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. 7 July 2021

Regular Meetings

Second & Fourth Mondays
"ZOOM" until we can all
get together again

Upcoming Events

Digital Net Mondays at 9:00 PM
PSK on 80 or10 meters
CW training Net, Thursday at 9:00 PM
Watch for Email announcements.

Meeting Schedule

Regular Meeting: 7:30—9:00 PM
2nd & 4th Monday
of each month

ZOOM until further notice

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 2021

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: KC2OSR: Sam Sealy
973-462-2014

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
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 K2JV, Barry

MOUNTAIN SPARK GAPS

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WB2QOQ Rick Anderson
W2PTP Paul Wolfmeyer
K2UI Jim Stekas

Climatological Data for New Providence for June 2021

The following information is provided by Rick, WB2QOQ, who has been recording daily weather events at his station for the past 39 years.

TEMPERATURE -
Maximum temperature this June, 98 deg. F (June 30)
Last June(2020) maximum was 88 deg. F.
Average Maximum temperature this June, 82.4 deg. F
Minimum temperature this June, 51 deg. F (June 1, 23)
Last June(2020) minimum was 49 deg. F.
Average Minimum temperature this June, 63.1 deg. F
Minimum diurnal temperature range, 8 deg. (71 - 63 deg.)6/11
Maximum diurnal temperature range, 28 deg. (85 - 57 deg.)6/18

Average temperature this June, 72.8 deg. F
Average temperature last June, 72.4 deg. F

PRECIPITATION -
Total precipitation this June- 3.66" rain.
Total precipitation last June- 2.39" rain.

Maximum one day precip. event this June-

June 8, 1.53" rain.
Measurable rain fell on 12 days this June,10 days last June.

YTD Precipitation - 22.15"

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Rick Anderson
7/20/2021
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 July 2021

I hope the summer is going fine for you…It was good to see a number of club members at the Sussex hamfest on the 18th. Eyeball QSOs are nice.

It being July we didn't have a business meeting. We did, thanks to Sam KC2OSR, however, have two program meetings on ZOOM. The first was given by Peter Dougherty W2IRT on the W2 QSL Bureau. Peter is a long time member of the North Jersey DX Association which runs the 2-land bureau. His talk was informative, and, if you are not registered with the bureau, I hope it inspired you to do so. It is a cost-effective way to get the QSL cards from the DX you work. Peter is also a certified card checker for DXCC so you may run into him at hamfests doing card-checking. Check out his QRZ.com page to find out more about getting cards checked.

The second program was about the other end of the QSL card process—that is having interesting QSL cards of your own that inspire the stations you work to QSL back. Julia Lovallo is a graphic designer and offered tips on "marketing" your station via the QSL card. She also shared practical techniques and software ideas on how to create interesting cards.

Thanks Sam for inviting her. And reader--give designing a card a try! Our August ZOOM meetings are August 9 and August 23.
And don't forget the nets, Sunday phone, Monday digital, and Thursday CW!

73, Wolf W2PTP, 201-404-6914, W2ptp@arrl.net

Skin Effect

Jim Stekas - K2UI

"Skin effect" refers to the tendency of RF current to flow in a thin layer on the surface of a conductor. Most of us hams have some degree of familiarity with the phenomenon, but few of us understand why it occurs, or when it becomes an important factor in a design.

The skin effect causes the current density to fall exponentially with distance from the the surface. The skin depth, δ, is the distance below the surface where the current is down by a factor $1/e$ from the current flowing near the surface. The current at any depth d is given by $I(d) = I(0)e^{-d/\delta}$, where $I(0)$ is the surface current. For design purposes we usually use a simplified skin effect model where all the current is uniformly distributed between a wire's surface and the skin depth of δ. For a wire with a diameter r the current would be confined to a cross sectional area of $A = 2\pi r\,\delta$.

Consider a 10 MHz dipole built with 18 gauge copper wire. The wire radius is 0.5 mm and the cross sectional area is $A_W = 0.8\,mm^2$. At 10 mHz, the skin depth is $\delta_{10\,MHz} = 0.021\,mm$ and the current would be confined to an area $A_S = 0.07\,mm^2$ at the outer surface of the antenna wire. Therefore the current is only using about 9% of the copper in the antenna. This is why "real" antenna wire is copper clad steel. The steel center provides strength, and the outer copper carries the current.

The ideal copper wire for carrying AC is a hollow copper pipe with a thickness equal to δ at the operating frequency. This is the approach used in small loop antennas where the radiation resistance may be only a few $m\Omega$. Resistive losses must be lower than the radiation resistance to achieve reasonable efficiency and the pipe shape puts every bit of copper to work.

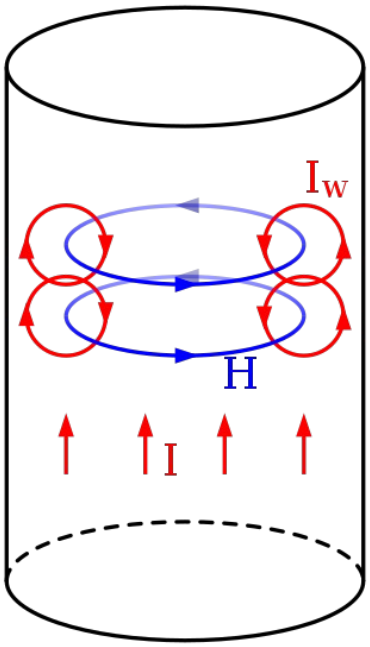
Even better is a copper pipe with a silver coating with a thickness equal to the skin depth. Many antenna tuners use this approach to maximize Q and minimize losses in their tank circuit coils. At microwave frequencies the skin effect makes wires useless for energy transmission and silver plated waveguide is used instead.

Skin depth in copper

Frequency	Skin depth (µm)
50 Hz	9220
60 Hz	8420
10 kHz	652
100 kHz	206
1 MHz	65.2
10 MHz	20.6
100 MHz	6.52
1 GHz	2.06

Skin effect isn't just an RF issue. Surprisingly, the skin depth at 60 Hz is $\delta_{60\,Hz} = 8.4\,mm$ which means any wire or bus bar with a thickness larger than 0.5 inches is wasting copper. For AC power transmission lines skin effect is very significant and must be addressed in the design to minimize power loss. Step-up transformers can compensate for a voltage drop but they cannot recover the lost power. DC power transmission does not suffer from skin effect losses and is seeing significant deployment in modern power grids.

To understand the skin effect quantitatively requires solving Maxwell's equations. But we can get a qualitative understanding by considering the relationships between current and magnetic field in a wire.



The figure at left depicts a wire where the in rushing current has gone from 0 to I over a short time. The increasing current induces a magnetic field, H, that encircles the current I. The changing magnetic field induces eddy currents, I_W, that "try" to cancel the magnetic field. Within the blue circles, the eddy currents I_W current oppose the inrush current I. Outside the blue circles the eddy currents I_W reinforce the inrush current I at the surface. The net effect is to move current from the center of the conductor out to the surface (skin) of the wire.

In actuality, there will be many concentric magnetic field loops, each with their own eddy currents circling them. The more central magnetic loops and eddy currents will be smaller in magnitude those closer to the surface. Each layer of eddy currents will cancel the the previous layer resulting in an exponential decrease in current as we move to the center. What isn't obvious from the diagram is that the phase of the current also changes with depth, so that once we get 3δ below the surface the current is not only down by a factor of 20, but it is also flowing in the opposite direction of I! That is an insight that only a solution to Maxwell's equations can provide.

Some Formulas

- The general formula for the skin depth in copper is $\delta = \frac{0.065}{\sqrt{f_{MHz}}}\ mm$.
- For cases where the skin depth, δ, is much less than the wire radius, r, the AC resistance is approximately $R_{AC} \approx \left(\frac{r}{2\delta}\right) R_{DC}$.
- The full blown formula for the current including magnitude *and* phase is:

$$I(d) = I(0)e^{-(1+j)\frac{d}{\delta}}$$

References

1. https://en.wikipedia.org/wiki/Skin_effect