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 52 NO. 8 August 2018

UPCOMING EVENTS

Holiday Luncheon
12/2
Chimney Rock Inn, Gillette, NJ

Kids Day?
1/7/2018 2:00—5:00 PM
DeCorso Community Center

Regular Meetings

9/11 & 9/25
Monday 7:30
DeCorso Community Center

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 2016

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: Open

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

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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WB2QOQ Rick Anderson
W2PTP Paul Wolfmeyer
K2UI Jim Stekas

Climatological Data for New Providence for July 2017

The following information is provided by Rick, WB2QOQ, who has been recording daily weather events at his station for the past 35 years.

TEMPERATURE -
Maximum temperature this July, 94 deg. F (July 20)
Last July(2016) maximum was 96 deg. F.
Average Maximum temperature this July, 84.4 deg. F
Minimum temperature this July, 57 deg. F (July 30)
Last July(2016) minimum was 59 deg. F.
Average Minimum temperature this July, 66.1 deg. F
Minimum diurnal temperature range, 7 deg. (72-65 deg.) 7/14
Maximum diurnal temperature range, 29 deg. (88-59 deg.)7/31

Average temperature this July, 75.3 deg. F
Average temperature last July, 77.4 deg. F

6 days this July had maximum temperatures of 90 degs. or higher.
13 days last July of 90 degs. or higher temps.

PRECIPITATION -
Total precipitation this July - 4.41" rain
Total precipitation last July - 7.17" rain

Maximum one day precip.event this July - July 7, 1.55" rain
Measurable rain fell on 12 days this July, 13 days last July.

YTD Precipitation - 29.49" (includes rain + melted snow; 22.25" snow as of 3/31/17)

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Rick Anderson
8/11/17
243 Mountain Ave.
New Providence, NJ
(908)464-8911
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 August 2017

Two good programs this month—the first on the NYC Marathon led by key ham leadership in the marathon with support from our own Kevin N2TO and Tim KD2EKN (including credentials, etc)! The second showed what can be done with portable contesting—thanks Al K2AL.

The eclipse was an exciting event for our country, in my view. At least four of our club members viewed it in totality: K2AL, K2UI, KC2ONL, and K2JV. I've asked Al to coordinate a sharing of their experiences for our September 11 meeting. So plan to be there!

We decided at the July 24 meeting to build the DIY mega 328 Transistor Tester, Capacitance, Inductance ESR Meter brought to the club by Jon Pawlik AE2JP. Since the kits are imported, it may take a few weeks to receive them. Individuals should order his/her own on ebay, according to the info posted by Jon on the reflector July 25 (and again last Monday nite)—I've received mine, as have at least three other club members—cost is under $17 with free shipping. We hope to tackle assembly in October. So get your kit on order (delivery took three weeks for mine). We'll have help for the little bit of surface mount soldering. But read Jon's reflector post and get prepared for fun.

We have set the date with the TriCounty Club for the Fox Hunt—Sunday afternoon, May 20 next year. This date was picked because OUR club members had trouble with fall dates this year for various reasons and we weren't ready. So the new date allows for preparation time. Equipment needed will be a 2meter HT, a directional antenna, and an attenuator. A possible antenna is at http://theleggios.net/wb2hol/projects/rdf/tape_bm.htm. We'll get a suggestion for a step attenuator. A barbeque will likely follow the hunt. So start getting prepared.

And, quickly, the HF Digital" net continues...for help, I'd suggest Dave K2YG, David KC2WUF, Al K2AL, or Bob K2GLS as possible mentors—talk to them or to me.

Finally, put down the first Saturday of December for the Holiday Luncheon at Chimney Rock—it has been reserved, thanks to James KB2FCV.

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

A Gentle Introduction to I & Q

Jim Stekas – K2UI

If you have had the chance to read about digital modes (PSK, RTTY, etc.) You will have stumbled upon the terms I and Q, the In-phase (real) and Quadrature (imaginary) components of a signal. Splitting signals into I and Q allows us to view them as complex functions of time, simplifying their mathematical treatment. Software Defined Radio is the art of generating and demodulating streams of digitally sampled I and Q.

Complex arithmetic is something we are already familiar with from dealing with impedances that combine resistive (real) and reactive (imaginary) elements. The reactance of an inductor is well known to be given by the formula $X_L = j\omega L$, which assumes (by convention) that the current is of the form $I(t) = I_0 e^{j\omega t} = I_0[\cos(\omega t) + j\sin(\omega t)]$. We can right the voltage using Ohm's law as

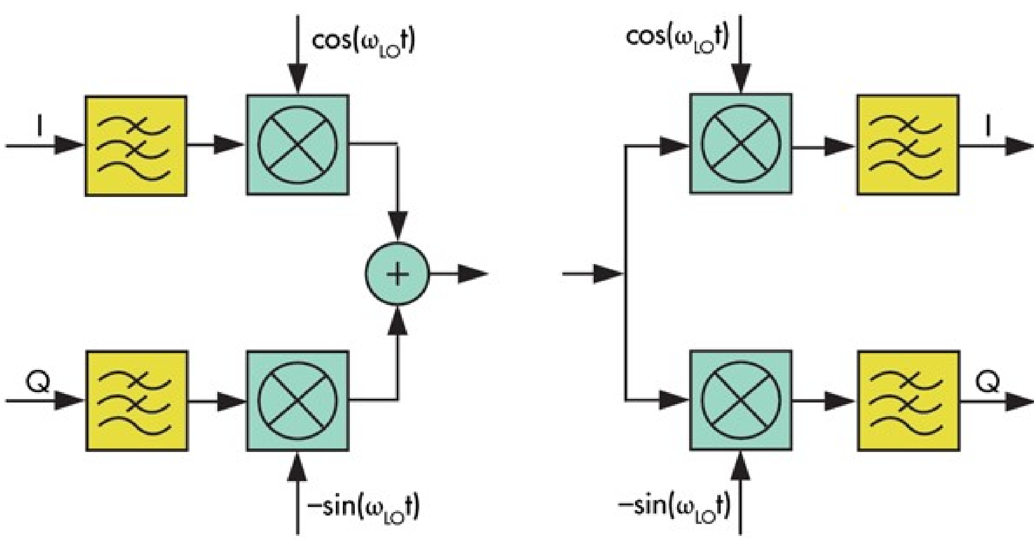
$$V(t) = X_L I(t) = (j\omega L) \cdot I_0 e^{j\omega t}$$

Taking the real part of the above equations gives the actual measured values of voltage and current

$$\mathrm{Re}\, V(t) = -(\omega L) \cdot I_0 \sin(\omega t) \quad \text{and} \quad \mathrm{Re}\, I(t) = I_0 \cos(\omega t).$$

Note that complex arithmetic gives not only the relation between the magnitudes of voltage and current, but also the 90^o phase difference. To get the same result using the real expressions for voltage and current would require calculus.

The figure below shows a block diagram of a generic SDR transmitter (left) and receiver (right). Blue blocks are implemented with analog circuits while the yellow bocks will generally be a mix of analog and digital filters. If the local oscillators (LOs) have identical frequency and phase, the I/Q modulating the transmitter will be faithfully recovered at the receiver (along with some added noise).



The transmitted signal in the above diagram is:

$$S(t) = I\cos(\omega_{LO}t) - Q * \sin(\omega_{LO}t) = \mathrm{Re}[(I + jQ)e^{j\omega_{LO}t}]$$.

In SDR, we think of the transmitted signal as the complex function

$$S(t) = (I + jQ)e^{j\omega_{LO}t}$$

Joseph Fourier showed that any function $x(t)$ can be decomposed into a sum of $\cos(\omega t)$ and $\sin(\omega t)$ functions. For example, a square wave results from summing the infinite series

$$s(t) = \sin(t) - \frac{1}{2}\sin(2t) + \frac{1}{3}\sin(3t) + \cdots$$.

It is convenient can think of $I(t)$ and $Q(t)$ as sums of cos() and sin() functions. Let's begin by considering the simple case where $I(t) = 2\cos(\omega t)$ and $Q(t) = 0$. For this case the transmitted signal is:

$$S(t) = 2\cos(\omega t)e^{j\omega_{LO}t} = (e^{j\omega t} + e^{-j\omega t})e^{j\omega_{LO}t} = e^{j(\omega_{LO}+\omega)t} + e^{j(\omega_{LO}-\omega)t}$$.

It is easy to see that the transmitted signal is composed of upper and lower sidebands above (USB) and below (LSB) the LO carrier frequency.

If we set $I(t) = 0$ and $Q(t) = 2\sin(\omega t)$ we get a transmitted signal of:

$$S(t) = 2j\sin(\omega t)e^{j\omega_{LO}t} = (e^{j\omega t} - e^{-j\omega t})e^{j\omega_{LO}t} = e^{j(\omega_{LO}+\omega)t} - e^{j(\omega_{LO}-\omega)t}$$.

Here the signal has the same USB but the sign of the LSB is now negative.

Combining $I(t) = \cos(\omega t)$ and $Q(t) = \sin(\omega t)$ gives:

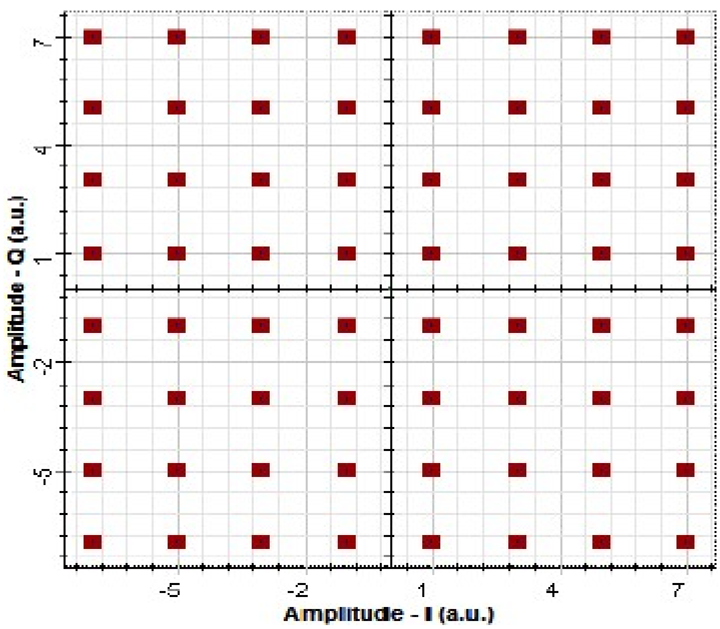
$$S(t) = [\cos(\omega t) + j\sin(\omega t)]e^{j\omega_{LO}t} = e^{j\omega t}e^{j\omega_{LO}t} = e^{j(\omega_{LO}+\omega)t}$$

which has only a USB. If we change the sign of Q we would generate an LSB signal instead.

The above example is nothing more than the phasing method of SSB generation using I/Q terminology. We have represented the human voice by a single frequency tone, which is admittedly unrealistic. In an actual system, $I(t)$ is the raw voice signal and $Q(t)$ is generated by from $I(t)$ by a magic little function called a Hilbert transform which performs a 90^o phase shift that maps every $\cos() \to \sin()$ and every $\sin() \to -\cos()$. Hilbert transforms are beyond the scope of this article, but for digital modes we don't need them since we can generate both I and Q mathematically.

For FSK (frequency shift keying) modes we have $I + jQ = e^{j\omega(t)t}$ where $\omega(t)$ now takes on different values over time. In the case of RTTY, $\omega(t)$ shifts between two values 170Hz apart approximately 45 times per second. Other FSK modes include MFSK which uses 16 different frequencies and MT63 which uses 64.

For PSK (phase shift keying) modes we have $I + jQ = e^{j\phi(t)}$ where the phase $\phi(t)$ assumes different discrete values over time. In BPSK31 the phase changes between 0^o and 180^o (a sign change) 31 times per second. QPSK31 shifts between four phases



In the general case, a digital mode is defined by a set of “symbols”, each being represented by a specific amplitude of I and Q. If we plot the I/Q values for each symbol we produce a graph called a “constellation”.

The figure above shows the constellation of 64-QAM, a modulation scheme where I and Q take one of 8 values for each symbol, for a total of 64 different symbols. Since 6 bits are needed to encode the numbers 0-63, 64-QAM transfers 6 bits in every symbol. 64-QAM is used for the highest speed modes in 4G wireless, but excellent propagation conditions are required.

Notes:

Assuming that the receiver and transmitter oscillators are phase locked seems ridiculous, but most digital modes allow effective phase locking of the receiver to the transmitter.

See the *Radio Amateur’s Handbook* for a basic overview of SDR and the digital modes used in ham radio.