WWW.MONITORINGTIMES.COM

2012 Amateur Radio Special

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

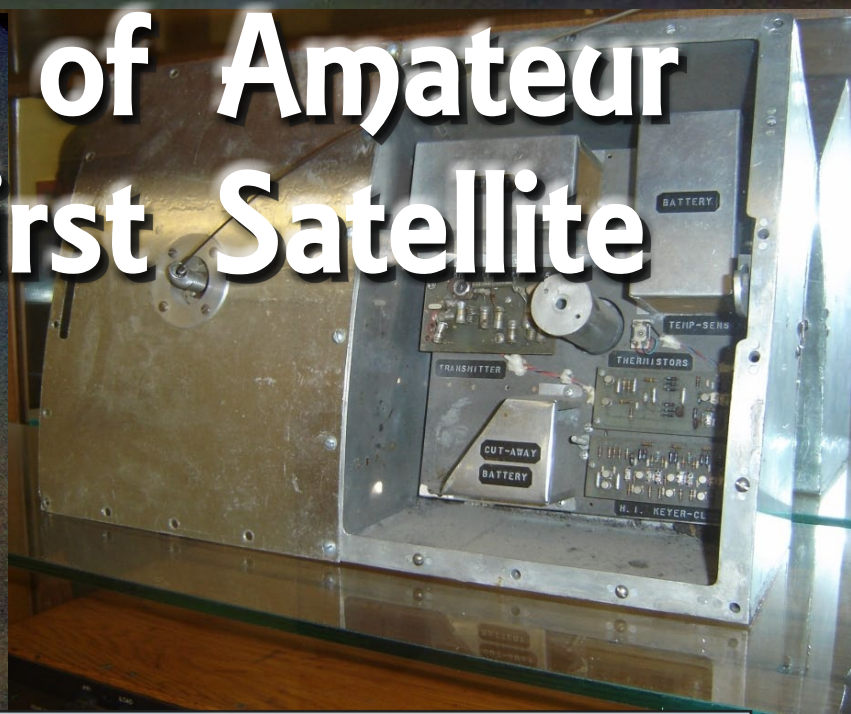
Monitoring Times®

A Publication of Grove Enterprises

Volume 31, No. 5
May 2012
U.S. $6.95
Can. $6.95
Printed in the United States

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

05
7 25274 74654 5

AR5001D Wide Coverage Professional Grade Communications Receiver

The Legend Lives On!

The AR5001D delivers amazing performance in terms of accuracy, sensitivity and speed.

Available in both professional and consumer versions, the AR5001D features wide frequency coverage from 40 KHz to 3.15 GHz, with no interruptions. Developed to meet the monitoring needs of security professionals and government agencies, the AR5001D can be controlled through a PC running Windows XP or higher. Up to three channels can be monitored simultaneously. Fast Fourier Transform algorithms provide a very fast and high level of signal processing, allowing the receiver to scan through large frequency segments quickly and accurately. AR5001D standard features include storage of up to 2000 frequencies, 45 MHz IF digital signal processing, direct digital sampling, a high performance analog RF front-end, a DDS local oscillator and advanced signal detection capabilities which can detect hidden transmitters. With its popular analog signal meter and large easy-to-read digital spectrum display, the AR5001D is destined to become the choice of federal, state and local law enforcement agencies, the military, emergency managers, diplomatic service, news-gathering operations, and home monitoring enthusiasts.*

Discover the next generation in AOR's legendary line of professional grade desktop communications receivers.

- Multimode receives AM, wide and narrow FM, upper and lower sideband and CW
- Up to 2000 alphanumeric memories (50 channels X 40 banks) can be stored
- Analog S-meter
- Fast Fourier Transform algorithms
- Operated by a Windows XP or higher computer through a USB interface using a provided software package that controls all of the receiver's functions
- An SD memory card port can be used to store recorded audio
- Analog composite video output connector
- CTCSS and DCS squelch operation
- Two selectable Type N antenna input ports
- Adjustable analog 45 MHz IF output with 15 MHz bandwidth
- Triple-conversion receiver exhibits excellent sensitivity
- Powered by 12 volts DC (AC Adapter included), it can be operated as a base or mobile unit
- Professional (government) version is equipped with a standard voice-inversion monitoring feature

Add to the capabilities of the AR5001D with options:

- Optional APCO-25 decoder
- Optional LAN interface unit enables control via the internet
- Optional I/Q output port allows capture of up to 1 MHz onto a computer hard drive or external storage device
- Optional AR-I/Q Windows software facilitates the easy storage and playback of transmissions captured within the selected spectrum in conventional modes, or, signals can be subjected to further analysis
- Optional GPS board can be used for an accurate time base and for time stamping digital I/Q data

The Serious Choice in Advanced Technology Receivers

AOR U.S.A., Inc.
20655 S. Western Ave., Suite 112
Torrance, CA 90501, USA
Tel: 310-787-8615 Fax: 310-787-8619
info@aorusa.com • www.aorusa.com

Authority On Radio Communications

Cellular blocked for US consumer version. Unblocked version available to qualified purchasers with documentation. Specifications subject to change without notice or obligation

The All-New *EXCELSIOR*™.

- 9 kHz to 3.5 GHz
- 16 MHz real-time spectrum
- 1 GHz/s search speed
- 2 simultaneous channels
- USB and PCIe models

Introducing the WiNRADiO G39DDC *EXCELSIOR*.
Is it a great receiver with an added spectrum analyzer?
Or a great spectrum analyzer with an added receiver?

You decide:

www.winradio.com/g39

WiNRADiO® by RADIXON®: Great receivers ahead of their time.℠

Monitoring Times

Vol. 31 No. 5 May 2012

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 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

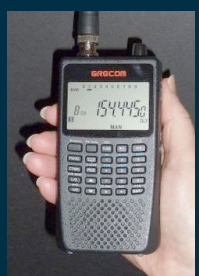
Over the decades, *MT* founder and antenna guru Bob Grove W8JHD has found that the subject of antennas is foremost on most amateur operators' minds. And, with good reason; it's the main thing keeping most hams from getting the most out of their transceivers.

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.

MTXPRESS

SPECIAL OFFER BELOW!

Going Green has never been more exciting!

Before the rising prices of gasoline, and before going "green" became a sales pitch, Monitoring Times created MT Express. The full version of the magazine you've come to depend on, in full electronic form. Now going into our 11th year of digital perfection, MT Express is better than ever. You get more with our digital magazine than you could ever have with print. The entire magazine is full color. All of the web links are clickable, so if you see a link to a website that you want to visit, just click on it! Want to email an author? Just click on their email address at the top of their column, and MT Express opens your email program, drops in their address, and is ready for your input! All of this, and it's even CHEAPER than the regular print version! Plus, you'll get it faster than you would your print copy, no matter where you are in the world. Now is the time to make the switch to digital. Sure, it's saving a tree and saving some gas, but it's also getting you what you need, when you want it. Make the switch today.

For a mere $19.95 U.S., ***MT EXPRESS*** gives you *Monitoring Times* magazine

- in PDF format viewable with free software, delivered by FTP
- viewable in **brilliant color** (the ***whole*** magazine, not just what you see in the print version) on your computer screen
- easily navigated by clicking on the Table of Contents
- printable using your own computer printer
- searchable to find every mention of a topic or station schedule
- compatible with software to convert text to audio for sight impaired listeners

Now with MTXTRA

Not only do you now have the complete Monitoring Times magazine, in full color, but for no extra cost, we are now adding MTXTRA, which will have a worldwide broadcast guide with ALL offered languages, not just English! So no matter where you are in the world, *Monitoring Times* has something just for you!

To find out if this new subscription is the delivery solution for you, you may download a sample issue for free! Just go to ***http://www.grove-ent.com*** *to find out how.*

If you order NOW, you will get 14 ISSUES for the price of 12! That's right, for only $19.95 you'll get an EXTRA 2 MONTHS AND MTXTRA! Just mention code MTMAY12 when you place your order! And, if you order MT Print AND MTXpress together, MTXpress is only $11 per year!

GROVE

800-438-8155

828-837-9200 fax: 828-837-2216

WWW.GROVE-ENT.COM

MONITORING TIMES (ISSN: 0889-5341; Publishers Mail Agreement #1253492) is published monthly by Grove Enterprises, Inc., Brasstown, North Carolina, USA.

Address: 7540 Highway 64 West, Brasstown, NC 28902-0098
Telephone: (828) 837-9200
Fax: (828) 837-2216 (24 hours)
Internet Address: ***www.grove-ent.com*** or ***www.monitoringtimes.com***
Editorial e-mail: ***editor@monitoringtimes.com***
Subscriptions: ***order@grove-ent.com***

Subscription Rates: $32.95 in US; $42.95 Canada; and $58.95 foreign elsewhere, US funds. Label indicates number of issues left. Renewal notice is cover sheet 3 months before expiration. *See page 76 for subscription information.*

WRITE FOR MONITORING TIMES:
Learn how at **www.monitoringtimes.com/html/write_for_mt.html** or write to ***editor@monitoringtimes.com***

Postmaster:
Send address changes to *Monitoring Times*, 7540 Highway 64 West, Brasstown, NC 28902-0098.

Subscription Questions?
belinda@grove-ent.com

Owners
Bob and Judy Grove
judy@grove-ent.com

Publisher
Bob Grove, W8JHD
bobgrove@monitoringtimes.com

Managing Editor
Rachel Baughn, KE4OPD
editor@monitoringtimes.com

Assistant and Reviews Editor
Larry Van Horn, N5FPW
larryvanhorn@monitoringtimes.com

Features Editor
Ken Reitz
kenreitz@monitoringtimes.com

Art Director
Bill Grove

Advertising Services
Judy Grove
(828) 837-9200
judy@grove-ent.com

Table Of Contents

Departments
Communications 6
Letters 74
Stock Exchange 76
Advertisers Index 76

First Departments
Getting Started
Scanning Report 20
By Dan Veeneman
Not All Change is Bad

Ask Bob 23
By Bob Grove W8JHD
DC power lines re-examined; Eavesdropper dipole installation; Digital modulation on MURS frequencies; HF vertical vs horizontal; "Invisible fence" as longwave antenna; Alkaline battery ratings; Listening for bats and insects on 10 Hz.

Utility World 24
By Hugh Stegman NV6H
WRC-12 New Amateur Band and More

Digital Digest 27
By Mike Chace
Spotlight on Algeria (Part 1)

On the Ham Bands 28
By Kirk Kleinschmidt NT0Z
60 Meter Madness!

Beginner's Corner 30
By Ken Reitz KS4ZR
Living the Very Limits of Your License

Programming Spotlight 32
By Fred Waterer
May Flowers and Music

Second Departments
QSL Report 34
By Gayle Van Horn W4GVH
ARRL and CQ Sign Awards Agreement

English Language SW Guide 35

MTXtra Shortwave Broadcast Guide 48
Portuguese

Milcom 52
By Larry Van Horn N5FPW
New Data on DoD Trunk Systems

Fed Files 54
By Chris Parris
Scanning Super Bowl XLVI

Boats, PLANES, Trains 56
By Iden Rogers
Aviation Related Frequencies

Globalnet 58
By Loyd Van Horn W4LVH
New Ways to Talk Amateur Radio

Below 500 kHz 60
By Kevin Carey WB2QMY
Bendix Navigator 420: Gaining Access

Technical Departments
Radio Restorations 62
By Marc Ellis N9EWJ
Signal Tracing and Signal Injection

Antenna Topics 64
By Dan Farber AC0LW
Get Creative with HF Antenna Solutions

Sky Surfing: Radio Astronomy 66
By Keith Baker KB1SF/VA3KSF
Spotlight on UOSAT-2 (UO-11)

On the Bench 68
By David Payne KB8NNT
Three Generations Tackle a Smoked Heathkit

First Look 70
By Bob Grove W8JHD
GRE PSR-120 Hand-held Scanner

What's New 72
By Larry Van Horn N5FPW
InnovAntennas appoints first American dealer; Review: "Modern Communications Receiver Design and Technology"; DXE- UT-KIT2-D; DX Engineering Aluminum Tubing; "Emergency Power for Radio Communications"; "Get on the Air with HF Digital"

You may contact any MT staff writer by email by combining their ***first and last name @ monitoringtimes.com.*** By postal mail, you may write them in care of MT Headquarters in Brasstown. Please enclose a self-adressed, stamped envelope if you wish the columnist to reply.

Study with the best!
License Study Materials by
Gordon West, WB6NOA & the W5YI Group

HAM IT UP! — AMATEUR RADIO — A NATIONAL RESOURCE

TECHNICIAN CLASS

***Technician Class* book**
for the 2010-2014 entry level exam! Gordo reorganizes the Q&A into logical topic groups for easy learning! Key words are highlighted in his explanations to help you understand the material for test success. Web addresses for more than 125 helpful, educational sites. Includes ***On The Air*** CD demonstrating Tech privileges. **GWTM $20.95**

Tech Book & Software Package
Gordo's book with W5YI software allows you to study at your computer and take practice exams. Explanations from Gordo's book are on the software – answer a question wrong and his explanation appears to reinforce your learning. Includes free Part 97 Rule Book. **NCS $29.95**

Tech Audio Course on CD
Welcome to Gordo's classroom! Technician audio theory course recorded by Gordo talks you through the Element 2 question pool. Follows the order of his ***Technician Class*** book, and is full of the sounds of ham radio operating excitement! An excellent study aid if you spend a lot of time in your car or pick-up! On 4 audio CDs. **GWTW $29.95**

GENERAL CLASS

***General Class* book**
Upgrade to the HF bands with Gordo & W5YI! Gordo's manual for 2011-2015 reorganizes all the questions into logical topic groups for easier learning. His explanations include highlighted key words to help you remember the material for test success. Companion CD is full of great operating tips! Available about May 1st. **GWGM $24.95**

General Book & Software Package
Study at your computer and take practice exams. Software includes explanations from Gordo's book, scores your results and highlights areas that need further study. Includes free Part 97 Rule Book. **GUS $34.95**

General Audio Course on CD
General Theory Course recorded by Gordo is full of the sounds that bring ham radio to life! He talks you through the Element 3 theory to help you understand the material and get you ready for your upcoming exam. On 4 audio CDs. **GWGW $29.95**

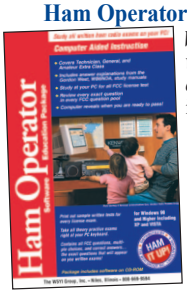
EXTRA CLASS

***Extra Class* book**
Go to the top with Gordo! 2008-2012 book includes all Element 4 Q&A reorganized into logical topic groups. Gordo's fun, educational explanations with highlighted keywords, and great memory tricks for those tough theory questions! Wait 'til you meet "Eli the Ice Man!" **GWEM $24.95**

Extra Book & Software Package
Study at your computer and take practice exams as the W5YI software scores your results and highlights areas that need further study. Includes explanations from Gordo's book. Free Part 97 Rule Book. **ECS $39.95**

Extra Audio Course on CD
Extra Class Theory Course recorded by Gordo talks you understand the material and get you ready for your upgrade to the top. On 6 audio CDs. **GWEW $39.95**

Ham Operator Software has All Exams

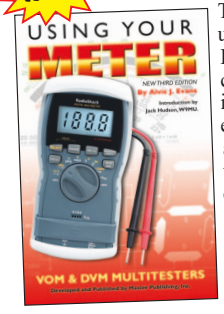


Want to study at your computer without tying up your internet connection? This value pack includes the Tech, General and Extra class exams (Elements 2, 3, and 4) along with a free Part 97 Rule Book. Software includes Gordo's answer explanations from his books! Everything you need to go all the way to the top!

Software only **HOS $29.95**
Software with all 3 West Books **HOSB $89.95**

NEW!

Using Your Meter



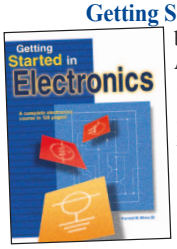
Teach yourself the correct use of your multitester. Book explains fundamental concepts of electricity including conventional and electron current and series and parallel circuits. It teaches how analog and digital meters work and tells you what the voltage, current and, resistance measurements mean. Then it provides fully-illustrated, step-by-step instruction on using your meter in practical applications in the home, workshop, automotive and other settings. An excellent learning tool and reference for the hobbyist and ham. **METR $24.95**

GROL + RADAR

Get your FCC commercial radio licenses and add valuable credentials to your resume! ***GROL+RADAR*** includes the new FCC Element 1 question pool for the Marine Radio Operator Permit (MROP), the Element 3 pool for the General Radiotelephone Operator License (GROL), and the Element 8 pool for the RADAR Endorsement. Many employers require these licenses for jobs in marine, aero, safety, and municipal positions. Gordo and his team have written clear explanations for all the Q&A to make studying for these exams educational and fun. If you're an Extra Class ham, many of the technical/math questions will look familiar to you. Fully-illustrated to aid your learning. Book includes a searchable CD-ROM with all FCC Rules for Parts 2, 13, 23, 73, 80 and 87. **GROL $49.95**

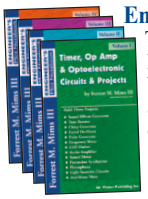
GROL+RADAR book & software package
Enhance your learning experience using our practice exam software along with the ***GROL+RADAR*** book. Software includes answer explanations from the book – when you select a wrong answer, the explanation from the book appears to reinforce your learning. **GRSP $79.95**

Getting Started in Electronics



by Forrest M. Mims
A great introduction for anyone who wants to learn the fundamentals of electronics. Includes 100 projects you can build, and great experiments that demonstrate how electricity works! **GSTD $19.95**

Engineer's Mini Notebooks



These Mims classics teach you hands-on electronics! Study and build 100s of practical circuits and fun projects. Each volume contains several of his famous Mini Notebooks. T science fair projects and a great way to learn about electronics! Useful reference guides for your workbench!

Vol. 1: *Timer, Op Amp, & Optoelectronic Circuits & Projects* **MINI-1 $12.95**

Vol. 2: *Science & Communications Circuits & Projects* **MINI-2 $12.95**

Vol. 3: *Electronic Sensor Circuits & Projects* **MINI-3 $12.95**

Vol. 4: *Electronic Formulas, Symbols & Circuits* **MINI-4 $12.95**

Order today from W5YI: 800-669-9594 or on-line: www.w5yi.org

The W5YI Group P.O. Box 200065 Arlington, TX 76006-0065 *Mention code 053736 for a free gift with your order!*

MT

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 *TV News Check,* 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.

Amateur Radio's Very First Satellite
The Amazing Story of OSCAR-1

By Keith Baker KB1SF/VA3KSF

Private 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.

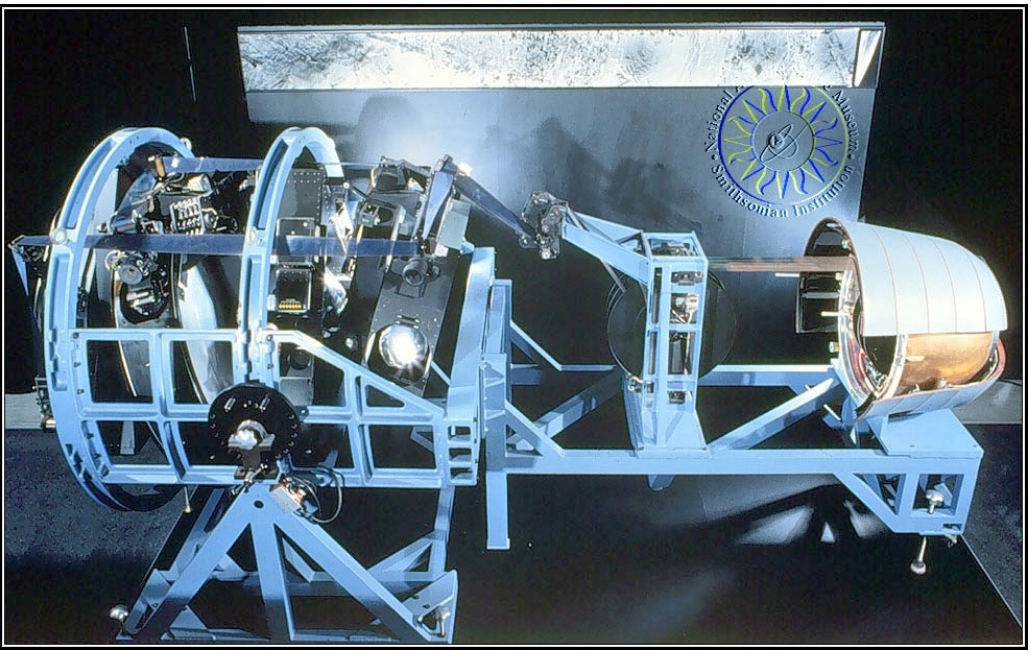
As it turned out, one of the radio amateurs employed by Lockheed at the time, Fred Hicks W6EJU, read Don's article and began to think that, indeed, it just might be possible to find a launch for such a satellite through his association with Lockheed and the U.S. Air Force. Remember, at the time, the 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."

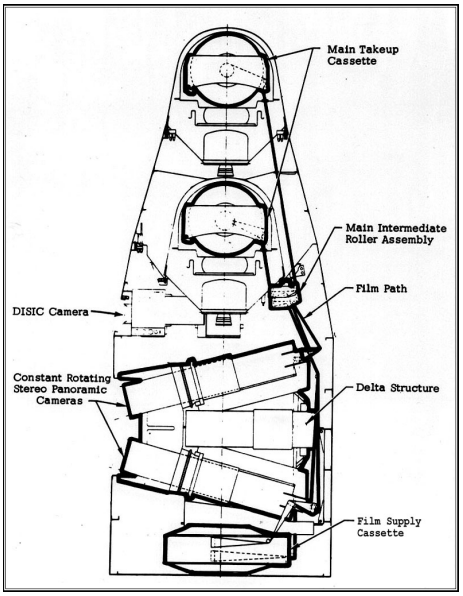
Fred and his group soon contacted the (then) Southwest Division Director of the American Radio Relay League (ARRL) and the head of the Jet Propulsion Laboratory's Space Instrumentation System, Dr. Harry L. Richter W6VZA, and plans started to come together for the very first amateur radio satellite.

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 1 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 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.

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)

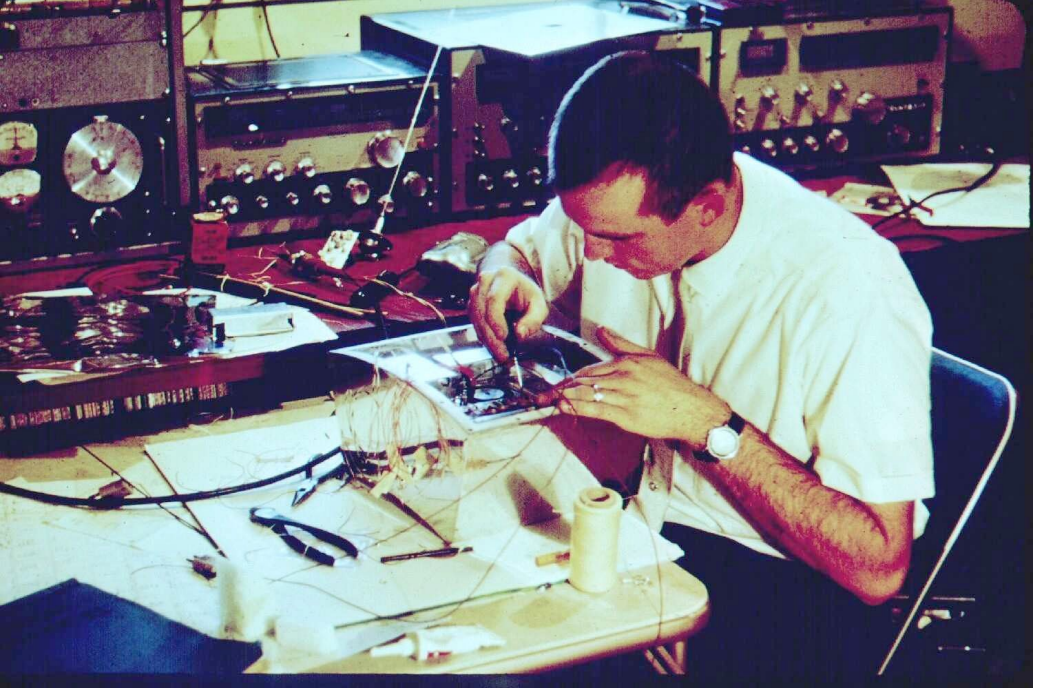
Resolution in early flight years was in the range of 35 to 40 feet. The canisters (called by the slang term "film buckets") were then separated, de-orbited and later recovered in mid air by specially equipped Air Force C-119 aircraft while floating back to Earth via parachute.

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-199 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**

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).

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

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

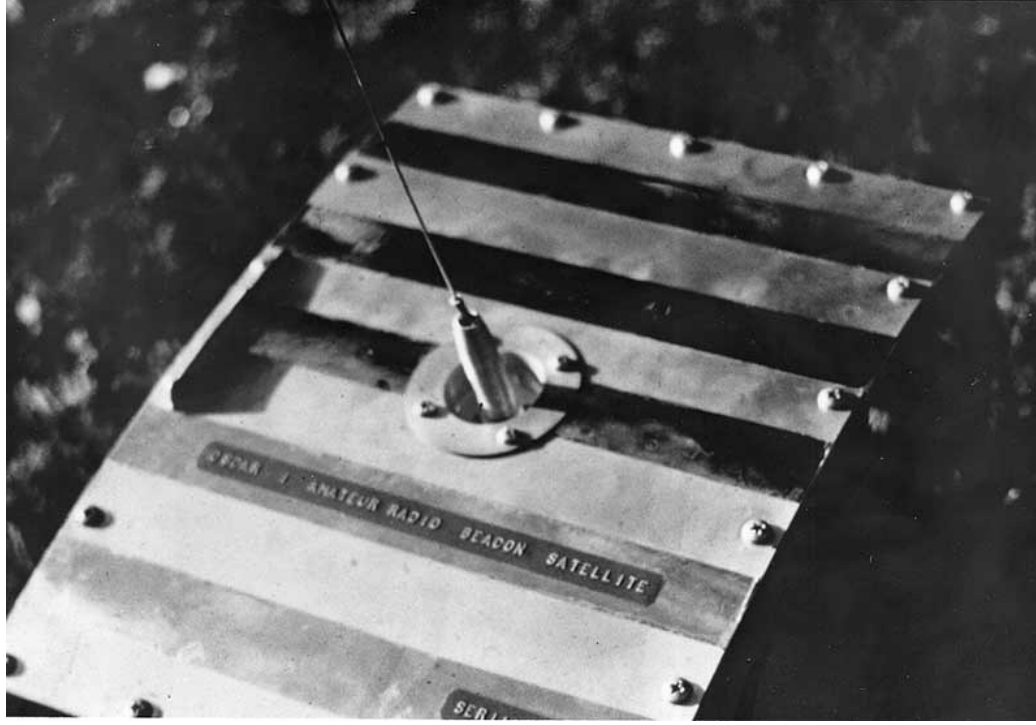
Needless to say, because of the highly classified nature of the main payload, getting the early OSCAR satellites approved for launch was a highly politicized process. The challenges that the Project OSCAR board faced in obtaining the necessary permission for them to fly a "home built" satellite on a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



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

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)

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 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.

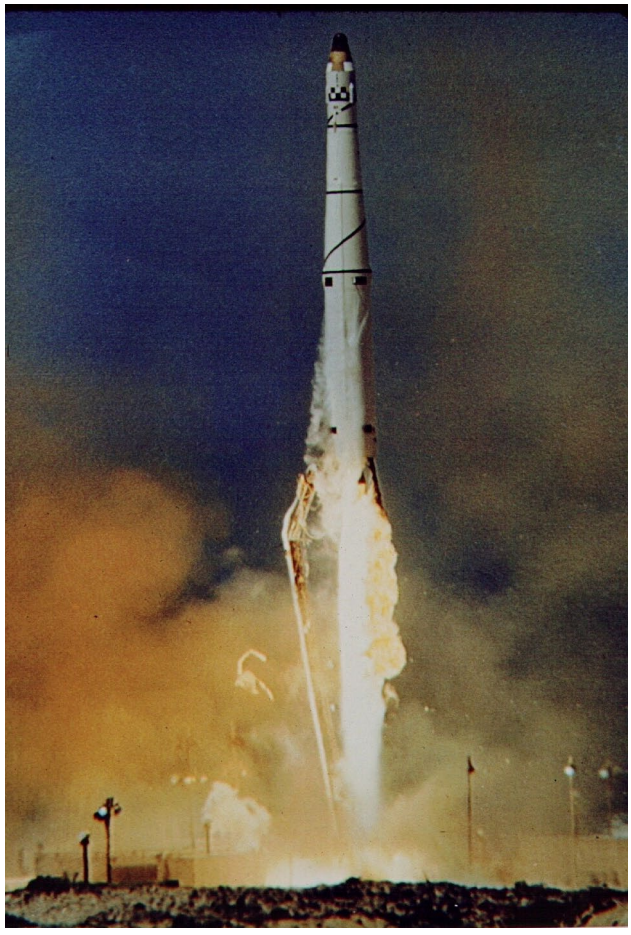
Fast Forward 50 Years

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!



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)

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 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 magazine.

SOURCES AND REFERENCES:

1) Morrison, Mark, "Amateur Radio and the Cosmos - Part 4". Hicksville, NY: CQ *VHF Magazine*, Spring 2010 Edition.
2) "Early Satellites in U.S. Intelligence," Remarks by Admiral William O. Studeman, Acting Director of Central Intelligence at the Signing of the Executive Order Declassifying Early Satellite Imagery, 24 February 1995.
3) Hartzell, David: "Between a Rock and Outer Space: Interview with OSCAR Pioneer Lance Ginner" Silver Spring, MD, *The AMSAT Journal*, September / October 2006 Edition.
4) Davidoff, Martin, *The Radio Amateur's Satellite Handbook*, 1998: American Radio Relay League, Newington, CT. Pages 1-4.

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.

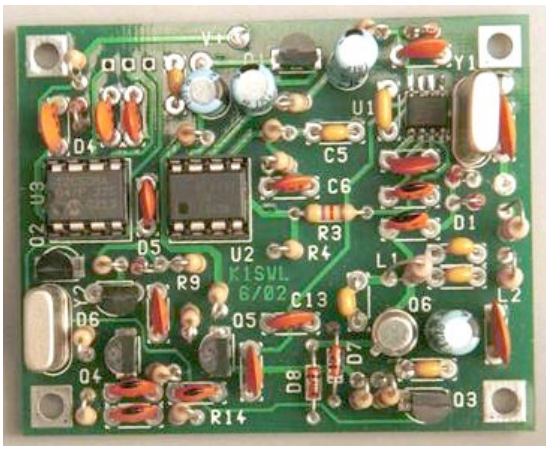
Equipment Cost – As with most amateur radio installations, you can spend a small amount or a large amount of money to get on the air, but a QRP station is made up of transceivers, transmitters, receivers, and accessories that are, overall, much less expensive than their higher power cousins. Simple transceiver 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 amateurs love to build rigs just for the fun of it!)



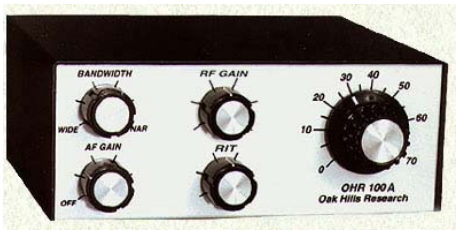
The Rock Mite, with over 8,000 sold and only $45 with knob/accessory pack, is the cheapest way to QRP. (Photo courtesy of Small Wonder Labs)

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 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!

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)

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 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 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		5.3465 CH2 (USA)
40	7.070 (USA)	7.285
		7.090 (Europe)
30	10.106	
	10.116	
20	14.060	14.285
17	18.096	
15	21.060	21.385
		21.285 (Europe)
12	24.906	
10	28.060	28.885
		28.360 (Europe)
6	50.096	50.185
2	144.060	144.285

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)

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 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.

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**

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

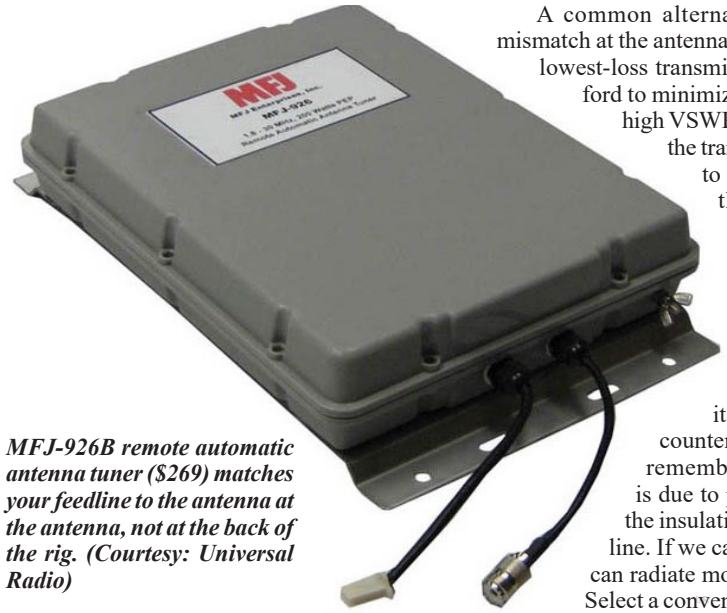
In the annals of antenna history, no antenna is mentioned more than the horizontal dipole, or "flattop," and with good reason. It's easy to design, cheap to make and works very well. The term "dipole" itself simply means it has two parts, the left and the right side of its feedpoint (transmission line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

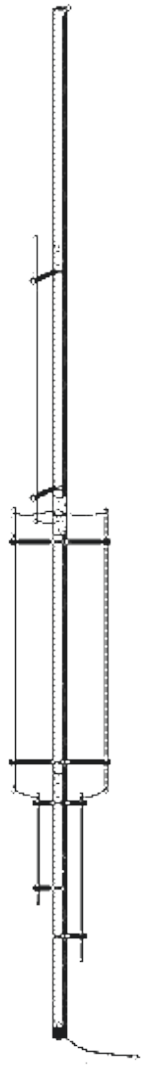
Solid bar, the same diameter as the tubing, would show absolutely no improvement over the tubing since radio frequency (RF) energy travels only a tiny percentage below the surface of the conductor, a characteristic known metaphorically as "skin effect."

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).

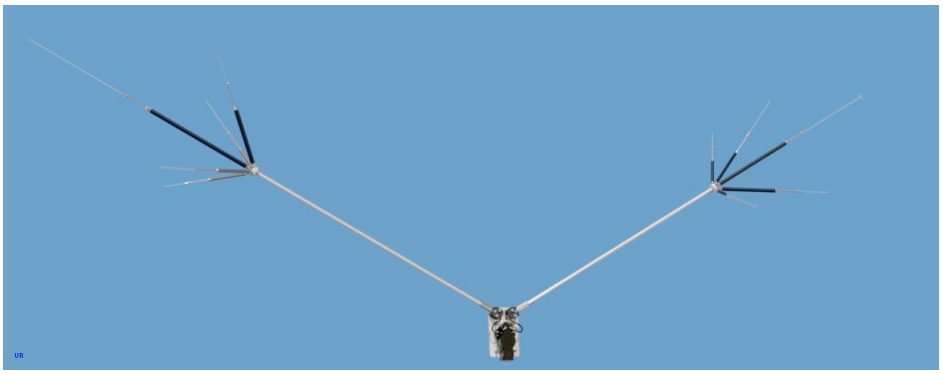
The math is simple for calculating the fundamental length: divide 468 by the center frequency in megahertz of greatest interest. The answer is in feet. As in the example above, 468 divided by 7.1 MHz is about 66 feet.

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)

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

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)

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.

SCANNING REPORT

THE WORLD ABOVE 30MHZ

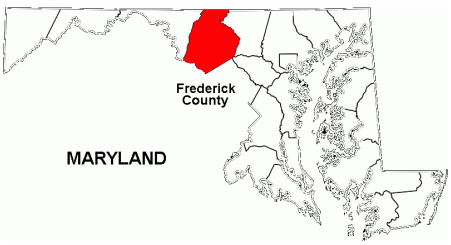
Dan Veeneman
danveeneman@monitoringtimes.com
www.signalharbor.com

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)

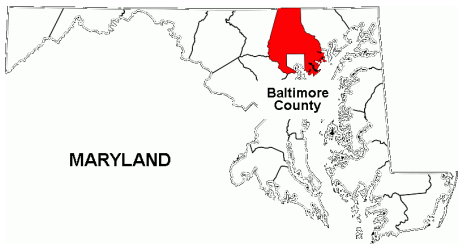
There are also a number of active conventional (non-trunked) analog frequencies in the county.

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 (Wilkens 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)

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 (Wilkens 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 (Wilkens 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 (Whitemarsh 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	Countyride 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.

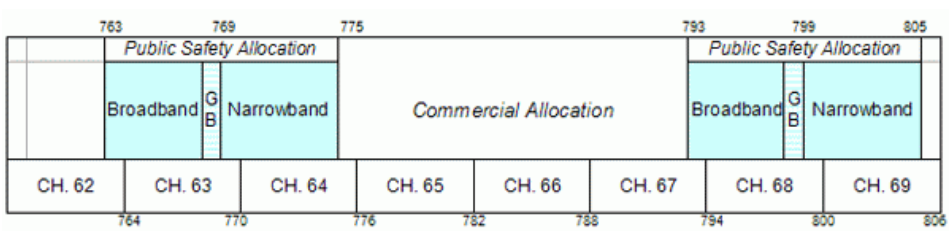
Maryland awarded a contract to Motorola for the design and installation of a statewide trunked digital radio system called FIRST (First Responders Interoperable Radio System Team). The system build out plan has the state divided into four regions, with region 1 in the center of the state to be operational 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 *danveeneman@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!

ASK BOB

GENERAL QUESTIONS RELATED TO RADIO

Bob Grove, W8JHD
bobgrove@monitoringtimes.com

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 shortwave 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 feedpoint 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.)

UTILITY WORLD

HF COMMUNICATIONS

Hugh Stegman, NV6H
mtutilityworld@gmail.com
www.ominous-valve.com/uteworld.html
http://mt-utility.blogspot.com

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

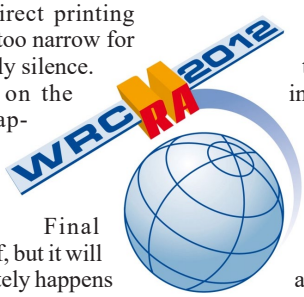
Item 1.15 was "to consider possible allocations in the range 3-50 MHz to the radiolocation service for oceanographic radar applications." WRC-12 has done just that, though information is once again sketchy.

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

135.6 HGA22-European ripple control, Hungary, ASCII control and time strings with transmitter ID, at 1658 (MPJ-UK).

263.0 QY-NDB, Sydney, NS, AM/MCW ID at 0404 (PPA-Netherlands).

286.5 001-Differential GPS, Baltiysk/Kaliningrad, Russia, 100 baud MSK corrections at 2114 (PPA-Netherlands).

315.0 A8UD3-Beacon on offshore oil drilling vessel *Noble Globetrotter*, MCW ID at 2117 (PPA-Netherlands).

391.0 DDP-NDB, San Juan, Puerto Rico, MCW ID at 0449 (PPA-Netherlands). *[7200 km! -Hugh]*

490.0 "I"-La Maddalena Radio, Italy, SITOR-B Navtex in Italian at 2125 (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).

1610.0 WPQJ 968-Hillsborough Township Office of Emergency Management, NJ, road information station rebroadcasting NOAA weather radio, at 1812 (Mario Filippi-NJ).

1650.0 WQEA 21-Burlington County, NJ, repeating NOAA KIH 28 from Philadelphia, at 1604 (Filippi-NJ).

1700.0 WPSH 468-Manville Office of Emergency Management, NJ, NOAA weather at 1605 (Filippi-NJ).

1714.0 FO74-Probable fishing beacon, CW ID at 0120 (Filippi-NJ).

1728.0 94W224-Probable fishing beacon, CW ID at 0118 (Filippi-NJ).

1743.0 Unid-UK Coast Guard, Stornoway, weather for Scotland coast, at 0714 (PPA-Netherlands).

1855.0 IQP-San Benedetto del Tronto Radio, Italy, navigation warnings in Italian at 0451 (PPA-Netherlands).

2187.5 A8CG4-Liberian flag bulk carrier *Swakop*, DSC with Lyngby Radio, Denmark, at 0740. UAVA-Russian flag cargo vessel *Kelarvi*, DSC with Lyngby, at 0752 (Michel Lacroix-France).

2311.0 Unid-Arklow Shipping, Ireland; positions from cargo vessels *Arklow Forest*, *Arklow Rebel*, *Arklow Rover*, and *Arklow Rogue*; at 2025 (PPA-Netherlands).

2572.5 CFH-Canadian Forces, Halifax, NS, RTTY weather and traffic list, at 2342 (Jack Metcalfe-KY).

2598.0 Unid-Probably VCP, Canadian Coast Guard, Placentia, NFD, weather at 0051 (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).

3290.5 PIAOPS-US National Guard, Peoria, IL, calling aircraft CH641, ALE at 0118 (Metcalfe-KY).

3338.0 33B-UK Army cadets, working 80C and 74B, at 2019 (PPA-Netherlands).

3810.0 HD2IOA-Ecuador Navy time signals, Guayaquil, LSB pips and Spanish announcements, at 0730 (PPA-Netherlands).

4033.0 IABA-Italian Navy vessel *Aretusa*, working IDR, Rome, at 2026 (PPA-Netherlands).

4051.5 3B2MR1RLTCMD1-USMC, likely exercise Bold Alligator, calling 2MARR1RLTCMD1, ALE at 0343 (Metcalfe-KY).

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).

4415.9 VCO-Canadian Coast Guard, Sydney, FAX ice chart at 2209 (PPA-Netherlands).

4441.0 Unid-English "Oblique" station (E11), null-message callup 248/00; similar on 5082, 7840, 10690, and 10800, at 0900 (Boender-Netherlands).

4458.0 FAV22-French military, CW training in 5-letter groups, also on 5242 and 5896, at 0829 (Lacroix-France).

4593.5 AFA5NF-USAF MARS, IN, nightly Northeast US net with AFA3LW, PA, plus many others, at 0008 (MDMonitor-MD).

4610.0 GYA-UK Royal Navy, Northwood, FAX sea surface charts at 2307 (Filippi-NJ).

4675.0 N832MH-Delta Airlines B767, answering selcal QS-KR from Shanwick (NAT-D), at 0857 (Lacroix-France).

5135.0 ARCNHQ2-American Red Cross National Headquarters, working ARC51 (unit 51), ALE at 2321 (Bob Wilczynski-MA).

5236.0 NNN0EBC-US Navy/ Marine Corps MARS, control of SHARES Northeast Net at 0015 (MDMonitor-MD).

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).

5295.0 XEX-UK Defence High Frequency Communications Service, calling XSS (Control, Forest Moor), at 1829 (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 (Metcalfe-KY).

5434.0 W46-US Army "Site R," PA, calling USADA1010, DC, ALE at 0855 (Lacroix-France).

5450.0 Unid-UK Royal Air Force Volmet, voice synthesized female with English accent, aviation weather at 0351 (Filippi-NJ).

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-YMMI, 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 Rescue125, 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 USSWASPP2MEBCMD-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 1XV7-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 VS0603, 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 AAR0NM, 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 Iowa 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 087CDCS51-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 CHPNSC140M-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).

DIGITAL DIGEST

DIGITAL MODES ON HF

Mike Chace
mikechace@monitoringtimes.com
www.chace-ortiz.org/umc

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 "VVV]]]]".

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 "XXXXXX". The meaning of these messages has yet to be determined.

ON THE HAM BANDS

THE FUNDAMENTALS OF AMATEUR RADIO

Kirk A. Kleinschmidt, NT0Z
kirk@monitoringtimes.com

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 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.

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.

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 overmodulating 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

Ken Reitz, KS4ZR
kenreitz@monitoringtimes.com

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 MJF'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.

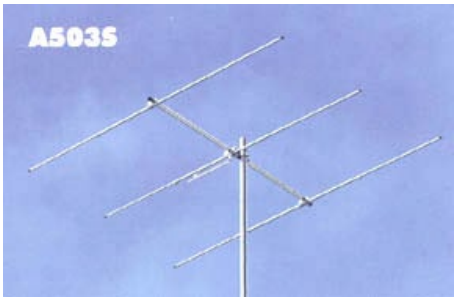
Yaesu VX-7R ($370): A Technician Class four band HT that transmits on 6 meters, 2 meters, 440 and 220 MHz FM and receives broadcast band AM and FM, Air Band and shortwave from 1.800 - 30 MHz. (Courtesy: Universal Radio)

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.

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 only18 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 SBB15 ($82) is a mobile vertical 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)

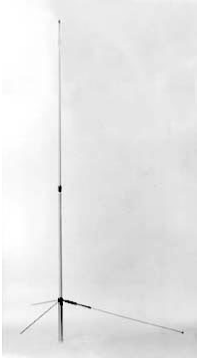
50.0 - 50.1	CW and Beacons
50.125 SSB	Calling Frequency
50.40 AM	Calling Frequency
51.0 - 51.1	Pacific DX Window
51.12 - 51.48	Repeater Inputs
51.62 - 51.98	Repeater Outputs
52.02 - 52.04	FM Simplex

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.



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)

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 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.

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 transnational 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.

Radio România Internațional

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.

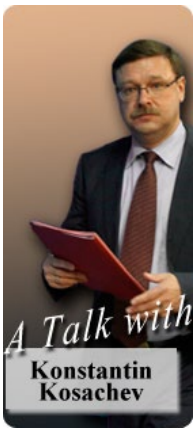
WYFR Shortwave
OAKLAND, CALIFORNIA 94621 U.S.A.

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/**

THE QSL REPORT

VERIFICATIONS RECEIVED BY OUR READERS

Gayle Van Horn, W4GVH
gaylevanhorn@monitoringtimes.com
http://mt-shortwave.blogspot.com
Twitter @QSLRptMT

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 Office 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 Northwestern 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

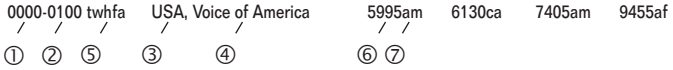
May 26-May 27, 1300-1600 UTC. W4JUP, West Palm Beach, FL. Jupiter Tequesta Repeater Group. Operations on: 18.130, 14.240, 14.07.70, 7.180 MHz. QSL. QSL Manager, PO Box 7751, Jupiter, FL 33469. Operating from underground in the bunker built as an atomic shelter and command center for President John F.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



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 broadcast⑤ will appear in the column following the time of broadcast, using the following codes:

Codes	
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 conditions, 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

MT MONITORING TEAM

Gayle Van Horn
Frequency Manager
gaylevanhorn@monitoringtimes.com

Larry Van Horn, MT Asst. Editor
larryvanhorn@monitoringtimes.com

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.

Adrian Peterson/AWR; Alokesh Gupta, New Delhi, India; Ashik Rajshahi, Bangladesh; Ashik Eqbal Tokon, Bangladesh; Bill Westhaver/RCI; Brenda Constantino/ WYFR; Ivo Ivanov, Bulgaria; Jaisakthivel, Tirunelveli, India; Rachel Baughn/MT; Sarah/BVB; Sean Gilbert UK/WRTH 2012; Wolfgang Bueschel, Stuttgart, Germany; and Claudius Dedio/AWR.

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

Note 4 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

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	DRM	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	sm	USA, WBCQ Monticello ME	5110am		
0000	0100		USA, WBCQ Monticello ME	9330am		
0000	0100	mtwhfa	USA, WBCQ Monticello ME	7490am		
0000	0100	sm	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, WWCR Nashville TN	3195eu	5070af	9980af 13845eu
0000	0100		USA, WWRB Manchester TN	3185na	3215na	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	asf	Canada, Bible Voice Broadcasting	9490as		
0030	0100	Sun	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/Hyderbad	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 7350eu 9410eu 9420as 9570na 9580na 11650as 11885as
0100	0200		Anguilla/Caribbean Beacon/Univ Network	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, WWCR Nashville TN	3195eu	4840na	5935af 9980af
0100	0200		USA, WWRB Manchester TN	3185na	3215na	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	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	4755 as		
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	9770as	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	12133usb
			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, WTWW Lebanon TN	5080am	5755am	
			12105na			
0200	0300		USA, WWCR 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	twhfas	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	15135do
0245	0300		India, All India R/Guwahati	4940do		
0245	0300		India, All India R/Hyderbad	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	13620as
			15120as			
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	15515pa
			17750va	21725as		
0300	0400		Bahrain, R Bahrain	6010me		
0300	0400	twhfas	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	15745as	
0300	0400		Taiwan, R Taiwan Intl	6875na	15320as	
0300	0400		UK, BBC World Service	3255af	5940me	
			6140af	6190af	7255af	9410as
			9460af	11860af	12095as	15310as
			17790as			
0300	0400		USA, Amer Forces Network/AFRTS		4319usb	
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
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, WTWW Lebanon TN	5080am	5755am	
			12105na			
0300	0400		USA, WWCR 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	17725as
			17855as			
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	17750va
			21725as			
0400	0500		Bahrain, R Bahrain	6010me		
0400	0500	twhfas	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	15745as	
0400	0500		Turkey, Voice of Turkey	7240as	9655va	
0400	0500		UK, BBC World Service	3255af	6005af	
			6190af	7255af	9410me	11860af
			12035af	12095af	15310as	15360as
			17790as			

0400	0500		USA, Amer Forces Network/AFRTS			4319usb
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
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	5755am
			12105na			
0400	0500		USA, WWCR Nashville TN		3215eu	4840na
			5890af	5935af		
0400	0500		USA, WWRB Manchester TN		3195na	5050na
			5745va			
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	4960af
			9885af	15580af		
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	twhfas	Canada, CBC Northern Quebec Svc			9625na
0500	0527		Germany, Deutsche Welle		6075af	
0500	0530		Germany, Deutsche Welle		9470va	9800af
			9850va			
0500	0530		Japan, R Japan NHK World		5975va	6110na
			9770va			
0500	0557		China, China R International			5960na
			6190na	7220af	7295af	9440af
			11880as	15350as	17505va	17540as
			17725as	17855as		
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		9660pa	12080va
			13630va	13690va	15160va	15240va
			17750va	21725va		
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		6010na	6050na
			6060ca	6125ca		
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			
0500	0600		Taiwan, R Taiwan Intl		6875na	
0500	0600	DRM	UK, BBC World Service		3955eu	
0500	0600		UK, BBC World Service		3255af	3955eu
			6005af	6190af	7255af	9410me
			12095af	15310as	15360as	15400af
			15420af	17640af	17790as	
0500	0600	Sat/Sun	UK, BBC World Service		15420af	
0500	0600		USA, Amer Forces Network/AFRTS			4319usb
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
0500	0600		USA, BBG/Voice of America		4930af	6080af
			9885af	15580af		
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	5755am
			12105na			
0500	0600		USA, WWCR Nashville TN		3215eu	4840na
			5890af	5935af		
0500	0600		USA, WWRB Manchester TN		3195na	5050na
			5745va			
0500	0600		Zambia, CVC/R Christian Voice			6065af
0530	0556	DRM	Romania, R Romania Intl		11875eu	
0530	0556		Romania, R Romania Intl		9700eu	17760eu
			21500eu			
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		9470af	13780af
			17820af			
0600	0630		Vatican City State, Vatican R		3975eu	6075eu
			7250eu			
0600	0650	DRM	New Zealand, R New Zealand Intl			13730pa
0600	0655		South Africa, Channel Africa			15255af
0600	0657		China, China R International			6115na
			11750af	11770as	11880as	13645as
			15145as	15350as	15465as	17505va
			17540as	17710as		
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		9660pa	12080va
			13630va	13690va	15160va	15240va
			15415va	17750va	21725va	
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		6010na	6050na
			6060ca	6125ca		
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			13590af
			17695af			
0600	0700		South Africa, TWR Africa		3200af	4775af
			6120af			
0600	0700		UK, BBC World Service		3955eu	6005af
			6190af	9410af	11760me	12015af
			12095af	15310as	15400af	15420af
			17640af	17790as		
0600	0700	DRM	UK, BBC World Service		3955eu	
0600	0700		USA, Amer Forces Network/AFRTS			4319usb
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
0600	0700		USA, BBG/Voice of America		6080af	9885af
			15580af			
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	5755am
			12105na			
0600	0700		USA, WWCR Nashville TN		3215eu	4840na
			5890af	5935af		
0600	0700		USA, WWRB Manchester TN		3185na	5050na
			5745va			
0600	0700		Zambia, CVC/R Christian Voice			6065af
			17695af			
0630	0645		India, All India R/Guwahati		7280do	
0630	0645		India, All India R/Hyderbad		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	21725va	
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	Eqt 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, WWCR 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	Eqt 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, WWCR 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/Hyderbad	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		

SHORTWAVE GUIDE

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	12095af
			15285as	15310as	15400af	15575me
			17760as	17790as	17830af	21470af
0900	1000		USA, Amer Forces Network/AFRTS			4319usb
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
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, WTWW Lebanon TN	5080am		5755am
			12105na			
0900	1000		USA, WWCR 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	13720as
			15190as	15210pa	15350as	17490eu
			17690as			
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	17510pa
			17800as	17895pa		
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	12095af
			15285as	15310as	15575me	17640af
			17760as	17790as	21470af	
1000	1100	Sat/Sun	UK, BBC World Service	15400af		17830af
1000	1100		USA, Amer Forces Network/AFRTS			4319usb
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
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, WTWW Lebanon TN	5080am		5755am
			12105na			
1000	1100		USA, WWCR 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, WRMI/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			15720pa

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			7285as
1100	1156		Romania, R Romania Intl	15210eu		15430eu
			17510af	17670af		
1100	1157		China, China R International			5955as
			5960na	9570as	11650as	11795as
			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	5995va		6020va
			6140as	9475as	9560as	9580pa
			9590pa	11945as		
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			15720pa
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	12095af
			15285as	15575me	17640af	17790as
			17830as	21470af		
1100	1200		USA, Amer Forces Network/AFRTS			4319usb
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
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, WTWW 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	9645as
			9730as	9760	oa	11650as
			11690as	11760pa	12015as	13665eu
			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	9590pa
1200	1300	DRM	Australia, R Australia	5995va		
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	11895as
			15310as	15575me	17640af	17830as
			21470af			
1200	1300		USA, Amer Forces Network/AFRTS			4319usb
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
1200	1300		USA, BBG/Voice of America	7575as	9640as	
			11700pa	11750pa	12150va	
1200	1300		USA, EWTN/WEWN Irondale AL			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, WTWW 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/Hyderbad	4800do		
1230	1245		India, All India R/Jeypore	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	9730as
			9765as	9870as	11760pa	11885na
			11900pa	11980as	13670eu	13790eu
			15230na			
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	12015eu
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	11760me
			11890as	12095af	15310as	15420af
			15575me	17640af	17830as	21470af
1300	1400		USA, Amer Forces Network/AFRTS			4319usb
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
1300	1400	Sat/Sun	USA, BBG/Voice of America	7575as	9640as	
			11700va	12150va		
1300	1400		USA, EWTN/WEWN Irondale AL			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, WTWW 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	11560as
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	
1400	1500		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, WWCR 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/Jeypore	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/Jeypore	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
1500	1600		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, WWCR Nashville TN	7490af	9980af	
			13845eu	15825eu		

1500	1600		USA, WWRB Manchester TN	9385na		
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/Hyderbad	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, WWCR Nashville TN	9980af		12160af
			13845eu	15825eu		
1600	1700		USA, WWRB Manchester TN	9385na		
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, WWCR 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/Hyderbad	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 9445af 11670eu 11935af
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 9445af 11670eu 11935af
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 12133usb 12759usb 13362usb
1800	1900		USA, EWTN/WEWN Irondale AL	15610af		
1800	1900		USA, FBN/WTJC 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, WWCR Nashville TN	9980af	12160af	13845eu 15825eu
1800	1900		USA, WWRB Manchester TN	9385na		
1800	1900		USA, WYFR/Family R Worldwide	5890af	7385af	7395af 9895af 11665af 13750af
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 9445af 11670eu 11935af
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	

SHORTWAVE GUIDE

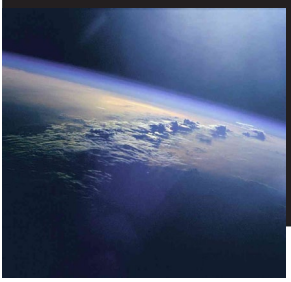
2100	2200	DRM	India, All India R/External Svc	9950eu
2100	2200		Malaysia, RTM Kajang/Traxx FM	7295do
2100	2200		Micronesia, V6MP/Cross R/Pohnpei	4755as
2100	2200		North Korea, Voice of Korea	3560as
			7570eu 12015eu	
2100	2200		Russia, Voice of Russia 7300eu	
2100	2200		South Africa, CVC 1 Africa R	4965af
			13590af	
2100	2200		Syria, R Damascus 9330va	
2100	2200		UK, BBC World Service 3255af	3915as
			5875as 5905af 5955af	5965as
			6190af 6195as 9410af	9915af
			12095af	
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	smtwhf	USA, WBCQ Monticello ME 7490am	
2100	2200	Sun	USA, WHRI Cypress Creek SC	9490va
2100	2200		USA, WINB Red Lion PA 13570ca	
2100	2200		USA, WJHR Intl Milton FL 15550na	
2100	2200		USA, WTWW Lebanon TN 9480na	9990am
			12105na	
2100	2200		USA, WWCR Nashville TN 7465eu	9350af
			9980af 13845eu	
2100	2200		USA, WWRB Manchester TN 3215na	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 Katherine 5025do	
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

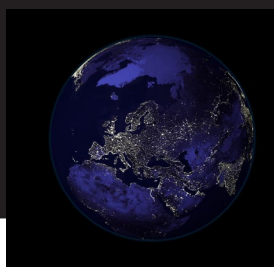
2200	2215	t	USA, WBCQ Monticello ME 7490am	
2200	2230		India, All India R/External Svc	7550eu
			9445eu 11670pa 11715pa	
2200	2230		Serbia, International R Serbia	6100eu
2200	2230		South Korea, KBS World R 3955eu	
2200	2230		Turkey, Voice of Turkey 9610va	
2200	2245		Egypt, R Cairo 6270eu	
2200	2256		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 Katherine 5025do	
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, WTWW Lebanon TN 9480na	9990am
			12105na	
2200	2300		USA, WWCR Nashville TN 7465eu	9350af
			9980af 13845eu	
2200	2300		USA, WWRB Manchester TN 3215na	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 Katherine 5025do	
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, WTWW Lebanon TN 9480na	9990am
			12105na	
2300	0000		USA, WWCR Nashville TN 3195eu	5070af
			9980af 13845eu	
2300	0000		USA, WWRB Manchester TN 3185na	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 do Amazonas		4805do
0000	0100	Brazil, R Difusora Roraima	4875do	
0000	0100	Brazil, R Difusora/Caceres	5055do	
0000	0100	Brazil, R Difusora/Londrina	4815do	
0000	0100	Brazil, R Difusora/Macapa	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 Guaruja Paulista	5045do	
0000	0100	Brazil, R Guaruja/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/Macapa	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 Guaruja Paulista	5045do	
0100	0200	Brazil, R Guaruja/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 Guaruja Paulista 5045do
0200 0300 Brazil, R Guaruja/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 Guaruja Paulista 5045do
0300 0400 Brazil, R Guaruja/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
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 Guaruja Paulista 5045do
0400 0500 Brazil, R Guaruja/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 Guaruja 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

SHORTWAVE GUIDE

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 11830do
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 Guaruja Paulista	5045do	
1000	1100		Brazil, R Guaruja/Florianopolis		5980do
1000	1100		Brazil, R Inconfidencia	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 11830do
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 Guaruja Paulista	5045do	
1100	1200		Brazil, R Guaruja/Florianopolis		5980do
1100	1200		Brazil, R Imaculada Conceicao		4755do
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	6160do	9550do	11895do
1200 1300	Brazil, R Brasil Central	4985do	11815do	
1200 1300	Brazil, R Cancao Nova	4825do	6105do	9675do
1200 1300	Brazil, R Capital	6070do		
1200 1300	Brazil, R Capixaba	4935do		
1200 1300	Brazil, R Clube do Para	4885do		
1200 1300	Brazil, R Congonhas	4775do		
1200 1300	Brazil, R Cultura do Para	5045do		
1200 1300	Brazil, R Cultura Filadelfia	6105do		
1200 1300	Brazil, R Cultura/Araraquara		3365do	
1200 1300	Brazil, R Cultura/Manaus	4845do		
1200 1300	Brazil, R Daqui	4915do	6080do	11830do
1200 1300	Brazil, R Difusora Acreana	4885do		
1200 1300	Brazil, R Difusora do Amazonas		4805do	
1200 1300	Brazil, R Difusora Roraima	4875do		
1200 1300	Brazil, R Difusora/Caceres	5055do		
1200 1300	Brazil, R Difusora/Londrina	4815do		
1200 1300	Brazil, R Difusora/Macapa	4915do		
1200 1300	Brazil, R Educacao Rural/Coari		5035do	
1200 1300	Brazil, R Educadora 6 de Agosto		3355do	
1200 1300	Brazil, R Educadora Rural/Tefe		4925do	
1200 1300	Brazil, R Educadora/Guajara Mirim		3375do	
1200 1300	Brazil, R Educadora/Limeira	2380do		
1200 1300	Brazil, R Gaucha	6020do	11915do	
1200 1300	Brazil, R Gazeta	5955do	9685do	
1200 1300	Brazil, R Guaiba	6000do	11785do	
1200 1300	Brazil, R Guaruja Paulista	5045do		
1200 1300	Brazil, R Imaculada Conceicao		4755do	
1200 1300	Brazil, R Inconfidencia	6010do	15190do	
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.worldwideuniversity network.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.awr2.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.classiccountryam1060.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**
Eqt 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.awr2.org/**
Germany, Deutsche Welle ..... **www.dw.de**
Germany, Pan American Broadcasting ..... **www.radiopanam.com/**
Germany, TWR Europe ..... **www.twr.org**
Guam, AWR/KSDA **www.awr2.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/Hyderbad ..... **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/Jeypore ..... **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.pmapacific.org/**
Nepal, R Nepal ..... **www.radionepal.org/**
Netherlands, R Netherlands Worldwide ..... **www.radionetherlands.nl/**
New Zealand, R New Zealand Intl ..... **www.rnzi.com**
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.awr2.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.awr2.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.org/**
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, WWCR Nashville TN ..... **www.wwcr.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**

MILCOM
MONITORING MILITARY COMMUNICATIONS

Larry Van Horn, N5FPW
larryvanhorn@monitoringtimes.com
Blog: http://mt-milcom.blogspot.com
Twitter: MilcomMP

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 386.1875/396.1765
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
388.7000/398.70000

❖ 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	Mineral Wells TX	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*

FED FILES

GOVERNMENT COMMUNICATIONS

Chris Parris
chrisparris@monitoringtimes.com
www

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 aplenty 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.**

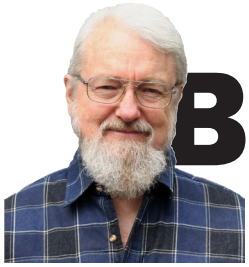
In early 2012, there were several news reports about the IWN project being halted, or even de-funded. I posted on the *Fed Files* blog page some items I had located on line concerning a "stop work" order being used to the IWN project due to concerns about procurement procedures. There was a flurry of 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.



BOATS, PLANES, AND TRAINS

PLANES

Iden Rogers
idenrogers@monitoringtimes.com

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.groveent.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 NBD 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 incudes 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/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/navaids/.** 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 primarily 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 trudge 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.

GLOBALNET

Exploring the World of Internet Radio and Television

Loyd Van Horn, W4LVH
globalnetmt@gmail.com
Twitter: @GlobalnetMT

New Ways to Talk Amateur Radio

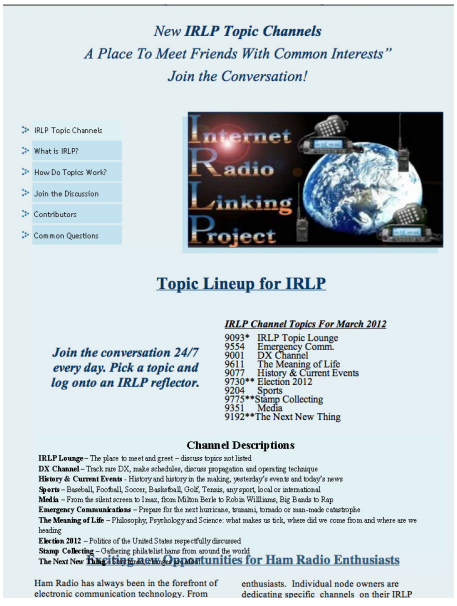
Amateur radio has always been a way to connect the world using innovative means. From the early days of experimenting with Morse code, to voice communications via tubed-based radios, amateur radio has often been at the forefront of experimentation in technology.

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 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.

The stations, through Commercial Radio

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/

BELOW 500 kHz

DXING THE BASEMENT BAND

Kevin Carey, WB2QMY
kevincarey@monitoringtimes.com

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.

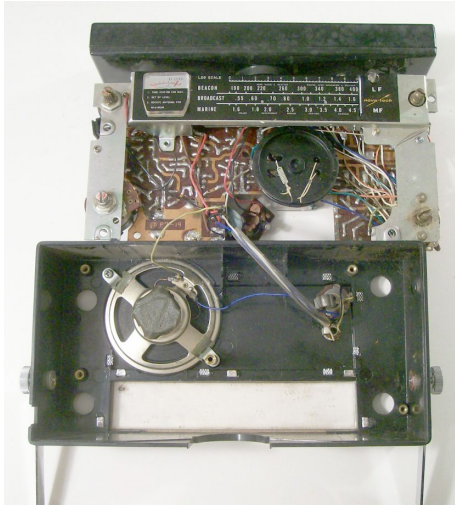


Figure 1. Bendix Navigator 420 with PC board removed

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 sure I had them spotless.

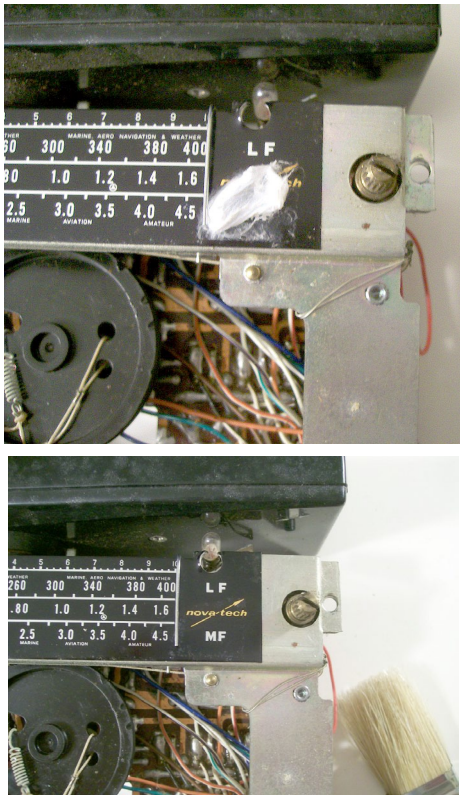


Figure 2. Close-up images showing the cocoon in place, and then removed

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.

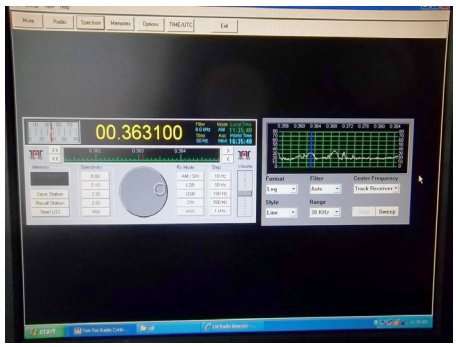
❖ 472-479 kHz Ham Band!

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
201	ZXU	London, ON
209	MT	Chibougamau, QC
215	YTR	Trenton, ON
221	HM	Hamilton, ON
235	CN	Cochrane, ON
243	YVB	Bonaventure, QC
248	KZ	Buttonville, ON
253	YTF	Alma, QC
266	ZMM	Montreal, QC
272	YQA	Muskoka, ON
274	YPM	Pikangikum, ON
276	YEL	Elliot Lake, ON
289	YLQ	La Tuque, QC
300	YOG	Ogoki Post, ON
326	VV	Wiarton, ON
328	YTL	Big Trout Lake, ON
334	YSH	Smiths Falls, ON
335	ZKF	Kitchener, ON
338	ZEM	Eastman, QC
341	YYU	Kapuskasing, ON
344	ZOW	Ottawa, ON
348	ANQ	Angola, IN
348	ZUL	Montreal, QC
351	PH	Mosinee, WI
353	IN	Int'l Falls, MN
356	HEU	Schenectady, NY
358	TNY	Fayetteville, TN
360	PN	Port Menier, QC
362	AK	Akron, OH
363	RNB	Millville, NJ
365	FKV	Gainesville, GA
368	ZYZ	Toronto, ON
404	YSL	St. Leonard, NB

RADIO RESTORATIONS

BRINGING OLD RADIOS BACK TO LIFE

Marc Ellis, N9EWJ
marcellis@monitoringtimes.com

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

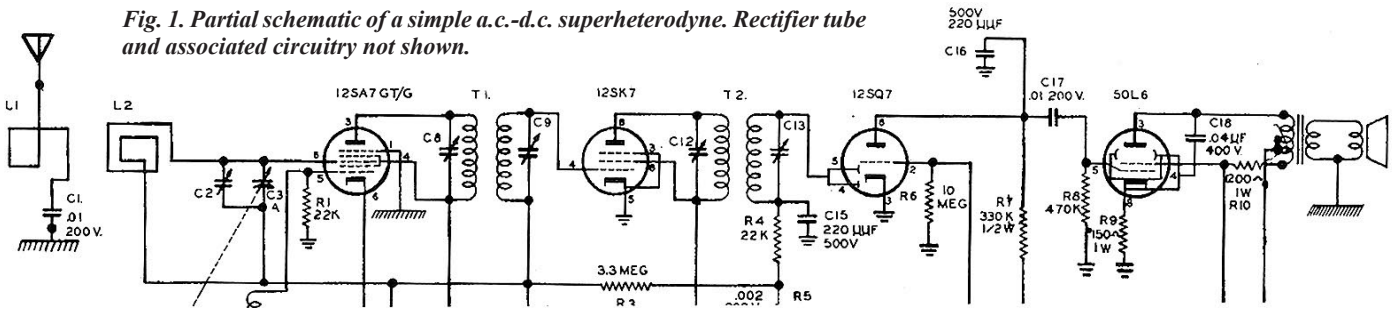


Fig. 1. Partial schematic of a simple a.c.-d.c. superheterodyne. Rectifier tube and associated circuitry not shown.

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!

ANTENNA TOPICS

BUYING, BUILDING AND UNDERSTANDING ANTENNAS

Dan Farber, AC0LW
danfarber@monitoringtimes.com

Improvise, Adapt, Overcome

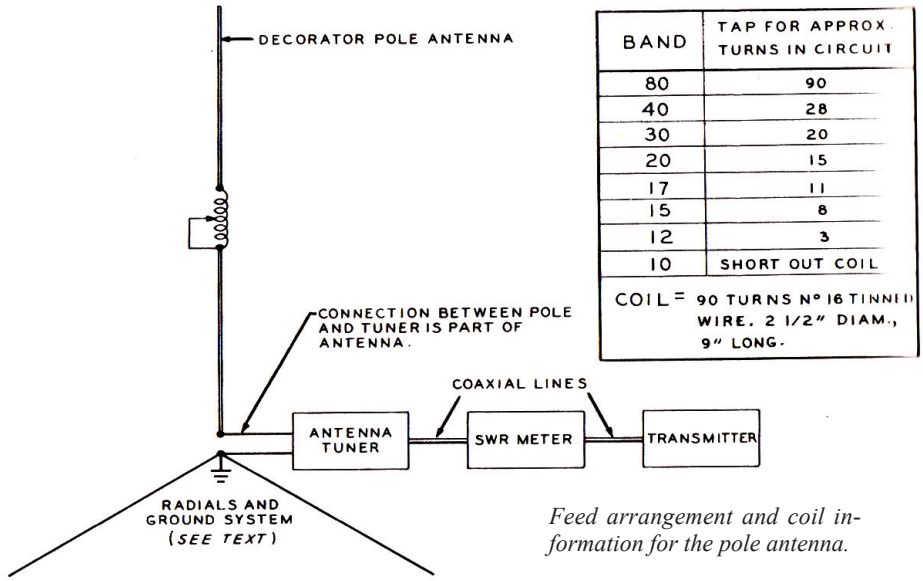
Get Creative with HF Antenna Solutions

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, 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.



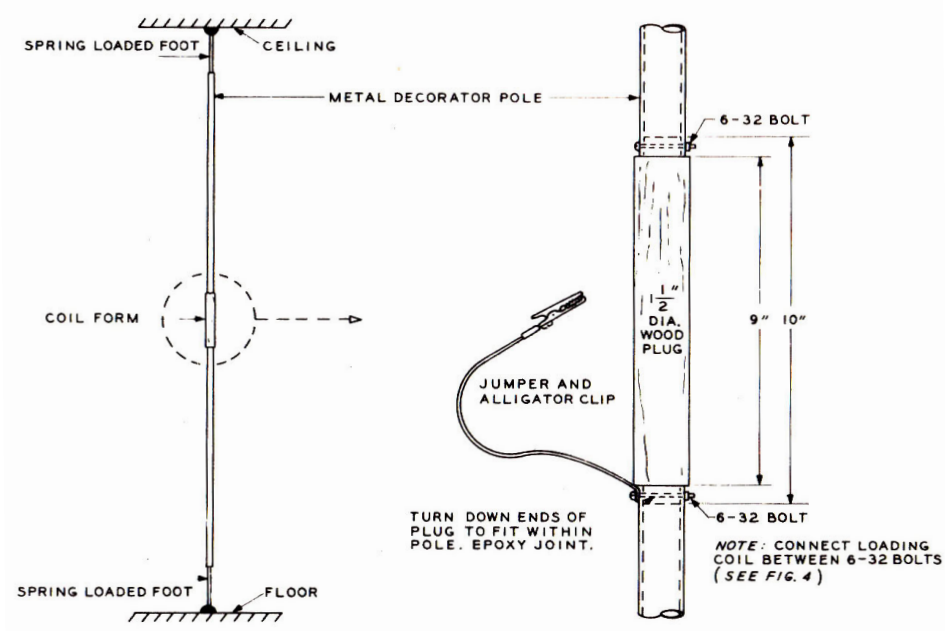
Feed arrangement and coil information for the pole antenna.

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 *tinned* 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!

SKY SURFING

RADIO FROM THE OUTER REACHES

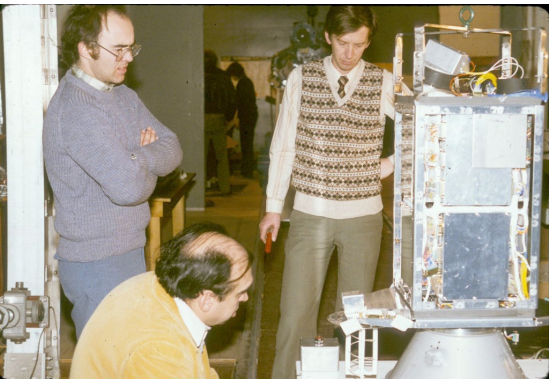
Keith Baker, KB1SF / VA3KSF
keithbaker@monitoringtimes.com

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 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.

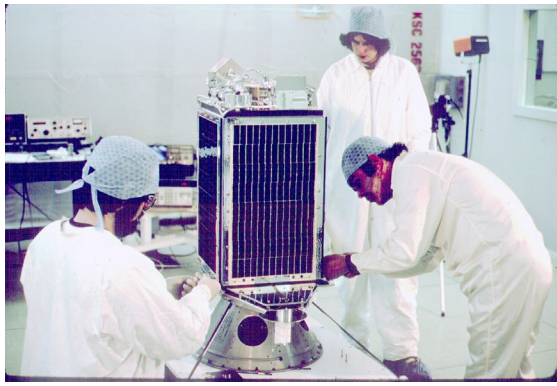
UO-11 FREQUENCY AND MODE DATA

BEACONS (MHz)	MODE	STATUS
145.826	AFSK FM ASCII Telemetry	Semi-Operational
435.025		Non-Operational
2401.50		Non-Operational

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 whether 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.g3cwv.co.uk/oscar11.htm.** I used the excellent information Clive has compiled about UO-11 on that page as background for this column.



Technicians clad in their clean room "bunny suits" prepare UoSAT-2 for shipment to the launch site. (Courtesy: AMSAT-UK/SSTL)

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.g3cwv.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.

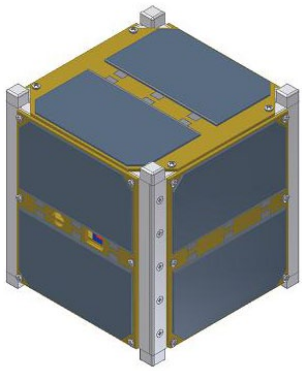
You will recall that Cosmonaut/Flight Engineers Sergei Volkov and Alexander Samokutyaev deployed ARISSat-1 from the International Space Station on August 3, 2011 during EVA-29. The satellite carried a student experiment from Kursk State University in Russia, which measured atmospheric density. Students 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 enjoy a brand new amateur radio spacecraft in orbit for just the cost of building (versus building *and* launching) the satellite."



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)

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 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.

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)

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.

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.

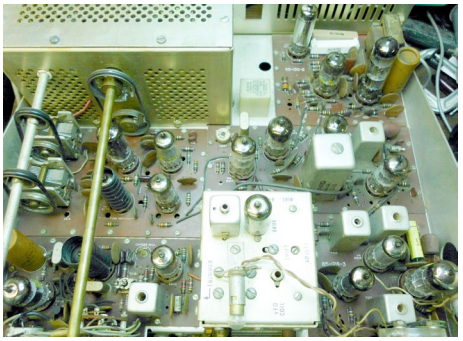
Back in the day, the Heath company claimed the HW-100 to be the world's fastest-selling transceiver. At the time, they were probably right. It first appeared on the market in early 1968, as a low-cost alternative to Heath's SB-101 transceiver that had come out a year before. It is nearly identical to 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.

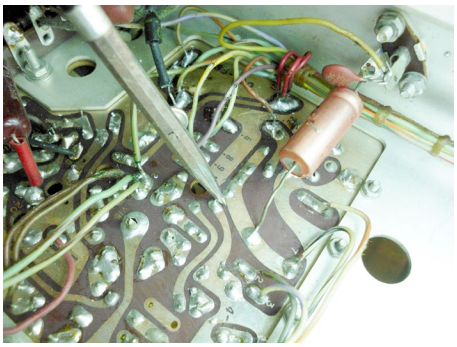
This radio had more than 40 years of dust inside, so I stood it on its side and used a makeup brush and small artist's paintbrush to carefully clean away the dust. The benefit of standing the radio on its side to do this is the dust falls instead of just being scattered around. Most of it sticks to tubes 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...

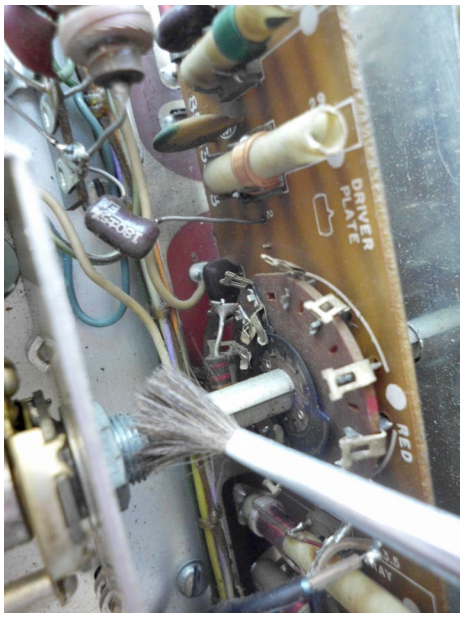
Here are the results of the resistance test: Shown are resistor number, original specified value in ohms and actual resistance value. Only those resistors undervalued by at least 30 percent or which have been on fire are shown. If you have a HW-100, HW-101, or perhaps even an SB-101 schematic, you can 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
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



With the radio on its side, I used a brush to gently sweep away the dusty innards of the HW-100.

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 midway 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.

As 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/adapter.

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).

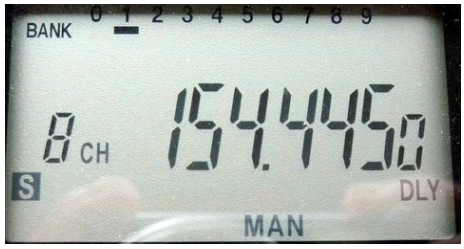
The user can select whichever bands he wants swept to capture unknown users. The PSR-120 will automatically display the discovered frequency and allow the user to monitor the signal.

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

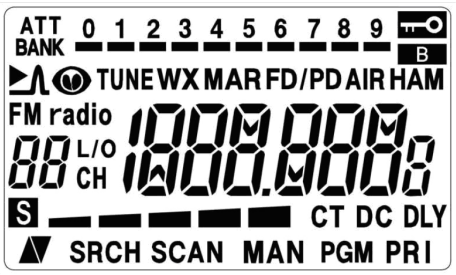
SAME/FIPS encoding for specific cities or counties can be custom selected, providing an alert tone during storm threats. A pushbutton press starts the automatic search for active NOAA weather channels in your area.

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 pressing 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.

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!"

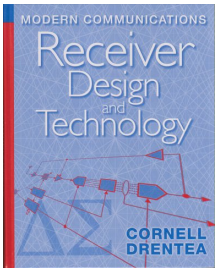
More information is available from R&L Electronics, 1315 Maple Avenue, Hamilton OH 45011, (800) 221-7735 or on the net at **RandL.com** or **www.InnovAntennas.com**.

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 comprehensive 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.

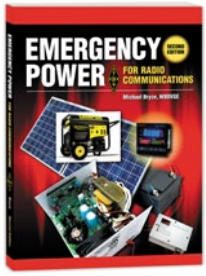
Three foot lengths are ideal for fast taper, low wind resistance applications, while the six foot slow taper lengths provide greatest bandwidth. Most sizes are available with a slit on one end for use with DX Engineering's marine-grade stainless steel element clamps. Optional UV-rated black vinyl caps, 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, WB8VGE

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.

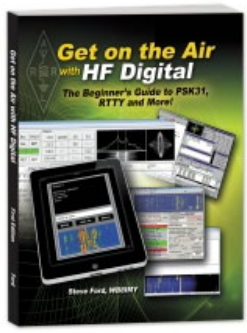
This hardcover 224 page book (ISBN: 978-0-87259-615-3) sells for $27.95 and is available from the ARRL, amateur radio dealers and various *MT* advertisers.

Get on the Air with HF Digital

By Steve Ford, WB8IMY

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!

Get on the Air with HF Digital is a step-by-step guide that'll get you started in the fascinating world of HF digital technology. Written in an easy to understand, conversational style, this book will show you how to set up and operate your own HF digital station. The text includes instructions for configuring software programs for popular modes such as RTTY, PSK31 and JT65. You'll also learn about other digital communication modes such as MFSK, Olivia and PACTOR. It's a fun and easy way for beginners to get on the air and work the world.



Topics in this new book include:

- Let's Build an HF Digital Station – Exploring the three essential components of your station: a radio, a computer and a device that ties them together.
- 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."
- PACTOR – To get your message through error free, PACTOR is a great way to go.

This new ARRL softcover, 128 page book (ISBN: 978-0-87259-601-6) sells for $25.95. You can purchase this and other ARRL books and products directly from the ARRL, 225 Main Street, Newington, CT 06111-1494, (860) 594-0200 or on the web via their website at **www.arrl.org**.

Books and equipment for announcement or review should be sent to What's New, c/o Monitoring Times, 7540 Highway 64 West, Brasstown, NC 28902. Press releases may be faxed to 828-837-2216 or emailed to Larry Van Horn, *larryvanhorn@monitoringtimes.com*.

When ordering or inquiring about the products mentioned in this column, be sure to tell them that you saw it in the pages of *Monitoring Times* magazine.

to the editors

editor@monitoringtimes.com

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&nvpair=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, Hispasat1C, 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-96v3Z1z06ysc** 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

GROVE

Your Source for Radio Scanners, Receivers, Accessories, and Publications

Grove means service. ***You won't find better customer service anywhere. BUY TODAY!***

Established in 1979 by well-known communications expert Bob Grove, Grove Enterprises has become a world leader in radio monitoring equipment, accessories, and publications.

If you decide you don't like a product, Grove Enterprises doesn't penalize you for it. There is NO restocking fee so long as you call our toll free number for a return authorization within fifteen days of shipment and the item is returned in new condition. Once the item is received we will give you credit toward another item or issue a full refund (less shipping charges). Software cannot be returned if opened.

That's it! No hassle! No negotiations! Just call 1-800-438-8155 and our friendly staff will assist you with a return authorization number.

BUY NOW!

Shipping/ Handling Charges

Total Order	Shipping Charges
$1-$19.99	$3.00
$20-$49.99	$6.95
$50-$99.99	$9.95
$100-$399.99	$13.95
$400-$899.99	$17.95
$900-$1499.99	$20.95
$1500-$1999.99	$24.95
$2000-$2499.99	$28.95
$2500+	$32.95

GROVE

CALL TODAY!

(800) 438-8155

www.grove-ent.com

Grove Enterprises, Inc. - www.grove-ent.com

(800) 438-8155; (828) 837-9200; fax: (828) 837-2216

7540 Hwy 64 W; Brasstown, NC 28902 - email: order@grove-ent.com

ALINCO

DJ-X7T	SCN 3	$179.95
DJ-X11T	SCN24	$319.95

GRE

PSR-100	SCN16	$89.95
PSR-200U	SCN17	$89.95
PSR-310	SCN22	$149.95
PSR-410	SCN23	$149.95
PSR-500	SCN18	$339.95
PSR-600	SCN19	$349.95
PSR-700	SCN56	$179.95
PSR-800	SCN57	$449.95

UNIDEN

BCT15X	SCN31	$209.95
BCD996XT	SCN21	$449.95
BCD396XT	SCN53	$449.95
BCD346XT	SCN45	$199.95
BCT8	SCN08	$162.95
HomePatrol-1	SCN55	$489.95
BC355C	DS-BC355	$99.95
BC95XLT	DS-BC95XLT	$99.95

ICOM

R6	SCN54	$199.95
R20	SCN 20	$539.95

AOR

AR8200IIIB	SCN51	$729.95

RAMSEY

ABM1 Air Band Monitor	SCN05	$149.95

ANTENNAS & CABLES

Grove Hidden Flex-tenna	ANT49	$19.95
Austin Condor	ANT 14	$34.95
Grove Scanner Beam III	ANT 03	$69.95
Procomm CD144M/BN mag mount antenna	ANT50	$19.95
OMNI II Scanner	ANT 5	$29.95
WiNRADiO AX-71C Discone	ANT01	$89.95
WiNRADiO AX-37A Wide-band Log Periodic	ANT28	$389.95
WiNRADiO AX-37AM Wide-band Log Periodic	ANT29	$499.95
WiNRADiO AX-07B flexible VHF/UHF	ANT47	$27.95
WiNRADiO AX-91M magnetic antenna base	ANT48	$27.95
Icom AH-8000 Wide-coverage Discone	ANT54	$269.95
Grove Flex-tenna HVU	ANT45	$14.95
Grove Flex-tenna VU	ANT46	$9.95
Professional Wideband Discone	ANT 9	$99.95
Scantenna + 50' coax	ANT 7	$49.95
Super-M Ultra Base Station	ANT61MBS	$189.95
Super-M Ultra Mobile antenna w/NMO mount	ANT61NMO	$109.95
Super-M Ultra Mobile mag mount	ANT61	$124.95
Super-M Multiband base antenna	ANT10MBS	$99.95
Super-M Mobile antennna w/ NMO mount	ANT10NMO	$79.95
AOR DA3200 ultra wideband discone antenna	ANT 62	$214.95
AOR MA500 Wide Range	ANT 12	$119.95
AOR SA7000 super-wide receiving	ANT 39	$269.95
WiNRADiO WR-AX-31C Log-Periodic Antenna	ANT 58	$189.95
WiNRADiO AX-24B discone antenna	ANT 63	$319.95
Grove Universal Telescoping Whip	ANT 6	$14.95
Diamond HT/Receiving & Scanner antenna	ANT 64	$21.95
Super-M Superior Mobile Antenna	ANT 10	$94.95
Create CLP51301N Log-Periodic Antenna	ANT 16	$439.95
Create CLP51302N Log-Periodic Antenna	ANT 17	$319.95
Diamond SRH77CA HT/Receiving & Scanner Ant	ANT67	$21.95
25' of RG-6U cable	CBL25	$14.95
50' of RG-6U cable	CBL 50	$19.95
100' of RG-6U cable	CBL 100	$24.95

MISCELLANEOUS ACCESSORIES

UNIDEN UA-72 DC CORD	DCC 19	$19.95
Universal Cigarette Adaptor	DCC 3	$12.95
Ramsey Broadband Preamp	PRE 2	$59.95
Scancat-Lite Plus	SFT 19	$29.95
PAR VHF Intermod Filter 152MHz	FTR 152DS	$69.95
PAR VHF Intermod Filter 158MHZ	FTR 158DS	$69.95
PAR VHF Intermod Filter 462MHz	FTR 462DS	$69.95
FM Trap Filter 88-108MHz	FTR-FMDS	$69.95
PAR NOAA Weather Filter 162 MHz	FTR 162DS	$69.95
GRE Superamplifier	PRE 1	$53.95
Noise Cancelling Mobile Speaker	SPK 7	$8.95

INDEX OF ADVERTISERS

AMSAT.....76
Antique Wireless 63
AOR CVR2
ARRL..... CVR3
Kevin Carey (Longwave).....76
C Crane.....31
CIDX.....76
Computer Aided Technology.....21
Grove 19, 21, 59, 65, 75
ICOM CVR4
MT Express 3, 73
NASB.....7
Profiles in Radio 76
Stealth.....76
TEAK Publishing 61
Universal Radio 71, 76
W5YI 5
WiNRADiO 1

Reach new customers with your advertising message in *Monitoring Times*! Contact Judy Grove at **1-800-438-8155** or **email judy@grove-ent.com**

Columnist Blogs and Web Sites

These blogs and web pages were created by some of our columnists to better serve their readers. While we highly recommend these resources, they are not official instruments of Monitoring Times.

AMERICAN BANDSCAN
http://americanbandscan.blogspot.com/ - by Doug Smith

ANTENNA TOPICS
www.wa5vjb.com - by Kent Britain

BELOW 500KHZ
http://below500khz.blogspot.com/ - by Kevin Carey

FED FILES
http://mt-fedfiles.blogspot.com/ - by Chris Parris

LARRY'S MONITORING POST
http://monitor-post.blogspot.com/ - by Larry Van Horn

MILCOM
http://mt-milcom.blogspot.com/ - by Larry Van Horn

SCANNING REPORT
http://www.signalharbor.com/ - by Dan Veeneman

SHORTWAVE
http://mt-shortwave.blogspot.com/- by Gayle Van Horn

UTILITY WORLD
http://mt-utility.blogspot.com/- by Hugh Stegman
www.ominous-valve.com/uteworld.html

Stock Exchange

For information on Stock Exchange or commercial advertising, contact Judy Grove at 1-800-438-8155 or judy@grove-ent.com

Line Ads $1 per word

*Just downloaded the August issue, saved it in iBooks, and have read about half. Looks *great* on the iPad. This is definitely the way to go....*

-Scott

Sent from my iPad

Don't Just Listen...Talk Too!

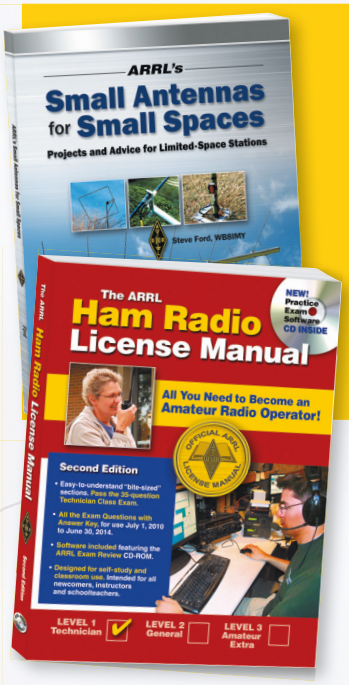
Communicate with People Around the World or Around the Corner

Join ARRL and Discover the Excitement of Ham Radio

The Amateur Radio Service offers a unique mix of public service, technology and experimenting with electronics – all with an emphasis on fun. Some hams use their skills to provide communications during emergencies and disasters when all else fails. Others enjoy talking to people across the country and around the globe, participating in local contests and building experiments. Whatever YOUR interest, ARRL – the national association for Amateur Radio – has all the resources you need to **get started, get involved** and **get on the air**.

ARRL members have direct access to all the top experts in the Amateur Radio Service. Members enjoy *QST* magazine – ARRL's official journal and the most widely read ham radio publication in the country, free e-newsletters, problem-solving technical advice, access to online product reviews, and much more!

Special Offer! **Free Book for Readers of *Monitoring Times***



Join ARRL today and get ***ARRL's Small Antennas for Small Spaces*** book FREE. You'll find ideas and projects that will get you on the air regardless of where you live!

Don't have your Amateur Radio license yet?
ARRL can help you with that, too! Join ARRL and get a FREE copy of ***The ARRL Ham Radio License Manual*** (book with practice exam software). Pass the 35-question license test.

Go to **www.arrl.org/join/MT** or call 1-888-277-5289 to take advantage of these special offers.

Join ARRL Today!

Learn more about Amateur Radio

Talk, don't just listen. Learn how YOU can become a licensed Amateur Radio operator and get on the air! Discover the benefits of ARRL membership and more by visiting **www.arrl.org/MT**.

Join Today! Online www.arrl.org/join/MT
or Call Toll-Free 1-888-277-5289

ARRL *The national association for AMATEUR RADIO®*
www.arrl.org

Icom has the receivers for the experts...

IC-R9500 The Ultimate Wide Band Receiver

- 0.005–3335.000MHz*
- USB, LSB, CW, FSK, FM, WFM, AM
- 1020 Alphanumeric Memory Channels
- P25 (Option UT-122)
- Five Roofing Filters and so much more!

For those just getting started...

IC-R75 Wide Band Receiver

- 0.03–60.0 MHz*
- Triple Conversion
- Twin Passband Tuning
- Digital Signal Processing (DSP)

AND for those on the go!

IC-R20 Advanced Ops

- RX: 0.150–3304.999MHz*
- AM, FM, WFM, SSB, CW
- 1250 Alphanumeric Memory Channels
- Dualwatch Receive
- 4-hour Digital Recorder

IC-RX7 Track Ready

- RX: 0.150–1300.0MHz*
- AM, FM, WFM
- 1825 Alphanumeric Memory Channels
- 100 Ch/Second High Speed Scan
- Computer Programmable[2]
- Water Resistance Equivalent to IPX4

IC-R6 Pocket Compact

- RX: .100–1309.995MHz*
- AM, FM, WFM
- 1300 Alphanumeric Memory Channels
- 100 Ch/Second High Speed Scan
- Computer Controllable[1]

IC-R2500 2 Wide Band RX in 1 Black Box

- RX: 0.01–3299.99MHz*
- AM, FM, WFM, SSB, CW (Main)
- AM, FM and WFM (Sub)
- 1000 Memory Channels
- Optional D-STAR (UT-118)
- Optional P25 (UT-122)
- Optional DSP (UT-106)
- PC Controllable

Limited Time Only!
See your dealer for details.

IC-PCR1500 PC Control Wide Band RX

- RX: 0.01–3299.99MHz*
- AM, FM, WFM, SSB, CW
- Record and Save Audio as .WAV File
- USB Cable Connection
- Optional DSP

Information & Downloads

RECEIVERS | AMATEUR TOOL KIT | COMIC BOOKS | VIDEOS | WWW.ICOMAMERICA.COM

ICOM®

*Frequency specs may vary. Refer to owner's manual for exact frequency specs. [1]Optional CT-17 required. [2]Optional CS-RX7 required.