·CTU·
CONTEST UNIVERSITY

Dayton Contest University
May 16, 2013
Crowne Plaza Hotel
Dayton, Ohio



HF

VHF

UHF



IC-7410 HF + 6m

100 Watt Output (40W AM)
RX: 0.030–60.000MHz*
32 Bit Floating Point DSP Unit
+30 dBm 3rd Order Intercept Point*
Double Conversion Superheterodyne System
Built-in 15kHz 1st IF Filter (Optional 3kHz/6kHz)
USB Port for PC Control and Audio In/Out



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Digital Twin Passband Tuning
USB Port for PC Control and Audio In/Out
Flexible Selectable Filter Width and Shape
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50W on 2M (20W AM),
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Digital Voice Recorder
Front Panel Separation
with Optional 3.5m
or 5m Cable (As Shown)



IC-9100 HF + 6m + 2m + 70cm + 23cm[1]

100/100/100/75/10[1] Watt Output[3]
RX: 0.030–60.000[2], 136.000–174.000[2],
420.000–480.000[2], 1240.000–1320.000[2,3]MHz
AM[3], FM, SSB, RTTY, CW, & DV[1]
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Double Conversion Superheterodyne
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*Frequency coverage may vary. Refer to owner's manual for exact specifications. [1]Optional UX-9100 required. [2]HF (14MHz) [3]See manual for AM output power.

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- 15MOWA-36, 15M7OWA-48, 15M8OWA-72
- 17MOWA-36, Inquire for other custom boom lengths
- 20MOWA-24, 20MOWA-36, 20M6OWA-48, 20M7OWA-72
- 30M1, 30M2-Moxon, 30M3V-Yagi, 30M3-36, 30M4OWA-36
- 40M1, 40M2-Moxon, 40M3V-Yagi, 40M4OWA-48, 40M5OWA-72
- 80M1-Tornado, 80M2-Moxon, 80M3V-Yagi, 80m4OWA-96

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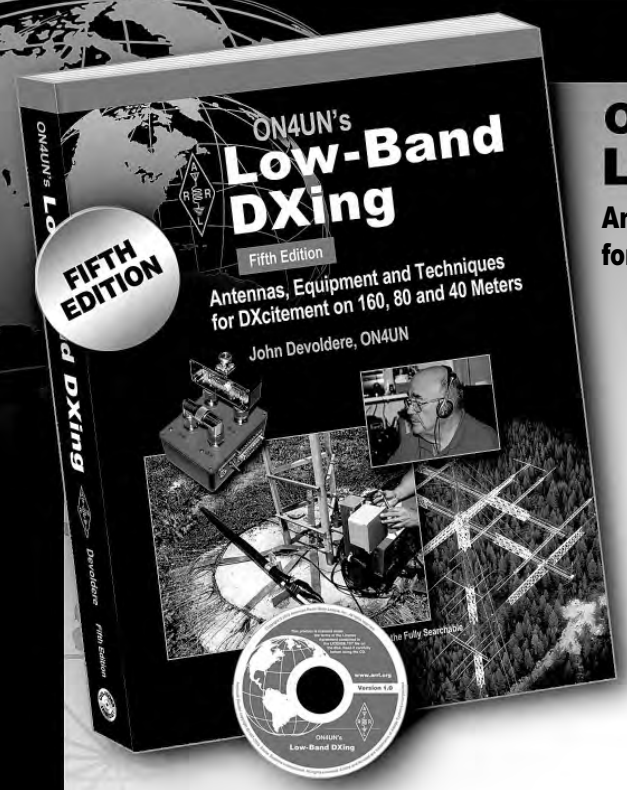
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CTU
CONTEST UNIVERSITY

May 16, 2013
Crowne Plaza Hotel
Dayton, Ohio USA

First Edition

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Welcome

On behalf of the CTU Board of Directors K1DG, N9JA and K1AR and the 13 Professors of Dayton Contest University 2013, we are pleased to extend a warm welcome to you!

This is the 20th Contest University. Seven have been held here in Dayton, two in South America (Brazil), ten in Europe (England, Germany, Finland and Italy). CTU Australia occurred this past in February.

Over 20 presentations are available here at Dayton Contest University 2013. They are the work product of many hours of hard effort by your Professors and the CTU staff (special thanks to W9PA, W3TX, W3YQ, N9RV 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. SuperBertha.com, CQ Magazine, ARRL, DX Engineering and INRAD 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, this is a work in process for all of us. 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 Universities in the future.

Always – Share, Learn, Enjoy and Encourage!

Very 73!

Tim Duffy K3LR
CTU Chairman

2013 Dayton Contest University "CTU" COURSE SCHEDULE – 7:00 AM to 5:00 PM

7:00 ALL SALON A & B – Student Registration and Buffet Breakfast – ALL – 60 minutes
8:00 ALL SALON A & B – Welcome to CTU 2013 – K3LR – 10 minutes
8:10 ALL SALON A & B – Radio Sport Contesting, It's More Than Rules – K5GN – 40 minutes

9:00 - CONTEST TOPIC SESSION #1 – attend ONE of 4 sessions – 60 minutes
SALON A – RFI and Ham Radio – K9YC
SALON B – Tips on Being a Better Single Operator – K5ZD
SALON C/D – Post-Contest Log Analyzers – K6MM
HARDING – 2013 VHF Contesting – W5ZN

10:00 ALL - CONTEST SNACK – 15 minutes

10:15 – CONTEST TOPIC SESSION #2 – attend ONE of 4 sessions – 60 minutes
SALON A – Ferrite Transmitting Chokes – K9YC
SALON B – Design, Installation & Maintenance of Antennas, Towers and Rotators – W3LPL
SALON C/D – How to Make your Multi-Op Contest Operation More Effective – K1DG
HARDING – Setting Up for RTTY Contesting – WØYK

11:20 - CONTEST TOPIC SESSION #3 – attend ONE of 4 sessions – 55 minutes
SALON A – How to Operate with Increased Accuracy & Contesting Fair Play – K3EST
SALON B – Contest Antennas and Coaxial Cables – W3LPL
SALON C/D – CW Skimmers, DX Cluster & The Reverse Beacon Network – N6TV
HARDING – Operating a RTTY Contest – WØYK

12:15 ALL SALON A & B - CONTEST LUNCH – ALL - 45 minutes

1:00 ALL SALON A & B – 2013 Eye Ball Sprint Contest **"LIVE"** – K1DG - 10 minutes
1:15 ALL SALON A & B – Station Notebook & Your 2013 Antenna Projects – K3LR – 25 minutes

***1:45 - CONTEST TOPIC SESSION by REQUEST to RERUN** - 50 minutes
*SALON A – As determined by *vote 1
SALON B – K9AY Loop Arrays for Low Band Contesting – K4IQJ
*SALON C/D – As determined by *vote 2
*HARDING – As determined by *vote 3

2:40 CONTEST OPEN DISCUSSION Q&A GROUPs #1 Attend ONE of 4 sessions – 30 minutes
SALON A – Low Band Receive Antenna Discussion Q&A – K4IQJ
SALON B – Propagation Trends 2013-2014 Q&A – W3LPL
SALON C/D – Logging Program Discussion Q&A – K6MM
HARDING – VHF Contesting Discussion Q&A – W5ZN
HARRISON – CW Skimmer, RBN and Contest Computers Q&A – N6TV

3:15 CONTEST OPEN DISCUSSION Q&A GROUPs #2 Attend ONE of 4 sessions – 30 minutes
SALON A – Audio, RFI and Chokes Q&A – K9YC
SALON B – Rotors and Construction Practices Q&A – W3LPL
SALON C/D – Station Design Discussion Q&A – K1DG and K5ZD
HARDING – RTTY Contest Discussion Q&A – WØYK
HARRISON – Operating Contests from Outside the USA and Canada Q&A – K5GN and K3EST

3:45 ALL - CONTEST SNACK – 15 minutes

4:00 ALL SALON A & B – 2013 Contest Radio Performance – NCØB – 50 minutes
4:50 ALL SALON A & B – CTU 2013 Wrap Up and Surveys – K3LR – 10 minutes

*** 1:45 - CONTEST TOPIC SESSION by REQUEST to RERUN**
Students will vote for 3 topics/classes (during lunch) that they missed and would like to have presented again – the top 3 by vote - will RERUN in this time slot

Contest University Professor Bios

Dave McCarty, K5GN
First licensed as WN2GAV at age 14 in 1972, Dave has been an active contester for about 40 years. It started with handling traffic on CW in the NTS, then FD and CD parties. He moved from NNJ to STX while still in high school, and has remained in Texas except for summers in Kansas during his college years and a recent overseas assignment in the Middle East. He is a long time member of the Texas DX Society. With W5KU he has built a competitive single-op station for serious guest operator efforts. He has been a top-ten competitor in domestic and international contests, both at home and abroad, including winning in the NA Sprint and setting a number of records. He has also participated in world-class multi-multi, multi-two, and multi-single teams most recently at K3LR and A73A. This is his first time as a CTU Professor.

Frank Donovan, W3LPL
Frank's contesting career began in 1959 as a 12 year old at the Providence Radio Assn, W1OP/1, ARRL Field Day two miles from his home in Providence, RI. Soon afterwards, he began to build a small contest station on 1/10 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. Immediately after college, U.S. Air Force 2nd Lieutenant Frank Donovan's first military assignment was working with PVRC member W3GN and his multi-multi mentor, W4BVV. W3LPL finished first place USA single operator in four CQ WW CW and four ARRL CW DX contests from 1973-78. His first multi-multi experience was with the 1974 PJ9JT CQ WW CW team. W3LPL multi-multi teams started with a small entry in the 1978 CQ WW Phone DX contest. During the 1982 ARRL Phone DX Contest, two incredible long nights of 10 meter JA runs unexpectedly produced our first USA multi-multi win. Our multi-multi teams have completed nearly one million QSOs and achieved 45 first place USA finishes (so far) out of 137 consecutive entries (without a single missed entry) in the CQ WW and ARRL DX Contests. Frank is a member of the prestigious CQ Contest Hall of Fame.

Ed Muns, WØYK
Ed entered CW and SSB DX contests initially in the early 1970s as a way to work new band/mode-countries for DXCC. His interest evolved from DXing to contesting as his early learning came from multi-multi experience at KØRF. 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 three times, and the world SOHP record in CQ WPX RTTY, having broken that record five times and the world SOHP record in 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. This is his fifth year at CTU delivering the two RTTY presentations.

Randy Thompson, K5ZD
Randy has been licensed and active in contesting since 1973 at age 13. He is an accomplished contester, having multiple single-operator wins in the ARRL Sweepstakes, CQ World Wide DX Contest, and the CQ WPX Contest, among others. He has also competed in four World Radiosport

Team Championships. In addition, Randy is a past editor of the *National Contest Journal* (a post he has held three separate times) and a co-founder of the eHam.net website. Randy was the Director of the CQ WPX Contest from 2008 until 2012, and is currently the Director of the CQ World Wide DX Contest. He is a member of the CQ Magazine Contest Hall of Fame. When not in front of a radio, Randy is in technical sales for an Internet software company.

Doug Grant, K1DG
Doug has been licensed since 1967. Over the years, he has managed to collect plaques for first-place scores in single-op, single-op-assisted, multi-single, multi-2 and multi-multi categories from his own station and numerous host stations. In addition, he was a competitor in 5 WRTC events, winning one gold and two bronze medals. He is past president of the Yankee Clipper Contest Club, past member and Chairman of the ARRL Contest Advisory Committee, member of the CQWW Contest Committee and has chaired the Dayton Hamvention Contest Forum for over 10 years. He is a Director of Contest University and the World Wide Radio Operators Foundation, and Chairman of the WRTC2014 Organizing Committee.

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 single op, breaking his record set in 1996. In 2001 he won first place, single op in the ARRL UHF Contest, setting a new Delta Division record and placed 2nd in the Rover category for that contest in 2000. In June 2009 Team W5ZN entered the Limited Multi-op category with a 6th place finish. W5ZN also has HF contest interests as a regular in the ARRL 160 Meter Contest and ARRL International DX Contest – CW. In 2006 in the ARRL DX Contest he set a new 80 meter record for the W5 call area that held until 2009. In 2010 his claimed score reclaims that record. Joel was President of the American Radio Relay League from 2006 until 2010. More about Joel can be found at w5zn.org

Rob Sherwood, NCØB
Rob was licensed 1961 as novice and general at age 14. He moved to Colorado 1969 after college, and worked for KOA radio as a tech and transmitter/maintenance engineer from 1969 - 1987. He started Sherwood Engineering 1974 offering Drake R-4C mods, and then started testing receivers and publishing the results in 1976. In a way, he invented the concept of a CW roofing filter for a multi-conversion radio in 1976 to fix the R-4C. Rob has published several articles in *Ham Radio Magazine*," and has had the pleasure of speaking at Ham Conventions at Dayton, New Orleans, YCCC, WØDXCC, W9DXCC, and Texas conventions in 2010. He started building his dream ham station on 10 acres in rural Colorado in 2007, presently with 5 towers and 7 mono-band Yagis.

Tim Duffy, K3LR
Tim has been an active contest operator for over 40 years. He has hosted 120 different operators as part of the K3LR Multi Multi DX contest efforts since 1992. 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 over 20 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 30 years. He is a founding member and past multi year President of the North Coast Contesters. K3LR serves as chairman of Contest University (7 years)

and the Dayton Contest Dinner (21 years), chairman of the Top Band Dinner – as well as coordinator of the Contest Super Suite (28 years) in Dayton. He is founder and moderator of the popular RFI Reflector (RFI@contesting.com). He has been a guest on Ham Nation four times. Tim was a member of team USA at WRTC - four times. Tim serves on the board of directors of the World Wide Radio Operators Foundation (WWROF) as Vice Chairman and the Radio Club of America (RCA) as Vice President and a member of the RCA executive committee. Tim is President of the Mercer County Amateur Radio Club (W3LIF) and a Director of the Edmond Amateur Radio Society (K5EOK). Tim was elected to the CQ Contesting Hall of Fame in 2006. He was honored with the prestigious Barry Goldwater Amateur Radio service award by the RCA in 2010.

Jim Brown, K9YC
First licensed in WV in 1955 as WN8FNI, then W8FNI, Jim received his Amateur Extra and First Class Radiotelephone Licenses in 1959. He received his BSEE in 1964 from the University of Cincinnati, with co-op work at WSAZ, WCAW, WLW, Pete Johnson's consulting engineering office, and RL Drake (where he tuned up some of the first TR3s). After college, Jim settled in Chicago, received W9NEC in 1964, K9YC in 2003. He worked briefly for Motorola, taught for five years at DeVry, and spent the remainder of his working life in pro audio. He is a Fellow of the Audio Engineering Society, principal author of all AES Standards on EMC, chair of the AES Technical Committee on EMC, and a contributor to the ARRL Handbook. Active only intermittently from 1960-2003, he has contested from city lots in WV and Chicago since 1957. Jim moved to the Santa Cruz Mountains in 2006, where he has been building a ham station beyond his wildest dreams, and is currently serving his third term on the NCCC board of directors.

Bob Cox, K3EST
Bob was the Director of the CQ World Wide DX contest for over 34 years. He retired from the CQ WW DX contest directorship in 2012. He is an accomplished operator having won many single operator awards. He has been a member of numerous multi-operator teams including W3AU, K2GL, K3LR, KC1XX, W3LPL, PJ4B, N6RO, and many others. He is a member of the CQ Contest Hall of Fame. Dr. Cox, a neurophysiologist, is retired from a position in the medical industry.

John Miller, K6MM
John was first licensed as WV2BQJ in 1958 in Syracuse, NY. He is an active contester, collecting both individual and team awards in several categories over the last 40 years. He enjoys operating all 3 contest modes: CW, SSB, and RTTY. In 1976, John’s career took him to Silicon Valley, where he has focused heavily on Contesting, DXing, and recruiting new operators into the hobby. John is Past-President of the Northern California Contest Club, a founding member of the CW Operators’ Club, a Director of the Northern California DX Club and Director of the Northern California DX Foundation. John also served as co-chair for the 2011 & 2013 International DX Convention in Visalia. He is on the editorial staff of the *National Contest Journal* responsible for the *NCJ Profiles* column. John was a member of the 2010 PJ7E DXpedition to Sint Maarten, relay pilot for the 2012 NH8S Swains Island DXpedition and will be an operator on the K9W Wake Atoll DXpedition in October 2013. His article entitled “The No Excuses 160M Vertical" won the cover plaque award for the June 2009 issue of *QST*. John recently retired. In addition to his four grandchildren, John's interests include website design, piano music composition, and exploring the back roads of the Bay Area on his Harley Davidson motorcycle.

Bob Wilson, N6TV
N6TV aka "TV Bob" is an active CW contester and Win-Test supporter. Licensed almost 40 years, Bob competed at the World Radiosport Team Championship (WRTC) in San Francisco (1996), Slovenia (2000), and Moscow (2010). He earned numerous Top Ten finishes in the CW NA Sprints from his home station in Silicon Valley, a small suburban lot with a single tower loaded with monobanders. Bob was an early adopter of the Perseus SDR and CW Skimmer, and has recently been analyzing signal reports using data from the Reverse Beacon Network (RBN). He voluntarily supports Win-Test users via the Win-Test Reflector, and also helps update the documentation. He participated with K2KW's original "Team Vertical" group (6Y4A, 4M7X), and has been a member of the multi-op teams at HC8N, K3LR, and W7RN.

Dick Jaeger, K4IQJ
Dick was first licensed as KN4IQJ in mid 1959 and upgraded a few months later. He is primarily a CW operator who enjoys DX and contest operation (NAQP, Sprint, Stew Perry, ARRL 160M and CQWW 160M) and is a member of the Alabama Contest Group. He is on top of the SSB/Mixed Honor Rolls, needs only P5 on CW, and has competed 5BWAZ. He has confirmed 254 countries and 38 zones on 160M. Over the years he has operated from PJ4, KH6, ZL, TA, KL7, BV, VS6 and UA3. In his other life, Dr. J. is Professor Emeritus of Electrical and Computer Engineering at Auburn University. He is an IEEE Fellow, Past President of the IEEE Solid-State Circuits Society, former Editor of the *IEEE Journal of Solid-State Circuits*, Founding Editor of *IEEE Micro Magazine* and received the 2004 IEEE Undergraduate Teaching Award.

2013 CONTESTING RELATED EVENTS

May 15 – Wednesday night – Contest Super Suite at the Crowne Plaza opens for the first of 4 nights at 7 PM in the Harding Ballroom. Hosted by Contest University 2013. CTU 2013 Registration is from 8 PM to 10 PM. 10:30 PM Pizza Party sponsored by Contest University 2013 http://contestsupersuite.com

May 16 – Thursday all day – Dayton Contest University 2013 at the Crowne Plaza – 2nd floor. CTU Registration opens at 7 AM. http://www.contestuniversity.com

May 16 – Thursday 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). 10:30 PM QSL Wings and Pizza Party in the Harding Ballroom sponsored by K8CC, K3WW and K3LR. http://www.contestsupersuite.com

May 17 – Friday – Antenna Forum at HARA Arena
2:30 PM – 4:45 PM Room 1 Moderator: Tim Duffy, K3LR:

“How to be Safe when Installing and Maintaining – Antennas, Towers and Supports” – Phil Theis, K3TUF

“Some ideas that I learned while recently constructing the K9CT HF/VHF antenna farm” – Craig Thompson, K9CT

“The Computer Model Design, Construction and Field Results – of the World Radio Team Championship 2014 TriBand Antenna” – Scott McClements, WU2X and Stan Stockton, K5GO

“Getting Things Up! Antennas via Tram, Trolley, Cranes and Man lifts” – John Crovelli, W2GD and Don Daso, K4ZA

May 17 – 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). 10:30 PM “Spurious Emission Band” Live in the Harding Ballroom. 11 PM Pizza Party sponsored by the Potomac Valley Radio Club (PVRC). http://contestsupersuite.com.

May 17 – Friday night – 24th Annual Top Band Dinner at the Crowne Plaza – Presidential Ballroom. Speakers are Tree, N6TR and Bob, K3UL. 7:30 PM – Tickets in advance from http://topbanddinner.com

May 18 – Saturday – Contest Forum at HARA Arena
12:30 PM – 2:30 PM Room 1 Moderator: Doug Grant, K1DG

"Adding remote capability to the existing W1KM multi–multi contest station" – Dennis Egan W1UE

"Who says Sweepstakes isn't exciting?" – Dwayne Allen, WY7FD and Katie Allen, WY7KRA

"Meet the new CQWW Director" – Randy Thompson, K5ZD

"TI5W (9143 Q, 349M) vs. VP2ME (9147 Q, 348 M)" – Mark Beckwith, N5OT, and Kam Sirageldin, N3KS/TI5W

May 18 – Saturday evening – 21st Annual Dayton Contest Dinner hosted by North Coast Contesters at the Crowne Plaza – Presidential Ballroom. Dinner Speaker is Bob Cox, K3EST. Space is limited. Details and tickets are available at http://www.contestdinner.com

May 18 – Saturday 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) with a 11 PM Pizza Party sponsored by the Yankee Clipper Contest Club (YCCC). http://contestsupersuite.com . Harding Ballroom.

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CTU Presents

Radio Sport Contesting – It's More Than Rules

Dave McCarty, K5GN

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The topic:

CHEATING

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Who is this guy?

WN2GAV, NNJ

K5GN, Check 72, STX

A7/M0FGA 59921

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Who are you?

It's an important question, when it comes to contesting.

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Consult the book of Webster!

cheat \ chēt\ v.i.

1 ***a*** **:** to practice fraud or trickery

b **:** to violate rules dishonestly <*cheat* at cards> <*cheating* on a test>

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And from Wikipedia

Contesting (also known as *radiosport*) is a competitive activity pursued by amateur radio operators. In a contest, an amateur radio station, which may be operated by an individual or a team, seeks to contact as many other amateur radio stations as possible in a given period of time and exchange information.

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http://www.wikipedia.org/

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In other words ...

A open massively multi-player on-air real-time intensely interactive game of cooperative exchanges defined by rather arbitrary rules.

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By contrast ...

A multiplayer video game is a video game in which more than one person can play in the same game environment at the same time.

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http://www.wikipedia.org/

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Massively Multiplayer Diablo

- Computer games went from single-player or two-player games played on mainframes to massively-multi-player on-line in the mid-90's
- One notable entry in this revolution was Diablo, by Blizzard Entertainment



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www.blizzard.com

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Diablo and the Cheaters

- Diablo's design was cutting-edge and was hugely popular
- People spent hours and hours building the capability of their on-line characters
- Then, cheaters found how to be just as powerful without the effort
- They found ways to circumvent key rules
- Sales plummeted as the users grew disenchanted

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http://www.stanford.edu/group/htgg/cgi-bin/drupal/sites/default/files2/akuo_2001_2_0.pdf

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The result for Diablo

- Popularity lost – *people opted out*
- *Clean players went to the dark side* – if you can't beat them join them



- Blizzard had to change the game *(change the rules)* to block the cheats

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http://www.gamesdomain.com/gdreview/depart/jun97/diablo.html

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How did we use to cheat?

- Excessive power
- Rubber clocking
- Feeding calls
- Listening in on the 2m spotting net



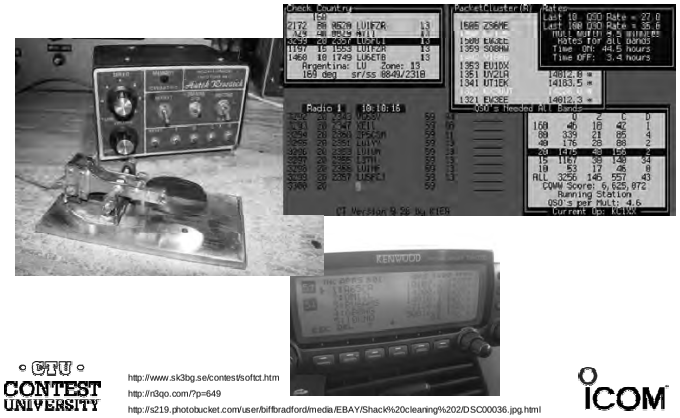


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Photo Credit: N6TR
http://www.scribd.com/doc/98449733/

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Ye Olde Game Changers



http://www.sk3bg.se/contest/softct.htm
http://n3qo.com/?p=649
http://s219.photobucket.com/user/biffbradford/media/EBAY/Shack%20cleaning/%202/DSC00036.jpg.html

The New Game Changers



http://www.sk3bg.se/contest/softct.htm
http://www.dxatlas.com/
http://www.dxsummit.fi/
http://www.reversebeacon.net/

What's new on the dark side?

- Linking separate operating sites
- New ways to hack the spots
- Chat rooms
- Remote receivers



ON4KST
The low band, VHF, UHF and microwave chats

Photo Credit: Karen McCarty

How do people decide to cheat?

Let me count the ways...

- Everybody does it
- I like being an outlaw
- It was exciting to push the rules
- Nobody was getting hurt
- Nobody was watching
- Rules don't mean much to me, I'm bigger than that
- It doesn't make a difference anyway
- Little to lose and much to gain by it
- It helped me overcome my unfair disadvantage
- I had to do it to win!
- The rules weren't clear but it seemed to me it might allow it
- The rule I broke was unfair anyway

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Hat tip: AB7E

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Which ways tempt you?

- Many of us are well-trained, morally
  - And well-practiced at rationalizing
- Others don't see this as a moral issue
  - So we make judgments based on peer norms and cost-benefit assessments

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Everybody does it

- K5**, NR5*, IQ2*, IR4*
- A little "evidence" easily becomes a widespread suspicion - "That guy is loud. He beats me all the time. Must be running power. Better get me a big amp."
- But the truth is that not everybody does it
- In fact the top competitors don't do it

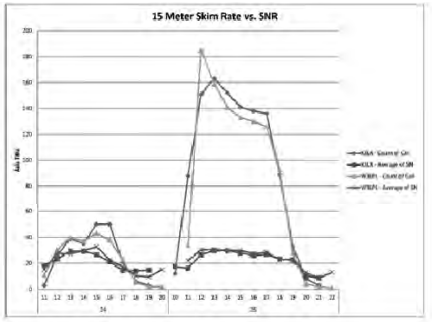
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Photo Credit: K5GN

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K3LR vs. W3LPL

- This is the very top level of competition



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Photo credit; K3LR

ICOM

K3LR vs. W3LPL

- Zooming in on the SNR

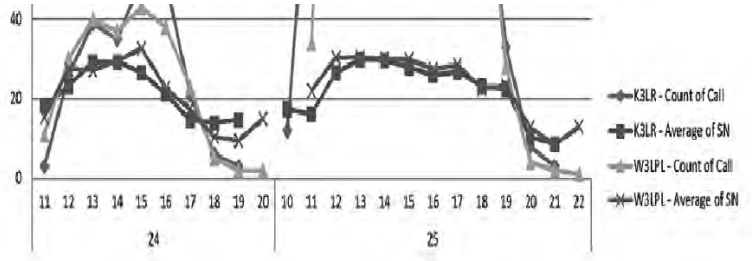


Photo credit; K3LR

Living Dangerously?

- It's exciting to break the rules
- I like being an outlaw





- Nobody is watching

Photo Credit: K5GN
http://www.rfconcepts.com/

In my mind, it's justified

- It helped me overcome my unfair disadvantage
- I had to do it to win!
- The rule I broke was unfair anyway

CQ-contest@contesting.com

No harm, no foul

- Nobody is getting hurt
- It makes no difference anyway



http://www.hayseed.net/~jpk5lad/Assorted%20Ham%20Stuff/K5LAD%20Awards/

I'm at the top of the food chain

- Rules don't mean much to me, I'm bigger than all that
- That rule was unclear so I thought I could stretch it to suit my operation

What's at risk here?

- As with online games, our favorite contests are at risk
- As with sports stars and others, our reputations are on the line

Lance Armstrong

- Led the cycling world for years
- Win at all costs attitude
- Thought of himself as invincible

- In the headlines for years suspected of doping
- "Confessed" recently on Oprah

Lance Armstrong

"I see the anger in people...and betrayal, it's all there and these are people that supported me, that believed in me, believed me – not just believed in me but believed what I was saying – and they have every right to feel betrayed, and it's my fault. I will spend the rest of my life – you know some people are gone forever – but I'll spend the rest of my life trying to earn back trust and apologize to people for the rest of my life."

http://armchairspectator.wordpress.com/2013/01/23/full-tanscript-lance-armstrong-on-oprah/

Lance Armstrong

"Look I love cycling, I really do, and I say that knowing that I sound like – people will see me as somebody [who] has disrespected the event, the sport, the color yellow, the jersey, and ... I disrespected the rules, regardless of what anybody says about the generation, that was my choice. I'd do anything to go back to that day."

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http://armchairspectator.wordpress.com/2013/01/23/full-transcript-lance-armstrong-on-oprah/

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Who are you?

What does winning the contest mean to you?

How important is your radio identity to you?

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Who am I?

Born in Virginia to W8 dad and PT7 mom

Graduated HS in Houston

Texas Aggie

Husband and father of two

Engineer

Soccer enthusiast

Follower of Christ

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Who are we?

- When we sit down at the rig, we sometimes find ourselves taking on a different persona.
- Do we forget that we are brothers, fathers, professionals?
- Does our chronically self-centered human nature lead us astray?

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Where do you get your norms?

- From those who taught you morality
- From people you admire – your heroes
- From the people you run with – your multi-op team and hosts, your club members

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Elizabeth Beisel

- Reigning world champion
- Seeded 1st in the 400IM final
- Set a Personal Record in the race
- But lost by almost three seconds to a WR performance by a competitor, Ye Shiwen!
- "She had the race of her life," said Beisel. "Congratulations to her a million times over. "

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Tim Duffy, K3LR

- Strictly legal
- Lockouts, amplifiers, property limits
- High expectations of his guest operators
- #1 CQ WW SSB 2012
- #1 CQ WW CW 2012
- #1 ARRL DX CW 2013
- #1 ARRL DX CW 2013

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And other heroes of mine...

K5ZD	N6ZZ	W2SC (8P5A)
N2NT	W5OV	N6TR
K4BAI	N5RZ	K1ZZ
N9RV	K0DQ	N2IC
N5TJ	K5TR	W3LPL
K5KA	N2NL	And ...

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What do we really want?

We know what's right.
We know how to apply the smell test.

We put a huge value on our competitive hobby.
We value our radio identities, too.

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So here's the challenge

Let's strive together to keep both our reputations and our sport clean

Let's strive to emulate our heroes in the observable and the non-observable

Let's work within our clubs and on the 'net to bring our peers – both those who get it and those who don't – to the same goals

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Thanks for your attention

Go! Fight!! Win!!!

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RFI and Ham Radio

Jim Brown K9YC
k9yc@arrl.net

Don't Bother Taking Notes – The Slides are on My Website

http://audiosystemsgroup.com/publish.htm

Two Major Kinds of RFI

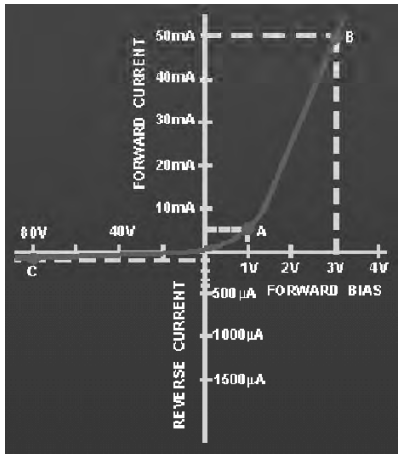
- **RFI <u>From</u> Our Ham Station**
  - **TVI, Audio/Video Equipment**
  - **Telephones, Computers, Data**
  - **Security Systems, Garage Doors**
- **RFI (Noise) <u>To</u> Our Station**
  - **Digital Equipment**
  - **Power Supplies, Chargers**
  - **Motor Controllers**
  - **Power Line Equipment Failures**

The Heart of the Problem

RFI From Our Ham Station

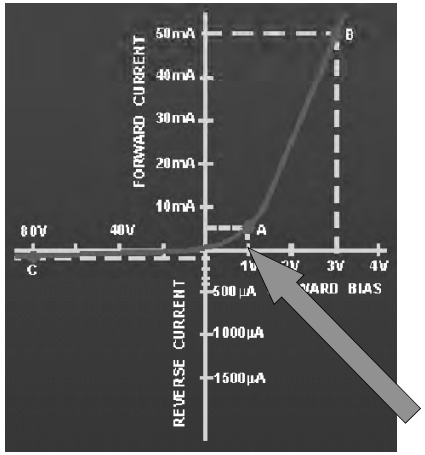
- Most electronic equipment can work as a radio receiver if allowed to do so
- The wires inside that equipment, and cables that interconnect equipment, are antennas, and can bring radio signals into that equipment

Square Law Detection



- Diodes
- Transistors
- IC's

Square Law Detection



- Diodes
- Transistors
- IC's

Differential Mode Signals

- Current flow is in opposite directions on conductors in a signal circuit
- Voltage difference between conductors
- Desired signal is differential mode



Differential Mode Signals

- Current flow is in opposite directions on conductors in a signal circuit
- Voltage difference between conductors
- Noise can be differential mode too



Killing Differential Mode RFI

- Low pass filters kill RF, pass the signal
  - Simple bypass capacitor shorts out noise
  - Series L (or R) blocks noise
- Most RFI is not differential mode



Common Mode Coupling

- Current flow in same direction on all conductors (or outside of coax shield)
- Voltage difference along conductors
- I/O wiring acts as long wire antenna

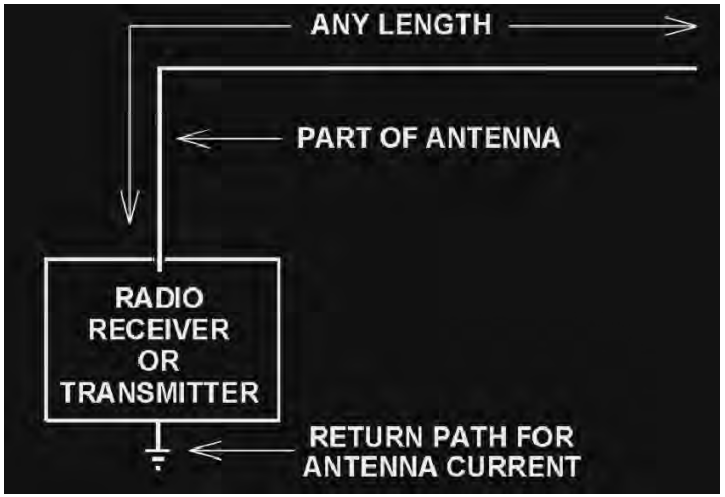


Common Mode Coupling

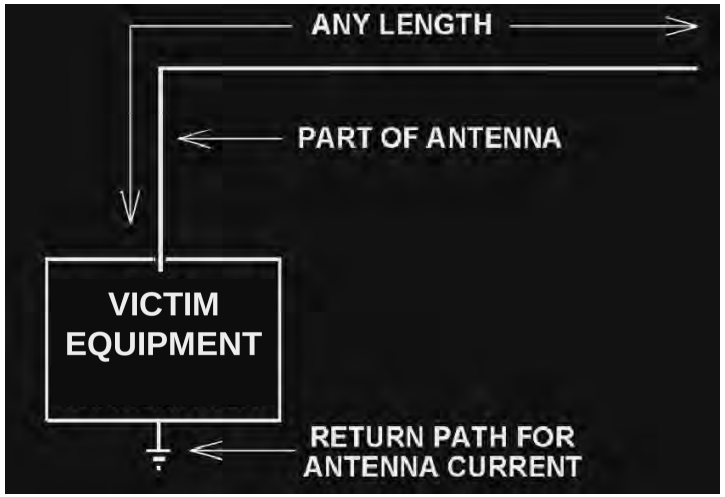
- Current flow in same direction on all conductors (or outside of coax shield)
- Voltage difference along conductors
- Also couples power line hum and buzz



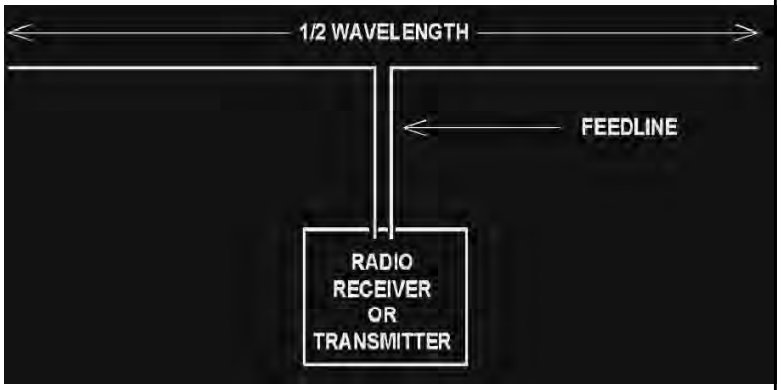
Basic Random Long Wire



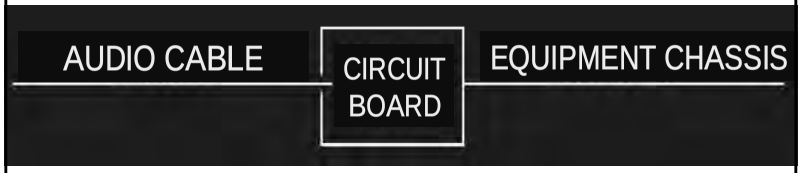
Basic Random Long Wire



A "Textbook" λ /2 Dipole



Equipment Can Form The Other Half of a Dipole



That's how a rubber duck works on a talkie – the chassis, plus our arm holding it, are part of the antenna!

Common Mode Coupling

- So How does RF get inside the box?



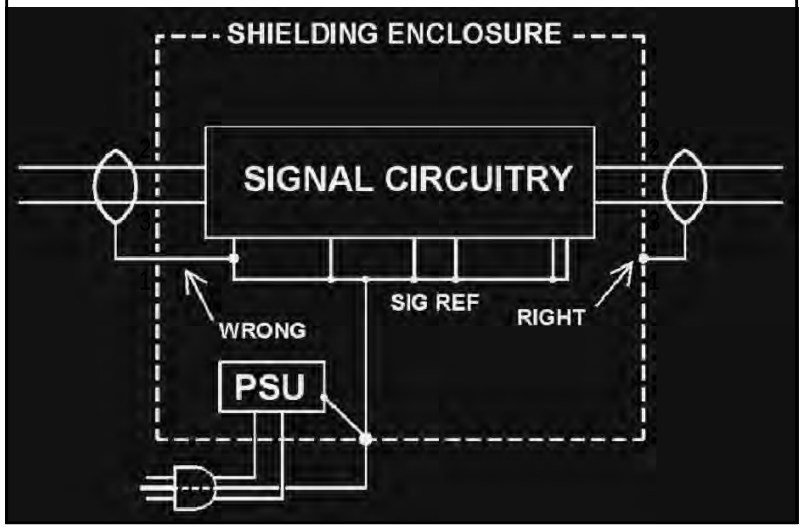
Common Mode Coupling

- So How does RF get inside the box?

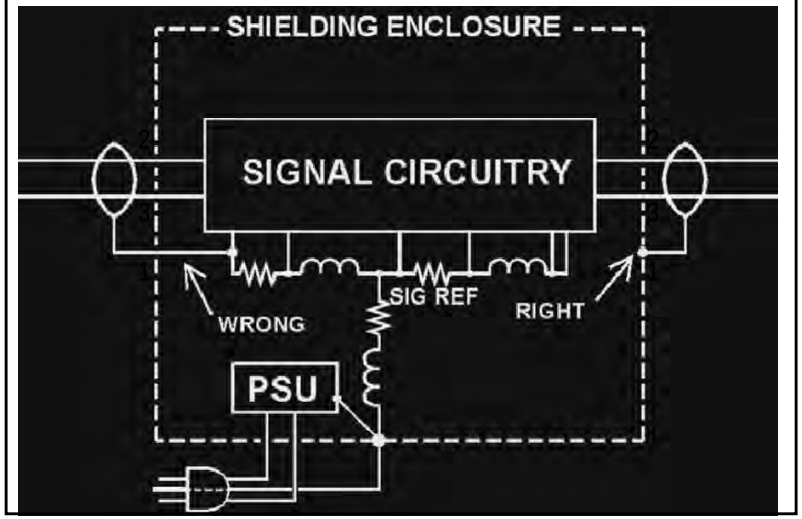
Pin One Problems!



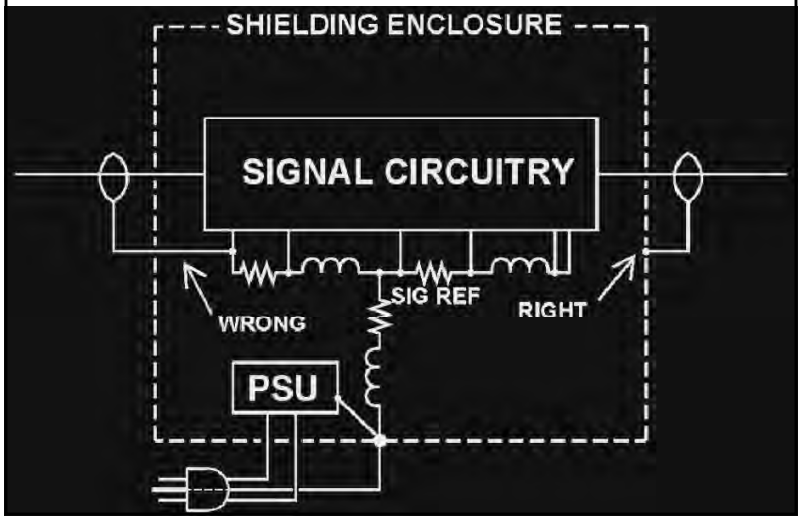
Pin 1 Problem in Balanced Interfaces



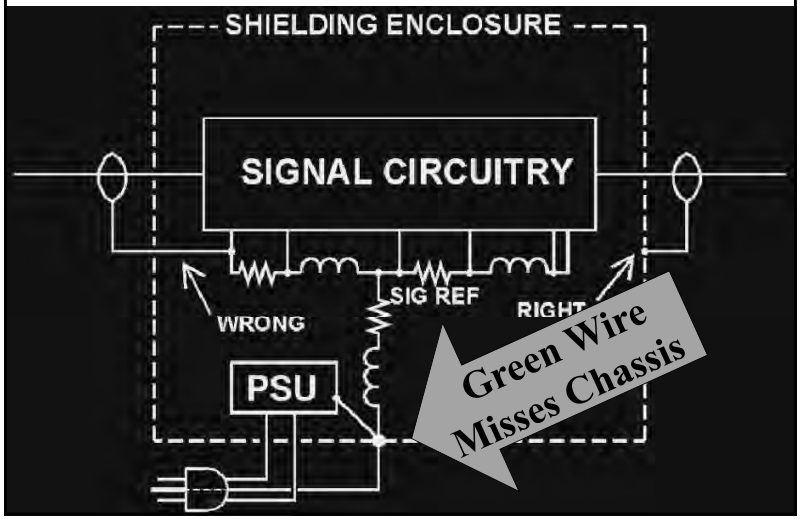
Pin 1 Problem in Balanced Interfaces



Pin 1 in Unbalanced Interfaces



"*Green Wire*" Pin One Problem



Most RFI is caused by Pin 1 Problems!

That Includes "RF in the Shack," or "RF Feedback!"

Nearly All Equipment Is Built With Pin 1 Problems

- Audio and Video Gear
  - Home and Professional Audio Systems
  - TV Sets, Video Recorders, Cable Boxes
- Computers and Accessories
- Ham Rigs and Accessories
- Telephone Equipment

Green Wire Pin One Problems

- Astron Power Suppplies
  - Green Wire to Terminal Strip insulated from chassis by paint

How Do Pin Problems Happen?



Insulating rings around all connectors prevents chassis contact!



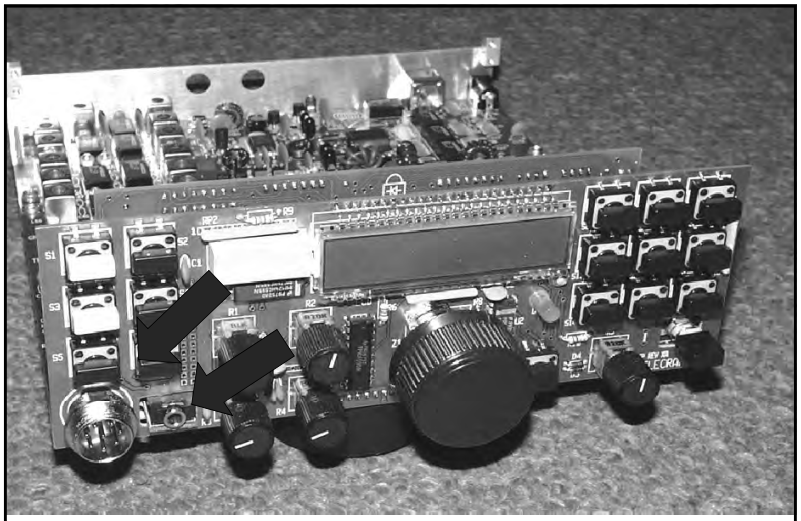
How Do Pin Problems Happen?

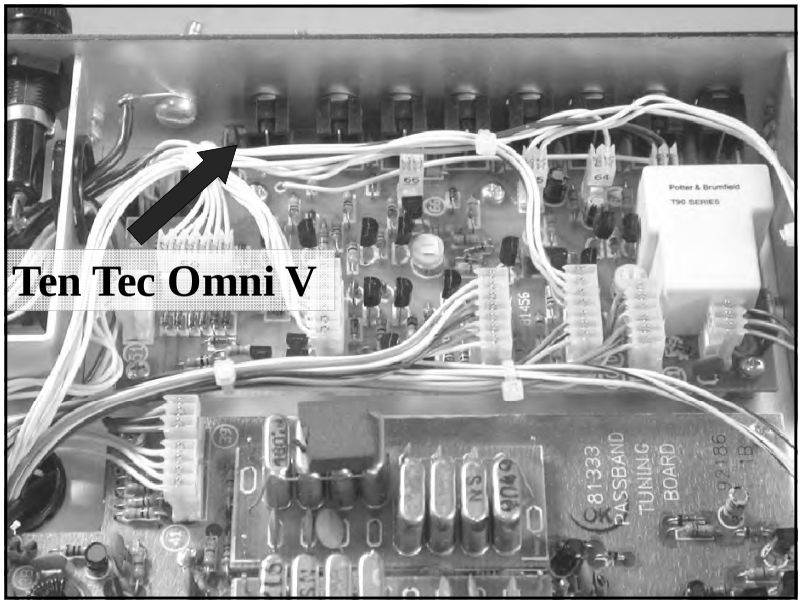
- **Pin 1 of XL's go to chassis via circuit board and ¼" connectors (it's cheaper)**
- **XLR shell not connected to anything!**
- **RCA connectors not connected to chassis**



Nice Radio, Has Pin 1 Problems





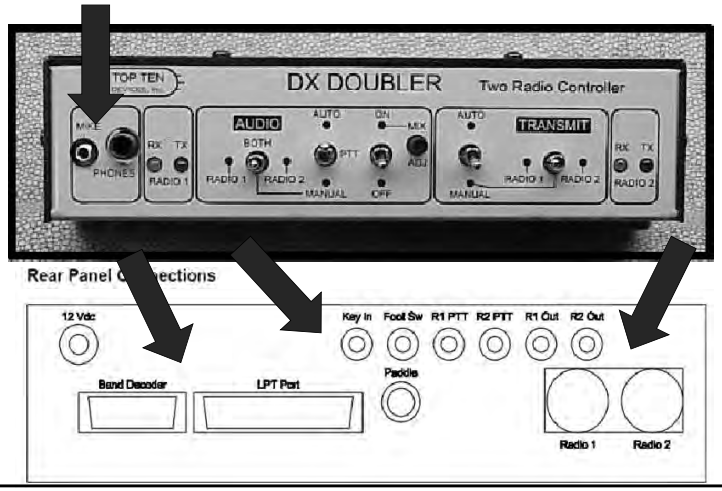


A Pin 1 Problem in FT-1000MP



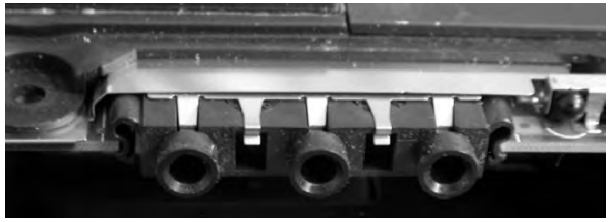
RF Feedback on 75 and 15 Meters

Multiple Pin 1 problems cause hum, buzz, and probably RF feedback



Where are the Chassis Connections for this laptop's sound card?

- **Hint: It isn't an audio connector shell!**
  - **They <u>should</u> be, but they are <u>not</u>!**



Where are the Chassis Connections for this laptop's sound card?

Yes, it's the DB9, DB15, and DB25 shells!



How Does It Happen?

- Connectors mounted to PC board
- Shell not bonded to chassis
  - It should be, but it isn't – that costs more!
- Often very difficult to fix
- All inputs and outputs are usually bad
  - Audio and video
  - Serial and USB interfaces
  - Control wiring

Two Ways to Kill Pin 1 RFI

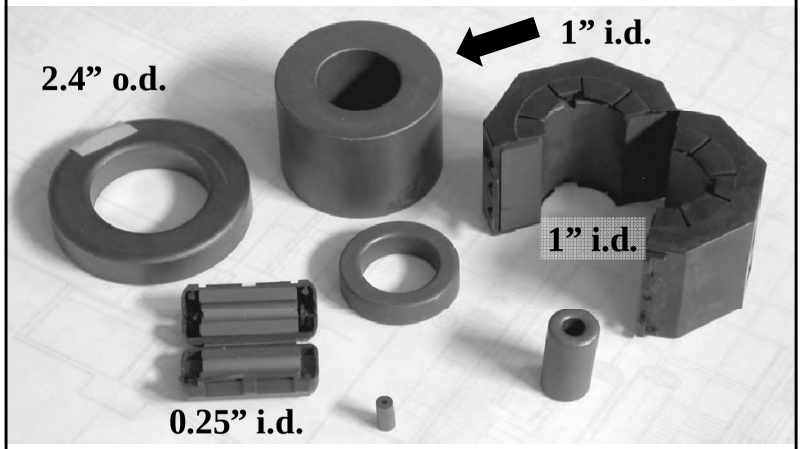
- Rewire/rebuild the connector
  - Wire shield to the chassis, not PC board
  - Bond connector to chassis, not PC board
- Kill the current
  - Make the wiring a lousy antenna
  - Add a common mode choke
  - Short out the current
  - Kill the voltage that causes current flow

Using Ferrites to Kill the Current

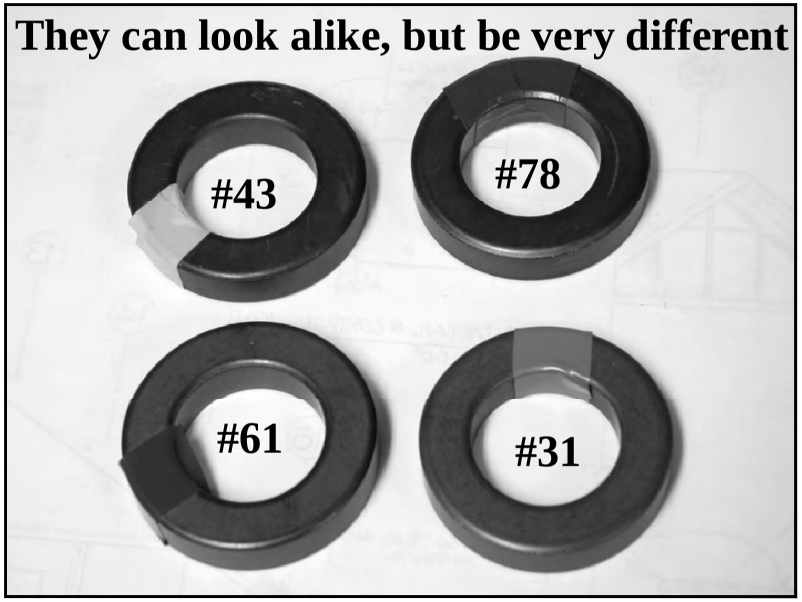
Ferrites can block the current!



Different sizes and shapes



They can look alike, but be very different



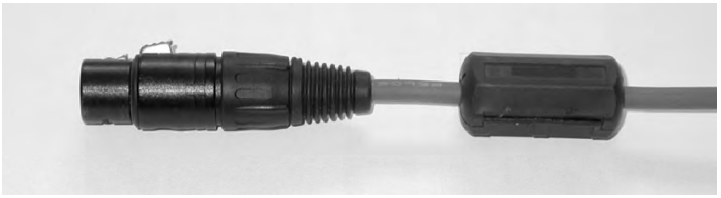
They’re brittle!



What Common Mode Chokes Do

- Add high resistive impedance in series with the common mode circuit, reducing antenna current
- Have no effect on <u>differential</u> signals carried <u>between</u> the conductors, inside the cable

This single-turn choke is effective from 80-300 MHz



This 4-turn choke is about right for 15-30 MHz



This 5-turn choke is about right for 10-30 MHz



An Effective Choke for 2-10 MHz

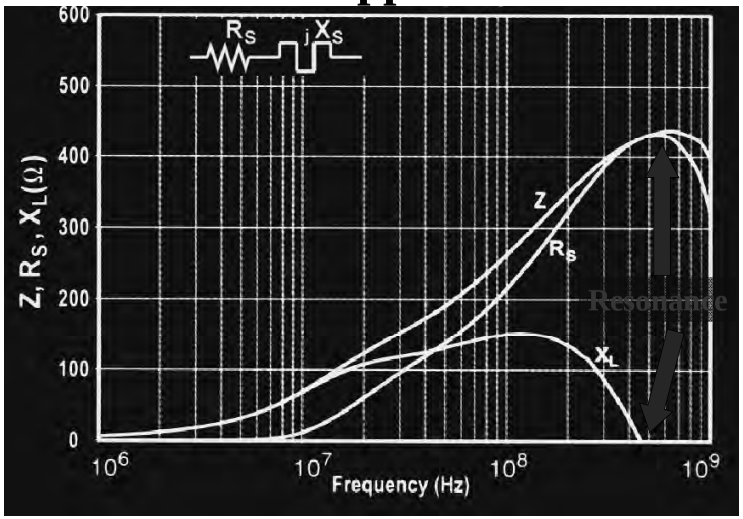


14 turns around a #31 core

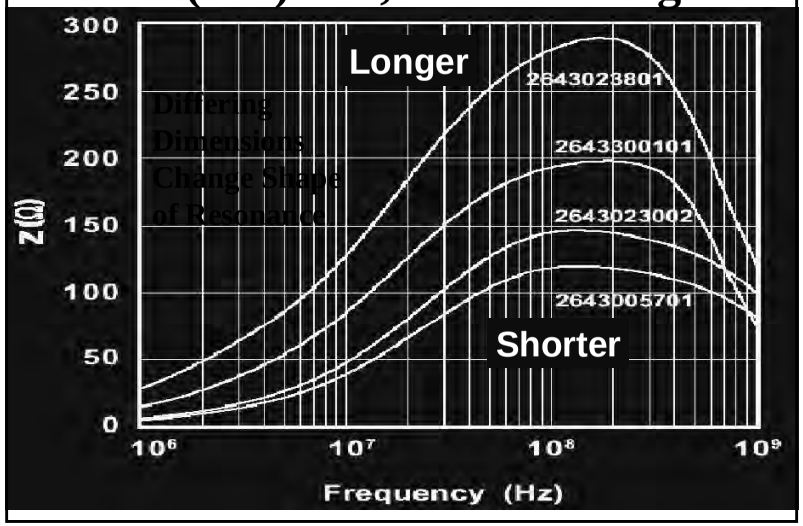
Ferrites and High Power

- If both conductors of high power circuits are wound through core, the fields cancel, so only the common mode current contributes to saturation
- Ferrite common mode are safe and effective on loudspeaker and power wiring
- Common mode chokes have no effect on audio, video, or control system signals – they are all differential signals

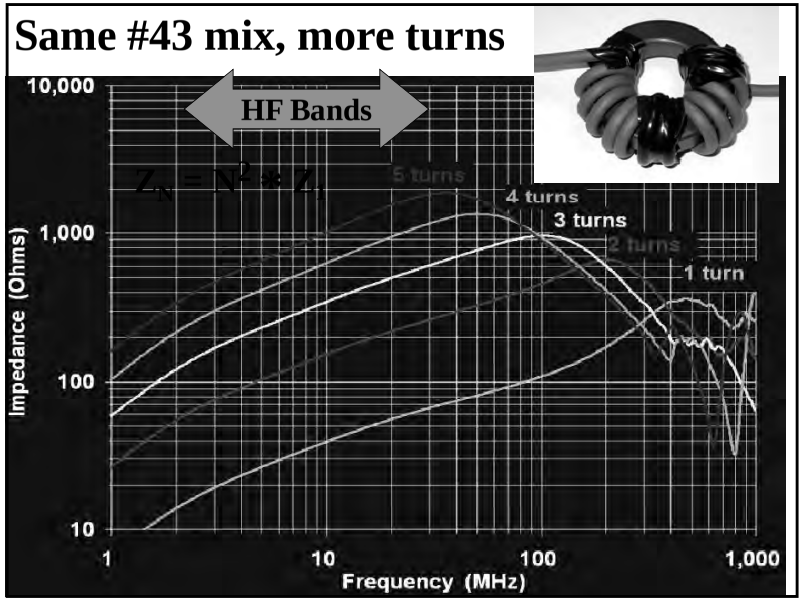
#61 Mix Suppresses UHF

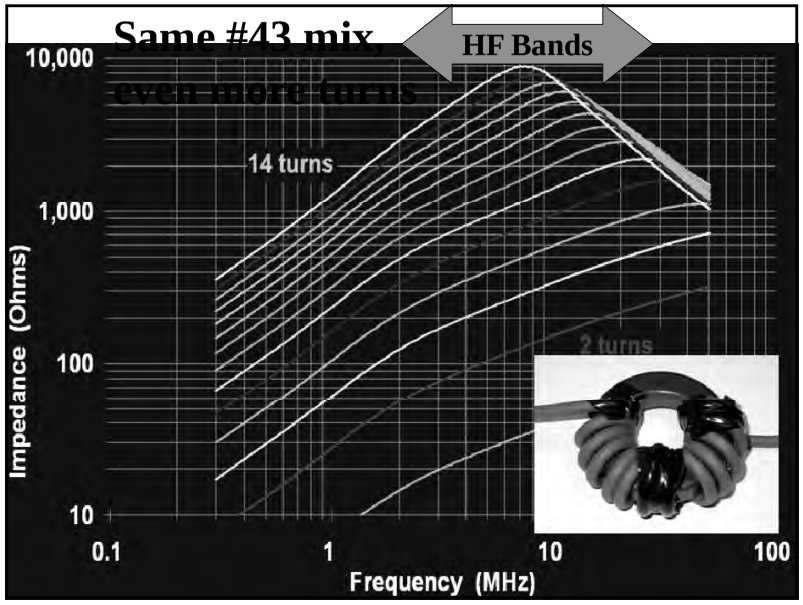


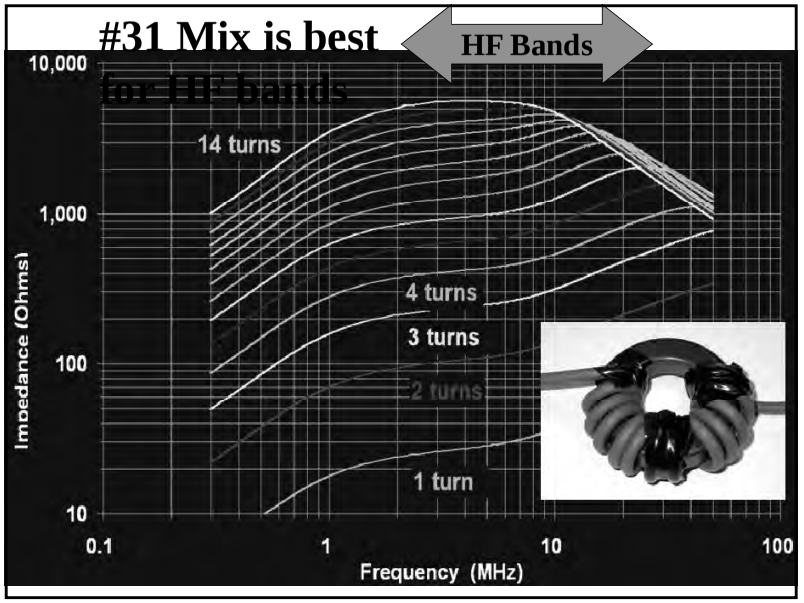
VHF (#43) mix, different lengths!

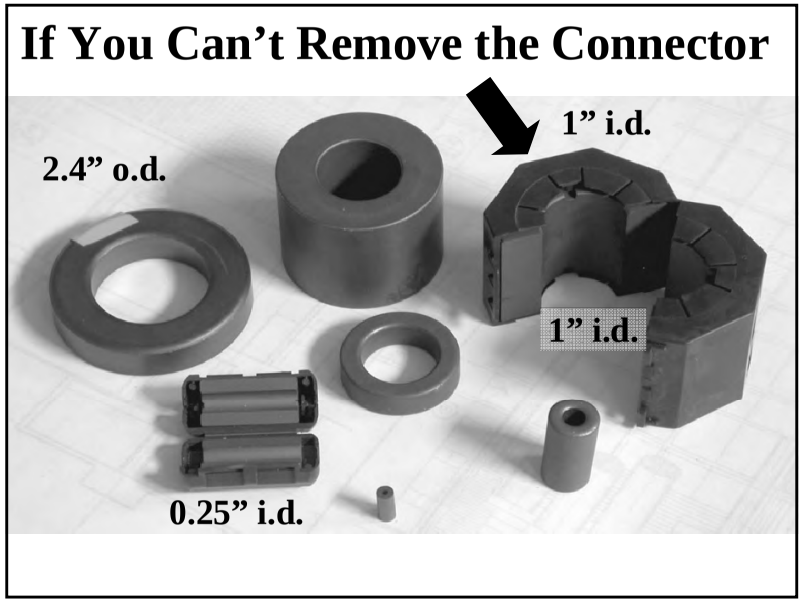


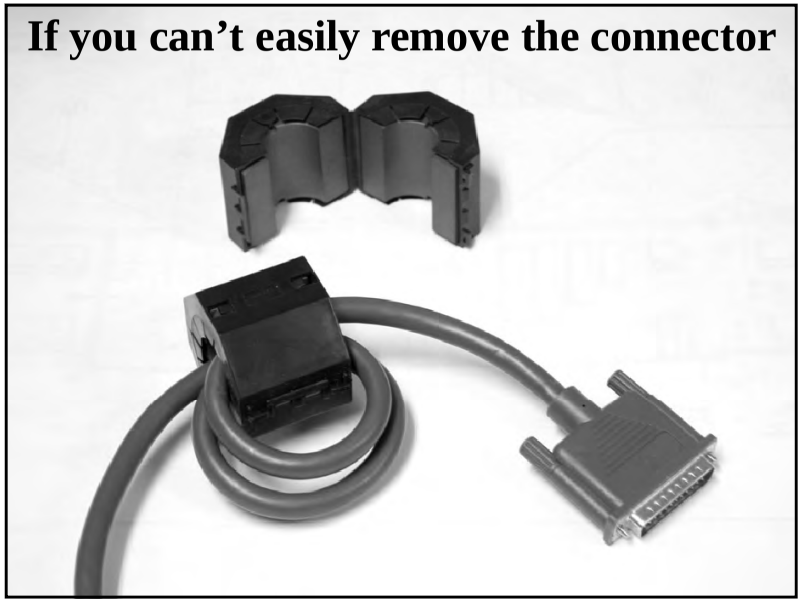
Same #43 mix, more turns

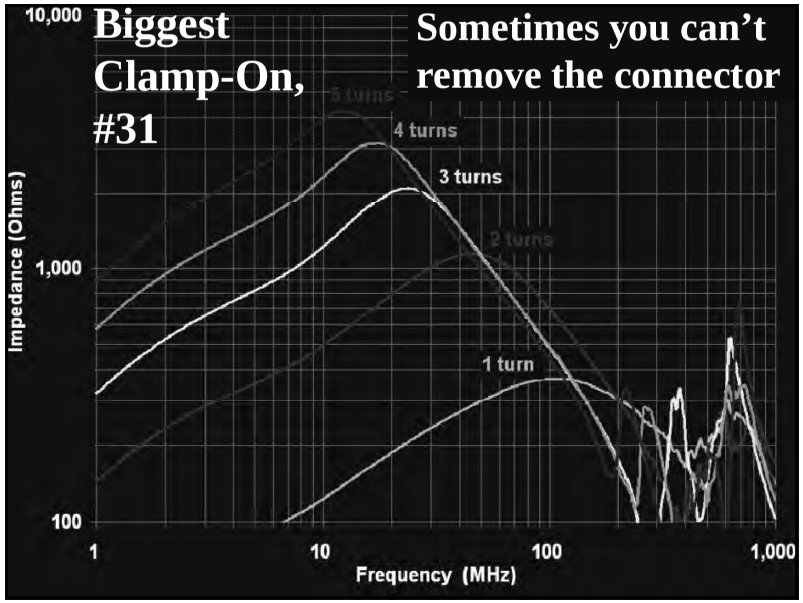



Same #43 mix,
even more turns
HF Bands
10,000
1,000
100
10
Impedance (Ohms)
14 turns
2 turns
0.1
1
10
100
Frequency (MHz)


#31 Mix is best
for HF bands
HF Bands
10,000
1,000
100
10
Impedance (Ohms)
14 turns
4 turns
3 turns
2 turns
1 turn
0.1
1
10
100
Frequency (MHz)


If You Can't Remove the Connector
1" i.d.
2.4" o.d.
1" i.d.
0.25" i.d.


If you can't easily remove the connector



Solving RFI Problems

Strategy to Kill RFI

- How bad is the problem?
- Where is it getting in (or leaking out)?
- Work on most common problems first
  - Pin 1 Problems
  - Speaker cable
  - Cable TV leakage
  - Cables with poor shielding
- These problems have easy solutions

RFI <u>From</u> Your Station

- How bad is the problem?
  - Reduce your TX power until RFI stops
  - Convert reduction to dB: 10 log (P_2/P_1)
  - That's how much suppression you need
  - Repeat for each ham band and victim product or system
- If problem is TVI
  - Interference to picture, or only sound?
  - Interference if TV is off?

Kill Antenna Current

- Identify the most likely antennas
- Add a choke tuned to the ham frequencies where there is RFI

RFI From Your Station

- Our stations are NOT the problem unless they're "broken"
  - Lousy power amps
  - Blown output filters in solid state amps
- Don't waste money on low pass filters or exotic grounding
- The victim is the problem

RFI From Your Station

- Identify the most likely RX antennas
- Start with longer "antennas"
  - Rooftop and CATV lead-ins, speaker cables
- Add a ferrite choke tuned to the frequency of the RFI (see graphs)
- Attack shorter antennas if still a problem
  - Interconnect cables in an A/V setup

This 4-turn choke is about right for 15-30 MHz



This 5-turn choke is about right for 10-30 MHz



An Effective Choke for 2-10 MHz



14 turns around a #31 core

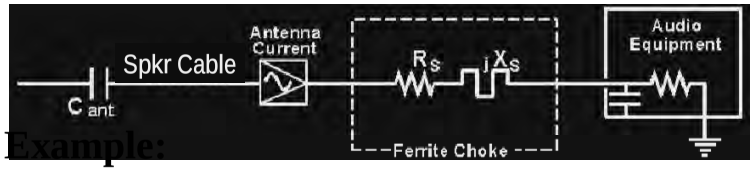
RFI From Your Station

- If RFI is only to sound, and happens with TV turned off (TV feeds A/V system)
  - Problem is in the audio equipment
  - Replace speaker wiring with twisted pair
  - Choke the speaker wiring first
  - Choke cable(s) between TV and audio rig
  - Choke coax from antenna or cable box

You May Not Need an Elephant Gun

- Most detection is square law, so:
  - A 10 dB reduction in RF level reduces audible interference by 20 dB
- But we must add enough impedance to overcome the threshold effect

Threshold Effect



Example:

Our antenna is short, so looks capacitive

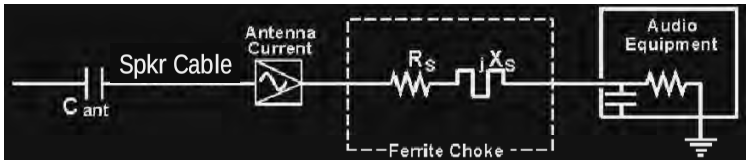
Without the choke, the total antenna circuit is 300∠-60 Ω,

and we add a choke that is 300∠60°Ω,

$Z_T = (150 - j260) + (150 + j260) = 300\ \Omega$

Our choke has not helped!

Threshold Effect



But if we make the choke larger (more turns or more cores in series), additional R_S will begin to reduce the current.

Increasing R_T to 425Ω (3 dB) reduces detected RF by 6 dB, and increasing R_T to 600Ω (6 dB) reduces detected RF by 12 dB (assuming no change in X_S).

Threshold Effect

- **The ferrite choke should add enough series R that the resulting Z is 2x the series Z of the "antenna" circuit without the choke. This reduces RF current by 6 dB, and detected RF by 12 dB.**
- **Very little suppression occurs until the added R is at least half of the starting Z.**
- **More choking impedance is better!**

Criteria for Good Suppression

- **Choke must be predominantly resistive**
  - **Low Q, near resonance, #31, #43 only**
  - **Use measured curves to set resonance**
- **1,000 ohms is a minimum design goal**
- **5k ohms or more needed for RX noise**
  - **Use more turns to lower resonance**
  - **Use chokes in series to get more resistance**

Criteria for Good Suppression

- Use only #31 material below 5 MHz
- Use #31 or #43 material above 5 MHz
  - #43 is better above 10 MHz

Covering Wide Frequency Ranges

- Use multiple chokes in series, each tuned to a different frequency range
- Put higher frequency choke closer to the equipment
- Example:
  - 14 turns on #31 toroid for 2-10 MHz
  - 8 turns on #31 or #43 toroid for 10-30 MHz

This expensive loudspeaker cable makes equipment vulnerable to RFI



Parallel wire (zip cord) has very poor RFI rejection

Twisted pair cables help equipment reject RFI



#12 POC * is great loudspeaker cable!



* POC – Plain Ordinary Copper

RFI From Your Station

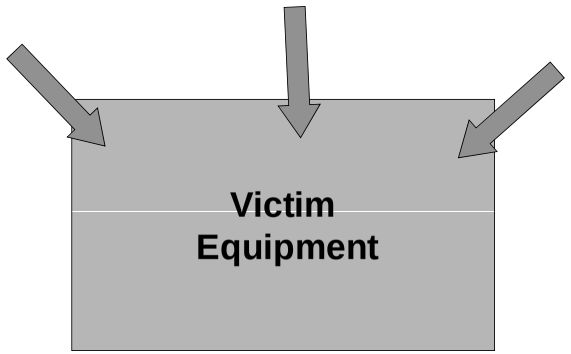
- If RFI causes picture and sound breakup, the TV or cable box is most likely problem
  - Choke coax from roof antenna, cable box, or satellite downlink
  - Choke cables to video recorder, A/V rig
- If chokes don't help and TV is on a CATV system, check for leakage in that system

Leaky Cable TV (CATV) Systems

- Tune an FM talkie to 145.25 MHz, probe around CATV wiring looking for a buzzy carrier (cable channel 18)
- When you find a buzzy carrier, you've found a leak
- There may be more than one
- The CATV company should fix their leaks
- Leaks also spew RF trash on ham bands

Poor Equipment Shielding

- Internal wiring is receiving antenna



Antennas Inside Equipment

- Wires and circuit traces are antennas too
- These problems must be solved by the equipment manufacturer

Shielding Failures

- Plastic cases
- Openings in shielded cases
  - Gaps between pieces of metal case
  - Paint at joint of metal surfaces creates a slot opening, RF escapes
- Cables enter case without bond to case
- Breaking a ground plane under a trace
  - Defeats the ground plane – current flows in a big loop, becomes antenna and magnetic loop

Fixing Shielding Problems

- Shield the equipment

or:

- Add a ground plane on a second layer
  - Each circuit trace is now a transmission line
  - Current returns on ground plane under trace
  - Minimizes the loop area
  - Minimizes antenna action
  - Microstrip (one ground plane)
  - Stripline (two ground planes sandwich the trace)

No Easy Fixes for Most Equipment Shielding Failures

- Scrape the paint to close slot openings
- Bond cable shields to the case
- Most other shielding problems usually require a complete rebuild
- Return to manufacturer as defective
- Give it the bucket treatment

The Bucket Treatment

- Find a bucket large enough to hold the defective equipment
- Fill it with water
- Put the equipment in twice
- Take it out once

Poor Cable Shielding

- Shield current is converted to a differential voltage
- Poor filtering lets it inside the box



Cable Shielding Problems

- Many common A/V cables have lousy shields
- Add a ferrite choke to the cable

or:

- Build your own cables using coax with a robust copper braid shield (RG174, RG58)

Making Your Own Audio Cables

- Much better than you can buy
- Use coax with robust copper braid shield
- Use Switchcraft or Neutrik Connectors
  - Full Compass Systems, Madison, WI
  - Sweetwater, Ft. Wayne, IN
- Buy connectors in quantity – shipping is much of the cost
- Expensive high futility stuff not a solution

Cable-Mount Audio Connectors

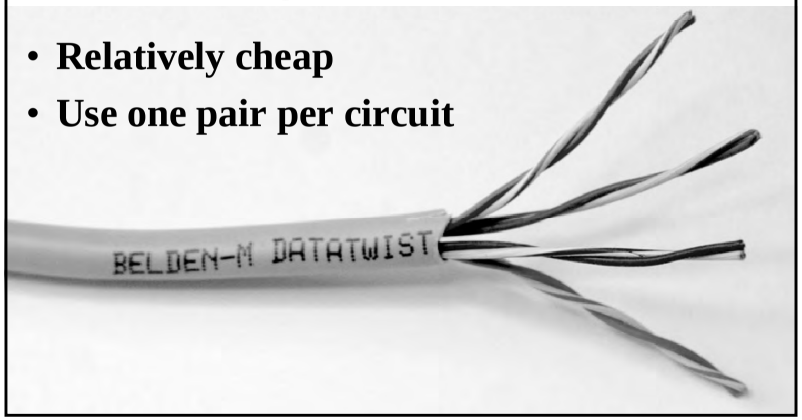
Description	Switchcraft	Neutrik
3-ckt male 1/8” plug	35HDNN	NYS231BG
2-ckt male 1/8” plug		NYS226BG
3-ckt female 1/8” jack		NYS240BG
Phono (RCA) male plug	3502	NYS352
Phono female jack	3503	

Cable Problems – Paired Cable

- Parallel wires (zip cord) cause RFI
- Twisted pair cable rejects hum, buzz, RFI
- Replace zip cord with twisted pair
  - CAT5/6 for telephone wiring, security systems
  - #14 gauge between loudspeakers and power amp
  - CAT5/6 for RS232 cables, one pair per circuit
  - Improvements of 20-30dB (100-1,000X the power)
- Twisting is far more important than shielding

CAT5 is 4 Very Good Twisted Pairs

- Excellent for audio, digital, telephone, control wiring, RS232
- Relatively cheap
- Use one pair per circuit



RFI to Telephones and DSL Modems

- Use only CAT5/6 for telephone wiring
- Use one pair for each circuit
  - Blue = hot, blue/white = return
- Tune DSL chokes to ~2 MHz
  - 30 turns on one #31 toroid
  - 22 turns on two #31 toroids
- Place choke very close to DSL modem
- Use add'l choke(s) if needed

RFI to Telephones and DSL Modems

- Choke every cable connected to phone or modem
- Try for at least 10k ohms
- Telephones are known RFI dogs
- For wireless phones, choke the cable(s) at the base station

Security Systems

- Very poor RF rejection
- Connections between sensor and main unit are usually a simple switch contact
  - Try a small cap (470-1000 pF) across the cable pair at the main unit
  - Replace wiring with twisted pair
  - Chokes may help, but are not the first thing to try

Security Systems

- When connections carry data
  - Do not use a capacitor
  - Replace wiring with CAT5
  - Add choke at both ends
- When data is carried on the power line
  - Use twisted triplet cable for power wiring
  - Put power in steel conduit if you can
  - Call the manufacturer, make them fix it

The Other Half of the Problem – RFI to Ham Radio

RFI To Ham Radio

- RF noise is generated inside equipment
- The wires inside equipment, and cables that interconnect equipment, are antennas, and can transmit that RF noise
- The same problems that let RF into the box also let it out of the box
  - Pin One Problems
  - Poor shielding and poor circuit layout
- Our antennas receive it like any other signal

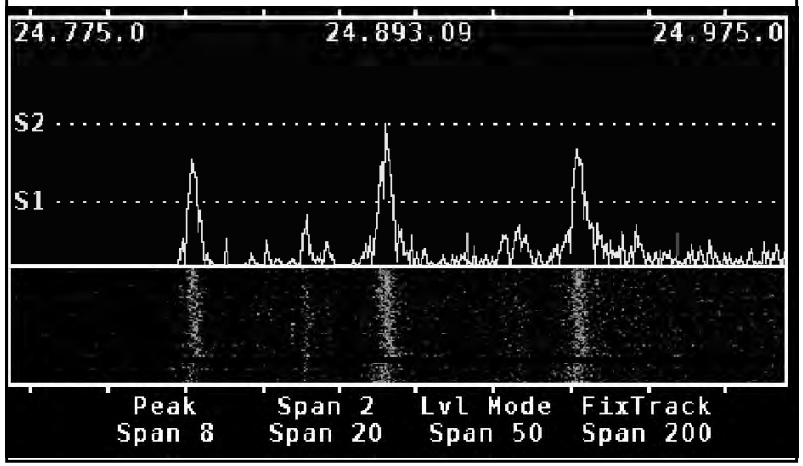
Sources of RF Noise

- Switching Power Supplies, including Battery Chargers
- Equipment with digital circuitry
  - Computers, audio and video gear, ham gear
- Plasma TV Sets
- Faulty Insulators in Power Systems
- Variable Speed Motors

What is Digital Noise?

- Most digital noise results from oscillators or clocks that produce square waves
- Square waves have lots of harmonics
- Fast rise times = strong harmonics

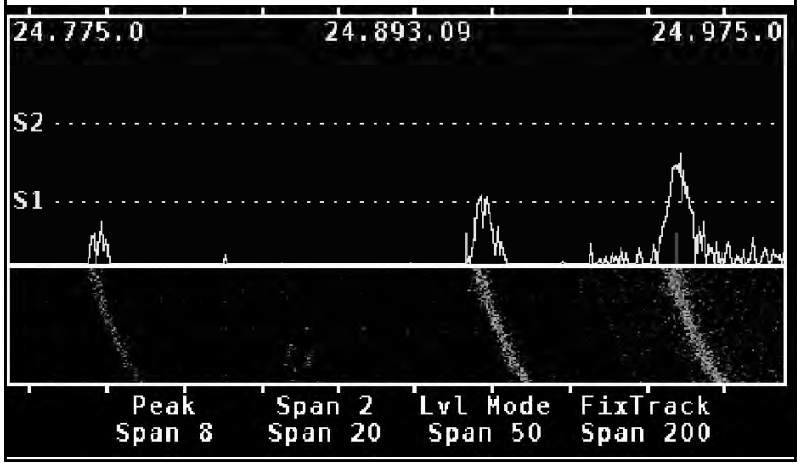
Typical noise signature of a switching power supply



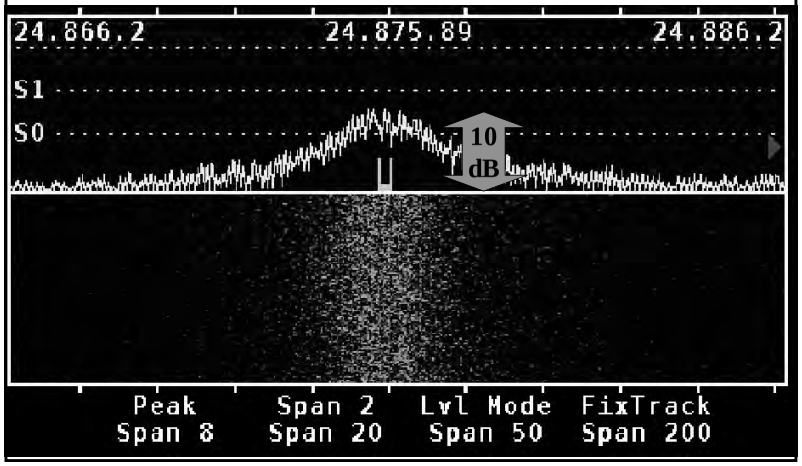
Why a Hump Instead of a Steady Carrier?

- Oscillators are *dithered* (FM-modulated by noise) to skirt FCC RFI rules
- That noise causes them to wobble around in frequency or drift, and the modulation makes them broad
- FCC rules limit the strength of carriers, so the FM noise moves some of power from carrier to sidebands

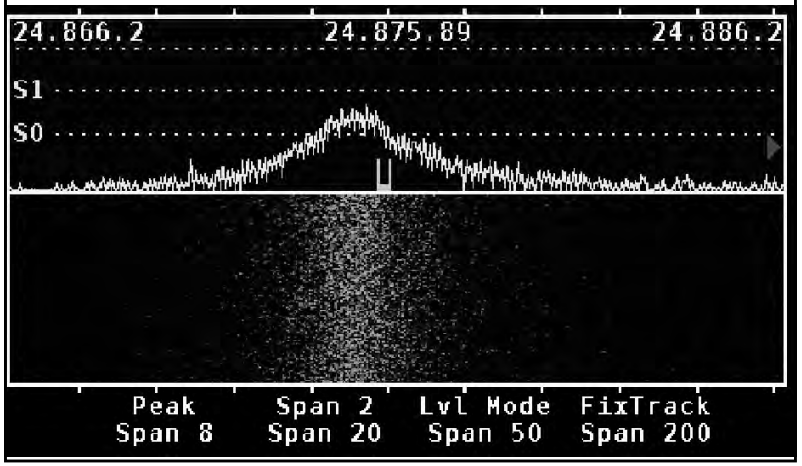
The same switching PSU drifting after being switched on



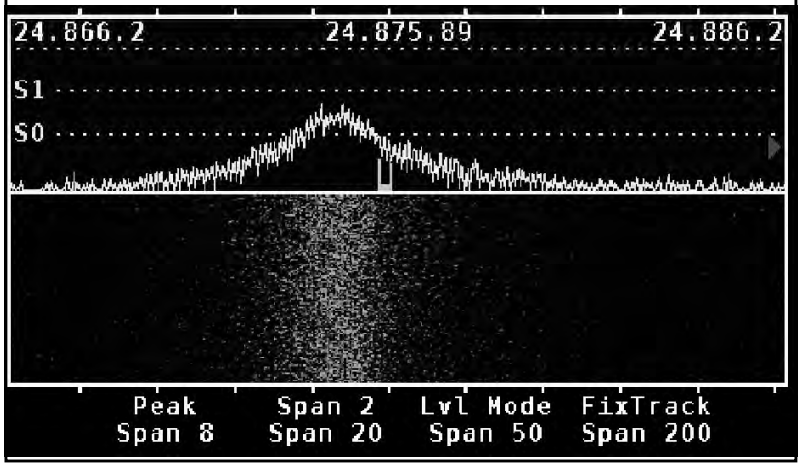
A closer look at one of the peaks



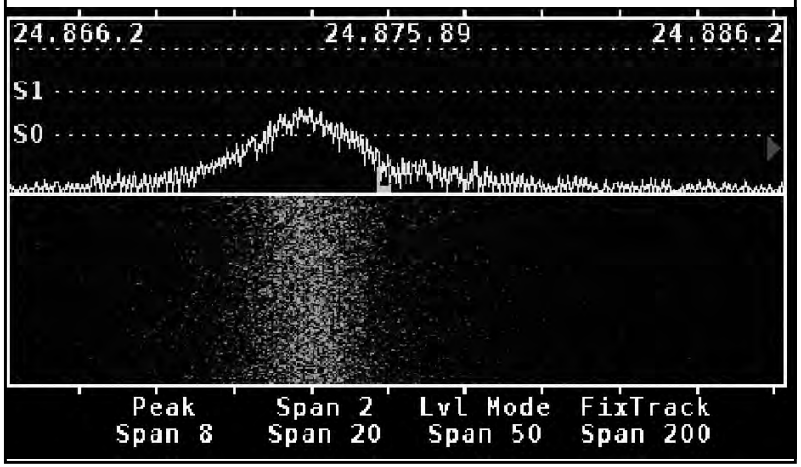
Same picture, a minute later



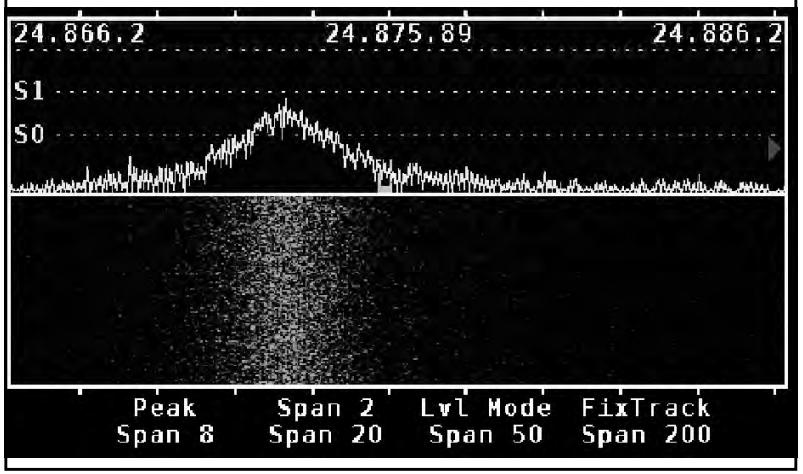
And another minute later



And another minute later



And another minute later



That's the PSU for my SteppIR

- I'd already suppressed the noise by more than 20dB before I took these pictures!
- I've worked a lot of guys who don't move my S-meter
- 10 dB of noise makes a 1kW signal seem like a 100W signal
- 20dB of noise makes 1kW seem like 1W
- You can't work 'em of you can't hear 'em!
- It's really worth it to chase and kill RX noise

The Principle of Reciprocity – Coupling Works Both Ways

- Problems that let RFI <u>into</u> the box also let it <u>out</u> of the box
  - Pin One Problems
  - Poor Shielding
  - Poor Filtering
  - Large magnetic loop area
  - Accidental Antennas

The Principle of Reciprocity – Coupling Works Both Ways

- Techniques that minimize received interference will generally also reduce radiated noise
- Relative strength of coupling depends on impedances of the coupled circuits, and may not be equal in both directions

RFI To Your Station

- How bad is the problem?
- Band noise should increase when the band is open, quiet when it is dead
  - 10-20dB increase is typical
  - Noise on 40, 80 and 160 should be low during the day, increase 10-20dB at night
  - Higher bands should also increase, but timing more complex

Measuring RFI To Your Station

- Most S-meters not very accurate
- One S-unit should be 6dB, but for most rigs it's more like 3-4 dB
- A properly aligned K3 is accurate
- Our objective is to reduce local RX noise enough that we see noise increase when the band is open

RFI To Your Station

- Start with your own home first
- Run your station on a battery and kill power to your home
  - Be sure to turn off any UPS units
- Any noise that goes away is your noise
- Restore power, and turn off one breaker at a time until noise stops (or gets weaker)

RFI To Your Station

- Start with your own home first
- Learn to locate and kill noise at home, so you don't look like a dummy if you can work on your neighbors' noise

RFI To Your Station

- Noise must be killed at the source
- We must find the source to kill the noise
- Exception – use antenna location and directivity to reduce noise
  - Move antennas away from noise sources
  - Use serious chokes on your feedlines at the feedpoint (that is, up in the air)

RFI From Digital Equipment

- What are the antennas?
  - Every interconnecting cable
  - The AC power line
- Wind multiple turns of AC cable through toroid to form choke
- Wind every interconnect cable through toroid to form choke

RFI From TV Sets, Cable Boxes

- What are the antennas?
  - Every audio/video cable
  - Coax from antenna, cable box, or DVR
  - The AC power line
- Wind multiple turns of AC cable through toroid to form choke
- Wind every interconnect cable through toroid to form choke

This 4-turn choke is about right for 15-30 MHz



This 5-turn choke is about right for 10-30 MHz

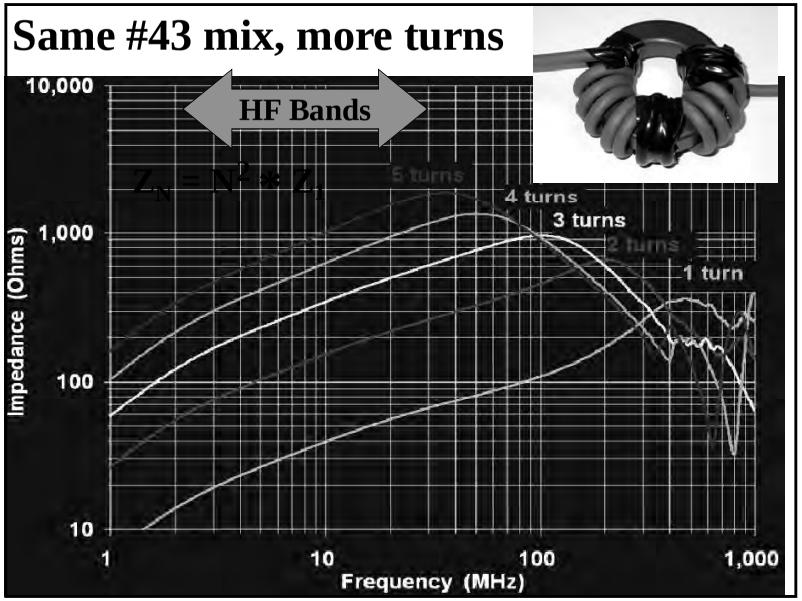


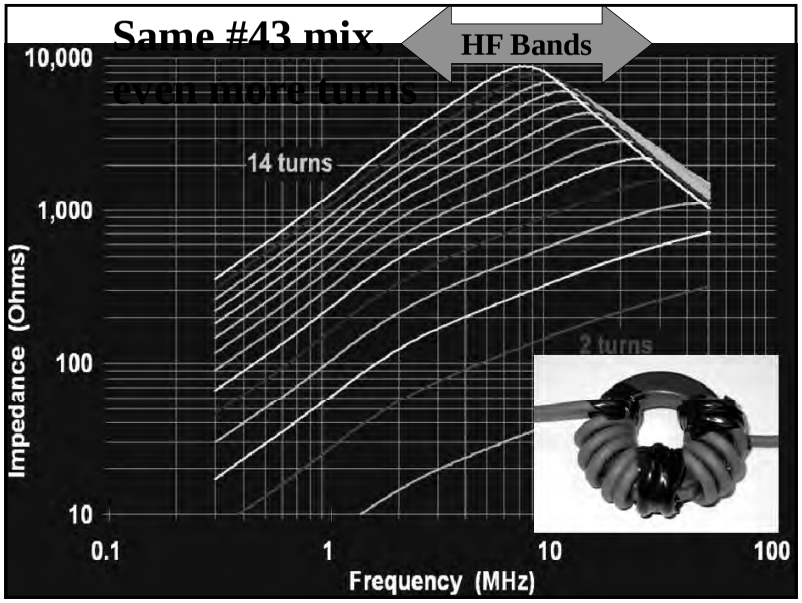
An Effective Choke for 2-10 MHz

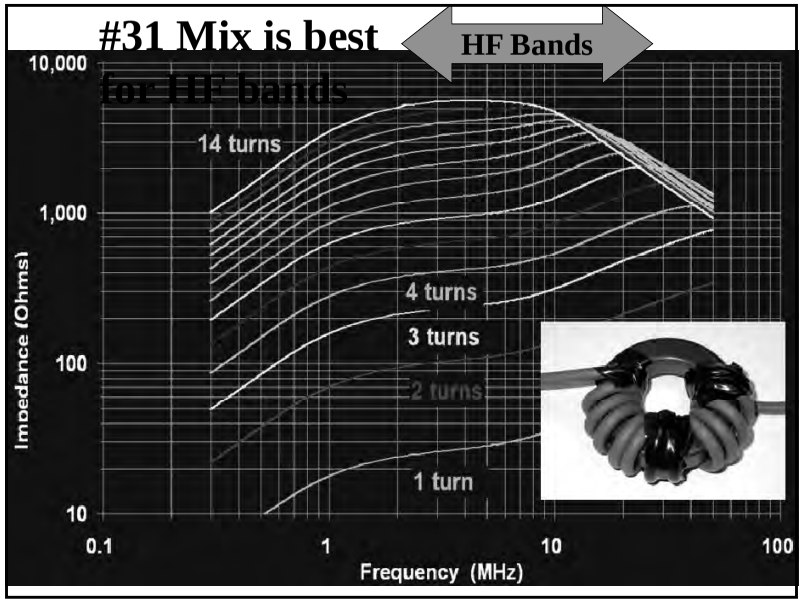


14 turns around a #31 core

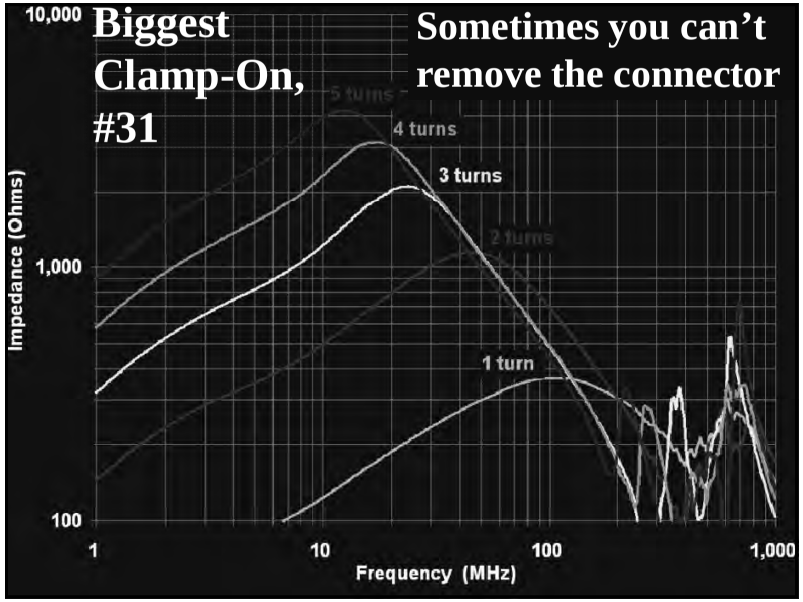
Same #43 mix, more turns




Same #43 mix, even more turns
HF Bands
10,000
1,000
100
10
Impedance (Ohms)
14 turns
2 turns
0.1
1
10
100
Frequency (MHz)


#31 Mix is best for HF bands
HF Bands
10,000
1,000
100
10
Impedance (Ohms)
14 turns
4 turns
3 turns
2 turns
1 turn
0.1
1
10
100
Frequency (MHz)


If you can't easily remove the connector


Biggest Clamp-On, #31
Sometimes you can't remove the connector
10,000
1,000
100
Impedance (Ohms)
5 turns
4 turns
3 turns
2 turns
1 turn
1
10
100
1,000
Frequency (MHz)

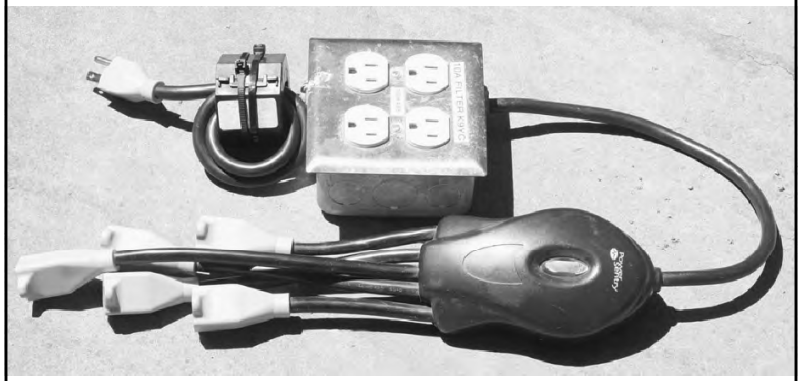
RFI From Switching Power Supplies

- What are the antennas?
  - The DC cable
  - The AC power line

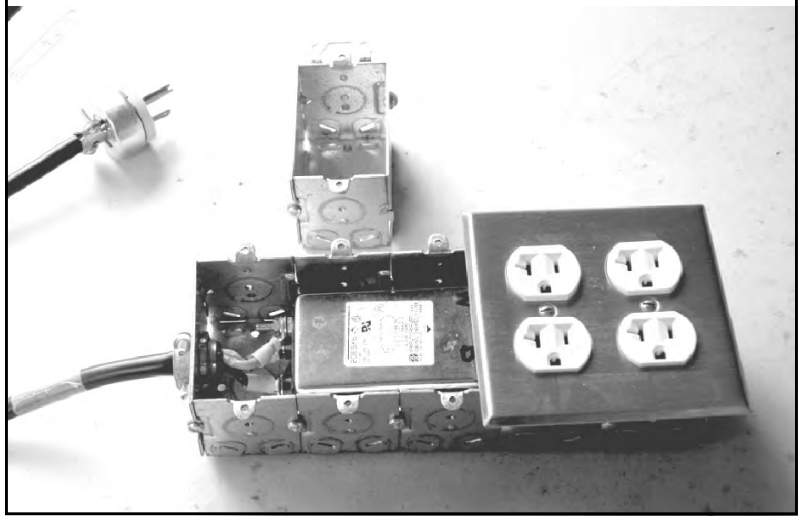
RFI From Switching Power Supplies

- Wind each DC cable through a ferrite core to form a choke
- Plug supplies into multi-outlet boxes and wind AC power cable through toroids to form chokes
- If you can, replace switching power supplies with linear power supplies
  - Rewire with Anderson Power Poles
  - Be sure to get the voltage right

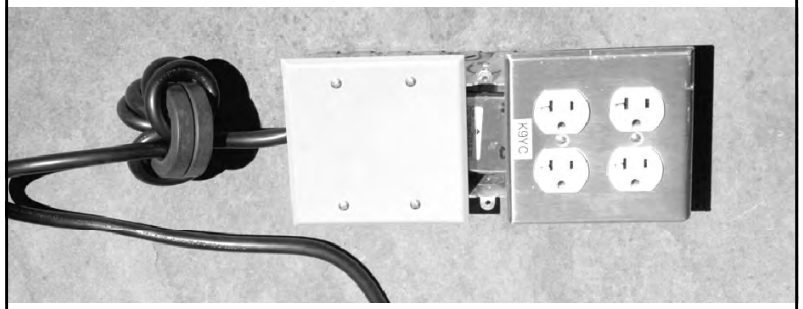
Plug Noisy Power Supplies Into Filtered Power Outlets



A Field Day Generator RFI Filter



Power Line Filters Also Needs Ferrite Choke



RFI From Battery Chargers

- What are the antennas?
  - The AC power line
  - The DC cable, if there is one
- Treat it like any other switching power supply – choke the antennas!

RFI To Your Station

- Identifying Ethernet birdies
  - Crystal controlled, wide tolerance, modulated
  - Around 14,030 kHz, 21,052 kHz, low end of 10M CW, low end of 6M
  - Multiple signals – you will hear your neighbors too, each on a slightly different frequency
  - Kill power to your router to see if birdies go away, work on those carriers
  - Wind each ethernet cable around toroid
  - 6-8 turns usually about right
  - Some trash due to poorly shielded box

RFI To Your Station

- Killing Ethernet birdies
  - Wind each cable around toroid
  - 6-8 turns usually about right
  - Don't forget power supply cable
  - Some trash due to poorly shielded box
- Use shortest cables possible
  - Longer cable is better antenna

Equipment/System Design Issues

- Magnetic Coupling
- Circuit Layout Issues
- Fast Rise Times

Magnetic Coupling

- A problem often overlooked by circuit and system designers
- A very potent coupling mechanism
- Strongly couples any large currents
  - Switching power supplies
  - Battery chargers
  - Variable speed motor controllers
  - Lighting controllers
  - Solar power systems and regulators

Current Flows in Loops

- Where does the return current flow?
  - Large loop area = strong magnetic field
  - Large loop area = more magnetic reception
  - Long wires = better antennas
- Good RFI design = very small loop areas and short antennas (or no antennas)
  - Place RF bypass cap directly between C and E of switching transistor, zero length leads
  - Keeps the loop area small for RF current

Keeping Loop Area Small

- Use multi-layer circuit boards
- Add a ground plane on a second layer
  - Each circuit trace is now a transmission line
  - Current returns on ground plane under trace
  - Minimizes the loop area
  - Minimizes antenna action
  - Microstrip (one ground plane)
  - Stripline (two ground planes sandwich the trace)

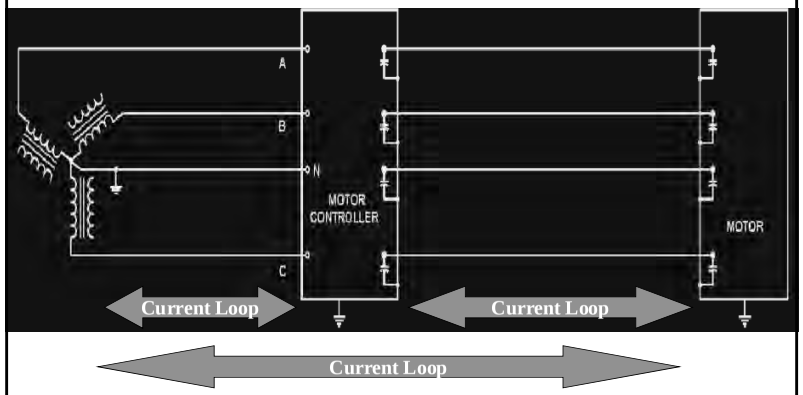
Circuit Layout

- Always ask, *"Where does the <u>return</u> current flow?"*
- Path at RF may be very different from the path at DC and low audio frequencies
- Henry Ott talks about "the hidden schematic lurking behind the ground symbols"
- Large loops cause magnetic coupling and/or antenna action

Rise Time

- RF trash proportional to switching speed
- Good RFI design = slow down the rise times of large pulsed currents
- Fast switching = lower power dissipation
- These are conflicting requirements
- Small rounding of waveform can greatly reduce RFI with little effect on dissipation

Variable-Speed Drive Motors



Variable Speed Drive Motors

- Operates by chopping DC to form a variable width pulse
  - 10-20 kHz typical switching frequencies
  - Harmonics extend to hundreds of kHz
- Stray capacitance (and filter capacitors) between motor and earth causes very large currents to flow on building structure
  - Establishes a very large current loop
- Controllers often widely separated from motors to make installation easier

Variable Speed Drive Motor Solutions

- Minimize the size of the current loops
  - Locate transformer, controller, and motor in closest possible proximity to each other
  - Transformer should have delta primary, wye secondary, bonded very close to motor
    - Prevents feeders to transformer from being part of the current loop
  - Twist neutral and phase conductors

Troubleshooting RFI

- RFI often enters equipment (and systems) by more than one path.
- When you find one path, always assume that there may be others!
- Take a methodical approach. Don't give up when one "right" technique doesn't fix it – keep on doing other "right" things. The "right" techniques really are right!

Troubleshooting RFI

- It usually helps to have an assistant
- You operate your station while your assistant watches/listens for RFI in your living room (or your neighbor's)
- Your assistant listens to your station while you kill breakers one at a time to find noise sources, then add chokes as needed
- Use talkies to communicate

The Biggest Myths

Myth: "I need a better ground"

Fact: A connection to earth almost never reduces noise or RFI, and it will often make it worse, because the "ground wire" can act as an antenna.

Fact: A connection to earth is very important for lightning protection.

The Biggest Myths

Myth: "I need a separate RF ground"

Fact: Separate grounds are unsafe – they can kill someone, increase lightning damage, even start a fire.

Fact: Separate grounds are more likely to cause problems than to fix them.

Fact: BY LAW, all grounds must be bonded together

References

- **Henry Ott, *Electromagnetic Compatibility Engineering*, Wiley Interscience, 2009**
- **E. C. Snelling, *Soft Ferrites, Properties and Applications*, CRC Press, 1969**
- **E. C. Snelling and A. D. Giles, *Ferrites for Inductors and Transformers*, Research Study Press, 1983**

References

- ***Fair-Rite Products Catalog*** **This 200-page catalog is a wealth of product data and applications guidance on practical ferrites. http://www.fair-rite.com**
- ***Ferroxcube Catalog and Applications Notes*** **More online from another great manufacturer of ferrites. http://www.ferroxcube.com**

References

- ***Noise Susceptibility in Analog and Digital Signal Processing Systems*****, N. Muncy**, JAES, June 1995
- ***Radio Frequency Susceptibility of Capacitor Microphones*****, Brown/Josephson** (AES Preprint 5720)
- ***Common Mode to Differential Mode Conversion in Shielded Twisted Pair Cables (Shield Current Induced Noise)*****, Brown/Whitlock** (AES Preprint 5747)
- ***Testing for Radio Frequency Common Impedance Coupling in Microphones and Other Audio Equipment*****, J. Brown** (AES Preprint 5897)
- ***A Novel Method of Testing for Susceptibility of Audio Equipment to Interference from Medium and High Frequency Broadcast Transmitters*****, J. Brown** (AES Preprint 5898)

References

- ***New Understandings of the Use of Ferrites in the Prevention and Suppression of RF Interference to Audio Systems*** , **J. Brown** (AES Preprint 6564)
- ***Understanding How Ferrites Can Prevent and Eliminate RF Interference to Audio Systems,* J. Brown** Self-published tutorial (on my website)
- ***A Ham's Guide to RFI, Ferrites, Baluns, and Audio Interfacing*, J. Brown** Self-published tutorial (on my website)

References

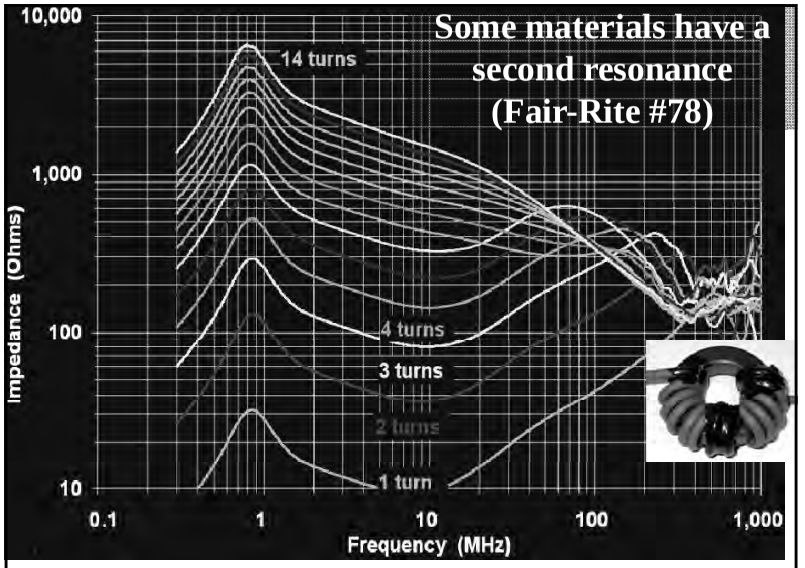
Applications notes, tutorials, and my AES papers are on my website for free download

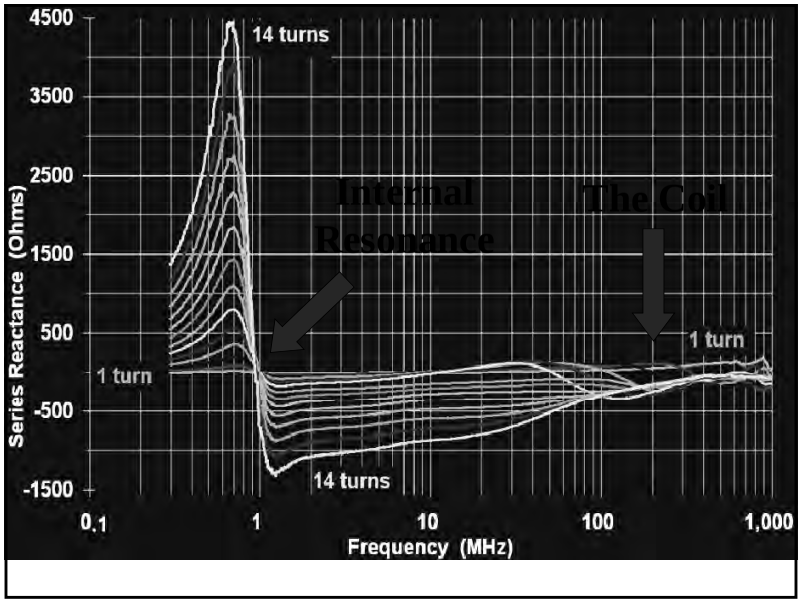
http://audiosystemsgroup.com/publish

RFI and Ham Radio

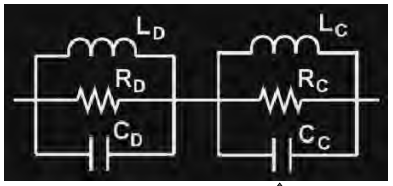
Jim Brown K9YC

k9yc@arrl.net





A Better Equivalent Circuit





Coil

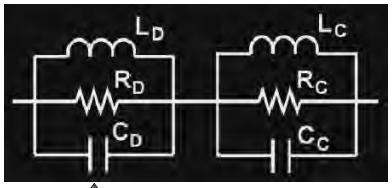
L_C is the inductance of the coil

C_C is the stray capacitance of the coil

R_C is the resistance of the wire.

L_C and C_C form the resonance that moves!

A Better Equivalent Circuit

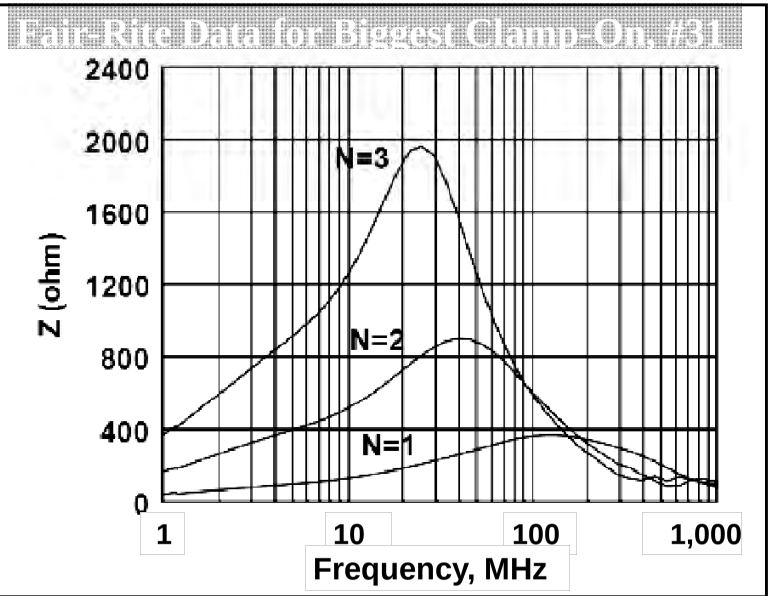




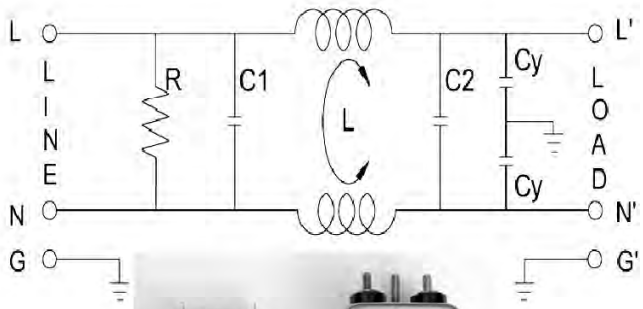
Ferrite

L_D and C_D represent the *dimensional* resonance of the ferrite itself

R_D is the loss within the ferrite



Line Filters Can Add Noise to Ground





Tips on Being a Better Single Operator

Randy Thompson, K5ZD

Contesting is a Game

- A game is a structured activity, usually undertaken for enjoyment.

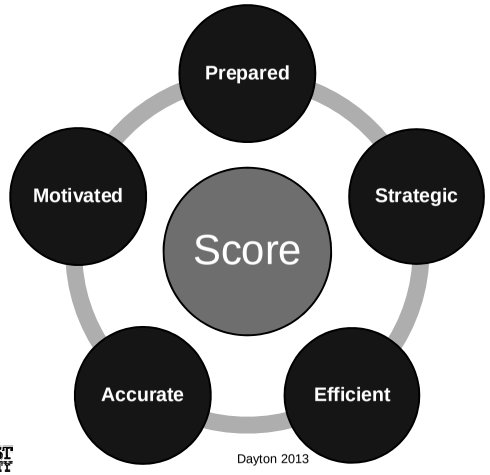
- Rules
- Players
- Method to determine winners (score)
- Strategy

The Players



At any level… Improving your skills makes the game more fun!

Winning Contesters are…



Prepared

Station Design

- Invest in antennas
  - Effectiveness
  - Flexibility
- Station Configuration
  - Everything within easy reach
  - Comfortable chair
- Reliability
  - Do things right
  - Have spares!

Station Layout



Automate Everything You Can

- Interface rigs to PC
  - Frequency control (serial/USB interface)
- Use all the control outputs available to you
  - CW output (serial or parallel) and paddles (parallel)
  - PTT output to key radio(s)
  - Sound card or voice keyer control
  - Parallel port band data for antenna and filter selection

Station Evaluation Question

- When you are tired…
- What prevents you from wanting to change bands?
- What causes you to forget a step in the process?
- Work on those!

Strategic

Choose the Game

- Select category
  - All band or single band?
  - Power – High, low, QRP?
  - Assisted or unassisted?
- Set a goal
  - Have fun?
  - Win a certificate?
  - Set a record?



Understand Scoring

- Points for each QSO?
  - Per mode?
  - Per continent?
  - By band?
- What is a multiplier?
  - Section? Zone? Country? Prefix?
- Constantly evaluate what you are doing against the final score

Score - 3,774,014 Points

Band	QSOs	Pts	Cty	ZN
1.8	7	14	5	5
3.5	143	408	42	21
7	761	2252	59	24
14	401	1142	64	28
21	2021	5980	70	27
28	118	322	14	14
Total	3451	10118	254	119

Score: 3,774,014

Example - ARRL Sweepstakes

- You have 1000 QSOs x 80 sec
  = 161,000 points
- Which is more valuable?
  - 1 more section or 10 contacts?

Example – CQ WW

- You have 1000 QSOs, 100 Zones, 250 countries **~ 980,000 points**
- Which is more valuable?
  - Getting the 40th zone on 20 meters?
  - Working 20 more contacts?

All scores assume 2.8 points/QSO

Tips

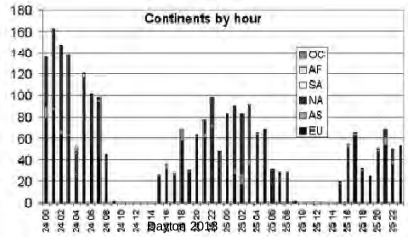
- Calculate trade offs based on expected final score!
- Short cut method
  - $Mult\ value = \frac{QSOs}{Mults}$
  - $Time\ value = \frac{QSOs}{Mults} * \frac{60}{Rate}$

The higher the rate
The less time you can spend

- Your logging software can display this calculation for you – use it!

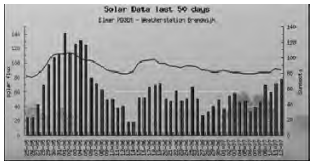
Log Analysis

- Study past results and logs
  - Do the winners focus on QSOs or multipliers?
  - Where do the QSOs come from?
  - Do activity patterns repeat?



Make a Plan

- CQWW logs are open…what did your closest peer do differently?
  - Review your log from the previous year
  - What hours to be on the air?
  - Expected opening times for each band
  - When to “run” and when to “search”



Efficient

Skills Development

- Driving a car
  - Had to think about everything at first
  - With experience, able to focus on other things
- Know the “flow”
  - Contest QSOs have a rhythm and sequence
  - Good operating habits require less thinking, less energy
- Learn to type
  - Contesting requires a lot of typing without room for errors

Phone Technique Hints

- Breathe
- Consistency & Efficiency
  - Find a rhythm that suits the conditions/rate
  - Learn not to say, “Uh”, “Please copy”, “Roger the 5914, you are…”; “QSL, QRZ?”
  - Say your call often – almost every QSO
- Answer guys with the phonetics they use
- Speech - Clean it up
  - Just enough processing

Technique – CW

- Be consistent
- Let the computer send
- Cut Numbers – Yes and No
- Speed Control
- PED, RUFZ-XP, Morsemaster, MorseRunner, practice

Know when to…

Run

- When you can

Search and Pounce

- When you can't run
- When you need mults
- When looking for a new run frequency

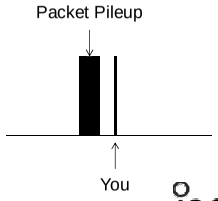
There is no magic formula for when to Run vs S&P
Decision based on log analysis, scoring formula, band conditions, a "feeling"

CQ-ing For Mid-Sized Stations

- Timing
  - Be the first or last on a band
- Don't fight with giants – move
  - High in the band is perfectly OK!
  - Position yourself where you can be heard
- Know your rate goal and thresholds
- Be aware of your "surroundings"
- Get whole calls the first time

Attacking a Pileup as a Caller

- Think "opportunity cost"
- Assess the worth of the target
- Assess the size of the pileup
- Is propagation improving or decaying?
- Smart beats loud
  - Avoid zero beat
  - Varying timing



Speed Search-and-Pounce

- Tune in a station on either VFO
- Set VFO-A = VFO-B
- Tune in another station and switch VFOs
- Assess, call, switch…repeat
- When one is worked, switch and equalize your VFOs
- Leapfrog your way along the band

Make Good QSOs

- Know who you are calling
  - NEVER NEVER TRUST CLUSTER SPOTS!
- Know who is calling you!
  - Does the prefix make sense for the situation?
- Ask for repeats if you are not sure
- "Prefill is pre-bust!"
- *ERRORS REDUCE YOUR SCORE!!!!*

Practice

- To exercise oneself by repeated performance in order to acquire skill: *to practice at making QSOs.*
- *Learn to listen*
- *Learn to call*
- *Learn the bands*
- *Learn your station*

"In theory there is no difference between theory and practice. In practice there is."
Yogi Berra

Evaluate yourself

- Listen to good ops and bad ops in minor contests
  - Which one sounds most like you?

Accurate

Cost of Errors

- Many contests have a penalty for errors
  - Loss of QSO
  - Loss of QSO + 3x penalty
- Errors happen
- Focus on yours and how to prevent them
- Post contest “log washing” is not an acceptable practice

Improve your Vocabulary

- English has 180,000 words
  - Average person uses 10,000 – 12,000 words
  - College educated uses 15,000 – 20,000 words
- The CQ WW SSB 2012 had 101,112 calls in the logs
  - 56,319 only appeared in one log
  - Experience says >80% of these are errors

Which of these calls are bad?

C73NL	FY5KE	LY7A	RG8U
CD6416	GT8IOM	OB9DCM	TM6M
E2E	IB1B	M5O	W0ASH
EY8MM	HI3TIJ	P3W	YU15OTC

Motivated

BIC – Butt in Chair

- No other single thing will help you more to improve your scores.
- It only works if you spend your time working people



BIC Strategy

- Plan your life to meet your contest goal
  - Work, family, food, rest, station repairs
- Part time?
  - BIC for the best rate or at different times each day
- Have a goal!

Sleep Facts

- You can not train for lack of sleep
- You can not store sleep
- Under sleep deprivation, highly practiced skills will deteriorate more slowly than those which require new or creative thought

Contest Sleep Strategy

- Preparation
  - Have good physical fitness
  - Stay on your normal sleep schedule
  - Get extra sleep 4-7 days before the contest
  - Take 3 hour nap before contest starts
- During the contest
  - Sleep for 90 or 180 minutes
  - Avoid caffeine until needed



Remember your goal!

- Fatigue will make you want to quit
- A short nap is better than quitting
- Sleep during low rates so you are fresh during the high rate periods

Keep Pushing

- Use time wisely
  - The clock never stops
- The next QSO could make the difference!
  - Pay attention to accuracy
- Everyone is experiencing the same conditions!
  - Don't get frustrated





Hour 43 – The "look"

Questions?

Post-Contest Log Analyzers

"Releasing the Gorilla in Your Cabrilla"

John Miller, K6MM

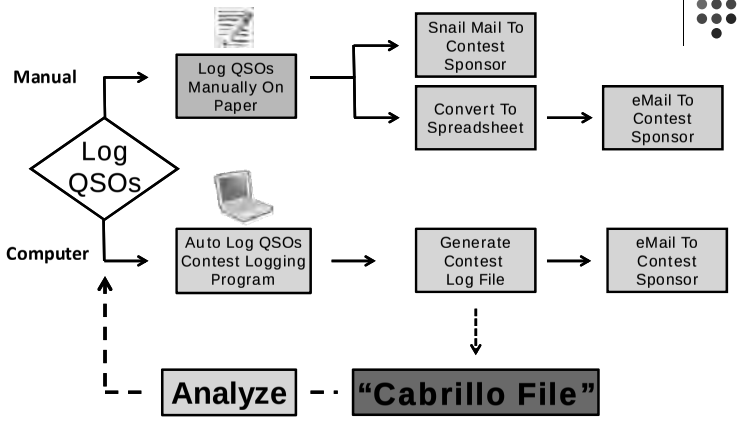
May 16, 2013



Contesting: Why Bother?

- Sharpen your operating skills
- Get the most out of your equipment
- Compete against your peers
- Support your local Contesting Club
- Prepare for WRTC 2014
- Become part of the contesting community
- Have more fun with the hobby

After The Contest: Log Submission



Cabrillo files can provide valuable feedback about your operating decisions and help to shape your strategy for future contests.

What's A Cabrillo File?

- File Format Standard developed by Trey, N5KO
- In late 1999 became standardized electronic contest entry specification
- Serves as a standard interface (i.e., "language") between logging program authors and contest sponsors
- Simplifies log collection, checking, and reporting of contest results.
- All common contest logging programs can automatically generate a Cabrillo Log file

Cabrillo Line Tags

START-OF-LOG: *Cabrillo version-number (3.0)*
CREATED-BY: *contest logger*
CALLSIGN: *callsign*
CATEGORY-ASSISTED:
CATEGORY-BAND:
CATEGORY-MODE:
CATEGORY-OPERATOR:
CATEGORY-POWER:
CATEGORY-STATION:
CATEGORY-TIME:
CATEGORY-TRANSMITTER:
CATEGORY-OVERLAY:
CLAIMED-SCORE: *n*
CLUB: *Northern California Contest Club*
CONTEST:
EMAIL: *text*
LOCATION:
NAME: *text*
ADDRESS:
ADDRESS-CITY:
ADDRESS-STATE-PROVINCE:
ADDRESS-POSTALCODE:
ADDRESS-COUNTRY:
OPERATORS: *callsign1* [*callsign2 callsign3...*]
OFFTIME: *begin-time end-time*
SOAPBOX: *text*
QSO: *qso-data*
END-OF-LOG:

Example File: K6MM Cabrillo Log
2010 California QSO Party

```
START-OF-LOG: 2.0
ARRL-SECTION: SCV
CALLSIGN: K6MM
CLUB: Northern California Contest Club
CONTEST: CA-QSO-PARTY
CATEGORY: SINGLE-OP ALL HIGH MIXED
CLAIMED-SCORE: 174249
OPERATORS: K6MM
NAME: John Miller
ADDRESS: 6349 Slida Drive
ADDRESS: San Jose, CA 95129
ADDRESS: USA
CREATED-BY: N1MM Logger V10.9.5
QSO: 14047 CW 2010-10-02 1600 K6MM        0001 CA   K6KQV      0001 SCLA
QSO: 14047 CW 2010-10-02 1602 K6MM        0002 CA   W7OM       0005 WA
QSO: 14047 CW 2010-10-02 1603 K6MM        0003 CA   N0AC       0004 CO
QSO: 14047 CW 2010-10-02 1604 K6MM        0004 CA   N4CD       0003 TX
QSO: 14047 CW 2010-10-02 1604 K6MM        0005 CA   K9EN       0002 WI

QSO: 14289 PH 2010-10-03 1950 K6MM        1165 CA   N4DXI      0158 FL
QSO: 14289 PH 2010-10-03 1950 K6MM        1166 CA   WA9DLB     0022 IL
QSO: 14289 PH 2010-10-03 1952 K6MM        1167 CA   AE1T       0306 NH
QSO: 21273 PH 2010-10-03 1957 K6MM        1168 CA   WA0AVL     0332 IL
QSO: 21317 PH 2010-10-03 2003 K6MM        1169 CA   W1UE       1170 MA
QSO: 21334 PH 2010-10-03 2007 K6MM        1170 CA   WB4FEV     0088 SC
END-OF-LOG:
```

What's A Post-Contest Log Analyzer?

Software designed to analyze a Cabrillo File for a specific contest, and produce statistically valuable information.

Log Analyzers: What Can I Learn?

- How much time did I really operate?
- Which times were most productive?
- Which bands were most productive?
- Which countries, continents, CQ/ITU zones, or grid squares did I work?
- What did my QSO rates look like?
- How effective were my antennas?
- How can I have more FUN next time?

Log Analyzers For Cabrillo Files:
Why Not Just Use My Own Logger?

- Good place to start
- N1MM, TR4W, WriteLog, Win-Test, etc. have some built-in post contest analysis capability
- Limited to the author's options
- Option to export files for further analysis
- Worthwhile exploring other methods
- Cheap, Fast, Fun

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Primary Log Analyzers

1. CBS (Cabrillo Statistics Program) (Bob, N6TV)
2. RCSS (Excel Spreadsheets) (Bob, K0RC)
3. SH5 (Dmitriy, UA4WLI)
4. LogView (Tim, EI8IC)

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	Cabrillo Log Analyzers				
	Name ==>	1. CBSW	2. SH5	3. RCSS	4. LogView
	Cost ==>	FREE	$20	FREE	FREE
1	ARRL-10	X			
2	ARRL-160	X		X	
3	ARRL-DX-CW	X		X	
4	ARRL-DX-SSB	X		X	
5	ARRL-FIELD DAY	X		X	
6	ARRL-RTTY	X		X	
7	ARRL-SS-CW	X		X	
8	ARRL-SS-SSB	X		X	
9	ARRL-VHF-JAN				
10	ARRL-VHF-JUN				
11	ARRL-VHF-SEP				
12	ARRL-UHF-AUG				
13	BARTG-HF			X	
14	CQ-160-CW	X			
15	CQ-160-SSB	X			
16	CQ-WPX-CW	X			
17	CQ-WPX-RTTY	X			
18	CQ-WPX-SSB	X			
19	CQ-VHF		ANY CONTEST		ANY CONTEST
20	CQ-WW-CW	X	but	X	but
21	CQ-WW-RTTY	X		X	
22	CQ-WW-SSB	X	Mults Not Always Accurate		Results Shown For W/VE Only
23	FIELD DAY	X		X	
24	IARU-HF	X			
25	NAQP-CW	X			
26	NAQP-RTTY	X			
27	NAQP-SSB	X			
28	NA SPRINT-CW	X			
29	NA SPRINT-SSB	X			
30	NA SPRINT-RTTY	X			
31	OK-DX RTTY			X	
32	QSO PARTY - CA	X		X	
33	QSO PARTY - FL			X	
34	QSO PARTY - MN			X	
35	QSO PARTY - NY			X	
36	QSO PARTY - OH			X	
37	QSO PARTY - PA				
38	QSO PARTY - WI			X	
39	STEW-PERRY	X			
40	TARA-RTTY				

Primary Log Analyzers Supported Contests



ICOM

	Top 4 Log Analyzers	CBS	SH5	RCSS	Log View
1	Band Changes - # of Changes	X		X	
2	Band Changes - Hourly Changes - Chart			X	
3	Beam heading - by Band		X		
4	Beam heading - by Band - Chart		X		
5	Break times - per Hour		X		
6	Callsigns - # Unique	X			
7	Callsigns - All Worked		X		
8	Callsigns - Length (# of Letters)	X	X		
9	Chart - Continents		X		
10	Continents - by Band	X	X		
11	Countries - by Band	X	X		
12	Countries - by Mode		X		
13	Countries - by Time		X		
14	Countries - by time-10		X		
15	Countries - by time-15		X		
16	Countries - by time-160		X		
17	Countries - by time-20		X		
18	Countries - by time-40		X		
19	Countries - by time-80		X		
20	Countries - Top 10 - Chart		X		
21	CQ zones		X		X
22	Distance		X		
23	Dupes	X	X		
24	Frequencies		X		
25	Grid Square Locators - by Band - List		X		X
26	Grid Square Locators - by Band - Table		X		X
27	Grid Square Locators - Grid Map		X		X
28	ITU zones		X		X
29	KML files		X		
30	Mosaic		X		

	Top 4 Log Analyzers	CBS	SH5	RCSS	Log View
31	Multipliers - by Band	X		X	
32	Multipliers - by Mode			X	
33	Not in master		X		
34	Operators	X	X	X	
35	Possible errors		X		
36	Prefixes - by Country		X		
37	Qs - by Hour - 10M - Chart		X		X
38	Qs - by Hour - 15M - Chart		X		X
39	Qs - by Hour - 20M - Chart		X		X
40	Qs - by Hour - 40M - Chart		X		X
41	Qs - by Hour - 80M - Chart		X		X
42	Qs - by Hour -160 - Chart		X		X
43	Qs - by Hour - All	X	X	X	X
44	Qs - by Hour - All - Chart		X		X
45	Qs - by Hour - Band - Mode	X	X		
46	Qs - Gross Total	X		X	X
47	Qs - Multi-Band Summary	X		X	
48	Qs - Club Roster Members			X	
49	Qs - Net Total	X		X	
50	Qs - Passed		X		
51	Qs - Per Station		X		
52	Qs - Second Radio		X		
53	Qs - Single by Band	X			
54	Rates - best 1 minute	X			
55	Rates - best 10 minutes	X	X		
56	Rates - best 120 minutes		X		
57	Rates - best 30 minutes	X	X		
58	Rates - best 60 minutes	X	X		
59	Rates = QSOs per Minute	X	X		
60	Sunspot Data		X		

Log Analyzer #1

CBS

Authors:
Ken Adams, K5KA (*SK*)
Bob Wilson, N6TV

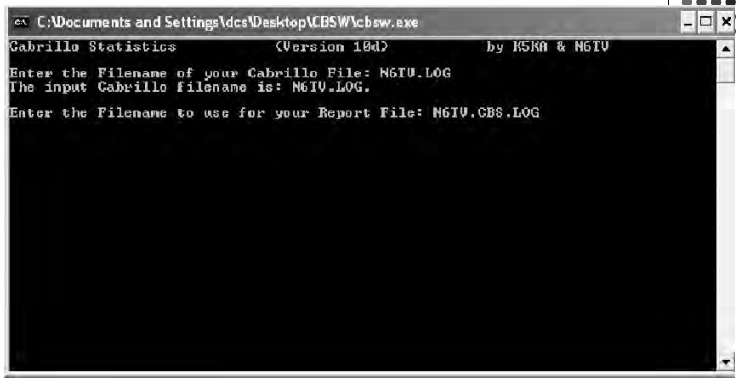
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CBS (Cabrillo Statistics Program)

- Original DOS version: K5KA; Windows + Mac: N6TV
- All Modes: CW, SSB, Digital
- ARRL: SS, 10M, 160M, DX, Field Day, RTTY
- CQ: 160, WPX, WW, WW-RTTY
- NAQP, NAQP-RTTY, NA-SPRINT
- IARU-HF, STEW-PERRY
- California QSO Party
- Produces simple, clean tables
- Generates QSO Rates, Mults, Countries, Uniques, # Dupes, Band Changes, Gross/Net QSOs

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CBS (Cabrillo Statistics Program)



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CBS: Quick Summary

Gross QSOs=1170 Dupes=3 Net QSOs=1167

Unique callsigns worked = 753

The best 60 minute rate was 108/hour from 1606 to 1705
The best 30 minute rate was 136/hour from 1607 to 1636
The best 10 minute rate was 156/hour from 1610 to 1619

The best 1 minute rates were:
4 QSOs/minute 7 times.
3 QSOs/minute 62 times.
2 QSOs/minute 241 times.
1 QSOs/minute 471 times.

There were 29 bandchanges

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CBS

QSO Rate Summary

QSO Rate Summary

Hour	160	80	40	20	15	10	Rate	Total	Pct
1600	0	0	0	105	0	0	105	105	9.0
1700	0	0	0	0	81	0	81	186	15.9
1800	0	0	0	14	57	0	71	257	22.0
1900	0	0	0	35	33	0	68	325	27.8
2000	0	0	0	82	0	0	82	407	34.9
2100	0	0	0	62	0	0	62	469	40.2
2200	0	0	0	55	0	0	55	524	44.9
2300	0	0	0	58	0	0	58	582	49.9
0000	0	0	47	11	0	0	58	640	54.8
0100	0	0	80	0	0	0	80	720	61.7
0200	0	16	15	0	0	0	31	751	64.4
0300	0	26	7	0	0	0	33	784	67.2
0400	0	6	0	0	0	0	6	790	67.7
0500	0	61	0	0	0	0	61	851	72.9
0600	8	39	0	0	0	0	47	898	76.9
0700	0	34	0	0	0	0	34	932	79.9
0800	0	0	0	0	0	0	0	932	79.9
0900	0	0	0	0	0	0	0	932	79.9
1000	0	0	0	0	0	0	0	932	79.9
1100	0	0	0	0	0	0	0	932	79.9
1200	0	0	0	0	0	0	0	932	79.9
1300	0	0	15	0	0	0	15	947	81.1
1400	0	0	0	56	0	0	56	1003	85.9
1500	0	0	0	22	19	0	41	1044	89.5
1600	0	0	0	45	11	0	56	1100	94.3
1700	0	0	0	9	17	0	26	1126	96.5
1800	0	0	0	10	2	2	14	1140	97.7
1900	0	0	2	6	15	2	25	1165	99.8
2000	0	0	0	0	2	0	2	1167	100.0
2100	0	0	0	0	0	0	0	1167	100.0
Total	8	182	166	570	237	4	1167		

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CBS

Single Band QSOs

Band	160	80	40	20	15	10
QSOs	2	101	39	315	80	2

Multi-band QSOs

1 bands	539
2 bands	151
3 bands	51
4 bands	11
5 bands	0
6 bands	1

U.S. Call Areas Worked

Area	QSOs	Pct
0	101	8.7
1	74	6.3
2	74	6.3
3	65	5.6
4	155	13.3
5	97	8.3
6	210	18.0
7	77	6.6
8	78	6.7
9	76	6.5
Total	1007	86.3

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CBS

Continent Summary

Continent Summary

	160	80	40	20	15	10	Total	Pct
North America	8	181	164	530	229	4	1116	95.6
South America	0	0	1	1	0	0	2	0.2
Europe	0	0	0	36	7	0	43	3.7
Asia	0	0	0	0	0	0	0	0.0
Africa	0	0	0	0	0	0	0	0.0
Oceania	0	1	1	3	1	0	6	0.5
Total	8	182	166	570	237	4	1167	

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CBS

Country Summary

Country Summary

Country	160	80	40	20	15	10	Total	Pct
DL	0	0	0	9	1	0	10	0.9
ES	0	0	0	1	0	0	1	0.1
F	0	0	0	4	0	0	4	0.3
G	0	0	0	1	0	0	1	0.1
GM	0	0	0	1	0	0	1	0.1
HA	0	0	0	3	1	0	4	0.3
HB	0	0	0	1	0	0	1	0.1
HK	0	0	0	1	0	0	1	0.1
I	0	0	0	0	2	0	2	0.2
K	8	176	153	461	205	4	1007	86.3
KG4	0	0	0	2	1	0	3	0.3
KH6	0	1	1	3	1	0	6	0.5
KL	0	2	2	5	1	0	10	0.9
LY	0	0	0	1	0	0	1	0.1
OK	0	0	0	6	3	0	9	0.8
ON	0	0	0	1	0	0	1	0.1
PY	0	0	1	0	0	0	1	0.1
S5	0	0	0	2	0	0	2	0.2
SM	0	0	0	4	0	0	4	0.3
SP	0	0	0	1	0	0	1	0.1
VE	0	3	9	62	22	0	96	8.2
YL	0	0	0	1	0	0	1	0.1
Total	8	182	166	570	237	4	1167	

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CBS

----------MULTIPLIER SUMMARY----------

	Mult	160	80	40	20	15	10	Total	Pct
1	TX	0	5	11	37	13	0	66	5.6
2	ON	0	1	5	37	19	0	62	5.3
3	PA	0	1	9	30	12	0	52	4.4
4	DX	0	0	1	37	7	0	45	3.8
5	TN	0	5	6	19	12	0	42	3.6
6	OH	0	1	5	21	14	0	41	3.5
7	CO	0	1	7	32	0	0	40	3.4
8	GA	0	2	4	24	10	0	40	3.4
9	IL	0	0	4	18	18	0	40	3.4
10	SCLA	1	8	5	16	6	2	38	3.2

----------MULTIPLIER SUMMARY----------

	Mult	160	80	40	20	15	10	Total	Pct
1	TX	0	5	11	37	13	0	66	5.6
2	ON	0	1	5	37	19	0	62	5.3
3	PA	0	1	9	30	12	0	52	4.4
4	DX	0	0	1	37	7	0	45	3.8
5	TN	0	5	6	19	12	0	42	3.6
6	OH	0	1	5	21	14	0	41	3.5
7	CO	0	1	7	32	0	0	40	3.4
8	GA	0	2	4	24	10	0	40	3.4
9	IL	0	0	4	18	18	0	40	3.4
10	SCLA	1	8	5	16	6	2	38	3.2

----------MULTIPLIER SUMMARY----------

	Mult	160	80	40	20	15	10	Total	Pct
52	HI	0	1	1	2	1	0	5	0.4
53	INYO	1	3	1	0	0	0	5	0.4
54	SBER	0	4	1	0	0	0	5	0.4
55	MB	0	1	0	3	0	0	4	0.3
56	ALAM	0	1	0	2	1	0	4	0.3
57	QC	0	0	1	2	1	0	4	0.3
58	MARN	0	1	1	1	1	0	4	0.3
59	SLUI	0	2	1	1	0	0	4	0.3
60	UT	0	2	2	0	0	0	4	0.3
61	MODO	0	2	2	0	0	0	4	0.3
62	CALA	0	3	1	0	0	0	4	0.3
63	NLI	0	1	2	1	0	0	4	0.3
64	NC	0	0	1	2	1	0	4	0.3
65	NNJ	0	0	1	2	1	0	4	0.3
66	NTX	0	0	1	2	1	0	4	0.3
67	VA	0	0	1	2	1	0	4	0.3
68	WCF	0	0	1	2	1	0	4	0.3
69	WTX	0	0	1	2	1	0	4	0.3
70	EWA	0	0	1	2	0	0	3	0.3
71	GH	0	0	1	2	0	0	3	0.3
72	NFL	0	0	1	2	0	0	3	0.3
73	SFL	0	0	1	2	0	0	3	0.3
74	STX	0	0	1	2	0	0	3	0.3
75	WPA	0	0	1	2	0	0	3	0.3
76	AK	0	1	0	2	0	0	3	0.3
77	EB	0	0	0	2	1	0	3	0.3
78	EPA	0	0	0	2	1	0	3	0.3
79	NV	0	0	0	2	1	0	3	0.3
80	WMA	0	0	0	2	1	0	3	0.3
81	AZ	0	0	0	2	0	0	2	0.2
82	EMA	0	0	0	2	0	0	2	0.2
83	ME	0	0	0	2	0	0	2	0.2
84	NM	0	0	0	2	0	0	2	0.2
85	FRES	0	2	0	0	0	0	2	0.2
86	SIER	0	2	0	0	0	0	2	0.2
87	ALPI	0	1	1	0	0	0	2	0.2
88	MEND	0	2	0	0	0	0	2	0.2
89	SACR	0	2	0	0	0	0	2	0.2
90	SBEN	0	1	1	0	0	0	2	0.2
91	YUBA	0	2	0	0	0	0	2	0.2
92	STAN	0	0	0	0	1	0	1	0.1
93	NT	0	0	0	1	0	0	1	0.1
94	MONT	0	0	1	0	0	0	1	0.1
95	PLUM	0	1	0	0	0	0	1	0.1
96	KERN	0	1	0	0	0	0	1	0.1
97	TRIN	0	1	0	0	0	0	1	0.1
98	MERC	0	1	0	0	0	0	1	0.1
99	DELN	0	1	0	0	0	0	1	0.1
100	SBAR	0	1	0	0	0	0	1	0.1
101	IMPE	0	1	0	0	0	0	1	0.1
	Total	8	182	166	570	237	4	1167	

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CBS: Summary



(+) FREE

(+) Quick

(+) Generates all the basic statistics

(+) Covers most U.S. based contests

(+) Continuous improvement by author

(-) Simple but time-worn DOS interface

(-) No graphics or charting options

Overall: Very useful log analyzer



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Log Analyzer #2

RCSS

(KØRC Spreadsheets)

Author:
Bob Chudek, KØRC

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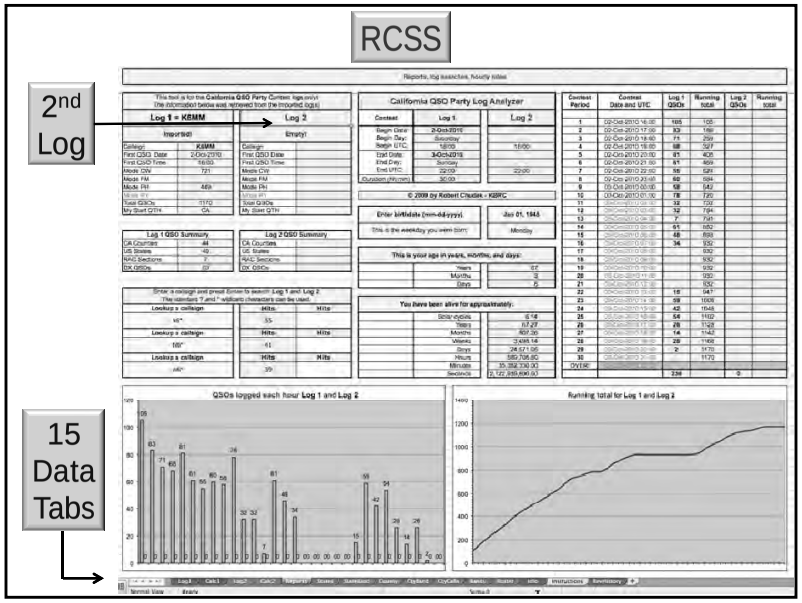
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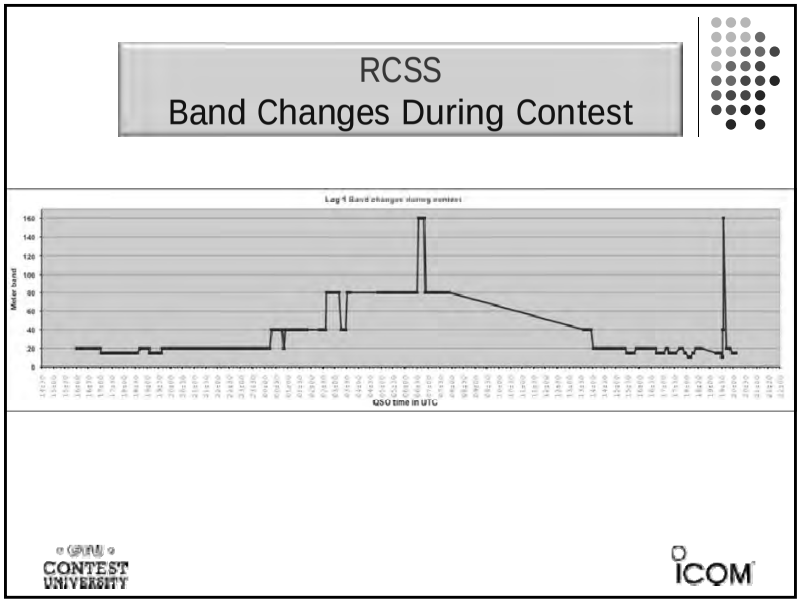
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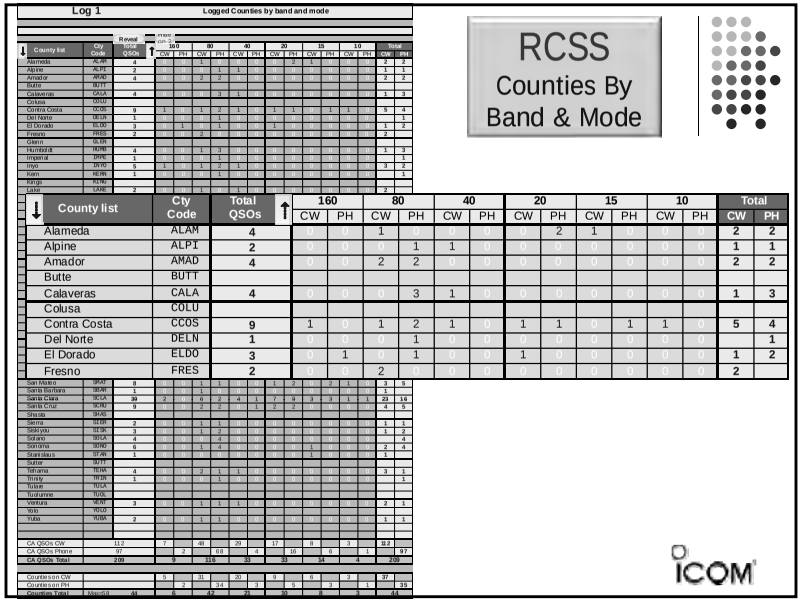
- Series of customized Excel spreadsheets for specific contests
- ARRL 160M, DX, Field Day, RTTY, Sweepstakes
- CQWW 160M, DX, DX-RTTY,
- OK DX RTTY
- QSO Parties: CA, FL, MI, MN, ND, OH, TX, WI
- Resulting statistics and charts generated automatically
- Can compare any 2 logs simultaneously
- Bonus: Built-in Roster check for Club Members!

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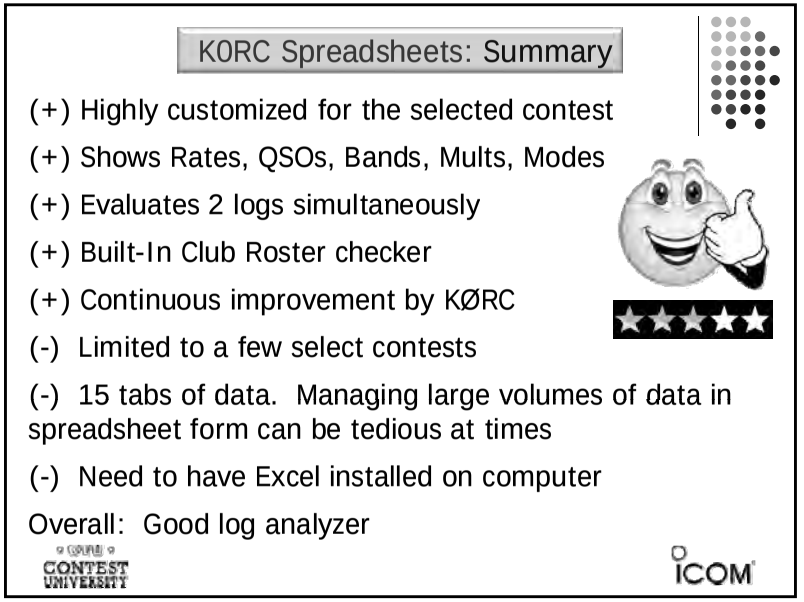
ICOM







County list	Cty Code	Total QSOs	160 CW	160 PH	80 CW	80 PH	40 CW	40 PH	20 CW	20 PH	15 CW	15 PH	10 CW	10 PH	Total CW	Total PH
Alameda	ALAM	4	0	0	1	0	0	0	0	2	1	0	0	0	2	2
Alpine	ALPI	2	0	0	0	1	1	0	0	0	0	0	0	0	1	1
Amador	AMAD	4	0	0	2	2	0	0	0	0	0	0	0	0	2	2
Butte	BUTT															
Calaveras	CALA	4	0	0	0	3	1	0	0	0	0	0	0	0	1	3
Colusa	COLU															
Contra Costa	CCOS	9	1	0	1	2	1	0	1	1	0	1	1	0	5	4
Del Norte	DELN	1	0	0	0	1	0	0	0	0	0	0	0	0		1
El Dorado	ELDO	3	0	1	0	1	0	0	1	0	0	0	0	0	1	2
Fresno	FRES	2	0	0	2	0	0	0	0	0	0	0	0	0	2	



Log Analyzer #3

SH5

Author:
Dmitriy Gulyaev, UA4WLI

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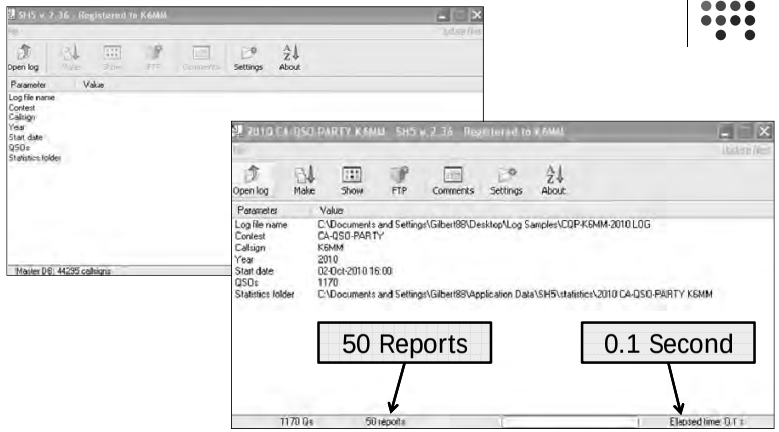
SH5

- Authored by Dimitry of TR4W fame
- Opens a Cabrillo, TR Log, *.dat, or ADIF file
- Nice user interface
- Extremely easy to use, and fast
- Can check any contest – although Mults aren't always accurately represented
- Very complete and useful statistical summary
- 50 outstanding Reports are automatically saved as HTML files for offline viewing

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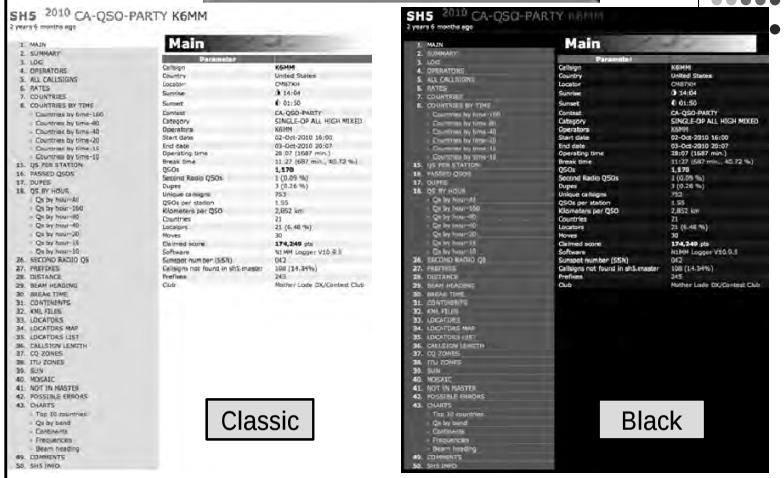
SH5 Interface



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SH5: Choice of 2 Color Schemes



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Main

Parameter	
Callsign	**K6MM**
Country	United States
Locator	CM87XH
Sunrise	◑ 14:04
Sunset	◐ 01:50
Contest	CA-QSO-PARTY
Category	SINGLE-OP ALL HIGH MIXED
Operators	K6MM
Start date	02-Oct-2010 16:00
End date	03-Oct-2010 20:07
Operating time	28:07 (1687 min.)
Break time	11:27 (687 min., 40.72 %)
QSOs	**1,170**
Second Radio QSOs	1 (0.09 %)
Dupes	3 (0.26 %)
Unique callsigns	753
QSOs per station	1.55
Kilometers per QSO	2,852 km
Countries	21
Locators	21 (6.48 %)
Moves	30
Claimed score	**174,249** pts
Software	N1MM Logger V10.9.5
Sunspot number (SSN)	042
Callsigns not found in sh5.master	108 (14.34%)
Prefixes	245
Club	Mother Lode DX/Contest Club

SH5: Main Screen

- 28h 7m Op Time
- 11h 27m Break Time
- 1170 QSOs
- 3 Dupes
- 753 Unique Callsigns
- 21 Countries
- 108 Callsigns (14%) Not in Master DX File
- 245 Unique Prefixes

ICOM

Summary

SH5: K6MM CQP 2010

Band	CW QSOs	CW %	Digital QSOs	Digital %	Phone QSOs	Phone %	All QSOs	All %	Countries
160	7	0.6			2	0.2	9	0.8	1
80	97	8.3			85	7.3	182	15.6	4
40	154	13.2			12	1.0	166	14.2	5
20	330	28.2			242	20.7	572	48.9	19
15	130	11.1			107	9.1	237	20.3	8
10	3	0.3			1	0.1	4	0.3	1
All	721	61.6			449	38.4	1170	100.0	21

- QSO Analysis: # and %
- Breakdown by Band, Mode
- Total Time spent on each Band
- # of Countries Worked by Band

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SH5: Rates

Rates

Period, min.	QSOs	QSOs per minute	QSOs per hour	From Time	From QSO #	To Time	To QSO #
10	26	2.6	156	02-Oct-2010 16:10	16	02-Oct-2010 16:19	41
20	48	2.4	144	02-Oct-2010 16:10	16	02-Oct-2010 16:30	63
30	68	2.3	136	02-Oct-2010 16:03	3	02-Oct-2010 16:33	70
60	108	1.8	108	02-Oct-2010 16:04	4	02-Oct-2010 17:04	111
120	190	1.6	95	02-Oct-2010 16:03	3	02-Oct-2010 18:03	192

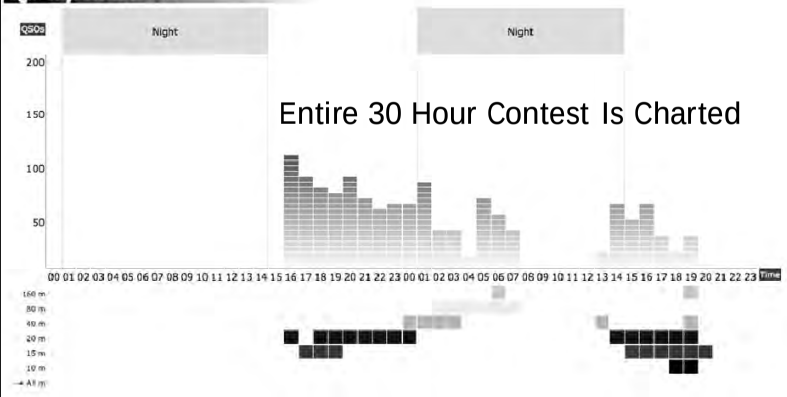
- Highest rates per hour
- Breakdown by 10, 20, 30, 60, 120 minute periods
- Specific From/To Time periods
- Specific QSO# range

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SH5: QSOs by Hour – All Bands

Qs by hour-All

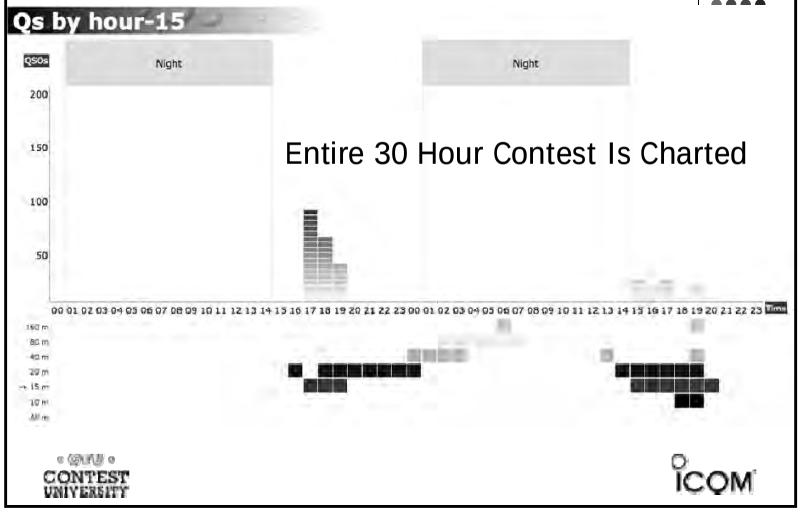


Entire 30 Hour Contest Is Charted

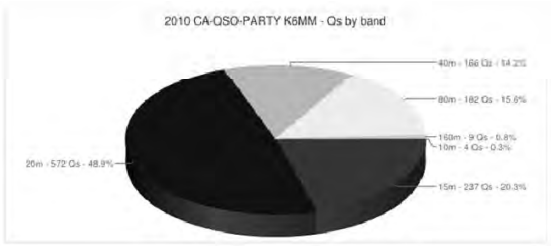
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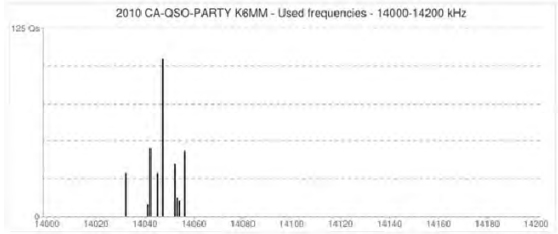
SH5: QSOs by Hour – 15M

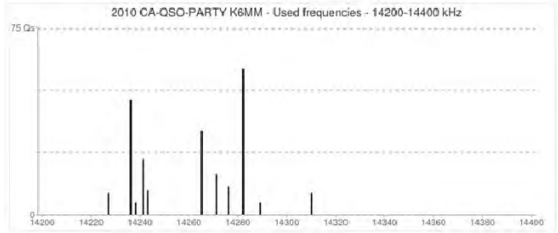


SH5: QSOs by Band

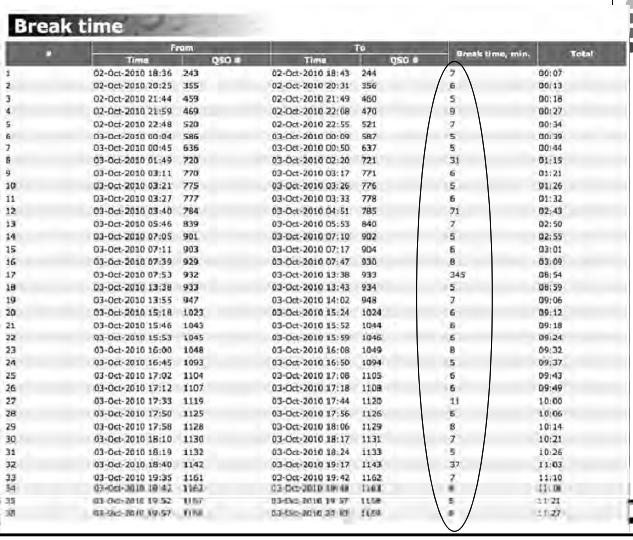


SH5: Frequencies Used Per Band + Mode: 20M





SH5: Break Times



Break time

#	From		To		Break time, min.	Total
	Time	QSO #	Time	QSO #		
1	02-Oct-2010 18:36	243	02-Oct-2010 18:43	244	7	00:07
2	02-Oct-2010 20:25	355	02-Oct-2010 20:31	356	6	00:13
3	02-Oct-2010 21:44	459	02-Oct-2010 21:49	460	5	00:18
4	02-Oct-2010 21:59	469	02-Oct-2010 22:08	470	9	00:27
5	02-Oct-2010 22:48	520	02-Oct-2010 22:55	521	7	00:34
6	03-Oct-2010 00:04	586	03-Oct-2010 00:09	587	5	00:39
7	03-Oct-2010 00:45	636	03-Oct-2010 00:50	637	5	00:44
8	03-Oct-2010 01:49	720	03-Oct-2010 02:20	721	31	01:15
9	03-Oct-2010 03:11	770	03-Oct-2010 03:17	771	6	01:21
10	03-Oct-2010 03:21	775	03-Oct-2010 03:26	776	5	01:26
11	03-Oct-2010 03:27	777	03-Oct-2010 03:33	778	6	01:32
12	03-Oct-2010 03:40	784	03-Oct-2010 04:51	785	71	02:43
13	03-Oct-2010 05:46	839	03-Oct-2010 05:53	840	7	02:50
14	03-Oct-2010 07:05	901	03-Oct-2010 07:10	902	5	02:55
15	03-Oct-2010 07:11	903	03-Oct-2010 07:17	904	6	03:01
16	03-Oct-2010 07:39	929	03-Oct-2010 07:47	930	8	03:09
17	03-Oct-2010 07:53	932	03-Oct-2010 13:38	933	345	08:54
18	03-Oct-2010 13:38	933	03-Oct-2010 13:43	934	5	08:59
19	03-Oct-2010 13:55	947	03-Oct-2010 14:02	948	7	09:06
20	03-Oct-2010 15:18	1023	03-Oct-2010 15:24	1024	6	09:12
21	03-Oct-2010 15:46	1043	03-Oct-2010 15:52	1044	6	09:18
22	03-Oct-2010 15:53	1045	03-Oct-2010 15:59	1046	6	09:24
23	03-Oct-2010 16:00	1048	03-Oct-2010 16:08	1049	8	09:32
24	03-Oct-2010 16:45	1093	03-Oct-2010 16:50	1094	5	09:37
25	03-Oct-2010 17:02	1104	03-Oct-2010 17:08	1105	6	09:43
26	03-Oct-2010 17:12	1107	03-Oct-2010 17:18	1108	6	09:49
27	03-Oct-2010 17:33	1119	03-Oct-2010 17:44	1120	11	10:00
28	03-Oct-2010 17:50	1125	03-Oct-2010 17:56	1126	6	10:06
29	03-Oct-2010 17:58	1128	03-Oct-2010 18:06	1129	8	10:14
30	03-Oct-2010 18:10	1130	03-Oct-2010 18:17	1131	7	10:21
31	03-Oct-2010 18:19	1132	03-Oct-2010 18:24	1133	5	10:26
32	03-Oct-2010 18:40	1142	03-Oct-2010 19:17	1143	37	11:03
33	03-Oct-2010 19:35	1161	03-Oct-2010 19:42	1162	7	11:10
34	03-Oct-2010 19:42	1162	03-Oct-2010 19:48	1163	6	11:16
35	03-Oct-2010 19:52	1167	03-Dec-2010 19:57	1168	5	11:21
36	03-Dec-2010 19:57	1168	03-Dec-2010 20:03	1169	6	11:27

SH5: Continents

Continents

Continent	QSOs							
	160	80	40	20	15	10	All	%
NA North America	9	181	164	531	229	4	1118	*95.6*
SA South America			1	1			2	*0.2*
EU Europe				37	7		44	*3.8*
AF Africa								*0.0*
AS Asia								*0.0*
OC Oceania		1	1	3	1		6	*0.5*

- QSO Breakdown by Band and Continent
- # and % of QSOs
- HTML Linked to other reports

37 European QSOs on 20M

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SH5: 37 European QSOs on 20M

QSO #	Band	Mode	Time	Qs	Callsign	Cont.	Country	Dist., km	Head., °	In MASTER	Dupe	CQ	ITU
8	20m	CW	02-Oct-2010 16:06	1	G4RRA	EU	G England	8630	34	In MASTER		14	27
44	20m	CW	02-Oct-2010 16:22	1	DJ9AO	EU	DL Germany	9270	27	In MASTER		14	28
58	20m	CW	02-Oct-2010 16:28	2	DL3GA	EU	DL Germany	9370	30	In MASTER		14	28
59	20m	CW	02-Oct-2010 16:28	2	DL3DXX	EU	DL Germany	9350	26	In MASTER		14	28
78	20m	CW	02-Oct-2010 16:37	1	S53M	EU	S5 Slovenia	9880	26	In MASTER		15	28
245	20m	CW	02-Oct-2010 18:44	1	HA8VK	EU	HA Hungary	9960	25	In MASTER		15	28
252	20m	CW	02-Oct-2010 18:50	1	F5IN	EU	F France	9090	33	In MASTER		14	27
338	20m	CW	02-Oct-2010 20:09	1	DL1OLI	EU	DL Germany	9100	28	In MASTER		14	28
339	20m	CW	02-Oct-2010 20:11	1	LY2RN	EU	LY Lithuania	9210	19			15	29
340	20m	CW	02-Oct-2010 20:13	1	GM3YOR	EU	GM Scotland	8150	32	In MASTER		14	27
346	20m	CW	02-Oct-2010 20:17	1	HB9IJJ	EU	HB Switzerland	9540	31			14	28
429	20m	CW	02-Oct-2010 21:17	1	DK4YJ	EU	DL Germany	9450	29	In MASTER		14	28
438	20m	CW	02-Oct-2010 21:23	4	OK4U	EU	OK Czech Republic	9500	24	In MASTER		15	28
950	20m	CW	03-Oct-2010 14:05	1	SM5QU	EU	SM Sweden	8640	20	In MASTER		14	18
956	20m	CW	03-Oct-2010 14:08	1	F5JU	EU	F France	8890	35	In MASTER		14	27
958	20m	CW	03-Oct-2010 14:09	1	SM5CSS	EU	SM Sweden	8640	20	In MASTER		14	18
960	20m	CW	03-Oct-2010 14:11	2	ON4RO	EU	ON Belgium	8840	31	In MASTER		14	27
970	20m	CW	03-Oct-2010 14:18	1	F5NKX	EU	F France	9260	34	In MASTER		14	27
971	20m	CW	03-Oct-2010 14:20	1	OK2PAY	EU	OK Czech Republic	9520	26	In MASTER		15	28
974	20m	CW	03-Oct-2010 14:23	2	ON4RO	EU	ON Belgium	8840	31	In MASTER	Dupe	14	27
978	20m	CW	03-Oct-2010 14:29	1	DM3ZF	EU	DL Germany	9260	26	In MASTER		14	28
979	20m	CW	03-Oct-2010 14:30	1	OK1CF	EU	OK Czech Republic	9350	26	In MASTER		15	28
980	20m	CW	03-Oct-2010 14:30	1	SM5IMO	EU	SM Sweden	8580	20	In MASTER		14	18
989	20m	CW	03-Oct-2010 14:43	1	SP6NIC	EU	SP Poland	9410	24	In MASTER		15	28
992	20m	CW	03-Oct-2010 14:44	1	OK2RU	EU	OK Czech Republic	9670	24	In MASTER		15	28
993	20m	CW	03-Oct-2010 14:48	1	SM5CCE	EU	SM Sweden	8540	20	In MASTER		14	18
1004	20m	CW	03-Oct-2010 14:58	1	ES7GN	EU	ES Estonia	8860	16	In MASTER		15	29
1011	20m	CW	03-Oct-2010 15:05	1	S51AP	EU	S5 Slovenia	9800	27			15	28
1013	20m	CW	03-Oct-2010 15:07	2	OK1VD	EU	OK Czech Republic	9420	25	In MASTER		15	28
1017	20m	CW	03-Oct-2010 15:11	1	F5JSD	EU	F France	8910	33	In MASTER		14	27
1021	20m	CW	03-Oct-2010 15:16	1	HA7UG	EU	HA Hungary	9860	25	In MASTER		15	28
1062	20m	PH	03-Oct-2010 16:13	4	OK4U	EU	OK Czech Republic	9500	24	In MASTER		15	28
1083	20m	PH	03-Oct-2010 16:35	2	DL3GA	EU	DL Germany	9370	30	In MASTER		14	28
1087	20m	PH	03-Oct-2010 16:37	1	YL2BJ	EU	YL Latvia	9560	17	In MASTER		15	29
1120	20m	PH	03-Oct-2010 17:44	1	DL8UI	EU	DL Germany	9100	28	In MASTER		14	28
1134	20m	PH	03-Oct-2010 18:27	2	HA7UG	EU	HA Hungary	9860	25	In MASTER		15	28
1135	20m	PH	03-Oct-2010 18:29	1	DL7OK	EU	DL Germany	9010	29	In MASTER		14	28

SH5: Country Summary

Countries

#	Cont.		Country	Distance km	QSOs CW	SSB	DIG	160	80	40	20	15	10	All	%	Bands	Propagation predictions	Map
1	EU	DL	Germany	9180	7	3					9	1		10	0.9	2	2011 2012	map
2	EU	ES	Estonia	8860	1						1			1	*0.1*	1	2011 2012	map
3	EU	F	France	9260	4						4			4	*0.3*	1	2011 2012	map
4	EU	G	England	8570	1						1			1	*0.1*	1	2011 2012	map
5	EU	GM	Scotland	8070	1						1			1	*0.1*	1	2011 2012	map
6	EU	HA	Hungary	9860	3	1					3	1		4	*0.3*	2	2011 2012	map
7	EU	HB	Switzerland	9540	1						1			1	*0.1*	1	2011 2012	map
8	SA	HK	Colombia	6170	1						1			1	*0.1*	1	2011 2012	map
9	EU	I	Italy	10090	2							2		2	*0.2*	1	2011 2012	map
10	NA	K	United States	2990	624	388		9	176	153	464	206	4	1012	86.5	5	2011 2012	map
11	OC	KH6	Hawaii	3680	1	5			1	1	3	1		6	*0.5*	4	2011 2012	map
12	NA	KL	Alaska	3520	7	3			2	2	5	1		10	0.9	4	2011 2012	map
13	EU	LY	Lithuania	9210	1						1			1	*0.1*	1	2011 2012	map
14	EU	OK	Czech Republic	9500	7	2					6	3		9	*0.8*	2	2011 2012	map
15	EU	ON	Belgium	9010	2						2			2	*0.2*	1	2011 2012	map
16	SA	PY	Brazil	8930	1					1				1	*0.1*	1	2011 2012	map
17	EU	S5	Slovenia	9800	2						2			2	*0.2*	1	2011 2012	map
18	EU	SM	Sweden	8400	4						4			4	*0.3*	1	2011 2012	map
19	EU	SP	Poland	9380	1						1			1	*0.1*	1	2011 2012	map
20	NA	VE	Canada	3730	50	46				3	9	62	22	96	*8.2*	4	2011 2012	map
21	EU	YL	Latvia	9060		1						1		1	*0.1*	1	2011 2012	map

9 Germany QSOs on 20M

QSO #	Band	Mode	Time	Qs	Callsign	Cont.	Country	Dist., km	Head., °	In MASTER	Dupe	CQ	ITU
44	20m	CW	02-Oct-2010 16:22	1	DJ9AO	EU	DL Germany	9270	27	In MASTER		14	28
58	20m	CW	02-Oct-2010 16:28	2	DL3GA	EU	DL Germany	9370	30	In MASTER		14	28
59	20m	CW	02-Oct-2010 16:28	2	DL3DXX	EU	DL Germany	9350	26	In MASTER		14	28
338	20m	CW	02-Oct-2010 20:09	1	DL1OLI	EU	DL Germany	9100	28	In MASTER		14	28
429	20m	CW	02-Oct-2010 21:17	1	DK4YJ	EU	DL Germany	9450	29	In MASTER		14	28
978	20m	CW	03-Oct-2010 14:29	1	DM3ZF	EU	DL Germany	9260	26	In MASTER		14	28
1083	20m	PH	03-Oct-2010 16:35	2	DL3GA	EU	DL Germany	9370	30	In MASTER		14	28
1120	20m	PH	03-Oct-2010 17:44	1	DL8UI	EU	DL Germany	9100	28	In MASTER		14	28
1135	20m	PH	03-Oct-2010 18:29	1	DL7OK	EU	DL Germany	9010	29	In MASTER		14	28

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SH5: KML Files Generated Automatically

Display Geographic Data in Google Earth

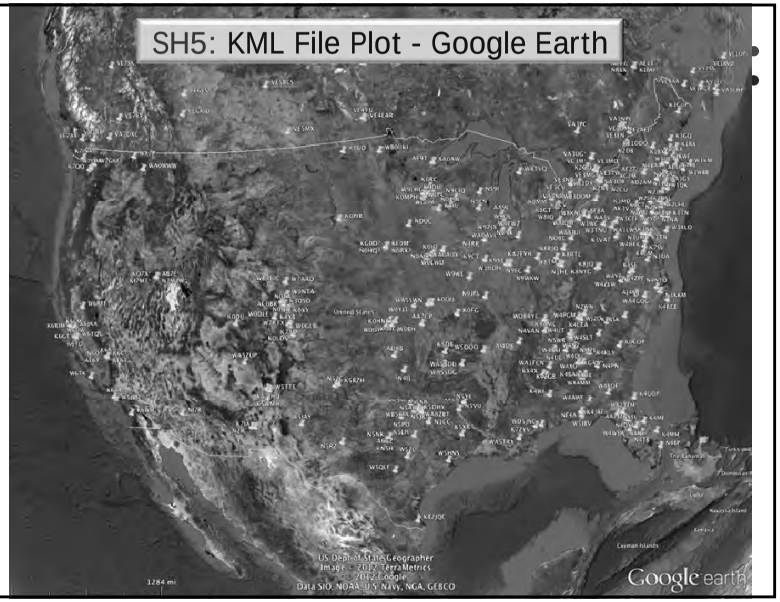
KML files

Band	KML file	Size, kB
160	2010_ca-qso-party_k6mm_160.kml	1
80	2010_ca-qso-party_k6mm_80.kml	17
40	2010_ca-qso-party_k6mm_40.kml	17
20	2010_ca-qso-party_k6mm_20.kml	52
15	2010_ca-qso-party_k6mm_15.kml	21
10	2010_ca-qso-party_k6mm_10.kml	0
All	2010_ca-qso-party_k6mm_All.kml	78

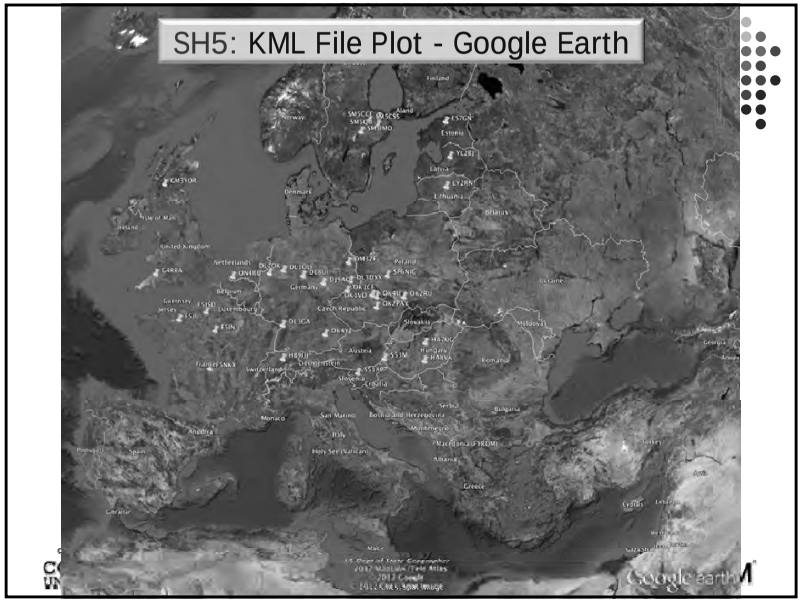
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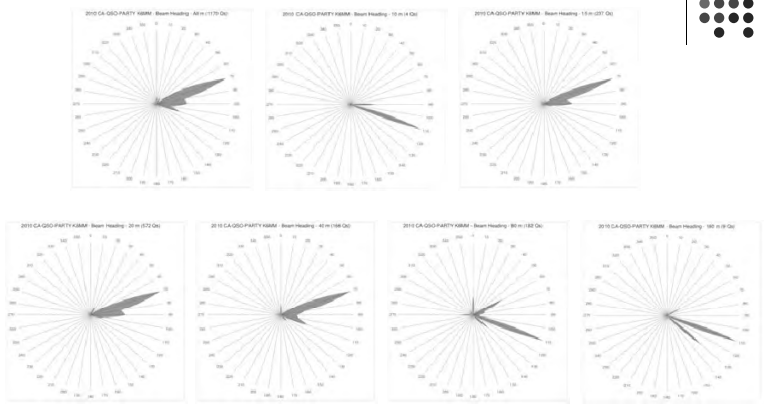
SH5: KML File Plot - Google Earth



SH5: KML File Plot - Google Earth



SH5: Beam Heading Charts - By Band



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SH5: Comparing Logs

- Compare two or more of your own logs for the same contest
- Compare your contest log to a public contest log
- Compare your contest log to a respected colleague's log

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Compare 2 Logs: K6MM - CQP 2009 vs CQP 2010

Rates

Period, min.	QSOs	QSOs per minute	QSOs per hour	From Time	From QSO #	To Time	To QSO #
10	20	2.0	120	03-Oct-2009 16:04	4	03-Oct-2009 16:13	23
20	36	1.8	108	03-Oct-2009 16:04	4	03-Oct-2009 16:24	39
30	54	1.8	108	03-Oct-2009 16:02	2	03-Oct-2009 16:33	55
60	86	1.4	86	03-Oct-2009 16:00	1	03-Oct-2009 17:00	86
120	160	1.3	80	03-Oct-2009 16:04	4	03-Oct-2009 18:05	163

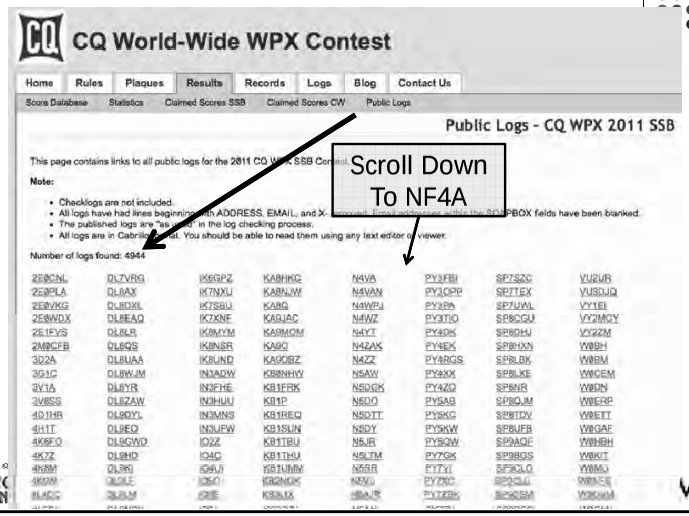
Rates

Period, min.	QSOs	QSOs per minute	QSOs per hour	From Time	From QSO #	To Time	To QSO #
10	26	2.6	156	02-Oct-2010 16:10	16	02-Oct-2010 16:19	41
20	48	2.4	144	02-Oct-2010 16:10	16	02-Oct-2010 16:30	63
30	68	2.3	136	02-Oct-2010 16:03	3	02-Oct-2010 16:33	70
60	108	1.8	108	02-Oct-2010 16:04	4	02-Oct-2010 17:04	111
120	190	1.6	95	02-Oct-2010 16:03	3	02-Oct-2010 18:03	192

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CQWW WPX 2011 SSB: 4944 Public Logs



CQWW WPX 2011 SSB Charlie Wooten, NF4A



- 47h 59m Op Time
- 21h 21m Break Time
- 1986 QSOs
- 4 Dupes
- 1625 Unique Callsigns
- 119 Countries
- 102 Callsigns (6%) Not in Master DX File
- 931 Unique Prefixes

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CQWW WPX 2011 SSB Charlie Wooten, NF4A



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4 Log Comparison

North American QSO Party (NAQP)
2011 RTTY Contest

All NCCC Members

John, K6MM
Kevin, K6TD
Stu, K6TU
Ron, N6EE

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2011 NAQP RTTY: Rules

1. Operating Time vs Break Time
   - Contest Duration: 12 Hours Total = 720 minutes
   - Single Operator: Maximum of 10 out of 12 Hours
   - Off time: 2 Hours = 120 minutes
   - Off times must be minimum of 30 minutes
   - Net operating time: 10 hours = 600 minutes
2. Strategy: Calling CQ vs Search & Pounce
3. Band Changes: How Often, Which Bands

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SH5: 2011 NAQP-RTTY: QSO-Band Summary



- QSO Analysis: # and %
- Breakdown by Band, Mode
- Total Time spent on each Band

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SH5: 2011 NAQP-RTTY – Breaks Between QSOs

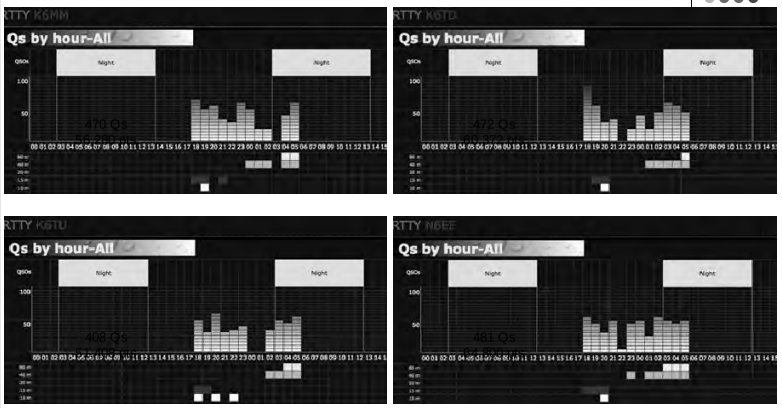


Off-Time Strategy

Net Operating Time: 10 Hours – (Intentional Breaks + Wasted Time)

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SH5: 2011 NAQP-RTTY – Qs By Hour

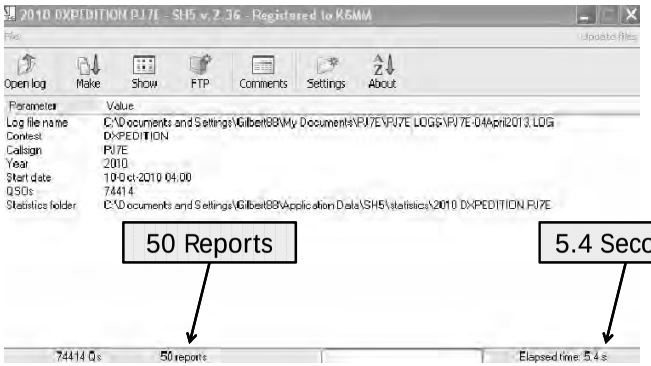


Band Strategy: How much time spent on each band?

Small Logs vs Large Logs?

- K6MM-2010 CQP Log = 1,170 QSOs
- What about a very large log?
- PJ7E (2010 DXpedition) = 74,414 QSOs
- NH8S (2012 DXpedition) = 105,000 QSOs
- Converted ADIF to Cabrillo log
- Analyze with SH5

2010 PJ7E DXpedition = 74,414 Qs



PJ7E

Main	
Parameter	
Callsign	**PJ7E**
Country	Sint Maarten
Locator	FK88LB
Sunrise	10:04
Sunset	21:54
Contest	DXPEDITION
Category	SINGLE-OP-ASSISTED ALL HIGH
Operators	PJ7E
Start date	10-Oct-2010 04:00
End date	20-Oct-2010 22:01
Operating time	258:01 (15481 min.)
Break time	17:15 (1035 min., 6.69 %)
QSOs	**74,414**
Second Radio QSOs	5,206 (7.00 %)
Dupes	5,119 (6.88 %)
Unique callsigns	22,005
QSOs per station	3.38
Kilometers per QSO	5,628 km
Countries	176
Locators	115 (35.49 %)
Moves	49,024
Claimed score	**0** pts
Software	N1MM Logger V13.2.2
Sunspot number (SSN)	013
Callsigns not found in sh5.master	11,410 (51.85%)
Prefixes	2054
Club	

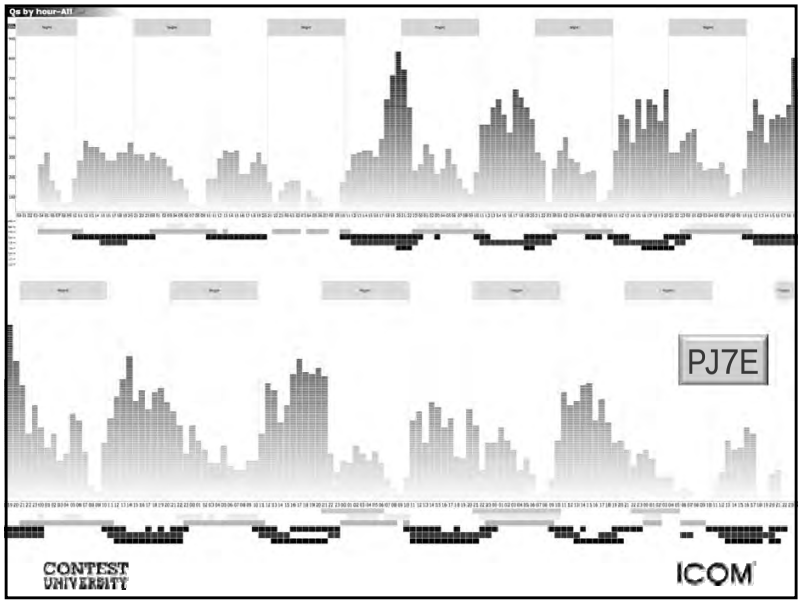
- 258 Hours Op Time
- 17 Hours Break Time
- 74,414 QSOs
- 5,119 Dupes
- 22,005 Unique Callsigns
- 176 Countries
- 11,410 Callsigns (14%) -Not in Master DX File
- 2054 Unique Prefixes

Summary

PJ7E

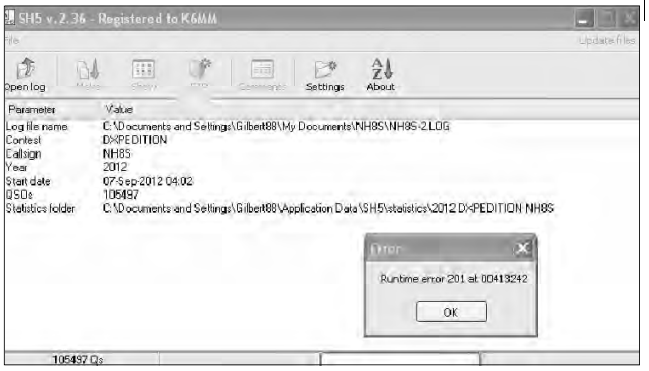
Band	CW QSOs	CW %	Digital QSOs	Digital %	Phone QSOs	Phone %	All QSOs	All %	Countries
160	1137	1.5			6	0.0	1143	1.5	47
80	1561	2.1	175	0.2	1755	2.4	3491	4.7	75
40	5204	7.0	710	1.0	5729	7.7	11643	15.6	127
20	5295	7.1	678	0.9	6282	8.4	12255	16.5	119
15	5241	7.0	652	0.9	7219	9.7	13112	17.6	118
10	2151	2.9	692	0.9	3847	5.2	6690	9.0	94
30	4869	6.5	1321	1.8			6190	8.3	98
17	6042	8.1	239	0.3	6466	8.7	12747	17.1	119
12	3061	4.1	479	0.6	3527	4.7	7067	9.5	96
All	34561	46.4	4946	6.6	34907	46.9	74414	100.0	176

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2012 NH8S DXpedition = 105,497 Qs



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SH5: Summary

(+) Attractive user interface

(+) Excellent Charts, Tables, Graphs

(+) Easy to use and understand results

(+) Can check any contest – very FAST!

(+) Great for comparative analyses

(+) Large Log Analysis



(+) 50 Reports linked as HTML files for offline viewing

(-) Can only display one log at a time

(-) No user manual or documentation

(-) Registration is $20.00

Overall: Outstanding Log Analyzer

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Log Analyzer #4

LogView

Author:
Tim Makins, EI8IC

LogView

- Web-Based Log Visualization Tool
- Plots Qs on to one of 8 different maps
- Online database of 1M+ W/VE callsigns
- Shows your QSO build-up over time
- Step through log manually or via animation
- Keep a running count of Multipliers worked
- Display all or selected bands
- Save map for offline viewing and analysis
- Highlight gaps in your antenna coverage

LogView



4. LogView: Summary



(+) FREE

(+) Unique Visualization Tool

(+) Replay your entire contest in “real time”, QSO-by-QSO

(+) QSO patterns are one measure of antenna effectiveness

(-) Can only plot W/VE callsigns. No DX database.

Overall: Pure Eye Candy!!

Post-Contesting Log Analyzers: Why Bother?

- Manager Operating Time
  - Manage Break Times carefully
  - Minimize Wasted Time
  - Maximize Net Operating Time = Maximum Allowed Time – (Required Breaks + Wasted Time)
- Improve Skills & Technique
  - Calling CQ vs Search & Pounce
  - Copying exchanges accurately
  - Manage Band Changes
- Check Station Efficiency

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Log Analyzers

- No “ideal” solution – but several very good log analyzers available in different formats
- Most are Free or very low cost
- Many useful ways to review your data
- Can provide valuable feedback on your operating strategy, technique and station efficiency
- Boost the Fun Factor in Contesting!
- Post-Contest Log Analyzer = **ONLY AFTER** your log is submitted. Not cool to use before!

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Bottom Line

- Working the contest and sending in that Log was the most difficult part
- Taking some extra post-contest time to further analyze your log now might just boost your next score by 20-30%
- Put another way……

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Release that Gorilla…

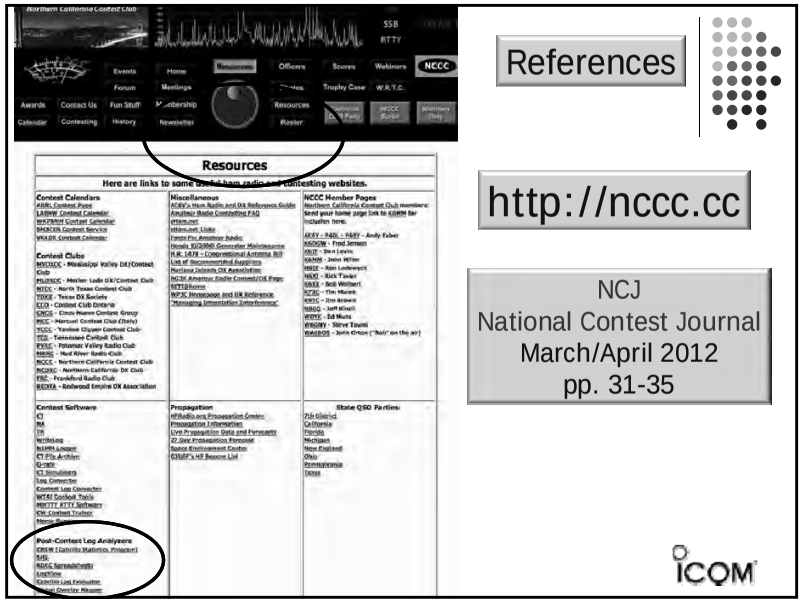
In your Cabrill-a

And you just might

Improve your Skilla!



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References

http://nccc.cc

NCJ
National Contest Journal
March/April 2012
pp. 31-35

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CTU Presents

VHF Contesting

Joel Harrison, W5ZN

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VHF Contesting

- **Magic Bands**

with

- **Super Results**

from

- **Average Stations**

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What Contests are Available?

- **ARRL**
  - **January**
  - **June**
  - **September**
- **CQ**
  - **July**

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Categories

- **Standard**
  - **Single OP**
  - **Multi Op**
- **Unique**
  - **Rover**
- **New & Unique**
  - **Single Op 3 Band (50, 144, 222, or 432)**
  - **FM Only**

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Categories - Rovers



N5AC Rover
Antenna Restricted at Home



W5ZN Rover

Station Basics

- **6 Meters**
  - Radio or transverter is fine
  - 50 watts is great, 100 watt is outstanding
  - 3 element antenna at 30 ft is good
- **2 Meters**
  - Radio or transverter is fine
  - >50 watts
  - 13 element beam @ ~50 ft

Station Basics

- **222 – 432 MHz**
  - >50 watts
  - 16 element & 25 element @ ~50 ft
  - Boom length
- **902 MHz & Up**
  - >10 watts
  - Loop yagis & parabolic (dish) antennas

Station Basics - Noise

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



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

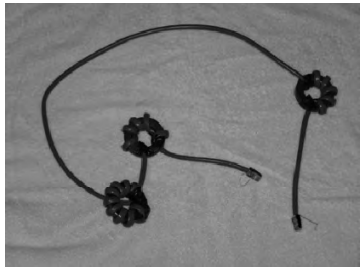
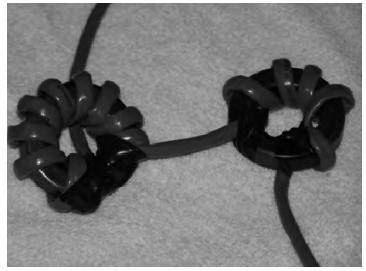
Station Basics - Noise

- 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

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Station Basics - Noise

- Internet Router noise can be significantly reduced or eliminated.

Also utilize shielded CAT5 cable and connectors

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Station Basics - Noise

- 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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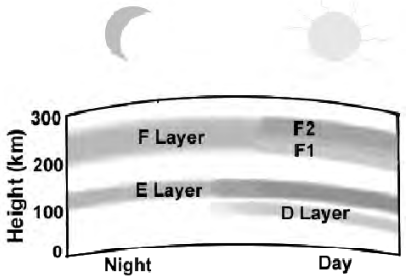
Propagation – What can I Expect

- Sporadic E – "Es"
- Tropospheric Ducting – "Tropo"
- Meteor Scatter – "MS"

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Propagation

At night the E layer and F layers are present. During the day, a D layer forms and the E and F layers become much stronger. Often during the day the F layer will divide into F1 and F2 layers.



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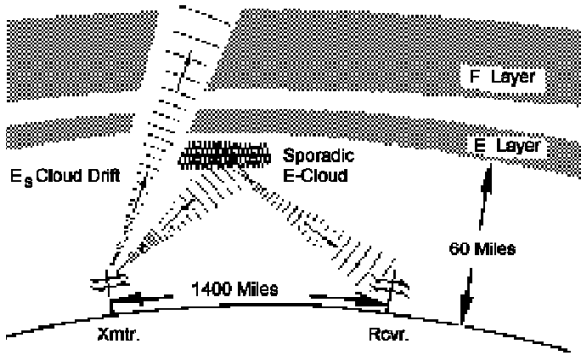
Propagation – Es

- **Sporadic ionization of the E-Layer**
  - Peaks May–July, Possibly generated by lightning
- **50 & 144 MHz, possibly 222 MHz**
  - Single-hop optimum range 900-1300 miles, maximum range 1350-1500 miles
  - Double-hop optimum range 2000-2600 miles, maximum range 2750-3100 miles
- **Peak time during daylight hours & early evening**

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Propagation – Es



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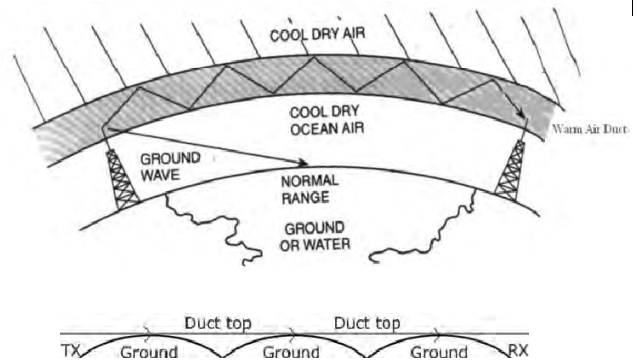
Propagation - Tropo

- **Natural atmospheric ducts that form due to temperature inversion and can shuffle VHF and UHF radio waves long distances**
  - All bands
  - Any time, but mostly warm weather months

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Propagation - Tropo

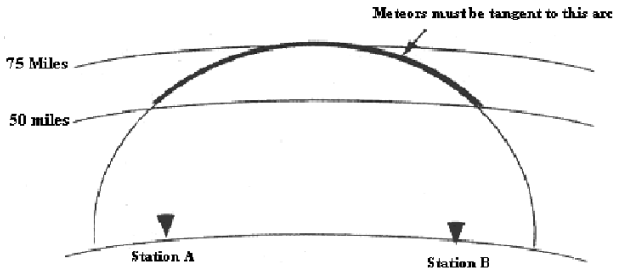


Propagation – MS

- **Meteor scatter is the reflection of radio waves from the ionized trails from meteors burning up in the upper atmosphere.**
- **Meteors 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**

Propagation – MS

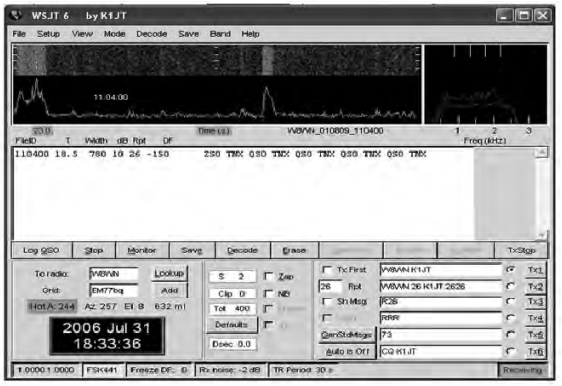
Reflection will occur when the trail is oriented as shown



Propagation – MS

- **Excellent for 50 & 144 MHz, possible at 222 MHz**
- **Very Predictable Paths**
  - Best times between midnight & approx 9 AM
  - Peak during “showers” – Anytime with high speed procedures like ***WSJT***

Propagation – MS *WSJT*



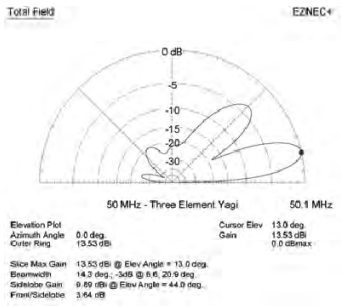
Equipment

- Antennas
- Receive Preamplifiers
- Amplifiers

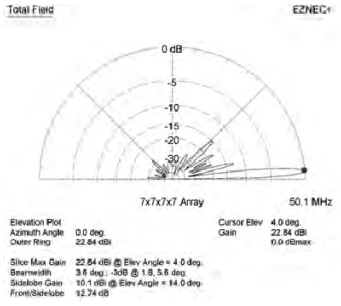
Equipment - Antennas

- VHF antennas are small in comparison to HF antennas
- Boom lengths can be large, 30’ to 50’, but elements length & diameter is much smaller
- Antenna stacking for added gain is much easier at VHF

Equipment - Antennas

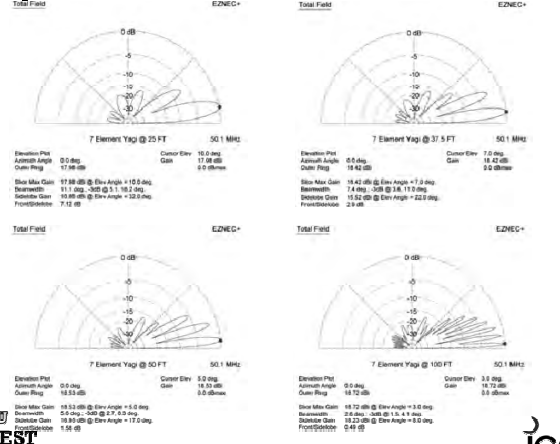


Single 3 element @ 20ft



7x7x7x7 Array

Equipment - Antennas



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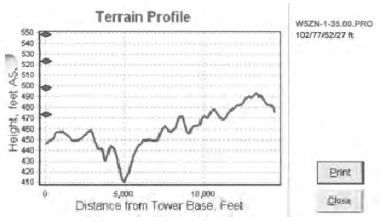
Equipment - Antennas
HFTA

- **Terrain analysis works for 50 MHz**
- **Elevation angle statistics may not be accurate**
  - Based on IONCAP/VOACAP which are only accurate up to 30 MHz

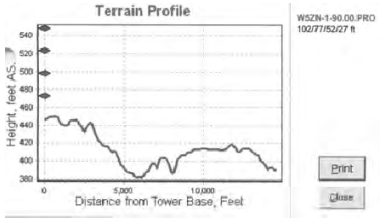
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Equipment - Antennas
HFTA



35° Beam Heading – 4 Antennas



90° Beam Heading – 4 Antennas

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Equipment - Receive Preamps

- **You do *NOT* need a preamp just because:**
  - You "think" you do
  - Your ham buddy that you "think" is an authority on the subject told you so!
- **LEARN ABOUT SYSTEM NOISE FIGURES!**
  - Don't rely on someone else's assumed judgment
  - What will a preamp actually do when you add it to the line?

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Equipment - Receive Preamps

- Preamp is not needed unless your receiver has a really bad noise figure
- What is a "bad" noise figure??
  - Total system noise figure depends more on antenna & sky temperature – they will dominate & you can't change them
- At VHF and above, gain is NOT as important as a low noise figure

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Equipment - Receive Preamps

- Assume T_{ant} = 3000°K
- If RX nf is 20 dB and you add a preamp with only 12 dB gain but it's nf is 2 dB you will improve your system nf by 10 dB!
- If RX nf is 10 db and you add a preamp with 25 dB gain but it's nf is 2 dB you will improve by 0 dB and cause other problems.

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Equipment - Receive Preamps

RX Noise figure (nf) to Noise Factor (NF)

$$\frac{nf\ (db)}{10}\ \text{Inv Log}$$

Noise Factor to Temp (K) = NF - 1 x 290

Total System Temp = TANT + TRX

$$\text{Improvement (dB)} = 10 \log \frac{\text{Temp 1}}{\text{Temp 2}}$$

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Equipment - Receive Preamps

- 50 MHz
  - Not needed unless your radio is really deaf
    - New radios like Flexradio SDR's and K3 do need a preamp!!!!!
- 144 MHz
  - Recommended for radios, DEMI xvtrs are FB
- 222 & 432 MHz
  - STRONGLY recommended
- 902 & Above
  - *Mandatory!*

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Equipment - Amplifiers

- Before you sink a lot of money into a high power amplifier, learn the real facts about “gain”!
- Only needed if you want to enter the high power category
- There are no “multiband VHF/UHF amplifiers
- Outstanding gain can be achieved by stacking antennas

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Contest Strategy

- **Once you decide what you want to do, you must fully understand what will be required to achieve that objective.**
  - How many points do I need?
    - How many Q’s? How many grids (multipliers) ?
  - What equipment do I need.
  - When are the prime propagation times to particular areas

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Contest Strategy

- **Determine what others are accomplishing**
  - Evaluate top 10 scores for past 10 years
- **Its not all about making the most QSO’s**
  - Maximize grid multipliers
- **Get Rovers out to dead grids**

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Contest Strategy

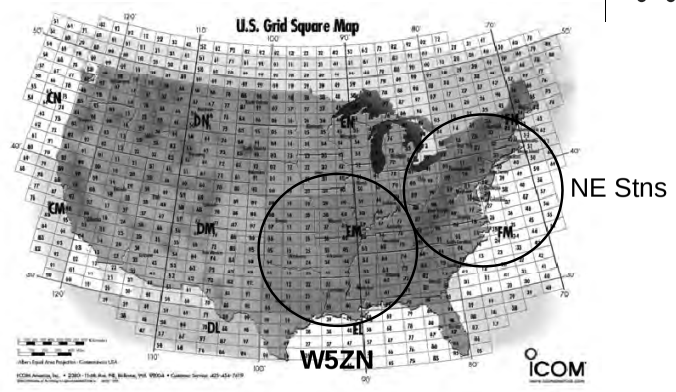
How To Maximize Your Score



Night time Satellite Photo Reveals Population Density

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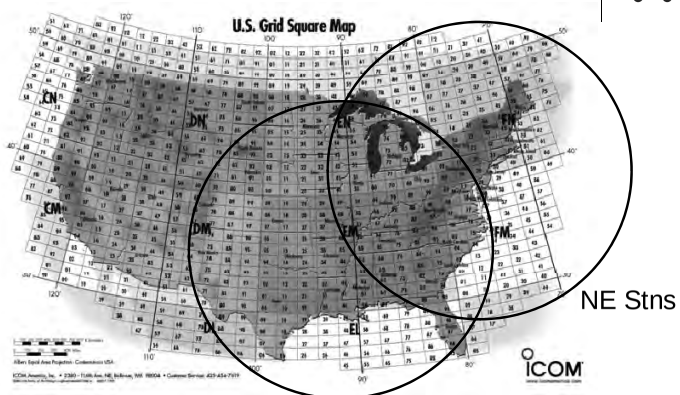
Contest Strategy
Grids Within 500 Mile Radius



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Contest Strategy
Sporadic E 1000 mi Radius



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Contest Strategy
How Do I Activate Dead Grids?

- **Rovers**
  - Assembled Your Own Rover stations
  - Recruite & Train Operators
  - Analyzed routes
    - Maximize grids, minimize travel time

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Operating Technique

- **The band will not be open continuously or with any certainty**
  - **Monitor & Listen!**
  - **Monitor & Listen some more!!**
  - **Monitor & Listen a lot more!!!**

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Operating Technique

- **How to monitor for an unpredictable band opening:**
  - **Radio with Panadapter**
  - **CW Skimmer**
  - **ON4KST Region 2 - 50 MHz Chat**
  - **DX Sherlock**
    - **Based on Cluster spots & shows paths**
  - **DX Cluster**

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Operating Technique

- **6 Meters**
  - Daylight hours, early evening
  - ***PRIORITY band when it is open***
- **144 MHz & Up**
  - Anytime
- **Sunday Morning – DO NOT MISS**
- **Midnight to 5 AM – DEAD!!!**
  - Have your rovers positioned
  - Meteors & EME with JT Modes

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Operating Technique

- **2 Meter FM**
  - FM is NOT a four-letter word
  - The Q's count and can add up nicely
  - Excites the local club and introduces them to contesting
  - They get to be a part of the big winning team!
  - Give a presentation at the local club, most new hams have an HT.

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Other Important Points

- **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

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Other Important Points

- **Can't Buy Me Love! – Beatles, 1964**
  - You can**not** buy a contest victory
    - Money can buy nice equipment & antennas but it will ***not*** teach you how to operate & apply them effectively
  - You **must** study & learn propagation
  - You **must** study & learn antennas
  - You **must** study & learn equipment
  - You **must** study & learn when & where to be at the right time

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Where Can I 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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Ferrite Transmitting Chokes

Jim Brown K9YC
Santa Cruz, CA
k9yc@arrl.net
http://audiosystemsgroup.com

Don't Bother Taking Notes

These slides (and a lot more) are at

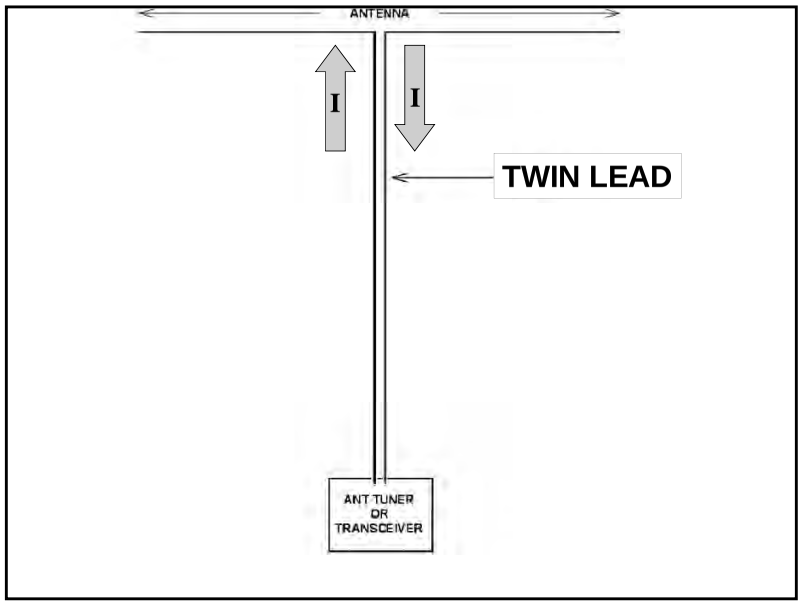
http://audiosystemsgroup.com\publish.htm

Why Do We Need Chokes?

Understanding Common Mode and Differential Mode Currents on Transmission Lines

Differential Mode Current

- Transmission line carrying power from transmitter to antenna, from antenna to receiver
- Signal is voltage between the two conductors
- Current flows out on one conductor and returns on the other
- Currents are equal and opposite in polarity

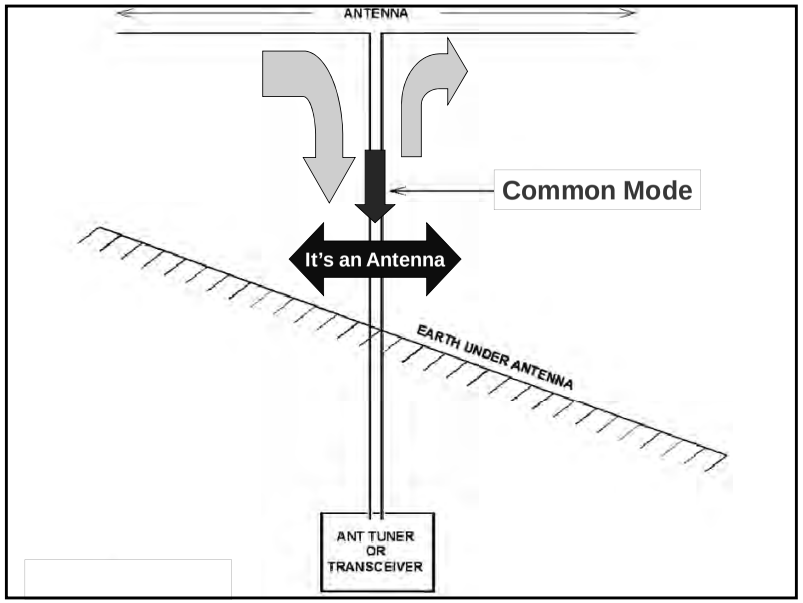


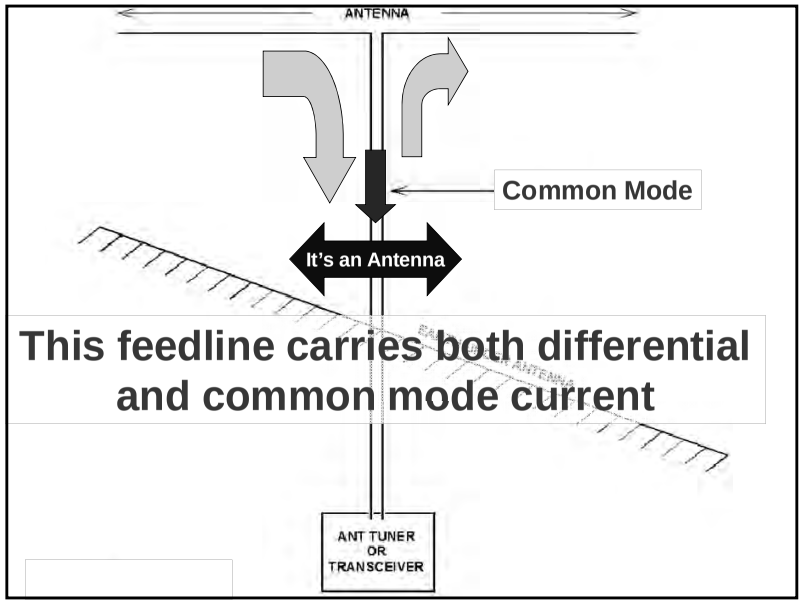
Differential Mode Current

- Currents are equal and opposite in polarity
- Field mostly between the two conductors
- No distant radiation from ideal line
  - At great distance, field of one conductor cancels field of the other conductor
- In the near field of an ideal line, field cancellation is not quite perfect
  - Most observers will be slightly closer to one conductor than the other

Common Mode Current

- Equal and flowing in the same direction on all conductors
- Current flows lengthwise on the line
  - No cancellation of one current by another, because they're in polarity
- Line acts as long wire antenna
  - It radiates and it receives





Ham Antennas and Balance

- Most ham antennas are <u>unbalanced</u> by their <u>surroundings</u>, even when fed by a balanced source and line

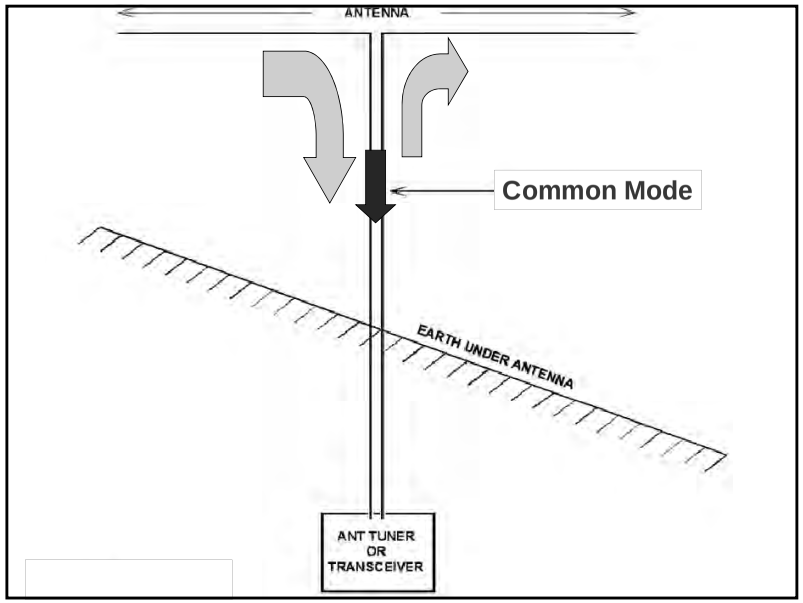
What Makes a Circuit Balanced?

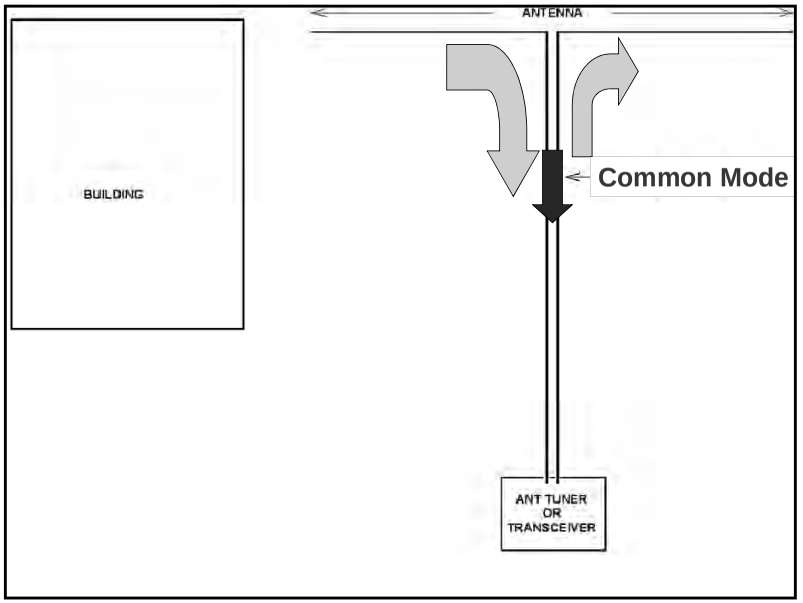
What Makes a Circuit Balanced?

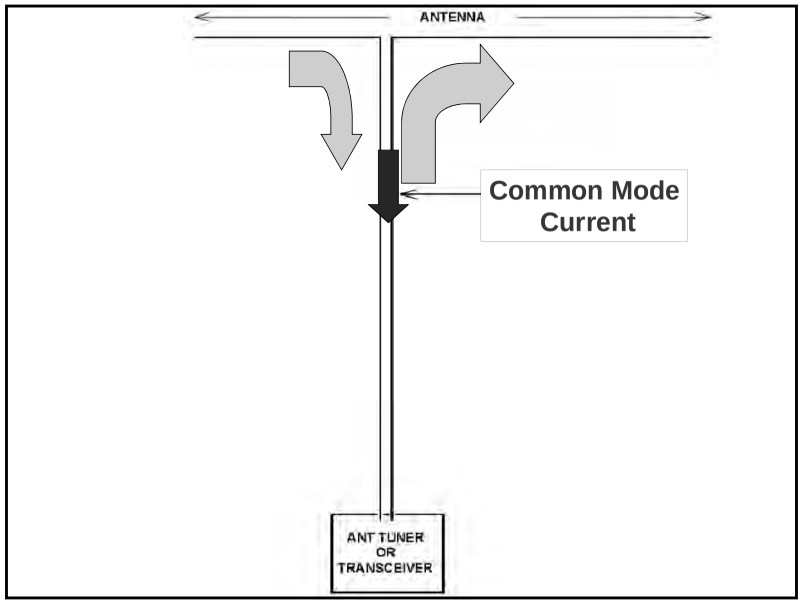
- The impedances of each conductor to the reference plane are equal
- Balance is not defined by voltage or current
- Impedance imbalance causes unbalanced currents

Ham Antennas and Balance

- Most ham antennas are unbalanced by their surroundings, even when fed by a balanced source and line
  - Unequal capacitances to nearby conductors
  - Unequal inductive coupling to nearby conductors
  - Trees, buildings, towers, terrain
  - Feedline comes off at an angle
  - Coax is not a part of these imbalances







Unbalanced Antennas and Lines

- If the antenna is unbalanced
  - Unequal voltage and current to earth
  - Unequal currents on the feedline
  - The difference is common mode current, and it radiates from the line
- This is with two-wire line
- Coax does not cause the imbalance in these antennas!
- Coax simply adds to the imbalance

Coax is Special

- All the differential power (and field) is confined inside the coax
- All the common mode power (and field) is outside the coax
- A ferrite core surrounding coax sees only the common mode power (and field)
- No differential mode radiation

Coax is Special

- Skin effect splits the shield into two conductors
  - Inner skin carries differential mode current (the transmitter power)
  - Outer skin carries common mode current (the current due to imbalance)

Now We Can Talk About Common Mode Chokes!

What's a Common Mode Choke?

- A circuit element that reduces common mode current by adding a high impedance in series with the common mode circuit
  - Reduces radiation from the cable
  - Reduces reception by the cable
  - No effect on differential signal

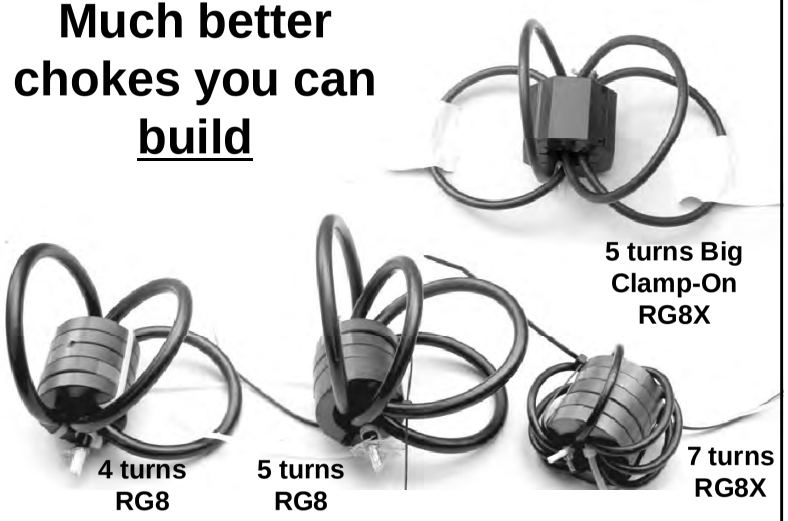
Some Common Mode Chokes

- A coil of coax at the antenna
- A string of ferrite beads around coax (Walt Maxwell, W2DU)
- Multiple turns of transmission line through a toroid (Joe Reisert, W1JR) or stack of toroids (W1HIS, K9YC)
- Most 1:1 "baluns" are common mode chokes

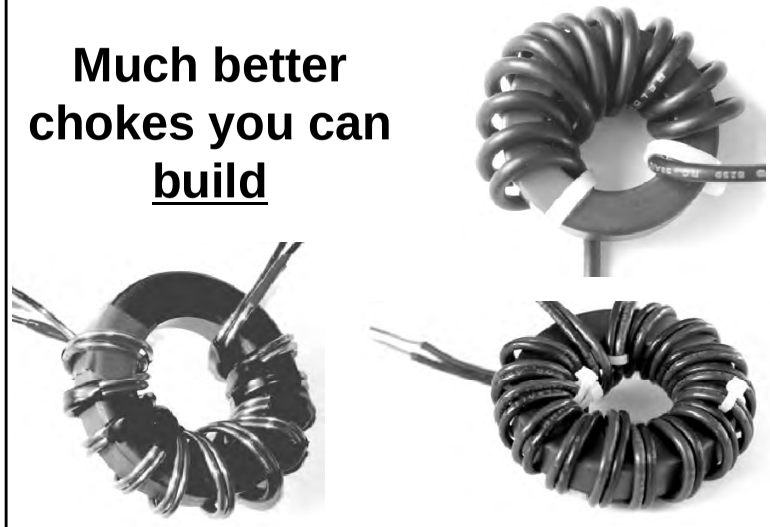
Chokes you can buy (W2DU, W0IYH Baluns)



Much better chokes you can build



Much better chokes you can build

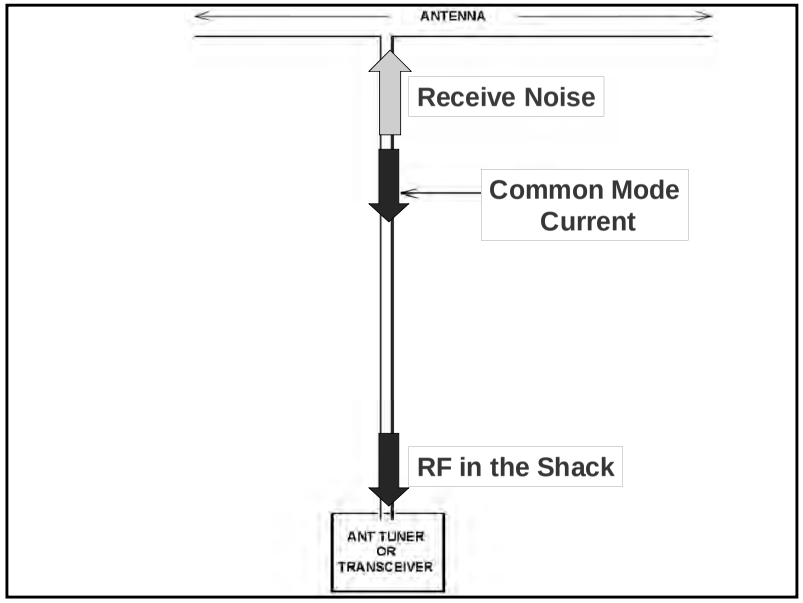


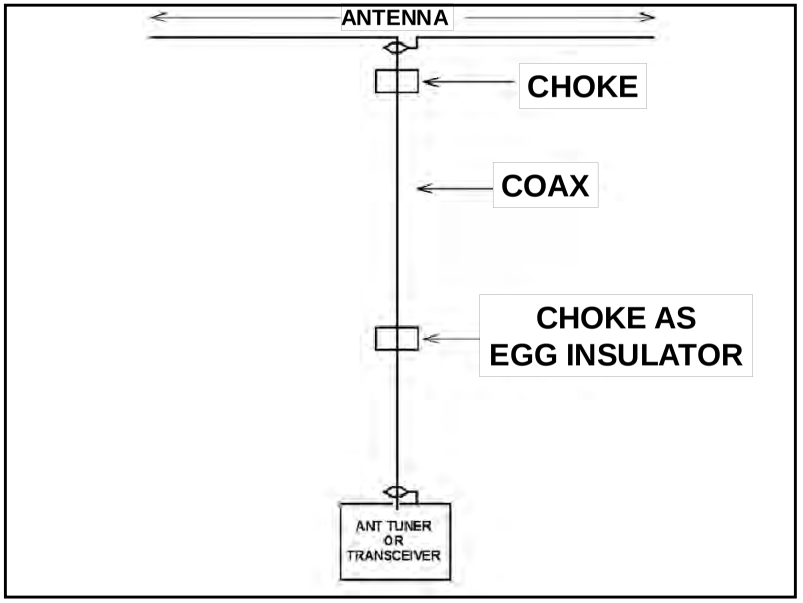
Some Common Mode Chokes

- Some 2:1, 3:1, and 4:1 “baluns” are also common mode chokes
  - Guanella balun
  - But the few I’ve measured aren’t very good common mode chokes

Why Transmitting Chokes?

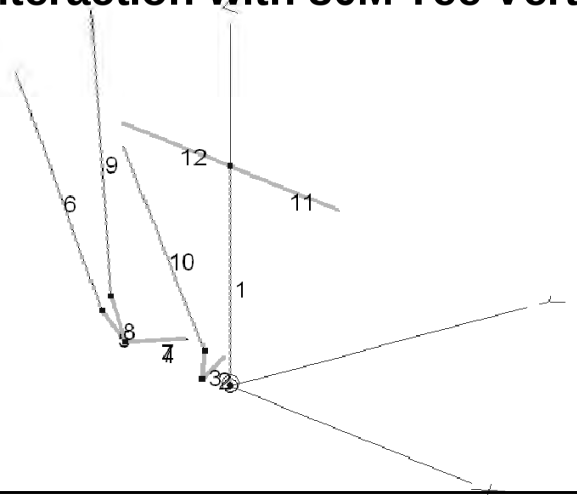
- Isolate antenna from its feedline
- Reduce receive noise
- Keep RF out of the shack (and your neighbor’s living room stereo)
- Minimize antenna interaction
  - Field Day, DXpeditions
  - SO2R, Multi-multi
  - Dipole feedline and vertical antenna



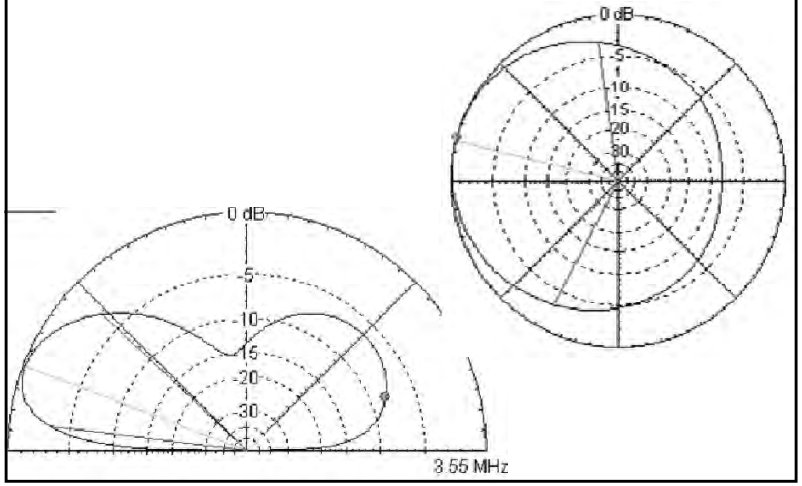


Chokes as "Egg Insulators" to Break Up the Feedline

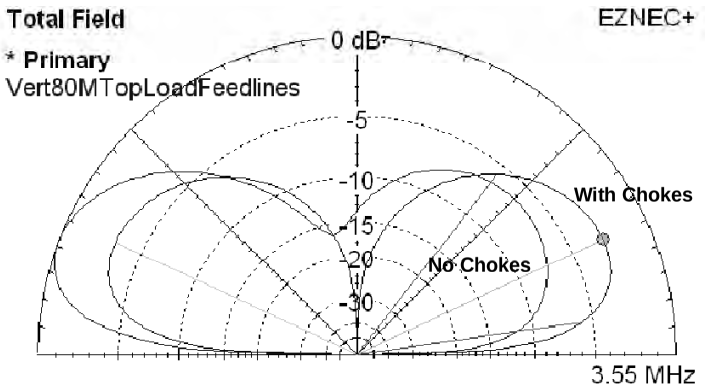
NEC Model of Feedline Interaction with 80M Tee Vertical



NEC Model of Feedline Interaction with Tee Vertical

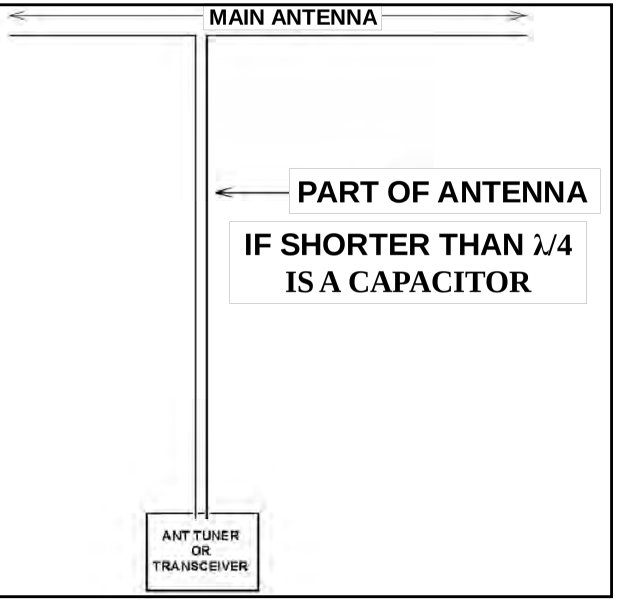


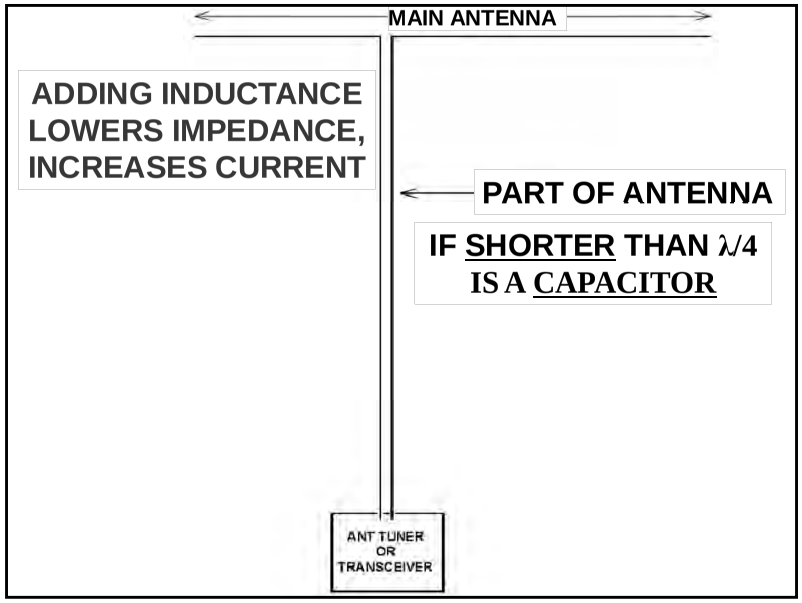
Add Choke in Each Feedline

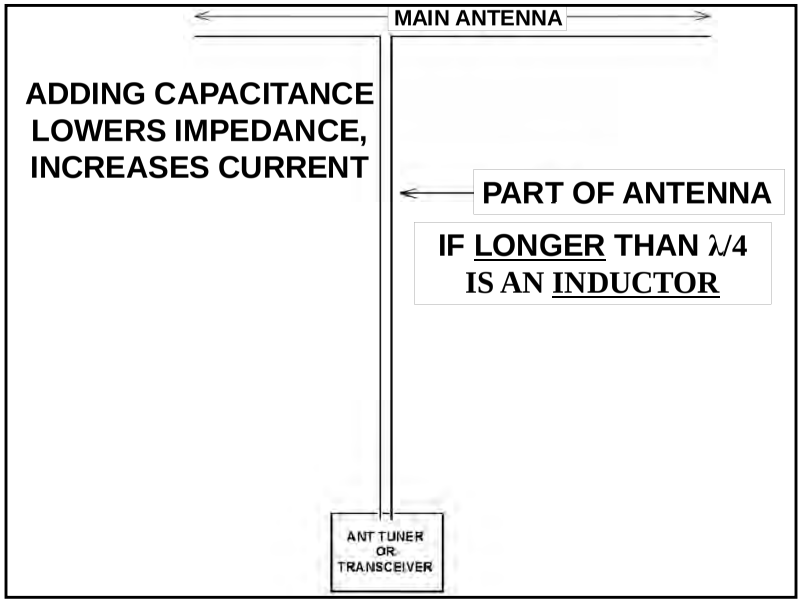


Design of Transmitting Chokes

- Higher impedance is better!
  - Reduces common mode current
  - Reduces noise
  - Reduces interaction
  - Reduces RF in the shack
  - Reduces dissipation
- Resistance is better than reactance







Why is Resistance Better?

- We want to reduce the current
- A cable shorter than λ/4 is capacitive
  - Series inductance resonates with it and increases the current
- A cable longer than λ/4 (and shorter than 3λ/4) is inductive
  - Series capacitance resonates with it and increases the current
- Resistance always reduces current

Why is a Simple Coil of Coax a Lousy Choke?

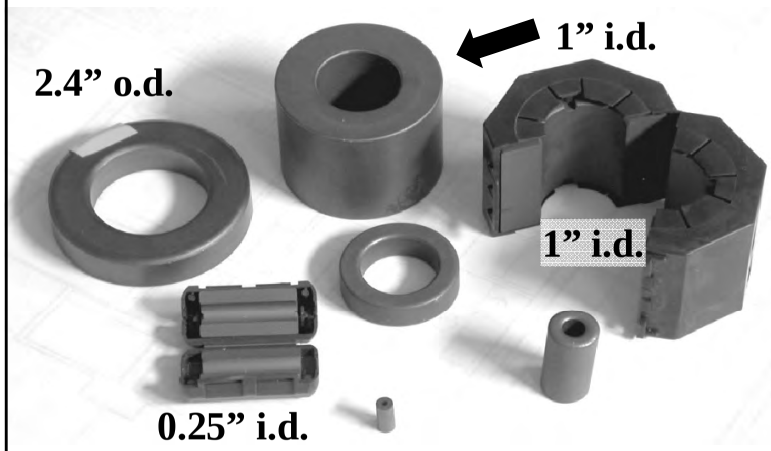
- Because it's only a small inductor
  - Can resonate with the line and increase the current
- Will resonate with its own stray capacitance (between turns)
- Above resonance it's a capacitor
  - Can resonate with the line and increase the current

Ferrite Chokes are the Answer!

What's a Ferrite?

- A ceramic consisting of an iron oxide
  - manganese-zinc
  - nickel-zinc
- Permeability (μ) much greater than air
  - Better path for magnetic flux than air
  - Multiplies inductance of a wire passed through it
- Is increasingly lossy at higher frequencies

Different sizes and shapes



What's Do the Numbers Mean?

- The "***MIX***" – the chemical formula of the iron oxide!
- A ceramic consisting of an iron oxide
  - manganese-zinc (MnZn) – 1-30 MHz (AM broadcast, hams) #31, #77, #78
  - nickel-zinc (NiZn) – 30 MHz-1 GHz (FM, TV, cell phones) #43, #61, #67
- #31 is a new MnZn *mix* that behaves like #43 at HF and VHF, but is much better below 5 MHz

Why Is Fair-Rite My Example?

- Most ferrites sold by ham distributors are actually made by Fair-Rite
- Their published data is FAR better than any of their competitors
- You can study it and understand
  - How ferrites work
  - How one part is different from another
  - How one mix is different from another
  - How each part will work in your circuit

Why Is Fair-Rite My Example?

- Most ferrites sold by ham distributors are actually made by Fair-Rite
- Ham distributors charge HUGE markups (typically 5X their cost)
  - Palomar, Amidon, Wireman, DX Engineering, etc.
- Industrial distributor prices are fair
  - Allied, Newark, Lodestone Pacific, Digikey, Kreiger

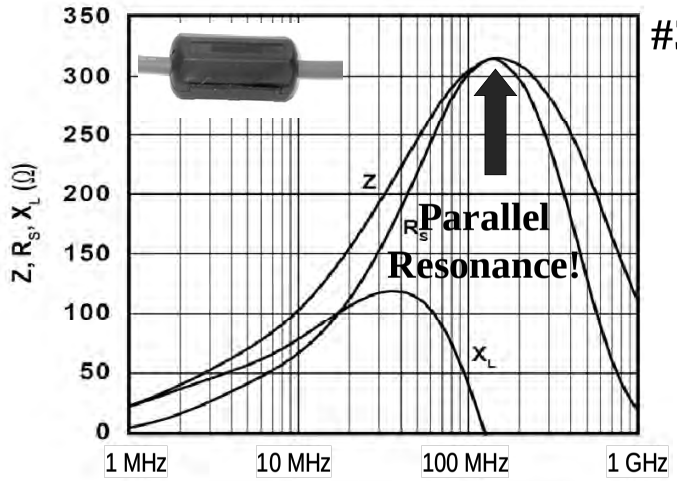
Why Is Fair-Rite My Example?

- They're a great company to deal with
- Their parts are the most useful for ham applications
- Easy to buy in North America
- Buy from the industrial distributors
- Buy direct if quantity is high enough
- They make ham group purchase easy
- The numbers I'm using are those that describe parts made by Fair-Rite

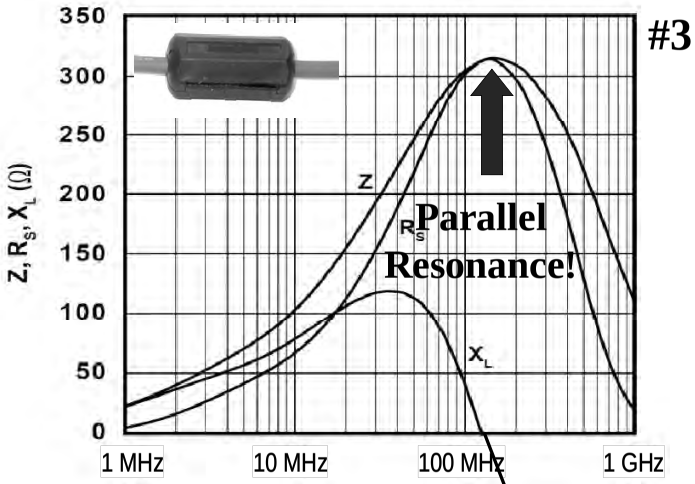
A (too) simple equivalent circuit of a wire passing through a ferrite



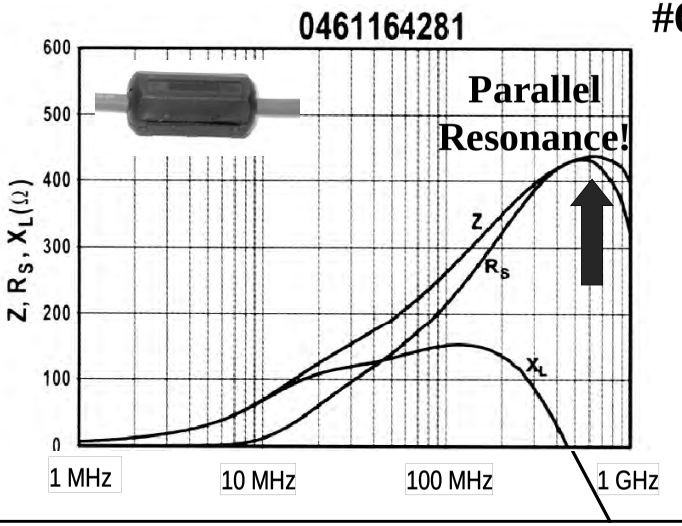
R_S and X_S vary with frequency!



R_S and X_S vary with frequency!



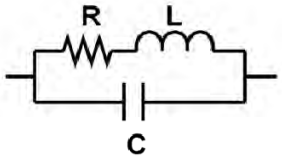
A Ferrite for UHF Suppression



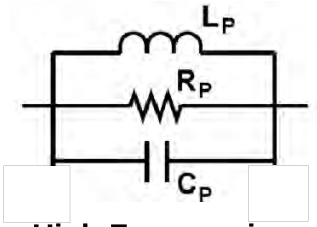
Equivalent Circuit of a Ferrite Choke



Low Frequencies

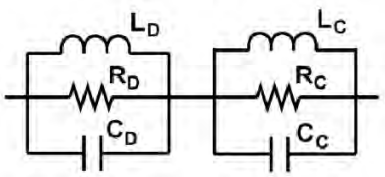


Mid-Frequencies



High Frequencies

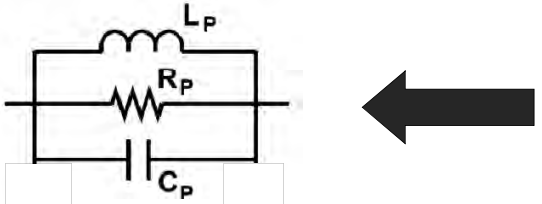
More General Equivalent Circuit



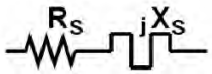
Includes Dimensional Resonance

(more than we have time to talk about)

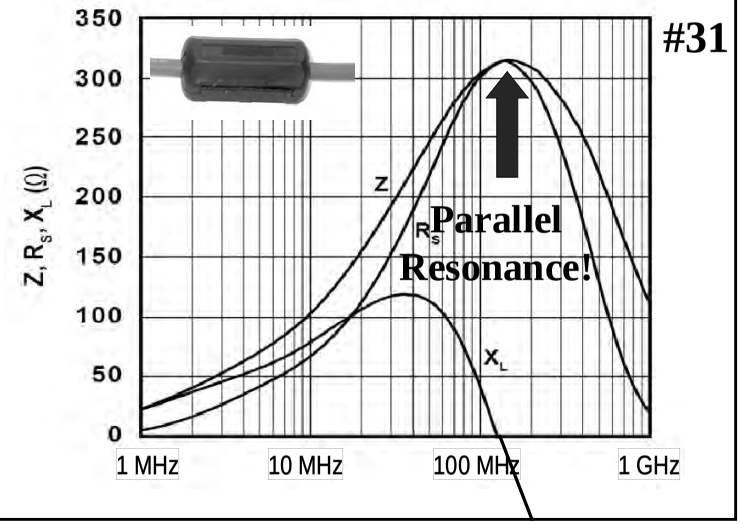
We'll Use This Physical Equivalent Circuit to Understand the Choke



Data Sheets Use This Equivalent Circuit to Graph the Impedance



R_S and X_S vary with frequency!



Where's the Capacitance here?



Where's the Capacitance here?



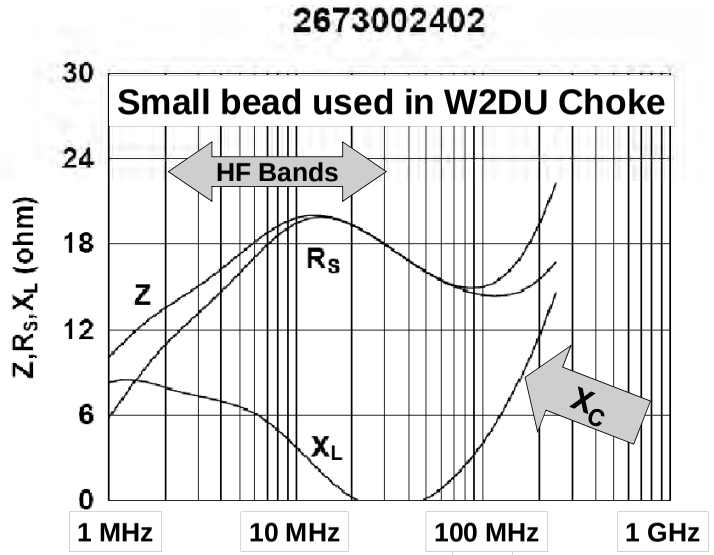
From the wire at one end of the choke to the wire at the other end, through the permittivity of the ferrite (it <u>is</u> a dielectric!)

"Strings of Beads" (W2DU, W0IYH Baluns)



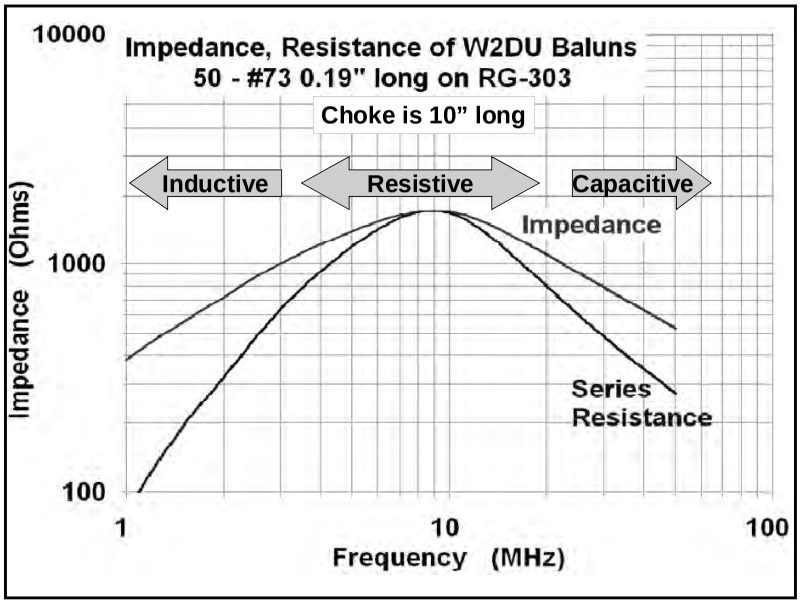
A String of Different Beads





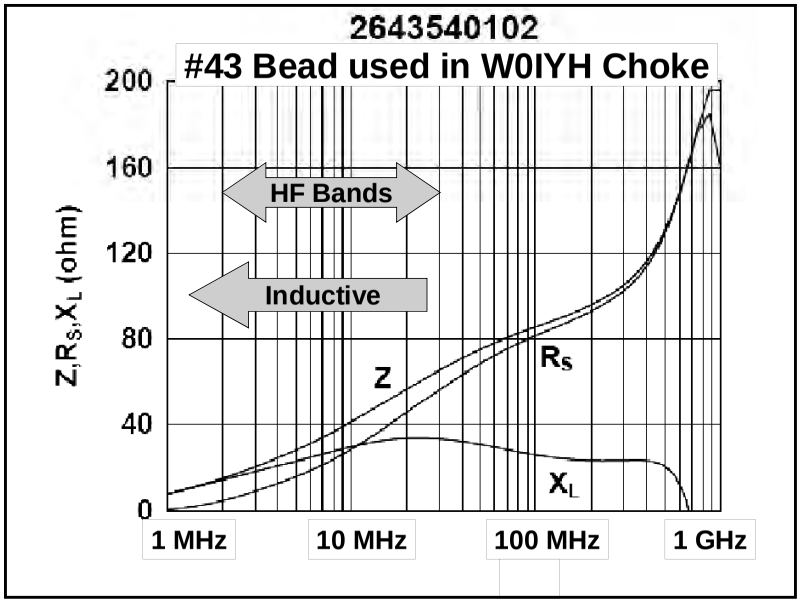
W2DU Choke

- A "string of beads" choke
  - Impedances in series add
  - 50 beads = 50 x Z of one bead
- W2DU used #73 mix (a very good choice)
- Increasingly resistive above 3 MHz
  - Less sensitive to feedline length
- Much better than bead of W0IYH choke
- Many more beads are needed
  - They're small and cheap (good)
- #73 only made to fit RG58 or RG303



Newer (Poor) Designs

- W2DU's design is 40 years old
- That's old fashioned -- certainly something newer must be better!
- W2DU's beads are tiny
- W0IYH tried something bigger
- BIG beads that fit on RG8



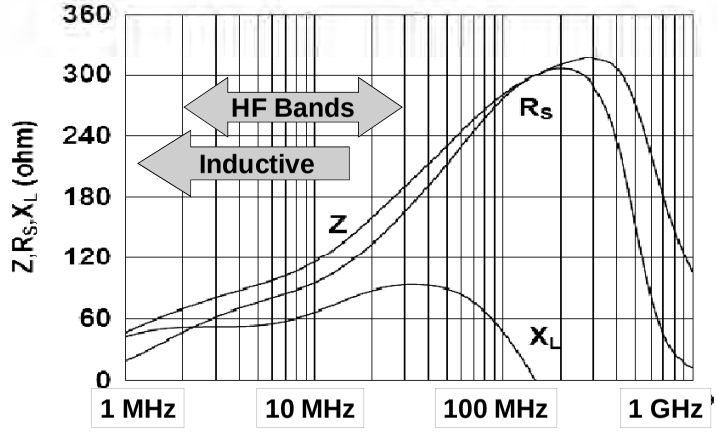
W0IYH Choke

- Also a "string of beads" choke
- Predominantly <u>inductive</u> below 25 MHz
  - Very sensitive to feedline length
  - Inductance resonates with a capacitive line
- Increasingly resistive above 25 MHz
  - Much less sensitive to feedline length
- Not very effective below 15 meters!

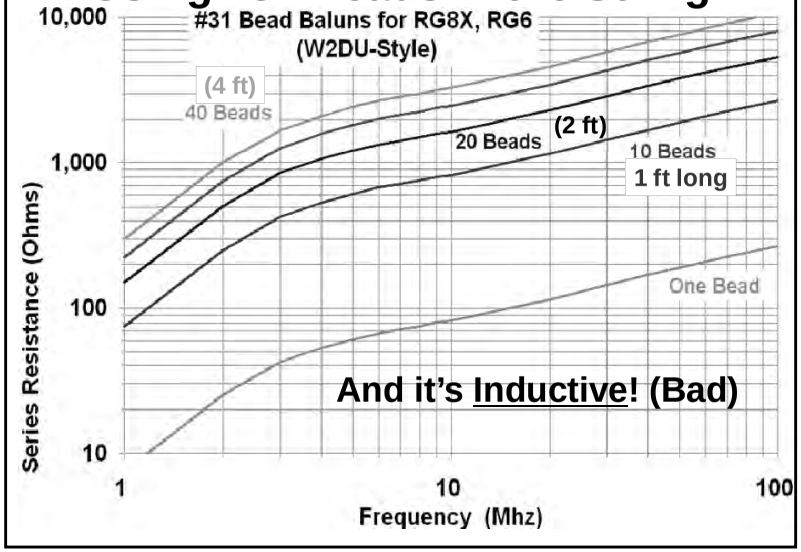
A #31 Bead for the String

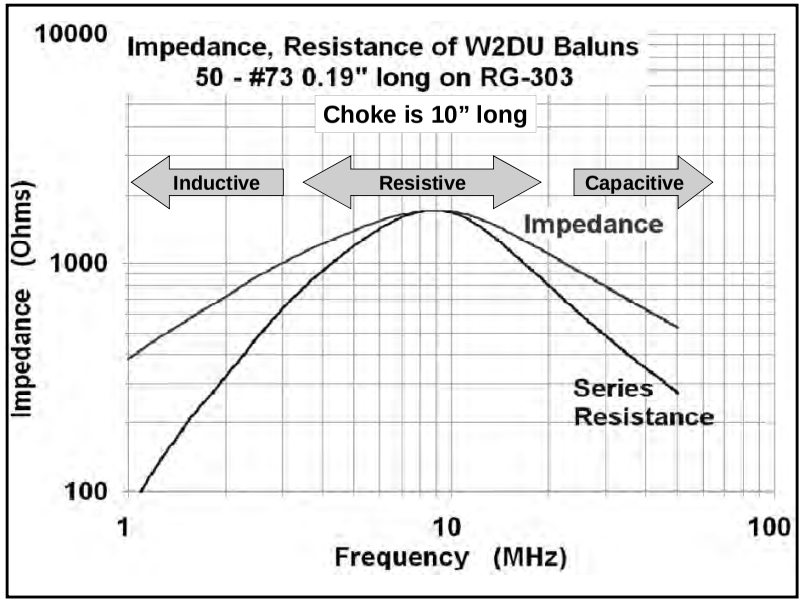
1" o.d. x 1.125" long (Fits RG8)

2631102002

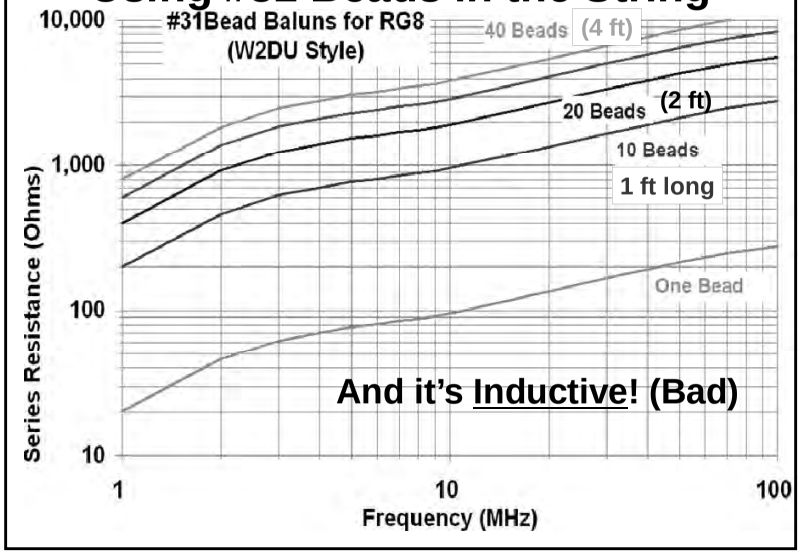


Using #31 Beads in the String



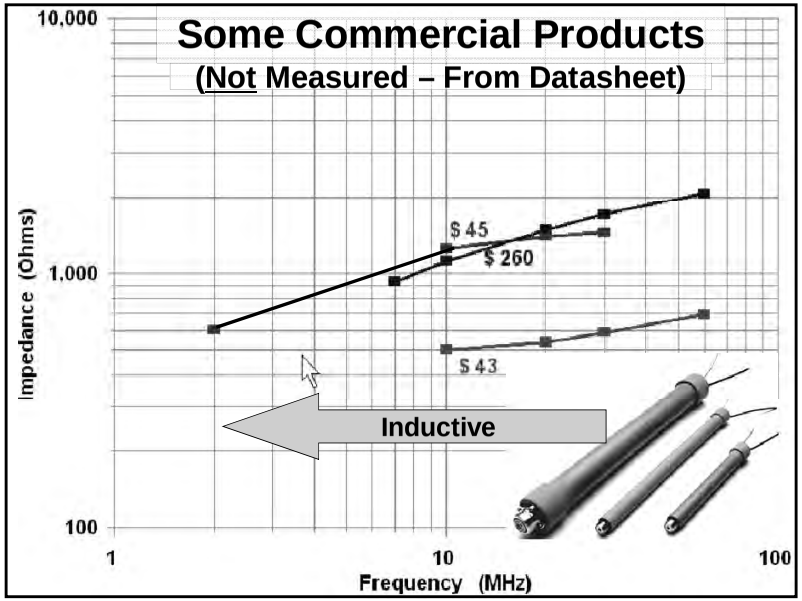


Using #31 Beads in the String



Some Commercial Products

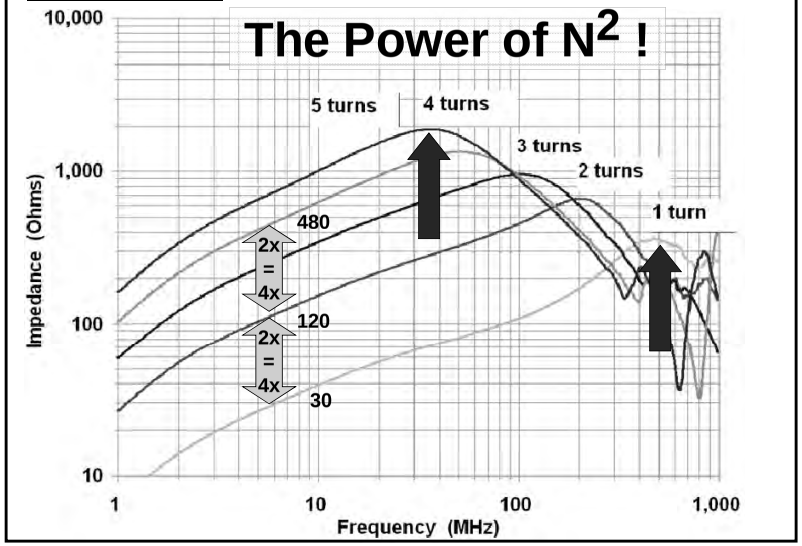
(Not Measured – From Datasheet)



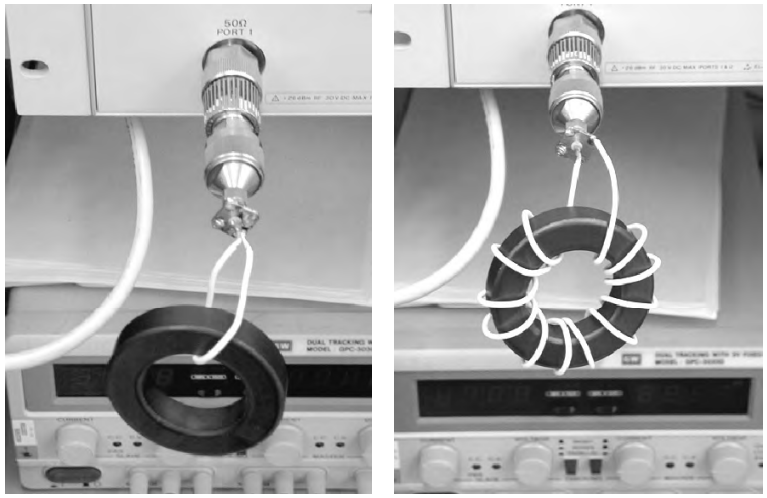
There's A Much Better Way to get Higher Impedance

- Inductance increases as N^2
- Inductively coupled resistance increases as N^2

Measured Data for #43 Toroid Chokes



HP8753C w/HP85046A S-parameter Test Set (by my anonymous collaborator)



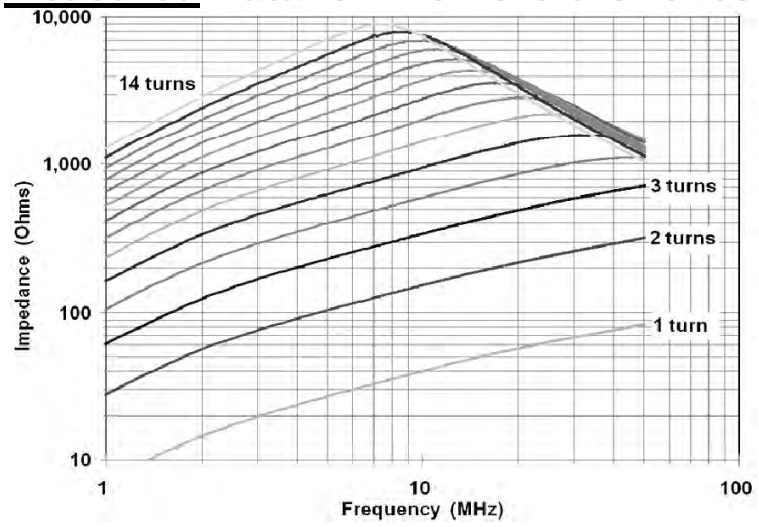
Why the Resonance Moves Down

- Inductance increases as N^2
- Inductively coupled resistance increases as N^2
- Capacitance increases with N
  - Capacitance between turns
  - Capacitance through the ferrite core
  - A bit more capacitance with much bigger wire (like coax)

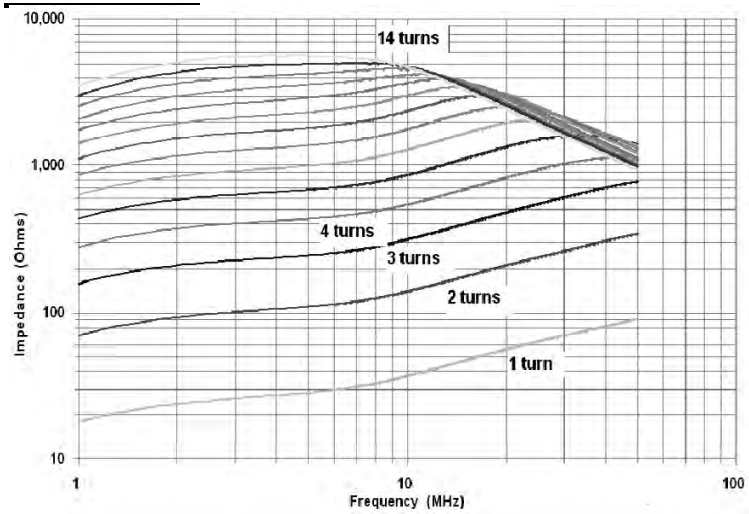
The Power of Turns at HF and MF

- Moves the resonance down from VHF to HF
  - More inductance
  - More capacitance
- Multiplies impedance at resonance
  - But not by N^2, because resonance has moved lower in frequency

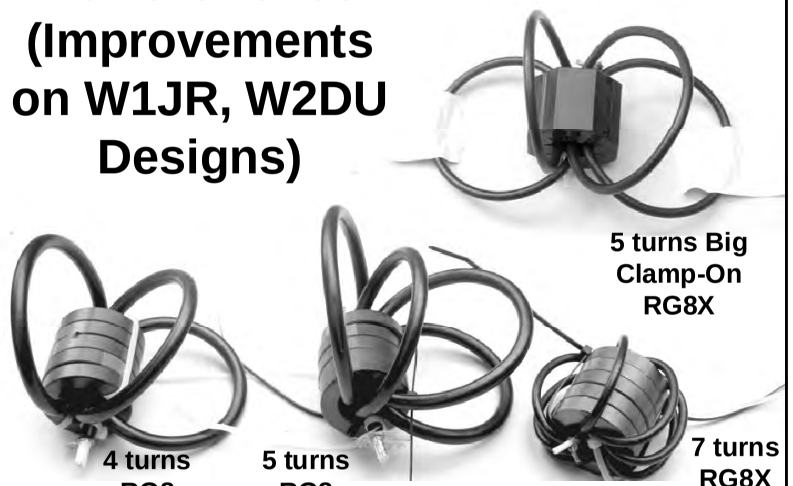
Measured Data for #43 Toroid Chokes

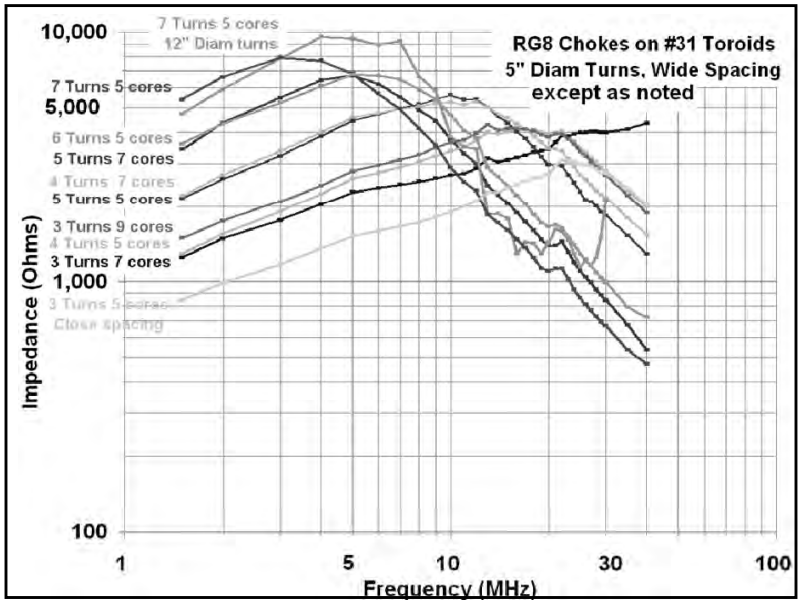


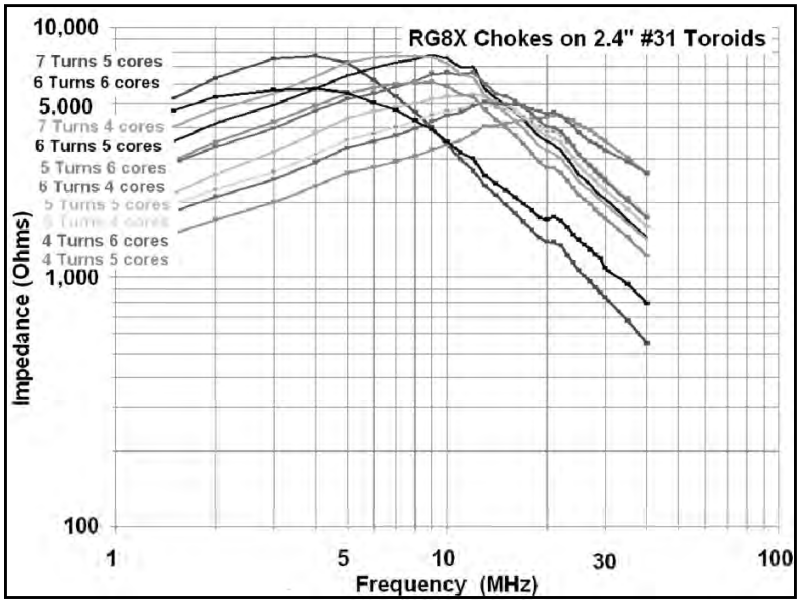
Measured Data for #31 Toroid Chokes



K9YC Chokes (Improvements on W1JR, W2DU Designs)

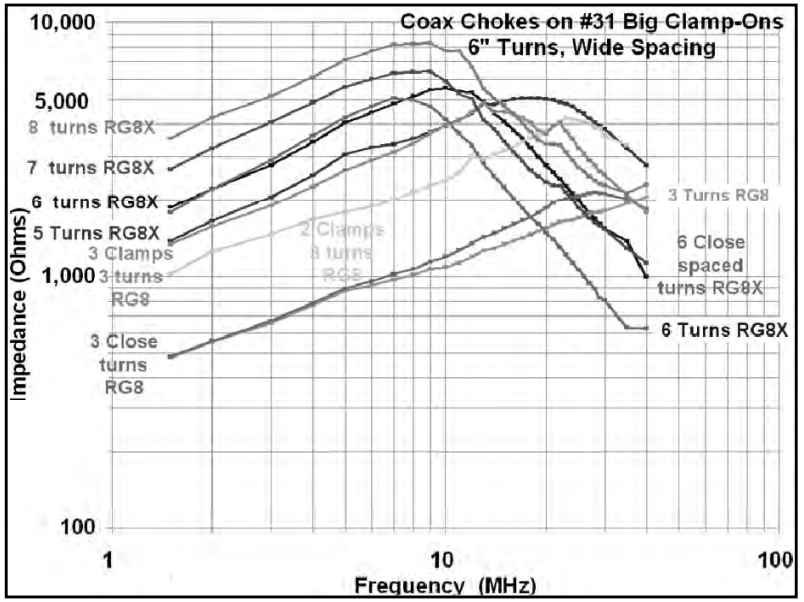






The "Big Clamp-On" When You Can't Easily Take the Connector Off





Wide or Close Spaced Turns?

- Close spacing lowers resonant frequency
  - More capacitance
  - More inductance
- Close spacing often better <u>below</u> 10 MHz
- Wide spacing usually best <u>above</u> 10 MHz
- Study the K9YC data and Cookbook for specific applications

Let's Talk About Dissipation (Heat, Power Handling)

Dissipation and Form Factor

- 1,500 W in 50 ohms = 275V @ 5.5A PEP
- Heat produced by the average power
  - With CW, ~ 3 dB less than PEP
  - SSB without speech processing or clipping ~ 14 dB less than PEP
  - SSB with heavy processing ~ 6 dB less than PEP
- Many power amps should be de-rated by 3 dB for RTTY, PSK, FM, AM

Dissipation and Duty Cycle

- We've got to listen sometime, so subtract another 3 dB (50% listening)
- Real world average ham power levels for intense contesting and DXing
  - ~ 6 dB less than PEP for CW
  - ~ 9 dB less than PEP for SSB
  - ~ 6 dB less than PEP for RTTY, PSK, FM

Heat in Common Mode Chokes

- Heat (Power) is $I^2 R$
  - I and R are common mode values
  - Make R very large
  - I falls in proportion to R
  - P falls as I^2 so power (heat) falls twice as fast as R increases
  - Obtain current from the NEC model of the common mode circuit

What About Heat?

- Heat is not a problem in coax chokes if R (the choking impedance) is large enough
- How large is enough?
- For an antenna with reasonably good balance, R = 5,000 ohms keeps dissipation low

Failures From Excessive Voltage

- $P = E^2 / R$
- Causes of excessive voltage
  - Antenna systems that make E very large
  - Feedline length near $\lambda/2$, λ, $3\lambda/2$, 2λ, etc.
  - Antenna tuners that step voltage up to high impedance lines
  - Severe imbalance
- Let's study an example in NEC

A Real Antenna, Unbalanced

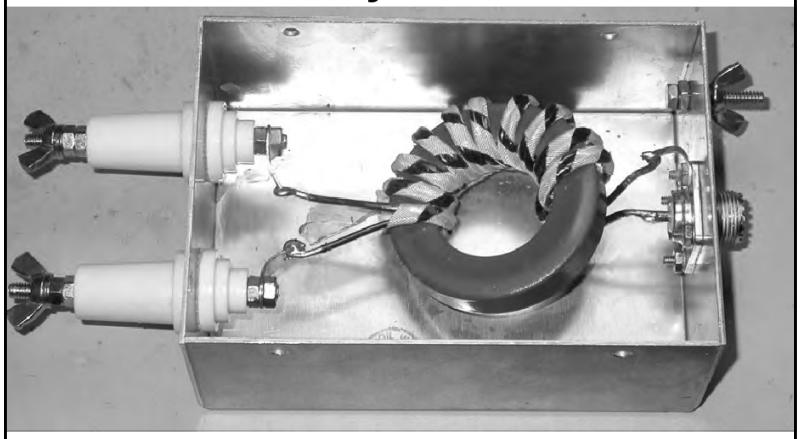
- NEC Model of 40M dipole, fed by 67 ft of coax (half wave), 5,000 ohm choke (Vf of coax ~ 0.98 for common mode)

	PEP		Constant CQing	
Legs (Ft)	Power	Volts	CW, FM, RTTY, PSK	SSB
30 - 36	30 W	387 V	8 W	4 W
27 - 39	80 W	632 V	24 W	12 W
24 - 42	150 W	866 V	40 W	20 W
20 - 46	253 W	1125 V	80 W	40 W

Chokes Exposed to Air Flow Can Handle More Power



A choke in a closed box is much more likely to overheat



Causes of Choke Failures

- Feedline near λ/2 combined with strong antenna imbalance
- Insufficient air circulation
- Choking impedance too low

How Much Choking Z is Enough?

- If your antenna is well balanced, 5,000Ω is plenty
- If your antenna has severe imbalance, 10,000Ω may not be enough
- Chokes on Windom antennas are notorious for failing

How Much is CM Current Reduced?

- NEC Model of 80M dipole @ 129 ft, fed with 129 ft of coax (Near half wave – Vf ~ 0.98 for common mode)
- Without choke, common mode current is 1/3 of antenna current (-10 dB)
- Adding 5,000 Ω choke reduces common mode current by an additional 24 dB

How Much is CM Current Reduced?

- NEC Model 80M dipole @ 66 ft, fed with 66 ft of coax (near quarter wave)
- Without choke, common mode current at TX end is 1/12 of antenna current (-22 dB), -38 dB at feedpoint
- Adding 5,000 Ω choke has no effect on common mode current

What About Bifilar Chokes?

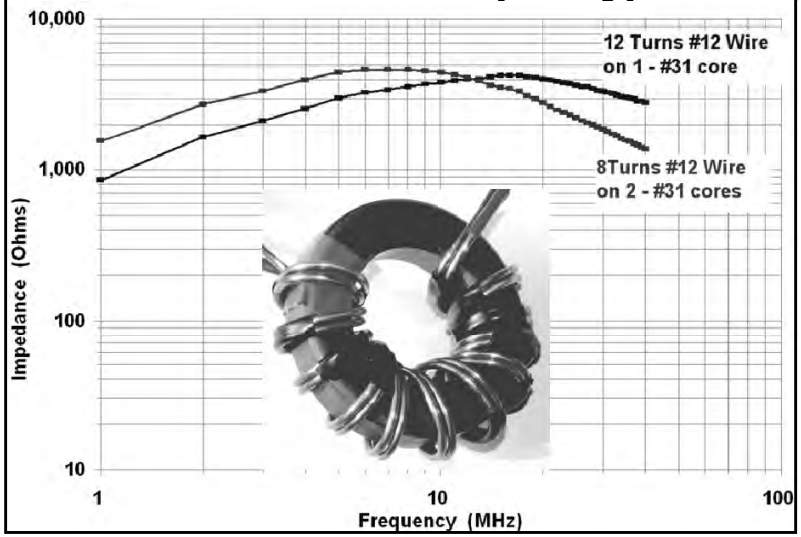
- These bifilar chokes are wired simply as a short section of two-wire line wound around one or two cores



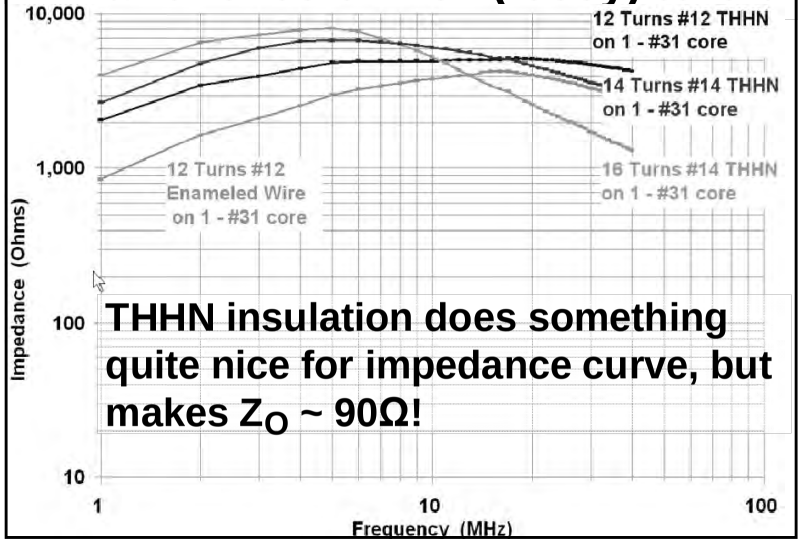
Bifilar Chokes

- Objective is a low cost choke that anyone can build cheaply
- Voltage rating depends on enamel coating, varies widely
- Enameled wire with known voltage rating can be hard to find, probably not cheap
- How about THHN? (House Wire)

Bifilar chokes on #31 (lossy) toroid



Bifilar chokes on #31 (lossy) toroid



THHN insulation does something quite nice for impedance curve, but makes Z_O ~ 90Ω!

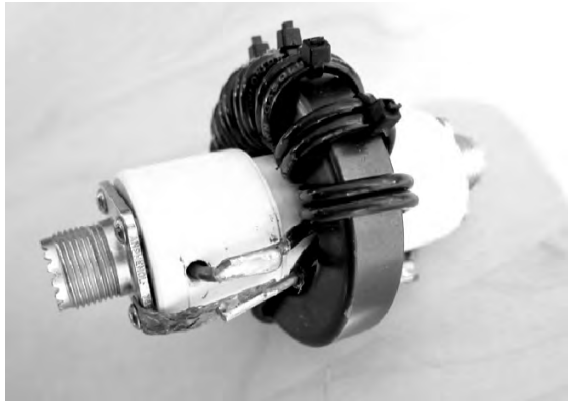
Chokes wound with #14 THHN (ordinary house wire)



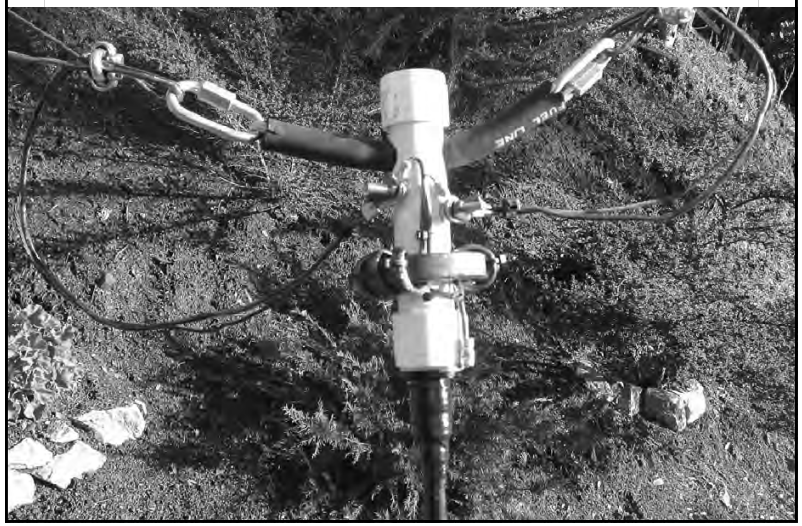
W6GJB's First In Line Choke



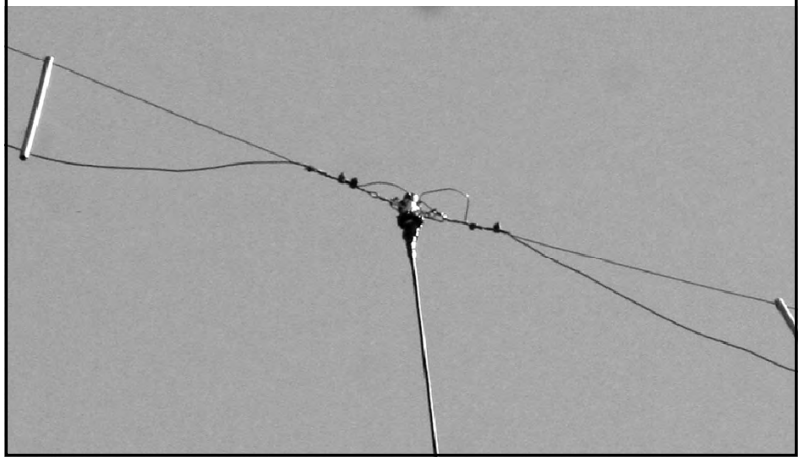
W6GJB In Line Choke #2



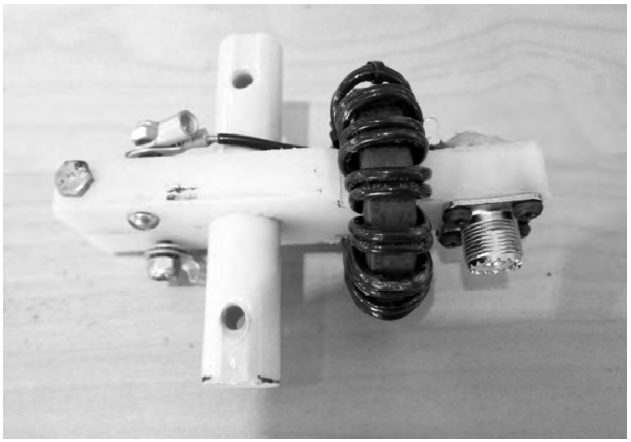
W6GJB Dipole Insulator



THHN Choke on W6GJB Dipole Insulator in 80/40 Fan at K9YC



W6GJB Vertical Insulator for W3DQ



Z_O of Bifilar Windings

- Winding is a 2-wire transmission line
- Z_O depends on spacing, wire size, and dielectric (insulation)
- Close spaced #12 - #14 wire on toroid
  - Enameled wire Z_O ~ 50 ohms
  - THHN Z_O ~ 90 ohms

Effects of THHN Windings

- Small impedance mismatch
- It's a short length of 90Ω line
  - 16 turns ~ 40 inches of line
  - About λ/40 at 4 MHz
- THHN insulation a bit lossy @30 MHz
- Almost no loss below 20M
- A small price to pay for high choking impedance and bandwidth!

Can They Handle High Power?

- Patched in series with my Titan amp at 1.5kW, they barely got warm!
  - Choke saw only differential power
  - All the heat was in the wire where it was wound around the core
  - No heating in the core itself!
  - No heating in the wire away from the core
- Like any other choke, dissipation due to common mode will be small if the antenna has reasonable balance

16 Turn #12 Bifilar Choke

Differential Mode Loss and Dissipation At Dipole Feedpoint

Band	1.5kW PEP		Constant CQing	
	Loss	Power	CW, RTTY	SSB
80M	.12 dB	8 W	2 W	1 W
40M	.2 dB	17 W	4 W	2 W

From VNA choke measurements and simulation using NEC and Sim Smith

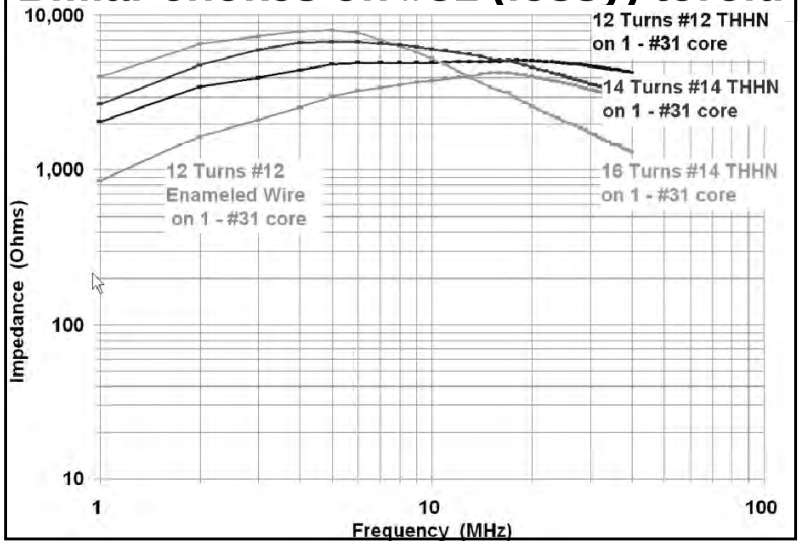
Bifilar Chokes

- #31 mix is still the right choice below 10 MHz
- Use #14, #12 for high power

Bifilar Chokes Work in Coax Lines

- Much lower cost, much more compact
- Can handle full legal power with reasonably well balanced antennas
- De-rate to 500W for poorly balanced antennas (off-center fed)
- 14 turns of #12 THHN on #31 toroid good for 80M - 30M dipoles
- 16 turns of #12 THHN on #31 toroid good for 160M – 40M dipoles
- A bit more power loss on higher bands

Bifilar chokes on #31 (lossy) toroid



See K9YC's Choke Cookbook (Chapter 7 in the RFI Tutorial) for specific recommendations

http://audiosystemsgroup.com/RFI-Ham.pdf

How About Commercial Products?

We Can Build At Least as Good As We Can Buy, and for the cost of the cheapies!

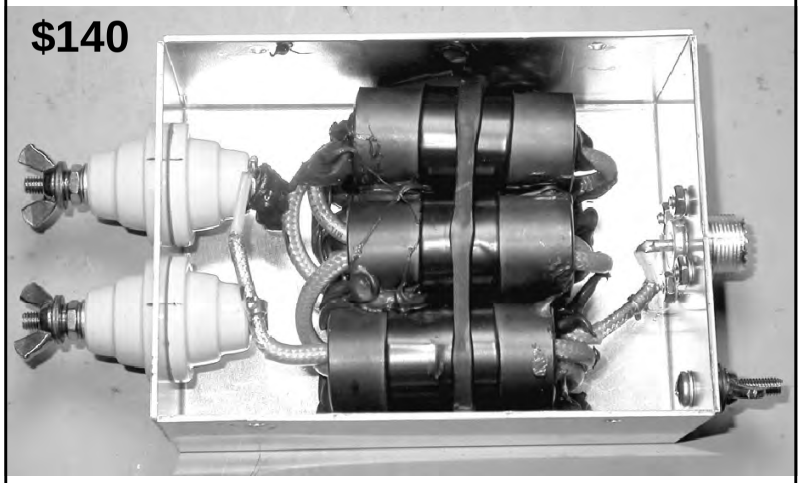
- **We must stock up on the right parts, buying in quantity**

How to Buy Ferrites?

- Get part numbers from my tutorial
  - http://audiosystemsgroup.com/RFI-Ham.pdf
- Buy in quantity from distributors listed on the Fair-Rite website
  - Newark, Allied, Lodestone Pacific, Kreger
- Buy large quantities direct from Fair-Rite
- Organize a group purchase

DX Engineering 50Ω Choke Balun

$140



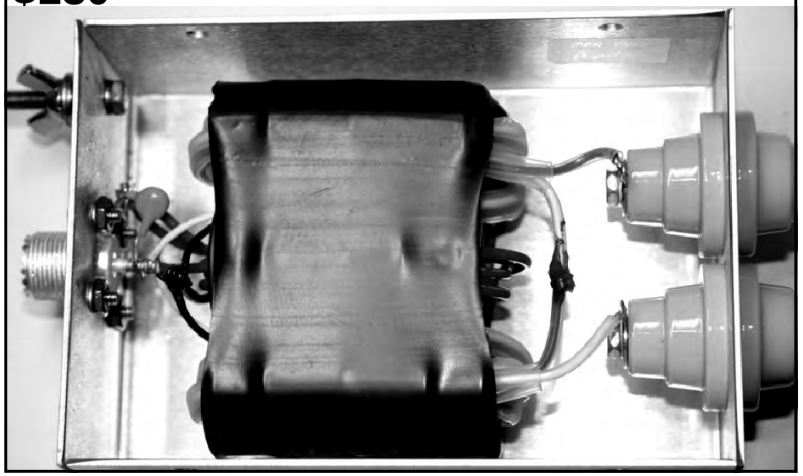
DX Engineering 200Ω – 50Ω Bifilar Choke Balun

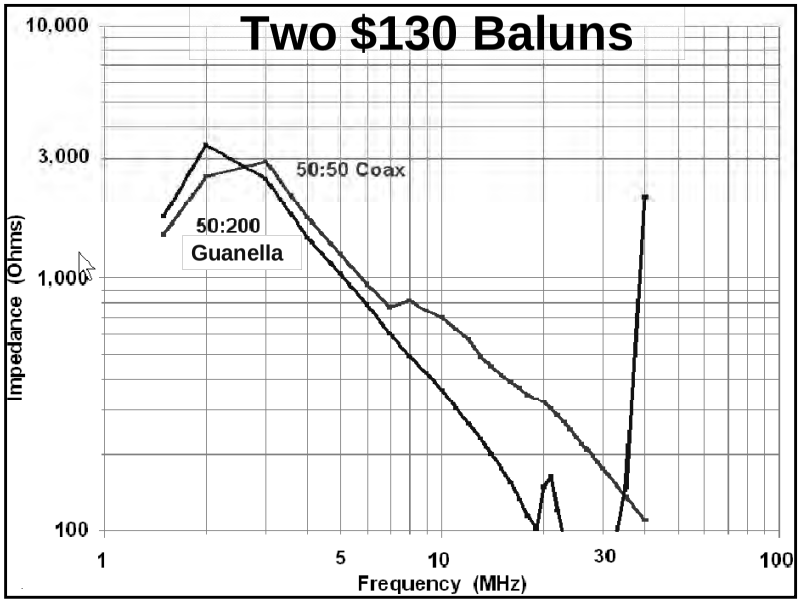
$130

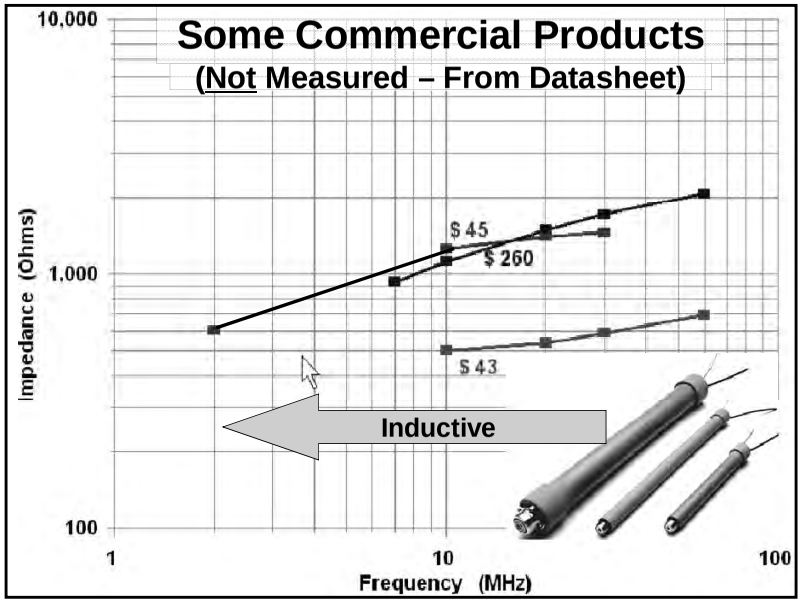


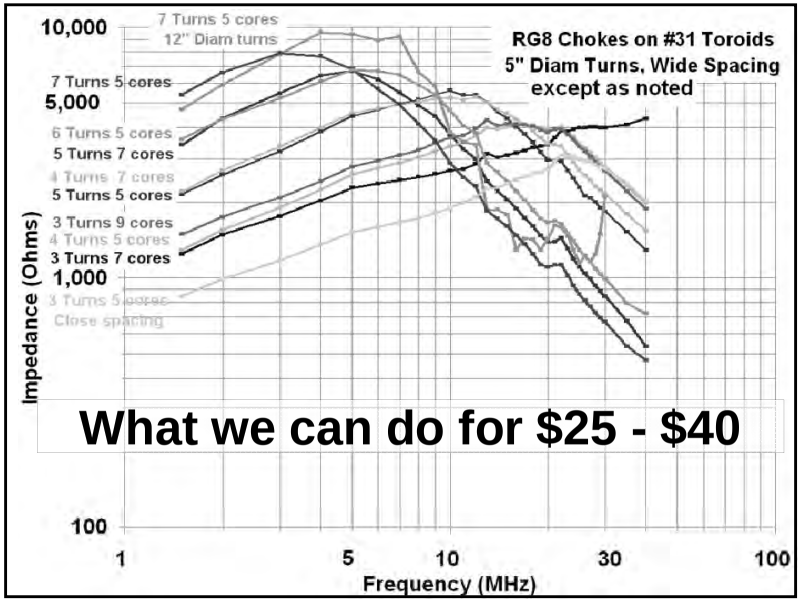
DX Engineering 300Ω – 50Ω Bifilar Choke Balun

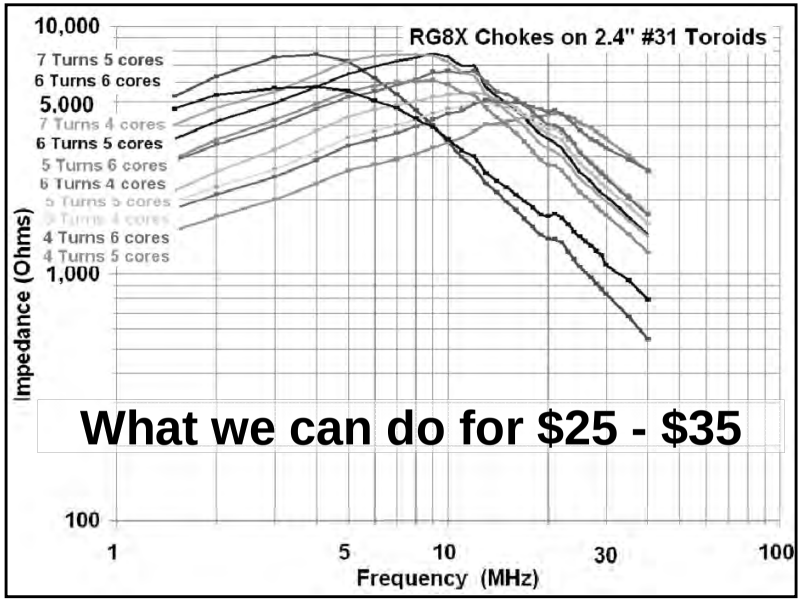
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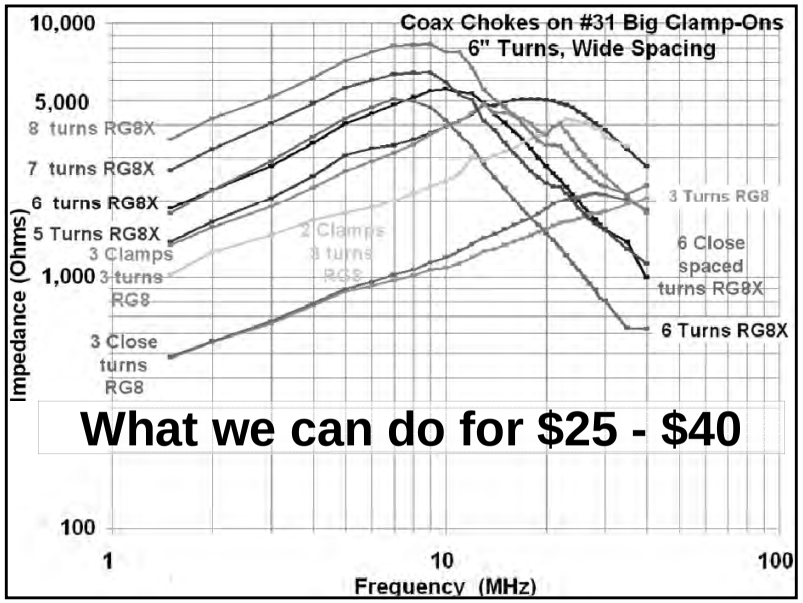


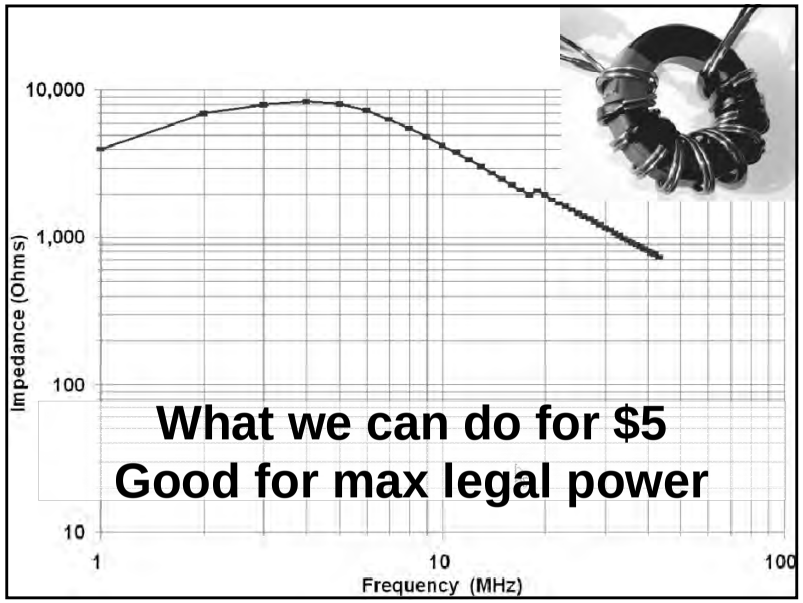

Two $130 Baluns
10,000
3,000
1,000
100
Impedance (Ohms)
50:50 Coax
50:200
Guanella
1
5
10
30
100
Frequency (MHz)

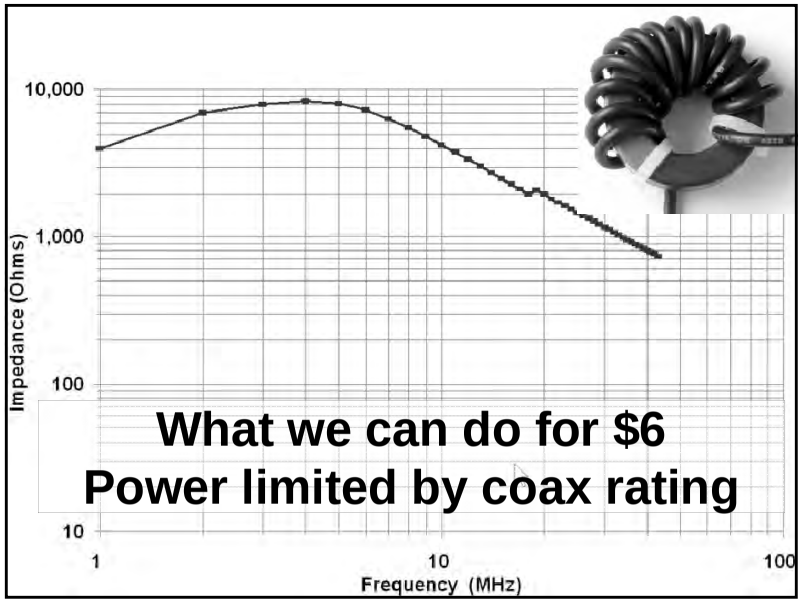

Some Commercial Products
(Not Measured – From Datasheet)
10,000
1,000
100
Impedance (Ohms)
$ 45
$ 260
$ 43
Inductive
1
10
100
Frequency (MHz)

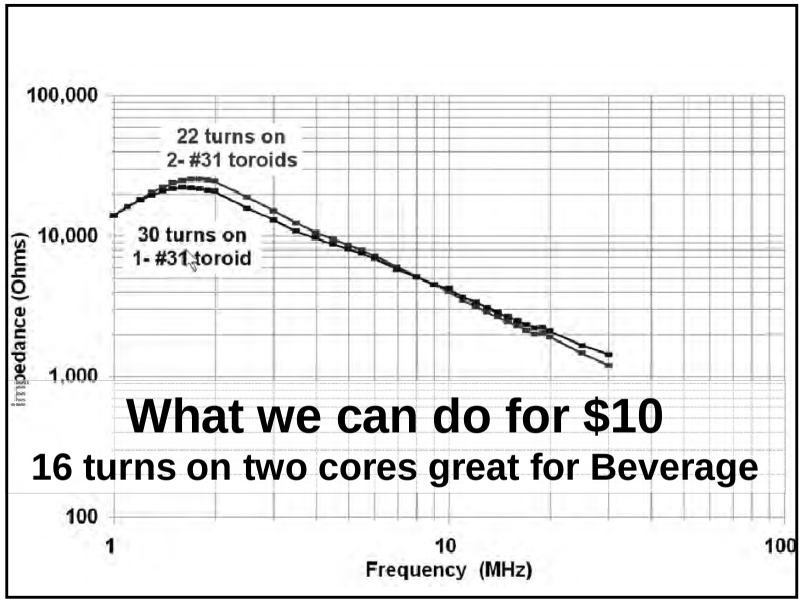

10,000
5,000
1,000
100
Impedance (Ohms)
7 Turns 5 cores
12" Diam turns
RG8 Chokes on #31 Toroids
5" Diam Turns, Wide Spacing
except as noted
7 Turns 5 cores
6 Turns 5 cores
5 Turns 7 cores
4 Turns 7 cores
5 Turns 5 cores
3 Turns 9 cores
4 Turns 5 cores
3 Turns 7 cores
3 Turns 5 cores
Close spacing
What we can do for $25 - $40
1
5
10
30
100
Frequency (MHz)


10,000
5,000
1,000
100
Impedance (Ohms)
RG8X Chokes on 2.4" #31 Toroids
7 Turns 5 cores
6 Turns 6 cores
7 Turns 4 cores
6 Turns 5 cores
5 Turns 6 cores
6 Turns 4 cores
5 Turns 5 cores
4 Turns 6 cores
4 Turns 5 cores
What we can do for $25 - $35
1
5
10
30
100
Frequency (MHz)


Coax Chokes on #31 Big Clamp-Ons
6" Turns, Wide Spacing
10,000
5,000
1,000
100
8 turns RG8X
7 turns RG8X
6 turns RG8X
5 Turns RG8X
3 Clamps 3 turns RG8
3 Close turns RG8
2 Clamps 3 turns RG8
3 Turns RG8
6 Close spaced turns RG8X
6 Turns RG8X
Impedance (Ohms)
1
10
100
Frequency (MHz)
What we can do for $25 - $40


10,000
1,000
100
10
Impedance (Ohms)
1
10
100
Frequency (MHz)
What we can do for $5
Good for max legal power


10,000
1,000
100
10
Impedance (Ohms)
1
10
100
Frequency (MHz)
What we can do for $6
Power limited by coax rating


100,000
10,000
1,000
100
22 turns on 2- #31 toroids
30 turns on 1- #31 toroid
Impedance (Ohms)
1
10
100
Frequency (MHz)
What we can do for $10
16 turns on two cores great for Beverage

See K9YC's Choke Cookbook (Chapter 7 in the RFI Tutorial) for specific recommendations

http://audiosystemsgroup.com/RFI-Ham.pdf

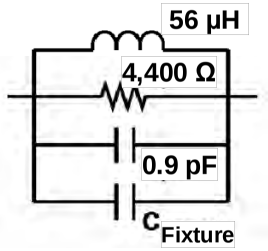
The Measurement Problem

Measuring Coax Chokes

- Very difficult to measure
- Traditional "reflection" measurements (S11) give wrong results
  - Poor accuracy if Zx > 500 Ω
- Stray capacitance of fixture causes additional errors
  - Most VNA's and other analyzers that claim to subtract it out don't
- A lot of smart people have missed all this!

What are we Trying to Measure?

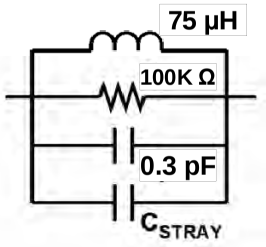




What are we Trying to Measure?

#61

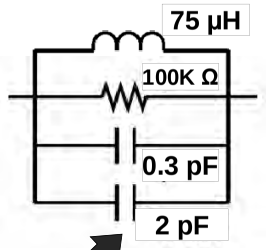




What are we Trying to Measure?

#61

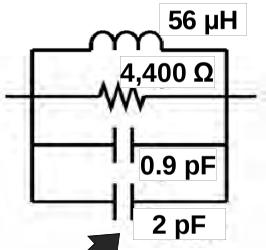




Typical “good” analyzers

What are we Trying to Measure?

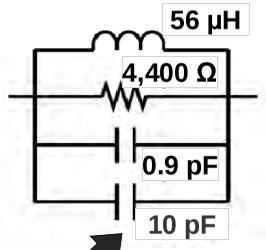




Typical “good” analyzers

What are we Trying to Measure?

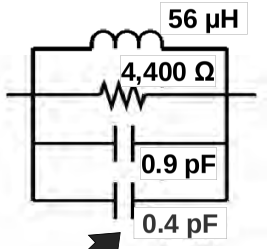




Cheap “antenna” analyzers

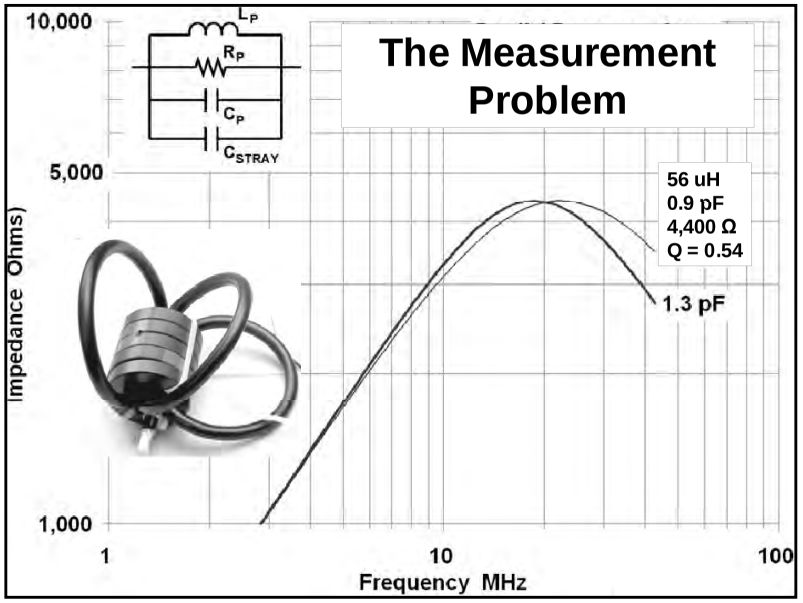
What are we Trying to Measure?



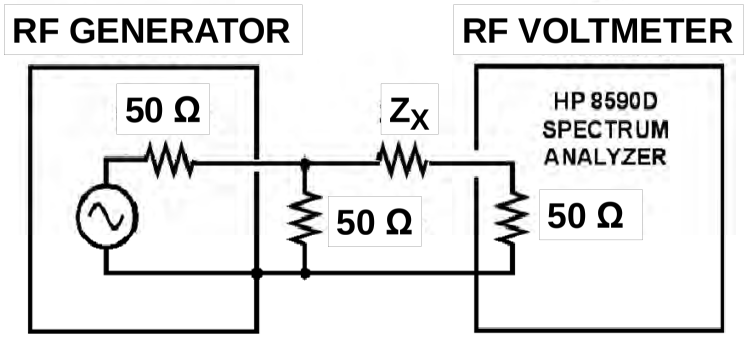


My measurement setup

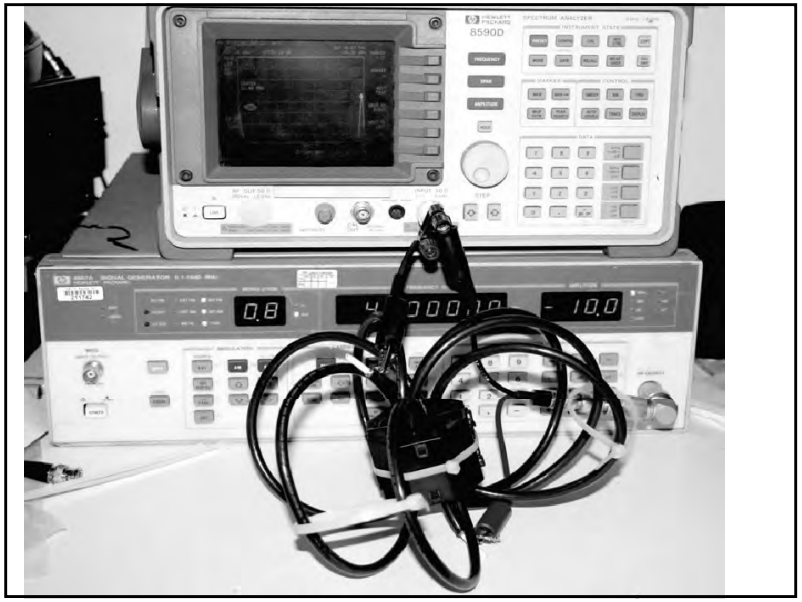
The Measurement Problem

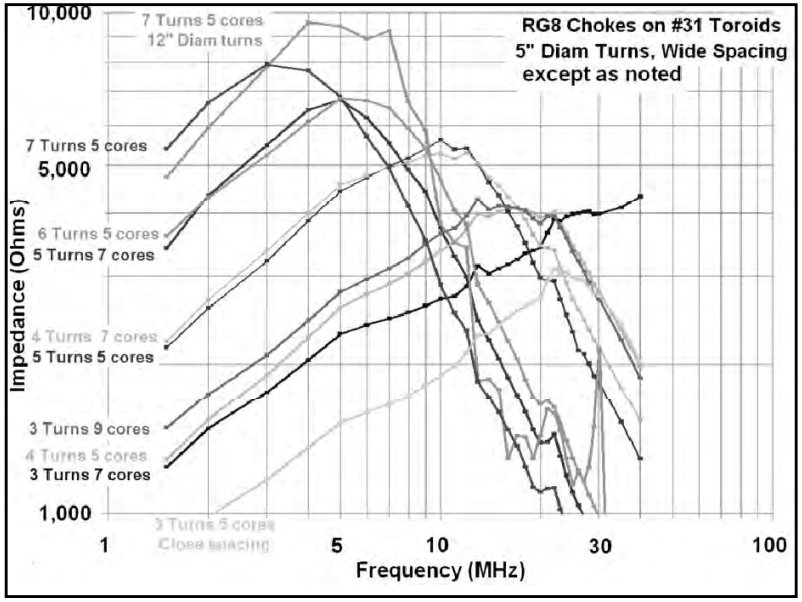


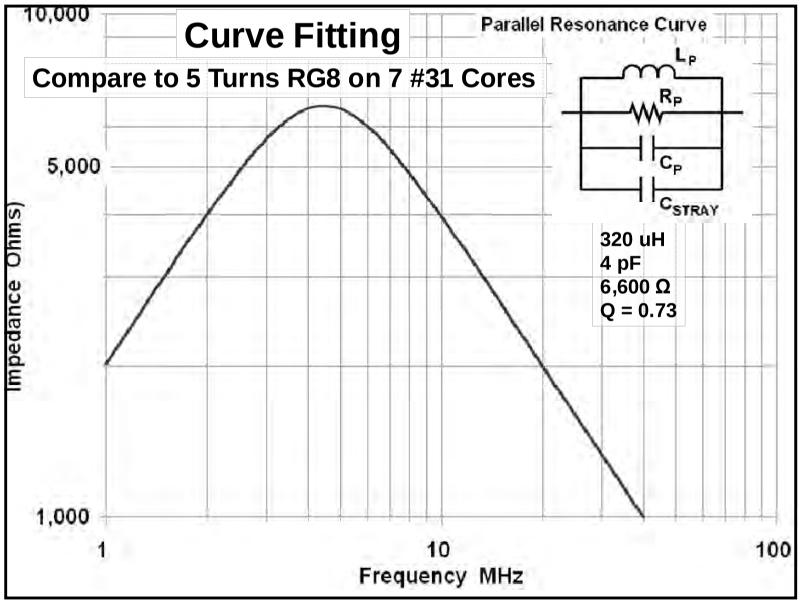
Measuring Coax Chokes

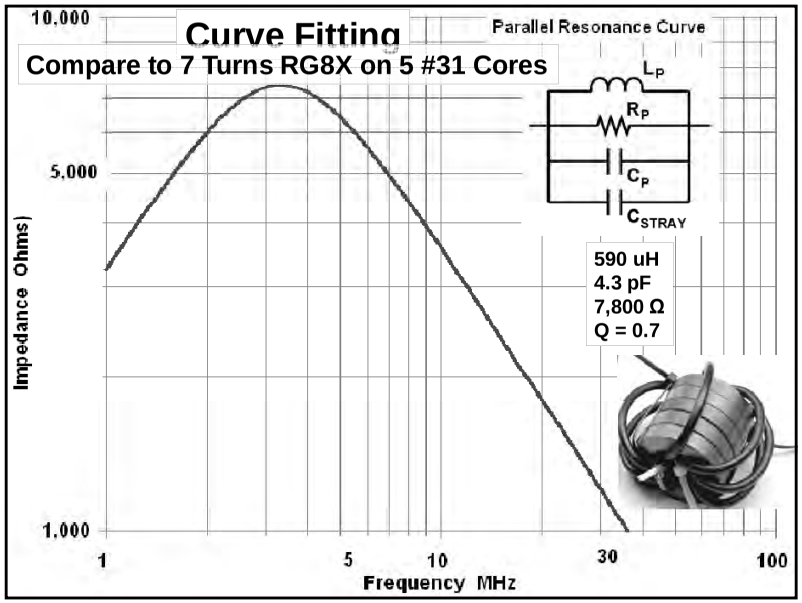


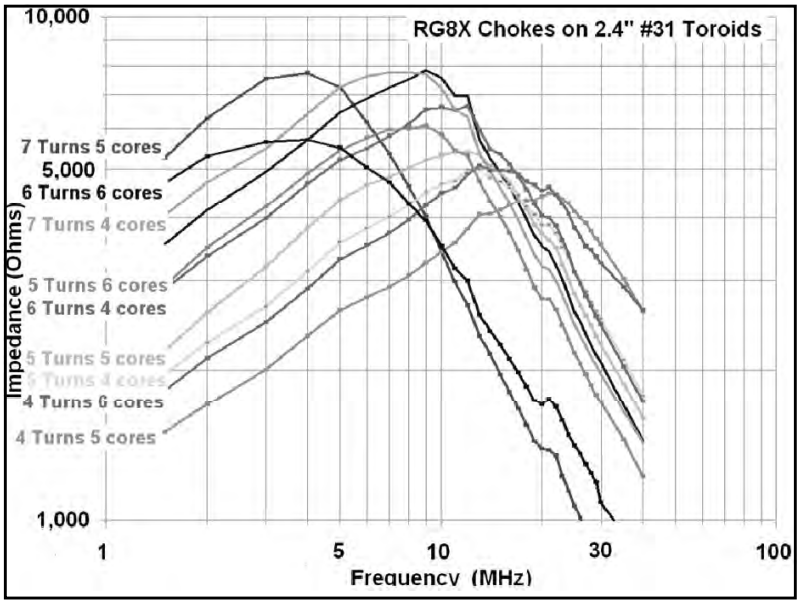


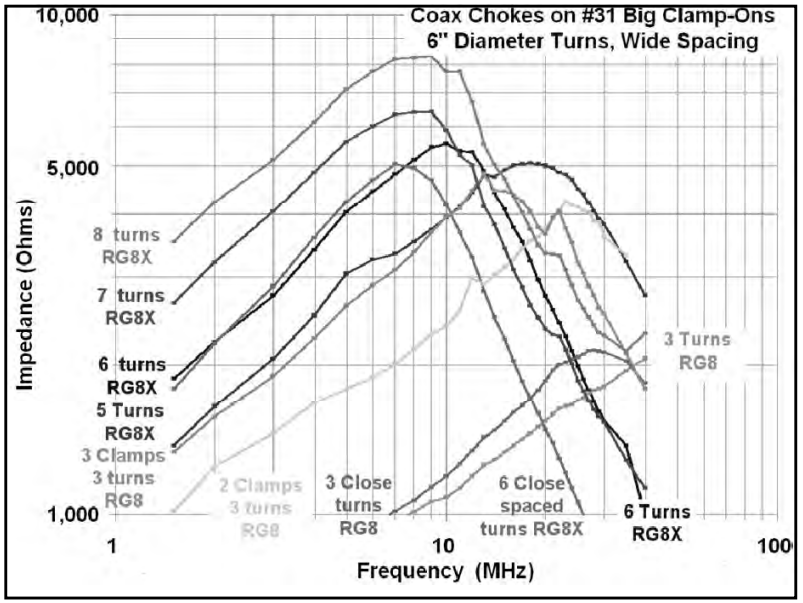


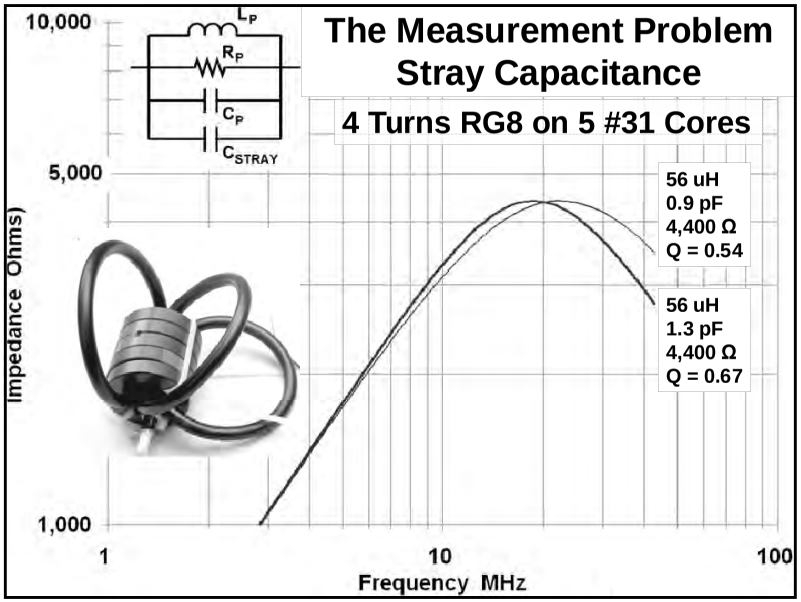

RG8 Chokes on #31 Toroids
5" Diam Turns, Wide Spacing
except as noted
7 Turns 5 cores
12" Diam turns
7 Turns 5 cores
6 Turns 5 cores
5 Turns 7 cores
4 Turns 7 cores
5 Turns 5 cores
3 Turns 9 cores
4 Turns 5 cores
3 Turns 7 cores
3 Turns 5 cores
Close spacing
10,000
5,000
1,000
Impedance (Ohms)
1
5
10
30
100
Frequency (MHz)

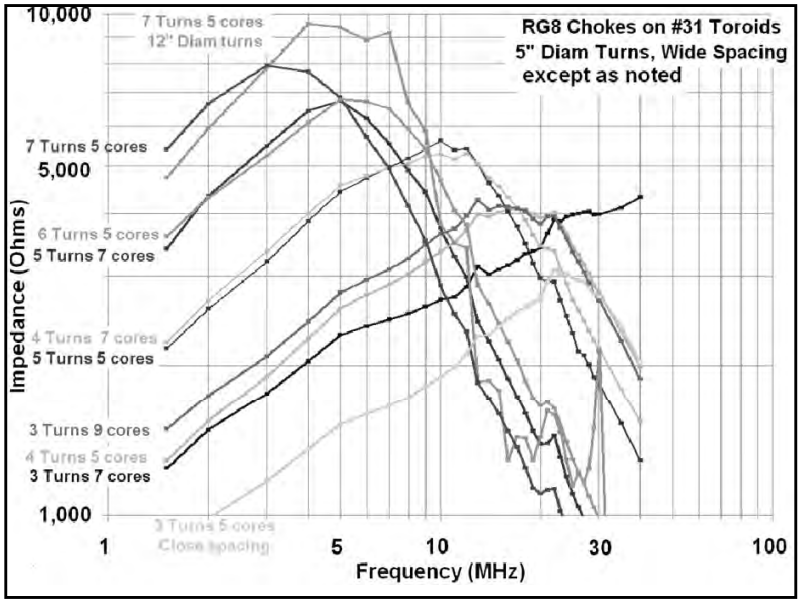

Curve Fitting
Compare to 5 Turns RG8 on 7 #31 Cores
Parallel Resonance Curve
L_P
R_P
C_P
C_{STRAY}
320 uH
4 pF
6,600 Ω
Q = 0.73
10,000
5,000
1,000
Impedance Ohms)
1
10
100
Frequency MHz


Curve Fitting
Compare to 7 Turns RG8X on 5 #31 Cores
Parallel Resonance Curve
L_P
R_P
C_P
C_{STRAY}
590 uH
4.3 pF
7,800 Ω
Q = 0.7
10,000
5,000
1,000
Impedance Ohms)
1
5
10
30
100
Frequency MHz


RG8X Chokes on 2.4" #31 Toroids
10,000
5,000
1,000
Impedance (Ohms)
7 Turns 5 cores
6 Turns 6 cores
7 Turns 4 cores
5 Turns 6 cores
6 Turns 4 cores
5 Turns 5 cores
4 Turns 6 cores
4 Turns 5 cores
1
5
10
30
100
Frequency (MHz)


Coax Chokes on #31 Big Clamp-Ons
6" Diameter Turns, Wide Spacing
10,000
5,000
1,000
Impedance (Ohms)
8 turns RG8X
7 turns RG8X
6 turns RG8X
5 Turns RG8X
3 Clamps 3 turns RG8
2 Clamps 3 turns RG8
3 Close turns RG8
6 Close spaced turns RG8X
3 Turns RG8
6 Turns RG8X
1
10
100
Frequency (MHz)


The Measurement Problem
Stray Capacitance
4 Turns RG8 on 5 #31 Cores
L_P
R_P
C_P
C_{STRAY}
10,000
5,000
1,000
Impedance Ohms)
56 uH
0.9 pF
4,400 Ω
Q = 0.54
56 uH
1.3 pF
4,400 Ω
Q = 0.67
1
10
100
Frequency MHz


RG8 Chokes on #31 Toroids
5" Diam Turns, Wide Spacing
except as noted
10,000
5,000
1,000
Impedance (Ohms)
7 Turns 5 cores
12" Diam turns
7 Turns 5 cores
6 Turns 5 cores
5 Turns 7 cores
4 Turns 7 cores
5 Turns 5 cores
3 Turns 9 cores
4 Turns 5 cores
3 Turns 7 cores
3 Turns 5 cores
Close spacing
1
5
10
30
100
Frequency (MHz)



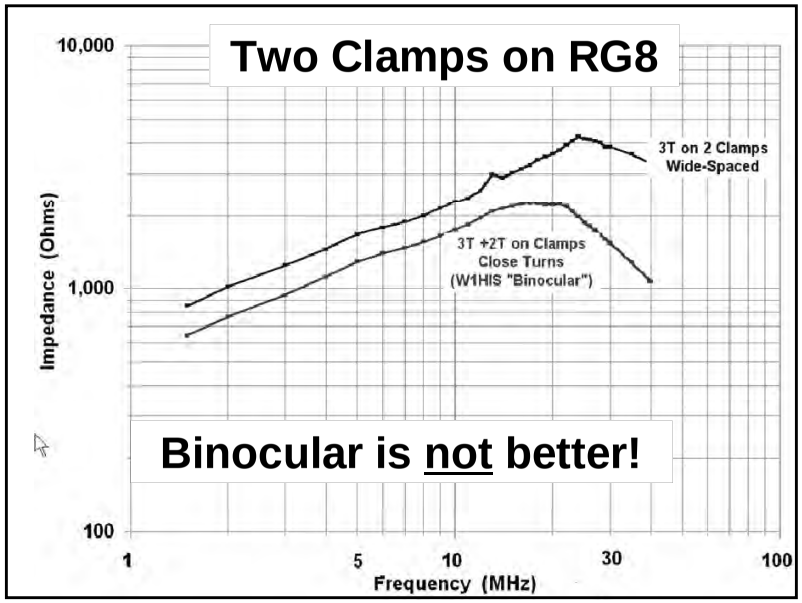
W1HIS Coaxial Choke

#43 cores









Thanks to Kevin, K6TD

- Helped me verify my suspicions about reflection-based measurements, and get good S21 data using his HP Network Analyzer

  (Unfortunately, we didn't have the extra hardware needed to get complex data out of the analyzer into a spreadsheet.)

Thanks to Chuck, W1HIS

- Chuck showed that we need 5,000Ω chokes to minimize receive noise

More Thanks

- Walt Maxwell, W2DU, for his great writing, and for his kind words.
- Danny, K6MHE, for prodding me to participate in a measurement roundtable that confirmed my work
- Henry Ott, WA2IRQ, for his insights, criticism, advice, and great teaching.
- Ron Steinberg, K9IKZ, for lots of help at critical times.
- The NCCC crew, for lots of antenna help.

Thanks to Richard Heyser

Dick's "day job" was at JPL, where he worked on underwater communications and communications for the space program, but audio was his hobby.

Dick invented Time Delay Spectrometry (TDS), which revolutionized audio by revolutionizing acoustic measurements. He was an articulate writer and teacher, teaching us how to always think about what we were measuring, to always question both the accuracy and the meaning of the data on the screen, and to use new ways of looking at the data to learn more from it.

References

- Henry Ott, *Electromagnetic Compatibility Engineering,* Wiley Interscience, 2009
- Henry Ott, *Noise Reduction Techniques in Electronic Systems,* Wiley Interscience, 1988
- E. C. Snelling, *Soft Ferrites, Properties and Applications,* CRC Press, 1969
- E. C. Snelling and A. D. Giles, *Ferrites for Inductors and Transformers,* Research Study Press, 1983
- *Fair-Rite Products Catalog* This 200-page catalog is a wealth of product data and applications guidance on practical ferrites. http://www.fair-rite.com
- *Ferroxcube Catalog and Applications Notes* More online from another great manufacturer of ferrites. http://www.ferroxcube.com

References

- ***New Understandings of the Use of Ferrites in the Prevention and Suppression of RF Interference to Audio Systems,*** **J. Brown** (AES Preprint 6564)
- ***Understanding How Ferrites Can Prevent and Eliminate RF Interference to Audio Systems*, J. Brown** Self-published tutorial (on my website)
- **A Ham's Guide to RFI, Ferrites, Baluns, and Audio Interfacing** Self-published tutorial (on my website)

Applications notes, tutorials, and my AES papers are on my website for free download
http://audiosystemsgroup.com/publish.htm

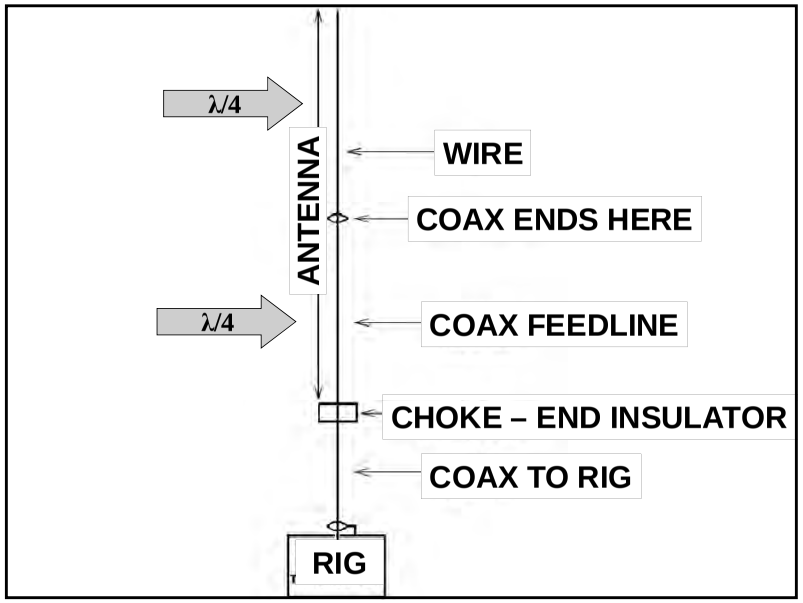
Ferrite Transmitting Chokes

Jim Brown K9YC
Santa Cruz, CA
k9yc@arrl.net
http://audiosystemsgroup.com

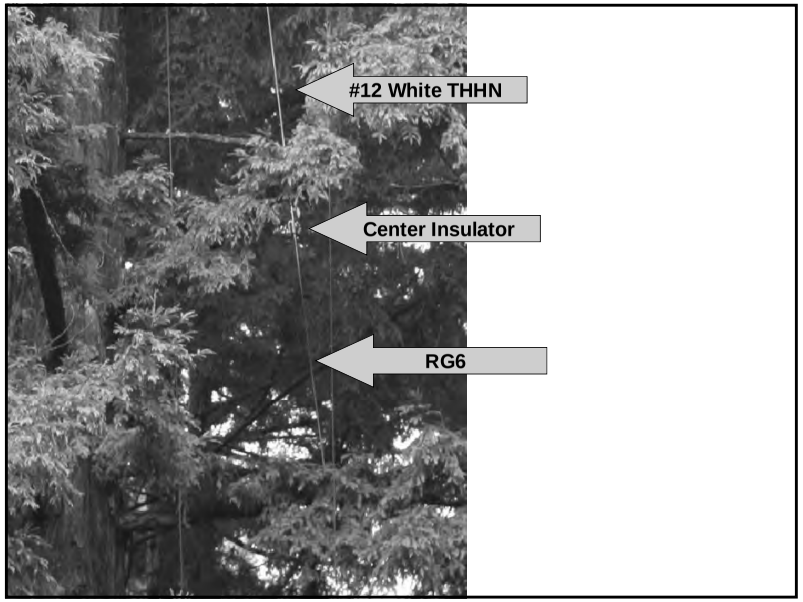


A Common Mode Torture Test

A Coax Choke as the End Insulator of an End Fed Vertical Dipole



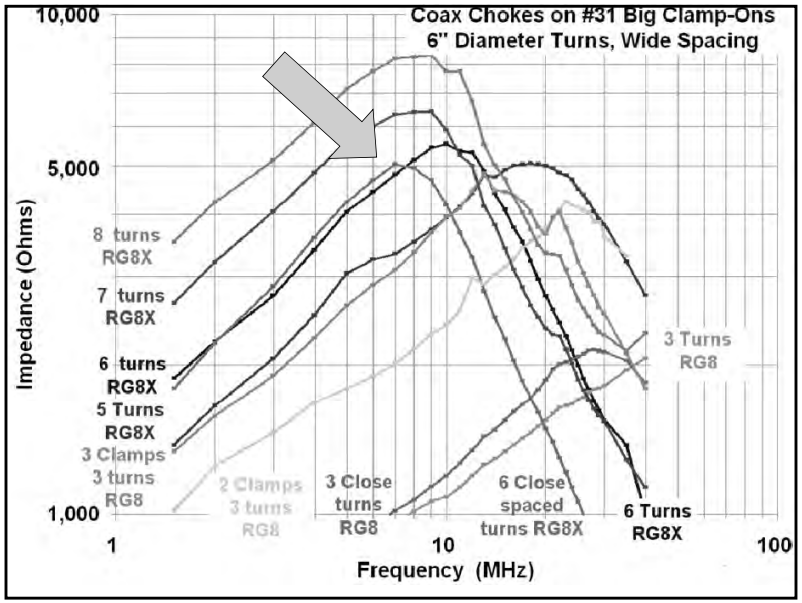




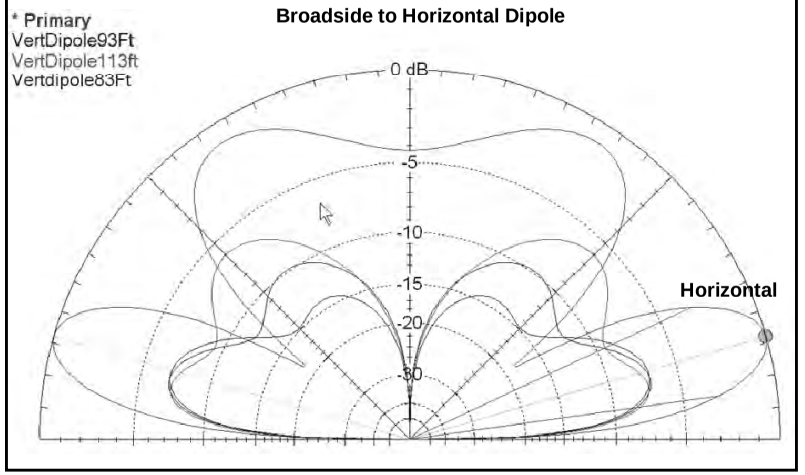
End Insulator for a 40M Dipole

- 6 turns of RG6 around a “big clamp-on” is enough for 500 watts of serious contesting
  - About 5,000Ω resistive impedance
- Two of these 6-turn chokes are needed for 1.5kW
  - About 10,000Ω resistive impedance

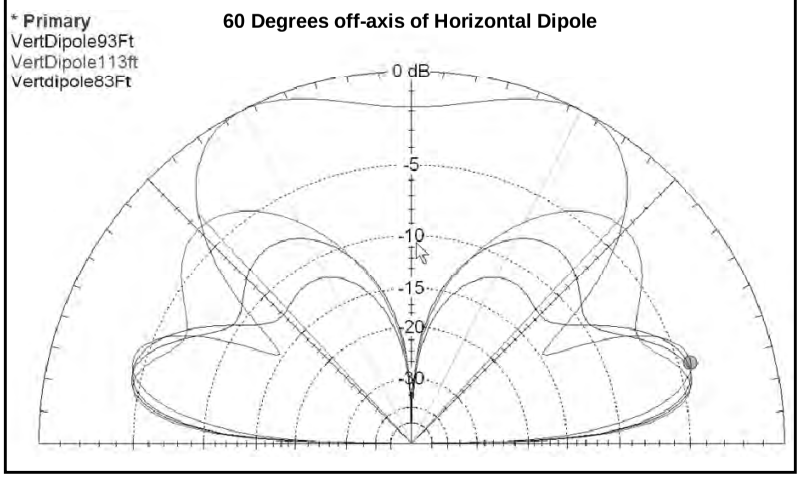




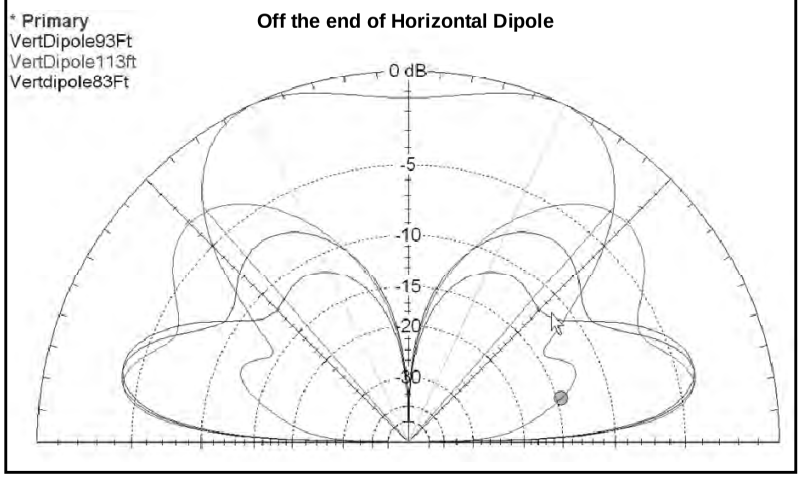
Before you fall in love with a vertical dipole, compare it to a horizontal dipole!



Before you fall in love with a vertical dipole, compare it to a horizontal dipole!



Before you fall in love with a vertical dipole, compare it to a horizontal dipole!



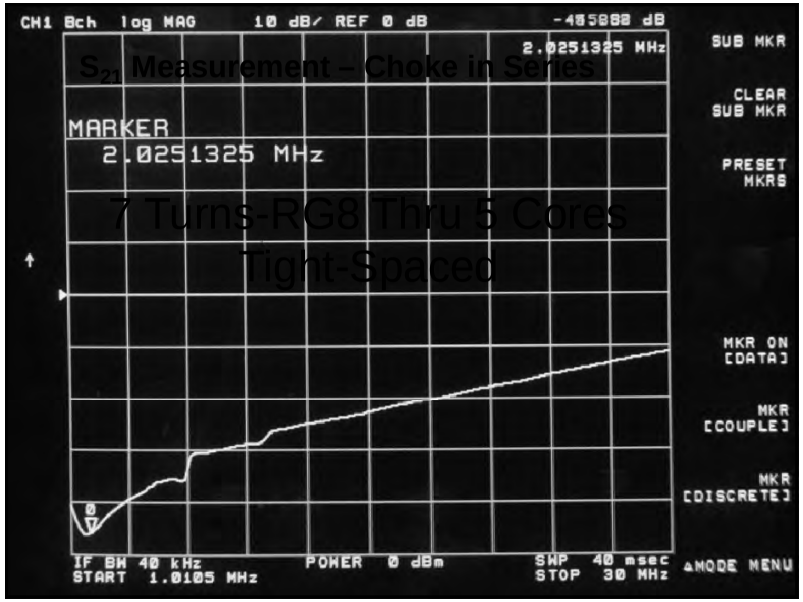
Thanks to Kevin, K6TD

- **Helped me verify my suspicions about reflection-based measurements, and get good S21 data using his HP Network Analyzer**

  (Unfortunately, we didn't have the extra hardware needed to get complex data out of the analyzer into a spreadsheet.)

7 Turns-RG8 Thru 5 Cores Tight-Spaced



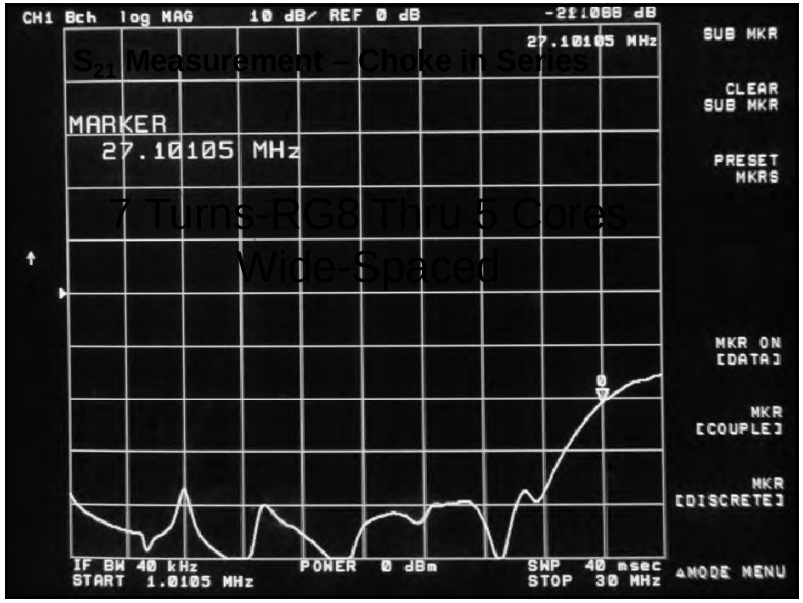


S_{21} Measurement – Choke in Series

7 Turns-RG8 Thru 5 Cores Tight-Spaced

7 Turns-RG8 Thru 5 Cores Wide-Spaced

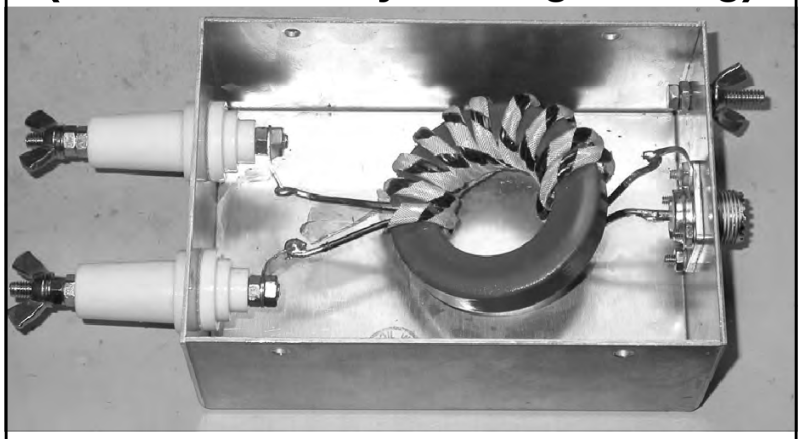


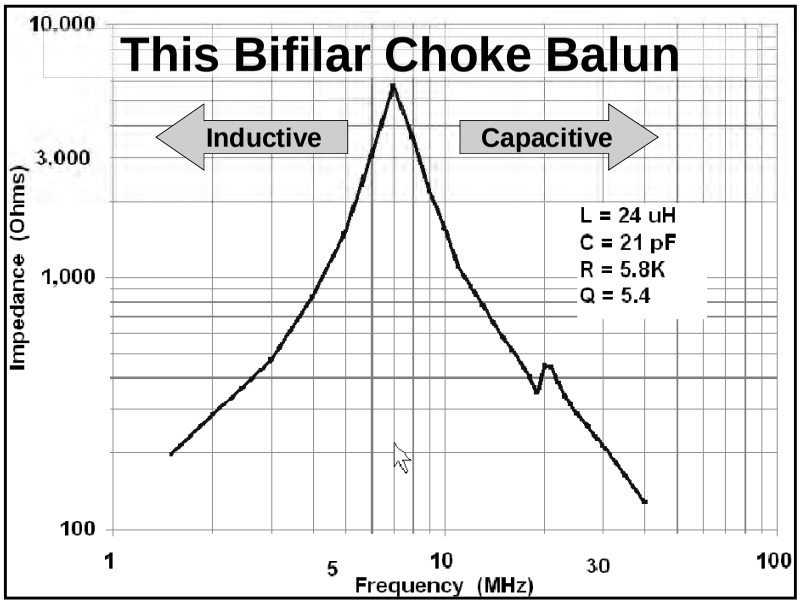


S_{21} Measurement – Choke in Series

7 Turns-RG8 Thru 5 Cores Wide-Spaced

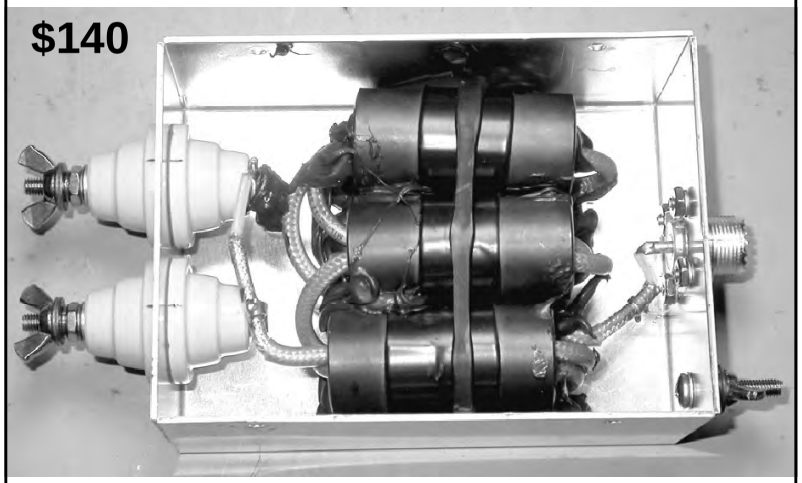
Bifilar Choke Balun on low loss core (Discontinued by DX Engineering)





DX Engineering 50Ω Choke Balun

$140



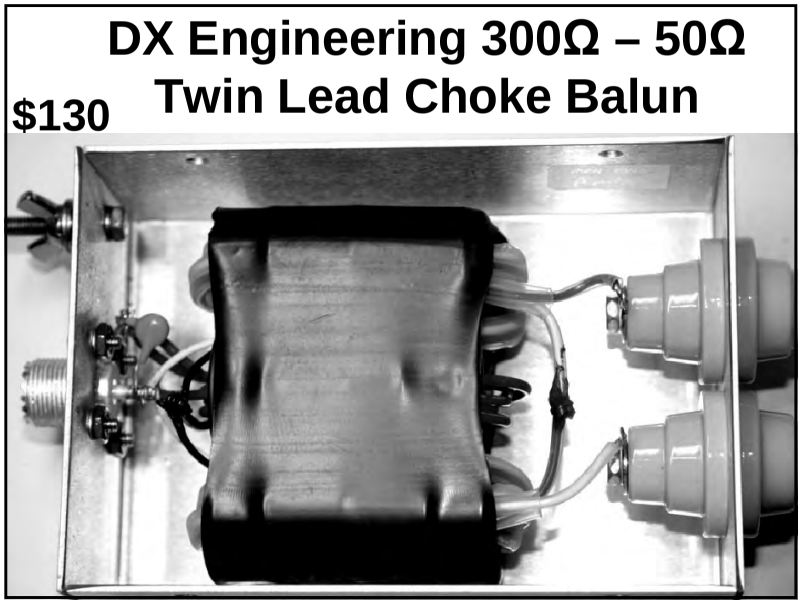
DX Engineering 200Ω – 50Ω Twin Lead Choke Balun

$130

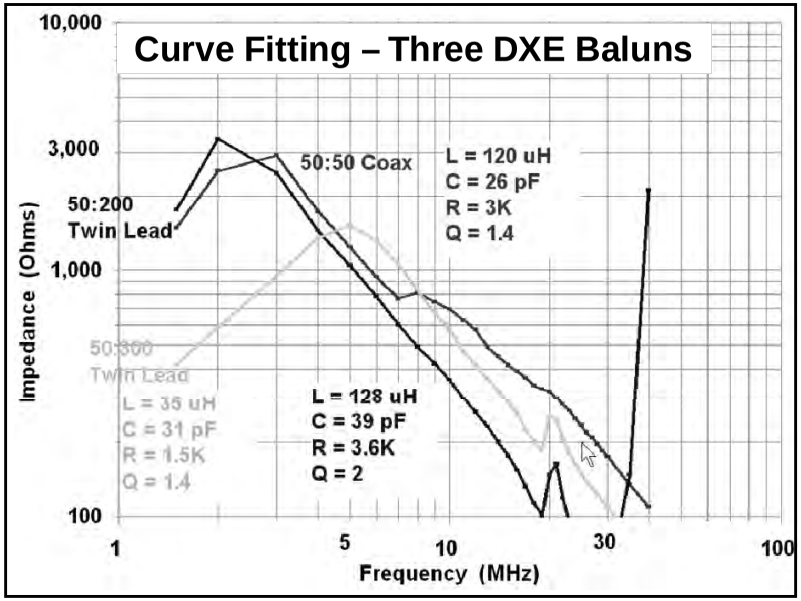


DX Engineering 300Ω – 50Ω Twin Lead Choke Balun

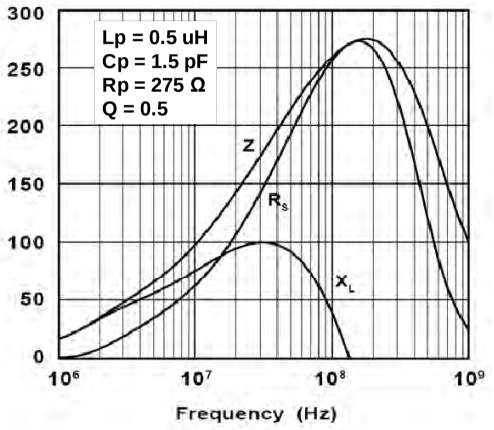
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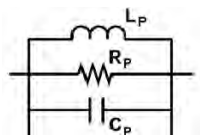


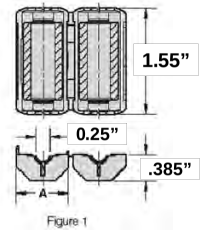
Curve Fitting – Three DXE Baluns



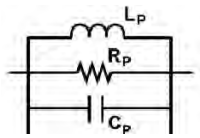
Curve Fitting – #31 HF-VHF Clamp-On Fair-Rite 0431164281

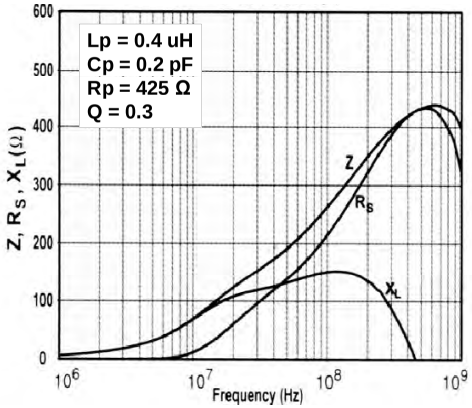


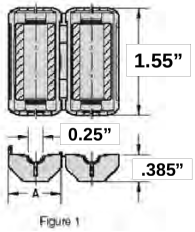




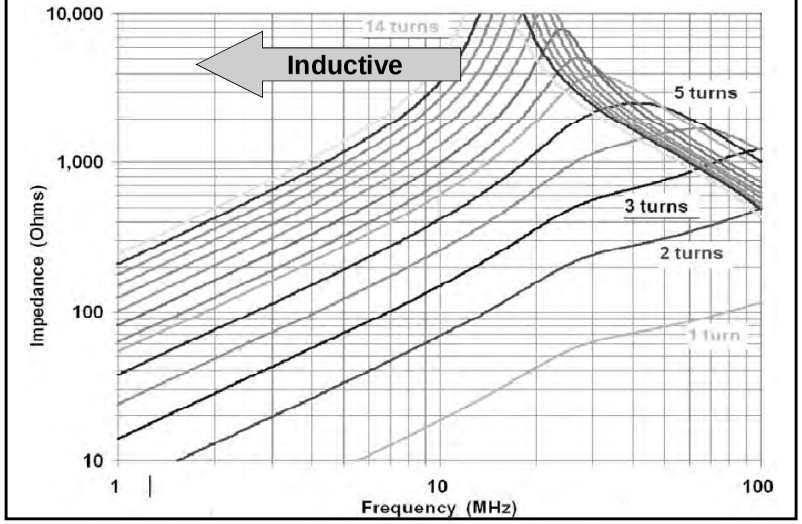
Curve Fitting – #61 UHF Clamp-On Fair-Rite 0461164281







Small Wire Chokes on a #61 toroid



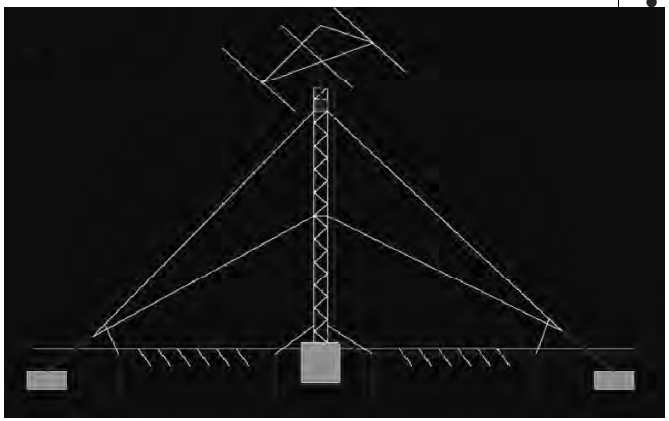
Design, Installation and Maintenance of Antennas, Towers and Rotators

By Frank Donovan W3LPL

for Storm Survival,
Long Term Reliability
and Safety

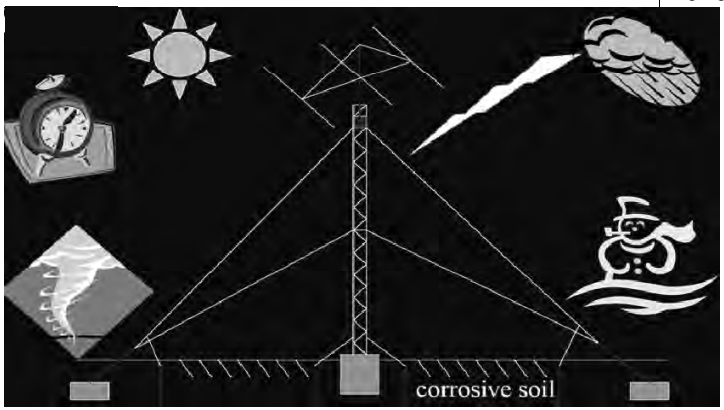
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A Typical Tower and Antenna



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Your Tower in its Environment



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Tower Sections Design and Construction

- Adequate load capacity for current and future use
  - antenna loads
    - especially unbalanced or unidirectional loads
  - coaxial and other cables
- Adequate load capacity for local environmental conditions
  - wind loads (especially severe site specific conditions)
  - ice loads (especially severe site specific conditions)
- Unidirectional or unbalanced ice and wind loads
- Corrosion protection
  - including site specific conditions

Beware of used or corroded tower sections with tubular legs

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Tower Sections
Maintenance and Inspections

- Inspect all tower sections one year after installation
  - then at least once every three years
  - after every serious storm
  - after any structural damage to the tower
- Check plumb and twist of the tower
- Pay special attention to damaged, loose, missing or corroded:
  - diagonal and horizontal trusses, welds and hardware
  - especially at and close to the guy attachments

Beware of used or corroded tubular tower sections

Regular inspections are key to safety and long term tower and antenna survival

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Tower Base
Design and Construction

- Use the manufacturer's recommended design
  - provide adequate depth for local frost conditions
- The top of your foundation should be at least six inches above grade
- Towers with tubular legs embedded in concrete require careful attention to reliable drainage during construction
  - each leg must drain into gravel at bottom of the foundation
  - concrete embedded tower sections are a risky practice in salt air or corrosive industrial environments

Your tower base must provide reliable drainage for tubular tower legs

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Tower Base
Maintenance and Inspections

- Inspect at least once every three years
- Pay special attention to:
  - corrosion at the tower-to-concrete interface
  - standing water on the foundation
  - dirt and debris accumulated on the foundation
  - settling and cracks

Dirt and debris accumulation on your tower foundation can lead to catastrophic tower failure

Guy Anchor
Design and Construction

- Guy anchor failure is one of the most common causes of catastrophic tower failure
  - determine if you have corrosive soil conditions in your area
  - adequate guy anchor depth for local soil conditions
  - use only heavy duty galvanized, forged hardware
  - use tower manufacturer's recommended guy anchor design
  - corrosive soil require professional guy anchor design
  - elevated guy anchors require professional design

Never use light duty home owner grade hardware

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Guy Anchor Maintenance and Inspections

- Inspect at least once every three years
  - dig down at least six inches to inspect for anchor rod corrosion
  - missing hardware
  - loose hardware
  - corroded hardware

Anchor rod corrosion is a very serious threat to tower safety survival

Guy Wire Design and Construction

- Use heavy duty galvanized, forged hardware
- Use tower manufacturer's recommended guy wire size
  - smaller guy wire risks catastrophic tower failure
  - heavier guy wire reduces the tower's load capacity
- Tension guy wires to 10% of breaking strength
  - less than 7% risks galloping guy wires and excessive tower flexing in the wind
  - greater than 15% risks guy wire vibration and reduced tower load capacity
  - guy wire vibration dampening hardware may be needed

Never use light duty home owner grade hardware

Guy Wire Maintenance and Inspections

- Inspect three months after installation
- Inspect at least once every three years
- Inspect after all serious storms
- Check guy wire tension (7-15% of breaking strength)
- Check for:
  - damage from rubbing of chaffing of guy wire
  - corrosion
  - loose hardware

Corroded guys and hardware risk catastrophic tower failure

Guy Attachment (tower and anchor) Design and Construction

- Guy force must be properly distributed to the tower structure
  - use the tower manufacturer's recommended design
- Heavy duty professional grade forged, galvanized hardware
- Install turnbuckle safety wires
- Use articulated guy wire connections
  - 10 degrees of free guy wire movement in any direction
  - no chaffing or damage to guy wire or hardware from frequent tensioning, loosening or movement of the guy wire in the wind

Use the manufacturer's recommended guy attachments

Guy Attachment (tower and anchor) Maintenance and Inspections

- Inspect guys at least once every three years
- Check all guy attachment hardware
  - missing or loose turnbuckle safety wires
  - loose, missing or corroded hardware
  - guy wire chaffing or rubbing
  - Integrity of tower structure in the vicinity of each guy attachment
    - damaged tower structural components
    - broken welds
    - loose or missing hardware

Replace all degraded or missing guy attachment hardware

Lightning Protection Design and Construction

- Use at least three ground rods adjacent to your tower foundation
  - at least 8 feet from each other and the tower base
- One ground rod for each guy anchor
- 8 foot galvanized ground rods (10 feet preferred)
- Large diameter (2/0) solid, tinned ground wire
  - rugged durable connections to tower and guys
  - buried connections to ground rods (Cadweld preferred)
  - buried wire between ground rods a tower base

Never use braided wire for tower grounding

Lightning Protection Maintenance and Inspections

- Inspect all ground wire connections at least once every three years
  - loose or missing hardware
  - missing wires
  - broken wires
  - corrosion

Repair all damaged or missing ground wires and connections

Rotator Design and Construction

- Do not exceed the manufacturers load capacity
  - use adequate size control cable
    - consider the total length of the control cable
  - rotator mounting hardware should be appropriate for your tower
    - use galvanized steel or stainless steel hardware
    - always use anti-galling compound on stainless steel hardware

An under rated rotator will fail prematurely

Rotator
Maintenance and Inspections

- Inspect three months after installation
- Inspect every three years
- Check:
  - excessive mechanical play in the wind
  - corroded hardware

An under rated rotator will be a major maintenance problem

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Antenna and Mast
Design and Construction

- Appropriate antenna and mast for local wind and ice conditions
  - heavy duty antenna when needed for local conditions
- Use only galvanized or stainless steel hardware
  - use anti-galling compound on stainless steel hardware
- Use vibration dampening of antenna elements to avoid premature failure
- Well designed coaxial cable connections to the antenna
  - electrical and mechanical
- Properly designed boom truss with professional quality hardware

Select an appropriate antenna and mast for your local wind and ice conditions

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Antenna and Mast
Maintenance and Inspections

- Inspect at least once every three years
  - loose or missing antenna hardware
  - loose or missing boom truss hardware
  - corroded hardware
  - ultra violet radiation damaged hardware
  - coaxial cable electrical connection to the antenna
  - coaxial cable physical connection to the antenna
  - damaged structural components

Coaxial cable connections to your antenna are easily damaged by wind, rain and UV

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Coaxial Cables and Control Cables
Design and Construction

- Select appropriate cables for local ultraviolet conditions
- Use appropriate hardware for tower attachment
  - consider local ultraviolet, wind and ice conditions
  - #12 insulated solid copper wire is a good choice for fastening cable to a tower
  - high quality electrical tape (Scotch 88) is also a good choice
- Electrically connect all coaxial cable shields to the tower
  - at the top and bottom of your tower

Fasten cables to your tower with high quality attachment hardware

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Coaxial Cables and Control Cables Maintenance and Inspections

- Inspect at least once every three years
  - loose, missing or UV damaged cable attachments
  - UV damaged cables
- Coaxial cables control cables and connectors damaged by water or moisture intrusion
  - best inspected by using a time domain reflectometer, vector network analyzer, VSWR meter or other appropriate techniques
  - good records are essential to detecting degraded coaxial cables

Degraded coaxial cable seriously affects station competitiveness

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Summary

- Use this presentation to help you avoid the most common design and construction errors
- Inspections are essential to long term tower and antenna reliability
- Conduct major inspections
  - during the first year after construction or major modifications
  - every three years
  - after serious storms or damage

Regular inspections are essential to tower and antenna safety and long term reliability

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How to Make your Multi-Op Contest Operation More Effective

Doug Grant K1DG

Define your goals for "more effective"

- Higher score than last time
- Contribute more to the club score
- Higher score than another comparable station
- Highest score in category
- Introduce new contesters to the game
- More laughs

This presentation

- For the station owner/host
- For the guest op

Multiop basics – for the host

- Make sure everything works
- Know your ops
- Establish ground rules
  - Operating-related
  - Other

Make sure everything works

- Antennas
- Rotators
- Rigs
- Amplifiers
- Computers
- Software
- Internet
- TVI/RFI/neighbors under control

- *Make a checklist with all these categories*

- "This connector is kind of flaky…if the receiver goes dead, just wiggle it"
- "The grid current meter on this amp doesn't work"
- "That rotator is off by 30-40 degrees"

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Know your operators

- What is each one's strength?
  - Running vs. S&P
  - Band preference/skill
  - Night shift
- Team player, leader, or prima donna?
- Familiarity with radios, logging program?
- Dietary issues/preferences?

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Before the contest: Communicate, communicate, communicate!

- Who is on which band, who is bringing what
- Who is in charge of food
- For new MS and M2 teams, set a schedule
- Get copies of previous year's log & rate sheets if possible
  - Don't be a slave to them if conditions are different

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Establish ground rules

- Expectations of behavior…
  - On the air…log Ws/dupes, mike gain settings…
  - Off the air…which food is OK to eat, where to sleep, which bathroom to use, OK to plug in chargers, smoking?
- Family/pets in the house?
  - Do they like contesters, tolerate them, or bite them?
- Practical issues
  - Car keys available in case car must be moved
  - Emergency contact

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Provide for the operators

- Comfortable tables and chairs
- Adequate environment
  - Heating/cooling
  - Lighting
  - Soundproofing
- Headphones, mikes, paddles (or arrange for them to bring their own)

Ummm…maybe not.



Provide for your guests – non-radio

- Someplace to sleep
- Someplace to park
- Someplace to hang out when not operating
- Appropriate Food & Drink
- *Be a good host and the good ops will come back!*



G6PZ “Break Room”

Patience - Rewards



N3GJ on 10 meters at K3LR
200/hour or 14/weekend

Make sure all the ops know the contest rules!

- **Band changes per hour**
  - **QSY to another band and back is TWO band changes**
  - **No "rubber-clocking"**
- **One signal at a time on a band (lockout)**
- **CQWW MS 10-minute rule vs. ARRL MS rule**
- **One sloppy op can result in the entry being reclassified or DQed!**

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Coach the newer guys

- Operating style
  - "We don't say 'please copy' "
  - "Keep the mike gain below 11"
  - "Why are you yelling?"
- Using spots
  - "That callsign on the cluster spot is wrong…did you listen to it?"
  - "That spot is out of the U.S. band"
- Propagation, etc.
  - "Try beaming skew path"
- Pileup management
  - "Maybe I should take it for a few minutes"

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After the contest

- Have a group meal (pizza is fine)
- Take a group photo (and send it to the contest sponsor)
- Talk about what worked, what didn't
  - *Take notes!*
- Thank everyone for coming
- Evaluate who you do/don't want to invite back

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After the final results are out

- Look over the UBN/LCR, distribute to team
- Identify any outlier bands/ops
- One-on-one QSO with high-error-rate op

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Resolving conflict

- State and confirm the commitment
  - "You said you'd be here early, and stay all weekend, and work hard to help us win, right?"
- State and confirm the breakdown
  - "You got here late, left early, did not pass a single multiplier, and had the highest error rate, right?'
- Enumerate the damages
  - "We lost, got DOed, you damaged the reputation of me and all the other ops."
- Negotiate restitution or renegotiate the relationship
  - "Apologize to the tam and do better next time" or "Don't come back"

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Assuming you have a good time and want to do it again…

- Thank the ops for coming
- Congratulate all of them
- If you win a plaque, get duplicates for the ops
- Ask for ideas of new ops to bring next time

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Now for the guest operator…

- Be a good guest!
- Respect the host's house, property, family, pets, food, etc.
- Offer to contribute towards food
- If the host wants to take over operating for a while, let him!

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Respect the other ops

- Some of them are better than you are, so listen and learn
- Take a shower, use deodorant, brush your teeth
- Some stations use a pre-determined operating schedule…good for new teams
- No whining

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"If you see something, say something"

- If you see an op doing something wrong, ask about it
- If the station is breaking the rules (e.g., high power), talk to the host
- If the operation makes you uncomfortable, you can leave or just not return
- Discuss the problem with the host op, and if no resolution, contact the contest sponsor

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Assuming all goes well and you want to do it again…

- Send the host a thank-you note or email
- Offer to help with antenna work, other prep
- Make suggestions (keep them reasonable)

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And for both hosts and guests…

- This is a hobby and is supposed to be fun!!!
  - If you don't enjoy visitors, don't host a multiop
  - If you don't like being part of a team, don't go to a multiop
- Multiops can be great fun and form strong bonds
  - "Remember that time at W2PV when…"
  - Traveling together creates adventures and memories
- Multiops can be a great way to learn
  - "I learned how to run JAs when I saw <callsign> do it."
  - Tips and tricks for station building
  - "I got a chance to use the new Icom radio at <multiop> and liked it so much I went out and bought one"

A few quotes about teams…

- Individual commitment to a group effort - that is what makes a team work, a company work, a society work, a civilization work. ~Vince Lombardi
- The way a team plays as a whole determines its success. You may have the greatest bunch of individual stars in the world, but if they don't play together, the club won't be worth a dime. ~Babe Ruth
- Gettin' good players is easy. Gettin' 'em to play together is the hard part. ~Casey Stengel

CTU 2013 Presents

Setting Up for RTTY Contesting—
Basic to Advanced

Ed Muns, W0YK

CTU CONTEST UNIVERSITY ICOM

The Cynics Say …

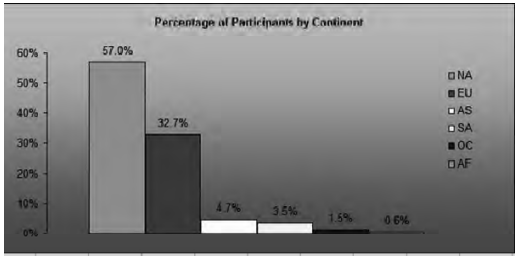
- "The RTTY decoder/encoder does everything."
  however, this attribute …
  - frees the operator to improve other skills
  - enables more contest participants
  - provides mode diversity for contest junkies
- "RTTY is a pain to set up and get working."
  … stay tuned, it's really not that difficult!

RTTY Contesting Setup

- What is RTTY?
- How do I set it up?
- Radios
- Loggers: N1MM, WriteLog, Win-Test
- Part 2: "Operating a RTTY Contest"

RTTY Contesters

2010 survey



- 825 participants; 13 questions
- conducted in February 2010

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)*

What is RTTY?

Space & Mark

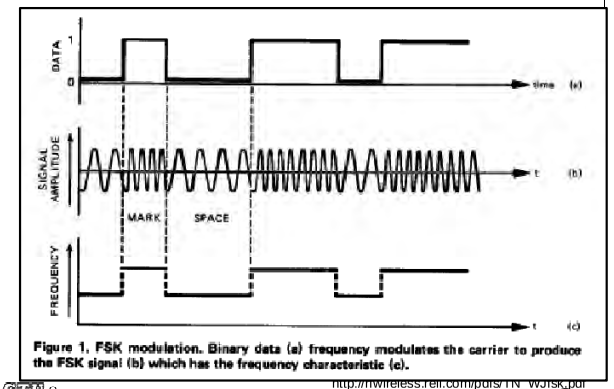
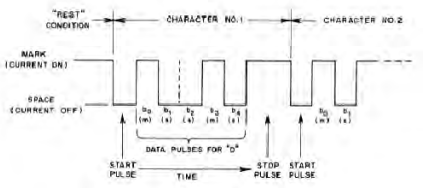


Figure 1. FSK modulation. Binary data (a) frequency modulates the carrier to produce the FSK signal (b) which has the frequency characteristic (c).

http://rfwireless.reli.com/pdfs/TN_WJ/fsk.pdf

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

- 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 (1967)
  - 7-bit ITA5 code

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

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*
  - *Explained in "Operating an RTTY Contest"*

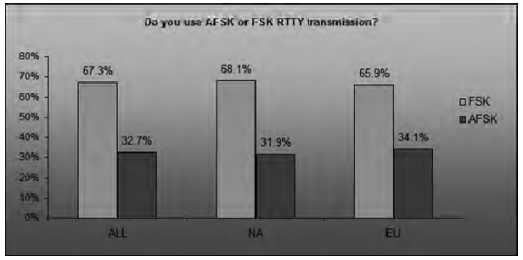
What is RTTY?

audio tones

- Space and Mark audio tones
  - Default: 2295 and 2125 Hz
  - Less fatiguing: 1085 and 915 Hz
- 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

AFSK vs. FSK

2010 survey



- AFSK has been overtaken by FSK since it first appeared in radios, circa 1990

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.

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)*

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 *(same as PSK31)*
- Must use high tones
- *NET (automatic TX tone control)*
- *Less bandwidth (sometimes)*
- *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*

What is RTTY?

summary

- Uses 5-bit Baudot … er … 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 Shift
  - optional UnShift-On-Space (UOS)
- AFSK vs. FSK transmission (receiving is the same)
  - Radio dial frequency differences
  - 100% duty cycle!

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
- ***Configure*** decoder/encoder
- ***Integrate*** decoder/encoder with logger

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

How Do I Set it Up?

RTTY decoder/encoder

- RTTY ***receive*** decoder converts printed characters from the two RTTY frequencies
  - 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 RTTY frequencies
  - 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)*

How Do I Set it Up?

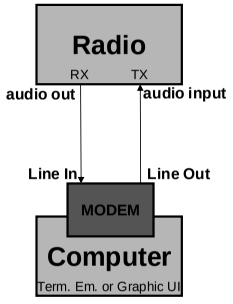
decoder/encoder terminology

- 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

How Do I Set It Up?

hardware *MODEM*

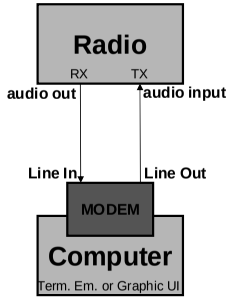
AFSK



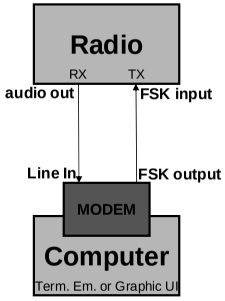
How Do I Set It Up?

hardware *MODEM*

AFSK



FSK



How Do I Set It Up?

hardware *MODEM*





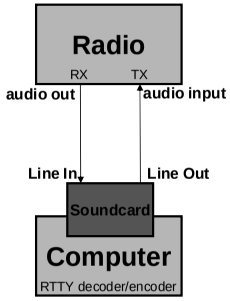




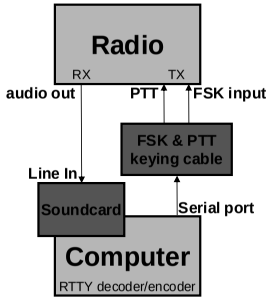
How Do I Set It Up?

software application & *soundcard*

AFSK



FSK



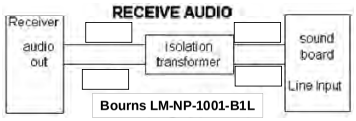
How Do I Set It Up?

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)

How Do I Set It Up?

homebrew audio isolation



Bourns LM-NP-1001-B1L



-90 dBc 3rd order IMD



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

How Do I Set It Up?

W2IHY iBox audio isolation



$60

How Do I Set It Up?

commercial interface audio isolation



Rascal





How Do I Set It Up?

radio audio isolation

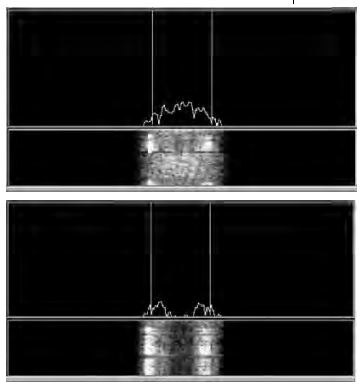
K3 audio isolation **IN – LINE – OUT**



How Do I Set It Up?

radio IF 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??
    - Icom Twin Peak Filter
    - K3 Dual-Tone Filter
- Audio filtering
  - JPS NIR-10/12
  - Timewave DSP-599zx
  - Modern DSP rigs



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??
    - Icom Twin Peak Filter
    - K3 Dual-Tone Filter
- Audio filtering
  - JPS NIR-10/12
  - Timewave DSP-599zx
  - Modern DSP rigs





How Do I Set It Up?

soundcard levels

- Adjust levels in Windows Volume Control
  *(or, in MMTTY **Options/Soundcard** …)*
  - Use isolation transformer
  - Avoid over-drive
  - 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.)

How Do I Set It Up?

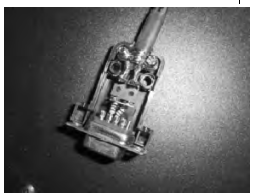
PTT vs. VOX

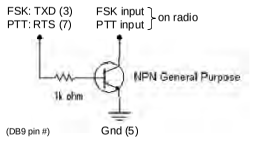
- AFSK uses VOX (or PTT); FSK uses PTT
- PTT by:
  - Computer control via Serial COM port
  - Footswitch *(not recommended)*
- FSK to use semi-break-in in the future?

How Do I Set It Up?

homebrew *FSK & PTT keying cable*

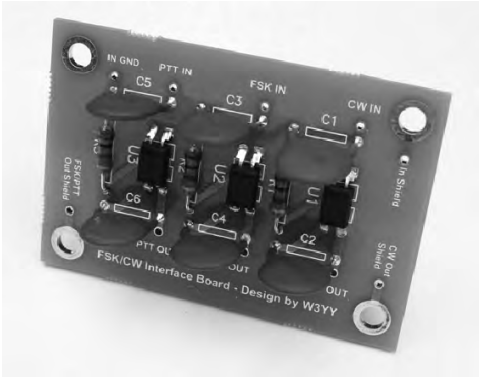






How Do I Set It Up?

W3YY *FSK & PTT keying cable*



How Do I Set It Up?

commercial interfaces

RASCAL







RIGblasters





How Do I Set It Up?

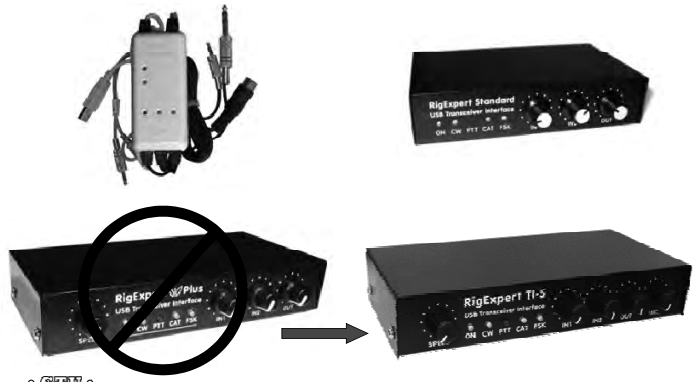
commercial interfaces

Vendor	Model	Price	PC Int'fc	PTT	Soundcard	Level ctrl	FSK	CW	WinKey	Voice	Radio Int'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	$ 80	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

How Do I Set It Up?

RigExpert Interfaces



How Do I Set It Up?

microHAM interfaces

One Radio



SO2R



How Do I Set It Up?

RigExpert & microHAM interfaces

Vendor	Model	Price	PC Int'fc	PTT	Soundcard	Level ctrl	FSK	CW	WinKey	Voice	Radio Int'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:
     - Set level so band noise is just above threshold

     OR
   - MMTTY via Soundcard Line In (or Mic In with pad):
     - Enable soundcard Line In (or Mic) input, disable/mute other inputs
     - Increase level so band noise is just above threshold

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

How Do I Set It Up?

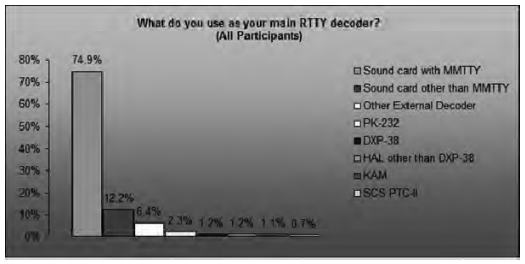
summary - FSK

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.

Decoders

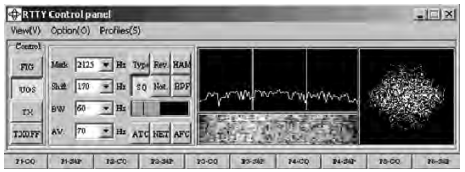
2010 survey



- 87% use soundcard decoding/encoding
- 86% of soundcard users run MMTTY
- 2Tone introduced late 2012

Decoders

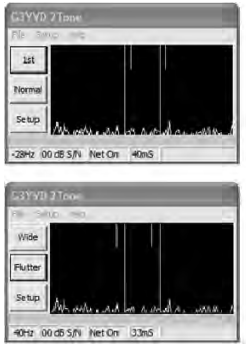
MMTTY



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

Decoders

2Tone



- Outperforms MMTTY
- Uses less CPU cycles
- AFSK only
- Pseudo FSK
- Contest loggers:
  - N1MM Logger
  - WriteLog
- Introduced late 2012
- David Wicks, G3YYD

Decoders

Logger Support

Feature	MMTTY		2Tone	
	AFSK	FSK	AFSK	FSK
WriteLog	☻	☻	😐	☻
N1MM Logger	☻	☻	☻	☹
Win-Test			☹	☹

😐 NET on
☹ not available

Decoders

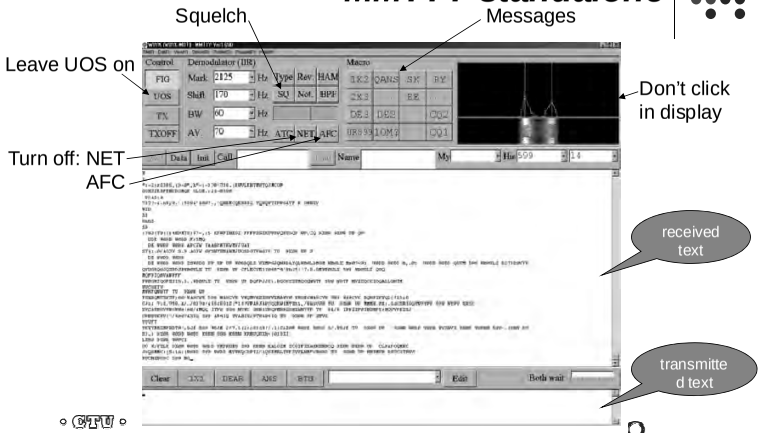
Logger Support

Feature	MMTTY		2Tone	
	AFSK	FSK	AFSK	FSK
WriteLog	☻	☻	😐	☺
N1MM Logger	☻	☻	☺	☹
Win-Test			☹	☹

☺ The “Sweet Spots”

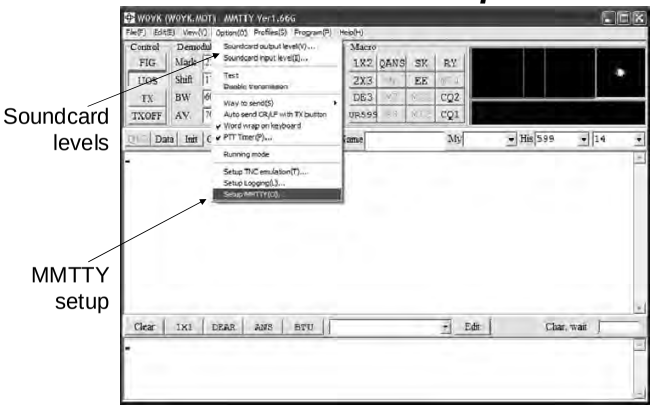
How Do I Set It Up?

MMTTY standalone



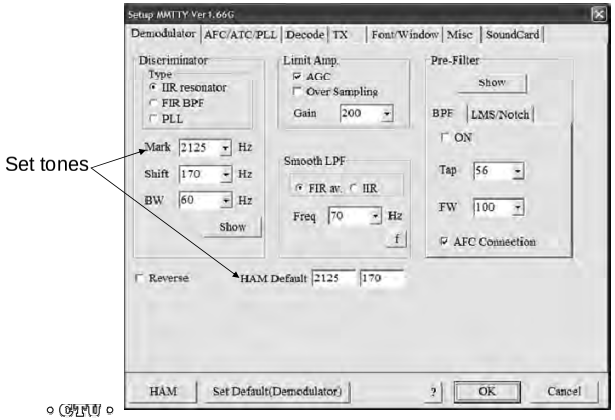
How Do I Set It Up?

MMTTY Option menu



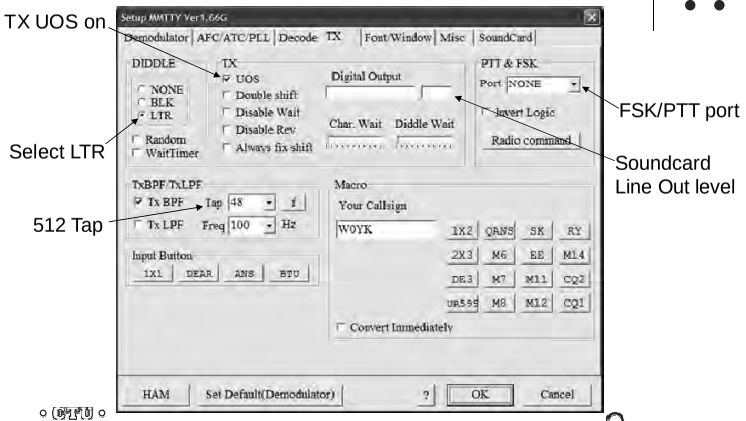
How Do I Set It Up?

MMTTY Option/Setup/Demodulator



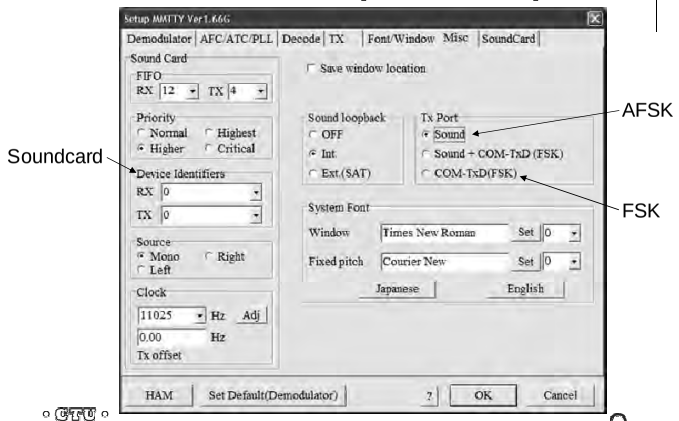
How Do I Set It Up?

MMTTY Option/Setup/TX



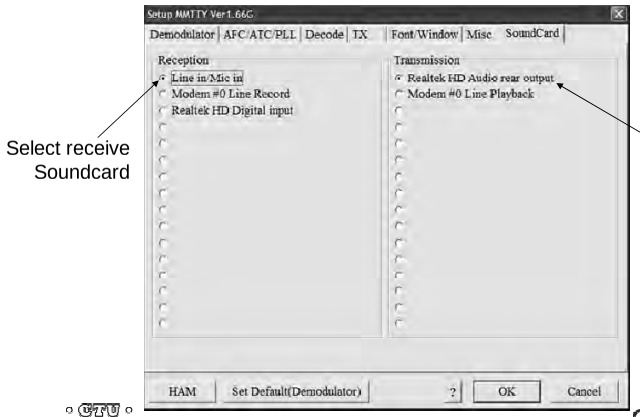
How Do I Set It Up?

MMTTY Option/Setup/Misc



How Do I Set It Up?

MMTTY Option/Setup/SoundCard



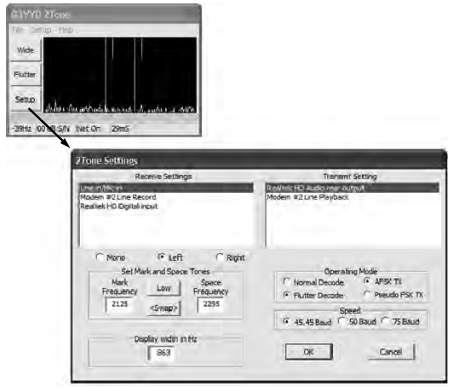
How Do I Set It Up?

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

How Do I Set It Up?

2Tone



How Do I Set It Up?

2Tone



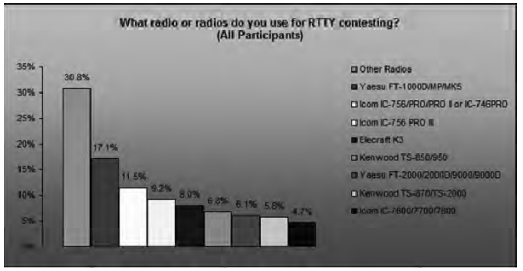
same



- Setup vs. Settings
- Window-width adjust

RTTY Radios

2010 survey

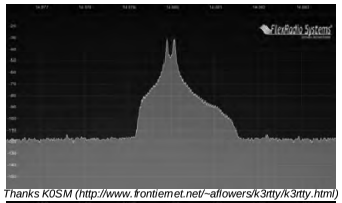


- Icom 756Pro series most popular
- Elecraft K3 growing rapidly

RTTY Radios

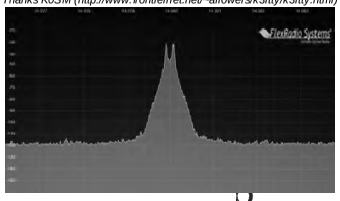
AFSK bandwidth

MMTTY - AFSK
- No TX filter
- K3 @ 1 mW



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

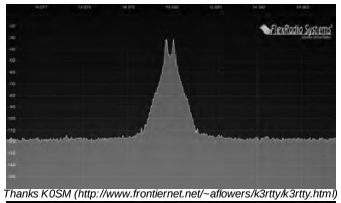
MMTTY - AFSK
- Default 48-tap TX BPF
- K3 @ 1 mW



RTTY Radios

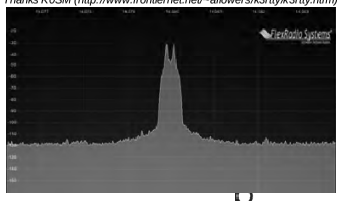
AFSK bandwidth

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



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

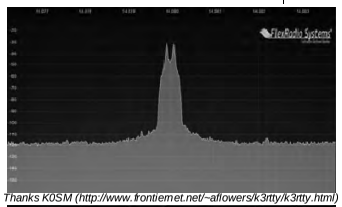
MMTTY - AFSK
- 512-tap TX BPF
- K3 @ 1 mW



RTTY Radios

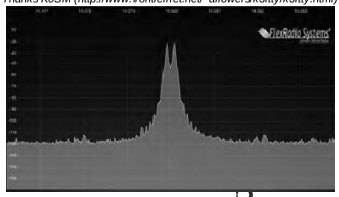
AFSK bandwidth

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



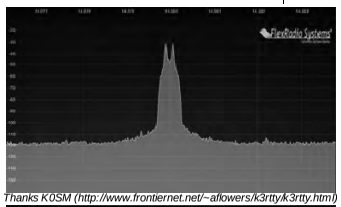
CTU CONTEST UNIVERSITY

ICOM

RTTY Radios

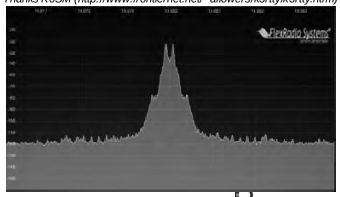
PA IMD impact on AFSK bandwidth

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



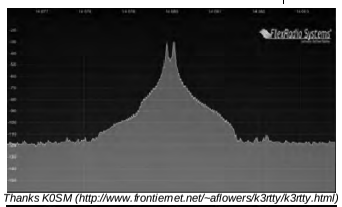
CTU CONTEST UNIVERSITY

ICOM

RTTY Radios

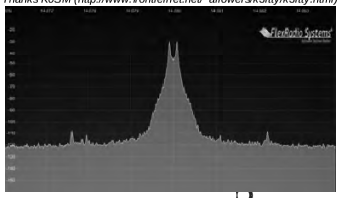
PA IMD impact on AFSK bandwidth

MMTTY - AFSK
- No MMTTY filter
- 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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ICOM

RTTY Radios

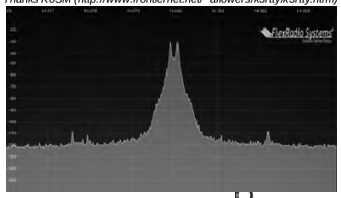
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- K3 @ 100 watts



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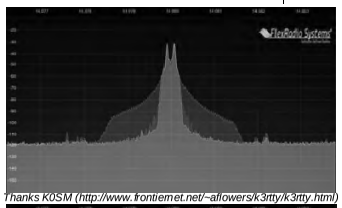
ICOM

RTTY Radios

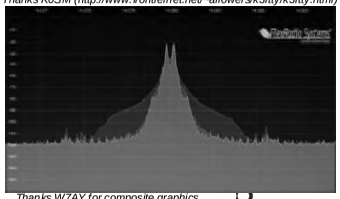
PA IMD impact on RTTY bandwidth

FSK/MMTTY/2Tone
- FSK unfiltered
- MMTTY 512-tap BPF
- 2Tone “AM” setting
- K3 @ 1 mW

FSK/MMTTY/2Tone
- Same encoders
- K3 @ 100 watts



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

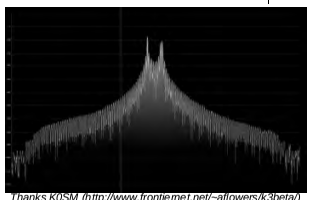


Thanks W7AY for composite graphics

RTTY Radios

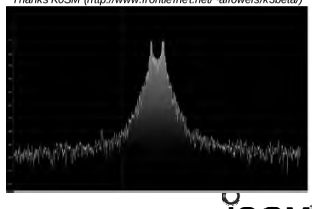
FSK bandwidth

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
- Lobby other mfrs to add a FSK filter!



RTTY Radios

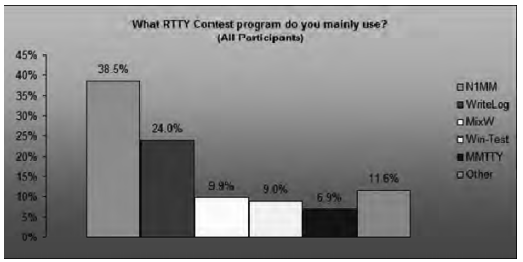
FSK & AFSK bandwidth

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

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

RTTY Contest Loggers

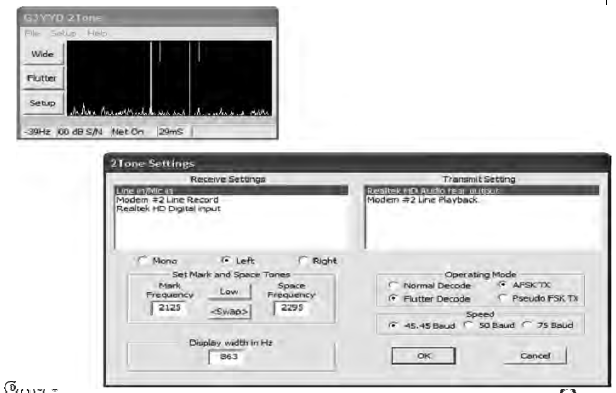
2010 survey



- MixW ahead of Win-Test
- MMTTY used stand-alone

2012 CQ WPX RTTY

3550 submitted logs



RTTY Contest Loggers

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

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

RTTY Contest Loggers

	WriteLog	N1MM	Win-Test
MMTTY	☻	☻	☻
2Tone	☻	☻	-
other decoders	☻	some	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*

RTTY Contest Loggers

relative ratings

- 13 features compared
  - Rated 0 to 5
  - Simplifying assumption: features equally weighted
- 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

How to Operate with Increased Accuracy and Radio Contesting Fair Play

Presented by Bob Cox, K3EST

CONTEST UNIVERSITY ICOM

Dayton 2013

1

You can make it better

- Logging accuracy and Fair Play, two seemingly different subjects.

What they have in common is **your increased attention** to getting your contest effort right. Both require your personal involvement.

Let's consider logging accuracy.

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Accuracy

Why should you care about accuracy?

Personal pride in your skill.
You may be penalized for a mistake.
You may need a correct QSO to receive a QSL card for an award.

An exchange must be logged correctly: a call sign + QSO data.

1.correctly: a call sign + QSO data
2.rd.
3.Usually, an exchange must be logged correctly: a call sign + QSO data



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Your Attention Required

- Accuracy is a **simple** and **difficult** topic. Out of the QRM, QSB, QRN and weak signals, you are supposed to log accurately a call sign and other data.
- **Simple**: All you have to do is accurately log the exchange. It is that simple.
- **Difficult**: How do you accomplish this?
- First, a little background data on call signs.

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Copying Call signs

- If you get the call sign wrong, you will receive no credit for the QSO or any part of the exchange.
- If you get the call sign right, you may receive some points even if parts of the exchange are wrong.

Call Sign Errors

Broken calls generated (CQ WW CW)

- **3V8BB** (1345): 3U8DD, 3V6BB, 3V7DD, 3V8AA, 3V8BD, **3V8DB (8), 3V8DD (7)**, 3V9BB
- **3W2J** (1791) 3W1J (3), 3W2JJ, 3W2O, 3W3W (2), 3W2Y
- **4K7Z** (1658): 4K6Z (4), 4K7A (2), 4K7C, 4K7CW, 4K7L, 4K7M, 4K7Y
- **4U1GSC** (3534): 4U1GC, 4U1GCC, 4U1GCS, 4U1GES, 4U1GFN (2), 4U1GHC (3), **4U1GIC (45),** 4U1GIF, 4U1GNC, 4U1GSG, 4U1GSN (2), 4U1GSV, 4U1GSZ, 4U1GTC, 4U1GUC
- 39 calls that were logged; **4 real calls**

Average Uniques per Category

CW

	High		Low		QRP	
	U	A	U	A	U	A
160	1.3	1.1	1.9	1.4	1.9	1.0
80	1.6	1.2	1.9	1.3	4.2	0.4
40	1.2	1.9	2.0	1.5	2.0	0.4
20	1.5	1.6	2.2	1.2	1.8	0.0
15	1.1	1.4	1.6	1.2	2.0	1.4
10	1.2	1.4	1.8	1.4	1.7	1.3

	U	A	U	A	U	A
AB	1.4	1.2	1.9	1.3	1.7	1.4
MS		1.4				
M2		1.3				
MM		1.4				

CW: 5,052,761 log entries (97%)
72,317 unique entries (4% more)
Average unique rate = 1.43

SSB

	High		Low		QRP	
	U	A	U	A	U	A
160	1.4	1.1	1.3	1.8	8.3	0.0
80	1.6	1.6	1.1	0.8	2.7	0.7
40	1.4	1.2	1.3	1.3	1.6	1.6
20	1.4	1.6	1.9	1.5	1.2	2.7
15	1.3	1.3	1.6	1.3	1.2	1.4
10	1.3	1.1	1.8	1.3	1.6	0.9

	U	A	U	A	U	A
AB	1.3	1.0	1.7	1.1	1.5	1.5
MS		1.4				
M2		1.4				
MM		1.3				

SSB: 5,182,572 log entries
69,702 unique entries
Average unique rate = 1.35

Call Sign Uniques

- All uniques are not miscopied calls, but **MOST are copying errors**. From experience, ~95+% of uniques are copying errors.
- OK, what leads to uniques and what can you do about it?
- First, what contest are you entering?

Know the Contest Rules

- Determine the exchange of the contest you enter. This will focus your ears on what is the variable.
- Call signs are always a variable.
- Examples (**not counting call signs**):

  Contests with a fixed exchange (CQ WW, JIDXC, RDXC, IARU)

  Contests with a fixed and variable exchange (SS)

  Contests with a variable exchange (WPX)

  What is your category?

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What Exchange Aids can you use During the Contest?

- A No assistance category

  Super check partial (suggested call: an error source)

  Your ears

  Your experience
- An assisted/Multi category

  Super check partial (suggested call: an error source)

  Packet/RBN (Suggested call: an error source)

  Another operator at the multi

  Your ears

  Your experience

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Call Sign Aids

- **Super Check Partial (SCP)**

  Do not trust the suggested call is correct.

  Many errors are included within SCP.

  Send the suggested call sign and GET a QSL. You are now probably OK.

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Call Sign Aids

- **Packet/RBN call signs**
- The packet/RBN system is notorious for false data. You point and click….the call from the packet screen is entered into your log. Is it correct? View packet as a suggestion.
- Make sure you hear the other guy say his call…DO NOT rely on a packet spot, even if it means sticking around until he IDs.

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Other Call Sign/Exchange Aids

- Your logging software provides a window showing a band call signs. After you have worked the same call on 2 bands, you can probably be sure it is correct. It might help you on a third band where the signals are weak.
- Exchanges are also shown such as in the ARRL DX contest. The power is displayed in the call sign window.

What are you doing?

- What is your status during the contest?
- Calling CQ
- Search & Pounce
- First, let's consider calling CQ.

Calling CQ

- Calling CQ means stations are calling you. Your job is to get the call sign/exchange correct. The only computer aid available is SCP and other band data.
- Errors can occur: be careful. You send the call correctly but log it incorrectly. You actually have the other guy's call wrong but think you are correct.
- Don't worry about the other guy's log, you have little control over what he logs. He almost never says your call just his call.

Calling CQ

- Getting the full, correct exchange on the first over = faster rates.



Search and Pounce

- If you are unassisted, SCP is a source of error. Another source of error is make sure the other guy is talking to you. Errors occur when you hear only a letter or two of YOUR call and you think it is a good QSO. Make sure you hear your full call. Don't settle for less.
- If you are assisted/multi, the same problems exits + packet, remember packet is only a suggestion. Again, trust only what you personally copy.

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How can you reduce errors?

- **Trust your ears** when you hear a call sign. Make sure you have it all correct. If you are not sure, ask again.
- **Trust your eyes** when you log a call sign.

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Hints

Receiving

- CW: Know your receiver; adjust the RF level for best copy; adjust the band pass
- SSB: Tough to get good copy; your brain is the best human speech analyzer; a useful site is: na0tc.org/Equalization_Presentation_Nov_6_2010.pdf

Transmitting

- CW: Do not use "cut" numbers except 9(N) and 0(T); when ever possible use programmed messages (less error); do not change speeds during the message (it confuses people and saves you almost nothing) and if you want the RBN system to discover you changing speeds makes you invisible; add an extra ½ space to the space between your calls on a CQ
- SSB: Adjust your compression properly, use a good microphone; when possible use programmed messages (they remain constant)

General

Reduce the ambient noise as much as possible (fans, room etc); use noise cancelling earphones if possible.

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Experience

- What does experience bring?
- A familiarity with call sign structure
- A familiarity with actual call signs
- A familiarity with band openings
- A personal conviction to get the exchange right.

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Pay Attention to Yourself

- Listening to the inner voice
- A sense of when you have it right or wrong.



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Pay Attention to Yourself

- If you are not sure, you are guessing to some degree. Try to eliminate as much doubt as you can. To be sure is a very good thing.



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Weak Signals

- Weak signals are a frequent source of logging error. Know when to give up when a very weak signal answers your CQ.
- We all have encountered situations where the caller is so weak and the QRM is interfering, that many “overs” are required.

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Unique to SSB

- Make sure you use international phonetics.
- Even with all your efforts on SSB, your speech maybe misunderstood by the other guy: e.g. R and L for Asian stations use Radio/Roger Lima/London; Even a drawn out “K” may sound like “KA”; use “kilowatt”.

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Commitment to Excellence

- Before the contest starts, pledge to yourself to make your log as accurate as possible.
- If you log the exchange correctly of the station you are talking to, you can do no more.

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Personal Best

- You should take personal pride in your copying skills. Skill should be reserved for something you obtain or achieve on your own. Achieving a low error rate is a reason to be proud. It requires diligence and real skill.
- Compare your rates from year to year and via your UBN (LCR) seek out where you made errors.
- Get you club involved in taking accuracy seriously.

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You are Important

- If contesting integrity is to improve, it will be because you spread the word to others to take charge of their operation .
- Now let’s consider Fair Play.

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Fair Play in Contesting

Being Your Own Referee

Contesting is Unique

- No referee in the shack
- No spectators in the shack
- No PTT inspectors in the shack

- ***Contesting uniquely <u>depends</u> upon the integrity of the contestants.***

FAIR PLAY

- Be your own referee
- Understand the rules …
  - Obey the limitations of your category
- Speak up to enforce FAIR PLAY
  - At multi-ops
  - As a guest-op
  - As a friend

Contesting Code of Ethics (CCOE)

- The World-Wide Radio Operators Foundation (WWROF)
- CCOE Endorsed and adopted by the CQ WW Contest Committee
- What are the principles of the Contesting Code of Ethics?

Contesting Code of Ethics

- Created by the WWROF (World-Wide Radio Operators Foundation) wwrof.org
- Endorsed and adopted by the CQ WW Contest Committee
- Two relevant points:
  - *I will learn and obey the rules of any contest I enter, including the rules of my entry category.*
  - *I will not modify my log after the contest by using additional data sources to correct call sign or exchange errors.*

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Respect for Fellow Contesters

- **Respect comes from honest accomplishments.**
- **Respect comes from your peers**
- **Respect comes obeying the rules: read them!**
- **Respect = Fair Play**

FAIR PLAY



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Fair Play

Contesters trying to win an award expect their competitors to practice Fair Play. To enjoy the fruits of success, it is not enough to have the biggest score. *Victory* must be scored by fair means and by honest contesting.



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Rising to the Top

Winning a category is a reward for effort, will, discipline and talent. Violating the rules to gain an unfair advantage over a competitor has nothing to do with winning; it's a form of cheating. It means that the participants are no longer all playing the same game; it demeans the efforts of every other participant, the integrity of the game and the essence of sport.

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Concept of Fair Play

- Contesting is unique. Why?
- No referee in the shack
- No spectators in the shack
- No PTT inspectors in the shack

Concept of Fair play: Contesting uniquely depends upon the integrity of the contestants and respect for the rules.



Rusty W6OAT in WRTC 2002 wearing his Seattle 1990 WRTC Judge shirt.
YOU will NOT have a referee of your own in your shack

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Integrity

Following the rules of your category is vitally important.

Integrity points to Fair Play



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Read the Rules

- Whether you are a casual or a serious contester, you are in a position to make a pledge to read the rules of your chosen category and decide to follow the restrictions.
- You can decide to respect the rules and follow Fair Play. Fair Play starts at home.

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Fair Play Knowledge - Power

- **Fair Play**: Run **only** the maximum power **allowed by your category** as written in the rules.
- **Fair Play**: High power must not exceed 1500 W **total** output power on a band at any time measured at the output of the active amplifier..



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Fair Play Knowledge – Single Op

- A single operator does **all contest operating activities** contributing to the score.
- Copying and logging all calls and exchanges and station operation.
- **Fair Play**: The Single Operator makes his score **all alone.**



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Fair Play Knowledge - Assisted

- Any QSO alerting assistance is allowed for all assisted categories.
- This includes, but is not limited to
  - DX Cluster-type networks
  - Local or remote Skimmer
  - Skimmer-like technology
  - Reverse Beacon Network
- An assisted entrant operates his station alone.



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Fair Play Knowledge - Multi

- Operating in a multi-operator category is lots of fun! You can learn a lot from your team. All multi-categories are allowed only one signal at a time on any band…just like all the single operator categories.



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Fair Play Knowledge - Witnessing

- In case you see **Fair Play**, please bring it up with your friend **and congratulate him/her**.
- In case you see **less** than fair play, you should bring up the matter with the people who are not playing fair. Help them to understand why Fair Play is important.
  - Explaining what to change or improve
  - Encouraging **Fair Play** is important



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SUPPORT FAIR PLAY



If Your club is interested in FAIR PLAY.

We can help you. Please contact

bobk3est@gmail.com

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Fair Play in Contesting

Being Your Own Referee

Be a Fair Referee
Be Fair to Fellow Contesters
Have Fun Contesting

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You can Help!

- Go back to your club and plan a meeting devoted to accuracy and Fair Play. If you need help, contact bobk3est@gmail.com
- Thank You

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Contest Antennas and Coaxial Cables

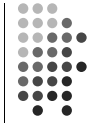
By Frank Donovan W3LPL

- Antenna heights
- Receiving antennas
- Stacking
- Single tower stations
- Low loss coaxial cables



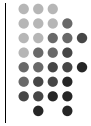
Dayton 2013

6 dB of "Free" Ground Gain



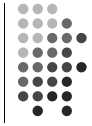
- On 40 through 10 meters a horizontally polarized dipole, Yagi or quad easily provides 6 dB of ground gain
  - **but only if you install it an appropriate height**
- 80 meters: If you cannot install a horizontal antenna (dipole or inverted-V dipole) at 70 feet high or higher:
  - use a vertical or a vertically polarized delta loop (corner fed)
  - a dipole 50-70 feet high is ideal for Sweepstakes and Field Day
  - a four-square vertical is competitive with high horizontal arrays – use at least 30-60 radials on each vertical
- 160 meters: a vertical, inverted-L or T-vertical is almost always a better choice than a horizontal antenna for DX

High Performance Transmitting Antennas for 160 Meters



- A single full size vertical or a vertically polarized delta loop
  - well spaced from all nearby tall towers
    - at least 140 feet from nearby towers over 80 feet tall
    - spacing much more than 140 feet optimizes performance
- A short inverted-L or T-vertical is a very good alternative
  - as little as 50 feet tall
  - supported from a tower or trees
- Use at least 32-64 shallow buried radials
  - At least 130 feet long
  - or at least two (but preferably four or more) elevated 125 foot radials
    - but only if buried radials are impossible

High Performance Transmitting Antennas for 80 Meters



- High horizontal dipole, at least 70 feet high for DX contests
  - 50-70 feet high for Sweepstakes and Field Day
- A single full size vertical or a vertically polarized delta loop
  - well separated from all nearby tall towers
    - at least 70 feet from nearby towers over 40 feet tall
    - much more than 70 feet of spacing optimizes performance
- A short inverted-L or T-vertical is a very good alternative
  - as little as 25 feet tall
  - supported from a tower or trees
- Use at least 32-64 shallow buried radials
  - at least 70 feet long, or
  - at least two (but preferably four or more) elevated 65 foot radials
    - but only if buried radials are impossible

4-Square Vertical Array for 80 and 40 Meters

- A four square vertical array is very competitive with very high horizontal Yagis and quads on 80 meters and is also an excellent receiving antenna
  - install at least 70 feet from all other towers
    - more spacing will significantly improve its performance
  - at least 30-60 slightly buried radials under each vertical
    - at least 70 feet long on 80 meters
    - at least 35 feet long on 40 meters

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The Comtek 4-Square Controller



www.dxengineering.com/search/brand/comtek

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Beverage Receiving Antennas for 160 and 80 Meters

- Single wire Beverage antenna
  - 500-1200 feet (250-600 feet on 80 meters)
  - elevated just high enough to safely clear people and large animals

    www.w8ji.com/beverages.htm
- Two-wire bidirectional Beverage antenna

  www.w0btu.com/Beverage_antennas.html
- Beverage on Ground (BOG)

  n4dj.com/Beverage.html
- Phased Beverages
  - staggered or broadside pairs of Beverages

    www.w8ji.com/beverages.htm

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Short Vertical Receiving Arrays for 160 and 80 Meters

- Active array of two or more 20 foot, high impedance verticals
  - much smaller footprint than a passive array of short verticals
  - as little a 50 foot element spacing on 160 meters (only 25 ft for 80 meters)
  - requires a high gain amplifier at the feedpoint of each vertical
  - requires very careful attention to all construction details
  - switchable in multiple directions
  - not suitable for installation in close proximity to nearby objects (trees etc)

    http://www.hizantennas.com
- Passive array of two or more 25 foot, low impedance verticals
  - significantly larger footprint than an active array of short verticals
  - typically requires eight 35-70 foot radials
  - no amplifiers needed, signal levels are similar to a Beverage
  - switchable in multiple directions

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

CONTEST UNIVERSITY ICOM

Small Loop Receiving Antennas for 160 and 80 Meters

- Very small 160 and 80 meter directive receiving antenna
  - the footprint of a four direction switchable array of K9AY loops is as small as 25x25 feet and 25 feet tall
  - small loops produce very low signal levels
    - requires a high gain preamplifier
    - requires careful attention to isolation of the coaxial cable shield
    - requires careful attention to isolation of the DC power wiring

www.arraysolutions.com/Products/lowbandrcv.htm

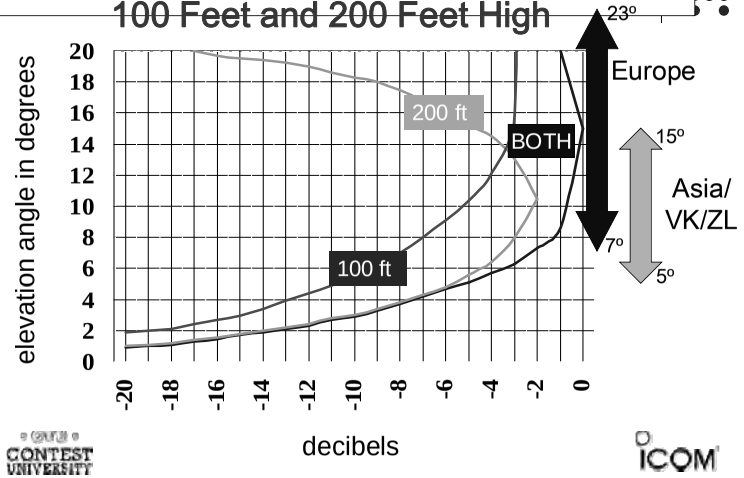
CONTEST UNIVERSITY ICOM

High Performance Antennas for 40 Meters

- High horizontal dipole at least 70 feet high for DX contests
  - otherwise use a four-square vertical array with extensive radials
  - a dipole at 35-50 feet high for Sweepstakes and Field Day
- Higher gain: 2 element Yagi at 70-100 feet high
  - significant improvement over a simple horizontal dipole for DX
  - a Cushcraft XM-240 at 70-100 feet high is very cost effective www.cushcraftamateur.com/Product.php?productid=XM-240
- Highest gain: full size 3 element Yagi at 100-140 feet high
  - but don't underestimate the high cost and complexity of the effort !
- High performance receiving antennas
  - Beverages and arrays of short verticals

CONTEST UNIVERSITY ICOM

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



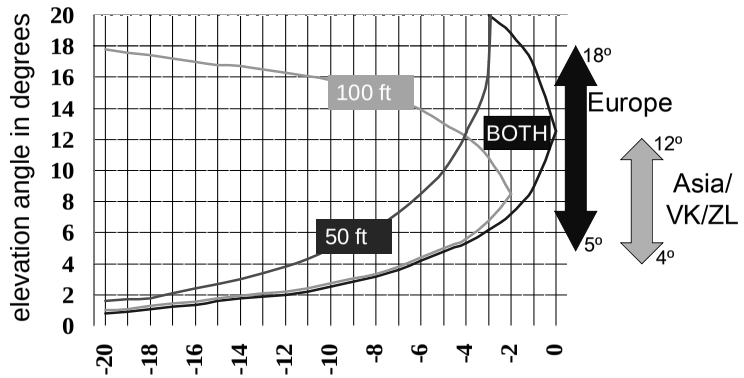
CONTEST UNIVERSITY ICOM

High Performance Antennas for 20 Meters

- A horizontal Yagi or quad is always your best choice
  - if you can install your antenna 50 feet high or higher
  - otherwise use a four-square vertical array with extensive radials
- Moderate gain: a small tribander, Yagi, Hex-beam or quad
  - a small Yagi at 50-70 feet high will produce good DX results
  - a small Yagi at 40-50 feet high for Sweepstakes and Field Day
- High gain: full size triband Yagi, small monoband Yagi or a quad at 70-100 feet high for excellent DX results
- Highest gain: two stacked monoband Yagis on a 100-140 foot tower (or 170-200 feet high for three stacked Yagis)
  - stack switching (a "stackmatch") provides high payoff at low cost

CONTEST UNIVERSITY ICOM

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



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ICOM

The Array Solutions Stack Match



www.arraysolutions.com/Products/stackmatch.htm

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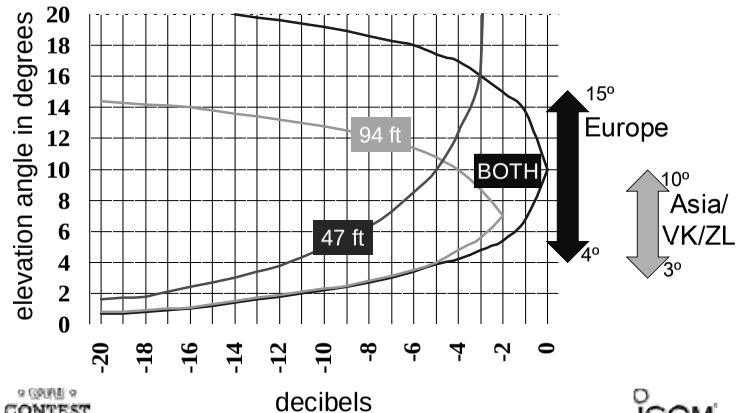
High Performance Antennas for 15 Meters

- Horizontal polarization is always your best choice
  - if you can install your antenna 35 feet high or higher
  - otherwise use a four-square vertical array with extensive radials
- Moderate gain: a tribander, small Yagi, Hex-beam or quad
  - a small Yagi at 35-50 feet high will produce good DX results
  - a small Yagi at 35-50 feet high for Sweepstakes and Field Day
- High gain: a full size tribander, small monoband Yagi or quad at 70-90 feet high for excellent DX results
- Highest gain: two stacked monoband Yagis on a 80-100 foot tower (or 120-140 feet high for three stacked Yagis)
  - stack switching (a “stackmatch”) provides high payoff at low cost

CONTEST UNIVERSITY

ICOM

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



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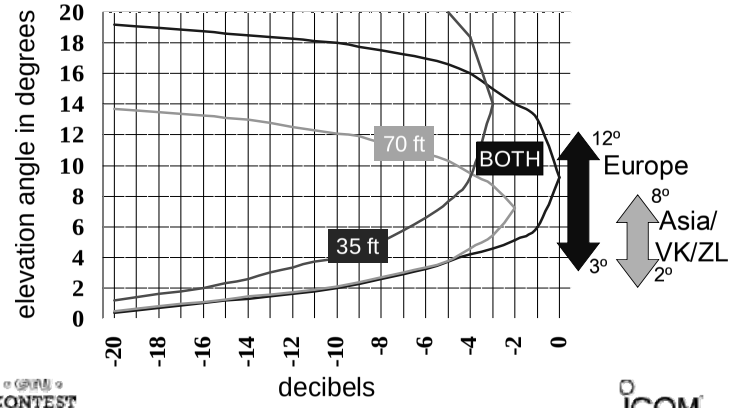
ICOM

High Performance Antennas for 10 Meters

- Horizontal polarization is always your best choice
  - if you can install your antenna only 25 feet high or higher
  - otherwise use a four-square vertical array with extensive radials
- Moderate gain: a tribander, small Yagi, Hex-beam or quad
  - a small Yagi 25-50 feet high will produce good results
  - a small Yagi at 30-50 feet high for Sweepstakes and Field Day
- High gain: a full size tribander, small monoband Yagi or quad, at 50-70 feet high for excellent DX results
- Highest gain: two stacked monoband Yagis on a 60-70 foot tower (or 90-120 feet high for three stacked Yagis)
  - stack switching (a "stackmatch") provides high payoff at low cost

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



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Competitive One Tower Antenna Systems

- 50-60 foot tower and a small rotator (e.g., HyGain Ham-IV)
  - small tribander, Hex-beam or quad
  - 40 and 80 meter dipoles and a 160 meter inverted-L
- 70-80 foot tower and a medium rotator (e.g. HyGain T2X)
  - Cushcraft XM-240 two element 40 meter Yagi
  - Large tribander such as the SteppIR 4 element Yagi
  - 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 HyGain LJ series on ring rotators
  - 80 meter dipole and a 160 meter inverted-L

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Achieving and Maintaining Low Loss Coaxial Cables

- Select appropriate low loss coaxial cables for each antenna
- Preserve your investment
  - water and moisture entry is a persistent threat
- Hard-line (e.g., Heliax or 75 ohm CATV) coaxial cables are the best choice for cable runs longer than 100 feet
  - RG-213 and other flexible jacket coaxial cables are very susceptible to physical damage and water entry
    - a pin hole can quickly cause a high loss cable
    - carefully protect your coax cables from physical damage and water entry
- Long term performance
  - test and inspect your cables and connectors at least annually

CONTEST UNIVERSITY ICOM

Coaxial Cable Investment Considerations

- The selection, installation and maintenance of coaxial cables and connectors should be among your most important investments when building and maintaining your competitive station
  - Is the proper grade of coaxial cable worth your additional cost?
  - Is attention to the many details of installation worth your extra effort?
  - Is annual inspection to preserve your investment worth your effort?
- Yes
  - If you want trouble-free low loss coax cables for 25 years or longer
- No
  - If you don't mind the high cost and disappointment of catastrophic failure when you least expect it

CONTEST UNIVERSITY ICOM

Coaxial Cable Environmental Considerations

- Constant exposure to wind, ice, water, condensation, heat, cold, ultra-violet radiation and lightning strikes
- Jackets of RG-213 and LMR-400 flexible coaxial cables are easily damaged during feedline installation, antenna installation, tower maintenance, wind, ice and lightning strikes
  - Never use 9913 or similar "water hose"
  - Never use air or foam dielectric flexible coaxial cable outdoors
    - except Davis RF Bury-Flex
- Heliax and jacketed CATV hardline are highly resistant to environmental damage and provide 25 years of service
  - If no installation errors are made
  - and annual inspections are performed

CONTEST UNIVERSITY ICOM

Coaxial Cable Connectors

- The most common choices are N and UHF connectors
- Insignificant loss and VSWR of both N and UHF connectors at HF
- High quality silver plated UHF connectors provide much greater center pin mating force than any N connector
  - eliminates cross-station interference and connector failures from unreliable N connector center pin mating force
- Avoid use of adapters, but if necessary be sure they are name-brand silver plated adapters, not nickel plated
- Always wrench tighten your UHF connectors (1/4 turn)

Avoid saving a few dollars on cheap unbranded hamfest connectors

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Amphenol 83-1SP PL-259 Connector



Shell labeled exactly: Amphenol 83-1SP

Silver Plated Center Pin

Silver Plated Body

Mouser Electronics part number 523-831SP

www.mouser.com/MobileCatalog.aspx?page=1369

This is not a good place to save money

CONTEST UNIVERSITY ICOM

Coaxial Cables
83-1SP Connector Installation



www.k3lr.com/engineering/pl259

/

An unconventional but superb method

Connector Waterproofing

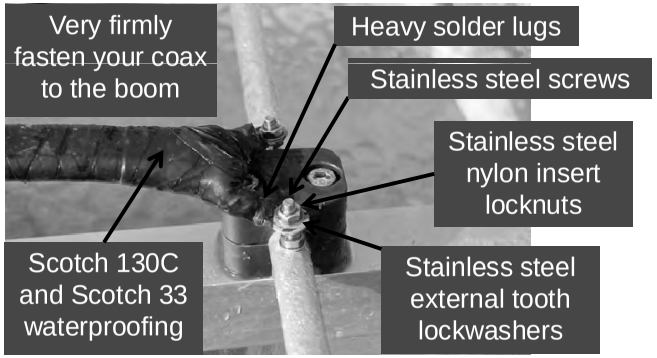




Cover your connectors with two 50% overlapped layers of Scotch 130C stretched to 50% of its original width, **sticky side facing out**

Cover the Scotch 130C with two 50% overlapped layers of Scotch 33+ or Scotch 88

Antenna Feedpoint
Waterproof and Shakeproof Connections



The most failure prone electrical connections in your station

Coaxial Cables Can Make or Break Your Competitive Performance

- How well you select, install, waterproof and maintain your coaxial feed lines and connectors can make or break the competitive performance of your contest station
- Cross-station interference in multi-operator and SO2R stations is often caused by
  - inappropriate coaxial cable
  - inappropriate connectors
  - Improper installation practices
  - Lack of annual inspections

Low Loss Coaxial Cables for Single Tower Stations

- Coaxial cable loss, proper installation and annual inspections are the most important concerns for single tower stations
  - Andrew LDF4-50A 50 ohm Heliax and connectors are commonly available at hamfests and eBay for ~ $1.00/foot
    - Less than 1 dB of loss on 10 meters for lengths up to 300 feet
  - If you must use flexible coaxial cable on your tower, Davis RF Bury-Flex is an acceptable alternative for single operator stations only, at about the same price.
    - Never use any other type of foam dielectric flexible coaxial cable
  - Non-flooded coax such as RG-213 and LMR-400 has short service life in the harsh environment on a tower
    - Never direct bury RG-213 or LMR-400 or lay it on wet ground

CONTEST UNIVERSITY ICOM

Low Loss Coaxial Cables for Multi-Op and SO2R Stations

- Andrew LDF4-50A Heliax is an ideal choice for lengths up to
  - 300 ft on 10 meters
  - 400 ft on 20 meters
  - 600 ft on 40 meters
- Eliminate some common cross-station RFI sources:
  - use Heliax to avoid RFI caused by the dissimilar metals in the aluminum foil and tinned braid shields of Davis RF Bury-Flex cable
  - signal coupling between RG-213 single braid shielded coaxial feedlines when they are bundled or run together in conduits
  - never use nickel plated connectors and adapters
  - minimize the use of connectors and adapters as much as possible
    - use only brand name silver plated connectors and adapters

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Low Loss Coaxial Cables for Multi-tower Stations

- Multi-tower stations often use coax cables longer than 300 ft
  - Andrew LDF5-50A Heliax is an ideal choice for lengths up to
    - 500 feet on 10 meters
    - 600 feet on 15 meters
    - 750 feet on 20 meters
    - 1000 feet on 40 meters
- Be cautious of the windload and weight (including ice load) of large diameter Heliax cables mounted on light duty towers (Rohn 25 and Rohn 45)

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Coaxial Cable Installation on your Tower

- Wind, ice, water, condensation, heat, cold, ultra-violet radiation and lightning strikes are important concerns
  - If any of these concerns are unusually severe in your environment, implement additional protective measures
- Heliax and CATV hardline must be firmly fastened to the tower at least every to five feet to protect them from wind and ice damage
- Flexible coaxial cables (e.g. RG-213) should be firmly attached to the tower at least every two or three feet to protect them from wind and ice damage
- Use electrical tape to cover plastic tie-wraps to protect them from ultra-violet radiation

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Coaxial Cable Interface to the Top of your Tower

- Coaxial cables must be bonded (“grounded”) to the top of your tower to prevent the coaxial cable jacket from developing pinholes caused by cable-to-tower arcing during lightning strikes
- Connectors should be carefully placed and waterproofed so that water cannot not flow down the coaxial cables into your connectors

CONTEST UNIVERSITY ICOM

Coaxial Cable Interface to the Bottom of your Tower

- Tower mounted coaxial cables must be bonded (“grounded”) to the bottom of your tower to prevent the cable jacket from developing pinholes caused by cable-to-tower arcing during lightning strikes
- An effective ground system must be connected to your tower base to strip lightning currents from your cables before they flow down the cable shields into your station
  - a minimum of three 8-foot galvanized ground rods
  - spaced at eight feet from each other and from the tower.
- Connectors should be carefully placed and waterproofed so that water cannot not flow down the feedlines into the connectors

CONTEST UNIVERSITY ICOM

Buried Coaxial Cables

- Direct Burial
  - use only direct burial rated coaxial cable
    - Andrew Heliax, jacketed CATV cable or Davis RF Bury-Flex
  - PVC jacketed coaxial cable should never be direct buried
- PVC conduit
  - use oversized conduit with plenty of room for pulling cables
  - use sweeps, not sharp right angle PVC connectors
  - include appropriate methods to drain moisture buildup
  - prevent water and vermin intrusion at the conduit entries
  - use only Heliax cables in multi-op or SO2R stations
    - bundled single shielded cables can cause cross-station RFI

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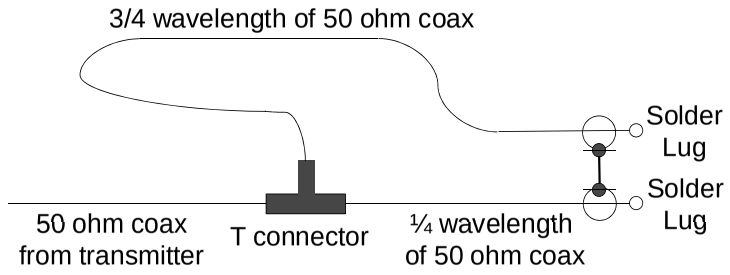
Antenna Rotation Coax

- Your antenna rotation coaxial cable is exposed to the most extreme environmental conditions in your station
- Carefully prevent the coax from rubbing or pulling against the tower or any other objects that could damage the jacket
  - rotators with more than 360 degrees of rotation make this extremely difficult to achieve
- Name brand, high quality RG-213 is a good choice
  - 95% shield, stranded center conductor, solid dielectric,
  - black UV-resistant jacket
- Replace the coax whenever you discover abrasion or damage during your annual inspections
- Replace the coax at least once every ten years or whenever damage is discovered

CONTEST UNIVERSITY ICOM

The Quarter/Three-Quarter Wave Balun

A High Performance 50 Ohm Single Band Balun



September 2012 QST page 57

CONTEST UNIVERSITY ICOM

Single Point Ground at the Cable Entry to your Station

- Your station cable entry interface should establish a single point ground as close as possible to the outside wall of your building
  - install a minimum of three 8-foot ground rods
  - spaced at least eight feet from each other
- Your single point ground strips the lightning currents off of the coaxial cable shields before they enter your station
- Lightning protectors should be installed at the station single point ground
  - never install lightning protectors at your tower base

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Coaxial Cables Inside your Station

- RG-213 is much more practical than Heliax cable
  - RG-223 and RG-400 double shielded coax are excellent choices for small diameter coax
- Eliminating cable, connector and adapter related cross-station interference in SO2R and multi-operator stations
  - never bundle single shielded coaxial cables
    - avoids cross-cable signal coupling between single shield coaxial cables
    - use only double shielded coax if you must bundle your coaxial cables
  - use UHF connectors and not N connectors for much better center pin contact pressure
    - use only high quality Amphenol 83-1SP silver plated connectors
  - to eliminate signal radiation, use K3LR's PL-259 installation technique and always avoid nickel plated adapters and connectors

CONTEST UNIVERSITY ICOM

Coaxial Cable Annual Inspections

- Inspect all indoor and outdoor coaxial cables, connectors and waterproofing for evidence of damage, cuts, cracks or moisture intrusion or improper installation
  - antenna feedpoint connection (wear and water intrusion)
  - antenna rotation coaxial cable (chaffing and wear)
  - tower top connectors and bonding to tower
  - tower base connectors and bonding to tower
  - all coaxial cable connectors in your station
  - all SO-239 chassis connectors on equipment in your station
- if in doubt, remove the connector for detailed inspection
- verify that all indoor and outdoor connectors are wrench tight
  - ¼ turn

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Coaxial Cable Measurements Inside Your Shack

- Immediately after installation, make a record of the following measurements at the hamshack end of every coaxial cable:
  - VSWR across the entire band(s)
  - feedline resistance
    - typically either a fraction of one ohm or many megohms
  - TDR and/or VNA plots
    - you should own at least one of the excellent tools!
- Well before your next competitive contest, repeat your measurements on every coax and verify that your measurements:
  - have not changed relative to your records
  - are not erratic
  - any change (better or worse) requires detailed investigation

CONTEST UNIVERSITY

ICOM

CW Skimmers, DX Cluster, and the Reverse Beacon Network

Presented by N6TV
n6tv@arrl.net

Overview

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

It all starts with one developer

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



What is CW Skimmer?

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







SDR Antenna

2. Wideband RX Antenna, 1.8-30 MHz

Pixel Tech. Loop RF Pro-1B:

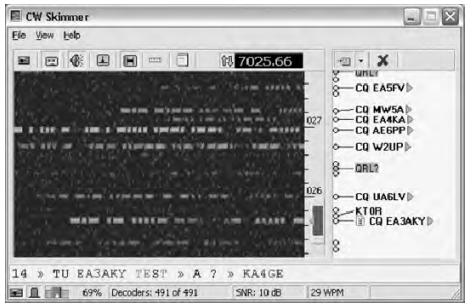


DX Engineering Active Horizontal ARAH3-1PE:



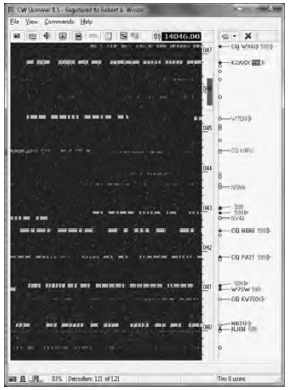
Software

3. CW Skimmer *or* Skimmer Server



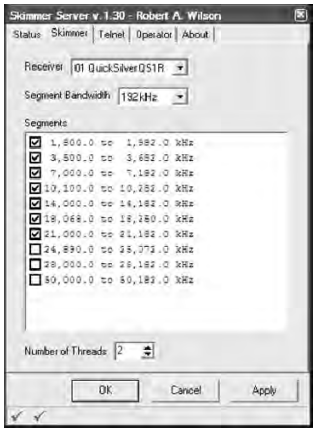


CW Skimmer by VE3NEA



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

Skimmer Server by VE3NEA



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

Telnet server (localhost port 7300)

- Emulates a DX Cluster Node

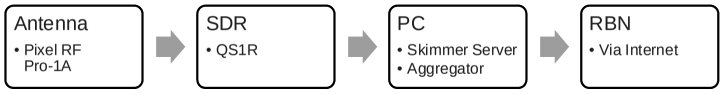
```
DX de N6TV-#:     14058.7  VR2HE          24 dB  31 WPM  CQ          2350
DX de N6TV-#:     14039.6  NM2D           39 dB  35 WPM  CQ          2350
DX de N6TV-#:     14059.5  YV4D           35 dB  31 WPM  CQ          2350
DX de N6TV-#:     14022.6  J39BS          11 dB  25 WPM  CQ          2350
DX de N6TV-#:     14066.8  NP6A           38 dB  30 WPM  CQ          2350
DX de N6TV-#:     14054.4  N5UM           26 dB  28 WPM  CQ          2350
DX de N6TV-#:     14021.2  NN5J           35 dB  31 WPM  CQ          2350
DX de N6TV-#:     14061.4  VX5S           12 dB  28 WPM  CQ          2350
DX de N6TV-#:     14064.2  WQ5L           15 dB  28 WPM  CQ          2350
DX de N6TV-#:     14032.2  VE7XF          18 dB  27 WPM              2350
DX de N6TV-#:     14042.9  NT5C           45 dB  31 WPM              2350
DX de N6TV-#:     14032.2  VE7XF          18 dB  27 WPM  CQ          2350
DX de N6TV-#:     14039.2  EA3FP          15 dB  31 WPM  CQ          2350
DX de N6TV-#:     14052.5  W0YR           20 dB  28 WPM  CQ          2350
DX de N6TV-#:     14022.9  AE2E           32 dB  25 WPM  CQ          2350
DX de N6TV-#:     14028.4  VA6R            7 dB  29 WPM              2350
DX de N6TV-#:     14065.6  KM2B           25 dB  29 WPM  CQ          2350
To ALL de SKIMMER <0952Z> : Clicked on "VE7XF" at 14032.2
DX de N6TV-#:     14069.6  KF6I           13 dB  28 WPM  CQ          2350
DX de N6TV-#:     14069.1  NN0M           25 dB  28 WPM  CQ          2350
To ALL de SKIMMER <0952Z> : Clicked on "" at 14031.4
DX de N6TV-#:     14035.5  KF8GE          12 dB  26 WPM              2350
DX de N6TV-#:     14028.4  VA6R            7 dB  29 WPM  CQ          2350
DX de N6TV-#:     14036.1  NZ1U           16 dB  28 WPM  CQ          2350
DX de N6TV-#:     14062.7  N4QS           11 dB  29 WPM  CQ          2350
DX de N6TV-#:     14045.1  YV1FM          22 dB  32 WPM  CQ          2350
DX de N6TV-#:     14059.6  YV4D           35 dB  31 WPM              2350
```

Reports Signal to Noise ratio, CW Speed, CQers

What is the Reverse Beacon Network (RBN)?

- Uses *any* CW signal as a beacon
- Multiple CW Skimmers world-wide record signal strength (S/N ratio in dB) and CW speed (WPM)
- A free "Aggregator" program forwards CW 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

How do spots get to the RBN server?



Acknowledgements

- RBN web site and first aggregator originated by PY1NB (similar to his other web site, www.dxwatch.com). Felipe pays all 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 Propagandist"
- Telnet server support by K5TR, W2QO, KM3T

Felipe Ceglia, PY1NB

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



Dick Williams, W3OA

- Created the newest RBN Aggregator software



Nick Sinanis, F5VIH

- Wrote the RBN Spots Analysis Tool



Pete Smith, N4ZR

- RBN Chief Evangelist
- Skimmertalk Reflector: http://dayton.contesting.com/mailman/listinfo/skimmertalk



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 CQ "properly"
- Entering a contest?
  - Before: Check antenna F/B, signal strength
  - During: See where you are being heard
  - After: Compare signal strength with the competition

How can I use RBN to improve my score?

- Make sure the Skimmers find *you*
- When permitted, use RBN as DX Cluster for CW and RTTY contests
  - Far more spots, with smaller pileups than human-posted Cluster spots
  - Quickly fills up your logging software band map
  - Helps you find clear spots (between stations you can't hear)
  - Shows where *you* are being heard
    - E.g. at K3LR on 15m: "Spotted by S50ARX-#" (First EU answered our 15m CQs 25 minutes later)

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 rusheverythingtogether
- Change your freq. *slightly* to get spotted again

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.



How do I use the RBN to Check My Antennas?

- To test performance, just call CQ on CW, 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 site

Accessing the RBN (SOA, Multi)

1. telnet.reversebeacon.net port 7000 (DX Spider software)
2. arcluster.reversebeacon.net port 7000 (V6 AR-Cluster software)
3. dxc.ve7cc.net port 23 (CC Cluster software – removes bad spots!)
4. Some clusters combine RBN *and* human spots (VE7CC, W9ZRX, N7TR)
5. http://www.reversebeacon.net

Filtering Spots (old way)

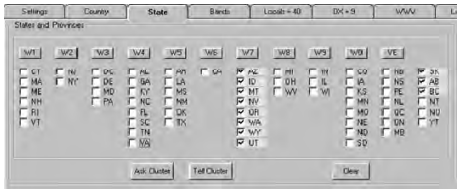
- telnet.reversebeacon.net port 7000
  - `accept/spots by_zone 1,3,4,6,7,31 and not by WZ7I or call N6TV`
  - http://www.dxcluster.org/main/filtering_en.html#toc1
- arcluster.reversebeacon.net port 7000
  - `set dx filter call=N6TV or (unique>1 and (spotterstate=CA or spotterstate=NV or spotterstate=UT))`
  - http://www.ab5k.net/ArcDocsVer6/UserManual/ArcDx.htm

Filtering Spots (new way)

- Use CC User software by VE7CC to log in to dxc.ve7cc.net and program filters with a full-feature Graphical User Interface
- CC Cluster nodes *automatically* reject "unique" (busted) spots
- Tutorial:
  - http://reversebeacon.blogspot.com/2010/11/using-rbn-telnet-server-brief-tutorial.html
- Reference:
  - http://www.bcdxc.org/ve7cc/default.htm#download

CC User Filter Dialogs





Some nodes combine RBN and “legacy” (human) spots

- dxc.ve7cc.net port 23 (CC Cluster, many filtering options, use CC User to set them)
- dxc.w9zrx.net port 7373 (AR Cluster)
- dxc.n7tr.com port 7373 (AR Cluster, but pre-filters to show only spots from Zones 3 and 4)

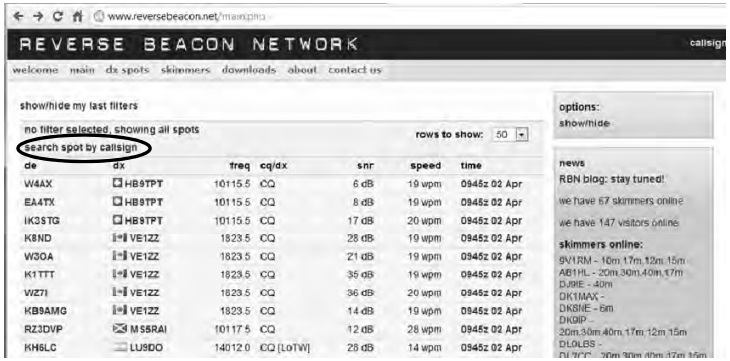
Using www.reversebeacon.net

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

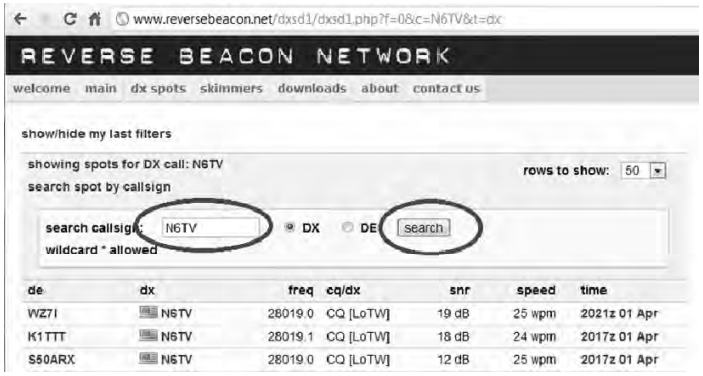
www.reversebeacon.net



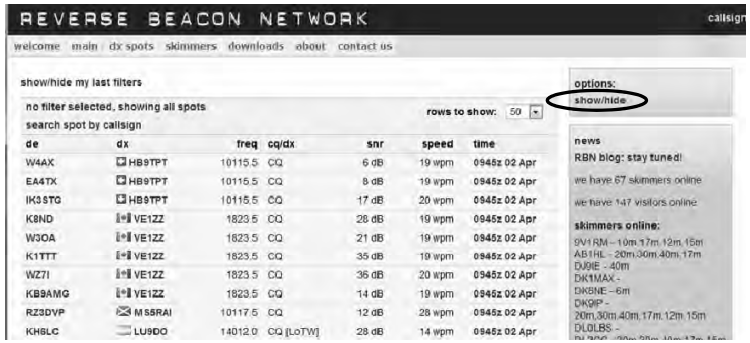
www.reversebeacon.net main



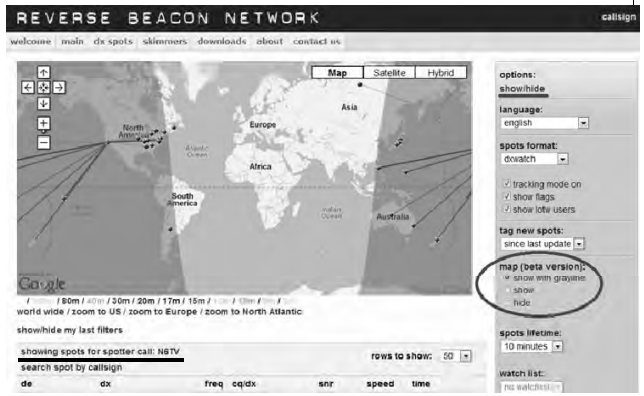
Where was I heard?



Plot spots on a map



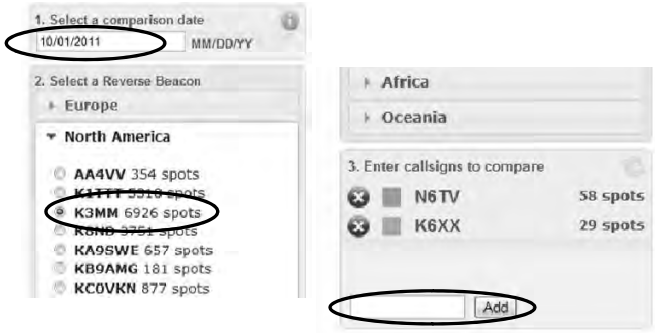
Which bands are open at *my* QTH?



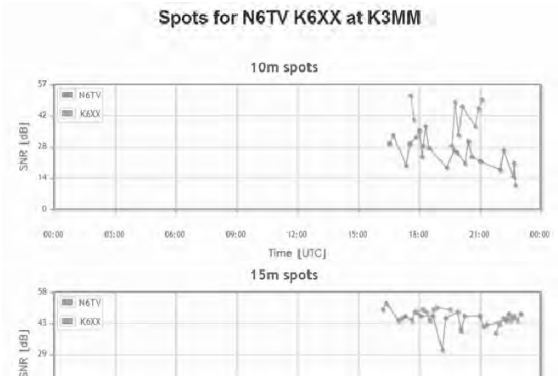
Spots analysis tool



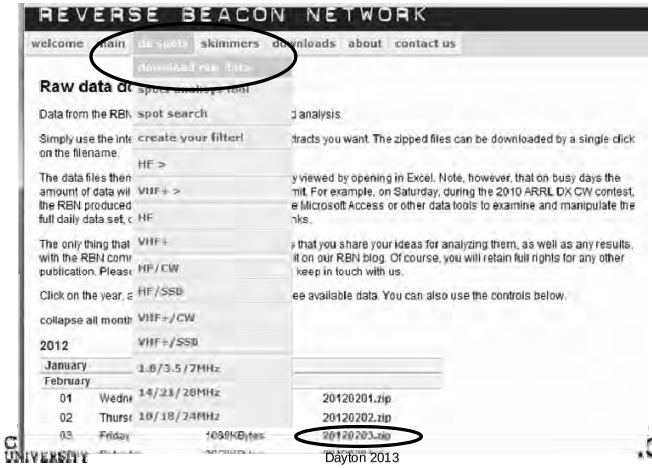
Pick a Date, a Skimmer, add callsigns to compare



And the winner is … K6XX!



Raw data downloads



Raw data is text file, Comma Separated Values

```
callsign,de_pfx,de_cont,freq,band,dx,dx_pfx,dx_cont,mode,db,date
   VK6IA,VK,OC,28028.4,10m,W6YI,K,NA,CQ,14,2011-11-26 00:00:00
   ON5KQ,ON,EU,7005.5,40m,K2QMF,K,NA,CQ,40,2011-11-26 00:00:00
   ON5KQ,ON,EU,7005.5,40m,K2QMF,K,NA,CQ,40,2011-11-26 00:00:00
   N4ZR,K,NA,7011.7,40m,OM5NS,OM,EU,CQ,22,2011-11-26 00:00:00
   N4ZR,K,NA,7020.6,40m,S50R,S5,EU,CQ,40,2011-11-26 00:00:00
   N4ZR,K,NA,7023,40m,NQ4I,K,NA,CQ,56,2011-11-26 00:00:00
   WA7LNW,K,NA,7051.5,40m,YR1C,YO,EU,CQ,15,2011-11-26 00:00:00
```

Total World-Wide RBN spots, 2012 CQ WW CW:

3,163,126 (18.3 spots per *second*)

2013 ARRL DX CW:

3,937,108 by all Skimmers (82,023 spots per hour)

2,013,282 by DX Skimmers outside USA

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

What's New?

- DL4RCK RCKSkimmer automatically adds RTTY spots into RBN network (but doesn't use wideband SDR)
- VE3NEA is attempting:
  - RTTY/PSK Skimmer
  - SSTV Skimmer
- But he says "Not close to completion"
- Not attempted:
  - SSB Skimmer

For more information

- http://www.reversebeacon.net
- http://www.bcdxc.org/ve7cc/default.htm#download
- http://www.dxatlas.com/CwSkimmer
- http://www.dxatlas.com/SkimServer
- http://www.srl-llc.com/ (QS1R)
- http://microtelecom.it/perseus/
- http://www.pixelsatradio.com/product/shortwave-magnetic-loop-antenna/ (RF Pro-1B loop antenna)
- http://www.dxengineering.com/parts/dxe-arah3-1pe (ARAH3-1PE horizontal antenna)

For more information

- http://www.pvrc.org/n4zr/rbn.pdf
- http://reversebeacon.blogspot.com
- http://www.ve7cc.net/
- http://www.qrz.com/db/n6tv

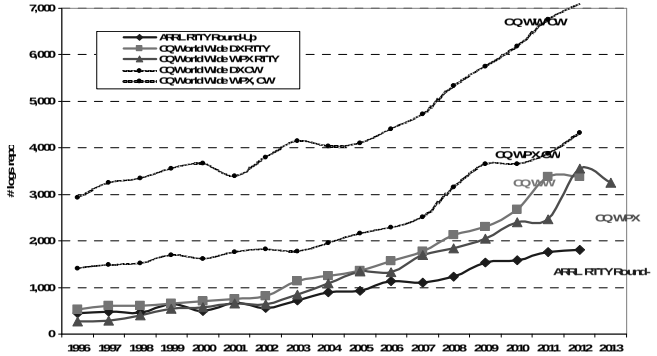
Questions?

CTU 2013 Presents

Operating a RTTY Contest—
Beginner to Expert

Ed Muns, W0YK

Three Largest RTTY Contests



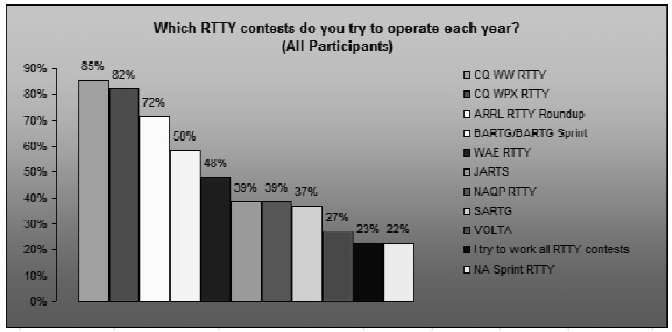
Lots of RTTY Contests

> 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

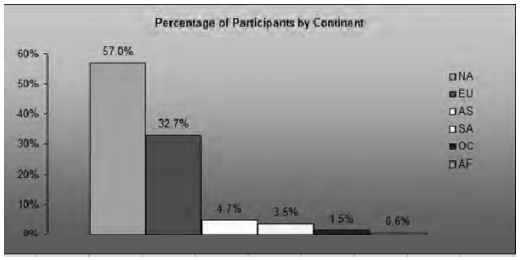
Contest Popularity

2010 survey



RTTY Contesters

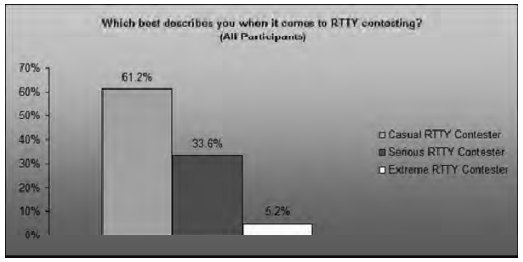
2010 survey



- 825 participants; 13 questions
- conducted in February 2010

RTTY Contesters

2010 survey



- The percentage of Casuals is much higher than shown, because few took the survey

RTTY Contesters

contester styles

- Casual
  - New
  - Making QSOs
  - Chasing awards

  ➔ majority of participants … sometimes slower operators
- Serious
  - High rates; snappy QSOs; no chit-chat

  ➔ minority of participants … faster operators (and easily annoyed by slower operators!)

RTTY Contesters

contester types

- "Gentleman RTTYers"
  - RTTY is the gentleman's *mode* (similar to 160 being the gentleman's *band)*
- RTTY contest junkies
  - Years of experience; many different contests
- New contesters
  - Many with extensive PC skill
- Multi-Mode contesters
  - Strong growth

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

Giving Back

- Open logs
  - Allows others to learn
  - Raises level of competition
- Sharing
  - Improves operating quality and skill
  - Raises level of competition
- Growing the sport
  - "Lighthouse": AA5AU & www.rttycontesting.com

The Cynics Say …

- "RTTY is a pain to set up and get working."
  … it's really not too difficult! (see first presentation)
- "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

Operating a RTTY Contest

- RTTY considerations
- Optimize message buffers
  - UnShift On Space (USOS or UOS)
  - Space vs. Hyphen
- Accelerator keys; stateful Enter key (ESM); key re-mapping
- Super Check Partial & Pre-Fill
- Callsign stacking ("slow down to win")
- Multiple decoders
- SO2V, SO2R-SOnR
- Logging Software: WriteLog vs. N1MM Logger vs. Win-Test
- Ergonomics

RTTY Considerations

Much like CW and SSB, except:

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

RTTY Sub-Bands

- 10 meters: 28080-28100, during contests 28060-28150
- 15 meters: 21080-21100, during contests 21060-21150
- 20 meters: 14080-14100, during contests 14060-14150
  - JA: 14070-14112
- 40 meters: 7025-7050 and 7080-7100, during contests 7025-7100
  - JA: 7025-7045
  - EU: below 7050
- 80 meters: 3580-3600, during contests 3560-3600
  - JA: 3520-3530 and 3599-3612
- 160 meters: No RTTY contesting

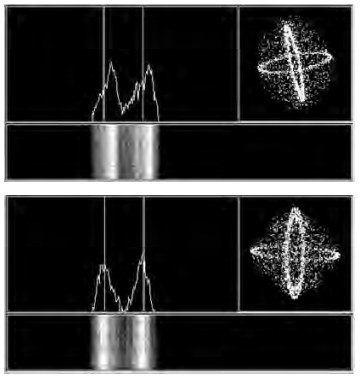
RTTY Sub-Bands

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/gettingstarted/rtty_subbands.htm

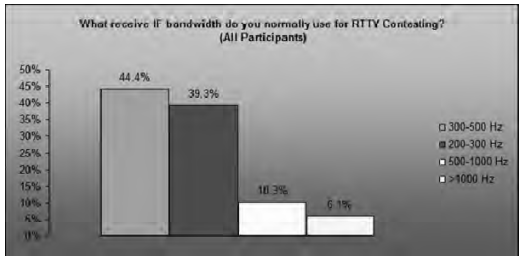
Receiving

- Set RX audio level
  - noise just above baseline
- 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



IF Bandwidth

2010 survey

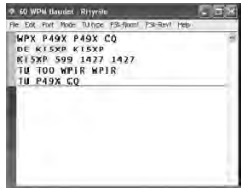


• Like FSK, narrow IF filtering for RTTY appeared in radios in the early 1990s

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
  - Use AFC/NET for S&P (only avail. with AFSK)
- Mode-independent skills, e.g.,
  - Bandmap usage
  - QSO ⊘4
  - Roving mult: "Squat & Shoot" *(Cajun-speak!)*

and … More Tips

- 100% duty cycle … *caution!*
- Practice
  - During frequent RTTY contests
  - NCCC Thursday night practices
- Multi-Ops
- SO2V & SO2R
- LoTW

Basic RTTY Contest QSO

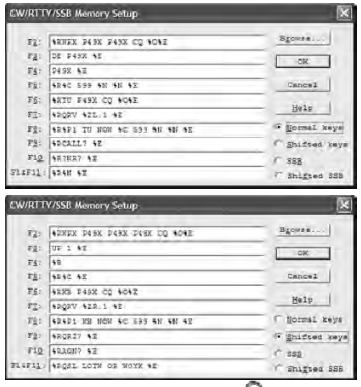
- ***WPX K5AM K5AM CQ***
- ***ZC4LI ZC4LI***
- ***ZC4LI 599 1349 1349***
- ***[K5AM] TU 599 985 985***
- ***[ZC4LI] TU K5AM CQ***

K5AM: running station
ZC4LI: S&P station

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)

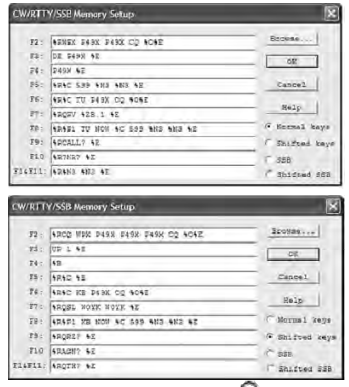
www.rttycontesting.com/rttymessages.htm



RTTY Messages

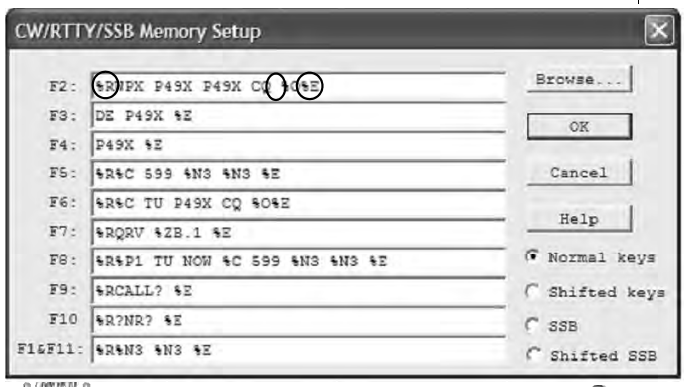
optimize

- Modular
  - Chaining
- Group logically
- Supports a cadence



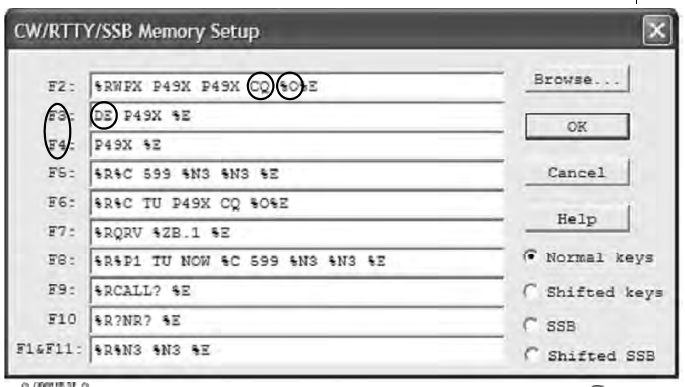
RTTY Messages

formatting



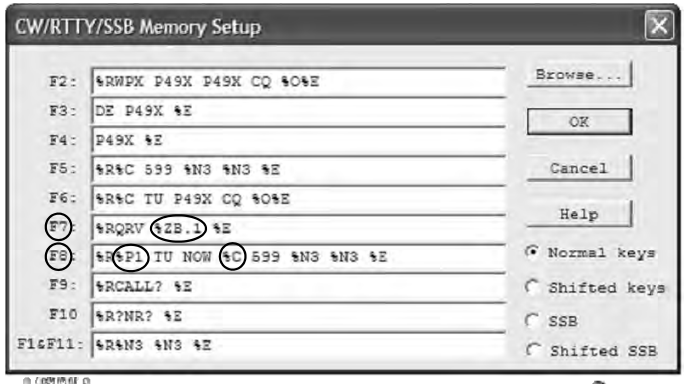
RTTY Messages

efficiency



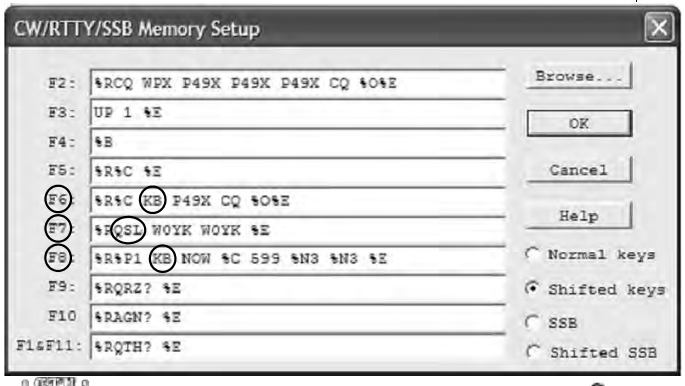
RTTY Messages

special



Operating

personal

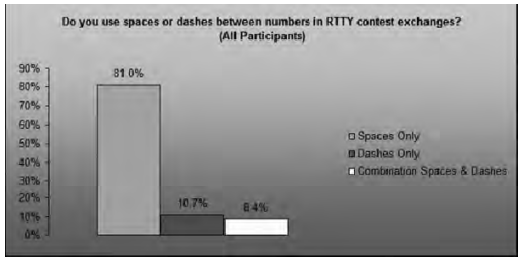


Interim Summary

- Predominantly casual RTTY contest participants
- RTTY sub-bands; 10-80 only; avoid PSK & beacons
- Narrow (CW) 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, exchange twice, Space delimiter

Space Delimiters

2010 survey



Space Delimiters

*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 lCA CA
UOS on	f599 QUE QUE	f599 lCA CA
UOS off	f599 123 123	f599 lCA CA
UOS off	f599 123 123	f599 lCA 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

Space Delimiters

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	xT00 f123 f123	f599 xQUE f123	xT00 CA CA	f599x:- CA
	UOS on	f599 f123 f123	f599 f123 f123	f599 CA CA	f599 CA CA
	UOS off	xT00 f123 f123	f599 xQUE f123	xT00 CA CA	f599x:- :-
	UOS off	f599 123 123	f599 123 123	f599 lCA CA	f599 lCA CA
	UOS on	xT00 QUE QUE	f599xQUE QUE	xT00 lCA CA	f599 x:- CA
worst case	UOS off	f599 123 123	f599 123 123	f599 lCA CA	f599 lCA CA
	UOS off	xT00 QUE QUE	f599xQUE QUE	xT00 lCA 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

Hyphen Delimiter?

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	xTOORAQUERAQVE	f599x123-123	xTOORA1CAf-1CA	f599-x:-f-1CA
UOS	on	f599-123-123	f599-123-123	f599-1CAf-1CA	f599-1CAf-1CA
UOS	off	xTOORAQUERAQVE	f599x123-123	xTOORA1CAf-1CA	f599-x:-f-1CA
UOS	off	f599-123-123	f599-123-123	f599-1CAf-1CA	f599-1CAf-1CA
UOS	on	xTOORAQUERAQVE	f599x123-123	xTOORA1CAf-1CA	f599-x:-f-1CA
UOS	off	f599-123-123	f599-123-123	f599-1CAf-1CA	f599-1CAf-1CA
UOS	off	xTOORAQUERAQVE	f599x123-123	xTOORA1CAf-1CA	f599-x:-f-1CA

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

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

LTRS/FIGS Characters

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

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
```

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!**

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

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

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

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*

Callsign Stacking

tail-ender

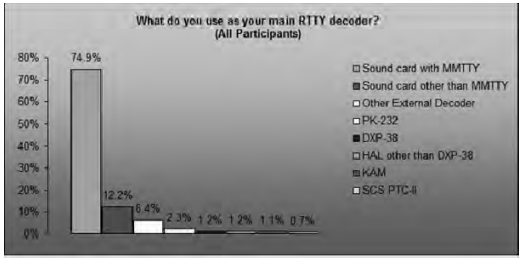
Normal	***Shortened***
1. WPX P49X P49X CQ, or TU P49X CQ	1. (skip CQ)
2. K3LR K3LR	2. (skip pile-up)
3. K3LR 599 2419 2419 K5ZD	*3. K3LR TU NW K5ZD 599 2420 2420*
4. TU 599 842 842	*4. TU 599 1134 1134*

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

RTTY Decoders

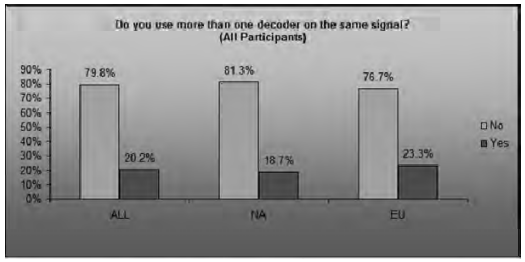
2010 survey



- 87% use soundcard decoding/encoding
- 86% of soundcard users run MMTTY

Multiple RTTY Decoders

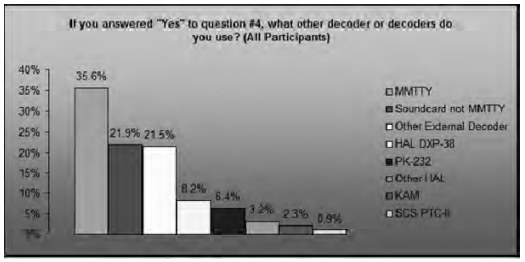
2010 survey



• 20% use multiple decoders

Multiple RTTY Decoders

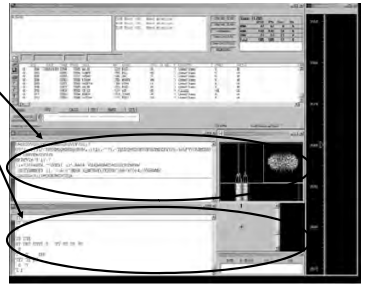
2010 survey



Multiple RTTY Decoders

MMTTY & DXP38-WriteLog

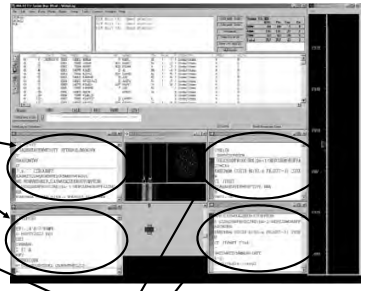
- Parallel decoding
  - Software, e.g., MMTTY
  - Hardware, e.g., DXP38
- Diverse conditions
  - Flutter
  - Multi-path
  - QRM, QRN
  - Weak signals
  - Off-frequency stations



Multiple RTTY Decoders

multiple MMTTY profile windows

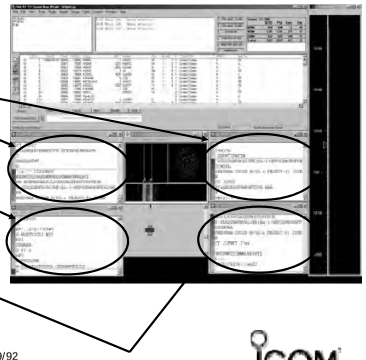
- Parallel decoding
  - same audio stream
  - switching takes too long
- Multiple profile windows
  - Standard
  - Fluttered signals
  - Fluttered signals (FIR)
  - Multi-path
  - hyper sensitive
  - EU1SA
  - AA6YQ-FIR-512
    - weak signals in QRN



Multiple RTTY Decoders

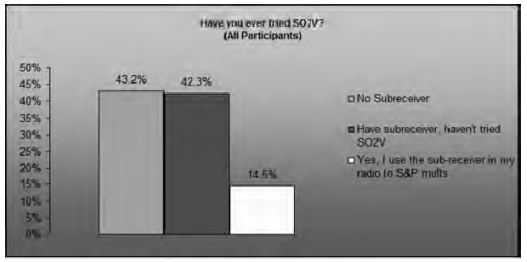
two IF bandwidths

- 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"



SO2V

2010 survey

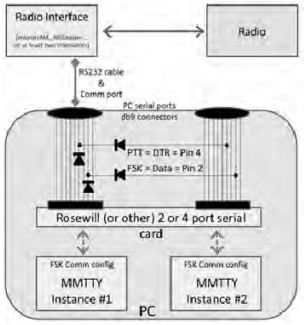


• Almost 15% have tried SO2V

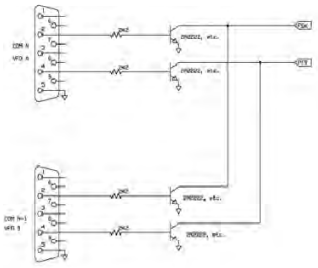
SO2V

- If Assisted and running on VFO-A, then
  - A<>B
  - Click spot, tune, ID station, work station
  - A<>B, resume running
- Or, setup decoder windows on A and B
  - Radio must have two true receivers
  - Monitor both frequencies simultaneously with right/left channels of sound card
    - Right-click call from 2nd RTTY window into VFO-B Entry Window
  - Two ways to transmit on VFO-B:
    - A<>B, work the mult, A<>B
    - 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

SO2V Wire-OR FSK/PTT

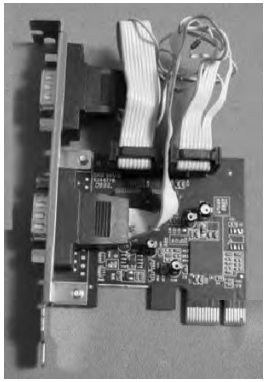


Serial Signals (K8UT)

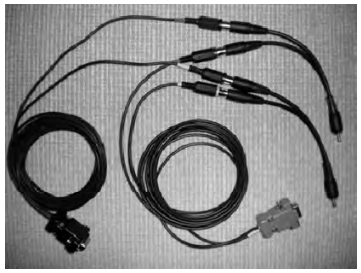


FSK/PTT Signals (W0YK)

SO2V Wire-OR FSK/PTT



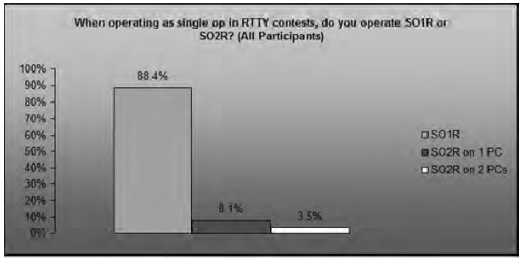
Serial Signals (K8UT)



FSK/PTT Signals (W0YK)

SO2R

2010 survey



- 12% operate SO2R
- 30% of SO2R users use 2 PCs

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!

SO2R

M2 configuration



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!

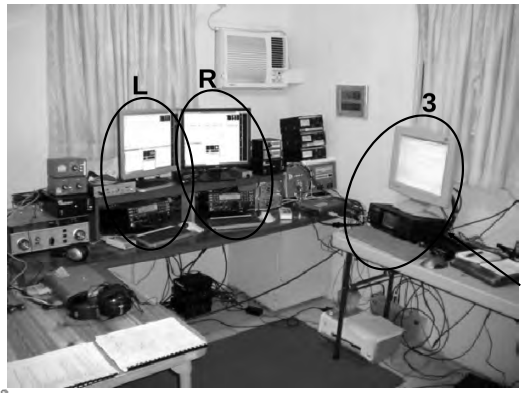
SOnR

> 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

SOnR

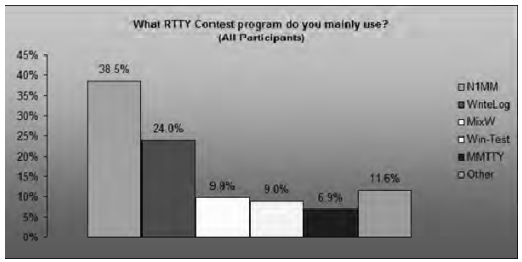
Multi-Multi configuration



dedicated to 10 meters

Logging Software

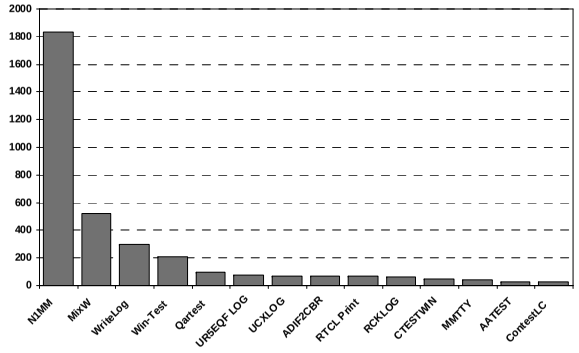
2010 survey



- MixW still ahead of Win-Test
- MMTTY used stand-alone

2012 CQ WPX RTTY

3550 submitted logs



Logging Software

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

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

RTTY Contest Loggers

	WriteLog	N1MM	Win-Test
MMTTY	☻	☻	☻
2Tone	☻	☻	-
other decoders	☻	some	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
MTTY 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

Logging Software
accelerator keys

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

- All three loggers
- Saves keystrokes

Logging Software
automatic QRV

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

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

RTTY Contest Loggers

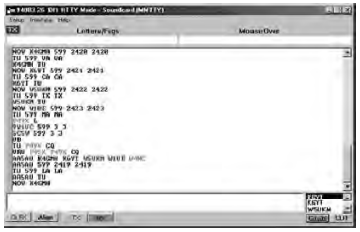
relative ratings

WL	*N1*	*WT*	*Logger*
5	3	4	• RTTY window readability
5	4	0	• Multiple decoders
5	4	0	• multiple MMTTY or 2Tone
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	3	5	• AFSK/FSK flexibility
40	***36***	***23***	***Overall***

Logging Software

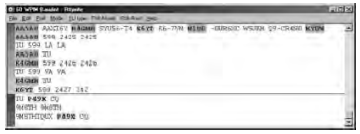
RTTY Window Readability

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.

Logging Software

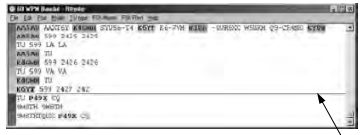
RTTY Window Readability

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!

Logging Software

multiple decoders

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

- 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

SO2R

M2 configuration

- PC & UI per radio; networked
- Single signal interlock
- Extendible to SOnR

- Only WriteLog
- Another user preference alternative; SOnR

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



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

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.

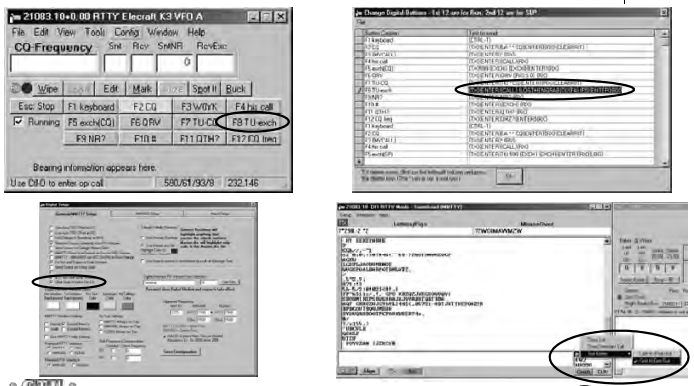
Logger Software

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”

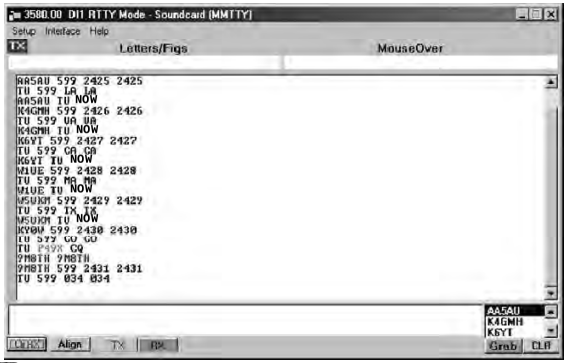
Logging Software

callsign stacking: N1MM Logger - 2



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”

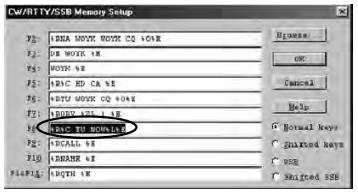
Logging Software

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



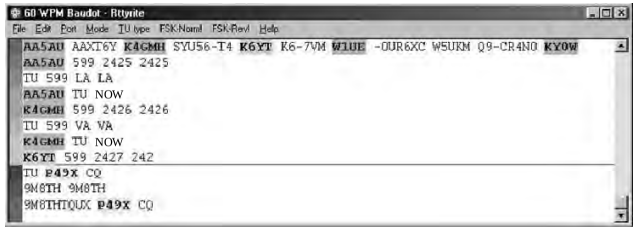
- Create Fn macro
  - %R%C TU NOW%L%E



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

Logging Software

callsign stacking: WriteLog - 3



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

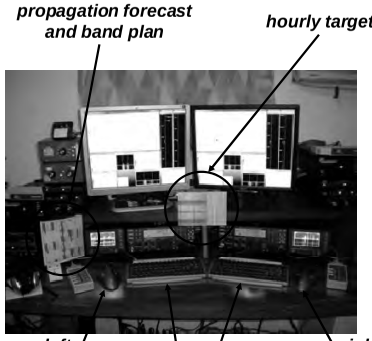
RTTY Contest Loggers

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5	5	3	• Call sign stacking
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40	***36***	***23***	***Overall***

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

Ergonomics

right-sized keyboard



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

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)

Resources

- www.rttycontesting.com
  - Tutorials and resources (beginner to expert)
  - WriteLog/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)
  - N1MMLogger@yahoogroups.com (N1MM Logger general)
  - N1MMLogger-Digital@yahoogroups.com (N1MM Logger RTTY & PSK)
  - writelog@contesting.com (WriteLog)
  - support@win-test.com (Win-Test)

CTU Presents

Station Notebook
&
Your 2013 Antenna Projects

Tim Duffy K3LR

Contest University Update

- 7th year for Dayton CTU
- 5 years for CTU Italy
- CTU Finland July 2012
- CTU Australia Feb 2013
- Over 3000 students have now attended CTU
- CTU Live Stream
- Look for more exciting CTU developments

Montichiari, Italy

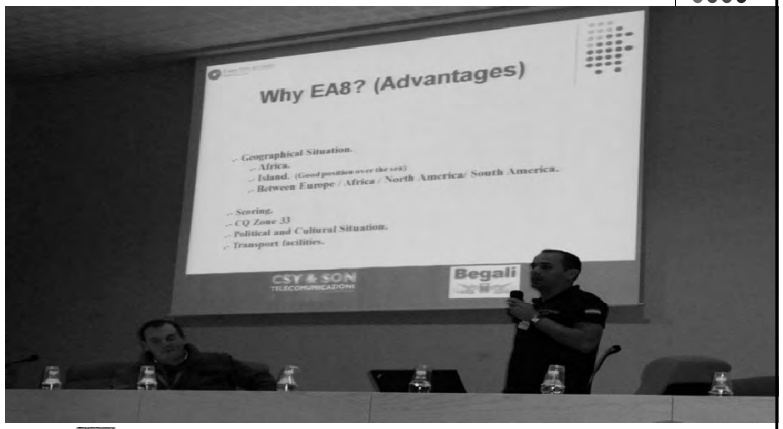


John, W2GD – aka P40W

300+ attended CTU Italy 2013



CTU Italy 2013



IK2QEI and EA8RM

2013 Wyong CTU Australia



Getting the most out of CTU 2013

Ask lots of questions this weekend and keep notes – if you are not asking questions you are falling behind!

- **Meet someone totally new and ask them why they came to CTU**
- **Share some of your "secrets" with others here at CTU**
- **Commit to giving a CTU related talk or write a contesting article - in the next 12 months.**

K3LR 2013 Notebook Ahha #1

RX Preamps can be good and bad.

- Be very careful with preamps around TX RF antennas
- Even the best preamps will cause bad IMD and harmonics when close TX overloads
- Using protection circuits that turn off (bypass) preamps when TXing - is a good option.
- Use BandPass filters when you can.
- The KD9SV Front End Saver is a good idea.

K3LR 2013 Notebook Ahha #2

- Trying to RX in the same band you are TX (Field Day for example) is VERY hard to do.
- Proper placement of vertical and horizontal antennas (even close spaced) can provide amazing results.
- The placement is not super critical – once you know where the null is – and why it is there.
- Compromised configurations will reduce the isolation.
- This is not a fix all "tool" and your station "system" still needs to be very "tight" for best results.

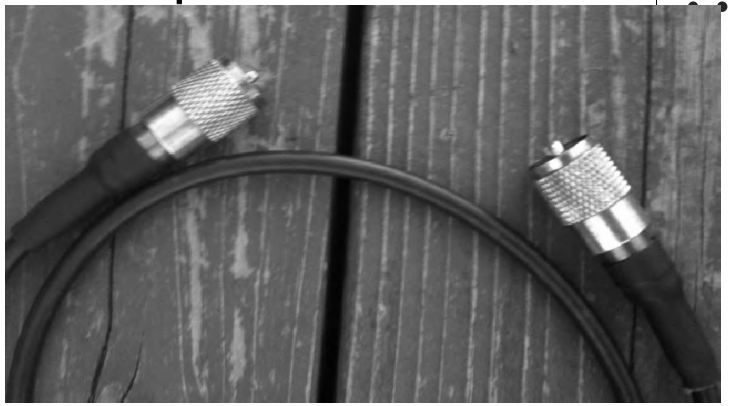
CQ CONTEST UNIVERSITY ICOM

It's 2359 Zulu – Are you worried about your connectors?



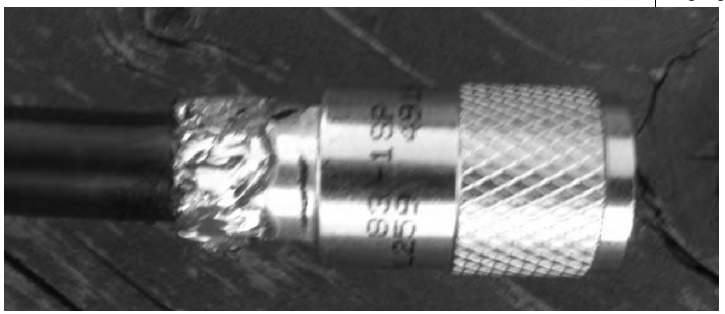
CQ CONTEST UNIVERSITY ICOM

Use the best connectors possible – here is a premade cable



CQ CONTEST UNIVERSITY ICOM

See Article in November 2012 QST



CQ CONTEST UNIVERSITY ICOM

Your 2013 Antenna Projects

- I hope you add to, change or improve your own antenna system this year!
- Share your CTU passion with others – help THEM put up or fix an antenna.
- Have an open heart to all who are willing to learn – encourage and send congratulations emails. BE AN ELMER!
- Be active in your local club – not just Field Day. Join, pay dues and contribute your time experience!
- Help at least TWO operators with their antenna systems and be active in your local club = a CTU 2014 discount!

CTU CONTEST UNIVERSITY

ICOM

K9AY Loop Arrays for Low Band Contesting

Richard C. Jaeger, K4IQJ

May 16, 2013

INTRODUCTION

- K4IQJ Interests /Background
- Introduction
  - RDF Definition
  - Basic K9AY Loop Pair
- K9AY Array Comparisons
  - 2-3-4 Element Arrays
- 4 Element Array Design & Simulation
  - Array Implementation
- Discussion / Observations

INTRODUCTION

- Interests
  - Low Band Contesting
    - NAQP CW
    - ARRL & CQWW 160 Contests
    - Stew Perry
    - CW Sprints (Alabama Low Power Record)
  - DXing
    - Top of the Honor Roll, Need P5 on CW, CQ WAZ
    - 300+ Countries Worked on 80 – 10
    - 255 Countries Worked on 160M

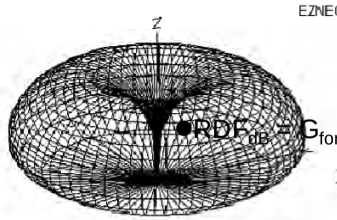
INTRODUCTION

- Need to Hear Well on 160/80 M
  - Big Advantage in NAQP and DX Contests
- Loops Seem Most Effective Receiving Antennas in My Locations (Poor Ground Conditions)
- Discussed 2-Element Arrays - 2012
- Presented 3-Element End-fire Array – 2011
- Latest Effort - 4-Element Array (15.1dB RDF)
  - 100 foot spacing (330' total length)
  - RDF greater than individual beverages

BACKGROUND
RDF: Receiving Directivity Factor

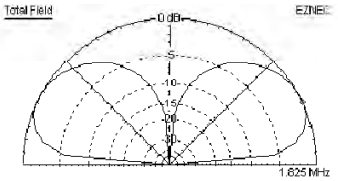
- Design Goal Here: Maximize RDF
- $RDF_{dB} = G_{for}(dB) - G_{avg}(dB)$
  - Noise generally comes from all directions
  - RDF compares the main antenna lobe gain to the average gain over the whole hemisphere of the antenna
  - Attributed to W8JI

BACKGROUND
Reference Antenna - Short Vertical (20')

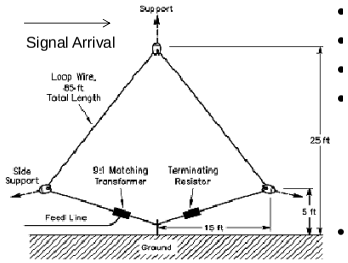


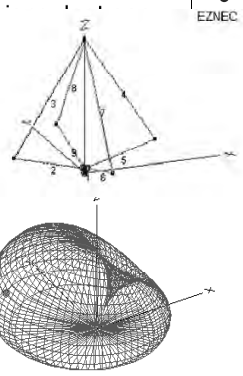
$RDF_{dB} = G_{for}(dB) - G_{avg}(dB)$

$RDF_{dB} = 1.0 - (-3.9) = 4.9$ dB



BACKGROUND
Basic K9AY Loop





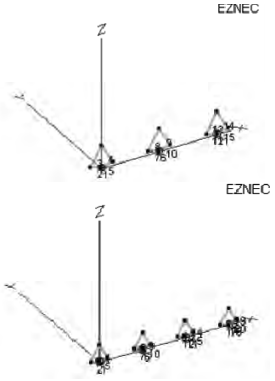
- 9:1
- C

$RDF_{dB} = G_{for}(dB) - G_{avg}(dB)$

Gary Breed, "The K9AY terminated loo
Receiving Array," QST, Vol. 71, No. 3, pp

RDF = (24.7) - (-32.1) = 7.4 dB

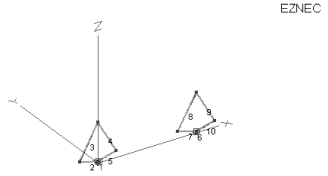
LOOP ARRAYS
Multi-Element Endfire Arrays



- "Lossy" Antennas
  - Resistive termination
  - Little or no mutual coupling
- Loops are Broadband – Usable over a Wide Frequency Range
- Array Output Decreases as Number of Elements Increases
  - (-24 dBi) → (-40 dBi)

Luis, IV3PRK: "K9AY Loops Always Seem to Work"

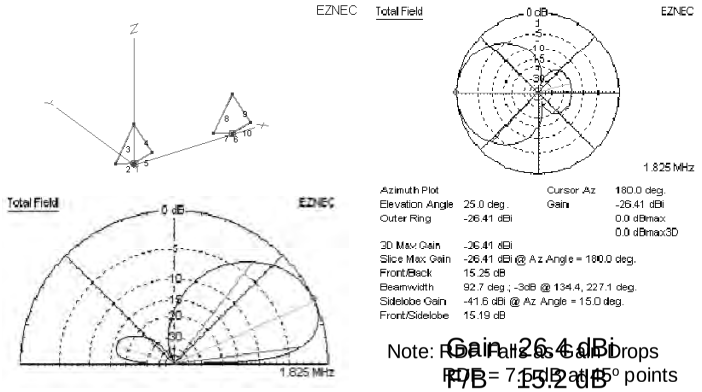
TWO-ELEMENT END-FIRE ARRAY
80’ Spacing – 200º phasing



Element 2 Phasing (-200º)

- Two-Element Array
  - Equal amplitudes
  - Single phasing line
  - Rear element lags front element by > 180º
- Gain: -25.6 dBi
- RDF: 10.5 dB (+3 dB)
- Beam Width: 96º
- W/C F/B: 16.6 dB
- Take Off Angle: 25º

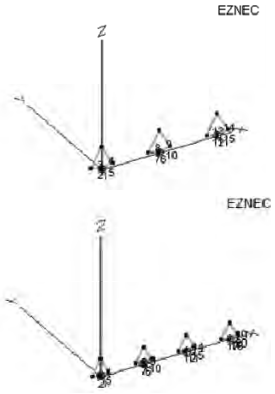
TWO-ELEMENT END-FIRE ARRAY
Simulation Results - 160 M



Note: Rear Falls as 6 dB Drops
RDF = 7.5 dB at 45º points

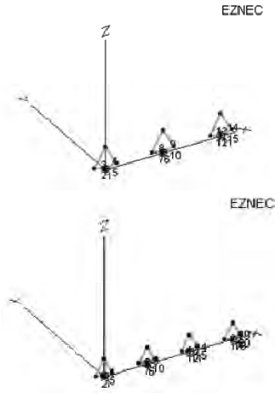
Gain -26.4 dBi
F/B 15.2 dB

LOOP ARRAYS
3 & 4 Element Endfire Arrays



- Binomial Endfire Array Nominal Amplitudes
  - 3 EL (1-2-1)
  - 4 EL (1-3-3-1)
- RDF Optimization
  - (1-2-1) → (1-1.84-1)
  - (1-3-3-1) → (1-2.4-2.4-1)

LOOP ARRAYS
3 & 4 Element Endfire Arrays



- 3 Element Array
  - 80’ Spacing
  - Gain: -29.5 dBi (20º)
  - Beamwidth: 66º
  - RDF: 12.5 dB
- 4 Element Array
  - 100’ Spacing (Sensitivity)
  - Gain: -35.6 dBi (16º)
  - Beamwidth: 49º
  - RDF: 15.1 dB

K9AY ARRAYS
RDF Comparisons

Table I - Comparison of End-Fire Arrays with a Single Loop - 80' spacing			
	160M RDF	80M RDF	160M / 80M Crossfire Phasing
Short Vertical	4.9 dB	4.9 dB	---
Single Loop	7.4 dB	7.4 dB	---
2-Element Array (1-1)	10.5 dB	10.0 dB	-200^o / -220^o
( )			
4-Element Array (0.42-1-1-0.42)	15.1 dB	13.8 dB	0, -190^o, -380^o, -570^o 0, -200^o, -400^o, -600^o

(1-2.4-2.4-1) → (0.42-1-1-0.42)

ARRAY IMPLEMENTATION
Cross-Fire Feed (W8JI)

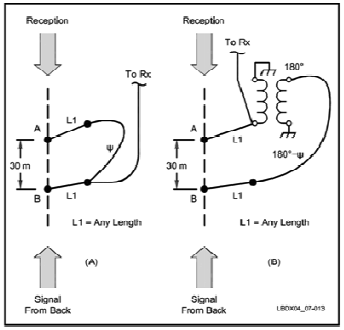


Fig 7-13 — Two ways of feeding the 2-element end-fire array. The system on the left is good for one frequency, while the system on the right can be used with the same length of phasing cable over a very wide range of frequencies (easily two bands).

From *Low Band DXing* [3]

ARRAY IMPLEMENTATION
0^o Hybrid Combiners

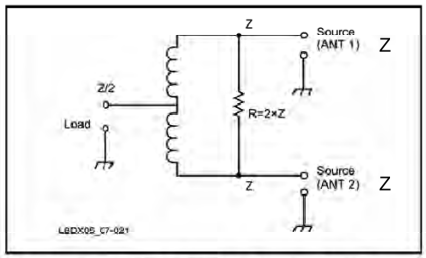


Fig 7-21 — Simplified schematic diagram of the 0° hybrid combiner.

From *Low Band DXing* [3]

4 EL ARRAY IMPLEMENTATION
Amplifiergs & Coax Phasing Lines

- Desired Gains (Hi-Z Plus-6 Amplifiers)
  - Elements 1 and 4: 0.42 or -7.5 dB
    - Adjust Output Resistance
  - Elements 2 and 3: 1.00 or 0 dB
    - Output Resistance at 75 Ω
- Desired Phase Delays on 160 M
  - Element 1: $\underline{0^o}$
  - Element 2: $190^o = 180^o + \underline{10^o}$
  - Element 3: $380^o = 360^o + 20^o \rightarrow \underline{20^o}$
  - Element 4: $570^o = 540^o + 30^o \rightarrow 180^o + \underline{30^o}$

4 EL ARRAY IMPLEMENTATION
Amplifier & Coax Phasing Lines

- Desired Phase Delays on 160 M
  - Element 1: 0^o
  - Element 2: $190^o = 180^o + 10^o$
  - Element 3: $380^o = 360^o + 20^o \rightarrow 20^o$
  - Element 4: $570^o = 540^o + 30^o \rightarrow 360^o + 180^o + 30^o$

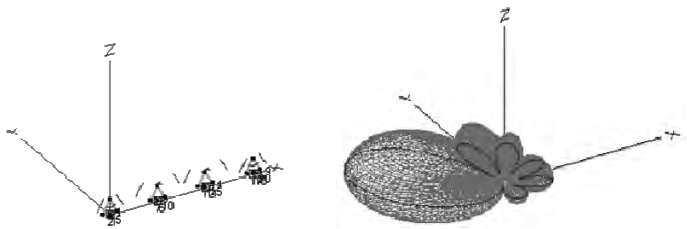
- Combiner: DX Engineering 4 Square Controller
  - Uses Three Separate Delay Lines
  - Two Inputs Go Through 180^o Phase Inversion Transformer
  - Two Inputs Have 0^o Shift Within the Controller
  - Antennas Reversed With External Switching

ARRAY IMPLEMENTATION
Coax Phasing Lines

- Network or Antenna Analyzer
  - Measure The Resonant Frequency Or Fault Of Open-circuited Line
  - Calculate Phase By Frequency Scaling

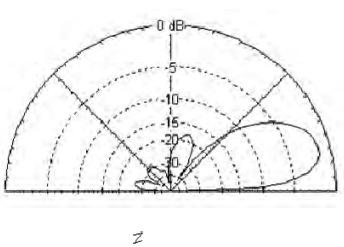
DXE Inputs and Phasing Line Design				
Antenna Element	**DXE Input**	**Delay Line**	**Delay**	**Length**
1 (Front)	**Antenna 1**	**None**	**–**	**–**
2	**Antenna 2**	**Delay 1**	**10^o**	**12.5 ft**
3	**Antenna 3**	**Delay 3**	**20^o**	**25.0 ft**
4 (Back)	**Antenna 4**	**Delay 2**	**30^o**	**37.5 ft**

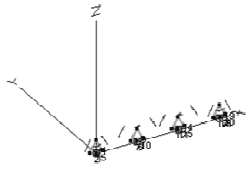
FOUR-ELEMENT ARRAY
Simulation Results – 160 M

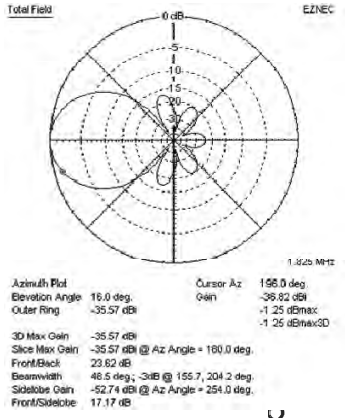


Spacing: 100 Ft
Amplitudes: 0.42-1-1-0.42
Crossfire Phasing: 0, -190º, -380º, -570º

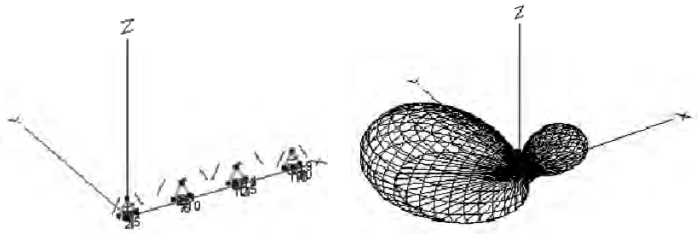
FOUR-ELEMENT ARRAY
Simulation Results (Cont.)





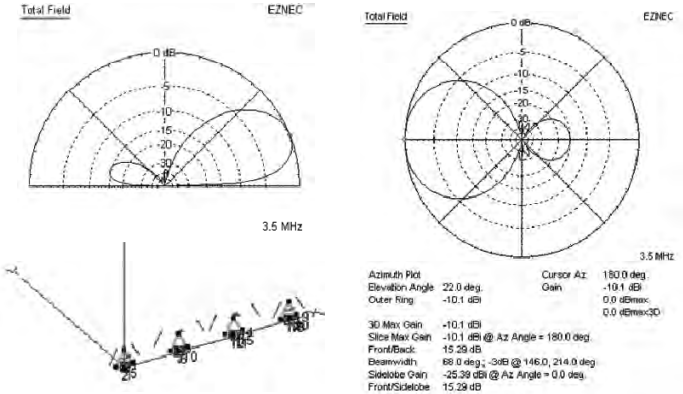


FOUR-ELEMENT ARRAY
Simulation Results - 80 M

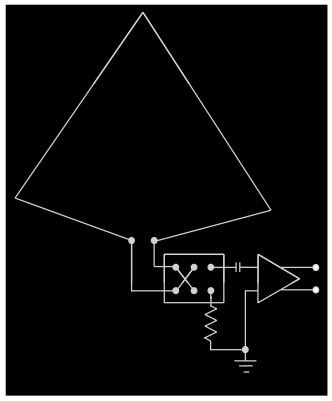


Spacing: 100 Feet Between Loops
Amplitudes: 0.42-1-1-0.42
Crossfire Phasing: 0, -200°, -400°, -600°

FOUR-ELEMENT ARRAY
Simulation Results - 80 M



ARRAY IMPLEMENTATION
Loop Termination and Switching

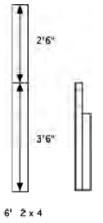




560 Ω Termination

ARRAY IMPLEMENTATION
Loop Design and Array Control





Loop Support, Direction Control Box, Hi-Z Amplifier

- Loops as Identical as Possible
- High Impedance Amplifiers
  - (Hi-Z Plus 6)
- ac Coupled (loop dc short)
- Single 510-Ω Termination
- Flooded RG-6 Coax
- DPDT Relay Switching
- A 3' Ground Stake at Loop Center
- Four 20' Radials Under Each Loop (45° relative to loop)
- Fiberglass Poles (MaxGain Systems)
- Aluminum Can Also be Used

4 EL ARRAY IMPLEMENTATION
Loop & Controller



Individual Loop



Controller During Installation

4 EL ARRAY IMPLEMENTATION
Loop Alignment!



Array Looking NE



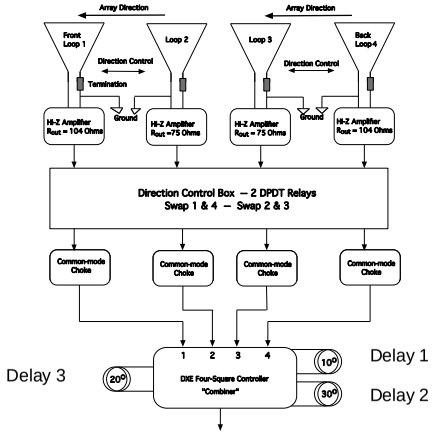
Array Looking SW

Control Cables and Coax in PVC on Ground

ARRAY IMPLEMENTATION
System Design

- Combiner – Spare DXE 4 Square Controller
- Hi-Z Plus 6 Amplifiers
  - 500 Ω antennas connected directly to amplifier inputs
- Must Switch Loop Terminations with Controller Direction
- Simple Switching of Inputs to Controller to Reverse Array
- "Common-mode" Chokes (The Wireman)

ARRAY IMPLEMENTATION
System Design



MULTIELEMENT ARRAY COMPARISONS

- Verticals are Easier to Install
  - No Direction switching
- Vertical Footprint Somewhat Smaller
  - Extra 30-40 ft Needed for Loops
- Loops Appear More Independent of Ground Conditions
- Simulation Gives Loops a Slight Advantage in RDF (0.5-0.6 dB)
- Simulation Gives Verticals a Large Output Advantage (Not realized!)

K9AY LOOPS & SHORT VERTICALS
Comparison of Simulation Results

Comparison - K9AY Loops (85') and Verticals (26.5')				
# of Elements	RDF (dB)		Output (dBi)	
	Loops	Verticals	Loops	Verticals
1	7.4	4.9	-23.6	5.8
2	10.5	9.8	-25.6	5.8
3	13.1	12.4	-29.2	7.9
4	15.1	14.7	-35.6	9.6
*Note: The actual output of the verticals is much lower when connected to high impedance amplifiers				

K9AY LOOPS & SHORT VERTICALS
Experiment Underway



- Interlaced 3- Element Arrays NE/SW Array
- K9AY Loops and 26.5' Verticals
- Aluminum Loop Supports form
- Vertical Array
- Single Switch between Arrays
- In Operation for 6 Months Through this Year's 160 M Season

K9AY LOOPS & SHORT VERTICALS
Qualitative Results Thus Far

- Simulation
  - Aluminum Supports Do Not Disturb K9AY Loops
  - Loops Must be Floated to Avoid Vertical Array Pattern Distortion
- Hearing of Both Arrays is Similar
  - Loop Array Almost Always has a Small but Perceptibly Better SNR (Ears can hear the 0.5 dB difference).
  - F/B of Loop Array is Better
  - Output of Loop Array is Actually Higher than that of Vertical Array

SUMMARY

- I Hear Well on the Low Bands
  - Big Advantage in NAQP and DX Contests
- The Arrays Act Similar to Yagis
  - Often Hear Signals Well that are Unreadable on My Transmit Verticals
  - Signals Pop Out of the Noise
  - Gain and F/B are Apparent
  - Unfortunately Not Rotatable
- Frequently Usable on All Bands
  - (Although with Unknown Patterns)

REFERENCES

1. Gary Breed, "The K9AY terminated loop – A compact, directional receiving antenna," QST, vol. 81, no. 9, pp. 43-46, September 1997.
2. Gary Breed, K9AY, "Arrays of K9AY Loops: "Medium-sized" low band RX antenna solutions," Sept. 15, 2007. http://www.aytechnologies.com
3. John Devoldere, *ON4UN's Low-Band DXing, Fourth & Fifth Editions*, ARRL, Newington, CT: 2005 & 2011.
4. Dallas Lankford, http://groups.yahoo.com/group/thedallasfiles
5. http://www.fcc.gov/mb/audio/m3/index.html
6. Hi-Z Antennas 4-Square, http://www.hizantennas.com
7. DX Engineering 4-Square, http://www.dxengineering.com
8. Max-Gain Systems, http://www.mgs4u.com
9. The Wireman, http://www.thewireman.com
10. Richard C. Jaeger, K4IQJ "Multi-Element End-fire Arrays of K9AY Loops," expanded version of 2011 Dayton presentation, May 15, 2011, available at http://www.k4iqj.com_. Also 2012 Presentation on 2 Element Arrays.
11. Richard C. Jaeger, "Multi-Element End-fire Arrays of K9AY Loops," QEX, pp. 22-31, Jan./Feb. 2013.

- THANK YOU FOR YOUR ATTENTION
- QUESTIONS?

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www.k4iqj.com

Propagation Trends 2013-2014

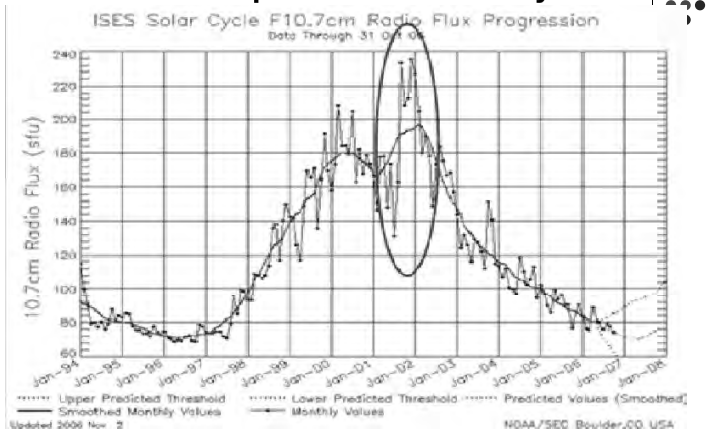


Solar Maximum !

A Double Peaked Sunspot Cycle ?

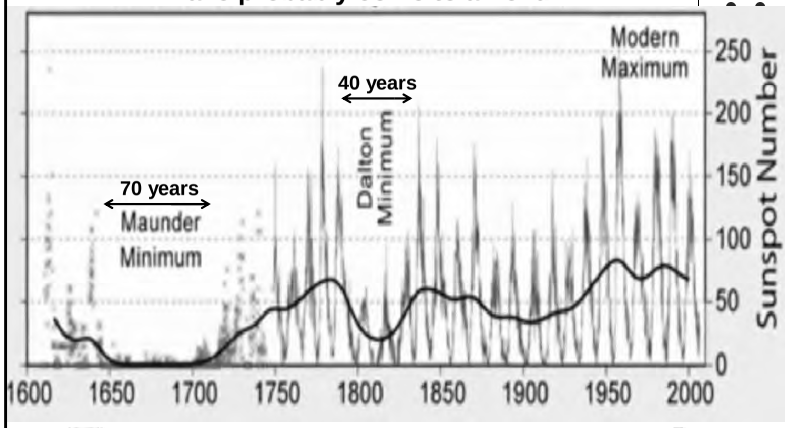
Every 6 Meter DXer Remembers This!

The Second Sunspot Peak of Solar Cycle 23



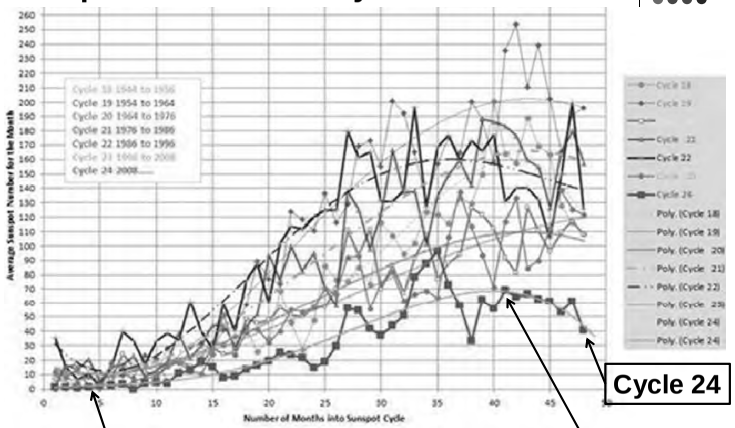
400 Years of Sunspot Observations

60 years of high sunspot cycles have probably come to an end



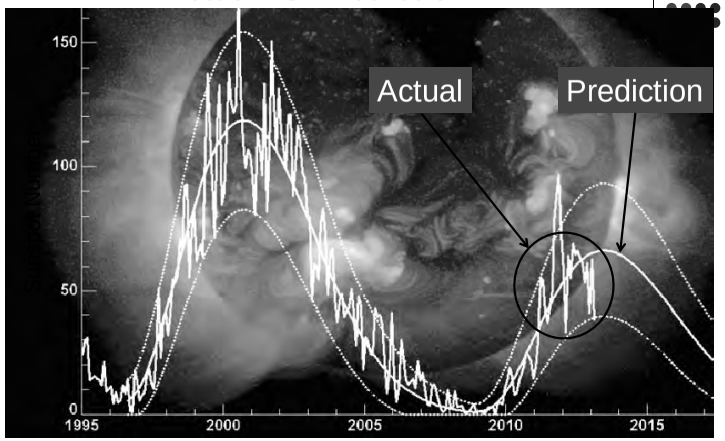
Solar Cycle 24

compared to all solar cycles since 1944



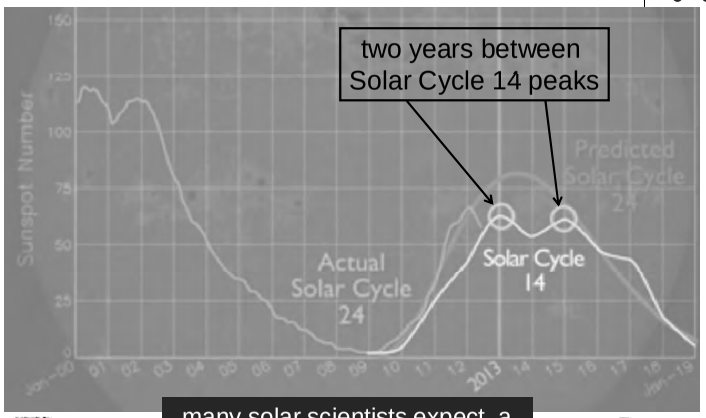
the lowest solar minimum in 100 years
followed by the lowest solar cycle in 100 Years

Sunspot Cycle 24 Progress
Actual vs. Prediction



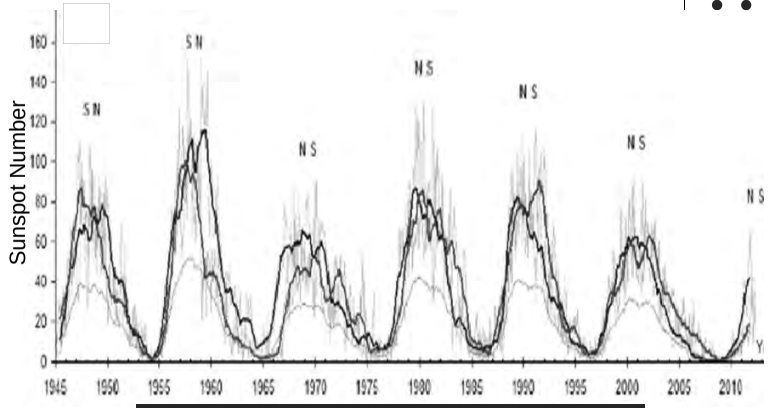
http://solarscience.msfc.nasa.gov/images/ssn_predict_l.gif

Solar Cycle 24 Prediction
compared to similar Solar Cycle 14



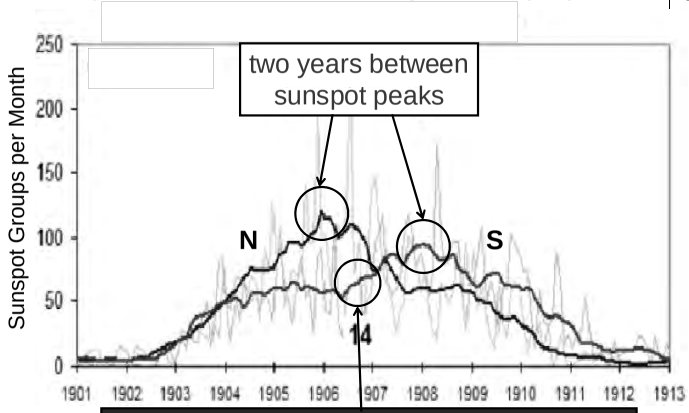
many solar scientists expect a double peaked Solar Cycle 24

Why are there Often Double Sunspot Cycle Peaks?



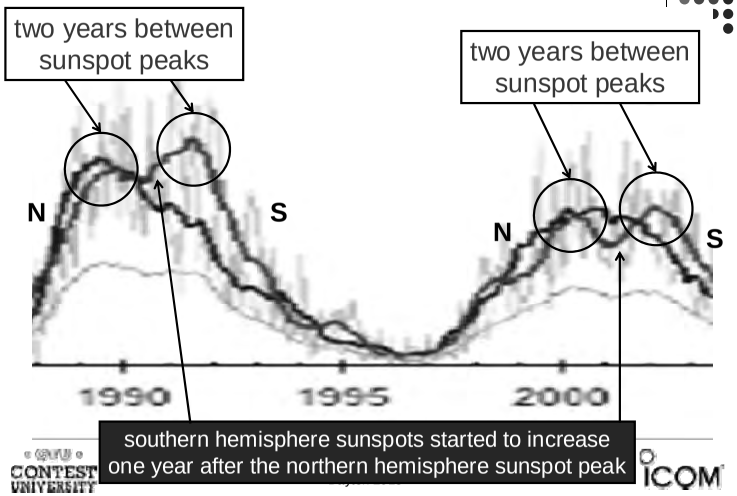
solar northern and southern hemisphere sunspot cycle peaks never occur at the same time

Solar Cycle 24 is similar to Cycle 14
the solar southern hemisphere sunspot peak occurred two years after the northern hemisphere sunspot peak

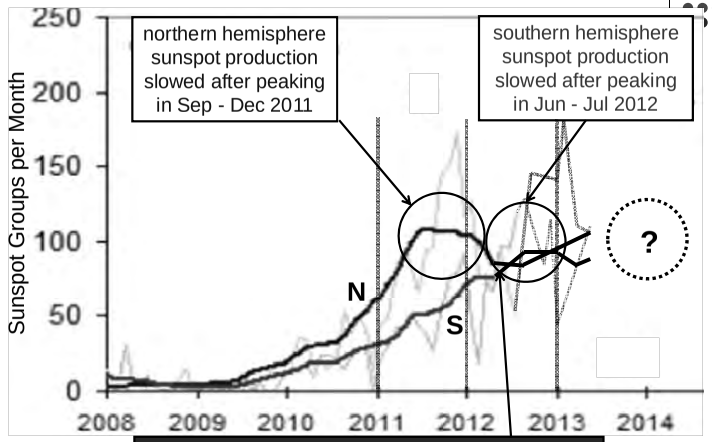


southern hemisphere sunspots started to increase one year after the northern hemisphere sunspot peak

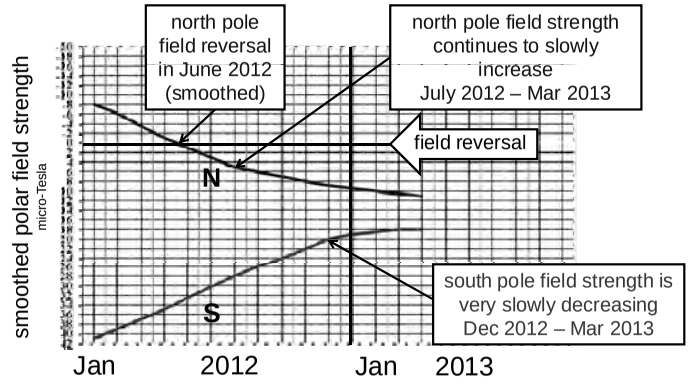
The Last Two Solar Cycles also had Double Peaks but very different than weaker Solar Cycle 24



Sunspot Production has Slowed in Both Solar Hemispheres

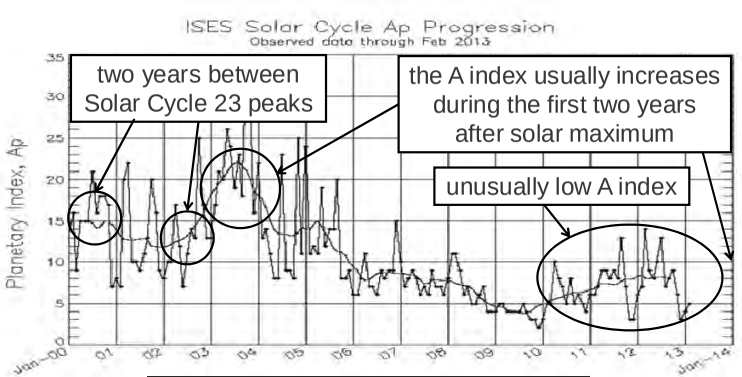


Solar North-South Polar Field Reversal solar maximum usually occurs when both polar fields have reversed polarity

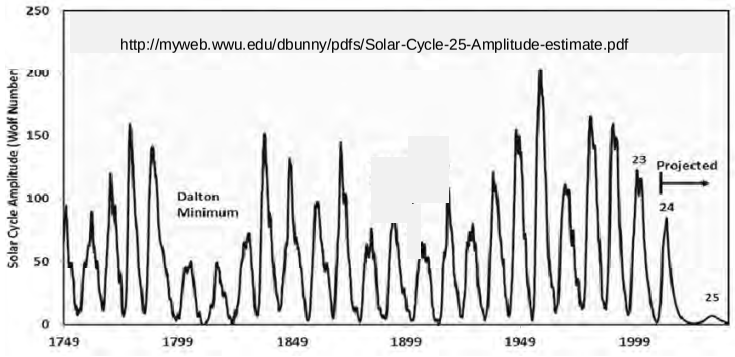


Weak Solar Cycle 24 has been Unusually Favorable for 160 and 80 Meters

The A-index has been much lower than normal



A Long Range Estimate of Solar Cycle 25
are sunspots disappearing?



some solar scientists expect Cycle 25 to be the weakest solar cycle in 400 years

http://www.landscheidt.info/?q=node/280

CONTEST UNIVERSITY

ICOM

Rotators and Construction Practices Q&A Session

Frank Donovan
W3LPL

Antenna and Tower Construction Books

- The ARRL Bookstore sells many excellent antenna and tower related books
- Three books in particular should be studied by anyone planning to install a tower:
  - Antenna Towers for Radio Amateurs
    www.arrl.org/shop/Antenna-Towers-for-Radio-Amateurs
  - Up the Tower
    www.arrl.org/shop/Up-The-Tower-Champion-Radio
  - Tower Climbing and Rescue
    www.arrl.org/shop/Tower-Climbing-Safety-and-Rescue

Popular Rotators for Small Yagis
12 - 24 foot booms

Yaesu G-800DXA $500
www.yaesu.com/?cmd=DisplayProducts&DivisionID=65&ProdCatID=104

HyGain Ham-IV $600
www.hy-gain.com/Product.php?productid=HAM-IV

Spid RAU $700
alfaradio.ca/docs/AlfaSpid-Price-11June2012.pdf

Popular Rotators for Mid Size Yagis
24 - 36 foot booms

Yaesu G-1000DXA $600
www.yaesu.com/?cmd=DisplayProducts&DivisionID=65&ProdCatID=104

HyGain T2X $700
www.hy-gain.com/Product.php?productid=T-2X

ProSistel 641D $995
www.prosistel.it/bigboyrotators/index.html

Spid RAK $1200
alfaradio.ca/docs/AlfaSpid-Price-11June2012.pdf

Popular Rotators for Large Yagis
36 - 48 foot booms
but not for full size 40 meter Yagis!

ProSistel 2051D $1285
www.prosistel.it/bigboyrotators/index.html

Yaesu G-2800DXA $1400
www.yaesu.com/?cmd=DisplayProducts&DivisionID=65&ProdCatID=104

M2 Orion 2800PX $1429
www.m2inc.com/pdf_manuals/OR2800PX%20%28AZ%29.pdf

TicRing 1022D $1500
www.ticgen.com/NT/products/products.htm

Spid – Big RAK $1700
alfaradio.ca/docs/AlfaSpid-Price-11June2012.pdf

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Popular Rotators for Very Large Yagis
full size 40 meter three element Yagis
and the SteppIR MonstIR 40-10 meter Yagi

TicRing 1032D Ring Rotator $3000
hwww.ticgen.com/NT/products/products.htm

K7NV Prop Pitch $3000
www.k7nv.com/proppitch

Prosistel 71D $3275
www.prosistel.it/bigboyrotators/index.html

Prosistel 110D $3795
www.prosistel.it/bigboyrotators/index.html

K0XG Orbital Ring Rotator $4500
http://www.k0xg.com/products/product4.html

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Tower Accessories
Sources

- Tower hardware
  - hillradio.net (Rohn tower hardware)
  - www.texastowers.com/towers/acc.htm
- Phillystran non-conductive guy line and accessories
  - www.dxengineering.com/search/brand/phillystran
  - www.arraysolutions.com/Products/phillystrantop.htm
  - www.therfc.com/philly.htm
  - www.texastowers.com/towers/acc/phillystran.htm

CONTEST UNIVERSITY ICOM

ASTM A325
Hot Dipped Galvanized Bolts
Popular Sources

hillradio.net (Rohn bolts)
www.mcmaster.com

U-bolts
Popular Sources

- Hot dipped galvanized u-bolts
  - hillradio.net (Rohn U-bolts)
  - cycle-24.com
- Stainless steel u-bolts
  - dxengineering.com
  - cycle-24.com

Stainless Steel Bolts and Hose Clamps
Popular Sources

www.mcmaster.com

Aluminum Tubing
Popular Sources for UPS Shippable Tubing

dxengineering.com
cycle-24.com
texastowers.com
cut2sizemetals.com
onlinemetals.com

Precut Aluminum Plate
Popular Sources

- 6061-T651 aluminum plate
  - onlinemetals.com
  - cut2sizemetals.com
  - www.mcmaster.com

Phenolic and Fiberglass Plate and Rod
Popular Sources

www.mcmaster.com

New Offerings 2013 Since Dayton 2012

Rob Sherwood
NCØB

New strides plus some disappointments

Sherwood Engineering

- **What is important in a contest or DX pile-up environment is still the same in 2013.**
- Good Dynamic Range to hear weak signals in the presence of near-by strong signals.
- You need a better receiver for CW than for SSB.
- There are some new top performers.
- **Design problems get into production.**

What New Rigs have Shipped?

Announced Dayton 2012:

Hilberling PT-8000A @ $18,000

Kenwood TS-990S @ $8,000

Flex 6000 @ $4,300 to $7,500

Yaesu FTdx-3000 @ $2,700

Elecraft KX3 with 100 watt PA option around $1,700

What is unusual about new rigs?

Hilberling may be the last virtually pure analog rig to be designed.
(Also has excellent phase noise, 10-25 dB better than FTdx-5000)
Kenwood TS-990 is 5X the cost of the effective TS-590S
Flex is advertizing a very flexible system that hasn't shipped yet.
Yaesu 3000 has a disappointing synthesizer compared to 5000
(Significant performance drop at half the price of FTdx-5000)
(Also FTdx-3000 has some serious ergonomic issues)
Elecraft KX3 has phase noise nearly as good as the Hilberling
(Due to direct conversion, close-in CW performance limited)
(KX3 QSK not competitive with K3 QSK)

Are there any Deal Changers this year?

- The Hilberling required many hardware updates after I tested it and used it in two contests.
- At $18K+, it will be a niche product.
- The 990 vs. 590 leave a significant pricing hole.
- Flex 6000 series: is Mouse Control OK for contests?
- Yaesu continues to do processing in their ALC.
- The advantages of Class A PA is negated by Yaesu ALC design.
- Unlikely the KX3 will appeal to serious contesters due to its size.
- That said, it worked really well in W1BB CW contest

Details - Hilberling PT-8000A

- Covers 160 – 2 meters
- 16-Pole crystal filters, plus audio DSP
- 600 watt PA derated to 200 watts quite clean
- Any 2012 production units require major hardware updates
- Until the new 250 Hz crystal CW filter is implemented, CW performance inadequate
- Price is a significant issue
- Requires computer for band scope

Details – Kenwood TS-990S

- Main receiver down conversion all bands
- Sub receiver same as TS-590S
- 50 V. FET PA, improved transmit IMD
- Built-in band scope
- CW limitations of 590S-style sub-receiver not present on main receiver for 10, 6 & WARC
- Price competitive with competing flagship products of other OEMs

Details – Flex 6000 series

Fantastic band scope with amazing resolution
Only used a prototype for 2 days
Can have multiple receivers and / or bandscopes
Only knob / buttons is external Pod
Needs more mouse sliders for quick settings adj.
Preamp selections seem odd to me.
Handles strong BC signals from 160 antenna well
Have not yet tested 13.8 volt transmit IMD

Details – Yaesu FTdx-3000

- Ergonomics a significant disappointment
- Band scope is close to useless
- Adjusting power to drive linear can take up to 8 operations of the menu / buttons / knobs !
- Has typical poor AGC impulse noise problem
- Processing is mostly in ALC, same as with the FTdx-5000 and FT-950.
- (No point in Class A with Yaesu ALC system)

Details – Elecraft KX3

- Amazing tiny radio that performs well
- Performed well in Stew Perry CW contest
- QSK a big disappointment with lots of clicks on receive audio
- Audio level inadequate for 30 ohm phones
- Had to use powered computer speakers to drive my Sony headphones
- DSP provides good bandwidth control
- Needs KXPA100 to drive any linear 1.5 kW
- Ergonomics OK for such a small rig

A few more comments on KX3

Limitations for CW are the opposite sideband rejection.

While the 2-kHz dynamic range is excellent, this doesn't tell the whole story. A signal on the opposite sideband is down only 60 to 70 dB. This is a limitation of direct conversion.

It is possible to have excellent phase noise in a $1000 radio.

Frequency wanders around 5 to 10 Hz due to the LO design. Would be an issue in some weak signal transmission systems such as WSJT.

AGC handles impulse noise well, just like K3

ARRL / Sherwood Testing Compromise

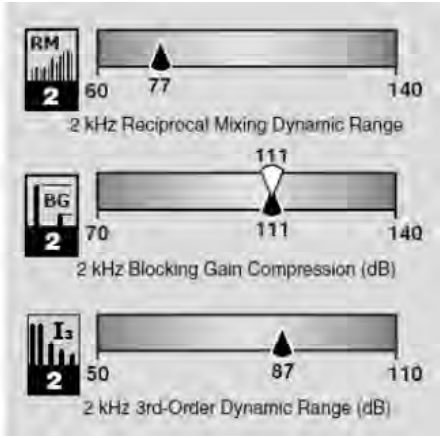
From 1976s through 2006 the ARRL and I tested radios in a 500 Hz bandwidth. Worst case data was published whether a radio was Intermod Dynamic Range Limited or Phase Noise (reciprocal mixing) limited.

Between 2007 – 2011 the League virtually took the effect of synthesizer phase noise out of the picture by making dynamic range measurements with a spectrum analyzer and a 3 Hz filter bandwidth.

While this measurement is technically accurate, the data usually had little correlation to how the radio performed on the air. It also eliminated the incentive for the OEMs to improve their synthesizers.

In the Fall of 2011, with the help of Adam Farson, VA7OJ, the League agreed to emphasize Reciprocal Mixing Dynamic Range (RMDR).

New Graphic for RMDR, IC-9100 Review



QST April 2012 P. 54

From a practical stand point, the 77 dB value is the limit on the air, not the 87 dB value.

IC-9100 RMDR Table Data QST 4/2012

Reciprocal mixing dynamic range,
500 Hz bandwidth, 3 kHz roofing filter:
14 MHz, 20/5/2 kHz offset: 101/80/77 dB.

In a CW pile-up, the reciprocal mixing limitation is more of an issue (77 dB) than if the QRM was up or down the band 20 kHz (101 dB)

Bob clearly explains importance RMDR

Note how reciprocal mixing relates to the two-tone third order DR figures, especially at 5 and 2 kHz spacing. A *single*, strong adjacent signal 5 or 2 kHz from the desired signal with resulting reciprocal mixing has a greater impact on a your ability to hear a desired weak signal than do *two* strong signals 5 and 10 kHz away (5 kHz spacing) or 2 and 4 kHz away (2 kHz spacing) with a resulting intermodulation distortion (IMD) product that covers up the desired signal. In many cases, reciprocal mixing dynamic range is the primary limiting factor of a receiver's performance.
– Bob Allison, WB1GCM, ARRL Laboratory Engineer

Elecraft KX3 December QST 2012

- For some reason, the next HF transceiver review lost the RMDR graphic, but the reciprocal mixing data was published.

Reciprocal mixing dynamic range (500 Hz BW):

14 MHz, 20/5/2 kHz offset:
120/119/114 dB

Third order dynamic range at 5 kHz, QST = 103 dB
Note: Phase noise is 16 dB better than the third order dynamic range. This is the best phase noise ever published in QST for an amateur transceiver !

FTdx-3000 QST Review April 2013

- Concerns:
- The RMDR Graphic is missing again.
- The table data is there, but not emphasized
- Third-Order Dyanmic Range with 3 Hz testing method = 100 dB @ 2 kHz
- RMDR @ 2 kHz = 82 dB !
- Quote from QST: “Reciprocal mixing dynamic range (-82 dBc at 2 kHz offset) is also an improvement over the FT-2000.”
- Not mentioned that RMDR is 18 dB worse than the third order value of 100 dB!
- The 100 dB number is meaningless on the air.

How to sort the wheat from the chaff

- The problem for the less technical amateur is how to sort out the data if one is considering advertized or QST lab values in making a purchasing choice.
- Bob Allison (QST Lab Engineer) clearly stated that RMDR is often “the primary limiting factor in receiver performance”.
- Since the RMDR graphic in QST was published only once a year ago, this data is easily overlooked.
- From Yaesu web site:
- **With frequency separation of only 2 kHz between the desired signal and an interfering signal, the dynamic range measures 106 dB and IP3 +33 dBm.**
- The 82 dB RMDR value is the real limit, not 106 dB !

Some Amateurs Upset

- Many hams have contacted me after buying a radio to say they feel mislead.
- If published data (magazine ads or ham publications reviews) emphasize performance that is 10 to 20 dB better than on-air performance, we have a problem.
- There was a flurry of chatter after I published the FTdx-3000 RMDR of 82 dB Dec 13, 2012.
- QST confirms the 82 dB value, but most hams are only seeing the 100 to 106 dB numbers !

E-mail quote from Bob Allison to Rick Stealey, K2XT

- “If one is serious about performance, that person will have a very large antenna array on a tall tower. After spending 10's of thousands of dollars on an antenna farm, one would hopefully choose a transceiver with the highest dynamic ranges and would consider each dynamic range carefully.”
- “The point is moot with a dipole antenna or even a tribander; there's just not enough voltage at the antenna jack to notice RM or 3 IMD DR.”
- This second bullet is NOT TRUE !
- Nearby locals can certain cause RM or DR3 limitations.

Examples of strong signals causing RM & DR3 IMD

- Locals, particularly 160 and 80 meters
- Field Day, a very difficult environment
- Multiple transmitters in Multi-Multi or Milti-2
- Multiplier station in a contest
- DXpedition with more than one transmitter
- East Coast short skip on low bands
- 40 meter broadcast, particularly EU stations

How do we chose a new transceiver?

- We should look at lab data, but the numbers can be misleading.
- It is a numbers game today!
- Evaluation in contest conditions is critical.
- A lab setup can never approximate CQ WW !
- There are many factors, as I have discussed here at CTU over the past 5 years.

Important factors to consider

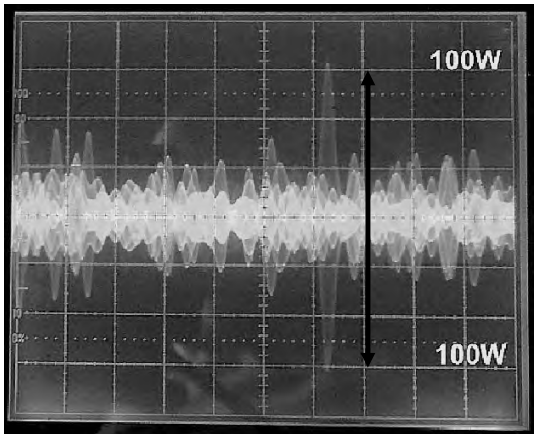
- Contest Fatigue is made worse by crappy receive audio and poor AGC performance.
- Bad ergonomics can drag down your score.
- Transmit IMD (splatter) is not improving.
- Is speech processor adequate?
- Is firmware regularly updated?
- Is warranty service done well and quickly?
- Is the radio supported with parts and service after it is out of production?
- Bottom Line: Do you enjoy using your radio?

Examples of problems from past CTUs

- It is amazing what gets into production, isn't even mentioned in reviews, but degrades performance on receive and transmit.
- TS-590S has a 80 to 100 watt ALC spike on SSB when set to 50 watts to drive a low drive linear. (Alpha 87A, 9500, Acom 1500, 2000)
- This causes splatter and can blow a low drive ceramic tubes.

Courtesy Adam Farson – VA7OJ

Set to 50 Watts Key Down - White Noise



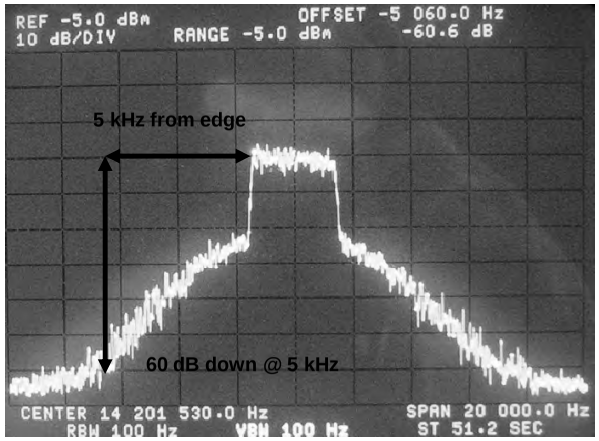
6 Div = 100 W PEP. Rig at half power, but spikes to 100 watts every 2 or 3 sec.

Transmit Intermodulation IC-7410

- White noise fed into mic jack to approximate speech using IC-7410.
- (This is a typical example, not just this rig.)
- Look at the “shoulders” of IMD close-in to the transmit passband.
- If this station is 3 kHz away and is strong, hearing a weak signal will be difficult.

Noise source = GR 1381, 5-kHz -3 dB BW

Icom IC-7410 Class AB, White Noise

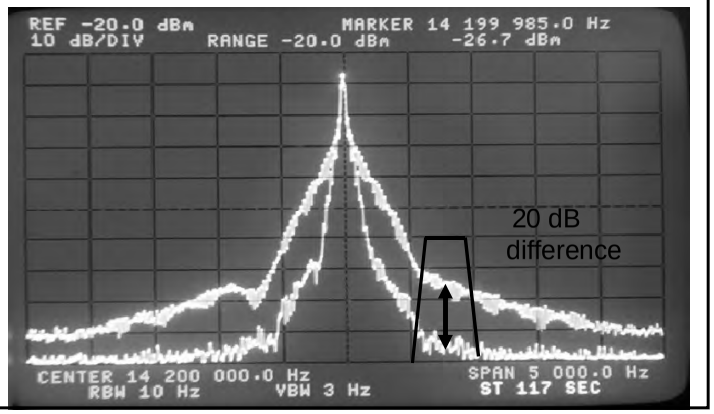


Broad signals Also Exist on CW

- The following slide shows the difference between a rise time of 3 milliseconds vs. 10 milliseconds.
- There is a 20 dB difference in the strength of the key click 700 Hz removed from the transmitting station.
- (Transmitter was a Ten-Tec Omni-VII that has a menu to adjust the rise time.)

Spectrum of CW Signal on HP 3585A Analyzer

Comparison of 3 msec vs 10 msec rise time



AGC Impulse Noise Anomaly

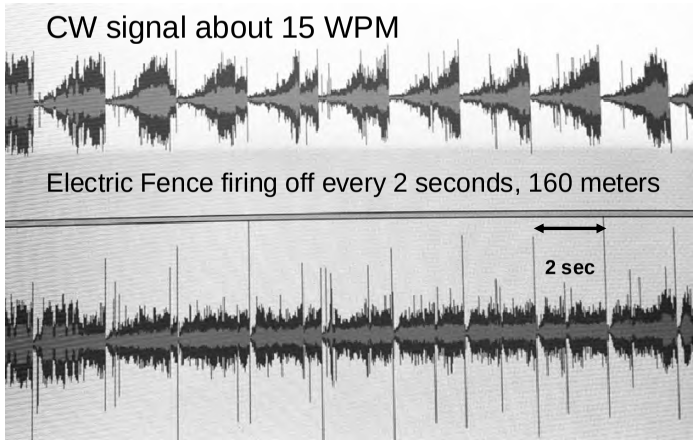
Most new radios since 2003 exaggerate impulse noise.

The exceptions: Elecraft K3, KX3 & Flex

Programmed DSP to ignore a tick, click or pop.

Elecraft calls it the Sherwood Test.

Omni-7 on Top - Pro III on Bottom



Listen to 30 second audio clip

- Audio Icom 756 Pro III
- 160 meters, 4 PM, Dec 13, 2008
- Electric fence & CW signals
- KV4FZ calling DX station
- Note volume level relatively constant

Audio clip with DSP AGC problem

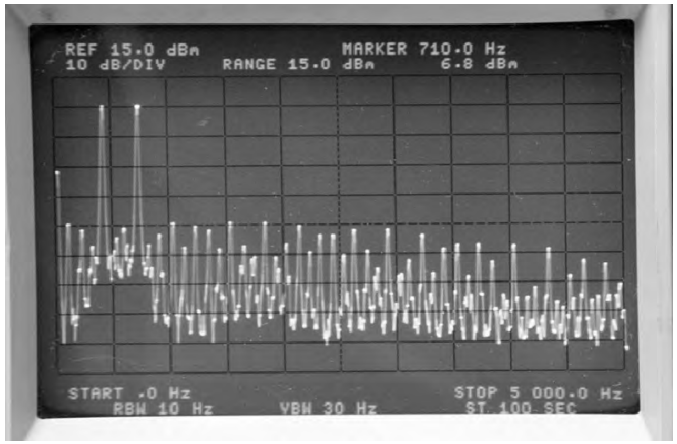
- Audio Ten-Tec Omni-VII
- 160 meters, 4 PM, Dec 13, 2008
- Electric Fence & CW signals
- Exact same signals as with Pro III
- Note AGC being hammered by impulses
- Other rigs with the same AGC problem:
- IC-7800, IC-7700, IC-7600 & IC-7000
- FTdx-9000, FTdx-5000, FTcx-3000
- Orion I & II

Contest Fatigue from audio artifacts

- In the “good old days”, a pair of 6V6s in push pull were common. Audio was smooth and pleasant.
- Often today receive audio is an after thought.
- The rig manufacturers need to be concerned about the noise and distortion beyond the 300 to 3000 Hz bandwidth. Our ears hear much more than 2700 Hz of bandwidth.

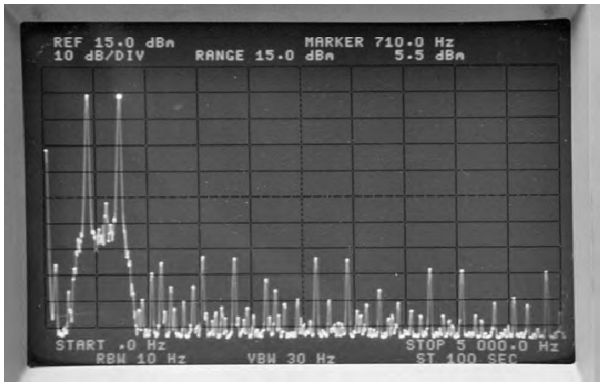
Factory Confirms K3 Audio Problem

Screen shot from Elecraft Lab Fall 2008



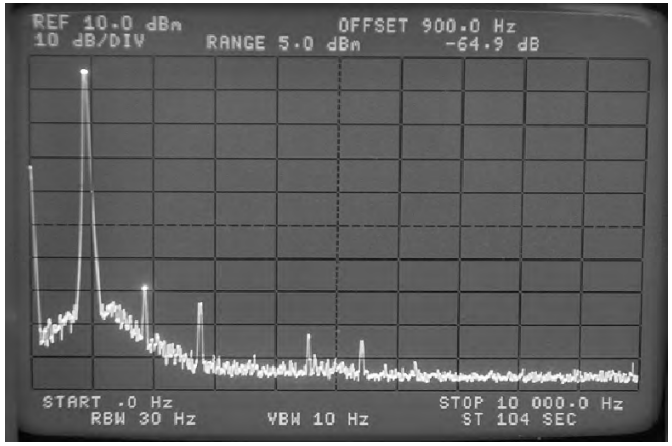
Factory Addresses K3 Audio Problem

K3 After New Choke Installed



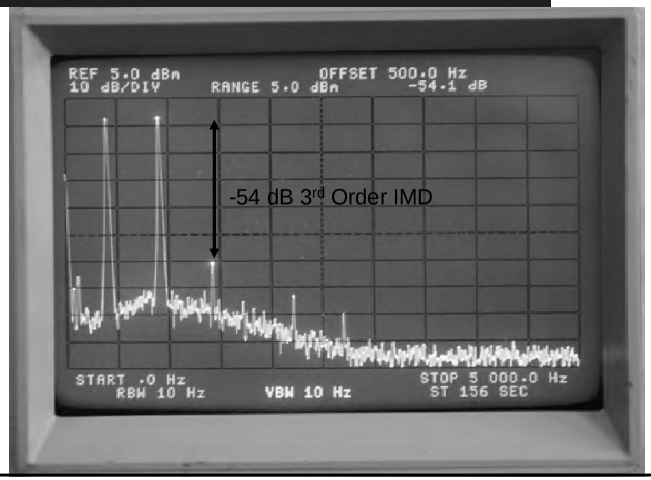
0.1 % distortion

Icom 756 Pro III Harmonic Distortion



< 0.3 % distortion

Icom 756 Pro III in-band IMD Distortion



Choices today on rig selection

- We have rigs for $1000 to $18,000 for sale.
- Many do well in contest conditions.
- It is hard evaluate on-air performance from some of the published data.
- Many aspects of a radio affect contest scores
- In the end, hopefully you enjoy using your rig on the air !

Sherwood Engineering

http://www.sherwood-engineering.com

http://www.NC0B.com

INRAD
international radio

Introducing the Inrad HF Triplexer



The Inrad HF Triplexer is the perfect solution for adding more fun and points at Field Day:

- Perfect for Field Day!
- Three stations may share one 10M/15M/20M tribander simultaneously using a single feedline. (Note: additional bandpass filters may be necessary to protect receivers.)
- Maximize your station's flexibility!
- Input Power Level (per radio port): 200W ICAS (into < 1.5 VSWR antenna)
- Insertion Loss: 0.25–0.35 dB (typical)
- Isolation (typical):

	20M Xcvr A	15M Xcvr B	10M Xcvr C
20M	–	25 dB	30 dB
15M	30 dB	–	20 dB
10M	>40 dB	20 dB	–

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TEL: 1-831-462-5511 ■ FAX: 1-831-612-1815

WRTC 2014
World Radiosport Team Championship

July 8 - 14, 2014
Contesting's Best are Coming to New England!

In July 2014 the world's top radio contesters will converge on the Northeast United States for the 7th World Radiosport Team Championship. This will be the first WRTC held in the United States since 1996.





Removing the variables of geography, power, and antennas, 59 two-operator all-star teams will battle for personal and national pride on a world stage.

More than just a competition, WRTC is an opportunity for competitors, referees, and visitors from around the world to make and renew friendships.





WRTC 2014 needs your help.

Funding for construction of the 59 identical stations comes from the generosity of the contesting community. Donations via PayPal to donations@wrtc2014.org. WRTC2014, Inc. is an IRS approved 501(c)(3) public charity.

What is WRTC?

Contesting is a unique sporting challenge. Everyone is trying to make the best score they can, but inequities such as location, power, antennas, and more make it difficult to compare one score with another. Held every four years, the World Radiosport Team Championship brings some of the world's best operators together to compete on a level playing field. The result is an intense all-star competition and showcase of amateur radio capabilities.

Qualifying to be a competitor in WRTC 2014 is based on 12 contest scores accumulated over a 3 year period. Operators who earn a coveted entry are truly some of the best in their region of the world.

Want to be involved?

In addition to the 118 competitors and 59 referees, there are hundreds of people who help make the competition possible. We need help with station setup, drivers, hosts, and logistics support. Be a part of WRTC 2014 and take advantage of this rare opportunity to meet and learn from these top operators.

If you can't make it to New England, you can still participate by working the WRTC stations and submitting your log to help with the log checking.

The first test of the WRTC stations will occur during the IARU Radiosport Contest July 14-15, 2012. Join us in person or look for us on the bands.

Participate in person or on the air…Plan to be a part of WRTC 2014!

Feel the excitement – Watch the video at www.wrtc2014.org

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WRTC World Radiosport Team Championship 2014

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