JOHNSON COUNTY RADIO AMATEURS CLUB, INC.
P.O. Box 93
Shawnee Mission, KS 66201

FEEDBACK

MARCH 2016

The JCRAC was well represented at the WW1USA commemoration of the Battle of Verdun.

Bill Brinker, WAØCBW explains "SWR and other Mysteries".

The success of inter-club cooperation with WW1USA led to the establishment of the MO-KAN Council of Clubs--shown at its first meeting, above left and right--to co-ordinate activities in the metro area.

Kathy Carter, RJ Wheeler and Steve Carter visited the club the night before taking their license exams

Coloradans Aldis Strautins, NØTFJ and John Raydo, NØIZ (decidedly NOT a first timer) visited the club

MARCH MEETINGS

***March 11** – Military Auxiliary Radio System (MARS) - Kent Dickinson, KØWEW*

***March 25** – Remote Operations - John Raydo, NØIZ*

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 <-

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

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Member Profiles

Deb Buckner, KDØRYE, has decided that the club is full of interesting people that she wants to get to know. So, she has decided to do just that. This issue of the FEEDBACK contains the first of what she terms a "regular" (she's not quite ready to commit to "monthly") feature on JCRAC club members.

For the first several installments, she has indicated that she wants to explore why and what about radio interests the other women in the club. Turn to page 11 to read about our "egg lady".

A Field Day "Try It" Table?

The club's Field Day site, near the observation tower at Shawnee Mission Park, draws many passers-by. Some stop and look. Some of the stopper/lookers ask questions.

Might we establish a "try it" table that offers casual visitors a low-commitment way to get their hands on some of the trappings of our hobby?

The CW people always have visitors. How about a key, a code practice oscillator and a Morse Code chart where visitors may tap out their names? A second station might have a device that sends a 5 WPM code greeting that visitors, armed with a pencil, paper and another Morse Code chart attempt to decode. A time-difference-of-arrival radio direction finding unit and a couple of foxes? An HT connected to a coat-hangar ground plane antenna might impress visitors with the possibility of low-cost entry to the hobby.

We're pretty good with "this is cool". What else can we do to impress people with "I could do this"?

PRESIDENT'S CORNER

The Club's 145.29 repeater is now a year old and performing great. The investment as well as the matching funds from persons unknown has proven to be a good decision. The repeater does not have any of the heat issues that plagued the old repeater during the summer months.

Thanks to all club members that volunteered at Ensor as tour guides. The Club received a nice check from Olathe Parks. Volunteering as a guide is really easy on a Saturday or Sunday for a couple of hours.

Event planning for 2016 is underway. Thanks to club members that put in extra time to make WW1USA special events, shootouts, Field Day, auction and Ensor camp fires a success. When you can, please assist these coordinators with their events.

Also please remember the public service events as listed on Larry's List. Each year there are more events that are reaching out to the amateur radio community for assistance.

– Bill Gery – WA2FNK

Johnson County Radio Amateurs Club - February 12, 2016

Attendance: Self introduction with name and call sign. 36 signed the check in sheet. This was followed by the Pledge of Allegiance.

The Minutes from the January 22, 2016 were accepted with 1 opposed vote.

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

Cash on Hand	$ 123.35	Repeater Operating Reserve	$ 701.44
Checking Account	$ 314.50	Memorial Fund	$ 310.00
Savings Account	$ 9,878.94		
Total	$ 10,316.79	Active Members: 147	

City of Olathe (Volunteering at Ensor) $720.00

CarMax Foundation (Nick Atkins KD0VXJ) $160.00

Amazon Smile Program $12.11

Old Business:

- Repeater Update – All Repeaters are working well.
- WW1USA – The Club is Sponsoring the May 7 – 8 Event at Liberty Memorial and Museum. This event will take place outside.
- Field Day 2016 – June 25-26 at the Observation Tower in Shawnee Mission Park. To gain additional point Aaron Boots, AA0RN will set up and manage a Facebook (social media) account.
- Harry Wilson, KA0JLN has asked for the Club's help in selling some of his Ham Radio equipment. After a short discussion a Motion was made to help Harry sell his equipment by First, offering to sell the equipment to any Club member. Second, putting unsold equipment on Larry's List (Eddy Paul, KY0F offered to help). And third, take remaining equipment to the Club's Auction in the Fall and not charge Harry consignment fee. The Motion was seconded and a unanimous vote followed.

New Business:

- We recently received our first Amazon Smile check for $12.11. AmazonSmile is a website operated by Amazon that lets customers enjoy the same wide selection of products, low prices, and convenient shopping features as on Amazon.com. The difference is that when customers shop on AmazonSmile (smile.amazon.com), the AmazonSmile Foundation will donate 0.5% of the price of eligible purchases to the charitable organizations selected by customers.
- Rod Rodriguez, K6TBJ has Ararat Shrine Hambash tickets for sale at a discounted price.

Reports:

- 6 m – NR.
- 10 m SSB Roundtable – NR.
- 440 Wheat Shocker net – 17 participated on February 10 and 17 participated on February 3.
- 2m Wheat Shocker net – 23 participated on February 11 and 18 participated on February 4.
- HF Activity – India on 40m, DXpedition to Lesotho 7P8C, and South Georgia.

Announcements:

- Welcome to all the 1st time visitors.
- Brian Short, KC0BS gave a short description of TV25 with some new programs that will start in the Spring.
- Ham 101 Class Saturday March 19 Smithville Fire Station.
- Hamclass.org will hold a Technician Class on Feb. 20 and 27. See Hamclass.org for details.
- Watch Larry's List for upcoming events.

Business meeting adjourned at 8:01 PM

Program: The Program for this meeting was presentation on Gonset Gear by Dennis Baker, KEØQM.

Johnson County Radio Amateurs Club - February 26, 2016

Attendance: Self introduction with name and call sign. 60 signed the check in sheet. This was followed by the Pledge of Allegiance.

The Minutes from the February 26, 2016 were accepted with 1 opposed vote.

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

Cash on Hand	$ 147.35	Repeater Operating Reserve	$ 722.44
Checking Account	$ 464.42	Memorial Fund	$ 310.00
Savings Account	$ 9,878.94		
Total	$ 10,490.17	Active Members: 154	

Old Business:

- Repeater Update – All Repeaters are working well.
- WW1USA – The Club is Sponsoring the May 7 – 8 Event at Liberty Memorial and Museum. This event will take place outside.
- Field Day 2016 – June 25-26 at the Observation Tower in Shawnee Mission Park. Looking for someone to coordinate the dinner on Saturday. Also looking to see if anyone wants to set up a solar/experimental Station.
- Rod Rodriguez, K6TBJ has Ararat Shrine Hambash tickets for sale at a discounted price.

New Business:

- Brian Short, KC0BS suggested that we have a "Bring a Friend to the Meeting" night. More information to follow.

Reports:

- 6 m – NR.
- 10 m SSB Roundtable – NR.
- 440 Wheat Shocker net – 22 participated on February 24 and 19 participated on February 17.
- 2m Wheat Shocker net – 22 participated on February 25 and 19 participated on February 18.
- HF Activity – Antarctica and Poland on 40m CW. John Raydo, K0IZ and John Morse, N0EI reported making several interesting DX contacts.

Announcements:

- Welcome to all the 1st time visitors.
- Johnson County ARES SAR Drill Monday March 14.
- Ham 101 Class Saturday March 19 Smithville Fire Station.
- Watch Larry's List for upcoming events.

Business meeting adjourned at 8:02 PM

Program: The Program for this meeting was presentation on SWR and other Mysteries by Bill Brinker, WA0CBW.

Hambone Goes HF--or Dude Saves the Day -- *Jaimie Charlton, AD0AB*

It's a crisp, snowy February morning when we find Hambone and his uncle Elmer standing in the driveway and sipping mugs of steaming chocolate as they study the new SSB transceiver in the trunk of Hambone's car.

"Well, your installation looks pretty good," observed Elmer. "You did a great job mounting the remote operating head on the dash, it looks very professional. Your cabling looks good, too."

"Thanks, Unck, it may look good, but it doesn't work good. I think the receiver is okay, but when I transmit the car lights dim and I get sort of a buzzing noise on my signal.

A guy at the club said that it might be some sort of RF feedback. He said that RF getting into the car's electrical system can cause all sorts of funny stuff."

"Maybe, but it sounds like you might have a weak battery, did you check it?"

"Yeah, I took the car over to Sears and they checked out the battery, alternator and charger and said it was all okay."

"Hmm, well, let's have a look at your antenna. I see you have grounded your coax properly and putting that little auto tuner right at the base of the whip is a great idea."

"Yeah, you know that guy, Dill, who comes to the breakfast clubs? That's the way his is and it works great. So, I copied it–whip, tuner, everything.

I also bonded the major parts of the car together to form a better ground plane. I remember what you said about HF mobile installations needing all the help they can get," added Hambone.

"Oh, so you were listening after all," chided Elmer. "Since your antenna and coax shielding all seems to be good, let's look at the power supply.

I see your radio is also grounded through the coax shield to the car body.

Does your car's negative battery terminal connect directly to the chassis or, is there something like a current sensing resistor between the terminal and the car body?" Not waiting for an answer, Elmer drifted into his lecture mode and continued.

"If the car's electrical system has a current sensor in the negative battery lead, you have shorted it out through the coax shield and that will cause some strange behavior in the car's electrical systems."

"I checked that," said Hambone. "This car's fifteen years old and doesn't have any fancy stuff like that. Its high-tech accessory is a cassette player.

I did put fuses at both ends of the power wires, I hope they aren't causing the problem."

"No, they aren't. Fuses are always essential to prevent fires when you wire directly to the battery terminals. Be sure they are sized to protect the wire. The radio has its own fuses.

I still think the problem is related to power," added Elmer. "Go and get your multimeter and your Power Pole splitter and let's see what's happening. Oh, and while you're at it, grab my portable short wave receiver and some more hot chocolate. Mine's gone cold."

Following his uncle's instructions, Hambone quickly returned with the items. He connected the splitter between the power wires and his radio. He then connected his meter, set for DC volts, directly to the splitter's free terminals. It read twelve volts.

"Well," observed, Elmer, "that's the right voltage, now turn the radio on."

When Hambone did so, the speaker came alive with noise and voices. The meter flickered slightly, but the reading remained at twelve volts.

"It sounds like the receiver and antenna are working fine and the voltage is still right on the money. Now key the transmitter and speak into the mike," said Elmer as he tuned the portable radio to the transmitter's frequency.

"Stop! Stop!" shouted Elmer as a loud buzz with overtones of Hambone's voice blasted from the shortwave radio's speaker. "I see what you mean about the buzz. It's not voice with a little buzz, it's buzz with a little voice. That is definitely not good."

"That's what the guy told me. I did notice if I turned the power way down to say 10-15 watts, the problem seems to go away. That's why I thought it was RF related."

"There you go thinking again, you thought wrong. While you were making all that noise, I watched the voltage at your radio and it dropped down to 11 volts. That is the problem," stated Elmer as he took a long slurp of his hot chocolate.

"I guess that makes sense," said Hambone. "It still buzzes when the engine is running, but I can run higher power before it does. But I still can't run the full one-hundred watts."

see HAMBONE on page 6

from HAMBONE on page 5

"I see you've run #12 wire directly from your battery to the radio in the trunk."

"Yeah, Unck, I used a wire table and picked wire size rated at thirty amps. The radio only draws about twenty amps peak, so I wanted to be safe."

"True, thirty amps is the wire table ampacity, but that's based on safety considerations like temperature rise and insulation type, not voltage drop which is of interest to us.

From the looks of that slack you have coiled up here, I bet you have about twenty-five feet of cable between your transceiver and the battery."

"Twenty-seven feet," added Hambone.

"Because you're going from the battery to the trunk and back, you have a total of fifty-four feet of #12 wire in series with your transceiver. According to the wire table, that amounts to about 0.08 ohms or resistance.

Ohm's law says that resistance will give you around 1.6 volts drop when you draw 20 amps on voice peaks. Add that to whatever drop you get from your battery and you are well below the operating voltage of the transceiver. That's why it's not working properly. You're starving it!"

"Sh**t Unck, that doesn't sound good."

"It isn't, but it's about as good as you're going to get. Even if you put in really big wire, you would still have the battery drop."

"A lot of guys with higher power mobile installations put bigger batteries and alternators in their cars. Some install an extra battery and alternator just for their radio equipment."

"That sounds expensive," moaned Hambone. "It took nearly all my money just to buy this used rig. There's no way I can buy a bigger alternator and battery."

"I've never used one, but there's a thing called a battery booster or something like that. It's sort of a regulated switching power supply that steps low battery voltage up to 13.8 volts. It's intended for this kind of problem. I think they cost something over $150."

"That's still too much for me."

"Well," mused Elmer. "You might grab that snow shovel and see if any of the neighbors will pay you to shovel their driveways. The exercise might even do you some good."

Elmer's last words were lost in the body-thumping sounds emanating from the rusty old car that slid into the driveway.

"Hi guys, what's happenin? How about my awesome new six-hundred watt car kicker!" announced Joey.

Dude and his pal Joey had arrived.

Joey, about Hambone's age, embodied everything Elmer disliked. A high school drop out with long red hair tied back in a ratty man bun, Joey wandered around town working a variety of part-time unskilled jobs. Yet, he always seemed to have enough money to buy the occasional cool gadget and support his fugitive-from-the-bone-yard car that he aptly named 'Rusty'. Joey's mastery of the latest colorful language was unparalleled. Dude, not yet having convinced his parents to buy him a car, enjoyed hanging and riding around with Joey. Joey's charming personality and quick smile and the fact that both Hambone and Dude liked him irked Elmer even more.

"Hi Joey," greeted Hambone. "Rusty sounds awesome. I'm feeling the beat way over here."

"Hi Mister Elmer," said Joey, continuing, "Yeah Hammy, I'm totally down with that boomer. Would you believe I found it all broken up at that weekend flea market? My main man, Dude, here, helped me bring it back to life and now it's totally awesome.

"Dude, fist bump!"

"That's wonderful," mumbled Elmer turning back to Hambone's mobile transmitter.

"What are you guys doing out here in the cold?" asked Dude who noticed his uncle's less than enthusiastic response to Joey's greeting.

"My new mobile rig's got issues," moaned Hambone. "Every time I try to transmit at one-hundred watts the car lights dim and the audio gets all buzzy. Unck says that the car's power is too weak. The best fix would be a bigger alternator and battery. Or maybe a battery booster might work. But, I can't afford either of those."

"That sounds like Rusty's problem, before Dude fixed it," said Joey, as he hitched his pants down to half-mast. "Whenever I tried to play my new Def Lep tunes ol' Rusty here sort of caved in on those awesome beats. But not now."

With that Joey hit a switch and Def Leppard's 'Dangerous' burst forth with skull-crushing volume.

"Awesome! You da man, Dude! Fist bump!"

"Okay, Dude, what did you do?" asked Elmer. "I know there's no new alternator and battery in that pile of… er, Rusty."

"Simple, I just ran heavy wire directly from the battery to the trunk where the six-hundred watt amp and speakers are. That made a really good connection."

"Yeah, yeah, I did that too, so I know that's not enough. What else did you do?" said Hambone.

"Simple, Bro, I put a five farad capacitor directly across the amp's power terminals."

see HAMBONE on page 7

from HAMBONE on page 6

"Sure you did," said Hambone, with a sarcastic tone in his voice. "A five mic cap wouldn't do anything."

"Bro, I said a five *farad* capacitor. It supplies that extra current to give that awesome kick without caving."

"Let's see that cap, it must be enormous and where did you get it?"

"It's right there, that sub-sandwiched-sized chrome thing with the blue LEDs showing how charged up it is. Joey got it from a bud at the car stereo store for about fifty bucks. That's a whole lot cheaper than whatever you and Unck were talking about.

You gotta get out of your shack more and check out the car music scene. They have all kinds of cool stuff," said Dude with a grin.

"Unck," said Hambone, "How can that work and would it work for me?"

"It works because music is mostly low power with the occasional high peak. Under normal conditions, the battery supplies all the current that his amp needs because it's putting out much less than 600 watts. But when a big thump comes along and the full 600 watts is needed, the capacitor supplies the additional current. And a five farad capacitor can supply a lot of current," explained Elmer.

"I think it would solve your problem. Let's say that on the average your transmitter draws only eight amps, but you hit voice peaks of 20 amps. Even though they only last about 50 milliseconds, it's those peaks that give you the distortion. Let's calculate how much a capacitor will help.

With the engine running, you get 13 volts at the transceiver. But when you hit a voice peak the voltage drops below 12 volts and you are in trouble. Look, here's how it works out," said Elmer as he produced his ubiquitous yellow pad and #2 pencil.

Oh no, Unck, it's too cold for all that. I agree it somehow works," moaned Hambone. "Besides, your pencil will freeze and not write."

"Don't worry, Hambone, the pencil won't freeze and a little thinking will warm you up.

Remember that the capacitor stores energy in an electric field by accumulating electrons. How much charge it has accumulated is shown in the blue LED voltage display. When that voltage is the same as your supply voltage, the capacitor is fully charged. We use the unit called a coulomb when measuring charge because the charge on an electron is so small, it doesn't amount to a fart in a whirlwind."

"I think I've heard of that before, in physics..."

"Probably, it takes 6,240,000,000,000,000,000 electrons to equal one coulomb."

"That's a lot of electrons," said Joey chiming in.

"Not that many," continued Elmer. One amp of current flowing for one second will give you that many.

Here's how it works out with a 5f cap and 13 volts from the car battery:"

$$Q = CxV = 5\,farads \times 13 volts = 65$$

Columbs

Q = coulombs stored in the capacitor

C = capacitance in farads

V = volts across the capacitor terminals and displayed by the blue LEDs

Seeing an opportunity to one-up his older brother, Dude interrupted, "It's simple, Hammy. Like Unck said, one amp for one second equals one coulomb. Using that formula and putting in 20 amps for the peak current and 50 milliseconds for the length of time the capacitor has to supply that current, we can find how many coulombs the capacitor has to give up to keep the transmitter going. Look here:"

$$Q = I \times T$$

$$Q_{Decrease} = 20 amps \times 50 ms = 1$$

coulomb

Since the capacitor has to give up one coulomb to supply the transmitter with 20 amps for 50 milliseconds, that means it has 64 coulombs left in it. Reworking Unck's formula, we can find the voltage left on the capacitor, like this:"

$$V = \frac{Q}{C} = \frac{64 coulombs}{5\,farads} = 12.8 volts$$

Which is still plenty of voltage to keep the transmitter going."

"Dude, you're really smart. Fist bump!" exclaimed Joey.

"Everybody knows that stuff. He just likes to show off," mumbled Hambone.

"This is actually worst case," continued Elmer. "Because your car voltage is actually closer to 14 volts and the battery is still supplying its eight amps, your voltage drop will be even less. But remember, the capacitor only works because voice has lots of peaks and valleys. It won't work for CW, AM, FM or RTTY transmission modes where the current is drawn continuously. Those modes would use up all the 'bonus' charge in the capacitor."

"Wow!" exclaimed Hambone. "Let's go get a giant capacitor."

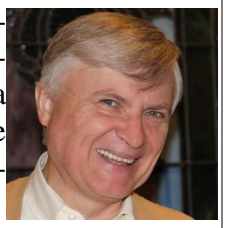
As Elmer and Hambone prepared to go the car stereo store, Joey and Dude took off in Rusty to the window-rattling beat of, you guessed it, 'Let's Go' by DL.

-> FEEDBACK <-

The "Amateur" in "Amateur Radio" -- Chip Buckner, ACØYF

Harmonic Resonance and the Heterodyne Hoax

Last month, my plan was to build **Tom Wheeler, NØGSG**'s improved code practice oscillator. For want of a MOSFET transistor, I had to postpone the project a month. With the arrival of the MOSFET, I began again.



What I am calling the "Mark 2" code practice oscillator looked substantially more complicated that the first version. Fortunately, Tom divided the project into several modules that could be built and tested separately. Section 1 is the "Automatic Power Switch". It calls for a MEGA ohm resistor, which is ten times the size of anything that came in my mail-order resistor assortment. Having twice failed to collect the necessary parts, I decided that there might be a lesson to learn here. I checked the whole schematic and created a bill of materials. It turns out that I needed 4.7, 47 and 100 uF electrolytic capacitors, which didn't match up well with the 10's and 220's in my collection. I've placed the necessary orders. Next month, perhaps?

Umm, the thing I intended to write about fell through. This could be a short column. The advantage of pervasive ignorance, however, is that there are always plenty of new things to learn.

WØDEW to the Rescue

Larry (Larry's List) Staples, WØAIB's, public birthday party at the Ararat Shrine, **Don Warkentien, WØDEW**, accosted me, and insisted that heterodynes were not difficult to understand. His explanation involved the "beat" one hears when violins tune to the same pitch. Later that day, Tom invited me to his shack full of radio gear and test equipment to give me a practical demonstration.

It turns out that heterodynes are pretty neat. The idea is that when waves A and B combine, you get "heterodynes"—that is, "bonus waves"—at frequency A+B and frequency A-B (or B-A). I remember that from one of the license exams. When your receiver is set to "CW" mode, it generates a signal that is 700 Hz "off" of the tuned frequency. It combines the CW signal it detects at/near the tuned frequency with the receiver-generated offset which creates waves at A+B and A-B, which--if you're tuned precisely on the signal, will be 700 Hz. If you're not tuned right on top of the received signal, the receiver-generated signal will be something other than 700 Hz away from the detected over-the-air signal and you will hear something other than a 700 Hz coming through your speakers. (Single side band works the same way, but we're working with CW today.)

Tom tuned a receiver to a VHF frequency. He then tuned a signal generator to the same frequency. Silence. The receiver made no sound. He moved the generated signal in 1 kHz increments. At 1 kHz, the reciever generated a 1 KHz tone. At 2 kHz, we got another tone an octave above the first tone. At this point, I took over, switching from 2 kHz to 3 kHz to 4 kHz to 5 kHz.

People have long known that a plucked string generates a pitch. Pluck it once--get a pitch. Pluck it again--get the same pitch. Change the length of the string and you get a different pitch. Pythagoras (500 BC) observed that there was a simple mathematical relationship between the lengths of string—the "string-length"—that made the notes that musicians liked to play together. We radio people understand the relationship between string-length and wavelength and frequency. It so happens that going from a 2 kHz tone to a 3 kHz tone to a 4 kHz tone to a 5 kHz tone plays a root note or "tonic", moves up a "fifth", up to the "octave" and then up a "third". This series of tones happens to be the series of notes that begins Richard Strauss' Also Sprach Zarathustra, which people of a certain age will recognize as the music Stanley Kubrick used in the opening sequence in the movie "2001: A Space Odyssey".[1]

At this point, I concede to Tom that there may be something to this heterodyne business, but that I'm going to have to do some additional experimentation to wrap my head around this.

Additional experimentation?

If I am going to do additional experimentation, I need a signal generator that will generate waves at a couple of known frequencies and a spectrum analyzer that will tell me that I am getting waves it detects that are different than the waves the signal generator created. This is not the kind of stuff I have in my, uh … "lab". I do, however, have this kind of stuff elsewhere in my home.

A piano generates signals at known audio frequencies. The "A" above

see THE AMATEUR on 9

[1] This is the kind of thing you have to put up with when you let a liberal arts guy edit your amateur radio club newsletter.

from THE AMATEUR on 8

middle-C sounds at 440 Hz. The "A" an octave lower sounds at 220 Hz. If I were to strike those notes together, I should generate waves/tones with frequencies of 220 and 440 Hz, of course. If the combination of waves generates a heterodyne, I should also get a heterodyne at 220 + 440 = 660 Hz, which is very close to the note "E" at 659.255 Hz.[2] The musical intervals between A-440, E-660 and A-880 happen to be the same as the intervals between the first three notes of *Also Sprach Zarathustra*, which is why I went into that discussion in the first place. And I have an organic spectrum analyzer connected to my ears that can tell the difference between the first, second and third notes of that melody.

I sit at the piano. I strike E-660 to tell myself what I am listening for. I locate the A-220 and A-440 and strike them together to produce … the sounds of a piano playing A-220 and A-440. No E-660.

Of course, having played octaves on a piano at other times in my life, I really didn't expect to hear 660. But <u>why</u> don't I hear it? Do I have a phase problem? Do I have a heterodyne, but at a signal strength so low I can't make it out over the loud 220/440? Or does heterodyning not work at audio?

I rule out phase. Tom's signal generator and his receiver were not coordinating phase. I put any sort of audio-doesn't-heterodyne to the side because Tom and Don both insist that heterodyning can be an audio phenomenon and I have no reason to believe that they colluded to perpetrate a hoax on me. So, let's test the idea that the heterodyne is substantially weaker than the waves used to create it and that I'm just not hearing it. Can I mask the sound of A-220 and A-440 and amplify the E-660 heterodyne?

I think I can use natural resonanace that occurs inside a piano to handle the amplification. "Resonance", WIKI reports, "is a phenomenon that occurs when a vibrating system or external force drives another system to oscillate with greater amplitude at a specific preferential frequency." If I create an E-660 wave, it should cause the E-660 string, "to oscillate with greater amplitude" at its "preferential frequency" of 660 Hz.

The other thing a piano does well is to mute the sounds we don't want to hear. Each string has a "damper". You press the key, the damper goes up and the string can vibrate. You release the key, the damper drops and stops the string from vibrating.

The other thing a piano does well is to mute the sounds we don't want to hear. Each string has a "damper". You press the key, the damper goes up and the string can vibrate. You release the key, the damper drops and stops the string from vibrating.

I depress the E key softly with my right index finger, so as not to make a sound. I then spread the thumb and pinkie on my left and to octave distance and smack and release the A keys. The two A's sound briefly and then … I hear the faint sound of E-660! All right, let's go the other way. We need to use E-660 and A-440 to generate the differential heterodyne (a term I might have just made up) of A-220.

I sit at the piano and—no matter how many times and how hard I pound 660 and 440—nothing.

But I did hear E-660. So, what did I hear? Do I get higher pitches rather than lower pitches because the higher pitched strings are shorter and, having less mass, are easier to vibrate? Or, as I think is likely, am I getting harmonics of the underlying notes? Let's run some tests.

Key(s) <u>Struck</u>	Key(s) <u>Held</u>	Tone(s) <u>Heard</u>
220+440	E-660	E-660
440+660	A-220	nothing
440	A-880	A-880
440	E-1320	E-1320
880	E-1320	nothing
220	A-440	A-440
220	E-660	E-660
220	A-880	A-880
220	C#-1100	(C#maybe)
220	440+600+ 880+1100[3]	440+660+ 880

It looks to me as if I am hearing whole-number multiples of the fun-

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[2] Musicians who are really into this stuff will know that there are a variety of musical tuning systems or "temperaments". A Pythagorean "E" would be at precisely 660 Hz. For reasons that do not belong in an amateur radio club newsletter, strict adherence to the Pythagorean temperament creates musical challenges. In J.S. Bach's era, musicians introduced some compromises into the Pythagorean temperament to make music writable and playable in a variety of keys. In the modern—modern compared to Pythagoras, anyway—"equal" temperament, "E" is really tuned to something like 659.25515 Hz. I'm going to call it E-660 anyway, (a) because it's really close to 660, (b) because it is cumbersome to keep writing 659.25515, (c) because no piano tuner can tune to 6+ significant digits and (d) because, even if a piano tuner could tune with that kind of accuracy, there is no chance that my piano is going to be in tune anyway. Incidentally, J.S. Bach was so delighted with the musically—if not mathematically—sensible temperament that enabled him to write in multiple keys that he composed a collection of preludes and fugues in all major and minor keys that he called the "Well-Tempered Clavier".

[3] My hand wasn't large enough to reach all of these. I used a paperweight to hold down C#-1100.

damental frequency. One explanation might be because the lower piano string generates overtones (for musicians) or harmonics (for engineers) that are being picked up by the higher string. Musicians like overtones. They add interest and variety to sound. They make clarinets sound different from violins, which is the reason orchestras contain both clarinets and violins.

Key(s) Struck	Key(s) Held	Tone(s) Heard
A-220	B-247	nothing
A-220	C-262	nothing
A-220	Eb-311	nothing
A-220	***E-330***	***E-660!***

I ought to test my theory on a bunch of notes that are NOT multiples of the fundamental frequency.

Things started well, but when I heard that E-660...? The piano damper was supposed to kill the sound of E-660. Instead, E-660 was sounding louder now than when I had the damper raised. The damper was AMPLIFYING the sound!

Now wait a minute. This cannot be happening. E-660 cannot possibly be vibrating, much less vibrating louder than it did when I had the damper disengaged. Of course, as the (now snickering) engineers know--and as I discovered when I released E-330 key--the E-660 string was not the one that was vibrating. The E-660 sound was coming from the E-330 string. When I struck A-220, it caused E-330 to vibrate at 660 Hz. I expected the E-330 string to resonate at its "preferred" E-330 frequency. I had--for whatever reason--not expected the E-330 string to resonate at 660 Hz.

It looks as though the third harmonic of A-220 (220 x 3 = 660) is causing E-330 to vibrate at twice its "normal" frequency (330 x 2 = 660). I tested other combinations to see if I could get a string to resonate at a multiple of its "natural" frequency. It turns out that it isn't very hard to do.

Key(s) Struck	Key(s) Held	Tone(s) Heard
A-220(x5)	C#-275(x4)	**C#-1100!**
A-440(x1)	A-220(x2)	**A-440!**
E-660(x1)	A-220(x3)	**E-660!**

I had been thinking about a piano as a signal generator. It is. But it is also an audio frequency antenna farm. I've got all these audio frequency antennas in there that vibrate/resonate at various frequencies. So, although my heterodyning experiment failed, I've gave myself a practical demonstration that an oscillating sytem may resonate at more than one frequency. On one level, I "knew" that 2m antennas worked at 70cm and that 15m antennas worked at 40m. I just didn't expect to experience it--or to have it so easily demonstrated--in the audio frequency domain.

Why don't I hear heterodynes?

The question remains, however, why I failed to hear heterodynes.

When normal people "combine" or "mix" things, we add them together. When normal people "combine" or "mix" waves, we "add" them together. When RF engineers "combine" or "mix" waves, they "multiply" them together. This raises two obvious questions. First, "whaddya mean MULTIPLY waves?" Answer: I have no idea.[4] Second, "why would RF engineers twist and distort the meanings of perfectly good words like 'mix', 'combine' and 'multiply'?" Ah, now we have moved on to MY home turf. This one is easy. Answer: Nefarious[5] purposes. I know nothing about RF engineering, but have some experience with twisting words for nefarious purposes. Trust me on this one. I'm a lawyer.

All of which suggests that maybe Tom and Don did collude to perpetuate a hoax on me.

ODDS AND ENDS

-- MORSE CODE ON AN HT --

Tom Wheeler, NØGSG, observed that an additional problem of using the PTT to key dots and dashes was that the HT has to switch between transmit and receive modes on each keypress/release, which when done at any reasonable speed is hard on the electronics.

Don Warkentien, WØDEW, informed me that HT's with numeric keypads--like your pushbutton telephones--generate DTMF (dual tone multi-frequency) signals. My experiments indicate that each row of buttons has a tone. Each column of buttons has a tone. When you push a button, you generate the row-tone and the column-town. If you push two buttons in the same row or column, you generate only the tone for the shared row or column, which can be used to key Morse code on an HT.

[4] Well, I DIDN'T have any idea. Tom directed me to the "mixers" section of the ARRL Handbook. It turns out that you don't multiply "waves", you multiply "voltages". Voltage is a number. I know how to multiply numbers together. Now WHY we multiply voltages or HOW/WHY someone decided that it would be a good thing to do or HOW/WHY a diode (as shown in the handbook diagram) would multiply voltages are questions for further/future consideration.

[5] Really, really evil.

Member Profile: Barb McKinney, KEØEGG -- *Deb Buckner, KDØRYE*

With the call sign **KEØEGG, Barb McKinney** knows she can never get a vanity sign. What could be better than being known as "the Egg Lady" of ham radio?

Licensed as a technician since April 2015, Barb's road to radio had an unfortunate beginning. Her husband, **Keith, KEØAEP,** suffered serious injuries in a motorcycle accident. Laid up for months with a broken hip, shattered ribs and a collapsed lung, Keith began listening to a scanner to help pass the time. Barb became interested, too, but looking at their old equipment, they decided to "see if we can upgrade." This led to several visits to Associated Radio. Keith had been active with CB radio in the 70s, and soon became interested in ham radio. They bought their first radio and listened in their truck where they had their only antenna.

Listening regularly, they began to know the voices, **Don Warkentien's WØDEW** being one of the first they came to distinguish. Keith said, "I think I want to do this!" With several months still before his complete recovery, he studied for his license, passed and soon had a radio in the house as well. They began to listen to the weekly nets, and Barb experienced the frustration of knowing "I can't talk to these people!" She decided she needed to be licensed, too.

Barb studied two or three weeks, using the Gordon West book and audio cds she played in the car to and from work. She found a lot of help from the QRZ practice exams. She began completing between five and ten practice exams each evening before taking and passing the real one.

Barb McKinney, KEØEGG and Deb Buckner, KDØRYE

"I want to understand all of it," Barb said. "But some comes easier than others." She acknowledges "we are so blessed to have so many brilliant people in this club" who can provide guidance.

Barb communicates using her "licensing gift", a dual band Icom 2730, in her car. She enjoys the nets and just listening while driving. At home, she and Keith have a Yaesu Fusion 400, while he also has a big Icom 7410 HF transceiver, a mixer and speakers. She and Keith enjoy club meetings, and she recently made it to a breakfast with club members as well.

Barb is studying for her general exam and then wants to learn CW. This Christmas, she received a straight key, an audio teaching guide and an oscillator. But tax season is a busy time for an accountant. Right now, "work is getting in the way of my hobby."

She is also interested in learning more about the YLRL (Young Ladies Radio League) and becoming involved. There are advantages to being a female voice in the world of ham radio. "We are such a minority, people are happy to hear a female regularly."

-> FEEDBACK <-

Adapting Microphones to Yaesu Transceivers: If it's not Broken, then Fix It! -- Tom Wheeler, NØGSG

Introduction

Many of us are trying out the new digital modes offered by the club repeaters, and the Yaesu FTM-100 and FTM-400 are popular choices. These are great radios, but the supplied microphones are clumsy, especially for base station use. A desk microphone is a much better choice for fixed operation, but there's just one problem: The Yaesu radios have a 6-pin RJ11-style connector and a really unique electrical interface. Getting a conventional desk microphone to work properly takes a little doing, but it's not hard to do.

Danger, Will Robinson!

First, a word of caution. If you construct an adapter for your own radio, make sure you check its wiring thoroughly before plugging it in. Modern transceivers are pretty unforgiving when it comes to miswiring on microphone connectors, and in particular, misconnections to power pins on these connectors may cause a trip to the radio hospital for your unit! If you're unsure, ask an Elmer for help.

Understanding the Interface

Most radios provide a simple microphone interface. The following are typical pins and functions that need to be connected:

- Microphone signal--the low-level signal from the microphone element passes from the microphone into the radio on this wire. It's usually a shielded, miniature coaxial cable. The signal levels are just a few millivolts, so shielding is absolutely necessary. Caution must be employed with the microphone signal, some radios provide a DC"phantom" voltage on this line to operate condensor microphones. (Yaesu generally does not.)
- Signal ground--the ground return for the microphone signal; it's usually the braided shield for the microphone wire.

- Push-to-Talk and Logic ground--a second ground is usually provided for the push-to-talk switch and any other control logic in the microphone. This reduces hum on transmit by isolating the sensitive analog ground for the microphone element (that's only making a few tiny millivolts) and digital / control grounds (where many volts and a few mA of current may be flowing).
- Push-to-Talk--usually (in 95% of cases), this is the magic wire that when grounded switches the radio to transmit, and when open-circuited puts the radio back into receive.
- People like to do additional things with their microphones, so manufacturers also add a few more signals:
- DC Power Supply--Some of the gadgetry (such as microprocessors--yes, some microphones actually have one or more computer chips within them!) in a microphone needs DC power to operate. Some microphones also use what's known as an "electret condensor" microphone element, which also requires a small DC voltage to operate. This DC power is also sometimes used to power LEDs for backlighting.
- Control Inputs--People like to tune and control their radios through the microphone, so these range from simple arrangements like up and down buttons for tuning, to more elaborate arrangements like 16-key touch-tone (DTMF) pads.

Every brand of radio has a unique twist on these basic interface signals. To build adapter cables, then, we must understand both the "pinouts" (what signal is on what pin), but also what kind of signal is expected on each pin by the radio. In general:

- Kenwood radios tend to provide dedicated pins for UP and DOWN buttons, as well as the PTT function. These are simply grounded when activated.
- Icom is similar, but also integrates a microcontroller into most of their microphones. The PTT function is still a discrete pin that's grounded for transmitting, but the microcontroller in the microphone makes the radio transmit by sending a control code to the radio through a separate data wire that's part of the microphone cable. It doesn't use the PTT pin! It's cool, but also complex and hard to adapt.
- Yaesu microphones use a dedicated PTT pin, but instead of a complex microcontroller in the microphone, they use two analog signals called SW1 and SW2 to

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send commands to the radio. The resistances presented on SW1 and SW2 by the microphone tell the radio what to do. It's a simple and elegant solution, and quite adaptable if you know the secret!

Secrets of the Yaesu MH48 Microphone

Figure 1 is a marked-up version of the MH48 hand microphone that is supplied with many of the new Yaesu units, including the FTM400 and FTM100. Don't be intimidated, as it's just a few switches and resistors that do the work!

In Figure 1 the power supply wire has been highlighted in red, and red boxes have been placed around two very important sets of resistors. The resistors in these two red boxes form the bottoms of two distinct voltage dividers, as shown in Figure 2 (on the following page)..

The "top" resistors for these two voltage dividers are not within the microphone, but are instead located inside the radio. They are around 100 k ohms each and are connected between an internal +3.3V source and each of two analog-to-digital converter inputs on the radio's CPU.

These two voltage dividers are connected to Pins 1 and 2 of the microphone connector, and are the signals "SW2" and "SW1," respectively. The CPU can therefore determine what voltages are on these pins.

The action is pretty straightforward. Referring back to Figure 1, suppose that the user presses the UP button, which is switch S5003 towards the left of the diagram. Through the top diode of D5005, the SW2 signal is effectively grounded, and through

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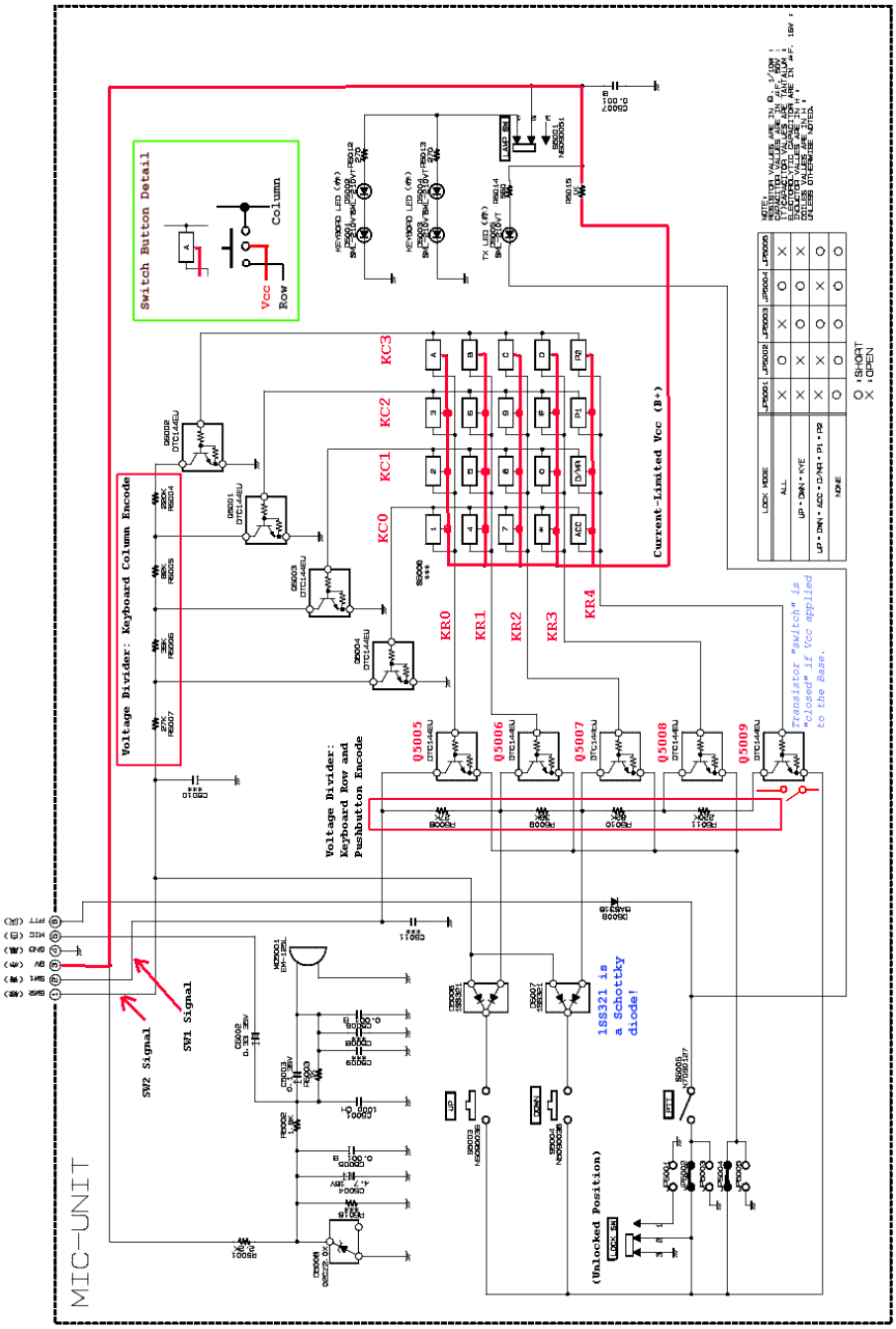

Figure 1: Yaesu MH48 Hand Microphone Schematic Diagram

from MICROPHONE on 13

the bottom diode of D5005, the bottom of R5008, a 27k resistor, is grounded. So as a result, the CPU in the radio sees ground on its SW2 input, and a 27k resistor to ground on its SW1 input.The CPU software interprets this as an UP button command and executes the appropriate command routine to bump the frequency or channel up, or start and stop a scan command.

Similar action happens when the DOWN button is pressed. Strangely, the SW2 input is again grounded, but this time through the top of D5007. However, the SW1 input now sees a total of 27k and 39k to ground, as the bottom of R5009, the 39k resistor, is now grounded instead of R5008.

The CPU now sees a different condition. It sees ground on SW2, but (27k + 39k) or 66k on SW1. It now understands that the DOWN button has been pressed and takes the appropriate action.

The keypad works in a similar way. The Yaesu keypad is not a normal keyboard matrix, though. Each key has two switches that close simultaneously when pressed! (The detail of what's inside each switch position is shown on the schematic of Figure 1 within the green box).

As an example, when the [1] key is pressed, positive voltage from the +5V supply is applied to the bases of NPN logic transistors Q5005 ("KR0") and Q5004 ("KC0"). Q5005 turns on and effectively shorts the SW1 signal to ground, while Q5004 connects the 27k resistor R5004 to ground on SW2. Again, the CPU sees this as a unique condition and understands that the [1] key has been pressed.

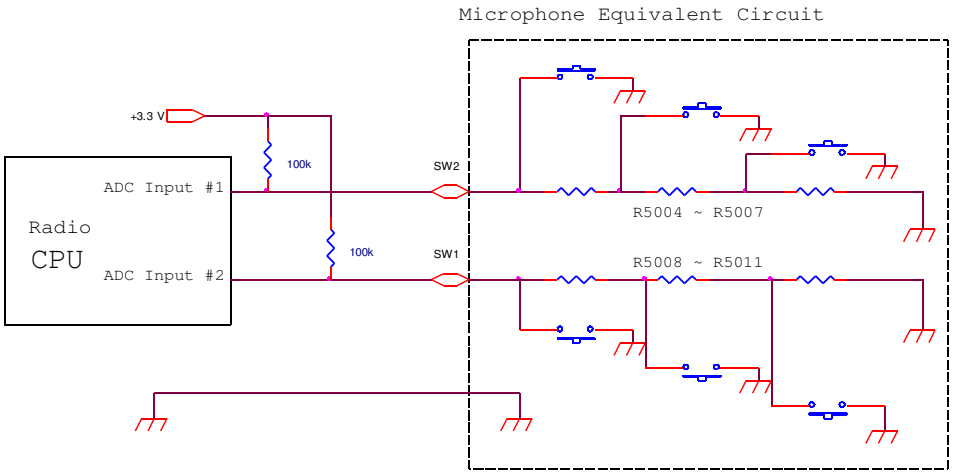

Figure 2: Simplified SW1-SW2 Control Circuit

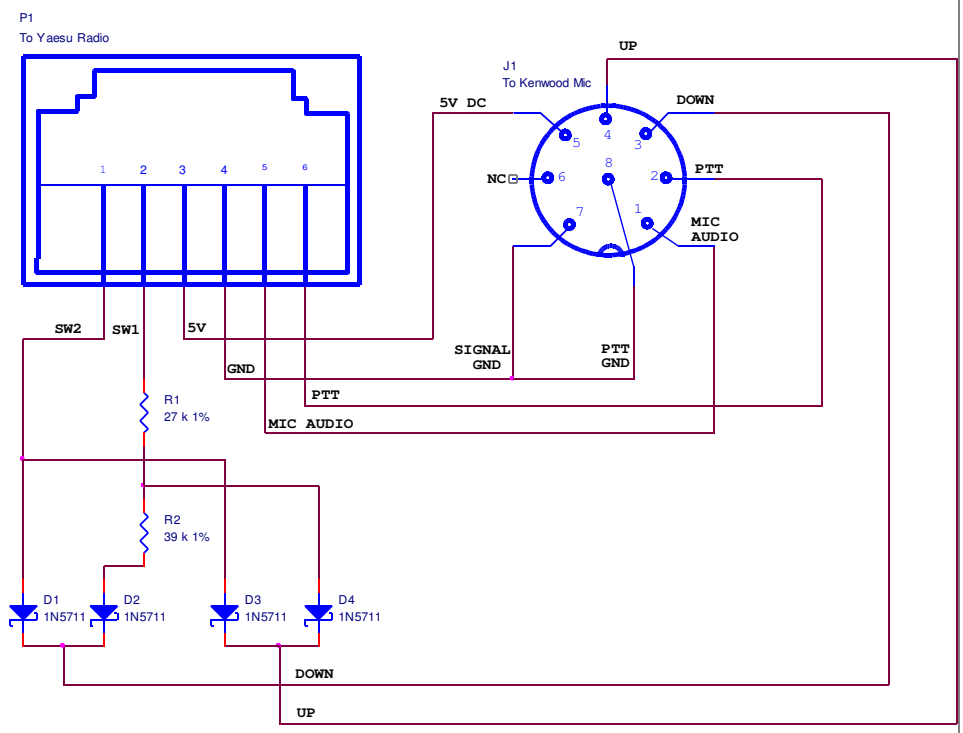

Figure 3: Adapting the Yaesu MH48 to a Kenwood 8-Pin Interface

This is a pretty slick control system. There's essentially nothing in the microphone but a few resistors and switches, yet more than 20 different commands can be reliably sent to the radio. And it's quite easy to adapt, as Figure 3 demonstrates.

In Figure 3, a small amount of the circuitry from the MH48 has simply been cloned to emulate the UP and DOWN signals the CPU needs. On a Kenwood base microphone, the UP and DOWN controls are simply switches to ground. Pressing either the UP or DOWN switch will cause the signal SW2 to be near ground potential, just like with an MH48, as either D1 or D3 will conduct.

Pressing UP connects only R1, the 27k resistor, to ground through D4, while pressing DOWN connects both R1 and R2 in series to ground through D3. It's that simple!

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from MICROPHONE on 14

both R1 and R2 in series to ground through D3. It's that simple!

All the diodes in this circuit must be Schottky types. The CPU in the radio expects correct voltages on the SW1 and SW2 signals as the various resistors in the microphone are switched in and out, and the voltage drops of the diodes (about 0.3V) are incorporated into the CPU's programming. The MH48 itself uses Schottky types, type 1SS321 dual-diode units, though, any generic Schottky diode will work.

Construction

This is a non-critical interface to build. Just be careful, and double check your work before plugging this into your precious radio! Your author was exceedingly lazy and had all the parts in surface-mount form, so he simply used Circuit Scribe ink (which is solderable) to draw the interface onto the back of a business card, as shown in Figure 3. Total construction time using this method was 15 minutes.

The Figure 3 circuit was simply placed in the base of a Kenwood-compatible base station microphone. You'll note that half of the business card was used--so that folding it over provided a free insulator to prevent short circuits. It might actually be better to put the entire interface and connectors in a separate plastic box. There are probably too many components in the circuit to attempt building it directly into a connector shell.

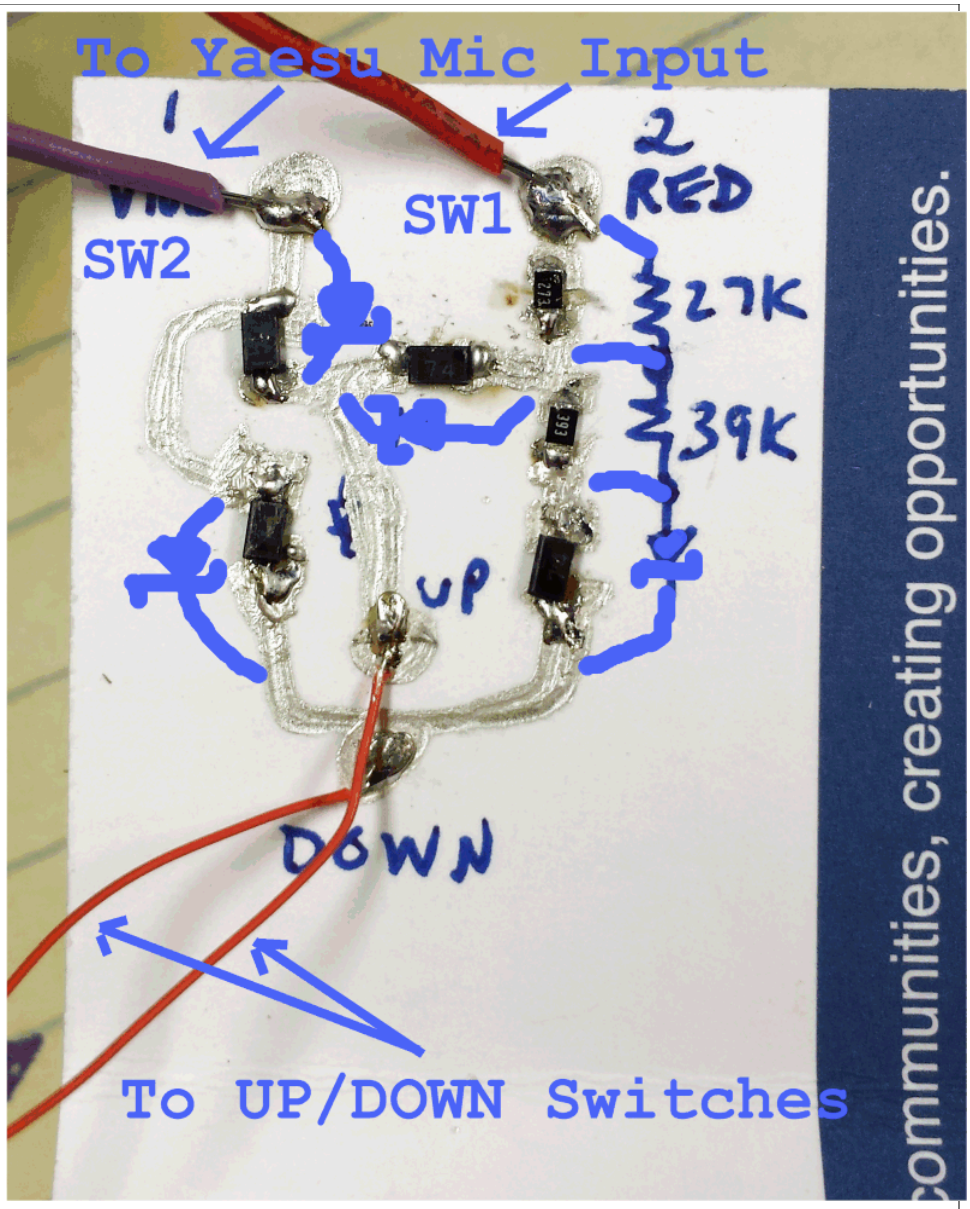

Figure 3: The Lazy Way of Building It

Conclusion

If you really want to ditch that hand microphone (which by the way is a quality unit), it's not hard to adapt your Yaesu radio to desktop operation. In an evening of time, you can easily build an interface that will do that for you, and increase your operating convenience--and with a little ingenuity, you can easily add other functionality if you need it.

-> FEEDBACK <-

The JCRAC has earned $12.11 from Amazon.com through its Amazon Smile program. If you are going to make a purchase anyway, consider visting http://smile.amazon.com/ch/48-1071476 ***to direct 1/2% of your purchase to the JCRAC. It costs you nothing.***