

FEEDBACK

FEBRUARY 2015

JCRAC Has A New Repeater

The Johnson County Radio Amateur Club's repeater 145.290/146.900 PL 151.4 is back on the air. It is a DMR (Digital Mobile Radio) Motorola MotoTrbo repeater operating in the Dynamic Mixed Mode. This means if you transmit into the repeater in analog mode it comes out analog or if you transmit into the repeater in digital (DMR) mode it comes out digital. For those with DMR radios the Talk Group Number is 913, the Color Code is 1 and the Time Slot is 1. The 145.210/144.610 PL 151.4 repeater in Shawnee also operates with the same Talk Group, Color Code and Time Slot. These repeaters are not linked but are using the standard local Talk Group for this area.

Anyone needing additional help programming their DMR radios or understanding DMR should contact **Bill Brinker, WAØCBW** at WAØCBW@arrl.net or **"Van" Van Deveer, KØHCV** at KØHCV@arrl.net.

Some additional operating notes: These repeaters have the standard 3 minute time-out timer and do not have a courtesy beep. For analog users it may be helpful to use receive CTCSS or Tone Squelch to eliminate the digital sound when the repeater is in the digital mode. When using CTCSS or Tone Squelch you will not hear the Identifier as the repeater strips PL when the ID is sent. The repeater never sends an ID when voice is present. And following FCC rules it is always good practice to monitor the channel prior to transmitting to be sure there isn't a conversation (either digital or analog) already in progress.

Some additional DMR programing notes: In the DMR world everyone has a unique identification number. This number is necessary primarily in the DMR linked repeater world and not an absolute requirement in our environment. However everyone should apply for and program into their DMR radio their unique number. The number is free, all you have to do is apply for it via the DMR-MARC website. The url is: <<http://www.dmr-marc.net/cgi-bin/trbo-database/register.cgi>>. Don't worry about all the verbiage on the page, just scroll down to the bottom and press the "user registration" button. Fill out the information and press the "register" button. The home repeater callsign box on the registration page would be WØERH. It is necessary for everyone to apply for and program their number into their radio even though we are not linked into the DMR network. If anyone has questions or needs their CSI radio programmed, just contact Van..

Welcome to the new and improved family of repeaters from the Johnson County Radio Amateur Club. Stand by for information about a new Yaesu Fusion repeater that will be added in the future to the family.

-- Bill Brinker, WAØCBW -- WØERH Trustee

FEBRUARY MEETINGS

February 13 – *Software Defined Radio*

February 27 – *Perhaps Herb Fiddick, NØZF – The Role of the Club in the Life of a New Ham*

The Johnson County Radio Amateurs Club normally meets on the 2nd and 4th Fridays of each month at 7:30 PM at the Overland Park Christian Church (north entrance), 7600 West 75th Street (75th and Conser), west of the Fire Station.

Much of the membership travels to the Pizza Shoppe at 8915 Santa Fe Drive (a block west of Antioch) for pizza buffet and an informal continuation/criticism/clarification of the topics raised at the meeting ... or anything else.

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-> FEEDBACK <-

*A publication of the
Johnson County Radio Amateur Club, Inc.*

Bill Gery, KA2FNK, President

Aaron Boots, AAØRN, Vice President

Ted Knapp, NØTEK, Secretary

Cal Lewandowski, KCØCL, Treasurer

* * *

Chip ACØYF and Deb KDØRYE Buckner, Editors

Remembering a Member

One of the joys of amateur radio is the people. Our hobby gives us the opportunity to encounter a variety of wonderful people who do great things both inside and outside of the radio world. The nature of our existence is such, however, that from time to time we lose these people. Because each life is going to be precious to a portion of our membership, the commemoration of one such loss in the FEEDBACK would risk the creation of the expectation that the FEEDBACK could/should commemorate each such loss. If followed, such a policy would quickly change this pamphlet from a club newsletter into a biographical journal.

And then there is the exceptional case, an individual who has been a part of the club for more than fifty years and an officer for more than fifteen years. Where better to remember James L. "Mac" McCoy than the pages of the JCRAC newsletter.

Other New Stuff

The "Local FM Net and Meeting Calendar" is an attempt to list recurring events that are likely to be of interest to all--but especially to newer--hams. The listing was born of a frustration of reading that a net existed, waiting by the radio, and--for whatever reason--hearing nothing. Our practice, until we change our minds, will be to list FM nets that look/sound as though they are local, when referred by a human being. If a FEEDBACK editor can hear the net, then we add bold-faced type to the listing. If an editor tunes in and cannot hear the net, the listing will be deleted.

We have missed things. If you will point them out to us, we can keep the listing up-to-date and, therefore, useful for our new members.

Learning on the Job

Every endeavor is a learning opportunity. Your editors quickly learned that the ham radio "Ø" is formed by holding down the Alt-key and typing "0216" on the keypad. This month, as Hambone learns to apply his knowledge of voltage dividers to practical problems, your editors learned how to use subscripts in the OpenOffice software they use to compose the FEEDBACK.

-- Chip and Deb

PRESIDENT'S CORNER

January 2015 ended on a very sad note. **James L. "Mac" McCoy, WØLQV**, who was our club treasurer for fifteen years became a silent key. During his years as treasurer Mac made sure that all the club's required filings were on time. We worked together to fill all



the necessary IRS forms so Johnson County Radio Amateurs Club could qualify as a not-for-profit corporation. Mac's generator was his pride and joy.

He was always close at hand to ensure that the generator quietly provided Field Day power for the Club. He will be missed.

The club's web site, w0erh.org, is now a year old. **Ted Knapp, NØTEK** has been doing a great job in keeping it fresh, which is no small task. Be sure to thank Ted for his efforts.

The new club 2 meter repeater (145.290) went on the air in January. Thank you, **Bill Brinker, WAØCBW** and **"Van" Van Daveer, KØHCV**. The repeater is a Motorola MotoTrbo operations in Dynamic Mixed Mode. This brings Digital Mobile Radio (DMR) and the analog mode in one package. Details and operating tips can be found on the club web site.

The public service events are already lining up. These events need volunteers. What a great way to meet fellow hams and improve your skills as an Amateur radio operator.

- Bill Gery - WA2FNK

James L. "Mac" McCoy, WØLQV, SK

James L. "Mac" McCoy, age 88, of Overland Park, KS passed away Sunday, January 25, 2015. Mac was born on August 15, 1926 in Des Moines, IA. His family moved to Kansas City in 1932, where he discovered that his neighbor, Lowell Divinia operated radio station W9VBK (later WØVBK). His family moved to Westwood, and Mac graduated from Shawnee Mission Rural (now "North") High School in 1944. Ten days later, he enlisted in the Navy and served as an Electrician's Mate Second Class until 1946.



On returning home--and "after a bunch of tries"--he conquered the 13 word-per-minute code and written examination to earn amateur radio license WØLQV in 1948. He left home to attend Kansas State College (now University) where he was



instrumental in putting college radio station WØQQQ (pictured here are Mac and Wilbur Goll, WØDEL) back on the air.

Fellow student John Wilson, KØIP, remembers Mac as being a great Elmer, a great ham, a great electronic technician and one of the people who "shaped my life". When not working on the station, Mac earned a BA in Business Administration.

Back in Westwood, Larry Woodworth, WØHXS remembers that, as a new novice in 1952, he picked up a big signal on 75 meters. Upon investigation, he discovered that it was Mac. Larry went to visit and found a gracious young man who welcomed him, both to the hobby and to the neighborhood, after which the two discussed ways to protect themselves from the big signals coming out of KMBC.

Ever the observant technician, Mac monitored--and corrected--ARRL propagation bulletins, which earned him an occasional mention in the follow-up issues.

Mac volunteered in the Civil Defense and Emergency Preparedness offices of Johnson County, KS. He enjoyed scouting and participated as an adult leader for over 20 years. He retired from the Department of Energy after 23 years of service as an assurance inspector.

In 2013, Mac completed eighteen years of service as the JCRAC Club Treasurer, where he patiently waited for club-meeting-minute-approval hijinx to subside before delivering the treasurer's report.



His longevity and stability in that position meant that, for many years, he was listed as being the club contact in club announcements and third-party websites. Even after turning over the financial responsibilities, he would come to club meetings and sit on the front row, facing his successor who, obviously, had no choice but to get things exactly right.

James and his wife Barbara loved traveling and he enjoyed spending time with his hobby amateur radio. Survivors include his wife, Barbara McCoy; his son, Michael McCoy and his wife, Tonya and two grandchildren.

Johnson County Radio Amateurs Club - January 9, 2015

The meeting Started at 7:30PM.

Attendance: Self introduction with name and call sign. 27 signed the check in sheet. This was followed by the Pledge of Allegiance.

The Minutes from the November 14, 2014 meeting were read and accepted with 2 opposed votes.

The Treasurer's report, as follows, was read and accepted unanimously.

Cash on Hand	\$ 77.11
Checking Account	\$ 305.30
Savings Account	<u>\$ 9,728.00</u>
Total	\$ 10,110.41
Repeater Op. Reserve	\$ 679.87
Memorial Fund	\$ 150.00
Active Members	142

Old Business:

- WW1USA Special Event Station at Liberty Memorial and Museum is looking for operators. The event starts on February 7 at 10AM and ends on February 8 at 5PM. See Herb Fiddick, NZ0F or theworldwar.org/amateurradio for details.
- Two Shootouts are being planned for this year. One inside using VHF and one outside using HF. Both events are being planned by Lon Matrin, K0WJ.
- Field Day 2015 – June 27-28, 2015. The Club's location will again be at the Observation Tower in Shawnee Mission Park.
- Repeater Update – As we are all aware, the 2m Repeater is off the air due to a power supply problem. An anonymous group of benefactors approached the Repeater Trustee Bill Brinker, WA0CBW and has offered to donate funds for a new Repeater. These would be matching funds and would match whatever funds the club would provide. The only condition associated with this gift would be the funds are used for the purchase of new Motorola equipment. This group feels that since Bill, WA0CBW is extremely familiar with Motorola equipment it would be in the best interests of the club to continue with the Motorola line. The current repeater dates back to the late 1970's early 1980's. It is also becoming more difficult to locate replacement parts (even with Bill's WA0CBW extensive inventory of supplies). The expected maximum amount for the brand new Motorola state of the art Repeater would be \$4,500. Therefore the maximum out of pocket expense for the club would be \$2,250. This would also include a new cabinet for the new Repeater. It is stressed that this is a maximum amount and could possibly be less. This information was provided by Bill Brinker, WA0CBW and presented by Harold "Van" Van Daveer KOHCV who said he was better looking than Bill, WA0CBW.

- After a short discussion a Motion was made and seconded to accept the offer from the anonymous group. A vote was taken and this motion passed unanimously. A second Motion was made and seconded to fund this project up to \$3,000. A vote was taken and this motion passed unanimously.

New Business:

- A suggestion was made by Brian Short, KC0BS to recognize individuals that either had a Birthday or License Anniversary during the month and any Silent Keys. All thought that was a good idea. Doug Tombaugh, N3PDT had his 5th License Anniversary in January. Chuck Simpson's (KCONUG) wife passed away unexpectedly.

Reports:

- 6 m – None. However, this is the prime time of the year for 6m to open up.
- 10 m SSB Roundtable – 5 participated on January 8 and 4 participated on January 1.
- 440 Wheat Shocker net – 19 check-ins on January 7 and 11 check-ins on December 31.
- 2m Wheat Shocker net – 11 check-ins on January 8 and 19 check-ins on January 1.
- HF Activity – 10m open to Europe and 40m open at night.

Announcements:

- Record number of contact (over 600) was made during Skywarn Recognition Day December 5-6 at the National Weather Service Training Center office in Kansas City. Thank you to all that participated.
- Technician Class at the NWS Training Center January 10 & 17. See Hamclass.org or Brian Short KC0BS.
- ARES Meeting January 12 at Salvation Army Community Center in Olathe at 7 PM.
- Weather Spotter Training January 26, 7PM at Olathe Northwest High School.

Business meeting adjourned at 8:03 PM

Program:

- The Program for this evening was planning for 2015 Programs.

Submitted by Ted Knapp, N0TEK, Secretary.

Johnson County Radio Amateurs Club - January 23, 2015

The meeting Started at 7:30PM.

Attendance: Self introduction with name and call sign. 47 signed the check in sheet. This was followed by the Pledge of Allegiance.

The Minutes from the January 9, 2015 meeting were read and accepted with 1 opposed vote.

The Treasurer's report, as follows, was read and accepted unanimously.

Cash on Hand	\$ 77.11
Checking Account	\$ 356.51
Savings Account	<u>\$ 9,728.00</u>
Total	\$ 10,161.62

Repeater Operating Reserve	\$ 689.87
Memorial Fund	\$ 150.00

Active Members	142
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Old Business:

- 2m Repeater Update – The 2m Repeater is back on the air! It is a DMR (Digital Mobile Radio) Motorola MotoTrbo repeater operating in the Dynamic Mixed Mode.
- WW1USA Special Event Station at Liberty Memorial and Museum is looking for operators. The event starts on February 7 at 10AM and ends on February 8 at 5PM. See Herb Fiddick, NZ0F for details.
- Field Day 2015 – June 27-28, 2015. The Club's location will again be at the Observation Tower in Shawnee Mission Park. We have reserved the SATERN Communication Van for this event.
- Club Shirt Update - Bill Gery, KA2FNK is still working on collection information.

New Business:

- WW1USA Special Event Station at Liberty Memorial and Museum will be operating 4 times in 2015. They are February 7-8, May 9-10, September 12-13, and December 12-13. The only event that does not have club sponsorship in the December 2-13. Herb Fiddick, NZ0F wanted to know if our Club would be interested in sponsoring this December event. After a short discussion a Motion was made and seconded to sponsor the December event. A vote was taken and this motion passed unanimously.
- The Santa Fe Trail Amateur Radio Club has changed their club meeting time and location. The club meets at 7:00 PM on the third Friday of each month at Faith Technologies in Lenexa, KS.

At this point in the meeting we had our guest speaker, Chris Wilson a representative from Yaesu, discussed Yaesu's new Fusion Radio System.

- After Chris's presentation "Van" Van Daveer KOHCV asked the Club to consider purchasing a Yaesu Production DR-1X System Fusion Repeater. Yaesu is currently offering these at a substantially discounted price of \$500 (these repeaters are typically over \$1,600). As an incentive, Van has offered to donate \$100 towards its purchase. Tom Wheeler, N0GSG also offered to donate \$100 as well. After a short discussion a Motion was made and seconded to purchase a Yaesu Fusion Repeater at a cost of \$300 (after the 2 - \$100 donations). A vote was taken and this motion passed unanimously.

Reports:

- 6 m – None.
- 10 m SSB Roundtable – 6 participated on January 22 and 3 participated on January 15.
- 440 Wheat Shocker net – 19 check-ins on January 21 and 20 check-ins on January 14.
- 2m Wheat Shocker net – 15 check-ins on January 22 and 19 check-ins on January 15.
- Licenses Anniversary – None
- Birthday's – None
- Silent Key's – None
- HF Activity – Japan and New Zealand on 15m (using a 10m antenna). Madagascar, Saint-Barthélemy, Costa Rica on 17m.

Announcements:

- Pete Bugio, W3PI has donated a Rotor to the club.
- WW1USA Special Event Station February 7-8.
- Watch Larry's List for upcoming events. In September there is an event that needs a coordinator. See Herb Fiddick, NZ0F for details.
- Kansas Day Special Event January 24. Hosted by the Santa Fe Trail Amateur Radio Club.
- Technician Class at the NWS Training Center January 10 & 17. See Hamclass.org or Brian Short KC0BS.

Business meeting adjourned at 8:30 PM

Program:

- The Program for this evening was a presentation on Yaesu's new Fusion Radio System by Chris Wilson a representative from Yaesu.

Submitted by Ted Knapp, N0TEK, Secretary.

Hambone Rediscovered Voltage Dividers

"Hi Hambone, I haven't seen you for a while, what've you been doing?"

"Hi, Elmer, I just started my electrical engineering classes at the community college and they are taking all my time."

"Well, that explains why I haven't seen you for about a month. How do you like it, so far?"

"One thing I can tell you, Elmer, it's way different from high school. I'm really taking the pre-engineering courses - English, Political and Government Studies and Chemistry - to get them out of the way before going on to State University. Dad said it's a lot less expensive to get in my first two years this way. Especially since I can live at home."

"He's right," replied Elmer. "I did that, decades ago. So, I guess things haven't changed much. If memory serves me, the real, hard-core engineering courses start in your junior year. Although you can sometimes get a taste sooner."

"Yeah, you're right," replied Hambone half-heartedly.

"What's the problem, aren't you looking forward to learning how all this electronics stuff really works? Who knows, you may invent something great!" added Elmer, trying, vainly, to raise some enthusiasm.

"I am taking one engineering course --Electrical Circuits and Measurements 101--which is supposed to be the easiest engineering course, and I'm already having trouble. I shouldn't have talked my advisor into letting me take it. But I told her that I already knew a lot about electronics because I have my General Class ham license. She was skeptical, but signed off on it anyway. I'm starting to think that was a mistake."

"It's true, there is a huge difference between hobby radio and professional electrical engineering, but you are very smart. Is there some specific problem that's troubling you? I'm not going to do your homework for you, but maybe I can point you in the right direction," offered Elmer.

"It's our lab problem," said Hambone, brightening up at the prospect of Elmer's help. "The instructor gave each of us a few unmarked resistors and said that we have to devise ways to measure their resistances." "That sounds easy enough. I guess your instructor wants you to get a practical as well as a theoretical grip on electronics," replied Elmer.

"I thought so, too. But he said we can only use some very basic tools - a DC voltmeter and some known resistors in the form of substitution boxes. Of course, there's also power supplies and batteries, but we can't use ammeters, ohmmeters, semiconductor checkers, RLC bridges or any other test equipment. He did say that the voltmeters have very high impedances so we don't have to worry about them affecting our circuits. Whatever that means. I always just used my multimeter. It has scales for resistance, capacitance, diode checking, volts, amps and even frequency. I don't know what to do without it. Oh, and we can't just give the answers, we have to write up with text and diagrams how we got them. If this is the easiest class, I don't know if I will ever become an engineer," pouted Hambone.

"Well," soothed Elmer, assuming his pontifical tone and posture as he always did when attempting to 'enlighten' Hambone, "as a hobbyist, you only need some vague idea about how things work. You can't get into any real trouble. But, as an

engineer, you must understand exactly how your components and tools work. People depend on you being right. Your screw-ups will always cost money and maybe even lives. Anyway, in this case, there are at least two ways to approach the problem. You could build a Wheatstone bridge, but I think Ohm's Law as it applies to voltage dividers is the basic level we're looking for."

"Yes," said Hambone, starting to brighten up. "The instructor explained the operation of Ohm's Law and voltage dividers last week. Now, I guess we are expected to apply it. Things move pretty fast at the college level."

"Your instructor is right in stressing the importance of Ohm's Law. It is very simple, but a lot of electronics is based on it, including the problem that's puzzling you.

Let's start with measuring this resistor marked #1." Said Elmer. "Since you can't use an ohmmeter, how else might you find its resistance?"

"Well," said Hambone, "Ohm's laws says:

$$R = E/I$$

where:

R = resistance in ohms

E = voltage in volts

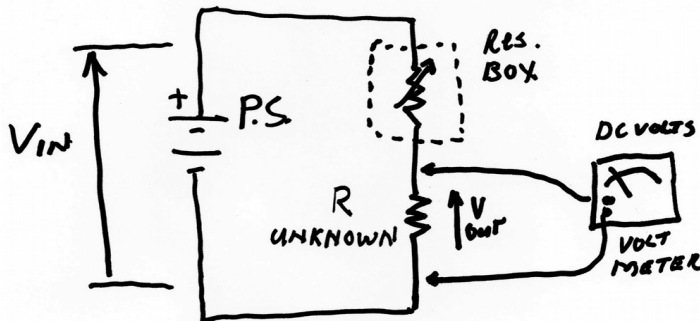
I = current in amps

So, if we apply a voltage to the resistor, measure the current that the voltage causes to flow through it, we can calculate R. Won't that work?" asked Hambone.

See Hambone on page 7

From Hambone on page 6

"It would, but remember that you only have a voltmeter, so you have no direct way of measuring the current. Maybe a voltage divider, using your unknown resistor and some known resistor from your resistance substitution box would be a better idea," intoned Elmer, sketching a small circuit on a scrap of paper.



"I get it!" interrupted Hambone. "You just change the setting on the resistance box until you get a reasonable reading on the meter. Then you use the voltage divider formula that we derived from Ohm's Law to find the unknown resistor. It goes something like this:

We re-work the basic voltage divider formula:

$$V_{out} = V_{in} \frac{R_{unknown}}{(R_{unknown} + R_{box})}$$

Solving for the unknown resistance in terms of the power supply voltage (V_{in}), the output voltage (V_{out}) and the known resistance from the substitution box:

$$V_{out}(R_{unknown} + R_{box}) = V_{in}(R_{unknown})$$

$$V_{out}(R_{unknown}) + V_{out}(R_{box}) = V_{in}(R_{unknown})$$

$$V_{out}(R_{out}) = V_{in}(R_{unknown}) - V_{out}(R_{unknown})$$

$$V_{out}(R_{out}) = R_{unknown}(V_{in} - V_{out})$$

Giving:

$$V_{out} \left(\frac{R_{box}}{(V_{in} - V_{out})} \right) = R_{unknown}$$

Since we know V_{out} because the meter is showing it, we know V_{in} because we set it on the power supply and we know R_{box} because we set it on the substitution box, we can calculate the unknown resistor," proclaimed Hambone proudly, all excited that he was finally getting it.

"By George, you've got it!" exclaimed Elmer. "It looks like you've gotten a lot better at basic algebra, too. Let's try an example with real parts. I've got a resistance substitution box, some resistors, a power supply and a voltmeter right here on the bench. You pick a resistor to be our unknown - don't look at the value - and wire up the circuit."

While Hambone grabbed some clip leads and began wiring up the circuit, Elmer went to the kitchen to make himself a mashed potato sandwich.

After a few minutes Hambone announced, "It's ready, but what voltage should I set the power supply for?"

"Since you don't want to burn out anything, start with the power supply set to some low voltage and set your meter to measure that same value or higher. You can always raise it later. Use ten volts to start. Be sure to measure your power supply voltage with the same meter you're using to measure the output voltage. Those little meters built into the power supply are not very accurate," warned Elmer.

"Okay, Elmer, I'm turning the knob on the box. I see when the box resistance is very low, the meter reads a little less than the power supply voltage. But look, as I increase the box resistance, the voltage across the unknown resistor goes down. Oh wait! With the box set for 47 K Ω , the meter reads 5.5 volts. Let's use that to calculate the unknown resistance. Putting our actual numbers into the formula, we get:"

$$V_{out} \left(\frac{R_{box}}{(V_{in} - V_{out})} \right) = R_{unknown}$$

$$5.5 \left(\frac{47,000}{10 - 5.5} \right) = 57,444 \text{ ohms}$$

"That sounds about right, let's check the value. You picked an old carbon resistor with three stripes, green - brown - orange, indicating 51,000 ohms," said Elmer.

"That's not very close to 57,444 ohms. That resistor must be bad," countered Hambone.

"No, it's not. Notice that it has only three stripes; there is no fourth metallic stripe indicating tolerance. Remember, a gold stripe indicates 5% and a silver stripe indicates 10% tolerance. But, no stripe indicates 20% tolerance. I would say that this resistor is not bad, it is within its marked value."

"Now you know a little bit more about resistors and maybe even understand how a voltage divider works," added Elmer.

"Thanks, Elmer, I've gotta run. I've got some lab homework to do!"

Circuit Scribe: A New System for Building Circuits - Tom Wheeler, NØGSG

Circuit Scribe is a relatively new system for constructing circuits that is being marketed to professionals, educators, and hobbyists the world over. With Circuit Scribe, users draw the circuit onto paper using a special conductive ink pen; after the ink dries, pre-fabricated components are simply laid on top to complete the circuit.

The Circuit Scribe *Basic* kit comes with an array of components including two LEDs, a SPST switch, an NPN transistor, and a two-pin header for interfacing a variety of components to the circuit. It also includes a pen, which the manufacturer claims is good for about 150 to 200 meters of drawing. The kit with book sells for around \$60; replacement pens are

Components are contained in pre-assembled modules. Underneath each pin of the modules is a high-strength magnet. Circuits drawn on paper are placed on top of a steel backing sheet; this allows the magnets in the modules to readily attract through the paper circuit, ensuring a fairly solid connection. Figure 2 shows the LED circuit with the modules in place.

The Verdict

The Circuit Scribe concept is a very cool idea. The ink performs amazingly well, and everything I built with it worked. (I did use an ohmmeter as I built each circuit to confirm the connections.) The system might be great for teaching K-12 students the basics of electricity and electronics--but it's an expensive approach. The strengths of the system are as follows:

- Components are packaged neatly on individual boards, with the symbols clearly drawn on them. The build quality of the components is excellent.

See Circuit Scribe on page 9

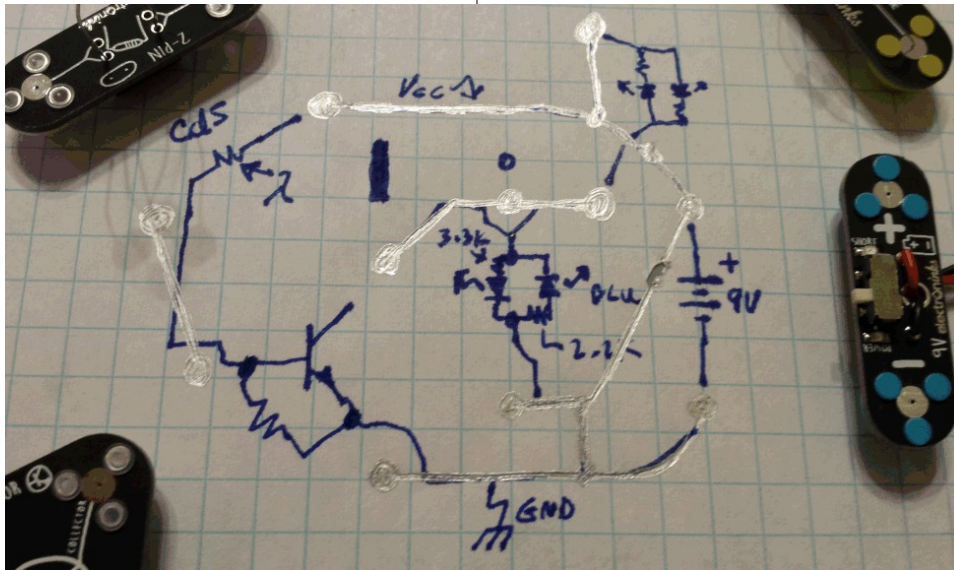


Fig. 1: A Circuit Drawn on Paper

The idea is simple in concept--but as you might suspect, the critical ingredient of such a system is the pen and ink. I can report that the Circuit Scribe pen in fact works very well. It contains a silver-bearing ink engineered by the Circuit Scribe team and is dispensed from a ball-point pen tip. The ink flows readily onto most paper surfaces and dries rapidly (one to two minutes at normal room temperatures). Figure 1, above, shows a circuit for activating an LED from a photocell drawn on a regular piece of notebook paper.

The "traces" drawn with the pen are typically about 0.050" in width, using regular paper, a total resistance of about 2 to 5 ohms per inch of trace is typical. You won't be using Circuit Scribe to build power circuitry, at least not a low levels of impedance!

about \$20 each. The *Basic* kit includes a workbook with a variety of circuits and a template for accurately drawing connection pads to the various component modules in the kit.

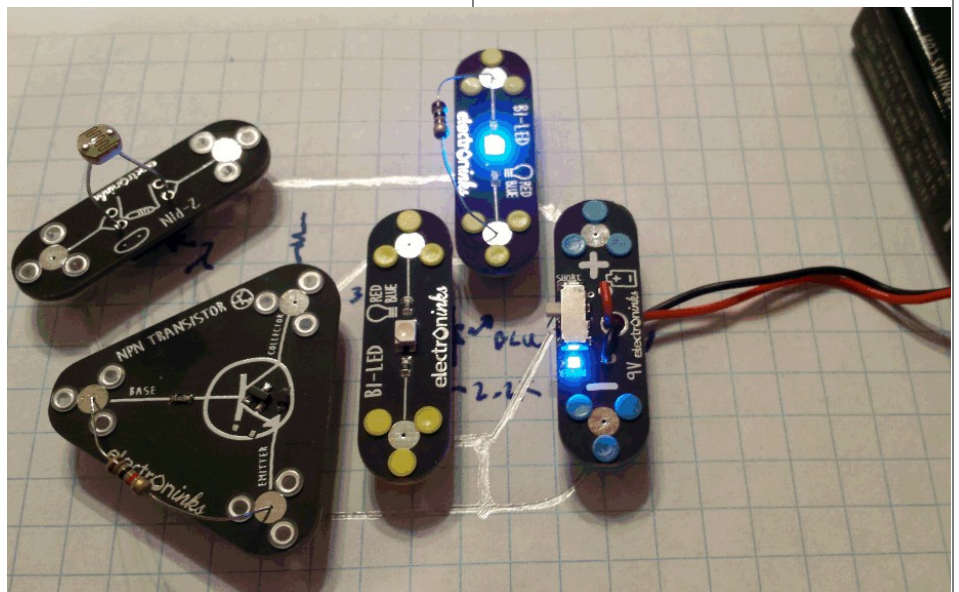


Fig. 2: A Circuit with Modules in Place

From Circuit Scribe on page 8

- Components are packaged neatly on individual boards, with the symbols clearly drawn on them. The build quality of the components is excellent.

- The components have been "student proofed." This is both a strength and a weakness. For example, the NPN transistor has a series resistor added to the base portion of the circuit to protect the base-emitter junction. This resistor alters the device characteristics and can't be bypassed. Likewise, the bi-color LED has two resistors in place to limit the current to each LED so that it can be directly placed across a power source without harm. The battery includes short-circuit protection.

- Holes are placed on each module pin of the preassembled parts to allow the experimenter to add on discrete components. This is undocumented, but you can clearly see where I cribbed a 1k resistor across the base-emitter of the transistor in Figure 2 using this feature.

- The ink performs very well and can even be soldered to, with care (more on this in a minute).

From an engineering and educational view, the following are the drawbacks of the system:

- The system is relatively expensive. For \$45 (the cost of the *Basic* kit without the manual), an experimenter could easily purchase a conventional breadboard and a host of discrete components to populate it.

- The *Basic* kit doesn't contain enough components to accomplish much beyond simple switching (on/off) circuits. I'm sure this is a pricing point trade-off--but it would have been very nice to have a couple of electrolytic capacitors and one additional NPN transistor to allow more elaborate creations. The *Maker* kit, about \$80, contains additional parts for creating more complex circuits.

- The accompanying handbook is fairly well written, but includes a fair number of grammatical and factual errors--very surprising since this is claimed as the product of PhD students. For example, on Page 5 the manual states that a semiconductor "restricts the flow of current (also called a resistor)." This is clearly in error.

- The method of circuit assembly, while fine for teaching fundamentals, is quite far from industry standards. Post-secondary students need to learn cutting-edge technologies (Circuit Scribe qualifies here), but also need solid background in conventional construction and prototyping practices used in industry. Circuits with more than a handful of components are likely to be unwieldy to build using Circuit Scribe.

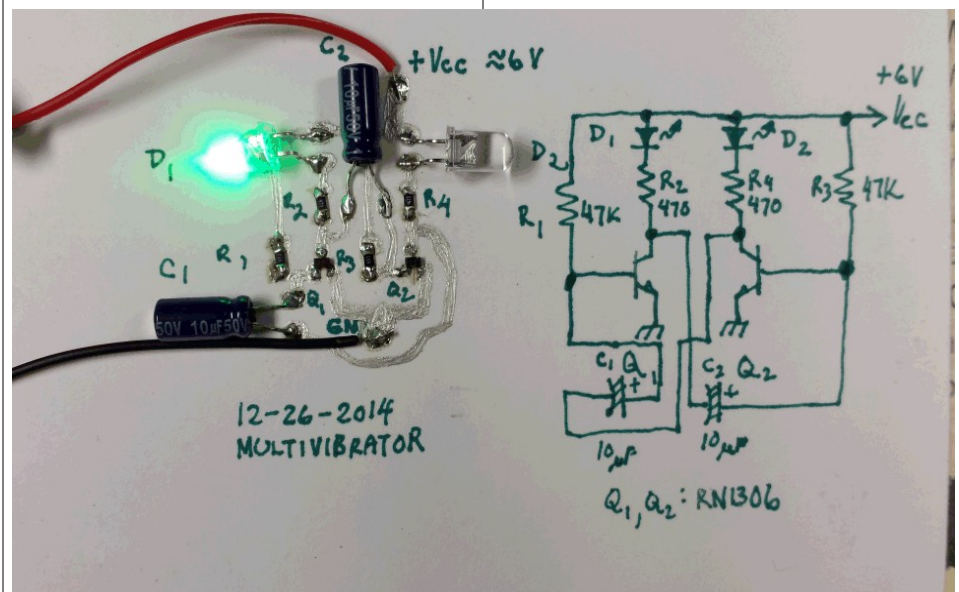
- The "student proofing" of components is not explained in the documentation. Students will learn some dangerous ideas; for example,

student isn't blowing something up every so often, he or she probably isn't learning!

- Components must be spaced relatively widely for reliable operation. Otherwise, the magnets of adjoining component legs will literally push against each other, causing open circuits.

Magic Ink

Circuit Scribe ink has a hidden capability that needs more exploration: With care, components can be directly soldered to the silver traces laid down with the pen. To test this idea, I literally threw together a two-transistor LED flasher on the back of a 3x5" postcard. (I noted that the traces had higher resistance on this medium than on regular paper--the manufacturer doesn't recommend this material, but I didn't know this until I had built a working circuit. Oh well!) Figure 3 shows this circuit. I didn't have any SMT LEDs or capacitors on hand, so I just soldered leaded parts for these.



LEDs cannot be connected directly across voltage sources in real life, but they can in the kit because of the hidden series resistors. This is great for protecting the components, but it should be better explained for students and teachers within the manual. Most electronics instructors will attest to the basic fact that if a

Fig 3. A LED flasher built using SMTs Soldered to Circuit Scribe Traces

If you promise not to laugh, I'll let you take a close look at the soldered portion of Figure 3. Promise? Okay, turn the page.

See Circuit Scribe on page 11

LOCAL MEETINGS AND FM NETS

	SUN	MON	TUE	WED	THU	FRI	SAT
07:00							
AM	0:00 Paul Revere 146.94- (88.5)		SATURDAY testing sessions @ 09:00->	2nd: Testing @ Indep. Emer. Op. Ctr. behind 950 N Spring St.	3rd: Testing @ JoCo Libr, 151st and Antioch	4th: Testing @ Blue Springs Mid-Cont Library, 850 Hunter Rd.	07:00 - Santa Fe Trail ARC @ Perkins, Santa Fe E. of I-35, Olathe 09:00 - Ray/Clay ARC - Bargain Town (Hwy 10&13), Richmond, MO
18:00	18:45 Miami County D4 ARES/Paola 147.360- (151.4)	18:30 4th: KCDX Club @ Better Homes & Gardens Realty, 8101 College Blvd, #100 OPKS	JoCo ARES Simplex 146.450				
19:00	Wheat State Net/Paola 147.360- (151.4)	145.47- (151.4) JoCo ECS 1st: Clay Co ARC @ Liberty Hospital (Dialysis Ctr - Lower Level)	JoCo ARES 145.29+ (151.4) 2nd: Indep. FM ARC, St. Matt's UMC, 2415 R D Mize Rd., Indep, MO 3rd: Heart of Amer RC - Red Cross HQ, 211 W Armor, KCMO 3rd: Testing @ Community Christ, 63rd & Manning, Raytown	2nd: Douglas Co ARC @ Douglas Co Fairgrounds Bldg#1 2nd: Wheat State Wireless Assn @ Paola Fire Station	Jayhawk ARS 147.150+ (151.4) 1st: Pilot Knob ARC @ Leavenworth Co Courthouse - Emer. Op. Ctr.	3rd: Santa Fe Trail ARC Meeting and Fun Night @ Faith Technologies, 11086 Strang Line Rd, Lenexa	
19:30	Swap and Shop 145.17- (151.4) Pilot Knob ARC 147.00- (151.4)		Ararat Shrine RC 145.13- ()	Clay Co ARC 146.79- (107.2) Pilot Knob ARC 147.00- (151.4)	4th: Raytown ARC @ basement of Comm of Christ, 63rd & Manning, Raytown	2nd/4th: JCRAC "Regular Meeting" @ OP Christian Church, 7600 W 75th St. OPKS	
20:00	Douglas Co ARES 146.76- (88.5) Raytown ARC 145.17- (151.4) Clay Co ARC 147.33+ ()	145.13- () KC Assoc of the Blind ARC 147.375+ (156.7) Ray/Clay ARC	Southside ARC 147.12+ () Santa Fe Trail ARC 147.24+ ()	Johnson Co RAC 443.725+ (151.4)	Johnson Co RAC 145.29+ (151.4)	VA Casual/Ham Roundtable 443.500+ (151.4)	
20:30				Jackson Co ARES Digital Training 146.97- ()	Independence RACES 145.31- ()		
21:00	Right Wing Wacko Net 146.97- ()			Swap and Shop 147.09+ ()		2nd/4th: JCRAC "Annex Meeting" @ Pizza Shoppe, 8915 Santa Fe Dr, OPKS	

Local nets, meetings and testing sessions are posted as the FEEDBACK editor becomes aware of them.

A net is "local" if it can be heard on an attic VHF/UHF J-pole near I-435 and US69. Boldfaced type indicates that FEEDBACK heard the net. Plain type indicates that someone reported it to the FEEDBACK or referred to it on Larry's List, but the FEEDBACK has not confirmed its presence.

A meeting is local if the FEEDBACK editor thinks it is local.

from *Circuit Scribe* on page 9

As you can see, the solder joints to both the SMT and leaded components look passable. After a little practice (as I built this!), I found that the best way to solder onto Circuit Scribe ink is to first tin the component lead (or contact pad), then gently reheat the lead while it's pressed against the ink. Heating the pad more than one second can make the ink break down - - of course if that happens, just draw some more ink on the circuit, let it dry, and give it another go!

It should certainly be possible to fabricate inductors, gimmick capacitors, striplines, and even VHF / UHF antennas using Circuit Scribe ink. How about a "paper transmitter" for HF / VHF?



Conclusion

Circuit Scribe is certainly an interesting fabrication system. If you know a youngster who's interested in electricity or electronics, this system might be a great way to start, if you're willing to help them here and there. For college students, the

kit can provide an introduction to printed fabrication--which represents a small but growing fraction of electronics manufacturing methods. Either way, it's simply fun to draw a circuit and watch it work just like magic!

FEB-1	2	3	4	5	6	7 WW1USA @ Liberty Memorial - 10:00 -> 08:00 - Mine Creek Winterfest @ LaCygne, KS
8 WW1USA ->17:00	9	10	11	12	13	14
15	16	17	18	19	20	21 08:00 - Freeze Your Keys @ Weston Bend State Park 08:00 - Mid-Amer. Antique RC Swap Meet 13:00 - JoCo ARES Doppler RDF "kit build" @ Olathe Salvation Army
22	23	24	25	26	27	28
MAR-1	2	3	4	5	6	7 08:00 - Severe Weath Sympos. @KU Memorial Union Ham 101 @ Smithville, MO FireStation 8am
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	APR-1	2	3	4