CTU
CONTEST UNIVERSITY

Dayton Contest University
May 18, 2017
Crowne Plaza Hotel
Dayton, Ohio

The **World Wide Radio Operators Foundation** was created in 2009 by a group of experienced radio operators who saw a need for an independent organization devoted to the skill and art of radio operating. Until now, many of the elements of modern radio contest operating such as log-checking software, log submission robots, etc., have been developed and supported by volunteers. Who will organize and fund the enhancement of these tools into the future? The **World Wide Radio Operators Foundation** was created to help fill that need.

WWROF is dedicated to improving the skills of amateur radio operators around the world, utilizing education, competition, advancement of technology and scientific research, promoting international friendship and goodwill, and preparing them to better serve society in times of communication need.

WWROF Programs

- Webinar series on contesting and operating topics
- Stewards of the Cabrillo log file standard
- Log submission and processing infrastructure
- Contest award management including certificate and plaque distribution
- Support of Contest University and WRTC
- Other projects that support contesting

WWROF Contester's Code of Ethics

- I will learn and obey the rules of any contest I enter, including the rules of my entry category.
- I will obey the rules for amateur radio in my country.
- I will not modify my log after the contest by using additional data sources to correct callsign/exchange errors.
- I will accept the judging and scoring decisions of the contest sponsor as final.
- I will adhere to the DX Code of Conduct in my operating style.
- I will yield my frequency to any emergency communications activity.
- I will operate my transmitter with sufficient signal quality to minimize interference to others.

Leadership

John Dorr, K1AR, Chair
Tim Duffy, K3LR, Vice-Chair
Ralph Bowen, N5RZ, Treasurer
Tom Lee, K8AZ, Secretary
Doug Grant, K1DG, Founding Director
Mark Beckwith, N5OT, Founding Director
Bob Cox, K3EST, Founding Director
John Sluymer, VE3EJ, Director
Tine Brajnik, S50A, Director
Randy Thompson, K5ZD, Director
Dennis Motschenbacher, K7BV, Director

Donate

Can you imagine contesting without electronic logs? Sophisticated log checking software? Certificates for winners? The World Wide Radio Operators Foundation is completely dependent on contributions for our funding. We welcome donations of any amount to help us fund our projects.

WWROF is recognized by the Internal Revenue Service as a tax-exempt public charity under section 501(c)(3) of the Internal Revenue Code.

Learn more. Visit wwrof.org

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Dayton, Ohio USA

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First Edition

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Welcome

On behalf of the CTU Board of Directors K1DG, N9JA and K1AR, K8MNJ and the 11 CTU Professors of Dayton Contest University 2017 we are pleased you are here and we extend a warm welcome to you!

There have been more than 40 CTU's held in the past eleven years. CTU's have been held here in Dayton, Chicago, Brazil, England, Germany, Finland, Italy, Australia, Russia and Puerto Rico.

Over 20 presentations are available here at Dayton Contest University 2017. They are the work product of many hours of effort by your Professors and the CTU staff (special thanks to K8MNJ, N9RV, DL1QQ and K1SO).

Icom America has led the way by sponsoring this event from the start in 2007. Contest University would not be possible without the support of Ray Novak, N9JA and Icom, DX Engineering, CQ Magazine, and The ARRL, all have contributed their help and guidance in making this CTU the best ever. Please support these vendors who have given back to our RadioSport hobby.

Contest University is a platform for sharing ideas and learning new ways to enjoy Amateur Radio Contesting. We hope you will enjoy and share what you learn here today.

Finally, while we have tried to make everything as perfect as possible for you here at CTU, I ask for your patience as we work out any problems. Your on going support for CTU is critical as we move forward to more Contest University's in the future.

Remember to Always – Share, Learn, Enjoy and Encourage!

Very 73!

Tim Duffy K3LR
CTU Chairman

2017 Dayton Contest University "CTU" – COURSE OUTLINE – 7:00 AM to 5:00 PM

7:00 ALL SALONS ABCD – Student Registration and Contest Buffet Breakfast – ALL - 60 minutes
8:00 ALL SALONS ABCD – Welcome to CTU 2017 – K3LR – ALL - 10 minutes
8:10 ALL SALONS ABCD – It's a Fun Game – Let's Operate The Right Way – W5ZN – ALL - 40 minutes

9:00 CONTEST TOPIC SESSION #1 – attend ONE of 4 sessions – 60 minutes
SALON A – How to Improve your Transmitting Antennas for Low Solar Activity – W3LPL
SALON B – Introduction to Introduction to Contesting – NØAX
SALON C/D – CW and RTTY Skimmer and the Reverse Beacon Network – N6TV
HARDING – Optimizing 6 Meter Contest Scores Utilizing JT Digital Modes – W5ZN

10:00 ALL - *CONTEST SNACK* – 15 minutes

10:15 CONTEST TOPIC SESSION #2 – attend ONE of 4 sessions – 60 minutes
SALON A – Easy to Build Low Band Receiving Antennas for Small and Large Lots – W3LPL
SALON B – A Deep Dive Into Stacking Yagis – W8WWV
SALON C/D – Grounding and Bonding for the Little Pistol and Medium Gun – NØAX
HARDING– RTTY Contesting, A to Z – WØYK

11:20 CONTEST TOPIC SESSION #3 – attend ONE of 4 sessions – 55 minutes
SALON A – How to Adapt your DX Contest Strategies for Low Solar Activity – W3LPL
SALON B – Little Pistols, Bigger Scores – K2YWE
SALON C/D – The Advantages of Waterfall Displays for Contesting and DXing – N6TV
HARDING – Advanced Topics in RTTY Contesting – WØYK

12:15 ALL SALONS ABCD - *CONTEST LUNCH* – ALL - 35 minutes
12:50 ALL SALONS ABCD – Contesting is Amateur Radio's Shining Star - ALL - 10 minutes – K3LR
1:00-1:35 ALL SALONS ABCD – The Wonderful World of Space Weather – Dr. Tamitha Skov

***1:45 CONTEST TOPIC SESSION by REQUEST to RERUN** - 50 minutes
*SALON A – As determined by *vote 1
SALON B – As determined by *vote 2
*SALON C/D – As determined by *vote 3
*HARDING – As determined by *vote 4

2:40 CONTEST OPEN DISCUSSION Q&A GROUPs Attend ONE of 4 sessions – 30 minutes
SALON A – Antennas and Propagation – W3LPL
SALON B – Contest Shack Design Ideas – NØAX
SALON C/D – Waterfalls, Recordings and Reverse Beacon Network – N6TV
HARDING – Antenna/Tower Reliability – W3YQ

3:15 CONTEST OPEN DISCUSSION Q&A GROUPs Attend ONE of 4 sessions – 30 minutes
SALON A – Small Stations With Big Ideas – K2YWE
SALON B – Receiving Antenna Ideas – W3LPL
SALON C/D – Grounding and Bonding – NØAX
HARDING – RTTY Contesting Discussion – WØYK

3:45 ALL - *CONTEST SNACK* – 15 minutes

4:00 ALL SALONS ABCD – Disruptive Technologies, How they Change our Hobby - NCØB – ALL – 50 minutes
4:50 ALL SALONS ABCD – 2017 CTU Survey – K3LR – ALL - 10 minutes

*** 1:45 PM CONTEST SESSION by REQUEST vote to RERUN**
CTU students will vote for 4 topics/classes that they missed and would like to have presented again – the top 4 WANTED by vote - will RERUN in this time slot.

Contest University Professor Bios

Frank Donovan, W3LPL

Frank's contesting career began as a twelve year old at the Providence Radio Assn. 1959 ARRL Field Day, W1OP/1, on a hilltop two miles from his home in Providence, Rhode Island. Soon afterwards he began to slowly build his own small contest station on 1/10th acre in a densely populated urban neighborhood.

17 year old K1LPL finished first place USA in the 1964 ARRL CW DX Contest low power category. In 1968 he was the leader of the W1OP/1 Field Day that finished in first place in the Field Day 4A category. Immediately after college, 2nd Lieutenant Frank Donovan's first military assignment was in the Washington D.C. area where he worked for PVRC member W3GN and with his multi-multi mentor W4BVV.

Frank finished first place USA single operator in four CQ WW CW and four ARRL CW DX contests from 1973 to 1978. His first multi-multi experience was with the world high scoring 1974 PJ9JT CQ WW CW team. W3LPL multi-multi teams started nearly forty years ago with a small entry in the 1978 CQ WW Phone DX Contest. Less than four years later, two incredible long nights of 10 meter JA runs unexpectedly produced his team's first USA multi-multi win in the 1982 ARRL Phone DX Contest.

W3LPL multi-multi teams have completed nearly one million QSOs and achieved 50 first place USA finishes out of nearly 140 entries in the CQ WW and ARRL DX contests. Frank is a member of the prestigious CQ Contest Hall of Fame and is a regular presenter at Contest University. He retired six years ago as a Chief Engineer at General Dynamics Corporation after a 45 year career in electronics and systems engineering.

Tim Duffy, K3LR

Tim has been an active contest operator for over 44 years. He has hosted over 130 different operators as part of the K3LR Multi-Multi DX contest efforts since 1992 – making over 700,000 QSOs. Tim served on the ARRL Contest Advisory Committee as a member and multi-year Chairman. K3LR has been an active member of the CQ Contest Committee for 27 years. Tim was the Atlantic Division Technical Achievement award winner in 1998. He was moderator of the Dayton Contest Forum for 10 years and has been moderator of the Hamvention Antenna forum for 34 years. He is a founding member and President of the North Coast Contesters. K3LR serves as founder and chairman of Contest University (11 years) and the Dayton Contest Dinner (25 years), chairman of the Top Band Dinner (6 years) – as well as coordinator of the Contest Super Suite (32 years) in Dayton. He is founder and moderator of the popular RFI Reflector (RFI@contesting.com). He has been a guest on Ham Nation many times. Tim was a member of Team USA at WRTC – four times – he will operate with DL1QQ in Germany for WRTC2018. Tim serves on the board of directors of the World Wide Radio Operators Foundation (WWROF) as Vice Chairman. He is President of The Radio Club of America (RCA). Tim is President of the Mercer County Amateur Radio Club - W3LIF (16 years). K3LR was elected to the CQ Contest Hall of Fame in 2006. He was honored with the prestigious Barry Goldwater Amateur Radio service award by RCA in 2010. Tim served as ARRL Section Manager for Western Pennsylvania 2015/2016. Tim was honored to be the 2015 Amateur of the Year as awarded by the Dayton Amateur Radio Association which runs the Dayton Hamvention®. K3LR was awarded the YASME Excellence Award in 2016. Tim is the Chief Operating Officer and General Manager at DX Engineering.

Joel Harrison, W5ZN

Joel was first licensed as WN5IGF in 1972. His first contest was the old ARRL CD Party in 1973. His interests later turned to VHF contesting, finally breaking into the top 10 in the ARRL June VHF contest in 1993. In June 1996 he won first place in the single op category setting a new world record under the callsign WB5IGF. In 1998 he returned to the June contest as W5ZN, once again winning first place and breaking his previous 1996 record. In 2001 he won first place single op in the ARRL UHF Contest and in 2011 the W5ZN team won first place in the Limited Multiop category of the ARRL June VHF Contest. W5ZN was a team member of the record setting WA8WZG contest team in 1999 and 2000 and the K1WHS team that finished first in the multiop category of the 2010 ARRL September VHF contest outing multi-year winner W2SZ. W5ZN is also active in HF contests. In the 2006 ARRL DX Contest he set a new 80 meter CW record for the W5 call area that held until 2009. In 2011 he reclaimed that record that still holds today. He is a member of the W2GD 160 Meter multiop team. Joel holds 10 band DXCC and 11 band VUCC, is an A-1 Operator and served as ARRL President from 2006 until 2010 when he retired from ARRL elected service after 27 years. In 2014 he was awarded the ARRL Medal of Honor for outstanding service to amateur radio. He has published many antenna articles in VHF/UHF/Microwave Conference proceedings including co-author of the W1GHZ Microwave Antenna Book. Joel has a passion for 160 meter receive antenna systems, authoring the First and Second Editions of "Design, Construction & Evaluation of the 8 Vertical Circle Array for Low Band Receiving". The First Edition appeared in the March/April 2010 issue of *QEX.* He just recently published "Comparison of the HiZ-8 and BSEF 8 Vertical Arrays for Low Band Receiving" and currently records comparative data from five different low band receive antenna systems during the winter low band season.

Tim Jellison, W3YQ/KL7WV

Tim was licensed in 1973 at 13 years of age. He achieved 5BDXCC then went on to confirm 100+ countries on 160. He is on the air regularly, chasing DX, and he participants in CW DX contests, these days primarily as an operator at the K8AZ multi-op station.

Professionally, he took a job managing a satellite communication facility following his graduation from Penn State in 1981. He then changed career paths in 1999 and accepted a position running a cellular network throughout the state of Alaska. He left corporate life in 2012 and is now semi retired, working for a commercial tower company.

Tim has been a technician and a technical manager all of his adult life. He's been involved in all aspects of electronics, radio, towers, and antennas. He holds a valid FCC Radiotelephone License and is Comtrain and CITCA certified as an Authorized Tower Climber/Rescuer. He's installed, maintained, and repaired numerous towers and antennas and can often be found working on K3LR's equipment and towers.

Ed Muns, WØYK

Ed, WØYK, entered CW and SSB DX contests initially in the early 1970s as a way to work new band/mode-countries for DXCC. His interest rapidly evolved from DXing to contesting with his early learning at the KØRF multi-multi. Today, CW and RTTY contesting dominate Ed's operating time. His local contest club, the Northern California Contest Club (NCCC), mounted an effort for the club competition gavel first offered in the 2004 ARRL RTTY Round-Up where Ed reluctantly (kicking and screaming) learned how to setup RTTY and ultimately won the Pacific Division SOHP plaque. He ironically enjoyed that induction into RTTY so much that he now includes all the major RTTY contests in his contesting schedule. With his P49X call sign, Ed holds the world SOHP record in ARRL RTTY Round-Up, having broken the record eight times, and the world SOHP record in CQ WPX RTTY, having broken that record seven times and set a world SOHP record in the 2010 CQ WW RTTY. Ed is the contest manager for the NCJ NA RTTY Sprint and the contest director for the two CQ RTTY contests, CQ WW RTTY and CQ WPX RTTY. He and Don, AA5AU, sponsor the Ten-Meter RTTY Contest which they initiated in December 2011 with nearly 700 logs submitted. He was inducted into the CQ Contest Hall of Fame in May 2014. This is his tenth year at CTU delivering the two RTTY presentations and Q&A.

Greg Ordy, W8WWV

Greg was first licensed as WB9CTH in 1969 at the age of 15. Active through high school and college, amateur radio went on the back burner while he obtained a BS and MS in Computer Engineering from Case Western Reserve in Cleveland, Ohio. He has worked in the field of digital simulation software and several small businesses ever since. The itch for amateur radio soon returned, and over the last 20 years he has been refining his HF station. His main interests include phased arrays, antennas for the lower HF bands, antenna measurements, and antenna modeling. He has contributed to the National Contest Journal, given several papers at the Dayton Antenna forum, helped with the ARRL Antenna book and the Low Band DXing book. Greg is also a professor at a local college. His web is site filled with lots of helpful “stuff”:

http://www.seed-solutions.com/gregordy/Amateur%20Radio/W8WWV%20Experimentation.htm

Rob Sherwood, NCØB

Ham radio began for me in 1961 in Cincinnati, Ohio, as both a novice and general-class operator. After graduating college in 1969 with a degree in physics, I moved to Denver and worked for KOA radio as an engineer until 1987. While at KOA, I maintained their 50 KW AM and FM transmitters, microwave links and studio equipment.

1974 saw the beginning of Sherwood Engineering, offering roofing filters and upgrade kits for the Drake R-4C. In 1976 I started measuring receiver performance on dozens of radios, since reviews in QST did not correlate with actual on-air observations at crunch time in CW contests. In 1977 “ham radio magazine” published the first of several of my articles on receiver problems and cures, vertical antenna ground systems and mobile antenna efficiency. Those articles are available on my web site as PDF files. Receiver test data is now web based with over 100 transceivers included at www.nc0b.com/table.html.

In the 80s I was invited to be a forum speaker at the Dayton Hamvention on several occasions, discussing both receiver and antenna performance issues. In 2004 I returned to the Dayton Contest Forum, giving a talk on the status of receivers both old and new, with special emphasis on the Orion and the Icom 7800. In 2007 the Drake Forum had me present a talk on the pros and cons of the new batch of DSP transceivers. In 2009 I made a presentation at the Dayton Hamvention Antenna Forum on ground systems for vertical antennas.

April 2016 included a presentation at the Visalia DX Convention, and a ninth appearance at Contest University run by K3LR on Thursday before Dayton.

Other speaking invitations at ham events have included WØDXCC, W9DXCC, W4DXCC, YCCC, New Orleans, Austin, Huntsville and Albuquerque hamfests. Locally around Colorado I have discussed receiver performance at the Boulder Amateur Radio, Northern Colorado Amateur Radio, Colorado QRP & 285 TechConnect Radio Clubs.

Ten years ago, my XYL encouraged me to build my dream contest station on 10 acres east of Ft. Collins, Colorado. This has made it possible to evaluate top transceivers in major contests in a real-world environment to augment my laboratory data. This rural setting has allowed me to focus my interest on effective antennas. Six towers support nine mono-band yagis and several wire antennas from 160 – 2 meters.

Ward Silver, NØAX

Ward has been an active contester since before his Novice days began in 1972, participating with high school club friends as WAØWBJ and WBØDQI. Ward is the author of Ham Radio for Dummies and is the Lead Editor of the ARRL Handbook, Antenna Book, and all three License Manuals. He was inducted into the CQ Contest Hall of Fame in 2015 and has received the Bill Orr Technical Writing Award from the ARRL twice, once in 2003 and again in 2017. He was a founder of the World Radio sport team Championships (WRTC) in 1990 and is currently Secretary of the WRTC Sanctioning Committee. In 2013 he was elected President of the Yasme Foundation which supports amateur radio activities around the world. His list of contest operating spans four continents and includes a variety of good scores from home and multioperator stations such as HC8N, PJ4Q, KH6RS/NH6T, K3LR, K9CT, W7RM, KL7RA, W5ZN , and W1AW. He considers himself fortunate to have a few top finish plaques on the wall of the radio room but the best part is participating in record-setting team efforts with friends from coast-to-coast. He has been known to amuse his fellow amateurs by “hamifying” popular songs and performing them publicly with the Spurious Emissions (Out of the) Band.

Tamitha Skov

Tamitha Skov works primarily in the fields of solar and space physics research and in the testing of spacecraft materials in realistic space radiation environments. She is an instructor at The Aerospace Institute and has served as an audio forensics analyst and instructor for the National Law Enforcement and Corrections Technology Center (NLECTC), funded by the Department of Justice. Her forecasting work as the “Space Weather Woman” is widely known on social media such as You Tube, Twitter, and Facebook. She is the space weather forecaster for the amateur radio TWiT TV show Ham Nation, and she has made appearances on several television shows for The Weather Channel and The History Channel.

Bob Wilson, N6TV

“TV Bob” is an active CW contester and Win-Test supporter. Licensed for 45 years, Bob competed at the World Radiosport Team Championship (WRTC) in San Francisco (1996), Slovenia (2000), and Moscow (2010). He finished first in the 2013 ARRL November CW Sweepstakes CW (Class B), and the September 2014 NA Sprint CW.

Bob was an early adopter of the Perseus and QS1R SDRs and CW Skimmer, and has recently been developing accessory hardware and software for the latest generation of HF transceivers. He voluntarily supports Win-Test users, and also helps update the documentation. He was a member of K2KW’s original “Team Vertical” group (6Y4A, 4M7X), and has been part of the multi-op teams at HC8N, K3LR, and W7RN (K5RC). Bob recently retired after 36 years as a software engineer at IBM.

Dan Zeitlin, K2YWE (K3AU)

Dan started contesting after almost 40 years of CW rag-chewing and leisurely DX chasing. In 1995 he was invited to be a member of a four-Op 2A Field Day team with W3LPL, K3RA, and K3MM. Dan loved the contest-like environment generated by the group. He summarily became infected with the contest bug and joined the W3LPL team. After several years at W3LPL, Dan struck out on his own with a "grass roots" low power station and eventually earned consistent top 10 finishes in domestic and international contests. Several 2nd place US/VE (always a bride's maid) and top 5 Worldwide being among the results. Concurrently, Dan maintained a presence at multi-multi stations in selected contests. Dan recently rejoined the W3LPL team, the Single Op "iron man" routine having become harder to sustain at his advancing age. He still operates as a little pistol from home, but mounts serious efforts only in shorter events like SS, where he holds two recent Atlantic Division plaques. K3AU has been Dan's contest call since 2004. He is a Vice President of PVRC and member of several CW clubs. Over the past ten years, Dan has given various contest presentations for radio clubs, an ARRL convention, and an international WWROF Webinar. He retired from the Aerospace industry in late 2008 and volunteers his time in STEM educational programs at the National Electronics Museum (NEM). Dan is a guest speaker actively promoting contesting to less experienced and new hams during the annual NEM Amateur Radio Operating class given by K3RA.

2017 Contesting Related Events

May 17th – Wednesday night

7 PM Contest Super Suite at the Crowne Plaza opens hosted by the Mad River Radio Club (MRRC), Frankford Radio Club (FRC) and the North Coast Contesters (NCC).

8 PM to 10 PM Dayton Contest University 2017 Registration

10:30 PM Pizza Party in the Harding Room sponsored by Dayton Contest University 2017. http://www.contestsupersuite.com.

May 18th – Thursday daytime

7 AM Dayton Contest University 2017 Registration opens. Must sign up in advance – http://www.contestuniversity.com.

8 AM – 5 PM Dayton Contest University 2017 at the Crowne Plaza – 2nd floor.

May 18th – Thursday night

6 PM: RTTY Contesting Dinner, Spaghetti Warehouse, Presentations by: W6SX, W1UE and K6TU

7 PM Contest Super Suite at the Crowne Plaza hosted by the Mad River Radio Club (MRRC), Frankford Radio Club (FRC) and the North Coast Contesters (NCC).

10:30 PM QSL Wing and Pizza Party in the Harding Room sponsored by K8CC, K3WW, K3LR, and Society of Midwest Contesters (SMC). http://www.contestsupersuite.com

May 19th – Friday daytime

2:30 PM – 5:00 PM Antenna Forum at Hamvention in Xenia, Ohio, Room 1 Moderator: Tim Duffy, K3LR.

"Enhancing Stacked Yagi Arrays with Parasitic Elements & BOLPA Log Periodic Development" – Justin Johnson, GØKSC

"Space Weather and Amateur Radio: Science, Forecasting and Effects – Dr. Tamitha Skov

"Using High Performance Multiplexer Technology to Improve Your HF Station Capability" – Andrei Fedorishev, RA6LBS

"Building and Installing the 3 Element 80 Meter Yagi at WØAIH" – Paul Bittner, WØAIH

May 19th – Friday night

7 PM Contest Super Suite at the Crowne Plaza hosted by The Mad River Radio Club (MRRC), Frankford Radio Club (FRC) and North Coast Contesters (NCC).

7:00 PM 28th Annual Top Band Dinner at the Crowne Plaza – Presidential Ballroom. Speaker is Nodir Tursoon-Zadeh, EY8MM. Tickets in advance from http://www.topbanddinner.com.

10:00 PM **"Spurious Emission Band"** Live in its **NEW** location – The Presidential Ballroom 2nd Floor of The Crowne Plaza

11:00 PM Pizza Party in the Harding Room sponsored by the Potomac Valley Radio Club (PVRC). http://www.contestsupersuite.com

May 20th – Saturday daytime

10:30 AM – 11:30 AM RTTY Contest Forum at Hamvention in Xenia, Ohio Room 3 Moderator: Ed Muns, WØYK

"SDR Advantages for RTTY Contesting", Stu Phillips, K6TU

"RTTY Contesting Q&A", Mark Aaker, K6UFO, Stu Phillips, K6TU, Ed Muns, WØYK

12:45 PM – 2:45 PM Contest Forum at Hamvention in Xenia, OH, Room 1 Moderator: Ward Silver, NØAX.

"WRTC2018 Planning Update" – Chris Janssen, DL1MGB

"The New CQWW Contest Directorate" – Doug Zwiebel, KR2Q; Bob Naumann, W5OV; Scott Robbins, W4PA

"Single–op Contesting in the 21st Century" – Tom Georgens, W2SC/8P5A
"25 Years of Multi Multi Contesting at K3LR" – Tim Duffy, K3LR

May 20th – Saturday evening

6:30 PM – 25th Annual Dayton Contest Dinner hosted by North Coast Contesters at the Crowne Plaza Presidential Ballroom. Dinner speakers are Tim Duffy, K3LR and John Dorr, K1AR. Space is limited. Details and tickets in advance are available at http://www.contestdinner.com.

7 PM Contest Super Suite at the Crowne Plaza hosted by The Mad River Radio Club (MRRC), Frankford Radio Club (FRC) and North Coast Contesters (NCC).

11 PM Pizza Party in the Harding Room sponsored by the Yankee Clipper Contest Club (YCCC). http://www.contestsupersuite.com

World Wide Radio
Operators Foundation

Contester's Code of Ethics

- I will learn and obey the rules of any contest I enter, including the rules of my entry category
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CTU Presents

It's a Fun Game

Let's Operate the Right Way

Joel Harrison, W5ZN

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ICOM

CASH PRIZES !!!!!!!!!!

- CQWW 1st Place Cash Price $25,000 ?
- ARRL DX 1st Place Cash Price $15,000 ?
- ARRL Sweepstakes 1st Place Cash Price $5,000 ?
- WHAAAAAAAAAAT????? No Money?

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Explaining Radio Contesting to a non-ham (or non-contester)

"We operate for 24/48 hours, log all the stations we contact, and see who can make the most contacts in the most states, countries"

"How do you know who won?"

"We send our logs to the sponsor, and they check them"

"How much money do you get for winning?"

"Nothing"

"Huh?? Then why do you do this?"

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Why do we do radio contests?

- ~~Financial Rewards~~
- Self Improvement
- Personal Satisfaction
- The thrill of competing "one-on-one" with Nobel Laureates, Rock Stars, Admirals, etc.
- Peer Recognition
- FUN and EXCITEMENT!!

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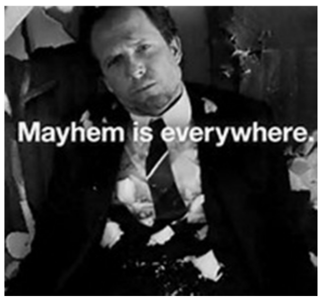
Why Do We Have Rules?

- Let's face it, if you're going to have FUN in an event such as ours we must have rules!
- What if there were none?



The Rules

"The rules are black & white, we make them gray" K5ZD

Which side of the fence are you on?

Right  Wrong

I don’t actually cross the fence

I just lean on it

I just straddle it a tiny bit !

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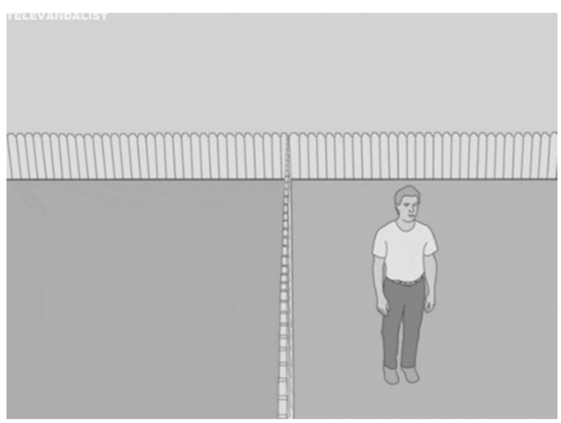
The Green Grass Temptation!



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Let’s Talk Ethics

- Discussion of what ethical behavior is in radio contesting
- Understand the impact of unethical behavior, and some of the motivations behind it
- Encourage participants to take ownership of their own behavior and encourage others to do the same

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Ethics & Attitude

- Let’s be honest – if you don’t embrace an ethical attitude you won’t put ethical behavior into practice!
- What are “Ethics”?
  - Moral principles that govern a person's or group's behavior
  - Ethics in practice is knowing the difference between right and wrong and choosing to do what is right

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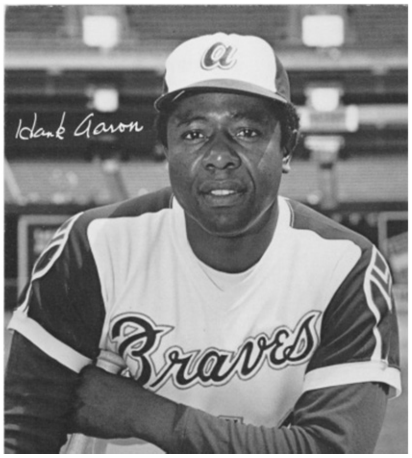
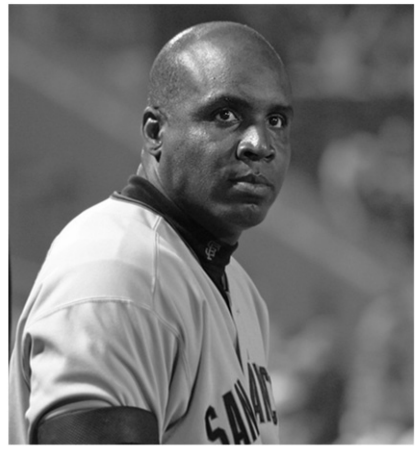
Why do ethics matter?



Hank Aaron
755 Home Runs



Barry Bonds
762 Home Runs

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Why do ethics matter?

Without ethics and respect – we have NOTHING

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Talk is Cheap

"I am NOT a crook!"

Neither am I !

Ethical *Actions* are *LOUD*

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Motivations for Cheating

- Desire to be a "hero" on the field of competition
- Achieve immortality via community legend, fame, and lasting peer recognition
- Seeking current community "stardom"
- Prove superiority over others (sibling rivalry)
- A means to prove self-worth
- These are *Powerful forces*, worthy of study and caution

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Multi-op Team ?

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Ethics in Contesting

- Unobservable rules require participants to choose right or wrong on their own.
- Ethics are in play particularly when no one is looking. We are free to choose.
- The freedom to choose right or wrong carries both responsibility and scrutiny.

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Ethics and Respect

- Ethical behavior requires ***respect***…

- Respect for ***others***
- Respect for ***the game***
- Respect for ***yourself***

- To ***get*** respect, you have to ***give*** respect

Rationalizations for Cheating

- *Everybody is doing it (#1 Reason)*
- Nobody was hurt (*Except those cheated*)
- Nobody was watching (*Not any longer*)
- Overcome unfair disadvantages
- Rules don't specifically disallow a practice
- Rules apply to others, not us

“All the guys at the top are cheating”

- NO! They are not
  - There are a few bad apples – this is true in any sport
  - They don’t last long
- This belief is the primary reason for cheating - in virtually every sport studied!

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“I’m not a big gun…it doesn’t matter if I cut corners a bit”

- **Yes it does!**
- Bad habits early on become seriously bad habits later
- Your reputation is established early
- Dealing with temptation is hard…“It’s easy to just give in! And it keeps getting easier.”

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Honor Code

- You are responsible for your own reputation
  - Follow the rules!
  - Don’t participate with people who cheat
- Lead by example
  - You never know who is listening or watching
  - Don’t do anything you would not want to be made public
- Be respectfully vocal
  - Confront cheating when you see it
  - Every incident is an opportunity to teach proper behavior
  - Provide Peer Checking for others

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What is this peer recognition?

- We are recognized by our achievements and how we went about achieving those results
- Our recognition is influenced by what other people say about us
- We all need peer recognition (external) more than we may realize (there’s no money!)
- The classical “hero” myth lives in our psyche. We rightfully cheer those who win fairly.

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Peer Pressure

- Good
  - Encourage others to follow the rules
  - People respect those who are true to their beliefs

- Bad
  - Letting others influence you into not doing the right thing
  - “everyone else is doing it."

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Negative Peer Recognition Examples

- That station was too loud in the NAQP
- That guy uses a pair of 8877s and has remote receivers in Europe
- Joe uses spots but enters as unassisted
- Jim padded his log with bogus QSOs
- Larry operated with a broad signal to push away nearby stations and keep his channel clear.

While most of these examples can not be proven – they are often based upon something not being quite right about a log entry.

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Applying Positive Peer Pressure

- Be aware of your motives
  - Is it personal?
  - If necessary, enlist others to help deliver the message
- Give the benefit of the doubt
  - They may not realize what they are doing is against the rules
- Choose the right time
  - Can they listen without feeling attacked?
- Don't be angry or accusatory
  - Treat the issue as a mistake, not a crime
  - Focus on actions, not character
- Be there
  - People cheat because they see others get away with it
  - Not confronting the problem hurts everyone

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Time for a Test!!

- Let's review some of our peer pressure techniques

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Scenario 1

- We discover a local contester uses cluster spotting and enters an unassisted category. What do we do?
  - They never win anything so assume it doesn't matter
  - Avoid speaking to them ever again
  - Publicly call them a cheater at the next club meeting
  - Send a letter to the contest sponsor
  - Call them up and ask if they are aware of the rules about using spotting information

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Scenario 2

- We are invited to a multi-op and upon arrival, we discover they are running 2.5 KW. What do we do?
  - We are there, loud is good, operate anyway
  - Turn the power down to 1500 W when we're operating
  - Loudly encourage the other ops to follow our example
  - Quietly ask the owner if he always runs excess power
  - Leave (hard to do if thousands of miles from home)
  - Send a note to the contest sponsor and FCC

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Scenario 3

- A local contester has key clicks that wipe out large chunks of the band. What do you do?
  - Sharpen up YOUR keying and give him a dose of his own medicine!
  - Send "KLIX" on his frequency anonymously
  - Call him, tell him he has key clicks, and sign your call
  - Contact him after the contest, explain the problem, and ask to help fix the problem
  - Notify the contest sponsor and his rig's manufacturer

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Communication Success is Defined by the Receiver

How do we know what to do?

- Written Rules
  - Specified by the contest sponsor in writing
  - Black and white
  - May, can, should, must…
- Unwritten Rules
  - Expectations about behavior
  - Interpreted norms
  - Gray areas – Ethical behavior ***required***

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Some written rules are very clear
(some people break these anyway)

- **“A. Single Operator categories**: For all single operator categories, only one person (the operator) can contribute to the final score during the official contest period.”
- “Total output power per band must not exceed 1500 watts or the output power regulations of the country in which the entrant is operating, whichever is less.”

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Essence of Unwritten Rules

- Just because it's not specifically prohibited by written rules doesn't mean you should do it!
- Keep the contest on the radio and within the contest period – no log washing or padding!
- Don't give or take unfair advantage of others
- Learn and follow the spirit of the rules

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Examples of Unwritten "Rules"

- **Do not** make pre-arranged schedules
- **Do** identify frequently
- **Do not** ask friends to work you … only
- **Do** encourage club members to work everyone
- **Do not** work friends with multiple calls
- **Do** work and spot stations equally

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Examples of Unwritten "Rules"

- **Do not** telephone or text message multipliers
- **Do** make an effort to help casual callers enjoy the contest and make a contact
- **Do not** let others "help" your single-op effort
- **Do not** plop down 100 Hertz away from your competitor to intentionally disrupt their run

See the ARRL's *"HF Contesting - Good Practices, Interpretations & Suggestions*"

No "Log Washing"

- Using QRZ.com, spot history, 3830 reports, LoTW, club databases
- Using utilities to analyze and correct the log
- Replaying the contest to change the log
- Asking others who they worked or if a call sign is correct
- "Fixing" off times or band changes
- It's **over** when the 2359 rolls over to 0000

Technology - A Game Changer

- With more technology comes more ways to cheat… and more ways to detect cheating..
- Remote operations - Specify transmitter QTH unambiguously. Adhere to RX distance rules.
- Crowd sourcing – CQWW 2014 CW – egregious cheating found through community effort. World high TO7A DQed – previous years also DQed!
- Few places left to hide with SDR, RBN, etc.
- Ethics becomes more important than ever as technology marches onward

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The Contest Code of Ethics www.wwrof.org

1. I will learn and obey the rules of any contest I enter, including the rules of my entry category.
2. I will obey the rules for amateur radio in my country.
3. I will not modify my log after the contest by using additional data sources to correct call sign/exchange errors.
4. I will accept the judging and scoring decisions of the contest sponsor as final.
5. I will adhere to the DX Code of Conduct in my operating style (see dx-code.org).
6. I will yield my frequency to any emergency communications activity.
7. I will operate my transmitter with sufficient signal quality to minimize interference to others.

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The CTU 2017 Challenge !

- Play by the rules **PERIOD!**
- Attend today’s sessions to gain an effective edge in operator skill
- Attend today’s sessions to gain an effective edge in station technology
- Apply that edge in your next radiosport challenge
- HAVE FUN !!!

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The W5ZN Multi-op Team Will See you on the Bands

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Acknowledgments

This presentation draws on material developed by:

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Larry Tyree N6TR
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Ward Silver, N0AX
Kirk Pickering, K4RO
Tim Duffy, K3LR

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How to Improve Your Transmitting Antennas for Low Solar Activity

- Vertically polarized 160 meter antennas
- Horizontally polarized 80-10 meter antennas
- Single Yagi and single tower stations
- Stacked Yagis
- Quantitative performance evaluation

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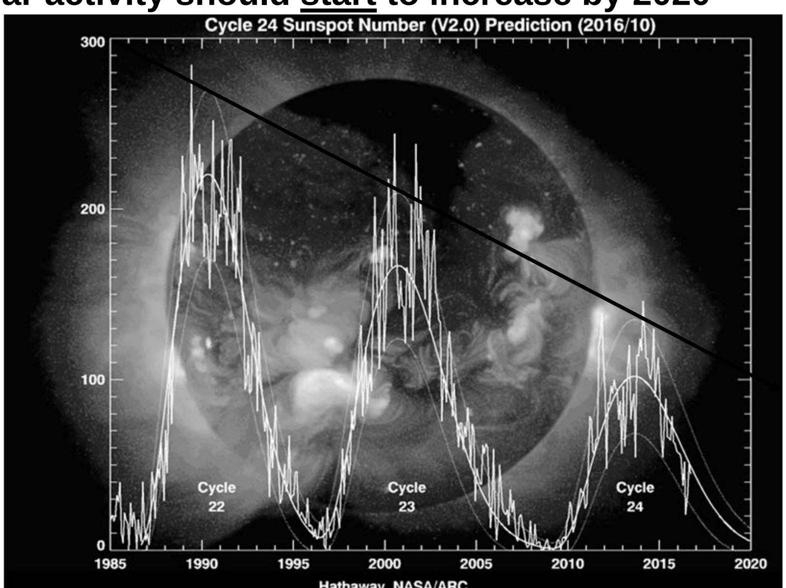
Five Years of Very Low Solar Activity

Solar activity should <u>start</u> to increase by 2020



Cycle 25

Solar activity remains low until 2022

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Transmitting Antenna Elevation Angles Needed for Low Solar Activity

- 10 meters – primarily open to the south
  - almost all DX propagation is at elevation angles below 10 degrees
  - many marginal DX paths require elevation angles well below 5 degrees
- 15 meters – much shorter openings to Europe
  - almost all DX propagation is at elevation angles below 10 degrees
  - many marginal DX paths require elevation angles well below 5 degrees
- 20 meters – the most crowded daytime DX band
  - almost all DX propagation is at elevation angles below 15 degrees
  - most marginal DX paths require elevation angles well below 10 degrees
- 40 meters – the most crowded afternoon and night DX band
  - almost a 24 hour DX band especially during CQWW CW in late November
  - wide variety of elevation angles are needed from 5 to 25 degrees
- 80 meters – a very important DX band for the next five years
  - very efficient antennas for angles below 10 degrees to 30+ degrees
- 160 meters – an excellent DX band for the next five years
  - vertical antennas are the only efficient 160M DX transmitting antennas

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6 dB of "Free" Ground Gain

- Vertically polarized antennas can achieve 6 dB ground gain only over highly conductive soil such as a salt marsh
- A horizontally polarized dipole, Yagi or quad easily provides 6 dB of valuable ground gain
  - but only if you install it an appropriate height
- Higher antennas are needed during low solar activity
- Stacked HF Yagis achieve higher gain mainly by suppressing undesired high angle radiation and redistributing the power into the main low angle beam
  - stacked Yagis must be installed at appropriate heights to achieve the expected results

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Vertical Polarization for 160 Meters

almost always **provides better DX performance than any horizontally polarized antenna**

- Vertical, inverted-L, T, and umbrella transmitting antennas *almost always* outperform horizontally polarized antennas at distances beyond 1500 miles
- Nearby tall towers and antennas can significantly degrade the performance of vertical antennas
  - antenna pattern degradation
  - losses
- Efficient radial systems are essential to achieving the full performance potential of vertical transmitting antennas

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Horizontal Polarization for 80 Meters

easily provides 6 dB of "free" ground gain

- Horizontal dipole or inverted-V dipole 50-70 feet high
  - superb Sweepstakes and Field Day antenna
  - a good DX antenna for distances up to about 5000 miles
- Horizontal dipole or inverted-V dipole at 70 feet or higher
  - outperforms a single 65 foot vertical installed over all but the most conductive soils such as a salt marsh
- Use a vertically polarized antenna if you cannot install a dipole or inverted-V dipole at least 70 feet high
  - 65 foot vertical, inverted-L, T or umbrella with at least 30-60 radials
  - or a corner fed delta loop or inverted-U
- **Four-square vertical array**
  - with at least sixty 70 foot shallow buried radials per vertical
  - very competitive with high horizontally polarized arrays

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High Performance Transmitting Antennas for 160 Meter DX

- 125 foot vertical: the gold standard 160 meter antenna
  - well spaced from all nearby tall towers and antennas
    - at least 140 feet from towers over 80 feet tall supporting large HF Yagis
    - optimum performance with spacing much greater than 140 feet
  - Install at least 30-60 shallow buried 125 foot radials
    - or at least two (preferably four or more) elevated 125 foot radials
      - but only if 30-60 shallow buried 125 foot radials are not possible
    - or a K2AV folded counterpoise (a counterpoise for small lots)
- Inverted-L, T and umbrella antennas are good alternatives
  - 50 feet or higher (as short as 35 feet with reduced performance)
  - supported by a tower, mast or trees
- Vertically polarized corner fed delta loop

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High Performance Transmitting Antennas for 80 Meter DX

- Horizontal dipole at least 70-100 feet high
  - higher is better
- 65 foot vertical
  - install at least 30-60 shallow buried 65 foot radials
    - or at least two (but preferably four or more) elevated 65 foot radials
      - only if buried radials are impossible
  - at least 70 feet from towers over 40 feet tall supporting a Yagi antenna
    - optimum performance with much more than 70 foot spacing
- Inverted-L, T and umbrella verticals are good alternatives
  - as little as 25 feet tall supported by a tower or trees
  - install at least 30-60 shallow buried 65 foot radials
    - or elevated radials
    - or a reduced size counterpoise
- Or a vertically polarized corner fed delta loop

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4-Square Vertical Array

an excellent high performance alternative to a very high 80 meter horizontal antenna

- A four square vertical array is very competitive with high horizontally polarized Yagis and quads
  - its also an excellent receiving antenna
- install at least 70 feet from all other towers
  - much more than 70 feet will significantly improve its performance
- at least 30-60 shallow buried 70 foot radials under each vertical

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Comtek 4-Square Controller

www.dxengineering.com/search/brand/comtek

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High Performance 40M Antennas

- High horizontal dipole at least 70 feet high
  - 13-45 degree elevation beam pattern at -3 dB points
  - otherwise use a four-square vertical array with 30-60 radials
- Higher gain: 2 element Yagi at 70-100 feet high
  - 10-30 degree elevation beam pattern at -3 dB points
  - significant improvement over a simple horizontal dipole for DX
  - a Cushcraft XM-240 at 100 feet high is very cost effective
- Highest gain: full size 3 element Yagi at 140+ feet high
  - 7-20 degree elevation beam pattern at -3 dB points
  - but don't underestimate the high cost and complexity of the effort !

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Elevation angles from <5-25º are needed

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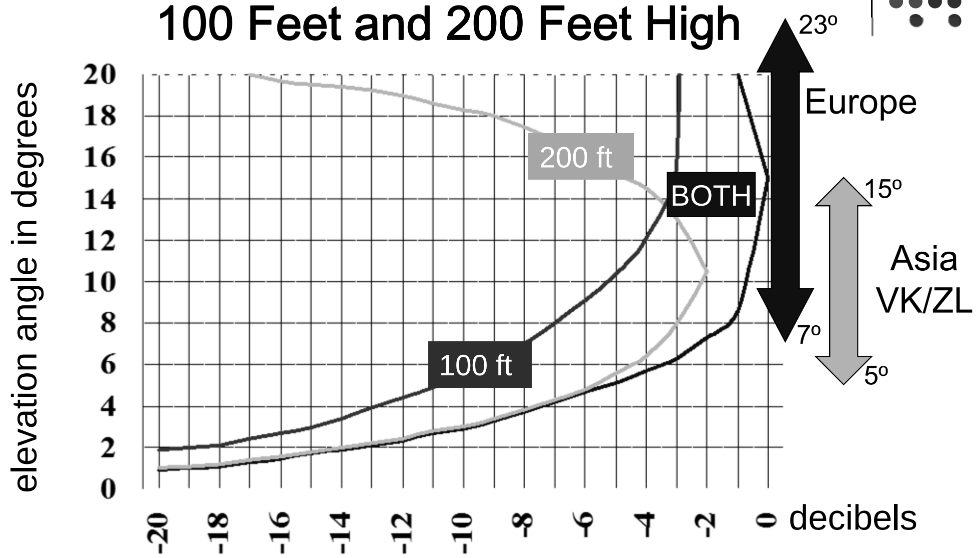
Stacked 3 Element 40 Meter Yagis
48 Foot Booms
100 Feet and 200 Feet High



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Elevation angles from <5-25º are needed

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4-Square Vertical Array for 40 Meters

- A 4-square vertical array is good alternative to a Yagi if you cannot install it at least 70 feet high
  - install a 4-square at least 40 feet from all towers
    - more spacing will significantly improve its performance
  - at least 30 to 60 slightly buried 35 foot radials under each vertical
- A 4-square is an excellent receiving antenna

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High Performance 20M Antennas

- A horizontal Yagi or quad is always the best choice
  - if you can install your antenna at 35 feet high or higher
  - 13-45 degree elevation beam pattern at -3 dB points
- Moderate gain: small tri-band Yagi, hex-beam or quad
  - a small Yagi at 50 to 70 feet high will produce good DX results
  - 10-30 degree elevation beam pattern at -3 dB points
- High gain: full size tri-band Yagi, small monoband Yagi or quad
  - 70 to 100 feet high
  - 7-20 degree elevation beam pattern at -3 dB points
- Highest gain: two stacked monoband Yagis
  - 100-140 foot tower (170 to 200 foot tower for three stacked Yagis)
  - 3-15 degree elevation beam pattern at -3 dB points
  - stack switching (a “stackmatch”) provides high payoff at low cost

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Elevation angles from <5-15º are needed

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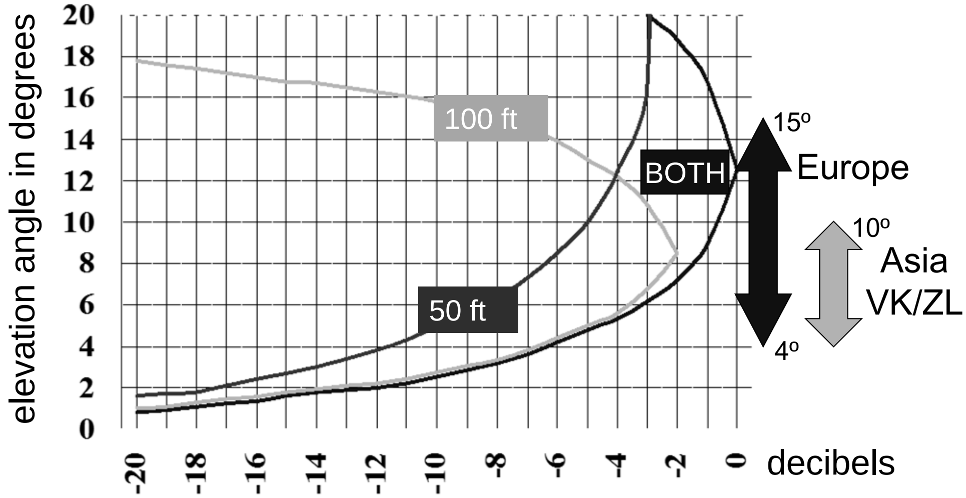
Stacked 5 Element 20 Meter Yagis
48 Foot Booms
50 and 100 Feet High



Elevation angles from <5-15º are needed

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The Array Solutions Stack Match

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www.arraysolutions.com/Products/stackmatch.htm

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High Performance 15M Antennas

- A horizontal Yagi or quad is always the best choice
  - if you can install your antenna at 25 feet high or higher
  - 13-45 degree elevation beam pattern at -3 dB points
- Moderate gain: small tri-bander Yagi, hex-beam or quad
  - a small Yagi at 50 feet high will produce good DX results
  - 7-20 degree elevation beam pattern at -3 dB points
- High gain: full size tri-band Yagi, small monoband Yagi or quad
  - 70 to 100 feet high
  - 5-15 degree elevation beam pattern at -3 dB points
- Highest gain: two stacked monoband Yagis
  - 70-90 foot tower (120 to 140 foot tower for three stacked Yagis)
  - 4-15 degree elevation beam pattern at -3 dB points
  - stack switching (a "stackmatch") provides high payoff at low cost

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Elevation angles from <5-10º are needed

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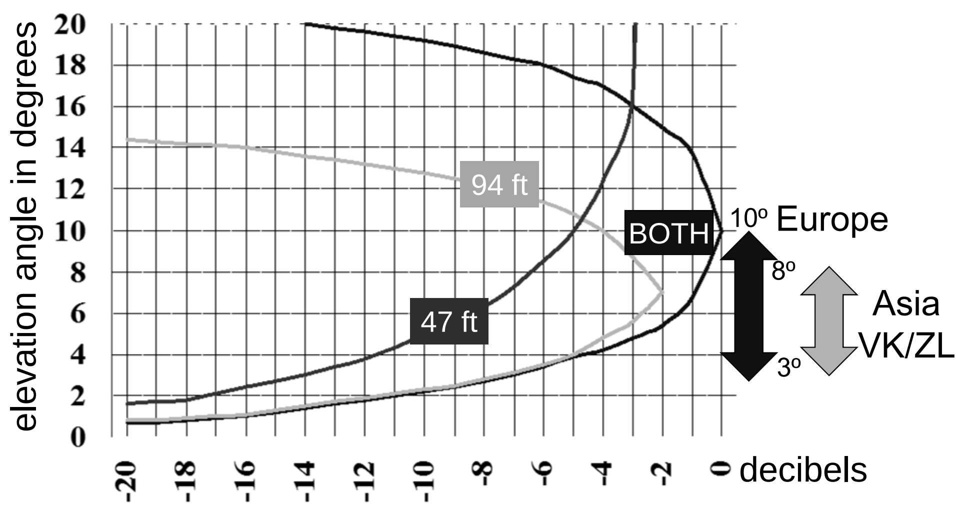
Stacked 6 Element 15 Meter Yagis
48 Foot Booms
47 and 94 Feet High



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Elevation angles from <5-10º are needed

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High Performance 10M Antennas

- A horizontal Yagi or quad is always the best choice
  - if you can install your antenna at 20 feet high or higher
  - 13-45 degree elevation beam pattern at -3 dB points
- Moderate gain: small tri-bander Yagi, hex-beam or quad
  - a small Yagi at 40 feet high will produce good DX results
  - 7-20 degree elevation beam pattern at -3 dB points
- High gain: full size tri-band Yagi, small monoband Yagi or quad
  - 50 to 70 feet high
  - 5-15 degree elevation beam pattern at -3 dB points
- Highest gain: two stacked monoband Yagis
  - 60-70 foot tower (90 to 100 foot tower for three stacked Yagis)
  - 4-15 degree elevation beam pattern at -3 dB points
  - stack switching (a “stackmatch”) provides high payoff at low cost

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Elevation angles from <5-10º are needed

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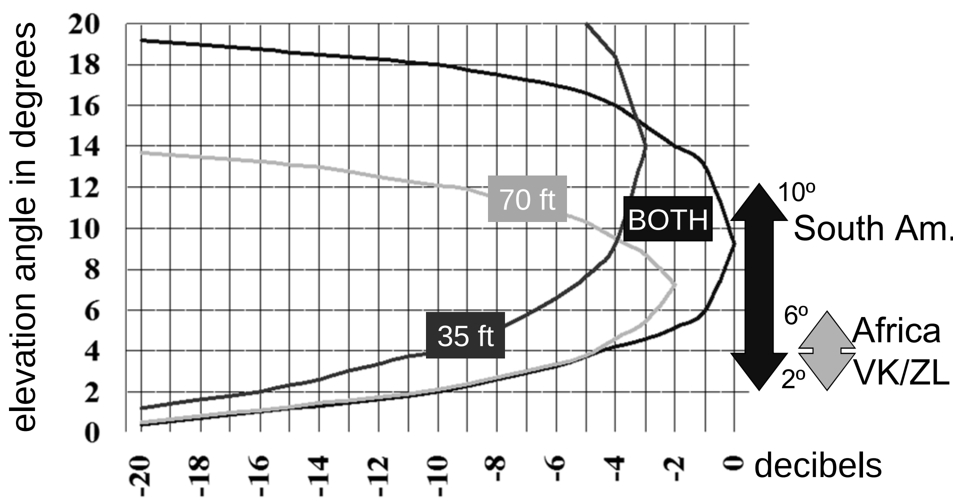
Stacked 6 Element 10 Meter Yagis
36 Foot Booms
35 and 70 Feet High



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Elevation angles from <5-10º are needed

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Competitive One Tower Antenna Systems

- 50-70 foot tower and a small rotator (e.g., HyGain Ham-IV)
  - small tri-band Yagi, Hex-beam or quad
  - 40 and 80 meter dipoles and a 160 meter inverted-L
- 70-90 foot tower and a medium rotator (e.g. HyGain T2X)
  - Cushcraft XM-240 two element 40 meter Yagi
  - large tri-band Yagi such as the DX Engineering Skyhawk
  - 80 meter dipole and a 160 meter inverted-L
- 100-140+ foot tower and a large rotator (e.g., M2 Orion)
  - Cushcraft XM-240 two element 40 meter Yagi
  - monoband Yagis such as the Hy-Gain LJ series on ring rotators
  - 80 meter dipole and a 160 meter inverted-L

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Quantitative Performance Evaluation

Use the WSPR network to compare your antenna performance

Date	Call	Frequency	SNR	by	mi
2017-03-30 02:22	W3LPL	3.594127	-18	LX1DQ	3944
2017-03-30 02:22	W3LPL	3.594134	-26	PI9ESA	3808
2017-03-30 02:22	W3LPL	3.594131	-18	EA1FAQ	3685
2017-03-30 02:22	W3LPL	3.594127	-19	DK6UG	4030
2017-03-30 02:22	W3LPL	3.594128	-28	ON7DS	3833
2017-03-30 02:22	W3LPL	3.594133	-22	DF2JP	3915
2017-03-30 02:22	W3LPL	3.594132	-16	ON5KQ	3792
2017-03-30 02:22	W3LPL	3.594145	-23	DL/PA0EHG	3914
2017-03-30 02:22	W3LPL	3.594142	-27	DL1GCD	4046
2017-03-30 02:22	W3LPL	3.594148	-28	DL1HI	4034
2017-03-30 02:22	W3LPL	3.594128	-24	DK8FT	4193
2017-03-30 02:22	W3LPL	3.594129	-25	DL9GCW	4138
2017-03-30 02:22	W3LPL	3.594129	-24	G0KTN	3551
2017-03-30 02:22	W3LPL	3.594128	-13	GX3WSC	3645
2017-03-30 02:22	W3LPL	3.594133	-19	ON7KO	3822
2017-03-30 02:22	W3LPL	3.594121	-25	HB9UQF	4089
2017-03-30 02:22	W3LPL	3.594167	-15	F5RRS	4057
2017-03-30 02:22	W3LPL	3.594129	-22	G0BLB	3544
2017-03-30 02:22	W3LPL	3.594129	-19	F1VMV	4045

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wsprnet.org/drupal/wsprnet/spots

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CTU Presents

Introduction to Introduction to Contesting (Be The Elmer!)

Ward Silver, NØAX

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Overview

- The importance of being an Elmer
- Self-improvement
- Training opportunities
- Station capabilities
- Training, guiding, and rewarding
- Attracting your crowd
- Having a good time!

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Goals of the Session

- **Show** how you can be a Contest Elmer
- **Convince** you to actually try it
- **Give** you some basic tips and ideas
- **Illustrate** some potential successes
- Make you **Laff** (in the right places)

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Why Be a Contest Elmer?

- Ham radio is about **mutual instruction**
- Somebody did it for you – **give back**
- Competition is a great way to **build skills**
- **Skill > Success > Sustain**
- If you want to learn something – **teach it**!
- Make **friends for life**

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Self-Improvement

- **Not** just for “Big Guns”
  - How do you think they got to be “Big Guns”?
- **Not** just for “Big Stations”
  - Success comes in all sizes
- “***Übung macht den meister***”
- Training makes you think about **yourself**
- You will **learn** a *ton* from hosting
- **Don’t** be afraid to make mistakes

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Cycle of Life

Observe

Judge

Act

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Cycle of Life

Observe

Judge

Act

Repent!!

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Cycle of Life

I know we all learn from mistakes…

but why do they always have to be mine?

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Training Opportunities

- Start **small** and **manageable**
  - M/M in CQ WW is probably <u>not</u> a good first step
  - Multi-single or Multi-two
    - Run/mult or just share a single radio as skill permits
    - M2 is less stringent on band-changes
  - Two or three ops with one or two Elmers
    - <u>Don't</u> invite the whole club or scout troop
    - <u>Don't</u> combine with open house or chili cookoff
    - <u>Not</u> a good idea to invite the media!

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Training Opportunities

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Training Opportunities

- Create **reasonable** expectations
  - Set **goals** within reach
    - Long-term vs Short-term
    - Waxing the Big MMs is <u>not</u> be a good first-time goal
  - Consider operating **time** and **availability**
    - How many operators?
    - How many Elmers?
  - Keep operating shifts **short** and **frequent**
    - Make sure ops can engage as much as they want

Training Opportunities

- Choosing the **right** contests
  - Big ones are fun but **overwhelming** to newbies
  - They will learn **quickly**
  - Medium-sized contests
    - State QSO Parties
    - North American QSO Parties
    - ARRL 10 Meter or June VHF / CQ WW VHF
    - Fun but not overwhelming
  - Graduate to Sweepstakes, ARRL DX, CQ WPX

Training Opportunities

- Know yours and the Elmer's **skills**
  - What modes can you teach?
  - What modes do your invitees operate?
  - Can they **operate** your equipment?
    - Can YOU operate your equipment?
    - Prepare to train (and practice, yourself)
  - One Elmer available per operator at first
  - OK for everybody to learn at once
    - But **manage expectations**

Training Opportunities

Station Capabilities

- Is there a contest in which you **do well**?
- What can your station **hardware** do?
  - Do you have an amp?
  - Is it a runner or S&P-er?
  - Computer logging – a must!
- What can your **antenna farm** do?
- What small **improvements** would make the biggest difference?

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Station Capabilities

- The Most Powerful Improvements
  - **Operator First**
  - Technique Second
  - Antennas Third
  - Radios and Amplifiers Fourth
  - Optional Gadgets Last

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Station Capabilities

- **Prepare, prepare, prepare**
  - No plan survives contact with the enemy
- Do a **dry run** before Friday afternoon
  - Update the logging software
  - Check all of the gear at full power needed
  - **Label, label, label**
- Elmer+trainee **support** accessories
- Have the station **ready** when first op arrives

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Training, guiding, & rewarding

- **Prepare** your operators, too!
  - Have the contest **rules** available
  - **Explain** what the contest is about
    - They will probably be a little nervous
  - **Demonstrate** basic operation (checklists, labels)
    - OK to start late – this is practice!
    - Walk through band switching, antenna pointing, etc
    - If anything is off limits, now is the time to say so
  - Encourage **questions**!

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Training, guiding, & rewarding

- **Hands-on assistance** at the beginning
  - One-on-one Elmering is the best
  - Let them **listen** first, if need be
  - Don't try to wow 'em – they're already wowed
- Encourage **questions**
- Walk them through
  - Very new ops will need a cheat-sheet
  - Be able to listen as they operate

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Training, guiding, & rewarding

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Training, guiding, & rewarding

- The first **solo flight**
  - You be the **judge** of when they're ready
  - Have **cues** to guide them
  - Maybe you can log while they operate?
- **Gentle** reminders are best
  - This is not driver's ed, no yelling
  - Hand signals or visual cues
- Be **kind** – make the first solo a short one

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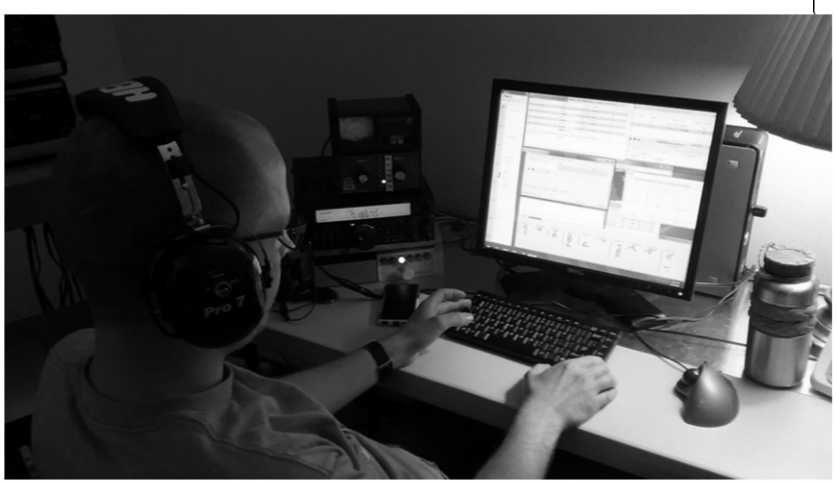

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Training, guiding, & rewarding

- **Appreciate** their successes!
- After the first shift…
  - One-on-one **review** for Q&A
  - What they did **right**
  - **Gentle** critique of what they did wrong
  - Where they have room for **improvement**
  - OK to take a **break**
- Keep some **stats** on how they did

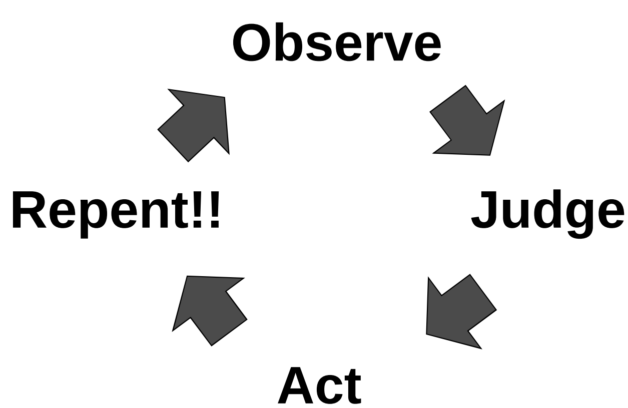
Training, guiding, & rewarding

- **Submit the log** right away – *no log-washing*
- Show them how to **post a score** on 3830scores.com
- **Follow-up** after the contest
  - On-site or in the next few days
  - What worked and what didn't
  - Detailed **question and answer**
  - Certificates of appreciation or thank-you note

Training, guiding, & rewarding

- Be **proud** of the results!
  - 18th place is just fine – enjoy it!
- Keep the team **updated** as scores post
- Exchange posts with other teams
- **Distribute** all results and writeups
- Make sure everybody gets **credit** equally
- **Talk it up** at meetings and on social media
  - Better yet, have *them* talk it up

Cycle of Life



Attracting Your Crowd

- Go out and **invite** your team!
  - Remember how badly *you* wanted to "join the team"?
- **Look** for those who look like they want to play but might be holding back
- **Mine** local and regional results for new calls
- **Extend** an invitation
- **Encourage** your ops to bring more ops

Attracting Your Crowd

- The more **fun** you sound like you're having the more **fun** you probably will have
- **Encourage** others to host
  - Make up challenges
  - Club-to-club? Emcomm teams?
- Include your **contact information** when posting results

Having a Good Time!

- Don't forget this **crucial** element
- Keep it fun for you and **your family**
- As **success** builds, so will your team
  - Raise your goals
  - Build your station capabilities
  - Give your team more responsibilities
- **Encourage** your ops to try it on their own
- **Pay it forward**

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Thanks!

- **Be** the amateur service we want to be
- If not us, then **who**?
- So have **fun. . .**

  and go get 'em!

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CW and RTTY Skimmer
and the Reverse Beacon Network

Presented by N6TV
n6tv@arrl.net

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1

Overview

- What is CW Skimmer and RTTY Skimmer?
- What is the Reverse Beacon Network?
- How does it work?
- What can the RBN do for *me*?
- How can I use it?
- How can I help?
- What's new?

2

It all starts with one developer

- Alex Shovkoplyas, VE3NEA
  (b. 1965, ex-UR5EMI, in Canada since 1998)

- Honored as RAC *Radio Amateur of the Year* for 2014

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3

What is CW Skimmer?

1. Hardware: PC + Software Defined Radio (SDR)

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4

SDR Antenna

2. Wideband RX Antenna, 1.8-30 MHz, e.g. DX Engineering (formerly Pixel) Magnetic Loop RF-PRO-1B® or ARAH3-1P Active Dipole:

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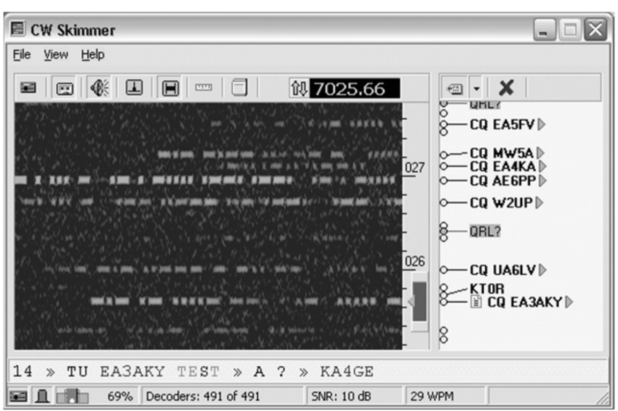
5

Software

3. CW (or RTTY) Skimmer *or* Skimmer Server



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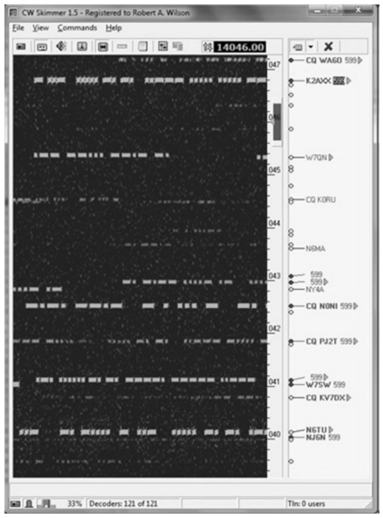
6

CW Skimmer by VE3NEA



- Works with many SDRs
- Decodes *multiple* CW signals in real time
- Can monitor *entire* CW band
- Waterfall Display
- Band Scope
- Uses MASTER.DTA
- Telnet Server (emulates a DX Cluster)

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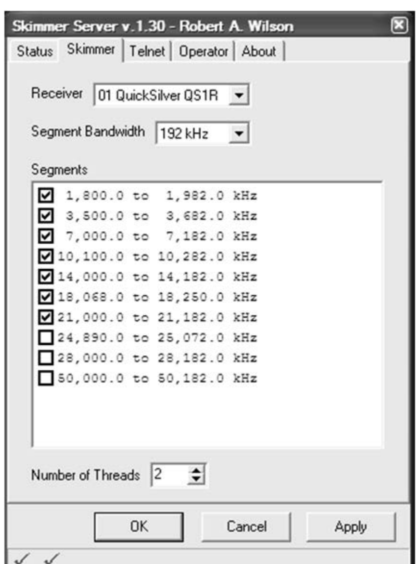
ICOM 7

Skimmer Server by VE3NEA



- Natively supports *only* the QS1R SDR
- Decodes multiple CW signals in real time
- Monitors *multiple bands* with single SDR
- *No* Waterfall Display
- *No* Band Scope
- *No* MASTER.DTA
- Telnet Server

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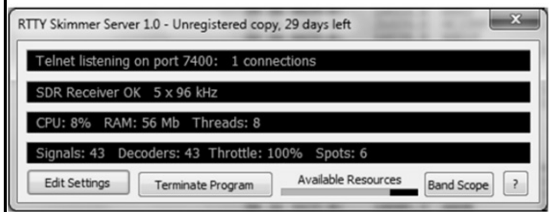
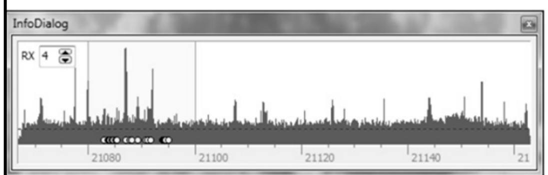
ICOM 8

RTTY Skimmer Server (new)





- Natively supports only the QS1R SDR
- Decodes multiple RTTY signals in real time
- Monitors *multiple bands* with single SDR
- Limited Band Scope
- Can use MASTER.DTA
- Telnet Server

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ICOM 9

Telnet server (localhost port 7300)

- Emulates a DX Cluster Node

```
DX de N6TU-#:    14058.7  WR7HE        24 dB  31 WPM  CQ      2350
DX de N6TU-#:    14029.6  NM7D         29 dB  25 WPM  CQ      2350
DX de N6TU-#:    14059.5  YW4D         35 dB  31 WPM  CQ      2350
DX de N6TU-#:    14022.6  J39BS        11 dB  25 WPM  CQ      2350
DX de N6TU-#:    14066.8  NF6A         38 dB  30 WPM  CQ      2350
DX de N6TU-#:    14054.4  N5UM         26 dB  28 WPM  CQ      2350
DX de N6TU-#:    14021.2  NN5J         35 dB  31 WPM  CQ      2350
DX de N6TU-#:    14061.4  WX5S         12 dB  28 WPM  CQ      2350
DX de N6TU-#:    14064.2  WQ5L         15 dB  28 WPM  CQ      2350
DX de N6TU-#:    14032.2  VE7XF        18 dB  27 WPM          2350
DX de N6TU-#:    14042.9  NT5C         45 dB  31 WPM          2350
DX de N6TU-#:    14032.2  VE7XF        18 dB  27 WPM  CQ      2350
DX de N6TU-#:    14039.2  EA3FP        15 dB  31 WPM  CQ      2350
DX de N6TU-#:    14052.5  W0YR         20 dB  28 WPM  CQ      2350
DX de N6TU-#:    14022.9  AB7E         32 dB  25 WPM  CQ      2350
DX de N6TU-#:    14028.4  WH6R          7 dB  29 WPM          2350
DX de N6TU-#:    14065.6  KH7B         25 dB  29 WPM  CQ      2350
To ALL de SKIMMER <0952Z> : Clicked on "VE7XF" at 14032.2
DX de N6TU-#:    14069.6  KF6T         13 dB  28 WPM  CQ      2350
DX de N6TU-#:    14069.1  NK0M         25 dB  28 WPM  CQ      2350
To ALL de SKIMMER <0952Z> : Clicked on "" at 14031.4
DX de N6TU-#:    14035.5  KF8GE        12 dB  26 WPM          2350
DX de N6TU-#:    14028.4  WH6R          7 dB  29 WPM  CQ      2350
DX de N6TU-#:    14036.1  NZ1U         16 dB  28 WPM  CQ      2350
DX de N6TU-#:    14062.7  N4QS         11 dB  29 WPM  CQ      2350
DX de N6TU-#:    14045.1  YU1FM        20 dB  32 WPM  CQ      2350
DX de N6TU-#:    14059.6  YW4D         35 dB  31 WPM          2350
```

Reports Signal to Noise ratio, CW Speed, CQers

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ICOM 10

What is the Reverse Beacon Network (RBN)?

- Uses *any* CW or RTTY signal as a beacon
- Multiple Skimmers world-wide record signal strength (S/N ratio in dB) and CW speed (WPM)
- A free "Aggregator" program forwards Skimmer spots to a central server
- Central server distributes spots via web page and public telnet servers
- You don't need to have an SDR to use it

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ICOM 11

How do spots get to you?

Antenna •Pixel RF Pro-1A	SDR •QS1R	PC •Skimmer Server •Aggregator	RBN •Via Internet	"Retail" DX clusters	You

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ICOM 12

Acknowledgements

- RBN web site and first aggregator originated by PY1NB (similar to his other web site, www.dxwatch.com). Felipe pays most of the bills.
- Lots of code by W3OA (aggregator), F5VIH (Spots analysis tool)
- CW Skimmer evangelized and tested by N4ZR (also publishes RBN blog) – "RBN Chief Evangelist"
- Telnet server support by K5TR, W2QO, KM3T

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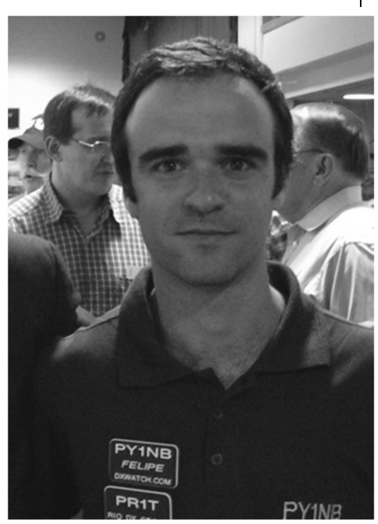
ICOM 13

Felipe Ceglia, PY1NB

- Created and maintains the Reverse Beacon Network
- Hosts dxwatch.com and reversebeacon.net



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ICOM 14

Dick Williams, W3OA

- Created and maintains the current RBN Aggregator software

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ICOM 15

Nick Sinanis, F5VIH

- Wrote the RBN Spots Analysis Tool

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ICOM 16

Pete Smith, N4ZR

- RBN Chief Evangelist
- Skimmertalk Reflector: http://dayton.contesting.com/mailman/listinfo/skimmertalk
- Yahoo Group: RBN-OPS https://groups.yahoo.com/neo/groups/RBN-OPS/info (130+ members)

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ICOM

17

What can the RBN do for *me*?

- It can improve your score
  - Fills spots in band map (SOA, Multi-op)
  - Spots *you* (very often, *if* you call CQ *properly*)
- Entering a contest?
  - Before: Check antenna F/B, signal strength
  - During: See where you are being heard, view skimmer-generated propagation maps
  - After: Compare signal strength with the competition

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ICOM

18

How can I use RBN to improve my score?

- Make sure the Skimmers find and spot *you*
- Access RBN via your favorite DX Cluster, for CW and RTTY contests (when allowed)
- RBN will post far more spots than DXers
  - With smaller pileups, less competition
- RBN quickly fills the band map in your logging software
- RBN helps locate clear spots to call CQ (between stations that you may not hear)

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ICOM 19

How can I use RBN to improve my score (cont'd):

- The RBN reveals band openings, shows where *you* are being heard
- At K3LR, sunrise on 15m:
  "Spotted by S50ARX-#"
- First EU answered our 15m CQs 25 minutes later

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ICOM 20

How do I CQ “properly”?

- Send *everything* at the *same consistent speed*
  - *Never* use >/< or +++/--- to change speed in messages
- Call CQ or TEST and send your call twice
  - CQ N6TV N6TV
  - TEST N6TV N6TV
  - CQ N6TV N6TV TEST
- Use proper spacing (let computer send)
  - Don’t send with paddles and *rush-everything-together*
- Change your freq. *slightly* to get spotted again

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ICOM 21

What counts as “CQ”?

- Originally just: “CQ”, “TEST”, and “QRZ”
- VE3NEA Added: “FD”, “SS”, “NA” and “UP”
- Examples:
  - P5DX P5DX UP
  - SS N6TV N6TV
  - NA N6TV N6TV
  - FD N6TV N6TV FD
- Short calls like “W1F” should always be sent twice to help Skimmer identify it quickly

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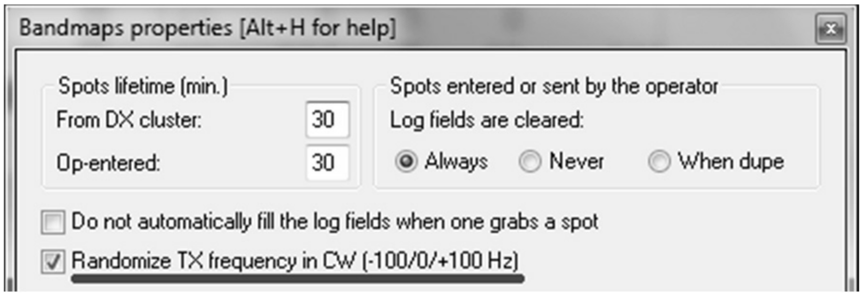
ICOM 22

How to improve your chances in a Skimmer-generated pileup

- Use XIT or the “randomize TX” feature of your logging program to call a bit off frequency.



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ICOM 23

How do I use the RBN to Check My Antennas?

- To test performance, just call CQ on CW or RTTY, check RBN web site (turn beam, repeat)
- Use RBN web site’s “Spots Analysis Tool” to compare your signal to the competition
- Download raw data files for deeper analysis
  - Every RBN spot posted since February, *2009* is archived on the RBN web site

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ICOM 24

Accessing the RBN (SOA, Multi)

1. Many DX clusters combine RBN and human spots using AR-Cluster V6 (see www.dxcluster.info for address listing).
   - Some ARC V6 clusters offer CT1BOH spot quality filters (flags busts, uniques)
2. dxc.ve7cc.net port 23
   CC Cluster software – removes many bad spots (uniques) and dupes

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Filtering Spots (old way)

- DXSpider
  - `accept/spots by_zone 1,3,4,6,7,31 and not by WZ7I or call N6TV`
  - http://www.dxcluster.org/main/filtering_en.html#toc1
- ARCluster V6
  - `set dx filter call=N6TV or (unique>1 and (spotterstate=CA or spotterstate=NV or spotterstate=UT))`
  - http://www.n8noe.us/ARC.html

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Filtering Spots (new way)

- Use CC User software by VE7CC to log in to dxc.ve7cc.net port 23
- CC User sets filters with a full-feature, Graphical User Interface (GUI)
- CC Cluster nodes *automatically* reject “unique” (busted) spots, eliminates dupes
- New AR-Cluster Client by AB5K
- Updated Tutorial:
  - http://reversebeacon.blogspot.com/2013/12/a-new-tutorial-on-using-rbn.html

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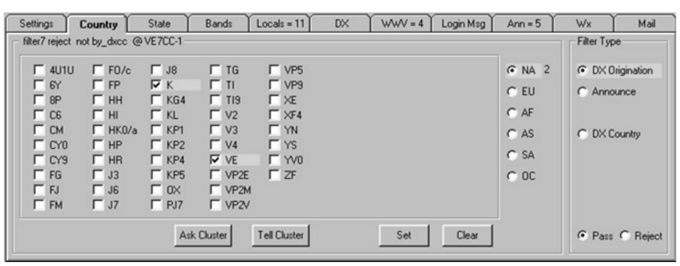
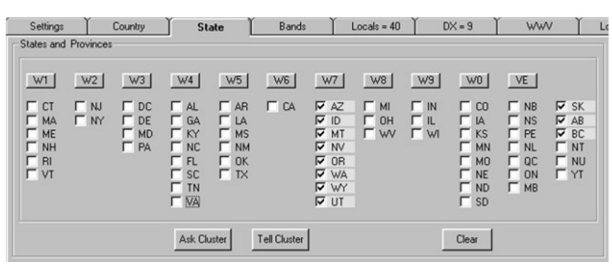
CC User Filter Dialogs





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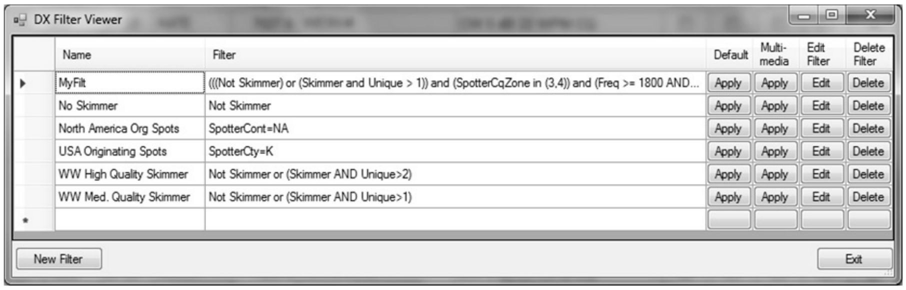
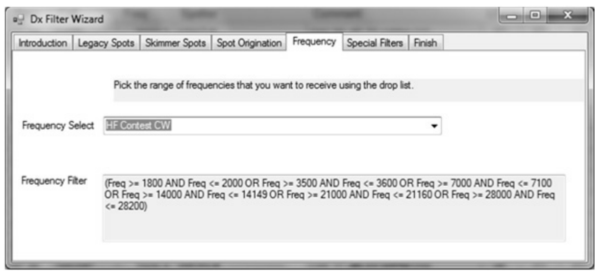
AR-Cluster Client by AB5K

www.n8noe.us/ARC.html





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Many nodes combine RBN and "legacy" (human) spots

- dxc.ve7cc.net port 23 (CC Cluster, many filtering options, use CC User to set them)
- dxc.w9pa.net port 7373 (AR Cluster)
  `set dx extension skimmerquality`
- dxc.n7tr.com port 7373 (AR Cluster, but pre-filters to show only spots from Zones 3 and 4)

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Real-time propagation maps

- http://www.dxmaps.com
- Click “HF” and band of interest
- Leave page open, it refreshes automatically

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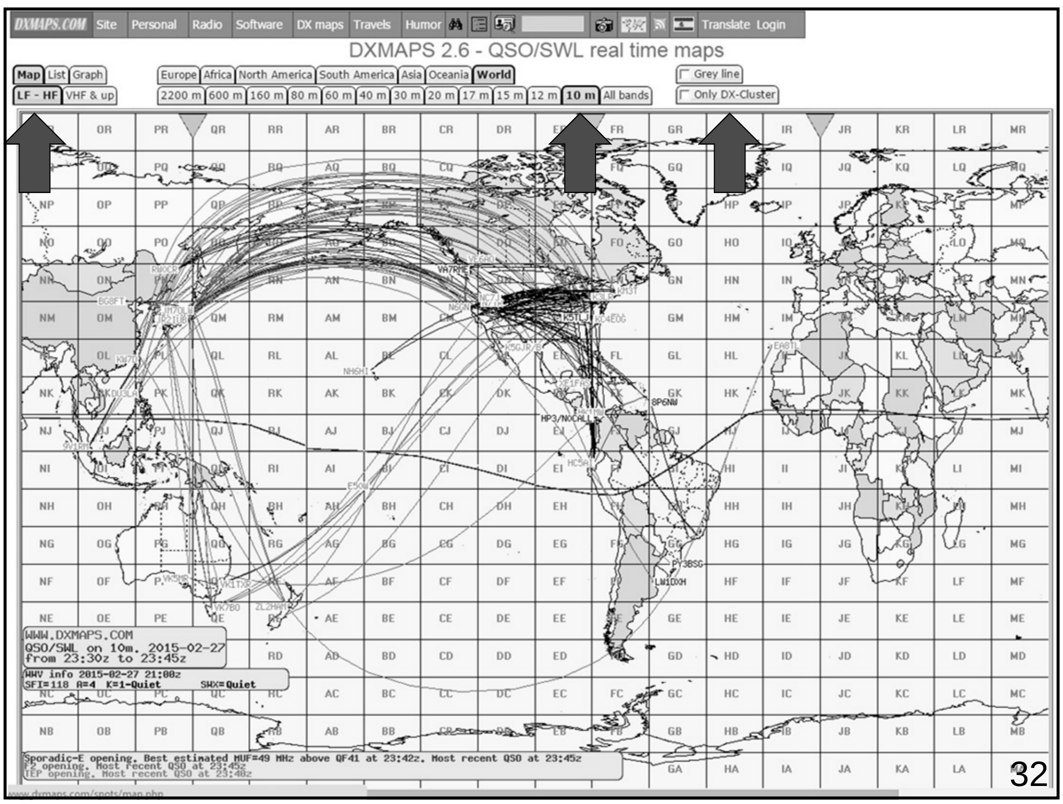
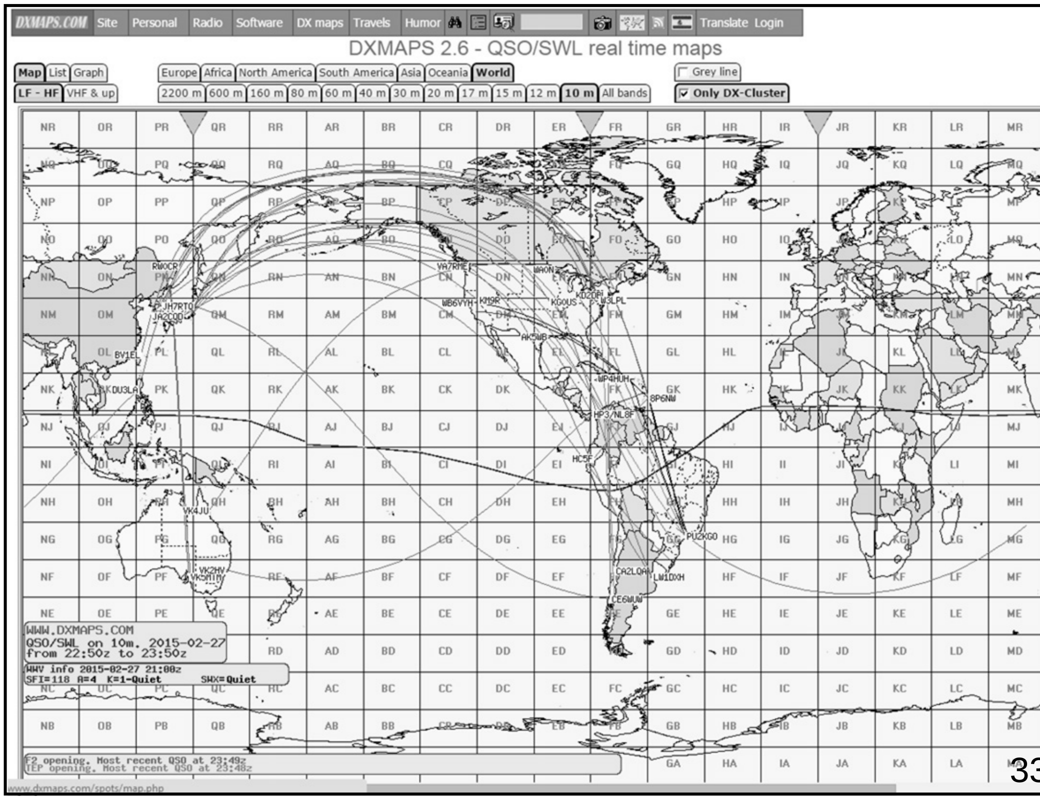


32



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Using www.reversebeacon.net

- Great for post-contest analysis
- Plot signal strengths
- Raw data files can be downloaded / analyzed
  - Millions of spots archived

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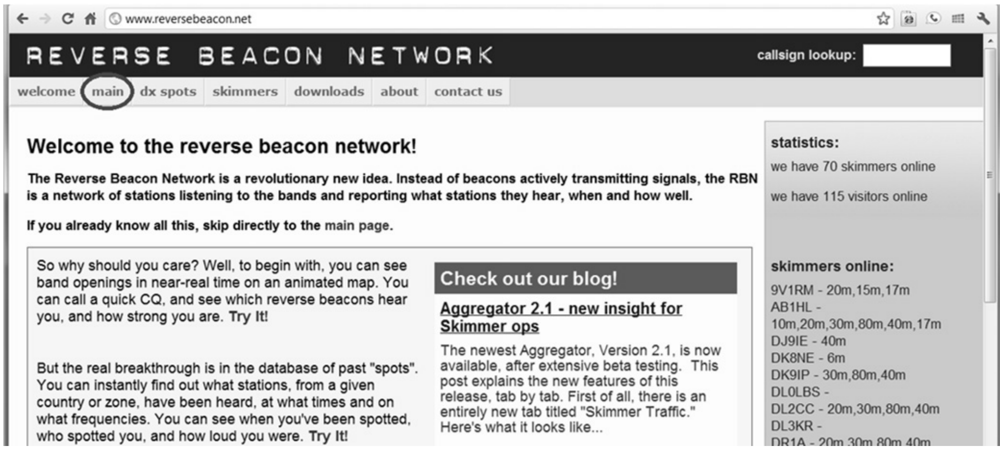
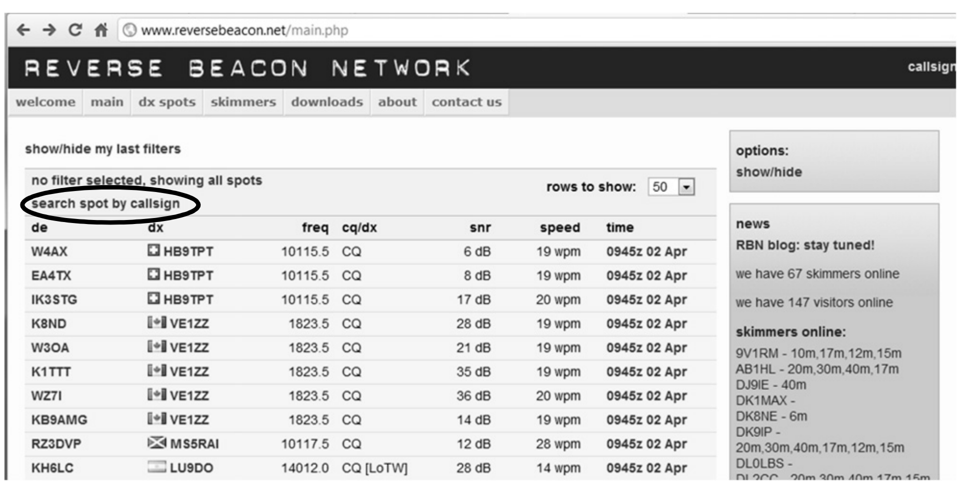
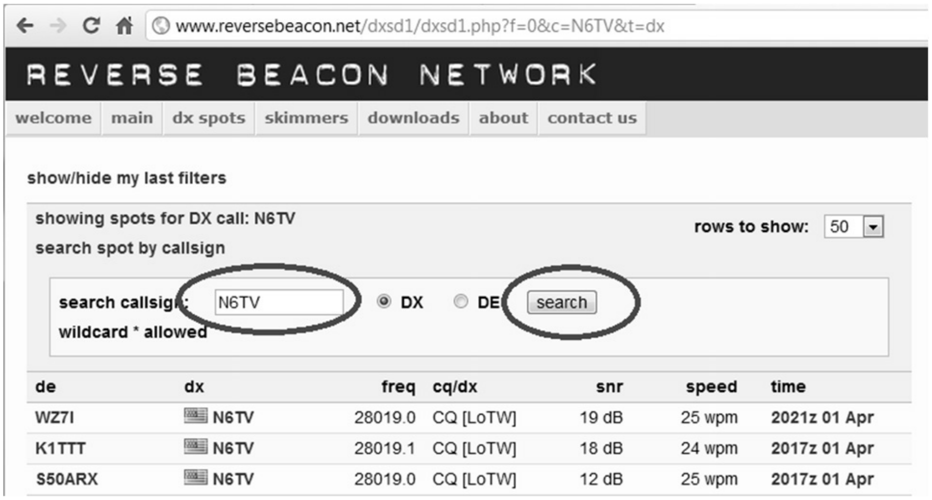
www.reversebeacon.net



www.reversebeacon.net main



Where was I heard?



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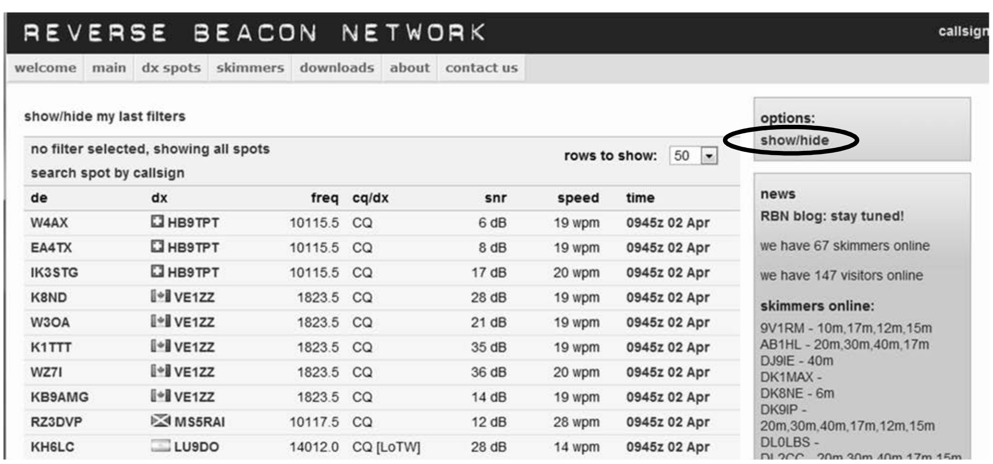
Plot spots on a map



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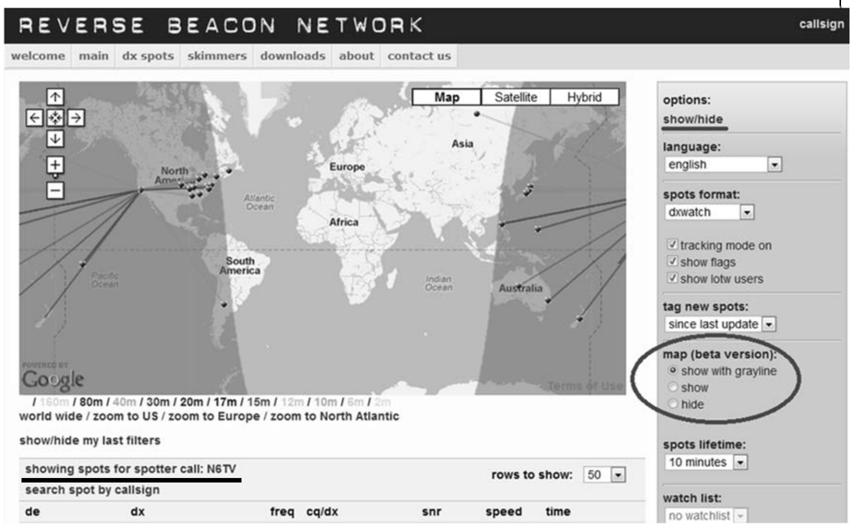
Which bands are open at *my* QTH?



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Spots analysis tool

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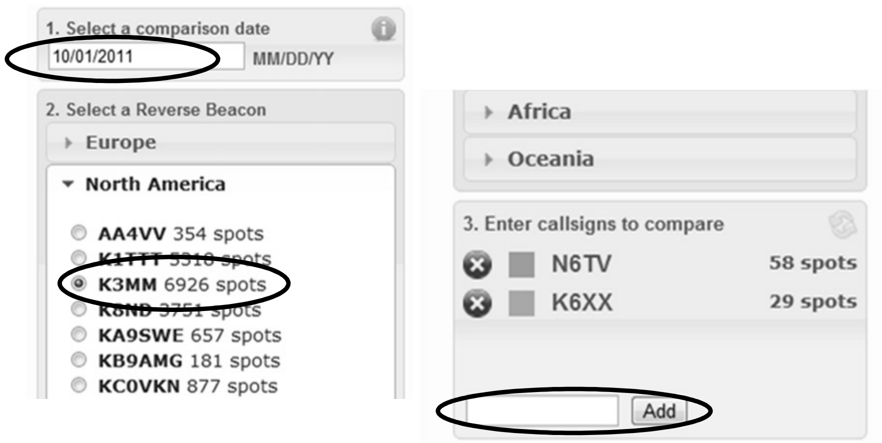
40

Pick a Date, a Skimmer, add callsigns to compare



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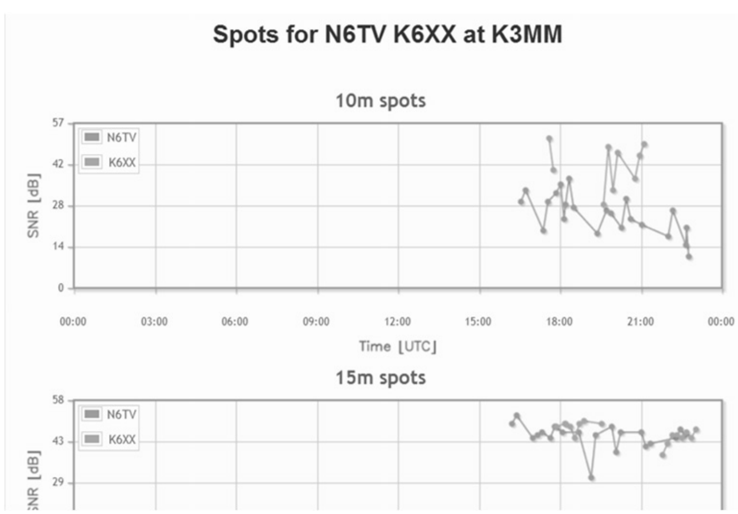
And the winner is … K6XX!



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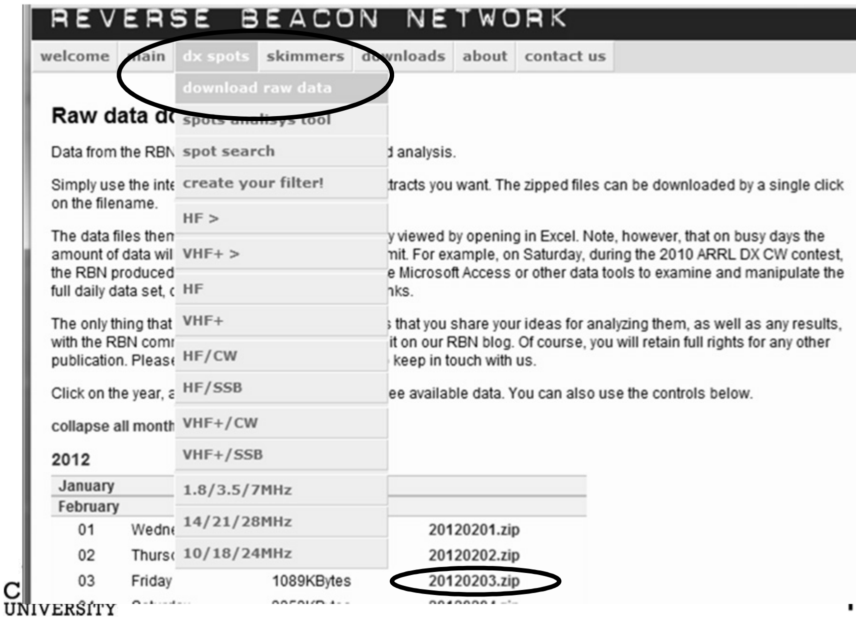
Raw data downloads



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Raw data is text file, Comma Separated Values

```
callsign,de_pfx,de_cont,freq,band,dx,dx_pfx,dx_cont,mode,db,date,speed,tx_mode
    JE1SGH,JA,AS,28032.6,10m,K6UW,K,NA,CQ,29,2014-02-15 00:00:00,32,CW
    XV4Y,3W,AS,14041.1,20m,PT5T,PY,SA,CQ,22,2014-02-15 00:00:00,28,CW
    XV4Y,3W,AS,14021,20m,PX2F,PY,SA,CQ,23,2014-02-15 00:00:00,23,CW
    NC7J,K,NA,28005.5,10m,N2IC,K,NA,CQ,11,2014-02-15 00:00:00,33,CW
```

- Total World-Wide RBN CW spots, CQ WW:
  2013: 5,743,545 (33.2 spots per *second*)
  2014: 6,200,340 (35.9) – up 8.0%
  2015: 7,085,553 (41.0) – up 14.0%
  2016: 6,060,130 (35.1) – down 14.5%
- ARRL DX CW:
  2014: 4,146,399 (86,383 spots per *hour*)
  2015: 5,537,017 (115,354) – up 33.5%
  2016: 3,924,585 (81,762) – down 29.1%
  2017: 4,285,719 (89,286) – up 9.2%

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What's the Average CW Speed of a Spot?

- CQ WW CW:

2013:	30.6 WPM
2014:	30.8
2015:	30.7
2016:	30.8

- ARRL DX CW:

2014:	29.6 WPM
2015:	30.1
2016:	29.9
2017:	29.6

RTTY Skimmer Stats

- CQ World-Wide RTTY (48 hours):

  2015: 922,311 (5.3 spots per *second*)
  2016: 994,212 (5.8) – up 7.8%

- ARRL January RTTY Roundup (30 hours):

  2016: 457,033 (15,234 spots per *hour*)
  2017: 470,377 (15,679) – up 2.9%

How can I help?

- Set up an SDR, feed Skimmer Spots to the RBN, using the Aggregator program
  - More skimmers needed in Asia/Africa/South America
- Call a bit off frequency (Win-test and N1MM both provide automatic randomization if desired)

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What's New?

- NCDXF and other HF Beacons can be spotted on RBN
  - reversebeacon.blogspot.com/2014/02/ncdxf-beacon-spotting-redux.html
- RTTY Skimmer Server 1.2
- CW Skimmer 1.91
- Aggregator v4.3
- Skimmer Server testing by JF2IWL using Red Pitaya and S9-C SDRs

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For more information

- http://www.reversebeacon.net
- http://www.dxmaps.com
- http://www.bcdxc.org/ve7cc/default.htm#download
- http://www.dxatlas.com/CwSkimmer
- http://www.dxatlas.com/SkimServer
- http://www.srl-llc.com/ (QS1R SDR)
- http://www.ba4tb.qth.com/ (S9-c SDR)
- http://microtelecom.it/perseus/ (Perseus SDR)
- https://redpitaya.com/ (Red Pitaya)

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For more information

- http://www.dxengineering.com/parts/ins-rf-pro-1b (RF Pro-1B loop antenna)
- http://www.dxengineering.com/parts/dxe-arah3-1p (Active Broadband Dipole antenna)
- http://www.pvrc.org/~n4zr/rbn.pdf
- http://reversebeacon.blogspot.com/2013/12/a-new-tutorial-on-using-rbn.html
- http://reversebeacon.blogspot.com
- http://www.ve7cc.net/
- http://www.qrz.com/db/n6tv

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Questions?

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CTU Presents

Optimizing VHF Contest Scores Utilizing JT Digital Modes

Joel Harrison, W5ZN

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Before We Talk "Digital" Let's Review Some Basic Topics

- **Antenna Techniques**
- **Station Techniques**
- **Propagation Techniques**
- **Operating Techniques**

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Antenna Techniques

- **What Kind of an Antenna?**
  - **Yagi**
    - **Horizontal polarization**
  - ~~**Vertical**~~
  - ~~**Dipole / Inverted Vee**~~
- **How Many Elements?**
  - **More is better up to a point.**
  - **7 is good**
- **How High Should it Be?**
  - **30 Ft ?**
  - **Let's look at some plots**

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Antenna Techniques

- **What is the best height for my antenna?**
  - You will always have dead zones and nulls regardless of height
  - Get your antennas as high as you reasonable can
- **How Many Antennas do I need?**
  - **Really depends on where you live**

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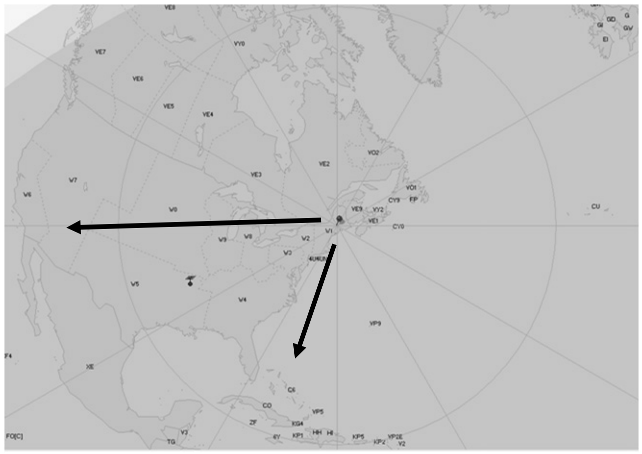
Antenna Techniques

QTH in Maine / Northeast USA



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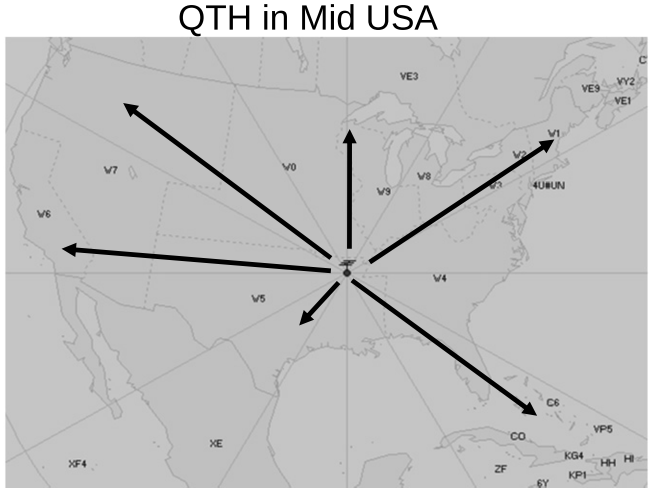
Antenna Techniques

QTH in Mid USA



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Antenna Techniques

How can you quickly change antenna direction??

Antenna, or a stack of smaller antennas in a fixed direction allow fast direction change without waiting for a rotor to turn.

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Station Techniques

- Radio
- Preamp
- Interconnecting cables
- Noise

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Station Techniques

- **Radio**
  - **All new radios include 6 meters**
  - **Good dynamic range, roofing filters essential**
- **Preamp**
- **Interconnecting cables**
- **Noise**

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Station Techniques

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Station Techniques

- **Radio**
  - **All new radios include 6 meters**
  - **Good dynamic range, roofing filters essential**
- **Preamp**
  - **Will improve weak sigs when band is dead but can cause problems in presence of strong stations**
- **Interconnecting cables**
  - **Ensure solid connections**
  - **Avoid cheap phono connectors & cable**
- **Noise**

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Station Techniques

Noise! The Grim Reaper of noise is *not* your friend!!

- Sky Noise
- Atmospheric Noise
- Line Noise
- Other man-made noise

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Station Techniques

- **Internet Routers can be a significant noise source at 50 MHz that will populate the band, especially the DX Window**
  - Multiple carriers of relatively constant amplitude but with modulation (Birdies)
    - 50.044, 50.058, 50.105, 50.120, 50.148, 50.166
  - Broadband trash
- ***Get your own station "clean" first!***

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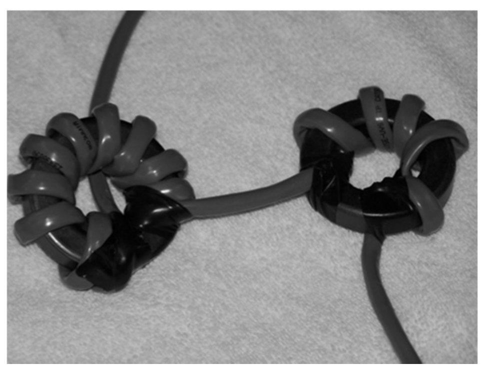
Station Techniques

Internet Router noise can be significantly reduced or eliminated.



Also utilize shielded CAT5 cable and connectors

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Station Techniques

- **Some Actual Results**
  - All “birdies” are gone
  - Noise floor dropped 8 dBm !!!
- **More technical info:**
  - A Ham’s Guide to RFI, Ferrites, Baluns and Audio Interfacing - Jim Brown, K9YC
    - http://audiosystemsgroup.com

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Station Techniques

Noise – Recap

- **Clean up your own station**
- **Address line noise issues**
- **Use Bandpass Filters**

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Propagation Techniques

- **Meteor Scatter – "MS"**
- **Moonbounce - EME**

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Meteor Scatter

- Meteor scatter is the reflection of radio waves from the ionized trails from meteors burning up in the upper atmosphere.
- Meteors (space debris) burn up in the upper atmosphere at a height of around 65 miles.
- This may be used to make QSOs up to about 1400 miles

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Meteor Scatter

- The earth is bombarded by a constant stream of small particles, remnants of comets that when entering the earth's atmosphere can ionize a column of atoms in the E region at approximately 100km (~60 miles) above the surface of the earth which can reflect radio waves in the VHF region of the spectrum

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Meteor Scatter

- There are seasonal variations in the number of sporadic meteors
  - Relative rate increases noticeably in May, peaking in July and August then tailing off into October and November.
- There is also an hourly variation in the relative rate of meteors peaking
  - around dawn local time with the minimum late afternoon before the ramp up begins again late evening.
  - The hourly relative rate is due to the fact that the earth's rotation is head on so to speak in the morning into the path of the particles and therefore there is an increase in the relative velocity of a particle entering the earth's atmosphere.

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Meteor Scatter

- The length of time of the ionization, or burst duration, is related to meteor velocity and increase in relative velocity results in longer ionization times.

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Meteor Scatter

- Most particles entering the earth's atmosphere are the size of a grain of sand resulting in ionization lasting only a fraction of a second
  - much too short to convey any meaningful information using SSB or even high speed CW.
- The digital modes of FSK441 and MSK144 were designed to compress a limited amount of information in a packet and transmit that packet in a very short period of time.
  - In the case of MSK144 the information packet, with a transmission length 0.072 seconds, is repeated over and over again during the duration of the selected transmit interval of 5, 10, 15 or 30 seconds.

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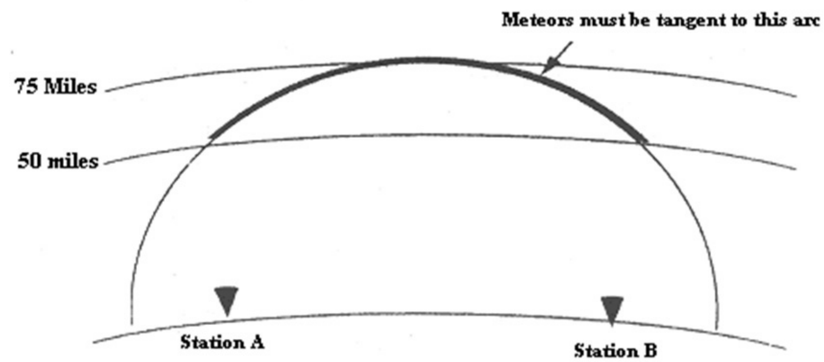
Meteor Scatter

Reflection will occur when the trail is oriented as shown



Meteor Scatter

- **Excellent for 50 MHz**
- **Very Predictable Paths**
  - Best times between midnight & approx 9 AM
  - Peak during “showers” – Anytime with high speed procedures like ***WSJT***

Operating Techniques

K1JT Digital Modes

- **Weak Signal Communication by K1JT (WSJT) offers specific digital protocols optimized for EME and meteor scatter at VHF/UHF**
- **Free open-source programs. Normal usage requires only a standard SSB transceiver and a personal computer with soundcard.**
- **Can Provide Outstanding access to new grid multipliers from moderate stations**

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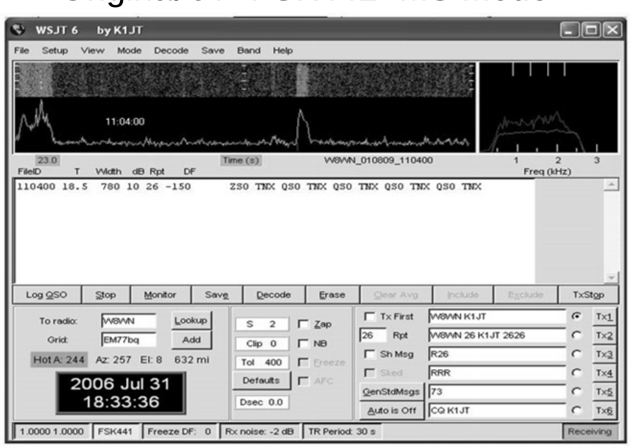
Meteor Scatter

Original JT "FSK441" MS Mode



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Meteor Scatter

- **New Mode introduced in WSJT-X**
  - Officially released in January 2017
  - Contains 8 new modes
  - **MFSK441 Mode**
    - **Calling frequencies 50.280**
    - **Many new features**

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Meteor Scatter

- Focussed toward contest style operation that include:
  - a machine human interface that facilitates rapid population of QSO specific information
  - shorter TX and RX periods than FSK441
  - auto sequencing that reduces human error and improves operator efficiency important considerations during contest operation

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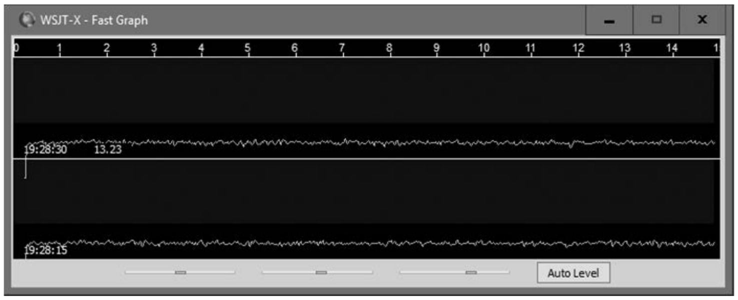
Meteor Scatter

Graph still exists but in a separate window called “Fast Graph”



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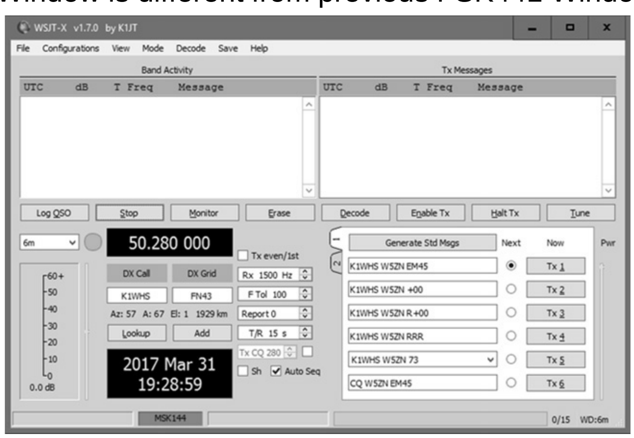
Meteor Scatter

MSK144 Window is different from previous FSK441 Window”



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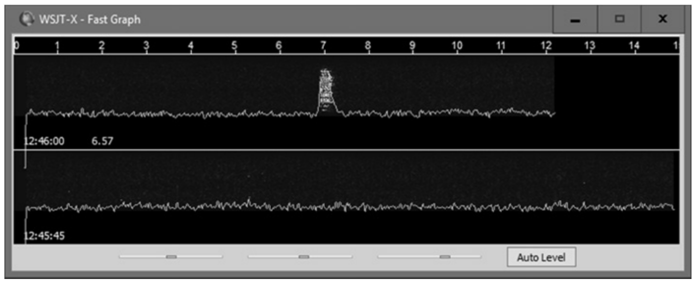
Meteor Scatter

Signal bursts still appear in the “Fast Graph”



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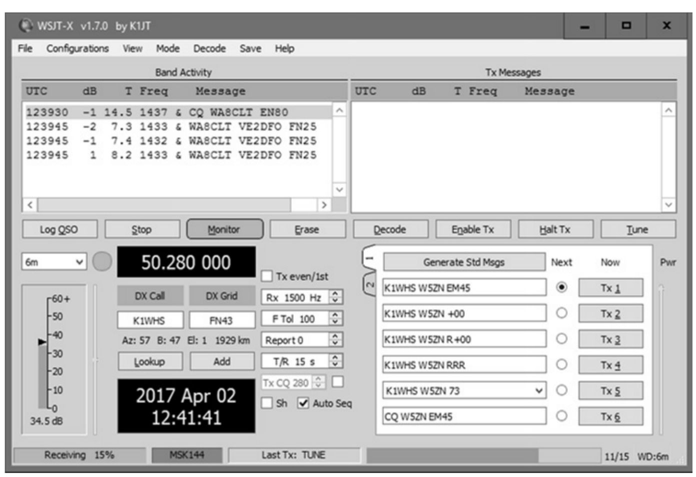
Meteor Scatter



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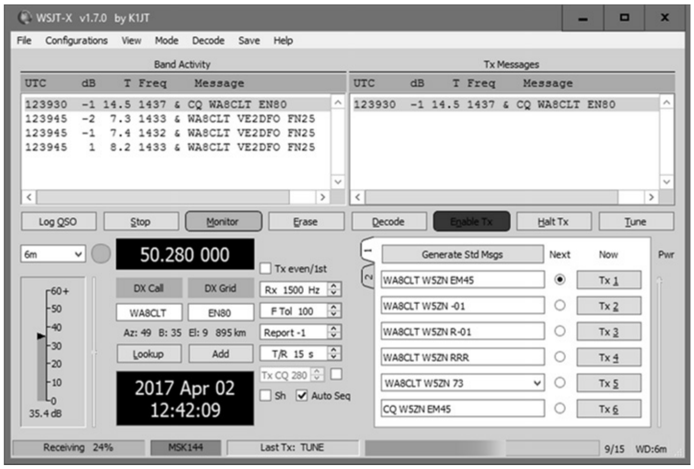
Meteor Scatter



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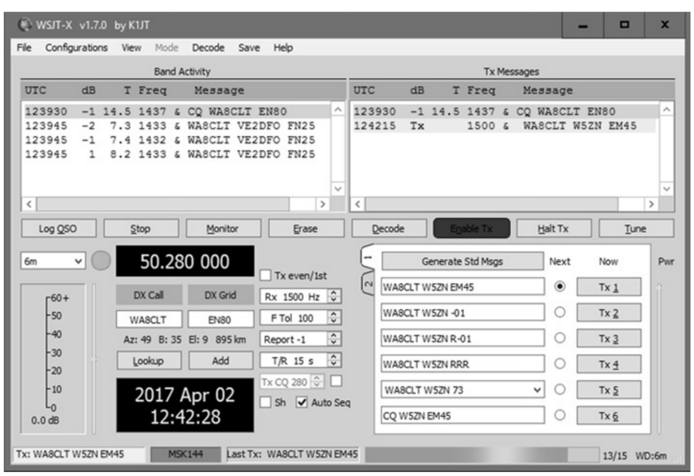
Meteor Scatter



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K8ZR Test Results

- **Contest QSO Non-Contest QSO**
- **Tx Time:**
- 15 sec. CQ N8JX EN64
- 15 sec. N8JX K8ZR EN91
- 15 sec. K8ZR N8JX R EN64
- 15 sec. N8JX K8ZR RRR
- 15 sec. K8ZR N8JX 73
- Total time: 75 seconds

- **Non-Contest QSO**
- **Tx Time:**
- 15 sec. CQ WB4JWM EM83
- 15 sec. WB4JWM K8ZR EN91
- 15 sec. K8ZR WB4JWM +05
- 15 sec. WB4JWM K8ZR R+07
- 15 sec. K8ZR WB4JWM RRR
- 15 sec. WB4JWM K8ZR 73
- Total time: 90 seconds

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K8ZR Test Results

50 MHz MSK144 QSO Summary

• Period January 23rd- March 13th:	50 days
• Number of 50 MHz MSK144 QSOs:	225
• Average number of minutes to complete a QSO:	4.6
• Number of unique callsigns worked:	50
• Number of unique callsigns decoded:	98
• Number of States worked:	22
• Number of unique Grids worked:	42
• Number of 90 second QSOs:	10
• Best DX K5DOG EM00wh:	1,223 miles

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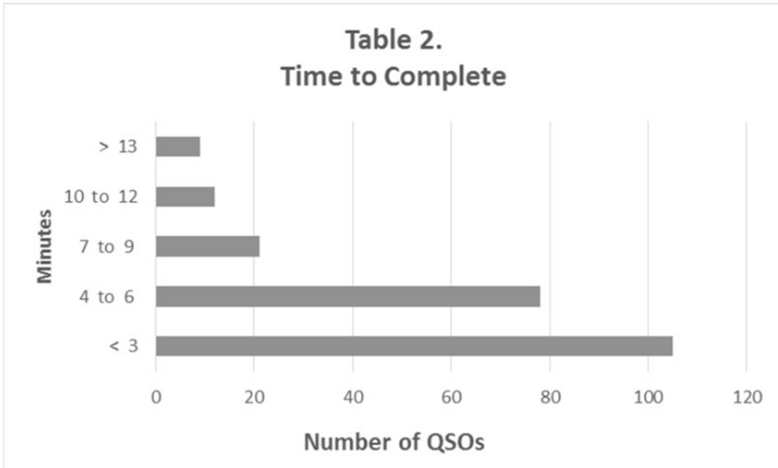
K8ZR Test Results



Important Techniques

- **The Same Principles for HF Apply to VHF**
  - Tower & Electrical Safety
  - Station Ergonomics
  - Physical Fitness
  - **ETHICS !!!**
    - A system of moral values and motivation based on right and wrong
      - "The rules are black and white, we make them gray!"
        K5ZD, CTU Dayton 2009

Where to Learn More

- VHF Conferences & Microwave Update
  - Central States VHF Society (CSVHFS)
  - Northeast Weak Signal Society (NEWS)
  - Southeast VHF Society (SEVHFS)
  - Western States Weak Signal Society (WSWSS)
  - Microwave Update Conference
- Not “traditional” hamfests
- Publish proceedings (compilation of technical papers)

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Acknowledgement

- Thanks to Tony, K8ZR (x-WA8RJF) for supplying additional information on Meteor Scatter

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Easy to Build
Low Band Receiving Antennas
for Small and Large Lots

- Small antennas
- High performance antennas
- Quantitative performance evaluation

Frank Donovan
W3LPL

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Dayton 2016

Why Receiving Antennas?

- Much better performance than most transmitting antennas
  - much lower cost
  - greatly reduced footprint
  - greatly reduced height (7 to 25 feet)
  - good directivity on as little as 650 to 2500 square feet
  - excellent directivity on less than an ¼ acre
  - superb directivity on less than 3/4 acre
  - greatly reduced mutual coupling between individual verticals
  - greatly reduced need for high efficiency matching and radial systems
- High performance arrays perform equivalent to a 5 element Yagi!
- Combining two antennas with a variable phase controller
  - steerable nulls
  - optimizes the front-to-back ratio of phased arrays of Beverages and verticals
- Diversity reception with dual phase locked receivers

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All receiving antennas dimensions are for 160 meters - simply scale them to 80 meters

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Receiving Directivity Factor (RDF)

- A proven measure of receiving antenna performance
  - compares forward gain at the desired azimuth and elevation angle to average gain over the entire hemisphere
  - assumes noise is equally distributed over the entire hemisphere, an invalid assumption for suburban and especially urban locations where noise is more intensely concentrated on the horizon
  - assumes that the noise is the far field of the antenna -- more than 1000 feet away -- where the antenna pattern is fully formed and the noise sources look more like a point sources

https://www.w8ji.com/receiving.htm

Re-radiation from antennas, towers and power lines within about 1000 feet can degrade your actual RDF **especially high RDF arrays**

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Small Receiving Antennas
4-9 dB RDF

- 4 dB: 8 foot diameter "magnetic" loop
- 5 dB: Single vertical antenna (short vertical or ¼ wavelength vertical)
- 6 dB: 225 foot Beverage on Ground (BOG)
- 6 dB: 250-400 foot Beverage
- 7 dB: Unidirectional terminated loop
  - flag, pennant, EWE, VE3DO
- 8 dB: Pair of 250-400 foot staggered Beverages
- 8 dB: Close spaced arrays of two small terminated loops
  - K9AY Array
  - Shared Apex Loop Array
- 9 dB: Two phased short verticals with 60-80 foot spacing
- 9 dB: Triangle array of phased short verticals with 60-80 foot spacing

Small antennas are the best RFI reduction antennas when your RFI sources are within about 1000 feet of the antenna

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High Performance Receiving Antennas 10-14 dB RDF

- 10 dB: 500-600 foot Beverage
- 11 dB: Two or three close spaced 500-600 foot Beverages, staggered 65 feet
- **12 dB: 4 square array of short Hi-Z or passive verticals (80 x 80 feet)**
- **12 dB: 3 element YCCC tri-band array of short verticals (84 x 84 feet)**
- **12 dB: 5-square YCCC tri-band array of short verticals (84 x 84 feet)**
- **12 dB: 9-Circle YCCC tri-band array of short verticals (120 foot diameter)**
- 12 dB: Horizontal Waller Flag: 2 phased horizontal loops at least 100 feet high
- 13 dB: BSEF array of four short verticals switchable in two directions (1/2 acre)
- 13 dB: Hi-Z 8-circle array of short pre-amplified verticals (200 foot diameter)
- 13 dB: 8-circle BSEF array of short passive verticals (350 foot diameter+radials)
- 14 dB: Four broadside/end-fire 800 foot Beverages (800 feet x 330 feet)

Large receiving antennas are much less effective when your RFI sources are within a few thousand feet of your antenna

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Small Loop Antennas 4-7 dB RDF 120-165º Beamwidth

- 8 foot diameter “magnetic” loop 4 dB RDF
  - 150 degree bi-directional beamwidth
  - a specialized antenna for steering a very deep null
- Unidirectional terminated loops 6-7 dB RDF
  - flag
  - pennant
  - EWE
  - K9AY
  - VE3DO
- Mechanically rotatable unidirectional terminated small loops
  - e.g., rotatable flag

Small antennas are the best RFI reduction antenna when RFI sources are within 1000 feet of your antenna

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Arrays of Small Loops
8-11 dB RDF   80-120º Beamwidth

- Electrically steerable compact arrays of two small loops
  - Two switchable K9AY loops   8-9 dB RDF
  - Shared Apex Loop Array   8-9 dB RDF
- 350 foot broadside spaced pair of small loops   9-10 dB RDF
  - pennant
  - EWE
  - K9AY
  - VE3DO
- Mechanically steerable array of two small loops   10-11 dB RDF
  - Vertical Waller Flag

Small antennas are the best noise reduction antenna when noise sources are within 1000 feet of the antenna

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BOGs and Arrays of BOGs
6-8 dB RDF   60-90º Beamwidth

- BOG   6 dB RDF   90º beamwidth
  - a 225 foot wire laid just above the surface of the ground
- Close spaced staggered BOGs   7 dB RDF   90º beamwidth
  - two or three close spaced staggered BOGs
  - significantly improves front-to-back ratio especially if a variable phase controller is used
- Two wide spaced BOGs   8 dB RDF   60º beamwidth
  - 350 foot broadside spacing

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Beverages and Arrays of Beverages

- 250-400 foot Beverage   6 dB RDF   90-120º beamwidth
  - 250-400 feet long, approximately 7 feet high
  - single wire or two wire bi-directional
- 500-900 foot Beverage   8-10 dB RDF 50-70º beamwidth
  - single wire or two wire bi-directional
  - bi-directional Beverage
- Close spaced Beverage arrays 11 dB RDF 50-70º beamwidth
  - two or three close 65 foot spaced end-fire (staggered) Beverages
  - significantly improved front-to-back ratio especially if a variable phase controller is used
- Wide spaced Beverage arrays 12-14 dB RDF 45-60º beamwidth
  - two Beverages with 350 foot broadside spacing
  - four Beverages with 65 foot end fire spacing and 350 foot broadside spacing

Arrays of Short Verticals
9-14 dB RDF   50-135º Beamwidth

- Active high impedance 20 foot verticals
  - requires a high input impedance amplifier at the base of each vertical
- Passive low impedance 25 foot verticals
  - **simple to troubleshoot and repair.   Low parts count.   Very reliable**
  - requires eight 70 foot or sixteen 35 foot radials at the base of each vertical
    - stabilizes feed point impedance in all weather and decouples the coax shield
  - four 25 foot umbrella wires
    - reduces the required height to 25 feet
    - increases the array bandwidth

Small Diameter Loop Antenna
Eight Foot Diameter "Magnetic" Loop

- Excellent for nulling a single nearby RFI source
  - but a poor low angle DX receiving antenna
  - RFI must be vertically polarized and received at a low angle via ground wave
- Excellent for very accurately locating RFI sources
- Bi-directional figure-8 pattern 150 degree 3 dB beamwidth
  - But its omni-directional for skywave propagated signals
- Very deep nulls (only 2 degrees wide) off both sides of the loop
  - mechanically rotate the loop until the single local RFI source is nulled
  - no useful nulls for skywave propagated signals
- Small loop antennas produce very low signal levels
  - requires a high gain, low noise preamplifier
- Decouple stray pickup from all attached cables
  - install chokes on the coaxial feed line shield and the DC power cable
  - bury cables about 12 inches deep for optimum null depth
- Avoid re-radiated signals from nearby antennas and power lines
  - locate the antenna as far as possible from other antennas and power lines

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The "Magnetic" Loop is a Specialized Antenna

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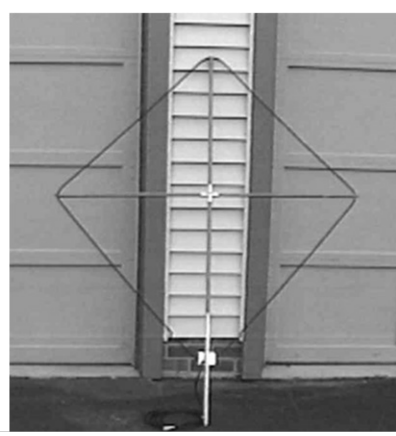
Small Diameter Loop Antenna
4 dB RDF

inexpensive and very easy to build and use
8 foot diameter
Very deep, 2 degree beam width nulls for local RFI suppression
bidirectional 150 degree 3 dB beam width



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www.seed-solutions.com/gregordy/
Amateur%20Radio/Experimentation/160loop.htm

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Electrically Steerable Loop Arrays

- Two K9AY loops
  - switchable in four directions
  - footprint is only 25x25 feet and 25 feet tall
  - 120 degree 3 dB beam width
  - 7 dB RDF
- Shared Apex Loop Array
  - switchable in eight directions
  - footprint is only 50x50 feet and 25 feet tall
  - 75 degree 3 dB beam width
  - 8 dB RDF
- Loops produce very low signal levels
  - a high gain, low noise figure preamplifier must be used
  - requires very careful attention to eliminating all unwanted signal coupling
    - decouple the coaxial feed line shield, control cable and DC power cable
    - bury cables about 12 inches deep for best unwanted signal rejection
- Avoid re-radiated signals from nearby antennas, towers and power lines
  - locate the antenna as far as possible from antennas, towers and power lines

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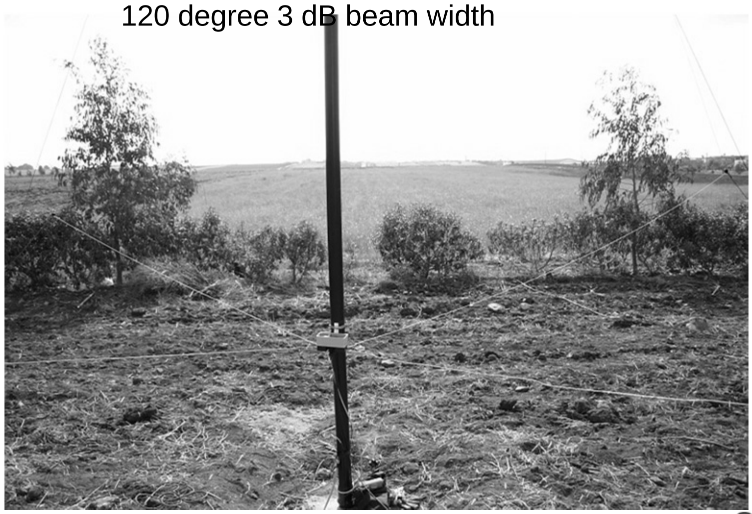
Two K9AY Loops
7 dB RDF in only 625 square feet

very small 25x25 foot square x 25 feet high footprint
switchable in four directions
120 degree 3 dB beam width



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www.arraysolutions.com/antennas/as-ayl-4-ant

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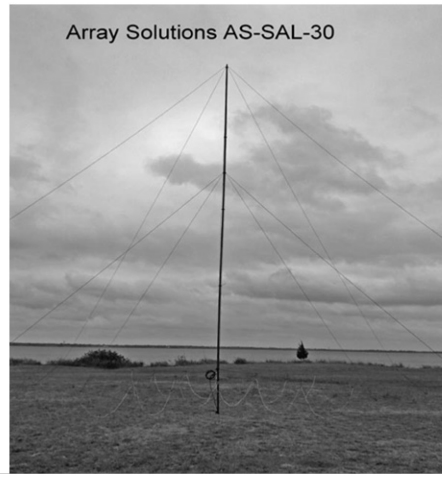
Shared Apex Loop Array
8 dB RDF in only 2500 square feet

50x50 foot square x 25 feet high footprint
switchable in eight directions
75 degree 3 dB beamwidth

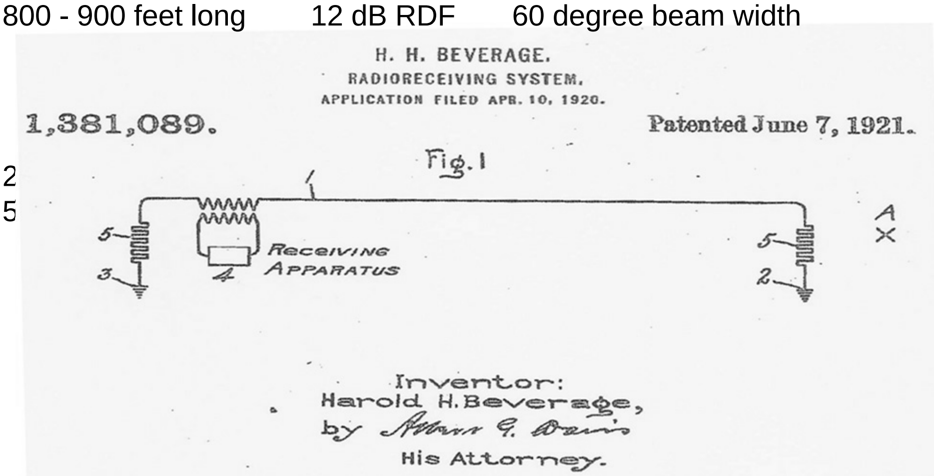


www.arraysolutions.com/antennas/as-sal-30

Single Wire Beverage

The simplest and most reliable high performance receiving antenna

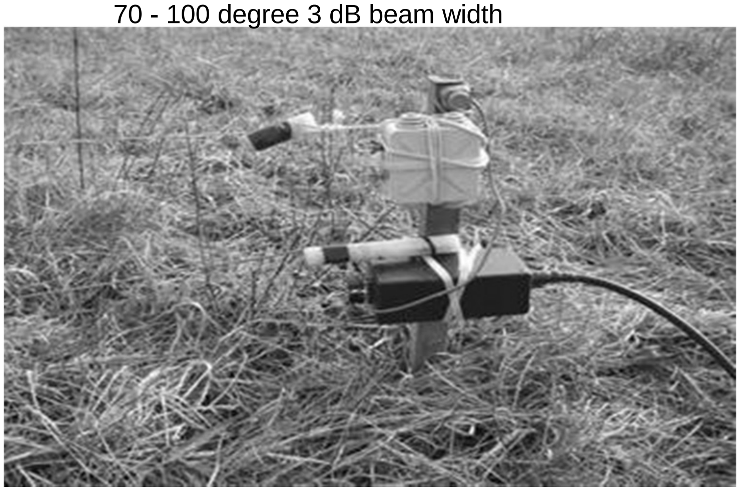
250 - 400 feet long	4 - 6 dB RDF	100 degree beam width
500 - 700 feet long	10 -11 dB RDF	70 degree beam width
800 - 900 feet long	12 dB RDF	60 degree beam width



http://www.w8ji.com/beverages.htm

Beverage on (or near) Ground
6-8 dB RDF with only 200 feet of length

a good choice when stealth is important
only 200-250 feet long for 160 meters
longer lengths degrade performance
70 - 100 degree 3 dB beam width



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https://vimeo.com/199235390

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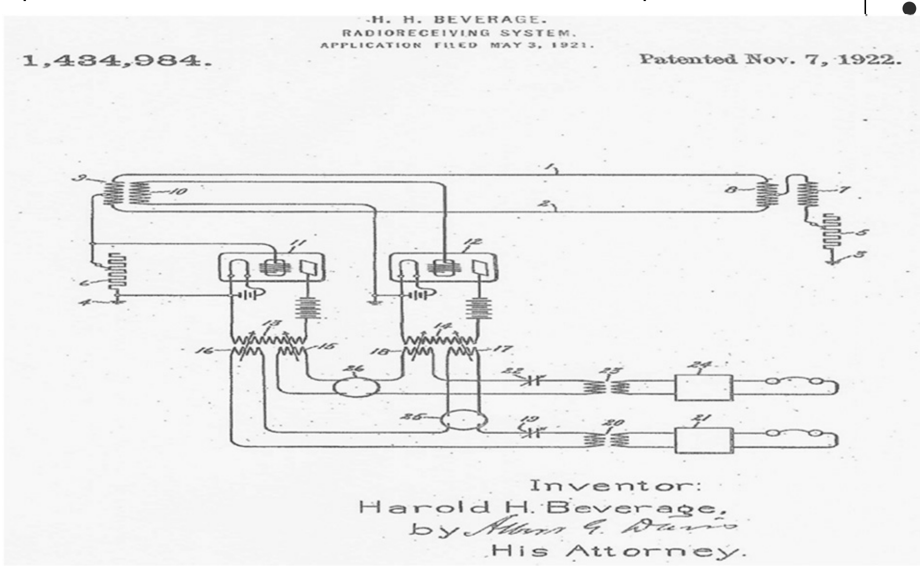
Two Wire Bidirectional Beverage

Switchable in two directions with one feed line
deep steerable rear null if both feed lines feed a variable phase combiner



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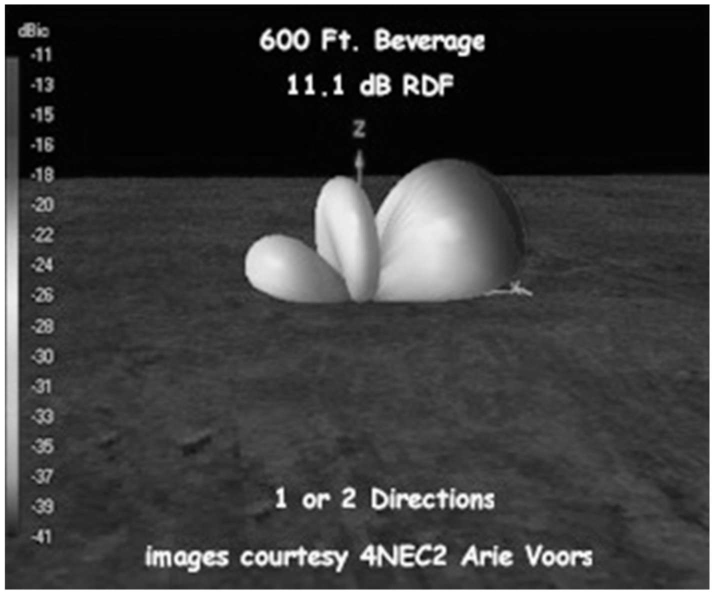
www.w0btu.com/Beverage_antennas.html

ICOM

Radiation Pattern of a 600 Foot Beverage



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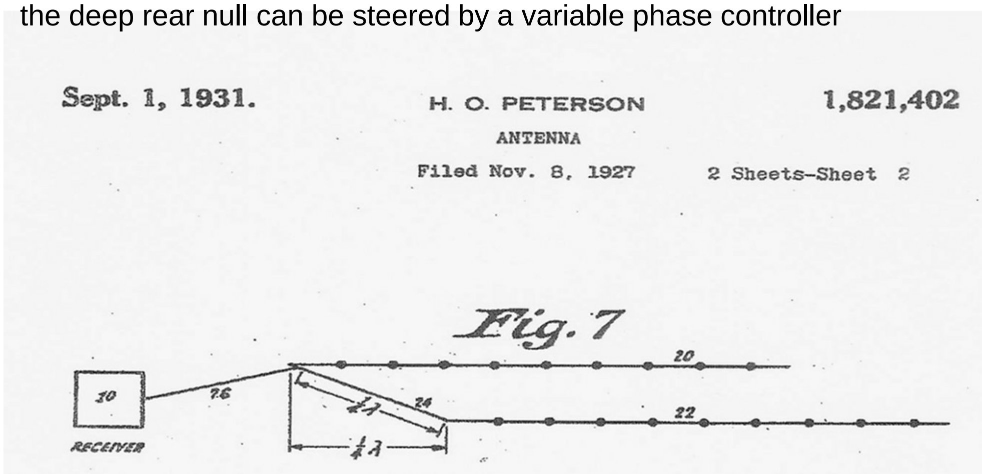
ICOM

Close Spaced Staggered Beverage Arrays 11 dB RDF on one acre

two or three close spaced, 500-600 foot staggered Beverages
two or three close spaced 200-225 foot BOGs – 7 dB RDF
enhanced front-to-back ratio compared to a single Beverage or BOG
the deep rear null can be steered by a variable phase controller



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http://ncjweb.com/features/sepoct11feat.pdf

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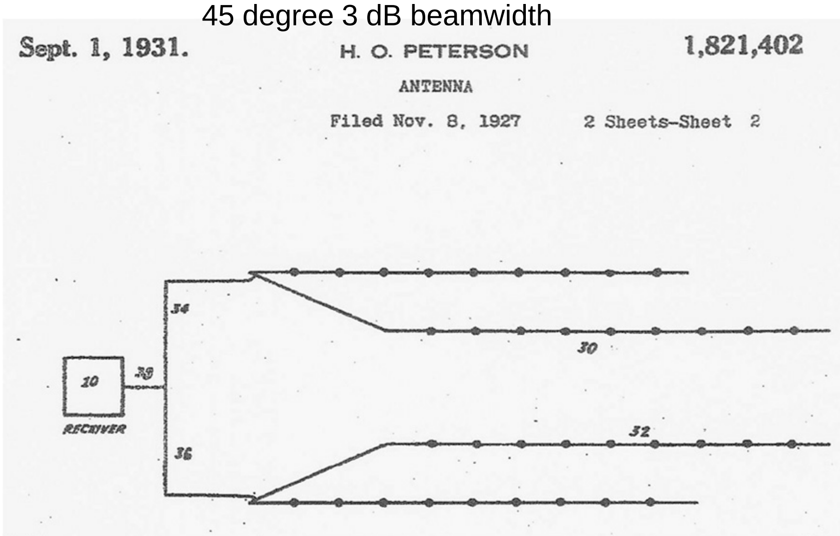
Broadside Pair of Staggered Beverages
14 dB RDF on 8 Acres

800-900 foot Beverages, 330 foot broad side spacing

45 degree 3 dB beamwidth



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ICOM

Phased High Impedance Verticals

Two or More 20 Foot Verticals

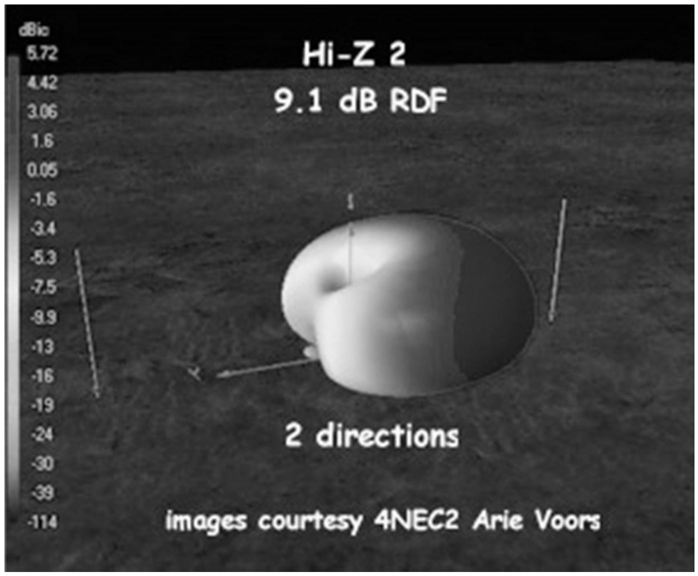
- No radials
- No umbrella wires
- Dual band operation with compromise 65 foot element spacing
- 80 foot element spacing for improved 160 meter performance
  - closer spacing is possible by using a variable phase combiner
- High input impedance amplifier at the feed point of each vertical
  - stray capacitance to nearby trees and other objects, at the feed point of each vertical and at the input to each amplifier must be as low as possible
- Switchable in multiple directions
- Verticals must not be installed within ten feet of nearby objects
  - Avoid nearby trees or any conductive or partially conductive structure
- Avoid re-radiated signals from nearby antennas and power lines
  - locate the antenna as far as possible from antennas, towers and power lines

www.hizantennas.com

CONTEST UNIVERSITY

ICOM

Radiation Pattern of a Two Element Array of 20 Foot Verticals



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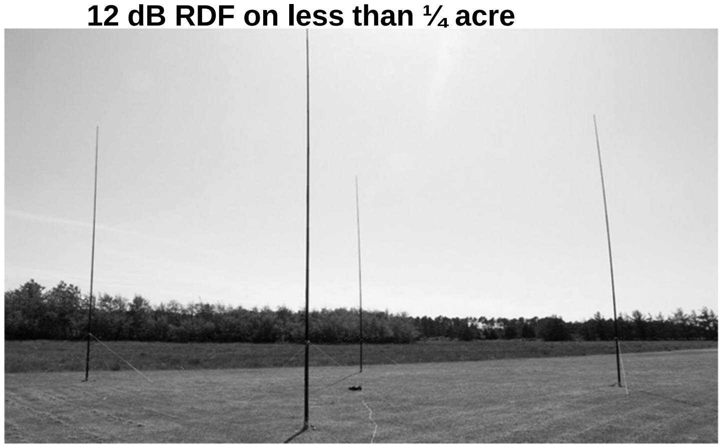
ICOM

Electrically Steerable 4-Square Vertical Array

four high impedance 20 foot verticals
no radials and no umbrella wires
80x80 foot square x 20 foot high footprint
high input impedance amplifier at the base of each vertical
switchable in four directions
100 degree 3 dB beam width
12 dB RDF on less than ¼ acre



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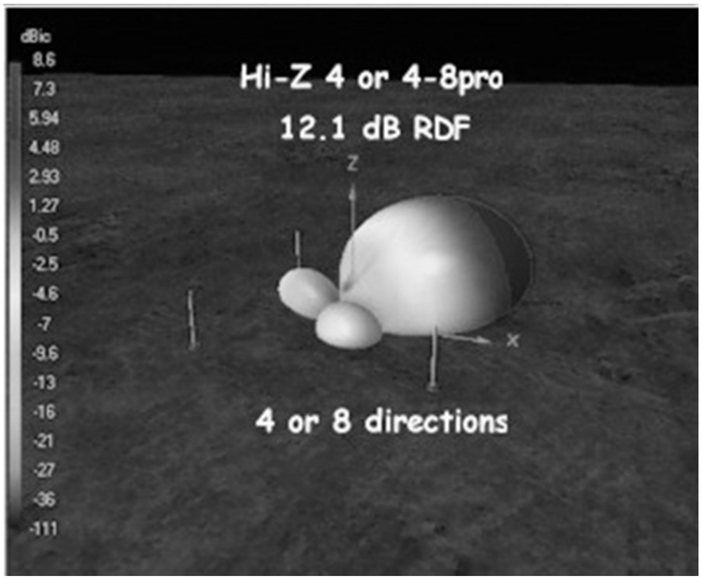
www.dxengineering.com/parts/hiz-4-lv2-80

ICOM

Radiation Pattern of a 4-Square Array of 20 Foot Verticals



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ICOM

Electrically Steerable 8-Circle Vertical Array

eight high impedance 20 foot verticals
no radials and no umbrella wires
requires a high input impedance amplifier at the base of each vertical
200 foot diameter array with 106 degree phasing
switchable in eight directions
50 degree 3 dB beam width, the performance of a 5 element Yagi
13.5 dB RDF on ¾ acre

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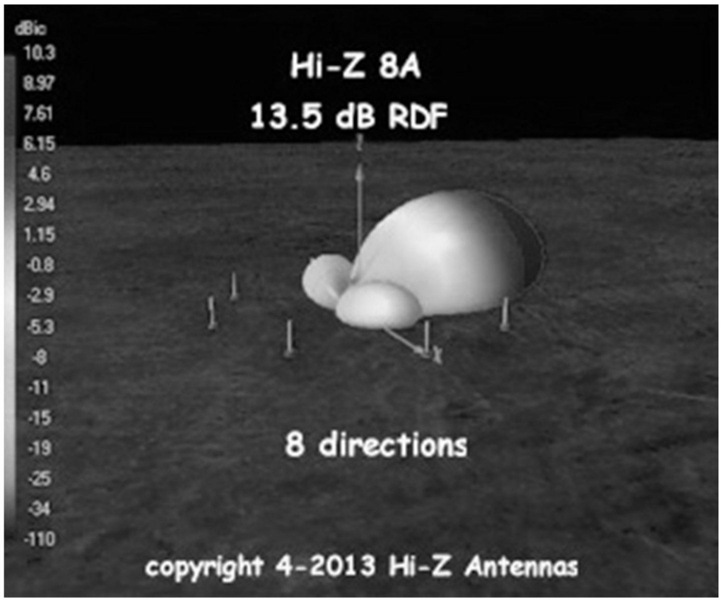
www.hizantennas.com/8_element_arrays.htm

ICOM

Radiation Pattern of a 200 Foot Diameter 8-Circle Array



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Eight phased verticals with 106 degree phasing

ICOM

Phased Low Impedance Verticals
Two or More 25 Foot Umbrella Verticals

- Short radials are required at the base of each vertical
  - eight 70 foot radials, sixteen 35 foot radials or chicken wire
  - randomly laid on the ground or shallow buried, symmetry is not important
- Four 25 foot umbrella wires attached to the top of each vertical
  - reduces antenna height and improves array bandwidth
  - if necessary, use 35 foot verticals with no umbrella wires
- As little a 65 foot element spacing
  - its difficult to achieve stable, repeatable performance with smaller spacing
- Amplifiers not needed at the base of each vertical – higher reliability
- Switchable in multiple directions
- Very easy and low cost to homebrew your own antenna
  - large diameter arrays are very tolerant of moderate amplitude and phase errors
- Low impedance verticals are tolerant of nearby trees and buildings
- Avoid re-radiated signals from nearby towers, antennas and power lines
  - locate the antenna as far as possible from other antennas and power lines

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Excellent Performance and High Reliability

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YCCC Triband Receiving Arrays
Nine High Impedance Short Verticals

- 3 element, 5 element and 9 element configurations
  - switchable in 180, 90 and 45 degree steps
  - All have identical 80 degree 3 dB beamwidths, slightly wider on 80 and 40M
- 120 foot diameter array
- No radials
- High impedance amplifier at the feed point of each 20 foot vertical
- A common mode choke must be attached to each feedline where it connects to the controller
- Must be kept clear of nearby trees and metallic structures
- Avoid re-radiation from nearby towers, antennas and power lines
  - locate the antenna as far as possible from other antennas and power lines

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static.dxengineering.com/global/images/instructions/dxe-yccc-3inline.pdf

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Electrically Steerable 4-Square Vertical Array

four low impedance 25 foot umbrella verticals
four 25 foot umbrella wires attached to the top of each vertical
eight 70 foot or sixteen 35 foot radials per vertical
65x65 foot square footprint plus additional space for radials
switchable in four directions
easy and inexpensive to build
100 degree 3 dB beamwidth
12 dB RDF on ¼ acre

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www.iv3prk.it/user/image/site2-rxant.prk_4-square_1.pdf

ICOM

Electrically Steerable 8-Circle Vertical Array

eight low impedance 25 foot umbrella verticals
four 25 foot umbrella wires per vertical
eight 70 foot or sixteen 35 foot radials per vertical
350 foot diameter with 1/4 wavelength spacing plus space for radials
or only 200 foot diameter with a 106 degree Hi-Z phasing controller
switchable in eight directions
Very easy and inexpensive to build
50 degree 3 dB beam width, the performance of a 5 element Yagi
13.5 dB RDF on one acre

construction details: http://www.w5zn.org

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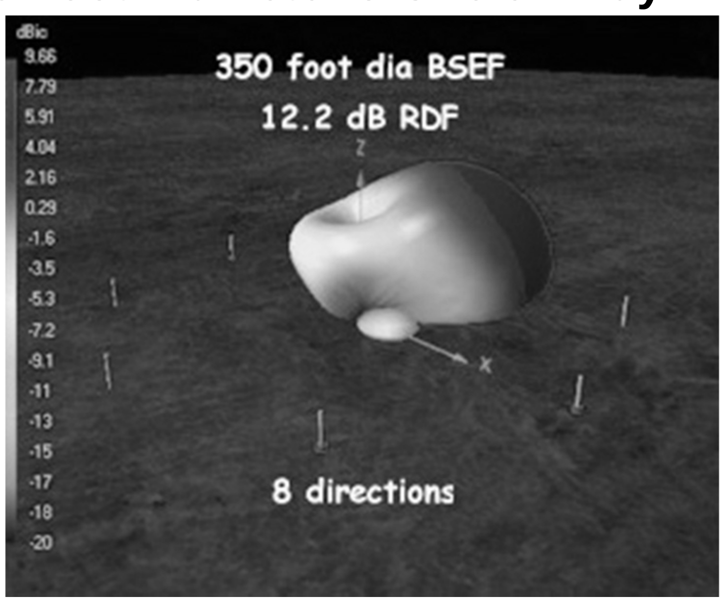
Radiation Pattern of a 350 Foot Diameter 8-Circle Array



Four phased elements with 115 degree phasing

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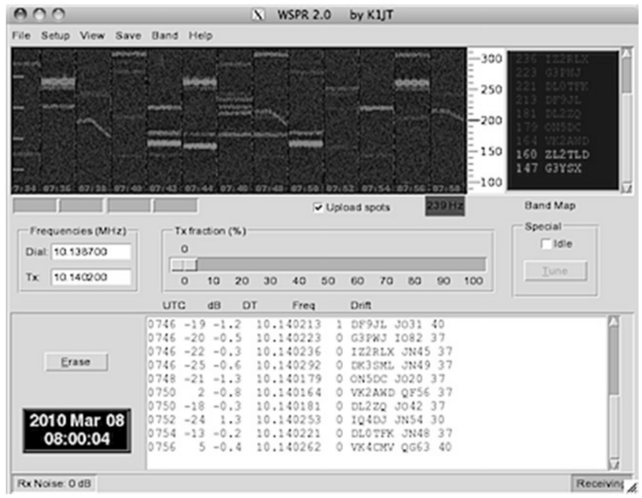
Quantitative Performance Evaluation K1JT's WSPR

Use WSPR to compare the performance of two antennas



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http://physics.princeton.edu/pulsar/K1JT/WSPR_2.0_User.pdf

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Receive Antenna Variable Phasing Controller DX Engineering NCC-2

Combines the inputs from two antennas

- creates a directional pattern with deep steerable nulls
- optimizes the performance of phased Beverages and phased verticals
- very well engineered and exceptionally easy to use

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www.dxengineering.com/parts/dxe-ncc-2

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Phase Synchronous Diversity Reception

two widely spaced antennas (500 to1000+ feet) feeding
two identical high performance phase locked receivers

Elecraft K3s transceiver with KRX3 sub-receiver

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CTU Presents

A Deep Dive Into
Stacking Yagis
by
Greg Ordy, W8WWV

CTU

Let's Get Started!

- This is a big topic, too long for one CTU session.
  - Could be a chapter in a book, or an entire book.
  - Let's limit it for this forum.
- We are going to be talking about HF Yagis in the 40 meter to 10 meter frequency range with horizontal polarization and stacked vertically.
- VHF/UHF Yagis change the playing field a little because of their very long boom lengths and extreme heights above ground – relative to wavelength. Propagation modes are also different.

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Stacking Introduction

- When I was a young ham, almost 50 years ago, I heard this nugget of wisdom about antennas:
- **Get as much metal as you can as high in the air as you can.**
- There is a lot of truth to that statement.
- When I first heard about the idea of *stacking Yagis*, I thought: *I get it, more antennas equals more metal equals more gain!*
- Although adding antennas should add gain, it is probably most important to make sure that we do not end up with deep nulls in the elevation pattern that negate all of our hard work in building the stack.
  - No matter how much maximum gain you have at some take off angle, a 20+ dB null wipes it all away at another take off angle.

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Stacking Introduction

- Evaluating the design of a stack should always include a consideration of the nulls and making sure that they don't swallow up energy from desirable take off angles.
  - This is the *open manhole cover* we want to avoid.
- This evaluation leads to an related question:
  - Can my Yagi antenna ever be *too high*?
- The answer is yes! Height above ground is the primary factor in determining the elevation pattern.

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Stacking Introduction

- Other factors matter too. Like gain!
- While we should all know that a low SWR is not proof of overall antenna performance, it is a factor to be considered.
  - A dummy load has a low and flat SWR but is a poor antenna. SWR is not everything, but it is something.
- Especially in contesting, often with guest operators, having a low and flat SWR reduces the need for endless amp tweaking in the heat of battle.
- This takes us into the different methods for feeding a stack to create a low SWR.

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Single Yagis over Ground

- Although a single Yagi is not a stack, we can learn a lot by taking a look at its performance as a function of height above ground.
- From *Yagi Antenna Design* by Jim Lawson, W2PV (SK) (page 5-7):
  - *Thus, we see that the main lobe of an antenna occurs at an angle primarily determined by its height above ground, but secondarily by the natural antenna directivity.*
- Maximum gain occurs in the main pattern lobe, and nulls occur above and below the main lobe, in fact they **define** the main lobe!
- The maximum forward gain of a Yagi occurs at a particular take off angle that is never too far from a null take off angle. They get closer together as the height increases.
- A single Yagi has properties like a stack because it is interacting with it's image antenna due to ground.

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Single Yagi over Ground

- Let's verify the height claim with some antenna models.
  - ARRL Antenna Book(23rd edition) model ARRL_315-12.EZ. 3 elements on 15 meters on a 12' boom @ 21.1 MHz. EZNEC Pro/4, version 6, real/average ground...
  - Step through the elevation patterns as a function of height, in ¼ wavelength steps starting at ¼ wavelength.
    - ¼ wavelength at 21.1 MHz is 11.66', rounded up to 12' because that's nice and round.
  - ¼ to 4 wavelengths is 12' to 192' in 12' increments (with a few feet of rounding error at the top end).

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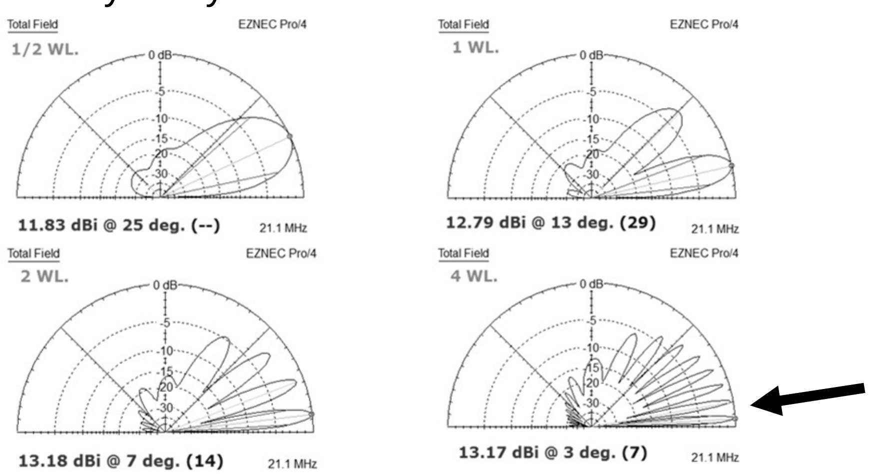
Single Yagi over Ground

- In case my fancy animation is not available:



The concern is *falling in a null*, especially as the height increases.

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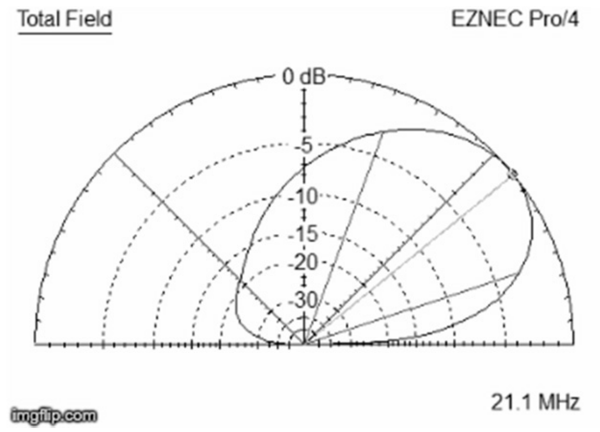
Single Yagi over Ground



¼ to 4 wavelength height off ground, ¼ wavelength steps.

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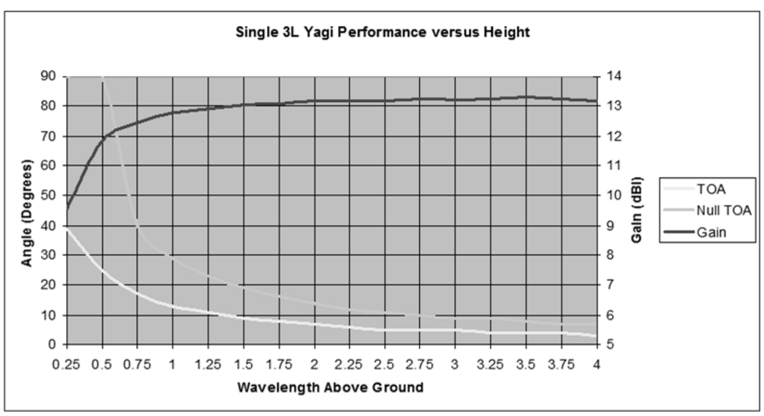
Single Yagi over Ground

- Graph of maximum gain, main lobe angle, and first null angle above the main lobe as a function of height.



Max. forward gain tops out around one wavelength, but the main lobe continues to tip down, as does the null.

The null angle grows closer to the max. forward gain angle.

The higher a Yagi, the more it *needs* to be part of a stack.

Extreme height is about getting access to extremely low angles.

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Single Yagi over Ground

- These results are for a 3 element Yagi.
- Increasing the boom length will make it more directive in the vertical plane, narrowing the main lobe even further.
- Stacks of Yagis have similar nulls, although depending upon heights and feed system you can get a wide range of results.
  - You can't have a high gain lobe without nulls on the sides whether it's due to 1 Yagi, or 2, or 10!
- But, a null(s) is usually in there, and we want to be aware of it and make sure it is *filled in* by using some particular configuration of the stack.
- Keep track of the maximum gain angles as well as the minimum gain (null) angles. Operating in a null is a buzz kill.
- The higher the maximum gain, the narrower the main lobe, and the closer the nulls are around the main lobe.

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Elevation Angles of Interest

- It's pretty clear that we need to understand the elevation angles of the signals we care about to see if they fall in a null.
- I know of two ways to generate that information.
  - The *old fashioned* way is to consult tables in the ARRL Antenna Book (and probably other sources).
    - This data is in the Antenna Book up to and including the 18th edition (1997).
  - The newer way is to use the HFTA (*HF Terrain Assessment*) program. It takes into account the actual site topography and combines it with antenna pattern information computed from a simple description of the stack.
    - This approach is in the 19th and later editions of the ARRL Antenna Book.
- Elevation angles are a function of many factors, including the band, point in the sunspot cycle, radio locations on the planet, number of *skips*, and height of the layers that cause *skipping* (e.g. E, F1, F2…).
- At different times, the same path may occur at different angles.
- That's part of the fun!
- When you think about it, without the *fun* of propagation, HF operation would be way too predictable.

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Elevation Angles of Interest

- From the 18th edition Antenna Book (1997).
  - Based upon IONCAP runs.
- The first two peaks are shown.
- Nulls falling over a peak are a problem!
- This is a very broad overview of the angles, but, it helps suggest a range.

Table 11
W8, Cincinnati, OH to World

		80m	40m	30m	20m	17m	15m	12m	10m
Europe	100%	14-33	3-20	2-16	1-28	1-12	2-12	2-11	2-11
	90%	14-27	3-19	4-14	3-12	2-10	3-11	2-10	2-9
	Peak Angs	15,18	12,18	13,9	8,3	8,4	8,3	2,9	3,8
	Peak Pcts	20,13	13,9	15,13	26,6	20,12	20,13	17,14	20,12
Far East	100%	10-18	9-16	2-18	1-16	2-12	2-16	1-16	3-12
	90%	12-18	10-15	4-15	3-12	3-12	3-14	3-14	3-12
	Peak Angs	14,18	12	14,10	10,5	10,6	10	5,12	5,12
	Peak Pcts	29,29	54	21,14	25,21	24,13	36	29,18	34,15
South America	100%	12-18	5-15	1-16	1-13	1-12	1-13	1-13	1-11
	90%	12-16	8-13	5-12	2-11	2-10	2-11	3-12	2-8
	Peak Angs	14	10,13	11,7	9,6	4,8	10,5	5,8	4,7
	Peak Pcts	37	34,9	24,13	16,14	24,11	16,15	24,12	20,16
Oceania	100%	5-10	5-10	4-10	1-10	2-10	2-10	2-10	1-10
	90%	5-10	5-10	5-10	2-10	2-10	3-10	4-10	3-10
	Peak Angs	10	10	10	5	8,3	10,3	10	10
	Peak Pcts	60	73	74	58	20,17	35,13	61	49
Southern Africa	100%	10-12	8-14	1-14	4-14	2-12	1-14	1-14	2-12
	90%	10-12	10-12	5-12	5-14	3-12	3-12	2-12	5-12
	Peak Angs	10	10	12,8	10,5	10,5	10,5	10,5	10,5
	Peak Pcts	81	48	35,12	27,24	24,16	25,11	23,10	30,18
South Asia	100%	0-0	8-12	3-13	2-14	1-12	2-14	2-14	2-12
	90%	0-0	10-12	6-12	3-12	2-10	3-14	3-14	2-12
	Peak Angs	0,0	10	10	10,5	3	12,3	12,3	3,8
	Peak Pcts	0,0	92	48	22,21	37	24,20	18,15	29,24

Elevation Angles of Interest

- Later Antenna Book editions began including similar information in a different format.
  - More detail, but less high level view.
  - We can see two peaks here, around 4-6 degrees and 10-12 degrees.
- Note that the angle range tends to cluster lower as you go up in frequency.

Table 3
Boston, Massachusetts, to All of Europe

Elev	80 m	40 m	30 m	20 m	17 m	15 m	12 m	10 m
1	4.1	9.6	4.6	1.7	2.1	4.4	5.5	7.2
2	0.8	2.3	7.2	1.4	2.8	2.8	3.7	5.3
3	0.3	0.7	4.3	3.1	[illegible]	2.2	4.4	7.9
4	0.5	4.1	8.7	11.6	[illegible]	9.4	8.1	3.9
5	4.6	4.8	7.5	12.7	14.3	13.1	9.2	11.2
6	7.1	8.9	5.5	9.2	9.6	12.2	9.2	7.2
7	8.5	6.9	7.2	4.6	7.9	7.4	10.0	5.9
8	5.1	7.0	5.4	3.2	5.9	7.4	4.8	6.6
9	3.3	5.6	3.2	3.1	2.1	3.9	8.1	9.2
10	1.0	4.0	7.9	6.3	5.1	3.7	11.1	6.6
11	1.9	3.8	9.7	10.2	7.2	5.4	3.7	7.9
12	5.6	3.4	4.8	8.5	[illegible]	7.4	4.8	6.6
13	11.0	3.0	2.4	4.1	5.9	4.6	3.3	2.6
14	7.6	4.8	2.0	2.7	3.8	3.9	6.3	5.9
15	5.3	7.9	2.0	1.5	2.4	1.7	1.5	2.0
16	2.8	6.4	3.8	2.9	1.5	1.3	2.6	2.6
17	5.0	3.4	4.5	3.1	1.0	1.5	0.0	0.0
18	4.2	2.0	3.1	3.1	2.0	2.2	1.8	1.3
19	5.7	1.4	1.4	2.3	1.3	0.7	0.0	0.0
20	6.6	1.4	1.2	1.8	1.1	1.3	0.7	0.0
21	4.4	1.4	0.5	0.8	0.7	0.7	0.4	0.0
22	2.3	2.4	1.0	1.1	0.6	1.3	0.7	0.0
23	1.3	1.8	0.1	0.3	0.1	0.0	0.0	0.0
24	0.6	1.0	0.5	0.5	0.4	0.7	0.0	0.0
25	0.3	0.8	0.3	0.1	0.4	0.0	0.0	0.0
26	0.0	0.5	0.7	0.2	0.1	0.4	0.0	0.0
27	0.1	0.1	0.1	0.2	0.1	0.2	0.0	0.0
28	0.0	0.3	0.1	0.2	0.0	0.2	0.0	0.0
29	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0
30	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
33	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Percentage of time a particular frequency band is open on this speci

Elevation Angles of Interest

- **HFTA** – *HF Terrain Assessment*, Dean Straw, N6BV.
  - Windows PC program.
- Part of the recent edition Antenna Books (on the CD at the back of the book).
- This program not only features more geographic locations, but includes elevation pattern information computed for a general stack description that is not as complex as a full blown NEC/EZNEC model (face it, coming up with a model is work).
- This makes it great for ***what-if*** analysis and project planning.
- A stack of 1 to 4 identical Yagis with 1 to 8 elements can be evaluated with both in and out of phase combining.

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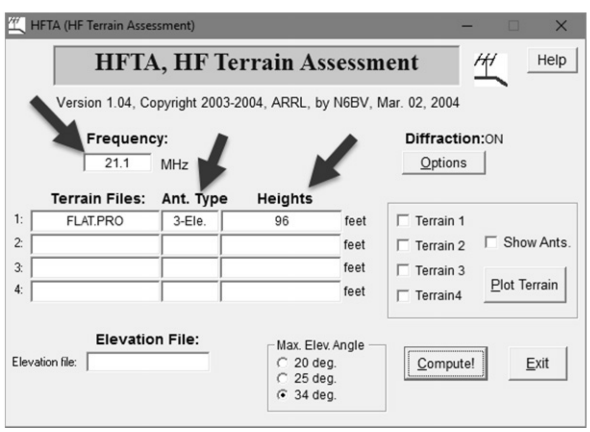
Elevation Angles of Interest

- Let's look at a generic 3 element 15 meter Yagi at 96' (2 wavelengths). This was an earlier example.



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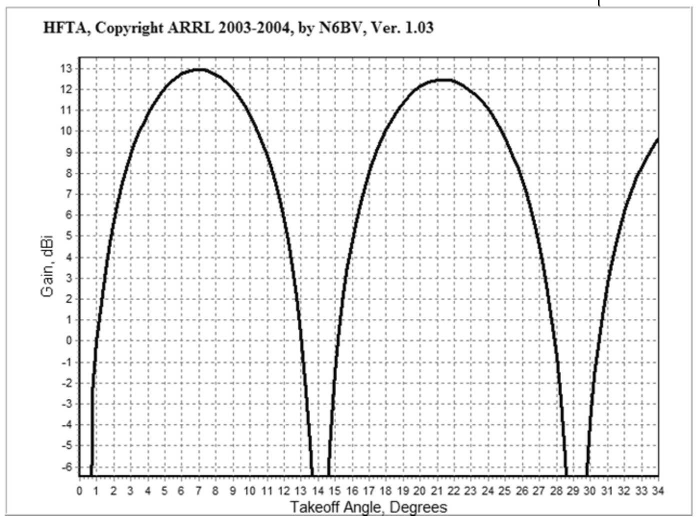
Elevation Angles of Interest

- But wait, this should be the same result as we saw with the antenna model, since the terrain profile is **FLAT**, as in an antenna model. A *perfect world*.



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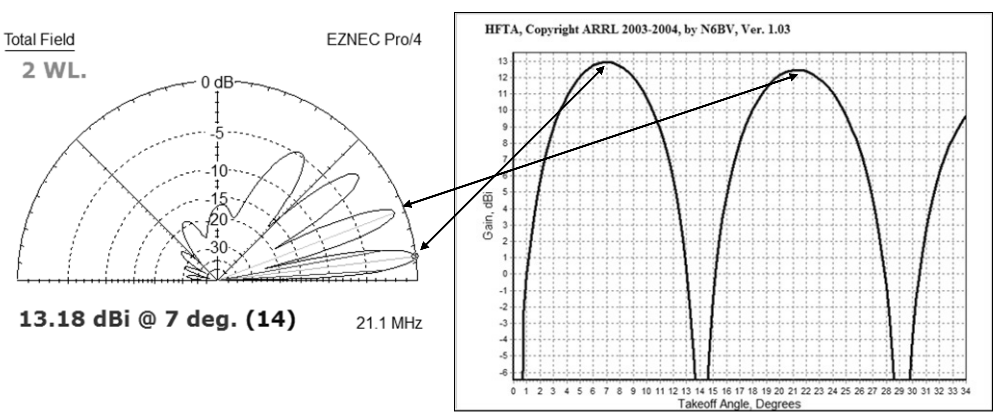
Elevation Angles of Interest

- Indeed we can compare the two and they are quite close.



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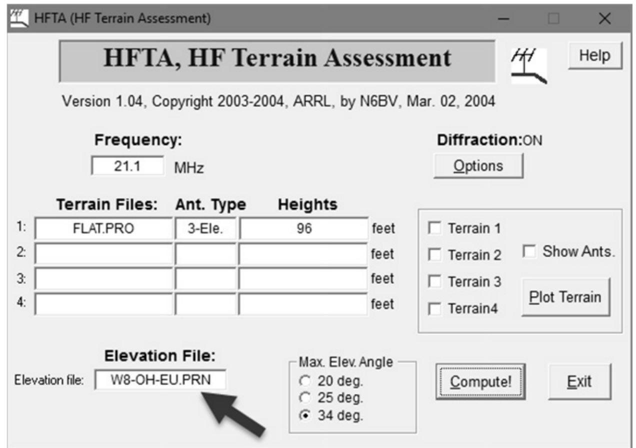
Elevation Angles of Interest

- But wait, there's more!
- We can add in elevation data representing two points on the globe.
- Let's pick W8-Ohio for one end, and Europe for the other.
- This is similar to what was once in the tables on paper.



There are over 1000 .PRN files on the 23rd edition.

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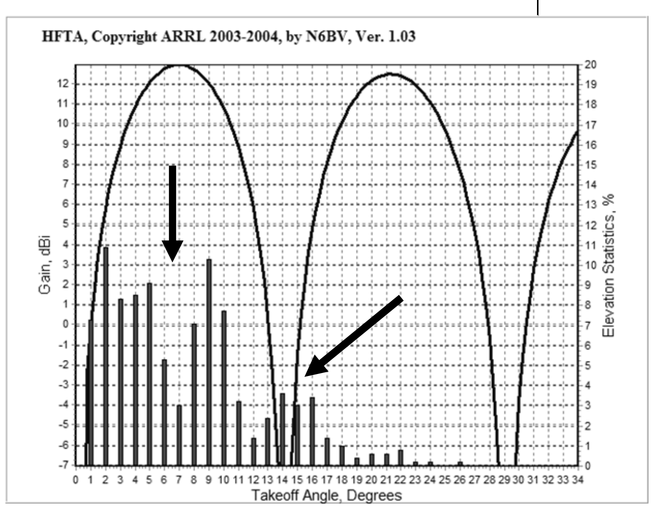
Elevation Angles of Interest

- On one graph we can see what we have versus what we need.
- Our main lobe is over a lower occurance range, and we have a null where a few percent of the signals occur.
- Keep high probability signals out of the nulls!



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Elevation Angles of Interest

- But wait, there is **even** more!
- We can bring in the actual terrain data for the location of our antenna tower.
- Local terrain can have a **substantial** impact on the actual pattern of the real antenna.
  - This explains why similar installations in the same general area can have very different performance. **It's the location, stupid.**
- Antenna models assume a flat and perfect region around the antenna.
- Generating the local terrain data can be a time consuming tedious process. But, **k6tu.net** has an online calculator that automatically generates data files for all 360 degrees of azimuth around a given longitude/latitude. See the site for information.

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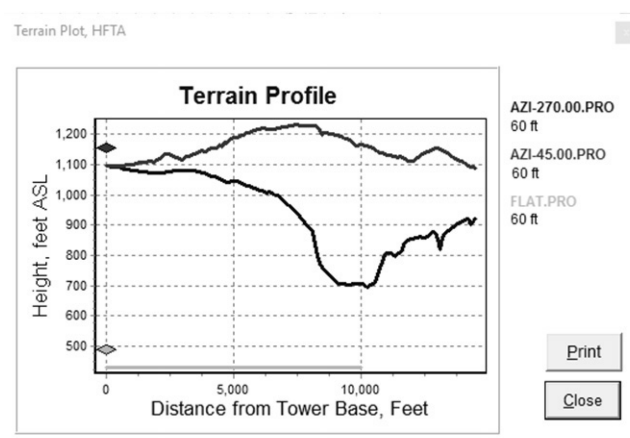
Elevation Angles of Interest

- I generated terrain data for my location. For the 45 and 270 degree directions, here is the result.
- The sharp drop to the west is the Chagrin River Valley.
- So what impact does the terrain have on my Yagi at 60'???



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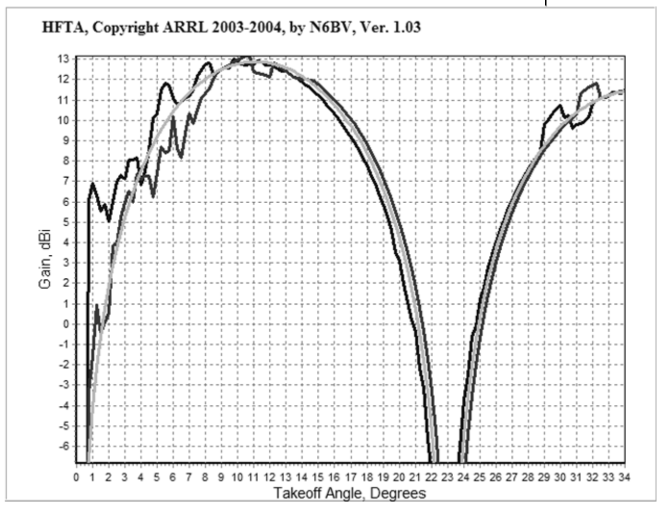
Elevation Angles of Interest

- Green is the response in a flat world, similar to the NEC model.
- Red is towards EU (45) which suffers a little from the hill.
- Blue is towards the west (270), that enjoys a boost, especially at very low angles.



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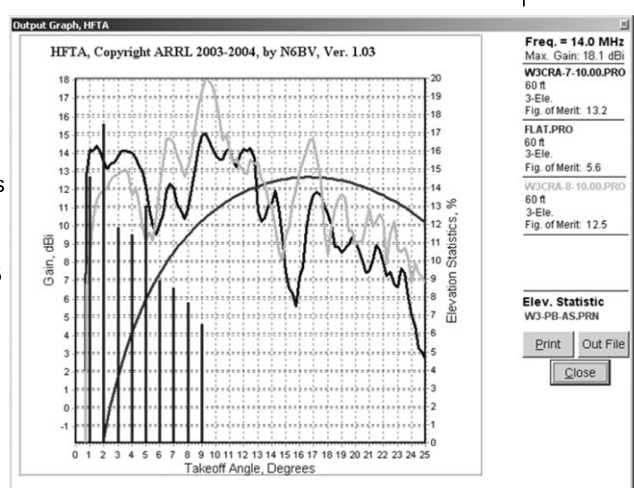
Elevation Angles of Interest

- Back in the day (~1960), Frank Lewis, **W3CRA** (SK), was known to have one of the consistently louder signals on 20 meters into **Asia**.
- He used a modest 3 element Yagi on a 70' tower!
- The magic turned out to be his location on the side of a hill over a valley sloping towards Asia.
- HFTA analysis shows 12 to 15 dB of added gain over a flat site. (!!!)
- His location (blue) was better than being located at the top of the hill (green).
- Red is the performance of a flat site.
- Material from the W4ZV web site.



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Elevation Angles of Interest

- Antenna models and HFTA are powerful tools for evaluating the performance of a stack.
- HFTA allows you to configure stack models in a matter of seconds with elevation patterns as good as a detailed antenna model.
  - It's possible to include the impact of the terrain around the tower site.
- Models (NEC, EZNEC, 4nec2) are more detailed and tedious to construct, but details like the feed system can be included that provide insight into characteristics such as SWR and bandwidth.
  - Models can evaluate factors such as the element tapering schedule – an essential part of the construction process.
- Whenever I'm involved in a stack project, I use both tools to make sure that important take off angles are not dropped into a null.

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Single Yagis over Ground

- Let's revisit the single Yagi once more before moving on. It's a *stack of one*.
- For a classic *tribander* on a tower, is there such a thing as the *best height?*
- This is one of those *religious* topics that is clearly a compromise situation.
- Very generally speaking if you take all of the data on take off angles together, you find that it tends to fit in the range of 3 to 17 degrees (Lawson, page 5-12).
- Covering this range translates into a height of 1.5 wavelengths.
- But, 1.5 wavelengths on 20 meters is 3 wavelengths on 10 meters.
- It's very hard to *have your cake and eat it too* with a single multiband Yagi at a fixed height!

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Single Yagis over Ground

- It has been suggested that a good overall ***compromise*** height for 20 through 10 meters is 60 to 80 feet. (~1 WL on 20, ~2 WL on 10)
  - This suggestion is based upon avoiding nulls, not maximizing gain.
  - It also weighs domestic and DX contacts equally.
- Raising the antenna higher will certainly improve lower angle performance.
- But, some signals will then fall victim to a higher angle null.
- Did you expect a *free lunch*?

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Stack Spacing

- **What's a stack?**
- I'm calling it two or more Yagis on the same tower having *at least one operating mode where they are combined together* and work collectively.
- It's also possible to have multiple (same band) Yagis on one tower that are independent of each other and picked for their individual characteristics.
  - Large differences in height where the combination is not a useful pattern.
  - Different azimuth directions. One is fixed on the Caribbean, for example.
  - In this case, they are combined in an antenna switch, not a box that additionally performs impedance matching and/or phase inversion.

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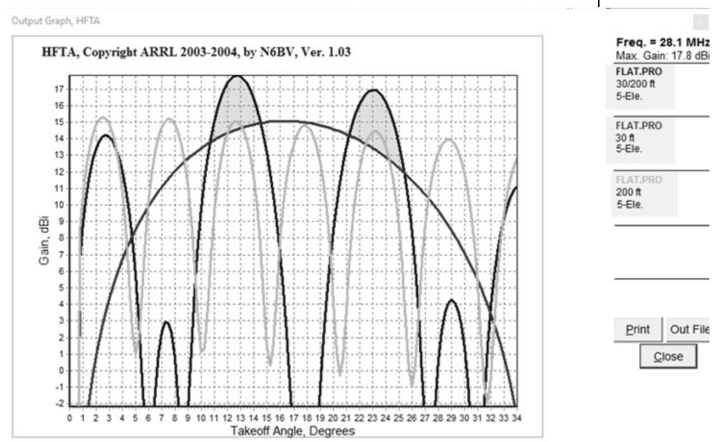
Stack Spacing

- Consider a tower with a 5L 10 meter Yagi at 30’ and one at 200’.
- Over flat ground, HFTA predicts:
- Where does the blue trace (combined in phase) win?
- Not very often!



There is value in each antenna, but not much in their combination.

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Stack Spacing

- Stacks help us avoid nulls at important take off angles by providing a set of selectable Yagi combinations.
- Each will have nulls. But between the set of combinations we want to have a choice for every angle in the range we care about. Every null is *filled in* with a lobe from another combination.
- The stack does not eliminate nulls, they are a necessary part of a focused main lobe which provides gain.
- It’s not uncommon to be quickly switching between stacking alternatives, looking for the take off angle that is best for the target signal.
- It’s not uncommon to prefer lower angle choices at the beginning and end of an opening, and higher angle choices during the opening.

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Stack Spacing

- In choosing the distance between Yagis, there are two important considerations (beyond available space on the tower!).
  - The impact on the gain and pattern.
  - The impact on the feed point impedance.
    - All of the practical feed systems I am aware of make the assumption that each Yagi has a minimal interaction with its neighbors (near zero coupling) and can be treated as a 50 Ohm load. So, for example, two 50 Ohm Yagis can be combined in parallel, creating a 25 Ohm junction impedance that can then be transformed back to 50 Ohms for the radio.
      - **Because of the assumption of 50 Ohm Yagi impedance, the OWA design is very attractive since that's its strong point (monobanders of course).**
    - If there is significant coupling between antennas the feed point impedances will shift because of the nearby antennas.
    - Solving coupling problems is not impossible, just much harder.

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Stack Spacing

- Typical HF Yagi spacing is 0.5 to 1 wavelength.
  - The ARRL Antenna Book highlights 0.6 to 0.75 wavelengths.
  - Larger spacing reduces coupling between Yagis.
- In theory, adding a second identical Yagi should increase the gain by 3 dB.
  - Practically, the gain increase is usuallyless.
- Moving from a stack of 2 Yagis to 4 adds an additional ~3 dB (6 dB total over 1 Yagi).

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Stack Spacing

- Let's investigate stack spacing with a model of two, 10 meter 6L OWA Yagis on 26' booms.
- The lower one will be fixed at 1 WL (35').
- The upper one will move up in steps of 0.1 WL (3.5') from 1.5 WL to 2.2 WL (77').
- This is a net spacing difference of 0.5 WL to 1.2 WL.
- **They will be fed with equal currents**.
- We want to follow the pattern and the feed point impedances.
- **Baseline: Single Yagi: at 35' : 15.06 dBi @ 13°, at 77': 15.56 dBi @ 6°.**

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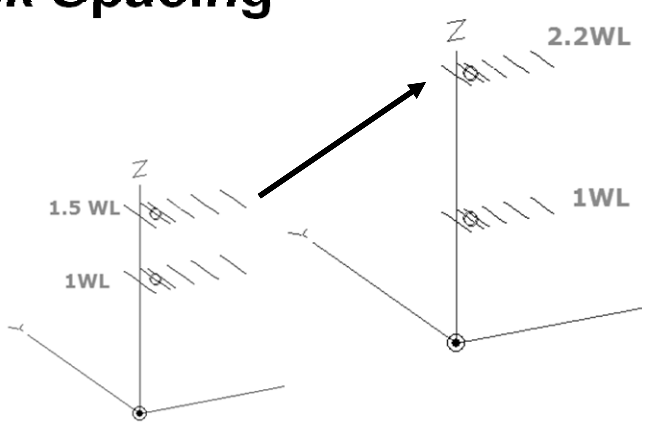
Stack Spacing



- 0.5 to 1.2 WL spacing in steps of 0.1 WL by moving up top Yagi.

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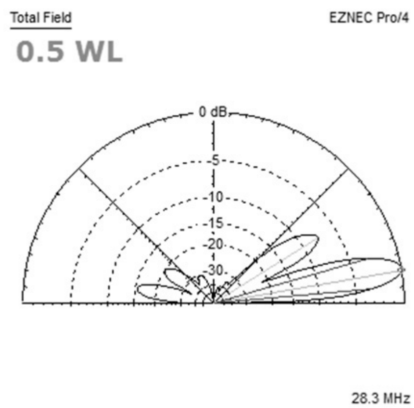
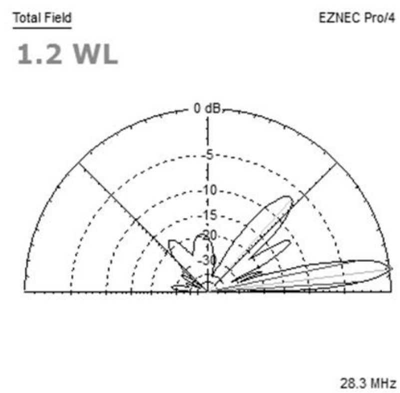
Stack Spacing

- In case my fancy animation is not available:





Greater spacing tips lobe down

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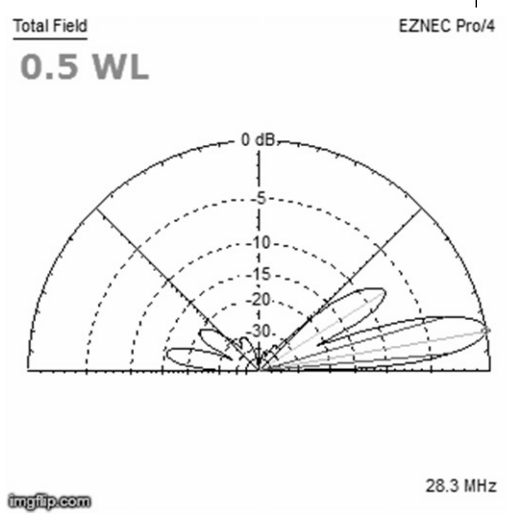
Stack Spacing

- Main lobe tips down a few degrees.
- Secondary lobes do a little dance.
- 0.5 WL spacing has the lowest overhead gain, although we expect very little energy from a 90 degree angle.



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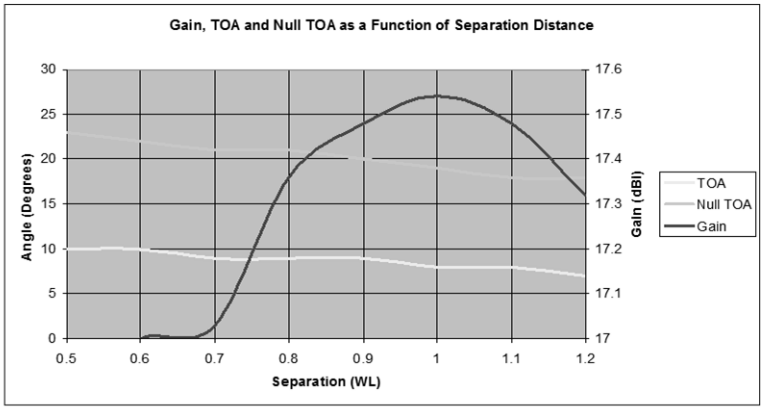
Stack Spacing



Baseline gain:

35’: 15.06 dBi

77’: 15.56 dBi

Max gain for stack is 17.54 dBi with 1 WL spacing.

That’s a 2.5 dB increased over the 35’ Yagi by itself.

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Stack Spacing

- What about the feed point impedances?
- How coupled together are the two Yagis?
- We are hoping for little coupling, as evidenced by little change in the impedance values.
- This is looking pretty good.
- Shorter boom Yagis might show more coupling.

Spacing	Lo Yagi Z	Hi Yagi Z
0.5	50.28 – j 5.3	50.19 – j 4.9
0.6	49.9 – j 2.1	46.06 – j 1.4
0.7	48.45 + j 2.7	47.64 + j 4.4
0.8	52.6 + j 3.4	52.8 + j 5.2
0.9	55.07 + j 1.6	55.5 + j 2.6
1.0	55.77 – j 0.7	55.74 + j 0.1
1.1	55.37 – j 2.4	54.76 – j 1.4
1.2	53.96 – j 1.8	54.31 – j 3.6

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Stack Spacing

- Conclusions from this one example.
- Max gain increased up to ~2.5 dBi depending upon your reference (the lowest single Yagi).
  - Max gain occurred with a 1 wavelength spacing.
- The coupling was low, suggesting that new impedance matching problems are not introduced.
  - If we start with 50 + j 0 Yagis, we can pretend they are dummy loads from the standpoint of combining them together.
- The secondary lobes danced around as secondary lobes like to do. They were relatively small compared a single Yagi.
- Spacing is largely a matter of *personal preference* and what you can construct on the tower.
- In other words, the advice of 0.5 to ~1 WL spacing is pretty darn good.
- Stack of more than 2 Yagis follow the same trends between pairs.
- ***Trust but verify*** – every stack needs to be analyzed individually.

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Stack Spacing

- So far, we have looked at 3 permutations of two Yagis.
  - Bottom Yagi by itself.
  - Top Yagi by itself.
  - Both together, fed in phase with equal currents.
- It turns out there is one more wrinkle.
- Both antennas fed with equal ***out of phase*** currents.
- This turns out to be a useful permutation because it causes the main lobe to tip up, potentially filling in a null when we are pointing at the lowest angles.
- The terms **BIP** and **BOP** are used, as in *both in phase* and *both out of phase*.

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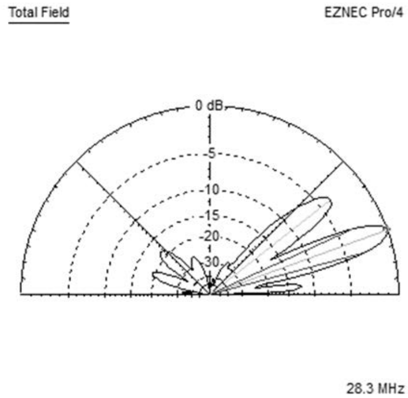
Stack Spacing



Elevation Plot		Cursor Elev	20.0 deg.
Azimuth Angle	0.0 deg.	Gain	16.19 dBi
Outer Ring	16.19 dBi		0.0 dBmax
			0.0 dBmax3D
3D Max Gain	16.19 dBi		
Slice Max Gain	16.19 dBi @ Elev Angle = 20.0 deg.		
Beamwidth	9.4 deg.; -3dB @ 15.1, 24.5 deg.		
Sidelobe Gain	12.62 dBi @ Elev Angle = 38.0 deg.		
Front/Sidelobe	3.57 dB		

Here's what BOP looks like by itself for the 35'/70' example.

BIP gain is 17.54 dBi.

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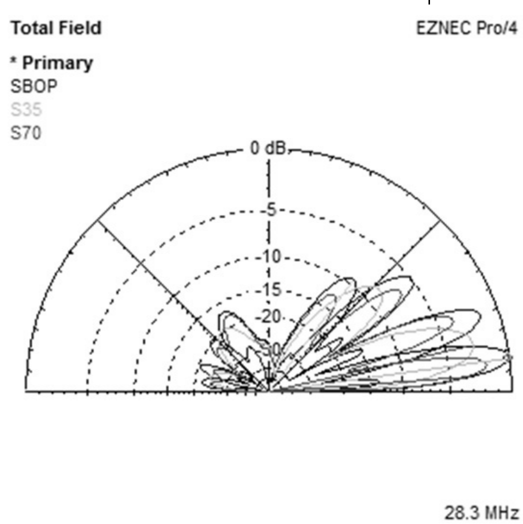
Stack Spacing

- Let's pick 1 wavelength spacing since it's a *round number*, with a bottom height of 0.5 wavelengths. What do the 4 combinations show when plotted all together?
- Let's start with EZNEC.
- Up through 30 degrees, the gain variation is about 2 dB, no deep nulls.



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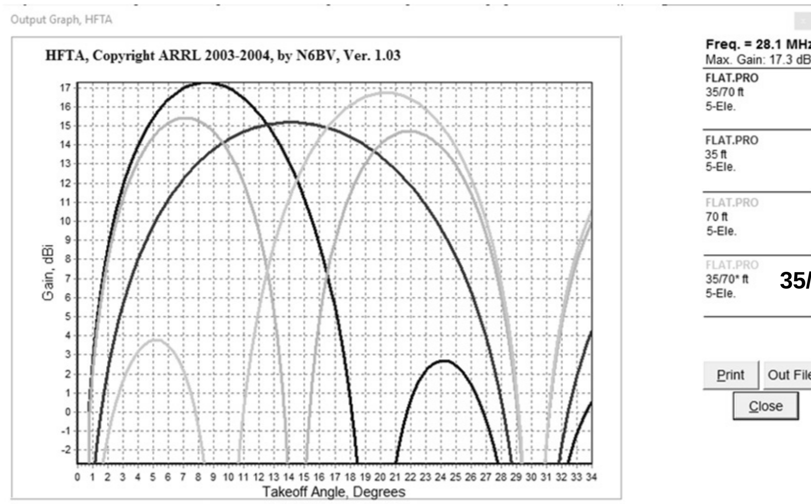
Stack Spacing (HFTA View)



35/70* is BOP

- From 0° to 13°, BIP, then 13° to 17° with 35’, and 17° to 29° with BOP. 30° is a Black Hole! This is one example.

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Stack Spacing

- These results have general validity, but the more important *take away* is the **process** used to evaluate this or any stack.
- Many factors are involved: Yagi design (# elements), spacing between Yagis, height of lowest Yagi, etc.
- A given Yagi can be included in phase in the stack, excluded from the stack, or included and out of phase.

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Combining Yagis

- How do we combine or feed Yagis?
- We need a box that has a 50 Ohm station feed on one side and 50 Ohm ports for all of the Yagis on the other.
- It should be possible to include a Yagi, either in phase or out of phase, and exclude a Yagi.
- Since we are assuming that a Yagi is a 50 Ohm load, any parallel junction of Yagis has an impedance equal to 50 divided by the number of connected Yagis (Ohms Law).

Combining Yagis

- Because the common junction inside the box must be at the same voltage, it is helpful to drive the Yagis through lengths of odd ¼ wavelength multiples of coax so that *current forcing* comes into play, and guarantees that each Yagi is driven with the same complex current.
- This helps *smooth out* imperfections in the *sameness* of Yagis and fights the impact of unequal impedances due to coupling (after all, we care about current, not power).
  - If a Yagi is not used in a configuration, its feed line should be shorted at the box so that the odd ¼ wavelengths transform the short into an open circuit at the feed point – discouraging current from flowing in the unused Yagi.
- Two popular approaches to impedance matching are ¼ wavelength transmission line matching sections and transmission line transformers.
- Conventional transformers are usually too lossy for 1500 watt power levels.

Combining Yagis

- I have found transmission line matching to be the most precise, reliable, easy to weatherproof, and tolerant of any power level (since it's made of 0.405" OD coax).
- The downside is that it is a single band solution. It does not apply to something like a triband Yagi.

Matching Line Utilization					
# Antennas	Junction Zo	¼ λ Zo	Composition[1]	Z_{final}	SWR
1	50 Ω	50 Ω	RG-213	50 Ω	1.00
2	25 Ω	35 Ω	RG-83	49 Ω	1.02
3	16.67 Ω	30 Ω	RG-213 || RG-11	54 Ω	1.08
4	12.50 Ω	25 Ω	RG-213 || RG-213	50 Ω	1.00

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Combining Yagis

- When using ¼ wavelength lines for matching, it's a good idea to make sure you ***always*** are using some ¼ wavelength line, even if you are selecting a single Yagi that requires no additional matching since it starts off as 50 Ohms.
- This is preferred because it removes *impedance inversions* that impact impedance but not SWR.
- This can reduce the need to retune an amp as a result of changing stack combinations.
  - The amp sees a more consistent set of impedance values across all of the stack combinations.
- For example, 55 Ohms is transformed into 45.45 Ohms by a ¼ wavelength 50 Ohm cable. The SWR is the same in each case (1.1) but the impedance is clearly not the same.

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Combining Yagis

- Transmission line transformers were championed by Jerry Sevick, W2FMI (SK).
- On one hand they are far more broadband than ¼ wavelength lines, but on the other hand, they tend to be not as precise as ¼ wavelength lines.
  - As best as I can tell, Sevick considered 1.5 to be a low SWR, which in the big picture it is, but often we are trying to get it as low as possible.
  - If you want multiband operation from a single box, this is the choice.
- An example of a commercial product based upon transmission line transformers is the Array Solutions *StackMatch*.

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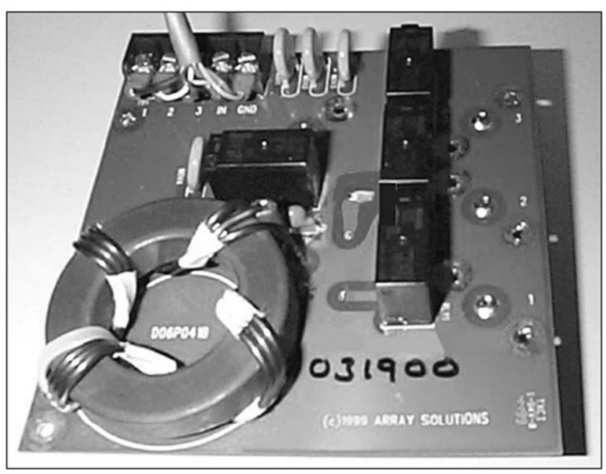
StackMatch

- From the ARRL Antenna Book from Array Solutions.



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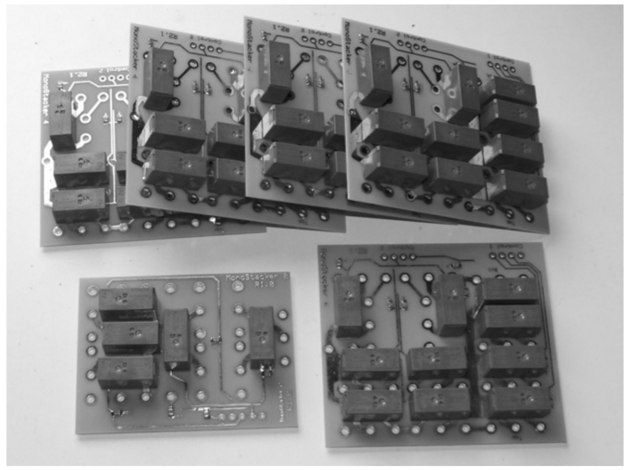
Relays

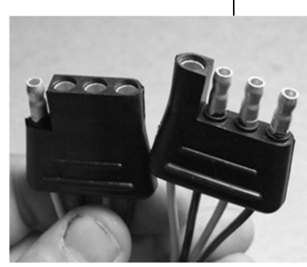
- Over the last 20 years or so, the *appliance relay* has become popular for use in antenna switches and stacking boxes.
- They have a 16 amp rating, and should have no problems in a 50 Ohm world of several KW.

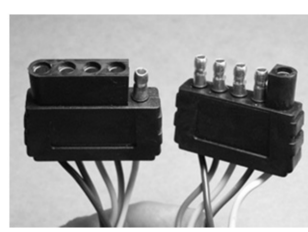


MonoStacker 2 & 4 PCBs.

Connectors

- Finding suitable connectors for outdoor use is often a challenge.
- For stacking boxes one very usable and readily available connector set is used with car trailers.
- They can take a lot of current, and if you tape them up they will last forever.





Connectors

- Another connector choice is the *greenie* or Euro-style connector.
- Some versions have locking screws which would be a good idea up on a tower.
- Be sure it's protected from the weather.

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180 Degree Phase Inversion

- BOP mode requires a phase inversion.
  - Ideally we want phase shift without loss (hard to do!).
  - This can be done with ½ wavelength of coax if you are going monoband.
    - Since there is loss in the cable maintaining equal currents in all Yagi's is thrown off a little by the loss.
  - Another choice is a balun or RF choke, AKA Guanella 1:1 phase inverting balun.
    - There is less loss, but it's desirable to put a balun in all Yagi lines so that they all have the same phase shift regardless of being inverted or not. The balun coax length should be subtracted from the odd ¼ wavelength feed lines.

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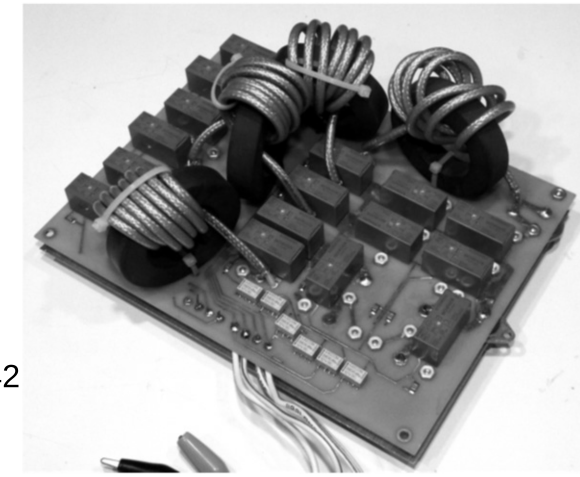
180 Degree Phase Inversion

- Here's the PCB for control box that uses both phase inverting baluns as well as selecting all set of up to 4 Yagis.
- There were 22 useful combinations of Yagis.
  - Which is too many!
- The baluns were RG-142 on 2.4" cores.



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A Large Example

- The 20, 15, and 10 meter *run* stacks at K3LR consist of 4 stacked OWA Yagis.
- The approximate heights are 1, 2, 3, and 4 wavelengths above ground.
- There are 10 combinations selectable via a pushbutton box at the radio.
- The combinations on 20 meters are:

1. All 4
2. Single 230'
3. Single 170'
4. Single 110'
5. Single 50'
6. Top 3
7. Bottom 3
8. Top 2
9. Middle 2
10. Bottom 2

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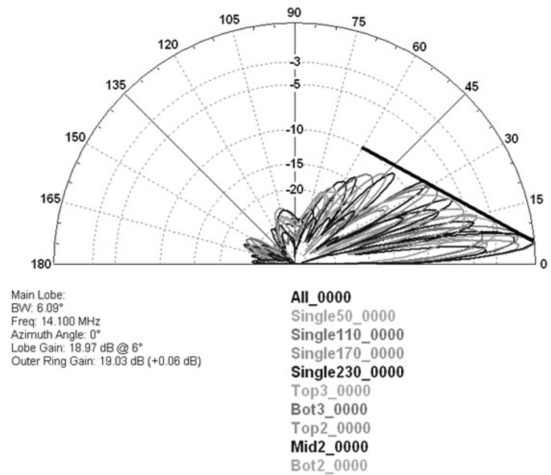
A Large Example

- If you plot the elevation patterns of all 10, together, you get the ink blot on the right.
- You can get up to 30 degrees with a gain roll-off of about 8 dB at 30 degrees.
- No nulls!



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A Large Example

- Each Yagi is on a ring rotator, so it's easy to point them in different directions.
- For example, you could point the bottom 2 towards the Caribbean and the top 2 at Europe, and switch instantly back and forth with the push of a button.
- For a contest station, this independence is a desirable feature.
- For a DX oriented station, or if there was a rotating tower instead of ring rotators, then adding out of phase (BOP) modes might make sense.

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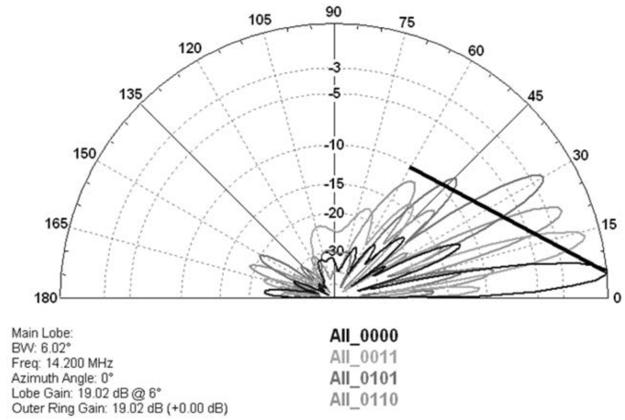
A Large Example

- The indicated out of phase combinations use all 4 Yagis.
- There are some lobes with gain higher than the current set of choices.
- They are at rather high angles, however.



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Odds and Ends

- Some folks have investigated being able to turn off the top Yagi on receive to reduce precipitation static.
- When there are 3 or more Yagi's in the stack, a binomial current distribution might make sense. 1:2:1 instead of 1:1:1.
- If you end up with long coils of coax on the inner Yagis of a stack, you can cut out multiples of 360 degrees.
- If BOP is being used, you can cut out odd multiples of 180 degrees if you reverse the sense of BIP and BOP.

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What about Multiband Yagi Stacks?

- Similar analysis, but a more complex task because of the compromises.
- The challenge is spacing.
- If you go with 0.5 WL on 20 meters, you have 0.75 on 15 meters and 1.0 WL on 10 meters, which is not too bad.
- Height off the ground matters too. What’s too low for 20 meters is not too low for 10 meters.
- If you want/need wider spacing on 20 meters, then one possibility is to introduce 10 meter monoband antennas to *fill in the gaps* so that the 10 meter spacing does not get too large.
- Accurate models of multiband Yagis are not too common. It might be necessary to model them as monoband Yagis to analyze the system. HFTA only understands one band at a time.

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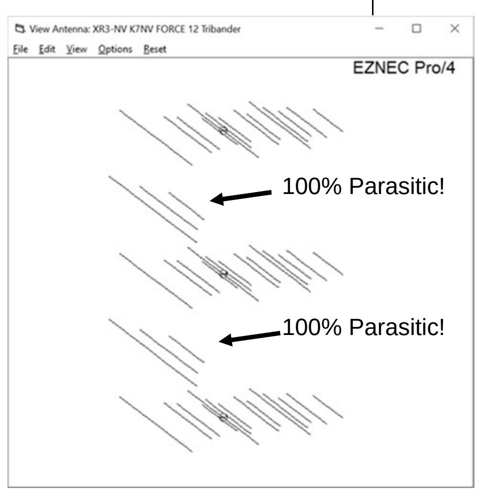
What about Multiband Yagi Stacks?

- Justin Johnson, G0KSC, recently presented a talk at CTU, Milan, Italy, titled: *Enhancing Performance of Stacked Yagi Arrays.*
- Note the use of parasitic elements in the vertical plane, not just horizontal.



From G0KSC, CTU Italy

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Stacking versus Longer Booms

- Is it better to stack two shorter boom Yagis rather than one longer boom Yagi?
- There are many practical considerations apart from the antenna performance.
  - Cost, the actual heights, space on the tower, avoiding guy lines, additional ring rotators, need for a switching box, etc.
- Considering just performance, however, this is often a good trade to make.
- If you cut the boom in half you give up ~3 dB, but you can get most of that back in the stack gain.
- The real improvement is in the range of take off angles that are possible with the stack.

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Stacking versus Longer Booms

- Back in the summer of 2013, Tom, K8AZ, was considering replacing two 7L10m Create Yagis (42') boom with four shorter boom Yagis.
- After discussions with Tim, W3YQ, and lots of modeling, a 5L OWA design on a 24' boom was selected.
  - The AutoEZ optimizer by Dan, AC6LA, was used – it's an excellent extension to EZNEC.
- The low angle *all driven* performance was nearly equal, but the stack of 4 offers more elevations combinations than a stack of 2.

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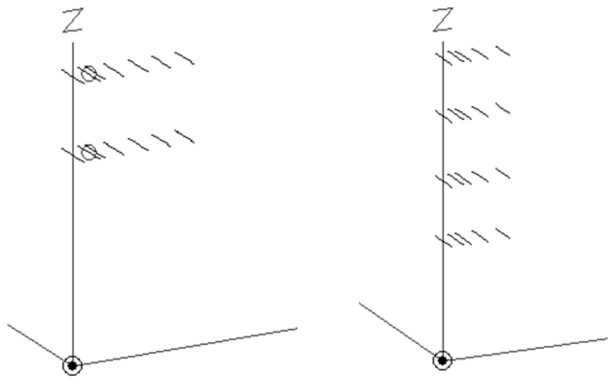
Stacking versus Longer Booms



2X42’ Create 4X24’ Homebrew

This was done on a rotating tower.

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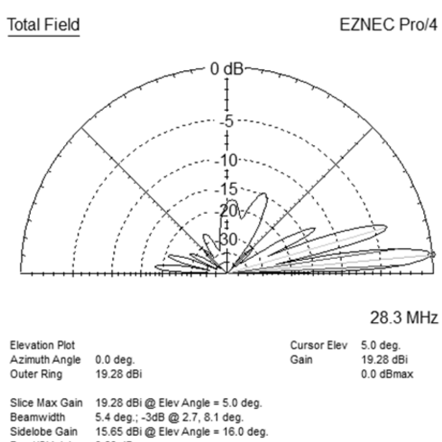
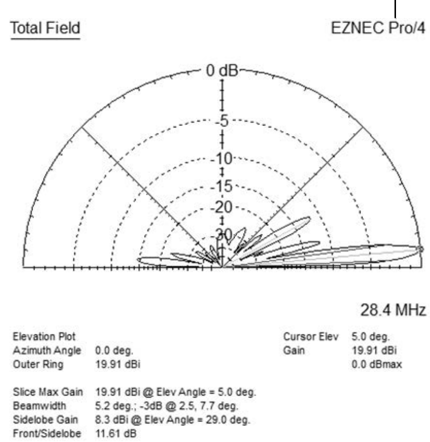
Stacking versus Longer Booms





2X42’ Create 4X24’ Homebrew

All Driven Configuration

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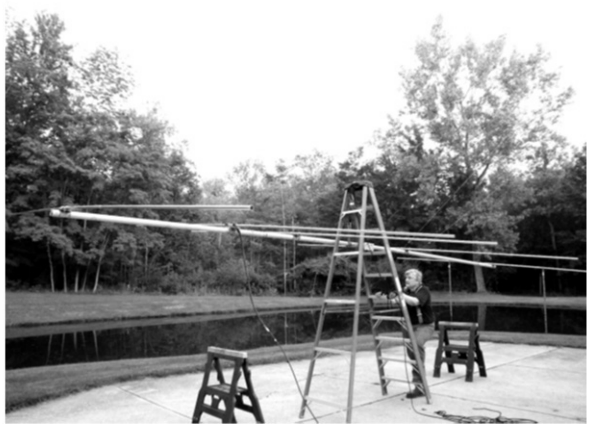
Stacking versus Longer Booms

2013 ARRL 10 Meter Contest Results

"Wow! Ol' Sol is back." — Sandy, K4PZC

Scott Tuthill, K7ZO, k7zo@cableone.net

We compared modeled results to measured results starting as low as 8' off of the ground.



Single Operator, CW Only, HP	
K8AZ (K8NZ, op)	1,424,528
NY3A	1,359,252
KD4D	1,335,040
KI1G	1,251,872
N5RZ	1,218,820
K5NA (K5OT, op)	1,217,216
N3RS	1,106,616
WJ9B	1,056,372
KH7Y	1,034,208
N2KW	1,006,056

Ron, K8NZ, did have a choice of 10, 10m Yagis at K8AZ!

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Stacking Non-identical Yagis

- Stacking non-identical Yagis is possible.
- If the gains and patterns are very different, then an antenna model of the system is the best way to see what's going on in detail.
  - HFTA assumes identical antennas.
- It is desirable to keep the driven elements in *phase alignment*.
- Most likely the driven elements will not be aligned vertically due to different boom lengths and element locations.
- This can be compensated for by adding delay in the more forward feed line so that electrically it is pushed back in alignment with the furthest back driven element.
- The ARRL Antenna Book has a section on this topic.

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References

- *Yagi Antenna Design*, Dr. James Lawson, W2PV (SK).
- *The ARRL Antenna Book*.

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CTU Presents

Grounding & Bonding for the
Little Pistol & Medium Gun

Ward Silver, NØAX

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Overview

- What ***IS*** "ground" anyway?
- What ***IS*** "bonding" anyway?
- AC Safety
- Lightning Protection
- RF Management
- Ground System
- Resources

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Goals of the Session

- Understand “ground” and “bond”
- Appreciate the different requirements for ac safety, lightning protection, RF and audio
- Illustrate some techniques
- Show how a system approach works
- Point you at more comprehensive resources

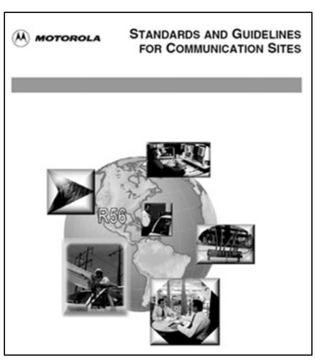
Who Is This Talk For?

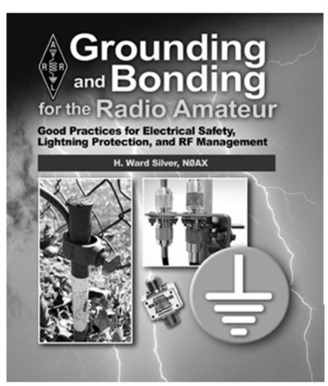
- Station builders…
  - Just starting out
  - Putting up a first tower
  - Expanding a station
  - In lightning country
  - Trying for better performance
- But not really for…
  - K3LR, W3LPL, KC1XX, NR5M, etc

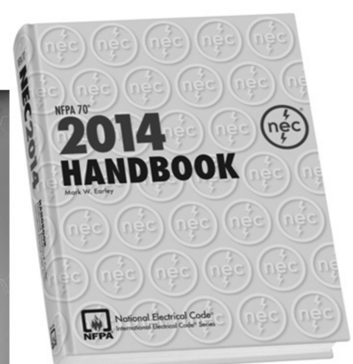
Background References

- *ARRL Handbook, ARRL Antenna Book*
- ***New*** *– Grounding and Bonding for the Radio Amateur*
- *NEC Handbook* – at your library
- *Standards and Guidelines for Communication Sites* (Motorola R56) – available online
- *Lightning Protection for the Amateur Station* (Ron Block, NR2B – Jun/Jul/Aug 2002 QST) – ARRL website
- *Power, Grounding, Bonding, and Audio for Amateur Radio* and *RFI, Ferrites, and Common Mode Chokes For Hams* – available at **k9yc.com/publish.htm**

Background References







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What *IS* "Ground" Anyway

- The right answer depends on what you are trying to do
- What you are trying to do depends on frequency, voltage, current
- Your **safety** depends on the right answer
- Your **equipment** depends on the right answer

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What *IS* "Ground" Anyway

- The right answer depends on what you are trying to do
- What you are trying to do depends on frequency, voltage, current
- Your **safety** depends on the right answer
- Your **equipment** depends on the right answer

- Your **sanity** depends on the right answer

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What *IS* "Ground" Anyway

- It can be a noun, verb, and adjective – *all at the same time*
- Noun - an "earth connection" (ac, lightning) or a local reference potential (circuits, RF)
- Verb - an action "to connect to the reference potential"
- Adjective - a type of connection, such as a "ground conductor" or "ground system"

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What *IS* "Ground" Anyway

- Fuzzy definitions:
  - "RF ground" – ain't no such thing
  - "Ground loops" – not the problem you think it is
  - "Single-point ground" – it depends…
- The Earth is NOT – a magic sink into which we can pour RF or lightning and expect it to magically and safely disappear

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What *IS* “Bonding” Anyway

- A connection intended to keep two points at the same voltage
- Sounds expensive but it’s not
- Sounds hard but it’s not
- Requires the right connecting materials and hardware
- Works in your favor for ac safety, lightning protection, and RF management

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What *IS* “Bonding” Anyway

- For bonding to work, it has to be…
  - Low-Z and “short” at the frequencies of interest
  - Heavy enough to carry the expected current
  - Sturdy enough to survive the environment
- Inside the ham station, use…
  - Strap (20 ga) or heavy wire (#14 or larger)
  - Flat-weave braid
    - Braid from old coax deteriorates

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AC Safety Grounding

- Before we go any further…

SAFETY FIRST

- Don't be the one to say, "I didn't think it would happen to me…"

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AC Safety Grounding

- And a friendly reminder from your AHJ*

LOCAL CODE IS THE LAW

- If you don't have a local code, use the NEC

* - Authority Having Jurisdiction

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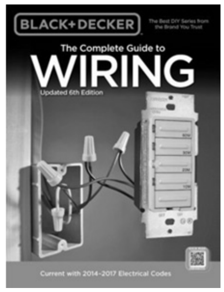
AC Safety Grounding

- If you aren't sure you know what you're doing…get a how-to reference

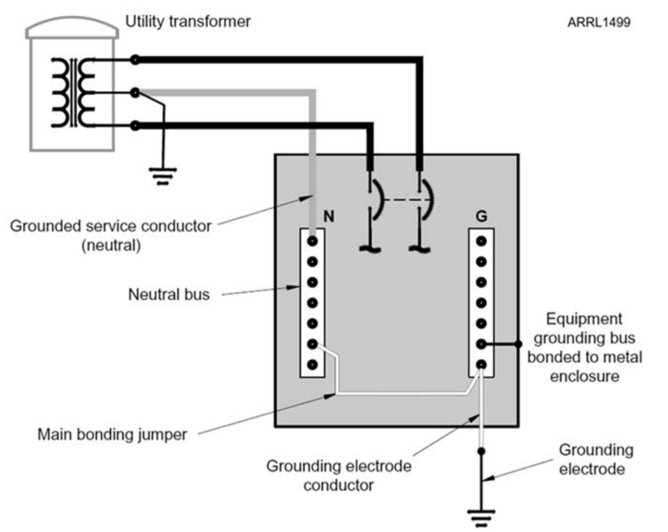


- Or hire a professional electrician

AC Safety Grounding

- Grounding for ac safety has several names
  - "Equipment ground", "third-wire ground", "green-wire ground"
- Purpose is two-fold
  - Provides a path to ac common point for fault current (shorts, leakage)
  - Stabilizes the ac power voltage during faults or transients, such as lightning

AC Safety Grounding



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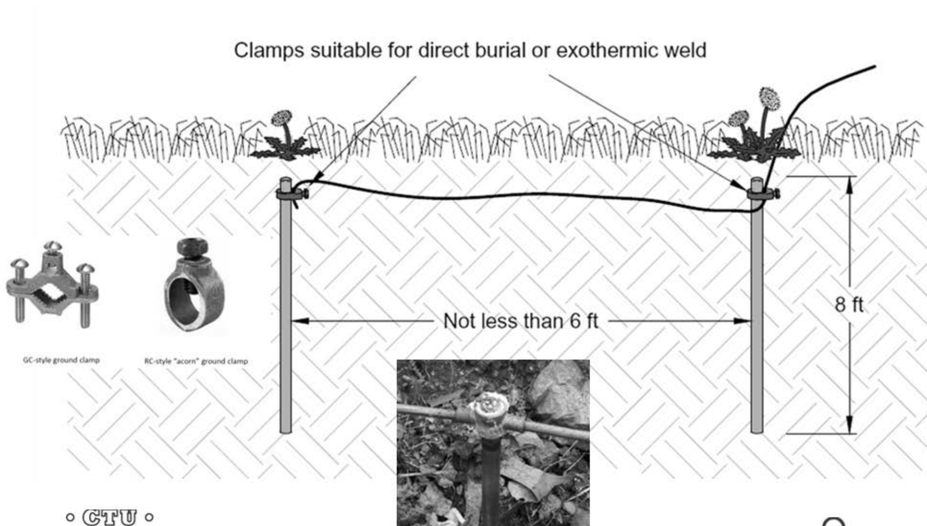
AC Safety Grounding



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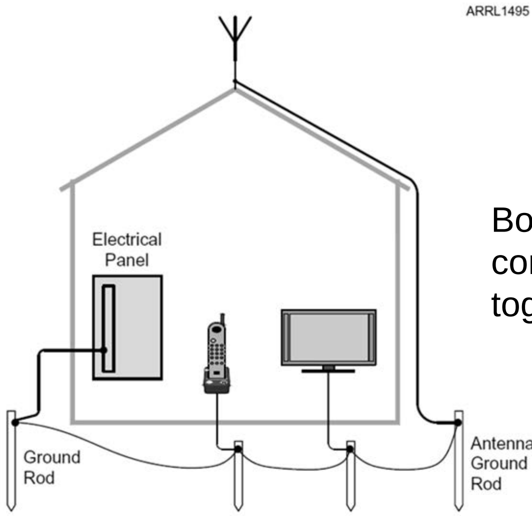
AC Safety Grounding



Bond ALL earth connections together

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Lightning Protection

- You can't steer lightning, but…you *can* help lightning make "good decisions"
  - Heavy, low-impedance paths to the Earth
  - Inductance is more important than resistance
  - Paths should be *outside* your residence
  - Don't make it easy for lightning to go <u>through</u> your station on its way to the Earth

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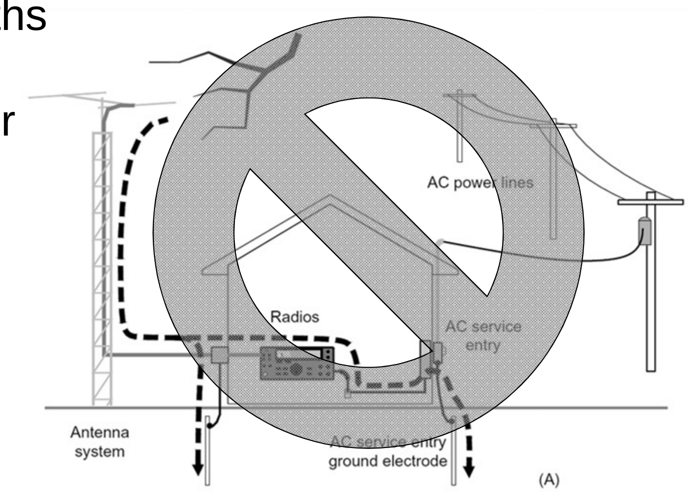
Lightning Protection

- Ground paths should go *around* your station



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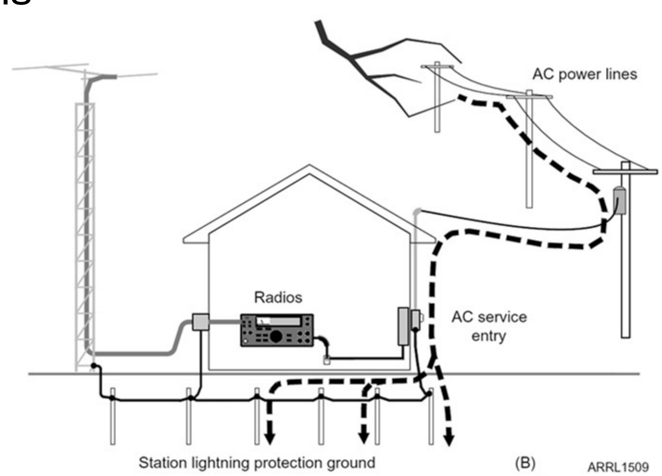
Lightning Protection

- Ground paths should go *around* your station



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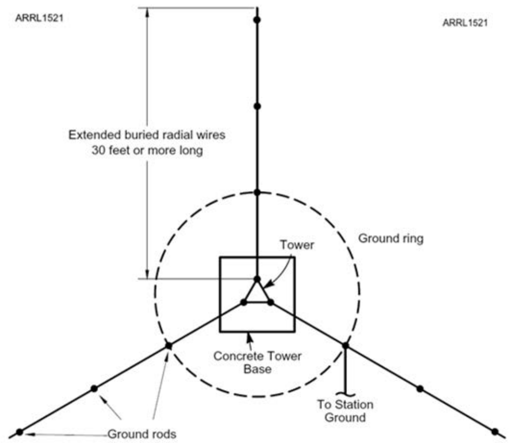
Lightning Protection

- Tower grounding



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Lightning Protection

- Bond feed lines to the tower

- Spark gaps across insulators

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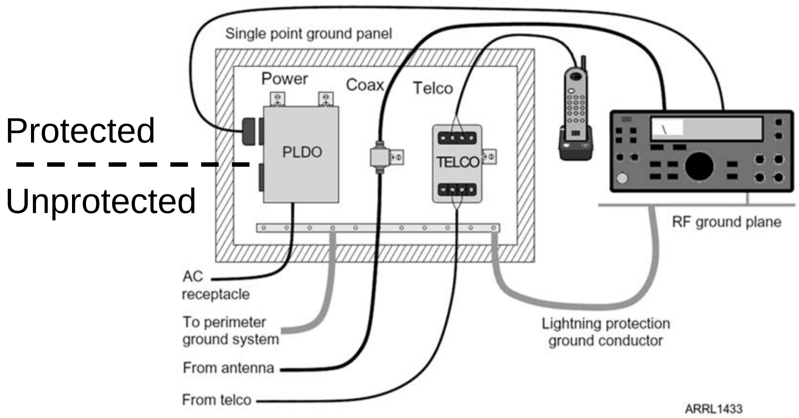
Lightning Protection

- Single-point Ground Panel



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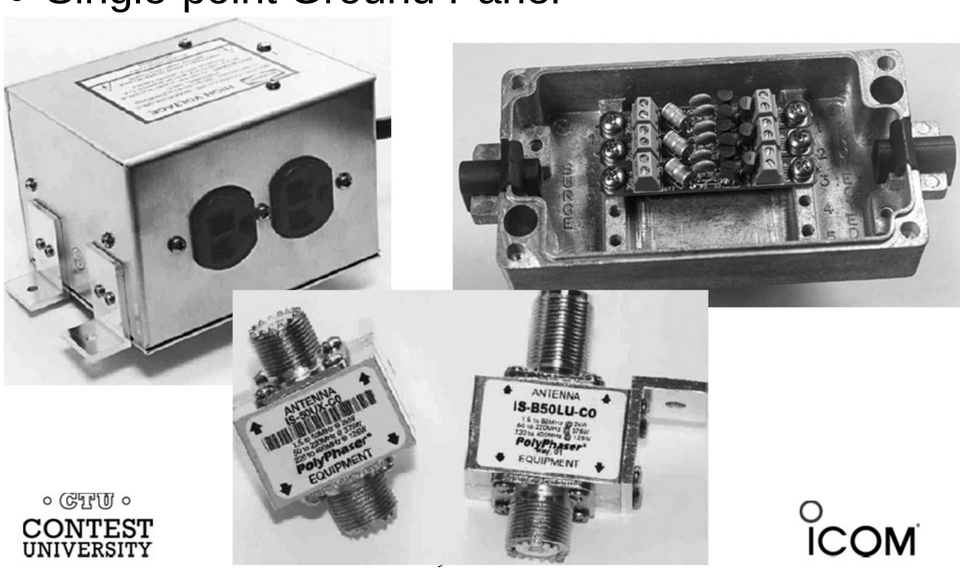
Lightning Protection

- Single-point Ground Panel



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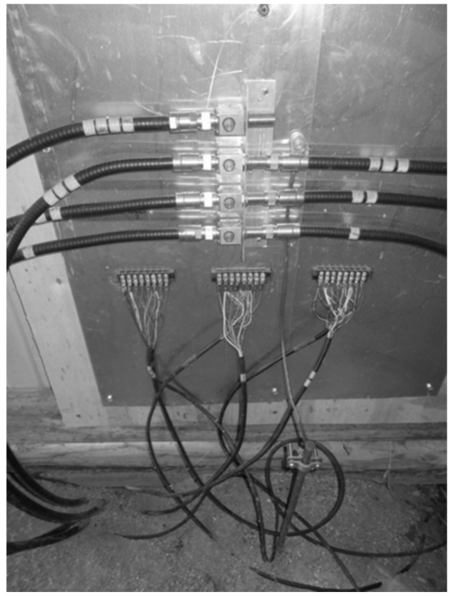
Lightning Protection

- Single-point Ground Panel



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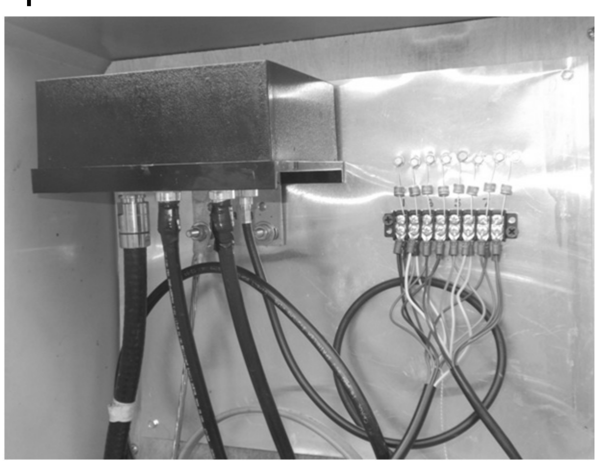
Lightning Protection

- Single-point Ground Panel



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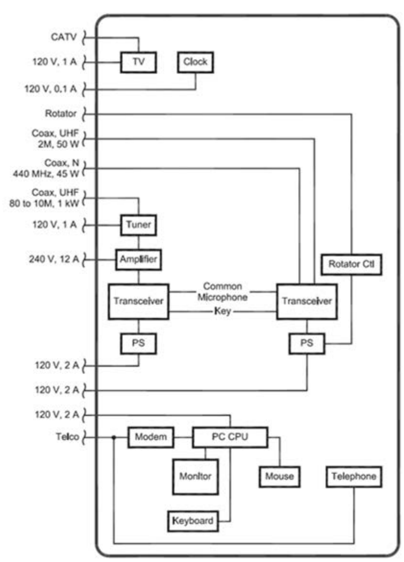
Lightning Protection

- Single-point Ground Panel

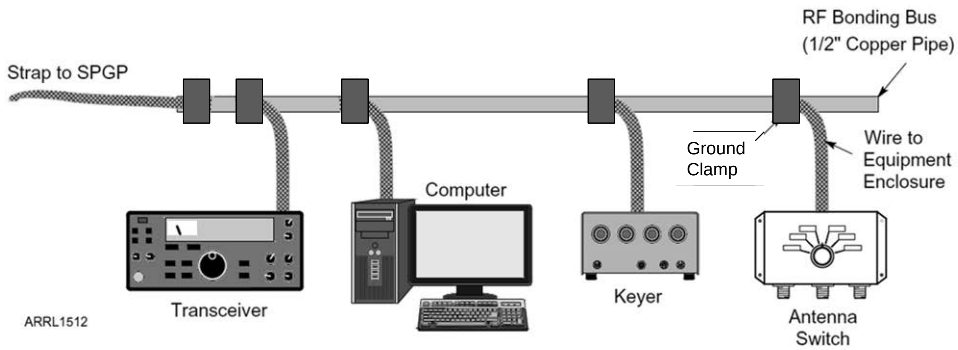
Lightning Protection

- Protected Zones
  - Every line crossing the boundary must be protected
  - Must all have a common or bonded ground connection
  - Bond equipment within the station



Lightning Protection

- Bonding inside the shack

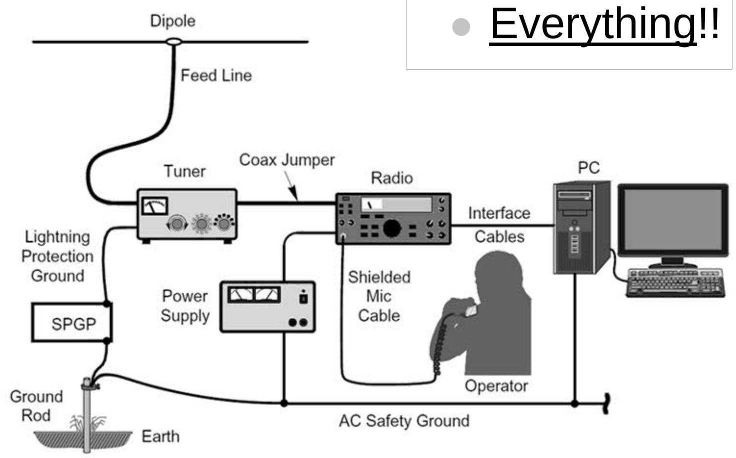


RF Management

- Everything in the station is an antenna

RF Management

- Everything!!



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RF Management

- Everything in the station is an antenna
- Forget about an "RF ground"
- Concentrate instead on bonding
- Equalize voltage to minimize current
  - Eliminates "hot spots"
  - Reduces RFI from common-mode current
  - Reduces sensitivity to physical configuration
  - Minimizes audio "buzz" and hum

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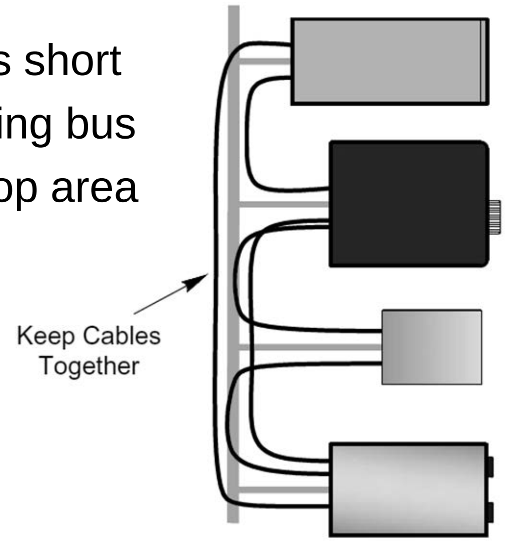
RF Management

- Keep cables short
- Use a bonding bus
- Minimize loop area



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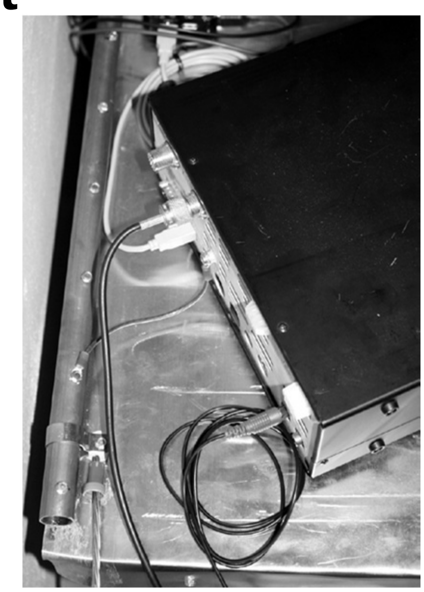
RF Management

- RF ground plane
- Sheet of metal
- Helps equalize voltage
- Run cables along the ground plane
- Bond to station ground system



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Ground System

- Now for some good news…

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Ground System

- “One system to rule them all”
- All currents flow on all wires
- A single, solid ground system made of short, heavy, direct connections satisfies all of the requirements for…
  - AC Safety
  - Lightning Protection
  - RF Management & Clean Audio

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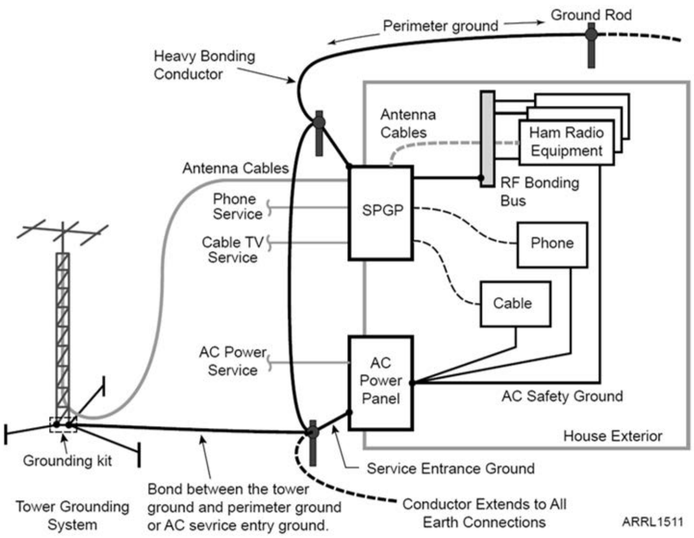
Ground System



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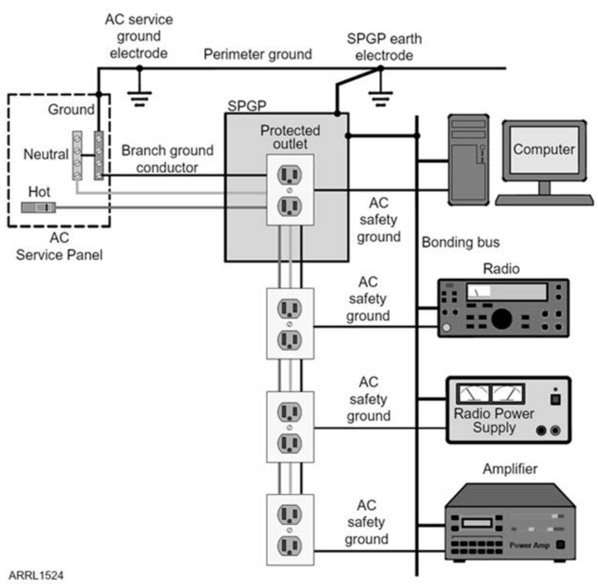
Ground System



ARRL1524

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Additional Resources

- Professional Associations and Companies
  - National Fire Protection Association (**www.nfpa.org**)
  - International Association of Electrical Inspectors (**www.iaei.org**)
  - Mike Holt Enterprises (**www.mikeholt.com**) — training and continuing education for electricians, many tutorials
  - Polyphaser (**www.polyphaser.com/services/media-library/white-papers**) — various papers and tutorials on lightning protection for communications facilities, including ham stations
  - Lightning Protection Institute (**lightning.org/learn-more/library-of-resources**) — papers and tutorials on lightning protection techniques

Additional Resources

- Standards
  - FAA Document on Practices and Procedures for Lightning Protection, Grounding, Bonding, and Shielding Implementation — **www.faa.gov/documentLibrary/media/Order/6950.19A.pdf**
  - IEEE Std 1100 – 2006 "IEEE Recommended Practices for Powering and Grounding Electronic Equipment" — **www.ieee.org** (available from most libraries)
  - MIL-HDBK-419A – Grounding, Bonding, and Shielding for Electronic Equipments and Facilities (Vol 1 and 2) — **www.uscg.mil/petaluma/TPF/ET/_SMS/Mil-STDs/MILHDBK419.pdf**

Additional Resources

- Books and Online Material
  - Block, R. R., The “Grounds” for Lightning and EMP Protection, Second Edition, PolyPhaser Corporation, 1993.
  - Rand, K. A., Lightning Protection and Grounding Solutions for Communications Sites, PolyPhaser Corporation, 2000.
  - ARRL Technical Information Service sections
    - Electrical Safety — **www.arrl.org/electrical-safety**
    - Grounding (various types and topics) — **www.arrl.org/grounding**
    - Lightning Protection - **www.arrl.org/lightning-protection**
  - W8JI’s web pages on ground systems (**w8ji.com/ground_systems.htm**)

ARE WE DONE YET?

THANKS!!

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CTU 2017 Presents

RTTY Contesting, A to Z

Ed Muns, W0YK

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RTTY Contesting, A to Z

- Introduction
- Part 1: Operating
- Part 2: Setting Up
  - RTTY Decoder/Encoder
  - PC-radio interface
- 2nd CTU RTTY session:
  "*Advanced Topics in RTTY Contesting*"

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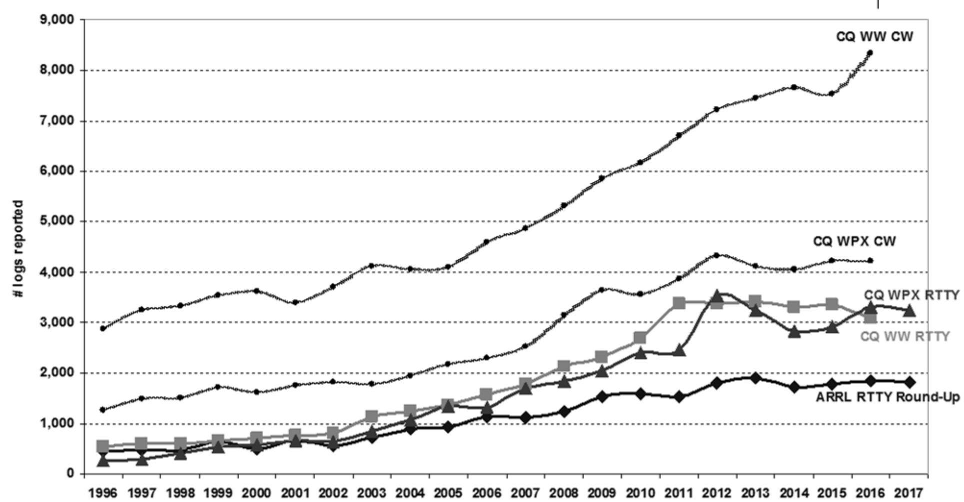
Three Largest RTTY Contests



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Lots of RTTY Contests

> two/month

- **Biggies (7)**
  - CQ WW RTTY (last weekend in September)
  - CQ WPX RTTY (2nd weekend in February)
  - ARRL RTTY Roundup (1st weekend in January)
  - BARTG (3rd weekend Jan, 3rd weekend March)
    - 75 Baud (April & September)
  - WAE RTTY (2nd weekend in November)
- **NCJ contests (4)**
  - NAQP RTTY (3rd Sat. in February, 2nd Sat. in July)
  - Sprint RTTY (2nd Sat. in March & October)
- **Other popular RTTY contests (20)**
  - Ten-Meter RTTY (1st Sat. in December)
  - JARTS, Makrothen, SARTG (2)
  - 15 others

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What Makes a Great RTTY Contester?

- Contester who happily logs casual callers
- Uses CW & SSB techniques where useful
- Strives to exploit RTTY uniqueness
  - Auto-decode frees operator time … use it to do things difficult with CW & SSB, e.g., SO3R!
  - Speed is ~2x CW
- Applies learning back to CW & SSB

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What is RTTY?

compared to CW

CW

- ***One*** RF carrier
- Local audio ***pitch***
- On ***or*** off
  - key up is data 0
  - key down is data 1
- ***Morse*** code
  - typically 25-40 wpm

RTTY

- ***Two*** RF carriers 170 Hz apart *(Space & Mark; Shift)*
- Local audio ***tones***
- One on ***and*** other off
  - Space is data 0
  - Mark is data 1
- ***Baudot*** code
  - constant 60 wpm *(or 45.45 Baud)*

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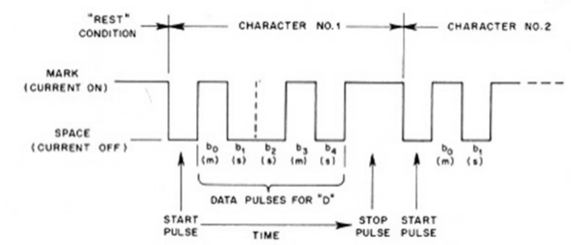
What is RTTY?

45.45 Baud = 60 WPM



- Asynchronous character stream
  - 1 bit Start pulse (Space)
  - 5 bits of data (character code)
  - 1, 1.5 or 2 bits Stop pulse (Mark)

What is RTTY?

code history

- Bacon's cipher (1605)
- Gauss & Weber (1833)
- Baudot code (1870)
  - Manual bit entry
  - 5-bit ITA1 code
  - Two 32-bit character sets
    - letters
    - figures
- Murray code (1901)
  - Teletype character entry
  - Western Union variation
- **5-bit ITA2 code (1930)**
  - **USTTY variation**
- ASCII (1963)
  - 7-bit ITA5 code

Code	Control Characters		
11111	LTRS		
11011	FIGS		
00000	Null		
00100	Space		
01000	LF		
00010	CR		
	Letters	Figures	
		ITA2	USTTY
00011	A	-	
11001	B	?	
01110	C	:	
01001	D	ENQ	$
00001	E	3	
01101	F		!
11010	G		&
10100	H		#
00110	I	8	
01011	J	BELL	'
01111	K	(	
10010	L	)	
11100	M	.	
01100	N	,	
11000	O	9	
10110	P	0	
10111	Q	1	
01010	R	4	
00101	S	'	BELL
10000	T	5	
00111	U	7	
11110	V	;	
10011	W	2	
11101	X	/	
10101	Y	6	
10001	Z	"	

What is RTTY?

Figures Shift

- 5-bit code→32 chars.
- 2 sets:
  - Letters set & Figures set
  - 6 common control chars.
    - LTRS (unshifted)
    - FIGS (shifted)
    - Null, Space, LF, CR
- LTRS or FIGS toggle set

<table>
<tr><th>Code</th><th colspan="3">Control Characters</th></tr>
<tr><td>11111</td><td colspan="3">LTRS</td></tr>
<tr><td>11011</td><td colspan="3">FIGS</td></tr>
<tr><td>00000</td><td colspan="3">Null</td></tr>
<tr><td>00100</td><td colspan="3">Space</td></tr>
<tr><td>01000</td><td colspan="3">LF</td></tr>
<tr><td>00010</td><td colspan="3">CR</td></tr>
<tr><th rowspan="2"></th><th rowspan="2">Letters</th><th colspan="2">Figures</th></tr>
<tr><th>ITA2</th><th>USTTY</th></tr>
<tr><td>00011</td><td>A</td><td colspan="2">-</td></tr>
<tr><td>11001</td><td>B</td><td colspan="2">?</td></tr>
<tr><td>01110</td><td>C</td><td colspan="2">:</td></tr>
<tr><td>01001</td><td>D</td><td>ENQ</td><td>$</td></tr>
<tr><td>00001</td><td>E</td><td colspan="2">3</td></tr>
<tr><td>01101</td><td>F</td><td></td><td>!</td></tr>
<tr><td>11010</td><td>G</td><td></td><td>&</td></tr>
<tr><td>10100</td><td>H</td><td></td><td>#</td></tr>
<tr><td>00110</td><td>I</td><td colspan="2">8</td></tr>
<tr><td>01011</td><td>J</td><td>BELL</td><td>'</td></tr>
<tr><td>01111</td><td>K</td><td colspan="2">(</td></tr>
<tr><td>10010</td><td>L</td><td colspan="2">)</td></tr>
<tr><td>11100</td><td>M</td><td colspan="2">.</td></tr>
<tr><td>01100</td><td>N</td><td colspan="2">,</td></tr>
<tr><td>11000</td><td>O</td><td colspan="2">9</td></tr>
<tr><td>10110</td><td>P</td><td colspan="2">0</td></tr>
<tr><td>10111</td><td>Q</td><td colspan="2">1</td></tr>
<tr><td>01010</td><td>R</td><td colspan="2">4</td></tr>
<tr><td>00101</td><td>S</td><td>'</td><td>BELL</td></tr>
<tr><td>10000</td><td>T</td><td colspan="2">5</td></tr>
<tr><td>00111</td><td>U</td><td colspan="2">7</td></tr>
<tr><td>11110</td><td>V</td><td colspan="2">;</td></tr>
<tr><td>10011</td><td>W</td><td colspan="2">2</td></tr>
<tr><td>11101</td><td>X</td><td colspan="2">/</td></tr>
<tr><td>10101</td><td>Y</td><td colspan="2">6</td></tr>
<tr><td>10001</td><td>Z</td><td colspan="2">"</td></tr>
</table>

What is RTTY?

Figures Shift

- The *LTRS* and *FIGS* characters do not print
  - The code for the characters “Q” and “1” is the same; which one prints depends on if you are in Letters or Figures set
  - Note that the *LTRS*, *FIGS* and *Space* characters appear in both sets
- Example: “***KI7GUO DE K4GMH***” gets sent as:
  - *LTRS* ***K I*** *FIGS* ***7*** *LTRS* ***G U O*** *Space* ***D E*** *Space* ***K*** *FIGS* ***4*** *LTRS* ***G M H***
- Why do we care to understand this?
  - If a burst of static garbles the *LTRS* or *FIGS* character, then what prints after that is from the wrong set until the next *LTRS* or *FIGS* character appears

What is RTTY?

UnShift on Space

- UnShift On Space (USOS or UOS)
  - Increases noise immunity for alpha text
  - Space character forces a shift to the Letters set
- Contest exchanges are alpha and numeric
  - Should UOS be on or off?
  - Should Space or Hyphen delimit exchange elements?
    - 599 JOHN NY   or   599-JOHN-NY
- *Recommendation:*
  - *Turn on both RX & TX UOS and use Space delimiters*
  - *(more detail in Advanced Topics in RTTY Contesting)*

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What is RTTY?

audio tones

- Space and Mark audio tones
  - Default: 2295 and 2125 Hz (“high tones”)
  - Less fatiguing: 1085 and 915 Hz (“low tones”)
- Analogous to CW pitch
  - Operator choice
  - Each operator can use different tone pairs
  - Transmission is always two carriers 170Hz apart
- Must be same in radio and decoder/encoder

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What is RTTY?

AFSK vs. FSK

Two methods of transmission:

- AFSK (Audio Frequency Shift Keying)
  - keyed audio tones into SSB transmitter via:
    - Mic input, or
    - Auxiliary audio input. e.g., Line In
- FSK (Frequency Shift Keying)
  - keys the transmitter just like CW

Note: Receiving is the same in either case.

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What is RTTY?

dial frequency

spots are often wrong

- RTTY RF is independent of local audio tones and whether LSB or USB is used:
  - The higher RF frequency is the Mark *(14090.000 kHz)*
  - The lower RF frequency is the Space *(14089.830 kHz)*
  - The difference between the two is the shift *(170 Hz)*
- FSK displays Mark *(14090.000 kHz)*
- AFSK displays suppressed carrier which varies with local audio tones and sideband used!
  - For Mark tone of 2125 Hz (Space tone of 2295 Hz):
    - LSB *(14092.125 kHz)*
    - USB – Mark & Space tones reversed *(14087.005 kHz)*

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What is RTTY?

AFSK vs. FSK

AFSK

- Indirect *(tones → Mic input)*
- Any SSB radio *(esp. legacy)*
- SSB (wide) filtering
- Dial = sup. car. frequency
- VOX
- Audio cable *(a'la JT65/9 or PSK31)*
- Must use high tones
- *NET (automatic TX tone control)*
- *Less bandwidth (depends on radio)*
- *Easier hook-up; NET*

FSK

- Direct *(like CW keying)*
- "Modern" radios
- RTTY (narrow) filtering
- Dial = Mark frequency
- PTT
- COM FSK keying cable
- Can use low tones
- *No audio level adjust*
- *No disabling speech proc.*
- *No erroneous sound keying*
- *Less pitfalls*

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What is RTTY?

summary

- Uses 5-bit Baudot (actually, USTTY) code with two sets of 32 characters: Letters and Figures
- Space & Mark frequencies separated by 170 Hz "Shift"
- Local Space & Mark tones analogous to pitch in CW
- Constant 45.45 Baud (60 wpm) asynchronous character stream with 5 data bits and 2-3 sync bits
- Figures Shift & Letters UnShift
  - Use optional UnShift-On-Space (UOS), plus space delimiter
- AFSK vs. FSK transmission (receiving is the same)
  - Radio dial frequency differences
  - 100% duty cycle!

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The Cynics Say …

- "RTTY is a pain to set up and get working."

  … stay tuned, it's really not that difficult!

- "The RTTY decoder/encoder does everything."

  however, this attribute …
  - frees the operator to improve other skills
  - enables more contest participants
  - provides mode diversity for contest junkies

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RTTY Considerations

Much like CW and SSB, except:

- Non-human decoding implications
  - *serial number repeat, universal "fist" or "voice"*
- Distractions are tempting
  - *watch TV, do email, read, etc.*
- RTTY established practice
  - *'CQ' at end of CQ message*
- Whisper-level headphone volume; low tones
  - *just to detect presence & timing*
- Key-down transmission … 100% duty cycle

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RTTY Sub-Bands

- 10 meters: 28080-28100, during contests 28080-28200
  - JA: 21070-21150
- 15 meters: 21080-21100, during contests 21080-21150
  - JA: 21070-21150
- 20 meters: 14080-14100, during contests 14080-14150
  - JA: 14070-14150
- 40 meters: 7025-7050 & 7080-7100, during contests 7025-7100
  - JA: 7030-7100
- 80 meters: 3580-3600, during contests 3560-3600
  - JA: 3520-3575 and 3599-3612
- 160 meters: No RTTY contesting

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RTTY Sub-Bands

don't QRM!

- Avoid PSK-31 operations near:
  - 28120, 21070, 14070, 7070 and 3580
- Avoid the NCDXF beacons:
  - 21150 and 14100

- More details:

  www.aa5au.com/rtty/rtty-sub-bands

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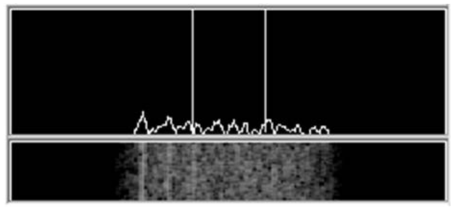
Receiving

- Set RX audio level
  - noise 5% of full-scale
- Use narrow filtering
  - CW filters ~ 500 Hz



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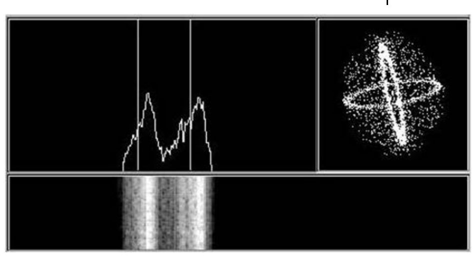
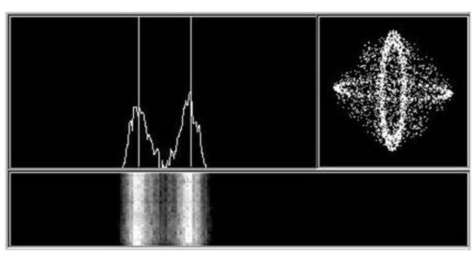
Receiving

- Set RX audio level
  - noise 5% of full-scale
- Use narrow filtering
  - CW filters ~ 500 Hz
- Learn to tune by ear
  - practice with eyes closed
  - get within 10-20 Hz
- Use “low tones” (if FSK)
  - less fatigue





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Basic RTTY Contest QSO

- ***WPX K5AM K5AM CQ***
- ***ZC4LI ZC4LI***
- ***ZC4LI 599 1349 1349***
- ***[K5AM] TU 599 985 985***
- ***[ZC4LI] TU K5AM CQ***

K5AM: running station
ZC4LI: S&P station

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Disciplined QSO Flow

- Standard keystroke (or mouse) sequences for:
  - Normal contact in Run mode
  - Normal contact in S&P mode
  - Repeats/Fills (in either mode)
  - QSO phase skip & tail-enders (in Run mode)
- Each sequence is executed the same way hundreds (thousands) of times during the contest
- Avoid deviations and special sequences

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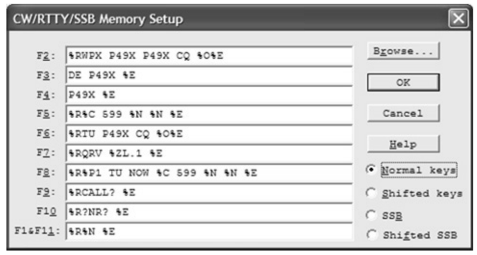
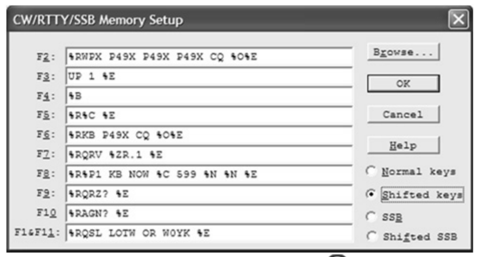
RTTY Messages

- Short, as with CW/SSB
- No extraneous info
- 599 (not 5NN) once
- Serial number twice
- Space (not hyphen)
- Omit 'DE'
- RTTY chars (%R, %E)

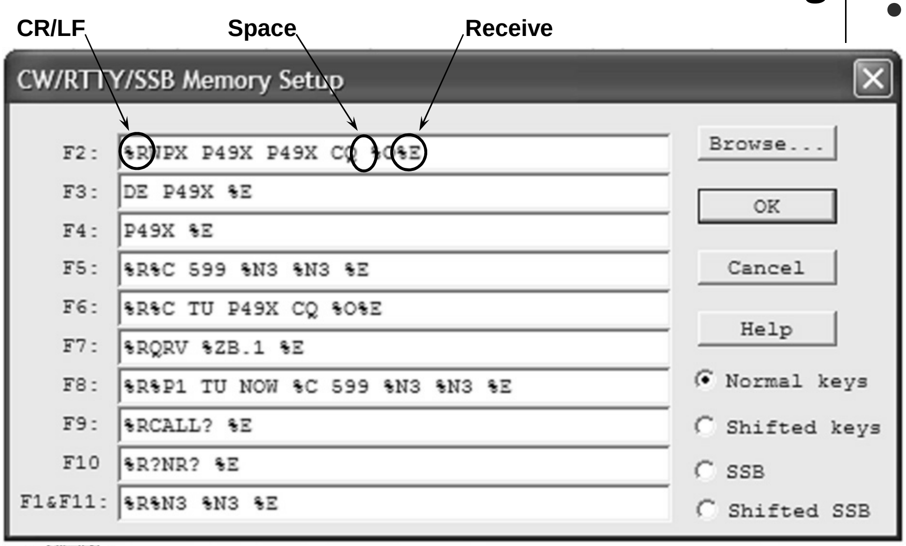
www.rttycontesting.com/tutorials/messages





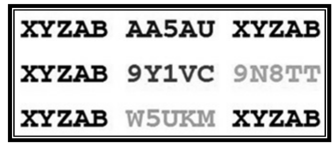
RTTY Messages

formatting



Super Check Partial

- SCP (Super Check Partial) enables computer to pick out call signs in receive window
  - Call signs
  - New mults and double mults
  - Dupes



N1MM Logger

- Use main SCP from CW/SSB/RTTY contests
  - RTTY SCP is a subset

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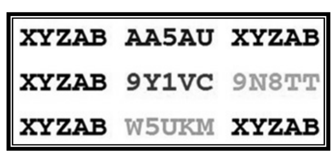
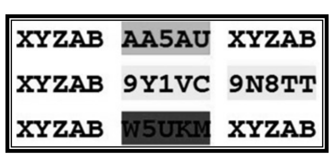
Super Check Partial

logger differences

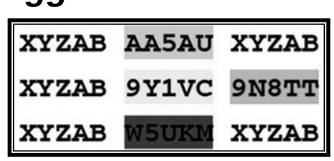


- ***Background option***
- ***Custom colors***

N1MM Logger



WriteLog



Win-Test

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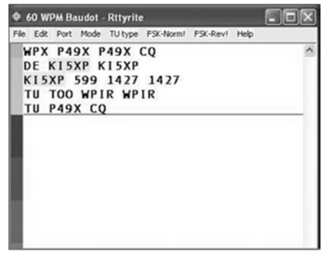
Tips

"All I receive is gibberish!"

- "Upside-down"
  - Reverse Mark & Space in software
  - LSB vs. USB
- Figures vs. letters
  - TOO=599, WPIR=2084
  - Shift-click to convert, or
  - Look at top two rows
- Mic/Line In, level, muting, tones, flutter



Tips

"They never answer me!"

- "Upside-down"
  - FSK polarity switch in radio
  - AFSK mode, LSB vs. USB
- MMTTY AFC & NET
  - AFC & NET are on by default!
    (and every time you choose a profile!)
  - Change defaults in USERPARA.INI
- Radio mode, tones, FSK interface,
  AFSK: Mic & SC level & speech processor

More Tips

- Transmit when others stand-by
- Add his call at end of exchange in pile-ups
- Recommend RIT, but if you use AFC/NET …
  - AFC only for running, not S&P
  - AFC/NET for S&P (NET only avail. with AFSK)
- Mode-independent skills
  - Bandmap usage
  - ~~QSO B4~~
  - Roving mult: "Squat & Shoot" *(Cajun-speak!)*

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and … More Tips

- 100% duty cycle … *caution!*
- Practice
  - During RTTY contests (~ two per month)
  - NCCC Thursday night practices (weekly)
- Multi-Ops
- SO2V & SO2R

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Interim Summary

- Predominantly casual RTTY contest participants
- RTTY sub-bands; 10-80 only; avoid PSK & beacons
- 500 Hz receive filtering
- Common problems
  - "Upside-down" or reversed Space/Mark (and, LSB vs. USB)
  - Figures vs. Letters
  - Audio:
    - RX audio output level and TX (AFSK only) audio input level
    - Unmuted soundcard inputs and outputs
    - Space and Mark tone consistency between decoder and radio
  - Off-frequency tuning (e.g., MMTTY AFC & NET); propagation flutter
- Messages ("macros")
  - Short, ~~5NN~~, unique exchange twice, Space delimiter

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The Cynics Say …

- "RTTY is a pain to set up and get working."

  … stay tuned, it's really not that difficult!

- "The RTTY decoder/encoder does everything."

  however, this attribute …
  - frees the operator to improve other skills
  - enables more contest participants
  - provides mode diversity for contest junkies

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How Do I Set it Up?
overview

- ***Acquire*** hardware and/or software to convert between the RTTY signal and text:
  - RTTY ***receive*** decoder
  - RTTY ***transmit*** encoder
  - PC-radio interface
- ***Configure*** decoder/encoder
- ***Integrate*** decoder/encoder with logger

The rest of the station setup is the same as for CW and SSB

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How Do I Set it Up?
RTTY decoder/encoder

- RTTY ***receive*** decoder converts printed characters from the two RF freqs.
  - CW and SSB receive audio is converted to typed characters by our ears/brain/hands

    (CW decoders are also available, similar to RTTY decoders, but seldom used)
- RTTY ***transmit*** encoder converts typed characters (or messages) into the two RF freqs.
  - Transmitted CW is converted from text by our brain/hand with the aid of a key and/or keyer
  - Transmitted SSB is converted from text by our brain/mouth via a microphone

    (*CW software keyers and SSB DVKs are also used, similar to RTTY encoders)*

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How Do I Set it Up?
decoder/encoder terminology

- The RTTY ***transmit encoder*** and ***receive decoder*** is sometimes referred to as a MODEM or a TNC:
  - MODEM = MOdulator DEModulator
  - TNC = Terminal Node Controller
- MODEMs can be:
  - a hardware box, or
  - a software application driving a PC soundcard

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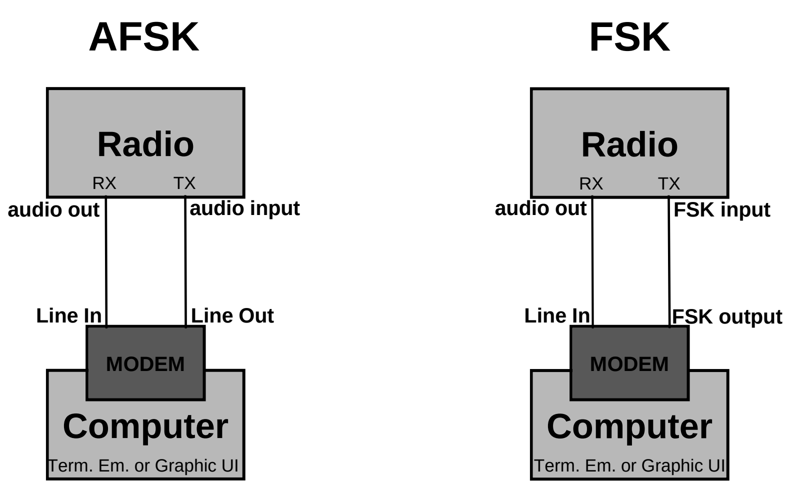
How Do I Set It Up?
hardware *MODEM*



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How Do I Set It Up?

hardware *MODEM*

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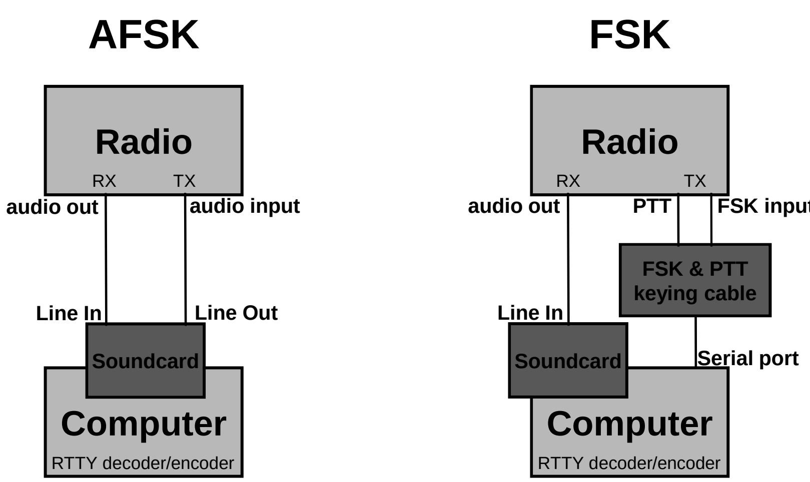
How Do I Set It Up?

software application & *soundcard*



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How Do I Set It Up?

ground loops

- Eliminate ground loops between radio and PC
- Otherwise insert 1:1 audio isolation transformer on:
  - RX output
  - TX Mic input *(AFSK only)*
- Alternatives:
  - Bourns LM-NP-1001-B1L transformer → homebrew cable
  - Ground loop isolators
  - W2IHY iBox
  - Commercial RTTY interfaces
  - K3 (uses Bourns LM-NP-1001-B1L on LINE IN & OUT)

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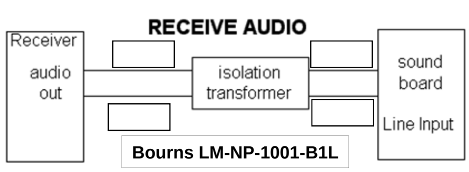
How Do I Set It Up?

homebrew audio isolation



-90 dBc 3rd order IMD

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How Do I Set It Up?
ground loop isolators

Radio Shack $19.49   or   eBay $6.99
-64 dBc 3rd order IMD

eBay $3.35

eBay $5.50

eBay $7.45

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How Do I Set It Up?
W2IHY iBox audio isolation

$60

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How Do I Set It Up?

commercial interface audio isolation

Rascal

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How Do I Set It Up?

radio audio isolation

K3 audio isolation **IN – LINE – OUT**

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How Do I Set It Up?

K3s audio isolation

digital: **soundcard**

analog: **IN – LINE – OUT**

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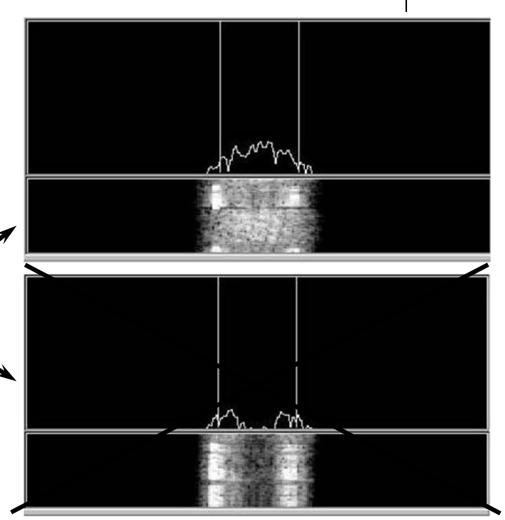
How Do I Set It Up?

radio IF filtering

- PC Audio isolation
  - Transformer
  - Commercial interface
  - Some radios (K3)
- Narrow IF filters (Roofing & DSP)
  - 500 Hz - normal
  - 250 Hz - extreme QRM only
  - Tone filters – don't use!
    - Icom Twin Peak Filter
    - K3 Dual-Tone Filter



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How Do I Set It Up

AF filtering

- PC Audio isolation
  - Transformer
  - Commercial interface
  - Some radios (K3)
- Narrow IF filters (Roofing & DSP)
  - 400 Hz - normal
  - 250-300 Hz – strong QRM
  - Tone filters – don't use
    - Icom Twin Peak Filter
    - K3 Dual-Tone Filter
- Audio filtering
  - JPS NIR-10/12
  - Timewave DSP-599zx
  - Modern DSP rigs

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How Do I Set It Up?

soundcard levels

- Adjust levels in Windows Volume Control *(or, in MMTTY **Options/Soundcard** …)*
  - Use isolation transformer, if needed
  - Mute other inputs and outputs
- RX audio goes to LINE IN (or, MIC w/pad)
  - ***Options/Soundcard input level***
- TX AFSK audio (mic) comes from LINE OUT
  - ***Options/Soundcard output level***
  - Turn off radio compression (speech proc.)
  - Avoid over-drive

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How Do I Set It Up?

PTT vs. VOX

- FSK uses PTT
  - Serial port controls FSK and PTT signals
- AFSK uses VOX

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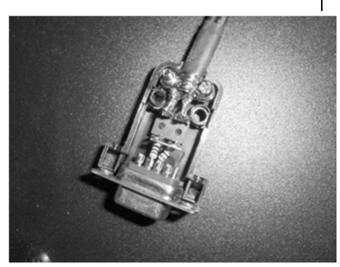
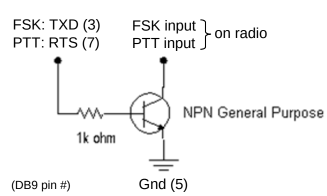
How Do I Set It Up?

homebrew *FSK & PTT keying cable*





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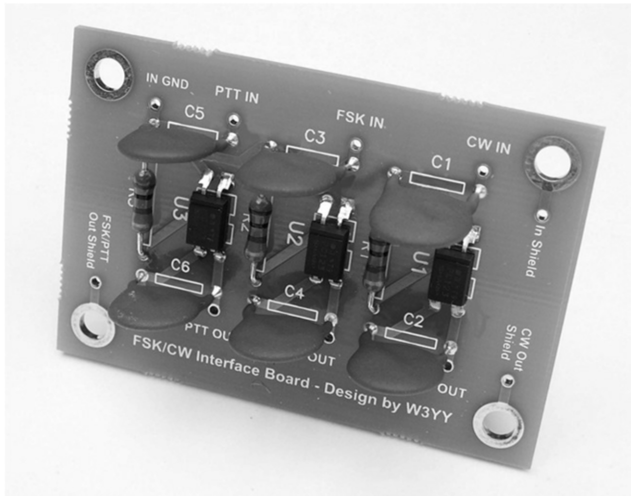
How Do I Set It Up?

W3YY *FSK & PTT keying cable*



How Do I Set It Up?

commercial interfaces

RASCAL

RIGblasters

How Do I Set It Up?

commercial interfaces

Vendor	Model	Price	PC In'fc	PTT	Soundcard	Level ctrl	FSK	CW	WinKey	Voice	Radio in'fc
generic (with K3)	(2) 3.5mm M-M audio cables	$ 10	-			√					
Buxcomm	Rascal-IIB or -IIIA	$ 69	-								
Buxcomm	Rascal GLX	$ 79	Serial	√							
Tigertronics	SL-1+	$ 80	-	auto							
Tigertronics	USB	$ 110	USB	auto	√	√					
MFJ	1273B	$ 60	Serial	√							
MFJ	1275	$ 110	Serial	√							
MFJ	1279	$ 140	Serial	√	√						
Mountain Radio	RIGblaster Nomic	$ 60	Serial/USB	√							
Mountain Radio	RIGblaster Plug & Play	$ 120	USB	√				√			some
Mountain Radio	RIGblaster Plus II	$ 160	USB	√			√ or CW	√ or FSK			some
Mountain Radio	RIGblaster Advantage	$ 200	USB	√	√	√	√ or CW	√ or FSK			√
Mountain Radio	RIGblaster Pro	$ 300	Serial/USB	√			√	√			√
Navigator	Navigator	$ 417	USB	√	√	√	√	√	√		√

See May-June 2012 NCJ, "RTTY Contesting" column

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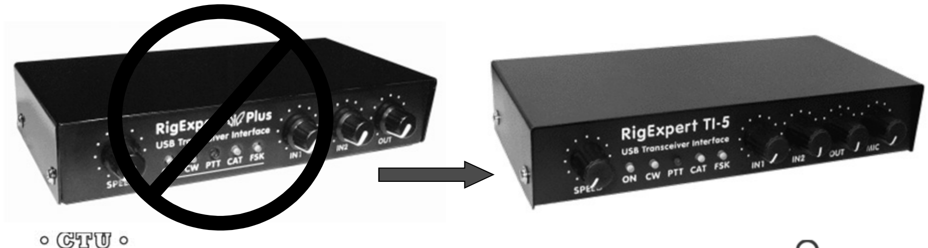
How Do I Set It Up?

RigExpert Interfaces



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How Do I Set It Up?

microHAM interfaces

One Radio

SO2R

How Do I Set It Up?

RigExpert & microHAM interfaces

Vendor	Model	Price	PC In'fc	PTT	Soundcard	Level ctrl	FSK	CW	WinKey	Voice	Radio in'fc	SO2R
RigExpert	Tiny	$ 120	USB	√	√			√		√	√	
RigExpert	Standard	$ 265	USB	√	√	√	√	√	√	√	√	
RigExpert	TI-5	$ 365	USB	√	√	√	√	√	√	√	√	
microHAM	USB Interface II	$ 179	USB	√				√			√	
microHAM	USB Interface III	$ 225	USB	√	√	√		√			√	
microHAM	Digi KEYER II	$ 369	USB	√	√	√	√	√	√		√	
microHAM	microKEYER II	$ 479	USB	√	√	√	√	√	√	√	√	
microHAM	micro2R	$ 369	USB	√		√	√	√	√	√	√	√
microHAM	MK2R	$ 899	USB	√		√	√	√	√	√	√	√
microHAM	MK2R+	$ 999	USB	√	√	√	√	√	√	√	√	√

See May-June 2012 NCJ, "RTTY Contesting" column

How Do I Set It Up?

summary - receive

1. Use appropriate receiver IF and AF filtering.
2. Receiver Audio Out (via isolation) to …
   - MODEM Audio In, or
   - MMTTY via Soundcard Line In (or Mic In with pad):
     - Enable soundcard Line In (or Mic) input, disable/mute other inputs
3. Set level so band noise is 5% of full-scale

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How Do I Set It Up?

summary - FSK

1. Connect the radio FSK and PTT inputs to:
   - the MODEM FSK and PTT outputs and connect the MODEM Serial port to the PC

     OR, if MMTTY

   - the RTTY interface FSK and PTT outputs and connect the interface Serial or USB port to the PC
2. If no PC Serial port, then use a USB-Serial adapter.
   - Beware that some won't key FSK properly. Edgeport USB-Serial adapters are known good.

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How Do I Set It Up?

summary - AFSK

1. Turn off speech processor in radio; enable VOX
2. Connect radio's Line In (Mic In with pad) via isolation to:
   - MODEM Audio Out
     - Set radio Mic level to just reach peak power output

   or …
   - Soundcard Line Out
     - Enable soundcard WAV output, disable/mute other outputs
     - Increase WAV level and/or radio Mic level to just reach peak power output
3. Do not overdrive!

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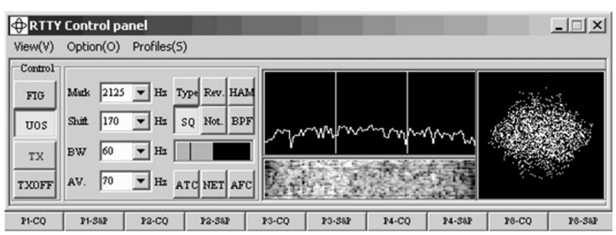
Decoders

MMTTY

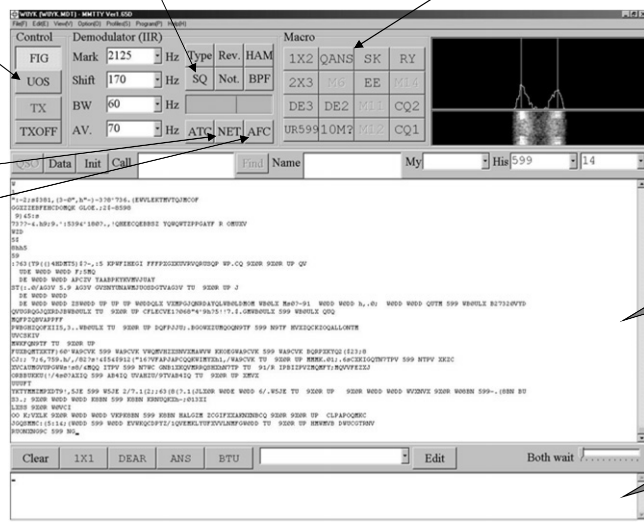


- Dominant soundcard MODEM in use today
- Exceeds performance of most other MODEMs
- Freeware since introduction in 2000
- Written by Mako, JE3HHT

62/74

How Do I Set It Up?

MMTTY standalone



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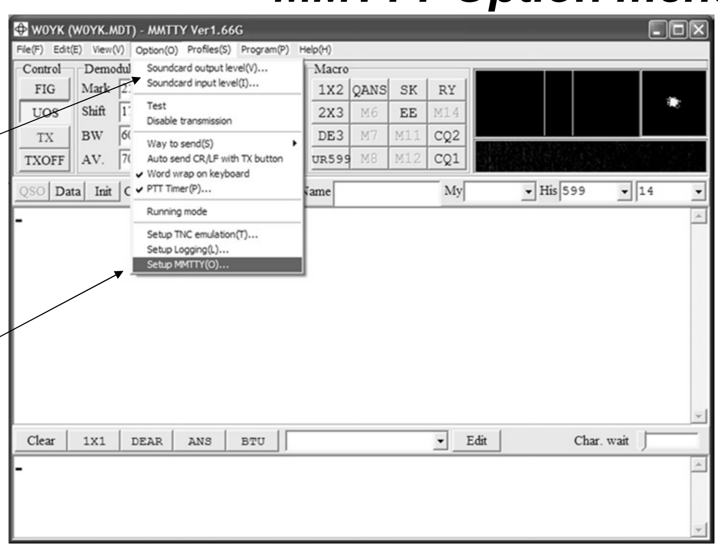
How Do I Set It Up?

MMTTY Option menu



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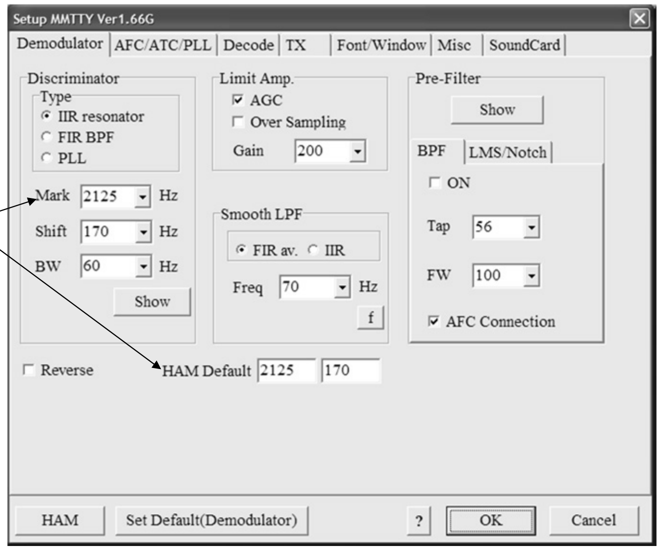
How Do I Set It Up?

MMTTY Option/Setup/Demodulator

Set tones



65/74

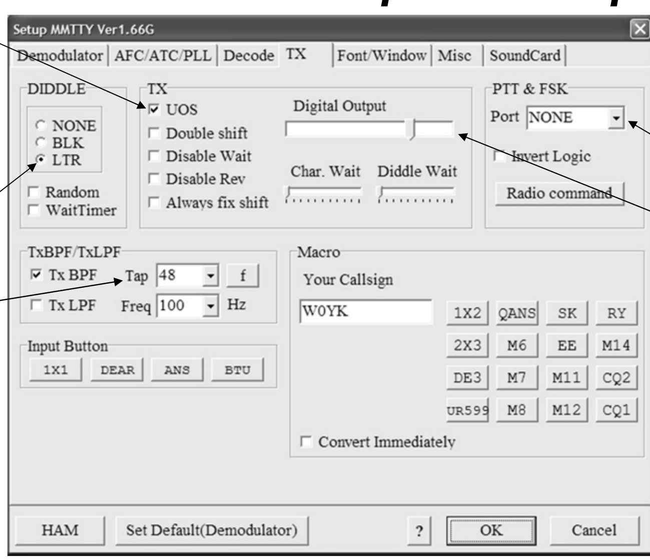
How Do I Set It Up?

MMTTY Option/Setup/TX

TX UOS on

Select LTR

512 Tap



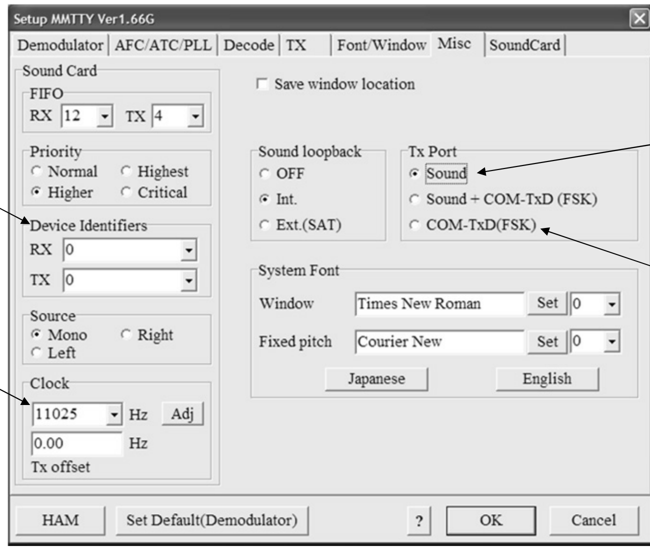
FSK/PTT port

Soundcard Line Out level

66/74

How Do I Set It Up?

MMTTY Option/Setup/Misc



Soundcard

Soundcard Format, 4x

AFSK

FSK

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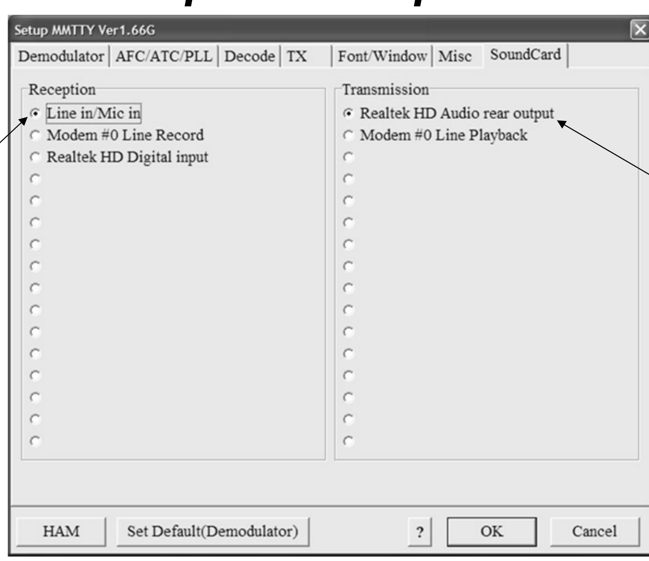
How Do I Set It Up?

MMTTY Option/Setup/SoundCard



Select receive Soundcard

Select transmit Soundcard (AFSK only)

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How Do I Set It Up?

MMTTY userpara.ini

- ***userpara.ini*** file (in MMTTY program directory) stores parameter defaults
- There is a section for each profile, e.g.,
  - [Define0]
  - Name=Standard RTTY
- In each section (profile) make sure:
  - NET and AFC are off [NET=0, AFC=0]
  - UOS and TXUOS are on [UOS=1, TXUOS=1]
  - Other parameters are set so that they do not have to be changed every time you load MMTTY or that profile

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RTTY Radios

FSK & AFSK bandwidth

FSK

- Use radio FSK filter
  - DSP TX filter (K3)
  - Crystal TX filter (K3)
  - Lobby other mfrs
- Otherwise, use AFSK
  - With TX filtering
  - Properly adjusted

AFSK

- Use radio AFSK filter
  - DSP TX filter (K3)
  - Crystal TX filter (K3)
  - Lobby other mfrs
- Use MODEM TX filter
  - MMTTY 512-tap
  - 2Tone default

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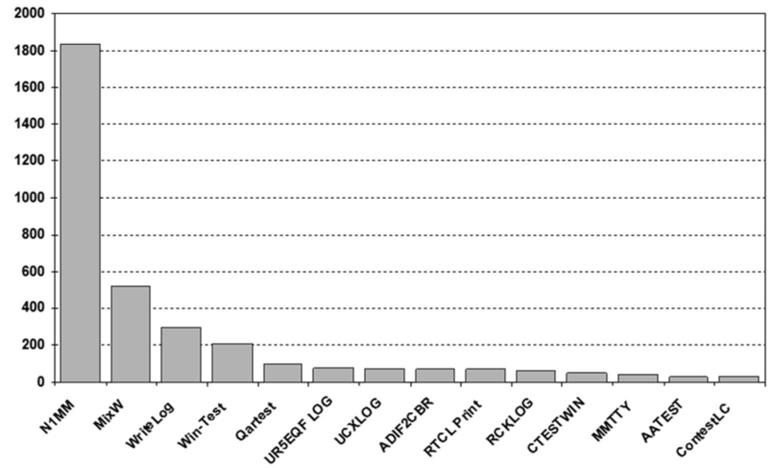
2012 CQ WPX RTTY

3550 submitted logs



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RTTY Contest Loggers

- WriteLog *(1994)*
  - created for RTTY *(CW & SSB came later)*
  - *www.rttycontesting.com/tutorials*
- N1MM Logger+ *(2000; dedicated RTTY software designer)*
  - Free
  - *www.rttycontesting.com/tutorials*
- Win-Test *(2003; RTTY is low priority)*

All three integrate MMTTY and have similar functionality for basic RTTY contesting.

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A Blizzard of Details!

this is fun??

Start Simple, then Enhance

- MMTTY *(free)*
  - get RX working *(std audio cable from radio to PC)*
  - get TX working; use either:
    - AFSK *(2nd std audio cable from radio to PC)*
    - FSK *(keying cable or commercial interface)*
- Integrate MMTTY with logging software
- Enhance later
  - Audio isolation *(highly recommended)*
  - Commercial interface
  - Advanced setup: SO2V, SO2R, multiple decoders, ...

Resources

- www.rttycontesting.com premier website
  - Tutorials and resources (beginner to expert)
  - WriteLog, N1MM Logger+ and MMTTY
- rtty@contesting.com Email reflector
  - RTTY contester networking
  - Q&A
- Software web sites
  - mmhamsoft.amateur-radio.ca/ (MMTTY)
  - n1mm.hamdocs.com/tiki-index.php (N1MM Logger+)
  - www.writelog.com (WriteLog)
  - www.wintest.com (Win-Test)
- Software Email reflectors
  - mmtty@yahoogroups.com (MMTTY)
  - N1MMLoggerplus@yahoogroups.com (N1MM Logger+)
  - N1MMLogger-Digital@yahoogroups.com (N1MM Logger+ RTTY & PSK)
  - writelog@contesting.com (WriteLog)
  - support@win-test.com (Win-Test)

How to Adapt Your DX Contest Strategies for Low Solar Activity

Frank Donovan
W3LPL

• CTU •
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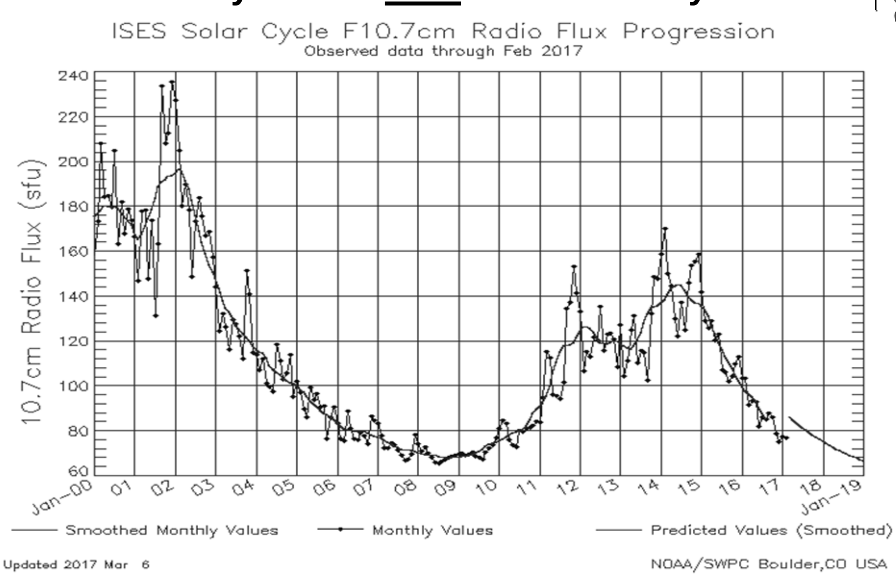
Five Years of Very Low Solar Activity

Solar activity should <u>start</u> to increase by 2020



http://services.swpc.noaa.gov/images/solar-cycle-10-cm-radio-flux.gif

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What About Solar Cycle 25 ??

Solar Cycle 25 is likely to be another weak cycle, slightly weaker than Cycle 24

- Solar polar magnetic field strength continues very weak during Cycle 24
  - slightly weaker than the very weak Cycle 23 field strength
  - an early indicator that Cycle 25 may be slightly weaker than Cycle 24
- Spotless days have recently become much more frequent
  - there were 817 spotless days over five years during the last solar minimum
  - weak cycles are preceded by at least 600 spotless days over five years
  - probably more than 100 this year, many more for the next three years
- Geomagnetically quiet days are much more frequent <u>after solar minimum</u>
  - very few solar flares and coronal mass ejections have occurred since 2016
  - there will be less frequent, less intense coronal holes <u>after solar minimum</u>
- Cycle 25 sunspots will be more frequent as solar minimum approaches
  - but solar flux will continue at low levels -- in the 70s – for five more years

High accuracy Cycle 25 forecasting isn't possible until about three years *after* solar minimum

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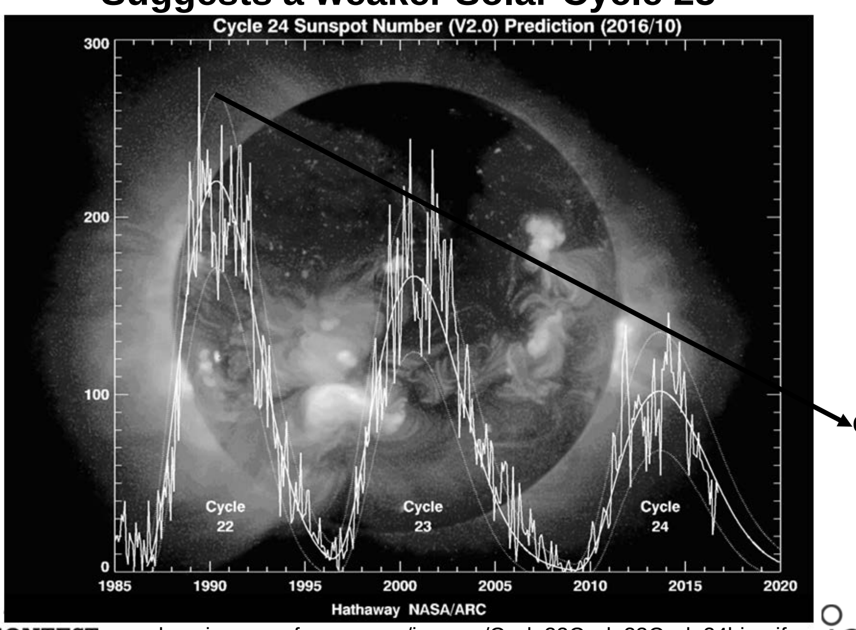
Declining Solar Activity Since Cycle 22

Suggests a weaker Solar Cycle 25

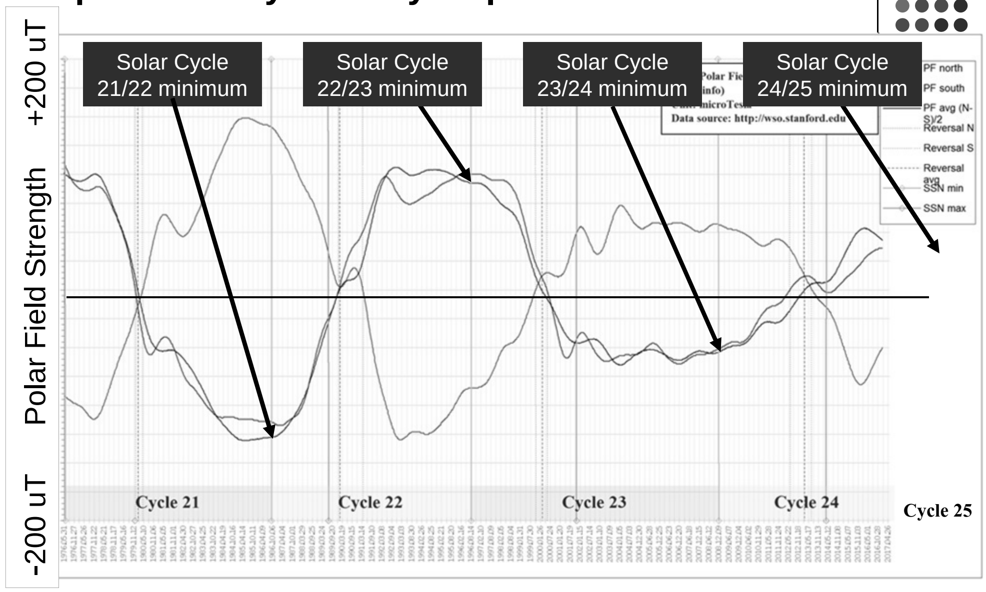


Cycle 25?

CONTEST UNIVERSITY solarscience.msfc.nasa.gov/images/Cycle22Cycle23Cycle24big.gif ICOM

The Solar Polar Field Precursor Method

A proven early solar cycle prediction method



www.solen.info/solar/polarfields/polar.html

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160 Meter Propagation

During five years of very low solar activity

- Significantly improved DX propagation
  - stronger signals
  - more reliable openings especially to Europe and Japan
  - consistently low absorption caused by less frequent coronal holes
  - especially after solar minimum in about 2020 until 2022
  - less intense daytime D layer absorption before sunset and just after sunrise
  - less intense night time E layer absorption
- More crowded band conditions
  - especially when there is no strong 40 meter propagation to Europe
- Longer, more regular and stronger worldwide DX openings
  - continuous openings to Europe, Mid-east and north Africa 2200-0830Z
  - frequent strong JA openings at sunrise mid-Nov to mid-Feb 1200-1230Z
  - direct short path polar opening to central Asia will be more frequent

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80 Meter Propagation

During five years of very low solar activity

- Significantly improved DX propagation
  - stronger signals
  - more reliable openings especially to Europe and Japan
  - consistently low absorption caused by less intense geomagnetic activity
    - especially for about two years after solar minimum from 2020-2022
  - less daytime D layer absorption before sunset and just after sunrise
- More crowded band conditions
  - especially when there is no strong 40 meter propagation to Europe
- Longer, more regular and stronger worldwide DX openings
  - continuous openings to Europe, Mid-East & north Africa 2130-0830Z
  - regular openings to JA starting before our sunrise ~1130-1300Z
  - direct short path polar opening to central Asia will be more frequent

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40 Meter Propagation

During five years of very low solar activity

- Nearly 24 hour DX openings during CQWW CW
- Europe, Mid-East and north Africa propagation
  - activity QSYs to 40 meters before mid-afternoon ~1930Z
  - don't miss the strong mid-afternoon/evening openings 2000-0200Z
  - propagation often fades/fails a few hours after sunset 0200-0600Z
  - strong openings usually resume at sunrise in Europe ~0600-0900Z
- Japan, Far East and Central Asia propagation
  - brief direct short path opening at JA sunset 0800-0900Z
  - weak skew path opening at about 240º ~0900-1130Z
  - strongest short path JA opening from the east coast ~1130-1300Z
  - strong long path Asia signals at 150º 2130-2215Z
- VK/ZL and southeast Asia long path 90-150º 2100-2300Z
- Southeast and central Asia long path ~240º ~1130-1300Z

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20 Meter Propagation

During five years of very low solar activity

- Usually closes well before midnight ~0300Z
  - Sporadic, weak night time Africa & south Pacific openings 0500-0700Z
- Europe, Mid-East and north Africa propagation
  - from before our sunrise until mid-afternoon ~1000-1900Z
    - the opening is sometimes delayed until after sunrise
    - the opening ends earlier in the afternoon than in recent years
- Japan, Far East and central Asia propagation
  - short evening short path opening 2100-0100Z
  - morning short path opening 1300-1500Z
  - both openings are much shorter than in recent years
- South Asia and Mid-East morning long path 1300-1500Z
- VK, ZL and south Pacific mid-afternoon long path 1900-2200Z

15 Meter Propagation

During five years of very low solar activity

- Europe, Mid-East and north Africa propagation
  - from just after our sunrise until early afternoon 1200-1800Z
  - shorter openings than we've enjoyed in recent years
- Japan and Far East propagation
  - weak late afternoon short path opening 2130-2300Z
    - sometimes only via the weak signal skew path to the southwest
  - much shorter openings than we've enjoyed in recent years
- 15M usually closes a few hours after our sunset ~0100Z
  - always stays closed all night

10 Meter Propagation
During five years of very low solar activity

- South America, Caribbean and Central America
  - PY and LU activity has increased significantly in recent years
  - usually opens about an hour after our sunrise ~1300Z
  - opening can fade for an hour or two, then return much stronger
  - usually closes about an hour before our sunset ~2100Z
    - always stays closed all night
- Southern Europe and north Africa
  - very weak signals on the SE skew path at 110-150º ~1400-1700Z
- VK/ZL and south Pacific
  - A fairly reliable weak signal opening ~1900-2100Z
- Japan, North Pacific and Far East
  - rare morning weak signal long path opening at 150º ~1300-1400Z
  - rare evening very weak signal skew path 200-240º 2100-2200Z

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DX Contest Strategies
for five years of very low solar activity

- High antennas are much more important during solar minimum
- Improve your low band transmitting and receiving antennas!
- Start every DX contest on 40 meters
  - the strong European opening ***often ends a few hours after sunset***
- Capitalize on improved 160 and 80M propagation 2200-0830Z
  - especially important when 40 meters is not strongly open to Europe
- Strong 40 meter opening after sunrise in Europe 0600-0900Z
- 160, 80 and 40 meter openings to VK, ZL and JA 0900-1230Z
- 20M European opening starts before sunrise 1000-1900Z
- 15M European opening starts just after sunrise 1200-1800Z
- 10 meters opens primarily to the south 1300-2100Z
- Strong 40M afternoon/evening openings to Europe 2000-0300Z
- 20 meter evening openings to Japan 2100-0100Z

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Little Pistols Bigger Scores

Collected Wisdom and Lessons Learned
K2YWE (K3AU)

What's this about?

Ways modest stations can improve their scores

- **Objective**
  - Improved Scores for Little Pistols
- **Intended Audience**
  - Low power "grass roots" HF stations
  - But . . . principles & tips apply almost universally

Agenda

- Elements of Success
- Preparation
- Station Considerations
- Q's and Rate
- Strategy
- Station Improvements
- Software
- Operating Tips and 'Best Practices'
- After Action
- Conclusion
- A Word about SO2R
- Appendix A - Best Practices Collection
- Appendix B – Selected Contest Loggers

Elements of Success

Same principles apply as in most successful endeavors

- **The Right Frame of Mind**
- **Preparation**
- **Attention to Detail**
- **Adoption of Best Practices**
- **Practice**
- **Improvement and Learning**
- **Perseverance**

"Which brings us to my next point"

The Right Frame of Mind

Get "in the zone"

- **Don't forget it *<u>is</u>* a competition**
  'It's a jungle out there' . . . de N6TR
- **You will not be alone**
  " . . contesting skill includes the ability to tolerate high levels of QRM, and if you can't do that, you might as well hang it up." . . . de K3ZO
- **Think Big**
  "If you think and act like you're a big dog, you will convince much of the pack that you are. Of course you may get nipped once in a while." . . . de K2YWE

QRL!

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Preparation

'Now the general who wins a battle makes many calculations in his temple ere the battle is fought. The general who loses a battle makes but few calculations beforehand.' . . . Sun Tzu

- **Have a strategy – write it down**
  - Provides baseline guidance
  - Try to optimize within your constraints
  - Modify as needed in 'battle'
- **Reassess during the contest**
  - Expect to change the details
  - Take big departures only if you have good reason to, like one or more of your assumptions is invalid

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Preparation

Get your act together before the performance

- **Check your set-up well before the start**
  - Antennas, Hardware, Software, support files
  - Software settings
  - Provide enough time for fixing any problems
    - I use my contest software **every day**

INS Key sticks!

- **Be well rested for the contest**
- **Listen day(s) & hours before to get a feel for Condx**
- **Have a simple means to restart software**
  - What did I call the file ? – Use consistent names

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Scoring Basics review

It's all about accuracy and Q's & Mults

- **Valid contacts require accurate two-way information**
- **Final score depends Q's & Mults**

Call	Freq	SNT	RCV	Prefix	Mult
UP4KEDR	21040.58	599	599	UP4	No
OK1MRZ	28006.23	599	589	OK1	No

  - **QSO points** – Based on number of valid contacts
    - Points per contact may vary (like WPX)
  - **Multipliers** – Based on a unique characteristic
    - Usually location
  - Same station may provide multiple Qs or Mults
    - QSO's on different bands or modes may each count

Score - 2,652,724 Points

Band	QSOs	Pts	WPX
1.8	239	1	1
1.8	13	0	0
3.5	485	69	4
3.5	90	1	1
7	1522	1005	131
7	167	253	41
7	17	6	0
14	545	661	69

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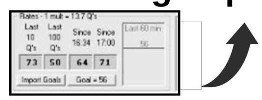
High Level Thoughts

Some reasoning to frame the problem

- **Q's fuel the engine. Mults provide a boost**
  - Both are important
- **More Q's are key for higher scores**
- **Operating Time is fixed, thus Rate must go up!**
- **Rate Drivers**



  - **Being Heard** and Hearing others
    - At fixed power level, this mainly means better Antennas
  - **Operating Efficiently** - wasting less time
    - Operating Practices
    - Shack Arrangement
  - **Available QSO's . . .**

Available QSO's

Sources of QSO's

- **Group 1 – Stations calling CQ (Runners)**
  - You hear them, most will hear you
  - You can generate high S&P rates with them
  - In spite of how it sounds, they are limited in number
- **Group 2 – Non-Runners (callers)**
  - QSO's you ***will never make*** unless you call CQ
  - They boost and help sustain rates
  - Some will be Multipliers
- **Thus . . .**
  - **You must Run at least part of the time**
    - Mix of Run / S&P will vary
    - Good conditions are good for Little Pistols running

Rate Time Efficiency

Higher rates require spending less time per QSOs

- **Minimize both parts of rate time**
  - **In** and **Between** QSO's
- **In QSO's**
  - Eliminate **wasted words**
    "Please copy my …"   "Thank you for …"
  - **Avoid repetition** unless conditions warrant
    "Maryland Mike Delta"   "Dan Delta Alpha November"
  - Fills - Give only **what's asked for**
    "QTH?" . . . "TX" not "123B K5ABC JOE 81 TX"
  - Fills - Ask only for **what's needed**
    *Get all fills **before you pass your info** (when S&P-ing)*

*More in **Best Practices***

Rate Time Efficiency

Less time between QSOs yields higher rates

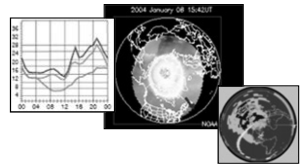
- **Between QSOs**
  - **Give your call once** unless otherwise warranted
    - **Timing** is important
    - Remember you're a "Big Dog"
  - **Don't give only part** of your call sign
    - Often leads to an extra transmission
  - Use K3ZO's "Rule of **Twice**"*****
    - Move on if he doesn't ID after transmitting Twice
    - Move on if he doesn't respond after Two calls*****
    - Move on if you can't pull him through in two tries*****
  - Use the **Bandmap**
    - Save calls in the Bandmap, even if you are Unassisted

*****Modify "twice" as is sensible, but stick to it

back to Strategy

Having a game plan pays off during the contest

- **Consider Propagation**
  - Range of prediction tools are available
    - 'Rules of Thumb'
    - Online resources and models
  - Temper with your own observations



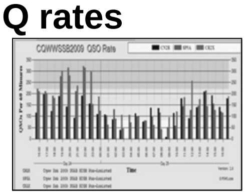
- **Block out expected S&P and Run times**
  - Set ground rules for changes
  - Balance with periodic short checks for Mults

- **Allow for time-of-day considerations**
  - What's going on outside your area

On/Off Times

Make the best use of your time

- **Choose Off times at lowest expected Q rates**
  - Base on your own or other stations' histories
  - Don't forget minimum OFF time rules



- **Ensure using your full time allotment**
- **Allow possibility you may want a late slot**
  - Don't get caught short of time at the end
  - I usually leave a late half-hour insurance slot
  - It's tricky, considering desire to use time fully

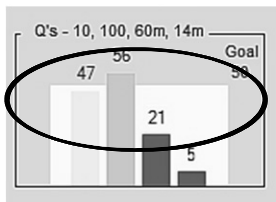
- **Sync with your personal needs (of course)**

Rate Targets

Setting Rate targets helps you achieve QSO goals

- **Set an average rate you want to achieve**
  - (Total Q's) / (Operating Hrs)
  - Make it a major element of your strategy
- **Set minimum rates you'll accept**
  - Adjust target rates over the contest period
- **Consider a change if you drop below target or keeps going down**

1,000/24 = 40	
00-04z	60
04-08z	45
08-12z	30
12-16z	40
16-20z	50
20-24z	25



- Change Freq, Band, Mode
- Swap Running and S&P
- Chase some Mults
- Change your Shirt
- ***Change Something!***

Station Improvements

Put method behind your madness

- **Assess Station Strengths and Weaknesses**
  - Take **band by band inventory** *based on performance history*
- **Attack Weaknesses with biggest payoffs first**
  - Incrementally **fill in the holes**
  - Expect Antennas to rank high
  - Don't forget to pick 'low hanging fruit'
  - ***Every*** improvement counts – **they all add up**
- **Set up for Efficiency** **. . . Huh?**

Station Improvements

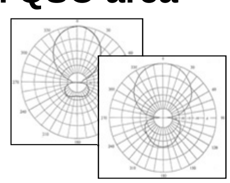
Improvements aimed at higher rates

- **Footswitch**
  - SSB - Frees hands for keyboard use 
  - CW - Quick T/R transition without listening to QSK noise
- **Boom or Headset Mic** 
  - Less fatigue, **freedom** to move, respond to local 'QRM'
- **Antenna switches and relays** 
  - **Quicker** band changes
- **Rearranged Equipment** 
  - Easier **more efficient**, operation
- **Improved Antennas**
  - Better sustain runs, snag S&P QSO's with less calls
  - More '**second tier**' QSOs

Antenna Improvements

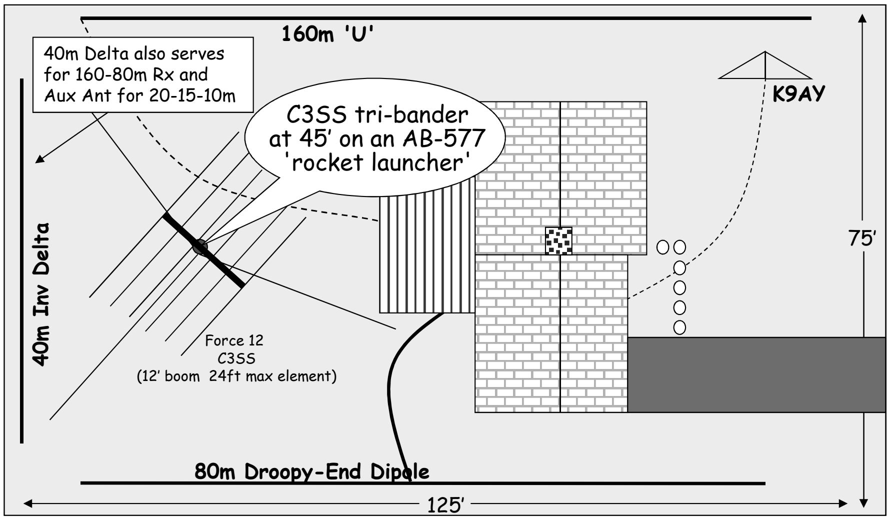
Be innovative within your constraints

- **What assets exist to hang antennas on?**
- **Use all the property lines to full advantage**
- **Add/change antenna to help your weakest band**
- **Try using monobanders**
- **Consider fixed antenna with gain to high QSO area**
- **Enable a new band, like 160m**
  - **New Mults and more Q's during slow times**
- **Add better SNR Rx Ant for low bands**
- **Add a Yagi or other rotatable if possible**



My Antenna Farmette (K2YWE)

Three wire monobanders and a 12' tribander in 1/5th acre



Started with multi-band horizontal loop
Made incremental improvements to address deficient areas

Software (S/W)

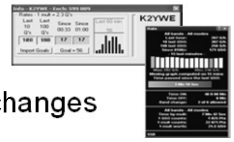
Use a dedicated contest logger, properly configured

- **Engage Radio and Keying interfaces**
  - Build or buy and integrate them if you haven't already
  - Facilitate high rates, reduce errors
- **Recommended S/W Setup Options**
  - Work Dupes
  - Correct all signs
  - Check Partial Window(s)
  - Score by Band Window
  - Bandmap & Spot List Windows
  - Rate Window
  - Available Q's & Mults (N1MM)
  - Populate Bandmap on move
- **Spotting Network? -** It's a strategic decision
  - Can be a valuable asset, especially in S&P and on CW (RBN)
  - Does not alleviate you from **confirming** all entries
  - Be careful **not** to get caught up in **chasing Mults**

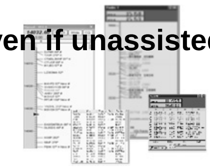
S/W Features I find most useful

Some features that pay off

- **Rate Window**
  - Rates & Targets
  - Band and S&P/Run changes

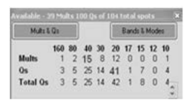


- **Bandmap**
  - Dupe check & 'check later' **even if unassisted**
  - List views
    - Jump to spot (if interfaced)
    - Hotkeys without mouse



- **Super Check Partial (SCP) or Check n and n+1**
  - Call sign possibilities
  - n+1 includes transposed and single char erro

- **Available Mults and Q's**
  - See band activity/'target density'



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Practice

It may not make you perfect, but it will make you better!

- **Be thoroughly familiar with your logging software**
  - A contest is **not** the time for a **first trial**
  - **Gain** familiarity in day-to-day use
  - **Exploit** helpful features
  - Try different modes
  - Modify settings to suit your style

Contest Hound using Morse Runner

- **Be comfortable with Run techniques**
  - **Practice** with a simulator (Morse Runner)
  - Operate 'run style' on the air (5NN MD DAN BK . . . TU)
    - Pick days with good conditions on your best band
- **Assess your Operating Practices**
  - Bounce your operation against the ***Best Practices***

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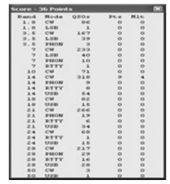
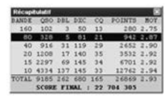
Some Tips

Overall



- **Every point counts!**
  - There's **no** such thing as '**not worthwhile**'
  - When it's really slow, call for 'anybody'
- **A rule of thumb strategy**
  - **Work bands that may close first.** Move with propagation
  - Usually means 10-15-20 in a.m. then 40-80-160 later on
  - **Try more running** when bands are **open**
  - Keep an eye out for **early and low-probability** openings
  - Chase Mults when one band slows, but other hasn't yet opened
- **Keep multipliers in mind**
  - **'Move' Mults** if you can do so efficiently
    - Have frequency on each band **set up** for quick jaunt
  - **Balance** effect on rate and total score when chasing Mults



Some Phone Tips

Apply these basic Best Practices for starters

- **Maintain a friendly sense of urgency in your QSOs**
  - Chattiness will slow your rate and lose you contacts
- **Use conventional or unmistakable phonetics**
  - 'Duck Soup' are poor phonetics for 'D S'
  - Use Standard (IPA) or 'Common' phonetics (countries, cities . ..)

- **Be mindful of SSB signal bandwidth**
  - Be away from strong runners not to get covered by an **unheard pileup**
- **Listen to what's on your frequency when calling split**
  - If you can hear it, you can better time your call or defer until later

Some CW Tips

Apply these basic Best Practices for starters

- **Work at being heard**
  - Try **moving frequency** a bit if no success calling
    - Sometimes bandwidths are set narrow
    - Spots put everyone on the same frequency
  - **Distinguish** yourself through Speed or Weight
  - **Moderate** your **CQ speed** by conditions & results

- **Beware of busted RBN spots**
- **Don’t let code speed keep you from CW contests**
  - Start with the slower stations **high in the band**
    - Don't worry if you need to hear the call or exchange **several times**
  - Call CQ **higher in the band** at a speed comfortable for you
    - When you’re ready

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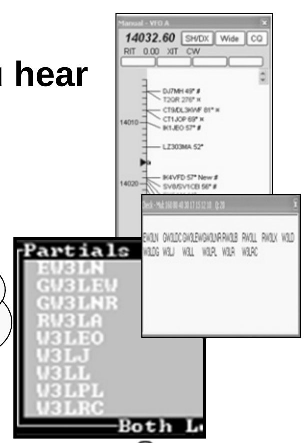
Best Practices Basics

Log what you hear, not what you read

- **Verify the callsign of the station you're working**
  - BV6U and 5C8N are not real callsigns (6V6U and HC8N) Don't log them that way
- **Always Hear the call and log what you hear**



Some tips on this page are courtesy of the 1999 YCC 'Cookbook'

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Best Practices Basics

Make the most of your available time

- **S&P rates can be very high early in the contest**
  - **Everyone** is **'fresh meat'** for you.
  - You can quickly hop from station to station with little fear of Dupes
  - You are often safe to call first and then fill-in the call (some risk)
- **Use S&P to find a spot to CQ**
  - You can maintain a **high rate** while **searching for** a **clear** spot
  - It beats the alternative of establishing a frequency before the Test
- **Be sure to try CQing late in the contest**
  - You will **be fresh meat** to some that have been CQing all along
- **Don't waste time repeatedly calling DX that has moderate signals when the band is otherwise quiet from their area**
  - They are probably 'opening the band' with lots of ERP

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K2YWE – PISTOLS-G 2017 p. 27

Best Practices . . . Running

Running

- **Call CQ when the band is active**
  - If **CONDX** are **good** for your station
- **Call CQ when bands are dead or worked out**
- **Use the widest IF bandwidth you can stand**
  - Less chance to miss **off-freq callers**, especially on CW
- **Use only a quick 'thanks' (or TU) if stations are waiting**
  - **They know your call**. Don't waste time on it
  - I use a '**progression**' as the crowd thins
    - "Thanks" alone with, periodic ID "Thanks K3AU"
    - "K3AU"
    - "K3AU Contest "
    - [CQ Message]

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K2YWE – PISTOLS-G 2017 p. 28

Best Practices . . . Running

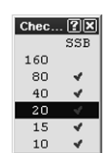
Running - continued

- **Speed up if your run is being sustained**
  - Especially in contests like SS with your call in the exchange
  - **Slow back down again** appropriately
- **Always work Dupes (set software to allow it)**
  - You **might not be in his log** and it's usually **quickest**
- **Send out a full exchange with a partial call**
  - Most **Ops will correct you**, many without a missing a beat
  - Fix the entry during his transmission
- **Send the corrected call as part of your 'bye' message**
  - **Enable call sign correction** in your software

Best Practices . . . Running

Running - continued

- **Don't break a run to pull one station through**
  - **Your rate will suffer** if you take too long
  - You will drive away impatient waiting stations
- **(CW) Hit SEND as soon as the call is in your head**
  - **Finish typing** in the log **while the exchange is sent**
  - Some programs can do this automatically after *n* characters
- **Move Multipliers to other bands if you have the time**
  - **Picking frequencies** in advance makes it easier to jump



Best Practices . . . Running

Running - continued

- **If another station calls CQ on your frequency, try ‘QRL’ or ‘Frequency in use, please QSY’**
- **Don't engage in extended frequency fights**
  - **If QRL/QSY fails**, it almost always pays to **move**
  - Sometimes you can move up or down a bit to lessen the QRM and still hang on to 'your' frequency
- ***NEVER NEVER NEVER* acknowledge a 'jammer'**
  - **NEVER**. Just keep your pace and **don't change** your tone of voice on phone or even synchronize your calls to his QRM.
  - Often throwing in a few fake Q’s will discourage the jammer

The Complete Best Practices Collection appears in Appendix A

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After Action (post mortem)

Analyze your performance after the contest is over

- **Note things you wish you had done differently**
  - Run to S&P ratio?
  - Handling Mults – chasing, moving
  - Station changes you wish you’d made
- **Compare with local contesters**
  - Miss any openings?
  - Band scores and band changes
- **Perhaps record the contest***
  - Later check against LCR
  - **Do Not** use recording to “fix” your log

*You must have a recording if you are a CQWW top 3 finisher

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Conclusion

Little Pistols with modest stations can successfully compete

- **Prepare and pay attention to detail**
  - Remember **Sun Tzu**
- **Strategies are important**
  - Pick and **plan** your contests. Use the plan for guidance
- **Adopt proven practices**
  - Try the **Best Practices**. Keep what works for you
- **Run, big dog, run**
  - Try to **Run** if at all possible

- **Start now to make incremental improvements**
  - Make a **list** and work it down

' It's not the size of your station, it's how you use it! '

A Word About SO2R **[single op 2 radio]**

Everyone has their own idea of an efficient SO2R layout . . .

jump to conclusion

A Word About SO2R

Save SO2R until other improvements are well in hand

- **Potential to add significantly to your score**
- **But, It's easy for SO2R to be a distraction**

- **KISS (Keep It Simple Stupid) is key**
  - Start with a simple to use setup
    - I use two networked computers and keyboards
- **Start using SO2R only when things are slow**
  - CQ on A - S&P on B
  - Alternate (ping-pong) CQs
  - Modify your setup and operation with experience
- **Try SO2V [Single Op 2 VFO] to get your feet wet**
  - Same caveats apply

I'm not a power SO2R user

Best Practices

Appendix A

K2YWE

What successful *competitors* say works for them

note: Order in the table was arranged for fit and is not necessarily logical

Best Practices

Appendix A

K2YWE 1 of 9 Best Practice	Rationale
General Operating	
• Assume a big dog attitude	• If you act like a big dog, most will believe you. If they bite back painfully, you can find other turf.
• Maintain an “friendly sense of urgency” in your QSOs	• Chattiness will slow your rate and lose you contacts
• Always work Dupes • Set your software accordingly	• You may *not* be in *their* log • It usually takes more time to rebuff than work
• Enable and use the Bandmap feature of your logging software even if you are not Assisted. • The Bandmap allows you to enter stations yourself on the fly	• If you need to check back later, the Bandmap will have the call sign and frequency noted for you • You’ll waste less S&P time on waiting for station ID or on calling Dupes

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K2YWE – PISTOLS-G 2017 p. 37

Best Practices

Appendix A

K2YWE 2 of 9 Best Practice	Rationale
General Operating - continued	
• In general, use K3ZO's 'Rule of TWICE’ • Modify ‘TWICE’ to suit your station capabilities and contest situation: • If you can't get a station after calling him TWICE, move on • If the station doesn't ID after transmitting TWICE, move on	• Your time can be better spent increasing your rate • A multiplier can quickly become worth less than the QSOs lost trying • You can put his frequency into the Bandmap to check back later
• Try moving frequency a bit if you don’t seem to be heard	• Often receiver bandwidths in a crowded band are set very narrow

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Best Practices

Appendix A

K2YWE
3 of 9

General Operating - continued

Best Practice	Rationale
• Do not waste time repeatedly calling DX stations that have moderate signals when the band is otherwise quiet from their part of the world • This is likely to happen when big guns are just 'opening the band' or 'keeping it open' • Try another time	• Many stations running high power will be heard when propagation is poor, but will not hear you despite elaborate antennas • Remember that 1.5kW vs. 100W is roughly the difference between S-7 and S-3. These are the guys that are S9 or more under better conditions.
• Send only the missing or wrong part when asked for a correction (FILL) • The response to K3? would be 'ABC' (a few times if needed) not all of 'K3ABC' since K3 wasn't in question • Similarly in SS if queried for your CK, don't send the entire exchange	• Time spent sending known information is wasted. • You may squander a clear interval or QSB peak on resending known info The time spent sending known info may be a missed opportunity for the Fill to be heard

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Best Practices

Appendix A

K2YWE
4 of 9

Running

Best Practice	Rationale
• Call CQ when the band is active if you are able to find and hold a frequency	• You will usually beat your S&P rate • An exception is the start of the contest when everyone is 'fresh meat' for you and your S&P rate can be very high
• Call CQ when the bands are dead for the day or worked out near the end of the contest	• That's when the stations that have been CQing will S&P for 'fresh meat'
• *Consider not* asking if the frequency is busy before CQing. You'll find out soon enough if it is. • *Do ask if you're uncomfortable not asking.* • *"?" is a fast reasonable compromise.*	• QRL? is an announcement to others that it's clear at your end • Someone else may jump in and CQ • Still low risk and courteous in the contest environment

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Best Practices

Appendix A

K2YWE 5 of 9 Best Practice	Rationale
Running - continued	
• Use the widest receiver bandwidth you can stand	• Less chance to miss off-frequency callers, especially on CW
• If another station calls CQ on your freq and fails to respond to your QRL-QSY message, carry on for a while to see if he leaves. But, don't do this for very long	• Even though he is not hearing you, if you are being heard by others he may not get many responses and might give up quickly. No one likes to waste time
• Don't engage in long frequency fights. Try 'QRL' or 'frequency in Use, QSY.' If that fails, it almost always pays to move. • Sometimes you can move up or down a bit in order to lessen the QRM and still hang on to "your" frequency	• It costs you QSO time • You may be in QRM at the other end

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Best Practices

Appendix A

K2YWE 6 of 9 Best Practice	Rationale
Running - continued	
• Don't break a run to pull one station through	• Your rate will suffer if you take long • You will drive away impatient waiting stations
• If you can't drag a station's call through after trying TWICE, ignore him and start calling CQ again • This is part of K3ZO's /Rule of TWICE./ Modify TWICE to suit your station capabilities and contest circumstances	• Running has to do with how fast you can accurately get Q's into the log. You don't want your rate to slow or waiting callers to lose interest • Equally important, on a crowded band you must transmit often to keep "your" frequency clear
• Speed up if your run is being sustained. This is especially true in contests like SS where the exchange includes your call sign.	• Waiting callers likely have your info • More stations will be inclined to wait • Your rate will go up with speed

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Best Practices

Appendix A

K2YWE 7 of 9 Best Practice	Rationale
Running - continued	
• Use only a quick "Thanks" or "TU" without your call sign or QRZ if you heard multiple callers. • Throw in your call every few Q's for new listeners. • Keep it up until there are no more responses, then build back to your "full" QRZ message and CQ. • If you get no responses after just 'Thanks', try only your call and 'TEST' before resuming a full CQ	• Most waiting stations will know your call. Don't waste time on it. • Minimizing the time stations have to wait for you will help to keep the impatient ones hanging around and will increase your QSO rate. • Less experienced contesters may not realize you are waiting for them. "TEST" will alert them you are ready for another station to call
• Send any call you have corrected as part of your goodbye message • Enable call sign correction in your software on CW	• Stations want assurance that you have them correctly. This will keep them from asking QSL? It might also save your from a mistake

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Best Practices

Appendix A

K2YWE 8 of 9 Best Practice	Rationale
Running - continued	
• When the call sign of a responder is questionable, send a complete exchange using the questionable call Correct it during his exchange. • You can use SCP to help guess incomplete calls on the first round • *Make sure* you have it right before you let him go	• Nearly all contest stations will correct you on their transmission, good Ops without missing a beat • It saves an extra exchange devoted only to getting the callsign right • You can revert to "normal" fill-in procedures if this practice fails
• Maintain an "friendly sense of urgency" in your QSOs	• Chattiness will slow your rate and lose you contacts
• Move Multipliers if you have the time (a slow run) • Pick frequencies in advance. Give up if you don't connect in a short while	• It's a quick way to gain band-Mults. • Many Ops will go with you • You probably won't make the Q if you don't connect quickly

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Best Practices

Appendix A

Best Practice	Rationale
Running - continued	
• Hit the Send key as soon as the call is in your head, and finish typing it into the log during your outgoing exchange transmission Some software can be set to do this after *n* callsign keystrokes (TR4W and N1MM, for example)	• If your fingers are like mine, they slightly lag my brain and I am still typing when the other station stops sending. • This practice reduces the lag between when the other station finishes calling and when you respond, increasing your rate
• NEVER NEVER NEVER acknowledge a 'jammer.' NEVER! • Just keep your pace, and don't change your tone of voice on phone or even synchronize your calls to his QRM	• With no response to his jamming, he can't be sure he is even bothering you, and it isn't 'fun' for him if he doesn't get a reaction

Got More?

Selected Contest Loggers

Appx B

Popular Contest Loggers Appx B

Similar capabilities with varying implementations

- **All run under Windows OS**
- **Need varying amounts of learning to fully utilize**
  - **N1MM logger plus (Free)**
    - Most popular Win logger. Continuous cooperative development
  - **Win-Test ($)**
    - Many features and options. Easy transition for CT users
  - **TR4W (Free)**
    - Very flexible. Evolution of popular TR DOS program
  - **Writelog for Windows ($)**
    - Full-featured contest program with SDR interface
  - **N3FJP ($)**
    - Good and improving, *but still lacks some contest features*

Popular Contest Loggers Appx B

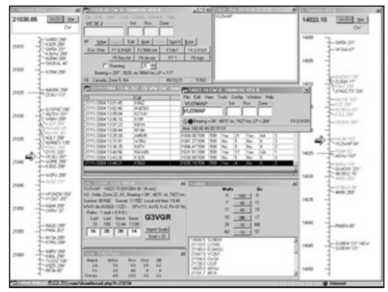
Facilitate operating, logging, and exploiting opportunities

- **Contesting-specific with advanced features**
  - Band Maps with S&P "point & shoot"
  - Rate, Scoring, and other contest visibility tools
  - Enter Sends Message (ESM) mode adaptive behavior
  - SO2R Support
  - Multi Transmitter/Operator Support
  - Spots through Telnet connection
  - Radio, CW & Voice Keying, and Rotator Interfaces
  - Sound card Voice Keyer
  - Digital modes using the sound card (with aux programs)
  - Sound card receive recording (some)
  - Support for External Voice Keyer control (some)

N1MM+ by N1MM et. al. (N1MM, N2AMG, K3CT, N2IC, NA3M, AB5K, KU7T)

Most popular (by far) Windows contest logger

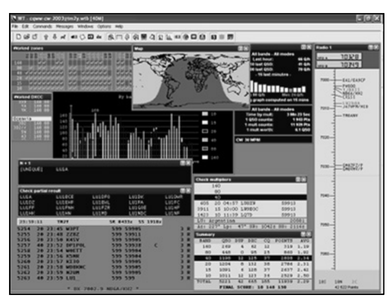
- **Cooperative project with multiple participants**
  - Rewritten in 2014 as N1MM logger plus (N1MM+) using SQlite
  - Large user community
  - 110 supported contests
- **Moderate system needs. Will utilize multi-core**
- **Extensive features and options**
  - Highly customizable
  - Configurable windows
- **Sound card voice keyer**
- **RS-232, Parallel, USB support**
- **Free**



Win-Test by F5MZN

Mature written-for-Windows high performance logger

- **Efficient with minimal processing and memory needs**
  - Strong CT (K1EA) keystroke emulation
  - Over 100 supported contests
- **Extensive features and options**
  - Highly customizable
  - Configurable windows
- **Sound card voice keyer**
  - Built-in editor
- **RS-232, Parallel, USB support**
- **~$70 (50€)**
  - Proceeds support Radio Amateur Club de Kourou contest activities, including FY5KE (French Guiana)



TR4W by UA4WLI (and UR7QM)

Win version of mature world-class adaptive contest logger

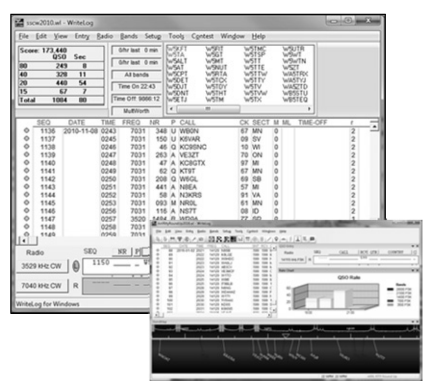
- **Small and fast 100% Windows API, 3GL* - Open Source**
  - Only 100,000 lines of code in 400KB
  - Over 155 supported contests
- **Substantially same features as DOS TRlog by N6TR**
  - Based on TRlog code provided by N6TR
  - (First with ESM and descrambler)
  - Continuously adding more features
- **Sound card voice keyer**
  - Flexible functionality
- **RS-232, LPT, USB support**
  - USB I/O includes log backup
- **Free and Open Source**

*** Also Runs under Linux/WINE**

Writelog for windows by Contesting Software, LLC

Mature written-for-Windows high performance logger

- **Recently re-Written**
  - *Latest version* ***requires Win7***
- **Configurable windows**
- **110 supported contests**
  - Also GP logging
- **Extensive sound card support**
  - Voice Keyer
  - Contest Recorder
  - SDR interface
- **RS-232, Parallel, USB support**
- **$30 incl 1 yr updates** ($18 for previous version ***Win XP OK***)



N3FJP by N3FJP

Basic contest log functionality

- **Recently re-written in C#.NET (was VB6)**
  - Improved, but lacks features and flexibility of top loggers
- **Single resizable Main Window + floating Bandmap**
- **65+ supported contests (31+34 State QPs and more)**
- **Sound card voice**
- **RS-232 and USB support**
- **No SO2R support**
- **$49 all programs** (includes daily log) or ala carte
  - $25 Daily Contact Log
  - $ 9 each contest separately

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Logs most used in CQWW 2015

N1MM/N1MM+ is overwhelmingly the most popular

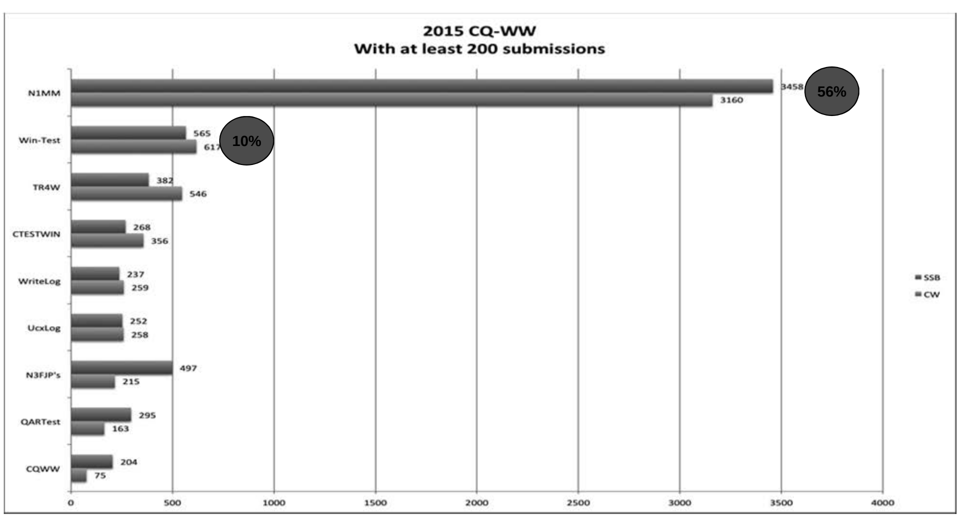

Chart generated by NY4I from CQWW Cabrillo logs

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Internet Links

Here are a few of the many available resources

- **Contest Organizations, Calendars, Info, & Sponsors**
  - WA7BNM Calendar — hornucopia.com/contestcal
  - SM3CER Calendar — sk3bg.se/contest
  - Contesting.com — contesting.com
  - National Contest Journal (NAQP …) — ncjweb.com
  - ARRL (Sweepstakes, Field Day, DX …) — arrl.org
  - CQ Magazine (CQWW, WPX …) — cq-amateur-radio.com
- **Popular Contest Logging Programs** *Treated in Appendix B*
  - N1MM — n1mm.hamdocs.com
  - Win-Test — win-test.com
  - Writelog for Windows — writelog.com
  - TR4W — tr4w.net

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Odds 'n ends

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The Advantages of Waterfall Displays for Contesting and DXing

Presented by N6TV
n6tv@arrl.net

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Presentation Overview

- Legacy "Panadapters"
- Waterfall scope in CW Skimmer
- Latest radios with waterfall displays
- Waterfall display advantages & disadvantages
- How to use waterfall displays while contesting or DXing
- Q & A

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Legacy Panadapters

- Kenwood SM-230 Station Monitor (25, 100, or 250 KHz):

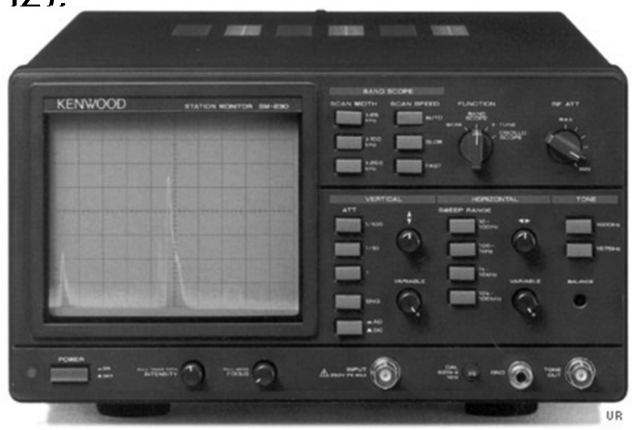

Photo courtesy http://www.universal-radio.com/

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Legacy Panadapters

- “Band Scopes” in Icom IC-781, IC-756ProIII, IC-7600, IC-7800, IC-7700 (before new firmware)

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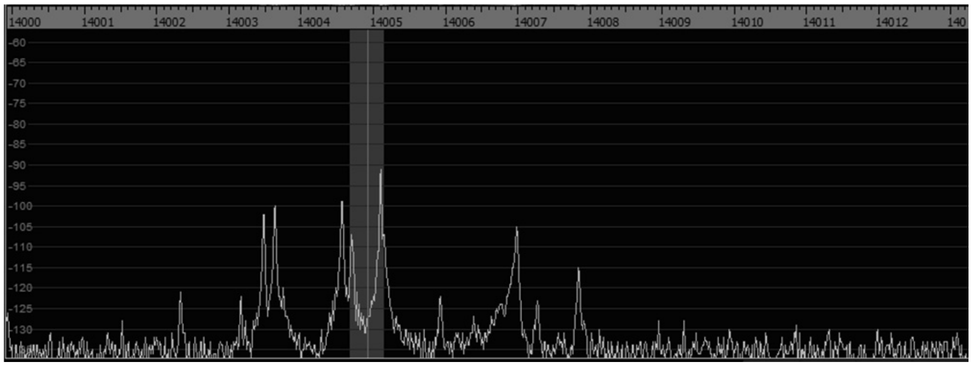
Spectrum Displays Hide Weak Signals



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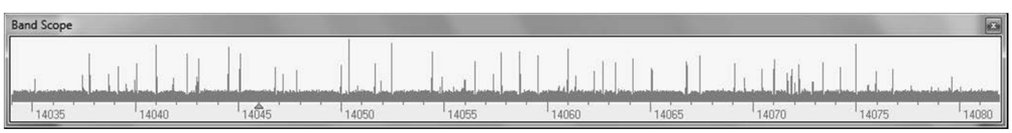
CW Skimmer's Band Scope

- From the CW Skimmer menu, select
  View → Band Scope



- Much better resolution, but display is very jumpy
- No "peak signal" memory
- Not useful on SSB

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Legacy Panadapter Limitations

- Big signals dominate the display
- Weak signals very difficult to spot
- Signal peaks disappear, no history
- Difficult to find “clear spots” on a crowded band
- Limited zoom in or out
- Display jumpy, distracting
  - Signal averaging helps, but it also hides things

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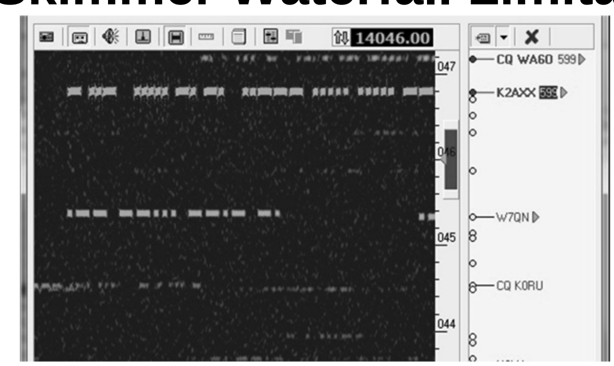
ICOM 7

CW Skimmer Waterfall Limitations



- You only see 10 - 15 kHz of the band at most
- Scale is fixed, cannot “zoom” in or out, or tune smoothly
- Narrow 500 Hz CW filter – *not* usable on phone

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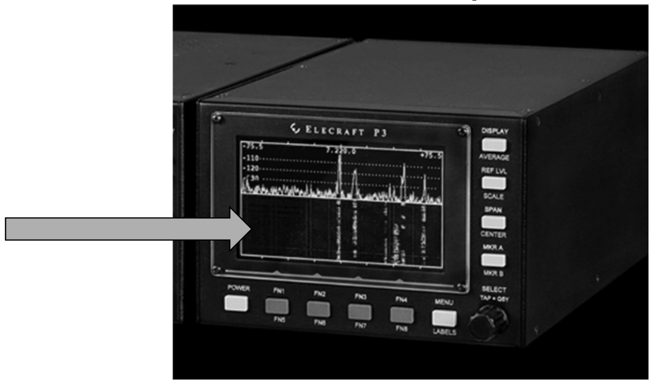
ICOM 8

Better Waterfall Displays

- The Elecraft P3 Panadapter



- Major improvement over legacy designs

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Photo courtesy http://www.elecraft.com

ICOM 9

Elecraft P3 + P3SVGA Option

- P3 resolution only 480 x 272 pixels
- P3SVGA: internal SVGA Large Screen Adapter
  - 1024 x 768
  - 1280 x 1024
  - 1440 x 900
  - 1920 x 1080
- Displays far more signals

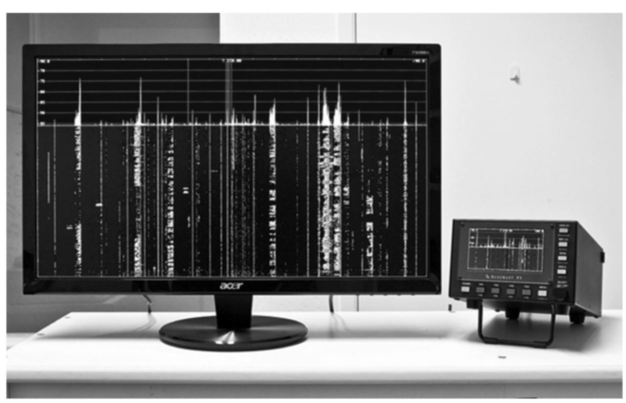

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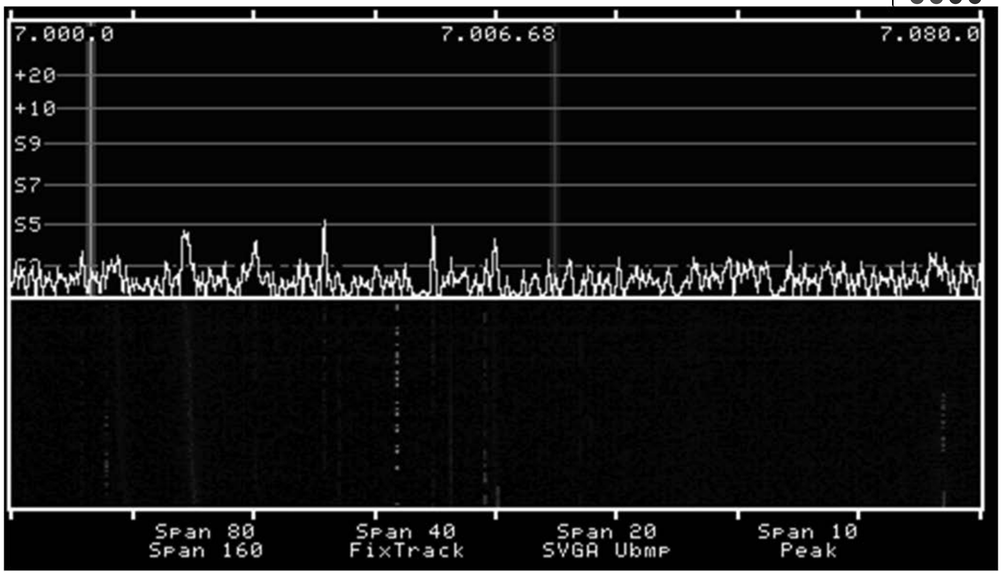
Photo courtesy http://www.elecraft.com

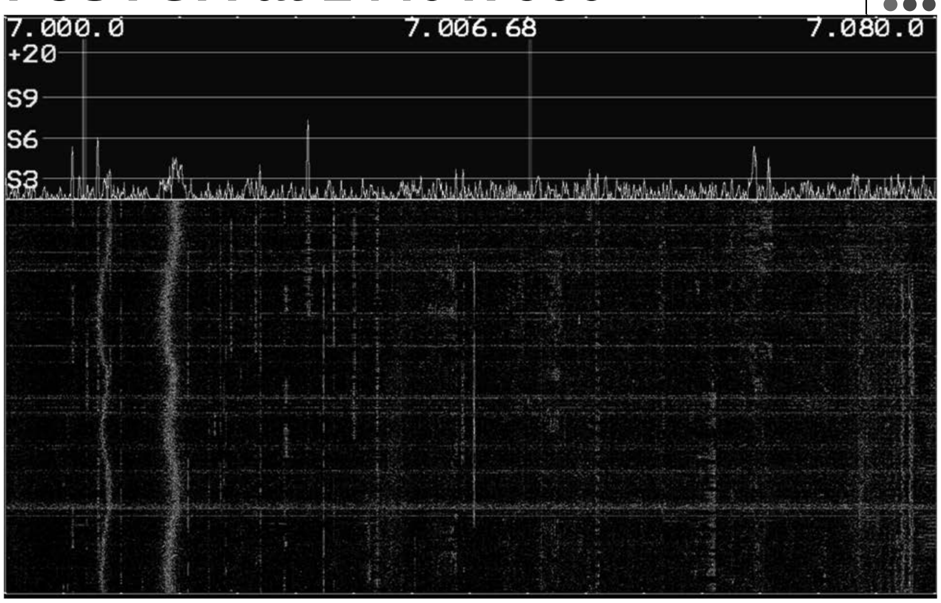
ICOM 10

P3 Built-in Display at 480 x 272



11

P3SVGA at 1440 x 900



12

Old Icom IC-7800 firmware

(no waterfall)

Photo courtesy http://www.icomamerica.com

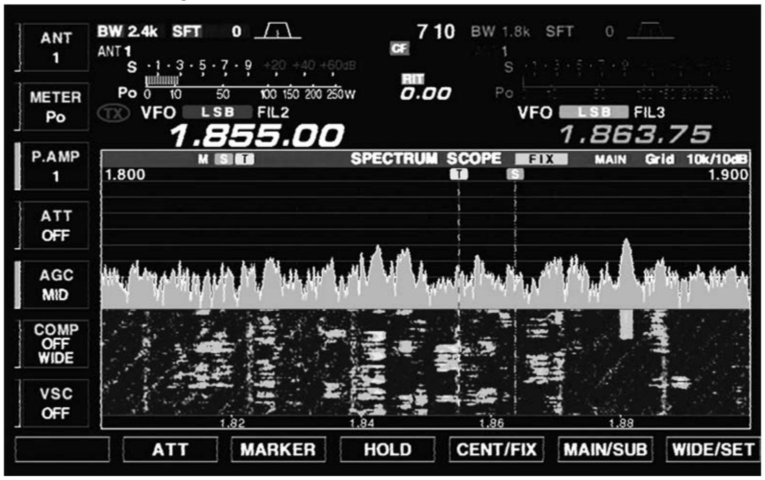
Icom IC-7800 with V3.0 firmware

Photo courtesy http://www.icomamerica.com

IC-7800 V3.0 Screen Shot

IC-7600, IC-7700 V2.0 Also Supports Waterfall

- 800 x 480 (with or without external monitor)



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15

IC-7850 / 7851 – *Huge* Improvement

- Fast, 800 x 600, MAIN only, or MAIN + SUB
- “Click to tune” with USB mouse

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16

New IC-7300 has fast waterfall too!

- With touch screen

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Photo courtesy http://www.icomamerica.com

New IC-7610 with dual band waterfall

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Kenwood TS-990S

Photo courtesy http://www.kenwoodusa.com

 19

FlexRadio FLEX-5000™, FLEX-6700™

Photos courtesy http://www.flexradio.com

 20

FlexRadio Systems® SmartSDR

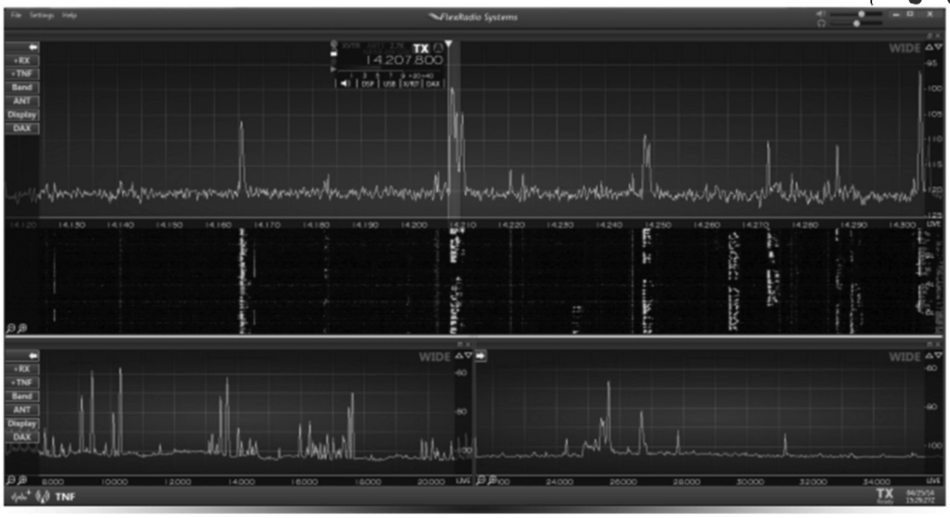

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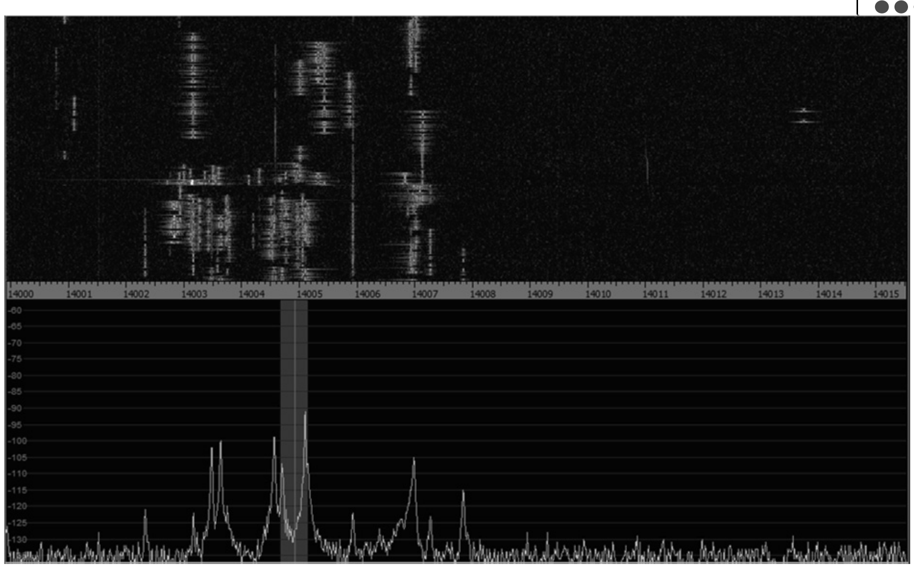
Image courtesy K3UK

ICOM 21

Winrad Software



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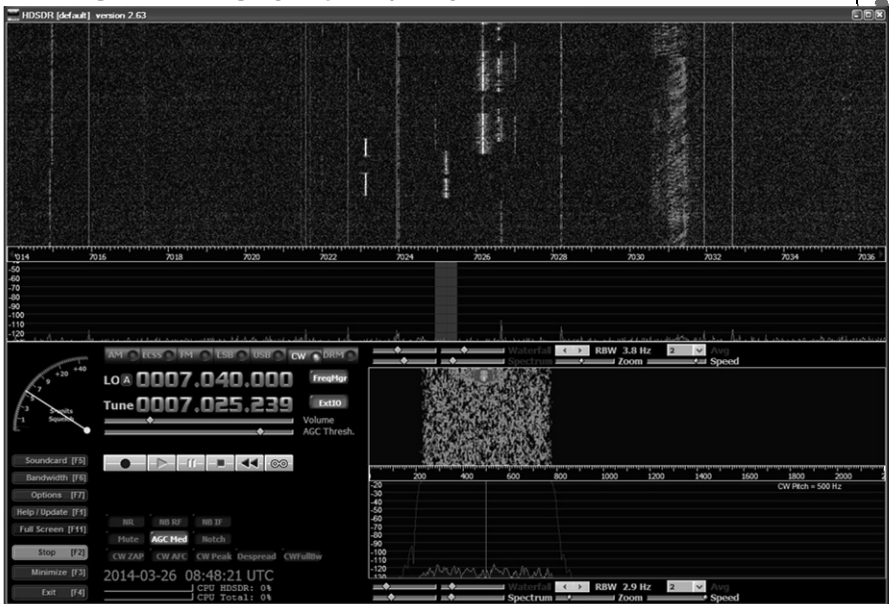
ICOM 22

HDSDR Software



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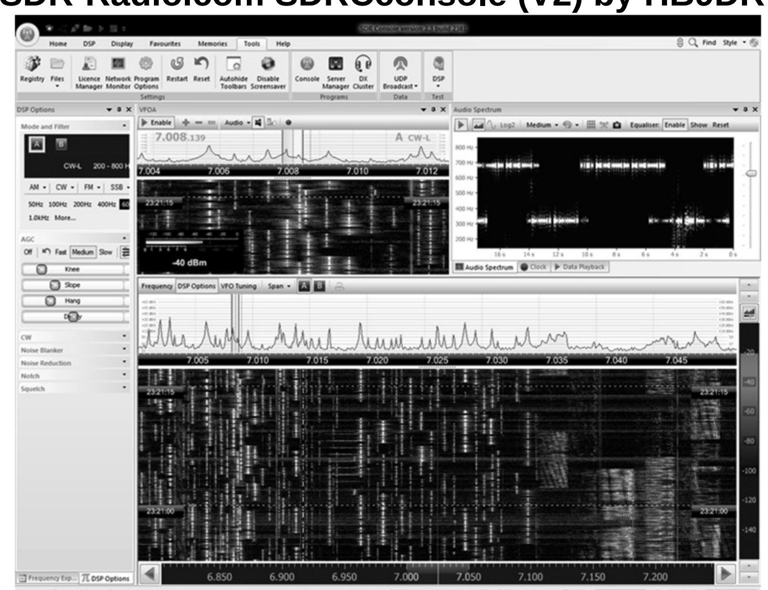
ICOM 23

SDR-Radio.com SDRCconsole (V2) by HB9DRV



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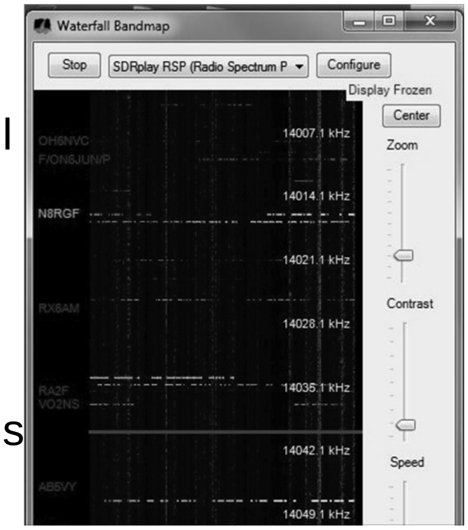
ICOM 24

Waterfall Bandmap by N2IC (new for N1MM+)

- Combines cluster spots from Internet or Skimmer with waterfall from local SDR
- Zoom Feature
- Click to tune feature
- Potential to support other logging programs



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ICOM 25

LP-Pan and NaP3

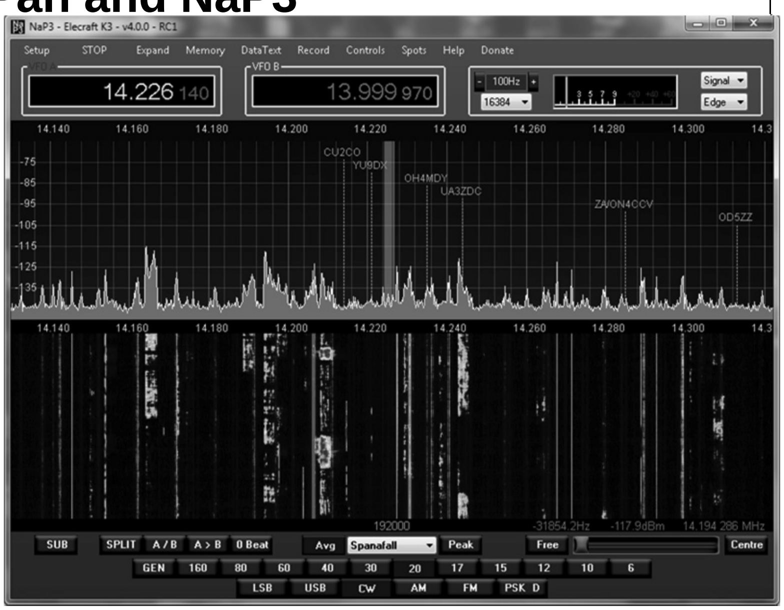

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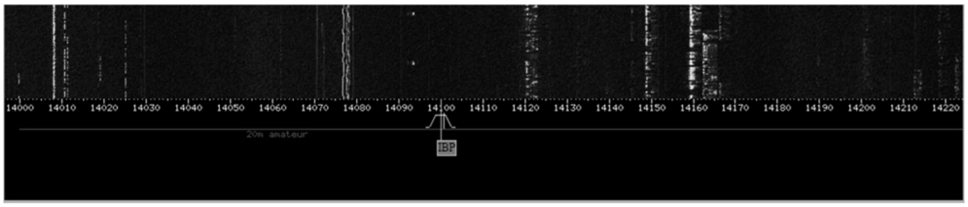
Photo courtesy http://www.telepostinc.com

ICOM 26

WebSDR: Waterfalls on the Web

- http://websdr.ewi.utwente.nl:8901/

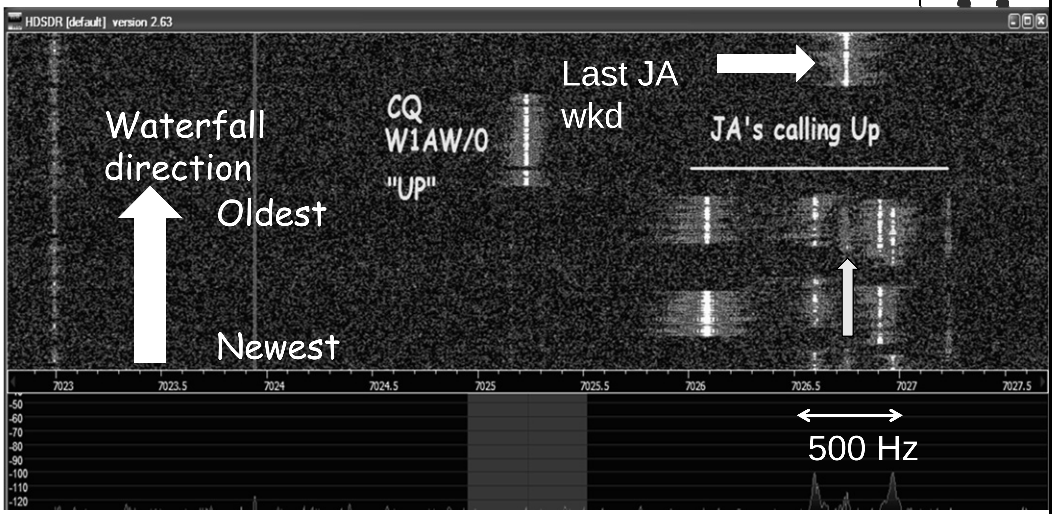


View / Zoom entire HF spectrum

Waterfall Display Advantages

- “Click to Tune” – direct access using a mouse or tap
  - IC-7300, IC-7610, IC-7800 V3.0, IC-7851, Flex/SmartSDR, HDSDR, SDRConsole (but *not* Elecraft P3)
- Weak signals easy to spot (faint traces)
- Many zoom levels: 5, 10, 30, 60, …, 800 KHz+
  - Watch the whole band at once, or a small slice
- Find clear frequencies *fast*
- Find who the DX just worked, *fast*
- Spot the gaps in a crowded CW pileup

Listening "Up"? Not a problem



Who will W1AW/0 answer next?

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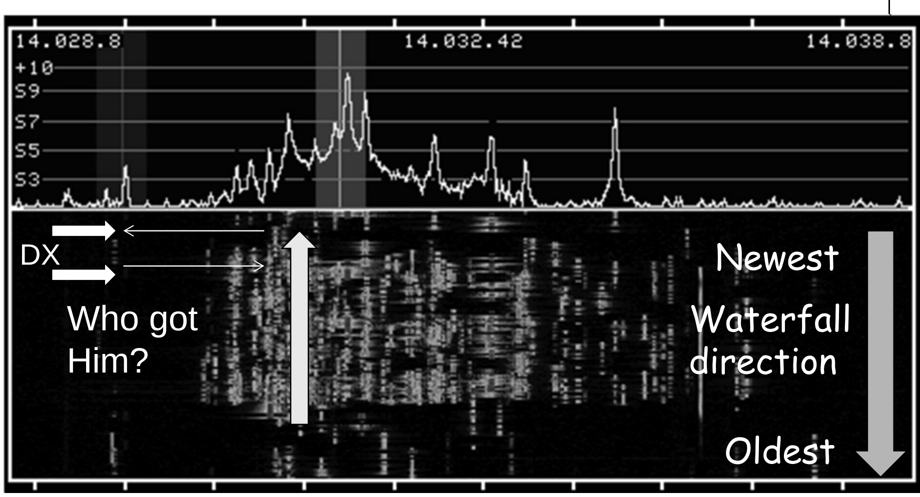
ICOM 29

E30FB CW Pileup on P3 display



Where will he listen next?

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ICOM 30

Advantage: Waterfall

- Find "good spots to call" in a CW pileup
- Find clear spots to call CQ
- QRM? You can *see* where to move your VFO to minimize it
- During S&P, find the "next" signal *fast* (no more slow and careful tuning)
- Position VFO B or 2nd receiver without having to *listen* to it
  - S&P while CQing, "SO2V" (single-op, two VFOs)
- Monitor overall band activity
- Keep an eye on the local competition

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Waterfall Display *Disadvantages*

- Radios don't automatically tune from signal-to-signal like CW Skimmer (yet)
- Clicking on a signal with the mouse not as precise as tuning with VFO, must still fine tune
- Contest software loses focus when you click on waterfall
- Some find it visually distracting
- Cumbersome to adjust scope width and band edges
- **But, if you're *not* using a waterfall display in a contest, you're really operating "blind"**
- A waterfall display is really the "killer app"

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Recommendations While Contesting

- Always enable the waterfall
- Use **Fixed** Mode (never “Center” mode)
  - You want the VFO cursor to move, not the scope
- Use narrow 5 - 20 kHz span for CQ, running
- Use wider 40 -100 kHz span for S&P, tuning
- Logging software can and should automate this:
  - In Win-Test, type **SPAN20** [Enter] to set a 20 kHz scope span, limited to band edges
  - See http://bit.ly/wtscripts - Win-Test Scripts P3scripts.zip, IcomScripts.zip, includes source code

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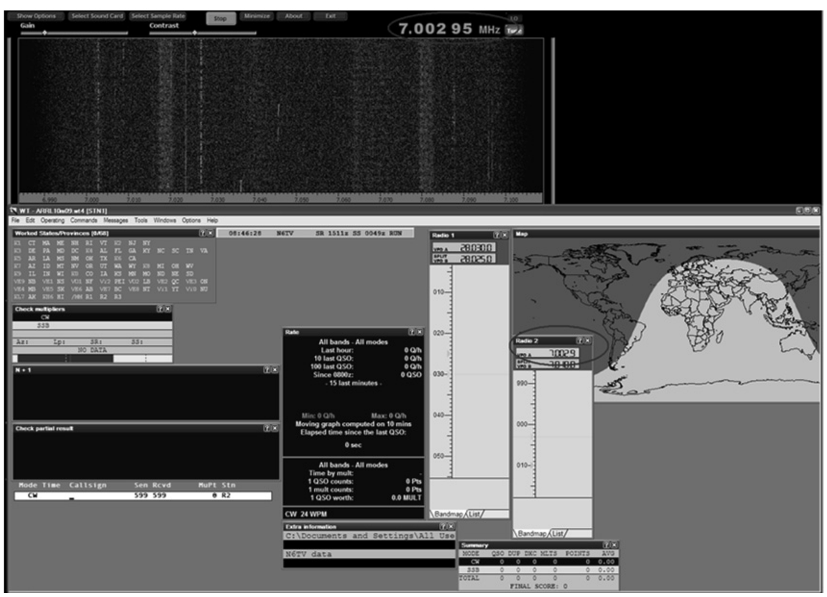
ICOM 33

Winrad on Top, Win-Test on Bottom



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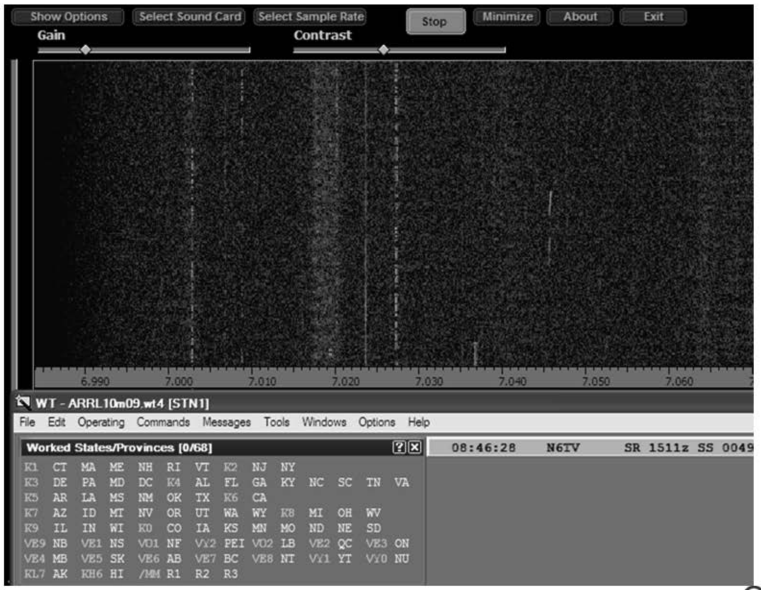
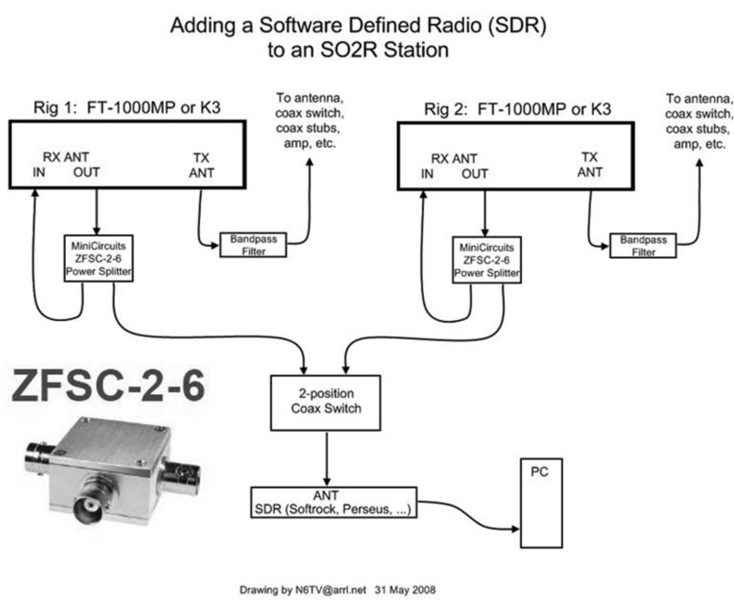
ICOM 34

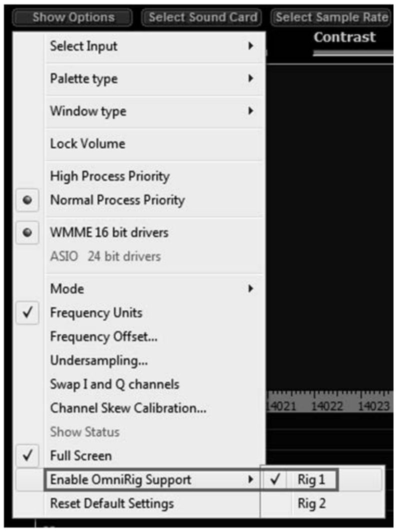
Winrad & Win-Test (zoomed)



Click-To-Tune with a "Legacy" Transceiver + SDR



Use Omnirig support in Winrad or HDSDR to sync freq. with any transceiver



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Try Winrad Waterfall Demo

- Perseus SDR used to make a wideband recording (122 KHz for 10 minutes = 300 MB)
- Demo will play back that recording and others
- To try the demo yourself, follow instructions at
  - http://www.kkn.net/~n6tv

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ICOM 38

Click-To-Tune, IF OUT to LP-PAN 2, NaP3, LP-Bridge

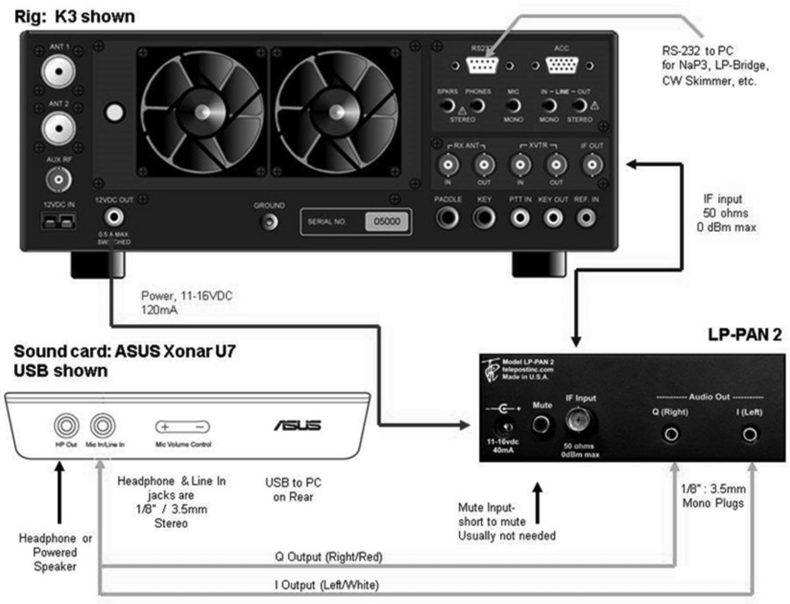

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Photo courtesy http://www.telepostinc.com

ICOM 39

Questions?

- http://www.winrad.org - Winrad software
- http://http://www.hdsdr.de/ - HDSDR software
- http://sdr-radio.com/Software - SDRConsole
- http://www.kkn.net/~n6tv - Winrad demo file
- http://www.telepostinc.com/LP-PAN.html
- http://www.qrz.com/db/n6tv - Links to this and other presentations

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ICOM 40

CTU 2017 Presents

Advanced Topics in RTTY Contesting

Ed Muns, W0YK

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ICOM

Advanced RTTY Contesting

- 1st CTU session: *"RTTY Contesting, A to Z"*
- Radio Configuration
- Messages
- Keyboard Optimization
- Super Check Partial & Pre-Fill
- Callsign Stacking
- Multiple Decoders
- SO2V, SO2R-SOnR
- Logging Software
- Ergonomics

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2/86

ICOM

Receiver Configuration

AGC

- Turn off AGC
  - or, at least minimize, e.g., AGC=Slow
  - AGC increases error rate in modern software decoders
- Use minimum discernible headphone volume
  - Ear protection from loud signals

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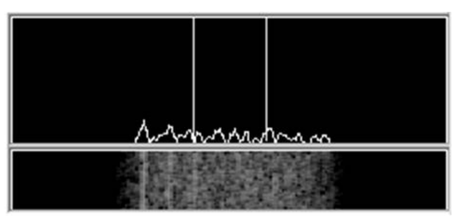
3/86

ICOM

Receiver Configuration

decoder level

- Decoder audio level
  - Band noise 5% of full-scale
  - Maximize dynamic range
- Note 500 Hz IF filtering



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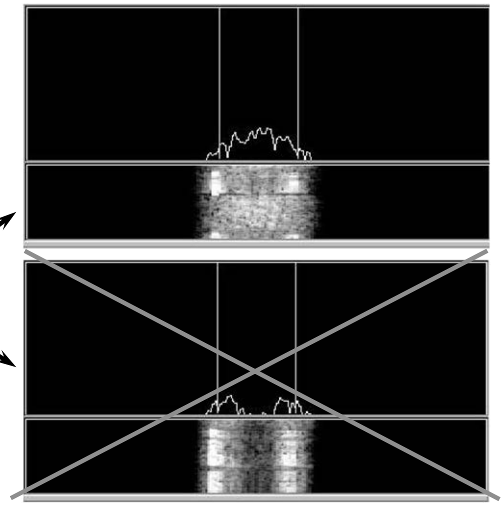
4/86

ICOM

Receiver Configuration

narrow *IF filtering*

- PC Audio isolation
  - Transformer
  - Commercial interface
  - Some radios (K3)
- Narrow IF filters (Roofing & DSP)
  - 500 Hz - normal
  - 250 Hz - extreme QRM only
  - Tone filters – don't use!
    - Icom Twin Peak Filter
    - K3s Dual-Tone Filter
- Audio filtering
  - JPS NIR-10/12
  - Timewave DSP-599zx
  - Modern DSP rigs



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5/86

ICOM

Radio Configuration

soundcard levels

- Adjust levels in Windows Volume Control *(or, in MMTTY **Options/Soundcard** …)*
  - Use isolation transformer, if needed
  - Mute other inputs and outputs
- RX audio goes to LINE IN (or, MIC w/pad)
  - ***Options/Soundcard input level***
- TX AFSK audio (mic) comes from LINE OUT
  - ***Options/Soundcard output level***
  - Turn off radio compression (speech proc.)
  - Avoid over-drive

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6/86

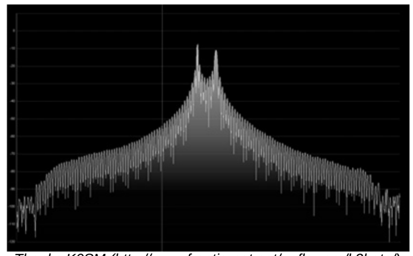
ICOM

Transmitter Configuration

FSK bandwidth

Old K3 FSK bandwidth

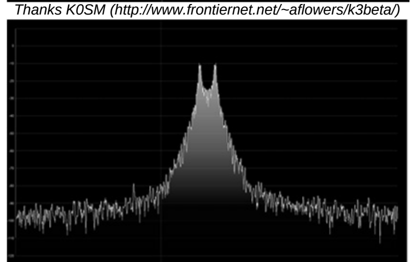
- No waveshaping
- < DSP281 firmware
- Typical of all radios
- 50 watts



Thanks K0SM (http://www.frontiernet.net/~aflowers/k3beta/)

New K3 FSK bandwidth

- Optimal DSP filter
- DSP281+ firmware, March 2013
- Lobby other mfrs

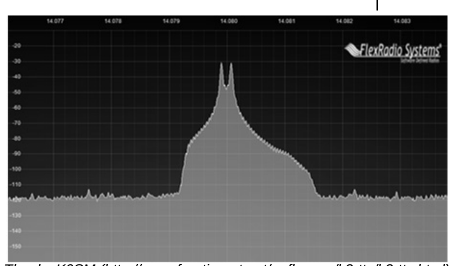


Transmitter Configuration

AFSK bandwidth

MMTTY - AFSK

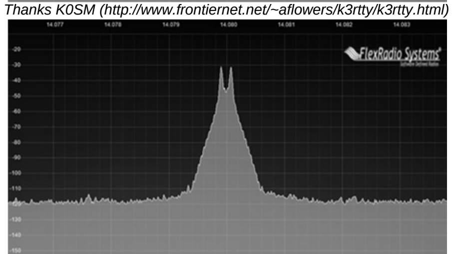
- No filtering
- K3 @ 1 mW



Thanks K0SM (http://www.frontiernet.net/~aflowers/k3rtty/k3rtty.html)

MMTTY - AFSK

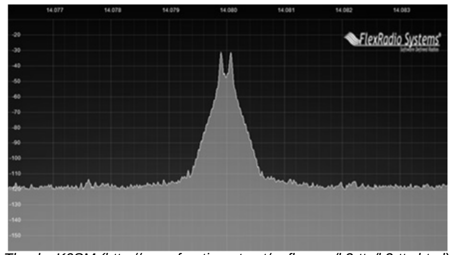
- Default 48-tap TX BPF
- K3 @ 1 mW



Transmitter Configuration

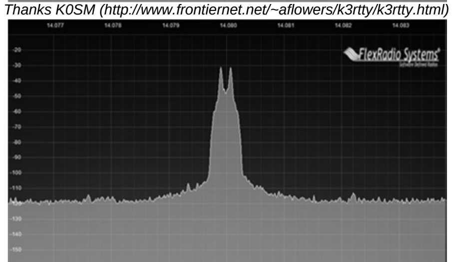
AFSK bandwidth

MMTTY - AFSK
- Default 48-tap TX BPF
- K3 @ 1 mW



Thanks K0SM (http://www.frontiernet.net/~aflowers/k3rtty/k3rtty.html)

MMTTY - AFSK
- 512-tap TX BPF
- K3 @ 1 mW



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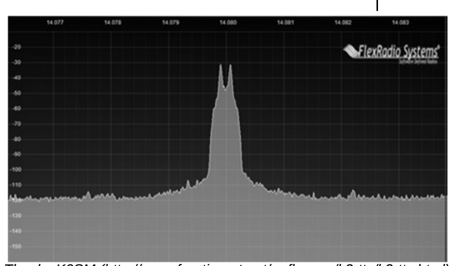
ICOM

Transmitter Configuration

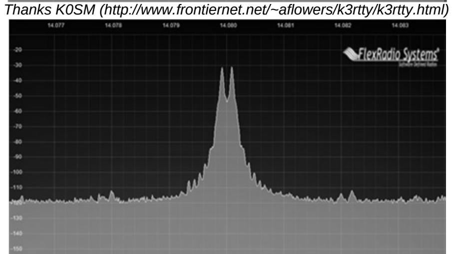
AFSK bandwidth

MMTTY - AFSK
- 512-tap TX BPF
- K3 @ 1 mW



Thanks K0SM (http://www.frontiernet.net/~aflowers/k3rtty/k3rtty.html)

2Tone - AFSK
- Default “AM” setting
- K3 @ 1 mW



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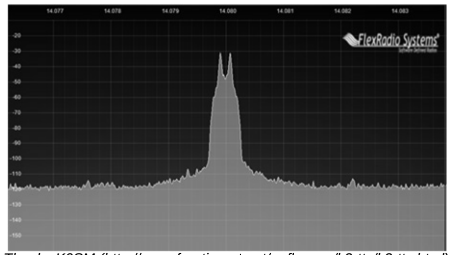
ICOM

Transmitter Configuration

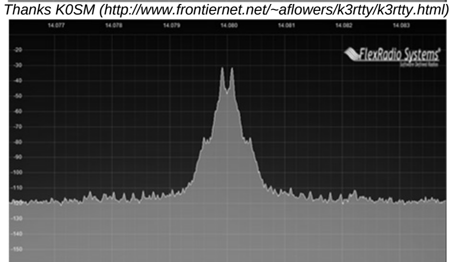
PA IMD impact on AFSK bandwidth

MMTTY - AFSK
- 512-tap TX BPF
- K3 @ 1 mW



Thanks K0SM (http://www.frontiernet.net/~aflowers/k3rtty/k3rtty.html)

MMTTY - AFSK
- 512-tap TX BPF
- K3 @ 100 watts



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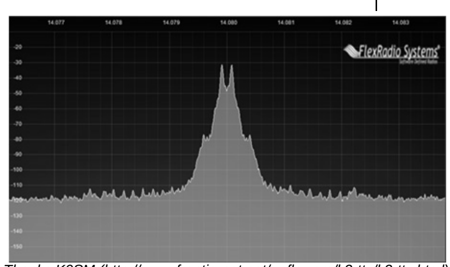
11/86

ICOM

Transmitter Configuration

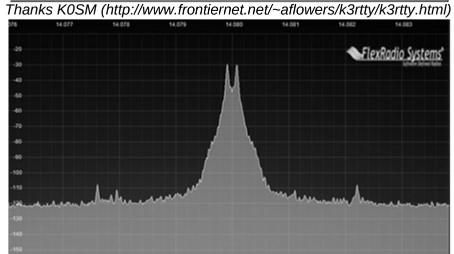
PA IMD impact on AFSK bandwidth

MMTTY - AFSK
- 512-tap TX BPF
- K3 @ 100 watts



Thanks K0SM (http://www.frontiernet.net/~aflowers/k3rtty/k3rtty.html)

MMTTY - AFSK
- No MMTTY filter
- K3 AFSK filter
- K3 @ 100 watts



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12/86

ICOM

Transmitter Configuration

FSK & AFSK bandwidth

FSK

- Use radio FSK filter
  - DSP TX filter (K3)
  - Crystal TX filter (K3)
  - Lobby other mfrs
- Otherwise, use AFSK
  - With TX filtering
  - Properly adjusted

AFSK

- Use radio AFSK filter
  - DSP TX filter (K3)
  - Crystal TX filter (K3)
  - Lobby other mfrs
- Use MODEM TX filter
  - MMTTY 512-tap
  - 2Tone default

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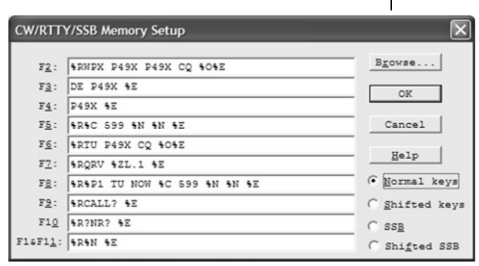
13/86

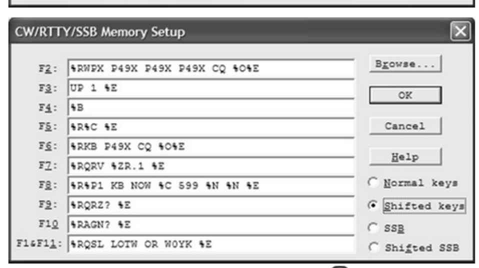
ICOM

Messages

- Short, as with CW/SSB
- No extraneous info
- 599 (not 5NN) once
- Serial number twice
- Space (not hyphen)
- Omit 'DE'
- RTTY chars (%R, %E)

www.rttycontesting.com/tutorials/messages





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14/86

ICOM

Messages

optimize

- Modular
  - Chaining
- Group logically
- Supports a cadence

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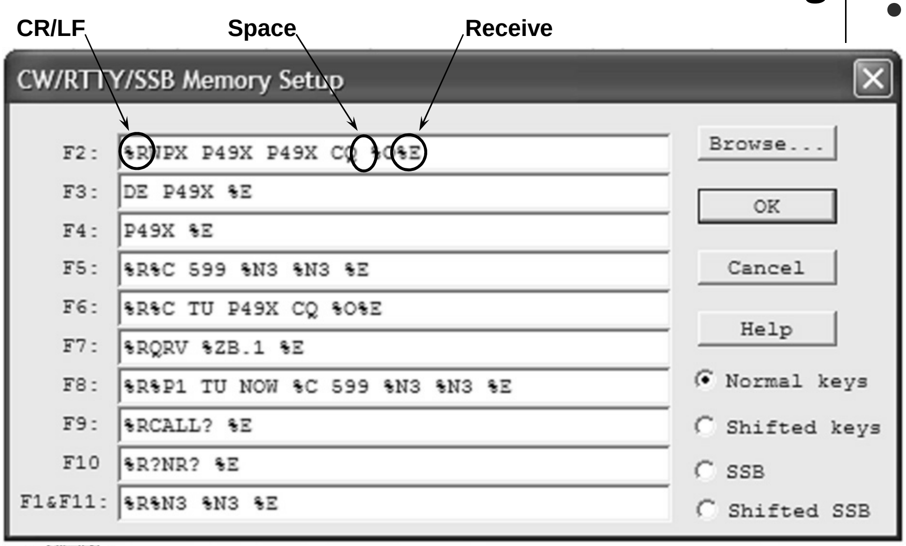
15/86

ICOM

Messages

formatting



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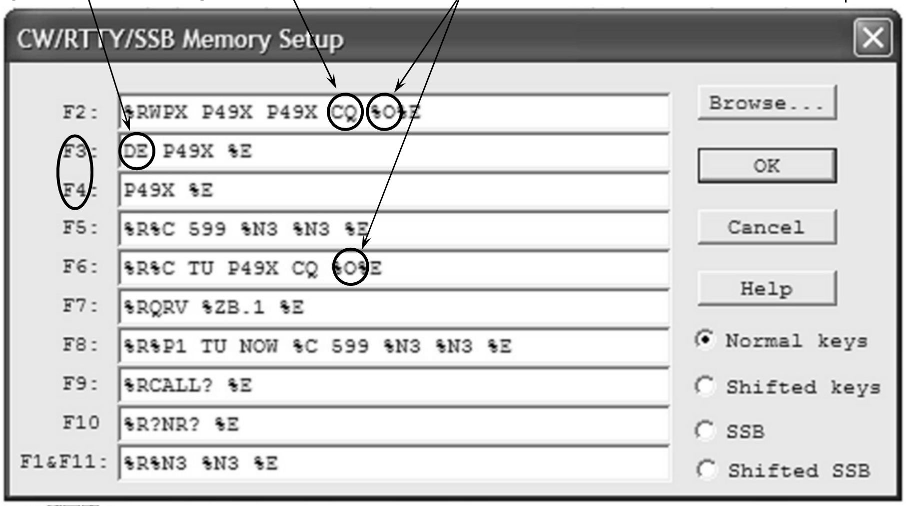
16/86

ICOM

Messages

efficiency

rarely used RTTY practice RIT clear



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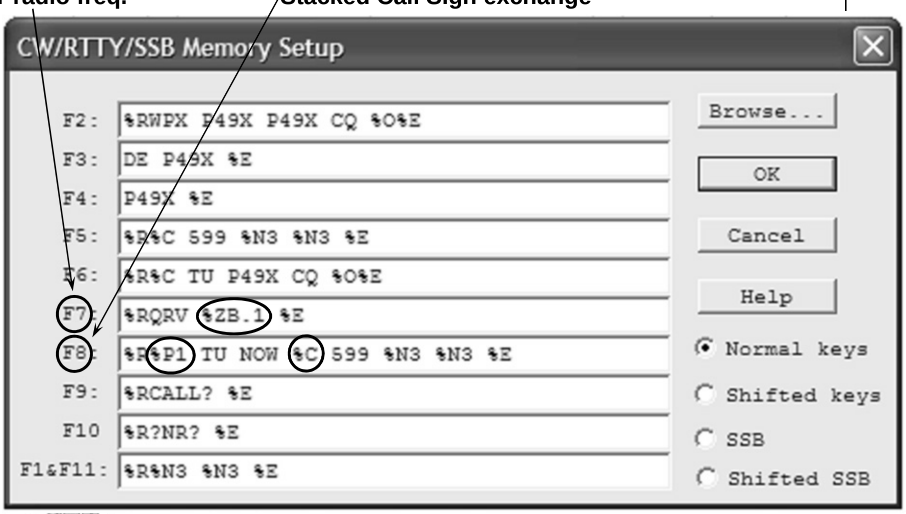
17/86

Messages

special

other radio freq. Stacked Call Sign exchange



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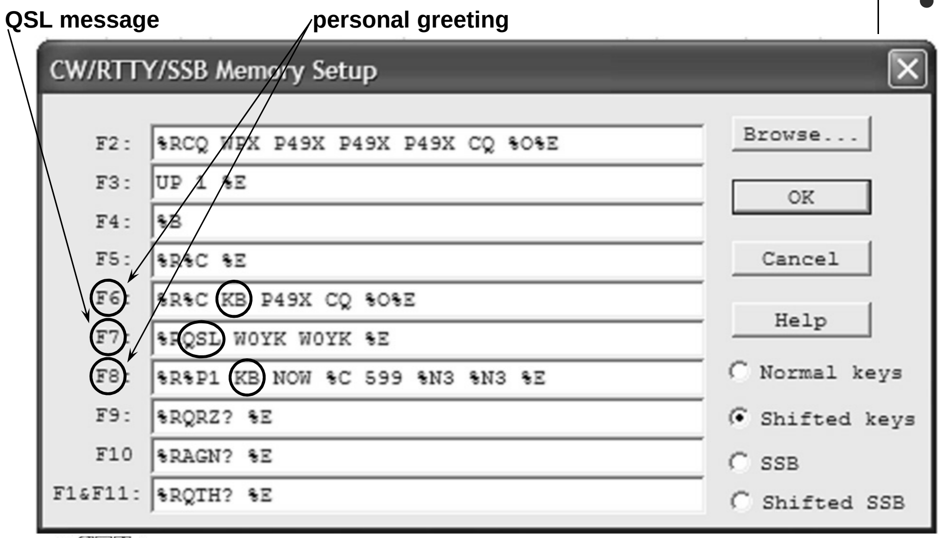
18/86

Messages

personal



CTU CONTEST UNIVERSITY 19/86 ICOM

Messages

CQ WW RTTY

- WW W1UE W1UE CQ
- <his call> 599 05
  (TU) 599 05
- TU W1UE CQ

- W1UE
- ZN
- AGN
- ?

CTU CONTEST UNIVERSITY 20/86 ICOM

Messages

CQ WPX RTTY

- WPX AK1W AK1W CQ
- <his call> 599 1867 1867
  (TU) 599 1867 1867
- TU AK1W CQ

- AK1W
- NR
- AGN
- ?

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21/86

ICOM

Messages

NA RTTY Sprint

- NA N0NI N0NI CQ
- <his call> N0NI 154 154 TONI TONI IA IA
  <his call> 154 154 TONI TONI IA IA N0NI
- TU

- N0NI
- NR
- NAME
- QTH
- AGN
- ?

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22/86

ICOM

Messages: Space Delimiter

*UnShift On Space**

UOS or USOS

TX RX	599 123 123	599 CA CA
UOS on	f599 f123 f123	f599 CA CA
UOS on	f599 f123 f123	f599 CA CA
UOS on	f599 f123 f123	f599 CA CA
UOS off	f599 f123 f123	f599 :- :-
UOS off	f599 123 123	f599 1CA CA
UOS on	f599 QWE QWE	f599 1CA CA
UOS off	f599 123 123	f599 1CA CA
UOS off	f599 123 123	f599 1CA CA

f: FIGS character
l: LTRS character

Garbled copy

- Protocol that provides some noise immunity for shift characters by:
  - forcing the Letters set after a received Space
  - sending a FIGS character after a Space when the next character is in the Figures set
- MMTTY:
  - RX UOS and TX UOS can be independently enabled or disabled

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Messages: Space Delimiter

UOS and a noise hit

	TX RX	599 123 123	599 123 123	599 CA CA	599 CA CA
best case	UOS on	f599 f123 f123	f599 f123 f123	f599 CA CA	f599 CA CA
	UOS on	xTOO f123 f123	f599 xQWE f123	xTOO CA CA	f599x:- CA
	UOS on	f599 f123 f123	f599 f123 f123	f599 CA CA	f599 CA CA
	UOS off	xTOO f123 f123	f599 xQWE f123	xTOO CA CA	f599x:- :-
	UOS off	f599 123 123	f599 123 123	f599 1CA CA	f599 1CA CA
	UOS on	xTOO QWE QWE	f599xQWE QWE	xTOO 1CA CA	f599 x:- CA
worst case	UOS off	f599 123 123	f599 123 123	f599 1CA CA	f599 1CA CA
	UOS off	xTOO QWE QWE	f599xQWE QWE	xTOO 1CA CA	f599 x:- :-

f: FIGS character
l: LTRS character

Garbled copy

Turning on UOS for both RX and TX is the best hedge:

- Most other stations will be that way
  - MMTTY default; 78% of survey respondents use MMTTY
- With only one noise hit, at least one of the important exchange elements is received properly

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Messages: Hyphen Delimiter?

UOS is defeated: so all four cases have identical noise results

TX RX	599-123-123	599-123-123	599-CA-CA	599-CA-CA
UOS on	f599-123-123	f599-123-123	f599-1CAf-1CA	f599-1CAf-1CA
UOS on	xTOOAQWEAQWE	f599x123-123	xTOOA1CAf-1CA	f599-x:-f-1CA
UOS on	f599-123-123	f599-123-123	f599-1CAf-1CA	f599-1CAf-1CA
UOS off	xTOOAQWEAQWE	f599x123-123	xTOOA1CAf-1CA	f599-x:-f-1CA
UOS off	f599-123-123	f599-123-123	f599-1CAf-1CA	f599-1CAf-1CA
UOS on	xTOOAQWEAQWE	f599x123-123	xTOOA1CAf-1CA	f599-x:-f-1CA
UOS off	f599-123-123	f599-123-123	f599-1CAf-1CA	f599-1CAf-1CA
UOS off	xTOOAQWEAQWE	f599x123-123	xTOOA1CAf-1CA	f599-x:-f-1CA

f: FIGS character
l: LTRS character

Garbled copy

- Sending Hyphen instead Space "defeats" UOS and speeds up the message slightly by eliminating the FIGS character
  - However, if the first FIGS character is hit by noise, then the entire exchange is garbled
- Space with USO enabled is a slightly better hedge
  - Majority of stations use MMTTY with UOS enabled so at least one of the important exchange elements is received

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Messages: "Double Shift"

LTRS/FIGS noise immunity

- MMTTY Double Shift may be enabled to send two LTRS or FIGS characters instead of one
- Eliminates single noise hits on LTRS and FIGS characters
- Moderate speed penalty for all transmissions

Probably not a good trade-off

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Keyboard Optimization

- Accelerator keys
  - Insert: grab call sign & send exchange
  - +: log QSO & send TU/CQ message
- ESM (Enter Sends Message)
  - Enter sends CQ, exchange or TU/CQ message
- Key remapping
  - Most-used messages
  - Group around Enter key

Keyboard Optimization

key re-mapping

Full-size QWERTY keyboard; no number pad; integrated cursor keys

Super Check Partial

- SCP (Super Check Partial) enables computer to pick out call signs in receive window
  - Call signs
  - New mults and double mults
  - Dupes
- Use main SCP from CW/SSB/RTTY contests
  - RTTY SCP is a subset

XYZAB	AA5AU	XYZAB
XYZAB	9Y1VC	9N8TT
XYZAB	W5UKM	XYZAB

N1MM Logger

Super Check Partial
logger differences

XYZAB	AA5AU	XYZAB
XYZAB	9Y1VC	9N8TT
XYZAB	W5UKM	XYZAB

- ***Background option***
- ***Custom colors***

N1MM Logger

XYZAB	AA5AU	XYZAB
XYZAB	9Y1VC	9N8TT
XYZAB	W5UKM	XYZAB

WriteLog

XYZAB	AA5AU	XYZAB
XYZAB	9Y1VC	9N8TT
XYZAB	W5UKM	XYZAB

Win-Test

Pre-Fill

"Danger, Will Robinson!"

- Pre-fill is a ***typing aid*** using prior log data
- Each logger is unique:
  - N1MM: Call History Lookup File (text file)
    - User-created with Excel from prior logs
  - WriteLog: Pre-fill File (ADIF file)
    - User-created with text editor from prior ADIF logs
  - Win-Test: Database File
    - Provided for specific contests by the Win-Test team
- **Log what is communicated to you!**

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Callsign Stacking

"Slow Down to Win"

- Sailboat racing analogy:
  - Pinwheel effect at mark-rounding
- Let pile-up continue 1-3 seconds after getting first call sign
  - Increase chance for another call sign or two
  - Increase chance for QSO-phase-skip
- Apply same tactic for tail-enders … pause before sending TU/CQ message

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The 4 Phases of a QSO

- Normal Run mode flow:
  1. Enter or F1 (CQ)
     - repeat
     - AGN?
  2. pile-up
  3. Insert or ‘ (grab call sign, send exchange)
     - Send fill(s)
  4. receive exchange
  - ➢ check pre-fill, click their exchange
     - AGN? or NR? or QTH? or NAME?
  1. Enter or + (log contact, send TU/CQ)
     - optionally send F7 (QRV message)

- Normal S&P mode flow:
  1. CQ
  2. Enter or F4 (mycall)
     - repeat
  3. receive exchange
  - ➢ check pre-fill, click their exchange
     - AGN? or NR? or QTH? or NAME?
  4. Enter or F5 (send exchange)
     - send fill(s)
  1. find next CQ

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Callsign Stacking

skip 2 phases

Normal	***Shortened***
1. WPX P49X P49X CQ, or TU P49X CQ	1. (skip CQ)
2. K3LR K3LR K5ZD K5ZD	2. (skip pile-up)
3. K3LR 599 2419 2419	*3. K3LR TU NW K5ZD 599 2420 2420*
4. TU 599 842 842	*4. TU 599 1134 1134*

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Callsign Stacking

tail-ender

Normal	***Shortened***
1. WPX P49X P49X CQ, or TU P49X CQ	1. (skip CQ)
2. K3LR K3LR	2. (skip pile-up)
3. K3LR 599 2419 2419 K5ZD	*3. K3LR TU NW K5ZD 599 2420 2420*
4. TU 599 842 842	*4. TU 599 1134 1134*

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Callsign Stacking

- Efficiently work:
  - multiple callers in a pile-up, and
  - tail-enders to a completing QSO
- Calls pushed onto the stack as they arrive
- Message parameter pops call off of the stack into the Entry window
- Eliminates 2 of 4 QSO phases, which doubles rate

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Multiple Decoders

choice of Tones

- Low tones are less fatiguing
- Low/High tones can be mixed to put two audio streams in one ear:
  - SO2R plus SO2V per radio
  - SOnR

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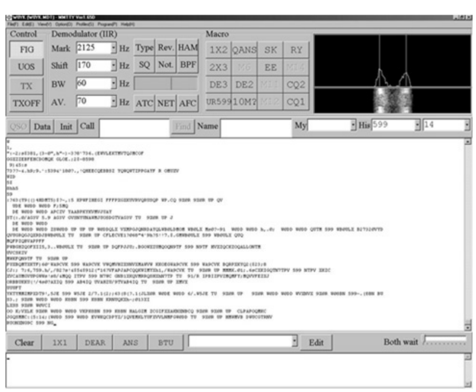
ICOM

Multiple Decoders

MMTTY



- Dominant SC MODEM
- Standalone, or …
- Contest loggers:
  - N1MM Logger+
  - WriteLog
  - Win-Test
- Introduced June 2000
- Mako Mori, JE3HHT

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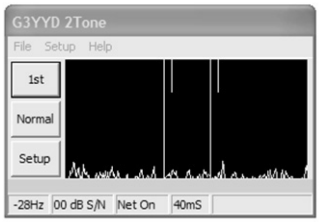
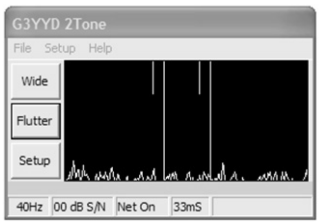
ICOM

Multiple Decoders

2Tone

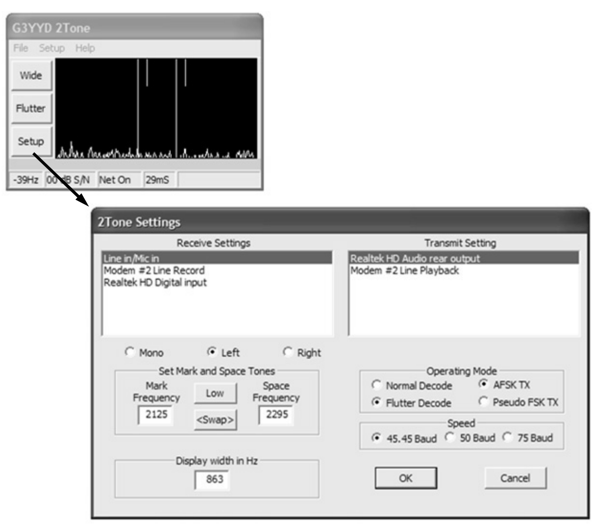




- Outperforms MMTTY ?
- Uses less CPU cycles
- Contest loggers:
  - N1MM Logger+
  - WriteLog
  - Win-Test
- Introduced late 2012
- David Wicks, G3YYD

RTTY Decoders

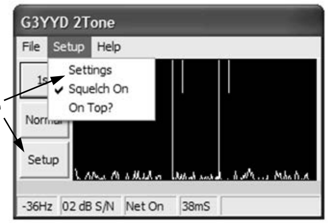
2Tone

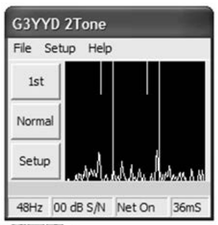


RTTY Decoders

2Tone

same

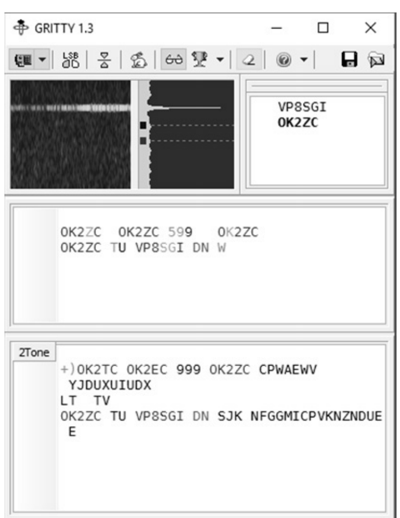




- Setup vs. Settings
- Window-width adjust

Multiple Decoders

GRITTY



- Best accuracy ?
- Bayesian statistics
- Standalone, or …
- Contest loggers:
  - N1MM Logger+ only
- Introduced late 2015
- Alex Shovkoplyas, VE3NEA

Multiple Decoders

hardware MODEM

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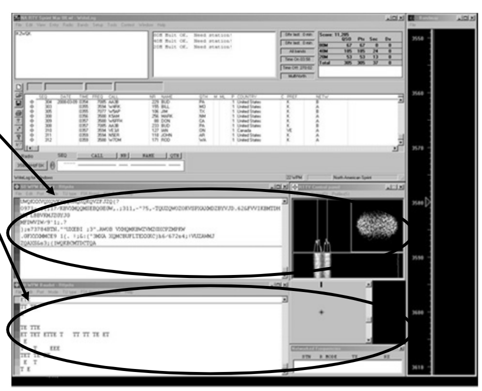
Multiple Decoders

MMTTY & DXP38 - WriteLog

- Parallel decoding
  - Software, e.g., MMTTY
  - Hardware, e.g., DXP38
- Diverse conditions
  - Flutter
  - Multi-path
  - QRM, QRN
  - Weak signals
  - Off-frequency stations



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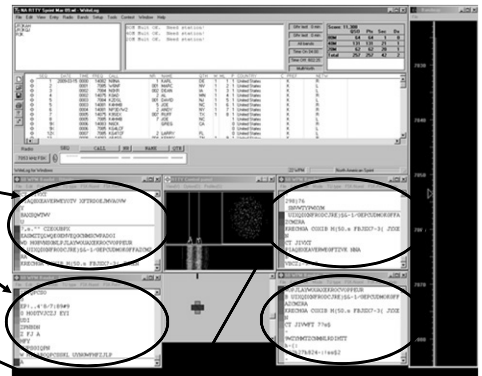
Multiple RTTY Decoders

multiple MMTTY profile windows

- Parallel decoding
  - same audio stream
  - switching takes too long
- Multiple profile windows
  - Standard
  - Fluttered signals
  - Fluttered signals (FIR)
  - Multi-path
  - hyper sensitive
  - EU1SA
  - AA6YQ-FIR-512
    - weak signals in QRN



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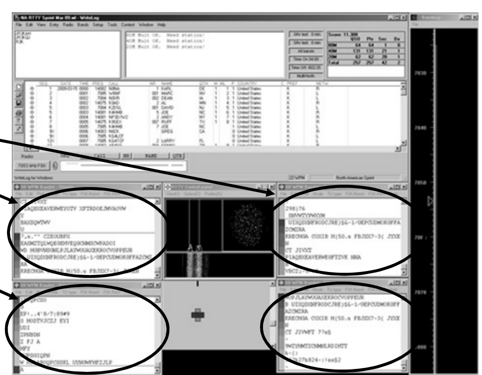
Multiple Decoders

two IF bandwidths

- Narrow IF filtering (main RX)
  - Hardware modem, i.e. DXP38
  - MMTTY profiles
    - Standard
    - Fluttered signals
    - Fluttered signals (FIR)
    - Multi-path
    - hyper sensitive
    - EU1SA
- Wide IF filtering (sub RX)
  - MMTTY profiles
    - AA6YQ-FIR-512
      - Dual Peak Filter
      - “Matched filter”



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SO2V

1. If Assisted and running on VFO-A, then
   - A<>B
   - Click spot, tune, ID station, work station
   - A<>B, resume running
2. Or, set up decoder windows on VFO-A and VFO-B
   - Radio must have two true receivers
   - Monitor both frequencies simultaneously with right/left channels of sound card
     - Left-click call from 2nd RTTY window into VFO-B Entry Window
   - Two ways to transmit on VFO-B:
     I. A<>B, work the mult, A<>B
     II. SPLIT, work the mult, SPLIT, resume running
        - Requires "wire-OR'd" FSK or AFSK and two transmit RTTY windows
        - K3/WriteLog invokes SPLIT when call is right-clicked

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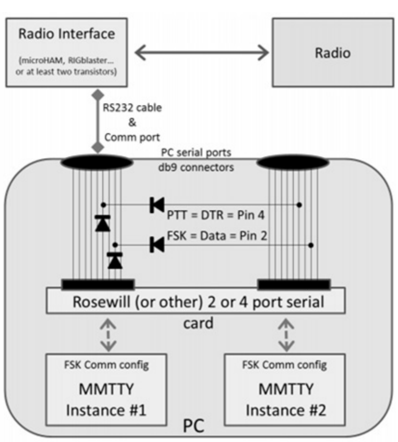
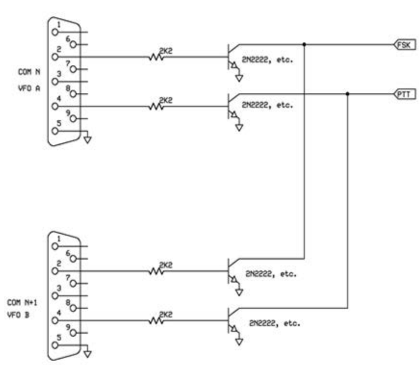
ICOM

SO2V

Wire-OR FSK/PTT



Serial Signals (K8UT)



FSK/PTT Signals (W0YK)

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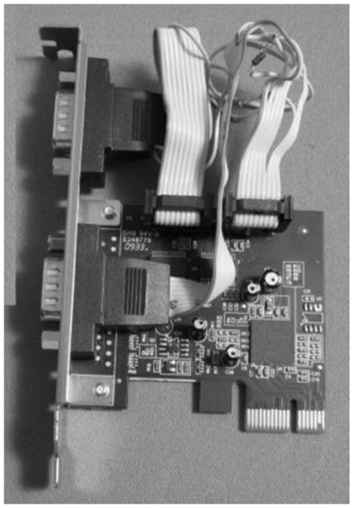
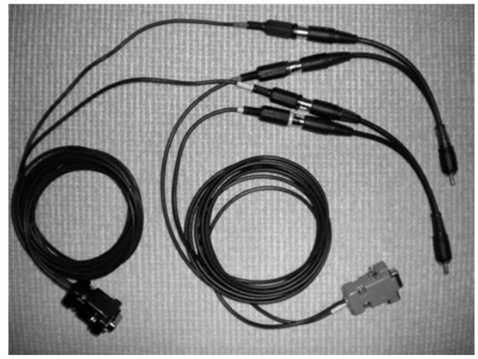
SO2V

Wire-OR FSK/PTT


Serial Signals (K8UT)


FSK/PTT Signals (W0YK)

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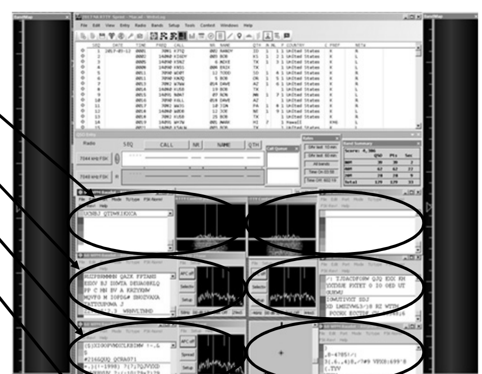
Multiple Decoders

SO2V

- VFO-A (main RX)
  - MMTTY Standard profile
  - 2Tone Flat profile
  - 2Tone Selective profile
  - DXP38
- VFO-B (sub RX)
  - MMTTY Standard profile
  - 2Tone Flat profile



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SO2R

- Eliminates SO1R RTTY boredom
- Think beyond run and S&P:
  - Dueling CQs; run on two bands simultaneously
  - S&P on two bands simultaneously, esp. w/Packet
  - SO2V on one or both radios (SO4V!)
- Two networked computers:
  - Eliminates PC focus swapping
  - RTTY doesn't require much typing
    - Mini-keyboards ideal for RTTY
  - 2 x SO2V=SO4V for picking up mults on both run bands
  - Easily extendible to SO4R

No time to watch TV or read spy novels!

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SO2R

M2 configuration

Left-hand Trackball

Right-hand Trackball

Right-sized Keyboards

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SO2R in the NA Sprint

- Set VFOs at least 10 kHz apart on both radios
- Find a clear spot on one radio and CQ while you tune the other radio for a station to work
- If you don't find a station to work quickly (within a minute), find a clear frequency and duel CQ
- After a QSO swap VFOs on that radio, search for up to a minute, then resume dueling CQ
- Don't waste time trying to work the "couplet" … CQing is OK in Sprint!

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SOnR

> 2 radios

- Simplify antenna/filter band-decoding:
  - Dedicate a band/antenna to the 3rd (or 4th) radio
- Networked PC/radio simplifies configuration
- RTTY (vs. CW or SSB) easier for operator
  - PC decodes for operator
  - Low tones & high tones allows two radios per ear
    - Classic audio headphone mixer provides radio 1, radio 2 or both

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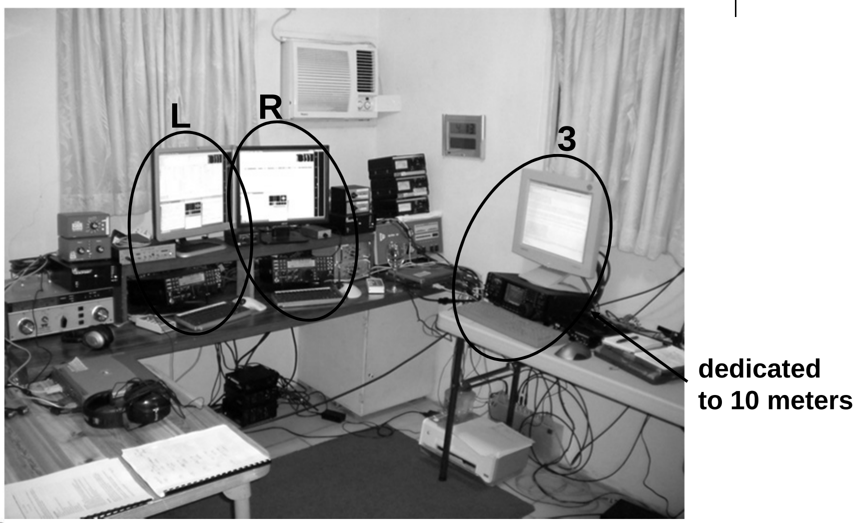
SOnR

Multi-Multi configuration



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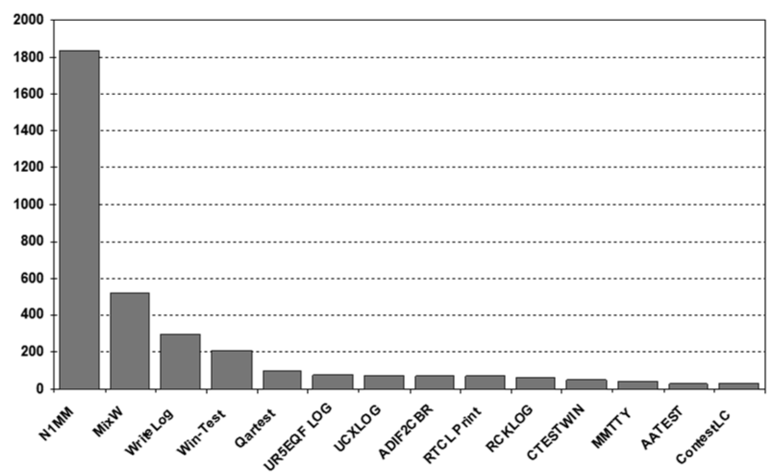
Logging Software

2012 CQ WPX RTTY



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Logging Software

The Big Three

- WriteLog *(1994)*
  - created for RTTY *(CW & SSB came later)*
  - *www.rttycontesting.com/tutorials*
- N1MM Logger+ *(2000; free)*
  - dedicated RTTY software designer
  - *www.rttycontesting.com/tutorials*
- Win-Test *(2003)*
  - RTTY is low priority.

Logging Software

	WriteLog	N1MM	Win-Test
MMTTY	☻	☻	☻
2Tone	☻	☻	☻
other decoders	☻	☻	none
Call sign acquisition	☻	☻	☻
Contests supported	☻	☻	fewer
Advanced RTTY	☻	☻	none

- *All three are entirely adequate for basic RTTY contesting*
- *Use the logger you are already familiar with for CW & SSB*

Logging Software

N1MM Logger, WriteLog, Win-Test

- 13 features compared
  - Simplifying assumption: features equally weighted
  - Rated 0 to 5
- All three score ‘5’ on:
  - MMTTY integration
  - Stateful Enter key (ESM: Enter Sends Message)
  - Accelerator keys
  - QRV message parameter
- Another 9 advanced RTTY features distinguish these loggers

Logging Software

MMTTY integration

- Install free MMTTY software
- Logger integrates MMTTY
  - WriteLog requires additional MMTTY plug-in SW
- All three loggers
- Integrated excellent encoder/decoder

Logging Software

stateful Enter key

- Stateful Enter key (ESM=Enter Sends Message)
  - Cursor in call sign field:
    1. Sends CQ if Call Sign Window empty, else
    2. Sends call sign & exchange
  - Cursor in exchange field:
    3. Sends TU/CQ
- N1MM Logger highlights active key(s)

- All three loggers
- Efficient keyboarding

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Logging Software

accelerator keys

- Insert grabs call sign & sends exchange
- + logs QSO & sends TU/CQ

- All three loggers
- Saves keystrokes

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Logging Software

automatic QRV

- *QRV 28079.3*
- Message parameter for other radio's VFO

- All three loggers
- Efficient QSY, mult move or "self-spotting"

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RTTY Contest Loggers

relative ratings

WL	*N1*	*WT*	*Logger*
5	5	5	• RTTY window readability
5	4	0	• Multiple decoders
4	5	0	• MMTTY, 2Tone, GRITTY
0	5	3	• ESM mouse ctrl & Sprint mode
5	5	0	• SO2V
5	3	3	• M2 SO2R configuration
5	4	5	• Re-mapped keys
5	5	3	• Call sign stacking
5	4	4	• AFSK/FSK flexibility
39	***40***	***23***	***Overall***

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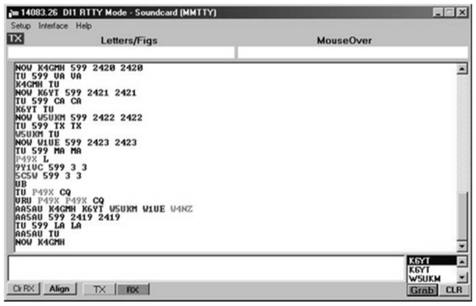
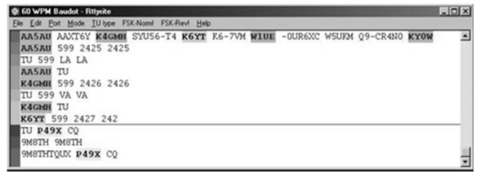
Logging Software
RTTY Window Readability

N1MM Logger



Colored text is difficult to read, especially the dark blue (unworked call) which has negligible contrast to black text or black background. The dark blue cannot be changed by the user. ***HOWEVER …***

WriteLog



Colored highlighting has outstanding readability. The text all remains black for maximum contrast and the highlighting does not detract. Rather the large highlight area around the text make it extremely easy to zero in on the call sign of interest, especially when quickly moving one's eyes between multiple windows.

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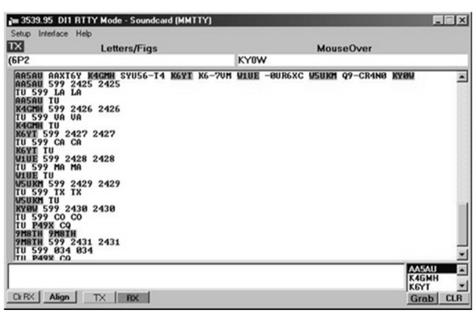
Logging Software
RTTY Window Readability

N1MM Logger



Colored text is difficult to read, especially the dark blue (unworked call) which has negligible contrast to black text or black background. The dark blue cannot be changed by the user. ***HOWEVER, there is now an option for highlighting like WriteLog and WinTest.***

WriteLog

Colored highlighting has outstanding readability. The text all remains black for maximum contrast and the highlighting does not detract. Rather the large highlight area around the text make it extremely easy to zero in on the call sign of interest, especially when quickly moving one's eyes between multiple windows.

WriteLog is unique in having a NON-SCROLLING RTTY window, so you don't have to chase text up the screen!

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Logging Software
multiple decoders

- N1MM Logger limited to 4 total, but has best DXP38 & GRITTY support
- WriteLog has 10 additional decoders per rcvr and the most hardware MODEMs
- Win-Test only supports one instance of MMTTY or 2Tone

- WriteLog & N1MM Logger only
- Multiple parallel decoders for marginal copy

Logging Software
ESM mouse control

- Left-click enters call sign or exchange
- Right-click (ESM) sends exchange or TU/CQ
- QSOs can be worked entirely with mouse action, except for the rare instance where a call or exchange must be typed in
- Particularly suited to unique non-prefillable exchanges such as serial numbers

- N1MM Logger only
- Eliminates keyboard for efficiency

SO2V

- Basic capability with two VFOs
- Advanced capability with two receivers
  - Requires second receiver in radio
  - Independent RTTY window for second receiver
  - radio/logger SPLIT mode
- N1MM Logger & WriteLog
- Interleave S&P QSOs on Run band

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SO2R

M2 configuration

- PC & UI per radio; networked
- Single signal interlock
- Extendible to SOnR
- Only WriteLog
- Another user preference alternative; SOnR

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Logging Software

key re-mapping

- Soft re-definition of keyboard keys
- Examples:
  - Insert → ‘
  - = → PopCallFromStack
- WriteLog provides a rich built-in function set for key shortcuts

- WriteLog & Win-Test remap keys and functions
- N1MM Logger uses HotKeys
- Relocates keys for efficiency

Logging Software

re-mapped keys

Full-size QWERTY keyboard; no number pad; integrated cursor keys

Logging Software
callsign stacking

- N1MM Logger can automatically fill stack
- WriteLog has convenient stack management
- Win-Test script can use partner stack

- All three loggers
- Doubles rate by skipping CQ & pile-up

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Logging Software
callsign stacking

- N1MM Logger automatically pushes calls into the Grab window.
  - It can also explicitly push calls onto the Call Stack (like WriteLog and Win-Test)
  - There is a rich list of stack functions and ESM integration
- WriteLog explicitly right-clicks calls onto the call stack
- Win-Test requires a LUA script to push calls onto the Partner Stack

Automatic vs. explicit pushing is personal pref.

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Logger Software

callsign stacking: N1MM Logger

- Setup:
  - Create a F8 message (macro):
    - {TX} ! {LOGTHENGRAB}TU NOW {F4}{F5}{RX}
    - ! or F4: his call; F5: CQ-exchange … your choice of Fn
  - Configure the Grab window:
    - Choose “Clear Grab window with CQ” (on DI tab of Configuration window)
    - Choose “First In, First Out” (right-click Grab window)
- Operate:
  - Each highlighted call in DI window automatically goes into Grab window
  - Send this macro in place of TU/CQ macro when you want to work the next call in stack
  - Sending the CQ message clears the Grab window
  - Delete calls from stack by right-clicking and choosing “Delete”

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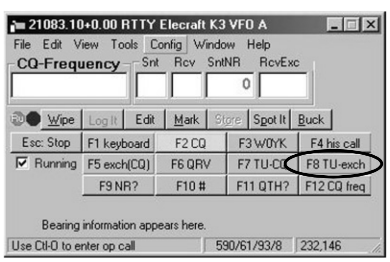
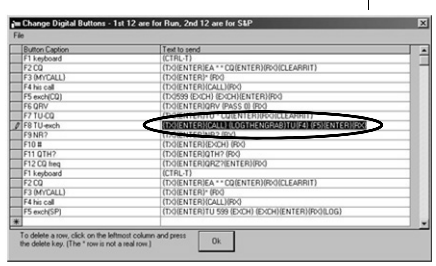
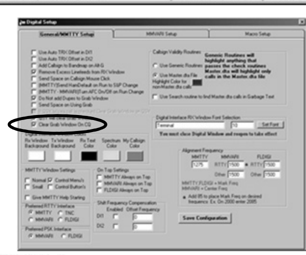
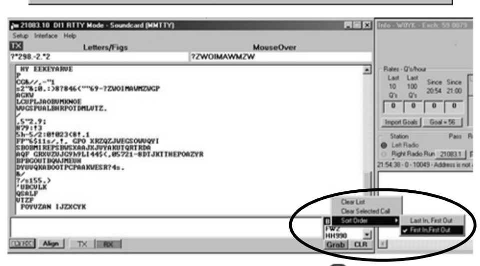
Logging Software

callsign stacking: N1MM Logger - 2









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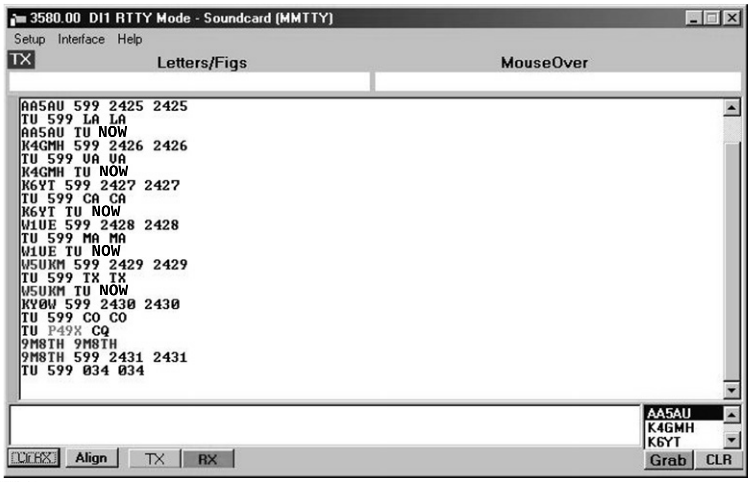
Logging Software

callsign stacking: N1MM Logger - 3



Logger Software

callsign stacking: N1MM Logger - 4

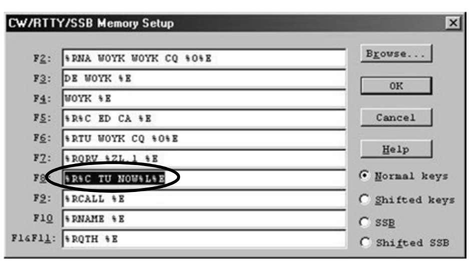
Alternatively, the Call Stack may be used:

- Setup:
  - Create a F8 message (macro):
    - {TX} ! {LOGTHENPOP}TU NOW {F4}{F5}{RX}
    - ! or F4: his call; F5: CQ-exchange … your choice of Fn
- Operate:
  - Alt-click a callsign to push it onto the Call Stack
  - Send this macro in place of TU/CQ macro when you want to work the next call in stack
  - Sending the CQ message clears the Call Stack
  - Delete calls from the Call Stack by right-clicking and choosing “Delete”

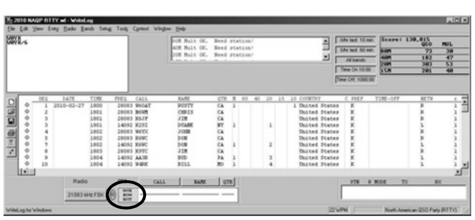
Logging Software
callsign stacking: WriteLog

- Setup:
  - Configure right-click for Push-only in writelog.ini:
    - [RttyContextMenuEntries]
    - 1=PUSHCALL
  - Define Push and Pop keys, using the Keyboard Shortcuts feature:
    - Push Call on the Graves (~) key
    - Pop Call on the Equals (=) key
  - Create <TU NOW msg>
    - %R%C TU NOW%L
- Operate:
  - Push calls onto stack
    - configure right-click for single menu item
    - right-click call in Rttyrite window
  - At the end of the current QSO, press <TU NOW msg> followed by the Insert key or Enter key (the normal CQ-exchange msg)
  - Press TU/CQ msg (rather than + or Enter) when you don't want to pop the stack for your next contact
  - Pop/Push to rotate the desired call into Entry window without losing others (replace Push with Alt-W to delete a call, or do another Pop)

Logging Software
callsign stacking: WriteLog - 2



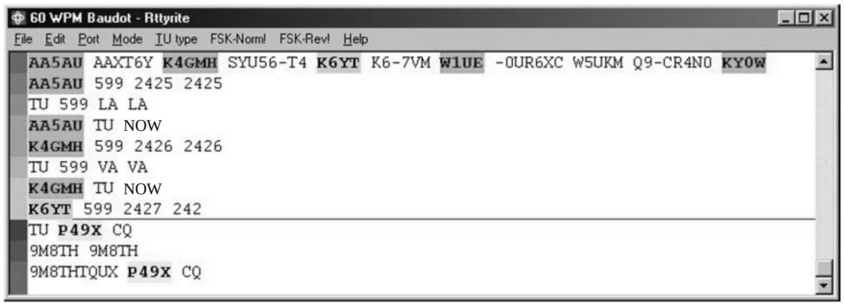
- Create Fn macro
  - %R%C TU NOW%L%E



- Push calls onto stack
  - Right-click call in Rttyrite window

Logging Software

callsign stacking: WriteLog - 3



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Logging Software

AFSK & FSK flexibility

- WriteLog has built-in AFSK & FSK
- N1MM relies on MODEM for AFSK or FSK

- WriteLog
- Independence from MODEM for transmit

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RTTY Contest Loggers

relative ratings

WL	*N1*	*WT*	*Logger*
5	5	5	• RTTY window readability
5	4	0	• Multiple decoders
4	5	0	• MMTTY, 2Tone, GRITTY
0	5	3	• ESM mouse ctrl & Sprint mode
5	5	0	• SO2V
5	3	3	• M2 SO2R configuration
5	4	5	• Re-mapped keys
5	5	3	• Call sign stacking
5	4	4	• AFSK/FSK flexibility
39	***40***	***23***	***Overall***

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Ergonomics

user interface

- Comfortable heights, reaches, layout
- Right-sized keyboard
  - Fn keys template
  - Label re-mapped keys
- Right & left trackballs
- Bose QC2 phones
  - Minimal volume
  - Stereo

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Ergonomics

keyboard or mouse?

- Keyboard – minimal typing in RTTY
  - Either:
    - F1, Insert and + … or,
    - Enter, Insert and Enter (ESM – Enter Sends Message)
  - Plus Fn keys or re-mapped Fn keys
  - Mouse click received exchange, if not pre-filled
- Mouse/trackball
  - 100% (N1MM Logger)
  - 80% (WriteLog and Win-Test)

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Resources

- www.rttycontesting.com
  - Tutorials and resources (beginner to expert)
  - WriteLog, N1MM Logger+ and MMTTY
- rtty@contesting.com
  - Email reflector
  - RTTY contester networking
  - Q&A
- Software web sites
  - mmhamsoft.amateur-radio.ca/ (MMTTY)
  - n1mm.hamdocs.com/tiki-index.php (N1MM Logger+)
  - www.writelog.com (WriteLog)
  - www.wintest.com (Win-Test)
- Software Reflectors
  - mmtty@yahoogroups.com (MMTTY)
  - N1MMLoggerplus@yahoogroups.com (N1MM Logger+)
  - N1MMLogger-Digital@yahoogroups.com (N1MM Logger+ RTTY & PSK)
  - writelog@contesting.com (WriteLog)
  - support@win-test.com (Win-Test)

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CTU Presents

The Wonderful World of Space Weather

Dr. Tamitha Mulligan Skov
The Aerospace Corporation

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Who is Impacted by Space Weather?

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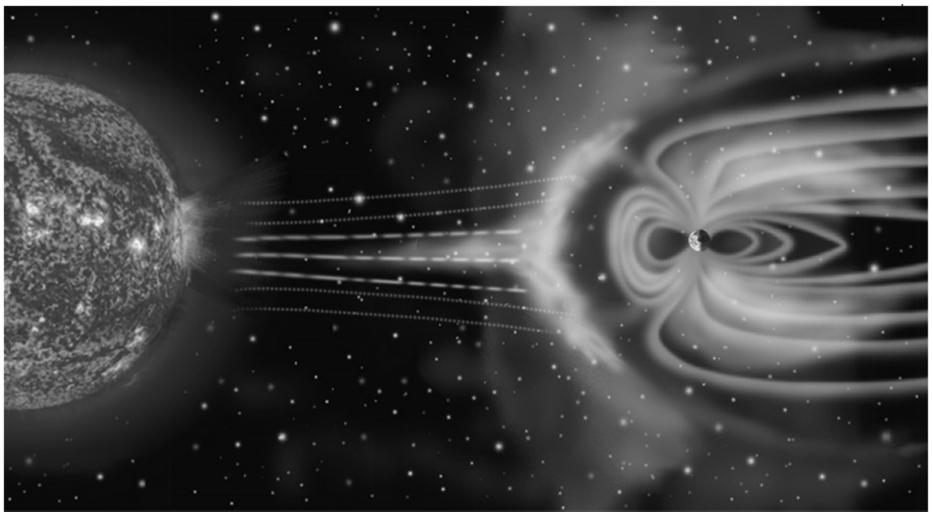
What is Space Weather?

Essentially Space Weather is:
A planet's interaction with its host star and the surrounding space environment.



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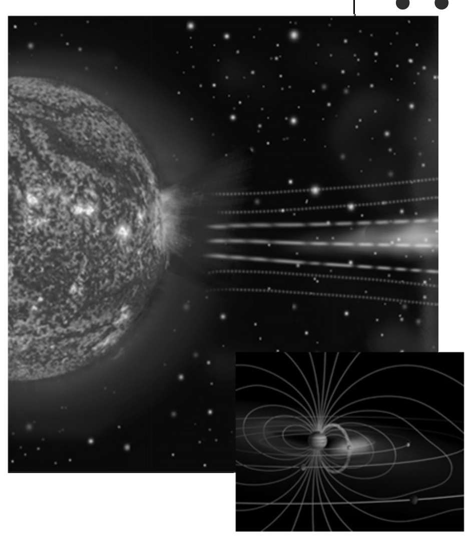
What is Space Weather?

More generally, it occurs at planets, moons, comets, asteroids, and other celestial bodies in the universe.

In our solar system

- We see aurora at Jupiter, Saturn, and recently at Uranus and Mars
- Effects are studied at Io, Europa, Ganymede, and Titan to name a few
- Highlight **Sun-driven processes**
- Will not cover other sources of space weather
    - Galactic and anomalous cosmic rays
    - Micrometeroids & interstellar dust
    - Space junk



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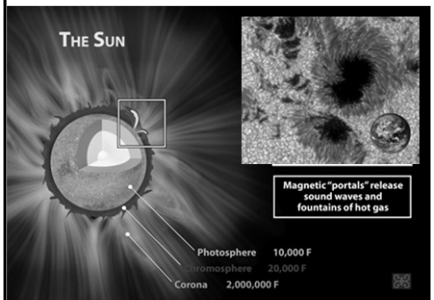
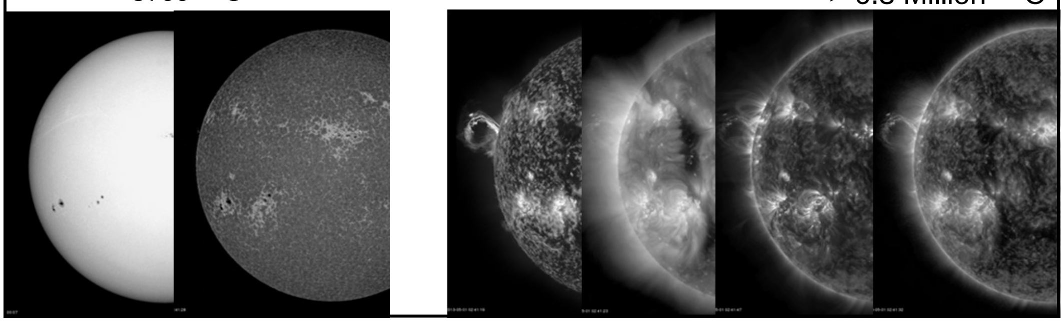
Our Star



- Giant fusion reactor: Drives Space Weather
- Energy output in the form of:
  - Electromagnetic radiation (from X-rays through radio)
  - Solar wind plasma & magnetic fields
  - Flares
  - Solar Energetic Particles (SEPs) (aka solar radiation storms)
  - Coronal Mass Ejections (CMEs)

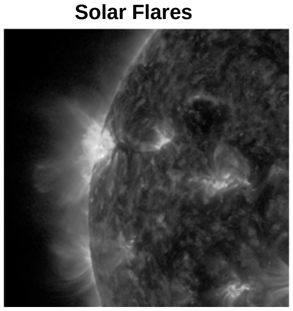
What do Space Telescopes See?

5700 ° C → 6.3 Million ° C

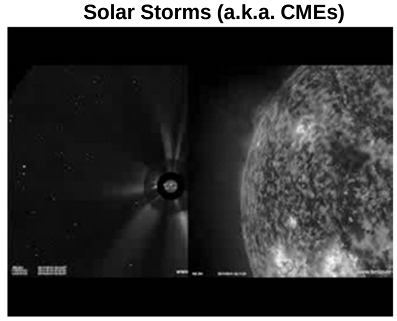


Four Basic Types of Solar Phenomena Affecting Earth

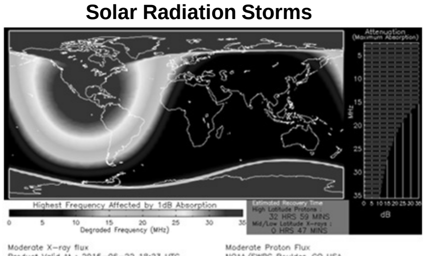
Solar Flares



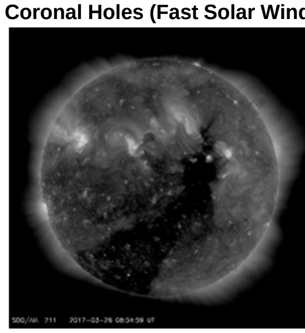
Solar Storms (a.k.a. CMEs)



Solar Radiation Storms



Coronal Holes (Fast Solar Wind)



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…So how bad can Space Weather be?

3 Categories:

- Geomagnetic Storms
  (CMEs and fast solar wind)
- Solar Radiation Storms
  (Particle Events)
- Radio Blackouts
  (Solar Flares)

Reprinted courtesy of NOAA

NOAA Space Weather Scales

Category: Scale	Category: Descriptor	Effect (Duration of event will influence severity of effects)	Physical measure	Average Frequency (1 cycle = 11 years)
Geomagnetic Storms			Kp values* determined every 3 hours	Number of storm events when Kp level was met; (number of storm days)
G 5	Extreme	Power systems: widespread voltage control problems and protective system problems can occur, some grid systems may experience complete collapse or blackouts. Transformers may experience damage. Spacecraft operations: may experience extensive surface charging, problems with orientation, uplink/downlink and tracking satellites. Other systems: pipeline currents can reach hundreds of amps, HF (high frequency) radio propagation may be impossible in many areas for one to two days, satellite navigation may be degraded for days, low-frequency radio navigation can be out for hours, and aurora has been seen as low as Florida and southern Texas (typically 40° geomagnetic lat.)**.	Kp=9	4 per cycle (4 days per cycle)
G 4	Severe	Power systems: possible widespread voltage control problems and some protective systems will mistakenly trip out key assets from the grid. Spacecraft operations: may experience surface charging and tracking problems, corrections may be needed for orientation problems. Other systems: induced pipeline currents affect preventive measures, HF radio propagation sporadic, satellite navigation degraded for hours, low-frequency radio navigation disrupted, and aurora has been seen as low as Alabama and northern California (typically 45° geomagnetic lat.)**.	Kp=8, including a 9-	100 per cycle (60 days per cycle)
G 3	Strong	Power systems: voltage corrections may be required, false alarms triggered on some protection devices. Spacecraft operations: surface charging may occur on satellite components, drag may increase on low-Earth-orbit satellites, and corrections may be needed for orientation problems. Other systems: intermittent satellite navigation and low-frequency radio navigation problems may occur, HF radio may be intermittent, and aurora has been seen as low as Illinois and Oregon (typically 50° geomagnetic lat.)**.	Kp=7	200 per cycle (130 days per cycle)
G 2	Moderate	Power systems: high-latitude power systems may experience voltage alarms, long-duration storms may cause transformer damage. Spacecraft operations: corrective actions to orientation may be required by ground control; possible changes in drag affect orbit predictions. Other systems: HF radio propagation can fade at higher latitudes, and aurora has been seen as low as New York and Idaho (typically 55° geomagnetic lat.)**.	Kp=6	600 per cycle (360 days per cycle)
G 1	Minor	Power systems: weak power grid fluctuations can occur. Spacecraft operations: minor impact on satellite operations possible. Other systems: migratory animals are affected at this and higher levels; aurora is commonly visible at high latitudes (northern Michigan and Maine)**.	Kp=5	1700 per cycle (900 days per cycle)

* Based on this measure, but other physical measures are also considered.
** For specific locations around the globe, use geomagnetic latitude to determine likely sightings (see www.sec.noaa.gov/Aurora)

Solar Radiation Storms			Flux level of ≥ 10 MeV particles (ions)*	Number of events when flux level was met**
S 5	Extreme	Biological: unavoidable high radiation hazard to astronauts on EVA (extra-vehicular activity); high radiation exposure to passengers and crew in commercial jets at high latitudes (approximately 100 chest x-rays) is possible. Satellite operations: satellites may be rendered useless, memory impacts can cause loss of control, may cause serious noise in image data, star-trackers may be unable to locate sources; permanent damage to solar panels possible. Other systems: complete blackout of HF (high frequency) communications possible through the polar regions, and position errors make navigation operations extremely difficult.	10^5	Fewer than 1 per cycle
S 4	Severe	Biological: unavoidable radiation hazard to astronauts on EVA; elevated radiation exposure to passengers and crew in commercial jets at high latitudes (approximately 10 chest x-rays) is possible. Satellite operations: may experience memory device problems and noise on imaging systems; star-tracker problems may cause orientation problems, and solar panel efficiency can be degraded. Other systems: blackout of HF radio communications through the polar regions and increased navigation errors over several days are likely.	10^4	3 per cycle
S 3	Strong	Biological: radiation hazard avoidance recommended for astronauts on EVA; passengers and crew in commercial jets at high latitudes may receive low-level radiation exposure (approximately 1 chest x-ray). Satellite operations: single-event upsets, noise in imaging systems, and slight reduction of efficiency in solar panel are likely. Other systems: degraded HF radio propagation through the polar regions and navigation position errors likely.	10^3	10 per cycle
S 2	Moderate	Biological: none. Satellite operations: infrequent single-event upsets possible. Other systems: small effects on HF propagation through the polar regions and navigation at polar cap locations possibly affected.	10^2	25 per cycle
S 1	Minor	Biological: none. Satellite operations: none. Other systems: minor impacts on HF radio in the polar regions.	10	50 per cycle

* Flux levels are 5 minute averages. Flux in particles $s^{-1} ster^{-1} cm^{-2}$ Based on this measure, but other physical measures are also considered.
** These events can last more than one day.

Radio Blackouts			GOES X-ray peak brightness by class and by flux*	Number of events when flux level was met; (number of storm days)
R 5	Extreme	HF Radio: Complete HF (high frequency**) radio blackout on the entire sunlit side of the Earth lasting for a number of hours. This results in no HF radio contact with mariners and en route aviators in this sector. Navigation: Low-frequency navigation signals used by maritime and general aviation systems experience outages on the sunlit side of the Earth for many hours, causing loss in positioning. Increased satellite navigation errors in positioning for several hours on the sunlit side of Earth, which may spread into the night side.	X20 ($2x10^{-3}$)	Fewer than 1 per cycle
R 4	Severe	HF Radio: HF radio communication blackout on most of the sunlit side of Earth for one to two hours. HF radio contact lost during this time. Navigation: Outages of low-frequency navigation signals cause increased error in positioning for one to two hours. Minor disruptions of satellite navigation possible on the sunlit side of Earth.	X10 (10^{-3})	8 per cycle (8 days per cycle)
R 3	Strong	HF Radio: Wide area blackout of HF radio communication, loss of radio contact for about an hour on sunlit side of Earth. Navigation: Low-frequency navigation signals degraded for about an hour.	X1 (10^{-4})	175 per cycle (140 days per cycle)
R 2	Moderate	HF Radio: Limited blackout of HF radio communication on sunlit side, loss of radio contact for tens of minutes. Navigation: Degradation of low-frequency navigation signals for tens of minutes.	M5 ($5x10^{-5}$)	350 per cycle (300 days per cycle)
R 1	Minor	HF Radio: Weak or minor degradation of HF radio communication on sunlit side, occasional loss of radio contact. Navigation: Low-frequency navigation signals degraded for brief intervals.	M1 (10^{-5})	2000 per cycle (950 days per cycle)

* Flux, measured in the 0.1-0.8 nm range, in $W m^{-2}$. Based on this measure, but other physical measures are also considered.
** Other frequencies may also be affected by these conditions.

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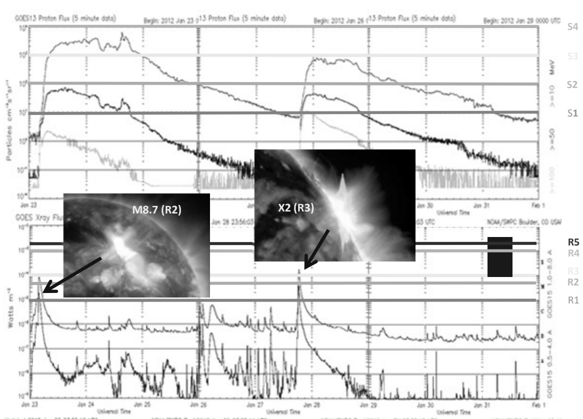
What Can a Typical Solar Storm Event Do?



Source of all official forecasting data is the NOAA Space Weather Prediction Center (SWPC)

January 23-30, 2012 solar storm series of events caused

- 2 radio blackouts
- 2 radiation storms
- 1 geomagnetic storm

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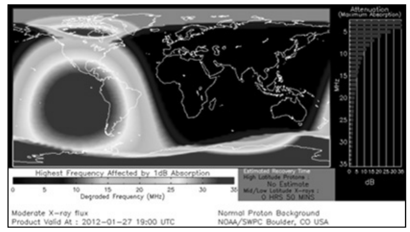
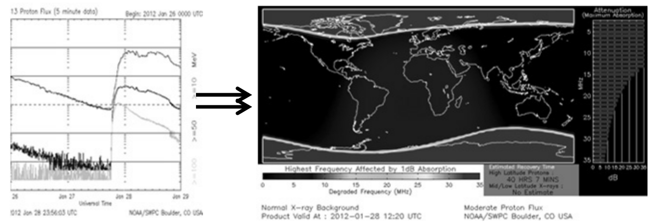
HF Band Communications Disruptions

FAA Radio Communications Center reported that the CEP (Central East Pacific) and CWP (Central West Pacific) regions were:
"impacted severely by solar activity between 1830Z and 1930Z on 27 Jan due to the R3 solar flare radio blackout. Thirteen requests were received from ATC for overdue position reports."



Several polar flights altered due to S3 Radiation Storm (23-25 Jan)



<u>Major airline report</u>: "…some of our polar flights (but not all) have reported HF comm outages/issues over the past 3 nights."

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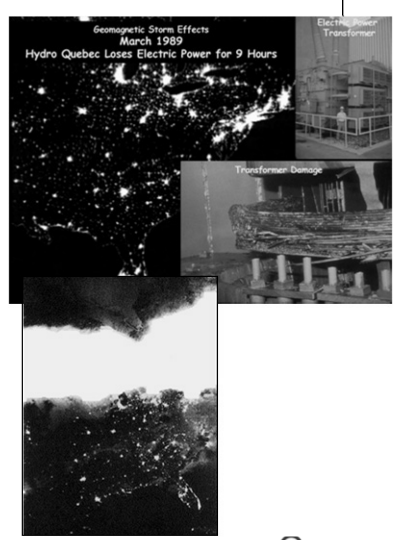
What Can a Super Solar Storm Event Do?

- **March 6-15, 1989**
  - X-15 Flare followed by a CME
  - Weather Satellites lost images for hours
  - TDRS-1 com sat had over 250 anomalies
  - Space Shuttle Discovery fuel sensor failed
  - Radio Free Europe disrupted thinking it was Soviet Jam Event
  - Quebec Hydro-Quebec Power Grid shutdown
  - James Bay Network, serving 6 million people, offline for 9 hours
  - Caused Toronto Stock Market to close
  - Brilliant Auroral Displays as far at Texas and Florida (aurora pic by DOD F9 weather sat)

- Many other examples of super storms in space age: 1998 Telstar 401, Anik 1,2, "Halloween Events" 2003



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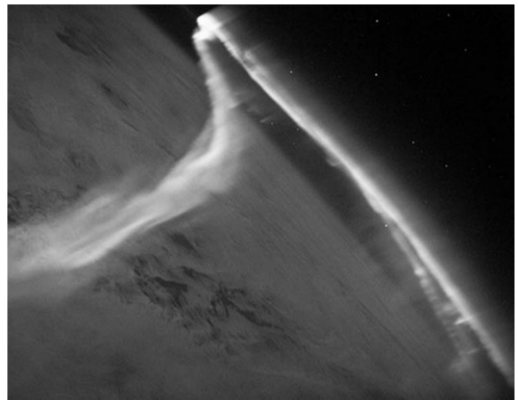
What is the Ionosphere?

- Ionosphere is a charged plasma layer above the atmosphere comprised of ions and electrons
- It would be neutral but it gets charged from exposure mainly to the Sun's UV radiation
- This charged nature facilitates radio propagation
- During geomagnetic storms, extra energy caught in the Earth's magnetic shield gets dumped into the ionosphere
- This energy (flow of charged particles) lights-up the plasma in the Earth's ionosphere similar to a fluorescent lamp or neon sign
- Result is the aurora borealis (northern lights) and aurora australis (southern lights)



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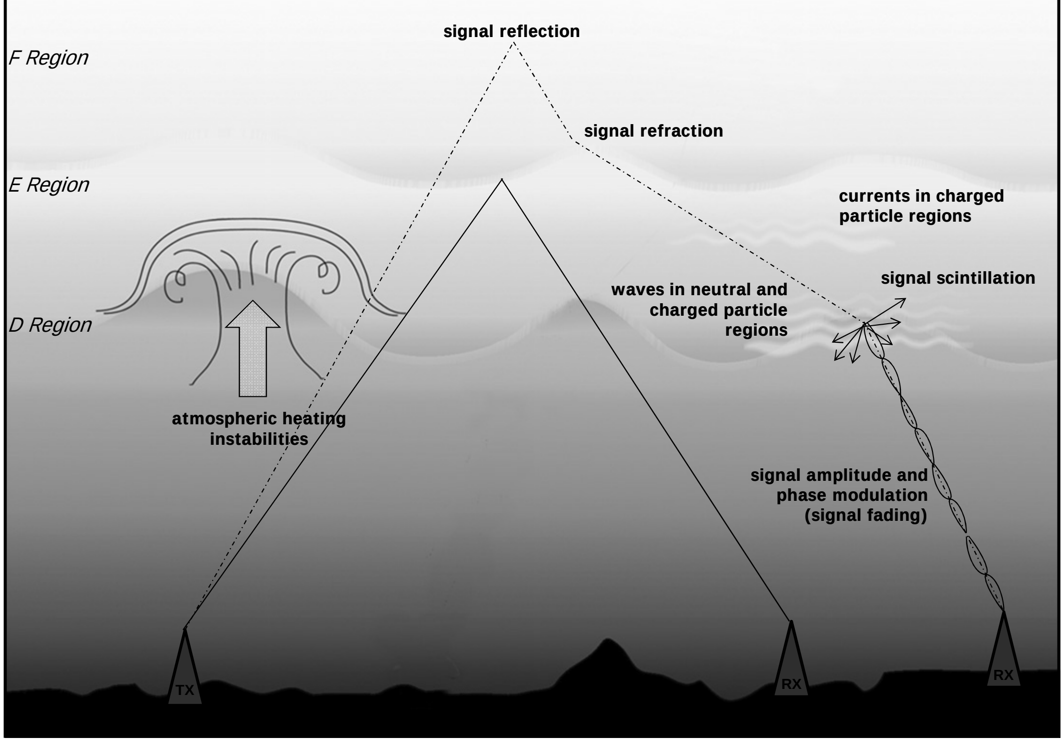
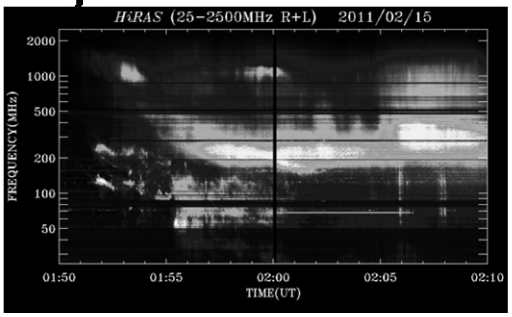
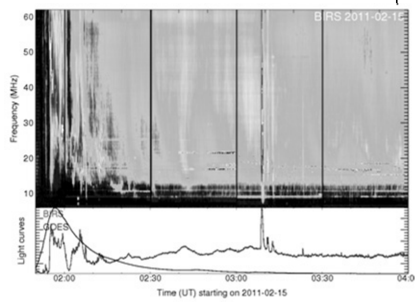
Space Weather Effects on Propagation



Space Weather Audible Interference





Solar flare: Solar radio bursts cause radio blackouts over a wide frequency range
https://www.wired.com/2013/02/radio-solar-outburst/

Dawn Chorus: Radio Waves due to energetic particles in the magnetosphere
https://www.nasa.gov/mission_pages/rbsp/news/emfisis-chorus.html#.VVWFy_lVikp

Sferics and Tweeks: Radio waves caused by lightning nearby
http://www.spaceweather.com/glossary/inspire.html

Whisters: Radio waves caused by lightning far away
http://www.spaceweather.com/glossary/inspire.html

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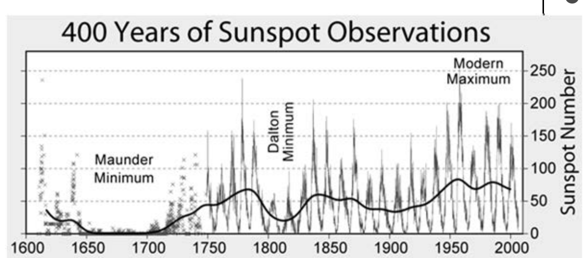
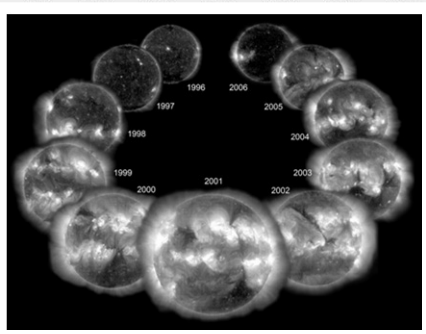
What about Solar Variability?

- Sun's activity cycle has a quasi 11-year periodicity
- Solar magnetic field constantly reversing orientation
- Activity increases for few years surrounding field reversal and decreases when field becomes dipolar again
- Other competing cycles cause deviations from 11-years and induce amplitude changes over long-term





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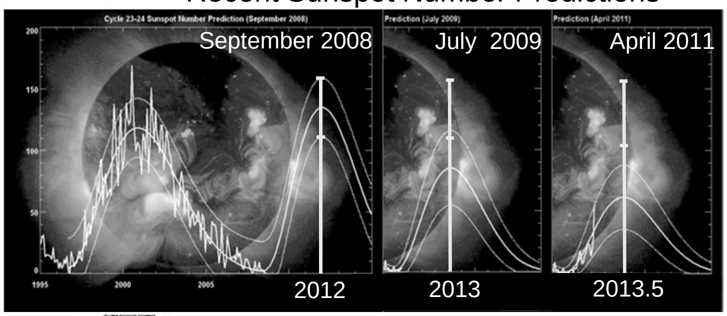
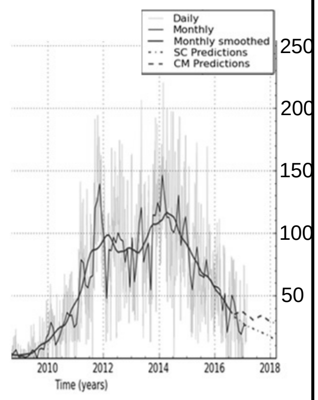
Solar Cycle: Where are We Now?

- Recent solar cycles are showing dramatic changes, making predictions more complicated
- Consensus is we are in a new Dalton-like Minimum
  - Cycle is slower, up to 14 years
  - Lower luminosity, slower plasma currents beneath Sun's surface, lower magnetic field
  - lower activity at maximum
- Solar maximum double-peaked
  - First peak in 2011-2012, second peak 2014-2015

Recent Sunspot Number Predictions





raphics (http://sidc.be/silso) Royal Observatory of Belgium 2017 March 1

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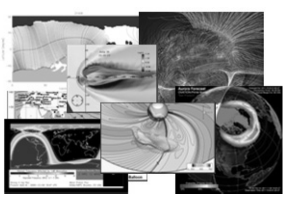
Space Weather Forecasting: A Return to the Sixties

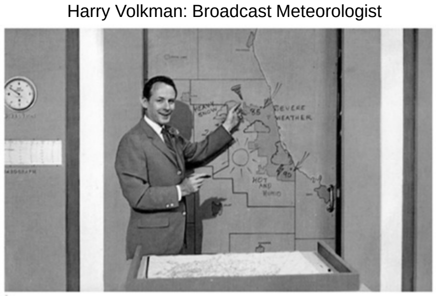


Space Weather Prediction Centers

- Developed mainly as a response to super storms
- Models that predict solar fields, CME transit, magnetospheric responses→ solar storm alerts
- Radio blackouts, solar radiation storms→ FAA alerts
- Space and ground telescopes for 24/7 monitoring of Sun, even on the backside
- "Spaceship Earth" networks

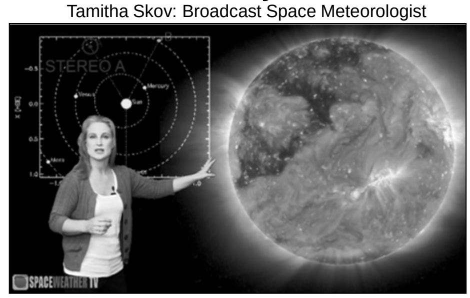
~1960

Harry Volkman: Broadcast Meteorologist



Today

Tamitha Skov: Broadcast Space Meteorologist



CONTEST UNIVERSITY

ICOM

Space Weather Forecasting: A Return to the Sixties

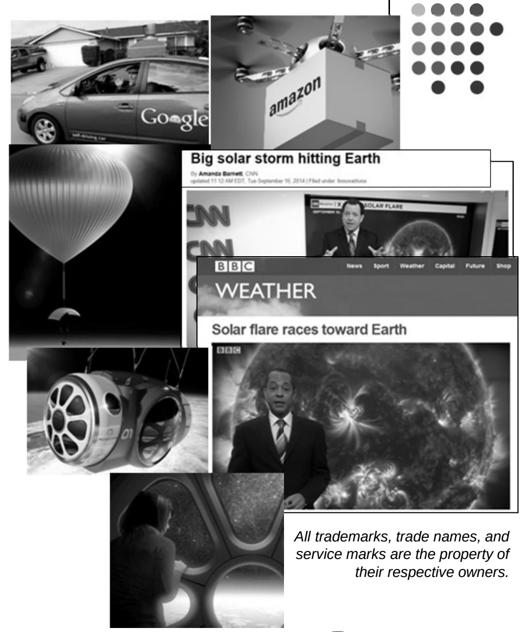
CTU CONTEST UNIVERSITY

ICOM

Our Future Relies on Predicting Space Weather

Reliance on Space is advancing:

- Wireless technologies
  - 6 Billion mobile phones in world today
  - GPS/GNSS receivers
  - Satellite service providers exploding
- Self-driving cars
  - CA law passed in 2012 Google car can share public roads
- Unmanned Aerial Vehicles (UAVs)
  - FAA allows GPS/GNSS enabled drones to share commercial airspace in 2015
- Space Tourism
  - World View to launch manned balloon test flights in 2017
- National Power Grids



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For more information visit:

*TamithaSkov on **SpaceWeatherWoman.com** and on YouTube for weekly forecast videos: (http://www.youtube.com/user/SpWxfx)*

*@**TamithaSkov** on Twitter for daily forecasts and often hourly updates*

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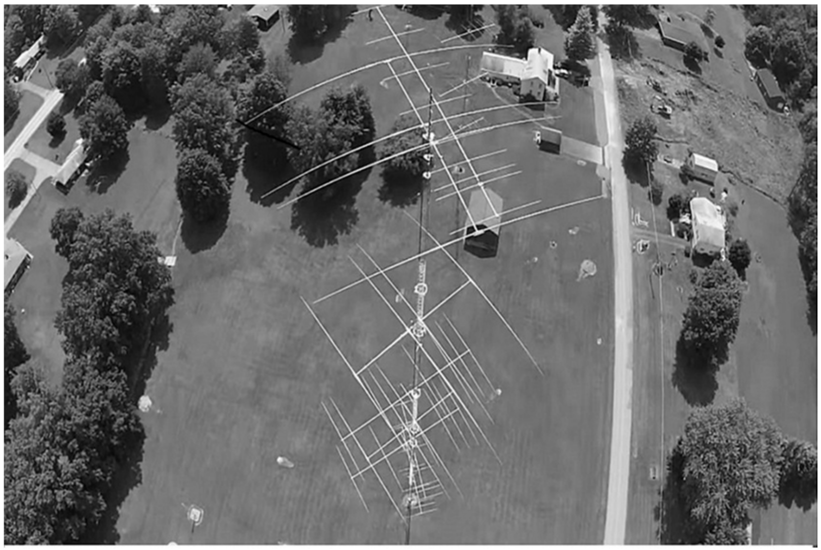
Antenna/Tower Reliability

Tim Jellison W3YQ/KL7WV

- Use quality materials (don’t be a cheap ham!)
- Do it right the first time
- Perform regular inspections
- Be safe when working on antennas and towers
- Is it K3LR approved?



Use only good quality materials

- Name-brand connectors only

Use only good quality materials

- Consider pre-made cables

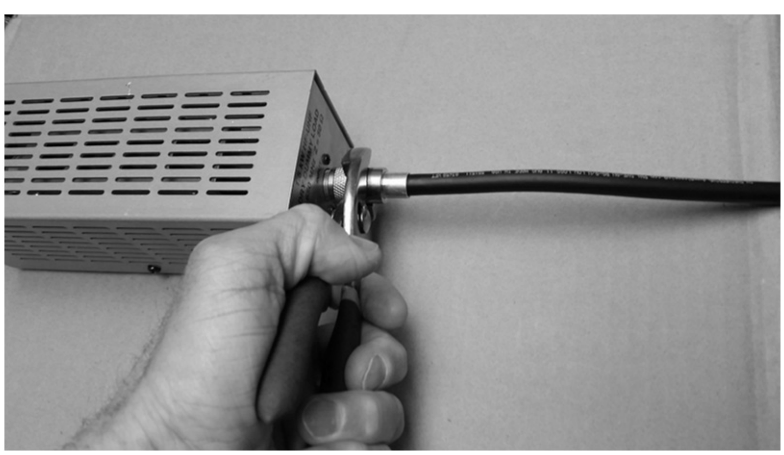
Use only good quality materials

- Only use good quality tape

Moisture is coax's worst enemy. All outdoor connections must be properly sealed. Here's a proven method to keep connections dry.

Weatherproofing connections

- First, tighten with pliers. Finger-tight is not good enough.



Weatherproofing connections

- One wrap of 88 tape. And always cut the end when taping. Never pull/tear the end or you'll end up with a tail.

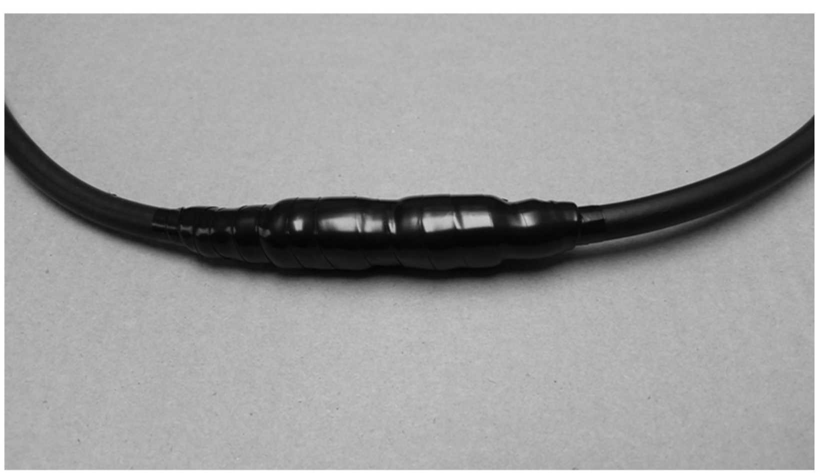
Weatherproofing connections

- Add a layer of mastic.

Weatherproofing connections

Weatherproofing connections

- Two wraps of 88 tape. Overlap each layer by ½ the width of the tape.



- There are two tips in the next photo.
- First, tape your cables with 88 tape – no tiewraps. Tiewraps can smash the coax and they will eventually fail due to weathering.
- Second, always put a barrel at the top of your tower if the feedpoint is out of reach. Makes antenna removal much easier.

Use a piece of split loom if there's a concern about cables rubbing.

Waterproofing a bearing

- Does your antenna sometimes not turn in the cold weather? It might be ice in your thrust bearing. Make a boot out of one of these.

Waterproofing a bearing

It can also keep the water out of an Orion 2800's top bearing.

The bolts in a TB3 can seize up. Apply anti-seize before installation or swap out the bolts with stainless (and maybe still use anti-seize?)

Notice all the blue stuff? You should also use a lubricant on all stainless hardware. Blue Locktite is a good choice. It lubricates, locks, yet can still be removed later.

Also, when installing a Rohn tower, use anti-seize on the leg joints. It’s conductive and makes the inevitable disassembly much easier.

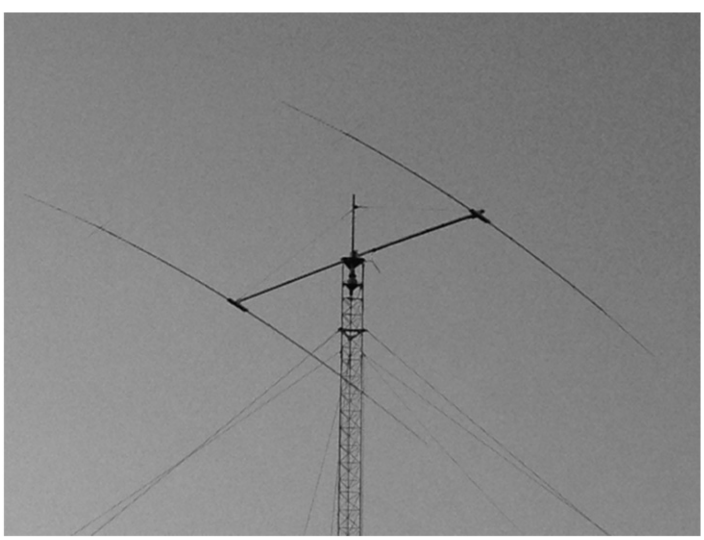
- Tidbits

Does your rotor or antenna slip on the mast? You can add a secondary clamp which will help out your U-bolts.

Here we give a Yaesu rotor some help

Here is a secondary clamp below the mast clamp of a 40M Yagi

If the top section of your tower is above the top set of guys, the leg bolts MUST be tight and should be regularly checked. This is a point of great lateral stress and if the bolts loosen, the holes in the legs will elongate.



Do not over tighten anything on a Rohn tower leg. You could smash the leg (it can even split) and the tower will be compromised.

When soldering PL259's, don't be afraid to use a big iron and get the connector hot – the solder must flow. Just keep everything straight in-line and be sure to let it cool down completely before you move it. That way the center dielectric will harden back up. I let mine sit about 10 minutes after soldering before doing anything with it.

Solder all your crimps, otherwise the wire could pull out. If you’re using insulated lugs, don’t worry about melting the plastic.

Conductive paste

- Usable on all metal to metal joints, especially aluminum antenna joints.

And above all, when climbing follow all safety rules!

NO SK's

Disruptive Technologies

How they change our hobby

Rob Sherwood
NCØB

Something new can be a game changer

- **Disruptive technology can do the following:**
- Create a new market that didn't exist
- Disrupt an existing market
- Drastically affect market share of existing companies
- Significantly improve performance
- Reduce costs

Three Examples disruptive technology

Tubes replaced by the transistor. Even microwave ovens are switching from magnetrons to LDMOS!

Digital Cameras vs. Kodak film

The sad thing is Kodak invented the digital camera and then lost the market to others.

Apple & the iPhone changed the cell phone industry forever.

Disruptive Technology

What are some amateur examples in our lifetime?

When I received my General class license in 1961, the Drake 1A had been out for 4 years and the KWM-2 for 2 years.

Of the two other hams in my village, one owned the KWM-2 and the other a 75A-4 and HT-32.

A lot of amateurs didn't like "slop bucket", but SSB was clearly winning out over AM by the late 1960s.

Computer Contest Logging – Major Change

- My first contest was a multi-2 160-meter contest.
- Logging was on serialized file cards.
- Calls also recorded on a wall size piece of paper in hopes of minimizing dupes.
- Computer logging has phenomenally improved our contest productivity.

Is there a Hardware Change Occurring?

Superheterodyne architecture is what most of us have known since we were licensed. It was invented by Edwin Armstrong in 1918.

Two interesting products went through the Sherwood lab in early 2008:

Elecraft K3 and an obscure direct sampling receiver Perseus

ARRL reviewed Perseus December 2008

Perseus was completely different, a direct sampling receiver with a “clock” but no “local oscillators”.

Perseus is only a receiver, but it foreshadowed what was coming.

Direct-Sampling Transceiver

- Flex announces 6000 series May 2012
- I first used a 6700 CQWW 160 CW January 2014.
- ARRL 160 CW contest December 2014
- ARRL 10 meter contest December 2014
- Software proprietary (Not open source)

(Latency 163ms to 51ms, filter shape factor dependent)

Apache ANAN 100D & 200D

- Used 200D December 2014 & January 2016 CW contests on 160 meters.
- OEMed out of India
- Software open source by US hams
- New features and bug fixes generally can come within days.
- Latency now under 20ms

In early 2016 two parallel tracks

- The Elecraft (down-conversion) K3S and Flex Radio direct sampling 6700 or Apache ANAN-200D are top performers.
- Both architectures have their advantages.
- Quibbling over a few dB of dynamic range is pointless at this 100 dB level of performance.

(85 dB dynamic range is usually good enough.)

An alternate testing method: IFSS

IFSS = Interference free signal strength

Third-order distortion products can be measured over a range of test signal levels, not just the one point where IMD level = noise floor.

If data is taken starting with distortion = noise floor, and then beyond that into significant overload, we can produce a graph of the overload characteristics.

Unlike legacy (superhet) radios, direct sampling radios produce distortion products at much lower signal levels.

The concept of IFSS is to ignore distortion below BAND NOISE.

Of course band noise varies all over the map from "band to band" and for each location. It also varies from "day to day" to some extent.

Band noise in 500-Hz bandwidth

How does band noise vary by band?

If we take the ITU rural data as a starting point, what is typical?

160 meters:	-87 dBm *
80 meters:	-93 dBm *
40 meters:	-101 dBm *
20 meters:	-109 dBm #
15 meters:	-114 dBm #
10 meters:	-119 dBm #

That's a 30+ dB difference in band noise
* = nighttime   # = daytime

Noise floors equal for both radios

An Interesting Comparison of IFSS *

I decided to compare the K3S and the 6700 by leveling the playing field.

The noise floors were set to be almost identical on 10 meters.

Normalized for -135 dBm noise floor K3S had an IFSS value 4 dB > than 6700

Normalized for -117 dBm noise floor 6700 had an IFSS value 4 dB > than K3S

* IFSS = Interference free signal strength

IFSS comparisons of well behaved radios

The K3S is an example of an excellent superheterodyne radio.
It has excellent phase noise and dynamic range.

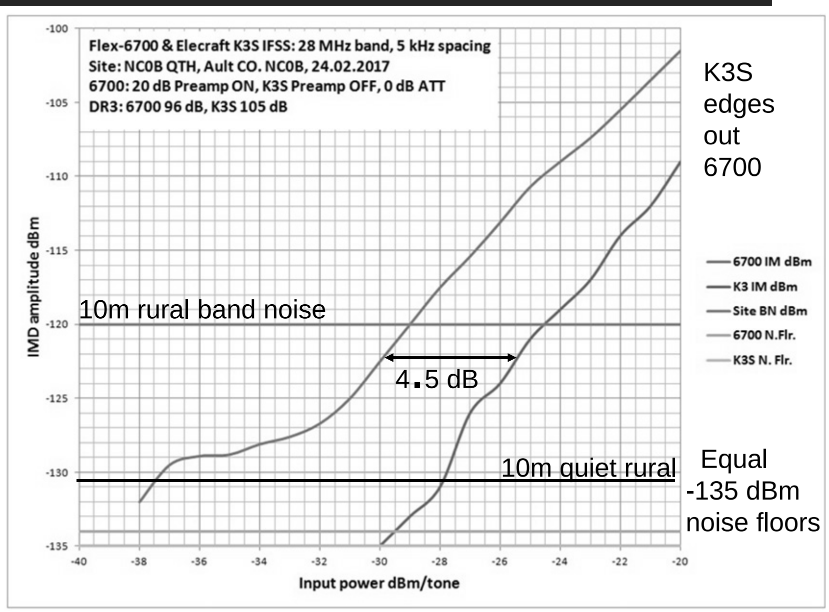
The Flex 6700 is an example of an excellent direct sampling radio.
It also has excellent phase noise and dynamic range.

The following two slides show that two-tone input level vs. distortion products produce smooth graphs.

This indicates that these radios should not exhibit unexpected overload characteristics.

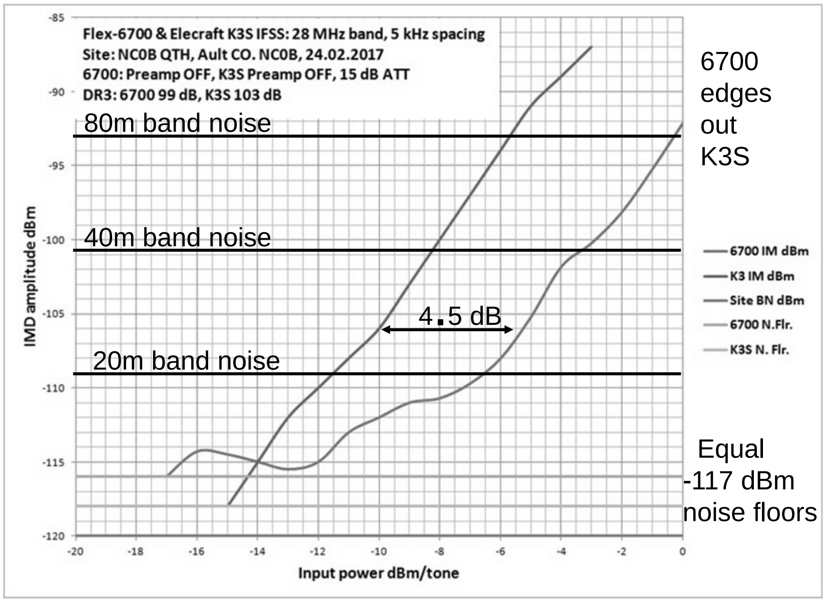
Data by NC0B Graph by VA7OJ

IFSS Chart: Elecraft K3S vs. Flex 6700 10 meters



Data by NC0B Graph by VA7OJ

IFSS Chart: Flex 6700 vs. Elecraft K3S



Not all direct-sampling radios are this well behaved

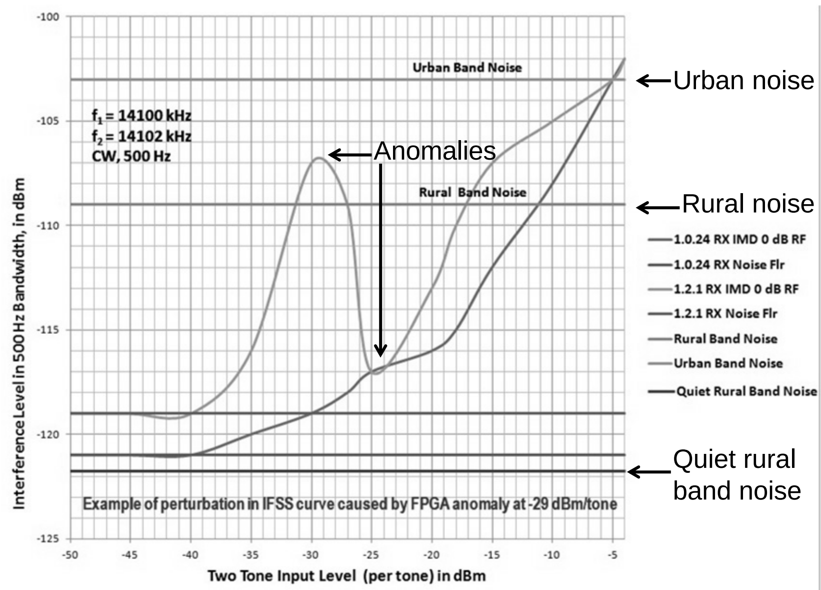
The following two graphs demonstrate direct-sampling IFSS distortion curves that are not as well behaved as the Flex 6700.

"Well behaved" means it should have a monotonic curve, i.e. smooth and does not reverse directions.

Note: The IFSS curve of a legacy (superhet) radio is virtually guaranteed to be monotonic and not reverse directions.

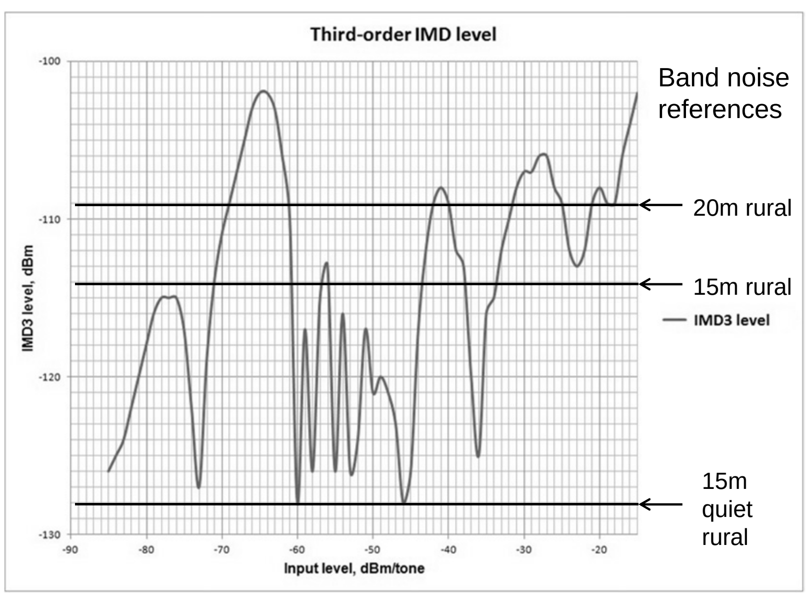
Data by VA7OJ   Graph by VA7OJ

IFSS curve with non-monotonic distortion pattern



Data by NC0B   Graph by VA7OJ

Worst case IFSS data I have measured



Disruption began in April 2016

- First quarter 2016 we had about 18 very good superhet transceivers and a couple of excellent direct sampling SDR radio types that used a computer interface.
- Icom dropped a grenade into the status quo.
- The IC-7300 hit the market at $1495 as a direct-sampling radio with knobs.

Sales of the IC-7300 went through the roof

No dealer could keep the 7300 in stock in April or May.

A mini price war occurred, offering a slightly lower price with possible delivery sometime in June.

Icom delivered 1000 units to their dealers at the Dayton Hamvention, all of which sold out by the end of the show.

Two things are apparent:

Many hams still like radios with knobs.

By summer at a price point of around $1300, the decision to try the new product was easy for 1000s of hams. World-wide sales continued at a stunning pace.

How did it perform?

An entry-level radio plays well

- Lab numbers were good, with some limitations on operating environments.
- Multi-transmitter Field Day would stress the radio, particularly without bandpass filters.
- Contest evaluation would have to wait until the fall of 2016.
- In the mean time, my 7300 was loaned to several hams.

IC-7300 during 2016/2017 contest season at NC0B

CQWW SSB October 2016 (10 meters only)

ARRL 160 meters CW December 2016

ARRL 10 meters CW & SSB December 2016

Stew Perry W1BB 160 meter CW December 2016

CQWW 160 meter CW, 6 hours Sunday January 2017

10-10 Winter QSO Party

ARRL DX SSB March (10 meters only)

How did the 7300 perform in 7 major contests?

In a nut shell, I was stunned how Icom's "Entry Level" Radio performed on both CW and SSB.

160 meter CW contest congestion is severe. For an S&P operator like myself, it can take three hours to tune in each signal and work every new station between 1800 & 1880 for each pass through the band.

At the other extreme, weak signal conditions were the norm for the December ARRL 10-meter contest. Except for a major E Skip opening to the pacific northwest on SSB, much of the time was spent working very weak signals on CW.

101 Qs CW all S&P & 176 Qs SSB

On Saturday afternoon I ran 94 SSB stations in 45 minutes before the sporadic E opening fizzled.

Which 7300 features worked ?

Selectivity is excellent on CW and SSB, and can be easily tweaked.

Used semi-breakin at 26 WPM. 2 relays limit QSK speeds.

All logging with N1MM+

Receive audio very clean and low fatigue

Noise reduction the best I have used to take the edge off of band noise.

¼ tuning speed perfect for CW

Latency under 10ms

Small spectrum scope and waterfall never let me down.

Drove an Alpha 89 or Acom 1000 in all 7 contests.

Does this define “Disruptive Technology” ?

Some sales number comparisons

From April 2016 through January 2017, Icom sold over 10,000 IC-7300 transceivers worldwide.

Over 5000 of those were in the US and Canada, and over 3000 in Europe.

To put this in perspective, Elecraft’s extremely successful K-Line took about 8 years to sell 10,000 radios.

Are we at the cusp of a major architecture change for the majority of ham transceivers?

We may not know for another year or two.

Icom expected to demo the IC-7610 tomorrow.

What has changed in last couple years?

- RMDR* has usually been the practical limit for superhet transceivers except the IC-7851 and the K3S.
- Direct Sampling SDR radios changed that.
- On the other hand, direct sampling radios are a challenge to test since they don’t behave like legacy radios.
- DS SDR front-end selectivity is all over the map
- How do we compare totally different architecture?
- * RMDR=reciprocal mixing dynamic range

What might be coming down the pike?

IC-7610 announced to have a tracking preselector & identical dual receivers for easy split operation in contests and all DXpeditions.

Solid-state T/R switching expected for QSK operation at high speeds.

ANAN 8000DLE promises improved phase noise, 200 watts LDMOS with internal DC to DC converter. (13.8 to 50 volts for PA)

(No expensive custom 50-volt power supply like in TS-990S)

Third-order IMD nominally -70 dB on 20 meters

Integrated Pure Signal for transmit IMD nearly as good as Class A

Dual 16-bit ADCs for up to 7 receivers

What happens long run?

Transceivers we have now:

- Superhets that perform quite well
- (At least a 18 good choices)
- DS SDR radios with Windows or iOS UI
- Flex and Apache 6 models total
- Apache 8000DLE plans to ship by April 1st
- Flex Maestro is a Windows tablet in a box with knobs. Can replace Windows PC
- IC-7300 DS SDR standalone radio with knobs and a small but very sharp LCD display
- IC-7610 ships to the US in July

How will this shake out in the long run?

- Major changes take time.
- Up-conversion-only radios are mostly gone.
- Most everyone wants a bandscope/waterfall.
- TS-590SG has a bandscope port for a dongle with lots of interest in that feature.
- In the long run preselectors went away because up-conversion was cheaper.
- In the long run up-conversion generally failed to keep up with performance demand.

Will DS SDR Prevail?

- There isn't anything inherently wrong with the superhet that has worked for 80+ years.
- K3S & IC-7851 are top performers.
- Cost may dictate DS SDR if it dominates over the next few years.
- Will remote operation due to antenna covenant restrictions and urban noise favor the computer-run DS SDR?
- Will the majority of operators choose a DS SDR with knobs, like the 7300?

The next year will be very interesting

- Has the IC-7300 this past year been a one-time anomaly or just the beginning of a tectonic shift?
- You can get amazing performance for a modest price today.
- There certainly has been disruption in the market price of used equipment.
- Time to contest with something new or simply new to you. Enjoy.

http://www.NC0B.com

Sherwood Engineering

Videos from past CTU presentations: 2013 - 2016

https://www.contestuniversity.com/videos/

CTU 2011, NC0B only, download wmv file

http://www.pvrc.org/webinar/radioperformance.wmv

Glossary – by Patrick Barkey, N9RV

10-minute rule

The 10 minute rule restricts band changes for some multi-operator categories for certain contests. The implementation of the rule depends on the contest -- in some cases it has been replaced by a band change rule. The rule was designed to prevent the interleaving of QSO's on different bands for "single" transmitter categories by stations which actually have multiple transmitters on different bands.

Categories: contest specific concept, operating classification,

See Also: Band change rule, MS, M2, rubber clocking

175 mile radius

A geographic requirement for groups of stations jointly submitting their scores as part of the club competition in ARRL contests. In the “unlimited” category of club competition, stations submitting their scores as part of a club for the club competition must either be within a single ARRL section, or within a 175 mile radius of a centroid, to be eligible to contribute their score to the club total..

Categories: contest specific concept, log checking and reporting

See Also:

3830

The frequency on the 75 meter band where stations congregate at the end of a contest to exchange scores informally. In actual practice, most of this now takes place on internet. The listserv, or reflector, where much of this takes place is called the 3830 reflector. It is hosted by contesting.com. A separate site, 3830scores.com, has comprehensive summaries of (unverified) contest scores reported by participants.

Categories: log checking and reporting

See Also:

4-square

An increasingly common array of four vertical antennas arranged in a square that is electronically steered in four, switchable directions using torroidal or coaxial delay lines. Once used mostly as transmit antennas, particularly on lower frequencies where yagis are not practicable, these arrays are also becoming common as receive antennas. 4-square controllers, which perform the switching, are both homebrew and commercially available.

Categories: station hardware

See Also: Receive antennas

ADIF

Amateur Data Interchange Format. A transport format for contest logs used for inporting/exporting files between different logging software and other programs. Similar in function to Cabrillo.

Categories: operating software/hardware

See Also:

AFSK

Audio Frequency Shift Keying is a RTTY mode where two audio tones are fed into the Mic or auxiliary audio input to the SSB transmitter to create the two RTTY RF frequencies.

Categories: general

See Also:

Assisted

Assisted is an "overlay" category that is interpreted in most contests as meaning that use of spotting information delivered from internet or packet radio based networks which give real-time information on frequencies and callsigns of stations in the contest is allowed. It is a single operator overlay -- most multi-operator categories already allow spotting assistance.

Categories: operating classification

See Also: SOA, unassisted

Band change rule

A rule which restricts band changes for certain multi-operator categories in some contests. A band change rule says that a station can, say, only make 8 band changes per hour. Note that moving to a band to work something, and then returning counts as two band changes.

Categories: contest specific concept

See Also: 10-minute rule, MS, M2

Band Decoder

A band decoder either operates through hardware or software to switch station hardware (e.g., antennas, filters) based upon the band selection of the radio. They are a fundamental part of most top tier stations.

Categories: station hardware

See Also:

Band Edge

The band edge generally refers to the lowest (or highest) frequency in the band where one can legally operate within the limits of his/her license. For US operators, for example, this would be approximately 21200.4, say, for 15 (USB), but would be about 7127 or so for 40 (LSB). The reverse is true for the upper band edge – e.g., on USB on 15 meters the practical limit for transmit frequency is approximately 21448. The lower band edge is sometimes desirable for US operators who are running since QRM from other W stations can only be on one side of your signal.

Categories: operating technique, ethics,

See Also:

Band Map

A graphical, real time display of stations arranged by frequency presented by most popular contest software. The map is either populated by telnet/packet spots from clusters and skimmers, and/or may be filled in using data entered by the user. Most software allows users to then click on stations on the map to be taken directly to the frequency the station is reported to be on. Stations listed on the map are color coded – with new multipliers distinctly noted. (Stations previously worked may not be listed at all). The accuracy of these maps is only as good as the data used to construct it – errors in callsigns are frequently encountered. Use of band maps (or packet/telnet and skimmer spots) are not permitted for Single Operator Unassisted categories.

Categories: operating software/hardware

See Also:

Beacon

Fixed, automated transmitters which transmit signals (typically CW) continuously to allow operators to check propagation. These transmitters are located around the globe and on HF are mostly found on bands such as 10 meters above 28.1 mHz. They typically use low power and omni-directional antennas. It can be good operating strategy to tune to these stations during contests to learn when propagation might support QSO’s even if activity and thus stations in the contest are not heard

Categories: operating techniques

See Also: RBN

Bip/Bop

A hardware switching arrangement for stacked yagis or other all driven antenna arrays that allows the operator to select both in phase (BIP) or both out of phase (BOP) operation. The latter can be dramatically better for very high angles of radiation..

Categories: station hardware

See Also: Stack, Yagi

Blind skimmer

A mode of operation for a CW skimmer that disables the decoding of callsigns as well as the integration with internet spots. In this blind mode, the operator only sees (potentially) a waterfall display showing recent historical activity across the band as with a panadaptor. Blind mode is legal for single operator, unassisted entrants in most major contests.

Categories: contesting hardware/software

See Also: skimmer, panadapater, spots, SOAB, SOA

Breakdown

The disaggregation of one's contest score into QSO's and multipliers worked, usually separately tallied for each band (or even additionally, for each hour).

Categories: log checking and reporting

See Also:

Buffers

To account for latency and jitter, most systems allow for an amount of 'buffering' or 'storing up' packets as they arrive, so that a momentary big swing in either latency or jitter won't interrupt the flow of conversation. Too many buffers introduces extra time and can make transmit / turnaround times grow to be an annoyance in contest situations

Categories: remote radio

See Also: Latency, Jitter

Bust

A bust is a QSO that is incorrect in some way -- the callsign or exchange was inaccurately recorded. May also refer to spots which are incorrect.

Categories: log checking and reporting, ethics,

See Also: Spot

Cabrillo

Cabrillo is a very flexible and generalized computer file format that is supported for score reporting by all modern contest software. Most contests have moved to require that electronic log submissions provide contest logs in this format. In most cases contest software will do this automatically.

Categories: log checking and reporting

See Also:

Check

A two digit number that corresponds to the first year that you obtained your ham radio license. The check is part of the exchange in the ARRL SS contest. Multi-operator stations use the same check regardless of who is

Categories: contest specific concept

See Also: Exchange

Checklog

A category for log submissions which removes the entrant from any competition or score listing. Instead, the log information is submitted solely for log checking purposes by the contest sponsor.

Categories: operating classification

See Also:

Claimed Score

The contest score that is computed before any deductions for incorrectly logged information (conducted after the contestant submits the log to the contest sponsor) take place.

Categories: log checking and reporting

See Also:

CODEC

CODE then DECODE. This is the software that puts audio from an analog form into a digital form, and reverses the process on the other end of a link. It is how we send audio over the internet. Without this, VOIP would not be possible.

Categories: remote radio

See Also: VO IP

Cty.dat

Cty.dat, or sometimes wl_cty.dat, also known as a "country file." is the computer file containing the lookup information that translates prefixes of callsigns into country and/or zone multipliers. Software would use this file, say, to tell you that N9RV counts as a W, and is in CQ zone 4 (or ITU zone 6). Since worldwide prefixes are frequently in a state of flux, an up-to-date country file is always desirable. More recent country files also contain data that may help determine a station'szone. Such information can be inaccurate and in all cases operators should gather such information from the contest exchanges themselves.

Categories: operating software/hardware

See Also: Mult, Exchange

Deadline

The latest day that logs can be submitted to the contest sponsor to be included in the competition.

Categories: log checking and reporting

See Also:

Digital Voice Keyer

Hardware which digitally records one's voice for CQ's, contest exchanges and other frequently spoken information. The recording is played back using keystrokes defined by software (or by pushing a button for a stand alone box), thus saving the operator the fatigue of doing it manually. Most modern software uses computer sound cards for this purpose. Older software used specially designed cards (e.g., the DVP by K1EA, the W9XT card) or even a stand alone box.

Categories: operating software/hardware

See Also:

DNS

Domain Name Service or Server. Since humans find it easier to remember names rather than a 12 digit number, we have created names for addresses. The Domain Name Servers keep track of the mapping of names to IP Addresses and provide the number when you put in a 'name', i.e. www.google.com

Categories: remote radio

See Also: IP address, dynamic DNS

DQ

Disqualifaction (DQ) is the disallowal of a contest entry by the sponsor of the contest, for serious rule violations. DQ is a serious step, which can have ramifications for WRTC eligibility and participation in future contests.

Categories: log checking and reporting

See Also: red card, yellow card

Dual-CQ

Dual-Cqing (or dueling CQ's) is supported by some contest software in a SO2R environment, where a CQ is called alternatively on each radio (typically on separate bands). It adds complexity, but can increase your transmitted presence.

Categories: operating technique, operating software/hardware,

See Also:

Dummy CQ

A dummy CQ is a CQ sent out by a SO2R station as a means of holding a frequency (e.g., discouraging others who might start Cqing themselves). Although it sounds just like any ordinary CQ, in a dummy CQ scenario the SO2R station is not prepared to answer responding stations until his/her QSO on the other radio is completed.

Categories: operating technique, operating software/hardware,

See Also:

Dupe

A dupe is a second contact with a station that does not count for additional points. Most contest software will inform you whether or not a station is a "dupe" so you don't waste time working it.

Categories: log checking and reporting

See Also:

Dynamic DNS service

This is a service provided to keep track of your current Dynamic IP address. Since your IP address can change at any time, it's easiest to come up with a name, then have the system keep track of your current IP number. The largest is www.dyn.com – and your router will have an option to communicate with it.

Categories: remote radio

See Also: IP address, router, DNS

Dynamic IP address

Your ISP provides your IP Address on a random basis. As the pool of numbers is limited, they recycle them. This number is assigned to your internet Modem or Router.

Categories: remote radio

See Also: ISP, IP address, Router, Fixed IP address

ESM Mode

Enter Sends Message mode. A concept for logging software that uses the Enter key on the keyboard to accomplish multiple tasks, depending on the context. While this is implemented differently in specific software, the general concept allows the user to press the Enter key at different stages to, say, start a CQ message, respond to a call by sending the exchange, or send one's own call, depending on the context in which the key is pressed. If a program does not enable ESM mode, then pressing a specific key always produces the same result.

Categories: operating software/hardware

See Also:

Exchange

The information that is passed between stations in a contest (in addition to the call sign). In the CQ WW, for example, the exchange is RST and the two digit CQ zone number.

Categories: contest specific concept, operating software/hardware,

See Also:

Firmware

Computer code that controls a device. The code is generally resident in a chip, and can be updated using whatever communications protocols are set up for this purpose. Many contesting devices are now microprocessor controlled, and the ability to update firmware (generally made available by the manufacturer but sometimes customizable by the user) can greatly add to the capabilities and functionality of the device. The Elecraft K3 tranceiver, for example, has a rich and vibrant community developing new firmware to improve its operation.

Categories: station hardware

See Also:

Fixed IP Address

For an extra fee, you may be able to have your IP Address not change. This makes connecting to your device easier since it's number never changes.

Categories: remote radio

See Also: IP address

Flutter

A propagation phenomenon that is characterized by very rapid QSB (fading signal strength), often accompanied by Doppler shift in frequency, which can produce a warbling tone on CW. Signals displaying flutter are most often associated with paths that travel close to or through the auroral zones around each pole of the globe, but during periods of high auroral disturbances flutter can affect almost all signals. For this reason the presence of flutter on a signal gives a useful clue for the callsign of a (possibly weak) station.

Categories: general, operating technique

See Also:

FSK

Frequency Shift Keying is a RTTY mode where the transmitter is keyed directly, similar to CW.

Categories: general

See Also:

Gab

Gab is a feature of many contest software packages that allows computers setup at different operating positions in a multi-operator station to send and receive messages at the keyboard to/from each other.

Categories: operating software/hardware

See Also:

Gab file

Gab file is the record of gab messages recorded by the software during the contest.

Categories: operating software/hardware

See Also:

Gas

A derogatory term that refers to running more transmitter power than is allowed by the terms of your radio license. Some contests (e.g., the CQ WW) limit transmitter power to a maximum of 1500W output no matter what the rules for one's country say.

Categories: ethics

See Also:

Golden Log

A log which survives the contest sponsor's log checking process with zero errors and no change to its claimed score. A golden log is the mark of a careful and skillful operator.

Categories: log checking and reporting

See Also:

Gray Line

The gray line, or daylight/darkness terminator, is a constantly moving circle around the earth where a daylight/darkness transition is taking place. When this circle is over your QTH, potentially enhanced propagation along the terminator is possible, especially on lower frequencies. The timing and potential for gray line propagation depend on a number of predictable (season of the year) and unpredictable (solar conditions) factors. Gray line QSO's can produce new multipliers and/or memorable contest experiences.

Categories: general, operating technique

See Also: long path

Grid Square

An alphanumeric geographical coordinate system, based on the Maidenhead Locator System developed by VHF enthusiasts in 1980, in which the entire globe is divided into equal-sized rectangles which are denoted by alphanumeric codes. E.g., the four digit grid square for N9RV (western Montana) is DN36. Four (or more) digit grid squares have found increasing popularity as contest exchanges, particularly for VHF contests, as they offer both an increased challenge for successfully completing contest QSOs with accuracy, as well as giving universal location information for all countries/states.

Categories: contest specific concept

See Also: exchange, http://en.wikipedia.org/wiki/Maidenhead_Locator_System

Great Circle

The bearing between two points on the globe which minimizes the physical distance is known as a great circle bearing. Thus the great circle bearing for working, say, India from the central U.S. is approximately due north. Great circle bearings can vary considerably from what might be suggested from the Mercator projection maps posted in most grade schools. During most openings on HF, great circle bearings are optimal for directional antennas. Long path (180 degrees different) or skew path (aiming towards the equator) are less frequent, but sometimes better, strategies for aiming antennas.

Categories: general

See Also:

IP address

The Internet Protocol uses numbers as addresses to find machines on the internet. It is analogous to a telephone number

Categories: remote radio

See Also: UDP, IP address

ISP

Internet Service Provider. This is the company that provides your connection to the internet.

Categories: remote radio
See Also: IP address

Jitter

This is the change of the latency over time. It is a particular problem on radio remote control, as the difference in latency can make it difficult to adjust the system which has settings to account for latency. If it changes a lot, you will probably experience some audio dropouts.

Categories: remote radio

See Also: Latency

K3

A popular HF transceiver available from Elecraft that is used by many contesters.

Categories: station hardware

See Also:

Keyboard focus

An attribute of contest software that controls more than one radio at a time. Keyboard focus is the particular radio that your keyboard is entering information for. This is the “active radio” for purposes of logging. If the software is well designed, keyboard focus will flow naturally between radios as the situation requires. In a two radio situation where radio 1 is on 40 meters and radio 2 is on 20 meters, while your radio 2 is CQing your keyboard focus should probably be on radio 1, and vice versa.

Categories: operating software/hardware

See Also: SO2R

LAN

Local Area Network. This refers to any device that is attached to your router, in your home system. Via wired or wireless connections, that is your local network

Categories: remote radio

See Also: Router, WAN

Latency

All of this travel between 2 machines over the internet takes time, and the time delay in internet parlance is referred to as latency

Categories: remote radio

See Also: WAN

LCR

An acronym for Log Checking Report. A report from the contest sponsor to each individual competitor that details the scoring adjustments to their submitted contest log, reflecting dupes, busted calls, NIL’s and other errors. The LCR is very useful as a means of improving your accuracy in future contests.

Categories: general, ethics,

See Also: bust, dupe, NIL

Lid

A lid, generally, is someone whose operating behavior shows a lack of awareness, competence or consideration for other amateurs.

Categories: general, ethics,

See Also:

Lockout

A means of preventing two transmitters from keying or transmitting simultaneously. A hardware lockout accomplishes this task by inhibiting the transmit/key line on the different radios with a lockout circuit. A software lockout does the same thing using software. This prevents the station from violating the rules of the contest. E.g., it could prevent a multi/multi station from having more than one transmitted signal on the same band, or it might prevent a single operator station from transmitting simultaneously on multiple bands.

Categories: operating software/hardware, ethics

See Also:

Long Path

A situation where HF propagation exists between two stations in the inverse direction of the great circle heading. "Beaming long path" means pointing your antenna 180 degrees different from the "short path," or great circle heading, for a particular station. Long path propagation, for example, might allow a North Carolina station to work a station in Hong Kong on 10 meters in the morning by beaming southeast. Depending on the season of the year and the propagation on any particular day, this can be an extremely effective event in a DX contest, allowing for long distance QSOs not possible during short path openings. Gray line QSOs, for instance, are frequently long path. Learning and checking the long path openings, in terms of times, bands and geographies, from your QTH can be very valuable for increasing your multipliers and contest scores in DX contests.

Categories: general, operating technique

See Also: gray line, skew path

M2

Shorthand for the multi-operator, two-transmitter category offered in some contests. This is a relatively new category that was intended to allow greater flexibility that older single transmitter categories, but with less hardware requirements than the open ended multi transmitter category.

Categories: operating classification

See Also: MS, MM

Master.dta

The master.dta, or "master database" file is a collection of so-called "known good calls" -- e.g., call signs of stations that have been worked in previous contests. It can be used as an operating aid with most contest software to suggest complete calls when only partial information is copied over the air.

Categories: operating software/hardware

See Also:

MM

The multi-operator, multi-transmitter category involves an unlimited number of operators and transmitters, with only one transmitted signal allowed per band.

Categories: operating classification

See Also: M2, MS

Moving Multipliers

An operating technique where one asks over the air for a station who is a multiplier (e.g., a new country, state or section) to move (QSY) to a different band so that an additional multiplier can be added to one's score. To be done successfully, there must be propagation between the stations on the new band, and the asking station must be able to move quickly. It is not good contest etiquette to ask a CQ-ing station with a pileup to move bands, but even rare DX that comes back to your own CQ's is fair game for this technique. For contests like SS and WPX that only count multipliers once (instead of once per band) this does not apply.

Categories: operating technique

See Also:

MS

The multi-operator, single-transmitter category found in many contests has evolved to have different definitions in individual contests. Once understood as a "one transmitted signal" category, its exceptions and specific band change rules make it among the most complex, yet most popular, categories.

Categories: operating classification

See Also: 10-minute rule, band change rule

Mult

Most, but not all, contests compute the final score as the product of (i) QSO points and (ii) a tally of zones, countries, prefixes or other unique characteristics. Since they impact the score multiplicatively, this second item is called the multiplier. For example, in the SS contest, the multiplier is the number of unique ARRL sections worked (maximum of 80). Thus when a new (e.g., unique) section is worked, it has a greater impact on the final

Categories: contest specific concept, operating technique,

See Also:

Mult station

The station in a multi-transmitter environment that is working only mulitpliers -- new countries, zones, or prefixes, depending on the contest. This usually entails tuning and answering others who are calling CQ.

Categories: contest specific concept

See Also: S&P, Run station

Multiplier

See the discussion under mult above.

Multiplier Bell

A frequently used motivational device for multioperator contests. The sound of a bell going off in a room of operators when a new multiplier is worked by one of them manning different radios is familiar to many successful multi-operator stations.

Categories: operating technique

See Also:

NIL

Not-in-log. A deduction made by the contest sponsor that refers to the situation where a contact claimed by one station is not confirmed by a record in the second station's log. In most cases an NIL results for you when there is nothing even "close" to your call in the other station's log at the time you claimed the contact.

Categories: log checking and reporting

See Also:

Off-by-1

A "one off" call is a call that differs by one character -- W9RV, N7RV, and N9RE are all one off calls for N9RV.

Categories: log checking and reporting

See Also: SCP

Off-time

Off-time is the amount of time during the contest period that a station is off the air -- no listening or transmitting taking place. Some contests (e.g., Worked All Europe, ARRL SS) require that single operator entrants take a minimum amount of off time. Off time lengths are usually restricted to a minimum block size (30 minutes in SS, for example).

Categories: contest specific concept, operating technique,

See Also: Rubber clocking

Online scoreboard

A web site that delivers real-time score information of participants in a contest, such as those at cqcontest.net . In most cases these scoreboards are designed to seamlessly interface with contest software at participating stations so that one can see at a glance the relative standings of the competitors in any category. Participation in live scoreboards is gaining popularity, but some have questioned whether or not the use of such information during a contest is consistent with unassisted operation.

Categories: operating hardware/software

See Also: unassisted

Packet

Packet originally referred to packet radio spotting networks, which were an application of (typically) VHF packet radio networks that were created in the late 1980's as a means of exchanging real-time spot information during contests. The rise of high speed internet since that time has caused almost all of these networks to migrate to the net, greatly increasing their speed and scope. Although no real connection to packet radio networks still exists, the term "packet" has survived, referring to spotting networks in general

Categories: operating software/hardware, operating technique

See Also: spot

Panadaptor

A band scope that displays signals on a band visually, usually as a line or area graph, allowing for a view of activity across an entire band at once. The display show signal strength on the vertical axis and frequency on the horizontal, and is sometimes combined with a waterfall display which presents a brief historical view of activity on a frequency instead of an instantaneous view. This can be a stand alone piece of hardware, integrated into a radio, or software produced by a product like a skimmer.

Categories: contesting hardware/software

See Also: skimmer

Partial

Partial calls are bits and pieces of full callsigns. They contain valuable information but cannot be logged until they are complete.

Categories: operating software/hardware, operating technique,

See Also: SCP, Super Check

Pass

Passing is an action where a station worked on one band is requested to QSY to a second band, typically in order to obtain additional multiplier credit. Proper contest etiquette holds that only stations who respond to your CQ can be passed -- it is not good manners to ask a station who has established his or her own running frequency to QSY to another band.

Categories: operating technique, operating software/hardware,

See Also:

Penalty

Penalties are additional deductions made for unverified or inaccurate information submitted as part of one's claimed score. For example, a NIL in the ARRL SS contest results in the loss of the claimed QSO as well as an additional penalty QSO deducted. Penalties and other score reductions are incurred by all contest competitors, both new and experienced, and are generally nothing to be ashamed or fearful of. Part of contest competition is acquiring operating habits that minimize these deductions.

Categories: log checking and reporting

See Also:

Pileup

Multiple stations calling a CQing station at the same time. Modest pileups are concentrated on a single frequency. Rare DX might result in a pileup that is spread out across multiple frequencies. The skill of picking calls out of a pileup, or alternatively, successfully breaking through a pileup to get a CQing station to respond to your call, is a critical contest skill.

Categories: operating technique

See Also:

Poaching

Poaching is when a third station strays onto the frequency of a station who is running in order to make contact with one of the responding stations. If N9RV is running stations on 14024, say, and you attempt to call one of the stations that he has just worked, you are poaching. As the term implies, this is aggressive and unethical contest

Categories: operating technique, operating software/hardware, ethics

See Also:

Point and shoot

Also known as point and click. A refinement of the search and pounce operating method which is supported by most major logging software programs. With this method, the operator clicks on calls presented in a window on the monitor, so that the frequency of the radio is immediately changed to the frequency of the call which is listed. Thus one may quickly hop around the band, each time landing on the frequency of a CQing station who can be called. The technique is only allowed for operating categories which allow access to packet/internet spotting networks. The technique, while very attractive, has two major difficulties: (i) calls which are spotted may be incorrect – unless one independently verifies the call one runs a very high risk of incurring penalties for busted QSOs, and (ii) when dozens or hundreds of stations in a contest use this technique simultaneously, it results in big pileups calling on exactly the same frequency, which are hard for CQing stations to disentangle.

Categories: operating technique, operating hardware/software

See Also: S&P, spot, bust, skimmer

Points per q

The number of QSO points that any particular contest contact contributes. In some contests, for example the NA Sprint or ARRL SS, the points per QSO is constant. Most DX contests employ points per q rules that give more credit for contacts outside your continent. Some give zero points for contacts within your own country.

Categories: contest specific concept, operating technique,

See Also:

Prec

Part of the exchange in the ARRL SS contest. It consists of a single letter, once soley based upon your transmitter power: Q = 5 watts or lower, A = 5-100 watts, B = more than 100 watts. Recently additional Prec's were added for multi-operator and assisted categories. See rules for ARRL SS contest.

Categories: contest specific concept

See Also: Exchange

Port

All internet traffic travels to the IP address of your home, which all comes to your router. Once it arrives, it has to ‘announce’ what type of service it is for… some is for a Web Page, another type is for VOIP, or control of a device such as a remote radio setup. Each type of service has been assigned a ‘number’ which gets sent to the device that is handling the particular service of the packet. The word ‘port’ has been given to this ‘service type’.

Categories: remote radio

See Also: IP address, Router, VOIP

Port forwarding

Once a piece of traffic arrives at your router, it may or may not need to be ‘forwarded’ to a particular device on your LAN, the devices in your home. For REMOTE CONTROL, this will be a particular PC or Device, such as a RemoteRig box. The router needs instructions on where to send a ‘packet’ depending on which device on your LAN is handlng that ‘Port’.

Categories: remote radio

See Also: Router, LAN, TCP/IP, Port

Prefill

Prefill refers to the features of some software packages which automatically fill in exchange information based upon information obtained either before or during the contest. Prefill software might enter "Pat" in the name field for the NA Sprint, for example, if you work N9RV, either based upon previous contests, or based on working N9RV on a different band in the current contest. If the prefill information is different from what the station actually changes, of course, it is up to the operator to manually correct it.

Categories: operating software/hardware, operating technique,

See Also: Exchange

Prefix

The portion of a callsign that contains the beginning of the all, up to, and including, the number. The prefix of N9RV is N9. The prefix of 3DA0X is 3DA0. Prefixes count as multipliers in some contests – e.g,, the WPX contest. In most cases, prefixes also reveal the geographical location of the station as well.

Categories: general

See Also:

QRP

QRP in contesting is generally where one's maximum output power is no more than 5 watts. In many contests, power is an overlay category. E.g., you can be QRP and SOAB.

Categories: operating classification

See Also:

Q-signals

A three letter code beginning with the letter Q. In theory, each code has a slighly different meaning when used with a ? appended. ARRL and other groups publish the codes and their text meaning. In contesting only a few of these codes are used, sometimes in ways that have evolved from their "official" meaning.

Categories: general

See Also:

Qso b4

QSO b4 is the CW message sent to tell responding stations that they have been worked for point credit previously in the contest and no second QSO is necessary/desirable.

Categories: operating technique

See Also: Dupe

Rate

Rate refers to the speed of making contest QSOs. It is typically measured in QSOs per hour, even when the time span referred to is longer or shorter than 60 minutes. E.g., if N9RV's 10 minute rate is 70.4, it means that if he continued to make QSOs at the same rate for 60 minutes as he just made in the last 10, he would have 70.4 QSOs in the log. The rate statistics provided by most contest software give valuable information on operating

Categories: operating technique, operating software/hardware,

See Also:

RBN

Reverse Beacon Network is a internet-based network of dedicated wide band receivers around the world which decode CW signals in real time and generate "spots" which contain frequency, signal strength and other information. The effect is that of a traditional beacon in reverse – instead of checking propagation by tuning one's receiver to a transmitting beacon at a particular frequency, one merely transmits (usually by calling CQ on CW) while connected to a RBN to see which of the receivers on the network hears you.

Categories: operating software/hardware

See Also: spot, skimmer, skimmer network, beacon

RDF

Receiving Directivity Factor is a measure of receiving antenna performance which compares the forward gain of an antenna at the desired azimuth and elevation grade to its average gain over the entire hemisphere (thanks W3LPL for this definition).

Categories: station hardware

See Also: receive antenna, receive diversity

Receive Antenna

Generally refers to an antenna that is used for receive purposes only – e.g., not the same as the transmitting antenna. These include specialized antennas, such as loops, short verticals, pennants or beverages. Receive antennas can be used singly or in combination – e.g., fed into separate receivers simultaneously – the latter is used for what is known as diversity reception. Most modern receivers allow for this. Receive antennas are often non-resonant, and are of particular advantage on lower frequencies to improve directivity and the signal to noise ratio.

Categories: station hardware

See Also: 4-square

Receive Diversity

The practice of using two antennas, each feeding a separate receiver locked onto the same frequency, to better capture a weak signal. This frequently is an advantage due to the differences in polarization, wave angle, noise susceptibility and other characteristics of propagation at any time. Receive diversity is especially important on the low bands where signal to noise ratios are low. Common practice feeds the audio from each receiver into a separate ear.

Categories: station hardware

See Also: receive antenna, RDF

Remote Operation

This generally describes a situation where the physical location of the transmitter/receiver is different from that of the controlling operator. This can be supported by software that allows receiver audio and other information to be sent to a remote computer (possibly located thousands of miles away) that also controls transmit, rotor, and other station functions. Contest and DX rules are still evolving on the validity of this configuration. Most seem to allow remote operation as long as the transmitters and antennas are in a single physical location.

Categories: station hardware, ethics

See Also:

Robot

The contest robot, or simply “robot,” refers to the automated process that examines contest logs that are submitted to contest sponsors (either via email or a web page) for proper syntax and formatting. Most contest robots will “bounce,” or reject with error messages, logs which fail to conform to the proper Cabrillo format, fail to include required information, or which contain other errors.

Categories: log checking and reporting
See Also: Cabrillo

Router

The internet works by sending ‘packets’ across the house or around the world using ‘routes’. It hands off a packet with a destination address to its nearest ‘neighbor’ router, and it then has instructions of how to reach the destination. Sometimes there can be a dozen or more ‘routers’ involved in reaching the ultimate destination.

Categories: remote radio

See Also: WAN, TCP/IP

Rover

A rover is a mobile station that travels during a contest to activate multiple geographic locations (typically grid squares) during the course of a contest. Rover stations are especially common in VHF contests, and often involve sophisticated setups that can activate multiple bands as well as high profile (elevation) locations. Rovers can make the contest more fun for everyone by making more multipliers available and thus adding to contest scores. The so-called “captive” rover refers to a rover whose express purpose is to work only a single competitor. The ethics of this variant to the rover concept is dubious at best.

Categories: operating classification, ethics

See Also:

Rubber Clocking

A slang term used to refer to the adjusting of times in the contest log to make QSOs appear to conform to the rules of a category and contest. This includes, for example, to make reported off-times in time-limited contests such as the ARRL SS conform to rules that require them to be at least 30 minutes in length, or making times of QSOs appear to obey the 10-minute rule for multi-operator categories in DX contests. Such changes are unethical and not allowed by contest rules and are grounds for disqualification.

Categories: ethics, log checking and reporting, contest specific concept

See Also: DQ, red card, yellow card, 10-minute rule

Run

Running refers to staying on one frequency and calling CQ to solicit new contacts. Running may, or may not, be the fastest way to make QSOs and/or build your score at any given time. Whether or not to run is a fundamental decision made during the entire duration of a contest.

Categories: operating technique

See Also: Run station

Run station

The station in a multi-transmitter environment that is "running" stations -- e.g., calling CQ and taking all who

Categories: contest specific concept

See Also: Running

S&P

Search & Pounce is the operating method where one tunes a band and responds to other stations who are running (e.g., calling CQ). The "traditional" tuning by spinning the receiver knob has been augmented by contest software that allows one to jump instantly to a spot frequency (for categories which allow this) and more recently through the use of panadaptors and other visual displays that allow operators to jump to a frequency based on visual

Categories: operating technique

See Also: spot, point and shoot

Schedule

Schedules are advance arrangements to make QSO's with specific stations at specific frequencies and times. Schedules are often made during a contest to try to work additional multipliers on times and frequencies when propagation is favorable. E.g., N9RV may work NH2T on 15 meters at 0100z and set up a schedule for 40 meters on 7030 kHz at 0700z. When 0700z rolls around, if NH2T and N9RV remember to go to 7030 kHz and they hear each other, a new QSO (which may be a new multiplier for one or both) can be made. Schedules made on the air during the contest can be an important and effective contest tactic. Schedules made via non-amateur means (e.g, email) and/or schedules made before the contest starts are not allowed by most contest rules. Even if rules do not explicitly forbid it, such practices are not considered ethical and should be avoided.

Categories: operating technique, ethics

See Also: mult

Sec

Abbreviation for ARRL section. Loosely corresponds to US states and Canadian provinces, but larger entities (e.g., NY or California) are divided, resulting in a total of 80 sections. Sections count as multipliers for some ARRL contests.

Categories: contest specific concept

See Also: Mult

Serial Number

A counter that begins at 1 for the first contest QSO, and increments by 1 for each successive contact. The serial number is part of the exchange for some contests (e.g., the CQ WPX, the Worked All Europe contest).

Categories: contest specific concept

See Also: Exchange

Single-Band

Competitors in the single band categories restrict their competitive efforts to one frequency band (e.g., 40 or 20). In some contests they are allowed to make contacts on other bands, but only their "single" band QSOs count towards their score.

Categories: operating classification

See Also:

Six-Pack

A six pack is a relay controlled matrix coax switch with two inputs and six outputs. It is used by many stations who use SO2R as a means of allowing either station to have access to any antenna. Newer variants of matrix switches allow for more than six outputs, but the term has stuck.

Categories: station hardware

See Also:

Skew Path

A propagation phenomenon where the ionosphere does not support direct-line propagation (along a great circle heading) between two stations, but contacts can be made by aiming closer to the equator (due east or west) so that the path is skewed, so that the first hops travelling in a more southerly direction (for northern hemisphere stations). For a North American station, for example, a skew path opening to Japan might make signals peak due west or even south of west. Skew path openings can take place at frequencies below the MUF, or maximum usable frequency, between two points on the globe, which is often the case under poor propagation conditions. Turning your antenna to explore skew path propagation is a very useful technique that can make a previously inaudible signal suddenly appear and make a QSO possible.

Categories: general, operating technique

See Also:

Skimmer

A CW Skimmer is a product developed by VE3NEA which combines a CW code reader with a broadband receiver, providing real time spotting information without the use of a spotting network.

Categories: station hardware, operating software/hardware, ethics

See Also: skimmer network

Skimmer Network

The global network of internet-connected skimmer stations which continuously copy and post call sign, frequency information and signal strength data for ever station they decode (CW and digital modes). The data stream can be used in real time by a variety of applications and contest programs to allow "point and shoot" operating during contests. Note that unassisted categories are not allowed to access skimmer networks.

Categories: station hardware, operating software/hardware, operating technique, ethics

See Also: skimmer, point and shoot

SO1R

Single operator single radio is not a formal category in most contests, but describes the less complex hardware/software setup where the operator tunes and transmits on one radio at a time.

Categories: operating classification, operating technique,

See Also:

Snow/rain static

QRN caused by electrically charged precipitation hitting antennas. Low antennas and quads are usually less susceptible than high yagis.

Categories: general

See Also:

SO2R

Single operator two radio operation involves using audio feeds from two radios simultaneously (but with only one transmitted signal at a time allowed), which enables an operator to tune and listen on a second radio (usually on a second band) while the primary radio is transmitting.

Categories: operating classification, operating technique,

See Also: Dual-CQ, Dummy CQ

SO2R Controller

A homebrew or commercially made accessory which automates the switching of station peripherals (e.g., headphone audio, key paddle input, microphone) between two radios to enable more effective and efficient two radio operation. These accessories typically integrate with contest software to manage two radio operation as seamlessly as possible.

Categories: station hardware, operating software/hardware

See Also: SO2R

SOA

Single operator assisted is a single operator category where packet/internet spotting assistance is allowed (see Assisted).

Categories: operating classification

See Also: Assisted

SOAB

Single operator all band is an operating category common to most contests. In most contests, packet/internet spotting assistance is not allowed, but the WAE and some other contests allow it. Due to the popularity of internet assistance, and the difficulty in detecting the (intentional or unintentional) use of this assistance by contest sponsors judging the results, this situation is changing. This category is sometimes referred to as "SOAB Classic" to reflect its legacy to the pre-spotting era. In all cases a single person is responsible for all operating and logging during the contest.

Categories: operating classification

See Also:

SOHP

Single operator high power refers to a SOAB, SOA, or SOSB station that runs more than 100 watts output from the transmitter.

Categories: operating classification

See Also:

SOLP

Single operator low power is a single operator who runs a maximum of 100 watts output.

Categories: operating classification

See Also:

SOQRP

Single operator QRP stations run a maximum of 5 watts from the transmitter.

Categories: operating classification

See Also:

SOSB

Single operator single band is a single operator station who operates a single band. It also may mean unassisted, although this is ambiguous.

Categories: operating classification

See Also:

SOU

Single operator unlimited is used interchangeably with single operator assisted as described above. Unfortunately, both terms "unlimited" and "assisted" have connotations (especially when translated frorm English) that are inconsistent with their intended meaning. They both are supposed to denote a single operator who receives spotting assistance via packet radio or internet.

Categories: operating classification

See Also: SOA, Assisted

SPG

Single point ground is a lightning protection practice that physically binds all of the entry wiring into a house/shack to a single ground -- e.g., RF, AC power, water pipes, telephone.

Categories: station hardware

See Also:

Split

Describes the situation where a CQing station is listening on a frequency that is different from his/her transmit frequency.

Categories: operating classification, operating technique,

See Also:

Sporadic E

Propagation that utilizes the E layer of the ionosphere. Since this layer is inconsistently ionized and is lower than the F layers that support more reliable HF propagation, such propagation is more rare. When it occurs (usually in the summer months) it can support long distance QSOs especially on 10 and 6 meters.

Categories: general

See Also:

Spot

A spot generally refers to a posting of information on the frequency and callsign of a station in the contest, usually received from an internet or packet radio network.

Categories: operating software/hardware, operating technique,

See Also: Assisted

Sprint

A short contest that emphasizes frequency agility. The original Sprint contest is the North American Sprint, held in February and September of each year, sponsored by the National Contest Journal. The most unique aspect of Sprint contests is the QSY rule – when a CQing station receives a response, they must QSY and leave the frequency to the calling station at the end of the QSO. Thus sprint contests do not allow the "running" of stations on a single frequency that is characteristic of most other contests.

Categories: operating classification, operating technique,

See Also:

Stack

A stack generally refers to two or more yagi antennas which are pointed in the same direction, aligned vertically on a tower or mast, and fed (typically) in phase to increase gain and better control the take-off angle of the antenna system's forward lobe.

Categories: station hardware

See Also: Bip/Bop

SteppIR

A commercially manufacturer yagi which works on multiple bands. The antenna elements consist of hollow fiberglass tubes which support a conductive ribbon that is adjusted in length with microprocessor controlled motors.

Categories: station hardware

See Also Yagi

Super check

Super check is another term for super check partial, as described above.

Categories: operating software/hardware

See Also: SCP

SWL

A station that only listens and does not transmit. This may be because the operator is not licensed to transmit. There is a long tradition of short wave listening (SWL) enthusiasts who compete for awards in a manner very much like amateur radio.

Categories: general

See Also:

TCP/IP

Transmission Control Protocol / Internet Protocol. This is how the internet does what it does. Developed by the Department of Defense in the 1970's to communicate between defense sites, it has grown into what we call The Internet. It delivers 'packets' of information, using an address, from one point on the network to another, which is now worldwide.

Categories: remote radio

See Also: UDP, IP address

UBN

An acronym for "unique, bad, not-in-log" which became slang for a log checking report.

Categories: log checking and reporting

See Also: LCR

UDP

Uniform Datagram Packet. The type of packet used to control a remote radio and send audio. These provide the fastest transmission time between 2 points. No error correction and highest priority. The other type you will see in nomenclature is TCP. This is an 'error corrected' packet, and one which can take a 'back seat' to other VIP packets. Not good for 'real time' applications.

Categories: remote radio

See Also: TCP/IP

Unassisted

Unassisted is the opposite of assisted, in that the use of spotting information delivered from internet or packet radio networks that is allowed in the latter is not allowed. It is a single operator overlay -- most multi-operator categories already allow spotting assistance.

Categories: operating classification

See Also: assisted, SOA

Unique

A claimed contact that is unique to all of the submitted logs in a particular contest. Such calls are much more likely to have been incorrectly copied.

Categories: log checking and reporting

See Also:

Unique+1

A unique+1 is a call that is (i) "one off" from a unique call and (ii) is a call of someone who was active in the contest. If you claimed contact with N9RU, and no one else in the contest worked N9RU, it is a unique. If N9RV was active in the contest, that is a unique+1. (N9RD might also be a U+1 if he was active).

Categories: log checking and reporting

See Also:

Unlimited

Unlimited means the same as assisted -- e.g., spotting network assistance is allowed.

Categories: operating classification

See Also: Assisted, SOA, SOU

VOIP

Voice Over Internet Protocol. Audio travels over the internet using this technique.

Categories: remote radio

See Also: TCP/IP, IP address

WAN

Wide Area Network. This refers to the network beyond your router, outside of your home. In general, this can be called the internet.

Categories: remote radio

See Also: Router

Waterfall Display

A useful mode of a panadaptor which gives an animated depiction of band activity over the chosen frequency range. In a waterfall display, received signals show up as solid points at a spot on a horizontal display that indicates their frequency. The pattern of the points gives visual information about what kind of signal it is – e.g., a carrier, a station sending CW or some other mode.

Categories: station hardware

See Also: Panadaptor

WRTC

World Radio Team Championship. Begun in 1990 at the World Cup Games in Seattle, the WRTC is a unique competition that occurs approximately every four years in July coincident with the IARU contest. WRTC assembles the competitors – two-person teams drawn from the top operators worldwide – in a single physical area, using identical antennas and power levels, to present a more level playing field in the competition. WRTC's have been held on three continents and in five different countries. WRTC 2018 will be held in Germany.

Categories: general

See Also:

WWROF

The World Wide Radio Operators Foundation is an independent organization committed to supporting radio contesting worldwide.

Categories: general

See Also:

Yagi

A directional antenna typically consisting of a dipole element that is directly fed by the transmitter and a number of closely spaced "parasitic," or indirectly energized, elements which re-radiate RF energy to produce a directional pattern.

Categories: station hardware

See Also:

Notes

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