HAMRAG

Visit our website for more club and area ham information at ***http://w9axd.org****, or join us on Facebook at this* ***LINK***

ROCKFORD AMATEUR RADIO ASSOCIATION

RARA Mission Statement

A member association with common interest of public service to the community through the use of amateur radio.

February 2023

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Presidents Message

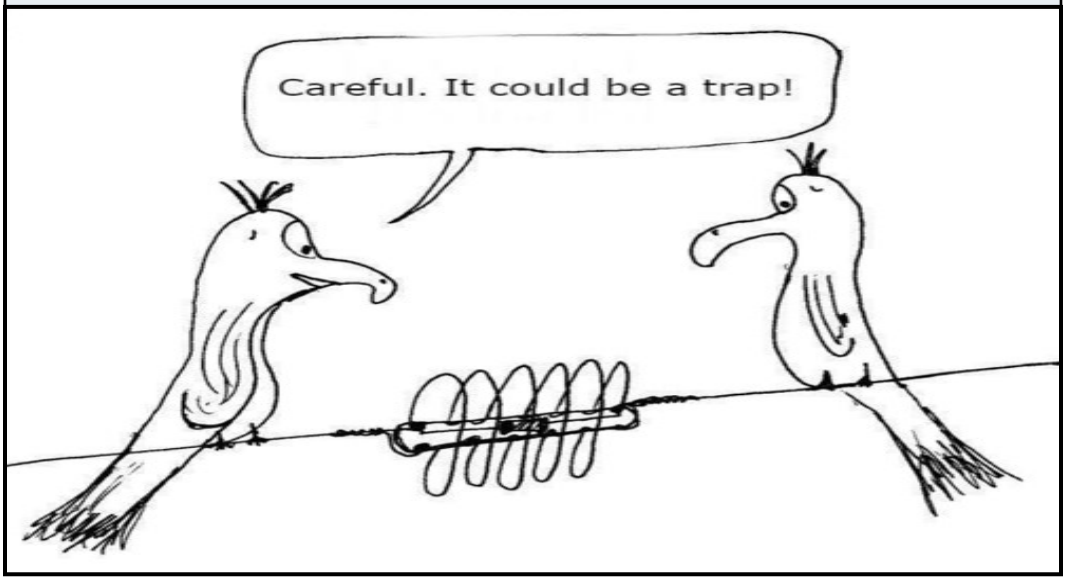
Hello Everyone,

February is filled with various operating activities and while we are inside with the cold weather, there is plenty to do. I have listed a few of these activities on page 3. If you like to operate CW, RTTY, or SSB, there's something for everyone.

Our meeting on Friday features a video on a little history, ham radio, and education for everyone. Everyone in your family would enjoy watching this video. Meeting time is 7:00pm and the link to the Google Meet meeting is: https://meet.google.com/nwf-bded-ytx.

See you Friday night,

Kurt Eversole—KE9N



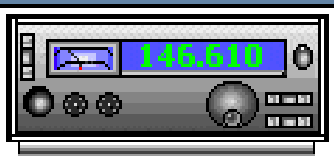
NEXT MEETING

FRIDAY
February10, 2023
7:00pm

"A Video Presentation"

Google Meet Link:

https://meet.google.com/nwf-bded-ytx



Local Events and Information

UPCOMING EVENTS

February 10, 2023 - General RARA Meeting 7:00pm on Google Meet

February 22, 2023 - RARA Board Meeting 7:00pm on Google Meet

March 10, 2023 - General RARA Meeting 7:00pm on Google Meet

March 22, 2023 - RARA Board Meeting 7:00pm on Google Meet

April 14, 2023 - In Person General RARA Meeting TBA

2023 RARA Officers and Board

Officers:
President - Kurt Eversole, KE9N, 815-389-2784, kurt.eversole@gmail.com
Vice President - Tom Shouler, N9VJU, 815-633-0089, n9vju@comcast.net
Secretary - Larry McFall, KD9HKX, 815-900-1820, lpmcfall@charter.net
Treasurer - Gordon Seaman, KC9NEX, 815-262-0294, kc9nex@gmail.com
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Kevin Puckett, N9EGF, 815-218-1551, krpuckett@gmail.com
Ron Callahan, N2RON, 608-289-0198, ron.n2ron@gmail.com
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Webmaster - Kerry Tatlow, KD9MAP, kd9map@gmail.com
Repeater License Trustee - Gordon Seaman, KC9NEX, 815-262-0294, kc9nex@gmail.com
Hamrag Editor/Repeater Chairman - Kurt Eversole, KE9N, 815-389-2784, kurt.eversole@gmail.com

Local Net Information

Mon - 7:00pm - RARA Info. Net & CW Lesson, 146.610 (-) offset, pl 114.8
8:00pm - McHenry Cnty. RACES Net, 146.835 (-) offset, pl 91.5

Tues - 7:00pm - Health & Tech Net & CW Lesson , 146.610 (-) offset, pl 114.8
7:00pm - Rock County Public Service Net, 145.450 (-) offset, pl 123.0

Wed - 7:00pm - Stephenson Cnty. ARES Net, 147.390(+) offset, pl 114.8
7:30pm - Greater Beloit Radio Net, 147.120 (+) offset, pl 123.0

Thurs - 7:00pm - Northern Illinois Skywarn Training Net,147.195 (+) offset, pl 114.8, with the Health & Tech Net & CW Lesson following.

Fri - 8:00pm - Friday Night Fun Net, KC9GCR, 146.610 (-) offset, pl 114.8

Sat - 8:00pm - Saturday Ragchew Net, 146.610 (-) offset, pl 114.8
9:00pm - Saturday Night Fun Net Milw., 146.910 (-) offset, pl127.3

Mon. thru Friday - 8:00am to 9:00am - Senile Net, 14.287 (HF USB)

On the Air Events

10-10 International Winter Contest, SSB, February 4, 0001Z to February 5, 2359Z. This QSO party (one of nine held by the organization annually) is open to new and prospective members of Ten-Ten International Net, Inc., which was formed in 1962 as the Ten-Ten Net of Southern California to promote activity and good operating practices on 10 meters. Over the years the group has expanded internationally, with more than 75,000 10-10 numbers issued worldwide. Here is a **list of affiliated chapters**. From the Ten-Ten website:

"In order to keep the interest up on the 10-meter band, the idea of collecting '10-10 numbers' as an incentive in keeping the 10-meter band occupied was developed. The ultimate benefit is to keep the 10-meter band for Amateur Radio.

NAQCC CW Sprint, February 8, 0130Z to 0330Z. With more than 10,000 members in 103 countries, the North American QRP CW Club hosts these CW sprints throughout the year. Open to licensed and shortwave listeners who have an interest in CW/QRP operation, these events and other club activities encourage "the use of CW and helping all hams increase CW speed and proficiency…using simple wire antennas," per the NAQCC CW Club website.

ARRL School Club Roundup, February 13, 1300Z to February 17, 2359Z. This bi-annual event is designed to foster contacts with and among school radio clubs. Participants can exchange QSO information with any amateur radio station, so non-school clubs and individuals are encouraged to participate as well. All amateur bands except 60, 30, 17, and 12 meters are permitted.

CQ WW RTTY WPX Contest, February 11, 0000Z to February 12, 2359Z. This annual event draws more than 20,000 **RTTY** enthusiasts trying to make as many contacts with as many different callsign prefixes as possible. Also, get ready for the North American RTTY Collegiate Championship, February 25, 1800Z to February 26, 0559Z. It will be running simultaneously with the North American QSO Party, RTTY. For a primer on RTTY, check out these *OnAllBands* articles from Ed Muns, W0YK: **Getting Started in RTTY** and **The Origins and Evolution of RTTY**.

CQ 160 Meter Contest, SSB, February 24, 2200Z to February 26, 2200Z. This annual contest challenges amateurs around the world to contact other amateurs in as many U.S. states, Canadian provinces, and countries as possible utilizing the 160-meter band.

State QSO Parties

- Vermont, February 4, 0000Z to February 5, 2400Z
- Minnesota, February 4, 1400Z to 2400Z
- South Carolina, February 25, 1500Z to February 26, 0159Z
- North Carolina, February 26, 1500Z to February 27, 0100Z

Looking Back and Ahead 60 Years

Why sixty years? That's easy. Sixty years ago, I had just been out of high school for a few years and it's a good round number. That being said, I got my first "HAM" license in about 1957, and though by that time it had expired, and could not be renewed, I still knew what was going on in the ham radio world. As an example, Oscar 1 had been launched in 1961. Oscar 1 was the first non-government satellite and the first amateur radio satellite put into space. It was launched into a low earth orbit on December 12 of 1961. OSCAR stands for Orbiting Satellite Carrying Amateur Radio. Oscar 1 was built by hams for about $68. It sent out HI in morse code, and the speed was determined by the temperature of the satellite. There are currently 18 active ham satellites in space in various modes fm, ssb, and digital.

Radio's 60 years ago were made with a combination of tubes and transistors. The transistors stabilized to a great degree the frequency of the receiver and the transmitter, and by this time manufactures were putting both in one case. The transistor also allowed them to add more features like ssb and fm in a case that was smaller than some of the receivers alone that weighed as much as 60 pounds. Single sideband was beginning to be accepted by this time, although a lot of it still sounded like Donald Duck, and it wasn't unusual to hear fights when an AM and a SSB station each ended up on or close to the same frequency. Two meters was becoming more popular at about this time, and hams were experimenting with things like telephone from the car. A friend of mine at about this time managed a phone call over 2 meters to a girlfriend from in front of her home, and asked if he could stop by. She agreed, and he got out of his car and walked up to her door and surprised her. I don't remember how he was able to pull it off, but I don't think there was a repeater involved. Phones were hooked to wires. The first actual phone I saw in a car was around 1970. It was a big unit, and as I remember it was connected to a box in the trunk. It didn't always work, and it was very expensive to operate. Ham radio was ahead on satellite communication as well as telephone.

Television at this time was mostly black and white. Pictures were done on a CRT tube. If you had problems, you would pull the tubes out of your set and take them down to the local drug store which generally had a tube checker with a small tray on the front. Using the tube checker was fairly easy to figure out with the instructions on the front. Basically, you set the checker for your type of tube, and mounted the tube in the socket it told you to use. You then turned it on and after a time it would generally indicate with a meter whether it passed or failed. If it failed you put it in one pile and if it passed another. Generally, after you checked all the tubes you would find one bad and you would summon the clerk to unlock the cabinet under the checker and search for the tube you needed, which you would purchase and take home with you. After another half hour of reinstalling the tubes, if you were lucky the new tube would fix the problem, and the family went back watching one of the three channels available at the time. The only place where there was cable available was where a few home owners got together to put up a higher antenna to pick up stations that they couldn't get. Before TV was available about the only thing everybody had was AM radio. Radio stations were only owned by networks in the big markets. Corporations were allowed to only own seven stations and only one in a city, and by law they had to provide public service. No one was allowed to own a newspaper in the same city where they owned a radio station. When FM and TV came out owners were allowed to own one of each in a city including an AM station. Across the country they could only own seven of each kind in total. So they could own seven AM, seven FM and seven TV stations. Often the FM stations were playing music and making public service announcements to make up for the AM and TV stations that were devoted to making money. Stations were required to not slant the news one way or another. I remember one AM, FM, and TV group in Lansing Michigan that were fined and put out of business because everything was slanted conservative. The owner managed to sell the group before the final hearing so that he wouldn't loose everything if his licenses were taken away. The law that was broken was probably the equal time provision where you were required to give equal time to all candidates or parties.

Cooking was done on a gas or electric stove. The only thing used to speed it up at the time was the pressure cooker. There was no air fryer, microwave, or convection oven. Washing machines had made big strides since the early 50's when the wringer washer was in vogue, but you never washed colored clothes with whites because the colors often would run, and you would end up with pink and blue underwear if you did. A lot of people still hung clothes on a line to dry, and some HAM's used clothes lines for their radios. Few dishwashers were available and even fewer were built in. Many of the appliances of the day worked with mechanical timers, and I would bet that they were a source of failure many a time. The solid state timers of today, if built properly would outperform those timers any day, and they can do so much more.

(continued)

Looking Back and Ahead 60 Years

Cars burned leaded gas, and most American made cars were either 6 or 8 cylinders and stick shift. They got terrible gas mileage for the most part. I remember in the late 60's having two cars that got less then 15 mpg on the highway. The two cars we have now both get over 30 mpg.

Now that we have looked back 60 years, and knowing what we know about the present what can we expect 60 years from now. Now I've got to admit, my crystal ball is a little cloudy. We now have forms of digital communication that make contacts around the world on very little power. It has already changed how many of us communicate. I think in 60 years from now we may be talking over the air by voice using a high speed digital form of communication that can be held in your hand. It may or may not use satellites. High speed computers on small chips will be a big part of our lives. You might be able to work DX while waiting for your partner to go somewhere. Hand held units would easily allow you to check into a HF net while you relax in your self driving car while heading to a family reunion, or sit back and watch a baseball game of your favorite team. The game will no doubt be in 3D with surround sound, each member of the family is watching what they want, or playing a game with someone across the world. One of the kids might be watching a lecture that involves many videos that support the point the teacher is making. I suspect that anything said on a broadcast station or in a newspaper will be subject to immediate fact check. All cars will be required to be self driving to be on major highways or arterial roads. Cars may be hydrogen powered by then with only water required to fuel them, or maybe a battery could be developed with a fuel cell. Science may be so supplemented by AI computers that our doubling of knowledge could go to seconds by then. When I received my Associate degree in 1985, I remember a teacher saying that human knowledge was doubling every 3 to 5 years. In 1900 it was every 100 years, by 1945 it was 25 years, and by 2014 it was down to just 12 months, and now with the help of the internet the total human knowledge is said to be doubling every 12 hours. To me it is mind blowing to think that whatever human knowledge that existed yesterday at this time has doubled twice since then.

How will our food be prepared by then? Will we see it come together like we saw on Star Trek where a meal would appear behind a door in the wall that you asked for. Will schools be taught by a computer or a robot? Will kids still go out and play at recess? With Covid, I think we learned that a virtual classroom at home with no interaction with other kids didn't work that well. It was found that children needed that time with other children to learn how to socialize with others. They also needed to mingle with kids that had been exposed to other cultures.

What will appliances be like 60 years from now? I could visualize dishwashers that work with no water, but instead use ultrasonic waves to vibrate the dirt off of the dishes. The process would take only a few minutes, require no water, and would be cleaned and sanitized at the same time. When the process is complete the dishes might automatically be put away and ready for use at the next meal. Any meals prepared for you will be designed for your health. They will not only healthy, but tasty as well.

Will our homes be anything like today? I envision homes being built to your standards by a 3D printer. We already have buildings being printed by 3D printers. I think most are built out of cement currently, but the homes of tomorrow might be made from anything. If you want a wood look, the printer would extrude a substance like wood on the building site. If you like bricks, it may make a brick exterior for you. I think whatever it uses will not only be safe for you and your family, but fire and water resistant and efficient as well. I think all homes will be off the grid. Each will produce their own heat and electricity as well as water. Sewage might be broken down into usable things like fertilizer and water, or maybe even farther to atoms that can be used for other products. I see each home with built in study pods which would contain computer access to the internet. Libraries on the net would send you any book in any language you want. You will be able to read it by a number of devices, or have it read to you. Movies or instructional videos will be available for anything and everything.

How about aircraft and trains? Public transportation? Sixty years from now we might have flying cars that are self driving as well as cars. Public transportation will all be self driving and always on time. The rides will be comfortable, and you will be able to enjoy a short story or just nap on your trip. Snacks will be available, as well as meals if you desire. It is all about your comfort.

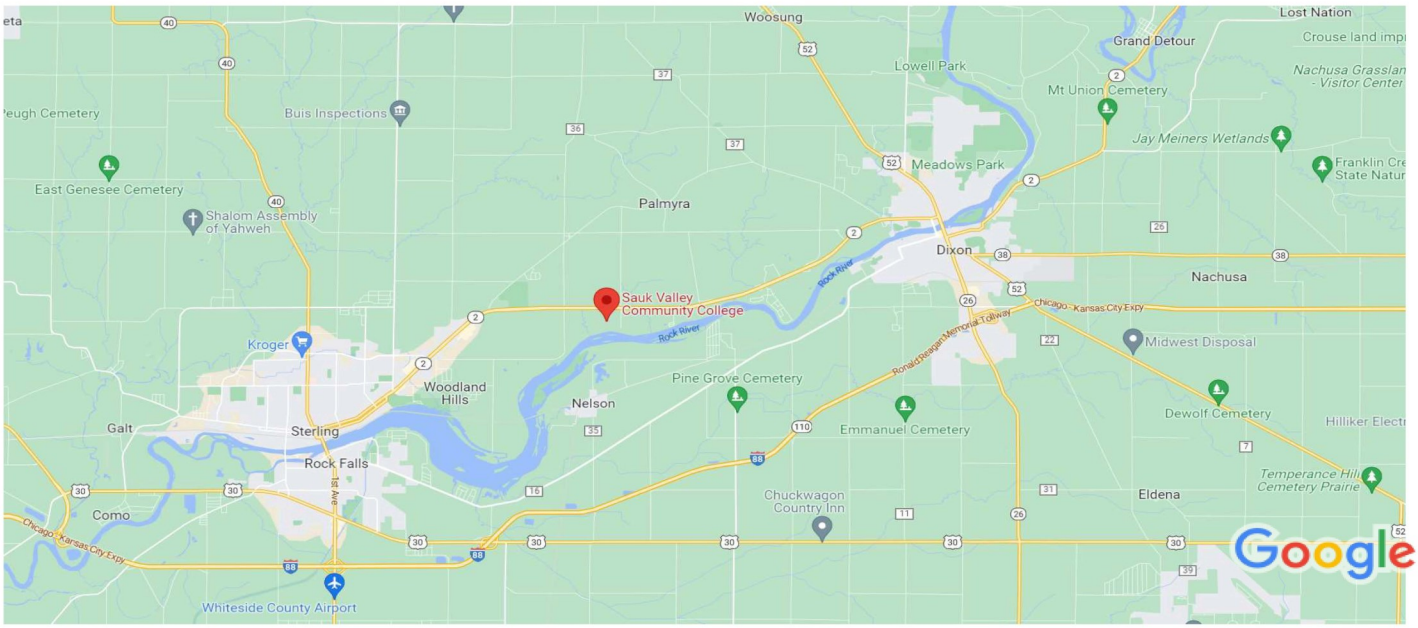
You may be able to visualize much more for the future, or you may think that we will still be working on these things in 60 years. The thing I can't really rap my head around is that we are currently doubling all of human knowledge every 12 hours, and in 60 years that could be down to seconds. Somehow I doubt that I'll be around to see it, but enjoy. 73, Larry AC9GO, larry.schubert@gmail.com

Hamfest Information

Sterling Rock Falls Amateur Radio Society Hamfest

Start Date: 03/19/2023 **End Date:** 03/19/2023
Location: Sauk Valley Community Collège GYM
173 IL. Rt2 Dixon , IL 61021
Sponsor: Sterling Rock Falls Amateur Radio Society
Type: ARRL Hamfest
Talk-In: 146.850 114.8 CT. W9MEP Repeater
Public Contact: Lloyd Sherman , KB9APW
P.O. Box 521 Sterling, IL 61081
Phone: 815-336-2434 **Email:** w9mepclub@hotmail.com

Google Maps Sauk Valley Community College



FRIDAY MORNING BREAKFAST

Meets every Friday morning from 8:00 am until about 10:00 am. An informal gathering of ham folks, no affiliations necessary, good food and good company.

OPEN 24 HOURS
Spring Garden
FAMILY RESTAURANT

Everyone is welcome to attend.

"The Spring Garden Family Restaurant"
4820 N. 2nd Street
Loves Park, IL 61111

Editors Note

If you would like to have something published , please call me, or email me at kurt.eversole@gmail.com

Cut-off for the March 2023 Hamrag will be Sunday, February 26, 2023
Kurt - KE9N, Editor

The DeKalb Hamfest

Sponsored by the Kishwaukee Amateur Radio Club
Sunday...May 7, 2023...8am to 1:00 pm
Vendor/Tailgate Setup—Saturday 1 PM to 9 PM
and Sunday 6 AM to 8 AM via Back Gate
$8.00 Advance Ticket (Double-Stubs—See Below)
$10.00 Admission at the gate (Single Stub).

Overnight Camping on Fairgrounds $20 per night - Includes Electric and Sewer

Rain or Shine
2 Large Buildings
3 Cash Prizes
Prize Drawings Every Half Hour

Free Outside Tailgating
No VE Testing
Chairs not furnished

Food Vendor: Hyvee

Fairground Regulations Prohibit Vehicles in buildings

Always the First Sunday in May. May 7, 2023
Sandwich Fairgrounds, Sandwich, IL
(Just North of RT. 34 Intersection of SUYDAM and GLETTY Roads)
TALK-IN: KARC Repeater 146.730 pl=100 (-) or 146.52 Simplex
****** PLEASE USE MAIN GATE ******

???????????? Questions ????????????
Phone: Bob Yurs—W9ICU—Hamfest Chairman at 815-757-3219
Or e-mail w9icu@arrl.net
KARC Hamfest Webpage / Hotel Info: www.karc-club.org

Return to: KARC, PO Box 371, DeKalb, IL 60115
Deadline: April 20, 2023 MUST INCLUDE SASE FOR ADVANCE TICKET SALES
Advance Tickets will not be for sale on site

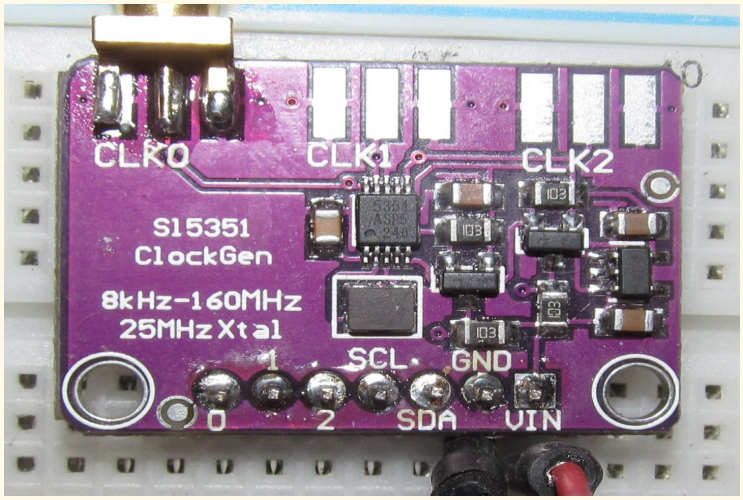
_____ **ADVANCE TICKETS @ $8 each (Dual Stubs)**
_____ **INSIDE TABLES @ $10 each (FREE TAILGATING)**
_____ **Total...Please make checks payable to KARC**
_____ **Telephone Number** _____ **e-mail address**
_____ **Call Sign**

The SI5351 VFO Chip

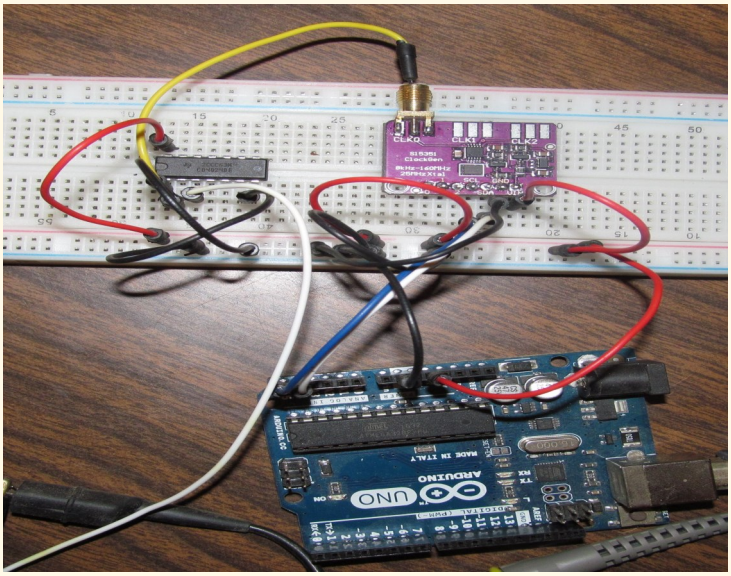
SI5351 VFO Chip, by Kerry, KD9MAP

When I was first licensed in the 1960s, if I needed an oscillator for a homebrew project, I'd have to construct it from discrete parts. Here in the 21st century, radio block functions are often more easily implemented with chips than with discrete components. One popular chip is the SI5351 oscillator, used in, for example, the QDX transceiver kit I wrote about in Jan 2023 HamRag.

SMD parts like the SI5351 are difficult for homebrewers to solder, so they are available on 'breakout boards,' which include necessary support components and provide through-hole soldering points. SI5351 breakout boards are inexpensive; this one cost $7, including shipping and tax, from walmart.com.



The common SI5351 breakout board provides three independently controllable oscillator outputs, synthesizing any frequency from 8kHz to 160MHz from the on-board 25MHz xtal. The chip is controlled by an I2C serial interface. I2C is a commonly used standard serial bus for smart chips to talk to each other. Little computers and controllers like Arduino have I2C interfaces that are easily wired to the SI5351. If your design needs only a fixed frequency LO, then you can just program the SI5351, disconnect it from I2C, and install it in your project. Or, if your design needs to be able to actively control the SI5351, as a VFO for example, then your project will likely include a microcontroller to tell it what to do via I2C.



The guts of the SI5351 are insanely complicated. Fortunately, there are software tools and libraries that hide all that complexity from us. There are at least a couple of libraries for Arduino, and I found the easiest one to use is from Etherkit. For a first project, I taught my SI5351 to play a song. Since the minimum output frequency available is 8kHz, it's a song that only dogs can hear. So I used a CD4024 counter to divide the frequency of my song by 128, to bring it down to where humans can hear it.

(continued)

The SI5351 VFO Chip

Here is my singing code built upon the Etherkit library, using their example as a starting point:

```
/*
 si5351_shave_0 uses Etherkit SI5351 library to play a song.
 */

#include "si5351.h"
#include "Wire.h"

Si5351 si5351;

void setup()
{
  bool i2c_found;

  // Start serial and initialize the Si5351
  Serial.begin(57600);
  i2c_found = si5351.init(SI5351_CRYSTAL_LOAD_8PF, 0, 0);
  if(!i2c_found)
    Serial.println("Device not found on I2C bus!");
  else
    Serial.println("Device found OK on I2C bus!");

  si5351.update_status();
  delay(500);
}

unsigned long long int f = 8000000ULL;
/* cs[] == chromatic scale */
unsigned long long int cs [] = { 131ULL, 139ULL, 147ULL, 156ULL, 165ULL, 175ULL,
                                 185ULL, 196ULL, 208ULL, 220ULL, 233ULL, 247ULL,
                                 262ULL };
/* shave[] = Shave and a haircut two bits, G-D-D-E-D F♯-G. */
unsigned long long int shave [] = { 196ULL, 147ULL, 165ULL, 147ULL,
                                    100000ULL, 185ULL, 196ULL,
                                    100000ULL, 100000ULL, 100000ULL };
int i = 0;

void loop()
{
  f = shave [i] * 30000ULL;
  si5351.set_freq(f, SI5351_CLK0);
  i++;
  if ( i > 9 )
    i = 0;

  delay(500);
}
```

Here is a link to the audio of my song playing:
https://drive.google.com/file/d/1U8yOh7ap0s4VKYc4uxiKm9FTCfDdV56g/view?usp=share_link

SI5351 datasheet:
https://cdn-shop.adafruit.com/datasheets/Si5351.pdf

Easy introduction to the SI5351 from Adafruit:
https://learn.adafruit.com/adafruit-si5351-clock-generator-breakout/wiring-and-test

CD4024 datasheet:
https://www.alldatasheet.com/view.jsp?Searchword=CD4024

73, DE Kerry, KD9MAP

An experimental VXO used to test various circuit configurations. Despite the haywire appearance, excellent stability could be obtained.

The Tunable Crystal Oscillator

BY LARRY LISLE,* K9KZT

OF ALL THE beasties in ye electronics woodes, one of the most fascinating to this writer, is the variable frequency crystal oscillator or VXO. Consider: stability unmatched by many conventional *LC* oscillators, simple circuitry, reduced mechanical requirements and – best of all for the amateur – there is still plenty of room for experimentation and improvement!

Illustrated in Fig. 1 is the diagram of the electrical equivalent of a piezo-electric crystal. *L* is very large, C is very small, and together they form a series-resonant circuit with an extremely high *Q*. If the crystal could be operated without any extraneous circuitry attached, it would oscillate at this series-resonant frequency. For practical purposes though, we have to put it in some kind of holder and attach it to a circuit – both of which add capacitance across the series-resonant combination. Consequently, if the crystal is going to oscillate, it must compensate for this added capacitance by becoming slightly inductive; the only way it can do this is by oscillating at a slightly *higher* frequency. Since we now have an inductive reactance in parallel with an equal capacitive reactance, the network is the equivalent of a parallel-resonant circuit. To raise the frequency of a parallel-resonant circuit, either the capacitance or the inductance must be reduced. Decreasing the capacitance substantially is somewhat difficult, but decreasing the inductance is easy – just place another inductance in parallel, as shown in Fig. 2.

* 326 N. First St., Rockford, IL 61107.

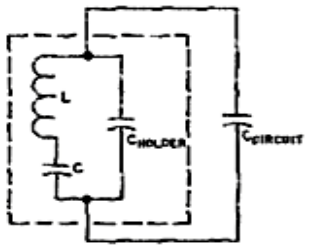


Fig. 1 – Electrical equivalent of a piezo-electric crystal and circuit.

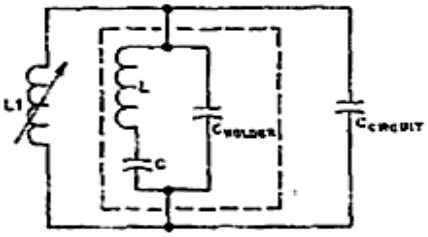


Fig. 2 – The configuration can be modified by placing an inductance in parallel with the circuit and crystal to raise the frequency of operation.

Increasing the Frequency

Adding inductance in parallel in this case will cause the oscillator frequency to increase. This is because the inductive branch of the network must remain in equilibrium with the capacitive:

$$(-1) \times X_C = X_{L\text{total}} = \frac{X_{L\text{xtal}} \times X_{L1}}{X_{L\text{xtal}} + X_{L1}}$$

As can be seen from the equation above, when the inductive reactance of L1 decreases, the inductive reactance of the crystal must increase.

Substituting numbers for letters will show that the inductive reactance of L1 must be variable over a considerable range, which can lead to difficult mechanical problems. Fortunately, the same effect can be realized by replacing L1 with a parallel-resonant circuit tuned slightly above the crystal frequency. The inductive reactance of the crystal and its frequency of oscillation can now be controlled by adjusting C1 – decreasing the capacitance raises the frequency.

Some plated crystals work better than others in this circuit, (third-overtone types working on their fundamentals were among the best tried) so particular attention should be directed to any sudden jumps in frequency as C1 is decreased. This would indicate a change in the mode of oscillation, or that the crystal has stopped oscillating and the circuit is operating as a conventional *LC* oscillator.

Operation Below the Crystal Frequency

To lower the frequency of oscillation, we have to make the crystal act as a *capacitive* reactance, *below* its series-resonant frequency. The easiest way to do this is to add an inductance in series with the crystal, Fig. 4.

Going just one step further, we have a Clapp oscillator, Fig. 5, in which the network between points A and B acts as a capacitor in series resonance with the coil L2. Since L2 and C_{AB} are series resonant, their reactances must be equal but opposite and:

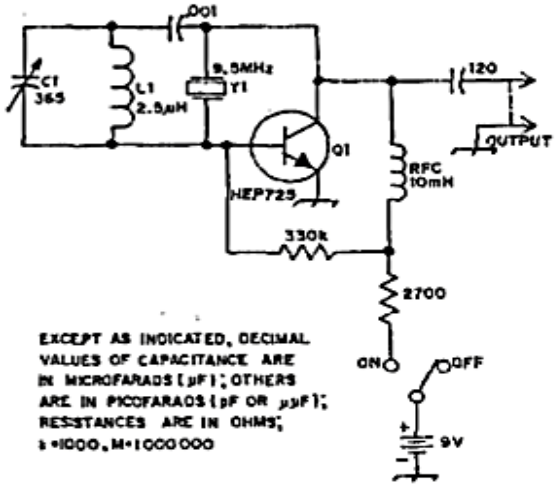
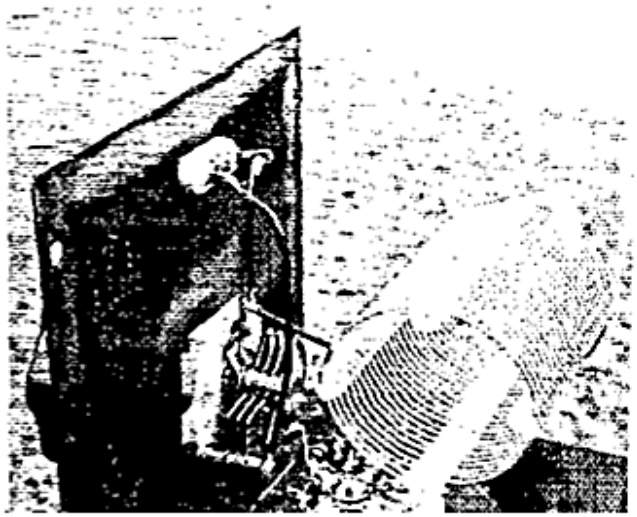


Fig. 3 – In a practical VXO, the operation may be above the crystal frequency by placing a tuned circuit across the crystal.

$$(-1) \times X_{CAB} = \frac{1}{\frac{1}{X_{C\text{holder}}} + \frac{1}{X_{C\text{xtal}}} + \frac{1}{X_{C2}}}$$

Since the total capacitive reactance of the network AB must remain in equilibrium with the inductive reactance of L2, as the capacitive reactance of C2 decreases, the capacitive reactance of the crystal (and downward frequency shift) increases. In other words, the frequency of oscillation of the crystal is primarily determined by C2 within limits set by L2.

In reality, the feedback capacitors also affect the situation, as does stray capacitance, but the effect is slight compared to that of C2. Again, care must be taken to assure that the crystal is controlling the frequency and that the circuit hasn't "taken off" on its own. The oscillator illustrated in Fig. 5 is very stable within 100 kHz of the crystal frequency. Though the values given are for the 9.5-MHz range for tripling to 10 meters, either circuit can be adapted to other bands by



No "build it like a battleship" blues here! Since stray capacitances can affect the performance of different VXOs using the same circuit, some pruning of the coil may be necessary to obtain the desired bandspread. Substituting a good-quality slug-tuned coil may make the job easier. Don't forget to insulate C2 from the chassis.

The Tunable Crystal Oscillator

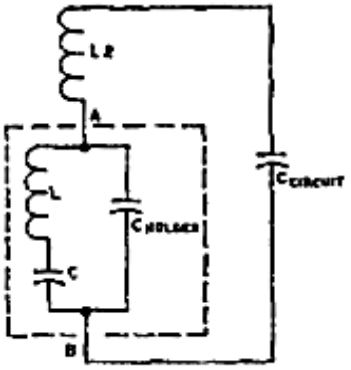
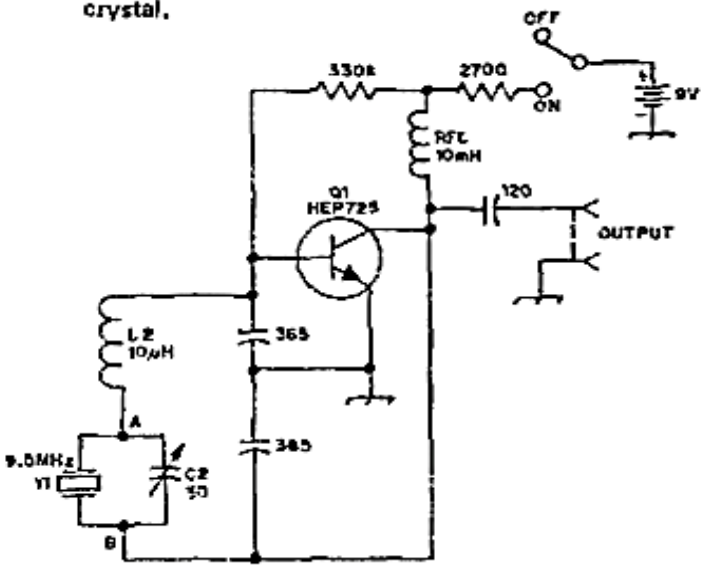


Fig. 4 — To obtain a frequency below that of the crystal, an inductance is placed in series with the crystal.



EXCEPT AS INDICATED, DECIMAL VALUES OF CAPACITANCE ARE IN MICROFARADS (μF); OTHERS ARE IN PICOFARADS (pF OR μμF); RESISTANCES ARE IN OHMS; k=1000, M=1000 000.

Fig. 5 — A Clapp-oscillator version of a VXO. The frequency was chosen to be tripled to 10 meters, but the circuit may be adapted to other bands.

keeping the reactances of the various components approximately the same. If difficulty is experienced in obtaining adequate frequency deviation below the crystal frequency, the first thing to suspect is that L2 is too small. Also, crystals mounted in the FT-243 pressure-type holders worked rather poorly compared to plated crystals. For maximum stability all voltages should be regulated, temperature compensation should be used, and the VXO should be isolated as much as possible from the load and operated at a low power level.

The field of variable-frequency crystal oscillators is still wide open for experimentation. Among the things needed are a single circuit for operation both above and below the crystal frequency, a linear tuning system, and a thorough mathematical treatment.

The author hopes this brief article will lead to further development and use of the VXO in transmitter frequency control, receiver local oscillators, secondary frequency standards and other areas where an ultrastable tunable oscillator is required. QST

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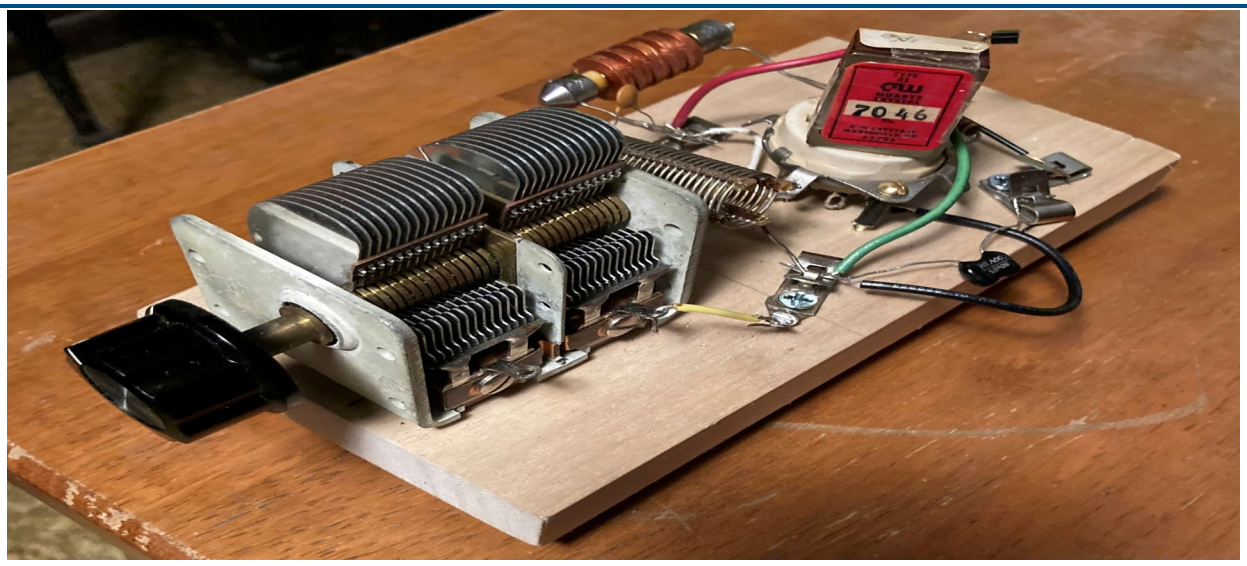

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