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. 6 June 2020

Regular Meetings

"ZOOM" until we can all get together again

Upcoming Events

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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Contributing Editors:
WB2QOQ Rick Anderson
W2PTP Paul Wolfmeyer
K2UI Jim Stekas

Climatological Data for New Providence for May2020

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 May, 83 deg. F (May 30)
Last May(2019) maximum was 86 deg. F.
Average Maximum temperature this May, 69.6 deg. F
Minimum temperature this May, 32 deg. F (May 9)
Last May(2019) minimum was 44 deg. F.
Average Minimum temperature this May, 49.8 deg. F
Minimum diurnal temperature range, 9 deg. (53-44 deg.)5/9
Maximum diurnal temperature range, 31 deg. (70-39 deg.)5/14

Average temperature this May, 59.7 deg. F
Average temperature last May, 63.3 deg. F

PRECIPITATION -
Total precipitation this May- 2.21" rain.
Total precipitation last May- 9.46" rain.

Maximum one day precip. event this May-

May 23, 0.52" rain
Measurable rain fell on 13 days this May,21 days last May.

YTD Precipitation - 15.60"

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Rick Anderson
6/17/2020
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 June 2020

Well, this "strange" Field Day has now come and gone…With the virus, we "could not/did not" operate as a group, missing the usual teamwork of setting up and having a fun weekend together at Governor Livingston High School. The ARRL did approve two changes: 1) Class D stations could work other Class Ds for QSO points, and 2) individual club member scores will be aggregated and reported in December QST (as long as we use the identical club name which is **New Providence ARC**).

So how will we "look" compared to last year's N2XJ/W2FMI score of 931 Qs and 4262 points? While it is early in the reporting, I've seen claimed scores that will easily surpass the Qs and points totals. For example: James, KB2FCV (and Kieran) had over 322 CW Qs, Dave K2YG had 243 CW Qs and 2780 points with battery and QRP, Al K2AL had 173 mixed mode Qs and 2070 points with battery and QRP, Bob K2GLS had 211 Digital Qs and 1094 points…. Other participants include KC2WUF, K2EZR, N2FYE, N2TO, W2IOC, W2EMC, WB2QOQ, KC2OSR, and myself. (If I missed you, I was unaware of your participation and I apologize.) I, along with others, was frustrated on Saturday (seemed very difficult to score Qs), but Sunday was much better!

Now last year we had 47 people onsite for the event and we will pale compared to that. And we missed having the opportunity for newer hams to gain experience operating—to me the biggest reason/benefit of Field Day.

Speaking of new hams, Don Madson passed both his Technician and General Class licenses—congratulations. He is now KD2UAW.

And another big achievement—Bob K2GLS received the certificate recognizing 5-Band DXCC—that's working at least 100 countries on each of the five bands—80, 40, 20, 15, and 10. Congratulations, Bob.

Again, no in-person meetings. So we had ZOOM meetings #4 and #5. We will continue with ZOOM meetings in July on the 13th and 27th. If you haven't joined in, please do. If you want some mentoring on using it—call me. We will have a program on DMR at the July 13th meeting. Don't forget our weekly nets-- the CW Net on Thursdays, the Digital net on Mondays at 9PM, and, of course, our regular Sunday phone net.
Let me know your thoughts as we navigate through this and stay safe and well… 73

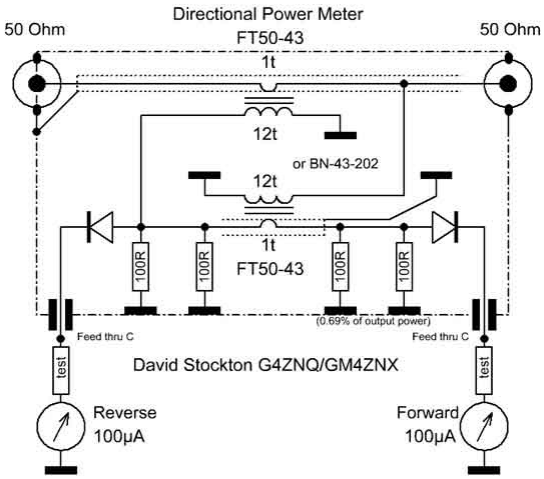
Wolf W2PTP
201-404-6914 or W2PTP@arrl.net

The Stockton SWR Bridge

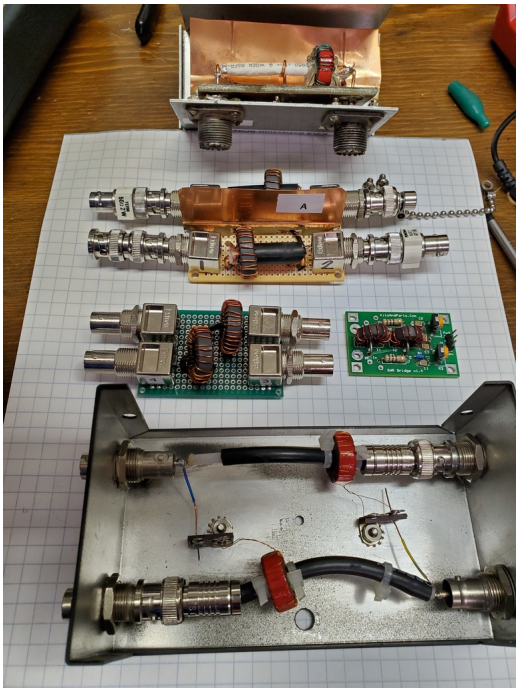
Jim Stekas - K2UI

A few years ago I built a power meter using an Analog Devices demo board and an Arduino. The board has three power measurement chips which makes it a great platform for a digital power/SWR meter. To make that happen I would need a bridge to sample forward and reflected signals and feed them to the RF board.

The Stockton SWR bridge (designed by G4ZNQ) seems like a perfect solution. It is easy and cheap to build, sensitive enough for QRP, and has a flat frequency response if properly designed.



The key elements of the Stockton bridge are two toroidal transformers. The circuit at right is a typical QRP design using FT50-43 ferrite cores with a 1:12 turns ratio. The upper transformer samples the forward current, injecting 1/12 of it into the measurement circuit below. The lower transformer operates as a 1/12 voltage step down. The power flowing in the measurement circuit is $(1/12)^2$ of the transmit power (-21 dB). For 100W transmitters, a 1:50 turns ratio would be more appropriate (-34 dB).



At left are various versions of the Stockton bridge that I built trying to get to one with a satisfactory performance. Terminating the output of the bridge should result in an SWR of 1.0 seen at the input. But all the bridges I built had SWRs varying from 1.1 to 1.2 from 3.5-28 MHz.

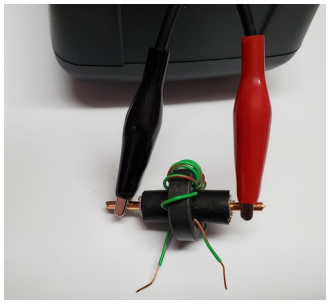
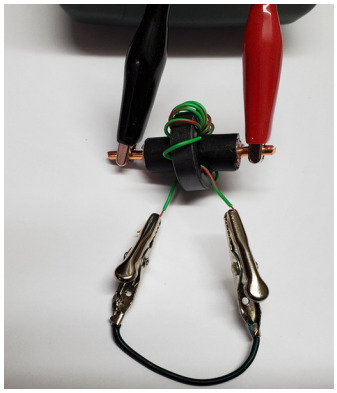
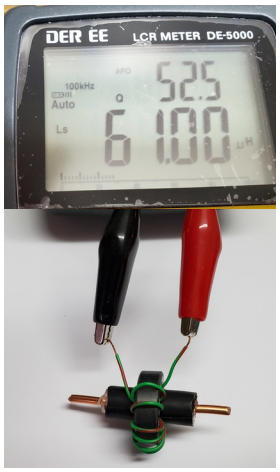
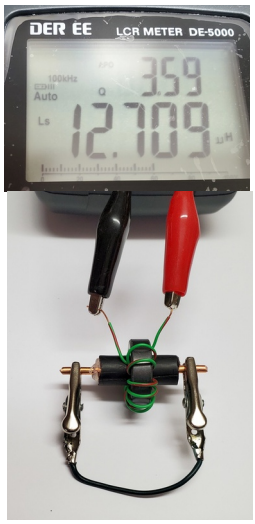
The typical figure of merit for a bridge is its "directivity", essentially the return loss, or the fraction of reflected power in dB[1] when terminated by $50\,\Omega$. Some folks claim a directivity of 35dB for their Stockton bridge which is equivalent to a SWR of 1.036.

None of the bridges I built came close to that magic 35dB, but they all fell consistently into that 20-25dB range. I began to wonder what it would take to get to 35dB directivity.

1 An SWR bridge actually ***measures*** return loss, but the scale on the meter ***displays*** SWR.

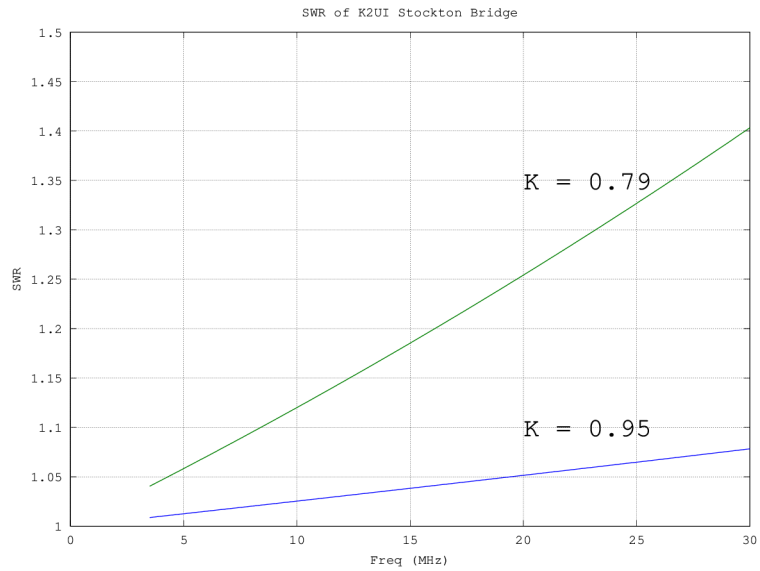
The Stockton bridge design starts with the assumption that the two toroidal transformers are ideal and identical. The ideal transformer has 100% coupling between the primary and secondary windings, which is impossible to achieve in practice. A bifilar wound transformer (where primary and secondary are a twisted pair) can approach 100% coupling, but the transformers in a typical Stockton bridge might have a single turn RG8U coax primary and a multi-turn 24 gauge secondary. There is every reason to expect coupling to be lower than 100%. For a coupling constant $\kappa<1$, there is a leakage inductance of $(1-\kappa)L_1$ that will appear in series with the primary winding and load. Even if the load is exactly $50\,\Omega$ this inductance will cause an SWR>1.

So let's figure out what κ is using the methods outlined last month.

  $L_1=0.43\mu H$	  $(1-\kappa)L_1=0.02\mu H$ $\kappa = 0.95$	The inductance of the single turn primary (measured at 100kHz) is $0.43\mu H$. When the secondary is shorted the inductance drops to $0.02\mu H$. This implies a coupling coefficient of $\kappa=0.95$. Since these inductance values are so low (try measuring $0.02\mu H$!) they likely have significant measurement errors, so we'll take $\kappa=0.95$ as an absolute best case.
 $L_2 = 61.0\mu H$	 $(1-\kappa)L_2=12.7\mu H$ $\kappa=0.79$	We can reduce the error by doing the same measurements on the 12T secondary where the inductance should be 144x greater the 1-turn primary. This gives us a different, and probably more accurate, value of $\kappa = 0.79$. The key point is that $\kappa<1$ and therefore the transformer does not perform as an ideal transformer.

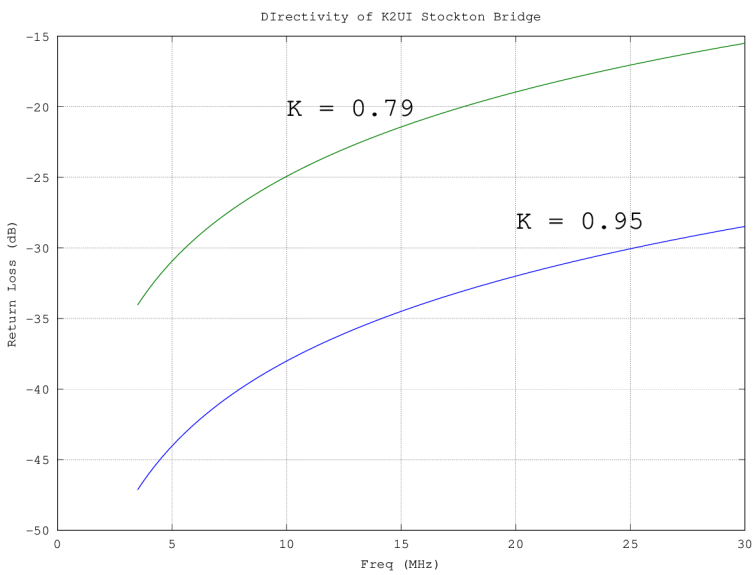
Given the measurements above we know that $0.79 < \kappa < 0.95$ and $0.02\mu H < L_{leakage} < 0.09\mu H$.

The graph below right shows the impact on SWR of $L_{leakage}$ due to imperfect coupling. The lines represent the SWR a transmitter would see looking through a Stockton bridge at a 50Ω load. The green line represents the most realistic model based on the highest confidence measurements, and is pretty consistent with the performance I get from the bridges I have built. The blue line represents the absolute best that might be achievable with the Stockton design.



A bridge characterized by the green line is not a lab grade instrument, but it is perfectly good for adjusting an antenna tuner for minimum reflected power (i.e. good match). All it means is that at an SWR of "1:1" your tuner is tuning out the reactance of your antenna plus the leakage inductance.

For the sake of completeness, the figure below left shows the return loss of a bridge built with the toroidal transformer in the figures. A -30dB return loss corresponds to a SWR of 1.05 and it is achievable for a DIY project.



The fact that the blue line dips below -35dB doesn't mean you will see that performance – you won't. It just means that other gremlins and imbalances will creep in below 15 MHz.

Bottom line, the Stockton bridge isn't a good choice for lab measurements, but it makes a good reflected power indicator for tweaking an antenna tuner, especially for QRP.