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 53 NO. 5 June 2020

Regular Meetings

"ZOOM" until we can all get together again

Upcoming Events

Field Day

Meeting Schedule

Regular Meeting: 7:30—9:00 PM
2nd & 4th Monday
of each month at the
New Providence Hall
Elkwood Ave. NP
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: KC2OSR Sam Sealy
973-635-8966

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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P.O. Box 813
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Editor: K2EZR Frank McAneny
Contributing Editors:
WB2QOQ Rick Anderson
W2PTP Paul Wolfmeyer
K2UI Jim Stekas

Climatological Data for New Providence for April 2020

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 April, 73 deg. F (April 5)
Last April(2019) maximum was 78 deg. F.
Average Maximum temperature this April, 58.7 deg. F
Minimum temperature this April, 30 deg. F (April 17)
Last April(2019) minimum was 30 deg. F.
Average Minimum temperature this April, 40.3 deg. F
Minimum diurnal temperature range, 8 deg. (49-41 deg.)4/24
Maximum diurnal temperature range, 32 deg. (65-33 deg.)4/19

Average temperature this April, 49.5 deg. F
Average temperature last April, 55.9 deg. F

PRECIPITATION -
Total precipitation this April – 4.21” rain.
Total precipitation last April – 4.94” rain.

Maximum one day precip. event this April -

April 13, 1.76” rain
Measurable rain fell on 13 days this April,15 days last April.
Measurable snow fell on 0 day this April.
Trace of sleet – April 23.

YTD Precipitation – 13.39”

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Rick Anderson
5/13/2020
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 May 2020

Another interesting month as we endure the COVID-19 shutdown and try to deal with it and think about the “new normal”—whatever that is.
No in-person meetings this month, of course. Two ZOOM meetings: one smooth and one not-so-smooth.

For me, the interesting thing about the May 11 meeting was the introduction of “show and tell”, e.g. Sam’s hat re ham’s and social distancing… We had about 20 attendees. We welcomed new member Don Matson (eager to get licensed). We spent time discussing Field Day, looking very unlikely to be done as an assembled in-person club. I was asked to take our request for score aggregation of club members to Ria’s (N2RJ) Hudson Cabinet ZOOM on May 12 (which I did, but more on this later).

I did send out a brief report on the cabinet meeting on the reflector--reprinting a few items of that report:
First, since all ARRL staffers are working from home and postal mail is only checked daily for critical items (e.g. bills, etc), email and phone are the best methods for contact with ARRL HQ Staff. Email and phone messages will get processed; mail items will encounter delay (likely very significant). Mailed and printed items, e.g. certificates, will also not be going out.
There are some new ARRL member benefits: you can get QEX and NCJ and On the Air **online** free, “youth” fee structure now goes up to age 26, and life membership is half-price if you are 70 and have 20 years as an ARRL member. There is a “surge” in the hobby, which is good. Approaches to exams are being tried, one of the more successful is the Warren Club’s drive-up exams. Doug, W2EN, of the W2 Bureau reported there will likely not be a mailing of cards until late June or early July.

I thought it was a good call and the ARRL is moving forward in spite of the pandemic. Link to Ria’s recorded call: https://www.facebook.com/watch/?v=241428620420577
We had a second ZOOM call/meeting on May 26 (as announced, the day after the holiday). It got off to a late start—we switched to my ZOOM account and a new invite. Why we didn’t tell people on W2LI to check their email for new info, I don’t know—unfortunately, I didn’t think of it and I can’t access the repeater from my ZOOM computer location. In the future, we will use my ZOOM account.

We had quite a bit of discussion about Field Day classes that we can use as individuals—but that all possibly changed Thursday with the announcement that 1) class D stations can work each other this year and 2) scores of club members will be aggregated. I’ll ask David KC2WUF to tell us the exact name to use on our submissions. We had lobbied for these changes—so we’re glad they were made.
Relative to which class to use, I find the rules and reporting of 2019 results in December 2019 QST helpful in clarifying about emergency power, qrp, and number of transmitters, and battery-only operation.

Al K2AL shared a short NPARC Field Day video put together by the daughter's friend—very nice—check it out if you haven't seen it: https://drive.google.com/open?id=1SOH_urRjrT0YdrHmL55F2l9WnqnsGDqh

There was a request to survey interest in establishing a community of NPARC DMR users. Hillary, KC2HLA, has put an item on the reflector for you to respond with interest or not. Please do so. I was surprised to hear a number of questions about "what is DMR?"—so maybe that's a clue we should have a short program or two about DMR—the technology, the structure, its uses, etc.

I plan to schedule June ZOOM meetings for June 8 and June 22 (our regular meeting nights). I will put the meeting information on the "reflector" as the meeting approaches. Start time will be 7:30PM.

Also, this month we got a request for assistance in the New Providence graduation "alternatives". James, KB2FCV, stepped up quickly to be our lead engineer/equipment man for this non-ham application of low-power FM transmission. Thank you James!! He already has a plan in place and has done some testing. The Governor's Tuesday announcement has already changed the planning to July—we will need help with testing—we'll let your know.
Don't forget our weekly nets-- New CW Net on Thursdays: Dave, K2YG, has gotten this off to a great start—check Dave's reflector messages. Digital net on Mondays at 9PM—again great leadership by Dave K2YG. And, of course, our regular Sunday phone net, run tirelessly by Al K2AL..

Let me know your thoughts as we navigate through this and stay safe and well… 73
Wolf W2PTP
201-404-6914 or W2PTP@arrl.net

Faraday, Motors and Transformers

Jim Stekas - K2UI

Micheal Faraday was the genius[1] who discovered the connection between electricity and magnetism. His experiments were simple, easily replicated in a high school lab, but his conclusions were revolutionary and profound. An immediate consequence of his work was the development of the electric motor and the creation of the discipline of electrical engineering to optimize power and efficiency.

Faraday discovered that the needle of a compass was deflected by a current carrying wire. His explanation of the phenomenon was that the current induced a magnetic field that deflected the magnet. The concept of a field replacing action at a distance was Faraday's greatest gift to theoretical physics[2]. His laws were captured in Maxwell's equations which describe electricity and magnetism as the interaction of charges and currents with electric and magnetic fields. Today, physics describes all particles and the forces between them in terms of quantum fields.

Figure 1 (right) shows the induction of a magnetic field by current flowing in a ring, essentially a 1-turn inductor. For this discussion we assume that I is an alternating current which will induce an alternating magnetic field B.

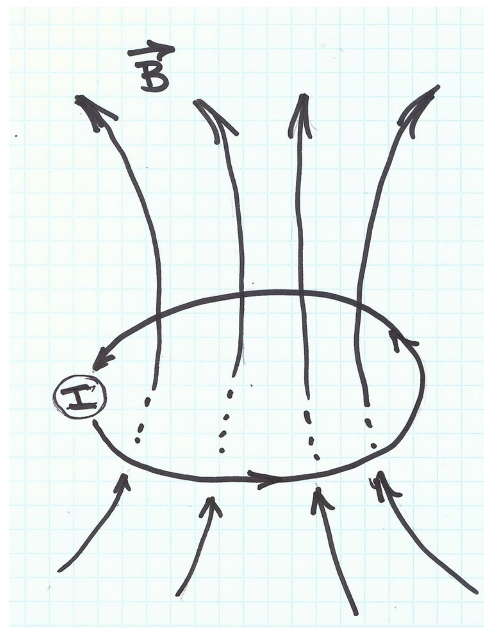

Fig 1: Magnetic field produced by current loop.

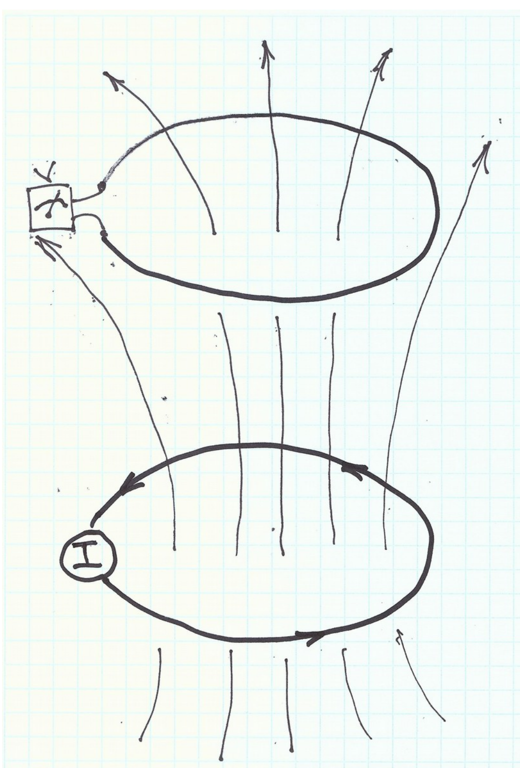

Fig 2: Magnetically coupled loops.

If we put an identical 1-turn ring above the first (Figure 2, left), it will experience a changing magnetic flux induced by the current in the lower ring. According to Faraday, this will create an alternating electric field, E, around the upper loop. An AC voltmeter connected across the upper loop will measure a voltage $V = 2\pi R E$.

1 Faraday was a hero to Einstein, and a portrait of Faraday hung in his office.

2 When confronted with the consensus of Cambridge physicists that fields could not exist, Faraday's reaction was “They are wrong.”

If we double the current , we double the magnetic flux, and therefore we double the voltage. We can express this linear relation as $V=(2\pi f L_M)I$ where L_M is the mutual inductance between the two loops[3]. If we inject the current into the upper loop and measure the voltage across the lower loop, we have the identical configuration turned upside-down. Therefore L_M from lower to upper and upper to lower are equal.

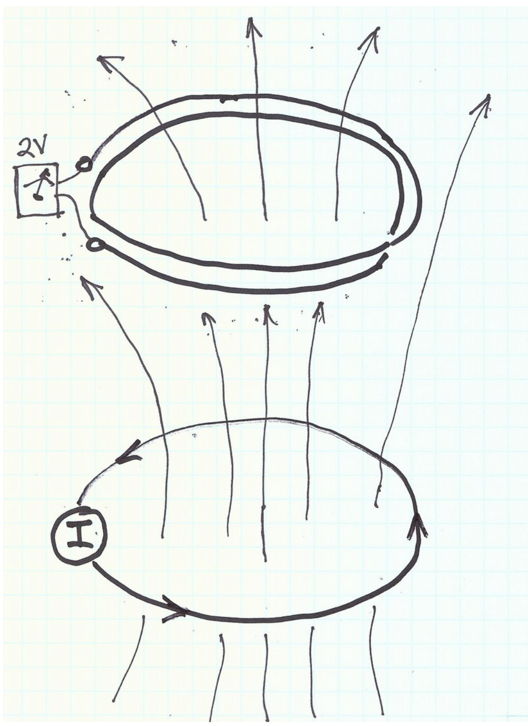

Fig 3: Doubled upper loop.

Next we replace the upper loop with two closely spaced identical loops connected in series, a 2-turn inductor (Figure 3, left). Each loop will contribute a voltage V, leading to a measured voltage of 2V. This means the mutual inductance between the 1-turn and 2-turn loops is $2L_M$, double the value of the dual 1-turn loops.

Now swap lower and upper loops again, and feed the current into the 2-turn loop (Figure 4, right). The result is that twice the current circles the 2-turn loop, creating twice the B field. Thus the magnetic flux in the upper 1-turn loop would be double that in Figure 2, doubling the voltage to $2V$. Therefore, the mutual inductance between the 2-turn and 1-turn loops is again $2L_M$. A current I in either loop will induce the same voltage in the other loop. Generalizing, the mutual inductance between n-turn and m-turn inductors with the same geometry would be $n \cdot m \cdot L_M$, where L_M is the mutual inductance between two 1-turn loops with the same geometry as shown in Figure 2.

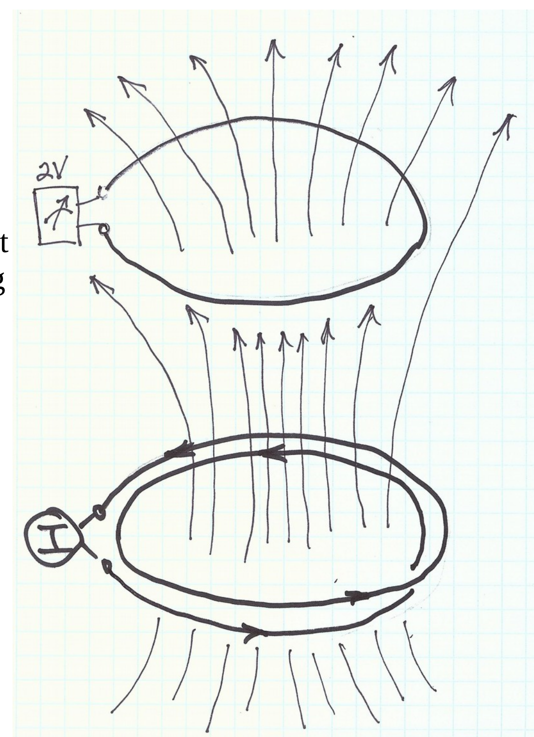

Fig 4: Swapped 1-turn and 2-turn loops.

3 For simplicity we ignore the 90 degree phase shift between current and voltage.

We can maximize the coupling between two 1-turn loops by placing them on top of each other so that the same magnetic flux goes through both loops. In this case, the mutual inductance would be the inductance, L_1 , of a single 1-turn loop. If we did the same with two n-turn inductors the mutual impedance would be $L_n = n \cdot n \cdot L_1 = n^2 \cdot L_1$, the inductance of an n-turn inductor.

This reproduces the familiar result that inductance is proportional to the number of turns squared when the turns are tightly coupled. The geometry in these examples assures 100% coupling, which would not be physically realizable with real wires of finite diameter. In practice L will increase more slowly than turns squared.

If we place an n-turn coil on top of an k-turn coil with *perfect* coupling the mutual inductance will be $n \cdot k \cdot L_1 = \sqrt{L_n \cdot L_k}$. In general two inductors cannot occupy the same space at the same time, so the mutual inductance between any two inductors L_a, L_b must be less then $\sqrt{L_a \cdot L_b}$. We typically express the mutual inductance as $\kappa\sqrt{L_a \cdot L_b}$ where $\kappa \le 1$ is a constant characterizing the coupling between the inductors.

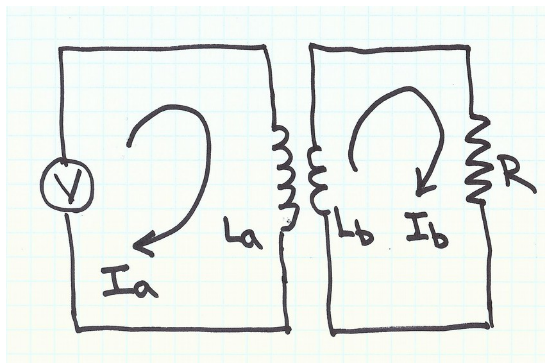

Fig 5: Simple transformer.

The hand-waving arguments above provide enough to model a transformer as a pair of coupled inductors L_a and L_b . (See Figure 5 at right.) Our goal is to derive the impedance, voltage, and current transformations.

We start with the equation for the I_a current loop:

$$V = j\omega L_a I_a - j\omega L_{ab} I_b \qquad \text{Eq 1}$$

The first term in Eq 1 gives the voltage drop across inductor L_a due to current I_a. The second term gives the voltage drop across L_a due to the current I_b where L_{ab} is the mutual inductance from inductor b to a .

If $R = \infty$, we have an open secondary and $I_b = 0$. In this case Eq 1 reduces to $V = j\omega L_a I_a$ which means the voltage source sees the impedance of $Z_{open} = j\omega L_a$. An important result.

The equation for the I_b current loop is:

$$0 = (R + j\omega L_b) I_b - j\omega L_{ba} I_a \qquad \text{Eq 2}$$

If $R = 0$, we have a shorted secondary and Eq 2 gives $I_b = \dfrac{L_{ba}}{L_b} I_a$. Substituting this into Eq 1 we find $V = j\omega \left(L_a - \dfrac{L_{ab} L_{ba}}{L_b} \right) I_a$. We already showed that mutual inductance is the same in both directions so $L_{ab} L_{ba} = L_{Mut}^2 = \kappa L_a L_b$. Substituting we find $V = j\omega(1-\kappa) L_a I_a$, or $Z_{short} = j\omega(1-\kappa) L_a$.

Taking the ratio of shorted and open impedances allows us to determine κ :

$$\frac{Z_{short}}{Z_{open}} = (1-\kappa)$$

Solving equations 1 and 2 for an arbitrary R results in an input impedance of:

$$Z_R = \frac{V}{I_a} = j\omega L_a \frac{R+(1-\kappa)\, j\omega L_b}{R+j\omega L_b} \quad \text{Eq 3}$$

We expect Z_R to be related to the square of the turns ratio, something like $Z_R = \left(\frac{n_a}{n_b}\right)^2 R = \left(\frac{L_a}{L_b}\right) R$ but Eq 3 doesn't look anything like what we expect. For Eq 2 to look like an ideal transformer we must have $|j\omega L_b| \gg R$ so that we can ignore R in the denominator. Assuming this is the case gives:

$$Z_R \approx \frac{L_a}{L_b} R + j\omega(1-\kappa) L_a$$

The first term is what we expect from an ideal transformer. The second term is Z_{short}, which looks like a small inductor. Ideally, we want the second term to be much smaller than the first, which means that: $(1-\kappa)|j\omega L_b| \ll R$. Combining both constraints we find:

$$(1-\kappa)|j\omega L_b| \ll R \ll |j\omega L_b| \quad \text{for ideal transformer behavior.}$$

Electrical engineers interpret "much larger" to mean more that 10x larger. Applying this rule of thumb for R=1 requires:

$(1-\kappa)10 \approx 0.1 \ll 1 \ll 10$, giving a value of $\kappa \approx 0.99$.

Next month we'll continue the discussion by applying these techniques to analyze a popular SWR bridge design.