MOUNTAIN SPARK GAPS

NPARC—The Radio Club for the Watchung Mountain Area

Website: http://www.nparc.org
Club Calls: N2XJ, W2FMI
Facebook: New Providence Amateur Radio Club (NPARC)

VOLUME 54 NO. 4 April 2019

Regular Meetings

5/13 Monday 7:30
DeCorso Community Center
Third Monday is Memorial Day

Upcoming Events

New Providence Memorial Day Parade

See inside

Field Day 6-22 – 6-23
More to come

Meeting Schedule

Regular Meeting: 7:30—9:00 PM
2nd Monday of each month at the
NP Senior & Adult Center
15 East Forth Street
New Providence

Informal Meeting: 7:30—9:00 PM
4th Monday of each month
Same location
Everyone is Welcome
If a normal meeting night is a holiday, we usually meet the following night.
Call one of the contacts below
or check the web site

Club Officers for 2018

President: W2PTP Paul Wolfmeyer
201-406-6914
Vice President:K2GLS Bob Willis
973-543-2454
Secretary: K2AL: Al Hanzl
908-872-5021
Treasurer: K2YG Dave Barr
908-277-4283
Activities: KA2MPG Brian Lynch
973-738-7322

On the Air Activities

Club Operating Frequency
145.750 MHz FM Simplex

Sunday Night Phone Net
Murray Hill Repeater (W2LI) at 9:00 PM
Transmit on 147.855 MHz
With PL tone of 141.3 Hz
Receive on 147.255 MHz
Net Control K2AL

Digital Net
First & Third Mondays 9 PM
28,084 — 28,086
Will be using PSK and RTTY
Net control K2YG

Club Internet Address

Website: http://www.nparc.org
Webmaster KC2WUF David Bean
Reflector: nparc@mailman.qth.net
Contact K2UI, Jim

MOUNTAIN SPARK GAPS

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The Watchung Mountain Area Radio Club
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WB2QOQ Rick Anderson
W2PTP Paul Wolfmeyer
K2UI Jim Stekas

Climatological Data for New Providence for March 2019
The following information is provided by Rick, WB2QOQ, who has been recording daily weather events at his station for the past 38 years.

TEMPERATURE -
Maximum temperature this March, 74 deg. F (March 30)
Last March(2018) maximum was 60 deg. F.
Average Maximum temperature this March, 47.8 deg. F
Minimum temperature this March, 16 deg. F (March 6)
Last March(2018) minimum was 22 deg. F.
Average Minimum temperature this March, 33.1 deg. F
Minimum diurnal temperature range, 5 deg. (40-35 deg.)3/10
Maximum diurnal temperature range, 25 deg. (59-34 deg.)3/24;(74-49)3/30; (63-38)3/31

Average temperature this March, 40.5 deg. F
Average temperature last March, 37.8 deg. F

PRECIPITATION -
Total precipitation this March - 4.25" rain/ melted snow; 12.0" snow.
Total precipitation last March - 4.41" rain/ melted snow; 23.2" snow

Maximum one day precip. event this March -

March 21, 1.11" rain
Measurable rain fell on 6 days this March, 5 days last March.
Measurable snow fell on 4 days this March, 5 days last March.

YTD Precipitation - 11.78"
Season to Date Snowfall - 23.3" (11/15/18-3/31/19)

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Rick Anderson
4/20/19
243 Mountain Ave.
New Providence, NJ
(908)464-8912
rick243@comcast.net

Lat = 40 degrees, 41.7 minutes North
Long = 74 degrees, 23.4 minutes West
Elevation: 380 ft.
CoCoRaHS Network Station #NJ-UN-10

President's Column April 2019

First, I want to call to your attention our program for our May 13 Meeting. Ria Jairam N2RJ, our Hudson Division Director will be speaking on SDR—Software Defined Radio. This is a good opportunity to learn and to hear Ria in a technical talk. We will be in the BIG room at the DeCorso Center.
Please plan on participating in the New Providence Memorial Day Parade. Rick WB2QOQ will be coordinating again—let him know you can participate…see his article in this edition. It is good to be visible in New Providence activities; the NP Rec Dept does provide our insurance…
And then—on to Field Day—**June 22 and 23**! Note this is **NOT the last full weekend of June—but rather the fourth full weekend of June** (June has 5 full weekends this year)…We will be at the Governor Livingston High School back lot as usual. At this point we have leaders for the VHF station, but we need them for the 2 HF stations and the GOTA station as well as assistance to Sam with food… we will be seeking help for all the other activities at the next meetings.

73 for now
Wolf
W2PTP
201-404-6914 or W2PTP@arrl.net

New Providence Memorial Day Parade

NPARC members are invited to participate in this years Memorial Day Parade, taking place on Monday, May 27. Our club has annually participated in this town event, for as long as I can recall; and a decent attendance in this club activity is requested. This is the one public event where hundreds of town's people get to see the club members, and a good attendance is most welcomed. Last year there were ten members participating in our parade unit. As in past years, we request members to initially meet in the New Providence Memorial Library parking lot at 9:25 a.m., and we will truck pool over to our starting position on Central Avenue.

Suggested dress code is club shirt, tan/khaki slacks, NPARC yellow cap, and of course your 2 meter HT, tuned to club frequency.

Our unit will walk the parade route, down Springfield Ave., between Central Ave. and Academy St. Please consider taking part in this community event. We always enjoy a break, after the parade, with hot dogs, beverages, and desserts; at the DeCorso Comm. Center Please contact Rick, WB2QOQ, if you will be participating in the parade or have questions. rick243@comcast.net; (908) 464-8911. Thanks Much !

The Persuit of Dynamic Range

Jim Stekas - K2UI

In the early days of radio, receiver performance was limited by gain. Crystal detectors were point contact diodes using a chunk of galena ore and a "cat's whisker" and they produced negative gain. Only a fraction of the incoming RF power was converted to audio that "rattled the cans.

Around the time of WWI the vacuum tube triode (Audio) was introduced into radio, providing gain and increasing the sensitivity of receivers. During the period between the wars hams chased the Holy Grail of sensitivity. The typical top-of-the-line receiver design of the 1950s was a triple conversion superhetrodyne with ~20 tubes providing high sensitivity. Good selectivity came from a low, 50KHz, 3rd IF frequency and a tuned RF amplifier and a high first IF provided good enough image rejection so that a signal appeared at only one frequency.

Combining lots of gain with multiple conversion stages resulted in intermodulation distortion (see below) becoming the limiting factor in receiver performance. On an quiet band all the 1950s boat anchors performed satisfactorily for weak signals. But in a crowded band, shared with high power SW broadcast stations, intermodulation distortion turned the band into a cacophony of noise that allowed only the strongest stations to be received. Despite this, a typical receiver spec would claim to be "virtually immune to intermodulation distortion " if it was mentioned at all.

By 1970, ham radio designers had unlimited gain at their disposal but not a good understanding of how it should be allocated across the stages of the receiver to optimize perfoemance. In the December 1997 edition of Ham Radio magazine the article "Present-Day Receivers – Some Problems and Cures" by Sherwood and Heidlman outlined weaknesses and improvements for the Drake R-4C. The mods turned the R-4C into the "best" contest receiver available, and R-4Cs with the full set of Sherwood mods still command high prices. (www.sherwood.com is a great source for information on receiver design, including a PDF of the original Ham Radio article.)

Doug DeMaw (W1FB - SK) and Wes Hayward (W7ZOI) were early evangelists for designing receivers with high dynamic range. Their efforts were targeted at hams building their own equipment and manufacturers of ham equipment. Their book *Solid State Design for the Radio Amateur,* published in 1977, contains a very accessible treatment of solid state receiver and transmitter design and used copies command a high price. Ulrich Rhode (DJ2LR) also made the case for high dynamic range design and published numerous Ham Radio articles on the use of balanced mixers.

Weak Signals

A ideal linear amplifier when presented with an input signal of x will produce and output signal of $g \cdot x$, where g is the amplifier gain. When signals are weak a real amplifier operate linearly and output is well modeled by:

$$A_{LIN}(x) = n + g_1 \cdot x$$

where n is noise generated by the amplifier. The noise floor of the amplifier is measured by applying an input test signal and increasing its power until the output power is double that of the no-signal case.

The Minimum Detectable Signal (MDS) is the power of the smallest signal x that can be received, and is generally taken to be 3dB higher than the noise floor. Note that adding a 1dB attenuator at the input of the amplifier will attenuate the signal by 1dB but not alter internal noise of the amplifier. Therefore the attenuator would raise the MDS of the amplifier and *decrease* the SNR of the signal. Clearly, lowering g_1 by 1dB is equivalent to adding 1dB of attenuation.

Strong Signals

A real amplifier operates linearly only in the limit of very weak signals. For stronger signals, non-linear terms become important:

$$A_{REAL}(x) = n + g_1 \cdot x + g_2 \cdot x^2 + g_3 \cdot x^3 + \textit{smaller terms}$$ where

- n is noise generated by the amplifier
- g_1 is the linear gain
- g_2 and g_3 are the gains of 2nd and 3rd order terms.

An important parameter characterizing an amplifiers ability to handle string signal without distortion is the third-order intercept point or IP3. It is defined as the signal level for which the linear and cubic terms are equal:

$$g_1 \cdot x_{IP3} = g_3 \cdot x_{IP3}^3 \text{ or } x_{IP3}^2 = g_1 / g_3 \text{ which becomes } IP3 = \frac{1}{2}(g_1 - g_3) \text{ in dBm.}^1$$

If we add a 1dB attenuator to the input of our amplifier it would be equivalent to lowering g_1 by 1dB and g_3 by 3dB. As a consequence IP3 and MDS would both increase by 1dB. The dynamic range is defined as:

$$DR = \frac{2}{3}(IP3 - MDS)$$, which is unchanged by adding input attenuation.

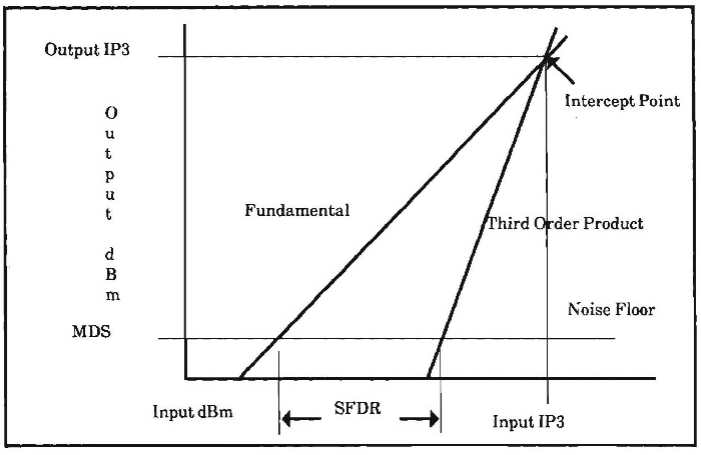

Fig. 1. Third order intecept point plot

Therefore two receivers (amplifiers) with the same DR an be made identical in performance by adding an input attenuator to the one with the lower MDS.

Today, top-of-the-line receivers have dynamic ranges exceeding 100dB as compared to 60-80 dBm for tube receivers of the post ware era. The best transceivers of the current generation can be operated on the same band during Field Day without degraded performance.

1 The best receivers have IP3 specs in the 20-30dBm range.

Intermodulation Distortion

A typical signal takes the form $x = m\cos(\omega t)$ where m is the modulation and $\cos(\omega t)$ carrier. The second order amplifier term contains $\cos^2(\omega t) = \frac{1}{2} + \frac{1}{2}\cos(2\omega t)$ which has a DC component and a second harmonic, both of which are very far from the carrier frequency and will be rejected by the next tuned receiver stage. Therefore we can we can ignore this term.[2]

The third order term has the form $\cos^3(\omega t) = \frac{3}{4}\cos(\omega t) + \frac{1}{4}\cos(3\omega t)$ contains a signal at the fundamental and a third harmonic that we can ignore.

Now consider a small signal $x = m_x \cos(\omega_x t)$ and a very strong nearby signal $y = m_y \cos(\omega_y t)$. Assuming our amplifier is followed by a crystal filter that passes ω_x and rejects ω_y, the output would be:

$$A_{REAL}(x) = n + g_1 \cdot m_x \cos(\omega_x t) + g_3 \cdot m_x m_y^2 \cos(\omega_x t)$$

The last term is the cubic term $x \cdot y^2$, the only part of $(x+y)^3$ that passes through the filter. It is the signal of interest x, with the modulation of y superimposed on top of it, whence the terminology "intermodulation distortion" or IMD.

2 Not so for linear power amplifiers since second harmonics cause out-of-band interference.