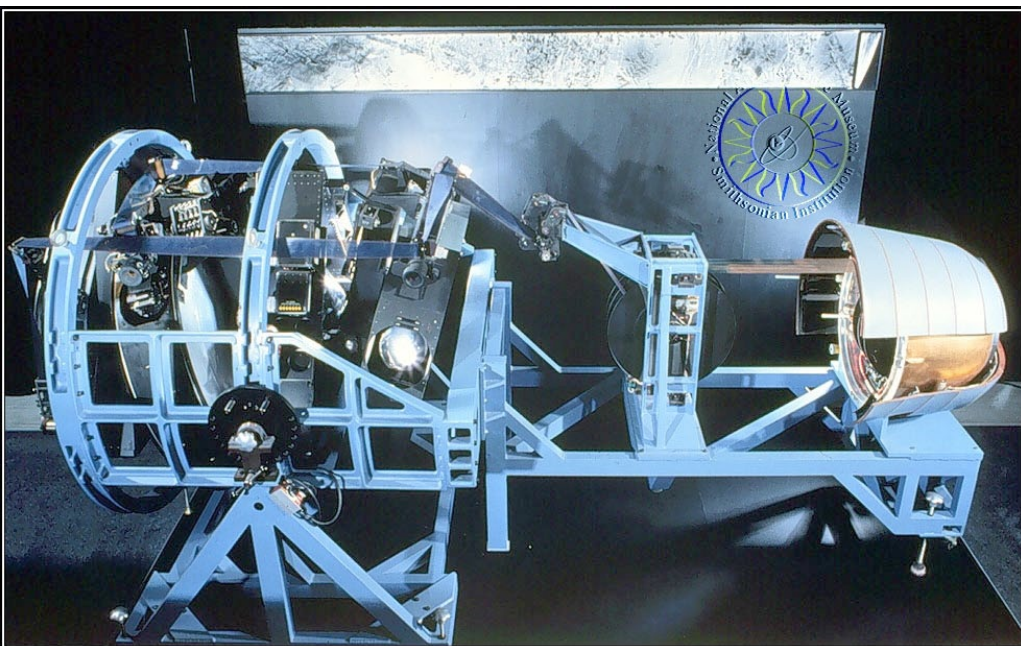
After discussing his “half-baked” idea with

an amazed and gratified Don Stoner, he and a group of similarly interested hams in the San Francisco Bay area formed what later became known as “Project OSCAR”...in true military fashion, OSCAR being an acronym for “Orbiting Satellite Carrying Amateur Radio.”

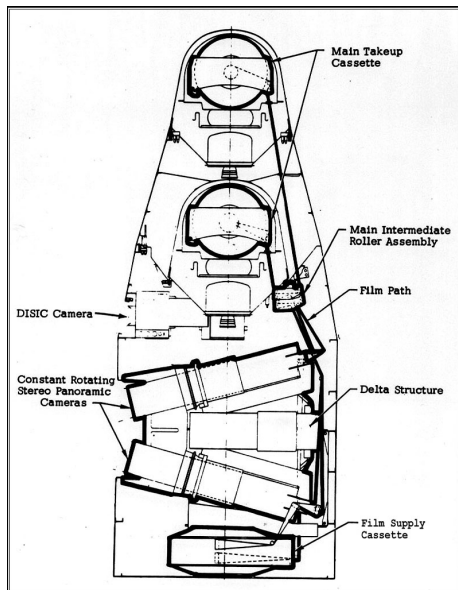
Fred and his group soon contacted the (then) Southwest Division Director of the American Radio Relay League (ARRL) and the head of the Jet Propulsion Laboratory’s Space Instrumentation System, Dr. Harry L. Richter W6VZA, and plans started to come together for the very first amateur radio satellite.

In the true spirit of amateur radio, the Project OSCAR organization would later develop into an impressive group effort that included not only Don and Fred, but other well-known hams of the day including Hank Brown W6HB, Bill Orr W6SAI, George Jacobs W3ASK, Nick Marshall W6OLO, Chuck Townes K6LFH, and Lance Ginner K6GSJ, along with many others.

But taking the idea of OSCAR from concept to reality involved clearing a number of



A full size mockup of the CORONA upper stage is now displayed in the Smithsonian Institution. (Courtesy: Smithsonian Institution)



A block diagram of the CORONA upper stage. The exposed film wound into a canister at the top of the vehicle for later ejection, de-orbiting and collection. (Courtesy: U.S.A.F.)

hurdles, the least of which was the fact that the launch opportunity being proposed for OSCAR I would involve what was at that time a very highly classified (that is, Top Secret) U.S. military project called CORONA.

The CORONA Program

Back in 1955, with Cold War anxiety skyrocketing, U.S. President Dwight D. Eisenhower made a remarkable proposal to his Russian counterpart, Premier Nikita Khrushchev. He suggested that each country allow the other to conduct reconnaissance flights in the air and from space over each other's country, and that the imagery obtained be given to the United Nations.

The Soviets, however, flatly rejected this "Open Skies" proposal, most likely because it would show just how inflated Khrushchev's boast that his country was building nuclear-tipped Intercontinental Ballistic Missiles (ICBMs) "like sausages." Thereafter, the United States and the Soviet Union proceeded separately to learn about each other's capabilities...in secret.

As a result of Khrushchev's rebuff, in 1958 President Eisenhower approved a program that would answer questions about Soviet missile capabilities and replace risky U-2 reconnaissance flights over Soviet territory that an "Open Skies" approach would have provided. Instead, the Central Intelligence Agency (CIA) and the Air Force would jointly develop satellites to photograph from space those areas of interest to which they had been denied access. That program had both a secret mission and a secret name – CORONA. It was organized under the new Keyhole security protocols that, at the time, constituted one of the most secret security orders in American history.

CORONA was conceived in an era when facts about Soviet capabilities were scarce and fears were rampant. The size and nature of the Soviet threat back then were largely unknown, but many believed that Khrushchev's boasts were very real and that the United States was falling dangerously behind Moscow in critical areas.

Indeed, the Soviet threat grew in the imagination of the public as U.S. leaders debated the supposed "bomber gap," the "missile gap," and the "science gap," to the point that, by the late 1950s, the successful launch of the first Soviet Sputnik in 1957 (along with subsequent launches of satellites far larger than anything the United States had orbited up to that time) raised public fears that the Soviets were developing scores of rockets and huge satellites capable of dropping nuclear bombs on the United States from space.

How It Worked

Largely as a result of these public pressures, the CIA and the U.S. Air Force developed this first-generation space program with great speed and tight secrecy. The CORONA vehicle was launched by a THOR booster, usually from Vandenberg Air Force Base in California into a roughly polar orbit. It used an AGENA spacecraft as the upper stage that also carried all the CORONA equipment. While in orbit, CORONA



Early CORONA imagery wasn't the greatest, but it was good enough to show the CIA's photo interpreters major features (such as this image of the Pentagon) on the ground. (Courtesy: USAF)

took photographs with a constant rotating stereo panoramic camera system (developed by Itek Corporation) and then loaded the exposed photographic film (specially made by Kodak for this purpose) into a recovery canister on the nose of the AGENA spacecraft.

Resolution in early flight years was in the range of 35 to 40 feet. The canisters (called by the slang term "film buckets") were then separated, de-orbited and later recovered in mid air by specially equipped Air Force C-119 aircraft while floating back to Earth via parachute.

After a number of failures, the CORONA system successfully photographed its first intelligence target on August 18, 1960 and then recovered the film capsule as it dropped from

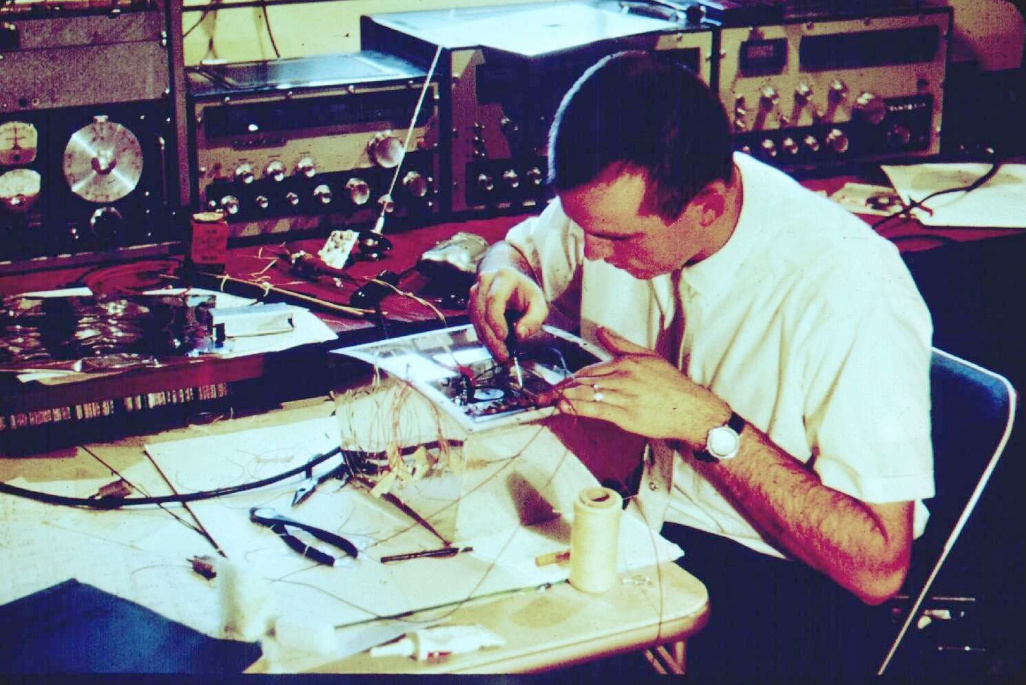
space. This happened only 110 days after the Soviets had shot down a U-2 spy plane piloted by Francis Gary Powers, an embarrassing setback for the United States that effectively ended all U-2 flights over Soviet territory.

By today's standards, the first images snapped by CORONA satellites from orbit looked fuzzy and distant, but technical advances soon produced sharper pictures. By 1972, CORONA was routinely delivering resolutions of six to ten feet. By the 1970s, flights could remain on orbit for 19 days, provide accurate attitude, position, and mapping information, and return coverage of some 8,400,000 square nautical miles per mission.

Needless to say, such photos held enor-



Exposed CORONA film was wound into its upper stage capsule that was later de-orbited and most often snagged in mid-air over the Pacific Ocean by a USAF C-119 cargo plane. (Courtesy: USAF)



Lance Ginner K6GSJ performs the final wiring of the flight model OSCAR-1 satellite on a card table set up in the ham shack of his California home. (Courtesy: Project OSCAR)

mous significance for the course of the Cold War as they provided information that allowed U.S. leaders to weigh the actual Soviet threat and measure their response. Even the very first photos from the CORONA project clearly debunked any remaining “missile gap” fears. If anything, the photos gave tangible proof that such a “gap”...if it had ever existed...was clearly very much in favor of the United States and that Khrushchev’s “building missiles like sausages” remark was nothing but bunkum.

However, because these efforts were all being done in secret, the wealth of satellite imagery CORONA was providing U.S. intelligence

experts couldn’t be released to the general public to allay their “missile gap” fears. To do so at the time might have very easily upset the delicate balance of national security in an era when both the United States and Soviet Union possessed more than enough nuclear weapons to virtually annihilate each other many times over.

CORONA Firsts

CORONA ushered in a whole series of technological firsts that contributed to advancements in other areas. The program taught U.S. technicians how to recover objects from orbit –

methods that were later adapted by the National Aeronautics and Space Administration (NASA) to recover astronauts. It also provided a fast and relatively inexpensive way to map the Earth from space. Before CORONA, cartographers had adequately mapped only a quarter of the Earth’s surface. CORONA also provided the first stereo-optical images from space, which gave photo interpreters a 3-dimensional view of terrain.

But, clearly, the most important contribution of the CORONA system to national security remains the intelligence it provided to U.S. military planners. CORONA routinely looked through the so-called “Iron Curtain” and helped lay the groundwork for later disarmament agreements and the eventual collapse of the Berlin Wall.

In all, there were 144 Corona satellites launched, of which 102 returned usable photographs. These satellites produced over 800,000 images taken from space, and 2.1 million feet of film. Individual images on average covered approximately 10 miles by 120 miles.

CORONA Finally Revealed

But, all of these fantastic technological accomplishments were very effectively kept from public view until President Clinton signed an Executive Order on February 22, 1995 directing the declassification of intelligence imagery acquired by the first generation of U.S. reconnaissance satellites. The order provided for the declassification of more than 860,000 images of the Earth’s surface, collected between 1960 and 1972. Today, all 800,000 images can be purchased for a fee via the U.S. Geological Survey Web site at: http://eros.U.S.gs.gov/#/Find_Data/Products_and_Data_Available/Satellite_Products

OSCAR 1 and CORONA

Now, obviously, with such a highly classified project keeping what the U.S. government was *really* up to with CORONA a secret was of utmost importance. So, they had to come up with an effective cover story to feed to the public so as to disguise the real intent of the project from “prying eyes.” As a result, the first CORONA satellites and their launches were deliberately cloaked in disinformation as being part of a scientific and space technology development project called the *Discoverer* program. And what better way to add to the cover story than to carry along a satellite built, quite literally, by a bunch of “amateurs” in their basements and garages?

The Rest of the Story

Indeed, that’s *exactly* what happened! And one of the key players in getting OSCAR-1 into orbit was a California radio amateur named Lance Ginner K6GSJ.

As often happens in our hobby, as a young up-and-coming aerospace engineer, Lance found himself in the enviable position of having his ham radio hobby fit seamlessly with the unique responsibilities of his “day job.” Lance started work at the Lockheed Missiles and Space Company in Sunnyvale California in January of



Lance Ginner K6GSJ poses with the completed flight model OSCAR-1 satellite (Serial Number 1) in the back yard of his California home. (Courtesy: Project OSCAR).

1960. He was 21 years old at the time and was immediately put to work in the Agena vehicle checkout complex doing the final checks on the (then) top-secret CORONA upper stage vehicles that would eventually carry their classified payloads into orbit. Initially Lance was responsible for designing and building test aids to facilitate the final checkout of these satellites prior to their shipment to Vandenberg Air Force Base, California for eventual launch.

About this same time (and being an active ham operator) Lance became aware of the (then) fledgling OSCAR project through his work association with Chuck Townes K6LFH and Nick Marshall W6OLO, both of whom also worked at Lockheed. As a result, Lance soon found himself smack in the middle of what would later become a pioneering effort in the proud history of amateur radio.

Politics

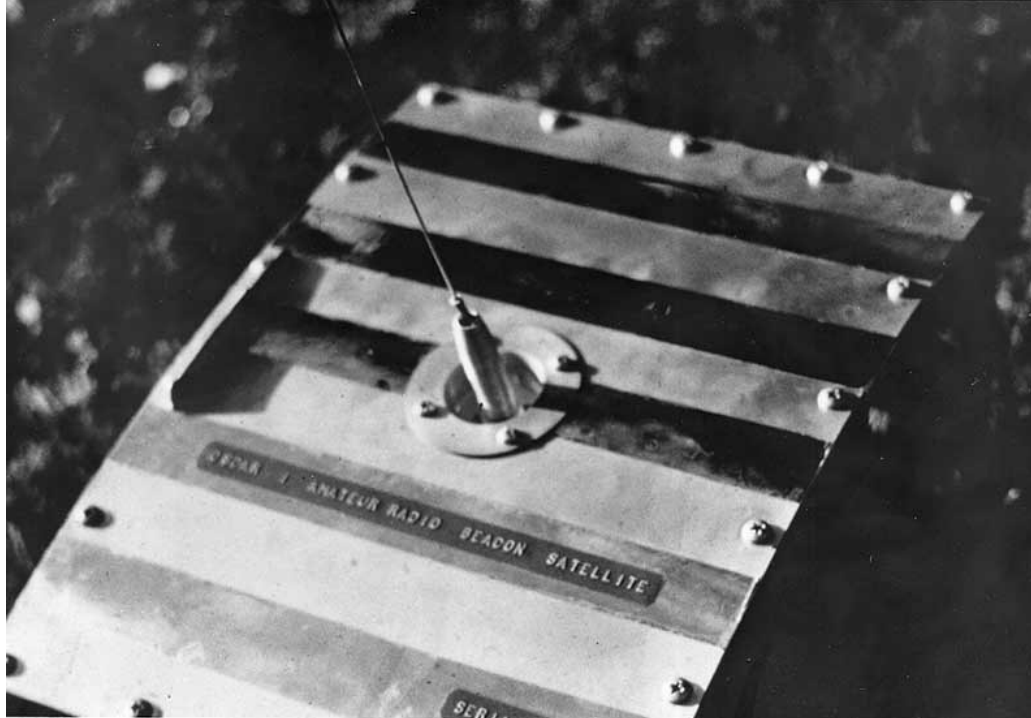
Needless to say, because of the highly classified nature of the main payload, getting the early OSCAR satellites approved for launch was a highly politicized process. The challenges that the Project OSCAR board faced in obtaining the necessary permission for them to fly a “home built” satellite on a classified space mission was absolutely daunting to say the least!

It's also important to remember that the idea of a small, erectable, sub-satellite being carried and launched into its own orbit as a secondary payload was absolutely unheard of at the time. As a result, convincing the various U.S. government and contractor agencies involved in the CORONA project (such as the CIA and the Air Force, not to mention their bosses at Lockheed!) that the very first object to test that idea should be one built by amateurs who had no official credentials to do such things was seen by CORONA project officials as a huge risk. Indeed, a premature release of the OSCAR satellite could keep the Agena satellite from deploying its booster adapter, thus bringing the main mission to a catastrophic (not to mention very expensive!) end.

As a result, there were numerous meetings with government and military representatives (including many well-connected hams at the ARRL and elsewhere) all in an effort to obtain the necessary permission for OSCAR-1 to fly. These discussions, along with the creation of an OSCAR-1 White Paper, helped establish both the political and technical credibility that the Project OSCAR team needed to obtain the necessary permission to launch. Indeed, Lance later noted that obtaining the necessary bureaucratic permission well exceeded those required to actually build the satellite.

OSCAR-1 at a Glance

The OSCAR-1 satellite consisted of a small curved box that measured 9 inches by 12 inches by 6 inches and sported a single, spring-loaded, 2 meter whip antenna on its top surface. OSCAR-1 did not offer two-way communications. Rather, its non-rechargeable, battery-operated radio simply transmitted a Morse beacon with 140 milliwatts of power on a frequency of 144.983 MHz. While 140 milliwatts doesn't seem like



The Plastic Dymo Label Tape on the top of the flight model OSCAR-1 satellite reads: “OSCAR 1 AMATEUR RADIO BEACON SATELLITE.” (Courtesy: Project OSCAR)

much power by today's standards, OSCAR-1's transmitter still put out some *fourteen times* the power of the 10-milliwatt radio carried in *Explorer-1*, America's very first satellite.

It's also important to remember that even with this simple transmitter arrangement, there were still some daunting technical risks to be overcome after launch in order to end up with an operating satellite on orbit. For example, back in 1961, there were no commercially available transistors that could put out any real power at 144 MHz. So, the Project OSCAR experimenters resorted to a prototype part manufactured by

Fairchild Semiconductor Corporation that was not even on the market yet. Indeed, as Lance later noted, back in those days, “You didn't have someone looking over your shoulder saying, you can't do it that way. That's because no one *had* ever done ‘it’ before!”

For his part, Lance was directly involved in the construction of all the early OSCARS. In fact, Lance did most of the internal wiring of OSCAR-1 in the basement of his California home, as well as all of the environmental testing and integration of the satellite onto the launch vehicle.



Lance Ginner, K6GSJ, looks over the carrying structure that will loft OSCAR-1 to orbit on the CORONA upper stage. Note the faint arrow pointing to OSCAR-1's \$1.15 Sears-Roebuck spring ejection mechanism. (Courtesy: K6GSJ)



Bob Allison WB1GCM, an ARRL Laboratory engineer, poses at the 2011 AMSAT Space Symposium in San Jose, California with the backup OSCAR-1 satellite that he recently restored to working condition. (Courtesy: Author)

beeping out the letters "HI" (the telegraphic laugh) on its 145 MHz downlink. However, besides being a beacon, there was also a bit of scientific value in OSCAR's Morse greeting in that the temperature inside the satellite controlled the relative speed of the message.

Unfortunately, OSCAR-1's battery wasn't rechargeable and had only enough strength to power the transmitter for 22 days. However, during that brief time (by today's standards), nearly 600 radio amateurs in 28 nations around the globe made careful measurements of its downlink signal and forwarded their observations to the Project OSCAR data reduction center. Sadly, the satellite's low altitude allowed it to only stay in orbit above Earth for about 50 days. As a result, OSCAR-1 slipped down into the atmosphere and burned up on January 31, 1962.

Fast Forward 50 Years

December 12, 2011 marked the 50th anniversary of the launch of OSCAR-1. In commemoration of that event, laboratory engineers at the ARRL decided to refurbish a backup model that had been sitting in storage for many years at ARRL headquarters. The model used for school demonstrations soon after the original was launched had subsequently been donated to the League for safekeeping. So, early in 2011, Bob Allison WB1GCM, an ARRL test engineer,

stepped up to the task and expertly "reverse engineered" the unit so as to get it back up and operating.

He first displayed his restored handiwork at the ARRL Expo booth during the 2011 Dayton Hamvention®, much to the interest and amazement of attendees there. Bob also brought the model along with him to the Radio Amateur Satellite Corporation's (AMSAT) Annual Meeting and Space Symposium held in San Jose California in November 2011. There, he once again had the model set up and beeping its restored "HI" message to all attendees. AMSAT, you may recall, is the follow-on organization that picked up much of the work of Project OSCAR back in the 1970s.

During the Symposium, Bob also got a chance to interview Lance Ginner to discuss Lance's own ham radio beginnings, along with his involvement in the building and launching of the early OSCARs. In return, Bob told Lance of his own efforts to restore the OSCAR-1 back to working condition. At press time, this most interesting interview was still available at www.youtube.com/watch?v=HgKc2ZY3LCA&feature=youtu.be

Also, during the AMSAT meetings in San Jose, Bob was frequently heard commenting to the many viewers of his restoration efforts that he had been frustrated in his attempts to locate an original schematic of OSCAR-1's transmitter so as to restore the backup OSCAR-1 satellite to its "absolutely original" operating parameters. That was, of course, until Lance Ginner walked into the room with a copy of the original OSCAR-1 transmitter schematic tucked under his arm and handed it over to a (now broadly smiling) Bob Allison!

About the Author

Keith Baker is a retired U.S. Air Force officer, past president, former executive vice-president and member of the board of directors for AMSAT. He is currently serving as AMSAT corporate treasurer. He holds a U.S. Amateur Extra Class license as KB1SF and the Canadian Advanced license under the call sign VA3KSF. He writes the Sky Surfing Amateur Satellite column and has contributed feature articles for Monitoring Times in addition to articles for AMSAT-NA Journal and The Canadian Amateur Radio magazine.

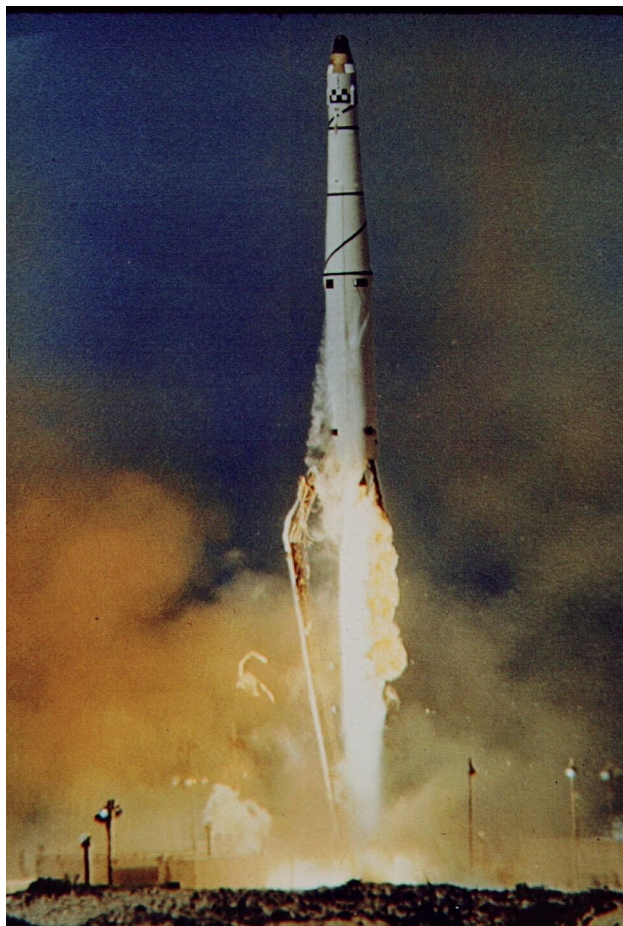
OSCAR-1 Firsts

OSCAR-1 holds the record for not only being the very first non-military satellite, it was also the very first secondary payload ever to be launched into orbit from a rocket and achieve its own orbit. Needless to say, as OSCAR-1 was the first satellite to reach orbit as an auxiliary package ejected from a parent spacecraft, its ejection mechanism was of great interest to other scientific groups who also wished to place their own free flying satellites into orbit. When these groups approached the Air Force for such information, they were routinely advised to study the OSCAR-1 design.

But what is even more amazing was that OSCAR-1's innovative ejection system (which was subjected to detailed stress analysis as well as careful mechanical and thermal balancing before launch) was all built around a \$1.15 cent spring purchased "off the shelf" from a local Sears and Roebuck store. So, in that sense, OSCAR-1 ushered in the era of "Commercial Off-The-Shelf" (COTS) space hardware as well.

Success!

On December 12, 1961, OSCAR-1's Discoverer-36 launch vehicle hurled the 10 pound satellite into an elliptical orbit ranging from 152 to 295 miles above the Earth's surface. Soon after launch, its 140 milliwatt beacon successfully activated and then began



OSCAR-1 was successfully launched as a secondary payload on Discoverer XXXVI (its unclassified CORONA cover name) on December 12, 1961 aboard a THOR-Agena rocket from Vandenberg AFB, California. (Courtesy: USAF)

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QRP: The Economy Vehicle of Amateur Radio

Bob Patterson K5DZE

Anyone who has been around amateur radio for any length of time will likely know the term QRP, but some newcomers may not know what it really means or how we picked up the term. QRP is one of the 3-letter group of “Q” signals used for decades to shorten CW (Morse code) messages by using standard letter “groups” to condense what you are saying when sending CW traffic. QRP actually means “decrease power,” and, when ended in a question mark (QRP?) it makes the statement into a question, “Shall I decrease power?” For amateurs, the term QRP has also become a conversational expression meaning, “I am using low transmit power.”

While there does not seem to be complete agreement on what constitutes QRP operation, most enthusiasts would agree that for CW, AM, FM and Data modes, transmitter output power should not exceed five watts. For SSB, maximum power should not exceed 10 watts peak envelope power (PEP). (Some operators think five watts on SSB should also be the maximum as with other QRP modes.) Many operators use no more than two or three watts power and some use much less. One group of amateurs within the QRP community call themselves QRPp operators. They use *very* low power levels such as 100 milliwatts, which is 1/10th of one watt!

You might ask why would anyone want to run such low power when several hundred watts or even a 1.5 kilowatts is authorized? First of all, Part 97 of the FCC regulations states that “...an amateur must use the minimum power necessary to carry out the desired communications.” The term “desired communications” is probably open to a little interpretation, but suffice it to say that QRP operation certainly does meet the letter of the law.

Perhaps more importantly, for many amateurs who have operated high power (QRO) for years, is something about which we could say, “Been there...Done that.” I personally reached a point, after decades of operating, that if my kilowatt and large antennas couldn’t reach all over the world, then something was probably wrong, such as really poor conditions or perhaps I needed to check the rig or antenna for problems. In truth, operating skills had less to do with my average contact than the brute force I had available. Certainly, high power was and still is a lot of fun, but making a contact with a

low power rig powered by flashlight batteries brings back the thrill of real accomplishment!

Advantages of QRP

Ask non-QRP operators about this type of operation and you may hear only about the limitations of running low power. I can assure you that while there are some limitations to running only low power, these seem to be far outweighed by the advantages. Let’s take a look at the plus side of QRP operation.

Equipment Cost – As with most amateur radio installations, you can spend a small amount or a large amount of money to get on the air, but a QRP station is made up of transceivers, transmitters, receivers, and accessories that are, overall, much less expensive than their higher power cousins. Simple transceiver kits can cost under \$50. Nicely equipped QRP transceivers can cost \$200 to \$300, while full featured rigs can be obtained for \$700 to \$800. Later in this article we will see some of the specific QRP equipment available.

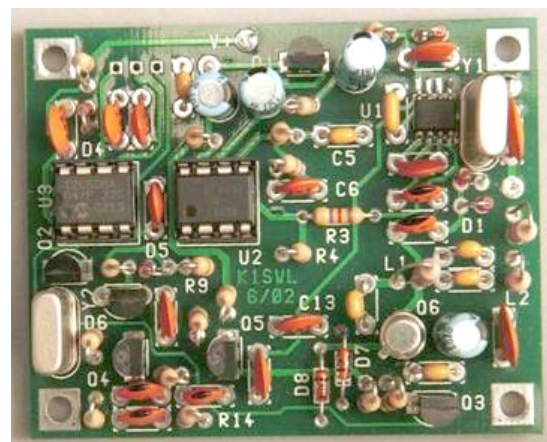
Accessories such as antenna tuners, watt meters, filters, and power supplies, are also much less expensive, since these components don’t have to handle high power, high current or high voltages.

The low cost of QRP equipment means it is very practical for the average amateur to get a nice QRP rig as an addition to his or her present one-transceiver shack. Many dedicated QRP operators have two, three or more QRP rigs and enjoy a host of operations from their shack, the field, or while traveling.

Kit Building is Alive and Well for QRP

– One thing you will quickly notice in the world of QRP is the number of kits available. Most of these kits are low to medium cost transceivers, and kits are available from the very basic to multi-featured rigs. Construction complexity ranges from beginner level to advanced level, so there are projects for anyone wanting to get into kit building.

But, don’t think you must build your rig to get on QRP: you don’t. Many companies offer assembled versions of their gear and a number of amateurs will offer to build your kit for you for a very small fee or for free if you don’t have the time or capabilities to build it yourself. (These



The Rock Mite, with over 8,000 sold and only \$45 with knob/accessory pack, is the cheapest way to QRP. (Photo courtesy of Small Wonder Labs)

amateurs love to build rigs just for the fun of it!)

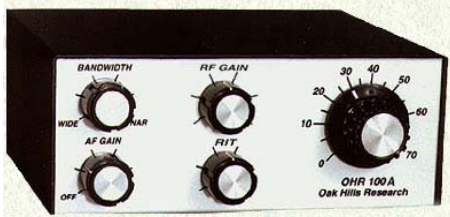
Experimentation Thrives – Due to the simplicity of many QRP rigs, particularly the single band CW-only designs, there is a lot of room for operators to experiment, redesign, or modify equipment as they wish. You can add visual or audio frequency readouts to little rigs that have no display, add a couple of components to vary a crystal’s frequency, or add a tiny keyer for your CW paddles.

The low power and low cost means you are not jeopardizing the resale of your primary “big rig” with mods or an idea that might not work out! Likewise, there are many accessories that you can make for low power operation that don’t require heavy components or heavy costs. These accessories include power supplies, tuners, watt meters, keyers, frequency displays, custom cabinets, portable “Go Box” rigs, etc.

QRP is Perfect for Suburban Living

– QRP is simply made to order for stealthy operation. If you don’t have a room to give to your radio hobby, then how about a rig built in tin can, in a decorative bird house kept on a room shelf, inside a book placed on a shelf, in a file drawer or desk drawer, or how about a complete station packed in a briefcase? Your imagination is the limit on where and how to have a rig capable of letting you make HF contacts worldwide.

Not only can you keep your rig out of sight



OHR 100A, more features and ten times the power of the Rock Mite, but still QRP. The OHR 100A costs \$150 in kit form, add \$95 for a factory finished product. (Photo courtesy of Oak Hills Research)

in your home, apartment, dorm, or hotel room, you can keep your operation very low key when operating QRP. Small end-fed antennas or antennas such as a Hamstick® or an Outbacker® can work inside many rooms, from a patio deck, or a balcony. Very small diameter wire and small coax antennas can be designed that will work well with QRP rigs.

A key advantage for QRP operation for amateurs in close quarters like condos, apartment buildings, or dorms, is that well tuned QRP systems are also less likely to cause interference to nearby boom boxes, stereo systems, TVs, and the like. Throw a hundred or so watts into an antenna in such surroundings and you may have the neighbors on the hunt for you! With QRP, they likely won't know you are operating.

Antennas Rule – Experienced amateurs know that in QRO (high power) operation, antennas rule. For QRP, antennas perhaps rule even more, since you don't have any power to waste. Any antenna used for high power operation can work for low power operation. The more efficient and usually the larger and higher your antenna is, then the better it performs to work DX. As mentioned, for QRP operation, smaller diameter wire and simple systems can be made to work, but you do need to figure them carefully for the frequencies you use and then tune them for maximum efficiency. Don't leave it to the antenna tuner to do all the work on QRP or you might wind up talking to yourself!

QRP is a Go-Anywhere Radio Option – QRP rigs, being smaller and far lighter weight than their high powered cousins, tends to make QRP gear very portable. Full featured QRP radios can be no larger than a modern 2 meter rig, while some single band CW transceivers can easily fit inside a 3.5" x 2.5" Altoids® mint tin. This small size also applies to QRP power



Elecraft K1 has an excellent reputation among users for quality and capability. The two-band kit is \$300, four-bands for \$400. (Photo courtesy of Elecraft)

supplies which can be a power pack made from a few AA batteries, a wall wart plug-in transformer, or a small table top supply running no more than 5 to 7 amps. Small radios; small power supplies!

QRP Awards for Operating – Think you have to give up chasing the WAC, WAS, or DXCC operating awards for QRP? Again, you don't! Almost every award you can think of (and some you haven't thought of) have a QRP-specific version available. The QRP Amateur Radio Club International (QRP ARCI) offers a host of QRP specific awards that you can work to achieve.

A really nice thing is that these awards don't require QSL cards. You just provide a log sheet of who, what, when and how in order to qualify. While it may seem like someone might cheat – and I guess some may – this is, after all, a hobby and most of us work toward awards to be proud of as the real accomplishment, not the paper.

Limitations of QRP

QRP is fun. Like so many things in amateur radio, surely QRP operation is done most of all because it is FUN. Yet, there are some disadvantages (perhaps better called limitations) to being 100% QRP, just as there are to running high power, so let's take a look at some of these.

More Skill is Required – I often compare QRP operations to hunting with a handgun. You won't likely get as much game as you would with a rifle or shotgun; it requires perhaps more skill in camouflage and tracking (you have to get closer!), you might not shoot as often, and you may also miss a little more often, but when you do bag something, you will feel pretty good about your accomplishment!

QRP May be Limited for Some Needs – While hunting with a handgun as mentioned above is an option, I would not want to hunt a Cape Buffalo or Grizzly with a handgun... any handgun! Likewise, while QRP can snag a log full of DX, it might be a stretch to try to operate QRP while serving as Net Control Station for a major national or state traffic net on a regular basis, or at times when interference and conditions are not the best. Why make other stations strain to hear you? Long, round-table rag chews on 75 meters or 40 meter SSB might also be a stretch using QRP.

In short, just realize the limitations for the

QRP OPERATING FREQUENCIES

Band (M)	CW (MHz)	SSB (MHz)
160	1.810 (USA)	1.910
	1.843 (Europe)	
80	3.560	3.985
		3.690 (Europe)
60	7.070 (USA)	5.3465 CH2 (USA)
		7.285
40	10.106	7.090 (Europe)
		10.116
30	14.060	14.285
20	18.096	21.385
17	21.060	21.285 (Europe)
15	24.906	28.885
12	28.060	28.360 (Europe)
10	50.096	50.185
6	144.060	144.285
2		



Ten Tec R4020 – a two band CW transceiver made in China to Ten-Tec specs and backed by Ten-Tec. The 4020 covers 40 and 20 meters plus 5-16 MHz shortwave for \$250 and is ready for action out of the box. (Photo courtesy of the author)

modes, frequencies, and tasks at hand when using QRP. Nothing works all the time in every situation, although if you are smart and a good operator, you can mitigate those situations.

QRP May Not Be as Comfortable as QRO – Tom Cruise said in the movie *Top Gun*, "I Feel the Need for Speed." There was no way he was going to be happy flying a "transport out of Hong Kong." You may be that kind of operator! Low power just isn't going to scratch your itch, and that's fine, but you might try some QRP operation with a small second or third rig, or turn your big rig down to 5 watts just to see what it's like. It might be good training in case you had to do so in an emergency.

If you don't want to give QRP a try but you do wonder how well it really works, spend a little time listening to the QRP frequencies to see what you hear. It might surprise you when you copy a station running 5 and 9 on PSK31 or CW using only a half watt! QRO and QRP don't have to divide amateurs into two opposing camps... we can do both!

Modes and Rigs

CW and Digital Modes Dominate QRP – Using CW or one of the digital modes may or may not be a limitation for you. CW transceivers are simpler and easier to build, so there are great designs for little QRP rigs. If you are a no-code or little-code amateur, QRP can be a great place to practice and get your code speed up. Most QRP CW operators are more than willing to slow down and make a contact with you to help you progress in your code speed. Hey, we all started once upon a time, too!

Still, if you don't do CW at all but want to try QRP, consider using a low power SSB rig on a digital mode such as PSK-31. This mode is downright amazing in what it can do using very low power. Most PSK-31 operators seem to be using less than 25 watts on a regular basis, in part because it keeps them from taking up so much of the spectrum, and in part because the digital mode is a continuous transmit mode, so you need to run modern SSB and CW transmitters on lower power to avoid damaging your rig. Experience has shown that normal operations

with 5 watts or less on PSK-31 can provide contacts about as fast as you can make them!

SSB is certainly not to be ignored as a very viable QRP mode. While signal reports may say something like, "You are not real strong here, but you are Q5," this is quite satisfactory to make contacts. Remember that a Q5 S6 DX report counts just as much as a Q5 S9+20 report and you still retain all of the QRP set up advantages.

A World of Equipment for QRP – If you don't follow QRP activities and equipment, you may think there is not much QRP gear out there for interested amateurs to consider. A quick look at eHam Reviews (eHam.net) under QRP will show you about 139 current and older QRP specific rigs listed, and these are just the QRP transceivers that have been reviewed! In short, there really is something for everyone from the smallest rig for backpacking and tinkering to the full featured, all mode, all band, do everything QRP rig that is at home camping, mobile or in the shack.

Let's take a look at just a few of the available QRP rigs from the simplest to one with all the bells and whistles.

Rock Mite – Small Wonder Labs

For a low cost, minimalist, easy to build, yet very capable unit, consider the Small Wonder Labs Rock Mite (<http://smallwonderlabs.com/Rockmite.htm>) which can be purchased for 80, 40, 30, or 20 meters. It is a 2" x 2.5" circuit board with all circuit parts and fits in either a custom enclosure or an Altoids® tin. It provides you a 1/2 watt CW transceiver on one frequency of your choice with a hot receiver and it is powered by flashlight batteries. Cost is \$29 plus \$16 for the control/knob accessory pack if you need it. With over 8,000 sold, these little rigs are everywhere!

OHR-100A – Oak Hills Research

Moving up in cost (and features) check out the Oak Hills Research 100A single band 4-5 watt CW transceiver (www.ohr.com/ohr100a.htm). Simply select a kit for 80 to 15 meters and you get a 70 kHz to 80 kHz tunable receiver, stable VFO, metal enclosure and a host of options to choose if you wish to add to the basic radio. You can even get this kit assembled by OHR. Basic kit cost is \$149 and the assembled model is an additional \$95.

Elecraft K1– Elecraft

The Elecraft K1 is another radio with an excellent reputation as a high quality, extremely capable, QRP CW transceiver. At 2.2"H x 5.2" W x 5.6"D, it is very small, but beautiful in appearance and to operate, according to users. It comes as a basic 2 band kit for \$299.95 or as a 4 band model for \$399.95.

Ten Tec R4020 – Ten-Tec

A two band CW transceiver made in China to Ten-Tec specs and backed by Ten-Tec, this



Flex 1500 from FlexRadio offers ready-made QRP in a Software Defined Radio (SDR) format for \$650. (Courtesy: FlexRadio Systems)

The SDR QRP Option

There's a new breed of QRP rig on the air, and it combines the best of traditional low power transceivers with the latest in computer Software Defined Radio (SDR) options. These rigs have advantages over traditional QRP rigs in that they have far more capability in terms of frequency accuracy and general coverage shortwave reception, but they require a connection to a computer. For portable work, a laptop is required.

A number of single-band, ready-made and kit QRP SDRs that simply plug into a USB port have appeared over the last few years and have been well received, but they have sold out and are no longer available. You can read reviews of all QRP transceivers from hams around the world here: www.eham.net/reviews/products/22

little radio is a recent QRP offering that seems to be doing very well. With a footprint no larger than a standard QSL card, this rig has built in digital display, keyer, recordable messages, RIT, and an internal battery box (8-AA batteries). It is fully assembled and tested for operation on 40 meters and 20 meters. (The companion model R4030 provides 40 and 30 meter operation.) The R4020 also provides limited shortwave broadcast receive capability tuning 5-16 MHz. At \$249, it is a ready to go out of the box as a nice little two-band QRP rig.

Elecraft K2 – Elecraft

Moving up toward the higher priced QRP transceivers is the Elecraft K2. This is another radio with an outstanding reputation among discriminating users. It is a CW-only kit (SSB can be added as an option) and offers two VFOs, multiple memories, split TX/RX operation, RIT/XIT, full break-in CW, and a memory keyer. Its receiver is reported by users to be exceptional. Additional options provide 100 watt capability if/when you desire the extra power, a 160 meter or 60 meter module and a host of filters, tuners, noise blanker, etc. Weighing only three pounds and in a 3" x 8" x 8" package, it is a lot of quality radio in a very small size. The basic price for this kit is \$739. See it at: www.elecraft.com/.

FT-817ND – Yaesu

When anyone says they want a commercially built, truly full featured, all mode, all

band, do everything QRP radio just like the "big boys," the 5 watt CW 10 watt SSB Yaesu FT-817ND quickly comes to mind. Physically this radio is no larger than a small 2 meter rig, but the radio operates all bands from 160 meters to 440 MHz and provides an all mode capability to include SSB, AM, CW, FM, PSK-31, RTTY, and Packet. It has a host of "big rig" features accessible via a large number of display menus. It will run nicely on its included "wall wart" external 12VDC power supply or internal batteries which are also included along with a plug in battery charger. The price for all this is a very reasonable \$680. There are also a number of third party accessories available for the 817. Visit Yaesu's home page at: www.yaesu.com/

It must be repeated that the radios mentioned here are just a few of the excellent radios available to the amateur community. Space doesn't allow us to mention more. Do your homework, shop around, read the reviews, browse the net, and see what might look like a good addition to your shack. Don't discard the option of getting nice pre-owned gear either. Be assured, there are a number of rigs out there that will meet your needs as to cost, capabilities, and features.

Join the QRP Community

If this article interests you enough to test the waters of QRP, there are several QRP organizations available to help you learn more and enjoy this facet of amateur radio. One organization you will certainly want to consider is the QRP Amateur Radio Club International. www.qrparci.org. This club provides a nice quarterly magazine totally oriented to QRP operations. It includes articles about QRP construction, access to QRP Awards, badges, pins, contest information, QRP news, reviews, QRP links and more. If you decide to join the group, make sure you note your QRPARCI "number," as it is often exchanged with other QRP operators for awards and contests.

In addition to the QRPARCI, give a look at www.qrpme.com and www.norcalqrp.org. These two QRP groups offer an abundance of ideas and info concerning QRP operation. In particular, both groups have some great kits and parts available to make QRP construction and building both fun and easy.

Be sure to ask around in your local club, among your on-the-air friends, and in your state or area to see if there is a QRP group active near you. If so, they surely would welcome you into their ranks and be available to help you with questions that might arise.

QRP operation is a worldwide interest with many dedicated and excited operators across the globe. This makes it even more fun when you make a contact and exchange information and QSL cards with another QRP operator. To make it easy to find those of like interest, there are QRP calling frequencies established (see side bar) that act as "Watering Holes" for QRP. Just fire up your low power rig and see who you can hear – and better yet, see who you can work on QRP. We are listening for you!

Antennas for Amateur Radio

Coping with space limitations and matching the mismatches

By Bob Grove W8JHD

Ah, spring, the season where radio hobbyists start thinking about new antennas! In my case such a consideration first became obvious when all of my strong local AM broadcast and shortwave signal strengths dropped to nearly nothing. Naturally, that happened on one of the coldest days of winter!

Shivering noticeably, I attached a 47 ohm resistor across one end of my coax and touched the prods of my ohmmeter to the other end. 1 ohm! Obviously, something was amiss; it was a dead short circuit. It turned out that a tiny piece of coax shielding had touched the center conductor of the coax where I had soldered a lead to my wire antenna element.

A few frigid moments later I finished the repair and dragged myself back indoors to thaw my blue fingers. But more recently, with weather more cooperative, we can consider plans for antenna improvements for transmitting and receiving in the high-frequency shortwave spectrum, 1.8-30 MHz.

Dawn of the Coax

In the early days of radio, single-wire feeds were used to couple antennas to receivers and transmitters alike. While that does work, such unshielded lines actually become part of the antenna itself, picking up electrical noise in the environment. They can't brush up against moisture or metal, make sharp bends, or curl around corners without messing up the efficiency of the system.

During the 1950s, TV twin-lead, and its superior cousin, ladder line (also known as "window line"), were commonly used as transmission lines for radio communications. These flat "ribbons" were more tolerant of impedance mismatch (which we shall discuss shortly), but still had to be run in the open to avoid bending and coming close to conductive surfaces.

Even so, they worked with vacuum-tube transmitters which could stand the high voltages produced by voltage reflections from poorly-



300 and 450 ohm ladder line for antenna construction comes in 100 foot rolls and cost around \$20. (Courtesy: Universal Radio)



300 ohm twin-lead, while hard to find at most Radio Shack stores is still available at 20 cents per foot from Universal Radio. (Courtesy: Universal Radio)

impedance-matched antenna systems. At about the same time, coaxial cable, which came into military prominence during World War II, found its way into amateur radio and other domestic communications.

While less tolerant of impedance mismatch, coax is now the de facto standard for transmission lines. Solid state electronics replaced vacuum tubes, and their lower working voltages forbade the high voltages that could be present on transmission lines. Impedance matching is now a critical part of design for transmitting antenna systems.

Questioning an Old Axiom

Does a good transmitting antenna always make a good receiving antenna? Yes.

Does a good receiving antenna always make a good transmitting antenna? No.

Good transmitting antennas efficiently radiate virtually all the energy sent to them by the transmitter. The corollary is that such antennas will also efficiently redirect all their intercepted signals down to the receiver.

But does a good receiving antenna necessarily efficiently radiate all the energy sent to it by the transmitter? Let's take for example a simple, end-fed, random wire for shortwave reception.

If you string a 100-foot length of wire

from your roof to a nearby tree and feed it with coaxial cable, it will give you dandy shortwave, longwave, and AM broadcast band reception.

But, hook a transmitter to it and much of your transmitted power will be wasted heating the coaxial cable on most ham bands. That's not an efficient system.

Fortunately, we can correct the problem with a transmatch, as we shall discuss shortly. But clearly, this antenna can't stand alone as a good transmitting antenna.

The Ubiquitous Dipole

In the annals of antenna history, no antenna is mentioned more than the horizontal dipole, or "flattop," and with good reason. It's easy to design, cheap to make and works very well. The term "dipole" itself simply means it has two parts, the left and the right side of its feedpoint (transmission line attachment).

The radiation and reception pattern would be in the shape of a fat donut with the wire antenna through the hole at right angles to the donut; in other words, at right angles to the axis of the wire. Transmission and reception in the direction of the ends of the antenna is, for all practical purposes, zero.

Dipoles are usually fed at the center for one good reason: If it's a half-wavelength long at the intended frequency, it matches the impedance of typical coaxial cable – approximately 50 ohms. Even 70 ohm outdoor TV coax like RG-6/U works well, and it's 100% shielded for less environmental electrical noise intrusion.

So who cares? With a transmatch ("antenna tuner"), we can make a nice, smooth, 1:1 impedance match with a dipole of virtually any length, right? Wrong.



Older transceivers without built-in tuners could benefit from MFJ'S 993B automatic antenna tuner (\$240). (Courtesy: Universal Radio)



MFJ-926B remote automatic antenna tuner (\$269) matches your feedline to the antenna at the antenna, not at the back of the rig. (Courtesy: Universal Radio)

The “conjugal match” between the transceiver and the antenna system merely provides a 50 ohm non-reactive load for the radio, but the antenna itself is still just as mismatched to the coax as it was. Reflected power will still produce standing waves (high voltage points) which waste power heating the insulation in the cable.

Voltage standing wave ratios (VSWR, often shortened to SWR), of up to 3:1 are usually tolerable with the use of low-loss coax like RG-8/U foam, RG-213, or Belden 9913, but the mere presence of high VSWR can trigger a transceiver automatic limiting circuitry to lower its output power.

There are more variables than simply the length of the antenna which determine the final impedance. Height above ground is a prominent determinant of feedpoint impedance for a half-wave horizontal dipole.

For example, an 80 meter dipole (3.5-4.0 MHz) has a convenient 50 ohm center feedpoint impedance so long as it is at an elevation of roughly 100 feet, but at appreciably lower elevations its impedance starts to rise toward a 2:1 VSWR, still quite usable.

The close proximity of reflective objects (buildings, trees, ground) can also affect feedpoint impedance, especially at the lower frequencies (longer wavelengths). And finally, as you tune from one end of a band to another, that also changes the feedpoint impedance.

A transmatch is a good investment; however, in order for it to correct the mismatch at the antenna, it would have to be physically located at the antenna feedpoint. This way, the 50 ohm transmission line is connected to the 50 ohm connection at the radio, providing a smooth ride to the antenna itself, and the antenna mismatch can be corrected by properly adjusting the transmatch right at the antenna feedpoint.

Of course our theoretical antenna feedpoint is way above the ground, so how are we going to tune the transmatch? There are remote tuners available commercially, and some are autotuned, requiring no manual adjustments. But they are expensive.

A common alternative is to allow the mismatch at the antenna feedpoint, but use the lowest-loss transmission line you can afford to minimize the power loss from high VSWR. You would still need the transmatch next to the rig to minimize the VSWR there. If you have a transceiver with a built-in autotuner, so much the better.

The simplest way to deal with antenna impedance mismatch is to allow it. While this may seem counter-intuitive, it must be remembered that signal loss is due to power wasted heating the insulation of the transmission line. If we can reduce that loss, we can radiate more of our power.

Select a convenient dipole length; the choice isn’t critical. Many hams select the 65 foot 40 meter half wave, but shorter or longer is just fine. Near its center attach a transmission line consisting of an open pair of parallel wires widely separated by porcelain, glass, or resin insulators. The loss is minuscule, and the match at the radio can be controlled by a transmatch. Even the reflected power coming back down the line is eventually radiated by the antenna. It’s a virtually lossless system, preferred by many hams for portable multiband operation during emergencies and Field Day, and it makes a dandy permanent antenna as well.

Another compact possibility is the trap dipole, typically a shortened 40 meter dipole interrupted on each side by parallel coil and capacitor in line with the wire element. The combination of wires, capacitors, and inductors allows several resonant frequencies, usually 80, 40, 20, 15, and 10 meters.

Boosting that Signal

How does your transmitted signal improve with a better antenna compared with simply boosting power with a linear amplifier? For your signal to be heard one S-unit stronger, that’s a boost of 6 dB (decibels) – the equivalent of quadrupling the power.

Thus, you can radiate one S-unit higher signal strength by switching from a half-wave dipole antenna to a four-element beam, or by attaching a 400 watt linear amplifier to your 100 watt transmitter.

Takeoff Angle

It would be nice if we could simply assume that pointing a directional HF antenna toward the horizon would result in a zero radiation angle with respect to the Earth’s surface. But phase relationships from ground re-

flections elevate the takeoff angle.

The resulting takeoff angle is a mix of near-field considerations like frequency (wavelength), initial angle of the radiation from the antenna element(s), and height above ground.

In the far field, waves may reflect and recombine in or out of phase, thus enhancing or diminishing the signal strength in some planes. Propagational effects of the atmosphere and the ionosphere absorb, reflect, and refract the waves.

Variables of the Wire Dipole

The thicker the element, the less the feedpoint impedance changes as frequency is changed. In that respect, copper tubing would be preferred over thin hookup wire for a dipole antenna.

Solid bar, the same diameter as the tubing, would show absolutely no improvement over the tubing since radio frequency (RF) energy travels only a tiny percentage below the surface of the conductor, a characteristic known metaphorically as “skin effect.”

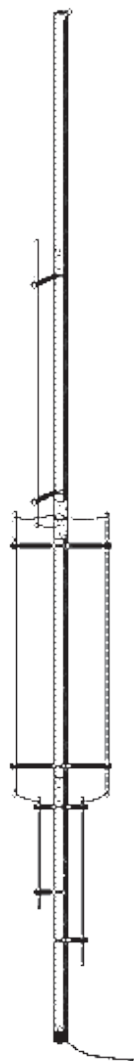
A half-wave dipole not only matches coax impedance well at its fundamental design frequency, but at odd harmonics (multiples) as well; thus, a 66 foot dipole used on the 40 meter band (7.0-7.3 MHz) repeats that impedance on its third harmonic, the 15 meter band (21.0-21.45 MHz).

The math is simple for calculating the fundamental length: divide 468 by the center frequency in megahertz of greatest interest. The answer is in feet. As in the example above, 468 divided by 7.1 MHz is about 66 feet.

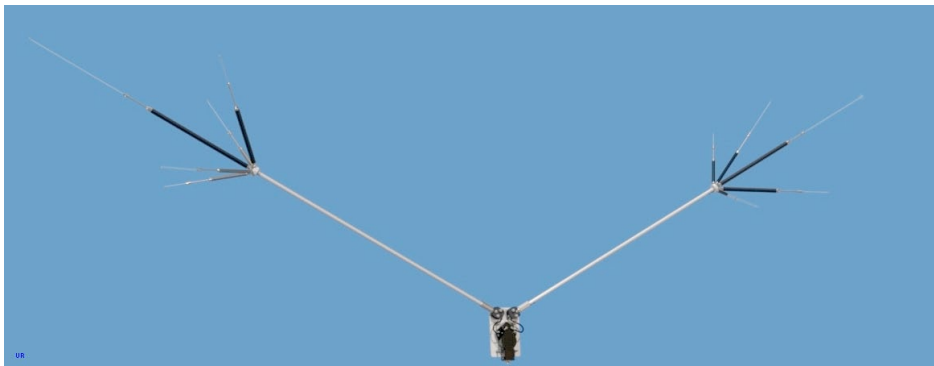
Another trick is to construct a “fan” dipole of multiple elements that all interconnect at the feedpoint, but gradually separate out at the ends. If the elements are all the same length, that helps maintain a steady impedance throughout a given band. If the elements are of considerably different lengths, then the antenna becomes a multi-band dipole.

But just because a multi-band dipole is properly impedance matched and at the right height doesn’t guarantee its directivity. The longer a dipole is, in terms of wavelength at a given frequency, the more the original “donut” shape of the emitted wave breaks up into multiple lobes. And those lobes tend to radiate more toward the

ends of the wire rather than at right angles to the wire’s axis.



Cramped for space? GAP’s complex-looking Challenger DX vertical antenna (\$368) will cover 80-2 meters and require a minimum of real estate to do it. (Courtesy: Universal Radio)



Comet CHV-5X (\$320) rotatable dipole is only 13 feet across and covers 40 through 6 meters. Use it for restricted locations where using a full-sized dipole is not possible. (Courtesy: Universal Radio)

Taking Aim

Plotting the pattern of a dipole antenna is done on a globe, not on a flat, dime store map. Using a piece of string, place one end on the globe where you live. Stretch the other end to the country(ies) or continent of greatest interest. That will reveal the true bearing(s) for your antenna.

Remembering that the pattern of a dipole is equal off both sides of the axis, you will simultaneously favor the desired direction and the 180-degree opposite direction.

If you have adequate real estate, you may wish to erect two dipoles at right angles to one another, each with a separate feedline, and switch between them for 360 degree coverage. Several manufacturers offer manual switches which work well for this task. These are available for maximum amateur power and are suitable up to 30 MHz and some up to several hundred megahertz for VHF/UHF communications.

Of course the operator still needs two separate coax lines running down to the interior switch. A single antenna relay could be placed where the two dipoles cross, allowing the use of a single coax line. A separate pair of smaller wires can be taped to the coax line and soldered to the relay solenoid for remote switching.

But how can we configure a dipole so it is unidirectional, thus concentrating its energy in one compass direction? Well, we can't. But we can make it *favor* one direction – somewhat.

Beams for HF

At the higher frequencies – VHF and UHF – rotatable beam antennas are quite practical. Their shorter wavelengths allow for shorter elements and closer spacing. But at HF, such proportioning becomes unwieldy. A three-element Yagi on 80 meters would take up some 18,000 square feet of space, and how are you going to hold it up? Don't even think of adding parasitic elements!

Sure, the military has some of these monsters for intercontinental base-to-base communications, but the average radio hobbyist would have a bit of a problem mechanically, financially, and neighborly!

But the upper end of HF – 20 meters and up – can be handled. In fact, it's quite common for multiband arrays to interlace several different elements on one boom, allowing automatic selection as the multiple antenna receives power at different wavelengths.

Beam antenna elements are invariably made of aluminum tubing; it's lightweight and conductive enough to handle RF power efficiently.

The singular exception to this challenge

is the wire beam, an array of three (or more) parallel wire elements following the design elements for a driven element, a reflector, and one or more directors.

Even then, such an array would have to be on high masts to avoid ground reflection which elevates the pattern, thus shortening the path toward the target area.

Sloping

A modicum of directivity – typically 3-6 dB – can be obtained at the lower frequencies by dipping one end of the dipole toward the ground. This is usually about a 45-60 degree angle from being horizontal.

Equally important are the distance from a metal support mast and the height above the ground of the lower end.

While a sloper does have gain in a preferred direction when compared to its other directions, that gain is not as high as it would have had if left as a bi-directional, horizontal antenna.



Hy Power off-center fed dipole (\$130) covers 80 through 6 meters and is 135 feet long. (Courtesy: Universal Radio)



Alpha Delta Communications' ready-made wire antennas come in a variety of designs including slopers and dipoles, trapped and untrapped for 160 through 10 meters. They range in price from \$100 to \$189 and size from just 60 feet to 110 feet. (Courtesy: Universal Radio)

Attic Antennas

While always a bad idea, indoor antennas are sometimes the only choice, especially in deed-restricted neighborhoods. If you must put an antenna indoors, put it in the attic away from electrical wiring and adjacent air ducts.

Few of us have the luxury of a 134 foot home in which to install a full length, 80 meter, half-wave dipole. But wire antennas can be bent dramatically to conform to their environmental limitations. They can be shaped to line the perimeter of the four walls.

As a general rule, route the wire so it never turns back on itself more than 90 degrees (a right angle bend). While not as predictable as a straight length, the results are frequently satisfactory.

Because of the unpredictability of their final feedpoint impedance, such configurations are most satisfactorily fed by twin-lead rather than coax to a transmatch. And if you're not particularly concerned with directivity, such an installation lends itself to multiband operation.

Nearby wiring does pose a problem, not

just because it can radiate electrical appliance noise into the adjacent receiving antenna, but because random, close-by wiring is parasitic in nature. Depending upon their lengths, they absorb and reflect radio signals emanating from and arriving toward the communications antenna. Copper and iron pipes, sheet metal ducting, and aluminum siding can do the same thing.

Verticals

So far we have only discussed horizontally polarized antennas. Verticals have a well-earned place as well. They can be mounted right at ground level and many require only one support at the base. But don't mount one right against the house or you'll invite electric noise and signal reflections and absorptions.

While it's possible to simply take a dipole and mount it vertically, this requires additional suspension, and the center-fed transmission line should lead straight outward for a considerable distance to avoid distorting the pattern. This is awkward.

Far more practical is to substitute a "counterpoise" for the lower half of the antenna, allowing the single mount support and the coax to lead out along or even below the ground. A counterpoise is nothing more than a conductive mass of metal or wires substituting for the missing lower part of the dipole. Often called a "ground plane," it is frequently made of four equally spaced, quarter-wavelength wires lying on or slightly below the ground and connected to the coax shield at the base of the antenna.



CushCraft A3S three element HF Yagi beam antenna (\$560) for 20, 15 and 10 meters concentrates your signal in one direction. (Courtesy: Universal Radio)

The vertical element is often a quarter wavelength at the fundamental frequency. To make it shorter, one or more loading coils may be used to add inductance, lowering its resonant frequency.

This same construction is commonly seen for VHF and UHF applications on rooftops with four drooping radial elements made of aluminum tubing or rod protruding from its base.

But getting back to HF verticals, why can't we simply attach the coax shield to a ground pipe at the base of the antenna? After all, don't we refer to "grounding" in radio?

The fact is that soil doesn't make a good, conductive ground plane. Sand is the worst. The ideal ground plane consists of 120 wire radials, each 0.4 wavelength long. But few of us can afford the real estate or the patience for that large of a ground plane installation.

Almost as effective – within 3 dB – is a field of 16 0.1 wavelength radials. The wire

gauge is not critical; as thin as #18 or #20 is perfectly satisfactory if no one is likely to drive over it.

While elevated ground-plane antennas are quite practical at VHF and more so at UHF, their quarter-wavelength elements would be cumbersome at the lower HF frequencies. But there is a way around this.

A short element may appear electrically long enough if it is connected in series with a loading coil. The inductive reactance of the coil cancels the capacitive reactance of the shortened antenna, appearing electrically as a quarter-wavelength element.

Such a length reduction is useful for both elevated and ground-mounted verticals.

Multiband Verticals

Any radiating antenna element may be considered multiband if it is tuned by a transmatch, regardless of its horizontal or vertical polarization. Since we've already talked about horizontal multiband operation, let's take a look at single, vertical, multiband radiators.

If we replace one half of a dipole with a ground plane, we have a monopole. This is the basis for most vertical radiators including mobile whips. A problem with HF monopoles is that their large size dictates ground mounting, and electrically resistive earth equates with lossy signal radiation.

However, trap dipoles are shorter than full-size flattops. They can be vertically suspended from a convenient tree limb, allowing easy installation and multiband operation in portable, emergency, and contest deployments.



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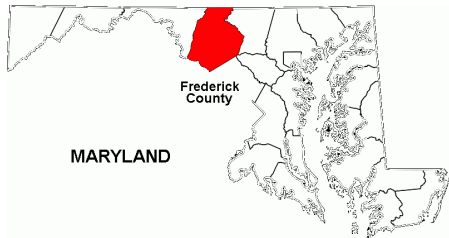
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Not All Change is Bad

Changes to radio systems can be driven by many factors. New rules and regulations may be just as likely as new technology to cause scanner listeners to update their hardware. This month we take a look at two Maryland counties whose public safety communications have been modified for two very different reasons and we examine a request to expand the usefulness of some under-utilized frequencies.

Frederick, Maryland

Frederick County, Maryland is located in the northwestern part of the state, bordering both Pennsylvania and Virginia. It is home to about 230,000 people and includes the Camp David presidential retreat and the U.S. Army's Fort Detrick.



Frederick County operates a Motorola Type II analog trunked system serving public safety and other municipal users. In February, the Division of Emergency Management issued a public memo to "all users of radio scanners who monitor Frederick County Government's 800 MHz trunked Radio System." The memo includes the notification that

Personnel with "trunk-tracker" scanners should expect to have to adjust their scanners in accordance with the manufacturer's instructions to accept the new frequencies listed in the outlined columns below.

In a demonstration of enlightened public service and in stark contrast to other jurisdictions that try to hide information about their radio system, the Frederick County memo goes on to list the following frequency changes:

Pre-Rebanding	Post-Rebanding	Type
866.6125	851.6125	Voice
866.9125	851.9125	Voice
868.4750	853.4750	Voice
868.7500	853.7500	Voice
860.4875	856.1375	Control/Voice
856.4875	856.4875	Voice
857.4875	857.4875	Control/Voice
858.4875	858.4875	Control/Voice
859.4875	859.4875	Control/Voice

To summarize, the current frequencies used by the Frederick County system are 851.6125, 851.9125, 853.4750, 853.7500, 856.1375c, 856.4875, 857.4875, 858.4875 and 859.4875 MHz.

Rebanding

These frequencies changed under a process called *rebanding*. As we've covered in previous *Scanning Report* columns, different types of users share the 800 MHz band. On one side are the public safety agencies, which typically use a small number of relatively high power repeater sites. On the other side are commercial operators like Nextel, which operate numerous cellular-type sites at somewhat lower power.

The original frequency assignment plan for the 800 MHz band mixed these two types of users together, placing low power and high power operations on adjacent channels. As commercial operators grew more successful and built up their networks, instances of significant interference became commonplace. Finally, in 2004 the Federal Communications Commission (FCC) established a new assignment plan for the 800 MHz band that put each type of user in their own separate block of frequencies.

This reconfiguration plan requires that users who are not operating in the correct block must give up their old operating frequencies and begin using new ones. This change in frequencies is called rebanding, since users must switch from an old band or block of frequencies to a new band.

Frederick County Talkgroups

The Frederick County system talkgroups include the following:

Decimal	Hex	Description
16	001	Sheriff (Dispatch)
48	003	Sheriff (Alternate Dispatch)
80	005	Sheriff (Tactical)
112	007	Judicial Services
144	009	Multiple Agency 1 (Interoperability)
208	00D	Criminal Investigations Section
240	00F	Sheriff (Command)
272	011	County Permitting
304	013	Construction Management
336	015	County Water and Sewer
368	017	Sediment Control
624	027	County Health Department
656	029	Animal Control
688	02B	County Parks and Recreation
720	02D	County Maintenance
752	02F	Fleetwide
816	033	County Highway 1
848	035	County Highway 2
880	037	TransIT Bus Operations
912	039	County Landfill
1008	03F	County Fire Marshal
1072	043	School Emergency Notification System
1616	065	School Resource Officer (SRO)
1648	067	Sheriff (Administration)
1680	069	Sheriff Traffic Operations
1712	06B	Sheriff Special Services Team (SST)
1776	06F	Sheriff Special Assignments
1808	071	Sheriff (Dispatch Three)
1840	073	Sheriff (Priority Calls)
1872	075	Maryland State Police (Operations)
1904	077	Maryland State Police (Tactical)
1968	07B	County Fire (Patch to Police)
9616	259	TransIT Paratransit
16048	3EB	County Fire (Dispatch)
16016	3E9	County Fire (Administration)
16080	3ED	County Fire Tactical 30
16112	3EF	County Fire Tactical 31
16144	3F1	County Fire Tactical 32
16176	3F3	County Fire Tactical 33
16208	3F5	County Fire Tactical 34
16240	3F7	County Fire Tactical 39
16272	3F9	County Fire Tactical 40
16304	3FB	County Fire Tactical 41
16336	3FD	County Fire Tactical 42
16368	3FF	County Fire Tactical 43
16400	401	County Fire Tactical 44
16432	403	County Fire Tactical 49
16464	405	County Fire Tactical 70
16496	407	County Fire Tactical 71
16528	409	County Fire Tactical 72
16560	40B	County Fire Tactical 73
16592	40D	County Fire Tactical 74
16624	40F	County Fire Tactical 79
16656	411	County Fire Tactical 80
16688	413	County Fire Tactical 81
16720	415	County Fire Tactical 82
16752	417	County Fire Tactical 83
16784	419	County Fire Tactical 84
16816	41B	County Fire Tactical 89
16848	41D	County Fire Tactical 20
16880	41F	County Fire Tactical 60
16976	425	County Fire Training 90
17008	427	County Fire Training 91
17040	429	County Fire Training 92
17072	42B	County Fire Training 93
17104	42D	County Fire Training 94
17136	42F	County Fire Training 99
17168	431	County Fire Enforcement
17200	433	Emergency Medical Service Call 1
17232	435	Emergency Medical Service Medical 4
17264	437	Emergency Medical Service Medical 8
16912	421	Emergency Medical Service Tactical 10
16944	423	Emergency Medical Service Tactical 50
32016	7D1	Law Enforcement Mutual Aid 1
32048	7D3	Law Enforcement Mutual Aid 2
32080	7D5	Emergency Operations Center (Officials)
32112	7D7	Emergency Operations Center (Staff)
32144	7D9	Multiple Agency 2 (Interoperability)
32176	7DB	Multiple Agency 3 (Interoperability)

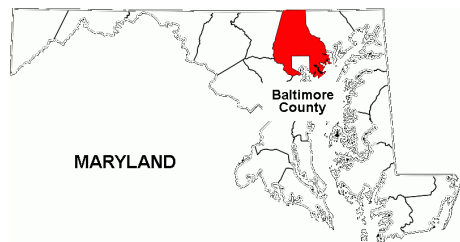
There are also a number of active conventional (non-trunked) analog frequencies in the county.

Frequency	Description
46.42	Fire Channel 1 (Mutual Aid)
46.34	Fire Channel 2 Pager Alert (Main Fire Simulcast)
46.24	Fire Channel 3 (Mutual Aid)
46.44	Fire Channel 4 (Aircraft patch to trunked radio system)
154.280	Fire Mutual Aid (F-MARS)
153.845	Fire Pager Alert (Main Fire Simulcast)
462.975	County Medical to Frederick Memorial Hospital
463.000	County Medical to Frederick Memorial Hospital
463.100	County Medical to Frederick Memorial Hospital
463.125	County Medical to Hospital (Med-6)
868.0125	Fire Talk-Around (I-Tac 4)
858.0875	Sheriff Talk-Around
857.0875	School Buses (Dispatch)

The City of Frederick Police Department operates a separate Project 25 digital system on four frequencies: 490.6625, 494.3125, 494.3625 and 494.4125 MHz. Reports indicate all the traffic on this system is encrypted.

❖ Baltimore County, Maryland

Also in February, Baltimore County in north central Maryland went live with several significant emergency communications upgrades. Located east of Frederick County, between the City of Baltimore and Pennsylvania, Baltimore County has more than 800,000 residents and covers more than 680 square miles.



The upgrades came with a \$76 million price tag, including \$18.5 million for a state-of-the-art 911 public safety answering point (PSAP) dispatch center. Just over \$5 million came from federal grants, while the rest was paid for directly by county residents.

The most obvious change for scanner listeners was the replacement of the county's 20-year-old analog trunked system with one based on Project 25 (P25) technology. The new digital system has 10 new repeater sites, added as part of the upgrade to the existing eight. The total of 18 repeater sites are divided into two zones: 15 sites comprise the main zone and support the majority of the county, while three sites form a northern zone to provide coverage near the Pennsylvania border.

Zone	Frequencies
Main	854.0375, 856.2125, 857.1125, 857.9625, 858.2125 MHz
North	854.0125, 854.0625, 854.0875, 856.4625, 856.6875, 858.1125 MHz

Although the new system does have encrypted channels, the Baltimore County Chief of Police has promised that "Citizens with scanners will still be able to listen to the

normal daily dispatches. The encrypted channels would only be for sensitive information."

Baltimore County Talkgroups

The Baltimore County system includes the following talkgroups. Note that the hexadecimal values listed here are computed differently than the more familiar Motorola values, due to the fact that the new system is a "pure" Project 25 system, meaning it uses a 9600-baud control channel as specified in the P25 standards, rather than the older 3600-baud Motorola format.



Decimal Hex	Description
9410	24C2 Sheriff (Dispatch)
9411	24C3 Court Security
9420	24CC Detention Center A
9421	24CD Detention Center B
9422	24CE Detention Center Maintenance
9440	24E0 School Security
9441	24E1 School Busses
9450	24EA County Fire (Dispatch)
9451	24EB County Fire (Central)
9452	24EC County Fire (North)
9453	24ED County Fire (East)
9454	24EE County Fire (West)
9455	24EF County Fire Administration
9456	24F0 County Fire Administration
9457	24F1 County Fire Supervisors
9458	24F2 Emergency Medical Services
9459	24F3 Facilities Management
9460	24F4 County Fire Announcement Call 10
9461	24F5 County Fire Tactical 11
9462	24F6 County Fire Tactical 12
9463	24F7 County Fire Tactical 13
9464	24F8 County Fire Tactical 14
9465	24F9 County Fire Tactical 15
9466	24FA County Fire Tactical 16
9467	24FB County Fire Tactical 17
9468	24FC County Fire Tactical 18
9469	24FD County Fire Tactical 19
9470	24FE County Fire Announcement Call 110N
9560	2558 County Fire Training 1
9561	2559 County Fire Training 2
9562	255A County Fire Training 3
9563	255B County Fire Training 4
9564	255C Fire-Rescue Academy
9577	2569 County Fire Volunteers
9578	256A County Fire Investigation
9579	256B Emergency Medical Resource Center (EMRC) Call 221
9580	256C Emergency Medical Resource Center (EMRC) 234
9581	256D Emergency Medical Resource Center (EMRC) 228
9582	256E Office of Emergency Management 1
9583	256F Office of Emergency Management 2
9600	2580 County Police (Wilkins Operations)
9601	2581 County Police (Woodlawn Operations)
9602	2582 County Police (Franklin Operations)
9603	2583 County Police (Pikesville Operations)
9604	2584 County Police (Towson Operations)
9605	2585 County Police (Cockeysville Operations)
9606	2586 County Police (Parkville Operations)
9607	2587 County Police (White Marsh Operations)

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9608	2588	County Police (Essex Operations)
9609	2589	County Police (Northpoint Operations)
9612	258C	Criminal Investigation Division
9624	2598	Regional Auto Theft Taskforce (RATT)
9634	25A2	County Police (Wilkins Tactical)
9635	25A3	County Police (Woodlawn Tactical)
9636	25A4	County Police (Franklin Tactical)
9637	25A5	County Police (Pikesville Tactical)
9638	25A6	County Police (Towson Tactical)
9639	25A7	County Police (Cockeysville Tactical)
9641	25A9	County Police (Parkville Tactical)
9642	25AA	County Police (White Marsh Tactical)
9643	25AB	County Police (Essex Tactical)
9644	25AC	County Police (Northpoint Tactical)
9652	25B4	County Police (Wilkins Detectives)
9653	25B5	County Police (Woodlawn Detectives)
9654	25B6	County Police (Franklin Detectives)
9655	25B7	County Police (Pikesville Detectives)
9656	25B8	County Police (Towson Detectives)
9657	25B9	County Police (Cockeysville Detectives)
9659	25BB	County Police (Parkville Detectives)
9660	25BC	County Police (Whitmarsh Detectives)
9661	25BD	County Police (Essex Detectives)
9662	25BE	County Police (Northpoint Detectives)
9683	25D3	Highways 1
9691	25DB	Highways 2
9695	25DF	Utilities 1
9698	25E2	Solid Waste Disposal
9700	25E4	Utilities 2
9701	25E5	Countywide Public Transportation
9707	25EB	Building Maintenance
9708	25EC	Animal Control
9710	25EE	Recreation and Parks
9850	267A	Event 1
9851	267B	Event 2
9852	267C	Event 3
9853	267D	Event 4
9854	267E	Event 5
9855	267F	Event 6
9856	2680	Event 7
9857	2681	Event 8
9858	2682	Event 9

❖ State of Maryland

While Frederick and Baltimore Counties are upgrading their respective systems, the State of Maryland has requested that the FCC allow the use of secondary trunking frequencies for communication between aircraft and ground units.

Maryland awarded a contract to Motorola for the design and installation of a statewide trunked digital radio system called FIRST (First Responders Interoperable Radio System



Team). The system build out plan has the state divided into four regions, with region 1 in the center of the state to be operational first. The State hopes to have the core area of region 1 up and running by the end of the year. Region 2 along the Eastern Shore is scheduled for activation by January 2013, while region 3 to the south and region 4 to the west will be brought on-line sometime later.

The system will operate in the 700 MHz band, using spectrum that was freed up when television broadcasters switched to digital operation. The FCC allocated 24 MHz in the 700 MHz band for public safety use, including 16 pairs of channels for trunking interoperability. These "secondary trunking" channels were originally intended to allow different agencies to communicate with each other during mutual aid events using 25 kHz wide trunking channels. The FCC later adopted the Project 25 standard for national interoperability channels, which require only 12.5 kHz wide channels, leaving the usefulness of the secondary trunking channels in doubt. Indeed, to date no licenses have been issued for operations on the secondary trunking channels in the United States.

Thanks to the much greater range of aircraft transmissions due to altitude, there is a correspondingly greater risk that such transmissions would interfere with distant 700 MHz systems and limit the ability of those systems to use their assigned frequencies effectively. In order to avoid this type of interference, frequencies used by aircraft should not be the same ones used by regular ground-based radios.

The National Public Safety Telecommunications Council (NPSTC) submitted a supporting request to the FCC and identified the secondary trunking channels as the most appropriate for public safety aircraft voice operations, due in part to the high likelihood that the channels will be lightly used. They also recommended that 700 MHz transmissions from aircraft be limited to two watts of power, in keeping with the existing rules for low power operation.

If Maryland's request is granted by the FCC, public safety aircraft will be able to access the FIRST system and communicate directly with personnel on the ground, rather than having all of their messages relayed through one or more dispatchers. Maryland has stated that they will also encourage aircraft from other agencies and commercial air ambulance aircraft to interoperate with the Emergency Medical Systems Control center (SYSCOM).



❖ Dayton Hamvention

If it's May it must be time for the Dayton Hamvention®. The world's largest annual gathering of amateur radio operators and enthusiasts will be held this year from May 18 through 20 at the Hara Arena in Dayton, Ohio.

For first-timers, the sheer size and scope of the event can be surprising. Three days of technical forums, hundreds of indoor equipment exhibitors and thousands of outdoor flea market vendors can keep a person engaged and occupied the entire weekend, or at least until exhaustion sets in.

This year the technical forum topics include High Performance Software Defined Radio (HPSDR), Automatic Position Reporting System (APRS), Digital Smart Technology for Amateur Radio (D-STAR), Radio Signal Propagation, Foxhunting (finding hidden transmitters), High Altitude Balloons tracked via High Frequency (HF) radio, Antennas, and Kit Building.

Astronaut Douglas Wheelock, former commander of the International Space Station and licensed radio amateur, will speak on Saturday about his experiences with spaceflight and communicating with amateur radio in space.

Indoor vendors include Amateur Electronic Supply, C. Crane Company, DX Engineering, Down East Microwave, Flexradio, GRE America, Ham Radio Outlet, ICOM America, Kenwood USA, M2 Antenna Systems, MJF Enterprises, Mini-Circuits, RF Space, Ten-Tec, Yaesu-Vertex Standard, Universal Radio and Winradio, along with more than 200 other companies and individuals. If it's related to radio, they will more than likely be at Dayton.

Perhaps the most interesting area is the outdoor flea market. More than 1,000 "tailgate" sellers will have new, used and vintage radio, computer, and electronic equipment for sale in the parking lot surrounding Hara Arena.

Dress for variable weather, wear comfortable walking shoes, and plan on spending an enjoyable weekend with like-minded professionals and hobbyists. As they say, "If you can't find it at Dayton, you can't find it." More information is available on the official web site at www.hamvention.org.

That's all for this month. You can find me searching for vintage computers and calculators during Hamvention weekend; otherwise I'm available by electronic mail at danveeman@monitoringtimes.com. More information about system upgrades and other scanning topics can be found on my web site at www.signalharbor.com. Until next month, happy scanning!

	763	769	775		793	799	805		
	Public Safety Allocation				Public Safety Allocation				
	Broadband	G B	Narrowband	Commercial Allocation			Broadband	G B	Narrowband
	CH. 62	CH. 63	CH. 64	CH. 65	CH. 66	CH. 67	CH. 68	CH. 69	
	764	770	776	782	788	794	800	806	



DC Power Lines

MT reader Ralph Craig supplied an addendum to my March Q&A on differences between AC & DC. Ralph pointed out that there still are some direct current power lines in the U.S. They are not for distribution to individual customers, but to deliver power over long distances to distant grid points.

The voltage are enormous, 800,000 VDC for example, and are more efficient than AC for several good reasons including this one: With the distances involved, there would be a phase delay on an AC line that would be hard to track, but the DC would be constant.

An excellent treatment of this exception to the AC preference can be found at: http://en.wikipedia.org/wiki/Electric_power_transmission#High-voltage_direct_current

Q. I have an Eavesdropper short-wave dipole antenna in my attic. Instead of running it in a straight line, can I take each leg and run each at a different angle to each other? (Carl Harden, email)

A. Yes, so long as you don't close it into a V. That would start making it directional, nulling out some signals depending upon frequency and bearing.

Q. I heard short bursts of digital modulation on 154.570 and 154.600 MHz. Aren't these both MURS allocations? (J.J. Owens, NC)

A. Indeed they are, right along with 151.820, 151.880, and 151.940 MHz. The Multi-Use Radio Service (MURS) allows voice or data for direct intercommunication or remote control and telemetry. Continuous transmission is prohibited.

Q. I presently alternate between a sloper wire antenna and a CB ground plane for shortwave listening. Why does the vertical CB antenna often "hear" better than the wire? (Chris Lummis, Kingston, Ont)

A. There are several possibilities, including:

1. The vertical is omnidirectional while the wire sloper is directional, so signals can be higher on the vertical from certain directions which are nulled on the wire.
2. If the sloper faces your home or another source of electrical interference, that would make the noise level higher than an elevated vertical.

3. Signal strength readings can be misleading, since what you are really looking for is signal above the background noise. In other words, a weak signal on a quiet background will be more readable than a strong signal on a strong interference background, even though the latter will produce an elevated S-meter indication.

4. The relative placement of the two antennas may produce dissimilar signal strengths on different frequencies.

5. Polarization patterns may be different for the arriving signals on each antenna.

Q. We recently put in an "invisible fence" to keep our dogs from roaming. It consists of about 1300 feet of copper wire some six inches underground. If the end is connected by coax and run to my receiver, will it be an effective antenna for long, medium and short wave? (John Bishop, Hawthorne, FL)

A. Yes, that 1300 foot wire would make a good receiving antenna; the lower the frequency the better. Since it will probably be in sand, it will be outstanding at long wave and medium wave, very good at shortwave up to a few MHz, and gradually taper off at the high end of SW.

Q. Does an elevated horizontal dipole antenna receive as well as a vertical antenna at the same location and of the same size? (Jim, email)

A. Theoretically, yes, provided it is in the same polarization plane as the signal it is receiving. In other words, if a signal is being transmitted by a vertical antenna, then it's best received by a vertical antenna if you are getting the signal without reflections.

But on shortwave, listening to signals hundreds or even thousands of miles away, it doesn't make any difference because the polarization of those signals is mixed because of the repeated reflections and distortions over those great distances.

On VHF/UHF, where you are normally hearing signals at much shorter distances, beamed as a straight line from the transmitting antenna, your receiving antenna must be mounted in the same plane for strongest reception.

Q. Why are alkaline batteries only rated for voltage and not capacity,

as rechargeable batteries are? (Jim Rubin, KC2LMH)

A. This is a good question. I suspect it's twofold.

First, discharge ratings for rechargeable batteries are much higher than primary (throw-away) batteries like alkaline and zinc-carbon. I don't think those customers would be impressed.

Second, and perhaps more important, rechargeable batteries maintain their full-charge voltage much longer, while primary batteries drop in voltage quickly as they discharge, so they deliver less current as they go down. Such a specification would have little meaning.

Q. I see that some receivers can tune as low as 10 Hz and they state that one can hear insects and bats. What kind of antenna does one need for this type of listening? I can't imagine the size of a 1/2 wave dipole or longwire at those low frequencies! (Mario Filippi, email)

A. Some general-coverage radio receivers do, indeed, tune down as low as 10 kHz, but not 10 Hz. But they wouldn't hear bats (typically 30-40 kHz), because while radio signals are electrical (electromagnetic), insects and bats emit acoustic (mechanical sound vibration) signals. It would be like thinking you could hear the overtones of an operatic soprano with a radio receiver.

Ultrasonic audio like this is detected by ultrasonic microphones which translate the high-pitched sounds into electrical signals which can be down-converted and fed into a speaker or earphones so we can hear them with our lower-pitched hearing systems.

So far as antennas for very-low-frequency radio monitoring, the only reason that we choose antenna lengths that are a half-wavelength long is that they are naturally resonant at our frequency of interest. That means that they represent a feed-point impedance of around 50 ohms, allowing a direct match to common coaxial cable.

But that impedance can be matched by much shorter antennas using a tuner (transmatch) or a transformer, or by substituting a short active antenna, or matching can be ignored entirely since any reasonable length of wire is going to intercept enough electromagnetic signal to be detected by the receiver, even if the impedance is mismatched.

Questions or tips sent to Ask Bob, c/o MT are printed in this column as space permits. Mail your questions along with a self-addressed stamped envelope in care of MT, or e-mail to bobgrove@monitoringtimes.com. (Please include your name and address.)



WRC-12: New Amateur Band and More

After a month of high-powered international deal making, the World Radiocommunication Conference 2012 (WRC-12) ended on February 17. Three thousand representatives from 165 countries spent one of Geneva's colder winters adopting a number of sweeping revisions to the International Telecommunication Union radio regulations.

Though changes typically don't take effect for several years, let's look at what's in store following this major world conference.

New Amateur Band

Agenda item 1.23 called for a narrow allocation for amateur radio in the very interesting, not to mention historic, medium-frequency (MF) band. Original language – as determined at a previous WRC – proposed 15 kilohertz (kHz) between 415 and 526.5 kHz, on a secondary basis.

Once the WRC began, the going got rough in a hurry. It became obvious that a number of interests in the world still consider this to be extremely valuable spectrum. A few countries wanted no amateurs at all, a few more wanted to protect aero navigation beacons, and everybody wanted to protect the remaining maritime mobile use of the band.

The result is one of those compromises with something for everyone to love and hate. What hams get is a 7 kHz secondary allocation from 472 to 479 kHz. Well, 7 kHz are better than no kHz at all.

As with a lot of these international decisions, the good stuff is in the footnotes. There is a short list of countries allowing no operation at all, and a longer list of those limited to one watt effective radiated power. Others can specify higher power, up to five watts effective, except in territory within 800 kilometers of these countries.

The only one of these anywhere near the United States is the Russian Federation, which, after all, comes out to within a few miles of Alaskan territory in the Aleutian Islands. The penguins will just have to watch the power. The rest are in Africa, Asia, and the Middle East.

As with any ITU decision, implementation will take around a year to enter into the Radio Regulations. Generally, it's quite a bit longer before each individual country actually authorizes operation by their amateurs.

This should turn out to be a good band. The hams will figure out how to get all over the planet on five watts. There's already quite a bit of Internet discussion of suitable modes, going ever deeper into the noise. One of these is named

Lentus (Latin for "slow") by its developer. Short messages take five minutes to send, but the mode is said to produce copy from signals undetectable with the typical computer waterfall, let alone by ear.

Other Maritime Changes

Agenda item 1.9 was "to revise frequencies and channeling arrangements... in order to implement new digital techniques for the maritime mobile service." The relevant changes for the high frequency (HF) band involve certain segments within the maritime mobile allocations at 4, 6, 8, 12, 16, 18/19, 22, and 25/26 megahertz (MHz).

The problem is channel width. Those who've been at this awhile remember why hundreds of channels were provided for Morse telegraphy and narrow-band direct printing (NBDP). Today, sadly, these are too narrow for other modes, and one hears mostly silence.

There's nothing specific on the World Wide Web yet, but it appears that at least some parts of these band segments will be re-channelized to 3 kHz. Others will be de-channelized altogether. Final implementation is quite a ways off, but it will be interesting to hear what ultimately happens to these bands.

Agenda item 1.10 was "to examine the frequency allocation requirements with regard to operation of safety systems for ships and ports and associated regulatory provisions." As part of this obviously sweeping process, the entire band between 495 and 505 kHz is now exclusively allocated to the maritime mobile service worldwide.

In addition, the frequency of 490 kHz is now exclusive to the Navigational Telex (NAVTEX) service worldwide. There have been issues in the past concerning this frequency, which along with 518 kHz is in common use for these formatted maritime safety and weather information bulletins. NAVTEX, which is compulsory for many vessels under international treaties, now has increased protection from interference.

Sea Surface Radar

Item 1.15 was "to consider possible allocations in the range 3-50 MHz to the radiolocation service for oceanographic radar applications." WRC-12 has done just that, though information is once again sketchy.

Like many new technologies, HF sea surface radar just showed up one day. It has promise for applications in research, meteorology, and

close-in coastal surveillance. The power levels and frequencies are dependent on the specific application. Some are barely audible, while others blast, especially at night. The one thing all have in common is a bandwidth considerably greater than anything used for communication or even broadcast.

The result, so far, has been chaos. Anyone who has tried to pull out weak signals from the nightly pinging around 4-5 MHz knows the feeling. Specified ranges and secondary, non-interference status might go a long way to improve co-existence in this matter.

WRC-12 Odds and Ends

Agenda item 1.16 has been adopted, providing specific frequencies for exclusive use by lightning detectors. Networks of these passive devices locate strikes using direction-finding techniques on radio frequencies in the audio range. They return essential weather data, but they are extremely vulnerable to interference on these low frequencies. They now have exclusive use of 8.3 and 11.3 kHz.

Finally, WRC-12 placed an item on the agenda for the next conference, WRC-15, to finally create a real amateur radio band around 5 MHz. Specifically, this calls for consideration of secondary use of frequency ranges, not necessarily contiguous, between 5250 and 5450 kHz. While this conference seems a long way off, preparation has already begun.

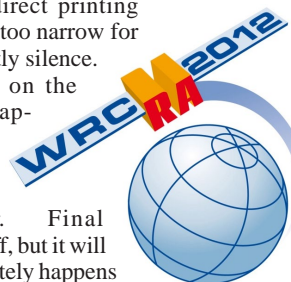
❖ More on DSC

Last month's Digital Selective Calling (DSC) frequency list only mentioned the simplex distress and safety frequencies required by international regulations. For those who missed the list, these are 2187.5, 4207.5, 6312.0, 8414.5, 12577.0, and 16804.5 kHz.

It's worth noting that other frequencies exist. One is in the VHF (Very High Frequency) maritime band, on 156.525 MHz. Also, 2177.0 kHz is available for ship-to-ship calling and acknowledging.

DSC is also authorized on a fairly large number of duplex channels for a number of routine purposes. It would be interesting to find out if any of these have much activity for port operations, position checks, and the like. They never get reported, and they're dead here.

The precise watch keeping and usage of DSC frequencies depends on which "sea area"



the vessel is in. This, in turn, is determined by the primary coverage areas of DSC-capable stations on VHF (Area A1), MF (A2), HF/satellite (A3), and HF only (A4). A4 is mostly in polar latitudes.

❖ Numbers Tidbits

The mysterious Vietnamese numbers station continues in operation, but all in Morse code. It is been designated M97 by ENIGMA, the European Numbers Information and Monitoring Association. Messages begin with a mixed callup containing numbers and what are apparently Vietnamese abbreviations, then the actual message in 5-figure numeric groups. Recent hits, as published by Ary Boender, have been on 10375.0 kHz continuous-wave (CW), at 1453 Coordinated Universal Time (UTC).

The Russian “polytone” time/frequency slot mentioned in a previous column as connected to alleged Russian spies arrested in Germany

continues on-air at this time. However, only null messages are being sent.

Cuba has continued, if not expanded, use of its digital transmission system. This is still designated SK01 due to early use of phase-shift keying (PSK). However, all transmissions are in an otherwise obscure ham mode called Redundant Digital File Transfer (RDFT).

The decode program in use is still an obscure ham radio freeware called DIGTRX. It handles the Cuban transmissions quite nicely, except when it crashes. This happens frequently, especially on newer machines. Successfully transferred files have the .txt (text) extension, but they are not text. They are binaries, and best viewed as hex dumps. Presumably, the spies targeted by these broadcasts have tools that process these files into something more meaningful.

As with everything from Cuba, considerable speculation continues on whether most messages are dummies. Check the usual newsletters for frequencies, and see you next month.

ABBREVIATIONS USED IN THIS COLUMN

ALE.....	Automatic Link Establishment	NASA.....	US National Aeronautics and Space Administration
AM.....	Amplitude Modulation	NAT.....	North Atlantic air route control, families A-F
ASCII.....	American Standard Code for Information Interchange	NATO.....	North Atlantic Treaty Organization
AWACS.....	Airborne Warning and Control System	Navtex.....	Navigational Telex
CAMSLANT.....	Communications Area Master Station, Atlantic	NCS.....	US National Communications System
CAP.....	US Civil Air Patrol	NDB.....	Non-Directional Beacon
COTHEN.....	US Customs Over-The-Horizon Enforcement Network	NOAA.....	US National Oceanic and Atmospheric Administration
CW.....	On-off keyed “Continuous Wave” Morse telegraphy	NS/EP.....	National Security/ Emergency Preparedness
DSC.....	Digital Selective Calling	PACTOR.....	Packet Teleprinting Over Radio, modes I-IV
FAX.....	Radiofacsimile	PSK.....	Phase-Shift Keying
FEMA.....	US Federal Emergency Management Agency	RTTY.....	Radio Teletype
FSK.....	Frequency-Shift Keying	S06s.....	Russian Lady variant, 00000 ending is slower
GPS.....	Global Positioning System	Selcal.....	Selective Calling
HF.....	High Frequency	SHARES.....	SHARed RESources, US Government frequency pool
HFDL.....	HF Data Link	SITOR.....	Simplex Telex Over Radio, modes A & B
ID.....	Station identification	UK.....	United Kingdom
LDOC.....	Long-Distance Operational Control	Unid.....	Unidentified
LSB.....	Lower Sideband	US.....	United States
M08a.....	Cuban MCW numbers, cut to ANDUWRIGMT	USAF.....	US Air Force
MARS.....	US Military Auxiliary Radio System	USCG.....	US Coast Guard
MCW.....	Modulated CW, direct or AM tone	USMC.....	US Marine Corps
Meteo.....	Meteorological (weather office), also “Metro”	USS.....	United States Ship
MFA.....	Ministry of Foreign Affairs	V13.....	Taiwan “New Star,” music and numbers in Chinese
MSK.....	Minimum Shift Keying	XSL.....	Japanese military PSK encrypted mode

All transmissions are USB (upper sideband) unless otherwise indicated. All frequencies are in kHz (kilohertz) and all times are UTC (Coordinated Universal Time). “Numbers” stations have their ENIGMA (European Numbers Information Gathering and Monitoring Association) designators in ().

18.1	RDL-Russian military strategic broadcast, coded message in FSK Morse, parallel 12742, at 1303 (MPJ-UK).	3290.5	PIAOPS-US National Guard, Peoria, IL, calling aircraft CH641, ALE at 0118 (Metcalf-KY).
135.6	HGA22-European ripple control, Hungary, ASCII control and time strings with transmitter ID, at 1658 (MPJ-UK).	3338.0	33B-UK Army cadets, working 80C and 74B, at 2019 (PPA-Netherlands).
263.0	QY-NDB, Sydney, NS, AM/MCW ID at 0404 (PPA-Netherlands).	3810.0	HD2IOA-Ecuador Navy time signals, Guayaquil, LSB pips and Spanish announcements, at 0730 (PPA-Netherlands).
286.5	001-Differential GPS, Baltiysk/Kaliningrad, Russia, 100 baud MSK corrections at 2114 (PPA-Netherlands).	4033.0	IABA-Italian Navy vessel <i>Aretusa</i> , working IDR, Rome, at 2026 (PPA-Netherlands).
315.0	A8UD3-Beacon on offshore oil drilling vessel <i>Noble Globetrotter</i> , MCW ID at 2117 (PPA-Netherlands).	4051.5	3B2MR1RLTCMD1-USMC, likely exercise Bold Alligator, calling 2MARR1RLTCMD1, ALE at 0343 (Metcalf-KY).
391.0	DDP-NDB, San Juan, Puerto Rico, MCW ID at 0449 (PPA-Netherlands). [7200 km! -Hugh]	4153.0	“The Slot Machine”-Japanese Defense Forces, jangly idler and data bursts (XSL), encrypted 1500 baud 4PSK; also on 4231.5, 6250, 6417, 6445, 8313, 8588, and 8703.5; at 1320 (Ary Boender-Hong Kong remote).
490.0	“I”-La Maddalena Radio, Italy, SITOR-B Navtex in Italian at 2125 (PPA-Netherlands).	4415.9	VCO-Canadian Coast Guard, Sydney, FAX ice chart at 2209 (PPA-Netherlands).
518.0	TFA-Grindavik Radio, Iceland, SITOR-B Navtex at 0350 (PPA-Netherlands). “A”-USCG, Miami, FL (NMA), SITOR-B Navtex at 0420 (Tony Agnelli-FL).	4441.0	Unid-English “Oblique” station (E11), null-message callup 248/00; similar on 5082, 7840, 10690, and 10800, at 0900 (Boender-Netherlands).
1610.0	WPQJ 968-Hillsborough Township Office of Emergency Management, NJ, road information station rebroadcasting NOAA weather radio, at 1812 (Mario Filippi-NJ).	4458.0	FAV22-French military, CW training in 5-letter groups, also on 5242 and 5896, at 0829 (Lacroix-France).
1650.0	WQEA 21-Burlington County, NJ, repeating NOAA KIH 28 from Philadelphia, at 1604 (Filippi-NJ).	4593.5	AFA5NF-USAF MARS, IN, nightly Northeast US net with AFA3LW, PA, plus many others, at 0008 (MDMonitor-MD).
1700.0	WPSH 468-Manville Office of Emergency Management, NJ, NOAA weather at 1605 (Filippi-NJ).	4610.0	GYA-UK Royal Navy, Northwood, FAX sea surface charts at 2307 (Filippi-NJ).
1714.0	FO74-Probable fishing beacon, CW ID at 0120 (Filippi-NJ).	4675.0	N832MH-Delta Airlines B767, answering selcal QS-KR from Shanwick (NAT-D), at 0857 (Lacroix-France).
1728.0	94W224-Probable fishing beacon, CW ID at 0118 (Filippi-NJ).	5135.0	ARCNHQ2-American Red Cross National Headquarters, working ARC51 (unit 51), ALE at 2321 (Bob Wilczynski-MA).
1743.0	Unid-UK Coast Guard, Stornoway, weather for Scotland coast, at 0714 (PPA-Netherlands).	5236.0	NNNOEBC-US Navy/ Marine Corps MARS, control of SHARES Northeast Net at 0015 (MDMonitor-MD).
1855.0	IQP-San Benedetto del Tronto Radio, Italy, navigation warnings in Italian at 0451 (PPA-Netherlands).	5250.0	“The Russian Lady”-Russian intelligence (S06s), “female” callup 374 985 and message in 6 5-figure groups, same message a week later, at 0700 (Boender-Netherlands).
2187.5	A8CG4-Liberian flag bulk carrier <i>Swakop</i> , DSC with Lyngby Radio, Denmark, at 0740. UAVA-Russian flag cargo vessel <i>Kelarvi</i> , DSC with Lyngby, at 0752 (Michel Lacroix-France).	5295.0	XEX-UK Defence High Frequency Communications Service, calling XSS (Control, Forest Moor), at 1829 (PPA-Netherlands).
2311.0	Unid-Arklow Shipping, Ireland; positions from cargo vessels <i>Arklow Forest</i> , <i>Arklow Rebel</i> , <i>Arklow Rover</i> , and <i>Arklow Rogue</i> ; at 2025 (PPA-Netherlands).	5399.5	AAR5RD-US Army MARS, voice and data mode testing with AAM5TMI, AAM5AMI, AAR5PJ, and AAV5VW, then went to 4445, at 0032 (Metcalf-KY).
2572.5	CFH-Canadian Forces, Halifax, NS, RTTY weather and traffic list, at 2342 (Jack Metcalf-KY).	5434.0	W46-US Army “Site R,” PA, calling USADA1010, DC, ALE at 0855 (Lacroix-France).
2598.0	Unid-Probably VCP, Canadian Coast Guard, Placentia, NFD, weather at 0051 (Filippi-NJ).	5450.0	Unid-UK Royal Air Force Volmet, voice synthesized female with English accent, aviation weather at 0351 (Filippi-NJ).
2680.0	4XZ-Israeli Navy, Haifa, CW coded message; also on at least 4331, 4539, 4595, 6379, and 6525; at 2045 (ALF-Germany).		

- 5510.0 ESZ-Colombian Navy, working KM3; similar on 5732, 7455, 8250, and 14922; ALE at 0221 (Wilczynski-MA).
- 5526.0 Cayenne-South American air route control, French Guiana, selcal MR-AE to KLM 706, a B777 reg PH-BQI, at 0454 (PPA-Netherlands).
- 5541.0 G-CELB-Jet2 flight Channex 159, patch to company operations via Stockholm LDOC, at 0700 (PPA-Netherlands).
- 5565.0 Dakar-South Atlantic air route control, Senegal, working Air Portugal 12, a TAP Air Portugal A330 reg CS-TOO, at 0428 (PPA-Netherlands).
- 5658.0 Mumbai-Air traffic control, India, selcal and position with Speedbird 277, a British Airways B777 reg G-YMML, at 2042 (PPA-Netherlands).
- 5667.0 Bahrain-Middle East air route control, selcal and position with QAF003, a Qatar government A320 reg A7-AAG, at 1816 (PPA-Netherlands).
- 5680.0 Kinloss Rescue-UK Royal Air Force, Scotland, working Sea King helo Rescue 125, at 0908 (Lacroix-France).
- 5687.0 Unid-German Air Force, working inflight medical emergency with flight DHM 0944, at 0354 (Lacroix-France).
- 5720.5 POH-Colombian Navy, sending KN2 a long ALE test message in English, at 0048 (Wilczynski-MA).
- 5726.0 USSWASP2MEBCMD-USMC, possibly aboard USS Wasp, (LHD-1), ALE traffic for exercise Bold Alligator, also on 5727.5 and 8285, at 2233 (Wilczynski-MA).
- 5757.5 SPARE32MEBCM-USMC, calling 8THCOMM2MEBCMD, Bold Alligator ALE at 2000 (Wilczynski-MA).
- 5772.0 FR5RA1-FEMA Region 5, ALE with unknown station XG5RA, at 1009 (Wilczynski-MA).
- 5815.5 EPA-Colombian Navy, ALE text message "FAXDATA CK" to KM3, at 0313 (Wilczynski-MA).
- 5875.0 KZN508-SailMail, SC, PACTOR-III weather for WDD6931, sloop Rachel E, at 1434 (Metcalfe-KY).
- 6248.0 TXV7-Venezuelan Navy river forces, LSB ALE with T5L1, and LSB voice with Armario, Puerto Cabella, at 0356 (Wilczynski-MA).
- 6340.5 NMF-USCG, Boston, very clear FAX wind and wave forecast, at 1918 (Filippi-NJ).
- 6501.0 NMN-USCG CAMSLANT Chesapeake, VA, weather at 0333 (Filippi-NJ).
- 6532.0 G-VMEG-Virgin Atlantic A340 "Mystic Maiden," flight VSO603, HFDL position for Shannon at 2356 (MPJ-UK).
- 6640.0 New York-New York LDOC, selcal check with Challenge Cargo 431, (Centurion Air Cargo), went to 8933, at 1240 (Allan Stern-FL).
- 6668.0 S06s, callup 176 289 and 5-group message in Russian, at 1610 (Boender-Netherlands).
- 6765.0 NCS031-NCS, TN, with information about SHARES activation for Super Bowl, at 2317 (Metcalfe-KY).
- 6823.0 AAM4TGA-US Army MARS, RTTY message regarding exercise Giant Step, at 2323 (Metcalfe-KY).
- 6844.5 NCS 042-Unknown NCS Auxiliary station, new SHARES Northeast Region frequency with WGY911, FEMA, MA, and WGY983, FEMA, DC, at 1604 (Metcalfe-KY).
- 6846.5 AAT7WE-US Army MARS, working AARONM, CW at 1700 (Metcalfe-KY).
- 6942.5 ERS-USMC, working ME4; also on 4645.5, 7332.5, 10839, and 10977.5; at 1531 (Metcalfe-KY).
- 6961.0 CIW681-Canadian Forces Affiliate Radio System, long ALE text messages at 0344 (Metcalfe-KY).
- 7346.0 USSKEKVI2MEBIN-USMC, probably aboard USS Kearsarge (LHD-3), Bold Alligator traffic with USSWAN7J2MEBIN, ALE and secure voice at 1807 (Metcalfe-KY). USSKEKVI2MEBIN, calling USSWASP2MEBIN, ALE at 2232 (MDMonitor-MD).
- 7527.0 Z14-USCG Sector St. Petersburg, FL, ALE link check with J24, USCG MH-60J #6024, COTHEN at 0115 (ALF-Germany).
- 7580.0 New Star Radio Station-Taiwan intelligence (V13), Program Number 4, music and numbers in Chinese by live announcer, at 0500, 0600, 1200, and 1300 (Boender-Hong Kong).
- 7615.0 Blue Mound 3-CAP, net with lowa CAP 4 and Louisiana 30, at 1502 (Metcalfe-KY).
- 7688.0 V13, Program Number 3, flute and messages at 0700 and 0818 (Boender-Hong Kong).
- 7842.0 COCABA2012-USMC, calling RIPTIDEBA2012, ALE at 1959 (Metcalfe-KY).
- 8023.0 087CDC551-US Centers for Disease Control, working 001CDCNHQ, national headquarters, also tried 12164, at 2055 (Metcalfe-KY).
- 8058.6 KWT93-US State Department, Europe, calling KWT95, ALE at 0839 (PPA-Netherlands).
- 8060.0 EKZ-Colombian Navy, calling KM3 in ALE, at 0405 (MDMonitor-MD).
- 8164.0 Vessel Rejoice-Unknown, tried to pass position to shore, told only "short-time vessels" were being taken, at 1340 (Metcalfe-KY).
- 8285.0 USSWASP2MEBCMD-USMC, working USSKEAR2MEBCMD, ALE at 1908 (Metcalfe-KY).
- 8286.5 USSWASP2MEBCMD-USMC, calling USSKEAR2MEBCMD, ALE at 1340 (MDMonitor-MD).
- 8294.0 Unid-USCG, clear and secure voice with "Air Station Ops," at 1915 (Metcalfe-KY).
- 8414.5 Relampago-Spanish patrol boat, DSC call requesting L61 meet on 6 megahertz band, at 0940 (Lacroix-France).
- 8502.0 NMG-USCG, New Orleans, LA, weather at 0340 (Filippi-NJ).
- 8743.0 HSW-Bangkok Meteo, Thailand, weather in Thai at 1801 (PPA-Netherlands).
- 8782.0 XSQ-Guangzhou Radio, China, phone call in Chinese at 1745 (PPA-Netherlands).
- 8816.0 16405-Russian Navy aircraft 1250, working RJF94 (Priboj, Moscow), CW at 1313 (MPJ-UK).
- 8912.0 NMH-USCG, VA, working NMH1, COTHEN ALE at 1921 (Wilczynski-MA).
- 8933.0 New York LDOC, came from 6640 for selcal check with Challenge Cargo 431, a freighter enroute to Santiago, Chile, at 1243 (Stern-FL).
- 8971.0 Fiddle-US Navy, FL, clear and secure voice checks with Cardfile 711, a P-3C, at 1453 (MDMonitor-MD).
- 8992.0 Unknown-USAF with two EAMs, missed station IDs, at 1804 and 1835 (Filippi-NJ). Andrews-USAF Andrews AFB, MD, EAM "for Unroll," simulcast 11175, at 2053 (Metcalfe-KY).
- 9090.0 POD-Colombian Navy, calling KM3 in ALE, at 0041 (MDMonitor-MD).
- 9106.0 KNY82-NCS, KS, ALE sounding at 1314 (MDMonitor-MD).
- 10315.0 Magic53-Back end of NATO E-3 Sentry AWACS, working DHN66, Geilenkirchen, Germany, at 1345 (Lacroix-France).
- 10432.0 Unid-Cuban MCW "Cut Numbers Station"3-message format (M08a), two started RWGNA and TRDTA, at 0914 (PPA-Netherlands).
- 10588.0 FC1FEM-FEMA Region 1 communications, MA, raised FCSFEM2, Mt. Weather, VA; then voice as WGY 901 calling WGY 912, but raised WGY 911, another Region 1 station, at 1414 (MDMonitor-MD).
- 10920.0 S06s, Russian callup 425 890 and message in 6 5-figure groups, same message a week later, at 1210 (Boender-Netherlands).
- 11000.0 RIW-Russian Navy headquarters, Moscow, short CW messages for RDND, at 0755 (Privat-France).
- 11175.0 Offutt-USAF, Offutt AFB, NE, telling Skier 92 (NY Air National Guard, LC-130H equipped to land on snow) to go secure on 11220, at 1825 (MDMonitor-MD). Incubate-US military, 28-character EAM simulcast on 8992, at 1905 (Jeff Haverlah-TX).
- 11184.0 OMA101-Oman Air flight, HFDL position for Reykjavik, Iceland, at 1431 (Lacroix-France).
- 11220.0 Skier 92-NY Air National Guard LC-130H, came from 11175 for ALE-initiated secure voice, at 1828 (MDMonitor-MD).
- 11226.0 Sentry 41-USAF E-3B AWACS, raised Offutt in ALE as E30003, then voice patch for coded traffic to Raymond 24 (Tinker AFB, OK), at 2200 (Metcalfe-KY).
- 11232.0 Canforce 2565-Canadian Forces CC-130J-30, patch via Trenton Military to wing ops, at 2215 (MDMonitor-MD).
- 11244.0 Involved-US military, EAM "6MU4ZM," at 2050 (Metcalfe-KY).
- 11256.0 Holloway-Ethiopian Airlines company LDOC, selcal JS-EF for Ethiopian 501, a B777 reg ET-ANN, at 1755 (PPA-Netherlands).
- 11354.0 Priboj-Russian Air Force, working unknown aircraft in Russian, at 0704 (Privat-France).
- 11407.0 AFA5QW-USAF MARS, IN, came from 13927 for patch with Rogue 09, a B-52H, to Barksdale AFB, LA, at 1711 (Stern-FL).
- 11451.0 CHPN5C140M-US telephone company NS/EP, Chapin, SC, calling CHGOIL120, Chicago, IL, at 1545 (MDMonitor-MD).
- 12155.0 S06s, same Russian message as 10920, at 1200 (Boender-Netherlands).
- 12216.0 FC1FEM-FEMA Region 1, MA, calling VT1FEM, VT, ALE at 1518 (MDMonitor-MD). FC6FEM-FEMA Region 6 communications, TX, ALE "HF Chat" text messages with WGY912 (FEMA, Mt. Weather, VA), at 1642 (Wilczynski-MA).
- 13611.5 2MARR2RLTCMD1-USMC, calling 1B10MR1RLTCMD1, also on 4051.5, ALE at 1913 (Metcalfe-KY).
- 13927.0 AFA5QW-USAF MARS, patch to Ellsworth AFB for B-1B Rama 61, at 1600 (Stern-FL).
- 14396.5 AAV4AR-US Army MARS, GA, control of weekly SHARES net with NCS 031, checking in many MARS and NCS stations, at 1542 (MDMonitor-MD).
- 14455.0 KHA959-NASA, Wallops Island, VA, weekly HF net check-ins from KHA908 (Ames Research Facility, CA), KHA925 (Johnson Space Center, TX), and KHA950 (Stennis Space Center, MS), at 1638 (Metcalfe-KY).
- 14484.0 Desert Eagle-Unknown US military exercise, taking "4-Line" traffic from unknown station, at 1639 (Metcalfe-KY).
- 16116.0 Unknown station with Russian 6-tone "Mazielka" selcal, at 0910 (Eddy Waters-Australia).
- 19682.0 VIE-Globe Wireless, Darwin, Australia, hexadecimal ID "C9" in Globe data marker, at 1243 (PPA-Netherlands).
- 19741.4 8PO-Globe Wireless, Bridgetown, Barbados, hexadecimal ID "E3" in Globe data marker, at 1237 (PPA-Netherlands).
- 19969.0 FC8FEM-FEMA Region 8, CO, sending ALE text message (weather report) identifying as WGY908, to FC8FEM2, possible mobile, then voice radio checks, at 1625 (MPJ-UK).
- 20124.0 HKI2-Finnish MFA, Helsinki, working ANK, Ankara embassy, ALE at 1313 (MPJ-UK).
- 21928.0 B-6810-Sichuan Airlines A320, flight 3U8737, HFDL with ground station 16, Agana, Guam, at 0108 (Hugh Stegman-CA).
- 21934.0 CN-ROE-Royal Air Maroc B737, flight AT951D, HFDL position (near Casablanca, Morocco) for ground station 01, San Francisco, CA, at 1813 (Stegman-CA).
- 21937.0 PR-AVB-Avianca Brazil A319, hex code E485A4, HFDL position (near Sao Paulo, Brazil) for ground station 02, Molokai, HI, at 0048 (Stegman-CA).
- 21949.0 ONE631-Unknown Avianca Brazil flight, HFDL position (near Salvador, Brazil) for ground station 08, Johannesburg, South Africa, at 1752 (Stegman-CA).
- 21955.0 A6-ERB-Emirates A340 flight UAE788, HFDL position (over Ghana) for ground station 17, Canary Islands, at 1715 (Stegman-CA).
- 21997.0 XA-SUN-Interjet A320 flight 4O2900, HFDL with ground station 13, Santa Cruz, Bolivia, at 1739 (Stegman-CA).
- 22372.0 3201-Maltese Maritime Service headquarters, working 3204, Patrol Boat P-22, ALE at 1535 (MPJ-UK).
- 24526.0 FC4FEM-FEMA Region 4 communications, GA, calling SC4FEM, SC Emergency Management, ALE at 1437 (MPJ-UK). FC8FEM001-FEMA Region 8, CO, ALE sounding at 1815 (MDMonitor-MD).
- 25120.0 R31-Moroccan Army, ALE sounding at 1327 (MPJ-UK).
- 29774.0 Unid-Narrowly shifted FSK, probably ocean data beacon telemetry, at 1832 (Filippi-NJ).
- 30975.0 WWCR-Probable AM harmonic or receiver image of World Wide Christian Radio, TN, identifying at 1830 (Filippi-NJ).



Spotlight on Algeria (Part I)

This month we begin a comprehensive look at the many organizations that can still be heard from Algeria using digital equipment on HF radio. As you'll find out, it's quite a wide variety!

❖ Algerian Air Force

The Algerian Air Force (Commandement des Forces Aériennes d'Algérie or QJJ in Arabic) operates a large number of mainly Russian-made aircraft ranging from fighters to transport aircraft and helicopters. It has been a long-time presence on the HF bands and now runs a more modern network with MIL-STD-188-141A ALE and MIL-STD-188-110A high-speed modems that are used to send both digital voice and data around the network. These stations can be heard on a daily basis on a wide variety of frequencies, including the following channels (kHz USB):

5450, 6765, 6921, 7568, 7595, 7633, 7716, 7745, 7935, 8016, 9055, 9257, 9262, 9438, 10180, 10785, 11125, 11129, 12197, 13327, 13370, 13984, 14463, 14475

The following identifiers have been noted on this network, reflecting the country's subdivision into six military regions:

COF	HQ, Cheraga
CM1	Blida Air Force Base
CM2	Oran Air Force Base
CM3	Bechar Air Force Base
CM4	Ouargla Air Force Base
CM5	Biskra Air Force Base
CM6	Tamanrasset Air Force Base
BSK	Biskra
CNC	HQ, Cheraga
BLI	Blida
DJT	Djanet
ILZ	Illizi
OR1	Oran
TF2	Tindouf

These stations can often be heard exchanging AMD (ALE's text messaging service) chatter in French. Note that the tactical two-letter, two number callsigns associated with some of the other Forces networks (see Army below) are typically used when stations identify using this method. Here's a recent example:

[FROM] CM2 [AMD] AMI ICI QA19 PR ESSAI RADIO
LE 04/09/2011 [THIS IS] CM2

Sometimes these stations will also acknowledge modem or digital voice transfers by using plain voice. MIL-STD-188-110A serial tone HF modem traffic usually exhibits the starting pattern "VVVJJJ".

Another Air Force related network, possibly operated by auxiliary forces or serving other smaller airports has also been identified. This network uses the following channels (kHz USB):

6565, 6738, 7925, 9053, 9070, 10146, 10544, 11125, 11415, 13324, 13369

The identifiers used by this network are not

100% confirmed, but here is the latest list:

AOS	Ain Oussera
ANB	Annaba
BLD	Blida
BSF	Bou Sfer
BSK	Biskra
CHL	Chlef
CNA	possibly Constantine
DJT	Djanet
ESA	possibly Es Senia
ESC	UNID
ESH	UNID
GRE	possibly Guerara
HBB	Hassi Bahbah
HMG	Hassi Messaoud
LAG	Laghouat
LJO	Unidentified
MNA	Mansourah or Menaa
OPS	Unidentified
REG	Reggane
TDF	Tindouf

Rather than the more modern equipment used on the other Air Force network, these stations use the venerable Swiss-made Haegelin Cryptos HC265 voice scrambler and a Bell standard 103 FSK modem for data and selcal (selective calling) purposes.

Data has also been (and continues to be) sent using the Siemens CHP200 modem which is a fast ARQ (Automatic Repeat Request) mode that uses FSK at 250bd and 170Hz tone shift. CHP200 can be regularly heard on the following channels kHz (the USB frequency is minus 1600Hz from the center of data given below):

7991.6, 9076.1, 9272.6, 10911.6, 11033.6, 11402.6, 12,225.1, 12561.6, 13342.1, 13421.6, 14387.6, 15004.6, 15957.6, 16479.6, 19670.6, 20386.6, 22378.6, 22734.6, 25360.6

CHP200 can operate as a simplex or duplex system (sender and receiver on different frequencies) and also has a frequency-hopping spread spectrum (FHSS) mode to provide greater security. It also has an ALE mode which you can easily hear by parking on a channel and listening for a while. While I haven't been able to determine all the channel pools for this mode, 10911.6 and 11402.6 kHz are part of the same network, as are 14387.6 and 15957.6 kHz.

❖ Army

The Algerian Army (ANP or People's National Army) is North Africa's second largest, comprised of around 110,000 regulars and about 250,000 reserves (National Guard) and is responsible for probably the greatest level of HF traffic using a very extensive MIL-STD-188-141A ALE network. A number of units also appear to be transitioning to more modern Thales Systeme 3000 equipment. This radio's ALE system uses the same waveform and sounds very similar to standard MIL-STD-188-141A ALE, but it has a 2000bd burst of data at the beginning and cannot be decoded with a standard

MIL-188-1141A decoder.

Units use a two-letter, two-digit structure both as identifiers and in chatter. Note that these identifiers have been known to change completely every few years. The current identifiers are as follows:

BJ23, 53
BK40, 43, 45, 47, 49, 50, 52, 54, 55, 56, 57, 58
CB40, 43, 45, 46, 48, 50, 51, 52, 53, 55, 56, 58, 59, 60
DJ32, 34
GS40
JB30
MDN (Ministère de la Défense Nationale, Algiers)
ND23
QA19
RM40
TD13, 15, 16, 18, 21, 22
TP01
UN01, 10, 30, 40, 50
VQ30, 35, 43
VR45, 46, 47, 48, 51, 52, 52, 56, 57, 59, 62
XT23, 25

Channels used by the Army and National Guard network are as follows (kHz USB):

2149, 3318, 3330, 3660, 3728, 4515, 4550, 4825, 5115, 5414, 5427, 5443, 5708, 5756, 5845.5, 6374, 6505.4, 6745.5, 6751, 6826, 6884, 6911, 6945, 6955, 6987, 7325, 7752, 16106.5, 17489, 19085, 19385

The newer Thales Systeme 3000 signals have been heard on the following frequencies (kHz USB):

11185, 14365, 15930, 16047, 16272, 17382, 18410, 19075, 19136, 19370, 19699, 20029, 20144, 20270, 20385, 20517, 22377, 22733, 23140, 23600, 26180

Yet another possibly Army or Air Force related ALE-based network uses a completely different set of identifiers and equipment. In this case, plain voice is used with Lincompex compression along with the TCC DSP9000-series voice scrambler for greater security. Data is sent using the MIL-STD-188-110A high speed modem which often comprises weather reports and other routine data in plain text French. The channels associated with this network include (kHz USB):

5251, 5754, 6706, 7535, 7630, 7638, 7641, 9126, 9130, 9155, 9185, 10714, 11114, 11428, 12179, 12360.5, 13943, 16000

The identifiers are as follows:

BS109A	Biskra
CO120A	Constantine
CR130A, B	UNID
CT001A, B	UNID
HG103B	UNID
OG100A	Ouargla
OR200A	Oran
SR003A	Souk Ahras
TD500A, B	Tindouf
WR110A, B	Ouargla

AMD text messages are also seen, usually with strings of repeating letters like "EEEEEEEE" or "XXXXXXX". The meaning of these messages has yet to be determined.



ON THE HAM BANDS

THE FUNDAMENTALS OF AMATEUR RADIO

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60-Meter Madness!

It's not every day that we get to experience something completely new: The taste of Tang as an orbiting astronaut; the first motion picture with sound; the thrill that comes from building your first crystal receiver – you get the idea. Today, March 5, 2012, was one of those special days. After updating the firmware on my FLEX-1500 software-defined radio (to handle the newest FCC-allowed “channel” on the 60-meter amateur band), I made a couple of Morse code QSOs at 5 MHz just to be a “part of history.”

Although soon to be eclipsed in weirdness by the upcoming “amateur allocation” at 497 kHz, today marks the beginning of a new era in operating flexibility on ham radio’s most unusual band – 60 meters. And if we’re not very careful it will mark the beginning of the end for amateur use of that band. Let me explain.

The 60-meter ham band – a secondary allocation of five discreet channels near 5 MHz – was begrudgingly wrestled away from commercial, government and military users in 2003. To operate on the band as secondary users, hams had to vacate any channel whenever it’s needed by a primary user, not interfere with primary users in any way, operate USB voice only, use low power, etc.

To make matters even more challenging, the way primary users define frequencies doesn’t jibe with the way hams define frequencies. And many ham rigs aren’t set up (or even capable) of successfully operating at 5 MHz. Like any band, a relative handful of die-hard explorers regularly work 60 meters, but the above-mentioned restrictions pretty much relegated the band to cult status.

The FCC’s changes, which took effect today, added CW and digital modes to the mix and upped the maximum power output by 3 dB. But in no way did they relax the most important operating restrictions: not interfering with primary users. This is where things could go south for hams in a hurry.

The addition of CW and digital modes will likely dramatically increase amateur radio use of the band. More users means more crowding and a greater chance of interfering with primary users. And even if we’re careful, how will hams effectively detect and identify primary users, and how will primary users detect and identify

secondary users (hams)?

It seems simple, but it’s not. Primary users on these five channels mostly transmit USB voice and wide-shift digital (so say the mysterious organizations that represent primary users). Hams using USB will be reasonably likely to hear and understand primary users when they come on frequency and say something like, “Hey, I’m a primary user, please vacate the frequency until I’m done with it.” That’s easy.

But what about when hams are transmitting CW or PSK31? Will primary users understand Morse code? Probably not. Can primary users tell whether CW or digital signals on frequency are being sent by hams or by other primary government or military users who have gone “off the reservation” frequency-wise? Probably not. Can primary users tune and decode PSK31? Probably not. Will hams using CW and PSK31 hear primary users’ USB voice pleas to relinquish the frequency? Maybe, but maybe not. When I’m locked onto a weak CW signal with a 100-Hz IF filter, I might not hear an earthquake, let alone a weak SSB signal from a primary user.

To reduce the chances of potentially incompatible cross-mode conflicts, hams are supposed to limit their use of each 60-meter channel to one QSO at a time, one mode at a time, with a

TABLE 1: 60-METER FREQUENCIES

Channel	Suppressed Carrier Frequency	Center Channel Frequency
1	5330.5 kHz	5332.0 kHz
2	5346.5 kHz	5348.0 kHz
3	5357.0 kHz	5358.5 kHz
4	5371.5 kHz	5373.0 kHz
6	5403.5 kHz	5405.0 kHz

Note: Center Channel Frequencies indicate the center of each 2.8-kHz-wide, 60-meter channel as referenced by government and military users. To transmit a USB signal that’s not off-frequency, tune your ham transceiver to display the Suppressed Carrier Frequency for the appropriate channel. See text.

signal plunked down right in the center of each channel’s pass-band. This restriction – and it’s a huge one for hams – is supposed to help primary and secondary users detect and identify each other, but I have serious doubts about its ultimate effectiveness.

Although each channel is wide enough to support an SSB voice QSO – which itself could sustain several CW QSOs or dozens of PSK QSOs – the rules limit secondary users to a single, center-frequency QSO.

Besides, as I tuned the 60-meter band tonight, it was a Wild West of signals and modes, with multiple off-frequency QSOs, multiple on-frequency QSOs – and not a primary user in sight. Not that I could have even identified a primary user for certain, having never heard one before! Someday, I hope to actually hear one!

This craziness could have been avoided if commercial, government and military spectrum allocators would have carved out even a tiny band for hams near 5 MHz that allowed for typical, non-channelized, amateur use. The existing rules, crazy though they may be, were designed to protect primary users and allow hams to use the band on a non-interference basis. In reality, I suspect that just the opposite is more likely. And that’s why I’m worried that March 5, 2012, may mark the beginning of the end for the 60-meter amateur band.

To maintain access to the band we have to be very careful. But we’re typically not. It’s not that hams are purposeful scofflaws, it’s that we’re used to operating the way we operate



Here’s something you’ve probably never seen before – a PSK31 signal in 5405 kHz! On March 5, 2012, U. S. hams were allowed new modes and increased power output on the five discreet channels that make up the 60-meter ham band. Originally limited to USB voice only, PSK31 and CW signals can now be heard (or not heard, as the case may be), causing potential on-air confusion and potential rules violations, as shown here on the band scope display of my FLEX-1500 transceiver. Both ham signals, the strong pip on 5405 kHz is a PSK31 signal, and the peaks on either side are from a USB voice signal on the same frequency. If the two stations can hear each other, that’s a definite no-no. If they can’t, well, they can’t. FCC rules allow for only one signal and one mode at a time. The two pips shown at 5412 and 5413 kHz are wide-shift digital signals typically transmitted by primary (government, commercial and military) users on these frequencies. See text.—NT0Z

elsewhere. We're used to copying weak signals through noise, making contacts no matter what, getting the job done with minimal gear and against all odds. We're MacGyver, and the FCC/NTIA/CIA/DIA/NSA/DHS/(???) is a fussy, bespectacled librarian who is telling us to behave and shushing us with a pointed finger and pursed lips.

I see three potential outcomes. (1) After the initial "new band" madness wears off, we'll settle down and conform to the established rules. (2) We'll operate on 60 meters as if it's a typical ham band, causing the powers that be to rescind access. (3) Primary users will realize that hams aren't typically interfering, that they don't really need to restrict 60-meter to a handful of channels and will carve out a small "real ham band" at a future World Radiocommunication Conference.

I'd prefer three, am worried about two, and will accept one! To that end, let's take a look at the new rules for operation at 60 meters. Don't try to make too much sense of these things or see the logic in them, because there isn't any (much). As difficult as it is, operating at 5 MHz requires compliance, not understanding! Here we go:

❖ New Rules of the Road

Under the FCC's new rules for 60-meter operation, which went into effect on March 5, 2012, U. S. amateurs with General, Advanced or Extra class tickets can operate on five discrete channels between 5332 and 5406 kHz with an effective transmission bandwidth of 2.8 kHz or less.

Power output is limited to 100 W or less, referenced to the gain of a half-wave dipole. This restriction isn't the norm for HF amateur bands and may tend to cause confusion. If you're using a "store-bought" antenna, the FCC insists that you retain a copy of the manufacturer's gain specs in your station log. You do keep a log, right?

If your 60-meter antenna is significantly directional (as in a beam or an array, not a dipole or other common wire antenna) you need to calculate its gain and note the figures in your log. And when you use your directional antenna you need to factor its gain when setting your RF output power.

For example, if your antenna has a gain of 3 dB when compared to a dipole (3 dBd), your maximum legal output power on 60 meters would be 50 W (50 W is 3 dB less than 100 W).

In addition to bumping the power output limit by 50 W the FCC also added CW and digital modes to the mix (hams could formerly make only USB voice QSOs). Because of the unique channelized nature of 60 meters in general, properly using each mode isn't as easy as you might think.

USB

Making USB contacts is pretty straightforward. Simply tune your transceiver to one of the five "suppressed carrier" (ham) channel designators shown in Table 1 (making sure your rig's mode selector shows "USB," of course). Typical ham transceivers have SSB transmission bandwidths of about 2.8 kHz, which meets the specs. If your rig allows you to adjust your TX bandwidth, set it to 2.4 kHz to add a margin of

safety. Either way, make sure you're not over-modulating or over-processing, which can create "out of band" splatter. Make sure your output power is in line with FCC rules and your antenna type.

CW

Unlike typical ham operation, your CW signal must fall into the very center of each channel's designated pass-band. See the "channel center" column in Table 1. Transmitting strictly at these "center of the channel" frequencies – frustrating and disappointing as it may be – is a necessary part of cooperating with the NTIA if we ever want to see 60-meter privileges expanded in the future (or, as I considered earlier, hams' inability or unwillingness to comply in this manner may lead to rescinded 60-meter privileges).

Actually placing your transmitted CW signal at the center of a 60-meter channel may take some experimenting (with a dummy load, please!). Some transceivers transmit CW at the exact frequencies shown on their displays, while others use various offsets, typically between 600 and 800 Hz. You may have to consult your rig's manual, or even its manufacturer, to figure out the exact display frequencies that correspond to the "channel center" frequencies assigned to each 60-meter channel.

To be absolutely sure, use a second receiver and/or a frequency counter while transmitting into a dummy load at low power. Make note of the frequencies and don't forget that many modern rigs have CW-upper and CW-lower settings, which will probably affect the resulting dial frequencies.

Many rigs that incorporate 60 meters are factory-restricted to USB-only operation on the five original channels (channel 3 has been moved to minimize QRM), so you may have to update your rig's firmware or modify it for "dc-to-daylight" operation to get it to transmit correctly on CW (this voids warranties, is technically illegal, etc, and the usual disclaimers apply).

Digital

In every practical sense, and to minimize potential interference between primary and secondary users, digital operating is essentially limited to PSK31 and PACTOR III. (That the new rules allow PACTOR III in the first place seems crazy, because it can only be decoded by those who possess expensive, proprietary terminal units, but that's another story...)

As with CW operation, your PSK31 tones must be placed at the very center of each assigned channel. Thankfully, getting them there is pretty easy. Place your rig in USB mode and tune it to one of the "suppressed carrier" channels listed in Table 1. Using your PSK31 software, make whatever selections are necessary (mouse or keyboard settings) to place your tones at 1500 Hz. As long as your radio is in USB mode, a 1500-Hz tone falls right onto the designated "center channel" frequency.

Tread Lightly

As secondary users on 60 meters, we must be very careful to avoid interfering with comms

from primary users. If you suddenly hear non-amateur transmissions on frequency, *stop transmitting immediately*. Don't respond to or try to engage non-amateur users on frequency! Don't ask, "Hey, are you a primary user?" or "What's your DXCC entity? I don't recognize your call sign, N76X45BD3." Unless you're making an emergency call (SOS, MAYDAY) or it's Armed Forces Day, trying to work non-amateurs on 60 meters is *verboten*!

Always listen before transmitting. If you hear someone else on frequency, whether ham, government or military, regardless of mode, don't transmit. If you hear a PSK31 signal and you want to transmit SSB, don't transmit. If you hear a PSK31 signal and want to toss in another pair of tones 200-Hz up the waterfall, don't transmit. It's one signal at a time folks, period!

As I write this we've only had these new privileges for less than a day, and as we (and NTIA-repped users) gain more experience, more detailed and specific usage plans may emerge. Much like repeater operation, keep your transmissions short and take breaks to listen for other signals.

Split-channel operation (transmitting on one channel and listening on another), is permitted under the rules, but it's a poor operating practice at best, because it ties up two precious channels at once and increases the potential for interference. Just don't do it.

Informally, the ARRL suggests that, to find a clear channel, USB operators should start at Channel 5 and move down (if necessary) to Channels 4, 3, 2 and 1 until a clear channel is found, while CW and digital operators should reverse this pattern, beginning at Channel 1 and moving up as necessary.

On Day One there was a fair amount of on-air discussion about this suggested Gentlemen's Agreement, and there seemed to be a lot of dissent, primarily because Channel 5 is the de facto "international DX channel." (It's the only channel shared by most other countries, officially or otherwise, that "allow" 60-meter operation.) As with other "DX Windows," try to avoid making domestic QSOs there, especially when DX propagation is present or likely.

If you hear a digital signal and you're not sure whether it's an amateur signal, move to another channel. Most primary users on 60 meters transmit USB voice or wide-shift digital signals, so they are relatively easy to recognize.

Be careful when using narrow filters for CW or PSK31. You need to be able to hear other stations on frequency to avoid interfering with primary users who may suddenly need the channel.

I sincerely hope that the 60-meter ham band someday morphs into something more typical. And if the delegation from Cuba has any say, expanding access and operations there will be addressed at a future (or the next) World Radiocommunications Conference (secondary access to 60 meters in this neck of the woods was spurred by the need for frequencies between 80 and 40 meters when handling disaster traffic into and out of the Caribbean).

Until then, 60 meters is a bit of a Wild West show, but a show nonetheless. Enjoy it, nurture it, and be on your best behavior!



GETTING STARTED

THE BEGINNER'S CORNER

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Living the Very Limits of Your License Class

It's easy to fall into a rut in amateur radio. It usually happens when work and family force us to limit our operating time, and budgets tend to cramp our dreams. One of the most common themes among Technician Class operators is the subject of license upgrade. I know this because I've heard it often throughout the years on our local 2 meter repeaters. But, it's really not the license class that keeps most hams in a rut.

In his *First Person Radio* account from the October 2009 issue of *MT*, Bob Heil K9EID, the world famous amateur radio audio guru, made this comment about his early years as a ham in the 1950s: "I lived the very limits of the Technician Class license I had earned."

What did he mean by that? He meant that he didn't see the Technician Class license as limiting his on-air activities. It's true that he didn't have HF privileges, but he still had quite a lot. Technicians today have even more! So, instead of limiting your on-air activities to your local 2 meter FM repeater, take a little time to explore the full capabilities of the license you worked so hard to earn.

It's remarkable the territory our introductory license allows hams to explore. There's no limit to modes: AM, FM, digital, SSB and CW are all allowed (see side bar). There's plenty of DX to work on 6 meters as we move into the peak years of the current solar cycle. There are even separate frequencies set aside for DX, called DX Windows.

The addition of a beam and a rotator will boost your signal and let you enjoy operating across the U.S. and, when skip is in, wherever the winds of propagation take your signal. Satellite communications let Tech ops work the leading edge of amateur technology with a minimum investment in equipment. And, if you really want to put some time and money into operating, you can leap into Earth-Moon-Earth (EME) work, something that HF operators can't do.

❖ Technician Class Rigs

One thing that Bob Heil didn't have access to as a young Tech op are the super-small, highly capable VHF/UHF rigs available today, some of which are surprisingly inexpensive. One that gets little attention from most hams is MFJ's 9406 six meter SSB/CW transceiver. Don't let the analog dial; small desk footprint, low power and traditional MFJ construction fool you. This capable rig has earned a 4.7 rating out of 5 among eHam.net's real ham



MFJ-9406 6 meter transceiver (\$290) transmits SSB/CW with 10 watts output and works as a mobile or base station. Technicians can break out of the 2 meter rat race and discover new territory on the "magic band." (Courtesy: MFJ Enterprises)

critics. Instead of dreaming of one day owning a pricey big-name, all-mode rig, the 9406 is available to you right now for under \$300.

If you're looking for a mobile rig to work 6 meter FM repeaters or FM simplex, Alinco offers their DR-06T. Many Tech ops find 6 meter FM operating a relief from overcrowding often found on 2 meters. Six meter FM repeater activity varies from region to region in the U.S. In general, the bigger the population the more likely there will be a 6 meter repeater in operation.



Alinco DR-06T (\$272) compact 6 meter FM portable rig works at home or in the car. Work FM repeaters or simplex FM with three power settings. (Courtesy: Universal Radio)

One intriguing Tech rig is the Yaesu VX-7R hand-held transceiver that covers 6, 2, 440 and 220 MHz in FM mode, but also has extensive receive coverage, including the domestic AM and FM broadcast bands and 1.8 - 30 MHz shortwave, as well as the Air Band. This model has earned a rating of 4.1 out of 5 from the ham critics on eHam.net. As with all HTs, the biggest problem you're likely to have is learning to program it and getting used to the small buttons. It would be interesting to see how the shortwave receiver in this rig

works in your car. Of course, it would be advantageous to have an external antenna for better in-car reception. This rugged little HT is even submersible.

Naturally, if you have the money you might spring for an all-band, all-mode transceiver that covers HF 6 and 2 meters as well as 440 MHz. The Icom IC-7000 is typical of this class of rig and comes with a top-end price tag: \$1,300. It covers HF through 6 meters with 100 watts and offers 50 watts on 2 meters and 35 watts on 440 MHz. But, the advantage is that when you upgrade to General or Extra Class you'll be ready to go as soon as your new license hits the FCC database. A transceiver like this could be the only rig you'll ever need.



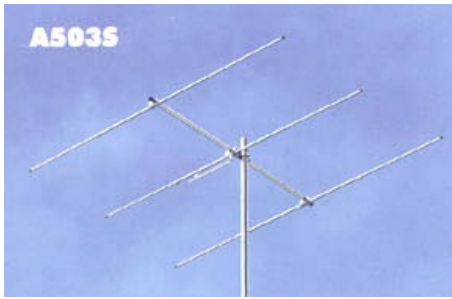
Yaesu VX-7R (\$370): A Technician Class four band HT that transmits on 6 meters, 2 meters, 440 and 220 MHz FM and receives broadcast band AM and FM, Air Band and shortwave from 1.800 - 30 MHz. (Courtesy: Universal Radio)



Icom IC-7000 (\$1,300) does it all: all-band, all-mode and could be the only rig you'll ever need. (Courtesy: Universal Radio)

❖ Technician Class Antennas

Here's another great thing about being a Tech operator: Even your beam antennas are small enough to use on a typical TV antenna rotator! Antennas are inexpensive, lightweight, high gain and easy to work with. To put a 3 element beam with 8 dB gain on HF will cost about \$600 (and you'll need a heavy-duty rotator to turn it), to do so on 6 meters: \$130. Even a 6 element beam for 6 meters with whopping 11.6 dB gain is only \$340, nearly



CushCraft A50 3S (\$130) 3 element beam for 6 meters is light weight (just 7 pounds), has a boom length of just 6 feet and has 8 dB gain over a simple dipole. (Courtesy: Universal Radio)

half the cost of the lowest price HF 3 element beam. And, it still weighs only 18 pounds. Keep in mind that polarity for 6 and 2 meters as well as 220 and 440 MHz is important. Typically, hams use vertical polarity for FM transmissions and horizontal polarity for SSB and CW.

If you're in an area where there's VHF/UHF action in every direction it might make more sense to put up an all-band vertical. The Diamond V2000A is a good example. It's an 8.3 foot tall vertical capable of handling 150 watts and covers 6 and 2 meters as well as 440 MHz. At \$160 it's a good choice for putting a signal into repeaters and working simplex in all directions.

Of course, an advantage to VHF/UHF operating is that it's conducive to going mobile, and antennas even at 6 meter frequencies are much smaller than those for HF. The Comet SBB 15 (\$82) is a mobile antenna that covers 6 and 2 meters as well as 440 MHz and is 58 inches high. You'll have get a mount and coax assembly (between \$50 and \$100) to mount it on your vehicle. A 2 meter/440 MHz-only antenna, such as the Hustler MX-270 (\$58) is inexpensive, comes with a heavy-duty magnetic mount, is only 44 inches high and handles up to 100 watts.



Hustler MX-270 (\$58) mobile antenna for 2 meters and 440 MHz has a solid magnetic mount, is 44 inches high and handles 100 watts. (Courtesy: Universal Radio)

An advantage Tech ops have that all hams enjoy is the freedom to build: Antennas, transmitters, and everything needed to make the two work. The FCC allows only licensed amateur radio operators to design, build and operate their own equipment on-air. No other radio service can do this: broadcasting, FRS/GMRS/MURS, even CB radio operators are forbidden from using anything other than FCC approved equipment. This is truly a gift.

TECH CLASS OPS HAVE FEW LIMITS

Technician Class operators can do it all: AM, FM, SSB, CW, digital modes, simplex, repeaters, DX, you name it. In fact the Moon is the limit! Yes, tech ops can work satellites and even Earth-Moon-Earth; DXpeditions, mountain-topping; base or mobile while commuting and much more. Below are just a few of the frequencies and modes allowed tech ops on six and two meters, but there's more action on 220 and 440 MHz as well as ham bands into the GHz range. Are you "living the very limits of the Technician Class license" you earned?

Six Meters: Full Mode Action for Technician Class Operators

Here are just a few popular frequencies (MHz)

50.0 - 50.1	CW and Beacons
50.125 SSB	Calling Frequency
50.40 AM	Calling Frequency
51.0 - 51.1	Pacific DX Window
51.12 - 51.48	Repeater Inputs
51.62 - 51.98	Repeater Outputs
52.02 - 52.04	FM Simplex

Two Meters: More Full-Mode Action for Techs (MHz)

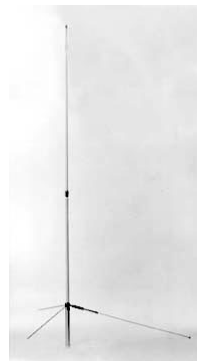
144.00 - 144.05	EME (Earth-Moon-Earth) CW
144.10 - 144.20	EME and weak signal SSB
144.200	National Calling Frequency
144.20 - 144.275	General SSB Operation
144.275 - 144.300	Propagation beacons
144.30 - 144.50	OSCAR subband
144.60 - 144.90	FM repeater inputs
145.20 - 145.50	FM repeater outputs
145.80 - 146.00	OSCAR subband

❖ SWL to Tech Op in Weeks

If you're a shortwave listener or scanner monitor you should consider getting your Technician Class license. It's a good way to expand on the knowledge base you've already acquired and it's very low cost (VECs usually charge a modest fee for conducting the exam). There's no charge from the FCC for your license unless you opt for a vanity call sign. Even devoting just an hour a day to study, you'll be ready for the Technician exam in just a few weeks.

Tech license study guides are not expensive, but worth every dime. The ARRL offers their own license manual (\$30) which comes with a practice exam CD ROM. You can order it on line here: www.arrl.org/shop/Ham-Radio-License-Manual-Revised-2nd-Edition/ or call the League toll-free at 888-277-5289.

Another study guide is from Gordon



Diamond V2000A (\$160) vertical base antenna covers 6 and 2 meters as well as 440 MHz. It's just over 8 feet tall and can handle up to 150 watts. (Courtesy: Universal Radio)

West WB6NOA and the W5YI Group. West's Technician Class book is \$21, or combine the book with W5YI's software that lets you study directly on your computer (and take practice exams based on the material) for \$30. To order this guide, go to www.w5yi.org or call 888-669-9594.

Another way toward earning your first amateur radio ticket is through an amateur radio club near you. Most offer in-person courses which has the added advantage of face-to-face instruction with local hams who will also be more than happy to help you continue in the hobby once you've passed the exam. To find such a program near you go here: www.arrl.org/find-an-amateur-radio-license-class and fill in the online search form.

Remember, the Technician license exam is based on an FCC approved question pool of 200 questions. You'll have access to the question pool with any of the above study guides. Your Technician exam will have only 35 questions on it and all of them will be from the pool. Each question is multiple choice and all you need is to get 70% of the questions correct in order to pass. Anyone can do it. As Mattie Clausen AE7MC wrote in her First Person Radio article, "If you're old enough to read, you're old enough to get your license!"

Remember, too, that receiving your license doesn't mean you know everything; it's nothing more than an official recognition that you know enough to start applying that knowledge toward your expanding base of on-air experience. The more you operate, the more you'll know.



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PROGRAMMING SPOTLIGHT

WHAT'S ON WHEN AND WHERE?

Fred Waterer

fredwaterer@monitoringtimes.com

www.doghousecharlie.com/radio

May Flowers and Music

Conventional wisdom states that April showers bring May flowers. This month and in the coming months, a lot of interesting programming will begin blooming. This month we shine the *Programming Spotlight* on a nice crop of special programming, including the Eurovision Song Contest, Queen Elizabeth's Diamond Jubilee, a cornucopia of music programming, the faded rose known as WYFR, and a long dormant voice from the CBC archives.

❖ Eurovision Song Contest

While this annual event tends to fly under the radar here in North America, in Europe it is a big deal, attracting eyeballs to television screens and ears to radios across the continent. The semi-finals are scheduled for May 22 and May 24, with the Grand Finale to take place on May 26, 2012. It's kind of like the Olympics of music, with nations competing against each other. This year the contest takes place in exotic Baku, Azerbaijan. In the days and weeks leading up to the crowning of the championship song, chosen by viewers/listeners, radio stations across Europe will be promoting the various entrants. Some nations may also broadcast their own national competitions. Already, there is a bit of a buzz over the UK entrant, none other than 76 year old Engelbert Humperdinck, making him one of the oldest performers to have competed in the contest.

In the past, Eurovision has been the launching pad for many careers, including Abba in 1974 with their song *Waterloo*, and Canadian singer Celine Dion in 1988 (who was representing Switzerland for some reason). And as the name suggests, it was one of the first trans-national television programs.

The Eurovision Song Contest has a Facebook page and an extensive website at www.eurovision.tv/page/baku-2012. You can apparently watch the proceedings from this website. It can also be heard via **BBC Radio 2** online. The **Radio 2** coverage is quite good. Last year I listened to it after the fact (most **BBC** radio programs are available online for seven days after they air). If I recall correctly, it was hosted by **Terry Wogan**. This is one of the biggest musical events of the year in Europe. Give it a listen and perhaps witness the breakthrough of some new artist, or the triumph of a veteran performer!

A week or so later, **BBC Radio 2** will also host the Queen's Diamond Jubilee Concert on June 4. In 2012, Queen Elizabeth will mark the 60th anniversary of her accession to the throne on the death of her father, King George VI.

"Kylie Minogue said: 'I'm honoured to be invited to perform at The Diamond Jubilee Concert. To share the stage in front of Buckingham Palace with music legends including Paul McCartney, Stevie Wonder, Tom Jones and Elton John in celebrating the Queen's Diamond Jubilee is very exciting.'

"Stevie Wonder said: 'It's an honour to celebrate The Queen. It's an honour to celebrate Great Britain. The time is overdue that I meet Her Majesty.'" www.bbc.co.uk/mediacentre/latestnews/2012/queens-diamond-jubilee-concert-stevie-wonder-and-kylie-minogue.html

This concert will probably air live on Canadian television, and I would wager a handful of Chicago Cubs World Series tickets that it will be heard on the **World Service** as well. As an aside, the concert for the Queen's Golden Jubilee (50th) in 2002 was organized by Lt-Col Richard Waterer.

❖ Summer Programming

Coming to a radio (or computer) near you soon: **CBC Summer Programming**



It is not true that summer in Canada is on a Tuesday, May 24, or the Monday closest to it, is the official start of summer in Canada. Officially it is Victoria Day, but it is commonly known as the May Two-Four Weekend – Two-Four being slang for a case (24) of beer. Sometime shortly thereafter, **CBC Radio One** (and the **CBC Northern Quebec Shortwave Service** on 9625 kHz) should be switching to their summer schedule.

Each year at this time, the **CBC** replaces many of its regular programs with different shows, allowing regular programs and hosts to go on hiatus until the fall. Sometimes these summer programs only last a few weeks and are never heard from again. Others thrive after this trial run and become regular, longstanding **CBC** programs. Examples of this latter group include the medical program *White Coat, Black Art* and *The Vinyl Café*. In the 1990s, the late **Jeff**

Healy hosted a summer show called *My Kind of Jazz* in the *Morningside* timeslot. The show later moved to FM in Toronto and he hosted it until his untimely death from cancer a few years ago.

As the weather heats up, keep an eye on the **CBC Radio One** website for details of this year's program changes. www.cbc.ca/radio/

❖ Music to my Ears

While on the topic of **CBC Radio**, the **CBC** recently introduced a new online music service, called **CBC Music**. There are dozens of different music streams and genres to choose from, as well as any number of concerts on demand and other features. I really like the variety of music on offer. Check it out at <http://cbcmusic.ca>. It is a great place to go for music!

The closest equivalent to this service was one I reported here in May 2009 from **Radio Denmark**. At that time I wrote that I had fallen in love with a number of music streams, which covered any number of musical genres. "I am particularly enamored with *DR Folk*. But there are different kinds of Rock, Classical, Jazz, dance R & B and my other favorite, *DR World*."

"I listened the other day to *DR World* for a couple of hours. Wow. What an amazing variety of music...It may just be my new favorite 'go to' music stream."

Well, as often happens, these Danish streams are either gone or cleverly hidden. I went to the **Danmarks Radio** website, using Google Chrome, and translated the page from Danish to English. While I did not find my old favorites, I did uncover some other buried treasures!

Danmarks Radio has a program archive like many other broadcasters. You can listen to most recent programs. Some of them look quite interesting and make me wish I spoke my grandmother's native tongue (Norwegian). I just sampled a few of these programs and was delighted to find a really great Jazz program called *Jazzens Giganter*, or *Jazz Giant*. 106 minutes of some really sweet music. The Danish commentary is lost on me, but there are snatches of English, when some of the musicians are interviewed, and the music makes up for any other shortcomings brought on by a lack of understanding of Danish. The two most recent programs available in the archive featured arranger, composer, pianist and orchestra conductor Gil Evans. The other looked at the career of saxophonist Coleman Hawkins.

If Google ever comes up with an audio translator, I would love to listen to *Sproglaboratoriet*, or *Language Laboratory*, which

explores the Scandinavian languages, but since Google is behind in this development, I'll stick to music. The other program that caught my ear is *Dansk Poppen*, or *Danish Pops*, a "weekly record harvest" featuring a mix of Danish and English light pop music. The program I heard featured everything from a Dolly Parton set to an amusing Danish language cover of Jackson (Nancy Sinatra and Lee Hazelwood). Recent episodes of *Dansk Poppen* can be heard at: www.dr.dk/radio/?t#/arkiv/danskpoppen Try *Jazzens Giganter* at www.dr.dk/radio/?t#/arkiv/jazzens-giganter Or log on to the website at www.dr.dk/radio, and, using Google Chrome to translate it into English, search for programming that appeals to you, unless of course you speak Danish! This Internet age we are living in offers access to thousands and thousands of programs from all over the world. It's fun to search them out! Kind of like DXing, isn't it!?

❖ Radio Romania International

Radio Romania International, in early spring, was putting a really decent signal into southern Ontario, Canada. Of course the programming can also be heard online at www.rri.ro I was spinning the dial, looking for a strong signal one Monday evening, and **RRI** was booming in with very little interference. The programming was quite interesting. On this particular evening, I tuned in as **RRI** was airing a history feature about the demise of the monarchy in Romania. As a "history geek" this immediately caught my attention. Combined with a good strong signal, the programming kept me on 6145 kHz until the end of the hour (0100-0200 UTC). Also heard were a Romanian by Radio lesson (*Romanian Without Tears*), and a sports report. But the best part of the broadcast was the music.



Perhaps it was unique to the night I listened, but the music heard between features was varied, and fantastic! There was a "jazzy" number described as a "Romanian oldie," and near the end of the broadcast a very futuristic, very modern piece that had me enthralled. The experience makes me want to tune in again to hear the programs and music of Romania. And it was also a reminder that international broadcasters are a great source of unique, unusual music not commonly heard here in North America. It makes a nice change from radio stations that seem to limit their playlists to alternating between Katy Perry and Lady Gaga tunes. Times and frequencies may have changed by the time you read this.

While we are on the topic of music, another great source of music is the **Voice of Vietnam**. During North American evenings, the **Voice of Vietnam** broadcasts in a number of languages via Sackville on 6175 kHz. During the various transmissions one will often hear a variety of songs and melodies from this exotic land. Even

the Vietnamese language has a sing-song quality to it which is quite pleasant to listen to. Often I will listen to the Vietnamese-language programming mainly to hear the hauntingly beautiful tunes and ballads that pop up now and then.

❖ Radio Japan

It is sometimes sobering to listen to Radio Japan broadcasts in English. Japan continues to deal with the aftermath of both the devastating earthquake and tsunami, as well as the Fukushima nuclear disaster that followed. Reports about these two events continue to dominate the news and features broadcast from Tokyo. Most recently, a program discussed the unexpected radioactivity of certain crops and the attempts by the authorities to protect consumers and clean up the affected areas so as to ensure the food supply was not permanently contaminated. Rather alarming reports indicated some fruits were unexpectedly high in radioactivity. Chilling stuff indeed. Check out **Radio Japan** at 0500 on 6110 kHz.

❖ WYFR

Family Radio was heard in March identifying itself as an "educational ministry." After the **Harold Camping** "end of the world" debacle in 2011, the station seems to have gone back to basics, airing some pretty nice Christian music, not quite contemporary, but not quite your grandmother's hymnal either. I was really interested to hear what **WYFR** had to say these days, post-non-Apocalypse. Long-time features such as *Scripture of the Week*, and *Family Bible Reading Fellowship* continue to be heard, along with the aforementioned music.



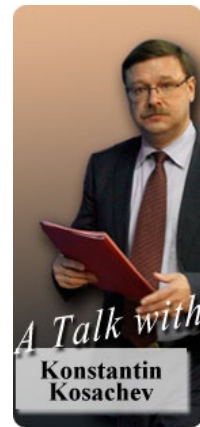
Having listened to **Family Radio** off and on since 1978, it was very strange to hear the station for two straight hours and never hear the voice of **Harold Camping** or even mention of his name. There was an interesting monologue near the end of the evening broadcast "to Canada" in which the host chatted about the station, how some people think its approach is old fashioned, and how others think it is just right. They are clearly (and understandably) attempting to avoid controversy and stick to tried and true programming, which mostly consists of Bible passages and music. A number of very brief (five minutes or so) Bible features and studies were also heard.

It will be interesting to follow **Family Radio** in the coming weeks and months to see how they move on from the Camping era, or even if they do.

❖ Voice of Russia

Yet another new program has been introduced to the **Voice of Russia**. It is called *A Talk*

With Konstantin Kosachev. He is apparently a member of the Russian Duma (Parliament) and is Deputy Chairman of the State Duma International Committee. **Voice of Russia** is really promoting this one with prominent links on most of its web pages. The first program dealt with events in Syria and Russia's role in the crisis there. The program debuted the first week in February. Each week, Mr. Kosachev debates foreign policy issues with an emphasis on Russia. So far, the program is not listed in the **Voice of Russia** programming grid, but it can be heard online at http://english.ruvr.ru/radio_broadcast/66026901/



Our final "May Flower" is also from the **Voice of Russia**. *Spiritual Flowerbed* is a supplement to the program *The Christian Voice From Moscow*. However, this particular Flowerbed may have been pruned, as it doesn't show up in the **Voice of Russia** program schedule any more. Look for it at http://english.ruvr.ru/radio_broadcast/2248514/

❖ Back to the Archives...

Last month, we looked at the **Canadian Broadcasting Corporation** archive site, and the career of the late Allan McFee. McFee's "partner in crime" at the **CBC** was **Max Ferguson**, who invented the character "Rawhide."

"According to his autobiography, *And Now...Here's Max* (1967), he was appalled to find among his assignments the task of hosting a cowboy music show called *After Breakfast Breakdown*. To protect his anonymity, and in hopes of quick reassignment, he improvised the character of 'Old Rawhide', assuming the voice of an elderly ranch hand and giving colourfully disdainful appraisals of the songs he introduced. The character was a breath of fresh air to listeners of the staid national broadcaster, and they relayed their approval with volumes of mail. Accepting his fate, **Ferguson** devised an entire repertory company of raucous and bizarre characters (all voiced by Ferguson) to amuse himself and his audience, creating daily skits which parodied literary classics and satirized current events and **CBC** personalities." (Wikipedia)

In a broadcast on Feb 26, 1960, "Rawhide" did a send up of **Radio Canada International**, then celebrating its 15th anniversary on the air. "How does a boss find people willing to work at **CBC International Service's** isolated transmitting station in Sackville, N.B.? The manager tells reporter Larry Lovelace the place is ideal for people who are tired of living. 'I meet potential suicide cases who just can't get up the nerve... they figure it's a good compromise,' he says. But it's all in jest as **CBC Radio** funnyman **Max Ferguson** celebrates the service's 15th anniversary on his show *Rawhide*." You can hear this amusing clip at http://archives.cbc.ca/arts_entertainment/media/clips/10984/



ARRL and CQ Sign Awards Agreement

ARRL, the national association for amateur radio, and CQ Communications (CQ), have signed an agreement to begin providing support for CQ-sponsored operating awards by the ARRL's Logbook of the World (LoTW) electronic confirmation system. The agreement was announced jointly by ARRL Chief Operating Officer Harold Kramer, WJ1B, and CQ Communications President Richard Ross, K2MGA.

CQ's awards will be the first non-ARRL awards supported by LoTW and will be phased in, beginning with the CQ WPX award. Additional CQ awards will follow. The ARRL's LoTW system, an interactive database recording contacts between radio amateurs, was created in 2003 and has been adopted by 47,500 radio hams worldwide. It already has records of 400 million contacts and grows weekly.

The new system began April 1, 2012, and amateurs are now using their LoTW logs to generate lists of confirmed contacts to be submitted for WPX credit. Standard LoTW credit fees and CQ award fees apply.

ARRL Chief Executive Officer David Sumner, K1ZZ, observed that this step gives radio amateurs throughout the world an inexpensive and convenient means of gaining credits toward CQ's popular operating awards. "LoTW has significantly increased interest and participation in the ARRL's DXCC, Worked All States and VUCC awards programs. We anticipate a similarly positive response to the addition of the CQ WPX award. Amateurs will be able to spend more time operating and less time chasing QSL cards."

CQ President Richard Ross, K2MGA, said he is very pleased to be able to move forward with

Logbook support for CQ awards. "We have had excellent results with electronic confirmations for several years," he said, "and I am glad that we are now able to begin expanding that convenience to those participants in our awards programs who use Logbook of the World. We look forward to a smooth launch for WPX, and to the expansion of LoTW support to include the rest of our award programs as well."

ARRL at www.arrl.org is the national association for amateur radio in the United States and publisher of its membership journal *QST*. CQ Communications, Inc www.cqcomm.com is publisher of *CQ Amateur Radio* and several other magazines. There are currently over 700,000 amateur radio licensees in the United States and approximately 2.5 million worldwide. To learn more, go to www.arrl.org/logbook-of-the-world.

Dayton Hamvention May 18-20

Hams across the globe gather one weekend in May, for what many consider to be the largest hamfest in North America. The Dayton Hamvention is an amateur radio convention held every year in the Hara Arena in Trotwood, Ohio, near Dayton, Ohio. The hamfest offers exhibit space, forums, and a flea market, and claims to have over 20,000 visitors. For information on purchasing tickets online, go to www.hamvention.org/tickets.php. Take a look from 2010 around the Yaesu, Icom, Kenwood, Elecraft and Ten Tec booths at www.youtube.com/watch?v=RDKza_IBpJM

Martha's Vinyard DXpedition

May 4-6, 1200-1800 UTC. W1ACT, Chilmark, MA. Team HAMCOW/Fall River Amateur Radio Club. Operating on: 28.380, 28.040, 14.280, 14.040, 21.380, 21.040, 7.280, 7.035 MHz. QSL. Roland Daignault Jr, 19 Davis Rd, Westport, MA 02790. 19th annual DXpedition to Gay Head Lighthouse, Martha's Vineyard Island IOTA NA-046, US Islands MA-005S. Dukes County, MA. Operating during NEQP. Updates available throughout the weekend. SASE only please. QSL direct via N1JOY. www.qsl.net/bcra_or_hamcow.net

Commemorate Kingmay, Arizona-Army Airfield WW2 Gunnery School

May, 5, 1700-2300 UTC. N7K, Kingman, AZ. Hualapai Amateur Radio Club. Operating on: 28.480, 21.380, 14.240, 7.240 MHz. QSL. Hualapai Amateur Radio Club, PO Box 6908, Kingman, AZ 86402. Special QSL issued with SASE and QSO information 30 days after event.

143rd Golden Spike Commemoration Celebration

May 10-12, 1500-2100 UTC. Z, W7G, Ogden, UT. Ogden Amateur Radio Club. Operating on: 28.355, 21.285, 14.255 MHz. QSL. OARC - W7G, PO Box 3353, Ogden, UT 84409. From the Golden Spike National Historic Site. Celebrating the 143rd anniversary of the Golden Spike ceremony that joined the rails connecting the Union and Central Pacific Railroads. on May 10, 1869 at Promontory Summit, Utah Territory. www.ogdenarc.org

Mother's Day Special Event

May 12, 0000-2359 UTC. W8SP, Grafton, WV. Mountaineer Amateur Radio Association. Bottom of general bands on 80, 40, 20 15 meter phone CW bands and Novice 10 meter phone subband. Certificate & QSL. Charles T. McClain, K8UQY, Rt 4 Box 161, Grafton, WV 26354. Commemorating the first official observance of Mother's Day.

Armed Forces Day, National Maritime Day, MARS Amateur Radio Crossband Operations Event

May 12, 1600-2359UTC. NI6IW, San Diego, CA. USS Midway (CV-41) Museum Radio Operations Room. SSB 14.320, 7.250 MHz, PSK31-14.070 D-STAR 012C and 2 m/70 cm SOCAL reports. QSL. USS Midway Museum Radio Room, 910 N Harbor Dr, San Diego, CT 92101. kk6fz@arrl.net

Lambert's Castle Shutter Telegraph

May 13, 0000-2359 UTC, GB5LCT, Lambert's Castle, Marshwood, Dorset, ENGLAND. Radio Society of Great Britain. 14.200 MHz. QSL. RSGB or direct to John Wakefield, Oakhurst,

Lower Common Road, West Wellow, Romsey SO51 6BT, ENGLAND. www.qrz.com/db/gb5lct

SEA-PAC 30th Anniversary-ARRL Northwest Division Convention

May 19-June 2, 1700-0200 UTC. W7OTV, Hillsboro, OR. Oregon Tualatin Valley Amateur Radio Club. Operations on: 28.460, 21.290, 14.260, 7.190 MHz. QSL. Oregon Tualatin Valley Amateur Radio Club, 880 NE 25th Ave., Ste 2-160, Hillsboro, OR 97124. Celebrating the first 30-years of the SEA-PAC Convention held in Seaside Oregon. www.otvarc.org

Peanut Island

May 26-May 27, 1300-1600 UTC. W4JUP, West Palm Beach, FL. Jupiter Tequesta Repeater Group. Operations on: 18.130, 14.240, 14.07.70, 7.180 MHz. QSL. QSL Manager, PO Box 7751, Jupiter, FL 33469. Operating from underground in the bunker built as an atomic shelter and command center for President John F. Kennedy during the height of the cold war. www.peanutisland.jtrg.org

75th Anniversary of the Golden Gate Bridge

May 26-27, 0000-2359 UTC. N6G, Healdsburg, CA. Will Pattullo. 21.265, 14.265, 7.265 MHz. QSL. Will Pattullo, 161 Presidential Cir, Healdsburg, CA 95448. www.ae6yb.tripod.com/n6g

May 26-27, 2000-2200 UTC. W6G, San Francisco, CA. San Francisco Amateur Radio Club. Operating on: 28.375, 24.975, 21.275, 18.125, 14.275, 7.175, 3.750 MHz. Certificate & QSL. Tony Dowler, PO Box 1749, Pacifica, CA 94044. SSB and CW. Certificate available for working 5 Bands. www.sfarc.org



HOW TO USE THE SHORTWAVE GUIDE

0000-0100 twhfa USA, Voice of America 5995am 6130ca 7405am 9455af
 ① ② ⑤ ③ ④ ⑥ ⑦

CONVERT YOUR TIME TO UTC

Broadcast time on ① and time off ② are expressed in Coordinated Universal Time (UTC) – the time at the 0 meridian near Greenwich, England. To translate your local time into UTC, first convert your local time to 24-hour format, then add (during Daylight Savings Time) 4, 5, 6 or 7 hours for Eastern, Central, Mountain or Pacific Times, respectively. Eastern, Central, and Pacific Times are already converted to UTC for you at the top of each hour.

Note that all dates, as well as times, are in UTC; for example, a show which might air at 0030 UTC Sunday will be heard on Saturday evening in America (in other words, 8:30 pm Eastern, 7:30 pm Central, etc.).

Not all countries observe Daylight Saving Time, not all countries shift at the same time, and not all program scheduling is shifted. So if you do not hear your desired station or program, try searching the hour ahead or behind its listed start time.

FIND THE STATION YOU WANT TO HEAR

Look at the page which corresponds to the time you will be listening. English broadcasts are listed by UTC time on ①, then alphabetically by country ③, followed by the station name ④. (If the station name is the same as the country, we don't repeat it, e.g., "Vanuatu, Radio" [Vanuatu].)

If a broadcast is not daily, the days of broadcast ⑤ will appear in the column following the time of broadcast, using the following codes:

<u>Codes</u>	
s/Sun	Sunday
m/Mon	Monday
t	Tuesday
w	Wednesday
h	Thursday
f	Friday
a/Sat	Saturday
occ:	occasional
DRM:	Digital Radio Mondiale
irreg	Irregular broadcasts
vl	Various languages
USB:	Upper Sideband

CHOOSE PROMISING FREQUENCIES

Choose the most promising frequencies for the time, location and conditions.

The frequencies ⑥ follow to the right of the station listing; all frequencies are listed in kilohertz (kHz). Not all listed stations will be heard from your location and virtually none of them will be heard all the time on all frequencies.

Shortwave broadcast stations change some of their frequencies at least twice a year, in April and October, to adapt to seasonal conditions. But they can also change in response to short-term condi-

tions, interference, equipment problems, etc. Our frequency manager coordinates published station schedules with confirmations and reports from her monitoring team and MT readers to make the Shortwave Guide up-to-date as of one week before print deadline.

To help you find the most promising signal for your location, immediately following each frequency we've included information on the target area ⑦ of the broadcast. Signals beamed toward your area will generally be easier to hear than those beamed elsewhere, even though the latter will often still be audible.

Target Areas

af:	Africa
al:	alternate frequency (occasional use only)
am:	The Americas
as:	Asia
ca:	Central America
do:	domestic broadcast
eu:	Europe
me:	Middle East
na:	North America
pa:	Pacific
sa:	South America
va:	various

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Additional Contributors to This Month's Shortwave Guide:

Thank You to ...

ADXC; BCL News; Cumbre DX; DSWCI-DX Window; DX Asia; DX India; Hard-Core DX; JPNpremium; DX Mix News 719-722, BC-DX WWDXC Top News; Nagova DX Circle.

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SHORTWAVE BROADCAST BANDS

kHz	Meters
2300-2495	120 meters (Note 1)
3200-3400	90 meters (Note 1)
3900-3950	75 meters (Regional band, used for broadcasting in Asia only)
3950-4000	75 meters (Regional band, used for broadcasting in Asia and Europe)
4750-4995	60 meters (Note 1)
5005-5060	60 meters (Note 1)
5730-5900	49 meter NIB (Note 2)
5900-5950	49 meter WARC-92 band (Note 3)
5950-6200	49 meters
6200-6295	49 meter NIB (Note 2)
6890-6990	41 meter NIB (Note 2)
7100-7300	41 meters (Regional band, not allocated for broadcasting in the western hemisphere) (Note 4)
7300-7350	41 meter WARC-92 band (Note 3)
7350-7600	41 meter NIB (Note 2)
9250-9400	31 meter NIB (Note 2)
9400-9500	31 meter WARC-92 band (Note 3)
9500-9900	31 meters
11500-11600	25 meter NIB (Note 2)
11600-11650	25 meter WARC-92 band (Note 3)
11650-12050	25 meters
12050-12100	25 meter WARC-92 band (Note 3)
12100-12600	25 meter NIB (Note 2)
13570-13600	22 meter WARC-92 band (Note 3)
13600-13800	22 meters
13800-13870	22 meter WARC-92 band (Note 3)
15030-15100	19 meter NIB (Note 2)
15100-15600	19 meters
15600-15800	19 meter WARC-92 band (Note 3)
17480-17550	17 meter WARC-92 band (Note 3)
17550-17900	17 meters
18900-19020	15 meter WARC-92 band (Note 3)
21450-21850	13 meters
25670-26100	11 meters

Notes

- Note 1 Tropical bands, 120/90/60 meters are for broadcast use only in designated tropical areas of the world.
- Note 2 Broadcasters can use this frequency range on a (NIB) non-interference basis only.
- Note 3 WARC-92 bands are allocated officially for use by HF broadcasting stations in 2007 WRC-03 update. After March 29, 2009, the spectrum from 7100-7200 kHz will no longer be available for broadcast purposes and will be turned over to amateur radio operations worldwide.
- Note 4

"MISSING" LANGUAGES?

A **FREE** download to MTXpress subscribers, the online MTXtra Shortwave Guide is 115+ pages of combined language schedules, sorted by time. Print subscribers: add the MTXtra SW Guide to your subscription for only \$11.95. Call **1-800-438-8155** or visit **www.monitoringtimes.com** to learn how.

0000 UTC - 8PM EDT / 7PM CDT / 5PM PDT

0000 0030	Egypt, R Cairo	6270na	
0000 0030	USA, BBG/Voice of America	7560as	
0000 0045	India, All India R/External Svc	6055as	7305as 11645as 13605as
0000 0045	USA, WYFR/Family R Worldwide	11720ca	
0000 0056	Romania, R Romania Intl	9700na	11965na
0000 0057	Canada, R Canada International	11700as	
0000 0057	China, China R International	6005as	6020na 6180as 7350eu 7425as 9425as 9570as 11650as 11790as 11885as
0000 0100	Anguilla/Caribbean Beacon/Univ Network		6090na
0000 0100	Australia, ABC NT Alice Springs	4835do	
0000 0100	Australia, ABC NT Katherine	5025do	
0000 0100	Australia, ABC NT Tennant Creek	4910do	
0000 0100	Australia, R Australia	9660pa	12080pa 13690va 15240va 17715va 17750va 17795va
0000 0100	Bahrain, R Bahrain	6010me	
0000 0100	Canada, CFRX Toronto ON	6070na	
0000 0100	Canada, CFVP Calgary AB	6030na	
0000 0100	Canada, CKZN St Johns NF	6160na	
0000 0100	Canada, CKZU Vancouver BC	6160na	
0000 0100	Cuba, R Havana Cuba	5040ca	
0000 0100	Malaysia, RTM Kajang/Traxx FM	7295do	
0000 0100	Micronesia, V6MP/Cross R/Pohnpei	4755as	
0000 0100	New Zealand, R New Zealand Intl	15720pa	
0000 0100	New Zealand, R New Zealand Intl	17675pa	
0000 0100	Russia, Voice of Russia	7250va	
0000 0100	Spain, R Exterior de Espana	6055na	
0000 0100	Thailand, R Thailand World Svc	13745na	
0000 0100	UK, BBC World Service	6195as	9410as 9740as 12095as 13725as 15755as
0000 0100	USA, Amer Forces Network/AFRTS	4319usb	5446usb 5765usb 7812usb 12133usb 12759usb 13362usb
0000 0100	USA, EWTN/WEWN Irondale AL	11520me	
0000 0100	USA, FBN/WTJC Newport NC	9370na	
0000 0100	USA, WBCQ Monticello ME	5110am	
0000 0100	USA, WBCQ Monticello ME	9330am	
0000 0100	USA, WBCQ Monticello ME	7490am	
0000 0100	USA, WHRI Cypress Creek SC	7385ca	
0000 0100	USA, WINB Red Lion PA	9265ca	
0000 0100	USA, WTWW Lebanon TN	5080am	5755am 12105na
0000 0100	USA, WWCN Nashville TN	3195eu	5070af 9980af 13845eu
0000 0100	USA, WWRB Manchester TN	3185na	5050na 5745va
0000 0100	USA, WYFR/Family R Worldwide	6115va	6155ca
0000 0100	Zambia, CVC/R Christian Voice	4965af	
0030 0100	Australia, R Australia	15415va	
0030 0100	Canada, Bible Voice Broadcasting	9490as	
0030 0100	Palau, T8WH/WHRI	15700as	
0030 0100	UK, BBC World Service	9510as	
0030 0100	USA, BBG/Voice of America	6170va	9325va 9490va 9715va 11695va 11730va 15185va 15205va 15290va
0030 0100	USA, BBG/Voice of America/Special English		6170va 9325va 9490va 9715va 11695va 11730va 12005va 15185va 15205va 15290va
0035 0045	India, All India R/Aizawl	5050do	
0035 0045	India, All India R/Chennai	4920do	
0035 0045	India, All India R/Guwahati	4940do	
0035 0045	India, All India R/Hyderabad	4800do	
0035 0045	India, All India R/Imphal	4775do	
0035 0045	India, All India R/Port Blair	4760do	
0035 0045	India, All India R/Shillong	4970do	
0035 0045	India, All India R/Shimla	4965do	
0035 0045	India, All India R/Thiruvananthapuram	5010do	

0100 UTC - 9PM EDT / 8PM CDT / 6PM PDT

0100 0115	Sat	Canada, Bible Voice Broadcasting	9490as
0100 0130		Vietnam, VO Vietnam/Overseas Svc	6175na
0100 0157		China, China R International	6005na 6020na 6075as 6175as 9410eu 9420as 9570na 9580na 11650as 11885as

0100 0200		Anguilla/Caribbean Beacon/Univ Network	
0100 0200		6090na	
0100 0200		Australia, ABC NT Alice Springs	4835do
0100 0200		Australia, ABC NT Katherine	5025do
0100 0200		Australia, ABC NT Tennant Creek	4910do
0100 0200		Australia, R Australia	9660pa 12080va 13690va 15240va 15415va 17715va 17750va 17795va
0100 0200		Bahrain, R Bahrain	6010me
0100 0200		Canada, CFRX Toronto ON	6070na
0100 0200		Canada, CFVP Calgary AB	6030na
0100 0200		Canada, CKZN St Johns NF	6160na
0100 0200		Canada, CKZU Vancouver BC	6160na
0100 0200		Cuba, R Havana Cuba	6000na 6050na
0100 0200		Malaysia, RTM Kajang/Traxx FM	7295do
0100 0200		Micronesia, V6MP/Cross R/Pohnpei	4755as
0100 0200		New Zealand, R New Zealand Intl	15720pa
0100 0200	DRM	New Zealand, R New Zealand Intl	17675pa
0100 0200		North Korea, Voice of Korea	4405as 7220as 9345as 9730as 11735as 13760as 15180as
0100 0200		Russia, Voice of Russia	7250va
0100 0200		Taiwan, R Taiwan Intl	11875as
0100 0200		UK, BBC World Service	5940as 5970as 9740as 11750as 12095as 15310as 15335as 15755as 17685as
0100 0200		USA, Amer Forces Network/AFRTS	4319usb 5446usb 5765usb 7812usb 12133usb 12759usb 13362usb
0100 0200		USA, BBG/Voice of America	9435as 11705as 15620as
0100 0200		USA, EWTN/WEWN Irondale AL	11520me
0100 0200		USA, FBN/WTJC Newport NC	9370na
0100 0200	mtwhfa	USA, WBCQ Monticello ME	7490am
0100 0200		USA, WBCQ Monticello ME	9330am
0100 0200	twhfa	USA, WHRI Cypress Creek SC	5920na
0100 0200		USA, WINB Red Lion PA	9265ca
0100 0200		USA, WTWW Lebanon TN	5080am 5755am 12105na
0100 0200		USA, WWCN Nashville TN	3195eu 4840na 5935af 9980af
0100 0200		USA, WWRB Manchester TN	3185na 5050na 5745va
0100 0200		USA, WYFR/Family R Worldwide	6115ca
0100 0200		Zambia, CVC/R Christian Voice	4965af
0120 0200	mtwhfa	Sri Lanka, SLBC	6005as 9770as 15745as
0130 0200	Sun	Palau, T8WH/WHRI	15700as
0130 0200	twhfa	Serbia, International R Serbia	6190va
0130 0200	twhfa	USA, BBG/Voice of America/Special English	5960va 7465va
0130 0200	twhfa	USA, WRMI/R Slovakia Intl relay	9955am
0140 0200		Vatican City State, Vatican R	5890as 7410as

0200 UTC - 10PM EDT / 9PM CDT / 7PM PDT

0200 0230		Thailand, R Thailand World Svc	15275na
0200 0257		China, China R International	11785as 13640as
0200 0300		Anguilla/Caribbean Beacon/Univ Network	
0200 0300		6090na	
0200 0300	twhfa	Argentina, RAE	11710am
0200 0300		Australia, ABC NT Alice Springs	4835do
0200 0300		Australia, ABC NT Katherine	5025do
0200 0300		Australia, ABC NT Tennant Creek	4910do
0200 0300		Australia, R Australia	9660pa 12080va 13690va 15240va 15415va 15515pa 17750va 21725as
0200 0300		Bahrain, R Bahrain	6010me
0200 0300		Canada, CFRX Toronto ON	6070na
0200 0300		Canada, CFVP Calgary AB	6030na
0200 0300		Canada, CKZN St Johns NF	6160na
0200 0300		Canada, CKZU Vancouver BC	6160na
0200 0300		Cuba, R Havana Cuba	6000na 6050na
0200 0300		Egypt, R Cairo	9315na
0200 0300		Malaysia, RTM Kajang/Traxx FM	7295do
0200 0300		Micronesia, V6MP/Cross R/Pohnpei	4755as
0200 0300		New Zealand, R New Zealand Intl	15720pa
0200 0300	DRM	New Zealand, R New Zealand Intl	17675pa
0200 0300		North Korea, Voice of Korea	3560as 13650as 15100as
0200 0300	Sun	Palau, T8WH/WHRI	17800as
0200 0300		Philippines, R Pilipinas Overseas	11880me 15285me 17700me

0200 0300	Russia, Voice of Russia	7250sa	
0200 0300	South Korea, KBS World R	9580sa	
0200 0300 mtwhfa	Sri Lanka, SLBC	6005as	15745as
0200 0300	Taiwan, R Taiwan Intl	5950na	9680na
0200 0300	UK, BBC World Service	5875me	5940as
	7385af	12095as	15310as
0200 0300	USA, Amer Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	
0200 0300	USA, EWTN/WEWN Irondale AL	11520me	
0200 0300	USA, FBN/WTJC Newport NC	9370na	
0200 0300 mtwhfa	USA, WBCQ Monticello ME	7490am	
0200 0300	USA, WBCQ Monticello ME	9330am	
0200 0300 twhfa	USA, WHRI Cypress Creek SC	5920na	
	7385na		
0200 0300	USA, WINB Red Lion PA	9265ca	
0200 0300	USA, WTTW Lebanon TN	5080am	5755am
	12105na		
0200 0300	USA, WWCN Nashville TN	3215eu	4840na
	5890af	5935af	
0200 0300	USA, WWRB Manchester TN	3195na	5050na
	5745va		
0200 0300	USA, WYFR/Family R Worldwide	5985ca	
	6115ca	7360ca	
0200 0300	Zambia, CVC/R Christian Voice	4965af	
0215 0225	Nepal, R Nepal	5005as	
0230 0257	China, China R International		15435as
0230 0300 twhf	Albania, R Tirana	7420na	
0230 0300	Myanmar, Myanma R/Yangon	9731do	
0230 0300	Vietnam, VO Vietnam/Overseas Svc	6175na	
0245 0300	Australia, HCJB Global Australia		15400as
0245 0300	India, All India R/Bhopal	7430do	
0245 0300	India, All India R/Delhi	4860do	6030do
	7235do	11830do	15135do
0245 0300	India, All India R/Gorakhpur		3945do
	6030do	7235do	11830do
0245 0300	India, All India R/Guwahati	4940do	
0245 0300	India, All India R/Hyderabad	7420do	
0245 0300	India, All India R/Imphal	7335do	
0245 0300	India, All India R/Itanagar	4990do	
0245 0300	India, All India R/Jaipur	4910do	
0245 0300	India, All India R/Kolkata	7210do	
0245 0300	India, All India R/Kurseong	4895do	
0245 0300	India, All India R/Lucknow	4880do	
0245 0300	India, All India R/R Kashmir	4760do	
0245 0300	India, All India R/Shillong	4970do	
0245 0300	India, All India R/Shimla	6020do	
0245 0300	India, All India R/Thiruvananthapuram	7290do	
0250 0300	Vatican City State, Vatican R	6040am	7305am
0255 0300 Sun	South Africa, TWR Africa	3200af	

0300 UTC - 11PM EDT / 10PM CDT / 8PM PDT

0300 0315	Croatia, Voice of Croatia	3985am	7375am
0300 0315	India, All India R/Imphal	7335do	
0300 0315	India, All India R/Itanagar	4990do	
0300 0315	India, All India R/Shillong	4970do	
0300 0325 Sun	South Africa, TWR Africa	3200af	
0300 0330	Egypt, R Cairo	9315na	
0300 0330	Myanmar, Myanma R/Yangon		9731do
0300 0330	Philippines, R Pilipinas Overseas	11880me	
	15285me	17700me	
0300 0330	Vatican City State, Vatican R	9660af	11625af
0300 0356	Romania, R Romania Intl	9645na	11795na
	11895as	15340as	
0300 0357	China, China R International		6190na
	9460as	9690na	9790na
	15120as		13620as
0300 0359	South Africa, Channel Africa		3345af
0300 0400	Anguilla/Caribbean Beacon/Univ Network		6090na
0300 0400	Australia, ABC NT Alice Springs		4835do
0300 0400	Australia, ABC NT Katherine	5025do	
0300 0400	Australia, ABC NT Tennant Creek		4910do
0300 0400	Australia, R Australia	9660pa	12080va
	13690va	15240va	15415va
	17750va	21725as	15515pa
0300 0400	Bahrain, R Bahrain		6010me
0300 0400 twhf	Canada, CBC Northern Quebec Svc		9625na
0300 0400	Canada, CFRX Toronto ON	6070na	
0300 0400	Canada, CFVP Calgary AB	6030na	
0300 0400	Canada, CKZN St Johns NF	6160na	

0300 0400	Canada, CKZU Vancouver BC		6160na
0300 0400	Cuba, R Havana Cuba	6000na	6050na
0300 0400	Malaysia, RTM Kajang/Traxx FM		7295do
0300 0400	Micronesia, V6MP/Cross R/Pohnpei		4755as
0300 0400	New Zealand, R New Zealand Intl		15720pa
0300 0400 DRM	New Zealand, R New Zealand Intl		17675pa
0300 0400	North Korea, Voice of Korea		4405as
	7220as	9345as	9730as
0300 0400	Oman, R Sultanate of Oman		15355af
0300 0400 Sun	Palau, T8WH/WHRI		17800as
0300 0400 mtwhf	Palau, T8WH/WHRI		17800as
0300 0400	Russia, Voice of Russia	7250sa	12040as
0300 0400	South Africa, Channel Africa		6155af
0300 0400 Sat	Sri Lanka, SLBC	6005as	9770as
0300 0400	Taiwan, R Taiwan Intl	6875na	15320as
0300 0400	UK, BBC World Service	3255af	5940me
	6140af	6190af	7255af
	9460af	11860af	12095as
	17790as		15310as
0300 0400	USA, Amer Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	12133usb
0300 0400	USA, BBG/Voice of America	4930af	6080af
	9885af	15580af	
0300 0400	USA, EWTN/WEWN Irondale AL		11520me
0300 0400	USA, FBN/WTJC Newport NC		9370na
0300 0400 mtwhfa	USA, WBCQ Monticello ME	7490am	
0300 0400	USA, WBCQ Monticello ME	9330am	
0300 0400 Sat	USA, WHRI Cypress Creek SC		7520va
0300 0400	USA, WINB Red Lion PA	9265ca	
0300 0400	USA, WTTW Lebanon TN	5080am	5755am
	12105na		
0300 0400	USA, WWCN Nashville TN	3215eu	4840na
	5890af	5935af	
0300 0400	USA, WWRB Manchester TN	3195na	5050na
	5745va		
0300 0400	USA, WYFR/Family R Worldwide		6115ca
	9930ca	11740ca	
0300 0400	Zambia, CVC/R Christian Voice		4965af
0330 0400	Iran, IRIB/VOIRI	11920eu	13650eu
0330 0400	Vietnam, VO Vietnam/Overseas Svc		6175na
0335 0345	India, All India R/Aizawl	5050do	
0335 0345	India, All India R/Delhi	7235do	11830do
	15135do		
0335 0345	India, All India R/Kolkata	7210do	

0400 UTC - 12AM EDT / 11PM CDT / 9PM PDT

0400 0430	Iran, IRIB/VOIRI	11920eu	13650eu
0400 0430	USA, BBG/Voice of America	4930af	4960af
	6080af	9885af	15580af
0400 0457	China, China R International		6190na
	9460as	13620as	15120as
	17855as		17725as
0400 0457	Germany, Deutsche Welle	6180af	7240af
	9470af	12045af	
0400 0458	New Zealand, R New Zealand Intl		15720pa
0400 0458 DRM	New Zealand, R New Zealand Intl		17675pa
0400 0500	Anguilla/Caribbean Beacon/Univ Network		6090na
0400 0500	Australia, ABC NT Alice Springs		4835do
0400 0500	Australia, ABC NT Katherine	5025do	
0400 0500	Australia, ABC NT Tennant Creek		4910do
0400 0500	Australia, R Australia	9660pa	12080va
	13690va	15240va	15515pa
	21725as		17750va
0400 0500	Bahrain, R Bahrain		6010me
0400 0500 twhf	Canada, CBC Northern Quebec Svc		9625na
0400 0500	Canada, CFRX Toronto ON	6070na	
0400 0500	Canada, CKZN St Johns NF	6160na	
0400 0500	Canada, CKZU Vancouver BC		6160na
0400 0500	Cuba, R Havana Cuba	6000na	6050na
0400 0500	Malaysia, RTM Kajang/Traxx FM		7295do
0400 0500	Micronesia, V6MP/Cross R/Pohnpei		4755as
0400 0500	Russia, Voice of Russia		12040as
0400 0500	South Africa, Channel Africa		7230af
0400 0500 Sat	Sri Lanka, SLBC	6005as	9770as
0400 0500	Turkey, Voice of Turkey	7240as	9655va
0400 0500	UK, BBC World Service	3255af	6005af
	6190af	7255af	9410me
	12035af	12095af	15310as
	17790as		15360as

0400 0500	USA, Amer Forces Network/AFRTS 5446usb 5765usb 7812usb 12759usb 13362usb	4319usb 12133usb
0400 0500	USA, EWTN/WEWN Irondale AL	11520me
0400 0500	USA, FBN/WTJC Newport NC	9370na
0400 0500 mtwhfa	USA, WBCQ Monticello ME 7490am	
0400 0500	USA, WBCQ Monticello ME 9330am	
0400 0500 m	USA, WBCQ Monticello ME 5110am	
0400 0500 hf	USA, WHRI Cypress Creek SC	7385na
0400 0500 Sun	USA, WHRI Cypress Creek SC	7465eu
0400 0500 Sat	USA, WHRI Cypress Creek SC	9640me
0400 0500	USA, WTWW Lebanon TN 5080am 12105na	5755am
0400 0500	USA, WWCR Nashville TN 3215eu 5890af 5935af	4840na
0400 0500	USA, WWRB Manchester TN3195na 5745va	5050na
0400 0500	Zambia, CVC/R Christian Voice	4965af
0430 0500	Australia, R Australia	15415va
0430 0500 Sun	Palau, T8WH/WHRI	17800as
0430 0500	South Africa, TWR Africa	3200af
0430 0500	USA, BBG/Voice of America 4930af 9885af 15580af	4960af
0435 0445	India, All India R/Delhi	4860do
0459 0500	New Zealand, R New Zealand Intl	11725pa
0459 0500 DRM	New Zealand, R New Zealand Intl	13730pa

0500 UTC - 1AM EDT / 12AM CDT / 10PM PDT

0500 0507 twhf	Canada, CBC Northern Quebec Svc	9625na
0500 0527	Germany, Deutsche Welle	6075af
0500 0530	Germany, Deutsche Welle 9850va	9800af
0500 0530	Japan, R Japan NHK World 5975va 9770va	6110na
0500 0557	China, China R International 6190na 7220af 7295af 9440af 11880as 15350as 17505va 17540as 17725as 17855as	5960na
0500 0600	Anguilla/Caribbean Beacon/Univ Network 6090na	
0500 0600	Australia, ABC NT Alice Springs	4835do
0500 0600	Australia, ABC NT Katherine	5025do
0500 0600	Australia, ABC NT Tennant Creek	4910do
0500 0600	Australia, R Australia 13630va 13690va 15160va 15240va 17750va 21725va	12080va
0500 0600	Bahrain, R Bahrain	6010me
0500 0600	Bhutan, Bhutan Broadcasting Svc	6035do
0500 0600	Canada, CFRX Toronto ON 6070na	
0500 0600	Canada, CKZN St Johns NF 6160na	
0500 0600	Canada, CKZU Vancouver BC	6160na
0500 0600	Cuba, R Havana Cuba 6060ca 6125ca	6050na
0500 0600 mtwhf	Eqt Guinea, R Africa 2	15190af
0500 0600	Malaysia, RTM Kajang/Traxx FM	7295do
0500 0600	Micronesia, V6MP/Cross R/Pohnpei	4755as
0500 0600	New Zealand, R New Zealand Intl	11725pa
0500 0600 DRM	New Zealand, R New Zealand Intl	13730pa
0500 0600	Nigeria, Voice of Nigeria	15120af
0500 0600	South Africa, Channel Africa	7230af
0500 0600	South Africa, TWR Africa 3200af 4775af 6120af	4775af
0500 0600	Taiwan, R Taiwan Intl	6875na
0500 0600 DRM	UK, BBC World Service	3955eu
0500 0600	UK, BBC World Service 6005af 6190af 7255af 9410me 12095af 15310as 15360as 15400af 15420af 17640af 17790as	3955eu
0500 0600 Sat/Sun	UK, BBC World Service	15420af
0500 0600	USA, Amer Forces Network/AFRTS 5446usb 5765usb 7812usb 12759usb 13362usb	4319usb 12133usb
0500 0600	USA, BBG/Voice of America 4930af 9885af 15580af	6080af
0500 0600	USA, EWTN/WEWN Irondale AL	11520me
0500 0600	USA, FBN/WTJC Newport NC	9370na
0500 0600	USA, WBCQ Monticello ME 9330am	
0500 0600 Sun	USA, WHRI Cypress Creek SC	11565pa
0500 0600	USA, WTWW Lebanon TN 5080am 12105na	5755am

0500 0600	USA, WWCR Nashville TN 3215eu 5890af 5935af	4840na
0500 0600	USA, WWRB Manchester TN3195na 5745va	5050na
0500 0600	Zambia, CVC/R Christian Voice	6065af
0530 0556 DRM	Romania, R Romania Intl	11875eu
0530 0556	Romania, R Romania Intl 21500eu	17760eu
0530 0557	Germany, Deutsche Welle	9800af
0530 0600	Australia, R Australia	15415va
0530 0600	Germany, Deutsche Welle	9850va
0530 0600 Sun	Palau, T8WH/WHRI	17800as
0530 0600	Thailand, R Thailand World Svc	12015eu

0600 UTC - 2AM EDT / 1AM CDT / 11PM PDT

0600 0630	Australia, R Australia	15290as
0600 0630	Germany, Deutsche Welle 17820af	9470af 13780af
0600 0630	Vatican City State, Vatican R 3975eu 7250eu	6075eu
0600 0650 DRM	New Zealand, R New Zealand Intl	13730pa
0600 0655	South Africa, Channel Africa	15255af
0600 0657	China, China R International 11750af 11770as 11880as 13645as 15145as 15350as 15465as 17505va 17540as 17710as	6115na
0600 0659	South Africa, Channel Africa	7230af
0600 0700	Anguilla/Caribbean Beacon/Univ Network 6090na	
0600 0700	Australia, ABC NT Alice Springs	4835do
0600 0700	Australia, ABC NT Katherine	5025do
0600 0700	Australia, ABC NT Tennant Creek	4910do
0600 0700	Australia, R Australia 13630va 13690va 15160va 15240va 15415va 17750va 21725va	12080va
0600 0700	Bahrain, R Bahrain	6010me
0600 0700	Canada, CFRX Toronto ON 6070na	
0600 0700	Canada, CFVP Calgary AB 6030na	
0600 0700	Canada, CKZN St Johns NF 6160na	
0600 0700	Canada, CKZU Vancouver BC	6160na
0600 0700	Cuba, R Havana Cuba 6060ca 6125ca	6050na
0600 0700 mtwhf	Eqt Guinea, R Africa 2	15190af
0600 0700	Malaysia, RTM Kajang/Traxx FM	7295do
0600 0700	Micronesia, V6MP/Cross R/Pohnpei	4755as
0600 0700	New Zealand, R New Zealand Intl	11725pa
0600 0700	Nigeria, Voice of Nigeria	15120af
0600 0700 Sun	Palau, T8WH/WHRI	17800as
0600 0700	Papua New Guinea, R Fly	5960do
0600 0700	Russia, Voice of Russia	17805pa 21805pa
0600 0700 DRM	Russia, Voice of Russia	11635eu
0600 0700	South Africa, CVC 1 Africa R 17695af	13590af
0600 0700	South Africa, TWR Africa 3200af 4775af 6120af	4775af
0600 0700	UK, BBC World Service 6190af 9410af 11760me 12015af 12095af 15310as 15400af 15420af 17640af 17790as	3955eu 6005af
0600 0700 DRM	UK, BBC World Service	3955eu
0600 0700	USA, Amer Forces Network/AFRTS 5446usb 5765usb 7812usb 12759usb 13362usb	4319usb 12133usb
0600 0700	USA, BBG/Voice of America 6080af 15580af	9885af
0600 0700	USA, EWTN/WEWN Irondale AL	11520af
0600 0700	USA, FBN/WTJC Newport NC	9370na
0600 0700	USA, WBCQ Monticello ME 9330am	
0600 0700 Sat	USA, WHRI Cypress Creek SC	9615me
0600 0700	USA, WTWW Lebanon TN 5080am 12105na	5755am
0600 0700	USA, WWCR Nashville TN 3215eu 5890af 5935af	4840na
0600 0700	USA, WWRB Manchester TN3185na 5745va	5050na
0600 0700	Zambia, CVC/R Christian Voice 17695af	6065af
0630 0645	India, All India R/Guwahati	7280do
0630 0645	India, All India R/Hyderabad	7420do
0630 0645	India, All India R/Kurseong	7230do
0630 0645	India, All India R/Mumbai	7240do

0630 0645 India, All India R/Thiruvananthapuram 7290do
 0630 0700 Germany, Deutsche Welle 13780af 17820af
 0630 0700 Vatican City State, Vatican R 7360af 9660af
 11625af
 0651 0700 DRM New Zealand, R New Zealand Intl 13730pa

0700 UTC - 3AM EDT / 2AM CDT / 12AM PDT

0700 0730 Myanmar, Myanma R/Yangon 9731do
 0700 0757 China, China R International 11785eu
 11880as 13645as 15125va 15350as
 15465as 17540as 17490eu 17710as
 0700 0758 New Zealand, R New Zealand Intl 11725pa
 0700 0758 DRM New Zealand, R New Zealand Intl 13730pa
 0700 0800 Anguilla/Caribbean Beacon/Univ Network
 6090na
 0700 0800 Australia, ABC NT Alice Springs 4835do
 0700 0800 Australia, ABC NT Katherine 5025do
 0700 0800 Australia, ABC NT Tennant Creek 4910do
 0700 0800 Australia, R Australia 9475as 9660pa
 9710as 11945as 12080va 13630va
 15160va 15240va 21275va
 0700 0800 Bahrain, R Bahrain 6010me
 0700 0800 m/DRM Belgium, TDP Radio 6015eu
 0700 0800 Canada, CFRX Toronto ON 6070na
 0700 0800 Canada, CFVP Calgary AB 6030na
 0700 0800 Canada, CKZN St Johns NF 6160na
 0700 0800 Canada, CKZU Vancouver BC 6160na
 0700 0800 mtwhf Eq Guinea, R Africa 2 15190af
 0700 0800 Malaysia, RTM Kajang/Traxx FM 7295do
 0700 0800 Micronesia, V6MP/Cross R/Pohnpei 4755as
 0700 0800 Papua New Guinea, R Fly 5960do
 0700 0800 Russia, Voice of Russia 17805va 21805va
 0700 0800 DRM Russia, Voice of Russia 11635eu
 0700 0800 South Africa, CVC 1 Africa R 13590af
 17695af
 0700 0800 South Africa, TWR Africa 3200af 4775af
 6120af
 0700 0800 UK, BBC World Service 3955eu 5875eu
 6190af 11760me 11770af 12095af
 13820af 15310as 15400af 15575me
 17640af 17790as 17830af
 0700 0800 DRM UK, BBC World Service 5875eu
 0700 0800 USA, Amer Forces Network/AFRTS 4319usb
 5446usb 5765usb 7812usb 12133usb
 12759usb 13362usb
 0700 0800 USA, EWTN/WEWN Irondale AL 11520af
 0700 0800 USA, FBN/WTJC Newport NC 9370na
 0700 0800 USA, WBCQ Monticello ME 9330am
 0700 0800 Sun USA, WHRI Cypress Creek SC 11565pa
 0700 0800 USA, WTWW Lebanon TN 5080am 5755am
 12105na
 0700 0800 USA, WWCN Nashville TN 3215eu 4840na
 5890af 5935af
 0700 0800 USA, WWRB Manchester TN 3185na
 0700 0800 Zambia, CVC/R Christian Voice 6065af
 17695af
 0730 0745 India, All India R/Aizawl 5050do
 0730 0745 India, All India R/Delhi 6190do 11710do
 15185do 15260do
 0730 0745 India, All India R/Guwahati 7280do
 0730 0745 India, All India R/Imphal 7335do
 0730 0745 India, All India R/Jaipur 7325do
 0730 0745 India, All India R/Kolkata 7210do
 0730 0745 India, All India R/Kurseong 7230do
 0730 0745 India, All India R/Shimla 6020do
 0730 0800 Australia, HCJB Global Australia 11750pa
 0730 0800 India, All India R/Chennai 4920do
 0759 0800 New Zealand, R New Zealand Intl 9765pa
 0759 0800 DRM New Zealand, R New Zealand Intl 9870pa

0800 UTC - 4AM EDT / 3AM CDT / 1AM PDT

0800 0815 Nepal, R Nepal 5005as
 0800 0815 w Romania, IRRS 11910va
 0800 0830 Australia, ABC NT Alice Springs 4835do
 0800 0830 Australia, ABC NT Katherine 5025do
 0800 0830 Australia, ABC NT Tennant Creek 4910do
 0800 0830 Australia, HCJB Global Australia 11750pa
 0800 0830 Sun Canada, Bible Voice Broadcasting 5945eu
 0800 0845 Sat Canada, Bible Voice Broadcasting 5945eu

0800 0850 Austria, TWR Europe 6105eu
 0800 0850 Germany, TWR Europe 6105eu
 0800 0857 China, China R International 9415as
 11785eu 11880eu 13350as 15465as
 15625va 17490eu 17540as
 0800 0900 Anguilla/Caribbean Beacon/Univ Network
 6090na
 0800 0900 Australia, R Australia 5995va 9475as
 9580pa 9590pa 9710as 11945as
 12080va 13630va
 0800 0900 Bahrain, R Bahrain 6010me
 0800 0900 t/DRM Belgium, TDP Radio 6015eu
 0800 0900 Bhutan, Bhutan Broadcasting Svc 6035do
 0800 0900 Canada, CFRX Toronto ON 6070na
 0800 0900 Canada, CFVP Calgary AB 6030na
 0800 0900 Canada, CKZN St Johns NF 6160na
 0800 0900 Canada, CKZU Vancouver BC 6160na
 0800 0900 mtwhfa Ecuador, HCJB/LV de los Andes 3995eu
 0800 0900 mtwhf Eq Guinea, R Africa 2 15190af
 0800 0900 Malaysia, RTM Kajang/Traxx FM 7295do
 0800 0900 Micronesia, V6MP/Cross R/Pohnpei 4755as
 0800 0900 New Zealand, R New Zealand Intl 9765pa
 0800 0900 DRM New Zealand, R New Zealand Intl 9870pa
 0800 0900 Palau, T8WH/WHRI 9930as
 0800 0900 Sun Palau, T8WH/WHRI 9930as
 0800 0900 Papua New Guinea, R Fly 5960do
 0800 0900 Sat Romania, IRRS 9510va
 0800 0900 Russia, Voice of Russia 17805va 21805va
 0800 0900 DRM Russia, Voice of Russia 7325eu 11635eu
 0800 0900 Sun South Africa, Amateur R Mirror Intl 7205af
 17760af
 0800 0900 South Africa, Channel Africa 9625af
 0800 0900 South Africa, CVC 1 Africa R 13590af
 17695af
 0800 0900 South Korea, KBS World R 9570as
 0800 0900 UK, BBC World Service 5760eu 5875eu
 6190af 11760me 12095af 15310as
 15400af 15575me 17640af 17790as
 17830af 21470af
 0800 0900 DRM UK, BBC World Service 5790eu 5875eu
 0800 0900 USA, Amer Forces Network/AFRTS 4319usb
 5446usb 5765usb 7812usb 12133usb
 12759usb 13362usb
 0800 0900 USA, EWTN/WEWN Irondale AL 11520af
 0800 0900 USA, FBN/WTJC Newport NC 9370na
 0800 0900 USA, WBCQ Monticello ME 9330am
 0800 0900 smtwhf USA, WHRI Cypress Creek SC 11565pa
 0800 0900 USA, WTWW Lebanon TN 5080am 5755am
 12105na
 0800 0900 USA, WWCN Nashville TN 3215eu 4840na
 5890af 5935af
 0800 0900 USA, WWRB Manchester TN 3185na
 0800 0900 Zambia, CVC/R Christian Voice 6065af
 17695af
 0820 0900 smtwhf Guam, TWR Asia/KTWR 15170as
 0830 0845 India, All India R/Aizawl 5050do
 0830 0845 India, All India R/Chennai 4920do
 0830 0845 India, All India R/Delhi 6190do 11710do
 15185do 15260do
 0830 0845 India, All India R/Hyderabad 7420do
 0830 0845 India, All India R/Imphal 7335do
 0830 0845 India, All India R/Itanagar 4990do
 0830 0845 India, All India R/Kolkata 7210do
 0830 0845 India, All India R/Shillong 7315do
 0830 0845 India, All India R/Thiruvananthapuram 7290do
 0830 0900 Australia, ABC NT Alice Springs 2310do
 0830 0900 Australia, ABC NT Katherine 2485do
 0830 0900 Australia, ABC NT Tennant Creek 2325do
 0830 0900 mtwhfa Guam, TWR Asia/KTWR 11840pa

0900 UTC - 5AM EDT / 4AM CDT / 2AM PDT

0900 0910 mtwhfa Guam, TWR Asia/KTWR 11840as
 0900 0930 mtwhf Palau, T8WH/WHRI 9930as
 0900 0930 Sun Palau, T8WH/WHRI 9930as
 0900 0957 China, China R International 9415as
 15210pa 15270eu 15350as 17490eu
 17570eu 17690pa 17750as
 0900 1000 Anguilla/Caribbean Beacon/Univ Network
 6090na
 0900 1000 Australia, ABC NT Alice Springs 2310do
 0900 1000 Australia, ABC NT Katherine 2485do

0900 1000	Australia, ABC NT Tennant Creek	2325do	
0900 1000	Australia, R Australia	9475as	9580pa
	9590pa	11945as	12080va
0900 1000	Bahrain, R Bahrain	6010me	
0900 1000 w/DRM	Belgium, TDP Radio	6015eu	
0900 1000	Canada, CFRX Toronto ON	6070na	
0900 1000	Canada, CFVP Calgary AB	6030na	
0900 1000	Canada, CKZN St Johns NF	6160na	
0900 1000	Canada, CKZU Vancouver BC	6160na	
0900 1000 3rd Sun	Germany, XVRB Radio	6045va	
0900 1000	Malaysia, RTM Kajang/Traxx FM	7295do	
0900 1000	Micronesia, V6MP/Cross R/Pohnpei	4755as	
0900 1000 DRM	New Zealand, R New Zealand Intl	9870pa	
0900 1000	New Zealand, R New Zealand Intl	9765pa	
0900 1000	Nigeria, Voice of Nigeria	9690af	
0900 1000 Sat	Palau, T8WH/WHRI	9930as	15700as
0900 1000	Papua New Guinea, R Fly	5960do	
0900 1000	Russia, Voice of Russia	7205as	17805va
	21805va		
0900 1000 DRM	Russia, Voice of Russia	7325eu	11635eu
0900 1000	South Africa, Channel Africa	9625af	
0900 1000	South Africa, CVC 1 Africa R	13590af	
	17695af		
0900 1000	UK, BBC World Service	6190af	6195as
	9740as	11760me	11895as
	15285as	15310as	15400af
	15575me		
	17760as	17790as	17830af
	21470af		
0900 1000	USA, Amer Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	12133usb
0900 1000	USA, EWTN/WEWN Irondale AL	9390as	
0900 1000	USA, FBN/WTJC Newport NC	9370na	
0900 1000	USA, WBCQ Monticello ME	9330am	
0900 1000 Sun	USA, WHRI Cypress Creek SC	11565pa	
0900 1000	USA, WTTW Lebanon TN	5080am	5755am
	12105na		
0900 1000	USA, WWCN Nashville TN	3215eu	4890na
	5890af	5935af	
0900 1000	USA, WWRB Manchester TN	3185na	
0900 1000	USA, WYFR/Family R Worldwide	9465as	
0900 1000	Zambia, CVC/R Christian Voice	6065af	
	17695af		
0905 0910	Pakistan, PBC/R Pakistan	15725eu	17700eu
0915 0930 mtwhf	Palau, T8WH/WHRI	9930as	
0930 1000 w	Palau, T8WH/WHRI	9930as	
0930 1000 Sun	Romania, IRRS	9510va	
0945 1000 m	Palau, T8WH/WHRI	9930as	
0945 1000 hf	Palau, T8WH/WHRI	9930as	
0945 1000 mtwhf	Palau, T8WH/WHRI	15700as	

1000 UTC - 6AM EDT / 5AM CDT / 3AM PDT

1000 1030	Japan, R Japan NHK World	9605as	9625pa
	9840pa		
1000 1030	Vietnam, VO Vietnam/Overseas Svc	9840as	
	12020as		
1000 1057	China, China R International	5955as	
	7215as	11640as	13590as
	15190as	15210pa	15350as
	17490eu		
1000 1057	Netherlands, R Netherlands Worldwide	12065as	
1000 1058	New Zealand, R New Zealand Intl	9765pa	
1000 1100	Anguilla/Caribbean Beacon/Univ Network	11775na	
1000 1100	Australia, ABC NT Alice Springs	2310do	
1000 1100	Australia, ABC NT Katherine	2485do	
1000 1100	Australia, ABC NT Tennant Creek	2325do	
1000 1100	Australia, R Australia	9580pa	9590pa
	11945as	12080va	
1000 1100	Bahrain, R Bahrain	6010me	
1000 1100 h/DRM	Belgium, TDP Radio	6015eu	
1000 1100	Canada, CFRX Toronto ON	6070na	
1000 1100	Canada, CFVP Calgary AB	6030na	
1000 1100	Canada, CKZN St Johns NF	6160na	
1000 1100	Canada, CKZU Vancouver BC	6160na	
1000 1100	India, All India R/External Svc	7270as	
	13710va	15020as	15235as
	17800as	17895pa	17510pa
1000 1100	Indonesia, Voice of Indonesia	9525va	
1000 1100	Malaysia, RTM Kajang/Traxx FM	7295do	

1000 1100	Micronesia, V6MP/Cross R/Pohnpei	4755as	
1000 1100 DRM	New Zealand, R New Zealand Intl	9870pa	
1000 1100	Nigeria, Voice of Nigeria	9690af	
1000 1100	North Korea, Voice of Korea	6185as	
	6285sa	9335sa	9850as
1000 1100 fa	Palau, T8WH/WHRI	9930as	
1000 1100 Sun	Romania, IRRS	9510va	
1000 1100	Russia, Voice of Russia	7205as	
1000 1100	South Africa, Channel Africa	9625af	
1000 1100	South Africa, CVC 1 Africa R	13590af	
	17695af		
1000 1100	UK, BBC World Service	6190af	6195as
	9740as	11760me	11895as
	15285as	15310as	15575me
	17760as	17790as	21470af
1000 1100 Sat/Sun	UK, BBC World Service	15400af	17830af
1000 1100	USA, Amer Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	12133usb
1000 1100	USA, EWTN/WEWN Irondale AL	9390as	
1000 1100	USA, FBN/WTJC Newport NC	9370na	
1000 1100	USA, KNLS Anchor Point AK	9615as	
1000 1100	USA, WBCQ Monticello ME	9330am	
1000 1100 Sun	USA, WHRI Cypress Creek SC	11565pa	
1000 1100	USA, WTTW Lebanon TN	5080am	5755am
	12105na		
1000 1100	USA, WWCN Nashville TN	4840na	5890af
	5935af	7465eu	
1000 1100	USA, WWRB Manchester TN	3185na	
1000 1100	USA, WYFR/Family R Worldwide	9465as	
1000 1100	Zambia, CVC/R Christian Voice	6065af	
	17695af		
1015 1100 Sun	Palau, T8WH/WHRI	9930as	
1030 1030 mtwhfa	USA, WRML/R Prague relay	9955am	
1030 1100	Iran, IRIB/VOIRI	21590va	21640va
1030 1100	Mongolia, Voice of Mongolia		12085as
1030 1100 mtwhf	Palau, T8WH/WHRI	9930as	
1059 1100	New Zealand, R New Zealand Intl	9870pa	

1100 UTC - 7AM EDT / 6AM CDT / 4AM PDT

1100 1105	Pakistan, PBC/R Pakistan	15725eu	17700eu
1100 1127	Iran, IRIB/VOIRI	21590va	21640va
1100 1130 f/DRM	Japan, R Japan NHK World	9760eu	
1100 1130 Sat/DRM	South Korea, KBS World R	9760eu	
1100 1130	UK, BBC World Service	15400af	
1100 1130	Vietnam, VO Vietnam/Overseas Svc	9840as	
1100 1156	Romania, R Romania Intl	15210eu	15430eu
	17510af	17670af	
1100 1157	China, China R International	5955as	
	5960na	9570as	11650as
	13645as	13665eu	13590as
	13720as		
	15110as	17490eu	
1100 1158 DRM	New Zealand, R New Zealand Intl	9870pa	
1100 1200	Anguilla/Caribbean Beacon/Univ Network	11775na	
1100 1200	Australia, ABC NT Alice Springs	2310do	
1100 1200	Australia, ABC NT Katherine	2485do	
1100 1200	Australia, ABC NT Tennant Creek	2325do	
1100 1200	Australia, R Australia	9595va	6020va
	6140as	9475as	9560as
	9580pa	11945as	9580pa
1100 1200 DRM	Australia, R Australia	12080pa	
1100 1200	Bahrain, R Bahrain	6010me	
1100 1200 f/DRM	Belgium, TDP Radio	6015eu	
1100 1200 Sat/Sun	Canada, CBC Northern Quebec Svc	9625na	
1100 1200	Canada, CFRX Toronto ON	6070na	
1100 1200	Canada, CFVP Calgary AB	6030na	
1100 1200	Canada, CKZN St Johns NF	6160na	
1100 1200	Canada, CKZU Vancouver BC	6160na	
1100 1200	Malaysia, RTM Kajang/Traxx FM	7295do	
1100 1200	New Zealand, R New Zealand Intl	9870pa	
1100 1200	Nigeria, Voice of Nigeria	9690af	
1100 1200 Sun	Romania, IRRS	9510va	
1100 1200 DRM	Russia, Voice of Russia	12000as	
1100 1200	Russia, Voice of Russia	7205as	7260as
	7350as	9560as	9670as
1100 1200	Saudi Arabia, BSKSA/External Svc	15250af	
1100 1200	South Africa, Channel Africa	9625af	
1100 1200	South Africa, CVC 1 Africa R	13590af	
	17695af		
1100 1200	Taiwan, R Taiwan Intl	7445as	11715as

1100 1200	UK, BBC World Service	6190af	6195as
	9740as	11760me	11895as
	15285as	15575me	17640af
	17830as	21470af	17790as
1100 1200	USA, Amer Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	12133usb
1100 1200	USA, EWTN/WEWN Irondale AL	9390as	
1100 1200	USA, FBN/WTJC Newport NC	9370na	
1100 1200	USA, WBCQ Monticello ME	9330am	
1100 1200 Sat/Sun	USA, WHRI Cypress Creek SC	7315ca	
1100 1200	USA, WTTW Lebanon TN	5755am	9990am
	12105na		
1100 1200	USA, WWCR Nashville TN	4840na	5890af
	5935af	7465eu	
1100 1200	USA, WWRB Manchester TN	3185na	
1100 1200	USA, WYFR/Family R Worldwide	9310as	
	13795as		
1100 1200	Zambia, CVC/R Christian Voice	6065af	
	17695af		
1130 1200 f	Vatican City State, Vatican R	15595as	17590as
1130 1200	Vietnam, VO Vietnam/Overseas Svc	9840as	
	12020as		
1135 1145	India, All India R/Aizawl	5050do	
1135 1145	India, All India R/Delhi	9595do	11710do
	15185do		
1135 1145	India, All India R/Shillong	4970do	

1200 UTC - 8AM EDT / 7AM CDT / 5AM PDT

1200 1215	Nepal, R Nepal	5005as	
1200 1230	Germany, AWR Europe	17535as	
1200 1230	Japan, R Japan NHK World	6120na	9695as
1200 1230	Saudi Arabia, BSKSA/External Svc	15250af	
1200 1257	China, China R International	5955as	
	7250as	9460as	9660as
	9730as	9760	11650as
	11690as	11760pa	12015as
	13790eu	13980as	17490eu
1200 1258	New Zealand, R New Zealand Intl	15720pa	
1200 1300	Anguilla/Caribbean Beacon/Univ Network	11775na	
1200 1300	Australia, ABC NT Alice Springs	2310do	
1200 1300	Australia, ABC NT Katherine	2485do	
1200 1300	Australia, ABC NT Tennant Creek	2325do	
1200 1300	Australia, R Australia	6020va	6140as
	9475as	9560as	9580pa
1200 1300 DRM	Australia, R Australia	5995va	9590pa
1200 1300	Bahrain, R Bahrain	6010me	
1200 1300 Sat/DRM	Belgium, TDP Radio	6015eu	
1200 1300 Sat/Sun	Canada, CBC Northern Quebec Svc	9625na	
1200 1300	Canada, CFRX Toronto ON	6070na	
1200 1300	Canada, CFVP Calgary AB	6030na	
1200 1300	Canada, CKZN St Johns NF	6160na	
1200 1300	Canada, CKZU Vancouver BC	6160na	
1200 1300	Ethiopia, R Ethiopia/Natl Pgm	9705do	
1200 1300	Malaysia, RTM Kajang/Traxx FM	7295do	
1200 1300	Nigeria, Voice of Nigeria	9690af	
1200 1300 Sat/Sun	Palau, T8WH/WHRI	9930as	
1200 1300 DRM	Russia, Voice of Russia	7325eu	7340as
	12000as		
1200 1300	Russia, Voice of Russia	7350as	9560as
	11660as		
1200 1300	South Africa, CVC 1 Africa R	13590af	
	17695af		
1200 1300	South Korea, KBS World R	9650na	
1200 1300	UK, BBC World Service	5875as	6190af
	6195as	9740as	11760me
	15310as	15575me	17640af
	21470af		17830as
1200 1300	USA, Amer Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	12133usb
1200 1300	USA, BBG/Voice of America	7575as	9640as
	11700pa	11750pa	12150va
1200 1300	USA, EWTN/WEWN Irondale AL	9390as	14610eu
1200 1300	USA, FBN/WTJC Newport NC	9370na	
1200 1300	USA, KNLS Anchor Point AK	9615as	
1200 1300	USA, WBCQ Monticello ME	9330am	
1200 1300 smtwhf	USA, WHRI Cypress Creek SC	7385na	
1200 1300	USA, WTTW Lebanon TN	5755am	9990am
	12105na		

1200 1300	USA, WWCR Nashville TN	4890na	5935af
	9980af	15825eu	
1200 1300	USA, WWRB Manchester TN	9385na	
1200 1300	USA, WYFR/Family R Worldwide	9310as	
	17520as	17880as	
1200 1300	Zambia, CVC/R Christian Voice	6065af	
	17695af		
1215 1300	Egypt, R Cairo	17870as	
1230 1245	India, All India R/Aizawl	5050do	
1230 1245	India, All India R/Chennai	4920do	
1230 1245	India, All India R/Delhi	4860do	6085do
1230 1245	India, All India R/Hyderabad	4800do	
1230 1245	India, All India R/Jeyapore	5040do	
1230 1245	India, All India R/Kurseong	4895do	
1230 1245	India, All India R/Port Blair	4760do	
1230 1245	India, All India R/R Kashmir	4950do	
1230 1245	India, All India R/Shillong	4970do	
1230 1245	India, All India R/Thiruvananthapuram	5010do	
1230 1300	Thailand, R Thailand World Svc	9720va	
1230 1300	Vietnam, VO Vietnam/Overseas Svc	9840as	
	12020as		

1300 UTC - 9AM EDT / 8AM CDT / 6AM PDT

1300 1330	Egypt, R Cairo	17870as	
1300 1330	Japan, R Japan NHK World	11730as	
1300 1357	China, China R International	5995as	
	7300as	9570na	9655as
	9765as	9870as	11760pa
	11900pa	11980as	13670eu
	15230na		13790eu
1300 1400	Anguilla/Caribbean Beacon/Univ Network	11775na	
1300 1400	Australia, ABC NT Alice Springs	2310do	
1300 1400	Australia, ABC NT Katherine	2485do	
1300 1400 DRM	Australia, R Australia	5995va	
1300 1400	Bahrain, R Bahrain	6010me	
1300 1400 Sun/DRM	Belgium, TDP Radio	6015na	
1300 1400 Sat/Sun	Canada, CBC Northern Quebec Svc	9625na	
1300 1400	Canada, CFRX Toronto ON	6070na	
1300 1400	Canada, CFVP Calgary AB	6030na	
1300 1400	Canada, CKZN St Johns NF	6160na	
1300 1400	Canada, CKZU Vancouver BC	6160na	
1300 1400	Indonesia, Voice of Indonesia	9525va	
1300 1400	Malaysia, RTM Kajang/Traxx FM	7295do	
1300 1400	New Zealand, R New Zealand Intl	5950pa	
1300 1400	Nigeria, Voice of Nigeria	9690af	
1300 1400	North Korea, Voice of Korea	3560as	
	7570eu	9335na	11710na
1300 1400 Sat/Sun	Palau, T8WH/WHRI	9930as	
1300 1400 DRM	Russia, Voice of Russia	7325eu	7340as
	9675eu		
1300 1400	Russia, Voice of Russia	7205as	7260as
	9470as	9560as	
1300 1400	South Africa, CVC 1 Africa R	13590af	
	17695af		
1300 1400	South Korea, KBS World R	9570as	
1300 1400	Tajikistan, Voice of Tajik	7245va	
1300 1400	UK, BBC World Service	5875as	6190af
	6195as	9410as	9740as
	11890as	12095af	15310as
	15575me	17640af	17830as
	21470af		17830as
1300 1400	USA, Amer Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	12133usb
1300 1400 Sat/Sun	USA, BBG/Voice of America	7575as	9640as
	11700va	12150va	
1300 1400	USA, EWTN/WEWN Irondale AL	9390as	15610eu
1300 1400	USA, FBN/WTJC Newport NC	9370na	
1300 1400	USA, WBCQ Monticello ME	9330am	
1300 1400 Sun	USA, WHRI Cypress Creek SC	9840na	
1300 1400	USA, WTTW Lebanon TN	9480na	9990am
	12105na		
1300 1400	USA, WWCR Nashville TN	7490af	9980af
	13845eu	15825eu	
1300 1400	USA, WWRB Manchester TN	9385na	
1300 1400	USA, WYFR/Family R Worldwide	5835as	
	9310as	9390as	11520as
1300 1400	Zambia, CVC/R Christian Voice	6065af	
	17695af		
1330 1345	India, All India R/Delhi	6085do	
1330 1400	India, All India R/External Svc	9690as	
	11620as	13710as	

1330 1400 Turkey, Voice of Turkey 12035va
 1330 1400 Vietnam, VO Vietnam/Overseas Svc 9840as
 12020as

1400 UTC - 10AM EDT / 9AM CDT / 7AM PDT

1400 1415 Sun Germany, Pan American Broadcasting 15205as
 1400 1430 Japan, R Japan NHK World 5955as 11695as
 21560af
 1400 1430 Serbia, International R Serbia 9640eu
 1400 1430 Thailand, R Thailand World Svc 9725va
 1400 1430 Turkey, Voice of Turkey 12035va
 1400 1457 China, China R International 5955as
 7300as 9460as 9700eu 9765eu
 9870as 11665as 13675na 13740na
 15230na 17630af
 1400 1457 Netherlands, R Netherlands Worldwide
 12080as
 1400 1500 Anguilla/Caribbean Beacon/Univ Network
 11775na
 1400 1500 Australia, ABC NT Alice Springs 2310do
 1400 1500 Australia, ABC NT Katherine 2485do
 1400 1500 Australia, ABC NT Tennant Creek 2325do
 1400 1500 Australia, R Australia 5995va 6080as
 7240pa 9590pa 11660as
 Bahrain, R Bahrain 6010me
 1400 1500 Sun Canada, Bible Voice Broadcasting 17495as
 1400 1500 Sat/Sun Canada, CBC Northern Quebec Svc 9625na
 1400 1500 Canada, CFRX Toronto ON 6070na
 1400 1500 Canada, CFVP Calgary AB 6030na
 1400 1500 Canada, CKZN St Johns NF 6160na
 1400 1500 Canada, CKZU Vancouver BC 6160na
 1400 1500 India, All India R/External Svc 9690as
 11620as 13710as
 1400 1500 Malaysia, RTM Kajang/Traxx FM 7295do
 1400 1500 New Zealand, R New Zealand Intl 5950pa
 1400 1500 Nigeria, Voice of Nigeria 9690af
 1400 1500 Oman, R Sultanate of Oman 15140va
 1400 1500 Sat Palau, T8WH/WHRI 9930as
 1400 1500 DRM Russia, Voice of Russia 7340as 9675eu
 1400 1500 Russia, Voice of Russia 4975va 7260as
 7310as 11660as
 1400 1500 South Africa, CVC 1 Africa R 13590af
 17695af
 1400 1500 UK, BBC World Service 5875as 5975as
 6190af 6195as 9410as 9740as
 11760me 11890as 12095af 15420af
 17640af 17830as
 1400 1500 USA, Amer Forces Network/AFRTS 4319usb
 5446usb 5765usb 7812usb 12133usb
 12759usb 13362usb
 1400 1500 USA, BBG/Voice of America 6080af 15580af
 17650af 17715af
 1400 1500 mtwhf USA, BBG/Voice of America 7575as 9760as
 12150va
 1400 1500 USA, EWTN/WEWN Irondale AL 15610eu
 1400 1500 USA, FBN/WTJC Newport NC 9370na
 1400 1500 USA, The Overcomer Ministry 9460eu
 1400 1500 USA, WBCQ Monticello ME 9330am
 1400 1500 Sun USA, WHRI Cypress Creek SC 21600af
 1400 1500 Sat USA, WHRI Cypress Creek SC 9680na
 1400 1500 USA, WJHR Intl Milton FL 15550na
 1400 1500 USA, WTWW Lebanon TN 9480na 9990am
 12105na
 1400 1500 USA, WWCN Nashville TN 7490af 9980af
 13845eu 15825eu
 1400 1500 USA, WWRB Manchester TN 9385na
 1400 1500 USA, WYFR/Family R Worldwide 9365as
 11540as 11560as
 1400 1500 Zambia, CVC/R Christian Voice 6065af
 17695af
 1405 1435 Sat/Sun Canada, Bible Voice Broadcasting 15270as
 1415 1430 mtwhfa Germany, Pan American Broadcasting 15205as
 1415 1430 Nepal, R Nepal 5005as
 1420 1440 India, All India R/Itanagar 4990do
 1425 1455 South Africa, TWR Africa 6025af
 1430 1445 Sun Germany, Pan American Broadcasting 15205as
 1430 1445 India, All India R/Aizawl 5050do
 1430 1445 India, All India R/Delhi 6085do 9575do
 9835do
 1430 1445 India, All India R/Jeyapore 5040do
 1430 1445 India, All India R/Mumbai 4840do

1430 1500 Australia, R Australia 9475as
 1430 1500 Sat Canada, Bible Voice Broadcasting 17495as
 1430 1500 Sat India, All India R/Gangtok 4835do
 1445 1500 Australia, HCJB Global Australia 15340as
 1450 1500 India, All India R/Itanagar 4990do
 1450 1500 India, All India R/Kurseong 4895do

1500 UTC - 11AM EDT / 10AM CDT / 8AM PDT

1500 1515 Sun Canada, Bible Voice Broadcasting 21460as
 1500 1525 Sun China, Haixa zhi Sheng/VO Strait 4940do
 9505do
 1500 1525 mhf Guam, TWR Asia/KTWR 15200as
 1500 1529 DRM Canada, R Canada International 17815as
 1500 1530 Australia, HCJB Global Australia 15340as
 1500 1530 India, All India R/Jeyapore 5040do
 1500 1530 Sun USA, The Overcomer Ministry 15190va
 1500 1530 USA, WRMI/R Prague relay 9955am
 1500 1530 Vietnam, VO Vietnam/Overseas Svc 7285as
 9840as 12020as
 1500 1535 twas Guam, TWR Asia/KTWR 15200as
 1500 1550 New Zealand, R New Zealand Intl 5950pa
 1500 1557 Canada, R Canada International 11675as
 15125as
 1500 1557 China, China R International 5955as
 6095va 7325as 7405as 9435eu
 9525eu 9720va 9785as 9870as
 13740na 17630af
 1500 1559 South Africa, Channel Africa 9625af
 1500 1600 Anguilla/Caribbean Beacon/Univ Network
 11775na
 1500 1600 Australia, ABC NT Alice Springs 2310do
 1500 1600 Australia, ABC NT Katherine 2485do
 1500 1600 Australia, R Australia 5995va 6080as
 7240pa 9475as 9590pa 11660as
 Bahrain, R Bahrain 6010me
 1500 1600 Bhutan, Bhutan Broadcasting Svc 6035do
 1500 1600 Sat/Sun Canada, CBC Northern Quebec Svc 9625na
 1500 1600 Canada, CFRX Toronto ON 6070na
 1500 1600 Canada, CFVP Calgary AB 6030na
 1500 1600 Canada, CKZN St Johns NF 6160na
 1500 1600 Canada, CKZU Vancouver BC 6160na
 1500 1600 Sat Clandestine, Sudan R Service 17745af
 1500 1600 Malaysia, RTM Kajang/Traxx FM 7295do
 1500 1600 Nigeria, Voice of Nigeria 15120af
 1500 1600 North Korea, Voice of Korea 3560as
 7570eu 9335na 11710na 12015eu
 1500 1600 DRM Russia, Voice of Russia 7340as
 1500 1600 Russia, Voice of Russia 4975va 9470va
 9660as 9880as
 1500 1600 South Africa, CVC 1 Africa R 13590af
 17695af
 1500 1600 Uganda, Dunamis Shortwave 4750do
 1500 1600 UK, BBC World Service 5875as 6190af
 6195as 9410as 9490af 9505as
 11830me 12095af 15400af 15420af
 17640af 17830as
 1500 1600 DRM UK, BBC World Service 5845as
 1500 1600 USA, Amer Forces Network/AFRTS 4319usb
 5446usb 5765usb 7812usb 12133usb
 12759usb 13362usb
 1500 1600 USA, BBG/Voice of America 4930af 6080af
 7575as 9930pa 11840va 12150va
 13570va 15580af 17715af 17895af
 1500 1600 USA, BBG/Voice of America/Special English
 6140va 7465va 7520va 9760va
 9945va
 1500 1600 USA, EWTN/WEWN Irondale AL 15610eu
 1500 1600 USA, FBN/WTJC Newport NC 9370na
 1500 1600 USA, KNLS Anchor Point AK 9655as
 1500 1600 Sat USA, The Overcomer Ministry 15190va
 1500 1600 USA, The Overcomer Ministry 13810me
 1500 1600 USA, WBCQ Monticello ME 9330am
 1500 1600 Sat USA, WBCQ Monticello ME 15420am
 1500 1600 Sun USA, WHRI Cypress Creek SC 17570va
 1500 1600 Sat USA, WHRI Cypress Creek SC 21630af
 1500 1600 USA, WINB Red Lion PA 13570ca
 1500 1600 USA, WJHR Intl Milton FL 15550na
 1500 1600 USA, WTWW Lebanon TN 9480na 9990am
 12105na
 1500 1600 USA, WWCN Nashville TN 7490af 9980af
 13845eu 15825eu

1500 1600	USA, WWRB Manchester TN9385na	
1500 1600	USA, WYFR/Family R Worldwide	6280as
	11610as 11995as 21840af	
1500 1600	Zambia, CVC/R Christian Voice	6065af
	17695af	
1515 1530 f	Canada, Bible Voice Broadcasting	15275as
1525 1555	South Africa, TWR Africa	6025af
1530 1545	India, All India R/Aizawl	5050do
1530 1545	India, All India R/Bengaluru	9425do
1530 1545	India, All India R/Bhopal	4810do
1530 1545	India, All India R/Chennai	4920do
1530 1545	India, All India R/Delhi	5015do
1530 1545	India, All India R/Guwahati	4940do
1530 1545	India, All India R/Hyderabad	4800do
1530 1545	India, All India R/Itanagar	4990do
1530 1545	India, All India R/Jaipur	4910do
1530 1545	India, All India R/Kolkata	4820do
1530 1545	India, All India R/Kurseong	4895do
1530 1545	India, All India R/Lucknow	4880do
1530 1545	India, All India R/Panaji (Goa)	9820do
1530 1545	India, All India R/Port Blair	4760do
1530 1545	India, All India R/R Kashmir	4950do
1530 1545	India, All India R/Shillong	4970do
1530 1545	India, All India R/Shimla	4965do
1530 1545	India, All India R/Thiruvananthapuram	5010do
1530 1550 mtwhfa/DRM	Vatican City State, Vatican R	15190as
1530 1550 Sat/DRM	Vatican City State, Vatican R	15190as
1530 1600	Afghanistan, R Afghanistan	7200as
1530 1600	Belgium, The Disco Palace	15775va
1530 1600 h	Canada, Bible Voice Broadcasting	15275as
1530 1600 Sun	Clandestine, Sudan R Service	17745af
1530 1600 smtwa	Germany, AWR Europe	15255as
1530 1600	Iran, IRIB/VOIRI 11945va	13780va 13720al
1530 1600	Mongolia, Voice of Mongolia	12015as
1530 1600 Sat	Vatican City State, Vatican R	7585as 11850as
	13765as	
1551 1600	New Zealand, R New Zealand Intl	9765pa
1551 1600 DRM	New Zealand, R New Zealand Intl	7285pa

1600 UTC - 12PM EDT / 11AM CDT / 9AM PDT

1600 1627	Iran, IRIB/VOIRI 11945va	13780va 13720al
1600 1630	Australia, R Australia	9580as
1600 1630	Belgium, The Disco Palace	15775va
1600 1630	Guam, AWR/KSDA	11750as 15360as
1600 1630	Vietnam, VO Vietnam/Overseas Svc	7220me
	7280eu 9550me 9730eu	
1600 1657	China, China R International	6060as
	7235as 7255eu 7420af 7435af	
	9435eu 9570af 9875eu	
1600 1700	Anguilla/Caribbean Beacon/Univ Network	
	11775na	
1600 1700	Australia, ABC NT Alice Springs	2310do
1600 1700	Australia, ABC NT Katherine	2485do
1600 1700	Australia, R Australia	5995va 6080as
	7240pa 9475as 9710as 11660as	
1600 1700	Bahrain, R Bahrain	6010me
1600 1700 Sat	Canada, CBC Northern Quebec Svc	9625na
1600 1700	Canada, CFRX Toronto ON	6070na
1600 1700	Canada, CFVP Calgary AB	6030na
1600 1700	Canada, CKZN St Johns NF	6160na
1600 1700	Canada, CKZU Vancouver BC	6160na
1600 1700	Egypt, R Cairo	15345af
1600 1700	Ethiopia, R Ethiopia	7235va 9560va
1600 1700	Malaysia, RTM Kajang/Traxx FM	7295do
1600 1700 DRM	New Zealand, R New Zealand Intl	7285pa
1600 1700	New Zealand, R New Zealand Intl	9765pa
1600 1700	North Korea, Voice of Korea	9990me
	11545af	
1600 1700 DRM	Russia, Voice of Russia	6180as
1600 1700	Russia, Voice of Russia	4975va 7270me
	9470me	
1600 1700	South Africa, CVC 1 Africa R	13590af
	17695af	
1600 1700	South Korea, KBS World R	9515eu 9640as
1600 1700	Taiwan, R Taiwan Intl	9440as 12055as
1600 1700	Uganda, Dunamis Shortwave	4750do
1600 1700	UK, BBC World Service	3255af 5875as
	5975as 6190af 9410as 9505as	
	11830me 12095af 13790af 15400af	
	15420af 17640af 17830as	
1600 1700 DRM	UK, BBC World Service	5845as

1600 1700	USA, Amer Forces Network/AFRTS	4319usb
	5446usb 5765usb 7812usb 12133usb	
	12759usb 13362usb	
1600 1700	USA, BBG/Voice of America	4930af 6080af
	15580af 17895af	
1600 1700	USA, BBG/Voice of America/Special English	
	13600va 15470va	
1600 1700	USA, EWTN/WEWN Irondale AL	15610eu
1600 1700	USA, FBN/WTJC Newport NC	9370na
1600 1700 Sat	USA, The Overcomer Ministry	15190va
1600 1700	USA, WBCQ Monticello ME	9330am
1600 1700 Sat	USA, WBCQ Monticello ME	15420am
1600 1700 Sun	USA, WHRI Cypress Creek SC	9840na
1600 1700	USA, WHRI Cypress Creek SC	11630af
1600 1700	USA, WINB Red Lion PA	13570ca
1600 1700	USA, WJHR Intl Milton FL	15550na
1600 1700	USA, WTWW Lebanon TN	9480na 9990am
	12105na	
1600 1700	USA, WWCN Nashville TN	9980af 12160af
	13845eu 15825eu	
1600 1700	USA, WWRB Manchester TN9385na	
1600 1700	USA, WYFR/Family R Worldwide	11740as
	17545af	
1600 1700	Zambia, CVC/R Christian Voice	6065af
	17695af	
1630 1700	Clandestine, Sudan R Service	17745af
1630 1700	Sri Lanka, AWR Asia	11740as
1630 1700 mtwhf	USA, BBG/Voice of America	9790af 9785af
	11905af 13635af	
1645 1700	Canada, Bible Voice Broadcasting	15215me

1700 UTC - 1PM EDT / 12PM CDT / 10AM PDT

1700 1710	Pakistan, PBC/R Pakistan	7530eu 9470eu
1700 1715 mf	Canada, Bible Voice Broadcasting	15215me
1700 1720 h	Canada, Bible Voice Broadcasting	15215me
1700 1750 DRM	New Zealand, R New Zealand Intl	7285pa
1700 1750	New Zealand, R New Zealand Intl	9765pa
1700 1755	South Africa, Channel Africa	15235af
1700 1756 DRM	Romania, R Romania Intl	9535eu
1700 1756	Romania, R Romania Intl	11740eu
1700 1757	China, China R International	6090as
	6100eu 6140as 7205eu 7255eu	
	7410as 7420as 7425as 9570af	
	9600as 13685af	
1700 1800	Anguilla/Caribbean Beacon/Univ Network	
	11775na	
1700 1800	Australia, ABC NT Alice Springs	2310do
1700 1800	Australia, ABC NT Katherine	2485do
1700 1800	Australia, R Australia	5995va 6080as
	9475as 9580pa 9710as 11880pa	
1700 1800	Bahrain, R Bahrain	6010me
1700 1800 asm	Canada, Bible Voice Broadcasting	15215me
1700 1800 Sat	Canada, CBC Northern Quebec Svc	9625na
1700 1800	Canada, CFRX Toronto ON	6070na
1700 1800	Canada, CFVP Calgary AB	6030na
1700 1800	Canada, CKZN St Johns NF	6160na
1700 1800	Canada, CKZU Vancouver BC	6160na
1700 1800	Egypt, R Cairo	15345af
1700 1800	Malaysia, RTM Kajang/Traxx FM	7295do
1700 1800 DRM	Russia, Voice of Russia	7300eu
1700 1800	Russia, Voice of Russia	4975va 7240as
	7270va 7330eu 9880as	
1700 1800	South Africa, CVC 1 Africa R	4965af
	13590af 17695af	
1700 1800	South Africa, TWR Africa	3200af
1700 1800	Taiwan, R Taiwan Intl	15690af
1700 1800	UK, BBC World Service	5875as 5975as
	6190af 7600as 9505as 12095af	
	13790af 15400af 15420af 17640af	
	17830af	
1700 1800 DRM	UK, BBC World Service	5845as
1700 1800	USA, Amer Forces Network/AFRTS	4319usb
	5446usb 5765usb 7812usb 12133usb	
	12759usb 13362usb	
1700 1800	USA, BBG/Voice of America	15580af 17895af
1700 1800	USA, EWTN/WEWN Irondale AL	15610eu
1700 1800	USA, FBN/WTJC Newport NC	9370na
1700 1800	USA, WBCQ Monticello ME	9330am
1700 1800 Sat	USA, WBCQ Monticello ME	15420am
1700 1800	USA, WHRI Cypress Creek SC	21630af
1700 1800 Sun	USA, WHRI Cypress Creek SC	9840na

1700 1800	USA, WINB Red Lion PA	13570ca	
1700 1800	USA, WJHR Intl Milton FL	15550na	
1700 1800	USA, WTWW Lebanon TN	9480na	9990am
	12105na		
1700 1800	USA, WCCR Nashville TN	9980af	12160af
	13845eu	15825eu	
1700 1800	USA, WWRB Manchester TN	9385na	
1700 1800	USA, WYFR/Family R Worldwide	7385af	
	7395af	17540af	17545af
1700 1800	Zambia, CVC/R Christian Voice	4965af	
	17695af		
1730 1745 h	Canada, Bible Voice Broadcasting	15215me	
1730 1745	India, All India R/Bhopal	4810do	
1730 1745	India, All India R/Delhi	5015do	7370do
	9575do	9835do	
1730 1745	India, All India R/Guwahati	4940do	
1730 1745	India, All India R/Hyderabad	4800do	
1730 1745	India, All India R/Jaipur	4910do	
1730 1745	India, All India R/Kolkata	4820do	
1730 1745	India, All India R/Kurseong	4895do	
1730 1745	India, All India R/Lucknow	4880do	
1730 1745	India, All India R/R Kashmir	4950do	
1730 1745	India, All India R/Shimla	4965do	
1730 1745	India, All India R/Thiruvananthapuram	5010do	
1730 1800 Sun	Romania, IRRS	7290va	
1730 1800 m	South Africa, Amateur R Mirror Intl	4895af	
1730 1800	Turkey, Voice of Turkey	11735as	
1730 1800	Vatican City State, Vatican R	9755af	11625af
	13765af		
1740 1745	India, All India R/Chennai	4920do	
1745 1800 Sat	Canada, Bible Voice Broadcasting	17515af	
1745 1800 DRM	India, All India R/External Svc	9950eu	
1745 1800	India, All India R/External Svc	7400af	
	7410af	7550eu	9415af
	11670eu	11935af	9445af
1751 1800 DRM	New Zealand, R New Zealand Intl	11675pa	
1751 1800	New Zealand, R New Zealand Intl	11725pa	
1758 1800 DRM	New Zealand, R New Zealand Intl	11675pa	
1758 1800 Sat	New Zealand, R New Zealand Intl	11725pa	

1800 UTC - 2PM EDT / 1PM CDT / 11AM PDT

1800 1830 w	Austria, AWR Europe	15325af	
1800 1830 m	South Africa, Amateur R Mirror Intl	3230af	
1800 1830	South Africa, AWR Africa	3215af	3345af
1800 1830	Turkey, Voice of Turkey	11735as	
1800 1830	UK, BBC World Service	5975as	7600as
	9505as		
1800 1830	USA, BBG/Voice of America	4930af	6080af
	13635af	15580af	
1800 1830	Vietnam, VO Vietnam/Overseas Svc	5955eu	
1800 1850 DRM	New Zealand, R New Zealand Intl	11675pa	
1800 1857	China, China R International	6100eu	
	6165as	7405eu	13685af
1800 1900	Anguilla/Caribbean Beacon/Univ Network	11775na	
1800 1900 mtwhf	Argentina, RAE	15345eu	
1800 1900	Australia, ABC NT Alice Springs	2310do	
1800 1900	Australia, ABC NT Katherine	2485do	
1800 1900	Australia, R Australia	6080as	7240pa
	9475as	9580pa	9710as
			11880pa
1800 1900	Bahrain, R Bahrain	6010me	
1800 1900 Sat	Canada, Bible Voice Broadcasting	9430me	
1800 1900 Sun	Canada, Bible Voice Broadcasting	6130eu	
	15215me		
1800 1900	Canada, CFRX Toronto ON	6070na	
1800 1900	Canada, CFVP Calgary AB	6030na	
1800 1900	Canada, CKZN St Johns NF	6160na	
1800 1900	Canada, CKZU Vancouver BC	6160na	
1800 1900 DRM	India, All India R/External Svc	9950eu	
1800 1900	India, All India R/External Svc	7400af	
	7410af	7550eu	9415af
	11670eu	11935af	9445af
1800 1900	Kuwait, R Kuwait	15540eu	
1800 1900	Malaysia, RTM Kajang/Traxx FM	7295do	
1800 1900	Netherlands, R Netherlands Worldwide	11655af	
1800 1900	New Zealand, R New Zealand Intl	11725pa	
1800 1900	Nigeria, Voice of Nigeria	15120af	
1800 1900	North Korea, Voice of Korea	3560as	
	7570eu	12015eu	
1800 1900	Poland, Polskie R Warsaw	3955eu	

1800 1900 fas	Romania, IRRS	7290va	
1800 1900 DRM	Russia, Voice of Russia	6145eu	7300eu
1800 1900	Russia, Voice of Russia	7270va	7330eu
	11985va	12060eu	
1800 1900	South Africa, CVC 1 Africa R	4965af	
	13590af	17695af	
1800 1900	South Africa, TWR Africa	3200af	
1800 1900	South Korea, KBS World R	7275eu	
1800 1900	Taiwan, R Taiwan Intl	3965eu	
1800 1900	UK, BBC World Service	3255af	5945as
	6190af	9430af	11810af
			15400af
1800 1900	USA, Amer Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	
1800 1900	USA, EWTN/WEWN Irondale AL	15610af	
1800 1900	USA, FBN/WJTC Newport NC	9370na	
1800 1900	USA, WBCQ Monticello ME	9330am	
1800 1900 fas	USA, WHRI Cypress Creek SC	21630af	
1800 1900 Sat/Sun	USA, WHRI Cypress Creek SC	9840na	
1800 1900	USA, WINB Red Lion PA	13570ca	
1800 1900	USA, WJHR Intl Milton FL	15550na	
1800 1900	USA, WTWW Lebanon TN	9480na	9990am
	12105na		
1800 1900	USA, WCCR Nashville TN	9980af	12160af
	13845eu	15825eu	
1800 1900	USA, WWRB Manchester TN	9385na	
1800 1900	USA, WYFR/Family R Worldwide	5890af	
	7385af	7395af	9895af
	13750af		11665af
1800 1900	Zambia, CVC/R Christian Voice	4965af	
	17695af		
1815 1845 Sun	Canada, Bible Voice Broadcasting	6130eu	
	9430me		
1830 1845	India, All India R/Delhi	5015do	
1830 1900	South Africa, AWR Africa	11840af	
1830 1900 m	South Africa, TWR Africa	9500af	
1830 1900	UK, BBC World Service	9410af	
1830 1900	USA, BBG/Voice of America	4930af	6080af
	13635af	15580af	
1851 1900 DRM	New Zealand, R New Zealand Intl	15720pa	
1858 1900 Sat/DRM	New Zealand, R New Zealand Intl	15720pa	

1900 UTC - 3PM EDT / 2PM CDT / 12PM PDT

1900 1930	Germany, Deutsche Welle	9735af	11800af
1900 1930	USA, WRMI/R Prague relay	9955am	
1900 1930	Vietnam, VO Vietnam/Overseas Svc	7280eu	
	9730eu		
1900 1945 DRM	India, All India R/External Svc	9950eu	
1900 1945	India, All India R/External Svc	7400af	
	7410af	7550eu	9415af
	11670eu	11935af	9445af
1900 1950 DRM	New Zealand, R New Zealand Intl	15720pa	
1900 1957	China, China R International	7295as	
	7435 `af	9440as	
1900 1957	Germany, Deutsche Welle	7365af	
1900 1957	Netherlands, R Netherlands Worldwide	11655af	
1900 1959	Netherlands, R Netherlands Worldwide	11615af	
1900 2000	Anguilla/Caribbean Beacon/Univ Network	11775na	
1900 2000	Australia, ABC NT Alice Springs	2310do	
1900 2000	Australia, ABC NT Katherine	2485do	
1900 2000	Australia, R Australia	6080as	7240pa
	9500as	9580pa	9710as
			11880pa
1900 2000	Bahrain, R Bahrain	6010me	
1900 2000	Canada, CFRX Toronto ON	6070na	
1900 2000	Canada, CFVP Calgary AB	6030na	
1900 2000	Canada, CKZN St Johns NF	6160na	
1900 2000	Canada, CKZU Vancouver BC	6160na	
1900 2000 mtwhfa	Ecuador, HCJB/LV de los Andes	3995eu	
1900 2000	Egypt, R Cairo	15290af	
1900 2000	Indonesia, Voice of Indonesia	9525va	
1900 2000	Kuwait, R Kuwait	15540eu	
1900 2000	Malaysia, RTM Kajang/Traxx FM	7295do	
1900 2000	Micronesia, V6MP/Cross R/Pohnpei	4755as	
1900 2000	Netherlands, R Netherlands Worldwide	7425af	
1900 2000	New Zealand, R New Zealand Intl	11725pa	
1900 2000	North Korea, Voice of Korea	7210af	
	9975me	11535af	11910af

1900 2000	DRM	Russia, Voice of Russia	6040eu		
1900 2000		Russia, Voice of Russia	7330eu		
1900 2000		South Africa, CVC 1 Africa R	4965af		
		13590af	17695af		
1900 2000		South Africa, TWR Africa	3200af		
1900 2000	mtwhf	Spain, R Exterior de Espana	9605af	9665eu	
1900 2000		Thailand, R Thailand World Svc		9680eu	
1900 2000		UK, BBC World Service	3255af	5945as	
		6005af	9410af	9430af	11810af
		15400af			
1900 2000		USA, Amer Forces Network/AFRTS	4319usb		
		5446usb	5765usb	7812usb	12133usb
		12759usb	13362usb		
1900 2000		USA, BBG/Voice of America	4930af	4940af	
		6080af	7480va	9590va	15580af
1900 2000		USA, BBG/Voice of America/Special English			
		7480va	9590va		
1900 2000		USA, EWTN/WEWN Irondale AL	15610af		
1900 2000		USA, FBN/WTJC Newport NC	9370na		
1900 2000		USA, WBCQ Monticello ME	9330am		
1900 2000		USA, WHRI Cypress Creek SC		9840na	
1900 2000		USA, WINB Red Lion PA	13570ca		
1900 2000		USA, WJHR Intl Milton FL	15550na		
1900 2000		USA, WTWW Lebanon TN	9480na	9990am	
		12105na			
1900 2000		USA, WWCR Nashville TN	9980af	12160af	
		13845eu	15825eu		
1900 2000		USA, WWRB Manchester TN	9385na		
1900 2000		USA, WYFR/Family R Worldwide	3230af		
		5850af	6020af	7395af	9610af
		9705af	9885af	18980eu	
1900 2000		Zambia, CVC/R Christian Voice	4965af		
		13590af			
1905 1920	Sat	Mali, ORTM/R Mali	9635do		
1930 2000		Germany, Deutsche Welle	11800af		
1930 2000	Sat	Germany, Pan American Broadcasting	6040af		
1930 2000		Iran, IRIB/VOIRI	5940eu	9540eu	9800eu
		11750af	11885af		
1930 2000		Serbia, International R Serbia	6100eu		
1930 2000		South Africa, RTE R Worldwide	5820af		
1930 2000		Turkey, Voice of Turkey	6050va		
1951 2000	DRM	New Zealand, R New Zealand Intl	17675pa		
1958 2000	Sat/DRM	New Zealand, R New Zealand Intl	17675pa		

2000 UTC - 4PM EDT / 3PM CDT / 1PM PDT

2000 2027		Iran, IRIB/VOIRI	5940eu	9540eu	9800eu
		11750af	11885af		
2000 2030		Egypt, R Cairo	15290af		
2000 2030	Sat	Germany, Pan American Broadcasting	6040af		
2000 2030	Sat	South Africa, TWR Africa	3200af		
2000 2030		Turkey, Voice of Turkey	6050va		
2000 2030		Vatican City State, Vatican R	7365af	9755af	
		11625af			
2000 2050	DRM	New Zealand, R New Zealand Intl	17675pa		
2000 2057		China, China R International	5960eu		
		5985af	7285eu	7295as	7415eu
		9440as	9600eu	11640af	13630af
2000 2057		Netherlands, R Netherlands Worldwide			
		7425af	11615af		
2000 2100		Anguilla/Caribbean Beacon/Univ Network			
		11775na			
2000 2100		Australia, ABC NT Alice Springs	2310do		
2000 2100		Australia, ABC NT Katherine	2485do		
2000 2100		Australia, ABC NT Tennant Creek	2325do		
2000 2100		Australia, R Australia	9500as	11650as	
		11660pa	11880pa		
2000 2100	mtwhf	Australia, R Australia	7240pa		
2000 2100	Sat/Sun	Australia, R Australia	6080as	7240pa	
		12080va			
2000 2100		Bahrain, R Bahrain	6010me		
2000 2100	mtwhf	Belarus, R Belarus	6155eu	11730eu	
2000 2100	DRM	Belgium, The Disco Palace	17755na		
2000 2100		Canada, CFRX Toronto ON	6070na		
2000 2100		Canada, CFVP Calgary AB	6030na		
2000 2100		Canada, CKZN St Johns NF	6160na		
2000 2100		Canada, CKZU Vancouver BC	6160na		
2000 2100	f	Clandestine, JSR/Shiokaze/Sea Breeze	5965as		
		5910al	6110al		
2000 2100		Cuba, R Havana Cuba	11760ca		
2000 2100		Germany, Deutsche Welle	6150af	9490af	
		11800af			

2000 2100		Kuwait, R Kuwait	15540eu		
2000 2100		Malaysia, RTM Kajang/Traxx FM	7295do		
2000 2100		Micronesia, V6MP/Cross R/Pohnpei	4755as		
2000 2100		New Zealand, R New Zealand Intl	11725pa		
2000 2100	DRM	Russia, Voice of Russia	6040eu		
2000 2100		Russia, Voice of Russia	7330eu		
2000 2100		South Africa, CVC 1 Africa R	4965af		
		13590af			
2000 2100		UK, BBC World Service	3255af	6005af	
		6190af	9410af	9430af	11810af
		15400af			
2000 2100		USA, Amer Forces Network/AFRTS	4319usb		
		5446usb	5765usb	7812usb	12133usb
		12759usb	13362usb		
2000 2100	mtwhf	USA, BBG/Voice of America	7470va	9480va	
		9490va			
2000 2100		USA, EWTN/WEWN Irondale AL	15610af		
2000 2100		USA, FBN/WTJC Newport NC	9370na		
2000 2100		USA, WBCQ Monticello ME	9330am	15420am	
2000 2100	smtwhf	USA, WBCQ Monticello ME	7490am		
2000 2100	Sun	USA, WHRI Cypress Creek SC		9895va	
2000 2100	Sat	USA, WHRI Cypress Creek SC		17520af	
2000 2100		USA, WINB Red Lion PA	13570ca		
2000 2100		USA, WJHR Intl Milton FL	15550na		
2000 2100		USA, WTWW Lebanon TN	9480na	9990am	
		12105na			
2000 2100		USA, WWCR Nashville TN	9980af	12160af	
		13845eu	15825eu		
2000 2100		USA, WWRB Manchester TN	9385na		
2000 2100		USA, WYFR/Family R Worldwide	6020af		
		15195af	15520af		
2000 2100		Zambia, CVC/R Christian Voice	4965af		
		13590af			
2020 2100	Sat/Sun	Belarus, R Belarus	6155eu	11730eu	
2030 2045		Thailand, R Thailand World Svc	9535eu		
2030 2056	DRM	Romania, R Romania Intl	9700eu		
2030 2056		Romania, R Romania Intl	11880na	13800na	
		15220na			
2030 2100		USA, BBG/Voice of America	4930af	6080af	
		7560as	15580af		
2030 2100	Sat/Sun	USA, BBG/Voice of America	4940af		
2030 2100		Vietnam, VO Vietnam/Overseas Svc	7270me		
		7280eu	9550me	9730eu	
2045 2100		India, All India R/External Svc	7550eu		
		9445eu	11670eu	11715pa	
2045 2100	DRM	India, All India R/External Svc	9950eu		
2045 2100	DRM	Vatican City State, Vatican R	9800am		
2050 2100		Vatican City State, Vatican R	3975eu	6075eu	
		7250eu			
2051 2100	DRM	New Zealand, R New Zealand Intl	15720pa		

2100 UTC - 5PM EDT / 4PM CDT / 2PM PDT

2100 2127		China, China R International	11640af		
		13630af			
2100 2130	mtwhfa	Albania, R Tirana	7530na		
2100 2130		Australia, ABC NT Alice Springs	2310do		
2100 2130		Australia, ABC NT Katherine	2485do		
2100 2130		Australia, ABC NT Tennant Creek	2325do		
2100 2130		Austria, AWR Europe	11955af		
2100 2130	Sat	Canada, CBC Northern Quebec Svc	9625na		
2100 2150		New Zealand, R New Zealand Intl	11725pa		
2100 2150	DRM	New Zealand, R New Zealand Intl	15720pa		
2100 2157		China, China R International	5960eu		
		5690eu	7205af	7285eu	7405af
		7415eu	9600eu		
2100 2200		Angola, Angolan National R	7217af		
2100 2200		Anguilla/Caribbean Beacon/Univ Network			
		11775na			
2100 2200		Australia, R Australia	9500as	9660pa	
		11650as	11660pa	11695va	12080va
		13630va	15515va		
2100 2200		Bahrain, R Bahrain	6010me		
2100 2200		Belarus, R Belarus	6155eu	11730eu	
2100 2200	mtwhf	Belarus, R Belarus	6155eu	11730eu	
2100 2200		Canada, CFRX Toronto ON	6070na		
2100 2200		Canada, CFVP Calgary AB	6030na		
2100 2200		Canada, CKZN St Johns NF	6160na		
2100 2200		Canada, CKZU Vancouver BC	6160na		
2100 2200		Germany, Deutsche Welle	11800af	11830af	
		11865af			
2100 2200		India, All India R/External Svc	7550eu		
		9445eu	11670pa	11715pa	

2100 2200 DRM	India, All India R/External Svc	9950eu	
2100 2200	Malaysia, RTM Kajang/Traxx FM	7295do	
2100 2200	Micronesia, V6MP/Cross R/Pohnpei	4755as	
2100 2200	North Korea, Voice of Korea	3560as	
	7570eu 12015eu		
2100 2200	Russia, Voice of Russia	7300eu	
2100 2200	South Africa, CVC 1 Africa R	4965af	
	13590af		
2100 2200	Syria, R Damascus	9330va	
2100 2200	UK, BBC World Service	3255af 3915as	
	5875as 5905af 5955af 5965as		
	6190af 6195as 9410af 9915af		
2100 2200	USA, Amer Forces Network/AFRTS	4319usb	
	5446usb 5765usb 7812usb 12133usb		
	12759usb 13362usb		
2100 2200	USA, BBG/Voice of America 6080af	15580af	
2100 2200	USA, EWTN/WEWN Irondale AL	15610af	
2100 2200	USA, FBN/WTJC Newport NC	9370na	
2100 2200	USA, WBCQ Monticello ME 9330am	15420am	
2100 2200	USA, WBCQ Monticello ME 7490am		
2100 2200 smtwhf	USA, WHRI Cypress Creek SC	9490va	
2100 2200 Sun	USA, WINB Red Lion PA	13570ca	
2100 2200	USA, WJHR Intl Milton FL	15550na	
2100 2200	USA, WTTW Lebanon TN	9480na 9990am	
	12105na		
2100 2200	USA, WWCN Nashville TN	7465eu 9350af	
	9980af 13845eu		
2100 2200	USA, WWRB Manchester TN3215na	9385na	
2100 2200	USA, WYFR/Family R Worldwide	7425af	
	15195af		
2100 2200	Zambia, CVC/R Christian Voice	4965af	
	13590af		
2115 2200	Egypt, R Cairo	6270eu	
2130 2200	Australia, ABC NT Alice Springs	4835do	
2130 2200	Australia, ABC NT Katherine5025do		
2130 2200 mtwhfa	Canada, CBC Northern Quebec Svc	9625na	
2130 2200	Turkey, Voice of Turkey	9610va	
2151 2200	New Zealand, R New Zealand Intl	15720pa	
2151 2200 DRM	New Zealand, R New Zealand Intl	17675pa	
2158 2200 Sat	New Zealand, R New Zealand Intl	15720pa	
2158 2200 Sat/DRM	New Zealand, R New Zealand Intl	17675pa	

2200 UTC - 6PM EDT / 5PM CDT / 3PM PDT

2200 2215 †	USA, WBCQ Monticello ME 7490am		
2200 2230	India, All India R/External Svc	7550eu	
	9445eu 11670pa 11715pa		
2200 2230	Serbia, International R Serbia	6100eu	
2200 2230	South Korea, KBS World R	3955eu	
2200 2230	Turkey, Voice of Turkey	9610va	
2200 2245	Egypt, R Cairo	6270eu	
2200 2256	Romania, R Romania Intl	7435eu 9540eu	
	9790eu 11940eu		
2200 2257	China, China R International	5915as	
2200 2300	Anguilla/Caribbean Beacon/Univ Network		
	6090na		
2200 2300	Australia, ABC NT Alice Springs	4835do	
2200 2300	Australia, ABC NT Katherine5025do		
2200 2300	Australia, R Australia	9855as 11550as	
	12080va 13630va 15230va 15240va		
	15515va		
2200 2300 fa	Australia, R Australia	9660pa	
2200 2300	Bahrain, R Bahrain	6010me	
2200 2300 smtwhf	Canada, CBC Northern Quebec Svc	9625na	
2200 2300	Canada, CFRX Toronto ON 6070na		
2200 2300	Canada, CFVP Calgary AB 6030na		
2200 2300	Canada, CKZN St Johns NF 6160na		
2200 2300	Canada, CKZU Vancouver BC	6160na	
2200 2300 DRM	India, All India R/External Svc	11645as	
2200 2300	Malaysia, RTM Kajang/Traxx FM	7295do	
2200 2300	Micronesia, V6MP/Cross R/Pohnpei	4755as	
2200 2300	New Zealand, R New Zealand Intl	15720pa	
2200 2300 DRM	New Zealand, R New Zealand Intl	17675pa	
2200 2300	Russia, Voice of Russia	7250va 11830na	
2200 2300 Sat/Sun	Spain, R Exterior de Espana	6125eu	
2200 2300	UK, BBC World Service	3915as 5875as	
	5890as 5965as 6135as 6190af		
	6195as 7490as 9915af 12095af		
2200 2300	USA, Amer Forces Network/AFRTS	4319usb	
	5446usb 5765usb 7812usb 12133usb		
	12759usb 13362usb		

2200 2300 smtwh	USA, BBG/Voice of America 5840as	7365as	
	7425pa 7570va 11860va		
2200 2300	USA, EWTN/WEWN Irondale AL	15610af	
2200 2300	USA, FBN/WTJC Newport NC	9370na	
2200 2300 smwhf	USA, WBCQ Monticello ME 7490am		
2200 2300	USA, WBCQ Monticello ME 9330am		
2200 2300 Sat	USA, WHRI Cypress Creek SC	9490va	
2200 2300 f	USA, WHRI Cypress Creek SC	15180na	
2200 2300 Sat	USA, WHRI Cypress Creek SC	9505va	
2200 2300	USA, WINB Red Lion PA	9265ca	
2200 2300	USA, WTTW Lebanon TN	9480na 9990am	
	12105na		
2200 2300	USA, WWCN Nashville TN	7465eu 9350af	
	9980af 13845eu		
2200 2300	USA, WWRB Manchester TN3215na	5050va	
	5745va 9385na		
2230 2300 fa	Palau, T8WH/WHRI	9930as	
2230 2300	Sri Lanka, AWR Asia	9730as	
2230 2300	USA, BBG/Voice of America 7545as	9570pa	
2230 2300	USA, BBG/Voice of America/Special English		
	5810va 7545va 9570va		
2245 2300	India, All India R/External Svc	6055as	
	7305as 13605as		

2300 UTC - 7PM EDT / 6PM CDT / 4PM PDT

2300 0000	Anguilla/Caribbean Beacon/Univ Network		
	6090na		
2300 0000	Australia, ABC NT Alice Springs	4835do	
2300 0000	Australia, ABC NT Katherine5025do		
2300 0000	Australia, R Australia	9855as 9660pa	
	12080va 13690va 15230va 15515pa		
	17795pa		
2300 0000	Bahrain, R Bahrain	6010me	
2300 0000 smtwhf	Canada, CBC Northern Quebec Svc	9625na	
2300 0000	Canada, CFRX Toronto ON 6070na		
2300 0000	Canada, CFVP Calgary AB 6030na		
2300 0000	Canada, CKZN St Johns NF 6160na		
2300 0000	Canada, CKZU Vancouver BC	6160na	
2300 0000	Egypt, R Cairo	6270na	
2300 0000	India, All India R/External Svc	6055as	
	7305as 13605as		
2300 0000	Malaysia, RTM Kajang/Traxx FM	7295do	
2300 0000	Micronesia, V6MP/Cross R/Pohnpei	4755as	
2300 0000	New Zealand, R New Zealand Intl	15720pa	
2300 0000 DRM	New Zealand, R New Zealand Intl	17675pa	
2300 0000	Russia, Voice of Russia	7250va 7290va	
2300 0000	Turkey, Voice of Turkey	5960va	
2300 0000	UK, BBC World Service	3915as 5875as	
	5980as 6195as 7490as 9740as		
	11955as		
2300 0000	USA, Amer Forces Network/AFRTS	4319usb	
	5446usb 5765usb 7812usb 12133usb		
	12759usb 13362usb		
2300 0000	USA, BBG/Voice of America 5840as	5895as	
	7365as 7460as 7480pa 7570pa		
	9490va 11840va 11860va		
2300 0000	USA, EWTN/WEWN Irondale AL	15610af	
2300 0000	USA, FBN/WTJC Newport NC	9370na	
2300 0000 smtwhf	USA, WBCQ Monticello ME 7490am		
2300 0000	USA, WBCQ Monticello ME 9330am		
2300 0000 Sat	USA, WHRI Cypress Creek SC	9505va	
2300 0000 smtwhf	USA, WHRI Cypress Creek SC	7385ca	
2300 0000	USA, WINB Red Lion PA	9265ca	
2300 0000	USA, WTTW Lebanon TN	9480na 9990am	
	12105na		
2300 0000	USA, WWCN Nashville TN	3195eu 5070af	
	9980af 13845eu		
2300 0000	USA, WWRB Manchester TN3185na	5050na	
	5745va 9395na		
2300 0000	USA, WYFR/Family R Worldwide	9430af	
	15400af		
2300 2330	Australia, R Australia	15240as	
2300 2330 DRM	Vatican City State, Vatican R 7370am		
2300 2357	China, China R International	5915as	
	5990me 6040na 6145as 7350eu		
	7415as 9535as 11790as 11970va		
2315 0000	USA, WYFR/Family R Worldwide	6115na	
2315 2330	Croatia, Voice of Croatia	3985ca 7375eu	
2330 0000	Australia, R Australia	15415va 17750va	
2330 0000	Vietnam, VO Vietnam/Overseas Svc	9840as	
	12020as		
2330 2345	India, All India R/Aligarh	9470do	



MTXTRA

Shortwave Broadcast Guide

PORTUGUESE

The following language schedule is extracted from our new MTXtra Shortwave Broadcast Guide pdf which is a free download to all MTXpress subscribers. This new online Shortwave Broadcast Guide has more than 9,100 station entries that include all languages being broadcasts via shortwave radio worldwide, sorted by time and updated monthly.

0000 UTC - 8PM EDT / 7PM CDT / 5PM PDT

0000 0045	Ecuador, HCJB/LV de los Andes	11920sa
0000 0045	USA, WYFR/Family R Worldwide	9430sa
	9690sa	
0000 0057	China, China R International	6100sa
	9435eu	
0000 0100 mtwhf	Argentina, RAE	11710am
0000 0100	Brazil, Educadora/Braganca	4825do
0000 0100	Brazil, Iguatemi	4975do
0000 0100	Brazil, R Alvorada/Londrina	4865do
0000 0100	Brazil, R Anhanguera	4905do
0000 0100	Brazil, R Aparecida	5035do 6135do
	9630do 11855do	
0000 0100	Brazil, R Bandeirantes	6090do 9645do
0000 0100	Brazil, R Boa Vontade	6160do 9550do
	11895do	
0000 0100	Brazil, R Brasil	4785do
0000 0100	Brazil, R Brasil Central	4985do 11815do
0000 0100	Brazil, R Cancao Nova	4825do 6105do
	9675do	
0000 0100	Brazil, R Capital	6070do
0000 0100	Brazil, R Capixaba	4935do
0000 0100	Brazil, R Clube do Para	4885do
0000 0100	Brazil, R Congonhas	4775do
0000 0100	Brazil, R Cultura do Para	5045do
0000 0100	Brazil, R Cultura Filadelfia	6105do
0000 0100	Brazil, R Cultura/Araraquara	3365do
0000 0100	Brazil, R Cultura/Manaus	4845do
0000 0100	Brazil, R Daqui	4915do 6080do 11830do
0000 0100	Brazil, R Difusora Acreana	4885do
0000 0100	Brazil, R Difusora Roraima	4875do
0000 0100	Brazil, R Difusora/Londrina	4815do
0000 0100	Brazil, R Difusora/Macapá	4915do
0000 0100	Brazil, R Educacao Rural/Coari	5035do
0000 0100	Brazil, R Educadora 6 de Agosto	3355do
0000 0100	Brazil, R Educadora Rural/Tefe	4925do
0000 0100	Brazil, R Educadora/Guajara Mirim	3375do
0000 0100	Brazil, R Educadora/Limeira	2380do
0000 0100	Brazil, R Guaiba	6000do 11785do
0000 0100	Brazil, R Guarujá Paulista	5045do
0000 0100	Brazil, R Guarujá/Florianopolis	5980do
0000 0100	Brazil, R Imaculada Conceicao	4755do
0000 0100	Brazil, R Inconfidencia	6010do 15190do
0000 0100	Brazil, R Itatiaia	5970do
0000 0100	Brazil, R Maria	4885do
0000 0100	Brazil, R Marumby	6080do 9515do
	11725do	
0000 0100	Brazil, R Mundial	3325do
0000 0100	Brazil, R Municipal	3375do
0000 0100	Brazil, R Nacional da Amazonia	6185do
	11780do	
0000 0100	Brazil, R Nove de Julho	9820do
0000 0100	Brazil, R Novo Tempo	4895do
0000 0100	Brazil, R Record	6150do 9505do
0000 0100	Brazil, R Trans Mundial	5965do
0000 0100	Brazil, R Verdes Florestas	4865do
0000 0100	Brazil, R Voz Missionario	5940do 9665do
	11750do	
0000 0100	Brazil, Super R Deus e Amor/Curitiba	6060do
	9565do 11765do	
0000 0100	Brazil, Super R Deus e Amor/Rio de Janeiro	11805do
0000 0100	USA, WYFR/Family R Worldwide	11885sa
0030 0100	Vatican City State, Vatican R	7305am 11690am

0100 UTC - 9PM EDT / 8PM CDT / 6PM PDT

0100 0130	Brazil, R Educadora/Guajara Mirim	3375do
0100 0145	USA, WYFR/Family R Worldwide	9930eu
0100 0200	Brazil, Educadora/Braganca	4825do
0100 0200	Brazil, Iguatemi	4975do
0100 0200	Brazil, R Alvorada/Londrina	4865do
0100 0200	Brazil, R Aparecida	5035do 6135do
	9630do 11855do	
0100 0200	Brazil, R Bandeirantes	6090do 9645do
0100 0200	Brazil, R Boa Vontade	6160do 9550do
	11895do	
0100 0200	Brazil, R Brasil	4785do
0100 0200	Brazil, R Brasil Central	4985do 11815do
0100 0200	Brazil, R Cancao Nova	4825do 6105do
	9675do	
0100 0200	Brazil, R Capital	6070do
0100 0200	Brazil, R Capixaba	4935do
0100 0200	Brazil, R Clube do Para	4885do
0100 0200	Brazil, R Congonhas	4775do
0100 0200	Brazil, R Cultura do Para	5045do
0100 0200	Brazil, R Cultura Filadelfia	6105do
0100 0200	Brazil, R Cultura/Araraquara	3365do
0100 0200	Brazil, R Cultura/Manaus	4845do
0100 0200	Brazil, R Daqui	4915do 6080do 11830do
0100 0200	Brazil, R Difusora Acreana	4885do
0100 0200	Brazil, R Difusora Roraima	4875do
0100 0200	Brazil, R Difusora/Caceres	5055do
0100 0200	Brazil, R Difusora/Londrina	4815do
0100 0200	Brazil, R Difusora/Macapá	4915do
0100 0200	Brazil, R Educadora Rural/Tefe	4925do
0100 0200	Brazil, R Educadora/Limeira	2380do
0100 0200	Brazil, R Guaiba	6000do 11785do
0100 0200	Brazil, R Guarujá Paulista	5045do
0100 0200	Brazil, R Guarujá/Florianopolis	5980do
0100 0200	Brazil, R Imaculada Conceicao	4755do
0100 0200	Brazil, R Inconfidencia	6010do 15190do
0100 0200	Brazil, R Maria	4885do
0100 0200	Brazil, R Marumby	6080do 9515do
	11725do	
0100 0200	Brazil, R Mundial	3325do
0100 0200	Brazil, R Nacional da Amazonia	6185do
	11780do	
0100 0200	Brazil, R Nove de Julho	9820do
0100 0200	Brazil, R Novo Tempo	4895do
0100 0200	Brazil, R Record	6150do 9505do
0100 0200	Brazil, R Trans Mundial	5965do
0100 0200	Brazil, R Verdes Florestas	4865do
0100 0200	Brazil, R Voz Missionario	5940do 9665do
	11750do	
0100 0200	Brazil, Super R Deus e Amor/Curitiba	6060do
	9565do 11765do	
0100 0200	Brazil, Super R Deus e Amor/Rio de Janeiro	11805do
0100 0200	USA, WYFR/Family R Worldwide	11825sa

0200 UTC - 10PM EDT / 9PM CDT / 7PM PDT

0200 0300	Brazil, Educadora/Braganca	4825do
0200 0300	Brazil, Iguatemi	4975do
0200 0300	Brazil, R Alvorada/Londrina	4865do
0200 0300	Brazil, R Aparecida	5035do 6135do
	9630do 11855do	
0200 0300	Brazil, R Bandeirantes	6090do 9645do
0200 0300	Brazil, R Boa Vontade	6160do 9550do
	11895do	
0200 0300	Brazil, R Brasil	4785do

0200 0300	Brazil, R Brasil Central	4985do	11815do
0200 0300	Brazil, R Cancao Nova	4825do	6105do
	9675do		
0200 0300	Brazil, R Capital 6070do		
0200 0300	Brazil, R Capixaba	4935do	
0200 0300	Brazil, R Clube do Para	4885do	
0200 0300	Brazil, R Congonhas	4775do	
0200 0300	Brazil, R Cultura do Para	5045do	
0200 0300	Brazil, R Cultura Filadelfia	6105do	
0200 0300	Brazil, R Daqui 4915do	6080do	11830do
0200 0300	Brazil, R Difusora Acreana	4885do	
0200 0300	Brazil, R Difusora Roraima	4875do	
0200 0300	Brazil, R Difusora/Caceres	5055do	
0200 0300	Brazil, R Difusora/Londrina	4815do	
0200 0300	Brazil, R Difusora/Macapa	4915do	
0200 0300	Brazil, R Educadora/Limeira	2380do	
0200 0300	Brazil, R Gaucha 6020do	11915do	
0200 0300	Brazil, R Gazeta 5955do	9685do	
0200 0300	Brazil, R Guaiba 6000do	11785do	
0200 0300	Brazil, R Guarujá Paulista	5045do	
0200 0300	Brazil, R Guarujá/Florianopolis		5980do
0200 0300	Brazil, R Imaculada Conceicao		4755do
0200 0300	Brazil, R Inconfidencia	6010do	15190do
0200 0300	Brazil, R Maria 4885do		
0200 0300	Brazil, R Marumby	6080do	9515do
	11725do		
0200 0300	Brazil, R Mundial 3325do		
0200 0300	Brazil, R Nacional da Amazonia		6185do
	11780do		
0200 0300	Brazil, R Nove de Julho	9820do	
0200 0300	Brazil, R Novo Tempo	4895do	
0200 0300	Brazil, R Record 6150do	9505do	
0200 0300	Brazil, R Trans Mundial	5965do	
0200 0300	Brazil, R Voz Missionario	5940do	9665do
	11750do		
0200 0300	Brazil, Super R Deus e Amor/Curitiba	6060do	
	9565do	11765do	
0200 0300	Brazil, Super R Deus e Amor/Rio de Janeiro		11805do

0300 UTC - 11PM EDT / 10PM CDT / 8PM PDT

0300 0400	Brazil, Iguatemi	4975do	
0300 0400	Brazil, R Alvorada/Londrina	4865do	
0300 0400	Brazil, R Bandeirantes	6090do	9645do
0300 0400	Brazil, R Boa Vontade	6160do	9550do
	11895do		
0300 0400	Brazil, R Brasil Central	4985do	11815do
0300 0400	Brazil, R Cancao Nova	4825do	6105do
	9675do		
0300 0400	Brazil, R Capital 6070do		
0300 0400	Brazil, R Capixaba	4935do	
0300 0400	Brazil, R Clube do Para	4885do	
0300 0400	Brazil, R Cultura do Para	5045do	
0300 0400	Brazil, R Cultura Filadelfia	6105do	
0300 0400	Brazil, R Difusora Acreana	4885do	
0300 0400	Brazil, R Difusora/Macapa	4915do	
0300 0400	Brazil, R Educadora/Limeira	2380do	
0300 0400	Brazil, R Gaucha 6020do	11915do	
0300 0400	Brazil, R Guaiba 6000do	11785do	
0300 0400	Brazil, R Guarujá Paulista	5045do	
0300 0400	Brazil, R Guarujá/Florianopolis		5980do
0300 0400	Brazil, R Imaculada Conceicao		4755do
0300 0400	Brazil, R Inconfidencia	6010do	15190do
0300 0400	Brazil, R Maria 4885do		
0300 0400	Brazil, R Mundial 3325do		
0300 0400	Brazil, R Nacional da Amazonia		6185do
	11780do		
0300 0400	Brazil, R Nove de Julho	9820do	
0300 0400	Brazil, R Novo Tempo	4895do	
0300 0400	Brazil, R Record 6150do	9505do	
0300 0400	Brazil, R Trans Mundial	5965do	
0300 0400	Brazil, R Voz Missionario	5940do	9665do
	11750do		
0300 0400	Brazil, Super R Deus e Amor/Curitiba	6060do	
	9565do	11765do	
0300 0400	Brazil, Super R Deus e Amor/Rio de Janeiro		11805do

0400 UTC - 12AM EDT / 11PM CDT / 9PM PDT

0400 0500	Brazil, R Alvorada/Londrina	4865do
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0400 0500	Brazil, R Aparecida	5035do	6135do
	9630do	11855do	
0400 0500	Brazil, R Bandeirantes	6090do	9645do
0400 0500	Brazil, R Boa Vontade	6160do	9550do
	11895do		
0400 0500	Brazil, R Brasil Central	4985do	11815do
0400 0500	Brazil, R Cancao Nova	4825do	6105do
	9675do		
0400 0500	Brazil, R Capital 6070do		
0400 0500	Brazil, R Capixaba	4935do	
0400 0500	Brazil, R Clube do Para	4885do	
0400 0500	Brazil, R Cultura do Para	5045do	
0400 0500	Brazil, R Cultura Filadelfia	6105do	
0400 0500	Brazil, R Difusora/Macapa	4915do	
0400 0500	Brazil, R Educadora/Limeira	2380do	
0400 0500	Brazil, R Guarujá Paulista	5045do	
0400 0500	Brazil, R Guarujá/Florianopolis		5980do
0400 0500	Brazil, R Imaculada Conceicao		4755do
0400 0500	Brazil, R Inconfidencia	6010do	15190do
0400 0500	Brazil, R Maria 4885do		
0400 0500	Brazil, R Mundial 3325do		
0400 0500	Brazil, R Nacional da Amazonia		6185do
	11780do		
0400 0500	Brazil, R Nove de Julho	9820do	
0400 0500	Brazil, R Novo Tempo	4895do	
0400 0500	Brazil, R Trans Mundial	5965do	
0400 0500	Brazil, R Voz Missionario	5940do	9665do
	11750do		
0400 0500	Brazil, Super R Deus e Amor/Curitiba	6060do	
	9565do	11765do	
0400 0500	Brazil, Super R Deus e Amor/Rio de Janeiro		11805do

0500 UTC - 1AM EDT / 12AM CDT / 10PM PDT

0500 0600	Brazil, R Alvorada/Londrina	4865do	
0500 0600	Brazil, R Bandeirantes	6090do	9645do
0500 0600	Brazil, R Boa Vontade	6160do	9550do
	11895do		
0500 0600	Brazil, R Brasil Central	4985do	11815do
0500 0600	Brazil, R Cancao Nova	4825do	6105do
	9675do		
0500 0600	Brazil, R Capital 6070do		
0500 0600	Brazil, R Capixaba	4935do	
0500 0600	Brazil, R Clube do Para	4885do	
0500 0600	Brazil, R Cultura do Para	5045do	
0500 0600	Brazil, R Cultura Filadelfia	6105do	
0500 0600	Brazil, R Difusora/Macapa	4915do	
0500 0600	Brazil, R Educadora/Limeira	2380do	
0500 0600	Brazil, R Guarujá Paulista	5045do	
0500 0600	Brazil, R Imaculada Conceicao		4755do
0500 0600	Brazil, R Inconfidencia	6010do	15190do
0500 0600	Brazil, R Maria 4885do		
0500 0600	Brazil, R Mundial 3325do		
0500 0600	Brazil, R Nacional da Amazonia		6185do
	11780do		
0500 0600	Brazil, R Nove de Julho	9820do	
0500 0600	Brazil, R Novo Tempo	4895do	
0500 0600	Brazil, R Trans Mundial	5965do	
0500 0600	Brazil, R Voz Missionario	5940do	9665do
	11750do		
0500 0600	Brazil, Super R Deus e Amor/Curitiba	6060do	
	9565do	11765do	
0500 0600	Brazil, Super R Deus e Amor/Rio de Janeiro		11805do
0530 0557	Germany, Deutsche Welle	9470af	
0530 0600	Brazil, R Aparecida	5035do	6135do
	9630do	11855do	
0530 0600	Germany, Deutsche Welle	17800af	
0530 0600	Vatican City State, Vatican R	7360af	9660af
	11625af		
0545 0600	Brazil, R Itatiaia	5970do	

0600 UTC - 2AM EDT / 1AM CDT / 11PM PDT

0600 0700	Brazil, R Alvorada/Londrina	4865do	
0600 0700	Brazil, R Aparecida	5035do	6135do
	9630do	11855do	
0600 0700	Brazil, R Bandeirantes	6090do	9645do
0600 0700	Brazil, R Boa Vontade	6160do	9550do
	11895do		

0600 0700	Brazil, R Brasil Central	4985do	11815do
0600 0700	Brazil, R Cancao Nova	4825do	6105do
	9675do		
0600 0700	Brazil, R Capital 6070do		
0600 0700	Brazil, R Capixaba	4935do	
0600 0700	Brazil, R Clube do Para	4885do	
0600 0700	Brazil, R Cultura do Para	5045do	
0600 0700	Brazil, R Cultura Filadelfia	6105do	
0600 0700	Brazil, R Difusora/Londrina	4815do	
0600 0700	Brazil, R Difusora/Macapa	4915do	
0600 0700	Brazil, R Educadora/Limeira	2380do	
0600 0700	Brazil, R Guaruja Paulista	5045do	
0600 0700	Brazil, R Imaculada Conceicao		4755do
0600 0700	Brazil, R Inconfidencia	6010do	15190do
0600 0700	Brazil, R Itatiaia 5970do		
0600 0700	Brazil, R Maria 4885do		
0600 0700	Brazil, R Meteorologia Paulista		4845do
0600 0700	Brazil, R Mundial 3325do		
0600 0700	Brazil, R Nacional da Amazonia		6185do
	11780do		
0600 0700	Brazil, R Nove de Julho	9820do	
0600 0700	Brazil, R Novo Tempo	4895do	
0600 0700	Brazil, R Trans Mundial	5965do	
0600 0700	Brazil, R Voz Missionario	5940do	9665do
	11750do		
0600 0700	Brazil, Super R Deus e Amor/Curitiba	6060do	
	9565do	11765do	
0600 0700	Brazil, Super R Deus e Amor/Rio de Janeiro		11805do

0700 UTC - 3AM EDT / 2AM CDT / 12AM PDT

0700 0800	Brazil, R Guaruja Paulista	5045do	
0700 0800	Brazil, Iguatemi	4975do	
0700 0800	Brazil, R Alvorada/Londrina	4865do	
0700 0800	Brazil, R Aparecida	5035do	6135do
	9630do	11855do	
0700 0800	Brazil, R Bandeirantes	6090do	9645do
0700 0800	Brazil, R Boa Vontade	6160do	9550do
	11895do		
0700 0800	Brazil, R Brasil 4785do		
0700 0800	Brazil, R Brasil Central	4985do	11815do
0700 0800	Brazil, R Cancao Nova	4825do	6105do
	9675do		
0700 0800	Brazil, R Capital 6070do		
0700 0800	Brazil, R Capixaba	4935do	
0700 0800	Brazil, R Clube do Para	4885do	
0700 0800	Brazil, R Congonhas	4775do	
0700 0800	Brazil, R Cultura do Para	5045do	
0700 0800	Brazil, R Cultura Filadelfia	6105do	
0700 0800	Brazil, R Difusora/Londrina	4815do	
0700 0800	Brazil, R Difusora/Macapa	4915do	
0700 0800	Brazil, R Educadora/Limeira	2380do	
0700 0800	Brazil, R Guaiba 6000do	11785do	
0700 0800	Brazil, R Imaculada Conceicao		4755do
0700 0800	Brazil, R Inconfidencia	6010do	15190do
0700 0800	Brazil, R Itatiaia 5970do		
0700 0800	Brazil, R Maria 4885do		
0700 0800	Brazil, R Marumby	6080do	9515do
	11725do		
0700 0800	Brazil, R Meteorologia Paulista		4845do
0700 0800	Brazil, R Mundial 3325do		
0700 0800	Brazil, R Nacional da Amazonia		6185do
	11780do		
0700 0800	Brazil, R Nove de Julho	9820do	
0700 0800	Brazil, R Record 6150do	9505do	
0700 0800	Brazil, R Trans Mundial	5965do	
0700 0800	Brazil, R Voz Missionario	5940do	9665do
	11750do		
0700 0800	Brazil, Super R Deus e Amor/Curitiba	6060do	
	9565do	11765do	
0700 0800	Brazil, Super R Deus e Amor/Rio de Janeiro		11805do

0800 UTC - 4AM EDT / 3AM CDT / 1AM PDT

0800 0900	Brazil, Iguatemi	4975do	
0800 0900	Brazil, R Alvorada/Londrina	4865do	
0800 0900	Brazil, R Anhanguera	4905do	
0800 0900	Brazil, R Aparecida	5035do	6135do
	9630do	11855do	

0800 0900	Brazil, R Bandeirantes	6090do	9645do
0800 0900	Brazil, R Boa Vontade	6160do	9550do
	11895do		
0800 0900	Brazil, R Brasil 4785do		
0800 0900	Brazil, R Brasil Central	4985do	11815do
0800 0900	Brazil, R Cancao Nova	4825do	6105do
	9675do		
0800 0900	Brazil, R Capital 6070do		
0800 0900	Brazil, R Capixaba	4935do	
0800 0900	Brazil, R Congonhas	4775do	
0800 0900	Brazil, R Cultura do Para	5045do	
0800 0900	Brazil, R Cultura Filadelfia	6105do	
0800 0900	Brazil, R Difusora Roraima	4875do	
0800 0900	Brazil, R Difusora/Caceres	5055do	
0800 0900	Brazil, R Difusora/Londrina	4815do	
0800 0900	Brazil, R Difusora/Macapa	4915do	
0800 0900	Brazil, R Educadora/Limeira	2380do	
0800 0900	Brazil, R Gaucha 6020do	11915do	
0800 0900	Brazil, R Gazeta 5955do	9685do	
0800 0900	Brazil, R Guaiba 6000do	11785do	
0800 0900	Brazil, R Guaruja Paulista	5045do	
0800 0900	Brazil, R Guaruja/Florianopolis		5980do
0800 0900	Brazil, R Imaculada Conceicao		4755do
0800 0900	Brazil, R Inconfidencia	6010do	15190do
0800 0900	Brazil, R Itatiaia 5970do		
0800 0900	Brazil, R Maria 4885do		
0800 0900	Brazil, R Marumby	6080do	9515do
	11725do		
0800 0900	Brazil, R Meteorologia Paulista		4845do
0800 0900	Brazil, R Mundial 3325do		
0800 0900	Brazil, R Nacional da Amazonia		6185do
	11780do		
0800 0900	Brazil, R Nove de Julho	9820do	
0800 0900	Brazil, R Novo Tempo	4895do	
0800 0900	Brazil, R Record 6150do	9505do	
0800 0900	Brazil, R Trans Mundial	5965do	
0800 0900	Brazil, R Voz Missionario	5940do	9665do
	11750do		
0800 0900	Brazil, Super R Deus e Amor/Curitiba	6060do	
	9565do	11765do	
0800 0900	Brazil, Super R Deus e Amor/Rio de Janeiro		11805do
0815 0900	Brazil, R Senado Federal	5990do	
0830 0900	Brazil, Educadora/Braganca	4825do	

0900 UTC - 5AM EDT / 4AM CDT / 2AM PDT

0900 1000	Brazil, Educadora/Braganca	4825do	
0900 1000	Brazil, Iguatemi	4975do	
0900 1000	Brazil, R Alvorada/Londrina	4865do	
0900 1000	Brazil, R Anhanguera	4905do	
0900 1000	Brazil, R Aparecida	5035do	6135do
	9630do	11855do	
0900 1000	Brazil, R Bandeirantes	6090do	9645do
0900 1000	Brazil, R Boa Vontade	6160do	9550do
	11895do		
0900 1000	Brazil, R Brasil 4785do		
0900 1000	Brazil, R Brasil Central	4985do	11815do
0900 1000	Brazil, R Cancao Nova	4825do	6105do
	9675do		
0900 1000	Brazil, R Capital 6070do		
0900 1000	Brazil, R Capixaba	4935do	
0900 1000	Brazil, R Clube do Para	4885do	
0900 1000	Brazil, R Congonhas	4775do	
0900 1000	Brazil, R Cultura do Para	5045do	
0900 1000	Brazil, R Cultura Filadelfia	6105do	
0900 1000	Brazil, R Daqui 4915do	6080do	11830do
0900 1000	Brazil, R Difusora Acreana	4885do	
0900 1000	Brazil, R Difusora Roraima	4875do	
0900 1000	Brazil, R Difusora/Caceres	5055do	
0900 1000	Brazil, R Difusora/Londrina	4815do	
0900 1000	Brazil, R Difusora/Macapa	4915do	
0900 1000	Brazil, R Educadora/Guajara Mirim		3375do
0900 1000	Brazil, R Educadora/Limeira	2380do	
0900 1000	Brazil, R Gaucha 6020do	11915do	
0900 1000	Brazil, R Gazeta 5955do	9685do	
0900 1000	Brazil, R Guaiba 6000do	11785do	
0900 1000	Brazil, R Guaruja Paulista	5045do	
0900 1000	Brazil, R Guaruja/Florianopolis		5980do
0900 1000	Brazil, R Imaculada Conceicao		4755do
0900 1000	Brazil, R Inconfidencia	6010do	15190do
0900 1000	Brazil, R Itatiaia 5970do		

0900 1000	Brazil, R Maria	4885do	
0900 1000	Brazil, R Marumby	6080do	9515do
		11725do	
0900 1000	Brazil, R Meteorologia Paulista		4845do
0900 1000	Brazil, R Mundial	3325do	
0900 1000	Brazil, R Municipal	3375do	
0900 1000	Brazil, R Nacional da Amazonia		6185do
		11780do	
0900 1000	Brazil, R Nove de Julho	9820do	
0900 1000	Brazil, R Novo Tempo	4895do	
0900 1000	Brazil, R Record	6150do	9505do
0900 1000	Brazil, R Senado Federal	5990do	
0900 1000	Brazil, R Trans Mundial	9530do	11735do
0900 1000	Brazil, R Voz Missionario	5940do	9665do
		11750do	
0900 1000	Brazil, Super R Deus e Amor/Curitiba	6060do	
		9565do	11765do
0900 1000	Brazil, Super R Deus e Amor/Rio de Janeiro		11805do
0930 1000	Brazil, R Difusora do Amazonas		4805do
0930 1000	Brazil, R Verdes Florestas	4865do	
0930 1000	Japan, R Japan NHK World	6145sa	

1000 UTC - 6AM EDT / 5AM CDT / 3AM PDT

1000 1030	Sat/Sun	USA, BBG/Voice of America	11915af	17850af
1000 1100		Brazil, Educadora/Braganca	4825do	
1000 1100		Brazil, Iguatemi	4975do	
1000 1100		Brazil, R Alvorada/Londrina	4865do	
1000 1100		Brazil, R Anhanguera	4905do	
1000 1100		Brazil, R Aparecida	5035do	6135do
			9630do	11855do
1000 1100		Brazil, R Bandeirantes	6090do	9645do
1000 1100		Brazil, R Boa Vontade	6160do	9550do
			11895do	
1000 1100		Brazil, R Brasil	4785do	
1000 1100		Brazil, R Brasil Central	4985do	11815do
1000 1100		Brazil, R Cancao Nova	4825do	6105do
			9675do	
1000 1100		Brazil, R Capital	6070do	
1000 1100		Brazil, R Capixaba	4935do	
1000 1100		Brazil, R Clube do Para	4885do	
1000 1100		Brazil, R Congonhas	4775do	
1000 1100		Brazil, R Cultura do Para	5045do	
1000 1100		Brazil, R Cultura Filadelfia	6105do	
1000 1100		Brazil, R Cultura/Araraquara		3365do
1000 1100		Brazil, R Cultura/Manaus	4845do	
1000 1100		Brazil, R Daqui	4915do	6080do
1000 1100		Brazil, R Difusora Acreana	4885do	
1000 1100		Brazil, R Difusora do Amazonas		4805do
1000 1100		Brazil, R Difusora Roraima	4875do	
1000 1100		Brazil, R Difusora/Caceres	5055do	
1000 1100		Brazil, R Difusora/Londrina	4815do	
1000 1100		Brazil, R Difusora/Macapa	4915do	
1000 1100		Brazil, R Educacao Rural/Coari		5035do
1000 1100		Brazil, R Educadora 6 de Agosto		3355do
1000 1100		Brazil, R Educadora Rural/Tefe		4925do
1000 1100		Brazil, R Educadora/Guajara Mirim		3375do
1000 1100		Brazil, R Educadora/Limeira	2380do	
1000 1100		Brazil, R Gaucha	6020do	11915do
1000 1100		Brazil, R Gazeta	5955do	9685do
1000 1100		Brazil, R Guaiba	6000do	11785do
1000 1100		Brazil, R Guarujá Paulista	5045do	
1000 1100		Brazil, R Guarujá/Florianopolis		5980do
1000 1100		Brazil, R Imconfidencia	6010do	15190do
1000 1100		Brazil, R Itatiaia	5970do	
1000 1100		Brazil, R Maria	4885do	
1000 1100		Brazil, R Marumby	6080do	9515do
			11725do	
1000 1100		Brazil, R Meteorologia Paulista		4845do
1000 1100		Brazil, R Mundial	3325do	
1000 1100		Brazil, R Municipal	3375do	
1000 1100		Brazil, R Nacional da Amazonia		6185do
			11780do	
1000 1100		Brazil, R Nove de Julho	9820do	
1000 1100		Brazil, R Novo Tempo	4895do	
1000 1100		Brazil, R Record	6150do	9505do
1000 1100		Brazil, R Rio Mar	6160do	9695do
1000 1100		Brazil, R Senado Federal	5990do	
1000 1100		Brazil, R Trans Mundial	9530do	11735do
1000 1100		Brazil, R Verdes Florestas	4865do	
1000 1100		Brazil, R Voz Missionario	5940do	9665do
			11750do	

1000 1100	Brazil, Super R Alvorada	2460do	
1000 1100	Brazil, Super R Deus e Amor/Curitiba	6060do	
		9565do	11765do
1000 1100	Brazil, Super R Deus e Amor/Rio de Janeiro		11805do
1000 1100	mtwhf	Vatican City State, Vatican R	21680am

1100 UTC - 7AM EDT / 6AM CDT / 4AM PDT

1100 1200	mtwhf	Argentina, RAE	6060am	11710am
1100 1200		Brazil, Educadora/Braganca	4825do	
1100 1200		Brazil, Iguatemi	4975do	
1100 1200		Brazil, R Alvorada/Londrina	4865do	
1100 1200		Brazil, R Anhanguera	4905do	
1100 1200		Brazil, R Aparecida	5035do	6135do
			9630do	11855do
1100 1200		Brazil, R Bandeirantes	6090do	9645do
1100 1200		Brazil, R Boa Vontade	6160do	9550do
			11895do	
1100 1200		Brazil, R Brasil Central	4985do	11815do
1100 1200		Brazil, R Cancao Nova	4825do	6105do
			9675do	
1100 1200		Brazil, R Capital	6070do	
1100 1200		Brazil, R Capixaba	4935do	
1100 1200		Brazil, R Clube do Para	4885do	
1100 1200		Brazil, R Congonhas	4775do	
1100 1200		Brazil, R Cultura do Para	5045do	
1100 1200		Brazil, R Cultura Filadelfia	6105do	
1100 1200		Brazil, R Cultura/Araraquara		3365do
1100 1200		Brazil, R Cultura/Manaus	4845do	
1100 1200		Brazil, R Daqui	4915do	6080do
1100 1200		Brazil, R Difusora Acreana	4885do	
1100 1200		Brazil, R Difusora do Amazonas		4805do
1100 1200		Brazil, R Difusora Roraima	4875do	
1100 1200		Brazil, R Difusora/Caceres	5055do	
1100 1200		Brazil, R Difusora/Londrina	4815do	
1100 1200		Brazil, R Difusora/Macapa	4915do	
1100 1200		Brazil, R Educacao Rural/Coari		5035do
1100 1200		Brazil, R Educadora 6 de Agosto		3355do
1100 1200		Brazil, R Educadora Rural/Tefe		4925do
1100 1200		Brazil, R Educadora/Guajara Mirim		3375do
1100 1200		Brazil, R Educadora/Limeira	2380do	
1100 1200		Brazil, R Gaucha	6020do	11915do
1100 1200		Brazil, R Gazeta	5955do	9685do
1100 1200		Brazil, R Guaiba	6000do	11785do
1100 1200		Brazil, R Guarujá Paulista	5045do	
1100 1200		Brazil, R Guarujá/Florianopolis		5980do
1100 1200		Brazil, R Imaculada Conceicao	6010do	15190do
1100 1200		Brazil, R Inconfidencia	6010do	15190do
1100 1200		Brazil, R Itatiaia	5970do	
1100 1200		Brazil, R Maria	4885do	
1100 1200		Brazil, R Marumby	6080do	9515do
			11725do	
1100 1200		Brazil, R Meteorologia Paulista		4845do
1100 1200		Brazil, R Mundial	3325do	
1100 1200		Brazil, R Municipal	3375do	
1100 1200		Brazil, R Nacional da Amazonia		6185do
			11780do	
1100 1200		Brazil, R Nove de Julho	9820do	
1100 1200		Brazil, R Novo Tempo	4895do	
1100 1200		Brazil, R Record	6150do	9505do
1100 1200		Brazil, R Rio Mar	6160do	9695do
1100 1200		Brazil, R Senado Federal	5990do	
1100 1200		Brazil, R Trans Mundial	9530do	11735do
1100 1200		Brazil, R Verdes Florestas	4865do	
1100 1200		Brazil, R Voz Missionario	5940do	9665do
			11750do	
1100 1200		Brazil, Super R Alvorada	2460do	
1100 1200		Brazil, Super R Deus e Amor/Curitiba	6060do	
			9565do	11765do
1100 1200		Brazil, Super R Deus e Amor/Rio de Janeiro		11805do

1200 UTC - 8AM EDT / 7AM CDT / 5AM PDT

1200 1300		Brazil, Educadora/Braganca	4825do	
1200 1300		Brazil, R Alvorada/Londrina	4865do	
1200 1300		Brazil, R Anhanguera	4905do	
1200 1300		Brazil, R Aparecida	5035do	6135do
			9630do	11855do
1200 1300		Brazil, R Bandeirantes	6090do	9645do

1200 1300	Brazil, R Boa Vontade 11895do	6160do	9550do	1200 1300	Brazil, R Difusora/Caceres	5055do
1200 1300	Brazil, R Brasil Central	4985do	11815do	1200 1300	Brazil, R Difusora/Londrina	4815do
1200 1300	Brazil, R Cancao Nova 9675do	4825do	6105do	1200 1300	Brazil, R Difusora/Macapa	4915do
1200 1300	Brazil, R Capital	6070do		1200 1300	Brazil, R Educacao Rural/Coari	5035do
1200 1300	Brazil, R Capixaba	4935do		1200 1300	Brazil, R Educadora 6 de Agosto	3355do
1200 1300	Brazil, R Clube do Para	4885do		1200 1300	Brazil, R Educadora Rural/Tefe	4925do
1200 1300	Brazil, R Congonhas	4775do		1200 1300	Brazil, R Educadora/Guajara Mirim	3375do
1200 1300	Brazil, R Cultura do Para	5045do		1200 1300	Brazil, R Educadora/Limeira	2380do
1200 1300	Brazil, R Cultura Filadelfia	6105do		1200 1300	Brazil, R Gaucha	6020do 11915do
1200 1300	Brazil, R Cultura/Araraquara		3365do	1200 1300	Brazil, R Gazeta	5955do 9685do
1200 1300	Brazil, R Cultura/Manaus	4845do		1200 1300	Brazil, R Guaiba	6000do 11785do
1200 1300	Brazil, R Daqui	4915do	11830do	1200 1300	Brazil, R Guarujá Paulista	5045do
1200 1300	Brazil, R Difusora Acreana	4885do		1200 1300	Brazil, R Imaculada Conceicao	4755do
1200 1300	Brazil, R Difusora do Amazonas		4805do	1200 1300	Brazil, R Inconfidencia	6010do 15190do
1200 1300	Brazil, R Difusora Roraima	4875do		1200 1300	Brazil, R Itatiaia	5970do
				1200 1300	Brazil, R Maria	4885do
				1200 1300	Brazil, R Marumby	6080do 9515do

MT SHORTWAVE STATION RESOURCE GUIDE

Afghanistan, R Afghanistan	www.rta.org.af
Albania, R Tirana	http://rtsh.sil.at/
Angola, Angolan National R	www.rna.ao/
Anguilla/Caribbean Beacon/Univ Network	www.worldwideuniversitynetwork.com/
Argentina, RAE	www.radionacional.gov.ar
Australia, ABC NT Alice Springs	www.abc.net.au/radio/
Australia, ABC NT Katherine	www.abc.net.au/radio/
Australia, ABC NT Tennant Creek	www.abc.net.au/radio/
Australia, HCJB Global Australia	www.hcjb.org.au
Australia, R Australia	www.radioaustralia.net.au
Austria, AWR Europe	www.avr2.org
Bahrain, R Bahrain	www.radiobahrain.fm
Belarus, R Belarus	www.radiobelarus.tvr.by/eng
Belgium, TDP Radio	www.airtime.be/schedule.html
Bhutan, Bhutan Broadcasting Svc	www.bbs.com.bt
Canada, Bible Voice Broadcasting	www.biblevoice.org/
Canada, CBC Northern Quebec Svc	www.cbc.ca/north/
Canada, CFRX Toronto ON	www.cfrb.com
Canada, CFVP Calgary AB	www.classiccountriam1060.com
Canada, CKZN St Johns NF	www.cbc.ca/listen/index.html
Canada, CKZU Vancouver BC	www.cbc.ca/bc
Canada, R Canada International	www.rcinet.ca/
China, China R International	www.cri.cn
China, Haixa zhi Sheng/VO Strait	www.vos.com.cn
Clandestine, JSR/Shiokaze/Sea Breeze	www.chosa-kai.jp
Clandestine, Sudan R Service	www.sudanradio.org
Croatia, Voice of Croatia	www.hrt.hr/
Cuba, R Havana Cuba	www.radiohc.cu/
Ecuador, HCJB/LV de los Andes	www.radiohcjb.org
Egypt, R Cairo	www.ertu.org
Eq Guinea, R Africa 2	www.radiopanam.com/
Ethiopia, R Ethiopia	www.erta.gov.com
Ethiopia, R Ethiopia/Natl Pgm	www.erta.gov.com
Germany, AWR Europe	www.avr2.org/
Germany, Deutsche Welle	www.dw.de
Germany, Pan American Broadcasting	www.radiopanam.com/
Germany, TWR Europe	www.twr.org
Guam, AWR/KSDA	www.avr2.org/
Guam, TWR Asia/KTWR	http://nea.ktwr.net/
India, All India R/Aizawl	www.allindiaradio.org/
India, All India R/Aligarh	www.allindiaradio.org/
India, All India R/Bengaluru	www.allindiaradio.org/
India, All India R/Bhopal	www.allindiaradio.org/
India, All India R/Chennai	www.allindiaradio.org/
India, All India R/Delhi	www.allindiaradio.org/
India, All India R/External Svc	www.allindiaradio.org/
India, All India R/Gangtok	www.allindiaradio.org/
India, All India R/Gorakhpur	www.allindiaradio.org/
India, All India R/Guwahati	www.allindiaradio.org/
India, All India R/Hyderabad	www.allindiaradio.org/
India, All India R/Imphal	www.allindiaradio.org/
India, All India R/Itanagar	www.allindiaradio.org/
India, All India R/Jaipur	www.allindiaradio.org/
India, All India R/Jeyppore	www.allindiaradio.org/
India, All India R/Kolkata	www.allindiaradio.org/
India, All India R/Kurseong	www.allindiaradio.org/
India, All India R/Lucknow	www.allindiaradio.org/
India, All India R/Mumbai	www.allindiaradio.org/
India, All India R/Panaji (Goa)	www.allindiaradio.org/
India, All India R/Port Blair	www.allindiaradio.org/
India, All India R/R Kashmir	www.allindiaradio.org/
India, All India R/Shillong	www.allindiaradio.org/
India, All India R/Shimla	www.allindiaradio.org/
India, All India R/Thiruvananthapuram	www.allindiaradio.org/
Indonesia, Voice of Indonesia	www.voi.co.id
Iran, IRIB/VOIRI	www.irib.ir/English/
Japan, R Japan NHK World	www.nhk.or.jp/english/
Kuwait, R Kuwait	www.media.gov.kw/
Mali, ORTM/R Mali	www.ortm.ml
Micronesia, V6MP/Cross R/Pohnpei	www.pmpacific.org/
Nepal, R Nepal	www.radionepal.org/
Netherlands, R Netherlands Worldwide	www.radionetherlands.nl/
New Zealand, R New Zealand Intl	www.rnz.co.nz
Nigeria, Voice of Nigeria	www.voiceofnigeria.org
North Korea, Voice of Korea	www.vok.rep.kp
Oman, R Sultanate of Oman	www.oman-tv.gov.om
Pakistan, PBC/R Pakistan	www.radio.gov.pk
Palau, T8WH/WHRI	www.whr.org/
Philippines, R Pilipinas Overseas	www.pbs.gov.ph/
Poland, Polskie R Warsaw	www.polskieradio.pl
Romania, IRRS	www.nexus.org
Romania, R Romania Intl	www.rri.ro/
Russia, Voice of Russia	http://english.ruvr.ru/
Saudi Arabia, BSKSA/External Svc	www.saudiradio.net/
Serbia, International R Serbia	www.glassrbije.org
South Africa, Amateur R Mirror Intl	www.sarl.org.za
South Africa, AWR Africa	www.avr2.org/
South Africa, Channel Africa	www.channelafrica.org
South Africa, CVC 1 Africa R	www.1africa.tv
South Africa, RTE R Worldwide	www.rte.ie/radio1/
South Africa, TWR Africa	www.twrafrica.org/
South Korea, KBS World R	www.worldkbs.co.kr
Spain, R Exterior de Espana	www.ree.rne.es/
Sri Lanka, AWR Asia	www.avr2.org/
Sri Lanka, SLBC	www.slbc.lk
Syria, R Damascus	www.rtv.gov.sy/
Taiwan, R Taiwan Intl	http://english.rti.org.tw/
Thailand, R Thailand World Svc	www.hsk9.org/
Turkey, Voice of Turkey	www.trt-world.com
Uganda, Dunamis Shortwave	www.biblevoice.org/stations/east-africa
UK, BBC World Service	www.bbc.co.uk/worldservice/
USA, Amer Forces Network/AFRTS	http://myafn.dodmedia.osd.mil/
USA, BBG/Voice of America	www.voanews.com
USA, BBG/Voice of America/Special English	www.voanews.com
USA, EWTN/WEWN Irondale AL	www.ewtn.com/
USA, FBN/WTJC Newport NC	www.fbnradio.com/
USA, KNLS Anchor Point AK	www.knls.com/
USA, The Overcomer Ministry	www.overcomerministry.org
USA, WBCQ Monticello ME	www.wbcq.com/
USA, WHRI Cypress Creek SC	www.whr.org/
USA, WINB Red Lion PA	www.winb.com
USA, WRMI/R Prague relay	www.wrmi.net/
USA, WRMI/R Slovakia Intl relay	www.wrmi.net/
USA, WTWW Lebanon TN	www.wtww.us/
USA, WWCN Nashville TN	www.wocr.com
USA, WWRB Manchester TN	www.wwrb.org/
USA, WYFR/Family R Worldwide	www.familyradio.com/
Vatican City State, Vatican R	www.vaticanradio.org/
Vietnam, VO Vietnam/Overseas Svc	www.vov.org.vn
Zambia, CVC/R Christian Voice	www.voiceafrica.net



New Data on DoD Trunk Systems

In this month's *Milcom* column, we are going to feature information on three 380-400 MHz trunk radio systems from the Air Force and Army. The build-out of these systems nationwide continues at a face pace. If you have not checked lately and have a P25 digital trunking scanner, you may want to do a search in the 380-390 MHz range for the telltale sign that indicates one of these new systems – a 9600-baud control channel signal.

If you are near the coast and close to a naval base that has warships assigned, you should also check the 390-400 MHz range for control channels. We have also discovered that there are simplex LMR frequencies (i.e., Intra Squad Radios, etc.) and remnant aeronautical frequencies that are still assigned in the 380-400 MHz portion of the military aircraft band.

❖ New AF Space Command System

One of our monitors in central Florida has discovered a new 380-400 MHz U.S. Air Force trunk radio system that is being set up on the Space Coast of eastern Florida. Based on the information available in the public domain, this new trunk radio system should replace the existing 406-420 MHz NASA trunk radio system sites at Cape Canaveral AFS, Malabar, and Patrick AFB once the new 380-400 MHz system is fully operational.

This new system is displaying a trunk radio system identification of 157, which has been observed on other Air Force trunk radio systems in the western part of the United States.

- Site 109 - Patrick AFB FL**
385.3500/395.3500 385.8875/395.8875
386.0750/396.0750 386.2625/396.2625
386.5000/396.5000 386.6500/396.6500
386.8000/396.8000 386.9500/396.9500
- Site 190 - Malabar Annex FL**
385.3125/395.3125 385.6250/395.6250
- Site 191 - Cape Canaveral AFS FL**
386.1875/396.1875 386.8750/396.8750
386.5125/396.5125 386.7000/396.7000
386.8875/396.8875 388.0375/398.0375
388.3625/398.3625 388.5625/398.5625
388.7375/398.7375 388.9375/398.9375

Talk groups IDs that have been observed, but not yet identified include: 48006 48021 48105 48311 48315 48316 48331 48334 48335 48339 48340 48341 48352 48352 48371

Based on over the air observations and material we have found in the public domain, these new TRS sites are part of a nationwide U.S. Air Force Space Command trunk radio network.

We have included below, some of the additional radio sites that we have been able to verify that are also part of this nationwide network. The P25 WACN for this system is BEE00.

Note: Sites 101-109 below are apparently the main sites at the bases indicated. All the other sites listed supplement coverage of the main TRS sites.

- Site 101 - Peterson AFB CO**
406.1500/415.1500 407.5625/416.5625
408.0875/417.0875 408.1625/417.1625
408.5625/417.5625 409.3125/418.3125
409.3500/418.3500 409.5125/418.5125
- Site 102 - F.E. Warren AFB WY**
138.0125/143.0125 138.0875/143.0875
138.1625/143.1625 138.2875/143.2875
138.3125/143.3125 138.3875/143.3875
138.4625/143.4625 138.5375/143.5375
138.6125/143.6125 138.6875/143.6875
138.8875/143.8875
- Site 103 - Malmstrom AFB MT**
138.0875/143.0875 138.1625/143.1625
138.2375/143.2375 138.3125/143.3125
138.3375/143.6375 138.3875/143.3875
138.5375/143.5375 138.6125/143.6125
138.6875/143.6875 139.9375/143.6625
- Site 104 - Schriever AFB CO**
406.5625/415.5625 407.8875/416.8875
408.3625/417.3625 409.2750/418.2750
409.9625/418.9625
- Site 105 - Cheyenne AFS WY**
386.2750/396.2750 386.4250/396.4250
387.4750/397.4750 387.5750/397.5750
387.7000/397.7000
- Site 106 - Vandenberg Air Terminal CA**
385.2125/395.2125 385.3125/395.3125
386.0125/396.0125 386.1250/396.1250
386.2250/396.2250 386.3750/396.3750
386.4500/396.4500 386.4875/396.4875
386.5875/396.5875 386.6500/396.6500
386.7000/396.7000 386.8125/396.8125
386.8500/396.8500
- Site 107 - Los Angeles AFB CA**
386.0750/396.07750 386.1375/396.1375
386.2250/396.2250 386.2875/396.2875
- Site 120 - F.E. Warren AFB WY Site 2**
138.0375/143.0375 138.1875/143.1875
138.3375/143.3375 138.6375/143.6375
139.1875/150.1125
- Site 130 - Malmstrom AFB - Belgian Hill MT**
138.1125/143.1125 138.3375/143.3375
138.5125/143.5125 138.7375/143.7375
139.0375/150.1125
- Site 131 - Malmstrom AFB - Teton Ridge MT**
138.0625/143.0625 138.2125/143.5215
138.3625/143.3625 138.5625/143.5625
138.7125/143.7125
- Site 132 - Malmstrom AFB - Highwood MT**
138.1125/143.1125 138.3375/143.3375
138.5125/143.5125 138.7375/143.7375
139.0375/150.1125
- Site 133 - Malmstrom AFB - Winnecook MT**
138.0875/143.0875 138.2375/143.2375
138.3875/143.3875 138.5375/143.5375
138.6875/143.6875
- Site 134 - Malmstrom AFB - Judith Peak MT**
138.0625/143.0625 138.2125/143.2125
138.3625/143.3625 138.5625/143.5625

- 138.7125/143.7125
- Site 135 - Malmstrom AFB - Sullivan Hill MT**
138.0375/143.0375 138.1875/143.1875
138.4125/143.4125 138.5875/143.5875
139.1875/150.4875
- Site 136 - Malmstrom AFB - Moccasin MT**
138.0375/143.0375 138.1875/143.1875
138.4125/143.4125 138.5875/143.5875
139.1875/150.4875
- Site 160 - Vandenberg AFB CA area**
385.0625/395.0625 385.3500/395.3500
385.6250/395.6250 385.9125/395.9125
386.1125/396.1125 386.3125/396.3125
386.5125/396.5125 386.7125/396.7125
- Site 161 - Vandenberg AFB CA area**
385.3500/395.3500 385.6250/395.6250
385.9125/395.9125 386.0375/396.0375
386.1125/396.1125 386.2500/396.2500
386.3125/396.3125 386.4500/396.4500
386.5125/396.5125 386.6500/396.6500
386.7125/396.7125 386.8500/396.8500
- Site 162 - Vandenberg AFB CA area**
386.0500/396.0500 386.2625/396.2625
386.4625/396.4625 386.6625/396.6625
- Site 170 - Fort MacArthur CA**
385.0875/395.0875 385.3250/395.3250
385.7250/395.7250 385.8750/395.8750

Based on some preliminary field reports we have received from several *MT* readers, there should be more sites to this system than we have published above. I hope to have more details on this Air Force Space Command nationwide trunk radio system in a future *MT Milcom* column as information becomes available.

❖ Eglin AFB Trunk Radio Network

In June 2004, this *MT Milcom* was the first hobby publication to break the story that the Department of Defense was creating a new LMR sub-band within the 225-400 MHz spectrum. The clue that tipped us off on this story was the testing of a new 380-400 MHz trunk radio system at Eglin AFB, Florida, that was interfering with home owner garage door opener systems in the Florida panhandle area.

Since that first column nearly eight years ago, the Air Force has continued to build out that system and here is the latest information that has been observed on the five sites we have found at Eglin and surrounding bases. System identification for this radio system is 14c, which is the same ID that is used nationwide by the 380-400 MHz U.S. Navy and Marine Corps ELMR trunk radio systems. The P25 WACN for this system is BEE00.

- Site 101 - Floridale Site**
386.4500/396.4500 386.8875/396.8875
388.4500/398.4500 388.9625/398.9625
389.7125/398.7125

Site 102 - Duke Field (Eglin AF Aux Nr 3)
 386.4625/396.4625 386.9625/396.9625 388.4000/398.4000
 388.9000/398.9000 389.4875/399.4875

Site 103 - Pierce Field (Eglin AFB Aux Field 2)
 386.4250/396.4250 386.9500/396.9500 388.4375/398.4375
 388.9375/398.9375 389.4375/399.4375

Site 104 - Eglin AFB, FL (VAS)
 385.0125/395.0125 386.1250/396.1250
 Other possible site 104 frequencies include: 385.9000 386.4000 386.6500 386.9125
 388.0000 388.3875 388.5000 388.8500

Site 105 - Hurlburt Field
 385.0625/395.0625 385.3500/395.3500 385.8875/395.8875
 386.1375/396.1375 386.4125/396.4125 386.6750/396.6750
 386.9375/396.9375 388.0250/398.0250 388.3500/398.3500
 388.8875/398.8875
 Other possible site 105 frequencies include: 380.3875 380.6625 380.9375 381.2750
 381.6750

❖ Fort Benning/Camp Merrill Ranger Training Trunk Radio Network

For years this Army Ranger training base in the north Georgia mountains near Dahlonega used a three-site 406-420 MHz EDACS trunk radio system. With the conversion of the parent base (Fort Benning) to one of the new P25 narrowband 380-400 MHz trunk radio systems, Merrill has also made the move to the new LMR band. System identification for this network is 01e and the P25 WACN is 90b20. Below is the latest frequency intel for this multi site radio system at both Army bases.

Site 101 - Main Site
 386.0750/396.0750 386.2250/396.2250 386.5250/396.5250
 386.6750/396.6750 386.9750/396.9750 388.0000/398.0000
 388.1500/398.1500 388.3000/398.3000

Site 201 - Bravo Site
 386.1375/396.1375 386.2875/396.2875 386.4375/396.4375
 386.5875/396.5875 386.7375/396.7375 386.9500/396.9500
 388.1125/398.1125 388.2625/398.2625 388.4125/398.4125
 388.5625/398.5625

Site 301 - Charlie Site
 386.8250/396.8250 388.2500/398.2500 388.4000/398.4000
 388.5500/398.5500 388.7000/398.7000 388.8500/398.8500
 389.4875/399.4875

Site 401 - Golf Site
 385.0125/395.0125 385.2125/395.2125 385.6250/395.6250
 385.8875/395.8875 386.0375/396.0375 386.1875/396.1875

Site 501 - Romeo Site
 385.0625/395.0625 385.3125/395.3125 385.9000/395.9000
 386.3375/396.3375 386.4875/396.4875 386.6375/396.6375

Site 808 - Camp Merrill - Location Unknown
 386.0750/396.0750 388.0250/398.0250 388.3250/398.3250

Site 909 - Camp Merrill - Black Mountain (NAC: 027)
 386.1000/396.1000 386.8500/396.8500 388.1125/398.1125
 388.4125/398.4125

Site 1010 (0a) - Camp Merrill - Brawley Mountain (NAC: 028)
 386.4000/396.4000 388.0000/398.0000 388.2500/398.2500
 388.7000/398.7000

❖ ARTCC Update: Fort Worth

This month we will continue our Air Route Traffic Control Center tour with Fort Worth ARTCC (Table One). I want to remind regular readers of this column to please be patient and we will get around to the ARTCC covering your area as soon as space and current events allow. Note: All frequencies listed in table One are in MHz and mode is AM.

And that does it for this month. Until next time, 73 and good hunting.

TABLE ONE: FORT WORTH ARTCC RCAG FREQUENCY LIST

RCAG* Freq V/U Pair MHz	RCAG Location (ICAO** Identifier)	Sector Number/Name: Notes
120.275/319.250	San Angelo TX (SJT)	Sector 61 Lee Hi
120.350/307.350	Graham TX (QWQ)/Palo Pinto TX (MWL)	Sector 32 Possum Intermediate
120.475/323.300	Marshall TX (ASL)	Sector 71 Sulphur Springs Hi
120.775/327.100	Lubbock TX (LBB)/Paducah TX (QPD)	Sector 93 Turki Hi
121.375/269.425	Palo Pinto TX (MWL)	Sector 39 Mineral Wells UH
123.925/269.475	Paris TX (PRX)/Texarkana TX (TXK)	Sector 27 Texarkana Lo
124.525/348.650	Paducah TX (QPD)/Wichita Falls TX (SPS)	Sector 47 Wichita Falls Hi (replaced 134.550 MHz)
124.750/377.100	Gainesville TX (GLE)	Sector 23 Frisco Lo
124.875/370.950	Blue Ridge TX (BYP)	Sector 24 Seaver Intermediate

125.225/348.000	Lubbock TX (LBB)	Sector 98 Raider UH
126.150/322.550	San Angelo TX (SJT)	Sector 40 Midland Lo
126.275/270.325	Lufkin TX (LFK)	Sector 86 Paxto Hi (replaced 119.600 MHz)
126.325/346.250	Monroe LA (MLU)/Shreveport LA (SHV)	Sector 30 Monroe Lo
126.450/316.100	Paducah TX (QPD)/Plainview TX (PVW)	Sector 64 Lubbock Lo (replaced 327.100 MHz)
126.575/322.450	Cumby TX (QZJ)/Texarkana TX (TXK)	Sector 90 Texarkana Hi
126.725/298.850	Cedar Creek TX (CQY)	Sector 29 Donie Intermediate
126.775/328.400	Gainesville TX (GLE)	Sector 53 Gainesville Intermediate
127.000/360.600	Palo Pinto TX (MWL)	Sector 20 Millsap UH
127.150/314.000	Dublin TX (QDU)	Sector 62 Acton Lo
127.450/290.300	Abilene TX (ABI)/Brownwood TX (ABI)	Sector 63 Abilene Lo
127.600/254.300	Blue Ridge TX (BYP)	Sector 24 Blue Ridge UH
127.925/254.350	Monroe LA (MLU)	Sector 92 Monroe UH
127.950/322.325	Wichita Falls TX (SPS)	Sector 75 Bowie Lo (replaced 360.700 MHz)
128.100/327.150	Ardmore OK (ADM)	Sector 36 Ardmore Lo
128.325/351.900	Dublin TX (QDU)	Sector 65 Hicoe Lo
128.400/269.375	Clinton-Sherman OK (CSM)	Sector 35 Oklahoma City Lo
132.025/317.750	Cumby TX (QZJ)	Sector 83 Quitman Intermediate
132.075/291.650	Midland TX (MAF)/San Angelo TX (SJT)	Sector 82 Wink Hi (replaced 278.800 MHz)
132.200/338.350	McAlester OK (MLC)/Okmulgee OK (OKM)	Sector 38 McAlester Lo
132.275/269.275	Shreveport LA (SHV)	Sector 52 Paxto Hi
132.450/363.100	Clinton-Sherman OK (CSM)/Oklahoma City OK (OKC)	Sector 49 Oklahoma City Hi
132.600/269.050	Lubbock TX (LBB)/Snyder TX (SNK)	Sector 43 Reese Lo
132.850/360.750	Cumby TX (QZJ)	Sector 26 Lake Lo
132.925/269.250	Wichita Falls TX (SPS)	Sector 94 Woven Hi
132.975/351.850	Ardmore OK (ADM)	Sector 48 Ardmore Hi
133.100/298.950	Hobbs NM (HOB)/Midland TX (MID)	Sector 40 Midland Lo
133.250/285.550	Gainesville TX (GLE)	Sector 98 Bridgeport Lo
133.300/269.500	Waco TX (ACT)	Sector 96 Waco Lo
133.375/353.525	Shreveport LA (SHV)	Sector 25 Shreveport UH (replacing 316.125 MHz?)
133.500/350.350	Paducah TX (QPD)/Wichita Falls TX (SPS)	Sector 34 Wichita Falls Lo
133.575/323.275	Wichita Falls Lo	Sector 97 Super Hi
133.700/350.200	Big Spring TX (BGS)	Sector 40 Midland Lo
133.775/-----	Clinton-Sherman OK, Monroe LA, Fort Worth TX, Plainview TX	FT Worth AFSS - High Altitude EFAS
133.875/285.650	Shreveport LA (SHV)	Sector 28 El Dorado Hi
134.025/251.150	Tyler TX (TYR)	Sector 89 Frankston Hi
134.250/290.550	Dublin TX (QDU)	Sector 39 Abilene Hi
134.475/352.050	McAlester OK (MLC)/Paris TX (PRX)/Texarkana TX (TXK)	Sector 42 Decod Hi
135.175/322.525	Fort Worth TX (ZFW)/Gainesville TX (GLE)/Hood TX (QWJ)/Fort Worth TX (ZFW)	Sector 51 Fort Worth UH
135.250/279.650	Tyler TX (TYR)	Sector 25 Scurry Lo
135.275/317.475	Wichita Falls TX (SPS)	Sector Unk Wichita Falls UH
135.375/354.050	Dublin TX (QDU)/Palo Pinto TX (MWL)	Sector 62 Ednas Intermediate
135.450/257.925	McAlester OK (MLC)	Sector 50 McAlester Hi
135.750/379.250	Cedar Creek TX (CQY)	Sector 46 Dallas Hi
136.125/307.125	Blue Ridge TX (BUJ)	Sector 71 Majors UH (replaced 133.575 MHz)
-----/254.275	Wichita Falls TX (SPS)	High Altitude Unknown Sector
-----/257.200	Snyder TX (SNK)	Lancer MOA Advisory (associated with Sector 43)
-----/270.300	Abilene TX (ABI)	Approach Control
-----/270.800	El Dorado AR (ELD)	Anne MOA Advisory
-----/281.525	Wichita Falls TX (SPS)	Westover MOA Advisory
-----/282.200	Abilene TX (ABI)	Roby MOA Advisory
-----/282.375	Lubbock TX (LBB)	Bronco 3 MOA Advisory
-----/288.300	McAlester OK (MLC)	Rivers MOA Advisory
-----/290.475	Abilene TX (ABI)	Approach Control (replaced 385.400 MHz)
-----/291.625	Wichita Falls TX (SPS)	Dickie MOA Advisory
-----/292.100	Lubbock TX (LBB)	Bronco 4 MOA Advisory
-----/298.900	Oklahoma City OK (OKC)	Washita MOA Advisory
-----/307.250	Shreveport LA (SHV)	Jones/Lady MOAs Advisory
-----/317.700	Abilene TX (ABI)	Military Tactical Special Use (TSU)
-----/335.500	Paducah TX (QPD)	Westover MOA Advisory
-----/338.300	Abilene TX (ABI)	Approach Control
-----/339.800	Clinton-Sherman OK (CSM)	Approach Control
-----/364.800	Shreveport LA (SHV)/Midland TX (MAF)/Wichita Falls TX (SPS)	Military Tactical Special Use (TSU)

* RCAG - Remote Communications Air to Ground

** ICAO - International Civil Aviation Organization



Scanning Super Bowl XLVI

In February 2012, the city of Indianapolis, Indiana played host to the National Football League championship game, Super Bowl XLVI. Although the game itself was played at Lucas Oil Stadium near downtown Indianapolis, events associated with the big weekend were occurring all around the Indianapolis area. As with other Super Bowl games this one was designated as a National Security Special Event by the federal government.

I was on the ground in Indianapolis this year, supervising parts of the international television coverage of the game. Since I was there for over two weeks, I was able to see and hear how the local, state and federal public safety response started to build as Super Sunday approached.



US Customs and Border Protection helicopter flies above the Super Bowl stadium.

There was no shortage of federal communications activity during the week prior to and during the big game, although it seemed like the number of federal frequencies used for this Super Bowl was slightly less than in past years. Some of this may be due to the heavy use of the Indianapolis Metro Public Safety 800 MHz trunked radio system by almost every agency that was in town for the event. Several federal agencies were heard doing radio checks with the public safety dispatchers on the Super Bowl special event talk groups.

Some people may be surprised at the number of federal agencies and military units that appear at these large events, but I've often believed that these events provide a chance for these agencies to actually get out and practice their emergency operations in the real world.

Besides the agencies on the ground, there was plenty going on in the air, including a military combat air patrol (CAP) over the stadium during the game.

The Customs and Border Protection (CBP) Office of Air & Marine (OAM) was well represented at Lucas Oil Stadium during the week prior to the big game. At least three OAM helicopters were seen daily around the stadium area, along with the Indianapolis Police helicopter; one from the State of Indiana and even some national guard helicopters made a few orbits around the stadium. The CBP helicopters were even heard patrolling the downtown Indianapolis area during the evenings.

Although only three helicopters were spotted around the stadium, using various OMAHA # call signs, military monitoring enthusiasts posted that they heard call signs OMAHA 1 through OMAHA 9 used over the entire event. There were reports of some fixed wing CBP aircraft in the area, but I was never able to see or hear them. I also suspect that the different call signs were related to the different flight crews rather than different aviation hardware.

So here is the "raw" list of what was heard during the time I was in Indianapolis. Some of these frequencies were utilized just for this event, while some are likely normal operating channels for federal agencies in Indianapolis. Some of these frequencies, particularly some of the noted FBI channels, are most likely in day-to-day use in Indianapolis, but there was an increase of activity due to the events taking place there.

Some unknown channels, particularly the UHF frequencies, may be interference from the many UHF channels that were being utilized in the 450-470 MHz bands by the NFL Super Bowl operations. When I have been able to decipher some indication of which agency was using a particular channel, I have provided that information.

- 123.0250 AM Area helicopter multicom channel
- 123.0500 AM Area helicopter multicom channel
- 136.3750 AM CBF OAM VHF "COMPANY"

- 148.0000 CSQ Unknown agency (possibly Indianapolis Metropolitan Police Dept (MPD), see below)
- 162.3250 Unknown
- 162.5875 Unknown
- 162.7625 N293 Unknown agency
- 162.8750 N023 Dept of Homeland Security (DHS) Immigration & Customs Enforcement (ICE), input to 170.1
- 162.8750 N293 Unknown agency
- 162.9125 N069 DHS ICE, input to 171.2500
- 162.9750 N293 Unknown agency
- 163.1000 N167 Federal Bureau of Investigation (FBI)
- 163.1125 N496 Unknown agency, input to 170.7875
- 163.1250 N301 CBP
- 163.1875 N167 FBI
- 163.2000 N023 Unknown agency
- 163.2375 Unknown
- 163.7000 N169 ICE TAC 1
- 163.7250 N169 ICE tactical channel
- 163.8625 N167 FBI, input to 167.5375
- 163.9000 N167 FBI, input to 170.9375
- 163.9375 N167 FBI A6 input
- 164.1000 N301 CBP Vehicle and Cargo Inspection System (VACIS) Operations
- 164.3500 NE03 Possible Department of Energy
- 164.4500 Possible EPA using DES encryption?
- 164.6500 N001 US Secret Service (USSS) TANGO
- 164.7875 N169 ICE TAC 4
- 165.2375 100.0 CBP NET 1 analog
- 165.2375 N301 CBP VACIS Operations
- 165.2875 N650 Bureau of Alcohol, Tobacco, Firearms & Explosives (BATFE) NET 1
- 165.3750 N001 USSS CHARLIE
- 165.5125 N301 CBP
- 165.6875 N301 CBP VACIS Operations
- 165.7250 N293 Unknown agency
- 165.8000 CSQ Unknown agency
- 166.4375 N325 CBP DNET 1 input
- 166.4625 103.5 Possible Transportation Security Administration (TSA) use at stadium, analog
- 166.5125 P-25 White House Communications Agency (WHCA) ALPHA, reported weeks prior but nothing heard during
- 166.5875 100.0 Unknown
- 166.5875 N301 CBP DNET 12
- 166.6750 141.3 Unknown
- 167.0000 N100 Unknown agency
- 167.0250 N169 Possible ICE tactical channel
- 167.2125 N167 FBI
- 167.2125 N167 FBI A1
- 167.2875 167.9 FBI
- 167.3125 167.9 FBI
- 167.3875 N167 FBI
- 167.4125 167.9 FBI

167.5375	N167	FBI D6
167.5625	N167	FBI
167.7625	N167	FBI
167.7625	N167	FBI A6
168.0000	141.3	Related to the 166.675 MHz?
168.1125	N68F	Federal Interoperability LE-4
168.5875	N169	ICE TAC 2
168.8375	N293	CBP AIR 1
168.9625	N293	Unknown agency
169.2625	N293	Unknown agency
169.5500	N325	CBP DNET 12 input
169.5625		Unknown
169.7250	N167	FBI
170.1000	N023	DHS ICE
170.4375	N167	FBI
170.4875	N167	FBI
170.7500	N293	US Marshals Service, Indianapolis Federal Courthouse
170.7875	N496	Unknown agency
170.9125	N167	FBI
170.9375	N167	FBI, A5
171.2000	NE03	Possible Department of Energy use
171.2000	N293	Unknown agency
171.2500	N069	ICE NET 1, repeater
171.3875	CSQ	USPS Bulk Mail Center, Truck Operations
171.6875	N293	Unknown agency
171.7750	N167	FBI
171.9500	N293	Unknown agency
172.1750		Unknown, possible data bursts
172.9000	N001	TSA at Indianapolis International Airport (IND)
228.9000	AM	Combat Air Patrol
238.2000	AM	Combat Air Patrol, TAC channel
260.9000	AM	Combat Air Patrol
350.0250	AM	CBP OAM UHF "3"
380.7875	NFM	Possible DoD land mobile use
383.4750	NFM	Possible DoD land mobile use
406.1375	127.3	Possible US Postal Service
406.2000	N201	Federal Protective Service, Region V
407.7250	N482	USPS Postal Inspection Service
407.7750	N482	USPS Postal Inspection Service
407.8375	N174	VAMC Maintenance
408.0375	N263	VAMC Police
408.9375	D162	Unknown
409.0750	D364	Unknown
409.2750	127.3	Possible US Postal Service
410.2000	127.3	USPS Bulk Mail Center, downtown Indianapolis
410.3000	156.7	Unknown
410.8750	146.2	Unknown
411.5250	127.3	Probably USPS operations
411.5500	127.3	Probably USPS operations
414.7250		Unknown
414.7375	D074	Unknown
415.0750	91.5	Unknown
416.7250	N482	USPS Postal Inspection Service, input to 407.7250
416.8375	N174	VAMC, input to 407.8375
417.0375	N263	VAMC, input to 408.0375
418.5250		Unknown
418.6000	136.5	Unknown
418.7750	100.0	Unknown

A few notes on some of the activity that was monitored: Some frequencies were encrypted full time, so positive identification will be difficult, but 171.6875 MHz, N293 was interesting in that several years ago I was in attendance

at the Brickyard 500 at the Indianapolis Motor Speedway. At that event, I found that someone was re-broadcasting some of the race team and track safety communications on this frequency in P-25 digital with no encryption. At the time I heard this I did not have any way of confirming the network access code (NAC) used, but I was interested to hear the same frequency in use in for the Super Bowl. This time, all monitored transmissions were encrypted.

Also interesting was 165.3750 MHz, N001, which is the US Secret Service channel CHARLIE. This was being used by the Secret Service security detail protecting DHS Secretary Janet Napolitano. She was at various events and did a walk-through of the stadium prior to the Super Bowl game. 166.5125 MHz, which is a White House Communications Agency (WHCA) frequency, was reported active in Indianapolis with encrypted traffic several weeks prior to Super Bowl weekend. While no traffic was heard from them during the game, it is possible they were doing some advance work in case the President decided to attend the game. Apparently they always plan for a possible visit by the POTUS (President of the United States) just in case one of his favorite teams ends up in the game.



Department of Homeland Security made its presence known.

164.3500, NE03 and 171.2000, NE03 both appear to have been related to Department of Energy activities at the stadium. Both appeared to be simplex and only sporadic encryption was heard.

148.0000 MHz, CSQ was heard around the stadium being used as a chatter channel by some agency providing perimeter security and traffic control. The Indianapolis Metro Police have a history of utilizing modified amateur radios on some unconventional VHF radio channels for private "chat" channels in the past.

I will be posting this list on the *Fed Files* blog page (<http://mt-fedfiles.blogspot.com/>), so if you are able to provide any further information regarding what was heard, please send it along to *The Fed Files* and I will update the blog post.

❖ The End of the IWN?

Over my years of writing the *Fed Files* column, I have often referred to a particular federal radio system called the Integrated Wireless Network, or IWN. The IWN is an APCO P-25 VHF trunked radio system, currently deployed in the Pacific Northwest and the Washington DC areas. Recent developments within the federal government have apparently spelled trouble for expansion of the IWN project, perhaps signaling its end. The IWN radio project began life in the

late 1990s as a concept to replace the aging and outdated radio systems from the various agencies of the Justice Department into a single, wide area trunking radio system that would support the activities of the various agencies into the future. After some initial planning, the U. S. Treasury Department, who were working on a similar concept, was invited to join the Justice Department in the deployment of this radio system. Later still, the Department of Homeland Security was also encouraged to join into this effort, but their participation came somewhat late for the DHS, who were engaged in their own efforts to update their disparate radio systems into a new, interoperable digital radio system.

During the initial deployment of the IWN trunked radio sites, there were problems with the project. Some were technical problems, some were practical issues, but the major problems seemed to be in the management of the system and how the project budget was being managed with the available funding. According to a report by the Government Accountability Office released in 2008, the cooperation between the various agencies had collapsed and needed to be seriously re-evaluated if the project was to succeed. The 2008 GAO report is available here: www.gao.gov/new.items/d09133.pdf.

In early 2012, there were several news reports about the IWN project being halted, or even de-funded. I posted on the *Fed Files* blog page some items I had located on line concerning a "stop work" order being used to the IWN project due to concerns about procurement procedures. There was a flurry of news items and postings on hobby forums about the news concerning the "failed" IWN radio system. The news items and some hobbyist comments seemed to give the impression that the IWN was suffering from technical or systemic failures and that the communications system wasn't working.

In fact, the existing radio system was working and providing secure communications to many Justice, Treasury and DHS agencies every day. The true failure appears to be the inability to manage the spending and cooperation of the various government agencies effectively. The IWN project was in danger of becoming a large hole into which federal funding disappeared. An audit report from the Justice Department's Office of the Inspector General (OIG) found that the project was failing due to lack of direction and focus as well as uncertain funding.

Both the Treasury Department and Homeland Security are no longer active participants in the IWN project, although they continue as users of this system. The OIG report is available here: www.justice.gov/oig/reports/2012/a1210.pdf

In mid-February, news reports throughout the federal procurement and two-way radio industries indicated that the IWN was officially halted. After costing nearly \$400 million, no further funding was going to be available for the continued expansion of the IWN radio system, although budgets were allowing for the continued operation and maintenance of the existing IWN sites.

In the next *Fed Files* column, I will explore the technical side of the IWN project and where it is currently operating, as well as provide some guesses as to what happens next. See you in July.



Aviation-Related Frequencies

Aviation-related frequencies span the radio spectrum from about 200 kHz to and including microwave – all within well-defined frequency bands. The frequencies of most interest to hobby listeners are those that regularly carry two-way voice communications. Perhaps surprising to some, certain navigation stations do include voice transmissions.

Due to the nature of radio propagation, some of the bands cover only local areas while others are useful over thousands of miles. There is a fascinating variety of radio listening opportunities among all the bands. Let's take a look!

❖ Non-Directional Radio Beacons (NDBs)

NDBs use the lowest of the aviation-related frequencies. They are below the standard AM broadcast band and are mostly in the 200-425 kHz range. They identify by continually sending their call signs in Morse code.

NDBs go way back in aviation history as an early aid to navigation (navaid). Pilots can use Automatic Direction Finder (ADF) receivers in the cockpit to tune in NDBs for navigating. For the curious, here is some interesting information on NDBs and ADF: <http://flyawaysimulation.com/contentid-11.html> and www.luizmonteiro.com/Learning_ADF_Sim.aspx

With enthusiasm, some hobbyists DX NDBs and try to log as many stations as possible and from as far away as possible. Distance reception is best at night during the part of the year with the longest nights.

A receiver like the Icom R75 www.grove-int.com/ICR75.html does a good job at beacon DX. It does require an outside wire antenna and, if at all possible, a quiet area in terms of local man-made radio noise.

This site www.classaxe.com/dx/ndb/rna/ may be used to look up NDB call letters. There are many features to the database, but with a little time they can be mastered.

❖ HF Aero Frequencies

The HF aero frequencies appear in bands scattered along the shortwave spectrum. These frequencies are primarily used for long distances like transoceanic flights, for over large unpopulated land areas in some parts of the world, and for world aviation weather broadcasts. Here again, the Icom R75 is a good receiver since it does a fine job at receiving single sideband (SSB) transmissions.

HF aero listening brings these terms to mind: MWARA, ARINC, RDARA, LDOC, VOLMET, HFGCS, and SELCAL. If this were a test, which term is the least consistent with the others?



Interesting things can pop up from time to time on 121.5 MHz. Consider including it in your scan sequence.

• MWARA (Major World Air Route Area)

These are world areas where the majority of transoceanic flights occur. Each area has its own designation – such as “NP” North Pacific, “CEP-1” Central East Pacific One, “NAT-A” North Atlantic-A, etc. Each has its geographic boundaries and its own set of air traffic control frequencies. MWARA frequencies can and do include military aircraft.

You will hear frequent position reports. They include flight number, current position, time in UTC, outside temperature Celsius, wind direction and degrees, altitude expressed as Flight Level, the next reporting point, fuel on board, and the SELCAL code.

For Pacific and Atlantic frequencies and area designations, go to www.arinc.com/products/ then scroll down to and click on “Air/Ground International Voice Service.” Once there, click on “Jeppesen Charts” and then click on “ARINC-3” for Atlantic/Caribbean and on “ARINC-4” for Pacific.

• ARINC (Aeronautical Radio, Inc.)

ARINC is a contractor to the Federal Aviation Administration (FAA) that provides HF Air Traffic Control communications by relaying information and requests back and forth between controllers and aircraft.

ARINC identifies as “New York” for Atlantic communications and as “San Francisco” for Pacific communications.

• RDARA (Regional Domestic Air Route Area)

RDARAs are common in other parts of the world. They can cover oceanic areas and areas over land. RDARAs provide challenges and opportunities for the serious U.S. DXer. One challenge is to hear them and the other is to identify what is heard.

RDARAs are numbered and incorporate

Sub-Areas. Example: RDARA-14 includes and surrounds Australia which is divided up into Sub-Areas 14A, 14B, and 14C. RDARAs have two or more HF frequencies each.

From ITU (International Telecommunication Union) *Appendix 27 (Rev. WRC-03)* (Extract)* “Where the operational area of an aircraft lies wholly within a RDARA or Sub-RDARA boundary, frequencies allotted to those RDARAs and Sub-RDARAs shall be used.”

This column editor has found no current listing neatly tying together frequencies to RDARA designators and to plain English geographic locations (as opposed to a string of Lat/Long figures).

• LDOC (Long Distance Operational Control)

MWARA frequencies are for transoceanic Air Traffic Control, whereas LDOC frequencies are for non-ATC uses like contacting airline company ground personnel or contracted medical support for inflight injuries and illnesses. These are typically done by phone patch on the ground side. They are arranged through ARINC on a regular MWARA frequency. The ARINC operator will call out the specific LDOC frequency. LDOC communications range from routine – to interesting – to suspenseful and dramatic. See the Jeppesen Charts for frequencies.

• HFGCS (High Frequency Global Communications System)

“The HFGCS System is a worldwide network of high-power HF stations providing air / ground HF command and control radio communications between ground agencies and US military aircraft and ships.” For more info go to <http://mt-milcom.blogspot.com/> and scroll down on the right to “MILITARY REFERENCE ROOM” and under that category, click on “JCS HFGCS HF Network.” For starters, try 11175 kHz USB and secondarily 8992 kHz.

• VOLMET (VOL METéorologique)

VOLMET aero weather broadcasts are either recorded or use voice robots. Stations are scattered around the world and can be fun to DX, to use as real-time propagation indicators for specific world areas, or for actual weather information.

Each VOLMET frequency or simulcast set of frequencies goes sequentially through an established list of stations for specific geographic areas on a published schedule. Quite unlike RDARAs, there are some great references for VOLMET broadcasts.

This very nice site www.dxinfocentre.com

[com/volmet.htm](#) lists VOLMET frequencies by frequency. This one [www.dxinfocentre.com/volmet-wx.htm](#) lists them by city. Notation example: *If a schedule states "H+30" for a particular station, it means that its broadcast in the sequence will begin at thirty minutes after the hour.*

For a quick start, for the Pacific, try these simulcast frequencies: 2863, 6679, 8828, and 13282 kHz USB. For the Atlantic, try: 3485, 6604, 10051, and 13270 kHz. Sample the various frequencies at different times of the day and night.

• **SELCAL (Selective Calling System)**

The previous categories all include entities that transmit voice. SELCAL is the odd one in the group, but you will hear SELCAL tones all the time on MWARA frequencies so it deserves a mention.

SELCAL tones are used by ground stations to open the squelch of individual aircraft radios so the cockpit crew doesn't have to listen to noise and communications that do not apply to them. SELCAL tone checks are common. There are four tones in any given SELCAL code. They are used in pairs of two tones. With Gulf Kilo Bravo Charlie for GKBC, the tones "G" and "K" are combined and then followed by the combined tones of "B" and "C."

Good SELCAL information may be found here: [www.selcalweb.co.uk/faq.html](#). You may look up tones here [www.selcalweb.co.uk/](#) that you hear called out on the air.

American 169 requested a SELCAL check with the above tones. The search brought up four aircraft worldwide due to a lack of codes. One search result was N756AM AAL B772. Since AAL is the three-letter identifier for American Airlines, it was the one. N756AM is the tail number / registration. B772 is the Boeing model number.

❖ **The 108-117.975 MHz Band**

This is an aeronautical radionavigation band. While listening, you will hear controllers refer to specific VORs (VHF Omnidirectional-Range) stations by name and to specific VOR degree radials. VOR and the VOR component of both VORTAC (VOR/Tactical Air Navigation) and VOR/DME (VOR/Distance Measuring Equipment) navigational stations exist in this range. TACAN (military) and DME both provide VOR-to-aircraft distance information to the pilot if the aircraft is so equipped.

In very basic terms, pilots refer to instrumentation in the cockpit to fly toward a specific VOR or away from a VOR in any selected direction. Pilots can go from VOR to VOR for much of their travels – like connecting the dots on a map.

On a frequency of a VOR that is reasonably close to you, you will hear a fast warble of sorts and the call letters in Morse code. The call letters may be looked up at [www.airnav.com/nav aids/](#). Some VORs broadcast voice weather information.

At this point, I was going to offer info on RunwayFinder as an on-line aero chart

resource, but sadly, notice was given in February that they are closing down. It appears that the FAA's decision to begin charging for chart downloads was a large part of it. AirNav.com allowed easy access to RunwayFinder so I wonder, as I write this, if AirNav.com will continue to have any sort of chart viewing option.

HF Aero Frequency Bands in KHz USB	
2850-3155	8815-9040
3400-3500	10005-10100
4650-4750	11175-11400
5480-5730	13200-13360
6525-6765	15010-15100

❖ **The 118-136.975 MHz Band**

If you want to hear VHF voice aero radio communications, this is the band! There are a variety of things to listen to here. It is primarily for civil communications, but the military can and does use the band. AM mode is used and with 25 kHz channel spacing.

• **ATC (Air Traffic Control)**

By far, most of the channels in this band are used by Air Traffic Controllers. A typical airliner, still parked, will contact Clearance Delivery to review the departure details and route. Next, the pilot switches to Ground Control for taxi instructions, sometimes through a maze of lettered taxiways to get to near the end of the runway. Ground Control hands the aircraft off to the Tower. When the timing is right, the Tower controller will clear the aircraft for takeoff.

After a few minutes and some elevation gain, the Tower will hand off the plane to Departure Control (DEP). If it is a long distance flight, most of the flight will be above 18,000 feet in elevation. After some additional elevation gain, the Departure Controller will hand off the plane to the area Air Route Traffic Control Center – often called "Center" or, for a specific center example: "Oakland Center."

An arriving aircraft will go through the same handoffs in reverse order, minus Clearance Delivery. Departure Control and Approach Control (APCH) are both functions of the same local Terminal Radar Approach Control (TRACON) – and oftentimes the same controller.

ARTCCs and TRACONS have sectors, each with their own controllers and three-dimensional airspace areas of responsibility.

To find the ATC frequencies at airports, go to [www.airnav.com/airports/](#) and enter the three- or four-letter code for the airport – but there are other search options. For an example, enter RNO for Reno/Tahoe International Airport. Under Airport Communications, you will see the above-mentioned frequency categories listed. At first, it may look somewhat cryptic but with some exposure to such listings, it will become clearer.

• **UNICOM**

Large commercial airports have Control Towers, but smaller and less busy airports do

not. The UNICOM frequency allocations for public-use airports are 122.7, 122.725, 122.8, 122.975, 123.0, 123.05, and 123.075 MHz. Each airport is assigned its own frequency.

Pilots make self-announcements on the assigned UNICOM frequency regarding their intentions when in the airport area. Pilots in the area communicate and work out their arrivals, departures, and taxiing with each other.

Pilots may contact the airport UNICOM operator, when one is available, about the wind direction, altimeter setting, active runway, and other things, but nothing relating to air traffic control at the airport. Airports using UNICOM can be an interesting listening alternative. The AirNav.com link above will provide the frequencies.

• **Guard Channel**

121.5 MHz is the VHF aero emergency frequency. It is frequently referred to as "Guard." The primary purpose is for pilots to use when in distress, but it is used for a few other things.

Some beacon transmitters aboard aircraft begin to transmit on 121.5 MHz upon impact. There are several types of beacons but some still use, or include, 121.5 MHz. You may hear them from time to time if near your location. You will also hear airline pilots reporting that they hear them.

If a controller is unable to contact an aircraft, he/she may ask another aircraft in the area to call the unresponsive aircraft on the Guard Channel in an attempt to learn its status and, if contact is made, then to contact ATC. This can happen over land on VHF and during transoceanic flights where the controller's request is made on an HF MWARA frequency.

If unintentionally or intentionally an aircraft enters unauthorized airspace, he may be greeted by a fighter interceptor that will attempt to make contact on 121.5 and/or otherwise cause the plane to exit that airspace.

❖ **Closing Thoughts**

Since this column is intentionally broad in scope, it lacks in many details. Previous *Planes* columns could likely provide more specific information on many of the above topics. For *MT* "Indexes of Contents," see [www.monitoringtimes.com/html/index.html](#). For anthologies on CD by year, see [http://monitoringtimes.com/html/mt_anthologies.html](#).

Take a quick journey with me through just a fraction of the FAA website. You may see interesting things along that way, but truncate on. We arrive at a destination that is brief and to the point and consistent with the theme of this column.

Start here [www.faa.gov/](#) and then follow the trail: About FAA (at the top) > Offices > Air Traffic Organization > Safety & Technical Training > Technical Operations > Spectrum Engineering Services > Spectrum Assignment and Engineering Office > Radio Frequency Bands.

See you next time – perhaps with a continuation of what I was unable to include this time.



New Ways to Talk Amateur Radio

Amateur radio has always been a way to connect the world using innovative means. From the early days of experimenting with Morse code, to voice communications via tubed-based radios, amateur radio has often been at the forefront of experimentation in technology.

It was amateur radio that saw the first forays into video transmissions, setting up the first 'TV' stations in many areas. It was amateur radio that first made mobile phone conversations possible through autopatch, well before cell phones were within the reach of the masses.

So it should be no surprise that amateur radio continues to operate within the leading edge of digital communications. Given the experimental nature of amateur radio and the worldwide reach of the Internet, it was only a matter of time before someone combined the two.

I have talked before about the **Internet Radio Linking Project (IRLP)**, especially the most popular venue for Internet-linked amateur radio communications, EchoLink. But there is more to IRLP than EchoLink alone. There is, to play on words, a wide world that serves to web together amateur radio operators all across the globe.

IRLP began back in 1997 as a way to try to link radio systems across Canada over the Internet. The techniques and technology have evolved over time, but the mission has remained the same. Now, there are more options than ever

for joining in on the world wide conversation, with nearly 3,000 nodes online.

As IRLP continues to evolve, even the ways of engaging in the conversation are evolving. Michael Bloom, W7RAT, of the Oregon Internet Radio Group, has developed a new way of conversing by means of Amateur Radio on the Internet. Bloom has basically developed amateur radio "chat rooms" called **Topic Channels** that allow amateur radio operators to connect online to discuss everything from the meaning of life, to sports, to history.

Each node is a different topic, including a few topics on what are called "flex channels" that allow new topics to be tried out. As of press time, IRLP Topic Channels are supported by reflector owners in the U.S., Australia, Canada and Norway. For those who are not quite as adept at using IRLP nodes, there are full instructions on the IRLP Topic Channels Web site (link included in the GlobalNet links at the end of this column).

Here is a full list of current topic channels:

IRLP Channel Topics (as of March 2012)

- 9093* IRLP Topic Lounge
- 9554 Emergency Communications
- 9001 DX Channel
- 9611 The Meaning of Life
- 9077 History & Current Events
- 9730** Election 2012
- 9204 Sports
- 9775** Stamp Collecting
- 9351 Media
- 9192** The Next New Thing

*Accessible on EchoLink
**Flexible channel, topics can change

There are plans for additional formats for conversations yet to come, such as moderated debates. So once again, amateur radio has evolved a new way to exchange information between operators around the world. Those who prefer to make contact the old-fashioned way can still do so. But now, if you just want to find like-minded individuals to engage in thought-provoking and intelligent conversations, you have a road map on how to do it.

❖ WWW Dot Breaker 1-9

Amateur radio isn't the only thing you can find online. Have you ever thought of tuning into CB radio online?

You can find more than just truckers on CB radio. Many folks rely on CB radio for non-commercial communications, although there is now less activity thanks to the Family Radio



Livecbradio.com

Service, which has taken the place of CB radio for most short distance communications.

Right now, the only thing you can do online is listen to communications. The main site for listening to online CB radio is called LiveCBRadio. You can obviously also tune in to online receivers to the frequencies for each channel on CB. But LiveCBRadio is an easy way to listen to CB transmissions online. They had at one time tested a way to transmit in a similar manner to amateur radio's EchoLink, but that feature has since been abandoned.

❖ Royalty Debate Rages on

Those of you who have been reading my column for a while remember how I watched, with great interest, the debate between the Recording Industry Association (RIAA) and the National Association of Broadcasters (NAB). The RIAA has been pushing to put a bill before Congress to force broadcasters to pay additional royalty fees to artists.

After a strong pushback by many in the broadcasting industry, led by the NAB and supported by many members of Congress, the initiative lost steam before ever being seriously considered as legislation. While the RIAA hasn't given up hope they can put a similar bill before Congress in the coming years, they have focused on other avenues to obtain revenue in a tough economy.


The next major effort we have seen is an attempt to curb online piracy of copy written materials. The recent Supporters of Performing Arts (SOPA) and Protect Intellectual Property Act (PIPA) initiatives also garnered heavy media scrutiny and eventually lost steam. At nearly the same time the bills were effectively canned, a popular file-sharing site, MegaUpload, was brought down by Federal authorities.

Now a movement in Australia is seeking to gather additional royalties from broadcasters. The Phonographic Performance Company of Australia Ltd (PPCA), the Australian form of the RIAA, was pushing the Australian federal court to make a declaration that the copyright license for broadcasters, as it was written, did not allow them to simulcast music over their Internet streams.

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- 9554 Emergency Comm.
- 9001 DX Channel
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Emergency Communications - Prepare for the next hurricane, tsunami, tornado or man-made catastrophe

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Election 2012 - Politics of the United States respectfully discussed

Stamp Collecting - Discussing philatelic issues from around the world

The Next New Thing - **Highlighting new opportunities for Ham Radio Enthusiasts**

Ham Radio has always been in the forefront of electronic communication technology. From enthusiasts, individual node owners are dedicating specific channels on their IRLP

Australia, had a non-exclusive license to broadcast copy written music. What the PPCA was trying to do was to get a declaration that Internet simulcasting was not considered a "broadcast." In doing so, they were trying to wrangle additional performance royalties from radio stations for performance of music over Internet simulcasts. While the measure was ultimately unsuccessful, it demonstrates the efforts that record labels are going to, to try and squeeze additional money from broadcasters around the world.

In addition to Australia and the United States, similar efforts are taking place in Canada as well. There, groups backed by artists and record labels are trying to amend the 1997 Canadian copyright law that allows broadcasters to pay a flat fee on the first \$1.25 million in advertising revenue, with a set 2.1 percent rate for all revenue above the \$1.25 million.

Those trying to change the law are saying that broadcasters are saving thousands of dollars on that first \$1.25 million, money they say should be going to artists who are already struggling with lowered revenue thanks to content piracy and other factors.

So, although we in the U.S. have seen the first push for extra royalties go down in flames, with international pressure mounting on broadcasters, we can expect this issue to come up again before Congress in the not-too-distant future.

From an Internet radio standpoint, there are several different angles to this issue that should be cause for concern. Traditional thinking is that if broadcasters are feeling the squeeze of extra royalties for their terrestrial broadcasts, they will simply turn to Internet radio as a safe-haven for broadcasting at lowered royalty rates.

It's still a bit early to tell what, if any, affect increased broadcast royalties would have on Internet radio. The original thought was that increased royalties would force broadcasters to turn to online streaming as an increasingly important source of revenue. In the economic downturn of the last few years, we have seen stations leave air completely, mostly because their key advertisers also disappeared. Whatever happens, though, it is safe to say that the battle between artists and broadcasters isn't going away any time soon.

❖ GlobalNet Mailbag

This month, we reach back in to the mailbag, where streaming video – specifically Netflix – gets another glance.

After reading your article, Cutting the Cable - Streaming Video, I wanted to share what I learned from Netflix. I was quite enraged when I called Netflix because of what I learned in the news about them phasing out DVDs. Since I prefer BluRay, I unloaded both barrels during my rant. I mentioned that I knew they were being sued by NBC and Comcast; however, they corrected me, saying it was Wal-Mart (found source from EFF). They also attempted to calm me down a bit. Netflix indicated that their goal is to replace new DVD releases with a Streaming format. This would, as they said, be the same

releases offered on DVD. That, to me, sounded like progress.

David - MT subscriber.

David, Netflix is by far and away the current lead-dog in the streaming video fight, but that hasn't stopped them from trying to figure things out as they go. A lot was made in the media and blogosphere about Netflix's apparent wishy-washy strategy regarding their business model. But all along, it comes down to the fact that no one has ever encountered an industry like this.

When Netflix first started as a subscription-based DVD delivery service, it heralded the beginning of the end for traditional video rental stores. Then, when Netflix introduced its streaming video service, it actually initiated the end of the DVD delivery service they had started! Seeing this as a potential problem for their bottom-line (a chief product offering becoming obsolete), Netflix tried to protect themselves the best way they thought they could, by splitting their business into separate entities.

The communication you have received from Netflix is very telling: They see the writing on the wall. People prefer streaming in increasing numbers, and with good reason. Carrying around your DVD collection takes either a large amount of hard drive storage or a large number of DVDs. Not exactly a prime example of portability.

Streaming video allows for access to hundreds of streaming movies and television shows with nothing more than an Internet connection. From a computer, tablet, smartphone or other WiFi-enabled device, a user can stream high-quality content in as much quantity as they want.

Also, use of a streaming service doesn't mean that DVD or BluRays will disappear. As much of a hardened streaming advocate as I am, I still have a large DVD and BluRay collection that continues to grow. I like the special features and other content that these media forms offer, that can't be found in a simple stream.

One other thing I have noticed is that, just because you find a movie or TV show on Netflix that you enjoy, doesn't mean you will be able to watch it forever. Content comes and goes, being replaced by other options. If I find something I really enjoy, I will purchase it so that I have my own permanent copy I can use forever.

So, for someone like you, David, Netflix can offer the best of both worlds. You can still buy your BluRays, but use Netflix as a quick streaming option or to find new content, especially while on the go.

Netflix isn't the only option. As I outlined in my streaming video column in the March issue, services like Amazon's Prime Instant Video, Sony's Crackle and Hulu all present options for streaming video. My feeling is that there are additional streaming services that will be available in the coming years. I also have a hunch that we will see, sometime within the next 3-5 years, someone with deep pockets step up to try to purchase Netflix. Especially if Netflix's public perception problems continue.

Who might be a willing buyer? My first thought is to look to someone like Amazon, a content distributor with a system already in place that would love to bring all of those Netflix subscribers to their Prime service. But don't rule

out an industry-insider like a Sony, Universal or Warner Brothers. They have a vested interest in being able to control distribution of their own content.

My money is still on Amazon. They already started a Netflix-copycat in the United Kingdom, called Lovefilm. Lovefilm takes the movie and TV formula a step further by offering console games as well, much like the Gamefly service in the U.S. With a good selection of both newer releases as well as standard classics like Netflix offers, Lovefilm could be a glimpse of what Amazon might do if they were to get their hands on Netflix.

Thanks for reading, and for joining in on the conversation! Have something you would like to ask or contribute to the GlobalNet column? Email me at loyd@globalnetmt.com.

Until next month, 73s and happy listening!

GLOBALNET LINKS

IRLP - www.irlp.net/
 IRLP Topic Channels - www.irlptopics.net/Index.htm
 Live CB Radios - www.livecbradio.com/
 No extra royalties for Internet simulcasting - www.themusicnetwork.com/music-news/industry/2012/03/02/commercial-radio-wins-simulcast-royalty-court-battle/
 Aussie record labels lose case against radio stations - www.theregister.co.uk/2012/02/15/labels_lose_radio_wins/
 Groups trying to end radio 'subsidy' in Canada - www.cbc.ca/news/politics/story/2012/02/14/pol-copyright-royalties-radio.html
 Lovefilm - www.lovefilm.com/
 Netflix versus Lovefilm - www.theregister.co.uk/2012/01/10/lovefilm_vs_netflix_szzz/

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Bendix Navigator 420: Gaining Access

Never would I have expected a portable radio to be so difficult to disassemble, yet the job is now done! In case you're just joining us, I'm referring to our latest long-wave restoration project, a Bendix Navigator 420 RDF receiver, which we started last month. This transistor set from the late 1960s-early 70s has no less than 14 screws and fasteners holding its PC board in place. These had to be removed to free the board from the radio's enclosure. Some screws were hidden beneath wiring or otherwise obscured by hardware, requiring some gentle "nudging" to even get at the screw heads.

With the screws removed, I could finally access the tuning scale, which was my main goal in doing all of this (see Figure 1). I needed to reach it so that I could remove a "cocoon" that had been built on the dial plate by an insect at some point in the past. To remove it, I used a cotton swab and simply brushed it away from the dial plate, as it was quite soft. The interesting thing is that the cocoon had been built directly over a "Nova-Tech" label on the dial plate which was not readable before.

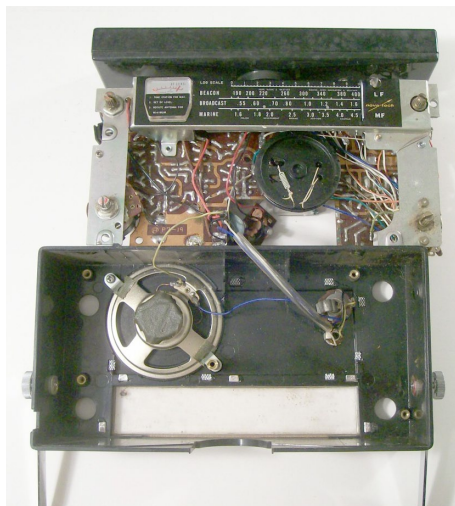


Figure 1. Bendix Navigator 420 with PC board removed

To get all traces of the cocoon off the dial plate, I moistened the cotton swab with warm water and rubbed it gently around the area where it had been attached. I followed this up with an overall cleaning of the plate (and window glass) with Novus Plastic Polish No. 1, which did a great job of sprucing things up.

With the radio open, this was my one chance to get all debris off the dial and window, so I checked them both under good light to make

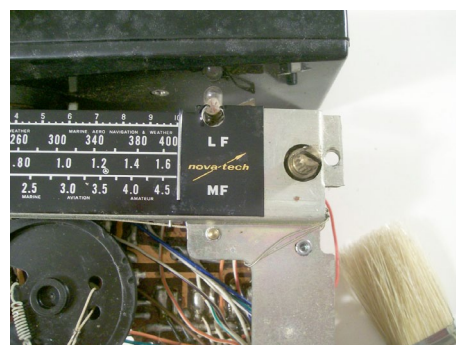
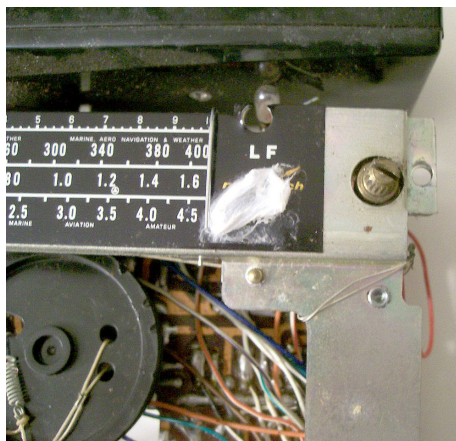


Figure 2. Close-up images showing the cocoon in place, and then removed

sure I had them spotless.

My next steps will be to remount the PC board in the case and test the operation to make sure everything is back together correctly. After that, I'll clean the outer cabinet of the radio, and polish it with Novus Plastic Polish No. 1. This should make a huge difference in the appearance, bringing back the original gloss black finish. We'll leave things here for now, and I'll continue my report in next month's issue.

❖ 472-479 kHz Ham Band!

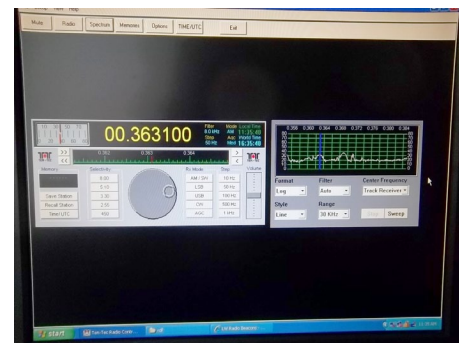
From the *ARRL Letter*, February 16, 2012 comes this exciting news: "It's official – delegates attending the 2012 World Radiocommunication Conference (WRC-12) have approved a new 7-kilohertz-wide secondary allocation between 472-479 kHz for the Amateur Radio Service." The release points out that no date has been set for enacting the allocation, but it is unlikely to be earlier than January 1, 2013. Amateurs are also reminded that no one can use the band until his or her national regulations are

revised to implement the allocation.

"This is a fantastic achievement for the Amateur Radio Service," IARU President Tim Ellam, VE6SH, told the ARRL. "A new allocation for spectrum is always something that should be celebrated. The success on this issue is due to the hard work over the last four years from our IARU representatives, as well as the volunteers from the numerous IARU Member-Societies who have worked within the ITU process on behalf of their national administrations. This is excellent work from our team in Geneva, and from those who have assisted from their home countries." More on this news release can be read on the ARRL website at www.arrl.org.

❖ Mailbag

Mario Filippi, N2HUN (NJ) has been DXing with his Ten-Tec RX-320D software-controlled radio purchased from Universal Radio. He did his research before buying, checking the reviews in *QST*, the *NASWA Journal*, and *MT*, as well as other Internet sites to decide on the right unit for him, and the RX-320 was the winner. He points out that eHam.net reviews gave it almost a perfect 5 out of 5 rating. Ten-Tec's long history of superb equipment and customer service also helped tipped the scale, as well as the radio being made in USA.



Ten-Tec RX-320D Receiver screen shot

Mario reports that for beacon hunting the RX-320D is quite a performer. He writes "I've included a screen shot showing the receiver panel and a scan from 350 – 380 kHz. The time was around 12:23 UTC so the band had pretty much closed for the day. You can see the peaks for three signals, RNB (363), YMW (366), and TT (369). RNB and TT are both locals, easily heard 24/7, but surpris-

ingly YMW from Quebec was still coming in. You can scan up to a 1.5 MHz portion of spectrum and choose log/linear or line/solid display. This option is invaluable in getting a hold of what's happening on the band. The comfort of 'seeing' a virtual radio on my computer screen also made me decide on this receiver. A third window can be pulled up (not shown) which has all the stations saved in memory, which is a big plus."

Mario also reports he is making good progress on his vintage Coastal Navigator RDF, and is now tackling the alignment of the Marine Band (2 – 4 MHz). We look forward to hearing more from you, Mario, whether your intercepts come from the modern RX-320D or the vintage rig!

Al Bauernschmidt, N3KPJ (PA) also wrote in for this month's issue: "I just wanted to drop a line to let you know that the ID for beacon CAT/254 kHz in Chatham, NJ has been fixed and is no longer miskeying. I heard it this morning and it appears that someone finally saw fit to correct the problem. As you recall it was sending CEM (and other mixed IDs) for a long time. So if you tune around 254 (especially in the morning before sun up) you can hear it loud and clear."

"Also, I wanted to let you know that I enjoyed the articles on the AquaGuide RDF-304 project. That is a sweet rig! I have been looking for an old RDF myself that I can work on but can't seem to find one. The rigs that were made by AquaGuide, Apelco, and Raytheon were all 'top shelf' in my opinion. But they do not seem to be available anywhere. I'll bet they are all hiding in some basement or attic somewhere!"

Thanks for writing, Al, and be sure to check your area hamfests for an RDF rig. They are still fairly common in these venues, although less so than a few years ago. Good luck, and stay in touch with *Below 500 kHz*.

❖ E1XM Update

Many will recall that the Eton E1/E1XM was released with great excitement a few years ago. Most reviewers felt that it rivaled, or even exceeded, the performance of the legendary Sony ICF-2010. Since I already owned a '2010, I was eager to see the difference and ordered an E1XM to try out. I was pleased with its performance, particularly on longwave, although the noise floor of the receiver did seem a bit higher than the Sony.

After several weeks of enjoyable use, I went to tune the radio one day using the front panel dial, and the entire LCD screen suddenly went into "scrambled mode." Nothing was visible on the display except for some rapidly scrolling vertical lines. A reset did not help. The radio was under warranty at the time, so I returned it for service, and it came back a short time later, fully repaired.

Things were great for quite a while, but about a year later the very same thing happened – this time with the radio *out* of warranty. A brief search online revealed that I was by no means alone. Display failures, and many other quality issues were discussed at length in various forums. I even learned there had been a recall on early units (although not ones in my serial number range).

Exploring my options, I learned that repair of the radio was likely to cost at least \$300 with parts, labor, and shipping both ways. Frustrated that the display had failed again, and with no assurance from the repair center that it wouldn't happen a 3rd (or 4th) time, I decided to cut my losses and sell the unit online with full disclosure of its condition. Fortunately, it sold quickly, and probably went to someone who understood the radio and its peculiarities. As for me, I went back to using my trusty Sony 2010, and have been happy ever since.

Several readers have asked my opinion of the E1 for longwave use, and since little has been written about it since its high profile introduction, I wanted to weigh in with my actual experience. In summary, the radio was a strong performer for me early on, but the concerns over quality were significant, and the second display failure was a deal-breaker for me. I want to be clear that this is my own opinion, and I do hope the experience of others is better. If you're looking to pick one up second hand (the radio is now discontinued), I suggest doing thorough research. I'm glad I never sold my '2010.

❖ Loggings

The interest in software-based receivers for longwave continues to grow. Our loggings this month are from **Ken Alexander (ON)**, who is using a Flex Radio 1500 SDR ham rig. He reports that it tunes well below the MW band but needs a little help for the best performance on longwave. He built a low-pass filter that gets rid of all the MW junk that clutters the LW band and leaves him with a nice quiet place to do some DXing.

Ken's antenna is a Wellbrook Loop, model ALA1530, mounted with a rotor about 7 feet off the ground. "The rotor does great things. I was able to pull two, and in one case three, stations out of the mud on the same frequency by nulling interfering stations. This, combined with a receiver that has infinitely adjustable brick wall filters and a display so you can see where you're going, is about as close to shooting fish in a barrel as it can get!"

(Note: there was only room for a limited number of Ken's extensive loggings - K.C.)

TABLE 1. SELECTED NDB LOGS (FROM ON)

kHz	ID	Location	kHz	ID	Location
201	ZXU	London, ON	334	YSH	Smiths Falls, ON
209	MT	Chibougamau, QC	335	ZKF	Kitchener, ON
215	YTR	Trenton, ON	338	ZEM	Eastman, QC
221	HM	Hamilton, ON	341	YYU	Kapuskasung, ON
235	CN	Cochrane, ON	344	ZOW	Ottawa, ON
243	YVB	Bonaventure, QC	348	ANQ	Angola, IN
248	KZ	Buttonville, ON	348	ZUL	Montreal, QC
253	YTF	Alma, QC	351	PH	Mosinee, WI
266	ZMM	Montreal, QC	353	IN	Int'l Falls, MN
272	YQA	Muskoka, ON	356	HEU	Schenectady, NY
274	YPM	Pikangikum, ON	358	TNY	Fayetteville, TN
276	YEL	Elliot Lake, ON	360	PN	Port Menier, QC
289	YLQ	La Tuque, QC	362	AK	Akron, OH
300	YOG	Ogoki Post, ON	363	RNB	Millville, NJ
326	VV	Warton, ON	365	FKV	Gainesville, GA
328	YTL	Big Trout Lake, ON	368	ZYZ	Toronto, ON
			404	YSL	St. Leonard, NB

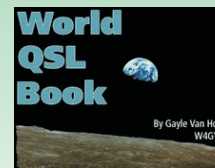
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Bob Grove - December 2008 *What's New Column, Monitoring Times magazine*

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Signal Tracing and Signal Injection

First we acknowledge a note from reader Don (Upland, CA), whose main hobby is DXing Low-Frequency NDBs (non-directional radio beacons). He has a collection of vintage LF receivers, mostly transistorized. His attention was drawn to the little BC-1206 beacon receiver after reading about our work with that model (which concluded in the September, 2011 issue). Don recently got his hands on one – which makes his fifth tube set – and reports that he had the same problem with QRM from buzzing that I experienced.

Don found that the buzzing disappeared when he converted the radio's antenna input to RG-174 Coax and connected it to one of his outdoor LF antennas. Despite the 1206's limited sensitivity specs, He was then able to pick up NDBs up to 40 miles away during the day and up to 600 miles away at night. Replacing that antenna with any length of wire connected to the coax center pin brought back the buzzing. Thanks for the report, Don!

Last month, we talked about some of the procedures that should be followed when starting up a long-dormant vintage radio for the first time. At the end of this start-up procedure, your radio might fall into one of three categories: (1) it works normally and thus would be ready for realignment; (2) it works, but reception is compromised in some way; (3) it doesn't work, although the set has plate voltage (you have fixed any shorts you may have encountered), the tubes check "good" and they light up. In this issue, we'll think about what to do next.

We'll be using a simple a.c.-d.c. superheterodyne we worked on in an earlier restoration as an example. It was chosen because of the clarity of its schematic – which is partially shown as Figure 1. Though it is a simple set, the general troubleshooting approach we will be using is just as appropriate for more sophisticated, transformer powered, radios.

But I don't want to mislead you. What you will learn in this session will definitely not

equip you to fix any kind of trouble in any model radio. What it will do is give you an organized approach to ferreting out trouble. It's an approach that will lead to success in many cases and will also provide solid groundwork you can use to increase your knowledge so that you can eventually handle the more difficult problems.

❖ Superheterodyne Stages

The first step in localizing and correcting trouble in a radio receiver is to understand what happens in each section, or stage, of the receiver. Referring to Figure 1, the radio signal is picked up by loop antenna L1/L2, which is built into the cabinet. From here, it passes to the oscillator/mixer stage (12SA7 tube). In some sets, the signal is amplified by passing through another tube, the "r.f. amplifier," before reaching the oscillator/mixer. Though in this radio, as in many, the oscillator and mixer functions are accomplished in a single tube, some sets employ separate oscillator and mixer tubes.

Understanding what happens in the oscillator/mixer stage is key to understanding the action of a superheterodyne receiver. An r.f. signal generated by the oscillator is mixed with the r.f. signal picked up by the antenna – resulting in the production of two new signals: one at the *sum* of the antenna signal frequency and the frequency of the oscillator; the other at the *difference* between the two frequencies.

In most of the radios you will encounter, the frequency of interest is the difference frequency, known as the *intermediate frequency*. In many of the radios that find their way into your shop that frequency will be 455 kHz, though the older superhets may well have different – often lower – i.f.s.

Also – and this is at the heart of superhet operation – the main variable capacitor controlling the frequency of the received signal is ganged on the same shaft with that controlling

the frequency of the oscillator. (Note the dashed line connecting the two, both labeled "C3.") And the circuit values are adjusted so that as the shaft (which is the station selector shaft) is turned, the oscillator frequency always maintains the 455 kHz difference from the received signal.

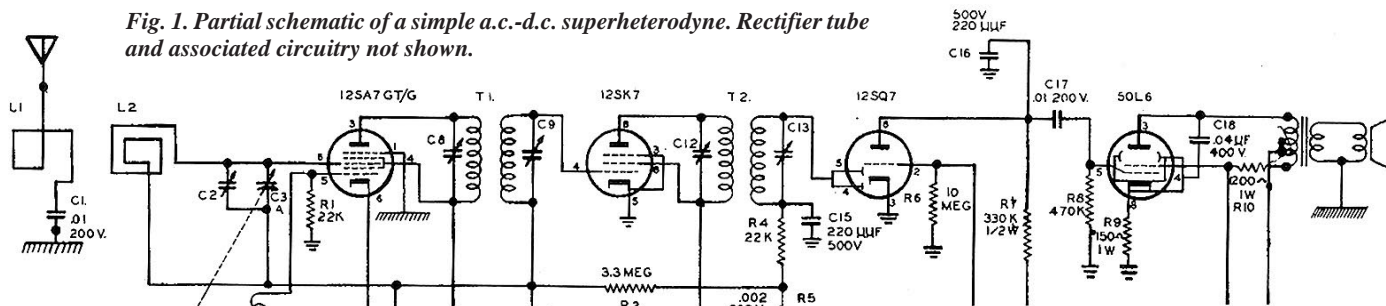
There are two powerful advantages of this arrangement: (1) further amplification of the radio frequency signal can be done, much more efficiently, at a lower frequency than that of the selected station; (2) further amplification is now done at a constant, fixed frequency, eliminating the need for continual retuning of the amplifying stage, or stages, as stations are changed.

In the case of this particular radio, the i.f. amplification is done by the 12SK7 tube, which is coupled to the preceding and following stages by i.f. transformers T1 and T2. The transformers are tuned to 455 kHz by capacitors C8, C9, C12 and C13. These are the little adjustment screws accessible through openings in the tops of the i.f. cans. Once adjusted with a screwdriver or a special tuning tool, the capacitors remained fixed, unless touched up during realignment. More sophisticated receivers may have two stages of i.f. amplification.

From the i.f. amplifier, the signal passes to the detector/first audio stage, which uses a 12SQ7 tube. This tube is a combination dual diode/triode, with the diodes acting as a detector, separating the audio signal from the r.f. carrier – otherwise known as *demodulating* it. This section of the tube also provides the a.v.c. voltage, which evens out the volume of the set, preventing "blasting" when the radio with its volume control set for a very weak signal is tuned to a strong local. The triode section of the tube provides some audio amplification before the signal passes to the 50L6 power amplifier, which provides the "punch" to deliver good speaker volume.

Now that we have a good picture of what

Fig. 1. Partial schematic of a simple a.c.-d.c. superheterodyne. Rectifier tube and associated circuitry not shown.



happens in each stage of a typical superheterodyne receiver, let's talk about how to isolate the problem stage in a radio that seems to have normal plate and filament voltages but does not operate. There are two general techniques that can be used to approach this problem: signal tracing and signal injection. The aim of both is to locate the stage where the path of the signal through the radio is broken.

❖ Signal Tracing

Signal tracing requires a modulated signal generator that covers the frequency range of the radio being diagnosed as well as a detection device known as a signal tracer. The tracer must respond to and demodulate the receiver's i.f. signal as well as reproduce the signals in the audio stages. If the receiver has an r.f. amplifier stage (not the case in the radio of Figure 1), the tracer must also be able to respond to and demodulate r.f. signals as they enter the oscillator/mixer stage.

A signal tracer might be thought of as a very simple radio receiver. It usually has a built-in speaker to provide an indication of the signals it picks up. Signal tracers are commonly found at radio meets, often built from kits by such companies as Heath or Eico. Their inputs usually have no tuned circuits to select particular r.f. or i.f. frequencies. They are broadbanded, responding to a range of frequencies, and thus have limited sensitivity – but are suitable for most purposes. The models with tuned circuits, such as the famous RCA Chanalyst, tend to be larger, heavier and more complicated to operate.



Signal tracers by Heath (left) and Eico are commonly found at flea markets.

To find a defective stage by signal tracing, a modulated test signal is applied at the antenna end of the radio and the receiver dial is tuned to the frequency of the test signal. Using the schematic of Figure 1 as an example, the signal is introduced at the loop antenna, usually via a temporary loop of wire loosely coupled to L1. To avoid engaging the radio's automatic volume control, keep the signal level as low as possible.

Then, using the probe of the signal tracer, the presence of the i.f. signal is verified at the plate of the 12SA7 oscillator/mixer and at the control grid and plate of the 12SK7 i.f. amplifier. While you probably wouldn't be making gain measurements in a test like this, you'll be looking for an obvious increase in amplification as you move from grid to plate.

Incidentally, though we're not getting involved with the radio's power supply circuits in this discussion, this is an a.c.-d.c. chassis. As

discussed in the April column, you should *not* be working on it or connecting test instruments to it unless you power it through an isolation transformer.

Next, you'll be verifying the presence of an audio signal at the grid and plate of the 12SQ7 detector/first audio amplifier. An obvious increase in amplification should be noted as you move from grid to plate. There should be a similar increase in audio amplification between the control grid and plate of the 50L6 power output tube.

If, at any of these test points, you find that the signal has disappeared or become weak, you now know that the trouble lies somewhere between that test point and the previous one. If you have found no trouble all the way up to the plate of the 50L6, then you know that the trouble must lie in the output transformer or the speaker itself. Most signal tracers provide binding posts for use in substituting their internal output transformer and speaker in place of the ones in the radio – allowing you to verify this problem.

Once you've successfully carried out the signal tracing procedure, you will have narrowed your troubleshooting search to a very restricted location in the radio involving just a few components. Thus your diagnostic challenge becomes much simpler.

❖ Signal Injection

In a variation of the signal tracing method known as signal injection or signal substitution, a similar diagnostic technique is used. But in this case, one works his way through the radio in the opposite direction, starting at the loudspeaker and proceeding towards the antenna. An advantage of this method is that no signal tracer is required. In effect, the radio itself acts as the signal tracer.

The only instrument needed is a modulated signal generator that covers the frequency range of the radio being diagnosed. The generator must also have an audio-only output. A .01 uF capacitor should be placed in series with the generator's signal probe to prevent damage to the instrument from high voltages encountered at various test points in the radio.

Begin by connecting the test probe cable to the audio output jack of the signal generator and touching the probe to the secondary of the output transformer (which is connected to the voice coil of the loudspeaker). Be sure to touch the *ungrounded* side of the secondary or you'll just short out the probe. You should hear the audio tone in the speaker. If not, the speaker is defective.

If you did hear the tone, move the probe to the primary of the output transformer where it connects to the plate of the output tube (in this case, the 50L6). You should hear the tone. If not, you'll need a new output transformer. If so, touch the probe to the grid terminal of the 50L6 and then to the grid terminal of the first audio tube (the 12SQ7). Audible tones at both spots mean that the rest of the radio's audio circuits are okay.

Now connect the probe cable to the r.f. output jack of the signal generator and set the

generator to provide modulated output at the radio's intermediate frequency (455 kHz in this and most cases). Tone should be heard in the speaker when touching the grid, then the plate of the 1.f. amplifier tube (in this case, a 12SK7) and the plate of the oscillator/mixer (12SA7).

With tone having been audible at all those points, readjust the generator to the same frequency to which the receiver's tuning dial is set and touch the probe to the signal grid of the oscillator/mixer tube (12SA7). This is the grid to which the connection from the loop antenna is made. If you are unable to pick up a signal from your probe at any of these test points, the defective stage will be the one between that point and the previous one. If your test signal goes all the way from the oscillator/mixer signal grid to the speaker, it's time to check the connections from the loop antenna. These are often made with fine wire that is easily broken.

❖ Now What?

By finding the defective stage in the receiver, either by the signal tracing or signal injection method, you have localized the problem to a single tube (which you have previously tested) and a few associated components. Your next step might very well be to check the voltage at each of the tube socket terminals against the voltage chart provided in the radio's service literature. A large discrepancy is an obvious clue to a component fault that can often now be deduced from careful study of the radio's schematic diagram.

Often, especially in the case of more sophisticated sets, the service notes will also provide resistance values to be found at various circuit points. Checking the resistance at these points might very well provide more data for your diagnosis. Of course one can't measure resistance in the presence of voltage, so such measurements should be made with the radio turned off (or, better, unplugged) and the filter capacitors discharged.

We'll talk more about how to correct a defective stage next month. See you then!

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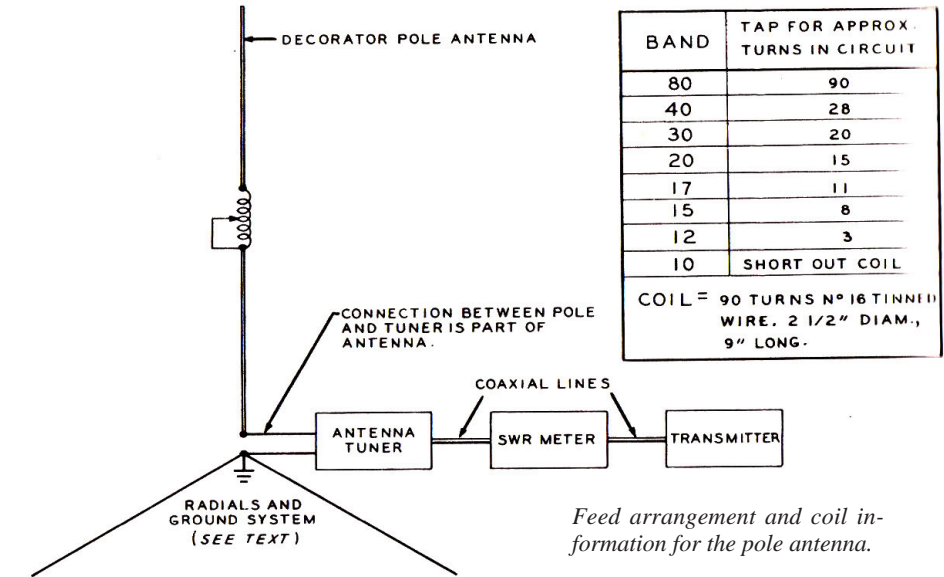


Improvise, Adapt, Overcome Get Creative with HF Antenna Solutions

Spring has sprung at last, and the propagation on HF steadily improves. It's time for another one of my pep talks about not letting yourself be kept from enjoying HF due to lack of an antenna, whether you're faced with lack of real estate and/or trees, neighborhood restrictions and covenants, or the lack of funds to buy that three-element beam and 100 foot tower. You've got your license for HF – come on down and see all the fun you're missing.

Recently I was talking with my good friend Brant, KG0YD, about this very issue. Bee had a really sweet 300 foot loop up in tall trees and fed with ladder line that had opened the wonders of 80 meters to him in a big way. I'm talking about "QSOs on SSB with stations in Central Asia" big way! Then, his personal situation changed, and he had to move to a new QTH with a small yard and inadequate trees. Me, I'd have been crushed by losing the huge loop, but to his credit Bee soldiered on, looking for a way to antenna up at the new location.

He had a really interesting twist on the old "rain gutter antenna" idea. He noted that the new house has two gutters, on front and back, of nearly equal length, and separated by the house's front to back length. He asked me what I thought of the idea of feeding one gutter as a random antenna – might the other gutter perhaps act as a parasitic element, like a two-element beam? As we discussed it, I realized that the gutter lengths,



Feed arrangement and coil information for the pole antenna.

spacing, and height above ground would probably preclude any bona fide "beam" effect...but I didn't have the heart to say so. It was such an excellent example of thinking outside the box when trying to come up with an unconventional antenna.

As things turned out, Bee laid some radials in his back yard and put up his R7 vertical, but I still like to think of what the gutter system might

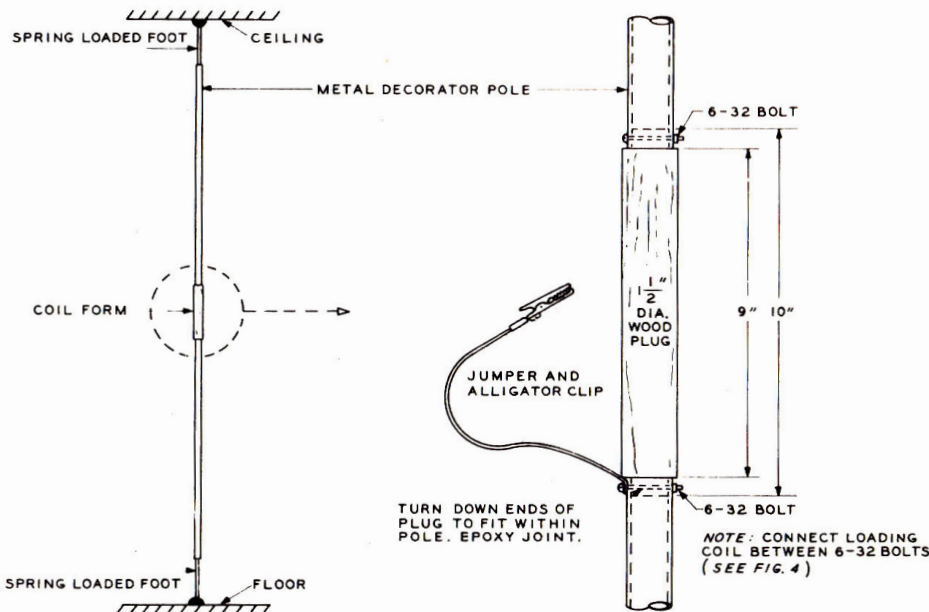
have accomplished. Would it be a world-beater? Of course not. But would it allow at least some sort of HF operation? Almost certainly.

This month I'd like to show you a couple of the unconventional antenna notions I've come across over the years. One of the great things about our hobby is this "pioneering spirit" that has come up with so many great ideas for alternate antennas, whether one is concerned with stealth, with a lean pocketbook, or just an incurable desire to experiment. Mostly we're going to be looking from a stealth-type perspective, since that's become such a prevalent topic in the hobby, but these ideas also apply to those with limited space and/or budget, or, um, domestic considerations that preclude full-size antennas.

❖ Hide it Indoors

One definite way to attain stealth is with an indoor antenna. Of course its performance won't equal an outdoor, full-sized antenna, and one may have issues with interference to TV, stereo, and other electronics within the home to deal with. *But it's invisible to the rest of the world!* This is certainly one way to work around the jackbooted Gestapo thugs that call themselves neighborhood associations. Let's look at a couple of possibilities.

The "default" setting on indoor antennas is the good old attic dipole. If you can manage it, this one's hard to beat for height above ground, invisibility, and isolation from family and pets. But what if you don't have an attic? How about, say, an antenna *in the front room?*



Details of the construction of the "decorator pole" antenna.

W6SAI, William Orr, published in 1990 an excellent book called *Wire Antennas Handbook*, a volume which I highly recommend. He devotes a chapter to concealed antennas, including this little gem, which uses a "pole lamp"-type decorator pole of the spring-loaded variety that fits between floor and ceiling. He points out that one either needs a pole that has a wooden center section, or one must modify an all-metal pole to include such a wooden section. This is necessary for the center loading coil.



Closeup of IW5EDI's ingenious hummingbird feeder antenna for 40-10 meters.

Feed it at the bottom of the pole with coax from a tuner, use radial counterpoise wires or the house's cold water piping for a ground, and – tah-dah! You're on multiple HF bands with both concealment and style. This might seem like a drastically small antenna for HF, but at 7 or so feet length and center-loaded with a coil, it's actually akin to a mobile whip antenna of the type that performs quite well for many operators every day.

Orr calls for the coil to be wound with #16 *timed* wire (though I can't think of a good reason that ordinary bare solid #16 wouldn't work) and more or fewer turns are shorted out with a clip lead tied to the bottom end of the coil, depending on the desired band. This is predicated on a 1-1/2" wooden center section with the coil occupying 9" of the plug length.

The table shows coil winding specs, and the taps required for each HF band.

Now, there are some obvious potential problems to address here. One must, for example, avoid having pets or people anywhere near the pole while operating, especially at 100 watts or more – nuking your kids or cats is illegal in most jurisdictions. Also there may be interference issues with TV, stereo, phone, or computer, which may require some line filters here and there on these devices. All in all, though – a pretty darn slick indoor HF antenna solution!

❖ Outdoor Stealth

Now let's step outside, where creative alternative HF antennas have really blossomed in recent years. There have been some quite ingenious ones, and some are even commercially-produced items, like Bila Isotron's line of "bird feeder-looking" HF antennas. This next one I'm going to show you, though, really *is* a bird feeder.

Simone Mannini, IW5EDI, has an excellent blog about concealed antennas (www.iw5edi.com). He's really put a lot of thought into the subject. This antenna is a real brainstorm of improvisation and "concealment in plain sight." He bought an ordinary plastic bird feeder and replaced the food reservoir with an ordinary two-liter plastic pop bottle which screws right

into the reservoir's place. He cut off five inches of the bottom of the two-liter and inserted a large coil with a wire soldered to each end of the coil.

The top wire, of at least 10-ft. length, runs up to a hanging spot for the feeder, and the rest is routed horizontally, to serve as a loading "hat." The bottom wire runs down to a convenient spot to enter the building, where it is routed to the tuner and fed as a random wire, against the best ground one can arrange – radial counterpoise wires, cold water piping, etc. Using this system, he has successfully operated on every band between 40 and 10 meters!

The best part of the story, though, is how he fields questions from the folks who notice the wires going to and from the feeder; he tells them it's an *ultrasonic repeller for large birds*, that it only operates within a one foot radius of the feeder, and chatters on, making up nonexistent technical details, until the listener tires and walks away. This is the true essence of success with stealth – keep a straight face, lie if you have to, and *never, ever let on that it's actually an antenna*.

I hope that these two off-the-wall ideas set you to thinking about the endless possibilities for an HF antenna, no matter where you live or what restrictions you may face. Sure, the alternate antenna may not beat a beam on a big tower – but it *will* allow you to operate HF, and that's the name of the game. Use your imagination, and be careful. The anti-antenna Gestapo is *everywhere*.

That's all for now, friends. Join me here in June, when we embark on yet another antenna adventure. See you on the air, and happy operating!

GRE PSR-120

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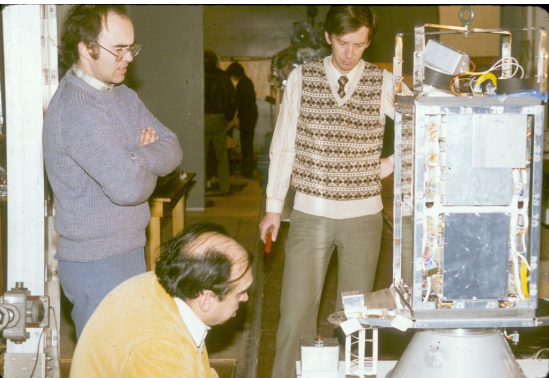


Spotlight on UOSAT-2 (UO-11)

In previous columns, I've been sharing information about the growing fleet of amateur radio satellites now in orbit and how you can receive their signals or, if properly licensed, actually work through them. In this installment, I'll discuss yet another "oldie but goodie" in our amateur satellite fleet, as well as bring you up-to-date on the latest happenings in the amateur satellite world.

❖ UO-11

UO-11 (also known as UoSAT-OSCAR 11, UoSAT-2 or UoSAT-B) is the second in a series of amateur satellites built at the University of Surrey in England. It remains active, though unstable with irregular periods of transmission. The satellite was still heard transmitting telemetry throughout 2011, more than twenty-seven years after launch. It transmits a beacon 2m, with inactive beacons on 70 Cm and 2.4 GHz.



Professor Sir Martin Sweeting, G3YJO, Director of the University of Surrey's Space Centre in England (left) oversees the final assembly of UoSAT-2 which later became UO-11 on orbit. (Courtesy: AMSAT-UK/SSTL)

The satellite carried a so-called "Digitalker" (speech synthesizer) magnetometers, a CCD camera, a Geiger-Müller tube, and a microphone to detect satellite vibrations caused by micrometeoroid impacts. Like its predecessor, UoSAT-1 transmits telemetry data on the VHF beacon at 1200 baud, using asynchronous AFSK, although all its analog telemetry channels have long since failed.

A Brief History

UO-11 FREQUENCY AND MODE DATA

BEACONS (MHz)	MODE	STATUS
145.826	AFSK FM	Semi-Operational
	ASCII Telemetry	
435.025		Non-Operational
2401.50		Non-Operational

UO-11 was launched on March 1, 1984 from Vandenberg AFB, California with the aim of providing telemetry and other digital services for amateur radio and educational users. During its many years of operation it has survived both long periods of eclipse and continuous full sunlight.

In 2002, its batteries began failing, and much like AO-7, it began operating principally with power generated from its solar panels...panels which were bought at a premium compared to those of UoSAT-1, the design having been space tested by its predecessor. The satellite's so-called "watchdog timer" (a device to reset the satellite's main computer if all contact with the ground is lost) started suspending activity for up to three weeks at a time following numerous power anomalies.

Then, in 2005 all the satellite's analog telemetry channels failed. Long solar eclipses also caused UO-11's watchdog timer to completely reset the satellite from time to time, switching it off for approximately 15 days. In 2008, solar eclipses became a permanent feature of every orbit, sometimes causing the satellite to switch off after only one orbit. At that time, the satellite was not expected to be heard from again for any continuous period until 2019, when there would be some eclipse free periods.

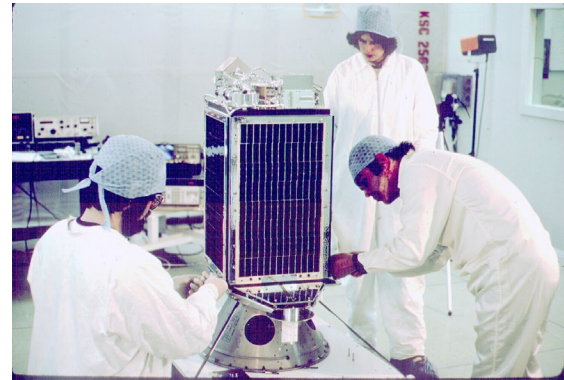
However, miraculously, the satellite started transmitting once again in November of 2008. These transmissions continued until March, followed by yet more long periods of silence. Then, after another 21-month gap in observations, UO-11 resumed sending telemetry in December 2009, and has apparently continued its watchdog timer-controlled transmission regime ever since, although now on a ten-days-on, ten-days-off schedule.

Sadly, the satellite's orbital condition has not otherwise improved, apart from a small recovery of its battery power, allowing some broadcasts to continue into partial eclipse. As of late, the satellite has been heard reliably during its ten-day on/off transmission cycle. Excellent signals have been reported from stations located around the world, and some useable decoded telemetry frames have also been obtained.

When and Where to Listen

UO-11's VHF downlink frequency is on 145.826 MHz, sending AFSK FM Telemetry in ASCII format. There are no uplinks. When last heard, the satellite was operating in its default mode, with a cycle time of 20.7 days...10.35 days on followed by 10.35 days off.

The easiest way to check wheth-



Technicians clad in their clean room "bunny suits" prepare UoSAT-2 for shipment to the launch site. (Courtesy: AMSAT-UK/SSTL)

er OSCAR-11 is operational is to look at the AMSAT Status Page for UO-11 (www.amsat.org/amsat-new/satellites/satInfo.php?satID=10&retURL=/satellites/status.php) or to Clive Wallis's extensive UO-11 status page at: www.g3cww.co.uk/oscar11.htm. I used the excellent information Clive has compiled about UO-11 on that page as background for this column.

Clive notes that OSCAR-11's VHF downlink has a unique sound...rather like a raspy slow Morse code signal, sending "di di dah dah dah dah dah dah" over a period of five seconds. If you are receiving a very weak signal, Clive suggests you switch your receiver to CW or SSB. You should hear several sidebands around the carrier frequency and you should be able to hear the characteristic "Morse code like" sound on at least one sideband. Clive also notes that you'll need a clean, (i.e., "noise-free") signal to decode UO-11's downlink and your receiver must be set to NBFM mode for such a decoder to work.

If you would like to know what OSCAR-11's beacon sounds like so you'll know what to listen for, there's an audio clip of its beacon on Clive's UO-11 page at: www.g3cww.co.uk/980214t.wav.

❖ AO-51 Goes Silent

On November 27, 2011, AMSAT-NA VP of Operations, Drew Glasbrenner, KO4MA, reported that after a long "illness" due to slow battery failure, AO-51 had ceased transmitting and was also not responding to ground commands. Drew noted that the last telemetry data indicated that the third of six batteries was approaching failure and other observations indicated that the voltage from the satellite's remaining three cells

was insufficient to power the UHF transmitters.

Soon after AO-51 went silent, dozens of condolence messages were posted to the AMSAT Internet Bulletin Board (AMSAT-BB). Many people fondly remembered their many contacts via this FM “bird” and several thanked the AO-51 all-volunteer operating team for their work in keeping AO-51 alive for so long. Several posters also noted that AO-51 was the satellite that brought them into this part of our hobby.

Of course, there is always the possibility that a battery cell will “open” (similar to what happened to AO-7) so the command team will regularly attempt communications with the satellite over the coming months and years. Fingers crossed that it, too, may someday be restored to partial, “daylight only” use.

❖ The Demise of ARISSat-1

Early on the morning of Wednesday, January 4, 2012, reception reports indicated that ARISSat-1 had stopped transmitting and had apparently burned up soon thereafter in the atmosphere over the South Atlantic Ocean. The last full telemetry frames captured and reported to the ARISSat-1 Telemetry Web Site at 06:02:14 UTC on January 4 were received from ground stations as the satellite passed over Japan.

Those telemetry reports showed that the temperature aboard ARISSat-1 had been steadily rising as atmospheric drag began to affect the satellite. Indeed, the last telemetry frames indicated that temperatures inside the satellite at the end of its life well exceeded 190 degrees Fahrenheit.

You will recall that Cosmonaut/Flight Engineers Sergei Volkov and Alexander Samokutyayev deployed ARISSat-1 from the International Space Station on August 3, 2011 during EVA-29. The satellite carried a student experiment from Kursk State University in Russia, which measured atmospheric density. Students from around the world provided the voices for the FM voice announcements.

During its brief lifetime, the amateur radio payload aboard ARISSat-1 achieved many “firsts” for amateur radio in space. These included the first test of an AMSAT Software Defined Transponder. That transponder transmitted an FM voice downlink that cycled between student messages, spoken telemetry and Slow Scan Television (SSTV) from several cameras on the space frame.

The satellite also sported a 16 kHz bandwidth linear transponder, a CW beacon that contained spacecraft telemetry, as well as the call signs of selected radio amateurs who have made significant contributions to amateur radio in space. ARISSat-1 also pioneered a robust, forward error correcting 1K bit rate BPSK downlink for the satellite’s telemetry.

ARISSat-1’s ground team developed and then later released a comprehensive piece of free software (ARISSat TLM) for both PC and Mac computers which allowed amateur stations worldwide to reliably copy and then decode the satellite’s BPSK and CW telemetry. The software also provided a way for those amateurs to automatically upload the data received at their stations via the Internet to the ARISSat engineering team. Other “firsts” included a new main onboard

computer and a new spacecraft power management system.

Soon after ARISSat-1’s demise, AMSAT President Barry Baines, WD4ASW noted that ARISSat-1 was the prototype for a completely new satellite design that also captured the attention of national space agencies around the world for its unique educational contributions. He said that, “By designing an educational mission aligned with NASA’s Science, Technology, Engineering, and Mathematics (STEM) goals, amateur radio operators around the world were able to enjoy a brand new amateur radio spacecraft in orbit for just the cost of building (versus building and launching) the satellite.”

And although ARISSat-1 has since burned up in the atmosphere, the good news is that ARISSat-1 was just the first of four ARISSat space frames built by AMSAT-NA volunteers. What’s more, there are a number of other (US-based) providers now vying for the chance to transport both cargo and humans up to the ISS, so the future looks bright for similar follow-on launch opportunities. AMSAT remains in contact with those potential launch providers and (hopefully) may be able to negotiate another free “lift ticket” along with a deploying “spacewalk” for one or more of their three remaining ARISSat spacecraft down the road.

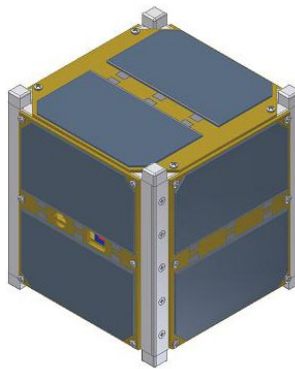
❖ AMSAT’s Next Project: FOX

Clearly, these two events.... the demise of AO-51 and the fiery re-entry of ARISSat-1.... are proof that, in order for amateur radio to remain in space, AMSAT groups need to keep building and launching new satellites. In my February *MT* column, I introduced you to AMSAT-NA’s next big project...a Cubesat design called “FOX.”

After a great deal of discussion, AMSAT’s experimenters have decided to split the FOX project into two parts. The first satellite, dubbed “FOX-1,” will contain a simple, hardware (vice software) controlled, FM “bent pipe” transponder. It will also sport a simple onboard computer for telemetry and control along with non-deployable solar panels. Such a simple design was predicated on the need for a quick, on-orbit replacement for AO-51 which, before its demise, one of AMSAT’s most popular satellites to date.

AMSAT’s experimenters are now building this spacecraft to operate in an approximately 650 Km (400 Mile) circular, sun-synchronous orbit. This somewhat lower orbit will create less path loss for the satellite’s uplinks and downlinks. FOX-1’s transponder is also now being built to operate in Mode U/V (the old Mode B), which will make it easier for most people on the ground (especially beginners) to use.

What’s more, the spacecraft will be designed for so-called “Zombie Sat” operation, similar to AO-7’s current status. That is, when FOX-1’s battery finally fails, the spacecraft will be “hard



An artist's concept of the FOX-1 satellite structure. The "Cubesat-class" satellite will only measure about 4 inches on a side and weigh in at about 3 pounds. (Courtesy: AMSAT-NA)

wired” to accept ground commands as well as to operate its FM transponder using power solely derived from its onboard solar panels. Transponder power output is expected to be in the 400-500 milliwatt range, which would be similar to the nominal output of previous FM spacecraft like AO-27 and AO-51.

A follow-on mission, dubbed “FOX-2” will tentatively sport a software defined transponder (similar to that carried aboard ARISSat-1), a more powerful and programmable main computer, somewhat higher RF output, deployable solar panels, and...if a suitable (i.e., “affordable”) launch can be found...a somewhat higher (800 km) Low Earth orbit.

In November 2011, AMSAT applied to NASA’s ElaNa (Educational Launch of Nanosatellites) program for a possible reduced cost launch for FOX-1 via one of their boosters in the 2013-2014 time frame. AMSAT teamed with the American Radio Relay League (ARRL) to write and deliver the 159 page educational proposal to NASA which also contained numerous letters documenting the importance of AMSAT’s satellites in the educational programs at the ARRL.

As this column was being written, AMSAT had just received word that FOX-1 had been selected by NASA to further participate in the program. AMSAT now needs to work with NASA to develop a collaborative agreement whereby NASA will cover both the integration and launch costs of the AMSAT-built satellite.

[Needless to say, the future continues to look bright for the program. In the interim, I suggest you stay tuned to the FOX page on the AMSAT Web site www.amsat.org/amsat-new/fox for all the very latest developments about the FOX project.

❖ Wrap Up

That’s all for this time. In future columns, I’ll bring you up-to-date on the progress of the FOX-1 effort as well as the status of our other amateur satellites still in orbit. I’ll also highlight some other amateur satellite projects that are on the drawing boards of other AMSAT groups. See you then.



FOX-1 will be powered by three ordinary, off-the-shelf, 1.2V Nickel-Cadmium rechargeable batteries similar to that shown here. However, the spacecraft is being specifically designed to keep working when it is in sunlight even if one or more batteries were to fail. (Courtesy: AMSAT-NA)

Three Generations Tackle a Smoked Heathkit

Story and photos by David Payne Sr., KB8NNT

I love my Heathkit HW-100, but there is just one little problem that has been keeping it off the air: plug it in and it catches fire. But otherwise, it's a fantastic radio with a great history.

Back in the day, the Heath company claimed the HW-100 to be the world's fastest-selling transceiver. At the time, they were probably right. It first appeared on the market in early 1968, as a low-cost alternative to Heath's SB-101 transceiver that had come out a year before. It is nearly identical to the SB-101; it just used a simpler, but still solid-state VFO.

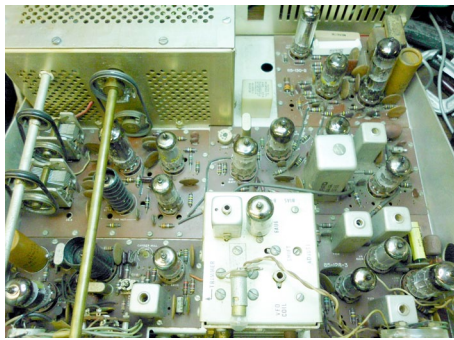
Mind you, this "low cost" is extremely relative. Adjusting for inflation, the \$380 cost of the SB-101 kit would be more than \$2,350 in today's dollars. It's no wonder that hams went crazy over the HW 100 with its \$250 price tag (a mere \$1,550 today) and the 100's successor, the HW-101. Even so, you still had to build the radios yourself!

The HW-100 has 19 vacuum tubes, five main printed circuit boards (yes, early radio PC boards), four bandswitch PC boards, and frequency stability of under 100 Hz per hour after warm-up. It was designed to put out 180 watts PEP (peak envelope power) on sideband and 170 watts CW. The frequency coverage is 500 kHz segments of 80, 40, 20, 15 meters, and the full 10 meter band and a certified boat-anchor weight of 22 pounds.



A front view of my Heathkit HW-100, minus the enclosure. It features a nice aftermarket dial modification

The only complaint hams really had was about the dial being wobbly and prone to backlash on the HW-100. When the updated version, the HW-101, came out soon after, it had an updated dial with a stouter bearing. Maybe the dial concerns were overblown, but there was quite a commotion at the time about dial mods for the HW-100.



A look at the inside of the HW-100. The audio circuit board, the scene of our little fire, is in the top right corner.

My radio has one of these aftermarket modification dials, a lovely piece of work with two ratios: one on the rear of the dial that I think is the original 28:1 ratio, with a superfine tuning knob that is 18:1 on top of that. My dad, (Greg Payne, KB8NJH, the reigning Heathkit expert of the family) says that dial cost as much or more as the radio itself when new.

This HW-100 had been sitting in my dad's basement for at least 10 years, and probably longer. A few months ago dad handed it down to me, but first decided that he would let it run at his shack for a couple days to see if it would develop any problems. Of course, it did, and there's a nice burn scar on the audio-circuit board for a nice visual to back up the ultimate sacrifice of two stone resistors and a diode.

❖ Finding the Fire Starter

Dad and I replaced the damaged 1k ohm R304 (the resistor's number on the schematic) and 2.5k ohm R305 stone resistors as well as the adjacent fried diode. The R305 is connected directly to the power supply, so our first thought was that it had gone bad and was sending too much current down the line, thus exploding the diode.

With those three components replaced, we fired it up (pun intended) using dad's Variac, which you can use to lower AC voltage to pretty much whatever you want. At first, all was OK, but as we increased voltage, it became obvious that something was definitely wrong, as the new R305 stone resistor started smoking.

It was now obvious that our little fire was a symptom of a problem farther down the circuit. There had to be a short somewhere. I searched the back of the circuit boards for anything that might cause a short on the circuit board, such as a



The scene of the crime on the audio circuit board, shown after the replacement of both stone resistors and the diode. When plugged in, these two resistors get very hot, thanks to a short farther down the line.

piece of errant solder bridging a gap somewhere. Finding none, I started looking for a cracked resistor that might be shorting to ground.

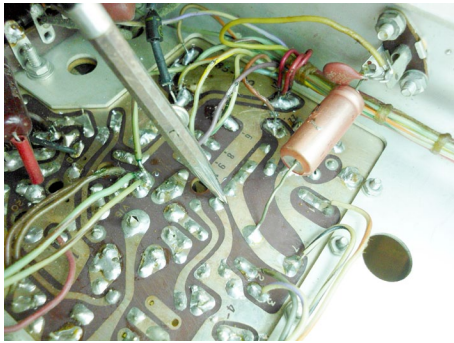
This radio had more than 40 years of dust inside, so I stood it on its side and used a makeup brush and small artist's paintbrush to carefully clean away the dust. The benefit of standing the radio on its side to do this is the dust falls instead of just being scattered around. Most of it sticks to tubes or other components, but you keep brushing and blowing until it gets to the side of the chassis where it can be easily brushed or blown out. I cannot emphasize enough that this needs to be done carefully so you don't damage any components.

With the dust out of the way, I had a better view of all the resistors. I checked them all under magnification and found no signs of physical damage. Of course, you can only see the tops and sides of a resistor. It could be cracked on the underside and you wouldn't be able to see it unless you actually removed it from the board.

❖ Enter the Third Generation

At this point, I decided to give this radio a complete checkup. I thought this would be a good experience for my 10-year-old, radio-loving son David II, so we started with the tubes. My dad has a super-cool universal vacuum-tube tester that customers in an electronics store used to test their tubes decades ago. With some guidance from me, little David ran tests on all 19 tubes over the course of two or three evenings.

Not being satisfied with just those, he also checked all the tubes in my Heathkit SB-310 international-broadcast receiver. Quite a few



When I started tracking down my short, I looked at the back of the circuit boards. I found none, but an errant piece of solder where the tool is pointing (or similar location anywhere on the boards) could have caused a short.

tubes were weak or bad, and we wound up replacing four or five in the SB-310 and six in the HW 100 transceiver.

Once little David satisfied his tube-testing ambitions, we shifted our efforts to the HW 100's resistors (where they were actually needed). David wrote the numbers down as I called out the resistor numbers, their original values, and what the actual resistance reading was on the meter. Of course, this was a very slow process, especially the part of finding the appropriate resistor in the mirror-image circuit-board pictures in the original kit-building manual, then finding the original value on the schematic.

Little David lasted through about half of the audio circuit board before he could no longer endure the boredom and found something else to do. Eventually, however, I checked every resistor in that radio over a two-week period, during which dad cleaned the switches, cleaned the variable capacitors with tuner cleaner, and probably did a lot of other stuff I wasn't aware of.

Honestly, I didn't really have to check every single resistor to find the problem. I could have focused my efforts on checking resistors that go directly to ground, but I wanted a complete picture of what was going on. (Or perhaps it would be more honest to say that I just wanted to have fun with my ohm meter).

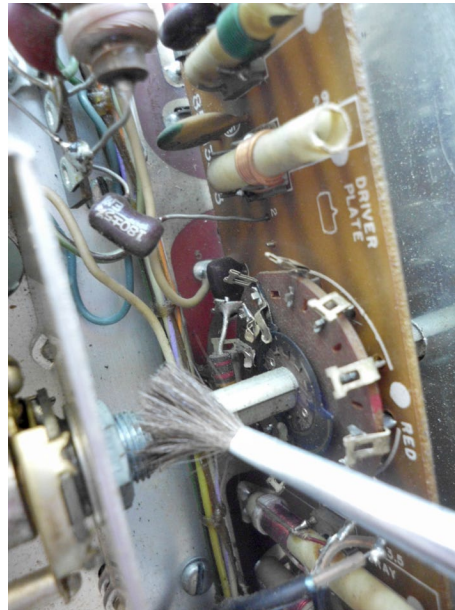
Most of the bad resistors were in the audio circuit board, the scene of our little fire. Of the 30 resistors there, seven were bad – and by "bad" I mean either 30 percent undervalued or previously on fire.

❖ The Envelope, Please...

Here are the results of the resistance test: Shown are resistor number, original specified value in ohms and actual resistance value. Only those resistors undervalued by at least 30 percent or which have been on fire are shown. If you have a HW-100, HW-101, or perhaps even an SB-101 schematic, you can follow along.

Audio Circuit Board

Resistor	Specified (Ohms)	Actual
R304	1k	Not tested because it burned
R305	2.5k	Also burned
R301	47k	25k
R 311	680k	30k
R309	47k	30k



With the radio on its side, I used a brush to gently sweep away the dusty innards of the HW-100.

R315	47k	18k
R306	47k	10k
R 303	330k	100k

IF Circuit Board

R107	100k	50k
R124	10M	600 ohms
R119	47k	5k
R123	470	5

The resistances on the modulator circuit board were all fine, and we only had one resistor which was more than 30 percent out of value on the RF driver board: R401, which should have had a resistance of 1M ohm, but actually tested at 300k.

Of all those bad resistors, five of them go directly to ground: R311, R308, R309, R306 on the audio circuit board and R124 and R123 on the IF circuit board.

I'm replacing all the resistors that are seriously undervalued, even though simply replacing those that go to ground should fix the problem.

❖ A Treasure of a Tool

If you run across a Variac at a hamfest, snatch it up. Everybody should have one, or at the very least have a father with one.

Now that we have some resistor suspects, our next step will be to use dad's Variac to run just enough voltage that our stone resistors don't get too hot but we can see what else gets hot. Whichever our culprit resistor actually is should get pretty hot.

Obviously, you don't want to stick your hand in to feel what's hot and what's not. There's high voltage in there when the current is on, and you can also burn yourself touching a hot resistor (as I did on the R305). My idea is to use an infrared thermometer (you just point a laser at the object and it tells you the temperature).

Of course, I could just replace all those bad resistors and be done with it. After all, I have to do that anyway. The downside would be dad and

I wouldn't get to play with the Variac, which is extremely cool.

❖ Finding a Schematic

It would have been much harder to track down this problem without supporting Heathkit literature from my dad's radio-tech library and dad's decades of experience working on Heathkits and various other radios.

While dad has a lot of the original kit manuals, he didn't have one for the HW 100, but he did have one for the HW 101, which was close enough to be useful. Especially valuable were the mirror-image drawings of the circuit boards, which show the boards as they actually would look in a mirror as opposed to how they appear in the circuit as they do in a schematic.

To make sure the diagrams were applicable, I first compared the HW 101 circuit boards shown in the book with what was in front of me on the HW 100. They were basically the same. I used them to get the Heathkit resistor numbers (e.g., R124), which I could then find on the actual schematic.

Only we didn't have a HW 100 schematic. When I got into radio as a boy in the late 1980s and early 1990s, if you needed a schematic, you had to know somebody or wait for the next hamfest and hope someone would have one to sell. It's much easier today.

I was able to find one online at www.vintage-radio.info. If you've never used one of the online schematics before, it can be a bit confusing, but they are easy to use if you know how. The HW 100 schematic I downloaded was broken into four separate images. Basically, you print it out and fold down the side of the paper (to get rid of the margin), then line it up with the next page's schematic and tape them together.

At first when I printed them, each page was to a different scale and nothing matched up. I remedied this in the print page setup by shrinking them all by 32 percent before printing instead of "fit to page." I wound up with five sheets of paper taped together for a really nice schematic.

Some manuals are less helpful than others in finding the values of components, as in the case of an old Allied radio (a DX-150 clone) dad and I worked on to give to little David. The manual gives now-meaningless Allied part numbers with no values. Dad said "they wrote these things like they were going to be in business forever." That was a very astute observation.

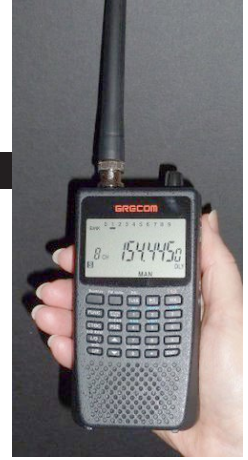
If you look, you can still find manuals which have the schematics as well as precious board diagrams. At one time, there were more manuals for these kit radios out there than actual radios. Remember, the SB-101 cost more than \$2,300 in today's dollars and the HW-100 about a third less. These kits, despite the savings over already-built radios, were still a major investment. Many hams purchased the build manuals just to get a sneak peaks at various radios before investing their money.

It's hard to imagine what an investment in hard-earned money and labor the original owner devoted to this radio more than four decades ago. Not just with the radio itself: he cared enough about it to fork over some major bucks for the dial upgrade as well.

The least I can do is get it back on the air.

GRE PSR-120 Hand-held Scanner

By Bob Grove, W8JHD



The most recent release from GRE America is intended for regions where trunking communications are not a consideration. That would be in the myriad small towns across the American midwest which haven't found the need for advanced digital communications.

The new, triple-conversion PSR-120 does not do trunking, nor does it have P25 decode capability. But the good news is what it *does* do!

Frequency range is in the following bands: 25-54, 88-174, 380-512, 806-960 (less cellular), and 1240-1300 MHz. This gives us total VHF/UHF land mobile allocations, ham radio bands, as well as civilian aeronautical (but no 225-380 MHz mil air), marine, business, CB band, and even FM broadcast coverage.

The inclusion of a dedicated button for FM broadcast is a cute idea. If you've been listening for scanner activity and it's really getting boring, just a press of this key and you connect to your favorite music station. Twenty separate memory channels are reserved for FM broadcasting. A toggling attenuator key can be invoked to reduce sensitivity by 20 dB in case nearby strong signals are overloading your scanner.

The accompanying photo shows, the 2.3-inch, well-backlit LCD is bold – there's never any doubt as to what frequency you're listening to. The display also registers relative signal strength, memory channel number, activated memory banks, and other selective functions as shown in the LCD illustration.

Seasoned scanner users will be pleased to see that the PSR-120 has a traditional BNC antenna connector rather than the more recent SMA threaded connectors found on new, sub-compact scanners.

The 4-inch rubber ducky does a good job considering its short length. For those listeners requiring maximum reception distance, high-performance replacement whips are available from some *MT* advertisers, like the popular Condor (www.grove-ent.com/ANT14.html) and Diamond RH77CA (www.grove-ent.com/rh77ca.html).

Audio is loud and clear, and a 1/8-inch (3.5 mm) mini phone jack is accessed from the top panel for the use of earphones (not included) if desired.

The compact scanner is powered by three AA cells – alkaline or rechargeable. A mini-switch in the battery compartment allows selection of battery type. When batteries are low, a "B" warning appears on the LCD. A 6 VDC jack on one side of the scanner affords use of an external charger/adaptor.

The PSR-120 weighs 9 ounces with batteries and antenna.

Finding Activity

For the frequency searcher, there are several options. Service Search automatically and selectively hunts for public safety, VHF maritime, VHF aircraft, and even amateur radio activity in the 10 meter, 6 meter, 2 meter, 70 cm, and 25 cm bands.

You can also set upper and lower band edge limits for a rapid sampling of all contiguous frequencies between, so as not to miss any active channels.

If you prefer the manual tuning procedure, use the arrow keys to step up or down from a central frequency in increments appropriate for the frequency range chosen. Frequency steps are automatically chosen to track the current bandplan intervals.

Sweeping the Spectrum

One recent addition to scanning is the automatic capture of nearby transmissions even if they aren't programmed into the scanner. On GRE products this useful function is called the Spectrum Sweeper.

The sweep is activated by pressing the sweep-symbol key (fourth key in the top row as shown in the illustration).



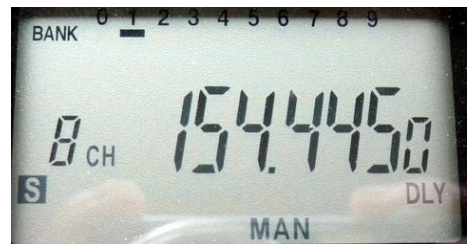
The user can select whichever bands he wants swept to capture unknown users. The PSR-120 will automatically display the discovered frequency and allow the user to monitor the signal.

A typical example of this useful feature is if you're on a trip and you pass a fire or accident. You simply press the key and local public safety activity can be monitored without preloading the frequencies. You can auto-store into memory these newly-discovered frequencies as well.

Since some bands contain irritating constant transmissions like paging tones, you can omit those from the search. In order to restrict the search to close by, you simply invoke the attenuator key to reduce scanner sensitivity.

Memory

Ten selectable banks, each holding up to 30 memorized frequencies, provide access to 300 memory channels. Any number of banks may be selected for scanning. You can also step up and down from those frequencies in appropriate increments for the particular band you are tuning.



Memorization is done in the conventional manner: Choose a vacant channel, or an assigned channel that you want to overwrite, and press the program key (PRG) followed by the frequency; then press PRG again.

If you hear three beeps, you've already entered that frequency on another channel. You can enter it again by once again pressing the PGM key, or you may simply enter a different frequency for that channel.

Priority

Any one memory channel may be selected for priority, forcing the scanner to switch to that channel when it becomes active regardless of its current frequency. The frequency is briefly polled automatically every two seconds to find an activation.

Lockout

During scan, or especially during a search, it's likely to stop on one channel you'd rather not continue to hear locking up the sequence. It could be weather, pager tone, or even a public safety channel that you'd like to discontinue monitoring.

Simply pressing the lockout (L/O) key when the scanner has stopped on the unwanted frequency will automatically prevent that frequency from being received.

As many as 200 discrete frequencies may be locked out in this manner (50 in the FM broadcast band). Lockouts can be restored later if desired by selecting that channel manually and pressing the L/O key again.

A review feature permits the operator to see all of the locked out frequencies he has chosen

by pressing L/O RVW and stepping through the channels with the arrow keys.

Squelch

GRE has chosen to allow quick access by a side-panel slide switch; choose a "HI" or "LO" setting depending on the severity of environmental electrical noise interference. An adjacent pushbutton allows a squelch defeat to listen for activity that might not have been strong enough to trigger the squelch.

If desired, the user can enter the proper CTCSS or DCS squelch code to prevent reception of co-channel interference. Don't know the code? The PSR-120 will decode it for you.

Weather Alert

SAME/FIPS encoding for specific cities or counties can be custom selected, providing an alert tone during storm threats. A pushbutton press starts the automatic search for active NOAA weather channels in your area.

Key Tone

Some people like to hear a "beep" when they press a function key, some don't. The feature can be quickly turned on or off by simply pressing either the 1 or 2 key while the welcome message is showing at power turn-on.

Key Lock

To prevent accidental bumping a key and changing the function, simply press the FUNC



(function) and key symbol. This doesn't change any function currently engaging the scanner, but merely deactivates the other keys. Repeat the two-key sequence to restore normal key operation.

Backlight Control

The backlight comes on when the power is switched on and it remains lit for five seconds. It can be turned on again at any time by pressing the LIT key, and may be switched on indefinitely by holding down the LIT key for at least one second. Another press shuts it off. Turning the power off will also deactivate the extended light time when the power is switched back on.

Data Cloning

A PC/IF connection permits the transfer of programmed data to another PRS-120. The two scanners may be interconnected by a cable (not supplied) which is terminated with 3.5 mm (1/8-inch) phone plugs.

The clone command is prompted by press-

ing the FUNC and CLONE keys, then initiated by pressing an arrow key.

Reinitializing your Scanner

As all of us have learned in the computer age, sometimes things just don't go right. If the scanner misbehaves or locks up, a key sequence allows the scanner to be reinitialized. This does, however, clear all stored memory information, so the procedure should be done only as a last resort.

The Bottom Line

The only criticism I can offer on this new product is the small key size. Users with jumbo fingers may find them hard to press. I often used just a fingernail tip to avoid pressing two keys at once.

I found the GRE PSR-120 to be intuitive to use once I understood the flow of the operation. Sensitivity is what I would expect on any hand-held radio with a short antenna.

Audio was excellent and, as pointed out earlier, there was never any doubt about what frequency I was listening to because of the large size of the numerals on the display. I also liked the Spectrum Sweeper, a handy function for unknown territory.

I have no reservations about giving this nice unit a high grade. The GRE PSR-120 will be available in the second quarter. Pricing has not yet been announced, but we are anticipating it will be a pleasant surprise.

Quality Communications Equipment Since 1942

KENWOOD



✓FREE HT Go-Bag

The **Kenwood TH-D72A Data Communicator** has an integrated GPS receiver and built-in TNC to provide superior APRS® operation. Other features include: 1000 alpha memories, 9 scan modes, CTCSS/DCS, cross-tone, waypoint export, DX cluster tune, clock, band mask, call channel, monitor, auto power-off, MHz mode, shift, VOX, auto repeater offset, simplex checker and ten DTMF memories.

TM-281A



- Weather Alert
- Front Speaker
- DTMF Hand Mic
- Built-in TCXO
- FM Nar. Ready
- DTMF Hand Mic
- 200 Reg Memories or
- 100 Alpha Memories
- PL Decode/Encode
- DCS Decode/Encode
- MIL-STD 810 C/D/E/F
- Wide/Narrow Deviation

The **TM-281A** provides a big 65 watts output and is built MIL-STD 810 C/D/E/F tough. This radio has NOAA weather built in with alert tone. You get 200 memory channels (or 100 alphanumeric), CTCSS, DCS and 1750 Hz tone burst. It scans: VFO, program, memory, group, call scan, tone scan, CTCSS and DCS. It has Wide/Narrow deviation and automatic repeater offset. With illuminated DTMF mic.

TS-590S



The **Kenwood TS-590S HF+6 meter amateur transceiver** has the best dynamic range in its class when handling unwanted adjacent off-frequency signals thanks to a down-conversion receiver, narrow first roofing filter and dedicated first mixer. Having the 6 kHz first roofing filter directly after the mixer enhances the noise blanker's ability to deal with adjacent signals. The result is excellent receive performance, revealing signals that would be hidden to lesser rigs. Covering 160 to 6 meters with 100 watts, this radio features: automatic tuner, RIT/XIT, keypad entry, full & semi break-in, NR, 10 Hz dual VFO display, USB port, dual quiet low RPM fans and is *SkyCommand II* ready. Call or visit the Universal Radio website for more info and current pricing.



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What's NEW

Tell them you saw it in Monitoring Times

Larry Van Horn, New Products Editor

InnovAntennas Appoints First American Dealer

The full line of high performance HF, VHF and UHF amateur radio antennas from fast-growing British company InnovAntennas are now available to customers across the United States via Hamilton, Ohio's R&L Electronics.

"Our customers have been hearing about the outstanding performance of InnovAntennas' designs from their amateur radio friends overseas, reading about them in European journals such as *DUBUS* and from a handful of 'early adopter' American hams who couldn't wait and purchased InnovAntennas products direct from the UK," said R&L Electronics' Roger Smallwood. "We are proud to be the first American retailer to represent this exciting new brand."

InnovAntennas was launched in 2011 by Justin Johnson, G0KSC, after his hobby of designing antennas for his personal use led to a flood of requests to "make one for me" from amateur radio operators who recognized that Johnson's designs outperformed ones they could buy in a store. Today, InnovAntennas is building antennas at a former boat factory in Canvey Island, England and selling its products directly via **InnovAntennas.com** and via a network of dealers in Europe, Australia, and now, the United States.

InnovAntennas' highly regarded designs include LFA (Loop Fed Array) and OP-DES (Opposing Phase – Driven Element System) Yagis. Performance of G0KSC designs routinely top the charts in their boom-length class on the survey of "moonbounce" antennas ("EME-ers" are among the ham world's most demanding operators). The charts compiled by VE7BQH are readily available online.

InnovAntennas America's William Hein said, "We selected R&L as our first American dealer due to their commitment to customer service, deep inventory, high order fill rate, great history, product knowledge and enthusiasm for InnovAntennas' approach to design and construction. We look forward to a long, productive relationship with the gang from HAMilton OH!"

R&L's Roger Smallwood added, "We work hard to have all ham radio products in stock and ready for immediate shipment. From a 50 cent connector to the thousand dollar radio, our customers will receive the same fast service at a great price. No one likes to hear that an item is out of stock or it will be drop shipped from the manufacturer. We already know InnovAntennas are high quality products and will be very well known in the USA in a short period of time. Our goal is to have it in stock when you are ready for it!"

More information is available from R&L Electronics, 1315 Maple Avenue, Hamilton OH

45011, (800) 221-7735 or on the net at **RandL.com** or **www.InnovAntennas.com**.

Modern Communications Receiver Design and Technology

By Cornell Drentea

We've witnessed enormous advances in receiver design over the last few years. Many traditional analog designs have been replaced by digitization. And in between are many advanced products that integrate the best of both worlds.

In order to scale his massive informational coverage, Cornell Drentea has chosen to present his treatise quite logically, allowing it to evolve from the earliest concepts to the most recent developments.

Beginning historically with the spark coherer (1891), he briefly touches on the detection capability of galena (1906), improvements offered by the Fleming valve (1904), and the amplification provided by the DeForest audion (1906).

Subsequent developments of regeneration, down- and up-conversion of the superheterodyne, and improvements in selectivity are described on the way.

Filter design is a major contributor to successful reception, and Drentea tackles it masterfully. Explanations are easy to read, and the math and graphs are there for those who want them. The entire book is copiously illustrated, making the concepts easier to understand with the visuals.

Long-timers may remember the introduction of a novel concept receiver in the 1970s, the Barlow-Wadley from South Africa. It ingeniously coupled its comb oscillator products in a manner that was drift-cancelling, resulting in a receiver with remarkable stability as described by the author.

With the basics in receiver evolution now well covered, Drentea tackles the requirements for high probability of intercept (HPOI) – the "ideal" receiver. How does one capture an enormous amount of spectrum with little or no lapse in time, and deliver its contents with wide dynamic range and high resolution?

Such requirements are essential to specialized applications like signals surveillance, radar, cosmic monitoring, and planetary mapping, as well as communications.

Not to be outdone by historic predecessors, the author then goes about to design his own receiver – and transceiver – the "Star 10," taking into account the dictates of his idealism.

Since the book is intended as a compre-

hensive yet basic work, the HF spectrum (2-30 MHz) is the primary focus. Elaborate charts, tables, and diagrams are provided to help the reader follow his development. Successive chapters disclose the considerations and resolutions of every stage.

While traditionalists will appreciate the expansive presentation of analog circuitry, futurists will laud Drentea's venture into current and future software defined receivers (SDRs). Products from WiNRADiO, a name well known to *MT* readers, are analyzed in the author's work.

Baseband sampling, digital signal processing (DSP), D/A and A/D conversion, Fourier transforms, and other considerations in software-based reception are described.

But circuitry is only one aspect of performance and practicality; packaging is another. The author illustrates methods of layout, interconnection, shielding, and ergonomics which enhance even further the success of design.

There is even a chapter covering some of the technical aspects of receivers designed for the search for extraterrestrial intelligence (SETI). Particularly detailed are the specifications for the Arecibo Observatory operated by Cornell University under a cooperative authorization by the National Science Foundation. Measuring 1000 feet across, the gigantic dish listens with its mating receivers to the 300 MHz-to 10 GHz portion of the spectrum, and the author describes just how they do that.

This book is not a "how-to" in the conventional sense; the *ARRL Handbook* does that. Drentea's work is a scholarly, definitive reference for setting the highest standards of receiver design, coupled with methods to accomplish those standards.

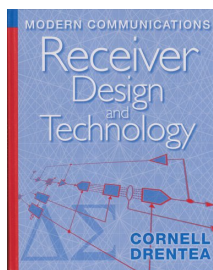
About the author – It's always a pleasure to review a product or publication from a friend of *MT*, and Cornell Drentea's new book is a shining example. Cornell Drentea is an independent telecommunications and electronics technical consultant with previous leadership positions at Hughes/Raytheon and Honeywell. A holder of five patents and a distinguished list of publications, Drentea has developed a wide variety of RF systems and products up to 100 GHz in his 40 years of professional experience.

Modern Communications Receiver Design and Technology by Cornell Drentea, 484 pages, hard cover, \$149. Available also as an ebook from Artech House, 685 Canton St., Norwood, MA 02062; Ph. (781) 769-9750 or order over the web **www.artechhouse.com/Detail.aspx?strISBN=978-1-59693-309-5**.

– Reviewed by Bob Grove, W8JHD

DXE-UT-KIT2-D Complete Coax Cable Prep

If you're preparing coax cables for ham radio applications, this time-saving kit provides all seven of DX Engineering's popular cable tools





and accessories together in a convenient carrying case. It features a rugged, lockable enclosure fitted with a precut foam insert location for each tool and spare connectors.

The DXE-CNL-911 coaxial cable cutter provides a flush cut to start cable preparation. Cable stripping tools DXE-UT-808X and DXE-UT-8213 accommodate most popular varieties of cable, removing the outer sheath and preparing cable for insertion of the coaxial fittings. Premium quality cutting blades assure clean cuts and long life. DXE-170M precision shear side cutters can be used to remove any excess shield wire.

To complete the job, the DXE-UT-80P for PL-259 and DXE-UT-80N N-connector tools aid in attaching the coaxial connectors prior to soldering, providing a visual guide at the end to verify strands are fully into center pin.

The included cable strippers in this kit prepare RG-8X, Belden 9258, LMR-240, RG-8, RG-213, 9913F7, and LMR-400 (not LMR-400UF) coax cables. Spare blades for both cable prep tools are provided. The price for the DXE-UT-KIT2-D is \$174.95. For more information or to order, visit www.dxengineering.com.

DX Engineering Aluminum Tubing

Antenna builders can now choose from a wide variety of tubing and accessories at DX Engineering. This custom-made, high strength Type 6063-T832 seamless drawn – not extruded – aluminum tubing is available in three and six foot lengths. Type 6063 alloy resists general corrosion, including stress corrosion cracking and has an excellent surface appearance.

The 0.058 inch wall tubing is available in 1/8 inch increments from 3/8 inch to 2-1/8 inch O.D., slit or no slit, smoothly telescoping from one size to the next on vertical or Yagi antenna elements. Precise ID and OD dimensions ensure an exact fit.

Three foot lengths are ideal for fast taper, low wind resistance applications, while the six



foot slow taper lengths provide greatest bandwidth. Most sizes are available with a slit on one end for use with DX Engineering's marine-grade stainless steel element clamps. Optional UV-rated black vinyl caps, designed to fit over the tubing ends, seal out moisture.

Larger sizes from 1.5 to 3.0 inches O.D. are also available in 0.120 inch heavy wall 6061-T8 aluminum, which ensures maximum strength for long assemblies, such as antenna booms. Pricing for the tubing ranges from \$1.45 to \$103.95 depending on size and wall thickness. For more information or to order, visit www.dxengineering.com.

Emergency Power for Radio Communications

Michael Bryce, W8SVGE

With this new ARRL book, *Emergency Power for Radio Communications*, Second Edition, you will explore the various means of electric power generation for every application – from charging batteries to keeping the lights on. This book covers the foundation of any communications installation: the power source.

Use this book to plan ways to stay on the air when weather or other reasons cause a short-term or long-term power outage. Find ways to reach beyond the commercial power grid. Identify methods for alternative power generation that will work best in your particular situation, perhaps taking advantage of possibilities already on hand.

Contents of this book include: Keeping the Signals on the Air, Emergency Lighting, Solar Power, Charge Controllers for Photovoltaic Systems, Generators: Gas, Wind and Water, Load Sizing, Battery Systems and Storage, Systems for Emergency Power, Inverters, Station Instrumentation, Safety, and Emergency Practices.

This hardcover 224 page book (ISBN: 978-0-87259-615-3) sells for \$27.95 and is available from the ARRL, amateur radio dealers and various *MT* advertisers.

Get on the Air with HF Digital

By Steve Ford, W8SIMY

The popularity of HF digital communications among amateur radio operators is growing rapidly. Even in times of poor propagation conditions a few watts of RF power are all it takes to work the world – digitally!

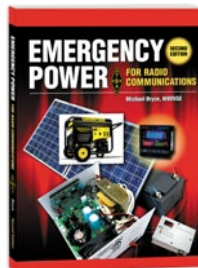
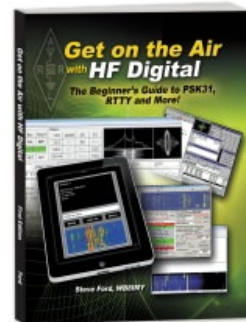
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- PSK31, RTTY and JT65 – Hands-on instructions to get started with the three most popular HF digital operating modes today.
- MFSK and Olivia – With these two modes you'll still be chatting long after the bands have supposedly gone "dead."
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to the editors

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This column is open to your considered comments. Opinions expressed here are not necessarily those of Monitoring Times. Your letters may be edited or shortened for clarity and length. Please mail to Letters to the Editor, 7540 Hwy 64 West, Brasstown, NC 28902 or email editor@monitoringtimes.com
Happy monitoring!
Rachel Baughn, Editor

Old Service, New Thrills

I arrived at work about 15 minutes early this morning (6:45 am) just before sunrise. I was sitting in my car reading your column in the March *MT* about Doug's AM challenge. I remember trying those frequencies last month to no avail. With a few minutes to spare, I tried again. I listened to 940 and could barely hear a song in the background. After the song, as luck would have it, the station IDed as WMIX. I was in Rockville, Maryland, so this was quite a catch. Thanks to you and Doug, I'm going to start AM DXing again.

Bruce KA3UIH

Way to go, Bruce! Despite all of its shortcomings, there's always something interesting in AM DX. I have really been enjoying trying to bag AM HD DX. If we're stuck with the hash we might as well make that a DX target and get something out of it. The best part is that you get an instant QSL, thanks to the LCD display.

Think about putting a new HD-capable after market radio in your vehicle. In the April issue of the *Beginner's Corner*, a reader tells how he did it. The model he bought is discontinued, but here are some fairly inexpensive options: www.crutchfield.com/g_300/Car-Receivers.html?tp=5684&npair=AG_General_Features|FFHD_Radio_Tuner_Built%40in

Read the reviews before settling on the one you want to buy. Keep us posted!

Ken Reitz KS4ZR

Free to Air

I thoroughly enjoyed your in-depth review of the Manhattan RS-1933 HD Free to Air Satellite receiver in January's "Getting Started" column. Reading your article inspired me to check out the latest C- and Ku-Band listings on www.skyvision.com. Interestingly, MPEG-4 has made significant inroads into the C- and Ku-band scene. Seems like only yesterday MPEG-2 was the predominant mode.

Every few weeks I perform a scan of the major FTA birds of choice such as Telstar 12, Hispasat 1C, Galaxy 18, AMC-1, SES-1, Gal 19, Gal 3C, AMC-3, and AMC-9 using my Openbox S9 receiver. Seems like some of the formerly-received stations had disappeared, but now that your column on the Manhattan RS-1933 has enlightened me, I realize that some of those stations are now in MPEG-4 format. Thanks to your review, the time has come for me to upgrade as technology is continually evolving and improving.

FTA satellite opens up the world to anyone willing to take the time and effort to venture into it, but as with other high technologies, the only thing constant is change. Thanks again for keeping us current.

Mario Filippi, N2HUN

Hi Mario - You're welcome! You're right about the inevitability of change in satellite TV technology. One thing I'm fairly certain of: MPEG2 and MPEG4 transmissions will coexist for the foreseeable future.

One reason is that OTA-TV stations use SD programming from retro networks for their second and third program channels which are SD anyway, and MPEG2 channels are much cheaper to transmit because they take up less bandwidth on the satellite. Also, many programmers such as are found on G19 are aimed directly at the FTA market and they are not concerned with whether or not the signals are in HD.

Audio-only programmers will also likely continue to use MPEG2 technology for the same reason. And, that's the beauty of the Manhattan RS1933, it does it all! It's a great little receiver: I've run it 24/7 for the last 5 months without a hitch. I think you'll find that it's the best \$200 yet in FTA reception. It also takes full advantage of current HDTV sets' display which didn't matter just a few years ago.

Ken KS4ZR

After reading the article "Over the air TV DXing..." I wanted to tell you of my experience with Digital TV. Two years ago during the analog days, we were able to receive about 26 stations in our rural location north of Lake Ontario. We could get Syracuse, Rochester, Buffalo, Toronto, etc. ... When the US went digital, we lost about 12 stations, and then when some of the Canadian stations switched to digital last fall, we had about 5 left.

So, to try and get back what we lost, we got a digital TV. Didn't help much: only got a couple of local Canadian stations, which duplicate programs we already receive. I contacted the manufacturer and they told me that 92% of their customers want digital TVs because they have some form of PayTV, cable or satellite. Consequently, the people out in the 'sticks' are not part of their intended group.

Some of the reason for not getting back the stations are as follows: some stations have reduced their effective power; digital TV has gone to the UHF band where there's more losses; the way digital works, you need a minimum signal strength or you just get no reception; the new TV's probably have poorer quality (less sensitive) tuners (why not, if the intended 92% of customers have a strong signal off cable or satellite and a sensitive tuner may overload).

We have a very good quality VHF/UHF antenna on a tower with a rotor. Here's what happens with these new TVs that wasn't a problem with analog: You have to set the antenna for the direction of your stations and scan the channels into its memory. But, stations from a different direction won't get scanned in. So, you have to reposition the antenna and do another scan. Guess what happens to the previous stations that were in memory? They're wiped out....

It's fine for your author to be 40 miles from New York City, but what about those people out in Wyoming, Utah, Nebraska? The end result of all this is that we returned the digital TV to the store, at a 20% restocking cost. Better that than to be stuck with a useless piece of high tech door stopper.

Regards, Joe

Hi Joe - Rachel passed your letter to me and I think I may be able to help. The article you refer to was by Mario Filippi who does indeed live between two major U.S. cities and, as you saw from his photos, needs very little in the way of an antenna to receive 55-60 channels. Many of us, as you point out in your email, aren't that lucky. Here are some things that may help.

Not all TV sets or DTV tuners are equal. I've used quite a few digital tuners and DTV sets and found that there is considerable difference among the various brands. The latest I have is a Vizio brand, found at Walmart www.walmart.com/browse/TV-Video/TVs/Vizio/_/N-96v3Z1z06yyc which range in price from \$160 to \$1,000. I have the 22" set which was about \$200.

Unlike the set you had, it holds the results of scans from various directions. It's the most sensitive TV set I've used. With a Winegard SquareShooter 2000 antenna sitting atop a bookcase above the TV, I get 16 channels from up to 60 miles away (some of them fairly low powered stations). It also has built-in WiFi which lets us stream Netflix and many other video sources via the Internet which we do through a wireless broadband modem, very low tech. The Vizio picture is great, better than many others at much higher prices.

It does have two drawbacks, easily remedied: The audio is not good because the speakers are so small. The fix is to connect the audio output to a set of larger, powered computer speakers. Second is that there's a built-in guide but not an electronic program guide that lets you view what's on all your channels over several hours or days. The fix here is www.titantv.com, an on-line TV guide that you can customize for your location (choose nearest U.S. city in your case).

If you don't want to get rid of your old NTSC TV set, keep it and get a Magnavox MDR 513 digital tuner/recorder: www.walmart.com/ip/Magnavox-MDR-513H-F7-320GB-DVR-and-DVD-Recorder/14291489#Item+Description

Just hook it up to your antenna and TV set and search for channels. I haven't used this model but it has many features that should suit your situation: a built in 320 GB hard drive recorder that lets you record over 300 hours of standard definition programming for later viewing. It also has built in DVD player/recorder. It costs \$200.

If you got both together you'd have a digital TV with a great picture and the ability to stream Netflix or other Internet movie sources and record Over-the-Air TV shows while you watch.

Finally, depending on how old your antenna system is, you may be able to improve reception by replacing older coax with RG/6 (it's much more efficient than older 75 ohm coax); check the fittings at the TV and the antenna for looseness, corrosion, etc., and make sure your mast-mounted preamplifier is also in top form.

I hope these suggestions help. Let me know how you fare and thanks for writing!

Ken KS4ZR

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-Scott

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www.wa5vjb.com - by Kent Britain

BELOW 500KHZ
<http://below500khz.blogspot.com/> - by Kevin Carey

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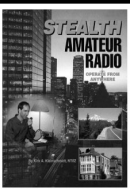
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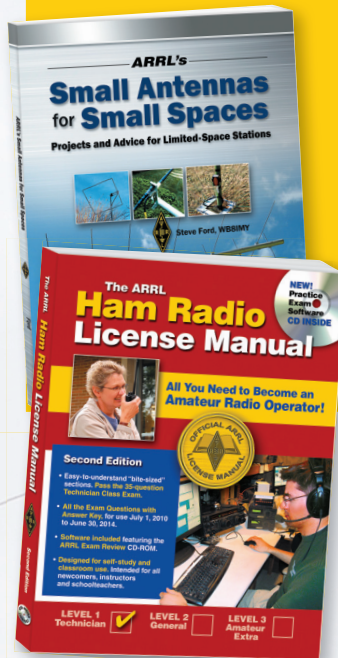
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