****

SIGNALS

Rockwell Collins

Monthly Newsletter of the

Amateur Radio Club

Volume 36 Issue 8 **Web Site** http://www.w5rok.us **May 2015**

****

RCARC
Membership Meeting

Tuesday 26 May 2015
1700 Social 1730 Meeting
1800 Program

Methodist Richardson Medical Center
At Bush/Renner/Shiloh Intersection
Second Floor Conference Room 200

Subject:
Program TBD

Local Club News

Meeting Notice

The program for this month was not finalized when the newsletter was ready for publication, but the meetings are always great, so be sure to be there on Tuesday, 26 May!

RCARC Community Service Activities

Siren Testing Dennis Cobb WA8ZBT, Chris Havenridge KF5GUN, John McFadden K5TIP and Jim Skinner WB0UNI participated in the Richardson emergency siren testing on 6 May 2015. The testing was cancelled by the City of Richardson due to cloudy weather. The siren testing is performed on the first Wednesday of each month. The sirens are monitored by amateur radio operators and reports made using the Richardson Wireless Klub (RWK) repeater at 147.120 MHz.

Crime Watch Patrol Jim Skinner WB0UNI participated in Richardson Duck Creek Crime Watch Patrol (CWP). CWP members, after successful completion of Richardson Police Department Training, patrol their neighborhoods and report all suspicious activities to the Police Department.

Rockwell Collins Fun Days

The Fun Days event has been postponed to 3-4 June this year due to all the rain in May. This is an opportunity for the club to make its presence known and hopefully attract some new interest by the employees.

Live Webcast B-29 FIFI DC Flyover

The Arsenal of Democracy: World War II Victory Capitol Flyover was streamed live on Friday, May 8, beginning at 10:30 a.m. Eastern Standard Time. The link for the live webcast is still up and the video can be watched at http://www.usvets.tv/Events/ArsenalofDemocracy2015.aspx.

(Contributed by Bob Kirby K3NT)

Storm Spotter Training from the NWS

The following link contains some very instructive and interesting videos on storm spotting.

https://www.youtube.com/watch?v=KzTBjS8uYB0&index=72&list=UU9hQvMjzSxurMirYDgOMezw

(Posted on rwk-ntx@yahoogroups.com by Samuel Barricklow K5KJ)

Membership Renewals

It is time for membership renewals for 2015. Please get your renewals in to Joe Wolf N5UIC. Joe's email address and telephone number are on page 2 of this newsletter.

RCARC OFFICERS

PRESIDENT
Mike Schmit WA9WCC
972.705.1394
maschmi2@rockwellcollins.

VICE-PRESIDENT
OPEN

SECRETARY
Jim Brown AF5MA
972.495.2209
jhksbrown@verizon.net

TREASURER
Mike Montgomery WD5TX
972.705.1498
dmmontgo@rockwellcollins.com

ACTIVITIES
OPEN

WEBSITE MANAGER
Mike Hollingsworth W5QH
972.571.6060
w5qh@arrl.net

STATION TRUSTEE
Steve Phillips K6JT
972.517.3332
k6jt@arrl.net

NEWSLETTER EDITOR
Jim Skinner WB0UNI
214.535.5264
wb0uni@arrl.net

MEMBERSHIP
Joe Wolf N5UIC
214.202.2757
n5uic@arrl.net

W5ROK CLUB STATION
972.705.1349
461-290

VE SESSIONS

Dallas tests are held on the fourth Saturday of each month at 1000 hrs. 13350 Floyd Rd. (Old Credit Union) Contact Bob West, WA8YCD 972.917.6362

Irving tests are held on the third Saturday of each month at 0900. Fifth and Main St. Contact Bill Revis, KF5BL 252-8015

McKinney VE test sessions are held at the Heard Museum the first Sunday of the month. The address is 1 Nature Place, McKinney TX. The time of the testing is 1430, ending no later than 1645. ***Note: no tests given on holiday weekends.***

Garland testing is held on the fourth Thursday of each month, excluding November, and begins at 1930 sharp. Location is Freeman Heights Baptist. Church, 1120 N Garland Ave, Garland (between W Walnut and Buckingham Rd). Enter via the north driveway. A HUGE parking lot is located behind the church. Both the parking lot and the Fellowship Hall are located on the east side of the church building, with big signs by the entrance door. Contact Janet Crenshaw, WB9ZPH at 972.302.9992.

Plano testing is on the third Saturday of each month, 1300 hrs at Williams High School, 1717 17th St. East Plano. Check Repeater 147.180+ for announcements.

Greenville testing is on the Saturday after the third Thursday, 1000 hrs at site TBA, contact N5KA, 903.364.5306. Sponsor is Sabine Valley ARA. Repeater 146.780(-) with 118.8 tone.

Richardson The Richardson Wireless Klub (RWK) VE team hold license testing on the third Thursday of each month at St. Barnabas Presbyterian Church, 1220 West Beltline Rd. Testing begins at 1900 hrs in room 12. Enter through the Northern most door on the east side of the church building. For further information contact Dave Russell W2DMR, at 972.690.9894 or E-mail warhog4@tx,rr.com.

President's Message

THIS SPACE RESERVED FOR PRESIDENT'S AND/OR VICE-PRESIDENT'S MESSAGE

Secretary's Report

28 April 2015

The meeting was called to order by President Mike Schmit WA9WCC at 1739.

The following members were present at the meeting:

Dennis Cobb	WA8ZBT
Kathy Cobb	TBD
John McFadden	K5TIP
Chris Havenridge	KF5GUN
Daneal Havenridge	TBD
Matteo Havenridge	TBD
John Kliewer	AC5NB
Mike Schmit	WA9WCC
Jim Skinner	WB0UNI
Joe Wolf	N5UIC

Officers and Committee Reports:
President's Report: There was no formal President's Report.

Vice-President's Report: There was no formal Vice President's Report.

Secretary's Report: The Secretary's Report is in this newsletter.

Treasurer's Report: There was no formal Treasurer's Report.

Website Manager's Report: There was no Website Manager's Report.

Station Trustee's Report: There was no Station Trustee's Report.

Database Manager's Report: There was no Database Manager's Report.

Old Business:
Joe Wolf N5UIC corrected a statement he made during his recent D-Star presentation. He said that the Icom ID-51 does charge while plugged in and being used.

Joe also informed the club members that the website password will be changing soon.

Joe commented on the membership forms: new forms will be required if renewal is not accomplished on time. Also, membership is now on a calendar year basis rather that fiscal year, and the forms will be changed to reflect this.

New Business:
Chris Havenridge KF5GUN suggested that the computers recently given to the club by the company be equipped with wireless adapter cards. He proposed to buy one card and try it, and if it works, then buy for the other two computers. The proposal was agreed to by all members present.

Chris also stated that the repeater phone patch function is not operational. He suggested that the club buy an ATA (Analog Telephone Adapter). The cost was estimated to be about $100. A discussion ensued about the need for an analog telephone line, which may no longer exist at Rockwell Collins, since the phone system has been digital for some years. Reestablishing this function may also require that the repeater controller be changed out. Chris volunteered to put in a work request with IT to work the issue. It was agreed by the members present for Chris to investigate and report back at the next meeting. An expenditure of up to $250 was also authorized to accomplish the task.

Dennis Cobb WA8ZBT commented that 10 meters was wide open last Saturday, 25 April, and he worked New Zealand and Australia with a signal report of 20 over S9 at about 14:00 local time.

John McFadden K5TIP questioned whether the K3 had been repaired. Michael Schmit WA9WCC told him that it has been repaired. Dennis Cobb WA8ZBT added that one driver was bad. Also a new synthesizer board was added and all software was brought up to date, all within the agreed to budget of $750.

Adjournment:
The meeting was adjourned at 1813.

Program:
The club enjoyed hearing Craig Fugate KK4INZ, who has headed FEMA since 2009, talk about the role that amateur radio plays in disaster response. The video presentation was on DVD.

Understanding Antennas For The Non-Technical Ham - Part 9

*Each month for the next year or so, we are including in **SIGNALS** excerpts of a book by Jim Abercrombie – N4JA (SK) on antenna design. This book is available online for free and can be located at http:// www.hamuniverse.com/basicantennas.pdf. Now, part 9...*

Understanding Antennas for the Non-Technical Ham

A Book By Jim Abercrombie, N4JA (SK)

Illustrations by Frank Wamsley, K4EFW

Edited by Judy Haynes, KC4NOR

Copyright July 2005. Second Edition

Edited for the web , N4UJW

X. OTHER TYPES OF DIPOLES (Continued)

14. The G5RV Dipole

An interesting antenna you can buy that will work somewhat on all high-frequency bands is the so-called G5RV antenna. It is named after the call letters of Louis Varney (SK) who designed it. It is a 102-foot long or three half-wavelength dipole antenna on 20 meters (14.150 MHz), and can be used with a tuner on other bands as well. In his original design, Varney calculated the length to be 102.57 feet, but chose to make it an even 102 feet since a tuner was going to be used with it anyway. It was originally fed through a 34-foot 500-ohm homebrew open wire matching section from a 70-ohm coax or parallel conductor feed-line. The 34-foot open wire line is a half wavelength on 20 meters and at the end of a half-wave feedline, you will see the antennas impedance repeated regardless of the feed-line impedance. The ladder-line helps partly to match the antenna on the other bands.

The G5RV antenna is around 20 feet short of being a half-wave on 80 meters, and on bands on 20 meters and up, it has theoretical gain. We believe that gain is negated by losses in the coax of the feed system, except for 20 meters. At the frequency of the best match, commercially made models of the G5RV are said to have a 1.8:1 SWR on 80 meters. Where the coax joins the open wire, Varney recommended using a choke made of 8 to 10 turns of coax. He advised against using a balun, because, as he says SWR of 2:1 or higher may cause the balun to heat and possibly burn out. The SWR will be moderately high or high on bands other than 20 meters. Varney recommends using the lowest loss coax available and as short a run as practical because of feed-line losses caused by high SWR. This recommendation is very important today, as it was when Varney designed it. Some G5RV antennas put out decent signals and some others have relatively weak signals. Without further investigating, the only way to explain this is that some are using lossy coax and baluns while others are not, and the height above ground may play a part in how well it works.

The G5RV antennas being made today use small diameter 50-ohm coax, 450-ohm ladder-line, and a balun between the ladder-line and the coax, contrary to Varneys suggestions. There are several variations of the G5RV antenna being sold today because many believe they can improve the original design. If you use a G5RV antenna, a tuner will be required.

The G5RV shown below is close to the original version of the antenna. This one pictured below is from an old article that K4EFW found somewhere. It is like the one he used. As you can see, it uses 300-ohm TV ribbon. The length of the parallel TV ribbon is 36 feet, but modern designs of this antenna use 34 feet of 450-ohm ladder-line. All these variations work equally well when they are used with a tuner. It is shown in the inverted-V configuration but it could be put up in the flattop configuration as is, with no modification.

Jeff, AI8H, in Oxford, Georgia, had a pair of G5RV dipoles oriented in different directions. Recently he put up a 75-meter half-wave inverted-V. Being able to switch antennas, he ran A-B tests on 3902 kHz and the inverted-V was 10 dB stronger than the first G5RV and 15 dB stronger than the other one. Now if we are saying the stronger signal is 40 dB over S-9 and the weaker signal is 25-30 dB over S-9, no one will notice the difference. Only under marginal band conditions will the difference be important. In addition, the G5RV antenna will work better on the other bands.

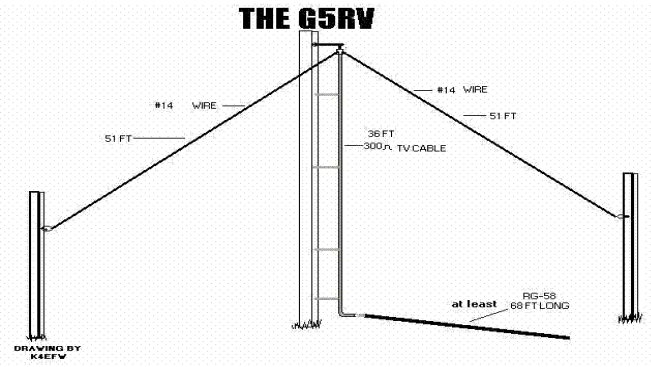

Figure 19. G5RV Dipole

15. Off-Center Fed Dipoles

A long dipole consisting of multiples of equal half-wave segments is normally fed in the center using ladder-line. Dipoles do not necessarily have to be fed in the center. They can be fed in the center of any one of these half-wave segments, even fed off-center. A fair match will occur if coax is used.

The dipole shown above is a one-wavelength dipole. It is nothing but two half waves end to end. It is being fed in the center of one half-wave segment or a quarter wave from one end. It is possible to make it any number of half waves, and if it is fed a quarter wave from one end, it will have a fair match. The way it is shown above is an example of how to feed an antenna with even multiples of a half wave using coax. A 2:1 or 4:1 balun will improve the match on longer versions.

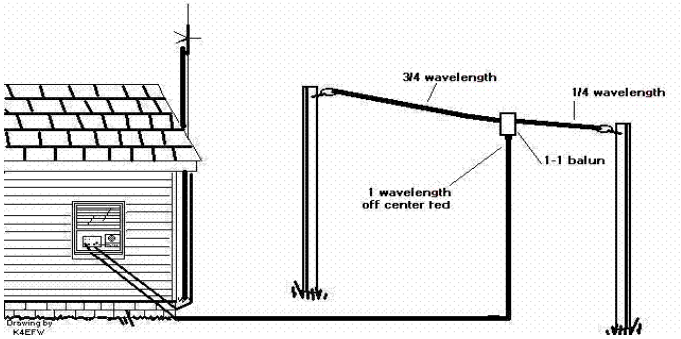

Figure 20. One wavelength Off-Center Fed Dipole

The windom antenna is another example of an off-center fed antenna. The original windom was fed off center with a single wire. The other side of the transmitter was connected to ground. The feed-point impedance at the transmitter was reported to be 500 ohms on all bands. The antenna was designed by William L. Everett and J.F Byrne at Ohio State University. W8GZ, whose last name was Windom, described the antenna in the September 1929 issue of QST.

A lot of research concerning the modern variations of the Windom antennas has been done, including the ones described by Fritzel, K4ABT, W4RNL, The Carolina Windom, and ON4BAA. The main differences in these variations are the slight differences in the position of the feed-point and the impedance of the baluns used for matching. The Windoms are sensitive to the height over ground, meaning the height above ground affects the SWR. The offset position of the feed-point will also determine the feed-point impedance. The one sold by K4ABT is a variation of the Fritzel antenna, and the one sold by Radio Works, The Carolina Widom , claims it has a vertical radiator.

There are two variations of Windoms, both claiming they have vertical radiators, The Carolina Windom, and the one previously marketed by W4COX have two pieces of transmission line in series. The upper piece is connected to the dipole, and the lower piece is connected to the transmitter. The feedpoint of the dipole is placed off center. In The Carolina Windom being marketed today, the upper transmission line is coax. The one made by W4COX had the upper piece made from ladder-line, but in either case, the principle is the same. The two pieces are connected together through a line isolator, a type of balun. The line isolator keeps the lower piece of transmission line from radiating. Because the antenna is fed off-center, the marketers of The Carolina Windom claims it causes an unbalance of current in the upper piece of transmission line. This is doubtful because there is a balun at the feedpoint, which should prevent the feed-line attached there from radiating. The main difference between The Carolina Windom and the one sold by W4COX is that a 4:1 transformer is between the coax and the ladder-line, and a 1:1 line isolator

is between the upper and lower coax cables. Both variations of this antenna show low SWR on several bands, but a tuner is used to match it.

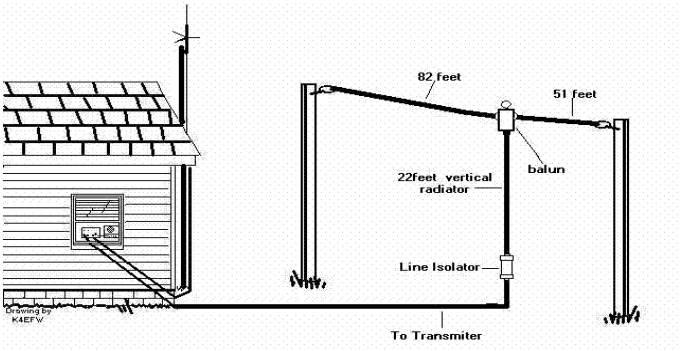

Figure 21. Carolina Windom

Another unique variation of the Windom dipole is the Fritzel antenna, named after its inventor and manufacturer, Dr. Fritz Spillenger (SK), a German ham, call sign DJ2KY. Alpha Delta is now selling an almost exact duplicate of the original Fritzel antenna. Alpha Delta calls it an OCF antenna and it is made by Buckmaster Antennas. There are two models of the Alpha Delta antenna: one for low power and one for high power, the power rating of the balun being the limiting factor. The Fritzels short side is 0.18 wavelength long and its long side is 0.32 wavelength long. It is fed with coax and a 6:1 balun. Theoretically, the feed point impedance is 300 ohms, and the balun provides a 50 to 300 ohm impedance transformation. Modeling the antenna on its lowest resonant frequency at 35 feet, it shows about 120 ohms impedance. The original Fritzel antenna being used by K4LMS reportedly will work all bands with a tuner, but it will work 40, 20, 17, 12, and 10 meters without a tuner with an acceptable SWR. The Windom being sold by K4ABT uses a 4:1 balun and the feed-point is at a slightly different location. That one is shown below.

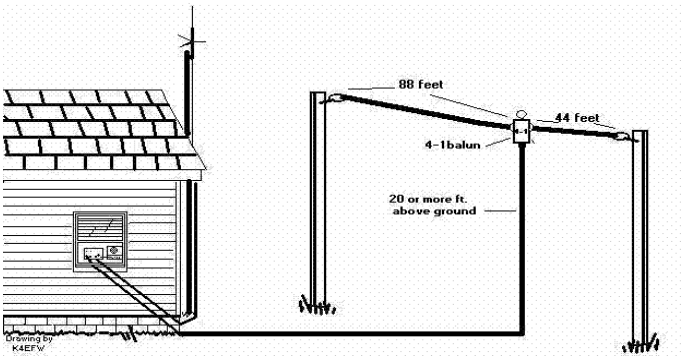

Figure 22. Windom Dipole (Fritzel Type)

The difference between the Windom antenna sold by K4ABT and the original Fritzel is the difference in the offset of the feed-point. Since the K4ABTversion uses a 4:1 balun, it appears his is fed at the 200-ohm point, and the original Fritzel is fed at the 300-ohm point. On any resonant dipole, the lowest feed-point impedance is found at the center. As you place the feed-point offset toward either end, the impedance gets higher. The highest feed-point impedance occurs at the end of the dipole.

AMSAT-NA Opportunity for Rideshare to Geosynchronous Orbit

Posted on April 25, 2015 by K9JKM

AMSAT is excited to announce that we have accepted an opportunity to participate in a potential rideshare as a hosted payload on a geosynchronous satellite planned for launch in 2017. An amateur radio payload, operating in the Amateur Satellite Service, will fly on a spacecraft which Millennium Space Systems (MSS) of El Segundo, CA is contracted to design, launch, and operate for the US government based on their Aquila M8 Series Satellite Structure.

(L-R) Sonya Rowe, KK4NLO; Jerry Buxton, N0JY; Bob McGwier, N4HY; Franklin Antonio, N6NKF; Tom Clark, K3IO; Michelle Thompson, W5NYV; and Phil Karn, KA9Q standing next to the Aquila M8 Bus flight article.

A meeting to discuss this potential rideshare took place on April 13 at Millennium Space Systems that included Dr. Bob McGwier, N4HY; Sonya Rowe, KK4NLO; Franklin Antonio, N6NKF, co-founder of Qualcomm; Jerry Buxton, N0JY, AMSAT Vice President of Engineering and member of the board for AMSAT-NA; Dr. Tom Clark, K3IO, Director and President Emeritus of AMSAT-NA; Phil Karn, KA9Q; and Michelle Thompson, W5NYV.

Hosting the meeting for MSS were Stan Dubyn as founder and chairman of MSS, Vince Deno as president of MSS, Jeff Ward, K8KA, of MSS as VP for Product Development, formerly with SSTL and University of Surrey Space Center, and Ryan Lawrence of MSS as Project Manager on the spacecraft mission. Attending by telephone were Dr. Jonathan Black, Associate Research Director of Hume Center for Aerospace Systems and Associate Professor of Aerospace and Ocean Engineering and Dr. Michael Parker, KT7D, founder of RINCON Research Corp.

Following the meeting, Dr. Bob McGwier, N4HY, Director of Research at the Hume Center for National Security and Technology of Virginia Tech, and former director and former VP Engineering of AMSAT, described this as an opportunity to go forward with “AMSAT-Eagle” which, in the 2006-2008 timeframe, evolved into a microwave payload to be flown to geosynchonous orbit as a hosted payload. It would have provided digital communications to small terminals on the ground and a linear bent pipe transponder had it flown. This failed to go forward in part due to lack of an affordable flight opportunity.

McGwier outlined the next steps toward developing this mission:

1) To organize an effort at Virginia Tech to make a firm proposal to MSS and its US government sponsor, and organize an effort to raise sufficient funds to pay for development of the mission.

2) Enable Dr. Jonathan Black to lead the construction project at Virginia Tech in the Space@VT Center. Sonya Rowe, KK4NLO, Project Manager at the Hume Center will be the project manager.

3) Work for development of a low-cost microwave ground station for amateur radio still needs to be determined.

4) Dr. Michael Parker, KT7D, will solicit the cooperation of the Rincon Research Corp. for development of the software radio technology for this payload.

The AMSAT Board of Directors has accepted the invitation to participate in this potential rideshare payload opportunity. AMSAT expects to be involved in the development of the ground station and the payload RF development, and will serve as the amateur radio (hosted) payload operator once the satellite has been launched.

McGwier summarized, "The launch is currently scheduled for 2017 and the payload must be delivered for testing and integration by Spring of 2016. It is an ambitious schedule and all involved will have to gain and maintain a serious level of commitment to that which they agree to undertake." AMSAT President, Barry Baines, WD4ASW, said, "The AMSAT leadership is excited to fly a Phase-IV geosynchonous amateur satellite payload. This is an evolving development as we collaborate with the VT Hume Center with a project that provides technical challenges to create a new amateur radio capability in space that will provide a variety of benefits not only for amateurs but also for emergency communications and STEM educational outreach."

The transponder is expected to support a wide range of voice, digital, and experimental advanced communications technologies. A decision is expected soon specifying the microwave uplink and downlink bands.

Additional information on the Aquila M8 Series Satellite can be viewed on-line:

http://www.millennium-space.com/

http://www.millennium-space.com/platforms#aquila

(Contributed by Frank Krizan KR1ZAN)

Call Blocking

The FCC provides the following hints on call blocking.

- To block your telephone number for any call, dial *67 before dialing the telephone number.
- To unblock your number for any call (if you have a blocked line), dial *82 before dialing the number.

For additional information see the following FCC website: http://www.fcc.gov/guides/caller-id-and-spoofing

(Contributed by John McFadden K5TIP)

Upcoming Events

JUNE

12-13	**Ham-Com 2015** Irving Convention Center, 500 W. Las Colinas Blvd Irving, TX 75039. The new facility increased the indoor air conditioned flea market from 60 tables to more than 140 tables. There will be no tailgating. Admission is $8 advance and $10 at the door. More information at http://www.hamcom.org/.
13-15	**June VHF** For amateurs in the US and Canada (and their possessions) to work as many amateur stations in as many different 2 degrees x 1 degree Maidenhead grid squares as possible using authorized frequencies above 50 MHz. Stations outside the US & Canada (and their possessions) may only work stations in the US (and its posessions) and Canada. Stations in KH0-9, KL7 & KP1-KP5, CY9 and CY0 count as W/VE stations and can be worked by DX stations for contest credit. Begins 1800 UTC Saturday, runs through 0259 UTC Monday. More info at http://www.arrl.org/june-vhf.
21	**Kid's Day** To promote Amateur Radio to our youth. Share the excitement with your kids or grandkids, a Scout troop, a church or the general public! Kids Day is designed to give on-the-air experience to youngsters and hopefully foster interest in getting a license of their own. It is also intended to give older hams a chance to share their station and love for Amateur Radio with their children. Kids Day always runs from 1800 UTC through 2359 UTC. Operate as much or as little as you like. More information at http://www.arrl.org/kids-day.
27-28	**Field Day** The objective is to work as many stations as possible on any/all amateur bands (excluding 60, 30, 17, and 12-meter bands) and to learn to operate in abnormal situations in less than optimal conditions. Field Day is open to all amateurs in the areas covered by the ARRL/RAC Field Organizations and countries within IARU Region 2. DX stations residing in other regions may be contacted for credit, but are not eligible to submit entries. More info at http://www.arrl.org/field-day.

REGULAR ACTIVITIES

Daily	DFW Early Traffic Net (NTS) at 6:30pm 146.88 – PL 110.9Hz
Daily	DFW Late Traffic Net (NTS) at 10:30pm 146.72 – PL 110.9Hz
Daily	Texas CW Traffic Net (NTS) at 7:00pm and at 10pm on 3541 KHz www.k6jt.com
1st Wednesday	Richardson Emergency Siren Test. At noon using the Richardson Wireless Klub (RWK) repeater at 147.120 MHz.
2nd Wednesday	ARES North Texas HF Net Every month—3860 KHz at 8:30 pm—9:30pm

HAM-COM 2015

Irving Convention Center
500 W. Las Colinas Blvd Irving, TX 75039
June 12-13, 2015

New location that can handle the entire event in air-conditioned comfort

- New & Used equipment
- Flea Market
- Presentations and Forums
- Food
- Visiting with Friends
- License Testing

Hotels & Lodging

We provide a lost of hotels that offer special discounts for **HAM-COM** attendees.

Please notify them that you are attending HAM-COM.

Prices and availability are subject to change.

Holiday Inn Express
3333 W John Carpenter Fwy
Irving, TX 75039
V: 972-910-0302
View Hotel / Check Pricing & Availability

Dallas Marriott Las Colinas
223 West Las Colinas Boulevard
Irving, TX 75039
V: 972-831-0000
View Hotel / Check Pricing & Availability

Fairfield Inn and Suites
630 W John Carpenter Fwy
Irving, TX 75039
V: 972-550-8800
View Hotel / Check Pricing & Availability

Hampton Inn
820 W Walnut Hill Ln
Irving, TX 75038
V: 972-753-1232
View Hotel / Check Pricing & Availability

Hyatt Place
5455 Green Park Dr
Irving, TX 75038
V: 972-550-7400
View Hotel / Check Pricing & Availability

Ham-Com Prizes for 2015

Online Registration Prize

Kenwood TM-D710G

Sign up on the web to get the registration discount before May 31 2015

https://www.hamcom.org/attending-gm-purchase.cfm

Friday Grand Prize = Mystery ?

Saturday Grand Prize = Kenwood TS-590S

Many other prizes ?

Daily Gift Certificates From HRO,ARRL,ETC

Show Hours:

Thursday Setup only 9:00am—7:00pm

Friday 8:00am - 5:00pm

Saturday 8:00am - 5:00pm

Pre-Registration $ 8.00 (before May 31)

Entry $ 10.00 at the door

Parking $5.00 per day

Parking for high profile vehicles adjacent to Convention center

Rockwell-Collins

Amateur Radio Club

Mail Station 461-290

P.O. Box 833807

Richardson, TX 75083-3807

TO:

CLUB STATIONS
(972) 705-1349

W5ROK REPEATER
441.875 MHz +5 MHz Input
131.8 Hz PL - RX and TX

W5ROK-1 PACKET BBS ROK Node
145.05 MHz

W5ROK-N1, W5ROK-N2 & W5ROK-N3 HSMM-MESHNET Nodes 2.4 GHz

Tuesday 26 May 2015

1700 Social 1730 Meeting

Methodist Richardson Medical Ctr
At Bush/Renner/Shiloh Intersection

Second Floor Conference Room 200

NEXT SIGNALS INPUTS DEADLINE:
➔➔➔ 12 June 2015 ➔➔➔