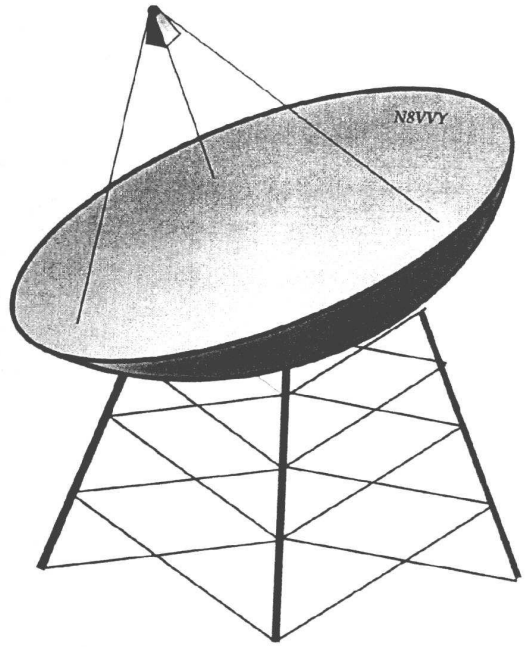
ANOMALOUS PROPAGATION

Newsletter: **The Midwest VHF / UHF Society**



Editors:
Gerd Schrick, WB8IFM
4741 Harlou Drive
Dayton, OH 454 32
(937) 253-3993
WB8IFM@AMSAT.ORG

Steve Coy, K8UD
3350 Maplewood Dr.
Beavercreek, OH 45434
(937) 426-6085
K8UD@ARRL.NET

Annual Society membership is $ 10.00. Please make checks payable to Gerd Schrick

MIDWEST VHF-UHF SOCIETY

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Upcoming Meeting Fri 26th of Mar (7PM)
at the Hometown Buffet near SR 725 and Yankee Rd. in Centerville

MVUS Sunday Net at 13:30 UT (currently 9:30 AM local time, DST).
The net frequencies are primarily 144.280 Mc and 28.960 Mc.

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Upcoming Events:

SE VHF Conference in Morehead Kentucky on 24/25 April, see page 3.

Hamvention 14/15/16 May

Club News (see also pg 8)

Dues will go up in May to $12 for everybody …. Read notice on page xx for details.
Check the roster for accuracy and report corrections to Steve, K8UD@ARRL.net or Gerd, WB8IFM@AMSAT.org

De N8ZM

Well, I guess it must be Spring, since I had to set my clocks ahead just over a week ago. So far, though, I don't feel like I've saved any time. Actually, I'm pretty sure I lost an hour that weekend.

However, if I don't change the subject pretty quickly here, I'll get going on some rant about the government, and I don't want to go there with you guys. So, let's talk about a few fun things, like radio!

Hamvention is less than two months away, and a lot of good things are shaping up, including: our club booth, the VHF/Microwave Forum, and the balloon launch (see below). I've talked about all of these recently, so this month I'll give it a rest, but plan to have a really great time!

Due to delays in the tower work that would have installed our 1296 beacon about 900 feet ASL, we have adopted an alternative plan so that the beacon will at least be on the air soon. There is a 10 story building in SE Dayton on Wilmington Pike on which we have obtained permission to install the beacon and our FM repeater on 444.25 MHz. Some preliminary tests of coverage have been done, and the site covers the metro Dayton area quite well, we think. So, once we get the antenna mounting hardware constructed, we'll be installing antennas and hopefully the electronic packages shortly afterwards.

The N8ZM VHF contest crew is planning to operate from Beaver Island, in Lake Michigan, for the June contest. The location is in Grid EN75, which is quite rare. We will certainly be on 6 and 2, and if the logistics work out, on 432. We could also be on higher bands if we have the equipment and manpower. Haven't settled yet on whether we'll use N8ZM or N8UR for the contest (will have to arm-wrestle John for that, loser gets to choose?) . If you are interested in being a part of this expedition, let me know. The island is beautiful, the weather should be pleasant, the accommodations will be comfortable, and the companionship will be...well, you know how we are.

The SEVHF conference is about a month away, and plans are being finalized for an MVUS contingent to attend. Several of us will be making presentations as well. Good exposure for our organization and the great guys who make it so much fun! Even if you can only make it down to Morehead, KY , for one day, it will be worthwhile.

See you guys on the 26th! de Tom, N8ZM.

BalloonSat launch from the Dayton Hamvention

On Friday afternoon, May 14, 2010, a weather balloon carrying amateur radio (BalloonSat) will be launched from the grounds of the Dayton Hamvention following the BalloonSat Forum. The balloon will carry APRS transmitters on 144.39 MHz (WB8ELK-10 and WB8ELK-11) as well as multi-mode downlinks on DominoEX22 and Hellschreiber on 144.36 MHz. The balloon should reach a peak altitude of 100,000 feet and will then parachute back to Earth. Onboard video camcorders will record an aerial view of the Dayton Hamvention during the ascent and will provide amazing views from the very edge of Space that will show the blackness of Space and the curvature of the Earth. Learn more at **www.wb8elk.com**.

This and That 3-10

Goat. Anyone who owns one will tell you there is no animal quite like a pet goat. Winchel (the goat) was my greatest joy one day and my greatest frustration the next. [Sharon K Taylor in the "Grit"]

Sperm Whale. It is difficult not to speak of whales in romantic terms. I have seen grown men cry when they see their first whale. Seeing a whale is not like seeing a sparrow in a city tree or a cat crossing the street. It is not even like seeing a giraffe dawdling on the African veld, batting its glamorous eyes in the dust. Whales exist beyond the normal; nothing else represents life on such a scale. If they did not move, it would be difficult to believe they were alive at all. [From the book The Whale by Philip Hoare]

Lunch at Mc Donald's. While having lunch at Mc. Donald's I observed a party wearing mechanic uniforms at the next table and noticed their Toyota patches. When they left I was surprised to see them climb into their Fords. [Bill, a HVAC mechanic]

Battery Torcher. Peter Roth abuses batteries beyond their limits. "He overcharges them, drives nails into them, presses them between scalding brass plates." Funded by the car makers for more than a decade Roth admires how much they have improved. They 're still not perfect, though, which is why he likes to say, "If you build it; it can fail." [from Spotlight in The Week 3-5-10]

Typo squatters. Google is very tolerant of typos. About 68 million people a day mistype the names of highly visited websites, landing on bogus sites. Those are typo squatters to which Google provides ads, thereby hauling in a fortune. [Research, Harvard U]

Silver is no Gold. A German luger broke his tooth when photographers asked him to take a bite of his silver medal. [The Week, 3-5-10]

Temperature Scales. It can be confusing. There are degrees Kelvin, Celsius and Fahrenheit. Degrees Kelvin is used by Scientists. Celsius is best suited for the kitchen where the temperatures from zero to 100 cover the freezing and boiling of water. Finally Fahrenheit is best used for the weather as it covers its range nicely and was actually also designed with the (European) weather in mind.

[David L Goodstein – Caltech]]

Midnight Physics. I came across a few fascinating lectures on heat engines, temperature, entropy and the Carnot process by David L. Goodstein from Caltech. (Around midnight on PBS) He is a good lecturer although he comes across somewhat dry. He is using a real blackboard and shows unique experiments. He had a small light bulb in series with a coil of copper wire, it looked like a tuning coil from an antenna tuner. The circuit was plugged in and the bulb was just glowing (he said). For me the bulb looked dark. Next he dipped the coil into a jar filled with liquid air at about –200C. The bulb lit up brightly. I had never seen that before! [Gerd, WB8IFM]

Marconi. His mother Anne Jameson, a daughter of the famous Irish whiskey empire was married to his Italien father Giuseppe, a prosperous farmer and businessman. Guglielmo was their second child born on April 25,1874. Family lore held that soon after his birth an elderly gardener exclaimed at the size of his ears: "What big ears he has!" Annie took offense. She countered, "He will be able to hear the still, small voice of the air." [From "Thunderstruck" by Erik Larson]

Distance. Theoreticians devised equations to explain phenomena; Marconi cut wire, coiled it, snaked it, built apparatus, and flushed it with power to see what would happen, a seemingly mindless process but one governed by the certainty that he was correct. He wanted distance!

[From "Thunderstruck" by Erik Larson]

A Role for Lissajous Figures?

By Dave Powis, G4HUP / ND8P

This extract is taken from an article to be found at http://g4hup.com and originally published in the Newsletter of Leiston Amateur Radio Club in 2009.

In these modern days of microprocessor controlled measuring and test equipment, that can give you 10 or more digits of readout, there are older techniques which are being forgotten. In some cases modern technology provides significant advances over the more traditional methods, but this is not necessarily always the case. In this short article I want to bring back to mind the work of the French mathematician and physicist Lissajous (1822-1880), and the display patterns produced on an oscilloscope by feeding two signals in, one to the X (horizontal) input, and one to the Y (vertical) input.

Using your oscilloscope for Lissajous figures

Any shack that has a 2 channel oscilloscope can make use of this phenomenon. As long as you are able to switch the time base off, and supply an external input to the X (horizontal) plates, you can do this. For example, the Hameg series scopes that I know some members have will do this admirably. The only penalty is that most scopes are not specifically designed for this, and the bandwidth of the horizontal (X) amplifiers is usually less than the vertical (Y) ones – this will limit the highest frequencies at which comparisons can be made.

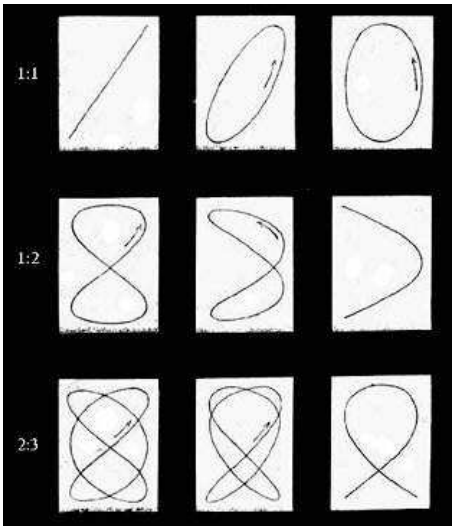
To start off with, it is best to use two frequencies which are nominally the same, for example a signal generator and a fixed oscillator. Put the scope into the X-Y mode, and connect one signal to the X and one to the Y input. Adjust the sensitivity of each input to see the display. It is extremely unlikely that the two signals will be identical in frequency and phase, so you will see a pattern occupying the screen – if you adjust the signal generator you will see that the rate at which the pattern moves changes, and with care you should be able to make it almost stationary. As the two signals drift one against the other, the position and the shape of the pattern will change, but you will see it pass through some of the examples below on the left.

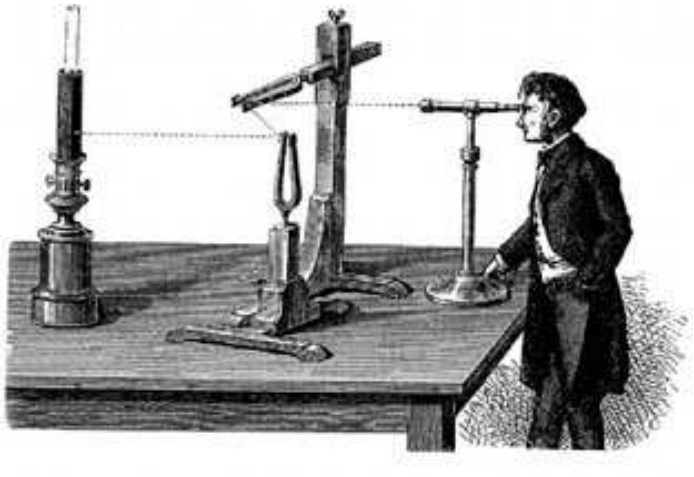
Well it's all very pretty – but what can I do with it?

Lissajous figures can be particularly useful when comparisons of waves that are very close in frequency and or phase are needed – and surprising accuracy can be derived from the simple scope screen!

The technique is especially useful when one oscillator is to be set accurately to be the same as another – for example, many stations now have 10MHz reference sources, that are controlled by GPS systems (GPS Disciplined Oscillators or GPSDO's). The 10MHz output is used to provide a reference for the station, for test equipment, for HF, VHF and microwave equipment. But the GPS controlled source will have jitter (timing uncertainties) on the output. The best way to use such a source is to use it as a reference for a good quality Oven Controlled Crystal Oscillator (OCXO) which is allowed to free run, and corrected every so often.

See the full article on our web site for the complete treatment, and how it can provide extremely good accuracy, even today! (pages 10 a,b,c,d)





Jules Lissajous observing Lissajous figures created by tuning forks through a microscope. (late 19th century) http://commons.wikimedia.org

KA8 EDE, Bruce Lundy

When I first got to know Bruce, he lived in my neighborhood and often we visited by bicycle, combining physical exercise with a Hamradio chat at the destination, before heading back home. So many problems could be discussed. Right away Bruce showed extra ordinary curiosity combined with considerable problem solving skill. I remember a half engine, a 3 cylinder cut from a V6, or was it a 4 cylinder cut from a V8. You get the idea!

<<<
Old but solid and well built. Notice the tube collection on the top shelf!

I really miss these visits. Now Bruce lives "Out in the country" and I might see him a few times a year. Bruce is still quite active with unusual projects, sometimes not exactly fitting our frequency profile. But he is always interested in what is going on and very helpful with solving problems and actively manufacturing complicated hardware! The last time I saw him, when he modified a hammerdrill bit to drive in ground rods for me. I took a few pictures and I thought to share them with you.

<<<
The "old man" himself surrounded with projects, test equipment and lots of parts.

<<<
Ready for the winter! How did he figure it would get that cold?

Worms, Viruses, and Trojan Horses

By Steve, K8UD and Gerd, WB8IFM

I had my computer infected sometime in October of 2009. It took me to mid January to finally be "clean" again and I hope it will stay like that for a long time. There is NO "Anti Virus" software that will completely protect you. The way the Internet and the "operating system" is designed invites cooks to sabotage it. Your best bet is to use an operating system that is less common than the Microsoft version. Like Apple or Linux. There are those who think, no "operating system" would be best. Actually that was the situation at first when the computer first appeared as a consumer product. To this day all computers have a basic core Program underlying the "operating System" called the BIOS, which deals with the various components or peripherals of the specific computer. The software then solved specific tasks like typing, or processing of pictures, solving mathematical problems and presenting graphs. Calculating satellite orbits or making address lists. The possibilities are endless. All these programs would provide their own interface solution. But it was obvious, that the wheel was reinvented gazillion of times.

I had great help from Steve, K8UD, who is very good with computers, and since he runs a business involving the web it is of utmost importance to him that nothing happens to his set-up. I have known him to work weekends and nights to fix a problem.

My pc just got worse and worse, Anti Virus programs, at least the ones we tried didn't work and then the pc just quit altogether. Since a bunch of data were "trapped' on the hard disk, in particular several years of pictures, erasing the disk was out of the question.

So, here is how we proceeded. We bought a new hard disk and although the pc was only 4 years old, these hard disks are harder to find and although we could double the size, compared what a hard disk can store today that still was only a fraction. The new hard disk is now designated the "C" drive. The original "C" drive with all the data, programs and the operating system and the viruses is relegated to the next drive in line which would be the "D' drive. This setup can be tricky and involves setting jumpers on the hard drives from master to slave etc. So you need to be up to that, and / or have a lot of patience (time)

Now you have in essence a new PC with one bad hard drive in a slave position connected. Now you install your operating system from the original disk. Then you get on the Internet and download AVG free an Antivirus program. This is what Steve is successfully using and recommending, and although other good programs might be out there, why do you want to experiment?

Once the anti virus program is installed, do a virus scan; this will be quick since you have a "virgin" pc with no infections. Then you set a periodic scan, Steve does his daily between 1-2 PM. Then you can sit back and relax.

Now you can install the other essential programs for your work like Microsoft office. With Microsoft, if you have "upgrades" you need to have an original disk for verification.

Then comes the fun part. You can selectively "virus scan" the affected drive and remove the infections. This worked really super. I also scanned a few memory sticks and was surprised to find a few viruses there.

Another investment recommended is a router. This is a device that takes the signal from the incoming Internet (through the modem) and distributes it, most often per wireless throughout the house to feed the Internet to other PCs and interconnect these or hook them up to a central printer. Although, in our case, we only are concerned with one pc, this router acts like an additionally locked door any intruder has to get through.

A good indication whether all is working fine is to measure the time it takes for the PC to get ready after you turn it on. I measured a little over 30 seconds and every once in a while repeat this measurement, it is still 33 seconds (just measured). For this measurement make sure the PC is completely turned off (separated from the mains), then wait a few minutes to make sure all charges have dissipated. +++

Definitions

NC State U (3-2010)

As computer devices have become more pervasive, so has **Malware**. Using cell phones, email, instant messaging, Internet browsing, everyone is threatened.

Definition of Worm:

A program that makes copies of itself; for example, ***from one disk drive to another***, or by copying itself using email or another transport mechanism. The worm may do damage and compromise the security of the computer. It may arrive in the form of a joke program or software of some sort. -

Definition of Virus:

A program or code that replicates; that is, infects another program, boot sector, partition sector, or document that supports macros, by inserting itself or attaching itself to that medium. Most viruses only replicate, though, many do a large amount of damage as well. -

Definition of Trojan Horse:

A program that neither replicates nor copies itself but causes damage or compromises the security of the computer. Typically, an individual emails a Trojan Horse to you -it does not email itself- and it may arrive in the form of a joke program or software of some sort.

Club News – Increase of Dues

One piece of bad news this year: our cheap copying place had raised its discount rate for 1000 copies considerably. This with the many postage raises over the last couple of years gets us into a position that we are now loosing money sending out the news letter.

Leafing through my ledger book I see where we paid dues of $ 6 back in 1989. This amount was raised several times to the $ 10 level in 2003. Figuring in the years (14) this amounts to about 30 cents per year. The postage rate during those years went from 25 c to 37c. Now, of course, the rate is 44 c.

This situation was discussed at our last meeting on 26 February and we voted to raise the dues to $ 12 per year for everybody (paper or electronic). That would amount to the same 30 cents per year raise for the 7 years since 2003. This also tracks with the post office rates, which have almost doubled since 1989.

Also decided was that, of course, we honor your present status (paid up dues) and that the new rate will go in effect at Hamvention time in May.

MVUS Roster 2010

CALL	FNAME	LNAME	STREET	CITY	ST	ZIP	PHONE	DUES	News	Email
WD0BWQ	David E.	Brandon	301 S. Hackett Rd.	Waterloo	IA	50701-1661	319-292-8724	5/1/2010		Brandondavide@mcksi.com
W0EKZ	Robert	Maxton	1262 E.90th Ave N.	Belle Plaine	KS	67013	316-488-3801	12/1/200		
AB0HP	Larry	Ballen	31993 Knollwood	Macon	MO	63552	660-395-4956	6/1/2009		
WB0SCD	Jim	Brude	31 Quayl Brace Ct.	Amelia	OH	45102	513-753-5183	6/1/2008		wb0scd@amsat.org
N0UU	Lawrence	Stoskopf	4408 E Country	Salina	KS	67401	785-823-9498	12/1/200		
W0VZK	William G	Buckner	PO Box 721	Marshall	MO	65340	660-886-3408	6/1/2011		
K1DS	Rick	Rosen	206 Kimberton Dr.	Blue Bell	PA	19422	610-270-8884			rick1ds@hotmail.com
K1GGI	Ed	Moxon	67 Seymour Rd	Harwich	MA	02645	508-432-8980	3/1/2011		K1GGI@comcast.net
N1GX	Adam Mac	Donald	616 Gardenia Ct	Rosamond	CA	93560		12/1/200		CalvinF15@SBCglobal.net
K2EVW	Richard	Subin	427 DeHarts Store Rd.	Medows of Dan	VA	24120	540-593-2151	12/1/200		rsubin@swva.net
W2RG	Rich	Griffiths	11 North Str.	Fairhaven	MA	02719	513-791-8023	12/1/201		W2RG@verizon.net
K2VEE	Ed	Kulesa	2095 South Linda Dr.	Bellbrook	OH	45305	937-848-2256	12/1/201		k2vee@arrl.net
N3BYN	Gary	Johney	1885 Poplar Ridge	Pasadena	MD	21122	410-437-4285	12/1/201		GJohnCY@comcast.net
VE3GYQ	David B	Toth	13233 Sarka Rd	Spencerville	OH	45887	419-235-6991	6/1/2010		
W3HMS	John A	Jaminet	912 Robert St.	Mechanicsburg	PA	17055-3451	717-697-3633	6/1/2010		w3hms@aol.com
W3HYM	David	Newman Jr	PO Box 459	Indian Head	MD	20640	301-743-6711	12/1/200		
KP4AQI	Al	Torres	4850 Hollywreath Ct.	Dayton	OH	45424	937-236-2534	2/1/2011		atorres@coax.net
AB4CR	Jack	Nyiri	909 Riverbend Rd	Nashville	TN	37221-4370	606-245-4162	12/1/201		JPNyiri@comcast.net
WA4FJC	Gordon	Batey	886 Quicks Mill Rd	Staunton	VA	24401	540-248-2732	3/1/2011		GPBatey@compuserve.com
WB4GCS	Jim	Sanford	10 Sugar Run Rd.	Eighty Four	PA	15330-2550		12/1/201		WB4GCS@AMSAT.org
K4RF	Steve	Adams	P.O.Box 1255	Cornelia	GA	30531	404-869-0565	12/1/201		
K4TG	Jerry	Shouse	1050 Hickory Hill Dr.	Lawrenceburg	KY	40342	502-839-4041	12/1/201		
KA4VC	Michael	Spanos	116 Port South Lane	Alabaster	AL	35007	205-663-4457	12/1/201		
WP4YJ	Robert	Sambolin	2151 Orchid Dr	W Lafayette	IN	47906	765-463-6360	12/1/200		
WA5LBQ	Bill	Koch	307 Brookhaven Ln.	Pittsburg	PA	15241	412-257-3885	12/1/201		
WA5VJB	NTMS Kent	Britain	1626 Vineyard Rd.	Grand Praire	TX	75052				
AA6LK	Lyle D	Kraft	4067 Heather Lane	Auburn	CA	95603		3/1/2011		AA6LK@cwnet.com
KI6SZ	Don	Kessler	3872 Rexford Rd	Beavercreek	OH	45430	937-429-8857	12/1/201		KI6SZ@sbcglobal.net
	Dave	Moninger	3663 Hickory Ridge	Georgetown	IN	47122	812-366-3912	6/1/2010		
AC7IT	Robert J	Super	2004 N Hodges Ln	Greenacres	WA	99016	509-928-1983	8/1/2009		AC7IT@Yahoo.com
W3/DJ7LC	Horst	Zodrow	530 Fairhill Dr.	Churchville	PA	18966-1457	215-355-2458	9/1/2010		
WR8A	Ed	Garner	3100 Oakmont	Kettering	OH	45429	937-293-2876	12/1/201		edwr8a@cs.com
KA8ABR	Michael P.	Murphy	8300 Schoolgate Dr	Dayton	OH	45424	937-235-1820	12/1/200		murph@erinet.com
N8ASB	Daun	Yeagley II	1353 Gurneyville	Wilmington	OH	45177	937-382-8262	10/1/201		daun@yeagley.net
W8ATH	Bob	Brubaker	5930 W Britton Rd.	W. Salem	OH	44287	216-745-2218	12/1/201		
KI8CA	Peter	Morris	11096 Congress Run	Glouster	OH	45732-9711	740-767-3629	12/1/200		
WB8DNO	Joe	Hopster	3706 Glendale	Cincinnati	OH	45241	513-733-1590	12/1/200		jhops25245@aol.com
WD8DPA	Mark	Travaglini	POB 341	Northville	MI	48167		12/1/201		
KA8EDE	Bruce	Lundy	1156 St.Rt.380	Xenia	OH	45385	937-376-5716	12/1/201		belundy@earthlink.net
K8HHP	Bob	Schank	35 Clarence St.	Belleville	MI	48111	734-697-7057	6/1/2010		
W8HUZ	Joe	Hausmann	1035 Firewood Dr.	Dayton	OH	45430	937-426-1303	12/1/200		
KA8HU	Tom	Reed	743 Deer Run Tr.	Lebanon	OH	45036	513-933-0471	6/1/2009		reed@go-concepts.com
ND8I	Bruce N	Raymond	3494 Fairwood Dr.	Beavercreek	OH	45432	937-429-5362	4/1/2011		bruceraymond@ameritech.net
NE8I	Lloyd	Ellsworth	P.O.Box 675	Glen Arbor	MI	49636-0675	248-225-3847	2/1/2011		ne8i@arrl.net
WB8IFM	Gerd	Schrick EM79WS	4741 Harlou Dr.	Dayton	OH	45432	937-253-3993	12/1/201		schrick@copper.net
W8JAQ	John	Schwall	163 Lee Dr.	Monroe	OH	45050	513-539-7675	12/1/201		w8jaq@infinet.com
W8KHP	Allen	Vinegar	2043 Treetop Ln	Hebron	KY	41048		12/1/201		tokens@myranch.com
KC8KH	Larry	Weaver	1711 E.Third St.	Dayton	OH	45403-1824	937-219-8250	5/1/2010		
WB8KMX	Bill	Pryor	829 Kammer Ave	Dayton	OH	45417	937-263-1608	12/1/201		
W8MM	Michael	Valentine	10280 Alliance Rd	Cincinnati	OH	45242	513-984-8900	4/1/2009		

CALL	FNAME	LNAME	STREET	CITY	ST	ZIP	PHONE	DUES	News	Email
W8NJR	Terry	Netzley	5920 Horseshoe Bend	Ludlow Falls	OH	45339	937-698-6426			w8njr@aol.com
K8OCL	John	Champa	2304 Woodglen Dr	Richardson	TX	75082-4510	972-705-1531	6/1/2009		
WA8OGS	Joseph	Burke	9168 Brehm Rd.	Cincinnati	OH	45252	513-385-4198	12/1/200		burkej@one.net
N8OIF	Edward S	Raybould	1094 Fountain Ln Apt	Columbus	OH	43213-3211	614-868-5955	2/1/2011		
N8OU	John	Berker	Box 125/43 E.Front	New Holland	OH	43145	740-495-5200	5/1/2010		
N8QHV	Michael	Schulsinger	1002 Woodlawn Av.	Springfield	OH	45504	937-206-4240	12/1/200		maschulsinger@yahoo.com
N8QOD	Joseph	Muchnij	1214 Cottingwood Ct.	Bellbrook	OH	45305	937-848-8527	12/1/201		muchnijj@saic.com
WA8RJF	Anthony L	Emanuele	7156 Kory Court	Concord	OH	44077-2221	440-357-1356	12/1/200		
W8RKO	Mike	Suhar	1108 E.Rahn Rd.	Dayton	OH	45429-6110	937-433-4332	12/1/201		michael.suhar@lexis-nexis.co
KD8SI	Leo	Schaaf	2648 Aragon Av N.	Kettering	OH	45420	937-294-8425	6/1/2010		
KB8SRQ	Jon	Thuermer	1976 Burnham Ln.	Kettering	OH	45429	937-298-3199	10/1/200		
K8TKQ	Bob	Mathews	73 Landrum Rd.	Baimbridge	OH	45612		12/1/200		k8tqk@qsl.net
KB8U	Russell	Dwarshuis	427 Barber Av	Ann Arbor	MI	48103-2721		8/1/2010		
K8UD	Steven S.	Coy	705 Watervliet Ave	Dayton	OH	45420	937-426-6085	2/1/2010		k8ud@arrl.net
W8ULC	Red	Dakin	4519 N Rt 123	Franklin	OH	45005	937-704-0835	12/1/200		redw8ulc@siscom.net
N8UR	John	Ackerman	15 Grandon Rd	Oakwood	OH	45419	937-445-2966	6/1/2008		n8ur@tapr.org
N8UVM	Robert	Peoples Jr.	66460 Sam Russel	Dundas	OH	45634	740-596-2364	12/1/201		N8UVM@AMSAT.org
KC8VEB	Bruce	Lerner	734 Suntree Dr	Westerville	OH	43081	614-985-4818	1/6/2009		bdl7431@sbcglobal.net
N8VES	Sam	Anderson	2143 Otello Ave	Dayton	OH	45414-4513	937-278-1029	12/1/200		octopus@sigcom.net
WB8VSU	James	Bacher	5849 Terrace Park Dr	Dayton	OH	45429-6049	937-865-2020	6/1/2010		
N8VZW	John	Human	4080 Danern Dr.	Beavercreek	OH	45430	937-429-0234	6/1/2008		jbhuman@fuse.net
WA8WZG	Tom	Whitted EN81OM	4641 Port Clinton E	Port Clinton	OH	43452-3805	419-732-2168	12/1/201		wa8wzg@wa8wzg.com
K8YMI	Bob	Halley	114 Red Bird Lane	Terrace Park	OH	45174		8/1/2010		
WB8YOB	Alan L	Smith	6303 King Arthur	Swartz Creek	MI	48473		6/1/2009		
N8ZM	Thomas	Holmes	1055 Wilderness Bluff	Tipp City	OH	45371	937-667-5990	12/1/201		tom_holmes@agilent.com
KB8ZR	Mark	Tessneer	2970 Indian Ripple	Beavercreek	OH	45440-3641	937-426-1355	12/1/200		kb8zr@amsat.org
KA8ZS	John	Hepner	9500 Huffman Rd.	Farmersville	OH	45325-9225	937-835-3149	12/1/201		HepnerJ@core.com
K9ATR	Milton	Gibson	5707 S Bridgeton Ln	South Bend	IN	46614	574-291-0886	12/1/201		
K9AYA	Bill	Eaton	1600 Boyle Rd.	Hamilton	OH	45013-1066	513-893-0933	8/1/2011		bill@rp-l.com
K9EA	Dan	Michnay	9406 Notestine Rd	Ft wayne	IN	46835-9449		12/1/200		K9EA@arrl.net
WG9F	Rod	Owen	13809 Schwipps Rd	Milan	IN	47031	812-623-3072	12/1/200		roderick.owen@ae.ge.com
W9FT	Ron	Henselman	1409 N.11th Ave	Melrose Park	IL	60160-3523	708-345-6981	12/1/201		
W9NBS	Tom	Stauffer	961 Silvercreek Dr.	Centerville	OH	45458	937-435-1870	12/1/200		
WB9SNR	Jim	Mitzlaff	1727 N.Chestnut	Arlington Hgts	IL	60004-3703	847-506-0805	12/1/201		wb9snr@att.net
W9XA	Kermit	Carlson	1150 McKee	Batavia	IL	60510	630-879-0983	12/1/201		
DB6NT	Michael	Kuhne	Birkenweg 15	D-95119		GERMANY	---9288-8232	12/1/201		kuhne.db6nt@t-online.de
7L3DNX	Takumi	Takeno	3-7-3-504-Simosinjo	Nakahara-ku	21	1-0042Japn	81-44-751-07	6/1/2010		naf01266@nifty.com

The forgotten work of Lissajous
–
Frequency Measurement on the Oscilloscope

Dave Powis, G4HUP

Introduction

In these modern days of microprocessor controlled measuring and test equipment, that can give you 10 or more digits of readout, there are older techniques which are being forgotten. In some cases modern technology provides significant advances over the more traditional methods, but this is not necessarily always the case. In this short article I want to bring back to mind the work of the French mathematician and physicist Lissajous (1822-1880), and the display patterns produced on an oscilloscope by feeding two signals in, one to the X (horizontal) input, and one to the Y (vertical) input.

Jules Antione Lissajous

At the age of 25 Jules Lissajous was appointed professor of mathematics at the Lycée Saint-Louis, a position he held until 1874. One of his main interests was waves, and he developed optical methods to enable the study of their vibrations. In 1855 he described a method of studying acoustic vibrations by using a mirror, attached to the vibrating object, to reflect them on to a screen. He went on to use two mirrors, one vibrating vertically and one horizontally, to discover what we now call *Lissajous figures*. We now have the advantage of the electronic oscilloscope, which enables us to display such patterns easily – at the time of their revelation, they were a wondrous new scientific technique!

A little theory…

Without getting mathematical about it, imagine looking a sine wave, not in the normal way, but from the end, as it is travelling towards or away from you. If the wave is in the vertical plane, all you would see is a vertical straight line. Similarly, if the wave was in the horizontal plane, you would see a horizontal line.

Now imagine two waves of the same frequency viewed in this way at the same time – as they travel towards you, the resultant of the two waves will describe one of a number of simple shapes, depending on whether they are 'in phase' or not. The shapes you may see (shown in Fig 1) are:

- a a line at 45°, when the two waves are in phase or antiphase
- b a circle, when the waves have a phase relationship of 90° or 270°
- c an ellipse with the major axis at 45°, when the waves are at either 45, 135, 225 or 315° phase difference.

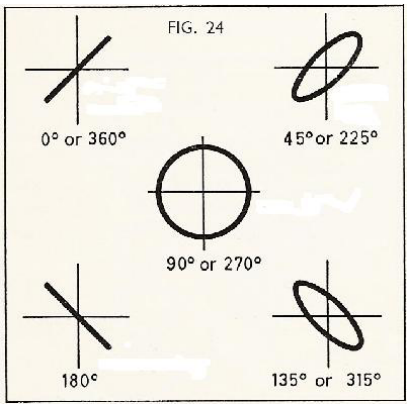
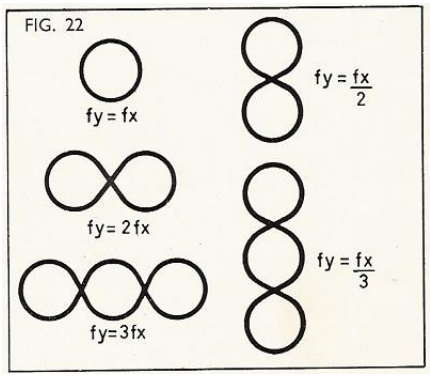


Fig 1 – Basic Lissajous figures

This is effectively what Lissajous was able to demonstrate with his two mirror system – the 'beat' note between two sine wave signals.

The wave patterns also vary if the two frequencies are not the same – and become particularly interesting when one is a multiple of the other – by examination both the relative frequencies and the phase relationships can be estimated. Figs 2 and 3 show views of some of the displays that may be expected, and their interpretation.



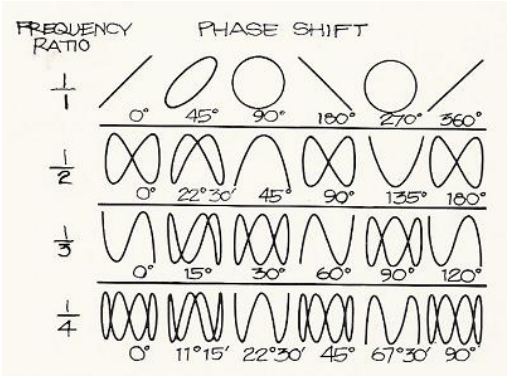


Fig 2 – Frequency Relationships **Fig 3 – Fractional relationships and phase**

Using your oscilloscope for Lissajous figures

Any shack that has a 2 channel oscilloscope can make use of this phenomenon. As long as you are able to switch the time base off, and supply an external input to the X (horizontal) plates, you can do this. For example, the Hameg series scopes that I know some members have will do this admirably. The only penalty is that most scopes are not specifically designed for this, and the bandwidth of the horizontal (X) amplifiers is usually less than the vertical (Y) ones – this will limit the highest frequencies at which comparisons can be made.

To start off with, it is best to use two frequencies which are nominally the same, for example a signal generator and a fixed oscillator. Put the scope into the X-Y mode, and connect one signal to the X and one to the Y input. Adjust the sensitivity of each input to see the display. It is extremely unlikely that the two signals will be identical in frequency and phase, so you will see a pattern occupying the screen – if you adjust the signal generator you will see that the rate at which the pattern moves changes, and with care you should be able to make it almost stationary. As the two signals drift one against the other, the position and the shape of the pattern will change, but you will see it pass through some of the examples from Fig 1.

When one signal is a multiple of the other, make sure that the higher frequency is connected to the Y input of your scope – bearing in mind the comments from above, this will give the best likelihood of success. You should be able to replicate and recognise some of the patterns in Figs 2 and 3.

Well it's all very pretty – but what can I do with it?

Lissajous figures can be particularly useful when comparisons of waves that are very close in frequency and or phase are needed – and surprising accuracy can be derived from the simple scope screen!

The technique is especially useful when one oscillator is to be set accurately to be the same as another – for example, many stations now have 10MHz reference sources, that are controlled by GPS systems (GPS Disciplined Oscillators or GPSDO's). The 10MHz output is used to provide a reference for the station, for test equipment, for HF, VHF and microwave

equipment. But the GPS controlled source will have jitter (timing uncertainties) on the output. The best way to use such a source is to use it as a reference for a good quality Oven Controlled Crystal Oscillator (OCXO) which is allowed to free run, and corrected every so often.

The correction process can be very easily done using the scope and Lissajous figures – the degree of inaccuracy can also be calculated, so this is not just a qualitative measurement. I recently carried out a comparison between my Rubidium 10MHz reference and a free running 10MHz OCXO, to see how close they were in frequency.

I found that the Lissajous display was not static, indicating that they were not precisely the same. There was a slow variation, with the display moving from the 45° line pointing NW through the circle shape to the 45° line pointing NE on the scope face – passing through the ellipses on the way. As you can see from Fig 1, such a movement represents a change of half a cycle, or 180°. See Fig 4a-c for the photos of the patterns.

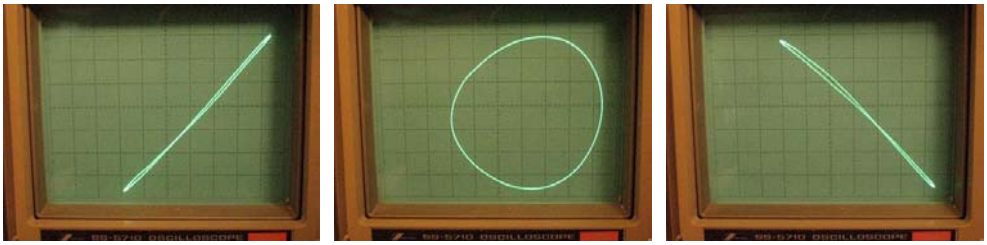


Fig 4a-c Patterns pictured from 0° through 90° to 180° - one complete half cycle of the 'beat'

I decided to measure the time taken for the change of shape to complete – on the basis that if I knew exactly how long to took, I might be able to do some calculations to find out how much then frequency error between the two sources was. Measurement with a stop watch gave a time of 5min 25 sec for the transition – 325 sec. This was for a 180° phase change, remember, so the time for a whole cycle of change would be 650sec. Now using simple maths this can be converted to a frequency error:

$$f = 1 / t, \qquad \text{where } f \text{ is frequency in Hz, and } t \text{ is time in seconds}$$

Substituting my measurement:

$$f = 1 / 650 = 0.0015\text{Hz}$$

Thus the error between the two signals was 0.0015Hz, or 1.5mHz! With careful adjustment, the beat between the two can be made even slower, and the measurement accuracy can be improved by making the time measurement over several half cycles – if you can stay awake long enough!

Errors in measurement

It is worth noting that there is an inherent error in the measurement, since you are watching a slow moving signal and making an optical estimate of when it reaches the 45° point to start or stop the stopwatch – but professional research has shown that any one person is surprisingly consistent in such activity, and although they may make an error each time, it is likely to be quite consistent. We can also estimate the error and its effect on the measurement:

Let's say that there is an error of ±0.5s in the measurement of a half cycle of drift – this is the same as ± 1sec for a cycle; in other words my reading could be anywhere between 649s

and 651s for the full cycle. Applying the same formula as above to this, then 649s converts to 0.001541Hz, and 651s converts to 0.001536Hz -a difference of 0.000,005Hz – or 5μHz! So even a quite large error in the timing will have a very small impact on the accuracy of the measurement provided that the beat between the two waves is very slow – an error of ±0.33% in this case. That is a big timing error – it is much more likely to be of the order of 100ms or so.

It is also important to note that the two signals must be good sine waves. Any distortion on them will show up as deviations from the straight line and circle responses as shown in Figs 1-3. Fig 5a and b show the effect of a distorted input signal due to excessive harmonic content.

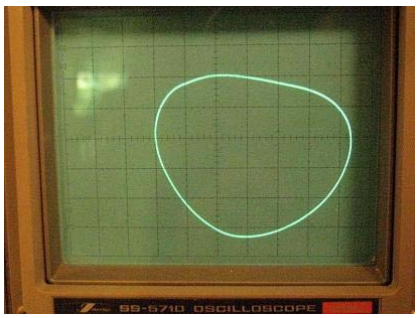


Fig 5a – two good sine waves (but not perfect!)

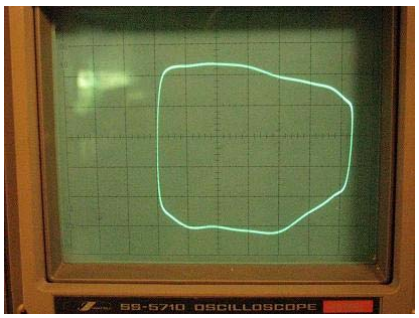


Fig 5b – One wave with high harmonic content

Summary

Of course I could have used a frequency counter, with one of the signals as the timing reference for the counter – but that will only give a 10 digit display, and given that the last digit is always to be treated suspiciously, would enable me to read down to 0.1Hz with confidence. That is 100 times less accurate than the method shown, and in fact it would appear on the counter as if the two oscillators were exactly on frequency!

Conclusions

In introducing Lissajous figures we have seen that they can provide a simple comparison between two sine wave signals of similar frequencies, or where one is a harmonic of the other. Where an accurate controllable signal source is available, the technique can be used to measure frequency using a scope, and as demonstrated extreme accuracy can be achieved in the measurements. There's more to a scope than first meets the eye!

References

Lissajous photograph - http://en.wikipedia.org/wiki/Jules_Antoine_Lissajous

Lissajous biography - http://www.gap-system.org/~history/Biographies/Lissajous.html

Fig 1 – Simple Oscilloscope Measurements (p16); Mullard Educational Service, 1960

Fig 2 - Simple Oscilloscope Measurements (p15); Mullard Educational Service, 1960

Fig 3 – The XYZ's of using a Scope (p26); Tektronix Inc 1981