



HARMONICS

1916

South Jersey Radio Association

2013



Joe Taylor, K1JT, is SJRA Guest Speaker

Princeton University Professor and Nobel Laureate Joseph H Taylor will be the honored guest speaker at the November meeting of the SJRA at the Gibson House on November 20. Professor Taylor, K1JT, is an active ham, has been a ham radio operator since his boyhood days in Cinnaminson, was formerly an SJRA member, and is an Honorary Lifetime Member of SJRA. In 1993 he and Russell Hulse were awarded the Nobel Prize in Physics for their discovery in 1975 of the first binary pulsar system. Professor Taylor also authored the ham radio

weak signal processing program suite WSJT, including JT65. Professor Taylor will speak on topics of interest to ham radio enthusiasts.

K1JT grew up in the Cinnaminson area as a teenage ham radio operator in the 1950s. See www.nobelprize.org/nobel_prizes/physics/laureates/1993/taylor-bio.html for some of his memories of that era and a description of some of his exploits. He is an active ham who is likely to be met on the air in several contests each year. In 2001 he authored the weak signal processing suite WSJT that is widely used for Earth-Moon-Earth and meteor scatter communication modes.

Joe Taylor began his study of pulsars shortly after finishing his graduate studies at Harvard in 1968, and after the discovery of the first pulsar in that same year. (A pulsar is now known to be a rapidly rotating neutron star that is observed to emit high accuracy periodic bursts of electromagnetic radiation with a characteristic dispersion property and a steadily increasing period). In 1975 he and Russell Hulse discovered the first pulsar that is a member of a binary star system in which the pulsar (neutron star) orbits another star. See http://www.nobelprize.org/nobel_prizes/physics/laureates/1993/taylor-lecture.pdf for a good description of his discovery and its significance. Joe has continued to be an expert on the measurement of binary pulsar properties

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SOUTH JERSEY RADIO ASSOCIATION

HARMONICS is published monthly and is the official news letter of the South Jersey Radio Association. The SJRA was established on June 16, 1916 and has been meeting continuously since its inception. The club has been affiliated with the American Radio Relay League since 1920.

The SJRA meets each month on the fourth Wednesday, January through September; and usually the third Wednesday, October, November and December; in one of the Meeting Room of the Gibson House at 525 East Main Street, Marlton, NJ 08053. Visitors are always welcome at our general meetings. **"Our Meetings are Smoke Free"**

SJRA operates the K2AA Repeater (145.290 - PL 91.5) located in Medford, NJ and the K2UK Repeaters (146.865 and 442.350 - PL 131.8) located in Pine Hill, NJ. The repeaters are open for use without restriction to all licensed amateur operators.

There are currently over 100 SJRA members active in most all aspects of amateur radio. Membership is by application and is subject to the approval of the Board of Directors. Club dues are currently \$30/yr. for memberships, \$22.50/yr for retired-person membership (62 plus 1 yr membership), and \$15/yr. for additional family members and student membership. Membership information is available on the K2AA Repeater or from Mary Von Lintig, KV2M, 856-772-6475

EMAIL: [sjra at sjra dot org](mailto:sjra@sjra.org) SJRA's web page www.sjra.org
Mark O'Brien, K2AX, is the SJRA/ARRL VUCC card checker
Joe Fisher, KC2TN, is the SJRA/ARRL WAS card checker

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President: Ken Botterbrodt, K2WB
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Picnic: Debbie Pullaro, W9QWN
Ways & Means: Ray Golley, N3RG
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Harmonics Staff:

Publisher/Editor: Ted Groke, W2TAG
or Don Beaulieu, WA2DUE
Circulation: Mary VonLintig, KV2M;
Jim Vecchiola, KR2T

★ **Harmonics** is now available on the WEB in pdf format at: ★
★ <http://www.sjra.org> ★
★ **South Jersey ARRL Section News** is available on the WEB at: ★
★ <http://www.arrl.org/sections/?sect=SNJ> ★

LOCAL WEEKLY NETS

Monday	K2AA, Medford	145.290 @ 8PM
Thursday	Various Locations	28.405 @ 8PM

Harmonics Deadline

Articles submitted for the next HARMONICS will be accepted until Monday, December 9, 2013. Email: [ted.w2tag at gmail dot com](mailto:ted.w2tag@gmail.com)

SWAP SHOP - For Sale/Wanted ads are free of charge and are accepted for Amateur Radio related items only. While ads are not restricted to SJRA members, there is only limited space available and members have priority for listings. No items will be accepted for inclusion in the Swap Shop from commercial vendors or traders. All ads must be submitted at least three weeks prior to the scheduled SJRA general meeting date.

GENERAL ADVERTISING - Limited commercial advertising is accepted on a space available basis. Annual advertising rates range from \$25/yr (Min 1/8 page) to \$200/yr (Full Page). Information is available from Ken Botterbrodt, K2WB.

Meeting Minutes

Minutes of General Meeting Oct. 23, 2013

The meeting opened at 1930 hours by Ken, K2WB. It was held at the Gibson house in Marlton, NJ. We opened with a flag salute. Ken mentioned the upcoming of the November sweeps and the need for at least 3 logs for a club award to be given.

Lou, N2HQL/Kathy, KM2KME, made the motion to accept the minutes as printed in Harmonics, which passed.

Treasurer's report by Ray, N3RG, "We're solvent." 123 paid up members to date. Jon, W2MC/Roy, WB2EOD, made a motion to accept the report, motion passed.

New Members by Mary, KV2M: Jordan n/c; John W2FDJ (welcome back). As historian, she displayed a picture from the 1942 club picnic in Berlin, NJ. People actually used to wear suits to a picnic.

Health & Welfare by Kathy, KM2KME: Got reports that Jack, N2VW, is doing OK, and she sent a card to Bruce, W2BE. Programs; Oct- Mario, N2AK, to describe a low power transmitter for 40M and take kit orders; Nov- Joe Taylor, K1JT; Dec- Christmas party.

VE Team by Al, N3AVT: Three candidates were tested and two have passed.

Nets by John, WY2J: doing ok on 2M, need two net controls on 10M.

Upcoming Contests: CQWW SSB, Nov SS.

Repeaters & Club Stuff, by Joe KC2TN: Reported that all repeaters are working and he showed off the Winter

jacket. He is still taking orders for anything in the catalog.

Web: We are moving the web site to new server; however the site is not getting much use.

Field day: The results are still not out.

Awards by Lou, N2HQL: We need nominations as few have been received.

New Business: Christmas Party at Gibson House, December 18th at 1830.

Board Meeting of Nov. 6, 2013

Open at 1930 hours by Ken, K2WB. Minutes approved as printed in Harmonics, N2HQL/KR2T.

No Correspondence sent or received. Repeaters still on the air.

Membership by Rich, KV2R, filling in for Mary, KV2M: Bob, K2UT, Welcome back- motion by N2HQL/W2MC.

Ken reported he has cleaned up the Harmonics mailing list.

History: Congratulations to Packrats for first EME contact to South America (1976), First Contact to South America listed as 5/30/1923.

After some discussion, a late year membership policy has been established. Those joining after 1 October pay the following years dues and get credit for the remainder of the current year. This will not include a badge, which will be billed separately. Motion N2HQL/AC2FO-passed.

Contests: Three logs received for CQWW. Nov SS is Nov 16-18.

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HAM TECH

Vol 4 No. 11 by John - WY2J

wy2j at arrl dot net

HF RECEIVER NON-LINEAR DISTORTION

Part 2 of 3 Dynamic Range Calculations

Introduction - Last month we explored non-linearity in receiver components and how it can generate in band spurious signals from two or more out of band signals. This process known as inter-modulation distortion (IMD) limits the upper end of a receiver's signal dynamic range while the lower end is limited by the greater of the receiver's internal noise level, the antenna received noise due to atmospheric events like lightning, galactic noise and man-made noise. While we can't control the antenna noise or out of band interfering signals we can prevent it from becoming worse with the addition of IMD. For the HF bands, up to about 10 to 14 MHz, the antenna noise sources can exceed the receiver self noise by 10 to 40 dB so low noise figure preamplifiers are seldom used at 20 to 160 meters as their gain will rapidly increase the in band interference caused by inter-modulation products in high QRM bands. Since inter-modulation products are so sensitive to signal level an analytical example requires a modeled receiver at least up to the final bandwidth determining filter.

For the model used in this example the receiver will consist of a manually set RF attenuator, an RF bandpass filter that covers a single band such as 40 meters, a high dynamic range double balanced ring quad diode mixer with a matching diplexer on its IF port, an 8 pole 2.4 KHz SSB roofing crystal filter and finally a low noise IF amplifier. The crystal filter is the final bandwidth determining filter so only the mixer will con-

tribute to inter-modulation distortion, the IF amplifier being shielded from out of band signals by the crystal filter. The other components are passive and if well designed will have extremely high intercept points thus contributing little IMD. You may think that this simple architecture would be lacking in sensitivity but it is a very common one in the highest dynamic range HF receivers. Preamplifiers can be switched in ahead of the RF pre-selector on 20 through 10 meters if needed if the antenna noise and QRM are moderate. The author's battery powered TenTec R4020 dual band CW QRP rig uses this configuration with much lower intercept point components and it works quite well on 20 and 40 meters with modest QRM.

The Model's Component Performance - The major performance characteristics of each component of the model with regards to sensitivity and IMD contributions is given in Table 1 below. Parameters critical to out of band selectivity and spurious responses have been omitted to avoid confusion to the reader. N/A indicates Not Applicable.

Component	IP ³	NF	Gain / Loss
RF Attenuator	N/A	N/A	0 to - 30 dB
RF BPF	N/A	N/A	- 1 dB
DB Mixer and Diplexer	+ 30 dBm	7 dB	- 7 dB
2.4 KHz BW Roofing Filter	N/A	N/A	- 3 dB
IF Amplifier	N/A	4 dB	+20 to +60 dB

Table 1. Model Receiver Component Values

(Continued on page 5)

(Ham Tech from page 4)

MDS Calculations - The lower floor of the receiver's Dynamic Range (DR) is the noise level received by the antenna plus the receiver component noise. The MDS is the minimum signal required for adequate copy by the operator. For SSB voice this is typically 6 to 12 dB or 1 to 2 S units above the noise floor. The receiver generated noise is calculated from **Equation 1**, as follows.

Equation 1 $P_N = -174_{dBm} + NF_{dB} + 10 \log (BW_{Hz})$

The NF for the model receiver is the 4 dB IF amplifier NF plus the 11 dB total losses of the RF filter, mixer and roofing filter or 15 dB.

The bandwidth of the roofing filter is 2400 Hz and is the final signal filter for this model receiver. The $10 \log (BW_{Hz})$ term is:

$$10 \log (2400) = +33.8 \text{ dB}$$

$$P_N = -174 + 15 + 33.8 = -125.2 \text{ dBm}$$

$$\text{Let the } S/N_{out} = 10 \text{ dB}$$

$$\text{MDS} = -125.2 + 10 = -115.2 \text{ dBm}$$

This is for antenna received noise considerably below the receiver self generated noise which is typical of the higher HF bands. For 30 to 160 meters the antenna noise will degrade the MDS and increase the effective value of P_N .

IMD Limited Dynamic Range - We will now look at how we calculate the upper end of the spurious free dynamic range with the help of Figure 1.

Let's assume that we have two equal out of band interfering signals of -20 dBm total power. What is the in band signal IMD interference level and the IMD dynamic range. Using the equations from Figure 1:

Equation 2 $(I - D) / (I - S) = 3$ for a 3rd order product where:

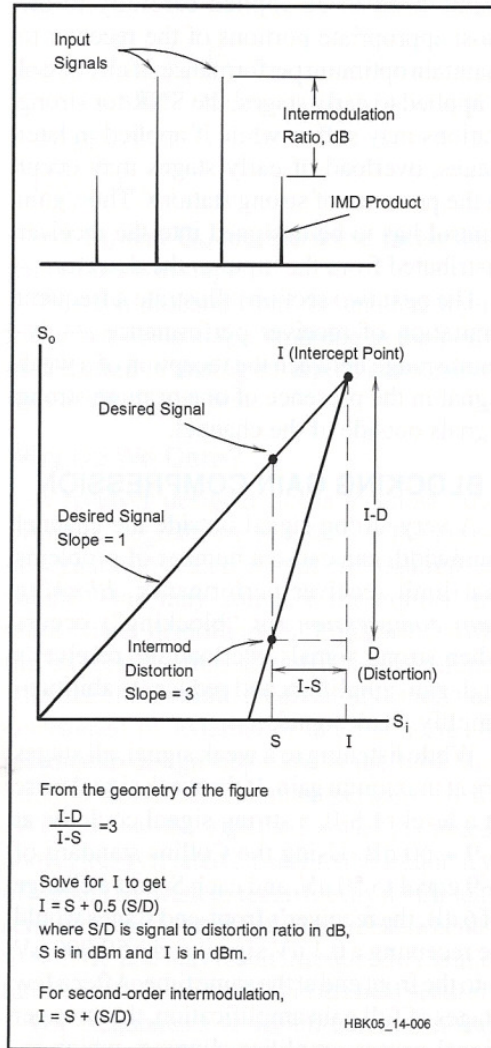


Figure 1 - IMD and IP³ Graphical Relationships

$I = 3^{\text{rd}}$ order intercept plus the losses ahead of the mixer. $I = +30 + 1 = +31 \text{ dBm}$

$S =$ The total power of the interfering two signals at the receiver input. $S = -20 \text{ dBm}$.

$D =$ The in band IMD level.

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Uno, Dos, Tres...

Dan, KB6NU, cwgeek at kb6nu dot com

If you have done any amount of listening to shortwave radio outside of the ham bands, you have undoubtedly run across "numbers stations." The broadcasts from these stations consist streams of numbers or letters, often in a computer-generated female voice speaking in Spanish. Every now and then, a numbers station pops up on 30m, sending five-character groups in Morse code.

According to the Conet Project (<http://www.irdial.com/conet.htm>), "Shortwave Numbers Stations are a perfect method of anonymous, one way communication. Spies located anywhere in the world can be communicated to by their masters via small, locally available, and unmodified Shortwave receivers. The encryption system used by Numbers Stations, known as a 'one time pad' is unbreakable. Combine this with the fact that it is almost impossible to track down the message recipients once they are inserted into the enemy country, it becomes clear just how powerful the Numbers Station system is."

The Conet Project sells a CD with a number of recordings for \$55, but you can find a bunch of mp3 files at <http://www.archive.org/details/ird059> for free.

Recently there was a thread on the Glowbugs Google Group about numbers stations. One fellow mentioned "The Numbers Station," a movie released earlier this year starring John Cusack. IMDB (<http://www.imdb.com>) says that The Numbers Station is about "a disgraced black ops agent dispatched to a remote CIA broadcast station to protect a code operator. Soon, they find themselves in a life-or-death struggle to stop a deadly plot before it's too late." It's

currently available for streaming on Netflix, and I watched it recently. It's kind of violent (lots of people get shot), but it's a decent thriller.

Jim, K6FWT mentioned ENIGMA 2000 (<http://www.apul64.dsl.pipex.com/enigma2000/>). The group's website describes ENIGMA 2000 as "a UK based online group, whose aims are to bring together listeners and enthusiasts who monitor and gather information on 'Number Stations' and other related radio transmissions. Through our Yahoo Group monitors can share their logs, discuss frequencies, thoughts and opinions on this most emotive subject." Jim says, "These folks are SERIOUS enthusiasts. I have heard that they surpass many intelligence services with their thoroughness. You can get in up to your eyeballs if you don't watch it."

These stations have been around since World War II. I remember as a kid in the 1960s and 1970s, reading articles about numbers stations in Popular Electronics and Electronics Illustrated. They're as much of a mystery today as they were back then.



When he's not listening to numbers stations, Dan, KB6NU enjoys working CW on the HF bands and teaching ham radio classes. For more information about his operating activities and his "No-Nonsense" series of amateur radio license study guides, go to KB6NU.Com or e-mail cwgeek at kb6nu dot com.

SJRA Member "Ken G Long, KA2GMP," SK at Rex Hospital in Cary, NC. Donations may be made to the Tin Can Sailors or the American Veterans Association or Disabled Veterans Association.

President's Message

Ken – K2WB

Joe, K1JT, will be speaking at our radio club this month. His talks are always exciting and informative, don't miss this meeting.

Our Holiday Party (December 18th) there will be a new format this year. The entire meeting and meal will be held at the Gibson house. After dinner there will be presentation of the club awards. Contact Rich, KV2R, and let him know if you plan on attending. Check out the web site for more detailed information.

Please contact Lou, N2HQL, regarding nominations for Awards, the sooner the better. When doing so give a reason for your nomination and for which award that you recommend. Award information can be found on the SJRA web page at www.sjra.org.

I am looking for someone for the Program committee. If you are interested please contact me for more information.

SJRA Thursday 10 M Net

- Two Control Operators Needed.
- First and Second Thursday's of the Month.
- All License Classes Eligible.
- It requires only a 10 M SSB rig, dipole antenna and a love of rag chewing.
- Contact John WY2J at wy2j@arrl.net or call 609-471-1843

List Your "For Sale" Ham Stuff in the SJRA Harmonics

- Email Ted, W2TAG, with your listing, ted.w2tag@gmail.com

Monthly Puzzle

Don – WA2DUE, wa2due@arrl.net

Last month's puzzles were:

You have a 2 microhenry coil and you want to make a resonant circuit at a frequency of 21.1 megahertz. What size capacitor must you use?

Solution: A circuit is said to be resonant when the inductive reactance equals the capacitive reactance. So, $X_L = X_C$ or $2\pi fL = 1/(2\pi fC)$ and solving for $C = 1/(4\pi^2 f^2 L)$. Since L and f were given therefore C can be calculated as 28.4 picofarads.

A merchant bought a batch of gizmos for \$6250 and sells all but 40 of these for \$7130. If he sold each gizmo for \$3 above cost. How many did he sell?

Solution: There are several ways to solve this kind of problem. I find it easy to determine the unit price for those sold and bought. Let n equal the number sold. The unit price for those sold is $7130/n$ and for those bought is $6250/(40+n)$. We are told that the items sold for \$3 above cost. Therefore $7130/n = 6250/(40+n) + 3$ and multiplying through by $n(40+n)$ to eliminate the denominators results in the following quadratic equation: $3n^2 - 760n - 285200 = 0$. To solve this equation let $a = 3$, $b = -760$, and $c = -285200$ and using the formula for solving quadratic equations $n = (-b \pm \sqrt{b^2 - 4ac})/2a$ we get 460 as the number of gizmos sold.

Next month, consider the following:

The sum of three numbers equals 72. The second of these numbers exceeds the first by 5 and the third number is greater than the second by 11. What are the numbers?

(Continued on page 10)

South Jersey Radio Association Continues to Leap Forward in the Last Leap Year Before She Celebrates Her 100th Anniversary – Part 12

The year 2012 was the 25th Leap Year that The South Jersey Radio Association celebrated, counting 1916. The 25th Wedding Anniversary is the Silver Anniversary. There should be something special for celebrating 25 Leap Years.

2012

Our Leaders at the beginning of this 25th Leap Year were:

President - Ken Botterbrodt, K2WB
 Vice President - Jon MacMillan, W2MC
 Treasurer - Ray Golley, N3RG
 Rec. Secretary - Lou Priestley, N2HQL
 Cor. Secretary - Ted Groke, W2TAG

Directors:

Kathy Edwards - KM2KME
 Mark O'Brien - K2AX
 Debbie Pullaro - W9QWN
 Ira Weinstein - W2IRA
 Mary Von Lintig - KV2M
 Jim Vecchiola - KR2T
 Al Witner - N3AVT

John, WY2J, continued to write his most informative and interesting articles for Harmonics, 'Ham Tech.' These articles are well written, contain pictures, tables and diagrams and would stimulate brain surgeons and rocket scientists. I have a friend who is a retired captain in the United States Navy who read one of John's articles. In his best 'Please May I have more' voice he asked me to send him my copy of Harmonics each month after I read it. When I had John autograph one of his articles that retired Captain practically saluted it.

Don, W2DUE, continues to try to stump the SJRAers with his monthly puzzles. To solve some of these, I think you would have to be a brain surgeon or rocket scientist. Each month I give it a shot but have only succeeded a few times. When I email Don my answer, he responds immediately and if I get it right, I get congratulated. What an honor to solve one of those puzzles. Thanks Don. Keep stimulating our brains.

At the tender age of eight, Mackenzie O'Brien passed the technician test and received the call KD2BMV. At the even more tender age of seven, Amber O'Brien passed the technician test and became KD2BOO. Both of these YLs were approved for membership in SJRA during February. There were now Five family members belonging to SJRA: Mark, K2AX; his XYL Donna, W2DOB; his twelve year old daughter who holds an extra class license Paige, N2PKP; and the two new additions Mackenzie. KD2BMV; and Amber, KD2BOO.

As of the end of March, there were 110 paid up members.

EI8EM, Alan was made an honorary member of SJRA.

Bob Chambers, WA2NEW, found buried in a bunch of stuff that was designated for that circular container a 1941 original photo of our 25th (there is that magic Silver number again) Anniversary dinner and donated it to the club. Both he and his daughter Kaylee, K2LAC, were welcomed as members to our club.

Field Day was again held at Savitch's Field, but fortunately this year we did not have to compete with the Lacrossers. K2AA bagged 13,318 points and came in 4th in the 6A category and 23rd overall.

(Continued on page 9)

(Joe Taylor from page 1)
 because these phenomena are a stringent test of Einstein's general theory of relativity and of the existence of gravitational waves. (The binary star system loses energy and slows down because it is radiating energy gravitationally). The rate of energy loss can be computed using various theories of general relativity. For their contributions Professor Taylor and Hulse were awarded the Nobel Physics Prize in 1993.
 Rich, KV2R

(Ham Tech from page 5)
 Rearranging *Equation 2* and inserting values for I and S:
 $(I - D) = 3(I - S)$ or $(+ 31 - D) = 3(+ 31 - (- 20))$
 $(+ 31 - D) = 153$
 $D = - 153 + 31 = - 122$ dBm and the Dynamic Range $(S - D) = - 20 - (-122) = 102$ dB
 The IMD level is just 3.2 dB above the noise level and 6.8 dB below the MDS. This is very significant receiver performance that rivals many of the best HF rigs on the market considering that the interference can be only a couple of KHz off of center frequency for the SSB receiver modeled. If a CW filter was installed the interfering signals could approach band center to within 300 to 500 Hz and maintain full IMD performance. These results are achieved by using a high dynamic range mixer, a roofing filter at the final signal bandwidth, and possibly accepting a few dB of sensitivity loss, by avoiding preamplifiers.
 There are a few other limitations of this receiver architecture that will be discussed next month, along with alternative architectures, in the final chapter of HF Receiver Non-linear Distortion.

(Monthly Puzzle from page 7)
 If you have a resistor of 220 Ohms rated at 5 Watts, what is the maximum allowable current?
 Please submit solutions and/or comments to wa2due at arrl dot net.

The SJRA would like to congratulate the following on his recent achievements:
 Test session date: 11/13/2013
 Robert W. Glauser, KD2EIL
 2260 Scovel Ave.
 Pennsauken, NJ 08110

	Tech	General	Extra
YTD	28	7	6

(Meeting Minutes from page 3)
 There was much discussion over "Board" awards and a decision was finally met. Members will find out the results at the December Party.
 Lou, N2HQL, stated that a change to the Amateur of the year plaque was needed since the Ameco key is currently not manufactured. The board discussed several options, then left it to the awards committee to do the change.



SJRA Jackets, Shirts, Hats

Order NOW - Next order going in soon!



Spring Jacket is \$44 (S,M,L,XL), Fall Jacket is \$55 (S,M,L,XL),
Shirts are \$27 (S,M,L,XL), Hats are \$25 (one size fits all)
Name and Call Sign embroidery included....Larger sizes slightly more!
Email Joe, KC2TN, with orders or additional info:
kc2tn at comcast dot net

Amateur Radio FCC License Testing

The SJRA sponsors *FREE* Amateur Radio FCC License testing on the second Wednesday of each month. The location is: 443 Commerce Lane, Suite 5, West Berlin, NJ 08091. Registration is at 7:00 PM and testing begins at 7:30PM. Walk-ins are accepted.

VE team members can be reached at VE@SJRA.org. A calendar and more information can be found on the SJRA web site.

November Meeting
Third Wednesday

November 20, 2013

“Our Meetings are Smoke Free”

The meeting commences promptly at 7:30PM in the first floor Meeting Room of the Gibson House on Main Street, Marlton, NJ 08053. Guests are always welcome.

Program For November:

This month we have a special guest!! Joe Taylor, K1JT. He will be speaking on “DXing with a weak signal.” You won’t want to miss this!! See you there!!

November 2013 Health and Welfare:

Happy Birthday to those celebrating in November: Happy Birthday to: 3- Joe Lameirns, WA2WJT; 8- Mary VonLintig, KV2M; 21- Jerry Parker, KC2JJT; 26- Richard VonLintig, KV2R.

Kathy Edwards, KM2KME

First Class Mail

South Jersey Radio Association
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