·CTU·
CONTEST UNIVERSITY

ARRL National Centennial Convention

Connecticut Convention Center

ARRL 100 YEARS

Hartford, Connecticut

July 17, 2014

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Printed in USA.

First Edition

Welcome

On behalf of the CTU Board of Directors, K1DG, N9JA, K1AR and the 6 Professors of Contest University Centennial we are pleased you are here and we extend a warm welcome to you!

This is the 26th Contest University in eight years. Nine have been held in Dayton, two in South America (Brazil), twelve in Europe (England, Germany, Finland and Italy), one in Australia, one in Russia and now one here in Hartford, CT.

Six presentations are available here at CTU Centennial today. They are the product of many hours of hard work by your Professors and Teri, K8MNJ. Please remember to thank them.

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

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

Very 73!

Tim Duffy K3LR
CTU Chairman
Hartford, Connecticut
July 2014

Table of Contents

CTU Presents

Contest Hints and Kinks

Ward Silver, NØAX

Overview

- Priorities
- Building On Success
- Bang for the Buck
- Refine & Enhance
- Q&A – Anytime!

Who the Heck is NØAX?

- And why do you care?

Goals of the Session

- Provide tips, suggestions, and guidelines
- Give you ideas for your own circumstances
- Find “Score dB’s” and “low-hanging fruit”
- Develop confidence in your own abilities
- Laff

Assumptions about you

- Contesting for a couple of years
- You feel comfortable with CQ or S&P
- A Division, State, or Regional winner?
- Decent radios and antennas
- Taken and given some lumps
- Want to give some more lumps
- What's the best way to get better?

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How To Use This Course

- Not a how-to cookbook
- Follow in the text
- Take short notes
- Record those ideas!

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Continuous Improvement

- When asked what was the most powerful force in the Universe, Albert Einstein replied, "Compound interest."
- Incremental improvement, applied relentlessly, is unstoppable.
- Plaques are won a dB at a time
- Hints & Kinks are the ham radio equivalent of incremental improvement.

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Most Powerful Improvements

Operator First
Technique Second
Antennas Third
Radios Fourth
Gadgets Last

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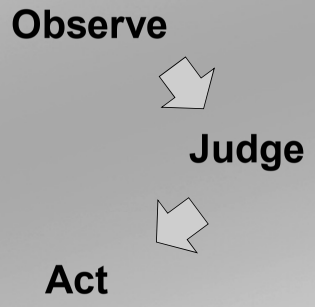
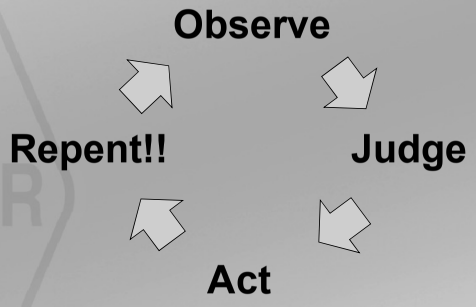
Cycle of Life



Cycle of Life



The Operator

- Ergonomics
  - Incredibly important
  - Fun or Slog? – Choose!
  - Maintain concentration, remove distractions
  - Make it ***EASY*** to do the right thing!
    - Especially when you are tired…
  - Labels and logical layout
  - Preserve and enhance accuracy

The Operator

- Head and Eyes
- Back & Arms
- Your Butt
- Fitness (Before and During)

Fitness

- Personal fitness
  - Blood flow and stamina
- Techniques for remaining alert
  - Diet, Catnaps, Breaks
- Understand your body rhythms
- Pacing - trade low-rate periods for sleep
  - Review old logs to find the right off-times
- The 90-minute magic

Knowledge

- Know your station equipment
- Study propagation – include possible events
- Learn your software
  - Turn ***OFF*** unneeded features and options
- Recognize calls
- Learn the goofy prefixes and zones
- Memorize approximate bearings by zone

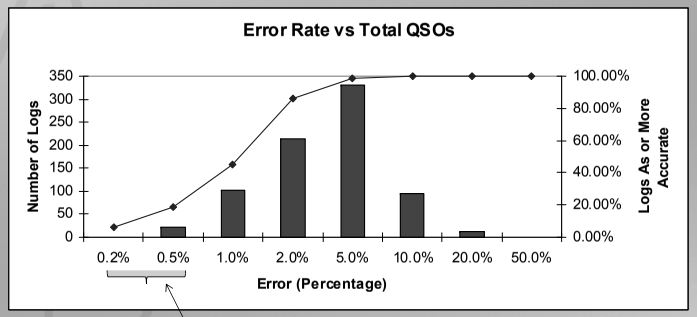
Technique

- Number one source of score dB's
- Practice makes the master
- Listen to the masters – up close and personal
  - Start working with multi-op teams
  - Or start one!
  - Ask them questions!
- Trade recordings or listen live

Technique Gimme's

- Run more and whenever you can
  - Find propagation that allows your station to run
  - You don't have to be on the band edge!
  - Think signal-to-noise on both ends
- Learn when ***NOT*** to log it! Avoid penalties!
- Type – send – speak – copy accurately
- Breathe, be consistent, find a rhythm
- The second radio – make it play

Technique - Accuracy



Here are the Top Ten – get there!

Technique – Accuracy

- Go for world class accuracy (<1% error)
- Study that LCR/UBN report
  - What do you consistently miss?
  - What do others consistently miss from you?
- Pull out full calls
- Avoid databases and be wary of prefill
- Don't trust spots from *any* source
- Learn not to guess and when to move on

Technique – Managing Time

- Running is key
- Rate meter – QSOs per multiplier
- Distractions
  - Spots and DX-ing
  - Fiddling with the antennas and rig controls
- Plan your operating time but be flexible
- Go get that next contact!
  - No TV, no Facebook, no browsing, no chat

Technique – Managing Score

- Watch for & move mults (Sunday!)
- Avoid penalties at all costs
- Expeditions – work 'em all!
- Make skeds – during the contest
  - Plan for propagation before the contest starts
  - Know the grey line
- Quick reviews of the situation now and then
- Compare to last year or the competition

The Second Radio

- Start simple
  - Spare transceiver
  - Amp not necessary
  - Vertical and 100 watts can work a lot of stuff
  - Filters are worth it – build or buy
- Learn your program's keystrokes
- Make SO2R *normal*

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The Second Radio

- Taking it up a level
- The quick QSY – be ready!
- Running and tuning at the same time
  - Learn to listen to two audio streams at one time
  - Practice shifting your focus
- Automate to beat fatigue
  - Build or buy a single-box controller
  - Make the layout match the equipment

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Pileup Management

- Don't panic – set a rate you can maintain
- Respond in a consistent amount of time
  - This establishes a rhythm and keeps order
- Pick the fast guys first
- Listen for "DX sound" and odd first letters
- Manage your RF Gain and Attenuation
- Learn to rely on your ears for filtering

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Interstation Interference

- Filters at the exciter, stubs on the amp
  - Wide-band noise must be filtered ***at the xmtr***
- QRP (and maybe LP) can S&P on the same band as the run radio!
  - Protect the receiver front end
- Bypass diodes connected to wires
  - Rotor control boxes, relay kickback diodes
- Good RF bonding of all equipment

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Antenna Selection

- Hear the next level (they already hear you)
- Think in terms of steps
  - Hear better, then transmit better, step-by-step
- Simplify switching and aiming
  - Contesting is not DX-ing
- A “temporary” tribander for mult-rich area
- Explore receive antennas on low-bands
- Still the biggest bang for the buck

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Software

- Turn off unused features & windows
- Upgrade and test ***before*** Friday
- Arrange windows to match your layout
- Learn how to edit a previous QSO while not suspending a run
- Put the monitor where you can see it easily
- Be familiar with several major programs

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Resources

- Other contesters & your contest club
- SO2R page - www.k8nd.com/Radio/SO2R/K8ND_SO2R.htm
- Amps, Towertalk, Top Band, cq-contest email reflectors
- W2VJN’s “Managing Interstation Interference” from International Radio
- W4RNL Antenna design via antennex.com
- ARRL *Contest Update* and NCJ

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Most Powerful Improvements

Operator First
Technique Second
Antennas Third
Radios Fourth
Gadgets Last

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Thanks!

And go get 'em!

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ICOM

Ergonomics for Contesters

Improve your scores by increasing your comfort and reducing fatigue

Doug Grant, K1DG
Contest University Hartford
July 2014

What is ergonomics?

- *Ergonomics is adapting the physical requirements of the job to suit your needs, especially your comfort.*
- *For contesting:*
  - *making your station more comfortable*
  - *less tiring as you spend long hours in the chair*

Comfort

- In contesting "chair time" is essential to success
- The longer you can stay seated comfortably at the rig working stations, the more points you'll make
- When you think about making changes to your operating position, comfort should be a first priority

How do you optimize a task involving man & machine?

- "***The Principles of Scientific Management"*** Frederick Winslow Taylor, 1911
  - Replace rule-of-thumb work methods with methods based on a scientific study of the tasks
- Measured time for component tasks to 0.01 minute
- Taylor's Shovels
  - Determined the optimum load for shoveling: 9.75kg
  - Designed different-size shovels for different materials

Frank and Lillian Gilbreth Motion Studies

17 “therbligs” (motion units) plus Rest to overcome fatigue

- Search
- Find
- Select
- Grasp
- Use
- Pre-position for next operation
- Unavoidable delay
- Avoidable delay
- Plan
- Hold
- Position
- Assemble
- Disassemble
- Inspect
- Transport loaded
- Transport unloaded
- Release load

How does this relate to Contest Station Design?

- Making QSOs faster means wasting less time:
  - Searching for the VFO/AF Gain… knob, Finding the knob
  - Selecting the antenna, Grasping the paddle
  - Using the keyboard, Pre-position the RIT for next operation
  - Unavoidable delay waiting for a slow caller
  - Avoidable delay reaching for the antenna switch
  - Planning to call someone split

Fatigue

- Being uncomfortable for long periods of time leads to fatigue.
- In a contest, fatigue will reduce your QSO rate and increase your errors
- A well-designed, ergonomic operating position should minimize fatigue

Chair, desk and equipment layout

- These are the three main areas where you can customize your operating position to suit your personal requirements.
- Included with equipment is:
  - Keyboard, mouse and monitor
  - Keyer paddle, mic/headphones
  - Rig, amplifier
  - Tuners, antenna switches
  - Other controls/accessories.

Features to look for in a chair

- Adjustable height
- Lumbar support
- Adjustable or removable arm rests
- Comfortable seat cushion with support extending to the back of the knees

Lumbar (lower-back) support

- Important for long-term comfort.
- Ergonomically-designed chairs fit the curve of your back.
- You can add lumbar support to your existing chair
- Lumbar-support cushions are available
- A rolled up beach towel or small blanket can also be used

The Chair

- Should have adjustable seat height
- Adjust the height of the seat for:
  - 90-degree bend in your knees
  - 90-degree bend in your hips, when seated with your feet flat on the floor
- Adjust arm rests so they fit under the desk

Chairs - Which one will enable you to make more QSOs?

"Aeron"
Herman Miller
$900

"Leather Executive Chair"
Wal-Mart
$60

The answer:

- Whichever one you sit in the longest!
- "Time in the chair" is a key determinant of contest success (both during and *before*)

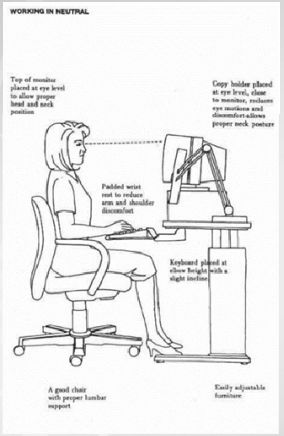
Bring your own

- Some multi-op stations do not have enough "good" chairs.
- Bring your own chair, especially if you have one that's comfortable for long sessions at the rig

The desk

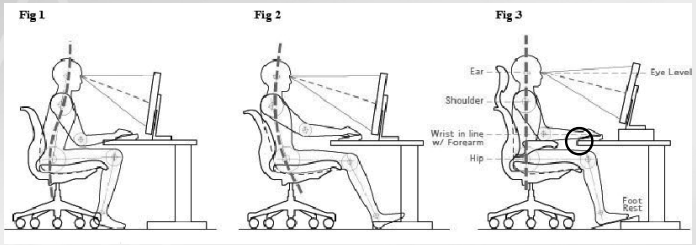
- Most desk tops are too high for comfortable use of a computer keyboard.
- When seated, your arms should have a 90-degree bend at the elbows (that "90-degree rule" again) as your hands reach to the keyboard.

Desk height vs. operator height



Op Height	Table Height
5'0" - 5'3"	25"-26"
5'4" - 5'6"	26"-27"
5'7" - 6' 0"	27"-30"
6'1" - 6'5"	30"-32"

Getting comfortable



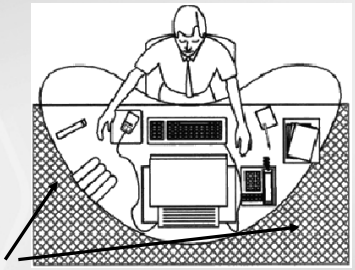
- Figure 3 shows the correct – most comfortable – position
- Avoid sharp edges on the desk if possible

Monitor placement

- The computer monitor should be directly in front of you at eye level so you don't have to look up, down or to the side to see it
- It also needs to be the correct distance from your eyes so you can see without squinting or leaning forward
- If you wear bifocal eyeglasses, consider buying a pair of mid-distance "computer glasses"

View from the top

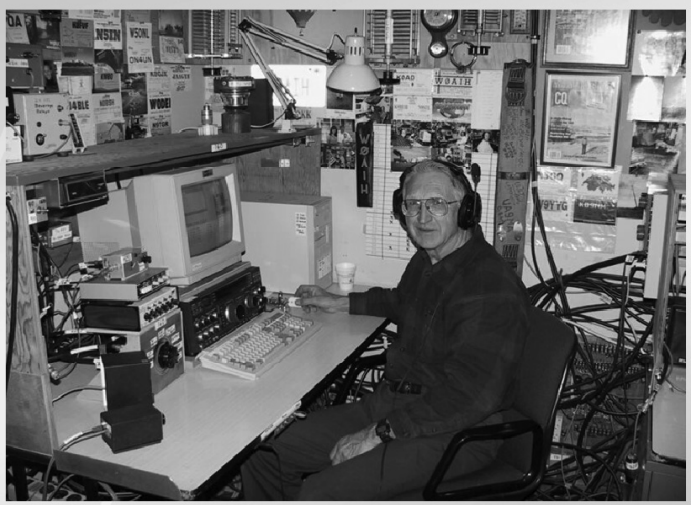
- Keyboard and mouse within easy reach and monitor straight ahead



- Use this area for power supplies, tuners, things not used often

Where does the rig go?

- Where it can be seen easily
- Controls can be accessed without reaching, turning or twisting
- For most single op stations, placing the rig below the monitor is a good choice
- SO2R stations may want to place radios side-by-side below the monitor

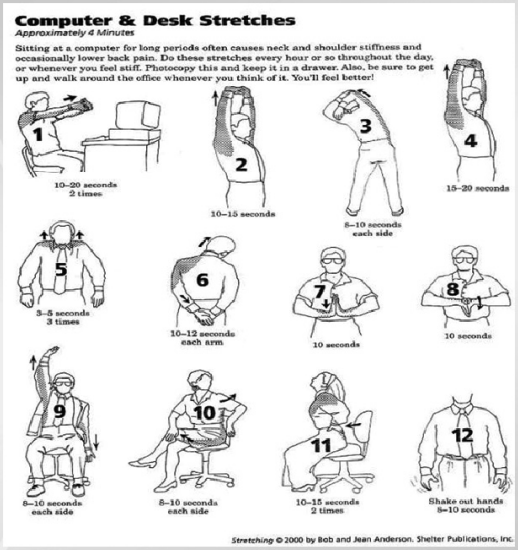


WØAIH 160 operating position

WC1M SO2R

Stay awake and alert

- Stand up and move around at least once every hour
- Sitting for long periods of time can make you uncomfortable, stiff, cause cramping
- Can cause more serious health problems like DVT
- Do simple stretching to stay loose and keep blood flowing
- Wear loose, comfortable clothes



Food and Drink

- Light snacks only
  - Too much input --> too much "output" --> too much time off
- No alcohol
  - Water is best…maybe "Gatorade"-type drinks
  - Coffee, Red Bull, etc. in moderation for single-ops
- Keep in shack to minimize time off (and temptation)
- Multiops: have good coffee!!!

Comfort is your goal

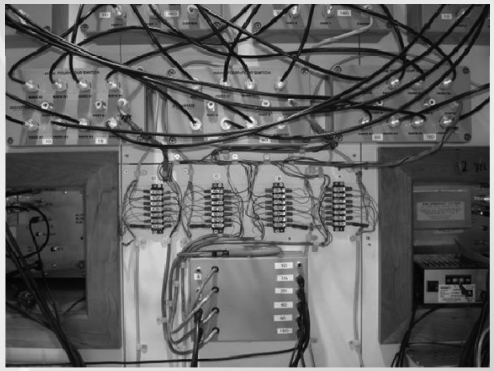
- The objective of making ergonomic improvements to your operating position should be to make it more comfortable for contesting
- If you can reduce fatigue and increase your comfort, you'll make more QSOs
- Start with a few just a few changes and add others as you think they're needed

Keep wiring neat and accessible

- When things break, you must be able to fix them quickly
- Long repair time = less QSO time!
- If things are neat, they can be located and repaired

WW4LL Station on Wheels

Which station would you rather fix? This one…



Or this one?

Neat wiring won't make you louder.

It does make things easier to fix when things go wrong

And when things go wrong, you aren't loud at all

Additional Ergonomic Considerations

- Heating/cooling
  - Continuous CQing generates a lot of heat
  - Even in W1, need cooling in winter contests
  - Basement shacks: keep feet off the floor!
- Acoustic Noise
  - Close the door
  - Isolate the HVAC acoustics from the shack
  - Consider noise-cancelling headphones

For Multiops

- Your 2-10 weekend guests need:
  - Food
  - Coffee
  - A quiet place to sleep
  - A place to shower
  - Parking spaces
- A nice meal after the contest is over

K3LR Flavia® Coffee Station

Quiz: How many mistakes can you find in this station?

Antennas and QTH are OK!!! (VY2ZM)

Friedrichshafen 2010

Thank you

Low Frequency Receiving Antennas for Small to Mid-Size Lots

Useful directivity on less than 1/10 acre
Higher performance on less than ¼ acre
Very high performance on less than ¾ acre

Frank Donovan
W3LPL

Why Receiving Antennas?

- Much better performance than most transmitting antennas
  - especially on 160 and 80 meters
- Greatly reduced footprint
  - excellent directivity on less than an ¼ acre
  - superb directivity on less than 3/4 acre
- Greatly reduced height
  - loops and loop arrays
  - Beverage and Beverage on Ground (BOG)
  - 24 foot phased verticals
- Greatly reduced mutual coupling between individual verticals
  - simplifies receiving antenna design, and phase and amplitude adjustment
- Greatly reduced need for efficiency
- Much lower cost

All dimensions in this presentation are for 160 meters
Simply scale them to 80 or 40 meters

Receiving Directivity Factor (RDF)

- Accurate, proven measure of receiving antenna performance
  - forward gain at the desired azimuth and elevation angle compared to average gain over the entire hemisphere
- 4 dB: small diameter "magnetic" loop
- 5 dB: single vertical antenna (1/4 wavelength vertical or a short vertical)
- 4 - 6 dB: 250 - 400 foot Beverage
- 4 - 6 dB: Beverage on Ground (BOG)
- 6 - 8 dB: small loop arrays (flag, pennant, EWE, K9AY, Shared Apex Loop Array)
- 9 dB: two element or triangle array of short verticals (80 foot spacing)
- 10 dB: 500 - 600 foot Beverage
- 11 dB: two or three close spaced 500 - 600 foot Beverages staggered 65 feet
- **12 dB: 4-square array of short verticals only 80 feet on a side (3/16 acre)**
- 13-14 dB: four short verticals switchable in two directions (less then 1/2 acre)
- 13-14 dB: steerable 8-circle array of short verticals (3/4 acre)

Reradiation from nearby antennas and power lines can degrade actual RDF
especially high RDF arrays

Popular Receiving Antennas

- Small loops (good)
  - small diameter "magnetic" loop
  - fixed unidirectional terminated loop (e.g., flag, pennant, EWE, K9AY)
  - electrically steerable compact array of loops (e.g., K9AY, Shared Apex Loop Array)
  - mechanically rotatable unidirectional terminated loop (e.g., rotatable flag)
- Beverages (better)
  - single wire Beverage
  - Beverage on ground (BOG)
  - two wire bi-directional Beverage or BOG
  - arrays of two or three close spaced Beverages or BOGs
- Arrays of short verticals (best)
  - active high impedance 24 foot verticals
    - requires a high input impedance amplifier at the base of each vertical
  - passive low impedance 24 foot verticals
    - requires 8-16 short radials at the base of each vertical
      - stabilizes feed point impedance in all weather, decouples feed line shield
    - four 25 foot umbrella wires
      - reduces the required height to 24 feet
      - increases the bandwidth of the array

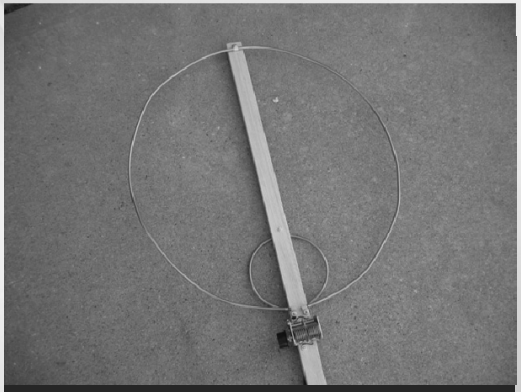
Small Loop Antenna
"Magnetic" Loop

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

The "Magnetic" Loop is a Specialized Antenna

Small Diameter Loop Antenna

inexpensive and very easy to build and use
24 - 36 inch diameter
bidirectional 150 degree 3 dB beam width
4 dB RDF



http://tomthompson.com/radio/ReceivingLoop/loop.html

Electrically Steerable Loop Arrays

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

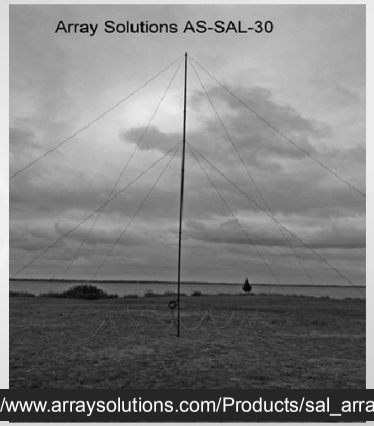
Two K9AY Loops

very small 25x25 foot square footprint
switchable in four directions
120 degree 3 dB beam width
7 dB RDF in 1/70 acre

www.arraysolutions.com/Products/lowbandrcv.htm

Shared Apex Loop Array

50x50 foot square footprint
switchable in eight directions
75 degree 3 dB beam width
8 dB RDF in 1/20 acre

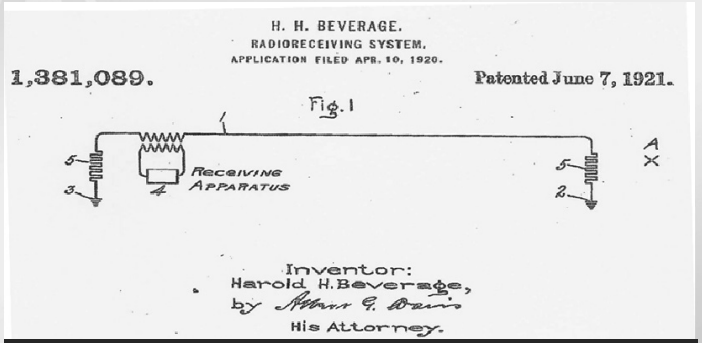


http://www.arraysolutions.com/Products/sal_array.htm

Single Wire Beverage

a very simple, effective and inexpensive antenna

250 - 400 feet long	4 - 6 dB RDF	100 degree beam width
500 - 600 feet long	10 dB RDF	70 degree beam width


H. H. BEVERAGE.
RADIORECEIVING SYSTEM.
APPLICATION FILED APR. 10, 1920.

1,381,089. Patented June 7, 1921.

Fig. 1

Receiving Apparatus

Inventor:
Harold H. Beverage,
by Albert G. Davis
His Attorney.

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

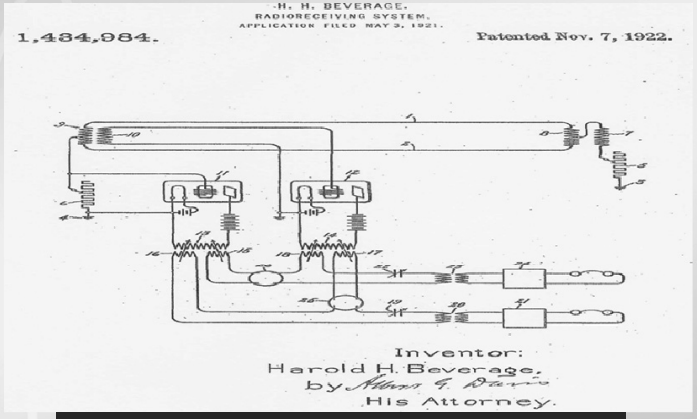
Beverage on (or near) Ground

a good choice when stealth is important
only 200-250 feet long
longer lengths often degrade performance
70 - 100 degree 3 dB beam width
6 - 8 dB RDF

http://www.n4dj.com/Beverage.html

Two Wire Bidirectional Beverage

two directions by using one switched feed line
deep steerable rear null if both feed lines feed a variable phase combiner


H. H. BEVERAGE.
RADIORECEIVING SYSTEM.
APPLICATION FILED MAY 3, 1921.

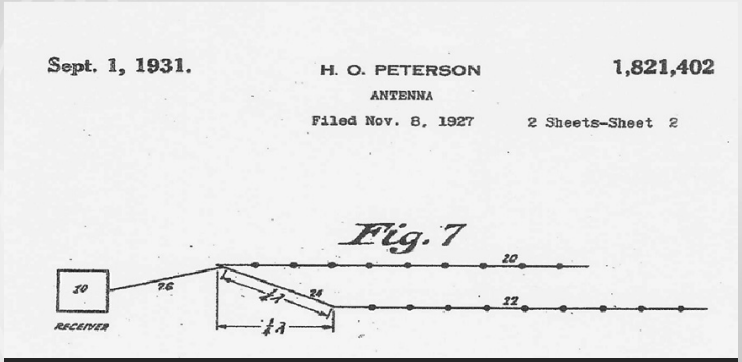
1,434,984. Patented Nov. 7, 1922.

Inventor:
Harold H. Beverage,
by Albert G. Davis
His Attorney.

http://www.w0btu.com/Beverage_antennas.html

Close Spaced Beverage Arrays

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


Sept. 1, 1931. H. O. PETERSON 1,821,402
ANTENNA
Filed Nov. 8, 1927 2 Sheets-Sheet 2
Fig. 7
RECEIVER

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

Phased High Impedance Verticals

Two or More 24 Foot Verticals

- No radials
- No umbrella wires
- 80 foot element spacing
  - somewhat closer spacing is possible with precise phase and amplitude alignment
- High input impedance amplifier at the feed point of each vertical
  - stray capacitance at the base of each vertical and at the input to each amplifier must be as low as possible
- Switchable in multiple directions
- Verticals cannot be installed within ten feet of nearby objects
  - trees or any conductive or partially conductive structure
- Avoid re-radiated signals from nearby antennas and power lines
  - locate the antenna as far as possible from other antennas and power lines

http://www.hizantennas.com

Electrically Steerable 4-Square Vertical Array

four high impedance 24 foot verticals
no umbrella wires and no radials
80x80 foot square footprint
high input impedance amplifier at the base of each vertical
switchable in four directions
100 degree 3 dB beam width
12 dB RDF in 3/16 acre

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

Phased Low Impedance Verticals

Two or More 24 Foot Umbrella Verticals

- Radials are required at the base of each vertical
  - eight 70 foot radials, sixteen 35 foot radials or chicken wire
  - randomly laid on the ground or shallow buried, symmetry is not important
- Four 25 foot umbrella wires attached to the top of each vertical
  - reduces the needed height and improves array bandwidth by reducing Q
  - or use 35 foot verticals without umbrella wires
- As little a 65 foot element spacing
  - closer spacing is impractical for good performance
- Amplifiers are not needed at the base of each vertical
- Switchable in multiple directions
- Easy to homebrew your own antenna
  - large arrays are very tolerant of moderate amplitude and phase errors
- Low impedance verticals are tolerant of nearby objects
- Avoid re-radiated signals from nearby antennas and power lines
  - locate the antenna as far as possible from other antennas and power lines

Electrically Steerable 4-Square Vertical Array

four low impedance 24 foot umbrella verticals
four 25 foot umbrella wires per vertical
eight 70 foot or sixteen 35 foot radials per vertical
65x65 foot square footprint plus additional space for radials
switchable in four directions
easy and inexpensive to build
100 degree 3 dB beamwidth
12 dB RDF in 1/10 acre

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

Electrically Steerable 8-Circle Vertical Array

eight high impedance 20 foot verticals
no umbrella wires and no radials
requires a high input impedance amplifier at the base of each vertical
200 foot array diameter (less than 3/4 acre)
switchable in eight directions
50 degree 3 dB beam width, similar to a 5 element Yagi
13.5 dB RDF on ¾ acre

http://www.hizantennas.com/8_element_arrays.htm

Electrically Steerable 8-Circle Vertical Array

eight low impedance 24 foot umbrella verticals
four 25 foot umbrella wires per vertical
eight 70 foot or sixteen 35 foot radials per vertical
300 - 350 foot array diameter plus additional space for radials (3-4 acres)
switchable in eight directions
easy and inexpensive to build
50 degree 3 dB beam width, similar to a 5 element Yagi
13 dB RDF on two acres

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

K3LR Presents

Preparations for Multi-op Contests and Field Day

Many Kinds of Multi-op Opportunities

- Field Day - by far the most popular multi-op activity
- HF CW, SSB and RTTY contests from the U.S.
- HF CW, SSB and RTTY contest Dxpeditions
- VHF/UHF/microwave contest fixed stations
- VHF/UHF/microwave contest portables (often mountaintop)
- Small multi-single and multi-2 contest stations
- Medium multi-single, multi-2 and multi-multi contest stations
- Large multi-2 and multi-multi contest stations
- Casual
- Competitive, top ten finisher
- Highly competitive, top three finisher

Planning and Hosting a Multi-op

- Planning
  - start well in advance
  - what contest and category to enter? (answer this early in planning)
  - should we attempt a serious competitive effort?
  - full time operators, its difficult to integrate part-timers into competitive efforts
  - operator band assignments and schedules
  - try to appropriately match your operator and station resources
- Team building, leadership, operator training and station familiarization
- Creature comforts and safety
  - seating, sleeping quarters, food, restrooms, shower, fire extinguishers
- Protect your family's privacy and all of their usual weekend activities
- Pre-contest preparations
  - checklist of equipment, software and antennas to be verified before the contest

Team Roles and Skills

- Leadership and strategic planning
- Broad technical skills and expertise
  - technical planning
  - every detail of radios, amplifiers, computers, software and networks
  - antenna and tower design, construction, installation and maintenance
  - RFI mitigation techniques
  - skills and knowledge to fix anything quickly during 48 hours of operation
- Highly skilled operators
  - high rate runners with very low error rates
    - multiplier and QSO passing skills
  - search and pounce operators with CW Skimmer and DX Cluster skills
- Contest tacticians
  - skills and experience to make tactical operating decisions
  - detailed expertise and comprehensive knowledge of contest rules
  - propagation expertise

Station Equipment

- Well matched to operator capabilities and competitive goals
- Networked computers
  - one computer per operator with computerized CW and voice messages
  - connected to external DX Cluster and CW Skimmer networks
- Protect every receiver from all co-located transmitters
  - a band pass filter to protect every receiver
- Minimize or eliminate all sources of locally generated RFI
  - excessive signal levels from other bands
  - RFI from "RF flooding" of switching power supplies and other electronics
- Two stations per band (run and S&P) for highly competitive multi-multi
  - a lockout is mandatory to make two simultaneous signals per band impossible
  - S&P station capable of listening through the run station with little QRM
    - requires widely spaced receiving antennas

Towers and Antennas

- One tower , one tribander, 80 and 40 meter dipoles
  - entry level for multi-single
- One tower, at least two Yagis, 80 and 40 meter dipoles, 160 inverted-L
  - top ten multi-single competitor
  - entry level for multi-2
- 2 towers, 40-10M Yagis, 80M dipole, 160 inverted-L, receiving antenna
  - top three multi-single competitor
  - top ten multi-2 competitor
  - entry level for multi-multi
- 3 towers, 40-10M Yagis, 80M gain antenna, 160 Inverted-L, receiving ant
  - top three multi-two competitor
  - top ten multi-multi competitor
- 4+ towers, 40-10M Yagis, 80M 4-square, 160 verticals, 2+ receiving ants
  - top three multi-multi competitor

Field Day!

- By far the most popular multi-op activity
  - local clubs always need your help and expertise
- Most Field Day teams are casual or semi-serious
  - but not all…
- Excellent opportunity to develop multi-op skills (valuable life skills too!)
  - leadership
  - planning
  - team work
  - operating
- Lots of fun and camaraderie

Your Role as an Operator

- Many skills to be learned, practiced and perfected
  - high rate running
  - improving your logging error rate
  - passing multipliers and QSOs between bands
  - efficient, effective use of CW skimmer spots and packet spots
  - working effectively with operators on the same band and other bands
- Teamwork
  - competitive teams have high expectations of every team member
  - accommodating unavoidable non-contest commitments during the contest
  - team operating schedules, sleep schedules, meals
  - inevitably the best laid plans will occasionally go wrong
    - don't lose your cool!
    - contribute to the solution, never be part of the problem
- Enjoy the fun and camaraderie!

How do I get invited as an operator ?

- Develop some of the skills needed by a multi-op team
  - operating is just one of the many needed skills
- Get to know the station owners and team members
- Volunteer to help
  - even to just contribute unskilled labor when needed
- Don't wait to be invited… volunteer

What to do after you're invited ?

- Understand the goals of the team
- Understand the role you're expected to fill
- Don't underestimate (or misrepresent!) your skill level
  - practice and perfect your operator skills
- Always ask what you can bring or contribute
  - radios, headphones, keyers, food, soft drinks etc
- Don't expect to be a primary operator the first time out
- Remember, you're a guest in the station owner's home
  - treat the host's family and property with respect
  - thank the XYL and the host after the contest!

And Above All

Contribute to the enjoyment of the team members

- contribute to the success of the team
- learn and improve from your experiences
- and have fun!

Tips for Being a Better Single Operator

Randy Thompson, K5ZD

Purpose of this Session

- Discuss factors important to creating winning scores
- Discuss how to avoid score reductions

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!

Elements of Success…

A winning contester is…

PREPARED

Station Design

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

Station Layout

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!

A winning contester is…

STRATEGIC

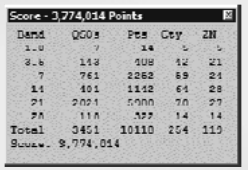
Choose the Game

- Set a goal
  - Have fun?
  - Win a certificate?
  - Set a record?

- Select category
  - All band or single band?
  - Power – High, low, QRP?
  - Assisted or unassisted?

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

Example - ARRL Sweepstakes

- You have 1000 QSOs x 80 sec
  = 160,000 points
- Which is more valuable?
  - 1 more section or 10 contacts?

1001 x 81 sections = 162,162 points
1010 QSOs x 80 sec = 161,600 points

It takes 14 contacts to equal that new section!

@60 QSOs/hour – 14 minutes
@30 QSOs/hour – 28 minutes

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 10 more contacts?

1001 x 352 = 986,586 points
1010 x 350 = 989,800 points

Each mult is only worth 2.8 QSOs!

@60 QSOs/hour – 4 minutes
@30 QSOs/hour – 7 minutes

All scores assume 2.8 points/QSO

Tips

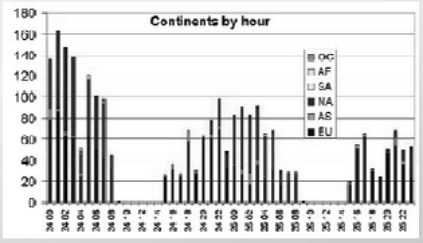
- Calculate trade offs based on expected final score!
- Short cut method
  - $Mult\ value = \frac{QSOs}{Mults}$
  - $Time\ value = \frac{QSOs}{Mults} * \frac{60}{Rate}$

The higher the rate…
The less time you can spend!

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

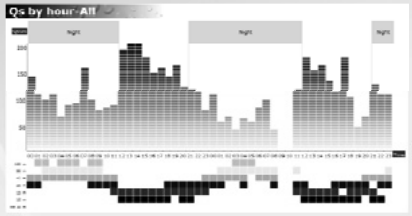
Log Analysis

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

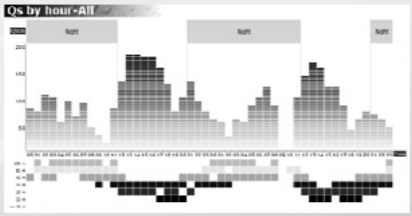


Activity Patterns Do Repeat

K5ZD/1
WW CW
2013



K5ZD/1
WW CW
2006



Rate charts by SH5 software

Make a Plan

- CQWW and WPX logs are open…what did your closest peer do differently?
  - Where do the QSOs come from?
  - Do activity patterns repeat?
  - What hours to be on the air?
  - Expected opening times for each band
  - When to "run" and when to "search"

A winning contester is…

EFFICIENT

Skills Development

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

A winning contester is…

ACCURATE

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
- *ERRORS REDUCE YOUR SCORE!!!!*

Cost of Errors

- Many contests have a penalty for errors
  - Loss of QSO
  - Loss of QSO + 1x, 2x, or 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
- CQ WW SSB 2013 logs had 108,210 calls
- 60,991 only appeared in only one log
  - Experience says >95% of these are errors
- 18,343 appeared in 20 or more logs
  - You should "know" 5,000 – 10,000 calls

Common Busts

SSB

- V and W
- E and I
- G and J

- WW SSB Most Busted
  - HA3ØS
  - B9/BY9GA
  - DFØHQ
  - TC9ØA
  - ES9C

CW

- I, S, H, 5
- V and 4
- B and 6

- WW CW Most Busted
  - JS3CTQ
  - ES9C
  - HF9Q
  - V47T
  - HA3ØS

Which of these calls are bad?

C73NL	FY5KE	LY7A	RG8U
CD6416	GT8IOM	OB9DCM	TM6M
E2E	1B1B	M5O	W0ASH
EY8MM	HI3TIJ	P3W	YU15OTC

Which of these calls are bad?

C73NL	FY5KE	LY7A	RG8U
CD6416	GT8IOM	OB9DCM	TM6M
E2E	1B1B	M5O	W0ASH
EY8MM	HI3TIJ	P3W	YU15OTC

Correct Calls

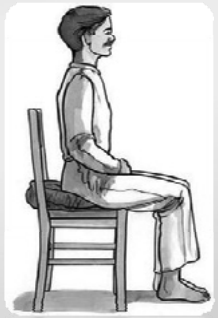
C37NL	FY5KE	LY7A	RG8U
CD6416	GT8IOM	HB9DCM	TM6M
E2E	IB1B	M5O	W0AIH
EY8MM	HI3TEJ	P33W	YU15OTC

A winning contester is…

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

Questions?

Hour 43 – The "look"

Randy Thompson, K5ZD
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CTU 2014 Presents

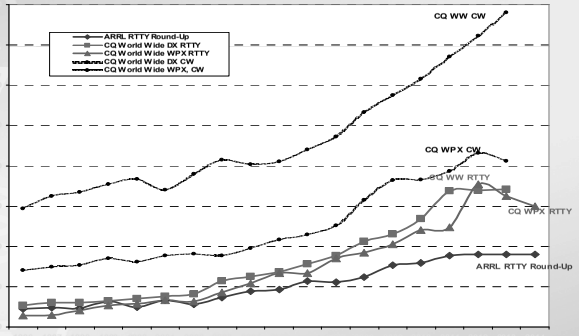
The Essentials of RTTY Contesting

Dennis Egan, W1UE
Ed Muns, W0YK

RTTY Contesting

- Introduction
- Part 1: Operating
- Part 2: Setting Up
  - RTTY Decoder/Encoder
  - PC-radio interface

Three Largest RTTY Contests



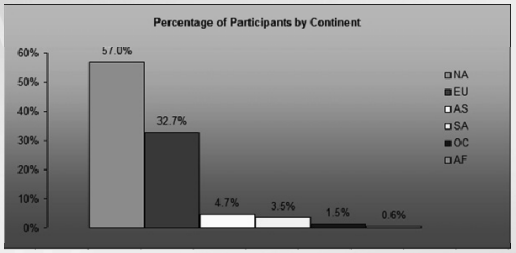
Lots of RTTY Contests

> 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

RTTY Contesters

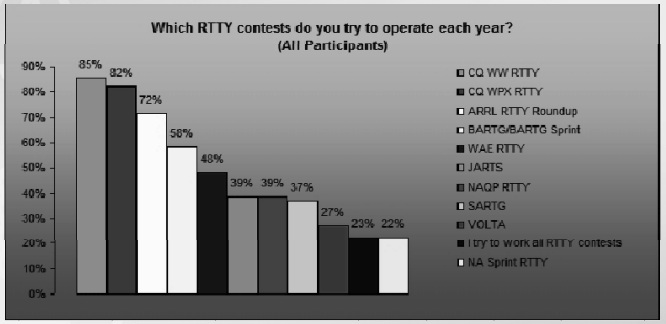
2010 survey



- 825 participants; 13 questions
- conducted in February 2010

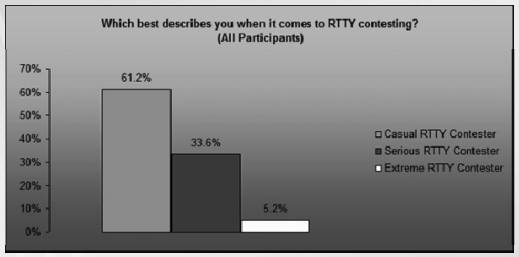
Contest Popularity

2010 survey



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 a few QSOs; willing to chat
  - Chasing awards
  - ➔ *majority of participants … sometimes slower, more verbose 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 improve other operating skills
  - 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 …

- "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 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; low tones
  - *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

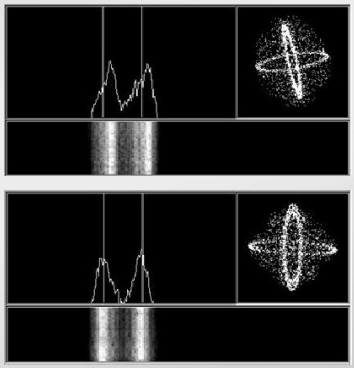
RTTY Sub-Bands

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

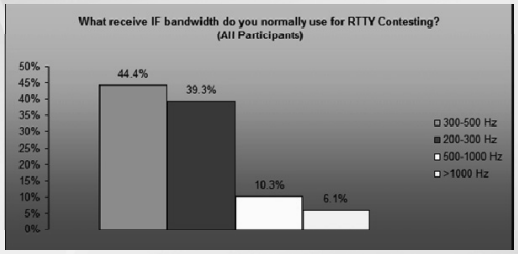
Receiving

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



IF Bandwidth

2010 survey

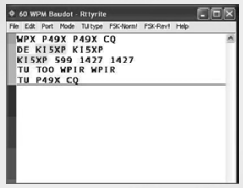


- Like FSK, narrow IF filtering for RTTY appeared in radios in the early 1990s

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
  - QSX B4
  - Roving mult: "Squat & Shoot" *(Cajun-speak!)*

and … More Tips

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

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

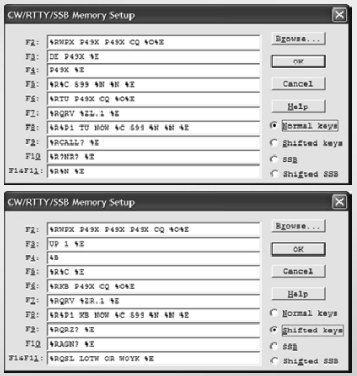
- Normal Run mode flow:
  1. Enter or F1 (CQ)
     - repeat
     - AGN?
  2. pile-up
  3. Insert or ‘ (grab call sign, send exchange)
     - Send fills
  4. receive exchange
     - ➢ check pre-fill, click their exchange
       - AGN? or NR? or QTH? or NAME?
  1. Enter or + (log contact, send TU/CQ)
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

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)

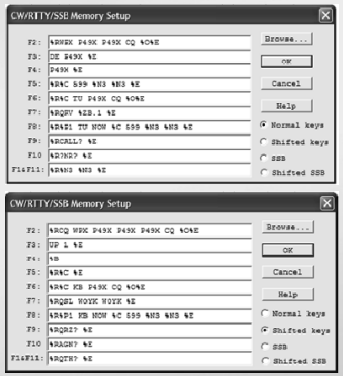
www.rttycontesting.com/rttymessages.htm



RTTY Messages

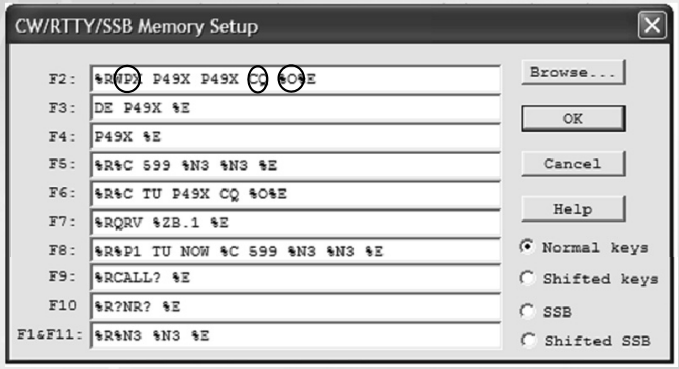
optimize

- Modular
  - Chaining
- Group logically
- Supports a cadence



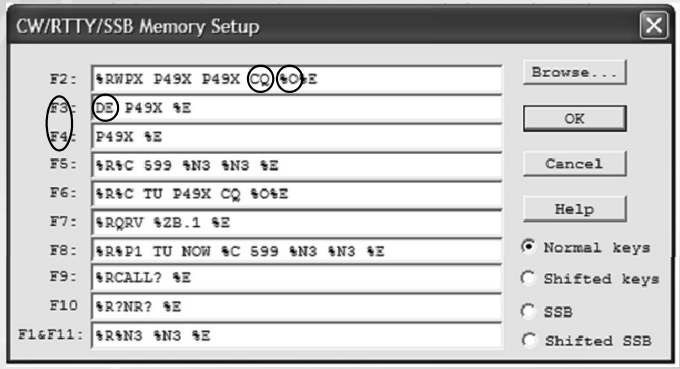
RTTY Messages

formatting



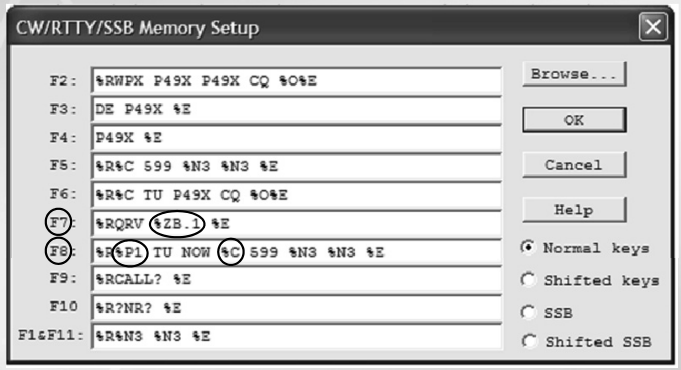
RTTY Messages

efficiency



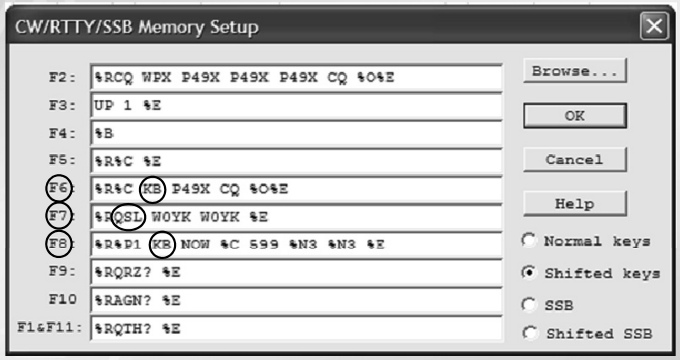
RTTY Messages

special



RTTY Messages

personal



RTTY Messages

CQ WW RTTY

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

- W1UE
- ZN
- AGN
- ?

RTTY Messages

CQ WPX RTTY

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

- AK1W
- NR
- AGN
- ?

RTTY Messages

NA RTTY Sprint

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

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

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, [illegible], exchange twice, Space delimiter

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

```
XYZAB AA5AU XYZAB
XYZAB 9Y1VC 9N8TT
XYZAB W5UKM XYZAB
```

N1MM Logger

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

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

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

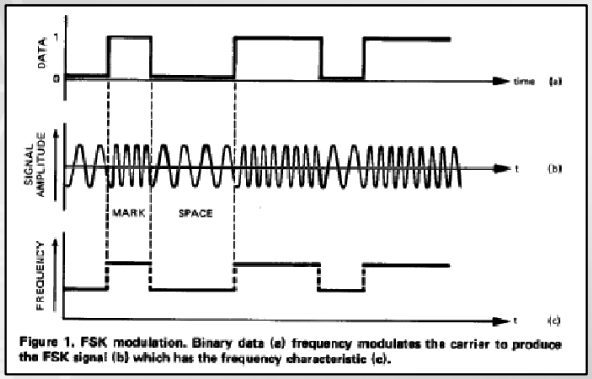
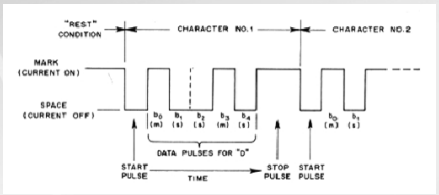


Figure 1. FSK modulation. Binary data (a) frequency modulates the carrier to produce the FSK signal (b) which has the frequency characteristic (c).

http://rfwireless.rell.com/pdfs/TN_WJfsk.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 / 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 / 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

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

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

What is RTTY?

Figures Shift

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

What is RTTY?

UnShift on Space

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

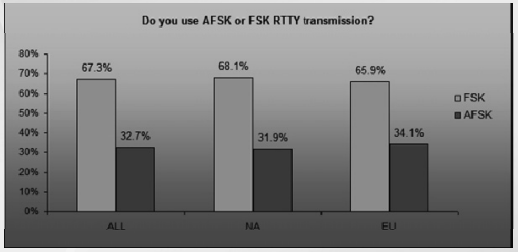
What is RTTY?

audio tones

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

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 (depends on radio)*

➢ *Easier hook-up; NET*

FSK

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

➢ *Less pitfalls*

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 UnShift
  - Use optional UnShift-On-Space (UOS), plus space delimiter
- AFSK vs. FSK transmission (receiving is the same)
  - Radio dial frequency differences
  - 100% duty cycle!

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!

How Do I Set it Up?

overview

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

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

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?

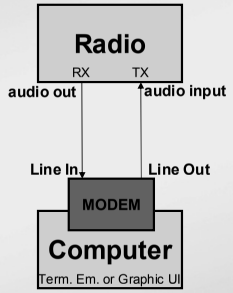
decoder/encoder terminology

- 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*

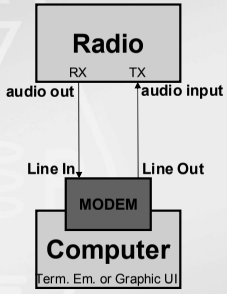
AFSK



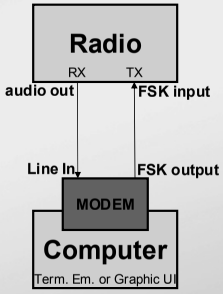
How Do I Set It Up?

hardware *MODEM*

AFSK



FSK



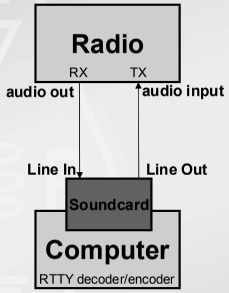
How Do I Set It Up?

hardware *MODEM*

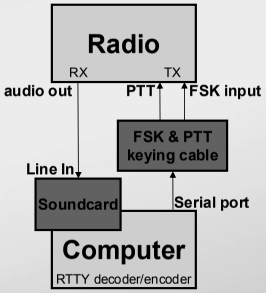
How Do I Set It Up?

software application & *soundcard*

AFSK



FSK



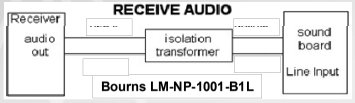
How Do I Set It Up?

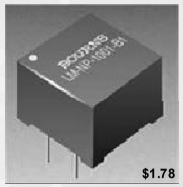
ground loops

- 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





-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

How Do I Set It Up?

commercial interface audio isolation

Rascal

How Do I Set It Up?

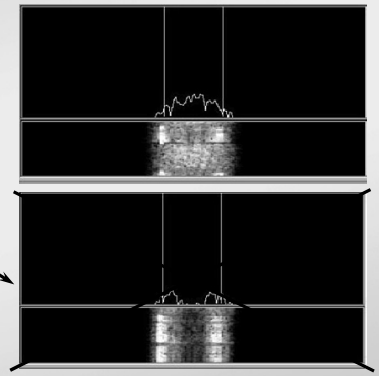
radio audio isolation

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)
  - 500 Hz - normal
  - 250 Hz - strong QRM only
  - Tone filters – don't use!
    - Icom Twin Peak Filter
    - K3 Dual-Tone Filter
- Audio filtering
  - JPS NIR-10/12
  - Timewave DSP-599zx
  - Modern DSP rigs



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

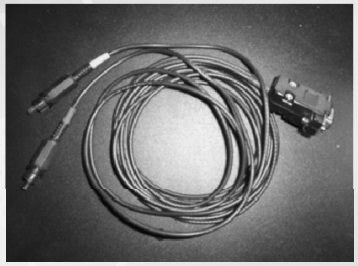
How Do I Set It Up?
soundcard levels

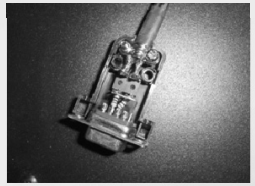
- Adjust levels in Windows Volume Control *(or, in MMTTY **Options/Soundcard** …)*
  - Use isolation transformer
  - Avoid over-drive
  - Mute other inputs and outputs
- RX audio goes to LINE IN (or, MIC w/pad)
  - ***Options/Soundcard input level***
- TX AFSK audio (mic) comes from LINE OUT
  - ***Options/Soundcard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

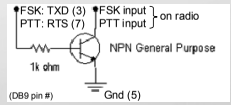
How Do I Set It Up?
PTT vs. VOX

- 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*

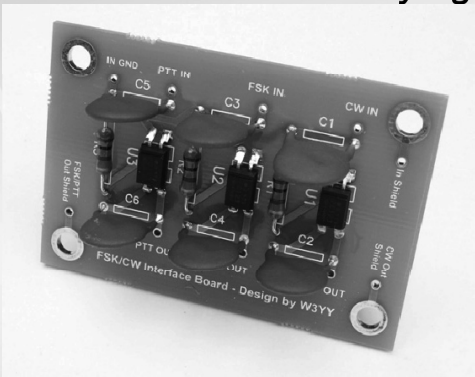






How Do I Set It Up?

W3YY *FSK & PTT keying cable*



How Do I Set It Up?

commercial interfaces

RASCAL

How Do I Set It Up?

commercial interfaces

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

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

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	PSK	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, or
   - MMTTY via Soundcard Line In (or Mic In with pad):
     - Enable soundcard Line In (or Mic) input, disable/mute other inputs
3. Set level so band noise is 10% of full-scale

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?

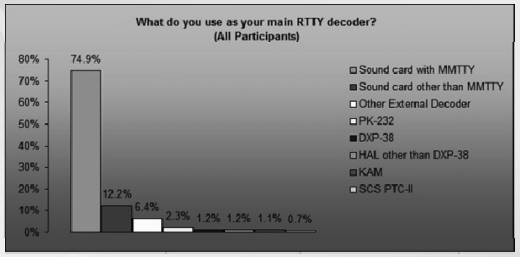
summary - FSK

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

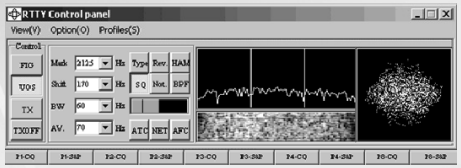
2010 survey



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

Decoders

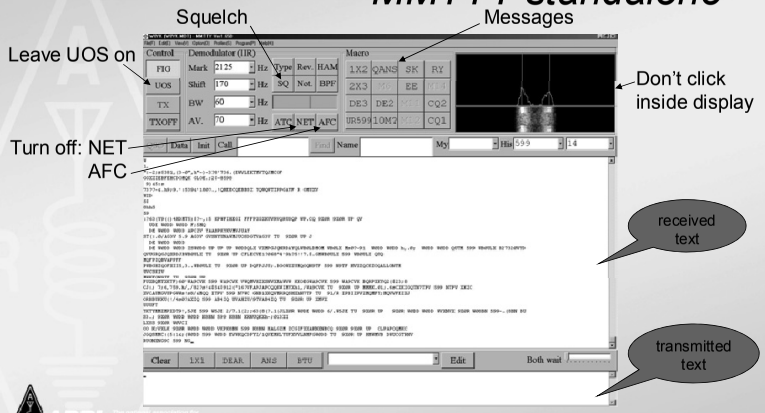
MMTTY



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

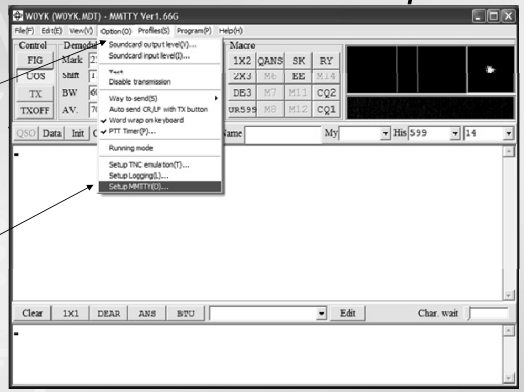
How Do I Set It Up?

MMTTY standalone



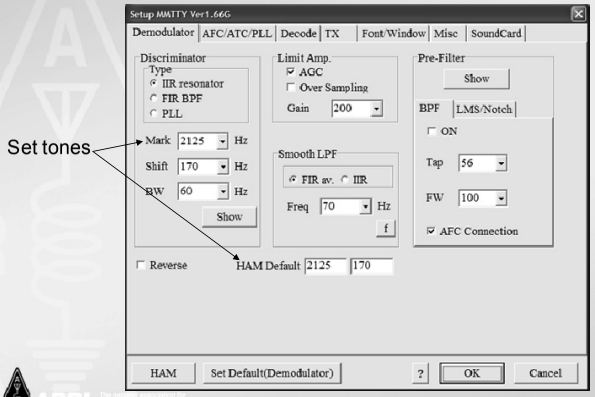
How Do I Set It Up?

MMTTY Option menu



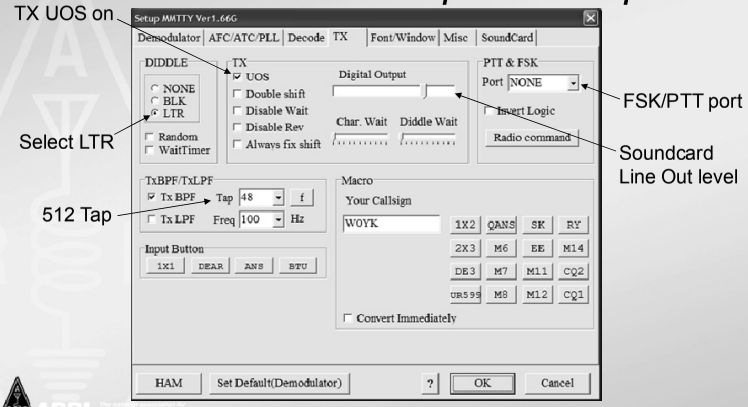
How Do I Set It Up?

MMTTY Option/Setup/Demodulator



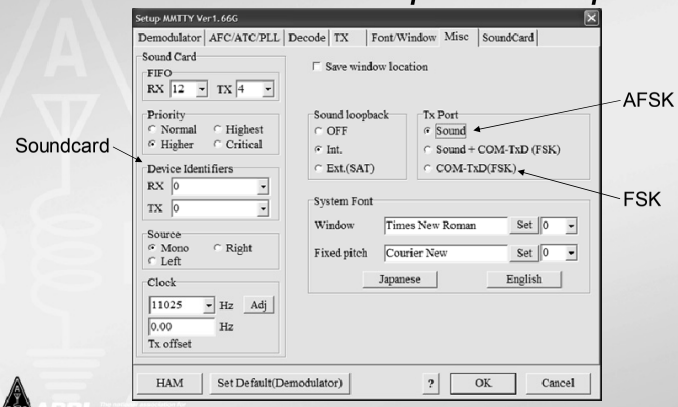
How Do I Set It Up?

MMTTY Option/Setup/TX



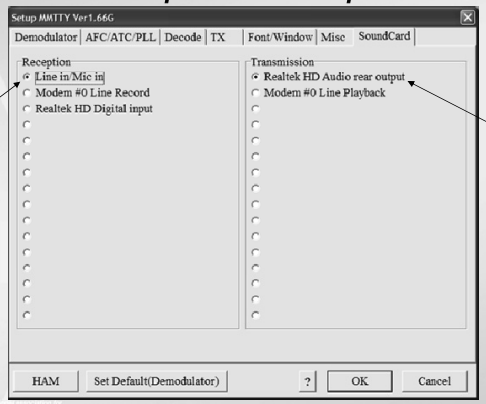
How Do I Set It Up?

MMTTY Option/Setup/Misc



How Do I Set It Up?

MMTTY Option/Setup/SoundCard



Select receive Soundcard

Select transmit Soundcard (AFSK only)

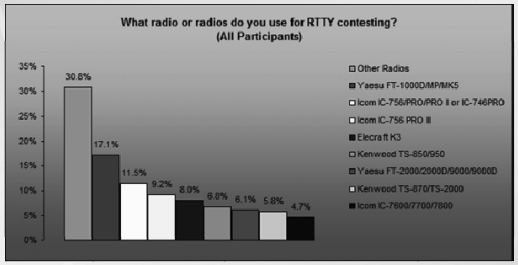
How Do I Set It Up?

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

RTTY Radios

2010 survey



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

RTTY Radios

FSK & AFSK bandwidth

FSK

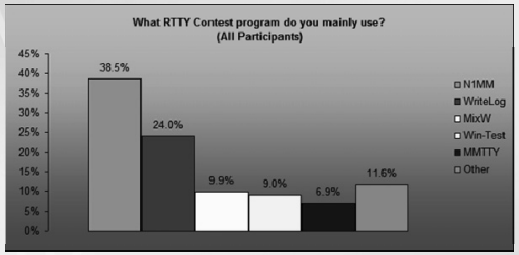
- Use radio FSK filter
  - DSP TX filter (K3)
  - Crystal TX filter (K3)
  - Lobby other mfrs
- Otherwise, use AFSK
  - With TX filtering
  - Properly adjusted

AFSK

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

RTTY Contest Loggers

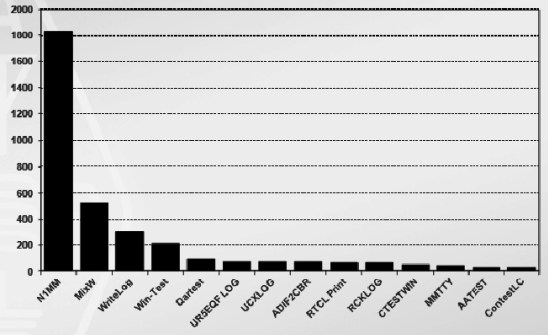
2010 survey



- 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* tutorials
- 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.

A Blizzard of Details!

this is fun??

Start Simple, then Enhance

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

Resources

- RTTY Contesting website: www.rttycontesting.com
  - Tutorials and resources (beginner to expert)
  - WriteLog/MMTTY/2Tone (N1MM Logger coming)
- RTTY email reflector: rtty@contesting.com
  - Email reflector
  - RTTY contester networking
  - Q&A
- Software web sites
  - mmhamsoft.amateur-radio.ca/ (MMTTY)
  - n1mm.hamdocs.com/tiki-index.php (N1MM Logger)
  - www.writelog.com (WriteLog)
  - www.wintest.com (Win-Test)
- Software Email Reflectors
  - mmtty@yahoogroups.com (MMTTY)
  - N1MMLogger@yahoogroups.com (N1MM Logger general)
  - N1MMLogger-Digital@yahoogroups.com (N1MM Logger RTTY & PSK)
  - writelog@contesting.com (WriteLog)
  - support@win-test.com (Win-Test)

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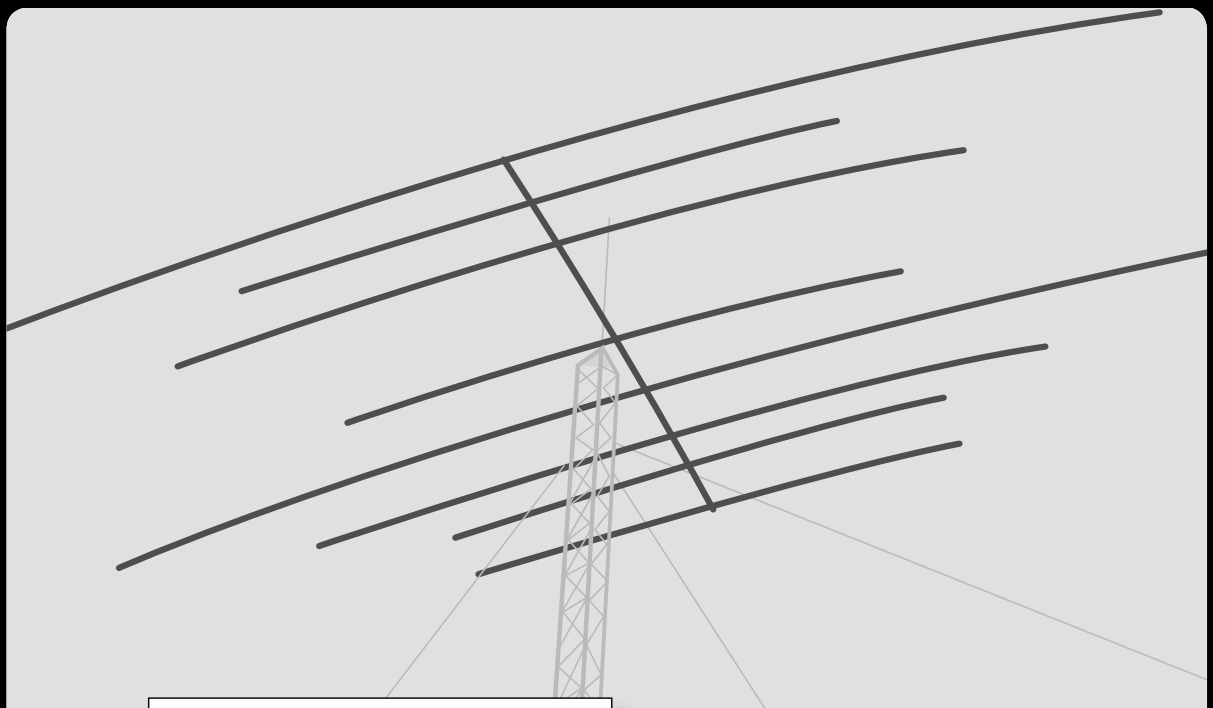

WRTC 2014 World Radiosport Team Championship

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TX38 Yagi Antenna

When the WRTC 2014 committee was searching for a high performance 20/15/10 meter antenna, the only one that could meet its exacting standards was the TX38 from 2X Arrays.

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The World Radiosport Team Championship 2014 Committee Had a Technical Challenge.

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In the course of testing WRTC 2014 locations during the 2013 IARU HF Championship, the organizers noticed a problem with noise, harmonics and interstation interference with the complete two-transmitter setups. The problem was traced to the switching power supplies used for the custom Score Collection Computer and Ethernet switch that are part of the real-time online scoreboard system.

This led to a search for a linear-mode power supply solution. No company offered a suitable unit with both the required output voltages and connectors compatible with the equipment.

Discussions with the staff of DX Engineering led to the development of a custom power supply system that met the needs of the WRTC 2014 organizers. DX Engineering went to work building the 60 power supplies the committee requested.

DX Engineering employees are just like you—experienced operators with a passion for Amateur radio. We're working hard to create products that improve your on air experience. Soon, these RFI-clean WRTC 2014 power supplies will be available for your station. In the meantime, you can outfit your shack with the same high-quality coax jumpers used at WRTC 2014, along with the now legendary TX38 tri-band Yagi. DX Engineering also carries the same Mastrant Rope and Rohn Towers used by the competing stations.

WRTC 2014 World Radiosport Team Championship

And if you have questions regarding your installation, a nagging technical problem, or have a question on a particular component, talk to us.

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