

FEEDBACK

SEPTEMBER 2015

JCRAC Members "Show" and "Tell"

August 14 was a "project show and tell" night at the Johnson County Radio Amateurs Club. **Keith McKinney, KEØAEP**, (below) who had had a career working with counter-balanced photographic equipment, showed how he had built a portable FM-satellite ground station using a pair of handi-talkies, bits of photographic kit and a pair of antennas. It is, he said, all **Eddy [Paul], KYØF**'s fault.



Jay Burgherr, NØFB (right), needed a collapsible portable J-pole antenna. He couldn't find a suitable structure, so he built one using PVC pipe ... and bungee cords, so that he wouldn't lose an important piece.

**More JCRAC Show-and-Tell on
pages 2 and 3**



SEPTEMBER MEETINGS

Sept 11 – TBA: But not at OPCC at the regular time. Watch Larry's List.

Sept 25 – TBA

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 for pizza buffet and an informal continuation/criticism/clarification of the topics raised at the meeting ... or anything else.

Leave the church, turn right (west) on 75th. Turn left (south) on Antioch. Turn right (west) on Santa Fe. Pizza Shoppe is just past the Sonic on your left.

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-> FEEDBACK <-

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Johnson County Radio Amateur Club, Inc.*

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* * *

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Personal Pioneering

The history of amateur radio--and all radio--is filled with stories of curious people who tinker. Virtually every ham knows that amateurs, who didn't know that frequencies above 1.5 MHz were useless for communication, invented HF. Eighty years ago, a ham developed single sideband. These pioneers advanced the state of the art.

This month, JCRAC provided a forum for its own tinkerers. Our handiest hams, of course, demonstrate their ingenuity at identifying and attacking problems large and small. Sometimes, we learned, success follows a series of setbacks. Sometimes success follows a suggestion from another, more experienced ham.

In connection with that theme, FEEDBACK used this space last month to challenge our "amateurs" to impress the club--not with technical expertise, but rather--with curiosity and the willingness to tackle something new. Bill McMillan, NØYUD took up the challenge. It may be that history fails to record that Bill's expereinces building a 80m half-watt Pierce oscillator CW transmitter constituted a pioneering advancement to the state of the art. The exercise was, however, a bit of personal pioneering that advanced the state of his self.



What have you done lately to advancethe state of your self?

-- Chip and Deb

PRESIDENT'S CORNER

Summer--and the list of public service events--is coming to an end. Take a look at Larry's List and select a couple of events to support. The sponsors appreciate your efforts and volunteering puts amateur radio in a good light.

Church activities prevent our use of the building on September 11. We may have a fox hunt. Listen to the club repeaters for details.

More Show and Tell



Inspiration struck **Eddy Paul, KYØF**, in a hardware store, when he realized that he could use a simple piece of hardware as a connector, which enabled him to finish a long forestalled antenna project.

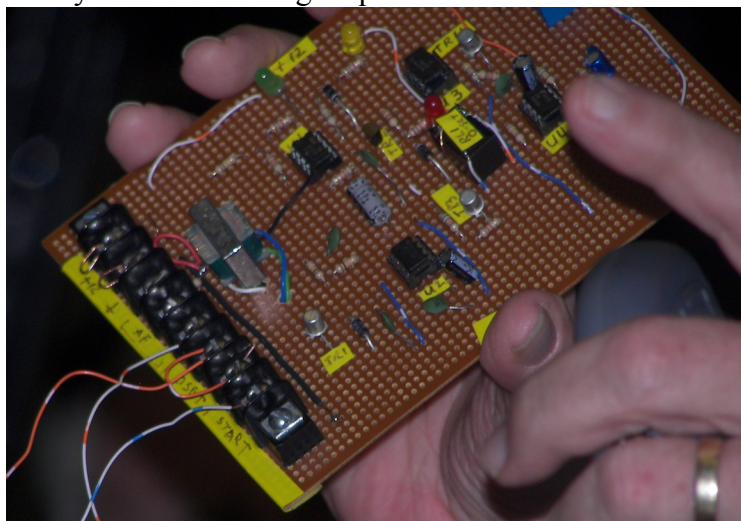


Aaron Boots, AAØRN watches **Ted Knapp, NØTEK** describe a cell phone app that enables the user to fill short periods of down-time during the day with Morse Code practice.

More JCRAC Show and Tell

John Raydo, KØIZ (right), who took great pains to keep turning his back to the photographer, began by showing the kind of professional results one can get putting lettering on project boxes using a laser printer, packing tape and lacquer. He then show the group a whole-house surge protector that could be found on eBay.

Jaimie Charlton, ADØAB (below), explained the concept of "feature creep". He started with a project designed to tell a ham which of several radios in a shack had last "spoken". The project grew to include a variety of timers and signal processors.



Tom Wheeler, NØGSG (below) brought several toys. He offered a variety of uses for an infrared camera, including the ability to test to see which components on a board were overheating. A less practical, but more amusing use was to photograph project presenters--in this case, Jaimie, ADØAB (right)--while they were speaking.



"Rod" Rodriguez, K6TBJ (right) showed an audio dish he had used in security and law enforcement work.



Johnson County Radio Amateurs Club - August 14, 2015 Meeting Minutes

Meeting Date: Friday August 14, 2015. The meeting Started at 7:30PM.

Attendance: Self introduction with name and call sign. 38 signed the check in sheet. This was followed by the Pledge of Allegiance.

The Minutes from the July 24, 2015 meeting were accepted with 1 opposed vote.

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

Cash on Hand	\$ 91.00	Repeater Op. Reserve	\$911.87
Checking Account	\$ 495.09	Memorial Fund	\$310.00
Savings Account	\$ 7,473.26		
Total	\$ 8,059.35	Active Members	137

Old Business:

- Ron Bozich, W0DXL became a SK on August 9. Ron was the individual that organized the Mexican Dinner for the last few Field Days.
- Repeater Update – All are working well with the exception of the 146.91 Fusion Repeater. The recent repairs did not entirely fix the issue. This Repeater is currently set up with a timer to periodically Re-boot it.
- Official Club Name Badges – Steve Romondo, W0MW owner of Sarco Engraving has offered to make Name Badges for the Club. Steve has made standardized Name Badges for several area Ham Clubs. Steve was able to take the Club's Logo and reproduce it on the Badge. After a sort discussion it was decided that the Badges would be Yellow with Black letters, have the Club's Logo with member's Call Sign and Name. The Badges are 1.7" x 3.5" and have a magnetic clip. The cost will be \$9 each delivered by Steve to a Club Meeting or for an additional \$3 mail to the individual. Details on how to order and pay will come later
- Ensor Auction – The dates for the Ensor Auction and activities is Friday and Saturday October 30 and 31. This is the weekend after the CQ Worldwide SSB DX Contest. More details to come later. Typically the Auction falls on the same weekend as the WW DX Contest.
- WW1USA – Upcoming Events are September 12-13 (organized by the Raytown Amateur Radio Club) and December 12-13 (organized by JCRAC).
- We are again currently looking for volunteer Ensor Tour Guides. Our Club needs to cover the Month of September. On Line Sign-up is available through Sign-Up-Genius. The link can be found on the Club's website

New Business:

- Due to the ongoing issues with this older model 146.91 Fusion Repeater, Harold "Van" Vandaveer, K0HCV has offered to purchase a new Fusion Repeater to replace it. See Van if you are interested in helping with the cost of this Repeater.

Reports:

- 6 m – NR.
- 10 m SSB Roundtable – 5 participated on August 13.
- 440 Wheat Shocker net – 21 check-ins on August 12 and 18 check-ins on August 5.
- 2m Wheat Shocker net – 25 check-ins on August 13 and 21 check-ins on August 6.
- HF Activity – Pirate stations D0A and D0B located somewhere in the Ukraine.

Announcements:

- Welcome to all the 1st time visitors.
- Summer Breeze Bike Event August 23. See Herb Fiddick NZ0F for details.
- 2015 Hawk 100 - 100 mile running around Clinton Lake September 12 and 13. See Bill Gery, KA2FNK.
- MS Ride September 19 & 20. See Herb Fiddick NZ0F for details.
- Bikers for Babies September 20.
- Watch Larry's List for upcoming events.

Business meeting adjourned at 8:17 PM

Program: The Program for this meeting was a "Project Show and Tell".

Submitted by Ted Knapp, N0TEK, Secretary

Johnson County Radio Amateurs Club - August 28, 2015 Meeting Minutes

Meeting Date: Friday August 28, 2015. The meeting Started at 7:30PM.

Attendance: Self introduction with name and call sign. 44 signed the check in sheet. This was followed by the Pledge of Allegiance.

The Minutes from the August 14, 2015 meeting were accepted with 1 opposed vote.

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

Cash on Hand	\$ 91.00	Repeater Operating Reserve	\$ 911.87
Checking Account	\$ 495.09	Memorial Fund	\$ 310.00
Savings Account	\$ 7,473.26	Active Members	137
Total	\$ 8,059.35		

Old Business:

- Repeater Update – All are working well including the 146.91 Fusion Repeater which periodically re-boots itself.
- Official Club Name Badges – Orders will be placed through Cal, KC0CL. Cost is \$9 each.
- Ensor Auction – The dates for the Ensor Auction and activities is Friday and Saturday October 30 and 31. Once again David Schulman, WD0ERU will be our Auctioneer and organizer of the donated items. David reported that there will be no online component of the Auction this year. Please start collection items for this year's auction.
- WW1USA – Upcoming Events are September 12-13 (organized by the Raytown Amateur Radio Club) and December 12-13 (organized by JCRAC).
- We are again currently looking for volunteer Ensor Tour Guides. Our Club needs to cover the Month of September. On Line Sign-up is available through Sign-Up-Genius. The link can be found on the Club's website

New Business:

- HF Mobile Shootout October 23. Lon Martin, K0WJ will be organizing this event. More details to come.
- Cal Lewandowski, KC0CL Treasurer reported the technology for reading and processing credit cards will be changing in October. In order to keep up with this technology and reduce the Club's liability with fraudulent charges, we will need to purchase a new credit card reading device. The device will cost \$150. A motion was made to purchase the device. After a short discussion a vote was taken and the motion passed unanimously.
- As an FYI, Herb Fiddick, NZ0F let the Club know that the Ararat Shrine Amateurs Radio Club might want to sell their mobile tower in case the Club was interested.
- Don, W0DEW will be organizing another campfire at Ensor on Saturday August 29.

Reports:

- 6 m – NR.
- 10 m SSB Roundtable – 8-10 participated on August 27 including 3 Mobiles.
- 440 Wheat Shocker net – 19 check-ins on August 26 and 23 check-ins on August 19.
- 2m Wheat Shocker net – 24 check-ins on August 27 and 20 check-ins on August 20.
- HF Activity – South Cook Islands on 20m.

Announcements:

- Welcome to all the 1st time visitors.
- Jay Burgherr, N0FB needs some help on August 30 putting up a Hexbeam Antenna.
- Summer Breeze Bike Event August 23. See Herb Fiddick NZ0F for details.
- 2015 Hawk 100 - 100 mile running around Clinton Lake September 12 and 13. See Bill Gery, KA2FNK.
- MS Ride September 19 & 20. See Herb Fiddick NZ0F for details.
- Bikers for Babies September 20.
- Skywarn Recognition Day is December 4 -5. The event starts at 7:00 pm on the 4th and ends at 7:00 pm on the 5th. See Bill Gery, KA2FNK for information.
- Watch Larry's List for upcoming events.

Business meeting adjourned at 8:07 PM

Program: The Program for this meeting was a presentation on the 3 different Antennas that were used during Field Day.

Submitted by Ted Knapp, N0TEK, Secretary.

JYE Tech DSO-138 Oscilloscope Kit - Tom Wheeler, NØGSG

Are you looking for an inexpensive, fun electronic build project--and do you need a small oscilloscope for your test bench? If the answer to either of these questions is "yes" you might consider the DSO-138 oscilloscope kit from JYE Tech (<http://www.jyetechnology.com>).

The DSO-138 is a tiny digital oscilloscope kit with a 2.4" color TFT LCD screen that runs about \$35. It's a bare board, with no case--you must provide the case and power supply.

For this price, you'll get a single-channel oscilloscope with about 150 kHz of useable bandwidth (the web site claims 200 kHz, but that's a stretch). The unit runs off a 9 volt power supply, which is not provided with the kit.

The kit is offered in two forms. The first is in the form of a totally bare PC board; there are several surface mount ICs and many chip resistors you'll have to install if you opt for this version. The second version, which I purchased, has all the surface mount parts pre-installed. This is the version I recommend, as it makes assembly much easier.

The kit includes the bare circuit board, both user and operating manuals, a 2.4" LCD panel, plus a rather large bag of parts.

The board is of good quality. As you can see in Figure 2 there are a lot of components to install, even with the surface mount pieces pre-installed, so it pays to take your time during the build.

Tips for Building the Kit

You can get into trouble quickly when constructing a kit of this type. The PC board is double-sided with



Figure 1: What's Inside

heavy ground plane coverage in most areas, so you'll need a good temperature-regulated soldering iron with a small tip (0.050" or less) to be successful.

Some general hints:

- You should use a magnifying lamp or other visual aid to assemble this kit. The parts are very tiny, and the solder joints are small. Make sure to inventory and identify all the parts

before starting. They come unsorted in a plastic bag. This is no Heathkit!

- The instructions recommend that you measure each resistor with an ohmmeter before installing it, and that is the only way of doing it. Even with a microscope, I couldn't accurately read the color bands on the 1/8 watt 1% parts supplied.

see OSCILLOSCOPE on page 7

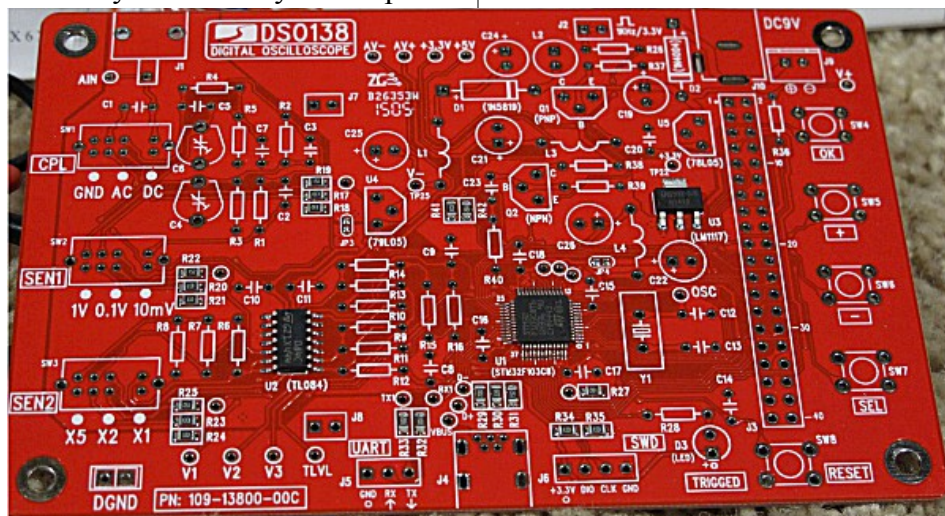


Figure 2: The Bare Board

from **OSCILLOSCOPE** on page 6

- Install all like parts in each step, and don't solder anything until you've confirmed the location of all the parts in that step. If you get a part in the wrong place, it's much easier to move it before you solder!

- Using a bench-top vise large enough to hold the board will make soldering much easier.

- The resistors will go slowly, but don't be discouraged. Take your time to avoid mistakes.

- Check your work and take frequent breaks. The average build time is probably 6 hours.

Performance

The unit pretty much performs as advertised. In Fig. 3 you can see the unit measuring a 2 kHz 6 volt peak-to-peak square wave from a signal generator. The displayed amplitude and frequency are spot-on, though there's quite a bit of jitter in the readings (which impacts the accuracy of the Vpp values shown), as well as residual system noise evident in the waveform. It did an equally good job on a 10 kHz square (showing usable bandwidth and flat frequency and phase characteristics out to at least 130 kHz), and even displayed a passable 50 kHz square wave (with a lot of rounding, of course).

Fig. 4 shows the unit reading out a 2 kHz sine wave. There's a fair amount of waveform distortion and glitches, but for \$35, you don't expect a Tektronix, do you? It's a very functional unit indeed.

There are several nice features:

- You can "freeze" waveforms for close inspection. The sample buffer is about three times the width of the LCD screen, and you can freely scroll through its contents.

- In real-time display, there's little

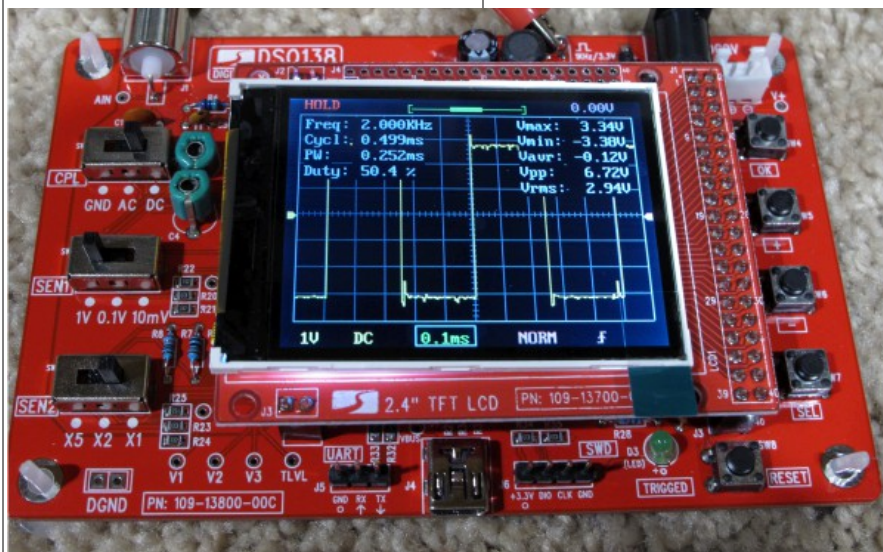


Figure 3: Completed Unit

visible flicker in the display. It's clear and sharp.

- The unit supports single-shot triggering, so you can use it to catch one-time events. - When using sweep rates slower than 50 ms per division, the unit switches to strip chart mode and provides a scrolling display. (You can select up to 500 seconds per division--that allows the unit to display up to 100 minutes of trace data. That's long enough to evaluate slowly changing phenomena, such as battery discharge curves.)

- There is a selectable on-screen readout for frequency, voltage, duty, and RMS voltage. The instrument calculates true RMS values for all waveforms. - The displayed values for voltage and time track the selector switches automatically, just as they should.

- Input frequency compensation is done with two trimmer capacitors. I didn't bother to adjust my unit. The frequency response was flat from DC up to 100 kHz or so. The unit can be used with standard 10:1 probes.

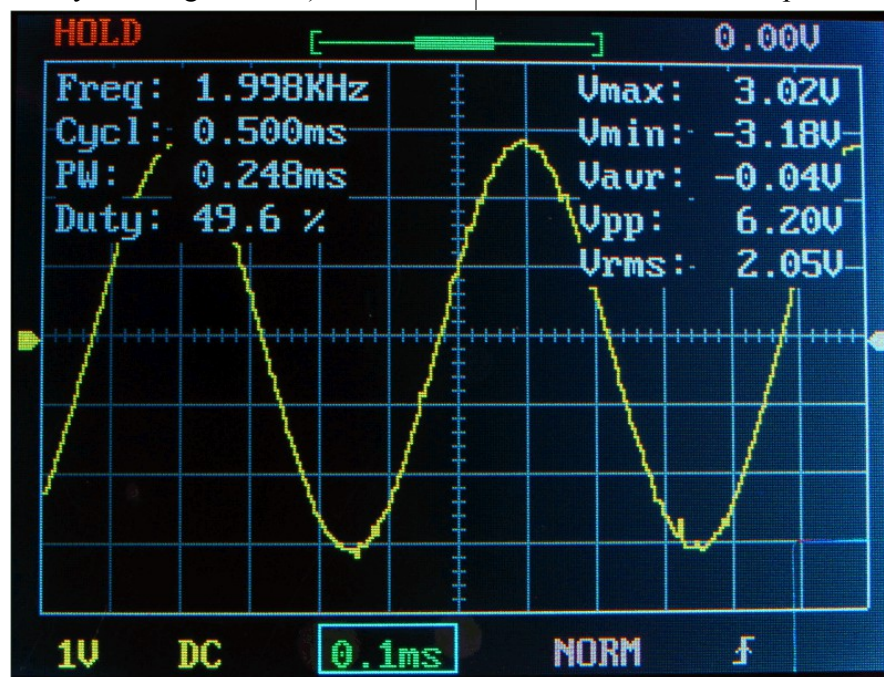


Figure 4: A 2 kHz, 6-v p-p sine

see **OSCILLOSCOPE** on page 10

A Hambone and Elmer Story

Hambone and the Underground Network - Jaimie Charlton, ADØAB

"How's that VHF repeater survey going?" asked Uncle Elmer when he saw his nephew, Hambone, come into his workshop.

"Pretty good Unck. It seems there are a lot of repeaters that get very little use while others are busy all the time. I really don't know why that is. But, I guess I do the same thing. I'm used to our local machines on two meters and 70 centimeters where I know almost everyone. I seldom tune anywhere else"

"Yeah, that's right, Hambone. I felt the same way when I first started using them. Now, I set my rig to scan other machines just to see what's happening. It's a good way to make new friends and it's a lot of fun, too. That radio over there is scanning now," added Elmer gesturing to the far corner of his workshop/ham shack.

"What's a lot of fun?" chimed in Dude, Hambone's younger and non-ham brother. "I'm always up for fun."

"We were just talking about Hambone's survey of local repeater use", explained Uncle Elmer. "He's found some interesting things."

"Yes, I have. Although most repeater operation and traffic is as you would expect, there are a few strange things out there.

"For example, there are a few guys who get on that Plaza repeater and chat for up to an hour, but never gie a call sign. Some days they nearly take it over, but other days they don't show up at all. I think they're all newbies because of the way they talk."

"There are a lot of brand new hams and nearly all of them start out with VHF/UHF handi-talkies," added Elmer.

"That might be what it is," mused Hambone. "I've tried to call them, but they never answer me. Shy, I guess. Oh wait, listen, that's one of them now!"

The two boys and their Uncle Elmer turned towards the scanner and listened to what sounded like a typical VHF repeater conversation. It began with two guys, each saying how clear the other's signal was and exclaiming how hot it was getting so early in the morning. They then went on about running some errands and, later, picking up the kids from school.

"That doesn't sound unusual to me," said Elmer turning back to his coffee. "They're just a couple of guys rag chewing on their drives to work."

"I'm not so sure," said Hambone. "That conversation sounds familiar. I'll be right back. I'm going to get my recordings."

"Of course it sounds familiar," added Dude. "Almost every ham talks like that on two meters. Wait! You've got recordings?"

"Yes, so I can do an accurate survey even while I'm at school. I've set up this recorder to record each QSO on this repeater because it's so busy.

Three sips of Elmer's coffee later, Hambone returned and wasted no time plugging his thumb driver into Elmer's super audio system. The voices boomed forth from the speakers. Only now the sound was much richer and life-like.

"Boy, everything sounds better through a high end audio system," exclaimed Hambone, grinning from ear to ear. "This is the QSO we just heard, now, here's one from the same guys two days ago."

"They sure do sound the same," added Dude.

"And here's one from last week," continued Hambone, "It's the same as the first two."

Realizing that something strange was going on, Elmer took the thumb drive and loaded the files into his Soundbooth audio editing system.

After a few minutes of looking at the brightly colored charts and graphs he announced, "These files are not just similar, they are almost identical. The voices are identical, not just word for word, but electrically cycle for cycle. But, there are two other tones mixed in. One appears to be steady at about 88 Hertz. That's probably the CTSS tone used to access the repeater. But the other is weird. It appears to be another CTSS tone at about 254 Hertz, but it's wavering, no, it's going on and off."

The boys and their uncle checked all of Hambone's files and found that they were the same except for the on-off sequences of the 254 Hertz tone.

"It's like they are playing recordings of QSOs rather than actually having QSOs," said Dude.

"In fact," added Hambone, "It could be only one guy trying to sound like two people having a QSO. But I don't see why, unless

see HAMBONE on page 9

from HAMBONE on page 8

he's testing something. Except for not identifying, I don't know if these guys are breaking any laws."

"I'm not so sure," said Elmer, I think there's more going on than meets the eye. I just sent an email with the files to my friend, Hal. He's both a ham and a detective and may know something about this."

"I have an idea!" exploded Dude, always one to overdo everything. "Let's pretend we are on a fox hunt and find who's making these transmissions. When we find them, we can tell them they need to identify properly. I'm sure they'd rather hear it from us than the FCC."

"That sounds like fun, but how can we fox hunt them when their signals are all coming through the repeater?" asked Hambone.

"We hunt them on the repeater's input frequency, DUH!" sighed Dude rolling his eyes.

"Yeah, you're right," admitted Hambone.

"I remember seeing an article written some time ago by Tim, one of our club's gurus, on building a fairly simple direction finder. I have always wanted to build it, but never needed one badly enough. I think now is the time."

"I remember that article, too. In fact, I tore it out and have been saving it right here on the wall," added Uncle Elmer. "Let's get started. You boys find the parts in my junk box while I go find another cup of coffee." Dude, who thought his uncle's junk box was more of a museum of stuff from radio's ancient days rather than a source of useful parts, was surprised to find all the needed components including the PIN diodes and integrated circuits.

The two boys worked together and quickly assembled a breadboard of Tim's direction finder. Just as they finished testing it—and Elmer finished his coffee—there was a loud knock on the shack door. It was Detective Hal.

Skipping the pleasantries, the detective started right in, "Elmer, how did you get these files?"

"Good morning to you, too, Hal. I didn't get the files, my nephew here, Hambone, did. He's doing a school project related to repeater usage and these files are part of his raw data. He has lots of files, but he thought that these seemed a bit strange so he brought them over here. I agreed with him and sent them to you. It appears that you have more than a passing interest in them, too. What might that be?"

Hal, somewhat flustered at his less-than-courteous entry continued, "It's nice to meet you Hambone, you have done some excellent work. These files will go a long way to helping us break a big case. Thanks for your help."

"C'mon Hal," chided Elmer, "We have more files that you can have if, you tell us what's going on."

"Well, okay. I guess it's no big secret since it's been in the news. You know there has been a series of bank robberies lately. These seem to be really well coordinated events. The robbers hit two, sometimes three, banks simultaneously. They take whatever cash they can quickly grab and escape. They wear masks and gloves, carry guns but never shoot. The only evidence we have so far is one getaway car that was abandoned. It had been stolen earlier so it wasn't much help. They pick banks in the same general area and synchronize their hits so the

police get so many alarms that, by the time we figure out what's going on, the robbers are long gone.

We never know what banks they will target, but we think they have some kind of underground radio network to coordinate their activities. We have been monitoring the citizen band, family mobile bands and even had the phone companies check their records for calls at the exact time of the robberies. None of these panned out. Until now.

The time stamps on your files exactly correspond to a couple of the robberies. Oh, and that 254 Hertz tone, that's their actual messaging in CW. The only thing we found in the abandoned car was one of those little CW readers. It all makes sense now. The fake voice QSOs are just to conceal the real message that's being sent in CW disguised as a CTSS tone. Now all we need to do is catch them doing it."

"That might be easier than you think," exclaimed Dude. "They are on the air right now and I can hear them on our new direction finder. Let's go!"

Before anyone could object, the boys took their newly-built direction finder outside, slapped the four little mag mount antennas on Elmer's van and placed the display on the dash. Elmer jumped behind the wheel and Hambone rode shotgun so he could operate the RDF. Hal and Dude were look-outs in the back.

Elmer drove as fast as he dared as Hambone gave often-conflicting directions.

"Can't you make up your mind, Hambone? First left, then right, I'm going all over the place."

see HAMBONE on page 10

<p>from Hambone on page 9</p> <p>“I’m doing the best I can, but the signal is reflecting off buildings and confusing the RDF. At least we’re past Corporate Woods so it should get better.”</p> <p>Meanwhile, Hal was informing his partner of their progress and a bevy of police cars was already following the van at a discrete distance. Since this involved bank robberies, there were a couple of black FBI SUVs in the pack, too.</p> <p>“When we find them,” informed Hal, “Don’t get very close, they were all armed in the last robbery. Just let my guys do their thing.”</p> <p>“No problem,” said Elmer. “It looks like they may be operating from a car in the Hardy’s parking lot on Metcalf. That’s a popular ham hangout so their antenna would not seem out of place. Only I don’t see anything that looks like a mobile antenna.” “I passed that info on and my guys are staying about half a mile back,” said Hal.</p> <p>“Let’s take another turn around the block, but don’t slow down. We’re</p>	<p>not exactly inconspicuous with those antennas all over this van.” Elmer turned left onto the street that runs behind Hardy’s and was about to turn right into the large parking lot directly behind the fast food restaurant when Dude burst out, “There he is!”</p> <p>“There’s two guys in that blue car with the short antenna on the roof and the 102 inch whip tied down on the driver’s side. It’s parked under that tree next to the drive-through lane. But I think we’ve been spotted. The driver looked right at me. Yes, he’s starting to move.”</p> <p>“I see them shouted Elmer.</p> <p>“I’ve got the car in sight,” said Hal as he relayed instructions to his colleagues over his iPhone. “Pull back and let our guys take him.”</p> <p>As Elmer was trying to do just that, the little blue car, trying to escape, skidded out of control and hit the van. An outsider would have seen Elmer expertly clip the car’s rear end, knocking it into a tree and thwarting the escape. To Elmer, it looked as though the blue car was</p>	<p>trying to disable his van. The driver and passenger jumped from the car. The driver headed for the back door of Hardy’s while the passenger sprinted across the parking lot towards the strip mall. But, Overland Park’s men in blue, and a few men in black, quickly caught and cuffed and stuffed the two into a police cruiser.</p> <p><i>Later that week...</i></p> <p>“On behalf of the Mayor and myself, I want to thank you, Elmer, Hambone and Dude, for your excellent work in helping us crack this very difficult case,” said the Overland Park Chief of Police using his most official voice for the TV cameras as the boys and a lot of bluebloods stood at attention in the Mayor’s office.</p> <p>“To show our appreciation,” added the Mayor, “I would like to present each of you with a key to our city.”</p> <p>With that, everybody shook hands, sipped punch, smiled a lot and said nice things to each other—and finally, left.</p>
<p>from OSCILLOSCOPE on 7</p> <ul style="list-style-type: none"> - The schematic and source code for the unit are provided. You can recompile the program code for the unit and truly make it your own. - The unit is pretty efficient. It draws only about 100 mA from a 9 volt supply, making it perfect for portable use. It's also fairly ham-proof; they even included a polarity-reversal protection diode in series with the DC input, a nice touch. There are a few issues as well: - There is a glitch or distortion in the displayed waveform that seems to be dependent upon the selected trigger level. This is a software 	<p>beast, so it's likely a bug in the implementation.</p> <ul style="list-style-type: none"> - The trigger circuitry is pretty iffy. It's really just a comparator driven by a D-A (PWM) output of the microcontroller, and you may need to fiddle with settings to get a clear view of waveforms. There's no knob to twiddle--you must adjust this from the menu, which really isn't too hard. An on-screen cursor shows the trigger level. Hardware hackers may want to add a manual knob and tweak the trigger circuitry--it's not too hard to do. - You will eventually break the 	<p>BNC connector off the board. (No, I did <u>not</u> break mine!) This is a mechanical weakness of the kit, and if you're going to put this thing to serious use, mount a BNC connector on a panel and go with that instead.</p> <p><i>Conclusion</i></p> <p>The DSO-138 is a neat little scope. It's too bad that JYE Tech doesn't sell a matching enclosure, because this is a great little unit with a lot of potential applications. If you've got the itch to build something and need a scope of this type, it's well worth the \$35 investment.</p>

Trying Something New

Making RF: The Michigan Mighty Mite - Bill McMillan, NØYUD

Several months ago I discovered the Solder Smoke podcast, hosted by Bill Meara N2CQR, and Pete Juliano N6QW.¹

For the past few months Bill and Pete have been urging podcast listeners to try their hand at building something. One of the projects they recommend for beginners is the Michigan Mighty Mite, a one transistor CW transmitter with only 7 parts. This transmitter uses the color burst crystal found in many older TV's which is conveniently ground for 3.57954mhz, a frequency right smack dab in the CW portion of the 80 meter band. I had never built a transmitter from scratch, so I thought I would give it a try and see what I might learn.²

Looking through my junk box I saw that I had everything I needed. Well, I did not have a 27 ohm resistor but I did have two 56 ohm resistors which I connected in parallel to give me 28 ohms. I built the circuit on a piece of perf board and wound the tank coil on an old 35mm film canister. I also decided to use sockets for the crystal and the coil so that I could change bands in the future. Terminal connectors provided attachments for the power, key and antenna, and I was ready to see what sort of signal the MMM produced.

I hooked up power and a key, then connected L2 to a

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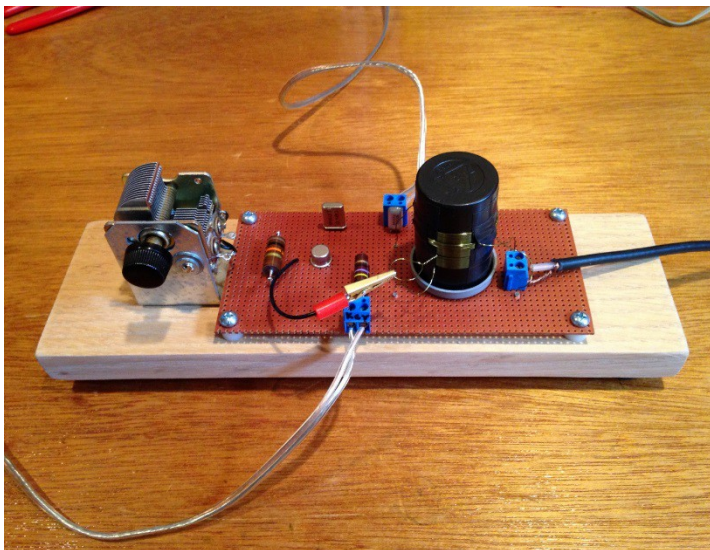


Figure 2: The Michigan Mighty Mite

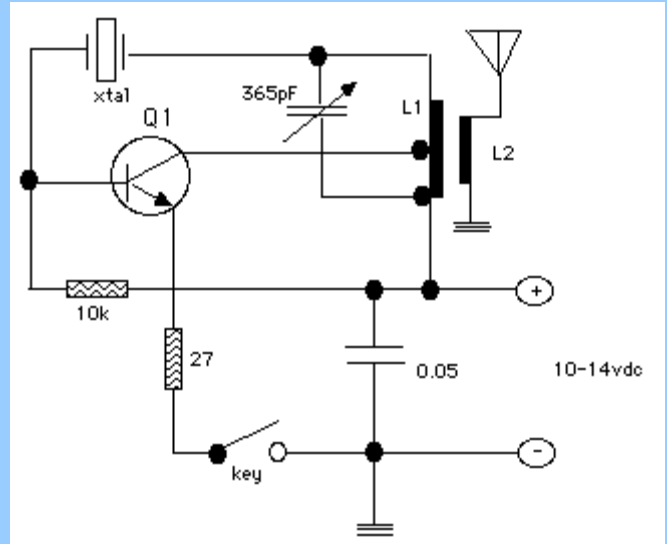


Figure 1: Schematic

XTAL: I used a color burst crystal but you can use any crystal in the CW portion of the 80 meter band.

Q1: Use a 2n2219, 2n2222a, or 2n3053 transistor. (Others may work, try any NPN transistor you have laying around.) I suggest using a TO-39 metal can style transistor because this gets hot. You may want to use a heat sink.

365pF: This is an air variable capacitor for tuning the circuit. If you don't have one you can place several capacitors in parallel until you are around 150 to 200pF.

10k: A 10k ohm resistor. You can use a normal 1/4 watt or whatever you have.

27: A 27 ohm resistor. You might have to chain a few 10 ohm resistors together since this is not a common value. This resistor should be rated for 2 watts.

.05: This is a .05uF capacitor which is a common value.

L1/L2: This is the tank coil. L1 is the primary consisting of 45 turns of enamel coated magnet wire with a tap at 15 turns from the bottom to go to the collector on Q1. L2 is the secondary with 6 turns placed directly on top of the primary windings.

More detailed information about the construction and options to make modifications for 160, 80, 40 or 30 meters appears at: http://makerf.com/posts/mighty_simple_shortwave_transmitter

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dummy load and tuned a nearby receiver to 3.58mhz. When I hit the key I was rewarded with a very clean sounding CW signal. Nice job Bill, you have created RF!

Next I decided to hook up my scope to see if the signal was as clean as it sounded. While keeping the dummy load connected, I placed my scope probe on the output of L2. I was expecting a perfect sine wave but Figure 3 shows what appeared on the scope.

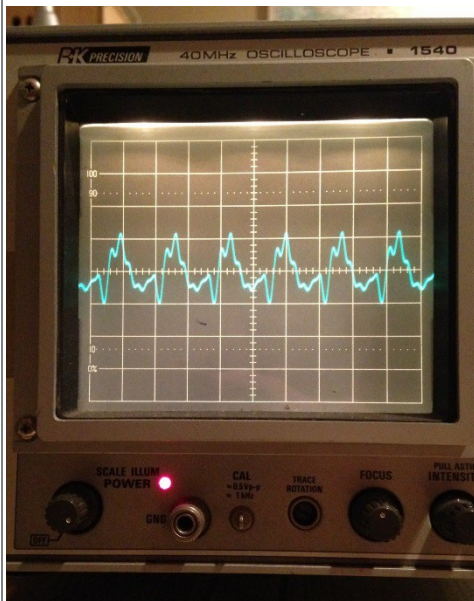


Figure 3: Squiggly lines!

What are all the extra squiggly lines? Is that what harmonics look like? It seems my Michigan Mighty Mite was producing more signals than I had bargained for!

Perfect! More learning opportunities. I had never built a low pass filter. Now I had my chance. Not really knowing what I was doing, I decided to use a simple Chebyshev filter, mostly because it looked fairly easy to build. I used an online calculator and figured if I pass everything below 7mhz I should be OK. Figure 4 shows the schematic.

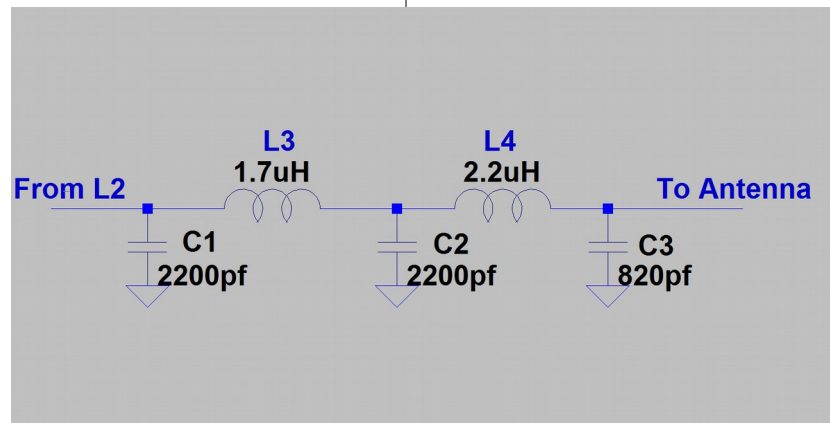


Figure 4: A low pass filter

I had some unknown toroid cores from another board. and, through trial and error, wound one for 1.7uH and the other for 2.2 uH. These were connected in series with two 2200pf and one 820pf capacitors going to ground and I had my low pass filter. You want to insert the filter between the output on L2 of the transmitter and the antenna. Figure 5 shows the filter added to the right side of the board.

was also a learning opportunity as I had never directly measured power output before. Apparently there are a couple of methods for determining power. I could use the scope to estimate voltage peak to peak, or I could use an RF probe and my multi-meter to directly measure the output voltage. I will let you investigate both methods on your own, but I did learn a nifty trick from Pete N6QW. If you take the voltage peak to peak and square

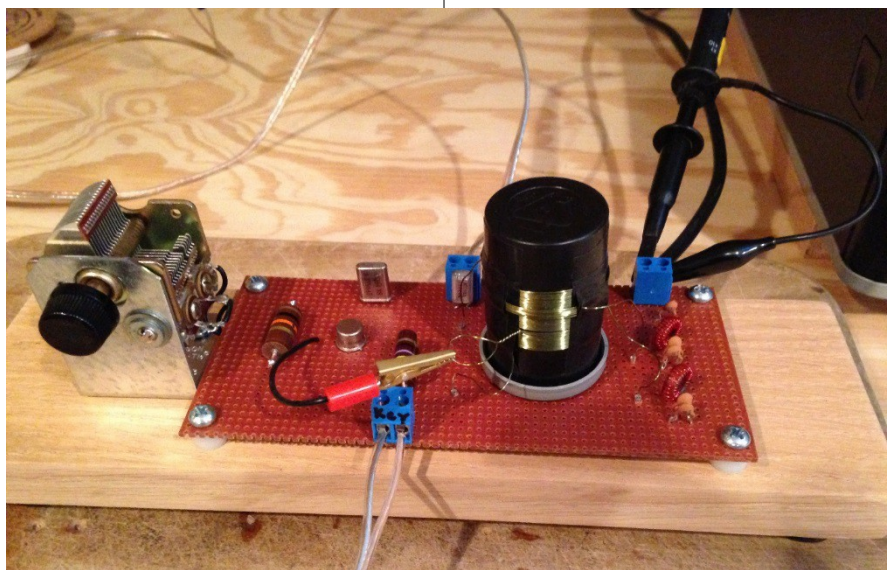


Figure 5: With the filter

After attaching the scope again I was rewarded, in Figure 6, with a very fine looking signal. Harmonics tamed!

Now that I had a respectable signal, I was curious to see how much power I was putting out. This, too,

it and then divide the result by 400 you will get a pretty good estimate of power output. In my case this worked out to about .45 watts. Not bad for one transistor.

*You have to know the resistance to
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You have to know the resistance to get the true power output. Ohm's law says $P=V^2/R$. Substituting peak-to-peak voltage, that becomes $P=V_{pp}^2/8RL$. The "pretty good estimate" in the text assumes a 50 ohm ($8 \times 50 = 400$) load.. -- TW

This was a great learning project. I don't know if I really understand the circuit. Is it an oscillator? Is it an amplifier? Is it an amplifier that oscillates? Maybe a little of all three.

This looks like a Pierce oscillator because the feedback is through the crystal from the oscillator and base.--JC This and other oscillators are amplifiers with positive feedback at a frequency greater or less than DC (0 Hz).--TW

I learned about tank circuits, low pass filters, measuring RF and how to recognize harmonics on my scope. I still have questions. Is it possible to add a mixer and modulate the signal? Where would I insert the modulated input?

It is possible to add a modulator, such as an old carbon microphone, by placing it in series with the (+) battery lead. The result would be an AM transmitter--JC

A mixer could be added after the stage to amplitude-modulate the signal. The mixer would be considered a "modulator" circuit, and at low levels (below 100 mW or so), any number of circuits would work. Additional amplification might be needed to compensate for loss in a passive (diode) mixer. Modulating the power supply voltage (like with a carbon microphone as Jaimie described) will definitely amplitude-modulate the output, whith the drawback of also generating a small amount of frequency modulation that most AM receivers will simply ignore as long as the FM modulation index was kept small ($mf < 0.25$)--TW

Why does this circuit generate harmonics?

The circuit is not linear because the base is being overdriven and the crystal may be operating in more than one mode. Pierce oscillators are brutal that way. Other oscillators, however, use more parts.--JC

*All amplifier circuits generate harmonics to some extent. Amplifiers that are being driven in large-signal mode, such as power oscillators, tend to flatten the top and bottom of waveforms, which results in harmonic output. The amplifier in Bill's circuit is biased pretty hard. If Beta DC is 100, and $V_{cc} = 14 V$, then $I_c(q)$, the quiescent collector current, could be expected to be in the neighborhood of 90 to 100 mA. This is an off-the-cuff guess based on $I_b = (V_{cc}-V_e-V_{be})/R_b$ and $I_c = I_b * \text{BetaDC}$. The transistor probably gets fairly warm, as it will dissipate $I_c(q) * (V_c - V_e)$ or $\sim 100 \text{ mA} * (14 V - 3.5 V)$ or $\sim 1.05 W$.--TW*

Where did those harmonics go when I added the low pass filter?

The harmonics are blocked by the filter because it presents a much higher impedance to them than it does to the desired signal. Filters block some of the desired signal, too.--JC

The power output dropped slightly after adding the filter...why is that?

Before interting the filter, the total power output was desired signal plus harmonics. When the filter blocked the harmonics, the harmonics no longer contributed to the total power output.--JC

Questions are good because one of the things I like best about ham radio is the opportunity to keep learning.

1. <http://soldersmoke.blogspot.com> or, for the podcast on iTunes, <https://itunes.apple.com/us/podcast/solder-smoke-podcasts/id160184385?mt=2>

2. FEEDBACK asked if it could refer the project to some more experienced RF engineers for their review comment. The author and regular FEEDBACK contributors **Tom Wheeler**, **NØSGS** and **Jaimie Charlton**, **ADØAB** all consented. Tom's and Jaimie's comments are italicized and interspersed within the main text.

Last Thoughts on the MMM ...

This circuit has been kicking around for some time. Its longevity is most likely due to its simplicity, due to the omission some parts that would improve its waveform. On the other hand, if one properly chooses the crystal frequency, the harmonic-rich waveform lets one transmit on more than one band at the same time. A possible advantage in contesting!-JC

The circuit lacks an effective total loading capacitance for the crystal. There should be a 5 to 10 pF capacitor from the transistor base to ground. In this application, parasitic (stray) capacitance in the circuit is likely serving as a portion of the loading capacitance, which for hand-built circuits will produce large unit-to-unit variations in performance.-TW

An interesting side note is that, without the components Tom mentions, this circuit actually oscillates slightly below the crystal frequency due to the fact it must appear slightly inductive to resonate with the stray capacitances of the circuit. But, a big advantage of the channelized marine radios of 50 years ago is that you only had to change crystals to change frequencies, no other tuning of the oscillator was necessary.

The circuit's greatest value, as the author said, is as a learning experience. We all started learning this stuff someplace and ultra simple is a good way to go.--JC

SEPTEMBER CALENDAR

SUN	MON-TUE-WED-THU	FRIDAY	SATURDAY
<p>Ensor Park & Museum open 13:00 - 17:00 Saturdays and Sundays - 18995 W. 183rd St., Olathe, KS</p>	<p>1-2-3</p>	<p>4</p> <p>Santa-Cali-Gon Days - Richard Tingey, KC0MCW - 816-806- 2938 - kd0mcw@yahoo.com http://independence.mo.read ytohelp.org/index.php/scg- events http://www.santacaligon.com /</p>	<p>5</p> <p>Santa-Cali-Gon Days</p>
<p>6</p> <p>Santa-Cali-Gon Days</p>	<p>7 -8-9-10</p> <p>Bike for the Brain (Shawnee/Downtown KC) Brian Short, KC0BS - <kc0bs@arrl.net> - 913-638- 7373</p> <p>Santa-Cali-Gon Days</p>	<p>11</p>	<p>12</p> <p>2015 Hawk 100 (see 9/13) Olathe Medical Center Women's Triathlon & Duathlon, Kill Creek Park, Olathe, KS - Mike Bellinger, K0UAA - 816-363-1118 - <mbbellinger@aol.com> WW1USA (see 9/13) @9:00 W5YI Testing Independence EOC 950 N Spring Street Norma Libby, WØKC - (816)353-8408 (816) 536-0469 normalibby@sbcglobal.net</p>
<p>13</p> <p>2015 Hawk 100 - 100 mile running around Clinton Lake Bill Gery, KA2FNK - 913-575- 3763 - ka2fnk@gmail.com</p> <p>WW1USA - The WW1 Museum and Memorial http://www.signupgenius.co m/go/10c044daeab2da2f49- ww1usa3</p>	<p>14-15-16-17</p> <p>15 @ 19:00 VE Testing - Raytown ARC -- Community of Christ -- 63rd and Manning - Steve Lufcy, KØOU - 816-353- 6705 - k0ou@comcast.net</p>	<p>18</p>	<p>19</p> <p>MS-RIDE (Olathe to Lawrence and back) Herb Fiddick, NZ0F - 913- 744-0586) - <hfiddick@gmail.com> @ 09:00 VE Testing -- Johnson Co. Library, 151st & Antioch -- Jim Lee, NØKCB - 913-745- 5121 - jimlee@kc.rr.com HamClass.org (Part 2) American Red Cross Midtown www.hamclass.org</p>
<p>20</p> <p>Bikers for Babies http://www.bikersforbabiesk c.org/aboutride - Matt May, KC4WCG - 913-384-6549 - matthewmay@kc.surewest.ne t MS-RIDE (Olathe to Lawrence and back) - Herb Fiddick, NZ0F - 913-744-0586)</p>			<p>26</p> <p>@09:00 W5YI Testing - Mid- Continent Library, 850 NW Hunter Drive, Blue Springs, MO. - Jim Arnold, NØSAK - 816-229-3209 - arnold- j@swbell.net</p>