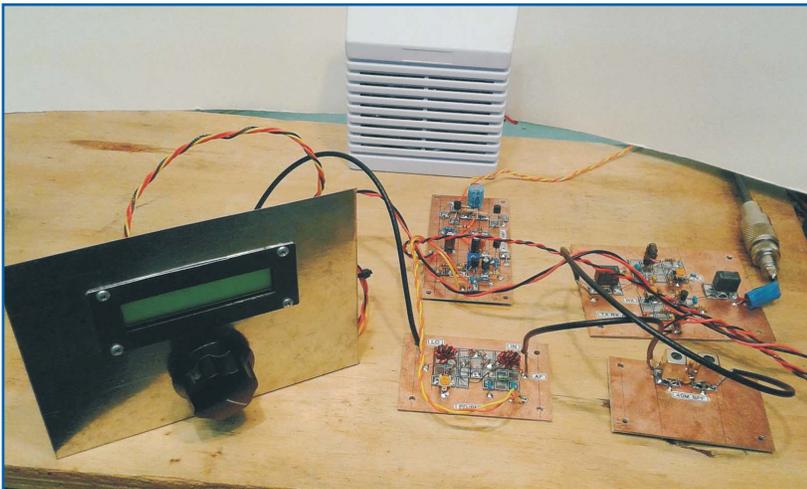
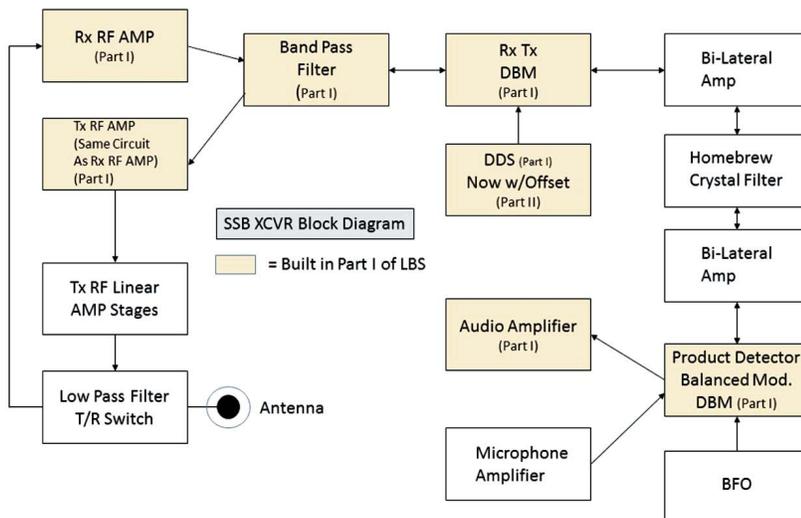


QRP Quarterly

Journal of the QRP Amateur Radio Club International

N6QW and KK6FUT say, “Let’s Build Something!” (Like a SSB Transceiver)



- **FDIM 2105 – May 14-17:**
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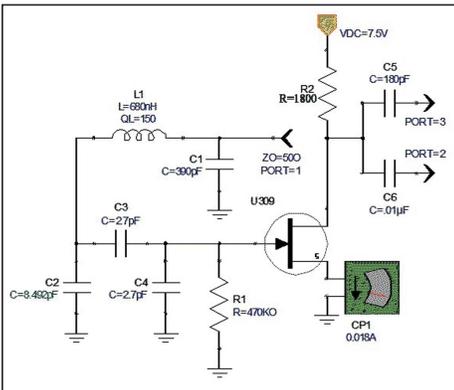
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Editorial

Tim Stabler—WB9NLZ

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As I remember, this is the beginning of my fourth year as your Editor. I know that as FDIM-2015 will be my fourth FDIM I have attended. My question is simply, “Will you be there?” As I write this, registration has not started yet, but is supposed to start in December.

I am getting used to my new home in Portage, IN. I simply drive down to the end of my street and there is an entrance to the Indiana Toll Road. I volunteer Thursday mornings at the Chicago Museum of Science and Industry and that road is the easiest way for me to get there. I have thought about getting the new TEN-TEC Patriot and doing some 5 watt SSB on my drive in but so far haven’t done that. Sorry, I do not trust myself doing CW on the road.

In my last Editorial, I mentioned that I had some camera problems. About two weeks after I wrote that, I got my camera back along with a warranty. The camera works fine now. For those who wonder what the camera was (and I had email asking), it is a Nikon D90. Now my attention turns to Ozarklcon 2015 and FDIM 2015. Over this past weekend, I purchased a copy of *Digital Photo*, an English publication. In the enclosed CD, there were templates for making a 2015 calendar. That fired up some interest, so I will be looking for things to include for making a 2016 calendar.

I know I should be writing about something electronic and QRP but, right now, I have nothing to write about. I did get out the NS-40 transmitter kit I got as a door prize at, Ozarkcon 2014. I then need to order a couple kits from 4SQRP to finish off my station. If you go to their website (4sqr.com), on the home page you can look at complete stations built from 4SQRP kits by WD9F and WØOTM. You will also see that the NS-40 transmitter has been retired but on the kit page, the assembly manual may still be downloaded.

I did have an email from “Ionospheric” columnist Kai Siwiak, KE4PT. He spent much of December in New Zealand doing DX work. In a later email, he told me that his results were very good. Sounds like fun *being* DX, not just working DX stations!

—72/73 de WB9NLZ

P.S.: Starting with this issue, we have changed the date designation to the month of publication (January, April, July and October) instead of the Winter, Spring, Summer and Fall season names that some readers—and staff—thought were a bit vague!



On the Cover

“Let’s Build Something!” (Part 1 of the article begins on page 34.)

The first issue of 2015 features the latest project from Ben, KK6FUT and Pete, N6QW—a single-sideband transceiver built step-by-step. Many of the construction steps are demonstrated by the authors in YouTube videos, just like having them in your workshop to show you how!

From the President

Ken Evans—W4DU

president@qrparci.org



Planning for FDIM 2015 is underway. We are now taking registrations for the seminar and banquet. The hotel is now accepting room reservations as well. FDIM 2015 dates are Thursday, May 14 through Sunday, May 17. This year marks the twentieth anniversary of FDIM. Please come and help to make it special.

As in the past, the FDIM hotel is the Holiday Inn—Fairborn. The room rate is

\$112.00 per night plus 12.75% tax. This includes a free breakfast buffet. This is the only hotel affiliated with QRP ARCI.

If you want to book a room at the Holiday Inn—Fairborn, call them directly at 937-431-4613 (do not call the toll free number!) Calls can be taken between 8 AM and 5 PM Monday-Friday (leave a voice mail at other times and your call will be returned). Tell them you are with “FDIM” to get the special rate.

To register for the seminar and/or banquet, go to the FDIM 2015 web site (<http://www.qrparci.org/fdim>) and click

on “register now”. Registration payment is accepted by PayPal or credit/debit card. A PayPal account is not required if people want to pay by card.

Information on speakers and all FDIM 2015 activities are at this site. Check this site for future FDIM announcements.

There are other important announcements in this issue regarding QRP Hall of Fame nominations. Please check them out.

See you all in May!

—72, Ken Evans, W4DU
President, QRP ARCI

QRP Hall of Fame Nominations

The time has come for the call for nominations for election to the QRP-ARCI QRP Hall of Fame. Nominations may be submitted via postal mail or e-mail, and must include the following information:

Name & Call of person nominated
Name & Call of person making the nomination.

A full description of why you think your nominee should be in the QRP Hall of Fame (HOF) is needed. Remember the vot-

ing body may not know this person and you must convince them that the person is worthy. Things such as “John Doe is a great guy and always helps out at the club” will guarantee he is rejected. Be specific in your recommendation and try to persuade as to why your person should be in the HOF.

The voting body consists of the QRP ARCI Board of Directors, President, Vice-President and last eight members inducted into the Hall of Fame. Nominations may be submitted by anyone, whether a member of the QRP ARCI or not. Similarly, membership in QRP ARCI is not required for

someone to receive the honor, since this is an award to recognize those who have made great contributions to the QRP community, not just to the QRP ARCI.

If no nominations are received or the nominee(s) receive(s) less than the required 2/3 vote there will not be an induction at Dayton for 2015. The BOD is adamant that it is not a requirement that we have an induction. A list of the current members of the HOF is included with this announcement.

Please forward your nominations to BOTH President, QRP ARCI president@qrparci.org AND to the Vice President, vp@qrparci.org. Nominations in writing should be sent directly to these addresses:

Ken Evans, W4DU
848 Valbrook Ct.
Lilburn, GA 30047
USA

Steve Fletcher, G4GXL
43 Philip Rudd Court, Pott Row
Kings Lynn, Norfolk PE32 1WA
United Kingdom

The closing date for nominations is March 1, 2015. When a nomination is received, a confirmation e-mail or letter will be sent to the person making the nomination. If you nominate someone and do not receive a confirmation, we did not receive it. You will need to receive a confirmation to insure your nominee will be considered.

—Ken Evans, W4DU, President;
Steve Fletcher, G4GXL, Vice-President

QRP Hall of Fame Members, December 2014

Chuck Adams, K5FO (1998)
Brice Anderson, W9PNE (1996) (silent key)
Rich Arland, K7SZ (2002)
Dave Benson, NN1G (1999)
Harry Blomquist, K6JSS (2008) (silent key)
Fred Bonivita, K5QLF (2007) (silent key)
Jay Bromley, W5JAY (2012)
Michael Bryce, WB8VGE (2000)
Wayne Burdick, N6KR (1998)
George Burt, GM3OXX (1996)
Rick Campbell, KK7B (2009)
Jim Cates, WA6GER (1998) (silent key)
L. B. Cebik, W4RNL (1999) (silent key)
Arnold (Arnie) Coro, CO2KK (2003)
Dave Cripe, NMØS (2014)
Mike Czuhajewski, WA8MCQ (1997)
Tom Davis, K8IF (1996)
Doug DeMaw, W1FB (1992) (silent key)
Drew Diamond, VK3XU (2013)
Rev. George Dobbs, G3RJV (1992)
James Duffy, KK5MC (2007)
Ken Evans, W4DU (2008)
Joe Everhart, N2CX (2000)
Graham Firth, G3MFJ (2003)
Tony Fishpool, G4WIF (2003)
Terry Fletcher, WAØITP (2012)
Dieter (“Diz”) Gentzow, W8DIZ, (2005)
Paul Harden, NA5N (1999)

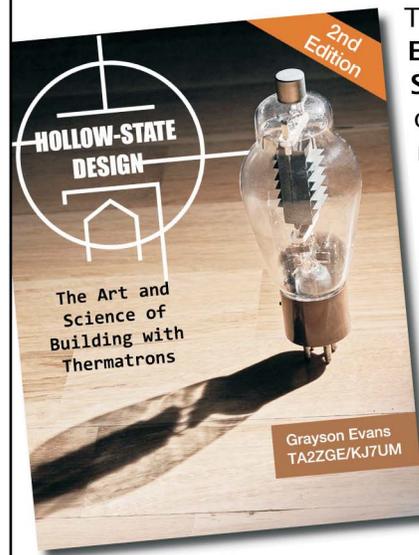
Ed Hare, W1RFI (2014)
Rex Harper, W1REX (2010)
Wes Hayward, W7ZOI (1996)
Dave Ingram, K4TWJ (2010) (silent key)
Doug Hendricks, KI6DS (1997)
George Heron, N2APB (2001)
Craig Johnson, AAØZZ (2013)
Martin Jue, K5FLU (2009)
Bill Kelsey, N8ET (2004)
Ian Keyser, G3ROO (2004)
Hank Kohl, K8DD (2007) (silent key)
Jim Kortge, K8IQY (2002)
Zack Lau, W1VT (2014)
Roy Llewellyn, W7EL (1992)
Rick Littlefield, K1BQT (1996)
Tony Parks, KB9YIG (2009)
Dick Pascoe, GØBPS (1997)
Randy Rand, AA2U (1992)
C. F. Rockey, W9SCH (1996) (silent key)
Eric Swartz, WA6HHQ (2005)
Jim Stafford, W4QO (2010)
Hans Summers, GØUPL (2009)
Dan Tayloe, N7VE (2013)
Gus Taylor, G8PG (1998) (silent key)
Steve Weber, KD1JV (2004)
Adrian Weiss, WØRSP (1996)
Peter Zenker, DL2FI (2001)
Kevin Zietz, VK5AKZ (2012)



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Idea Exchange

Technical Tidbits for the QRPer

Mike Czuhajewski—WA8MCQ

wa8mcq@verizon.net

In this edition of the Idea Exchange:

Note from N2CX

Simple QRP TX/RX Tester—K1MBO

Fixing Elecraft K1 Paddle Contact Bounce—K8AX

Portable 6M Tomato Stake Loop Antenna—W1FMR

Reseating Chips to Cure Bad Connections

Beware the Solderless Breadboard—WA8MCQ

Note from N2CX

Idea Exchange and Quickie aficionados: After a long unbroken string of Quickies I have to beg off temporarily. Health issues have left me short of mental and physical energy for the short term. I actually had one in process. However, it required some breadboarding that proved unsuccessful after zapping a bunch of components due to lack of focus. Never fear though, I'm on the mend and expect to resume the series come next issue.

—de N2CX

Simple QRP TX/RX Tester

From Dave Potter, K1MBO—

I have the pleasure, once a year, of helping student teams debug the NorCal 40A transceivers that they have built as part of our Wireless Communications Circuits course. Student life being what it is, the demand on resources peaks approx-

imately 48 hours before their final reports are due. We have to scramble to find signal generators and loads that the teams can use to debug and align the rigs. This project is a solution to that equipment problem.

I initially built a simple dummy load with a meter or LED indicator to allow students to verify that the transmitter was working and we passed around the signal generator. This second iteration of the design includes a simple crystal oscillator for the center of the receiver passband as well as the dummy load.

Since I had to attenuate the oscillator output down to the -73 dBm level, I combined the dummy load with the attenuator and came up with a device with only one RF port and that can be powered by a wall wart or a 9V battery. Figure 1 shows the schematic. [WA8MCQ note: Although the oscillator is connected to the dummy load, the large attenuator between them insures that no damage occurs.]

It works very well and has been used successfully by a number of student teams. The build cost is in the \$20 range depending on your junk box. We decided to use a printed circuit board since we want to use the testers every year. A breadboard version works just as well and is more than sufficient if you are building a single kit or design. The board is also useful as a demo for oscillator concepts and for a soldering class. Figure 2 shows the assembled circuit on the board.

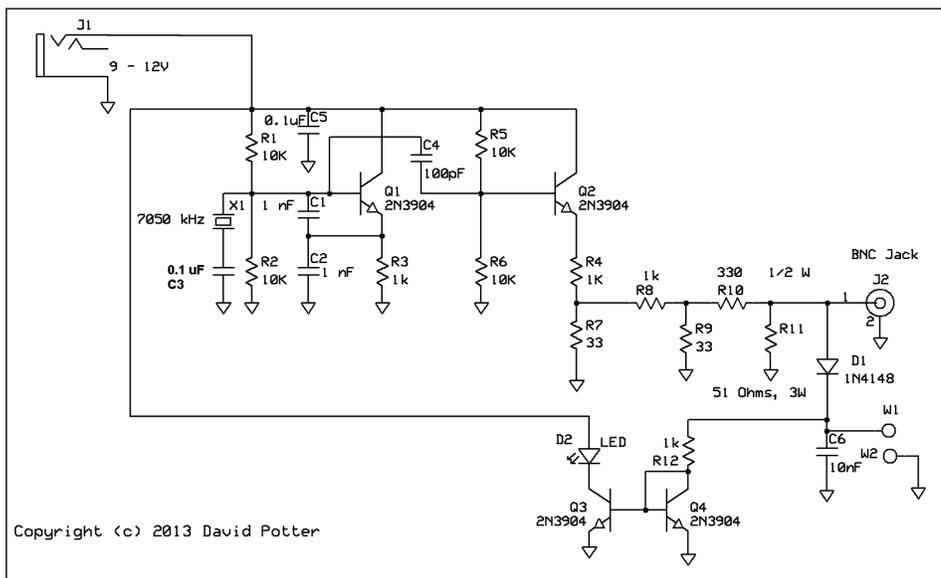
Although the C5 bypass cap is shown as 0.1 μ F on the schematic and a ceramic part was used on some boards, this particular one has a 0.47 μ F electrolytic since that was what was on hand at the time.

[WA8MCQ notes: The board was designed with ExpressPCB, Ref. 1. The top has the traces and the bottom is a ground plane. Dave later told me that he has no boards for sale. —MCQ]

I bought the 7050 kHz crystals from Expanded Spectrum Systems (Ref. 2), as one of their standard values. Obviously, the circuit, with appropriate adjustments, can be used on other frequencies as well. The rest of the parts are available from suppliers such as DigiKey, Mouser and Newark.

The 50 ohm resistor is a 3 watt metal film type and seems to work just fine. I checked the return loss with my trusty MFJ antenna analyzer and it is useable at least through 6 meters. You can also increase the power rating of the resistor to accommodate higher power transmitters. The Caddock series of thick-film resistors in TO-220 packages (Ref. 3) is suitable; I have a version of the tester with a 50 watt load that is very useful for dabbling with QRP amplifiers but do be careful about power ratings. Heat sinks are essential if you exceed more than about 10% of the rating of the resistor. Check the derating curve on the datasheet and use a reasonable size piece of metal to absorb the energy, perhaps with a small fan to transfer it to the atmosphere.

The nominal voltage at the output of detector D1 is about 14 volts when the rig is putting out 2 watts. I used a current mir-



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Figure 1—Schematic of the TX/RX tester.

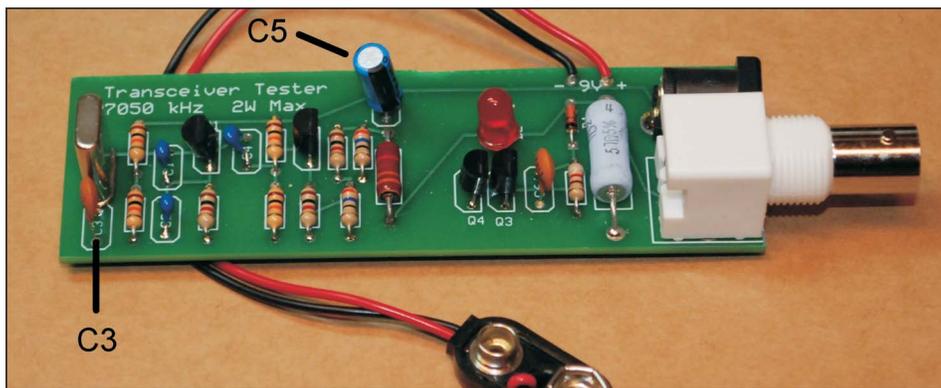


Figure 2—Assembled tester on the PCB.

ror to drive the LED. Since a red LED has a forward voltage drop of about 1.2 volts and the diode detector takes away another 0.7 volts, you would not be able to see if the transmitter was putting out any power below about 75 mW. With the current mirror, you can use the indicator down to approximately 10 mW.

There are lots of ideas that could be incorporated into this basic circuit, such as a power switch for use with batteries (they never remember to disconnect those), a pushbutton switch to key the transmitter, and so on. Perhaps I will design an improved version someday. In the meantime, we can get everyone's transceiver debugged and checked out before the grades are due.

[WA8MCQ notes: One of my duties at my last job was performing quality control inspections of boards, so one thing jumped out at me immediately when I saw this one. Dave realized the same thing when he received them. The metal can of the crystal is extremely close to the pad of C3 that goes to the crystal and also runs over the trace between the crystal and Q1. Although that trace is covered with solder mask the can could still contact it (there might be gaps in the mask or the can could punch through), and if the can also touches the pad the crystal would be shorted out. No damage would result, but it wouldn't work.

The crystal could be repositioned slightly to avoid the pad or raised a bit off the board, and there is plenty of space to change the layout slightly if the board is revised later. One could also cut a spacer out of a bit of plastic to insulate the can from everything. Since circuit density is much greater on a lot of boards, spacers are often the only option for dealing with possible shorts.]

References

1. ExpressPCB provides free schematic capture and PCB layout software to design your board and send the files to them for fabrication, although many people use the software to make their own schematics and/or boards. The web site is at <http://www.expresspcb.com/>
2. www.expandedspectrumsystems.com
3. To find the Caddock resistors on DigiKey.com or Mouser.com, search on that name, select "through hole resistors", then search for 50 ohms. They are available in several power ratings. If you have access to the Winter (January) 2007 issue, check out Figure 31 of the Idea Exchange. It shows one of them built into a small Pomona die cast box by Walt Thomas, K3ASW (formerly WA4KAC). I tested it with a network analyzer and it performed well. I can't find my notes but I seem to recall from experiments with my own Caddock resistors that they do need to be mounted against a ground plane to give good RF performance. —WA8MCQ

Fixing Elecraft K1 Paddle Contact Bounce

From David Brown, K8AX (e-mail dbbrown624@gmail.com)—

I have owned an Elecraft K1 QRP CW Transceiver (S/N 757) since 2001 and have always used it with either a straight key or an external keyer. I have never had a keying problem with it other than operator errors. I recently purchased a single lever paddle to use with the internal keyer. For this, the K1 was programmed to use my new paddle with the keyer in iambic mode A.

The first use of the new paddle and K1 was on a trip to North Carolina to visit

family. I used a 40 meter inverted vee for a sked with friends back in Ohio. Good propagation was with us. However, I struggled through it while making multiple keying errors. This couldn't have anything to do with the keyer being in iambic Mode A since I was using a single lever paddle. Was it my inexperience with the new paddle? What was going on here?

After returning, I sat down and experimented with the new paddle/K1 arrangement. With the internal keyer set for 20 WPM, I could not complete sending the entire alphabet without at least one keying error (using a dummy load, of course). I tried just sending the Morse letter "A" multiple times. Occasionally, the K1 would transmit the letter "N". My friend Steve, N8WL, visited me and brought his much newer K1 along (S/N 3225). He used my new paddle and K1 for the experiment of sending multiple "A" characters. Sure enough, he had about the same error rate as I had. His newer K1 was then substituted for mine, keeping my new paddle. Again, the same outcome. I should mention that my K1 has the latest updates, including the MCU* firmware which matched that in Steve's K1 (version 1.09E). So just what is the problem here?

*(The MCU is a PIC16C77 low-power 8-bit microcontroller from Microchip Technology. It controls the radio, including implementation of the keyer function and transmitter keying, and handles user interface components such as switches and display. You can find the data sheet for the PIC16C7x family on their web page at <http://www.microchip.com/>)

Paddle contact bounce was the prime suspect in these keying errors at this point. A Google search for "Elecraft K1 keyer problem" yielded a few incidences of errors similar to my experience. The conventional wisdom in addressing this issue has been to clean your paddle contacts to minimize contact bounce. But my paddle was brand new! I decided to investigate what contact bounce may exist and how the K1 deals with it before doing any contact cleaning. I'll begin by describing my investigation of the problem, describe what I have learned and what I have done to essentially eliminate it.

I instrumented my K1 with two oscilloscope probes connected to the MCU. One was connected to the keying input ("KEYIN") and the other to the keying line

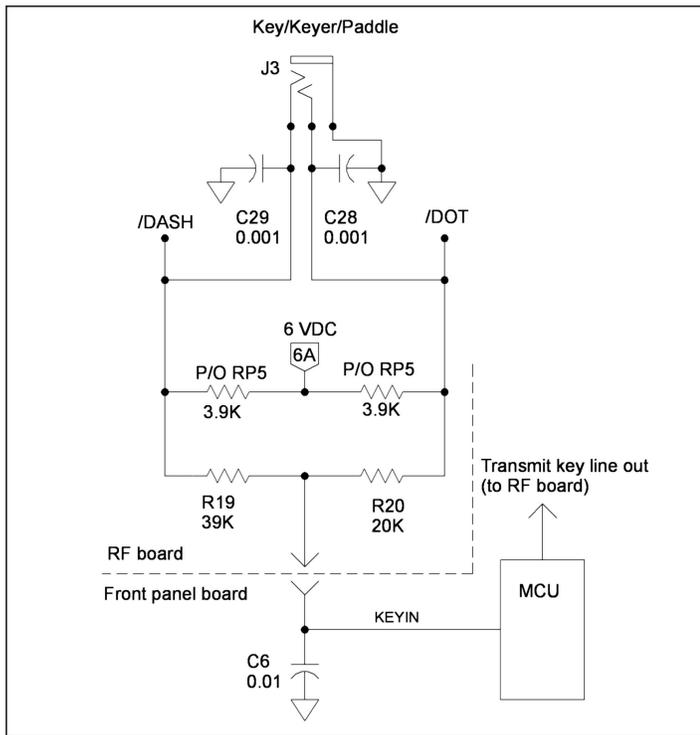


Figure 3—K1’s key/keyer/paddle connection to the MCU.

output that keys the transmitter. Figure 3 shows the resistor/capacitor network that connects a key, keyer or paddle to the keying input on the MCU. Note that this clever design combines the DASH and DOT paddle inputs into one MCU input, labeled KEYIN in Figure 3.

The figure is based on circuitry shown in the K1 Owner’s Manual. Capacitor C6 and the MCU are located on the front panel board and the remaining circuitry is on the RF board. Node 6A is connected to a 78L06 six volt regulator. The table below shows measured steady state voltages at the KEYIN node on the MCU, voltages that are derived from the input resistor network. Since a single lever paddle is being used in this investigation, the dot and dash contacts will never be closed at the same time. Firmware in the MCU must read the KEYIN voltage to detect contact closures and, in turn, key the transmitter.

KEYIN Measured Voltages:

Dot & Dash open	6.1
Dash closed	3.8
Dot closed	1.9
Dot & Dash closed	0

With the K1 instrumented with the two probes, sending the letter “A” with the paddle was repeated many times while lis-

tening to the transmitted audio and watching the oscilloscope. For example, sending the letter “A” is shown in Figure 4 where the

lower trace is the MCU KEYIN node and the upper trace is the MCU line that keys the transmitter, not shown in Figure 3. (The screen shots are based on the “.wfm” files output from my Rigol oscilloscope, using WFM Reader from sourceforge.net.) The total width of the trace is 600 msec. Note that the lower KEYIN trace drops from 6.1 volts down to 1.9 volts when the dot contact is closed. The lower trace returns to 6.1 volts briefly between the opening of the dot contact and closing of the dash contact. Then the voltage drops to 3.8 volts when the dash contact is closed and finally returns to 6.1 volts when it is opened. The iambic keying algorithm produces the upper trace showing the Morse letter “A” that keys the transmitter.

Figure 5 is an expansion of Figure 4 showing the contact bounce when the dot contact is closed. The total duration of this bounce is about 6.0 msec. The resistor network in Figure 3 and capacitor C6 are responsible for the rise and fall times shown.

Figure 6 shows the same Morse letter “A” being keyed in with very similar timing to that shown in Figure 4. However, the K1 transmits the letter “N” instead of the letter “A”! A slight increase in the bounce at the leading edge of the dot closure can be seen, compared to Figure 4. Figure 7 is

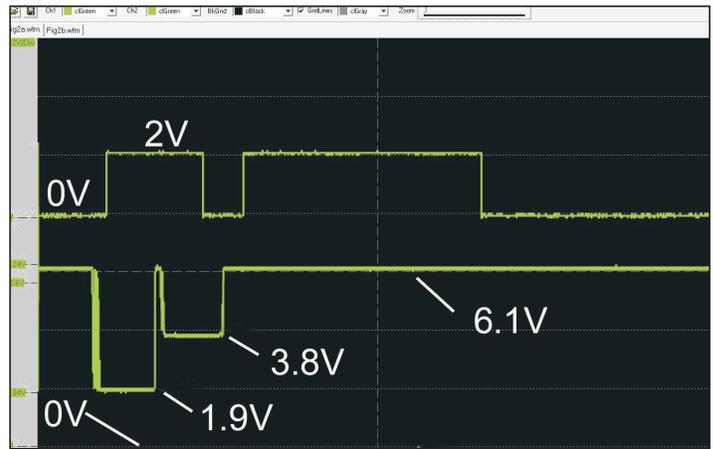


Figure 4—Lower trace, KEYIN; upper trace, K1 transmitter control. Vertical scale in all screen shots is 2 volts per division. Capacitor C6 is the original value of 0.01 uF.

an expansion of Figure 6 showing the transmitted audio and the bounce when the dot contact is closed. The total duration of this bounce is about 6.8 msec.

The above measurements were taken with the stock C6 value of 0.01 uF. Next, C6 was increased almost by a factor of ten by changing it to 0.094 uF (2x 0.047 uF). All attempts to send the letter “A” with this value of C6 failed. An example is shown in Figures 8 and 9. Figure 8 shows the incorrect letter “N” generated from the KEYIN voltage. Here, the rise and fall times of KEYIN are significantly increased from what were previously seen due to the increased value of C6. Figure 9 is an expansion of Figure 8 showing the bounce when the dot contact is closed. The total time duration of this bounce, which is an integration of the bouncing contacts, is about 11.0 msec.

More measurements were taken with C6 set to values greater than the stock 0.01 uF, but less than 0.094 uF. Screen shots are not shown for these measurements, but data for a value of 0.02 uF will be shown shortly. Using different values for C6 showed that the Morse “A” experiment error rate dropped as the value of C6 decreased. This suggested repeating the measurements for C6 set lower than the 0.01 uF stock value. Values of 100 pF and zero (no C6) were tried. These measurements showed a continued drop in the error rate compared to the stock value and greater. Figure 10 is one example taken from the 100 pF measurements. Figure 11 shows the expansion of the dot paddle bounce where the total width of the bounce



Figure 5—Expansion of dot contact closure fall time.



Figure 6—Lower trace, KEYIN; upper trace, transmitter control.

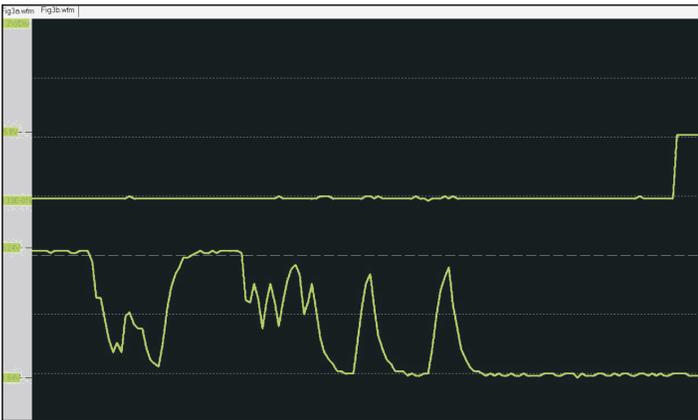


Figure 7—Expansion of dot contact closure fall time from Figure 6.



Figure 8—Lower trace, KEYIN; upper trace, transmitter control. C6 has been increased to almost 0.1 uF.



Figure 9—Expansion of dot contact closure fall time from Figure 8.



Figure 10—Lower trace, KEYIN; upper trace, transmitter control. C6 has been reduced to 100 pF.

is about 6.2 msec.

Table 1 summarizes data recorded while sending the letter “A” with the paddle many times for several values of C6. As stated in the discussion above, this data illustrates the failure rate decline as the value of C6 is reduced.

I’ll show one more figure before

attempting to wrap this investigation up by describing what I think is going on here. With capacitor C6 equal to 100 pF, the total width of the dot contact bounce was recorded for one hundred repetitions (not part of the data in the table above) of a single dot contact closure. The histogram in Figure 12 summarizes this data. The x-axis

identifies a range of bins, each 0.2 msec wide, where all the contact bounce times are recorded. The y-axis identifies the frequency or number of occurrences in each bin.

Here is an important observation. Two failures occurred while collecting this data. Each failure consisted of a single dot con-

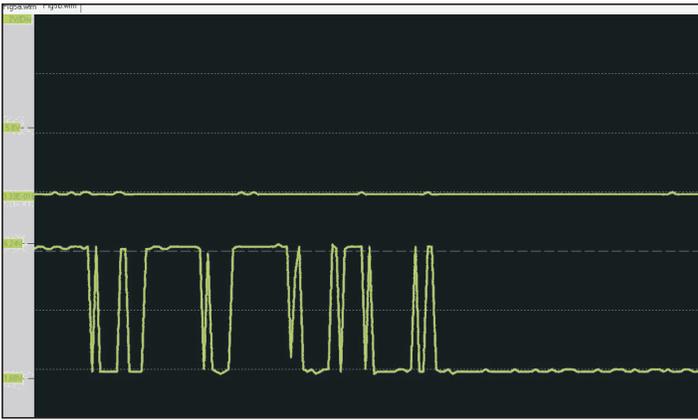


Figure 11—Expansion of dot contact closure fall time from Figure 10.

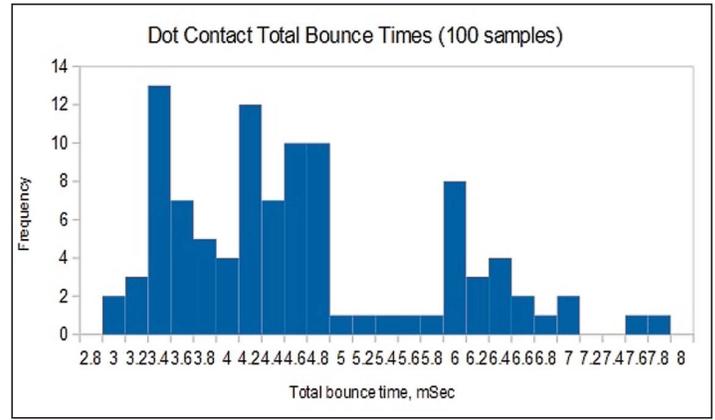


Figure 12—Histogram of dot contact bounce times.

Morse “A” Error Rate for various Capacitor C6 Values			
C6 Value	Sample Size	Number of Errors	Percent Failures
.094 uF	25	25	100.00%
.02 uF	200	63	31.50%
.01 uF	400	35	8.75%
100 pF	400	5	1.25%
0	200	2	1.00%

Table 1.

tact closure producing a Morse letter “N” instead of a single dit. This is a big clue as to what is going on. It’s interesting to note that these two failures had a total contact bounce time of 4.7 and 4.8 msec, which do not fall within the larger contact bounce times of the somewhat bi-modal distribution seen in Figure 12. The failure shown earlier in Figures 6 and 7 had a total contact bounce time of about 6.8 msec on the dot contact closure.

To complete this investigation, we would need to know the details of the K1 firmware that monitors the KEYIN voltage and implements the iambic keyer. We don’t have this, but we do have the K1 schematic as well as the MCU data sheet. From this it is clear that the KEYIN line connects to an MCU input where A/D conversion is done and that capacitor C6 is connected directly between this input and ground. Without knowing the firmware details, it is impossible to determine if proper A/D acquisition times are occurring in the presence of paddle contact bounce—probably not. Here is what I believe is happening.

Please refer to the KEYIN Measured Voltages table appearing earlier for this discussion. In the Morse “A” experiment, the KEYIN voltage must initially switch

from 6.1 volts down to 1.9 volts with the dot contact closure. In doing this, the voltage must drop through the vicinity of 3.8 volts which represents a dash contact closure. With larger values of capacitor C6, the time it takes for the dot contact closure voltage to pass through the vicinity of 3.8 volts is increased. This in turn can cause the A/D conversion and firmware to sometimes mistakenly recognize this transition as a valid dash contact closure that is followed by a dot contact closure. Hence, “N” is transmitted instead of “A”.

When this happens, the dash closure used in sending “A” appears to be ignored while “N” is being transmitted. With smaller values of capacitor C6, the transition through the 3.8 volts region is faster. This in turn reduces the probability of falsely detecting a dash closure. However, with multiple transitions through the 3.8 volt region due to ongoing contact bounce, the problem can still occur.

In general, in the presence of contact bounce, a false detection of a contact closure can occur if the KEYIN voltage must transition through a region that represents a valid but unintended contact closure. The problem gets more complicated when true iambic keying is used, where four dis-

tinct voltage levels must be detected instead of three. (Closing both dot and dash contacts at the same time produces the fourth level, which is 0 volts.) It is a difficult problem to design a real time A/D conversion and voltage detection system that meets acceptable A/D charge holding times in the presence of significant contact bounce.

Here is my solution to this problem for my particular paddle. I am going with 100 pF for capacitor C6 in place of the 0.01 uF stock value, as this has clearly been shown to reduce the keying error rate in the presence of paddle contact bounce. C6 does provide some RC filtering for keying wires running external to the K1 that connect directly to the MCU. Consequently, I am uncomfortable with removing C6 entirely even though the data shows a slight decrease in keying errors with C6 totally removed. If I ever go back to using an external keyer, I’ll return C6 to the stock value.

Next, paddle adjustments were made to somewhat reduce contact bounce. Here is a list of actions that I experimented with:

- *Contact cleaning*—I lightly cleaned the paddle contacts with 600 grade ultra fine sand paper. No significant change in contact bounce was seen here. Some silver plating was removed from the contacts; be very careful if you attempt any contact cleaning by this somewhat harsh method.

[WA8MCQ note—For contact cleaning, you might want to try the dollar bill method instead since it is much less abrasive than sand paper. This is a very old trick. Place a dollar bill (or any other denomination) between the contacts, gently close them and pull the dollar out.

Repeat a few times. Disclaimer: I haven't done this personally in a number of years; I'm presuming that the basic "paper" of the latest bills, with all the security enhancements, is still the same as always.]

- *Contact spacing*—Narrowing the contact spacing provided a significant shortening of the contact bounce distribution. I settled for a very narrow contact spacing, narrower than I would have selected without this contact bounce study.

- *Spring tension*—Increasing spring tension helped with reducing the probability of an error.

- *Keying style*—This refers to paddle use such as slapping versus gently touching the paddle. I am a paddle slapper and all data presented in this article was taken with my slapping the paddle. Keying by gently pressing the paddle increased contact bounce.

My K1 and new paddle are now a joy to use. The error rate is not zero, but it has been reduced to a very low background level that is well below my own paddle errors. I intentionally didn't mention the manufacturer of my new paddle. That is because I have not compared it's contact bounce with any other paddle from this or any other manufacturer and don't want to assign a stigma to any particular paddle.

—de K8AX

Portable 6M Tomato Stake Loop Antenna

From long time QRP'er Jim Fitton, W1FMR—

This square, center fed full wave loop for 6 meters is simple, light and easy to tune. Hung from a low branch at the Lobstercon QRP camping event in Maine, KØZK and his Elecraft K3 had a bunch of us taking turns working Europeans. (It was my antenna and compared against his vertical it was more compact, went up quicker, heard better and was quieter.)

Figure 13 shows the basic idea. These bamboo stakes came from Ace Hardware but an online search for "bamboo garden stakes" brought up many sources.

The top and bottom supports are thin, 5 foot bamboo garden stakes and the conductor is 20 feet of #14 standard insulated wire. (Stranded is best, to reduce the chance of the wire breaking while in the field.) Form a wire square 5 feet on a side and tie it to the stakes at the top and bottom

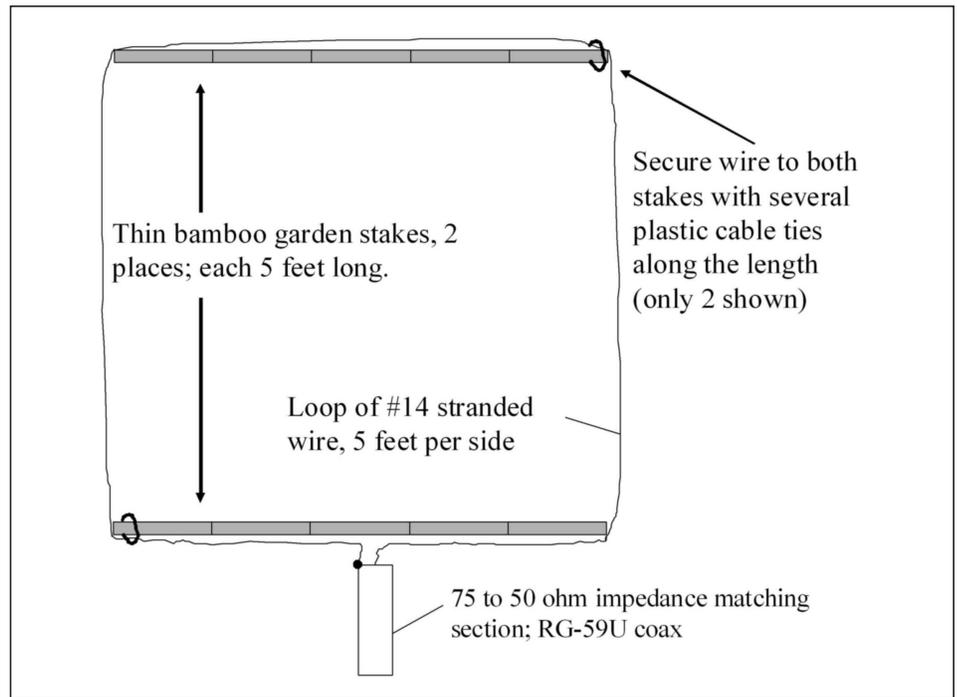


Figure 13—Some bamboo garden stakes and a bit of stranded wire make a handy portable 6 meter loop antenna.

with standard plastic cable ties. [Or Ty-raps, if you prefer the trademarked name. —MCQ] Put the loop opening at the center of the bottom stake.

Using some kind of antenna analyzer or "grid dip oscillator" (GDO), adjust the resonant frequency by connecting it to the loop ends and tune for a drop in SWR (dip). It occurred at 48.9 MHz for this loop. Bits of wire were cut off the loop while measuring for a dip until the frequency rose to 50.09 MHz. That frequency was chosen because it is the CW calling frequency in this country.

For a 100 to 50 ohm six meter quarter wave matching transformer, use a length of RG 59U coaxial cable. The coax is Belden # 9248, 75 ohms, with a VP of 82% and a BNC male connector on one end. (VP is the Velocity of Propagation for the particular type of RG59/U that you are using.)

The coax length was measured from the tip of the BNC to the other end. The formula: $(234/\text{freq.}) \times V_p \times 12$ provides the necessary RG59 coax length in inches. For #9248 coax use: $(234/50.090) \times 0.82 = 3.83$ feet, $\times 12 = 45.97$ inches.

Connect the shield and center conductor to the loop ends and a low SWR is possible and no antenna tuner is needed.

I thought it was so simple, cheap, and quick to build that it was worth trying and would probably outlast the tomatoes grow-

ing in the garden (a common use for the stakes).

—de W1FMR

Reseating Chips to Cure Bad Connections

During my USAF career in another life I was in electronics maintenance. We had to fill out a form on all repair jobs and a frequent phrase used for "corrective action" was "reseated" or "cleaned dirty contacts." Everything had sockets and connectors; vacuum tubes, ICs, circuit boards, cable connectors, etc. and there were lots of switches as well. All of this metal to metal contact sometimes produced open or intermittent connections for various reasons, and reseating and/or using contact cleaner would fix a lot of problems. If you have something that fails, simple actions like this will sometimes fix it right away without having to do extensive troubleshooting.

There was a discussion on the QRP-L online forum on the topic a while back.

From John Parnell, K7HV—

My trusty little QRP rig would not transmit or receive and the display was going crazy. It was odd since I had not been using it for a few weeks and it worked OK the previous time. I despaired since troubleshooting is not my strong suit. I

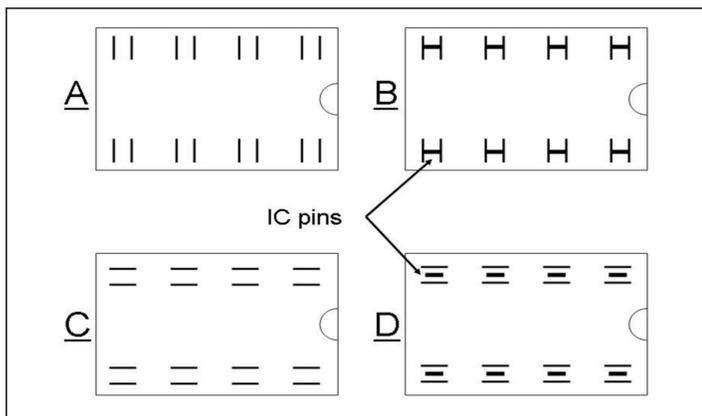


Figure 14—IC sockets with and without pins inserted. The contact orientation in C and D will have better long term reliability than A and B.

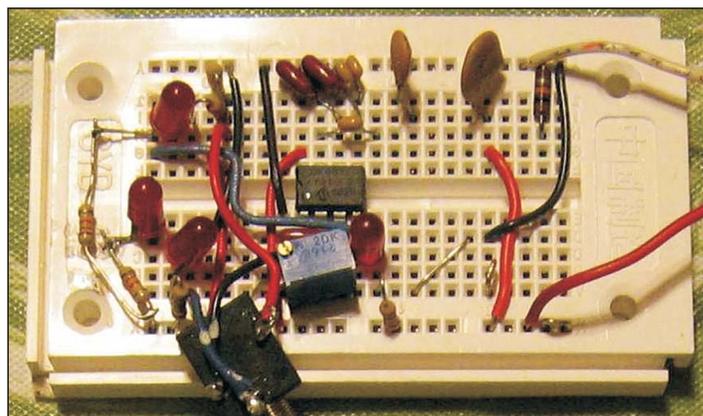


Figure 15—A typical solderless breadboard. If your circuit doesn't work right and everything else checks out OK, some of the internal contacts could be bad.

pulled the board out of the rig and gave it a careful once-over; all looked OK.

Then, while seeing all those ICs, I recalled what a techie friend suggested to me many years ago: try pressing them firmly to make sure they are seated properly. Sometimes the ambient heating and cooling can cause ICs to “wiggle” out a bit, resulting in a weak (or open) contact. I went through the board and GENTLY pressed each of the ICs into their sockets and noted that each moved in a bit when pressed. Then I applied power, antenna, speaker and key and everything was fine again. It had good receive and full output. I thought this was worthy of sharing since it might save some other poor soul some grief.

—de K7HV

KU8H reported a similar experience with his keyer, which also has socketed ICs. He said that he knew what to try first as soon as he opened it up and saw the sockets.

From John Farler, K4AVX—

When I was working as Tech Coordinator for our school system, and the PCs were at best DOS-based 286 versions, I would have to troubleshoot some of them, and the teachers were amazed that the first thing I did was a good slap or two on the work stations. They were more amazed when it sometimes worked.

Most devices, serial ports, printer ports and video cards were on separate cards that plugged into the motherboard, and were notorious for slipping as you described. I usually had to open the PC and wiggle to

reset the boards. Hot and cold rooms in schools made the effect worse, I think.

—de K4AVX

From Brad Thompson, AA1IP—

There's one type of IC socket that's particularly troublesome, and it was manufactured by Texas Instruments and possibly other companies. If you look at an 8-pin sockets openings, you'll see contacts that are oriented across the body as shown in Figure 14A.

These contacts grip the edges of an IC's pins as shown in Figure 14B. The IC pin edges are jagged and tend to cut through the contacts plating, which puts the pins base metal in contact with the contacts base metal, making for an oxidized and high-resistance contact that's intermittent. [WA8MCQ note: while the jagged edges may not be apparent to the naked eye, look at some of them under a low power stereo microscope and you'll see what he's talking about.]

If you remove and reinstall the IC (or even simply press down on its body), the pins will saw through the oxide and restore a reliable contact—for a while.

The most-reliable inexpensive IC sockets grip the pins' faces (Figure 14C and D) and provide a wiping contact that doesn't chew through the plating. Of course, crummy plating (e.g., silver pins that turn black in a sulfurous atmosphere) can degrade the contact performance, but here again, reseating the IC wipes the contact against the leads surfaces.

The most-reliable (and most expensive) IC sockets feature machined pins

with gold-plated inner gripping surfaces that perform well with either round or flat IC leads.

—de AA1IP

WA8MCQ comments—

The original posts on QRP-L mentioned specific companies and models but I deleted those so no one gets the wrong impression. These issues are hardly unique to them and can happen to anything electronic that relies on metal to metal contact for circuit paths.

Over the years I've seen occasional posts on various online forums in which a variety of things were restored by reseating ICs, circuit boards, etc. Experienced techs will usually try that first. If you have anything electronic that stops working properly, reseating all circuit boards, connectors, cables, etc. can sometimes clear the problem right away. Anything that has metal to metal contact is potentially a problem. It's a lot simpler to try that first before dragging out the multimeter, scope, etc. and spending a lot of time troubleshooting only to eventually discover that a bad connection was the problem. (I'd check all power supply voltages first, though. That, plus reseating and cleaning contacts, will often resolve performance issues.)

Beware the Solderless Breadboard

Design News, an industry trade journal, has an interesting blog on their web page called Made By Monkeys. It features stories from readers about strange design features and other issues in a wide variety of products which cause early failure, poor functionality, etc. An entry dated 9/3/2014

was titled “Defective Solderless Breadboard Causes Confusion” and subtitled, “When a circuit does not perform as expected, consider every part defective until it proves itself to be good!”

It talks about someone’s experiences with one that turned out to be bad. Figure 15, recycled from an N2CX Quickie in 2007, shows a typical one.

The bottom line is that if you build a circuit on one and it doesn’t behave like you think it should, don’t forget to suspect the breadboard itself when all else fails. These tie your entire circuit together with wires stuffed into a large number of spring loaded contacts, and there are various ways these can go bad internally, resulting in poor or open connections. For instance, the contact surfaces can get contaminated by foreign matter or oxidation over the years, or they could lose their springiness from repeated use or by inserting wires that are far too large. If the contacts are dirty or loose, trouble is sure to follow. If you have been using the same one for a long time you might want to make it the first thing you suspect when something goes wrong.

Some of the comments on the article reinforce what the author said; his was

hardly an isolated case, and this happens to a lot of people. I’ve personally seen this drive a few engineers crazy over the years at a previous job when their prototypes didn’t work right.

One person said that these have a bad reputation among all of the technicians and engineers that he has worked with, and that if a circuit did not work as expected it should be the first thing you suspect.

If you want to read the full article, the best way to find it is go to this URL:

http://www.designnews.com/author.asp?section_id=1367&doc_id=274607

You can also find it from the home page although it’s not terribly easy to find. Click on Blogs, then View Content by Month, select September 2014, then scroll down to 9/3/2014. It’s on the second page of the list.

You might see some other interesting articles on the way down. One of those is “Always Inspect the Fuses” from the Sherlock Ohms blog, a bit higher on the list, about fuses that look perfectly good to the naked eye but aren’t. (I’ve run across a lot of those over the years.)

If you register for the web site (www.designnews.com), you can subscribe to some of their free e-mail newsletters. I receive a few interesting ones such as Sherlock Ohms, Made by Monkeys, and Gadget Freak.

—de WA8MCQ

The Fine Print

The usual rules apply; send your ideas and projects to Severn any way you can get it here (e-mail, snail mail, 3 1/2" floppy, CD, handwritten on a napkin, etc), or tell me where you found something of interest on the Internet.

If you have something of interest and aren’t sure just where it should go in the *QRP Quarterly*, send it to whichever member of the editorial staff you think is best, and they’ll pass it along to someone else as appropriate. See page 3 for the *QQ* staff listing.

Well written, Pulitzer Prize quality articles are nice, as are computer drawn schematics, but don’t worry if you can’t do all that. We’ll take care of the rest, editing, redrawing, etc. The readers are waiting!



ERRATA:

Arduino SWR Analyzer

Figure 4 of the article, “The \$20 Arduino SWR Analyzer”, which appeared in the Fall 2014 issue of *QRP Quarterly*, contains an error. The integrated circuit U2 in the schematic should be marked as a type MCP6002.

RF RMS Voltmeter

Re: “Building and Using an L-Q Meter” in Fall 2014 *QRP Quarterly*.

I am ashamed to say in my haste I made 2 mistakes in the article on the L-Q Meter. In the Bill of Materials for the RF RMS Voltmeter:

- R3 was listed as a 10k fixed and should have been a trimmer, part number 3299W-103LF with a price of \$3.39.
- R6 was listed as a 1k fixed and should have been a trimmer, part number 3299-102LF, with a price of \$3,39

I realize it is obvious to the most casual observer, however, I wanted to pass the info on in case you are interrogated by an interested reader.

Thanks for publishing my article!

72, Fred E. Piering
WD9HNU

CW Sender Part IV: Adding a PC Keyboard

Ben Kuo—KK9FUT
Pete Juliano—N5QW

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radioguy90@hotmail.com

In this last article in the CW Sender series, we finally put all of the pieces together for a fully independent, stand alone project which you can use to send CW using a PC keyboard and an LCD display. In our three earlier articles, we provided an introduction to the power of the Arduino microprocessor and environment, with the aim of introducing more hams to the flexibility and power of combining software and microprocessors with homebrew ham radio projects. It's important to note that the purpose of this series was not to create the most efficient code or the ultimate CW keyer; it was to help hardware savvy hams to learn more about software and how it might be applicable to ham homebrewing.

If you've followed us along this journey, we started out with simply blinking LED ON and OFF to send CW (CW Sender Part I), gradually building up to driving a mechanical keyer using the Arduino (CW Sender Part II), to allowing users to type messages to the serial port on your PC and automatically sending that CW from the keyer (CW Sender Part III). In this process, we've shown you a little bit about writing software; helped you learn about subroutines, functions, and libraries; and also given you a little bit of a taste of how easy it is to add hardware like knobs, dials, and LCD displays to the Arduino.

In CW Sender Part II, we left you with an Arduino which was able to take serial port input from your computer, and use that to drive CW output, echoing that output to an LCD screen. The last step we have for CW Sender is to make this entirely independent of your PC, by adding an easy-to-obtain PS/2 keyboard to the project.

The Hardware

Our hardware is identical to the CW Sender in Part 3, with the addition of four additional connections. The pins on the PS/2 keyboard connector are +5 and GND, along with two data pins, which we connect to Arduino PIN3 (Clock) and Arduino PIN 4 (Data). A diagram of this connection is in Figure 1.

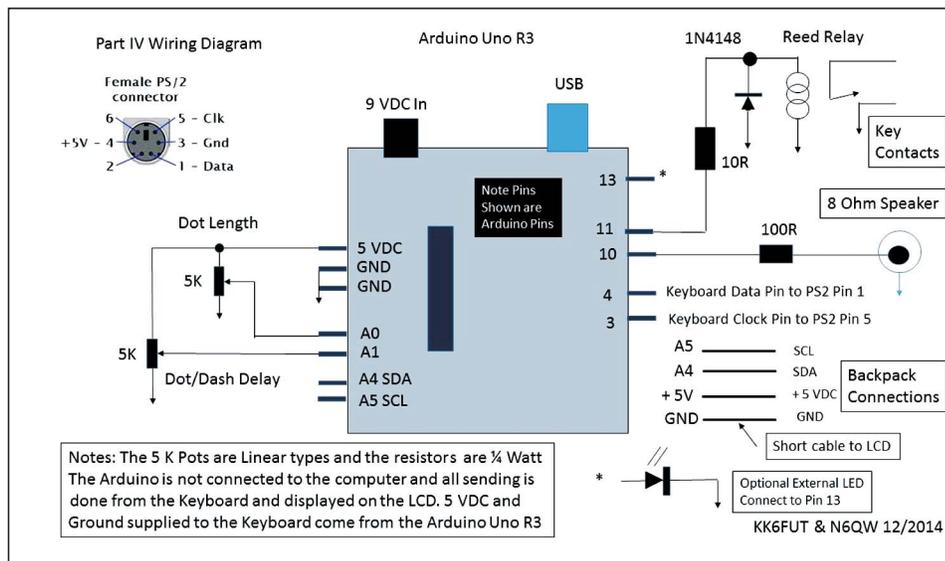


Figure 1—Addition of the PS/2 keyboard to the CW Sender.

The Software

Fortunately for us, as is often the case with Arduino, there are pre-existing libraries which help us to implement support for the PS/2 keyboard. We've used the PS2Keyboard library to fully implement all of our keyboard support. The PS2Keyboard library handles all of the software routines needed to intercept keys pressed on the keyboard, and makes them available in a buffer for the software to manage. Note: some versions of the PS2Keyboard library do not support upper and lower case, which is fine for us, as there is no such thing as lower case or upper case in CW!

In order to set up the keyboard libraries, we have to include two lines in the code prior to the setup() code. The first, shown in Figure 2, is to include the library itself. You'll have to include the library in your code, and also install the proper PS2Keyboard library in the Arduino library location. We've omitted the steps to install a library, which is well documented on the Arduino website. The second part of setting up the software, shown in Figure 3, is to initialize the library and that is done by the PS2Keyboard keyboard declaration. Again, these statements go in the code prior to the setup() function but in a slightly different location. We are not showing

the code in between as it has not changed. This is an example of one of what is called object-oriented programming, an artifact of the use of C++ type software coding in Arduino. We actually quietly did this in Part II with the Serial class. Understanding how object oriented programming works is way, way beyond the scope of this article, but the important thing to know is that rather than running functions on a variable, an object oriented variable like keyboard has built in functions. This is shown in the keyboard.available() function—which simply tells if there are characters available in the keyboard buffer when called.

In addition to the declarations of the keyboard, we also have to add another line to our setup routine, which starts the PS2 keyboard monitoring software. You can see that additional line in Figure 4.

In our loop() function, which we created before for the earlier version of the CW Sender, we are changing the software to go from monitoring the serial port, to checking the PS/2 keyboard. To do this, we use the PS2Keyboard library to check if any characters are available, and if so, reading that character and acting upon what was received. An example of that follows in Figure 5, where we've shown the snippet of code which checks for input. You'll note that the rest of the software is identical to

```
#include <Wire.h> // Needed for the LCD Display
#include<LiquidCrystal_I2C.h> //Needed for the LCD Display. This specific library is for the 16X2 LCD with the I2C backpack
#include <PS2Keyboard.h> // Needed for PS2 keyboard
|
```

Figure 2—Including the Library.

```
//keyboard
#define DATA_PIN 4
PS2Keyboard keyboard;
```

Figure 3—Setting up the keyboard control.

what we developed in the last article; the only difference here is we are now monitoring the keyboard—not the serial port—for input. In theory, you could write this to accept input from either source, but to simplify the code we’re only accepting PS/2 keyboard input in our example.

In the new loop, we use the function `keyboard.available()` to determine if there is keyboard input available; if so, we use `keyboard.read()` to read that byte. These are analogous to the `Serial.available()` commands and `Serial.read()` functions we

used for the serial port in Part III.

Next, we check for a canned message. As you might recall from CW Sender Part II, we check for special characters in a special function, using those characters as shortcuts to print a canned message. We have already used the equal sign (=) as a special character, because it is not used in normal CW conversation—and if that key is pressed, we send out a CQ. Be sure to change the code to your own call sign. The function `check_canned_message()` can be expanded to check for any ASCII character (including function keys) if you wanted to send your own different canned messages from the PS/2 keyboard. If the data read from the keyboard matches any of the special characters, a canned message is sent (case 1). If no canned message is indicated then data from the keyboard is sent (case 2).

Conclusion

In this article, we’ve wrapped up our CW Sender series, showing you how to go from blinking an LED on and off using the Arduino, to creating a fully independent project which you can use to send CW using a PC keyboard and an LCD display. Hopefully, you will have gained some understanding on how you can use Arduino in your ham radio projects, and learned a little bit about software and software building blocks.

Note: The complete Arduino sketch for part IV of the CW sender will be available for download from the following link. About mid-page the sketches for all parts of this series are available for downloading. See: http://www.jessystems.com/arduino_build.html.

—73, Ben, KK6FUT & Pete N6QW

```
void setup()
{
  pinMode(LED, OUTPUT); // sets the digital pin as output
  pinMode(relay, OUTPUT); //sets the relay pin
  pinMode(tonepin, OUTPUT); //Sets the speaker output
  keyboard.begin(DATA_PIN); // start monitoring PS2 keyboard

  Serial.begin(19200); // opens serial port, sets data rate to 19200 bps. 9600 (slower) can be used.
                      // But you must use the same data rate in the serial terminal program

  //lcd.init(); // initialize LCD - commented out by KK6FUT for testing
  lcd.backlight();
  lcd.setCursor(0,0); // This places a display on the LCD at turn on at the 1st line
  lcd.print(" KK6FUT & N6QW "); //Any LCD message can be place here. Just make sure there are 16 spaces between the "" marks
```

Figure 4—Our new setup() routine.

```
int incomingByte = 0; // for incoming serial data

void loop() {

  if(keyboard.available()) {
    // send data only when you receive data:
    // read the incoming byte from PS2:
    incomingByte = keyboard.read();
    if (check_canned_message(incomingByte)) {
      // if =1, we sent canned message, so don't send that character
    } else {
      incomingByte = toupper(incomingByte); // make sure this is uppercase
      sendchar(incomingByte);
      Serial.write(incomingByte); // this is used to display the letters on the computer screen
    }
  }
}
```

Figure 5—Snippet of our new loop routine.

Out and About with QRP

Craig Behrens—NM4T

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It's 27 degrees out this 12/12/14 morning and it's a great time to be inside, settled in my easy chair.

I've already watched hyper Weather Channel professionals on television jumping around, waving their arms at the many crazy weather events scattered about our country this time of year and I just refilled my favorite coffee cup with some fresh Duncan Donuts coffee.

Time to write this Winter *QQ* column. First, I'll offer a belated (but sincere) Season's Greetings—I hope that you and yours have had a great holiday season! Now, let's take a look at a couple great QRP adventures.

If you're like me, you probably have a short list of guys that you especially like to share field operation adventures with. (If you don't—I suggest that you pursue this idea.) Four of my favorite "short list" guys are: Jerry Brown, N4EO, Bill Milligan, K4BX, Larry Morphew, NS4Q and Randy Moore, KS4L.

Major fun begins when we start our brainstorming activities, looking for new, interesting places to visit for the expressed purpose of getting into some major QRP mischief. This starts out wild and crazy and (eventually) settles down to something that is humanly possible.

We last shifted into the "serious" mode when a short window of opportunity presented itself. Two weeks of superb Fall weather was ours to exploit before the Winter weather would start rolling in.

Our intrepid little team pursued Randy's idea to operate along the historic Natchez Trace. So, I'll present these two outings as examples we can vicariously relive together and ponder where we might go next.

The October 30th Water Valley Overlook was our first Natchez Trace site outing (Figure 1). An interesting footnote about this location is that it was once part N4EO's father's 130-acre farm, originally purchased in 1948 for \$64 an acre. (The government since reclaimed this part of his land.)

Here's Jerry's short summary for this operation:

"Special thanks to Terry WAØITP and Randy KS4L for getting us off to a good start with the QSOs!

The Water Valley Overlook turned out to be a "magic spot," since 10 and 15 meters proved HOT.

K4BX, NS4Q and N4EO started the day early, just after 9 AM CDST, with 40 meter Qs: WAØITP, KS4L, K4PHA, K8MP/m, and W3KC.

On to 10 Meters: DL4CF, LI6CF, UX3IW, 9A1KDE (handle BOZO), SP2XF, XE2I, GJ3YHU, CN8KD (BX QSO), G4RRA. EA7ATE, CN8KD (EO QSO), and S59N.

On to 15-Meters: OH6NVC, N2JI, VO1MP, CO8LY, and FT4TA (worked at 1904Z).

They snagged FT4TA, Tromelin Island in the Indian Ocean some 9700+ miles

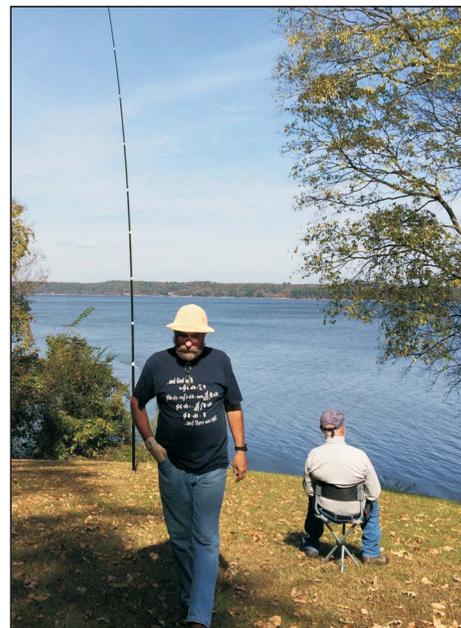


Figure 2—N4EO all business as NS4Q enjoys the view.

away—more than 1,900 miles/watt—as their best DX of day. (See link <<http://www.tromelin2014.com/en/>> for more information on FT4TA.)

This contact was made with a K3 running 5-watts to an end-fed 3/2 wavelength sloper antenna with the top at 38 feet and other end at ground level. The antenna was sloped on an azimuth of 60 degrees."

And, as is often the case with QRP—they got him first and while simplex—just one step ahead of the giant PILEUP that



Figure 1—K4BX and NS4Q transmitting at Water Valley Overlook.



Figure 3—K4BX and NS4Q at caffeine and carbo generator.



Figure 4—KS4L working the “big rig” (K3).



Figure 5—N4EO and KS4L cranking out QSOs.

immediately followed.

Finally, Jerry’s loud hoots from this thrill still lingers. He just informed me that he finally got the ARRL’s Logbook of the World up and running with his call. And guess what—his first confirmation happens to be none other than FT4TA. Not a bad way to start with LoTW, I’d say!

Our second Natchez Trace outing by KS4L, NS4Q, K4BX and N4EO was November 4th at Colbert Ferry, on the Alabama side of the Tennessee River, between parkway mile markers 320 and 330. Here’s the link to map:

http://www.nps.gov/natr/planyourvisit/upload/NATRmap_230-341_web.pdf

The guys operated Jerry’s Elecraft K-3 (the one he operated from YI9EO), Larry’s K-2, and Randy’s ATS-4.

An end-fed half-wave, (EFHW) sloper antenna (Figure-2) was used for 40 meters and EFHW verticals were used on the higher bands. And the “Carbo Generator” station (Figure 3) was up and running. Everything was ready for a fun day.

10 meters proved the band of choice and here is a list of our contacts from there with N4EO’s K-3 (Figures 4 & 5) between 1600Z and 1930Z.

G4TMQ, KW7D, CO8ZZ, EA8OM, HB9CVQ, CT3FT, F6HKA, PA3DRL, and KH6BB (Battleship Missouri Radio Club Station in Pearl Harbor).

15 meters: Randy made a few contacts with his ATS-4 (Figure 6) and an EFHW. Mostly, we enjoyed the time for fellowship and wonderful Indian summer weather and the views.

The best DX this time was the club station for the Mighty Mo (Battleship Missouri) at Pearl Harbor (KH6BB). This was on 15 meters at 1930Z with their operator, Ray, WH6ASW. (NOTE: both of these calls have interesting write-ups on QRZ.com.) Photos composed by K4BX can be viewed at the following link:

<http://youtube/scV6CKq4C7M>

Asking Randy about this trip would (I’ll bet) produce a smile and a quick confession that the 95-mile drive from his front door was well worth it!

Please note that such outings are always more successful and more memorable when the rest of us (at home) make a special effort to work the field ops and to spot them on the Internet so others will join in the fun.

Next, let’s take a different kind of look at our portable power sources, an item

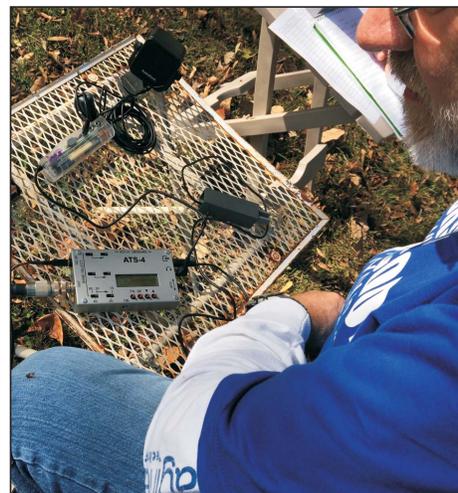


Figure 6—NS4Q with ATS-4 setup.

wrought with compromises and system design trade-offs.

QRPer’s share (and continually struggle with) the challenge of finding the best power source trade-offs for our field and emergency operation activities. Here, we are faced with decisions that we seldom feel good about.

Many backpackers, for example, who must carry their equipment long distances and to mountain summits, count their equipment weight in fractions of ounces. They sacrifice the size of their batteries and often have less than the full 12+ volt-age source that most rigs require to achieve full transmitter output levels. Therefore, their operational time becomes severely limited due to the trade-offs they’ve had to make to minimize weight.

At the other end of the spectrum, some operators simply take an old car battery to a picnic table in a park. This is often a cheap solution and having enough power is not an issue. Off course, the likelihood of getting a hernia from carrying the battery might prove this approach to be a less than perfect, too.

We portable operation fans spend a lot of time researching batteries and other power sources. Most of us have evolved a (not so) short list with candidate products we would like to own. However, as with most things in life—the most effective power sources are also the most expensive and difficult for us to justify owning.

Since this is so, I thought it would be of value for us to redirect our thinking concerning what we currently use for our portable power sources.

I’m thinking that it’s time to take a



Figure 7—Goal Zero YETI-400 Power Pack.



Figure 8—Goal Zero YETI-50 and YETI-100 Power Packs.

“value proposition” approach, one that factors in new technology and power products that are now available and becoming more affordable.

This should also be a defensive action that deals with the many unique battery chargers required to keep all of our devices with batteries working.

So how does one address this dilemma without having to carry 20 different battery chargers with us everywhere we travel?

Let’s consider adjusting our current system trade-offs to those that better justify the “all-around utility” of the power sources we currently own. The question becomes “How can we make our investment better serve our needs by making them more flexible and capable?”

Let’s start with the given that we want these portable radio operation grab-and-go systems for our to work reliably in the field, to our performance expectations. Further, we want systems that can be easily maintained and always ready with a full-charge for use on short notice.

However, suppose for example that our radio power system implementations would also include support capabilities for:

- Keeping cellphones, PDA’s, computers charged
- Emergency situations with medical equipment
- For miscellaneous needs at non-radio events we support
- For outdoor outings and tailgating—lights, tools, music, etc.
- As loaner power for those without home power

OK, so what might such a portable power system look like?

One easy way to approach this is to highlight a couple new, representative technology products that are now available to consumers. Let’s start with a few Goal Zero power products to illustrate some new design possibilities worth consideration.

I’ll briefly point out some of the design approach features that relate to our goal for increased functionality via incorporation of flexible interfaces.

First a disclaimer: I don’t work for or receive any pecuniary considerations from Goal Zero company. They didn’t solicit my comments, etc. However, I do own some of their products and they have served me well.

As a side note: Goal Zero has been recognized as one of the best new American companies for solar and power-centric components, something that should be easy to understand when you check out their technology offerings.

First let’s look at the Goal Zero YETI-400 in terms of its power application flexibility (Figure 7). With 400 Wh, 33 Ah and weighing 29 pounds, this is my car transportable battery. Its AGM battery is can be charged via AC, DC and solar cell panel sources (i.e. at home, in the car and in the field).

(NOTE: The photo shows my handie talkie being charged via the cigarette lighter socket, while my iPad is being charged via a USB port and a PowerPole cable provides power to a rig.)

Although you wouldn’t want to carry this very far-this size of power source

allows one to campout in style and/or live “off the grid” for periods of time. If home power is lost, for example, it is big enough to keep laptops, CPAP and even allow for a modest amount of TV operation.

Anderson PowerPole connectors on two of its sides facilitate chaining of these batteries, if desired.

The front panel connectors include a charging port, a battery status charging/discharging indication status display, 12 VDC, USB and AC ports as well as on/off switches and status LEDs for functions selected. (NOTE: Solar panels can also plug into all the units I’m presenting.)

As you can see by taking a look at the Goal Zero website for this product (and the other product designs I reference below), this degree of integration presents a lot of application possibilities:

<http://www.goalzero.com/power-packs>

The cost to acquire innovative and integrated products like this is somewhat expensive, but the price for this technology continues to drop as capability increases for better performance per dollar invested.

However, the operative point to consider here is-how cost effective this could be if you were to scrounge parts and home brew similar implementations yourself.

Next, let’s take a very quick look at two other field portable batteries (Figure 8) that I current use. The YETI-50 is great for short radio field operations of a few hours and the YETI-100 works well for full day and/or weekend outings.

While the packaging for these portable



Figure 9—Goal Zero Torch-250 Cross-Functionality.

power systems may be slightly larger and heavier than what you may be currently using, it should be obvious as to how much value they could provide when your application does not demand a highly specialized (minimalist) design configuration.

Now, let's change product types while maintaining the same path of thought for functional integration and application flexibility. Let's take a look at Goal Zero's new portable light product, the Torch-250 (Figure 9) for addressing more than just field application needs.

Besides providing white or red light for 7 to 48 hours in various forms and intensities, the Torch-250 allows recharging its Li-NMC battery via an USB port, and it has its own built-in solar panel and a hand crank for alternate charging means. In addition, it has an USB output for charging your cellphone and/or other personal devices. (I own two of these, one for home use and I keep the other in my Jeep.)

Hopefully, by now, you are coming up with additional ideas on how you/we can improve the value proposition for our power support resources.

Next, let's look at the NOMAD-20 Solar Panel (Figure 10), a non-battery power source product that also goes the extra mile in terms of user flexibility.

The NOMAD-20 Solar panel (I own 2 of these) folds into a 2.5-pound bundle (Figure-11) that includes a pocket with the charge controller, charging cables and various adaptors for your battery. It also provides a separate USB charging output port for charging your personal devices.

To give you a feel for how long it takes to charge a battery and the different charging times per approach let's look at one of



Figure 10—Goal Zero NOMAD-20 Solar Panel power interfaces.

the batteries I mentioned above, the SHERPA-100 (with 98 Wh).

Using the wall charger (45W) will take approximately 3 hours; the car charger (30 W) will take 4 hours; the Nomad 20 Solar Panel 10-20 hours, depending on sunlight conditions.

So, we can see that recharging the SHERPA-100 will (most likely) require two NOMAD-20 solar panels to get a full recharge done on a day with reasonable sunlight.

Besides being application friendly, this product is designed to be particularly durable for this kind of technology. Additional details for this can be found at:

<http://www.goalzero.com/solar-panels>

I've included one last illustration to conclude this topic. Three really cool things about these portable solar arrays. First, they can easily be attached to your backpack (Figure 11) charging equipment while in transit and quickly laid-out on a rock (or whatever) for use. Second, they can be used to power devices directly (i.e. without using batteries). And third, perhaps of most value to us hams—they can be charging our batteries while we're operating our radios and/or other devices to extend the length of uninterrupted time we can have power available.

Off course, we have only scratched the surface as to what can be done to improve our operational capabilities, but I hope I have tweaked your interest and that I have encouraged you to surf the Internet to seek out other new product types that can provide more value and flexibility. Another product area, for example, to examine is that of emergency battery jump-starting



Figure 11—Goal Zero NOMAD-20 Solar Panel deployed.

systems for motor vehicles. Here, you may discover a different set of functions you would like to have to better address your specific application needs.

To help you get started—here's a site that compares the top seven (of the many) products of this application type that are currently available:

<http://www.carbatterychargerscentral.com/car-starter-top-7-compact-battery-jump-starters/>

In closing this column, my *QRP Quarterly* challenge is for ya'll to get busy and improve the capabilities of your portable power systems. (Not surprised by this one, are you.)

However, this time, I am upping the ante by suggesting that the person(s) who take(s) this to the next level will have extremely worthy entries for the next Four Days in May (FDIM) Home Brew Contest!

So... Who will emulate and improve upon the power system device interface examples I presented above?

And, who will create kits with heavy printed circuit boards so we can all build our own new, improved power go-pack systems?

Hey! I'm ready to buy and build such a kit—aren't you?

So, please get busy and email me direct (craigb44@msn.com) to let me know how you're doing!

—Craig, NM4T



Improving the Vackar Oscillator

David White—WN5Y

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Recently, I had a work assignment which required me to investigate a type of oscillator called the Vackar oscillator, which typically has above average stability and a relatively wide tuning range. In the early phases of that investigation, I happened to attend a Webinar called “Discrete Oscillator Design” by Randall Rhea, N4HI [1]. A review of this Webinar will help in understanding the concepts of this article and can be found on the Internet at:

<https://www.youtube.com/watch?v=VjFWZpCaNkg>

Or, use this search entry, “YouTube Discrete Oscillator Design.” In this webinar, new theories for oscillator design were illustrated using a Genesys design software workspace designed by Rhea for a Colpitts oscillator [1]. Mr. Rhea mentioned that a workspace for a Vackar oscillator was available to run in Genesys [2].

Now, I had a ready-made method for doing my investigation. All I had to do was obtain a copy of that design software and Rhea’s Vackar model. Most of my time could be spent gaining a wider understanding of this useful oscillator and see if it could be improved. Fortunately, the software was available on a 30 day free trial basis, which meant that I could avoid the usual hassle of trying to obtain company funds. That was indeed fortunate because the price of this high performance design software can easily exceed \$10,000.

So, I downloaded the free trial software and the Vackar workspace and went to work. All I had to do was enter the part values and change the operating frequency. The workspace has the circuit, ports and goals already configured. [3]

The first subjects to explore are the basics of the simulation and dissecting the oscillator to understand its operation.

Basics of the Simulation

Genesys uses S-parameters to show the results of its simulations. If you need a quick course on this method of describing circuits, I suggest http://en.wikipedia.org/wiki/Scattering_parameters. In particular, we will be talking about S_{21} , a complex

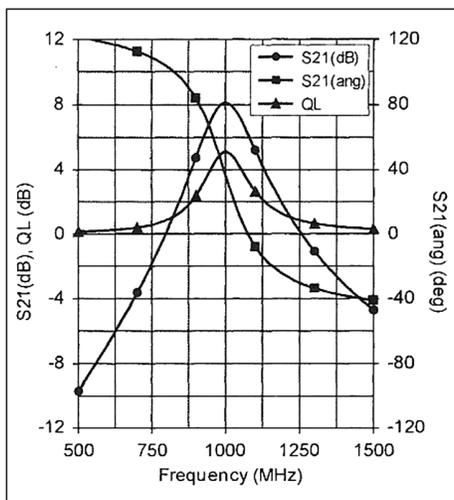


Figure 1—Typical response chart.

number showing the forward gain of the circuit. Magnitude and phase angle of the gain will be shown in charts as a function of frequency. The charts will show the gain of the amplifier, Q_L (loaded Q of the resonator), phase zero crossing and angle. The goals of this graph are to make S_{21} (ang) as steep as possible, S_{21} (dB) between 3 to 8 dB, and Q_L to >30 dB. The zero crossing of the S_{21} (ang) should line up with the peak of S_{21} (dB) and Q_L . A typical Response Chart is shown in Figure 1. [4] Notice that the S_{21} (ang) zero crossing is a half a division to the right vertically of the peaks of the S_{21} (dB) and Q_L curves. The S_{21} (ang) zero crossing should be in line with the peaks of the other curves. The oscillator the chart represents needs improvement.

The Genesys program produces the chart from the part values in the schematic and running the simulation. Multiple part values can be marked for tuning. All marked part values will be available for tuning in the simulation.

The simulation is governed by the goals set in the Opt and Opt Linear parts of the simulation. The goals are preset in the workspace, plus all other values needed for the simulation. The only changes made to the original workspace are setting the frequency values and the part values in the schematic. Q_L is determined by an equation inserted into the workspace tree based on the S-parameters.

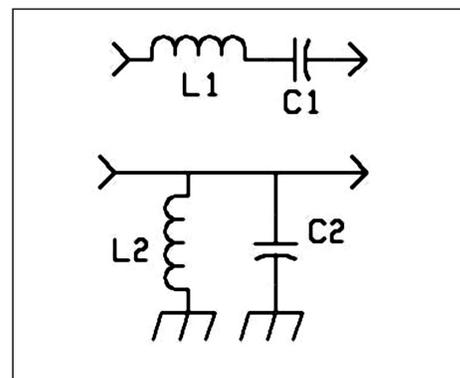


Figure 2—Series (top) and parallel (bottom) resonators.

Dissecting an Oscillator

An oscillator is broken into three parts for analysis: the resonator, resonator coupling and the amplifier (or sustaining stage). “The amplifier provides energy for the system and is sometimes called the sustaining stage. The resonator controls the operating frequency and this critical component determines many performance parameters of the oscillator.” [5] Power is taken from a node of the amplifier or resonator using a coupling capacitor.

The resonator determines the oscillation frequency, the long-term stability, and the phase noise. “The resonator provides three functions:

1. Insures that phase 0 exists at one and only one frequency. This is accomplished by amplitude selectivity.
2. Used to create a steep slope in the cascade transmission phase. This improves long- and short-term stability that makes the oscillator immune to perturbations in the phase shift of the amplifier caused by device variation, temperature, the power supply voltage, and device noise.
3. Used as a matching device to correct for dissimilar impedance at the input and output of the cascade amplifier eliminating the need for additional matching networks that would add to the complexity of the oscillator.” [6]

Figure 2 illustrates series and parallel resonators that realize the functions listed above.

Most important to resonator coupling is the RL (Return Loss) figure that is read in the Match Chart, a version of the Smith

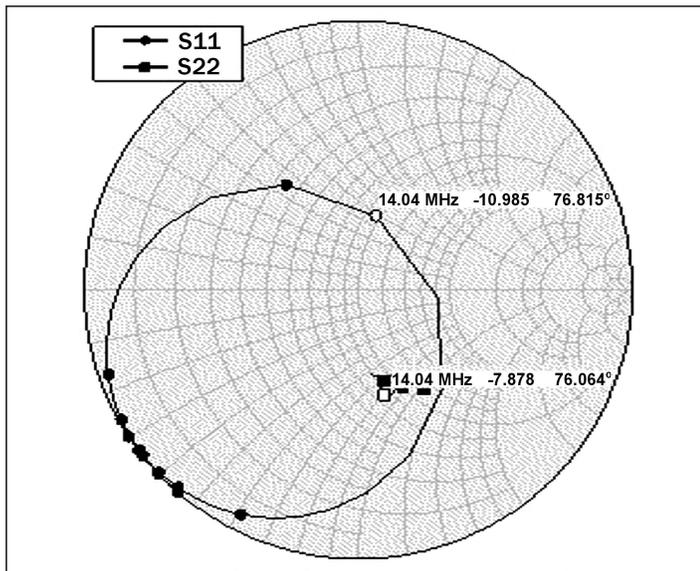


Figure 3—Match chart for the simulated oscillator.

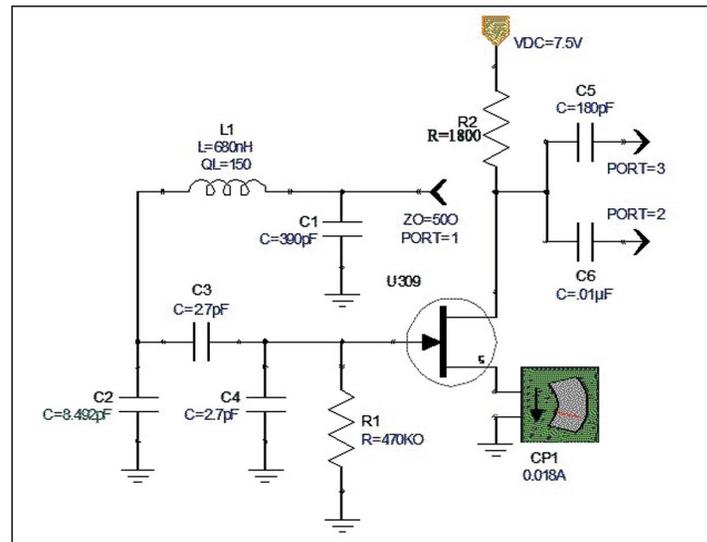


Figure 5—100 MHz Vackar oscillator from Rhea's workspace simulations.

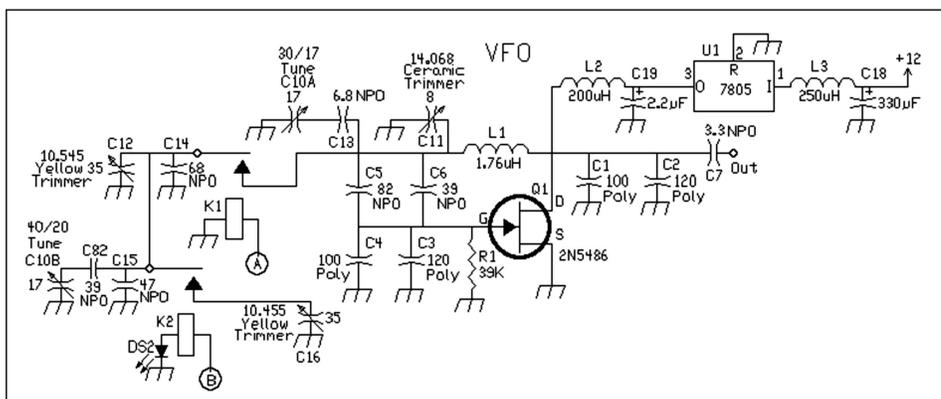


Figure 4—Original schematic derived from WUØL's article.

chart produced by Genesys. It indicates the match of the resonator with the sustaining stage. S-parameters S_{11} and S_{22} are used to produce the lines on this chart. At the simulation frequency, the chart will show a negative value. The positive of those values is the RL for the resonator (Figure 3).

The desired values are 10 dB (−10dB on the chart). This value can be a little below 10 dB and still be OK. “When the S-parameters of −10 dB are achieved, the error of the predicted cascade gain and phase are small. If the S-parameters at one port are small, a poorer match at the remaining port is tolerated.” [7] It is very important that these values are close to optimum or the entire analysis of the oscillator will be invalid.

The sustaining stage provides the gain margin and supplies oscillator output power. The amplifier needs to be stable and low noise. The ideal amplifier pro-

vides only gain and power and does not influence the transfer phase, which determines the oscillator frequency, noise and stability. The Vackar uses a JFET amplifier for its sustaining stage. The best JFETs suggested by Mr. Rhea are the J308, J309, and the J310 for they do not require the stabilization that many other JFET and GaAsFET devices require.

A typical goal for amplifier gain is 3 to 8 dB. Higher gain leads to excessive compression leading to high harmonics, spurious oscillation modes, and degraded noise performance. Lower gain and the oscillator will not oscillate. When gain is at the upper limit, higher power helps lower the phase noise of the oscillator. Other benefits are faster starting and high conversion efficiency.

Designing for Low Phase Noise

Mr. Rhea states that oscillators start

from ringing caused in the tuned circuit from the initial hit of startup voltage. This “start up ringing” allows circuit improvements to lower oscillator noise and still have fast oscillator starting.

Optimizing the Vackar for maximum power lowers phase noise. Higher power lowers phase noise for almost any oscillator configuration. [8]

Other points to consider in lowering phase noise are the following:

1. Avoid zeners and inexpensive voltage regulators. The very best low-noise power supply is a battery.
2. Output power coupling should be full coupling. Do not use a very low capacitor value to couple the oscillator to the buffer.
3. Do not use a buffer. A higher power oscillator uses more current but the current of an active buffer is avoided.
4. Varactor modulation noise is reduced if the tuning range of the varactor is very small. This indicates that Huff and Puff stabilizers that only tune 5 to 10 kHz contribute very little to the noise of an oscillator. Maintain reverse DC bias on the tuning varactors and the RF voltage below 1 volt peak. Use back-to-back varactors.
5. Higher loaded Q for the resonator will reduce phase noise. However, increasing the resonator unloaded Q without increasing the loaded Q is of limited benefit.
6. Keep the oscillator cool. There is a trade-off between high output power for low noise and device temperature. [9]

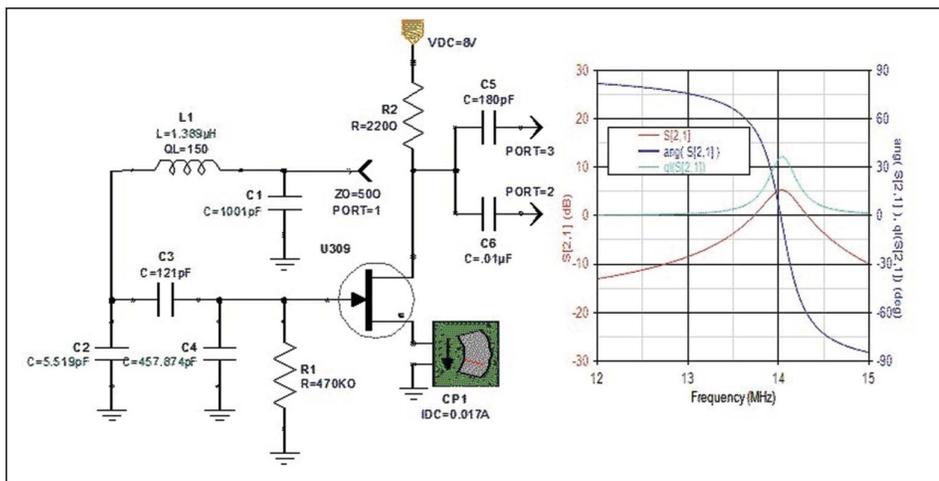


Figure 6—First successful simulation.

A major design change in the Vackar was the elimination of the RF choke on the B+ feed. Rhea replaced the RF choke with an 1800 ohm resistor. I found that the RF choke caused considerable drift if the choke was not carefully chosen. Eliminating this choke adds stability to the Vackar especially above 10 MHz.

The Vackar Simulation

The example oscillator used to illustrate Rhea's theories in the Genesys simulation program is the Vackar oscillator used in the Electroluminescent Receiver Kit (ELR). [10] The ELR kit's Vackar oscillator is from *QEX*, July 1997, "Meet the Vackar: The Simple, Stable VFO You've Been Looking For," by Mark L. Meyer, WUØL. This circuit was optimized for 4 MHz. WUØL's component formula was used to change the part values to the frequency of choice (14 MHz). See Figure 4. The combination of C5 and C6 is the value of the feedback capacitor. The oscillator is designed for 14 MHz and extra capacitance is added with switches to get 10.455 MHz and 10.545 MHz.

The simulation used Rhea's Vackar workspace and is shown in Figure 5. It incorporates the modifications suggested for low phase noise operation. Changes to WUØL's circuit were a J309 FET replaced the 2N5486, the RF choke was removed, and an eight-volt regulator was used. R2 replaced the RF choke and was changed to 2.2k so the current draw approximated the original value of 0.018 amps in the workspace (0.017 amps was the final value).

The oscillator was simulated with Genesys at 14 MHz, built on the bench and

checked for oscillation at 10.455 MHz and 10.545 MHz.

The first successful simulation is shown in Figure 6. Notice that oscillator gain and Qu peak are in line with the phase zero crossing of $\text{ang } S(2,1)$.

As this simulation progressed, it was tested on the workbench. The value of the feedback capacitor (C3) determined the range of the tuning capacitor (C10A from Figure 4, C3 in Figure 6). The smaller the value of the feedback capacitor, the wider the range of the tuning capacitor—from 150 kHz with 121 pF to over 500 kHz with values around 50 pF.

The feedback capacitor value was then locked at 121 pF and the simulation run with all other capacitor values made variable. The resulting tuning range was a little higher (~200 kHz). It may be assumed that, with a given tuning capacitor value, the value of the feedback capacitor can set its range.

The capacitor values needed to move the frequency to the lower values (10.545 & 10.455 MHz) were much smaller. C16 (Figure 4) had to be changed to a 1 to 5 pF trimmer and C14 and C15 were lowered to less than half their original value. Values were influenced by the printed circuit board (PCB) stray capacitance.

Workbench tests have shown that the feedback capacitor is critical to achieve good stability. The highest quality NPO capacitor must be used! When running stability tests on the Figure 4 schematic with a polystyrene feedback capacitor (a negative coefficient capacitor), the oscillator showed very strong negative drift. This effect carried over to the bench tested sim-

ulated oscillators.

Another successful simulation is shown in Figure 7, included to show the result of very high values of L1 (5.359 uH) and C1 (650 pF). Notice a steeper $\text{ang } S(2,1)$ curve and a much higher Qu value. Who would ever image that these resonator values would produce a 14 MHz oscillator! The simulation lowered the values of C2 and C3 needed to achieve oscillation at 14 MHz.

On the workbench, 6 turns were taken off L1 and the value of C2 was about 1.6 pF. To be within the simulation values, the tuning capacitor would have to be a single plate variable capacitor and would have a very wide tuning range. A 2 to 5 pF ceramic trimmer was used on the workbench to tune the Figure 7 oscillator.

Comments and Results

1. Even though Genesys is relatively low-cost software for a commercial venture, it is way above casual homebrewer's budgets. Fortunately, Keysight Technologies [*the recently changed name for Agilent Technologies—ed.*] offers a 30-day free trial period. [12] Thirty days may seem like a long time, but with a 40 hour work week, it goes by very fast. So, have a specific goal in mind and a well thought out project before beginning the trial.

2. Workbench validation of the simulations is a necessary part of any project. Maximize your time by having a specific oscillator with a test PCB or dead-bug prototype already set up in which components can be quickly switched out. Building the simulations must be done to evaluate what will work for an application and shows what factors are important for additional simulations. For the author, the tuning range of the oscillator proved to be an important factor and was very easy to determine with the simulations.

3. The smaller the feedback capacitor (C3), the wider the tuning range became.

4. As a rule, the value of the feedback capacitor (C3) was directly related to the output level, i.e., the higher the feedback capacitor value the higher the output. "Capacitors C3 and C4 form a voltage divider that reduce the open-loop gain. Therefore, capacitor C3 may be used to control the gain." [11]

5. Going outside of the recommended values set by Rhea for optimal oscillator functionality did not result in a better oscil-

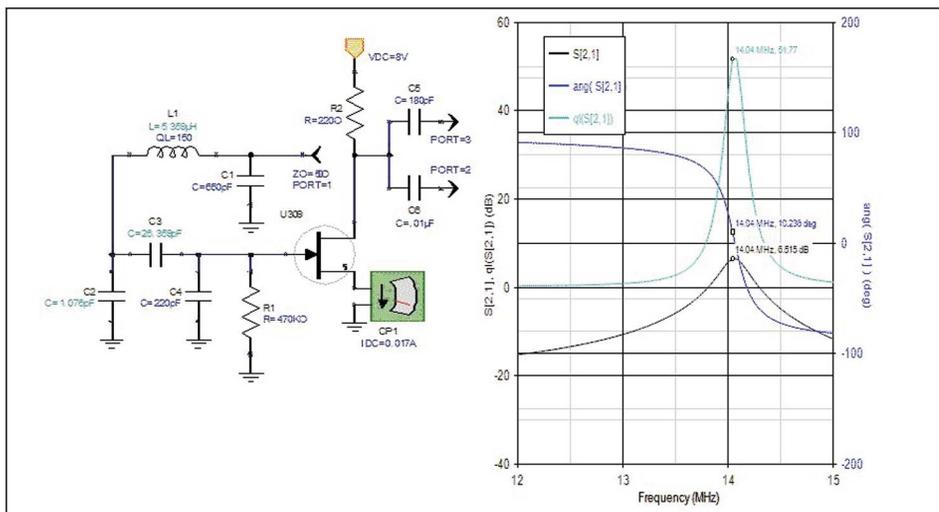


Figure 7—Resulting simulation with high L1 and C1 values.

lator. For example, using the high L/C resonator values with very high Q made the oscillator very sensitive to PCB trace L/C values and any nearby objects. Stability equal to the original oscillator was very difficult to achieve. The very small feedback capacitor value of 23 pF was contributing to this problem.

4. Maximizing stability for the Vackar is still a matter of selecting the right capacitors and testing temperature drift over a period of time. If a very steep $S_{21}(\text{ang})$ curve could be achieved without compromising tuning range, optimal gain and Q values, stability would improve.

5. Very wide ranges of L/C resonator values can be used. If an advantage can be found for a certain set of L/C values, Genesys can calculate the values of the other capacitors for the oscillator to work at the given frequency. Trying to guess at these values on the bench is very difficult. Genesys calculates them in a couple of minutes. Just line up the phase zero crossing with the gain peak and make sure the gain is between the 3 to 8 dB range. Q_L will be >40 dB at extremely high L/C resonator values.

6. The high L/C (Figure 7) version's high sensitivity to capacitor values made it very easy to find capacitors that caused a lot of drift. Using a slightly better NPO feedback capacitor made a slight improvement. However, a 2-5 pF ceramic trimmer was a huge negative coefficient drift offender. This version of the Vackar made it easy to improve drift of the other simulation and the original circuit.

7. The equipment for phase noise mea-

surements was not available so improvements in phase noise could not be determined. All the simulated circuits had excellent short-term stability, but long-term stability with temperature changes at the workbench caused slow drifting. A perfect VFO that was immune to active device parameters or temperature changes was not found ($S_{21}(\text{ang})$ curve almost perfectly vertical). Thirty days was not enough time to achieve that goal.

Conclusion

The purpose of this article is to open the reader's mind to an expanded theory of oscillator design. Having a new understanding of oscillator theory can lead to wiser choices and improve on older oscillator designs. Knowing oscillator parameters helps choose the right VFO for a receiver design.

Working with Genesys and Rhea's workspaces was pure joy. It was very disappointing when the evaluation period ran out. This program is as much fun and addictive as a video game.

As a final note, if you plan to contact Keysight Technologies concerning their 30 day trial of the Genesys software be sure to include your callsign as this will connect you with the article and insure approval.

References

1. A review of this Webinar will help in understanding the concepts of this article and can be found on the Internet at: <https://www.youtube.com/watch?v=VjFWZpCaNkg>.

Or use this search entry: YouTube

Discrete Oscillator Design

2. Genesys can be found at <http://www.keysight.com/ja/pc-1297125/genesys-rf-and-microwave-design-software>

Or use this search entry: Keysight Technologies Genesys

3. Workspaces can be found at: <http://www.agilent.com/find/eesof-genesys-osc-workspaces>. Or use this search entry: Keysight Technologies Discrete Oscillator Design

Note: The link to the Webinar does not work on this page.

4. Randall W. Rhea, *Discrete Oscillator Design*, Artech House, Boston | London, Page 2.

5. Ibid., Page 1

6. Ibid, Page 43

7. Ibid, Page 10

8. Two excellent articles by Ulrich L. Rohde, "Effects of Noise in Receiving Systems," by Ulrich L. Rohde, DJ2LR, *Ham Radio*, November 1977, pg 34, has a couple of low noise VFO and crystal oscillator circuits for further study. Second, "Evaluating noise sideband performance in oscillators," by Ulrich L. Rohde/DJ2LR, *Ham Radio*, October 1978, pg 51, has 2 very nice low noise crystal oscillator circuits with +17 dBm output that cover 400 kHz-30 MHz and 30-100 MHz. Also, K7HFD's low noise high power oscillator in the 2000 *ARRL Handbook*, Page 14.18, and in *Solid State Design for the Radio Amateur*, 2nd edition, by Wes Hayward & Doug DeMaw, Page 126.

9. Mr. Rhea lists 17 points on how to reduce noise in section 4.4.6, "Reducing Oscillator Noise Summary," Page 204-205.

10. Amateur Radio Receivers at <http://www.amateurradioreceivers.net/elrvfo.htm> and "Meet the Vackar: The Simple, Stable VFO You've Been Looking For," by Mark L. Meyer, WUØL, *QEX*, July 1997. Also see <http://www.amateurradioreceivers.net/svfo.htm> for information about the article. For a list of Vackar articles, check out <http://www.amateurradioreceivers.net/elrvfo.htm#refer>

11. Rhea, *Discrete Oscillator Design*, Page 300-301

12. A link for the Genesys download and free trial request can be found at the Keysight Technologies Discrete Oscillator Design page: <http://www.agilent.com/find/eesof-genesys-osc-workspaces>

FDIM 2015

May 14-17, 2015

Holiday Inn—Fairborn, OH

FDIM 2015 is just a few months away and 'right now' would be a great time to start making plans.

The 2015 event is our 20th !

We will be having some special attractions—check the FDIM webpage for details. Here's a quick guide for first-timers and regulars alike:

What is FDIM ?

FDIM or 'Four Days in May' is the annual convention of QRP ARCI. It is held in Dayton, Ohio and runs concurrently with the famous Dayton Hamvention®.

When is FDIM ?

In 2015 FDIM starts on Thursday 14th May and ends on Sunday 17th May

Where is FDIM ?

We take over the Holiday Inn at Fairborn, OH. It's a pleasant area near Wright State University and around 20 minutes from the Hamvention venue. All FDIM activities are at the Holiday Inn—just about every guest in the hotel is a QRPer! There is a good selection of restaurants within walking distance; many more with a very short drive.

The hotel has plenty of space for parking. We run a bus service from the hotel door to the Hamvention entrance on Friday and Saturday.

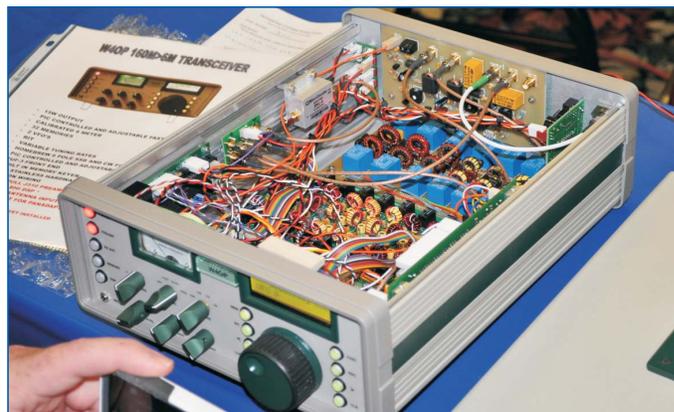


What happens at FDIM ?

• Wednesday 13th May

Check in at the hotel and collect your FDIM badge and goodie bag in the evening.

This is a great time to meet up with old friends



• Thursday 14th May

A full day of seminars from 8am to 4pm. Draws are held during the seminars and prizes will be presented to the lucky winners.

An evening presentation (subject to confirmation).

Vendor Night—avoid the Hamvention crowds. Buy kits, antennas, books and components right in the hotel. We will provide a table if you have products to sell.

• Friday 15th May

Attend the Hamvention—use the buses that we run from the hotel direct to the Hamvention entrance.

Buildathon and Pizza Party in the FDIM hotel.

QRP Club Night—promote your local club and enjoy the hospitality of other clubs.

It's a lot of fun, with games, and music later in the evening.

Enter one of the Homebrew Construction competitions. Entries are displayed for all to see and everyone attending joins in with the judging.

• Saturday 16th May

Attend the Hamvention again. The buses will be running.



The FDIM Grand Banquet is held in the evening. Food, drink and great company!

Door prizes are drawn (usually several THOUSANDS of dollars in value!).

Awards are made and speeches are short.

The QRP Hall Of Fame inductions are announced.

• **Sunday 17th May**

Attend the Hamvention if you want, then make your way home.

Who will speak at the seminars ?

This year we have:

- George Dobbs, G3RJV
- Mike Bryce, WB8VGE
- Paul Darlington, MØXPD
- Jay Slough, K4ZLE
- Jim Everly, K8IKE
- Glen Popiel, KW5GP

...and others to be confirmed

What else ?

FDIM is “not just about the radio”!

It’s a social event. You will make new friends and meet people who are well known in the QRP world. First timers can be identified from their FDIM badge, everyone is encouraged to say ‘Hi’ to those who have travelled on their own. Participate as much as you want. Spectate or join in, it’s up to you.

What can you do to help ?

Everything that happens at FDIM is done by volunteers. Checking people in, handing out badges, selling bus tickets, taking publicity photos, manning tables, selling raffle tickets, supporting vendors, elmering at Buildathon, and more... Helping out is very rewarding—give something back to FDIM!

What about registration and reservations ?

Register for the Seminar (\$40) and Banquet (\$35) online on the FDIM page. Payment is by PayPal or credit/debit card

If you register online then you will be entered in the seminar drawings to win a prize. Registering by mail or at the hotel will not qualify for entry in the drawing.

To book a room call the hotel direct—

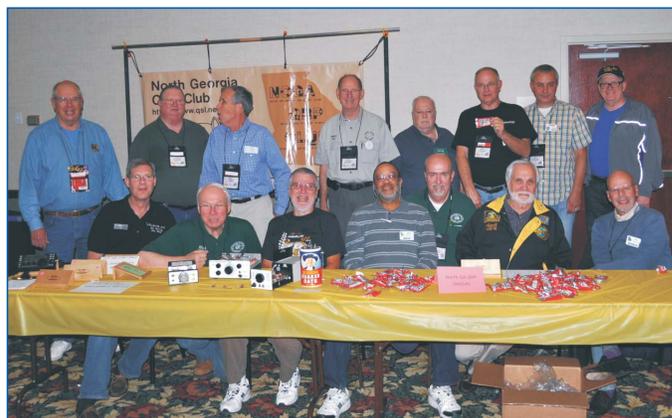
Holiday Inn—Fairborn

- (+1) 937-431-4613 (do not call the toll free number!)
- Call between 8 AM and 5 PM local time (Eastern), Monday-Friday; leave a voice mail if no one is available; your call will be returned
- You must tell them you are with ‘FDIM’ !
- Room rate is \$112.00 per night plus 12.75% tax
- Free breakfast buffet is included
- This is the only hotel affiliated with QRP ARCI

Details are also available on the FDIM webpage and in the ‘From The President’ column in the January issue of *QRP Quarterly*.

Where can I find out more ?

Go to the FDIM webpage—www.qrparci.org/fdim



FDIM 2015 · May 14-17, 2015 · Holiday Inn—Fairborn, OH

Be sure to check - www.qrparci.org/fdim - regularly for updates!

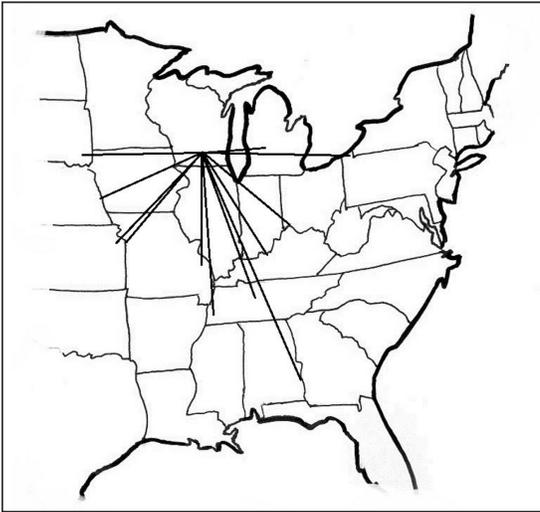


Figure 3—Map showing 2M tropo contacts.



Figure 4—Map showing 2M Es contacts.

7-7-83—CW QSO with WB8ISK, Cincinnati, OH

7-23-84—SSB QSO with WBØPJB, Sioux Falls, SD (57 report received)

Some years after the IC-202 had been “semi-retired” and the yagi taken down, the rig was again pressed into service when I stumbled upon good tropo conditions. On July 29, 1999, I worked KØMQS in Delta, IA, SSB from the shack using only the 18" telescoping whip antenna built into the rig. I was pleasantly surprised (make that astounded) when Dick gave me a 56 report. I put the little rig on the air again during a strong and widespread tropo opening on July 16, 2006, feeding only a mobile whip antenna mag-mounted to the top of an AC supply sitting on the desk in the shack. That session netted SSB QSOs in grid squares EN 34, 41, 51, 61, 63 and 74.

Tropo WORKS from the home QTH! (See Figure 3)

Sporadic E can also provide lots of excitement. Better known as the “go-to” summertime (and early winter) propagation mode for 50 MHz DXing, the Es MUF can surge much higher; sometimes reaching 144 MHz, and beyond. Because signal strengths usually peak at or near the MUF, 2 meter Es—when it happens—can provide some astonishingly loud signals over paths of up to 1,200 miles, or so. (The first time you hear such a signal, you will probably think someone is pulling your leg!) But unusually intense E-layer ionization is required to support propagation at 144 MHz, and that means these are much shorter-duration events than at 50 MHz.

Signals pop up and vanish quickly; you must be fast on your feet.

The trick is to carefully watch the evolution of path lengths on 6 meters as an Es opening progresses. As paths shorten at 50 MHz, you can be assured that the MUF is rising. 144 MHz Es propagation is likely to be supported through the midpoint of any active 6 meter path shorter than about 400 miles. Aim your 2 meter yagi at that midpoint and start making some calls! In all events, it's smart to monitor 144.200 any time strong Es signals are heard on 6M.

Once again, this has worked for me! Here are some more representative loggings:

7-5-81—SSB QSO with WD4GXN, Chesapeake, VA (55 Report received)

7-8-81—CW QSO with AIØL, LaPlata, MO; SSB QSO with N5AXP, San Antonio, TX (55-57 report received); SSB QSO with N5BMT, Boerne, TX (53 report received)

7-9-81—SSB QSO with N5BMY, Boerne, TX (55 report received); SSB QSO with AIØL, LaPlata, MO (51 report received)

7-21-82—SSB QSO with KL7JGI/4, Panama City, FL (59 report received)

7-24-83—A memorable day, during which a very intense Es opening provided almost three hours of 2 meter action:

SSB QSO with W3ZR/4, South FL, EL86 (59 report received); SSB QSO with N4PZ, South FL, EL87 (59 report received); SSB QSO with W4AWS, South FL, EL87 (55 report received); CW and SSB QSOs with WA5WXD, Denham Springs, LA (569/59 reports received);

SSB QSO with W5JTL, MS (59 report received); SSB QSO with W5UKQ, LA (59 report received); SSB QSO with W5FYZ, LA (59 report received)

6-8-85—SSB QSO with W5FF, Albuquerque, NM (59 report received)

SSB QSO with N7AIH, Albuquerque, NM (53 report received)

Es WORKS from the home QTH, too! (See Figure 4)

Granted, all of these QSOs are largely “ancient history” now. And I sense that 2 meter weak-signal activity has waned somewhat since those days. On the other hand, all of these loggings were made long before the internet revolution; undreamt-of propagation forecasting tools, DX spotting clusters and real-time MUF data are now readily available on line (see, for example, <http://www.dxinfocentre.com/tropo.html> and <http://www.dxmaps.com/spots/map.php?Lan=E&Frec=144&ML=M&Map=N A& .>)

Thus, you'll undoubtedly spend fewer hours at the rig and listen to a whole lot less white noise between QSOs today than I did then. The propagation mechanisms I used continue to work precisely as they always have, and plenty of great ops and stations still seem to come out of the woodwork for contests and when conditions favor us with great 144 MHz DX opportunities.

So, can you work long-haul 2 meter DX from the home QTH with your FT-817 or KX3? Absolutely! Just be on the lookout for enhanced propagation and make some noise on the low end of the band. VHF QRP adventures await! ●●

East Central Indiana QRP Group

In October, the East Central Indiana QRP Group held their semi-annual meeting at the Marry Hunt Library in Muncie, IN. When I went to the Spring meeting, as I approached Muncie, I had a telephone call that my home alarm had gone off. I immediately returned home to find no problems. Figured that somehow my dog had set off the motion sensors. This time I made sure they were off!

The meeting is held in two parts with the first part a featured speaker, and then time for everyone to talk about whatever they have been up to. The speaker for this meeting was Neal Thomison, W9IGY (Figure 1). He spoke on “The TEN-TEC Rebel: An Invitation to Experiment.” He told us that the Rebel is basically a radio and microcontroller (at FDIM 2013 Jim Wharton, NO4A, told everyone there that the microcontroller in the Rebel is basically “an Arduino with steroids”). Neal talked about the basic specs of the unit and changing from 40 meters to 20 meters required some internal jumpers to be moved. He then talked about the many possibilities that the Arduino offered for working with the radio. In part, these include frequency cycle modes, keyers, mode displays, digital signal processing, signal decoding and internet connections. Having an engineering background, Neal got into some of the internal components. He found the AD9834 DDS to be not so basic, a variable IF filter and MOSFET final.

The Rebel that Neal used in the talk belonged to Donnie Garrett, WA9TGT. Donnie showed us how the radio gave off a morse code frequency and several other things he had programmed the Arduino of his Rebel to do.

After a coffee break, we had our round table discussion (Figure 2). Donnie told us he had made a paddle for his KX-3 and then showed us his first QSL card he had received from Burland Hertle, WA9AGG, which he had received 48 years ago. Gar Lee, KB9ZUV, talked about moving into his new house this past summer and that he has a vertical going up. Robert Rai, KB7ZGB, then talked about getting into some old electronics books and finding a planer antenna. He decided to build one and with two 12" pizza pans and a piece of 4 board did so. The pans are, simply nailed to the board, one above the other and fed with coax. For 220 and



Figure 1—Neal Thomison shows the East Central Indiana QRP Group the TEN-TEC Rebel he talked about.

440, the antenna works very well, even inside the library. Richard Meiss, WB9LPU, showed us two keys he had made, one of which was first in the FDIM show. Bill Murray, W9VC, showed us a transmit-receive relay he had made and a new dial he had made for his home made receiver. I talked about the presence of QRP ARCI at the ARRL Centennial celebration, the amount of people we saw at the booth that stopped to see Jack Nelson’s (K5SFE) KX-3 and his adjoining loop antenna and the new TEN-TEC Patriot, which does SSB. For those of us who were there, we felt it had been a very good meeting. Our next meeting is scheduled for Saturday, April 18th at 12 noon at the Maring Hunt Library.

G-QRP

In a recent email, Dick Pascoe, GØBPS, a former President of QRP ARCI, sent me this information on G-QRP:

At the recent G-QRP Convention held at the Rishworth School on October 25th members celebrated the 40th anniversary of the G-QRP club. By chance this was also the 25th Annual Convention. The convention was held at Georges Church Hall for 19 years and moved to the Rishworth School 6 years ago

Members presented the founder of the club Rev George Dobbs



Figure 2—The group listens to Rich Meiss WB9LPU as he talks about keys he has made.



Figure 3—Tony G4WIF, JoAnna GØOWH, Dick GØBPS, Fabio IKØIXI, George G3RJV and Graham G3MFJ.

G3RJV with a bottle of his favorite single malt scotch whisky and a certificate and also a certificate and a bunch of flowers to JoAnna Dobbs GØOWH. Fabio IKØIXI also presented George with a plaque on behalf of Italian members. (Figure 3 is a photographic record of the event.)

The G-QRP club was founded by G3RJV in 1974 after chatting to low power operators on 80m. He put an advert in the then *Short Wave Magazine* and the club was born. It took a long time to get to 100 members but by the time I joined in 1984 I was given

the membership number of 2559. Not a good thing to use on CW as I was often asked to repeat my report!!!

—*de GØBPS*

In closing, there are some clubs who have sent me updates on their clubs for some time. I won't list clubs by name here. You all know who you are. This is my shortest column since I began writing it. So, please send me something by March 10th for the April issue. I would appreciate it. Thank you. ●●

Some QRP Notes

Book Review

The World's Best Hobby
Dave Bell, W6AQ
ISBN-10: 1496914031

There are people who make things happen, there are people who know why things happened, and there are people who wonder what happened.

For decades, Dave Bell, W6AQ, was one of the people in the middle of things and knows why things happened. As a Hollywood producer, hobnobbing with politicians, amateur radio leaders, kings and celebrities, as well as being a very active ham operator, he was privy to many interactions and events that shaped ham radio into the forms we know today. So when he wrote a book about his life in ham radio, people are taking notice.

Bell retired from being a major producer for television and movies. You may remember him as the producer of the successful movie "Amateur Radio Today" with Walter Cronkite and the creative force behind many other ham related movies and videos.

I had the pleasure of working with him on one of his projects, "The DIY Magic of Amateur Radio." Despite his impressive credentials, I found him to be very personable and low key. This style shows up in the conversational tone of his writing and makes for a fast and pleasurable reading experience. The 290 page book is full of insights, conversations and the personalities that inform the reader not only what was happening in the 1965 to 1980s period, but also spotlights the attitudes, thoughts and expectations that shaped amateur radio during those decades. It's a good book and one that any ham will enjoy reading.

The World's Best Hobby is available through www.Amazon.com.

—Reviewed by Allen Pitts, WIAGP

Letter to the Editor

Editor@qrparci.org:

If your hiking expeditions take you into deep woods with dense, tall trees, a QRP HF rig is an ideal communications set. You want to use NVIS (Near Vertical Incidence Skywave) mode because all you really need to see is a bit of sky above your head. Just string your wire antenna horizontally about six feet off the ground and operate on 7 MHz in the daytime and 3.5 MHz at night.

Propagation is essentially straight up and is refracted back down over a 50-200 mile radius. The limited coverage holds down the noise picked up from equatorial lightning crashes and other QRN/QRM sources. This makes for reliable communications with base camp or home so long as your Morse code is up to snuff!

To learn how to copy complete code words and phrases in your head, take a look at <http://morsefusion.com>

(Share this email with your ham radio friends and club members!)

—73, Steve Harris,
<http://morsefusion.com>

QRP Hall of Fame Nominations

(This announcement also appears on page 4, but is worth repeating!)

The time has come for the call for nominations for election to the QRP-ARCI QRP Hall of Fame. Nominations may be submitted via postal mail or e-mail, and must include the following information:

Name & Call of person nominated
Name & Call of person making the nomination.

A full description of why you think your nominee should be in the QRP Hall of Fame (HOF) is needed. Remember the voting body may not know this person and you

must convince them that the person is worthy. Things such as "John Doe is a great guy and always helps out at the club" will guarantee he is rejected. Be specific in your recommendation and try to persuade as to why your person should be in the HOF.

The voting body consists of the QRP ARCI Board of Directors, President, Vice-President and last eight members inducted into the Hall of Fame. Nominations may be submitted by anyone, whether a member of the QRP ARCI or not. Similarly, membership in QRP ARCI is not required for someone to receive the honor, since this is an award to recognize those who have made great contributions to the QRP community, not just to the QRP ARCI.

If no nominations are received or the nominee(s) receive(s) less than the required 2/3 vote there will not be an induction at Dayton for 2015. The BOD is adamant that it is not a requirement that we have an induction. A list of the current members of the HOF is included with this announcement.

Please forward your nominations to BOTH President, QRP ARCI president@qrparci.org AND to the Vice President, vp@qrparci.org. Nominations in writing should be sent directly to them. Addresses may be found on page 4, along with a list of current QRP Hall of Fame members.

The closing date for nominations is March 1, 2015. When a nomination is received, a confirmation e-mail or letter will be sent to the person making the nomination. If you nominate someone and do not receive a confirmation, we did not receive it. You will need to receive a confirmation to insure your nominee will be considered.

—Ken Evans, W4DU,
President, QRP ARCI
—Steve Fletcher, G4GXL,
Vice-President, QRP ARCI ●●

A Multiband Sleeve Dipole

John King—W5IDA

w5ida@arrl.net

For some time, I have been thinking about a vertical antenna for use on the lower bands to replace or augment my horizontal dipoles at approximately 45 ft. At that height, a dipole for 40M or 80M is likely to have most of its radiation occur at fairly high elevation angles (especially on 80M), thus making it less effective as a DX antenna. A ground mounted, quarter wave vertical would be the logical choice here. However, the configuration of my small suburban lot would not support the large number of buried radials needed to make the antenna effective.

How could I solve this problem? The light bulb came on over my head when I read one of Kai Siwiak's articles [1]. His article discussed an off-center fed sleeve dipole he used as a portable antenna when traveling. Because of his background in antennas and propagation, I had good confidence that a similar antenna might work for me. As a bonus, the antenna could be made to cover several bands. The final encouragement came about when I saw an article [2] in *QST*, which described a similar sleeve dipole mounted vertically as a permanent antenna.

How it Works

A dipole is formed when two conductive elements are separate but close to each other and fed with a two wire line having an RF voltage source at the far end of the line. To be effective, each conductive element must have at least one dimension that is a significant fraction of the wavelength of the RF voltage source. Ideally, the feed line generally has balanced currents of opposite sign on each leg. Such a feed line does not radiate to any significant degree. If the currents are not balanced, then radiation occurs and the feedline becomes part of the antenna which can distort the radiation pattern and make a general mess of things.

We generally think of a dipole as being two wires of equal length with the feed line being at the center where the two wires are closest to each other. However, this does not have to be the case. The familiar Windom antenna is an example of an off center fed dipole which works perfectly well, although the feed point impedance is

not typically a purely resistive 50 ohms. An antenna tuner fixes that problem by transforming the impedance at the transceiver to the desired 50 ohms. The trick is to keep the impedance at the far end of the feedline within reasonable bounds so that the antenna tuner can function within its limits. This generally limits the length ratio of the two dipole legs. Length ratios of between 2:1 and 3:1 will usually suffice, providing neither leg is a half wavelength at the operating frequency. Consequently, Kai imposed these ratios on his antenna.

Suppose we form a dipole structure using a coaxial cable (the feedline) and a single wire attached to the center conductor. Obviously, the wire could be one leg of a dipole. But, where is the other leg? We need that other leg or this will not be an effective radiating structure. However, the two legs do not need to be the same length, or even the same shape. We have seen at least one example in the familiar quarter wave vertical. The quarter wave element rising in the air is one leg. The other leg is formed from a conductive plate (metallic automobile surface) or many radial wires extending from the feed line leg not attached to the quarter wave element. The radial wires form what looks like a conductive surface at HF. The other leg can even be saltwater. Many DXpeditions use this approach.

Yet another approach to providing this second leg of the dipole works because of the "skin effect" occurring in conductors at radio frequencies. Skin effect means that currents present on a conductor at RF are present for only a very short depth within the conductor, regardless of the actual physical depth dimension of the conductor. In the case of a thick conductive tube for example, it is perfectly possible for two very different currents to exist on the inner wall of the tube and the outer wall of the same tube. The shield of a coaxial cable is just such a tube at radio frequencies. Thus, it is possible for the outer wall of a coaxial cable shield to be the second leg of our dipole in the structure consisting of a coaxial cable and a single wire attached to the center lead in the coaxial cable. The feedline consists of the center conductor and

the inside surface of the shield; the outer surface of the shield is the second dipole leg. Electrically, the antenna looks like a thin conductor on one side (the wire) and a "fat" conductive tube (or sleeve) with the coaxial cable inside it.

Of course, we will want the current on the outside of the shield to end at some point on the cable so that we can control the length of this second dipole leg and thus establish a ratio between the legs that will be easily transformed with an ordinary antenna tuner. That is easily done with some form of choke. Kai used split bead ferrites to surround the cable and stop this current. This is exactly the same way a balun works when used with an ordinary half wave dipole fed by coaxial cable. The balun forms a choke that forces currents in the two dipole legs to be equal and preserve the radiation pattern we desire.

Building and Installing My Vertical Dipole

The configuration of my sleeve dipole is shown in Figure 1. In my case, it is hung in a vertical position and supported by a rope over a tree limb. I added a pulley at the far end of the rope so that I could haul the antenna up and down. I put an insulator on the rope running through the pulley and lowered the insulator to the ground so a string could be attached. Raising the rope to the top and noting the length told me how tall the antenna would be.

The next task would be to determine the length of each leg of the dipole. This is best done with a simple spreadsheet, like the one shown in Figure 2. The spreadsheet is made so that if a total antenna length is specified, both dipole legs are calculated for a specific ratio between the legs. The lengths are then shown in meters so that a half wavelength is not inadvertently chosen for either leg. Note also that the electrical length is not identical to the physical length of the coaxial cable. That is because the outer shield appears to be a "fat" conductor with diameter equal to the diameter of the cable. Conductors of this type generally appear to be electrically shorter. The author of Reference 2 used a factor of 0.95 times the physical length for RG-8 and I did likewise. That factor would not be sig-

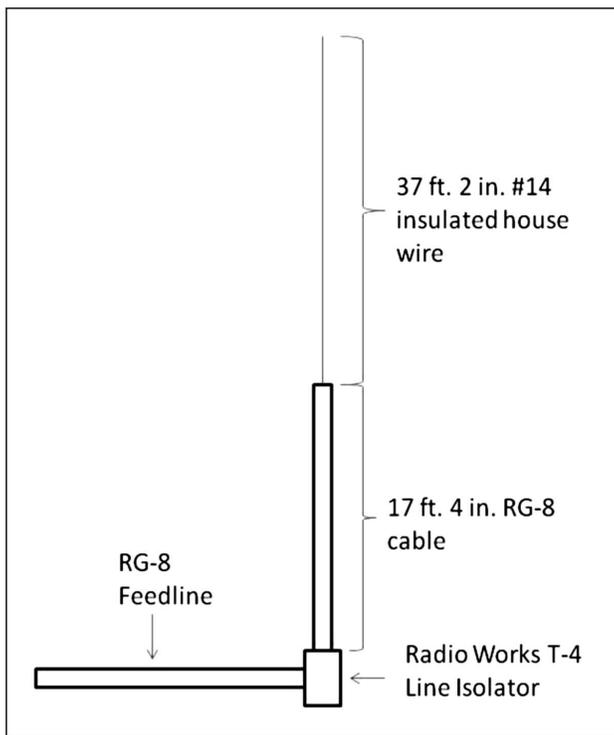


Figure 1—Sleeve dipole configuration.

Ratio	Short Leg (ft.)	Short Leg (m)*	Wave-length (m)	Long Leg (ft.)	Long Leg (m)	Wave-length (m)	Frequency (MHz)
2	18	6.84	13.68	36	12.996	25.992	11.542013
2.05	17.704918	6.727869	13.45574	36.29508	13.10252	26.20505	11.448175
2.1	17.4193548	6.619355	13.23871	36.58065	13.20561	26.41123	11.358806
2.15	17.1428571	6.514286	13.02857	36.85714	13.30543	26.61086	11.273594
2.2	16.875	6.4125	12.825	37.125	13.40213	26.80425	11.192255
2.25	16.6153846	6.313846	12.62769	37.38462	13.49585	26.99169	11.114531
2.3	16.3636364	6.218182	12.43636	37.63636	13.58673	27.17345	11.040186
2.35	16.119403	6.125373	12.25075	37.8806	13.6749	27.34979	10.969005
2.4	15.8823529	6.035294	12.07059	38.11765	13.76047	27.52094	10.90079
2.45	15.6521739	5.947826	11.89565	38.34783	13.84357	27.68713	10.835359
2.5	15.4285714	5.862857	11.72571	38.57143	13.92429	27.84857	10.772545
2.55	15.2112676	5.780282	11.56056	38.78873	14.00273	28.00546	10.712195
2.6	15	5.7	11.4	39	14.079	28.158	10.654166
2.65	14.7945205	5.621918	11.24384	39.20548	14.15318	28.30636	10.598326
2.7	14.5945946	5.545946	11.09189	39.40541	14.22535	28.4507	10.544555
2.75	14.4	5.472	10.944	39.6	14.2956	28.5912	10.492739
2.8	14.2105263	5.4	10.8	39.78947	14.364	28.728	10.442774
2.85	14.025974	5.32987	10.65974	39.97403	14.43062	28.86125	10.394561
2.9	13.8461538	5.261538	10.52308	40.15385	14.49554	28.99108	10.348012
2.95	13.6708861	5.194937	10.38987	40.32911	14.55881	29.11762	10.30304
3	13.5	5.13	10.26	40.5	14.6205	29.241	10.259567
Total Antenna Length (ft.) =			54.				
Pulley height is 55.5 ft.							
* Electrical Length = Physical Length/0.95							

Figure 2—Spreadsheet for analyzing and choosing the leg lengths.

nificant for Kai’s original antenna because he used much smaller cable. The factor is noticeable but minor for something like RG-8. (If you don’t have much experience with spreadsheets, contact me and I will send you the Excel version.)

Now the antenna could be built. I could easily select the leg lengths that would meet the criteria and only needed to find a convenient way to build it.

The major difference between from Kai’s antenna is that mine had to be weatherproof. The center connection between the cable and wire is the major issue. Figure 3 shows the solution I used—two PL-259s connected by a double female coupler. On the wire side, I placed a short piece of insulation from inside the coaxial cable. Then various pieces of heat shrink tubing were used to seal the connector, starting with a piece of tubing large enough to cover the outside of the connector and long enough to contain the piece of insulation. Successively smaller tubing was used to provide a gradually decreasing diameter and ending with tubing not much bigger than the wire. Finally, the whole connection was covered with coax sealer. At the bottom of the antenna, I placed a Radio Works T-4 Line Isolator. This is essentially a choke balun with coax connectors on both ends. It is a waterproof version of

Kai’s ferrite beads.

Figure 4 shows the antenna from the most visible angle. The picture was taken from a distance of about ten feet. This is obviously a low profile antenna, which should make it attractive to hams living with deed restrictions.

One caution is worth noting—If you make a similar antenna and are going to run more than QRP power, make sure the supporting rope to another tree and placed weights at the end. That way, the tree could bend in a strong wind and the antenna should stay up. The reason for this caution is that larger amounts of power can cause high RF voltages at the end of the antenna. The voltage might be enough to burn or

melt the rope if it is in contact with the antenna. (I speak from experience here.)

How Well Does it Work?

I was able to tune this antenna and achieve a match below 1.5 :1 on all bands between 80M and 10M, using an old MFJ 941D tuner. With a good match, I could get contacts on all those bands. I could even achieve a match on 160M, but with an acceptable SWR bandwidth that was only about 10 kHz without retuning and the tuning was very “touchy”. I have my doubts that the antenna would be very effective on 160M because it was quite short (54 ft.) with respect to a half wavelength (~270 ft.) on that band.

In order to answer the question of how well it worked on 80M through 10M, I

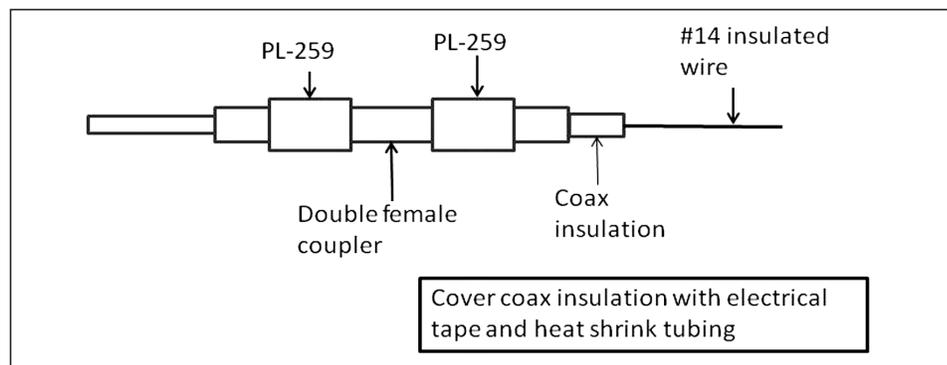


Figure 3—Center connection detail.



Figure 4—Photo from ten feet away, showing low visibility of the installation.

Band	Countries
10M	Morocco, Guantanamo, England (2), Brazil, Montserrat, France
15M	Aruba, Curacao, Ireland, Canary Islands, Columbia, Alberta (Canada), England, France, Germany
20M	Portugal, British Columbia (Canada), St. Kitts & Nevis, Italy, Puerto Rico, Cayman Islands, Finland
40M	Slovenia, Lithuania, Virgin Islands, Italy
80M	Ontario (Canada), Quebec (Canada)

Figure 5—Listing of DX contacts worked during the CQWW DX CW contest.

entered into the CQ WWDX CW contest occurring in late November. I used the sleeve dipole and my trusty Elecraft K2 at five watts. I was not looking for a maximum number of contacts; rather, I was trying to determine how many different countries with whom I could make QSOs. That somewhat limited the number of QSOs but it did tell me something about where in the world the antenna might produce a credible signal. I worked the contest for about three or four hours total at various times during the contest. Figure 5 shows the results. In total, I reached a bit over twenty countries, with the featured DX being Morocco. Not a bad score for the time spent getting QSOs, but not what you might achieve with a couple of hundred watts and a forest full of monoband beams at a hundred feet.

In summary, I thought the antenna acquitted itself well given what it cost and the simplicity of its structure. It did so with a modest physical foot print and a low profile. For many hams living in a suburban setting, it would be a very reasonable antenna choice.

Variations

There is no reason to make your version of this antenna exactly like mine. Only the limits on the ratio between dipole legs and restrictions concerning the prohibitions of half wavelengths on a single leg need be of concern. If you follow these limitations, it will probably be a per-

fectly suitable antenna.

Being self contained, the dipole can be oriented differently. For instance, it could be vertical for some length and then go horizontal like an inverted L. The radiation pattern would likely be different but it should still work in some fashion.

If you don't have a suitable tree for a vertical antenna, a second suggestion would be to place the antenna within some sections of PVC pipe as a support. The antenna could be hung from a pipe cap at the top of the pipe. Then, you could support the antenna next to your house and perhaps use some guys for support.

You could even support the antenna horizontally, thus making a type of Windom antenna.

The main concern is that your antenna should represent a major fraction of a half wavelength in total length of both legs in order to be reasonably effective.

—73, John W5IDA

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1. Siwiak, Kai, "Off-Center-End-Fed Dipole on a 'DX Fishing Pole'," *QRP Quarterly*, Spring 2012, pp.34-35.
2. Yerger, Al, "A Coaxial Cable Vertical Dipole Antenna," *QST*, May 2014, pp. 45-47. ●●

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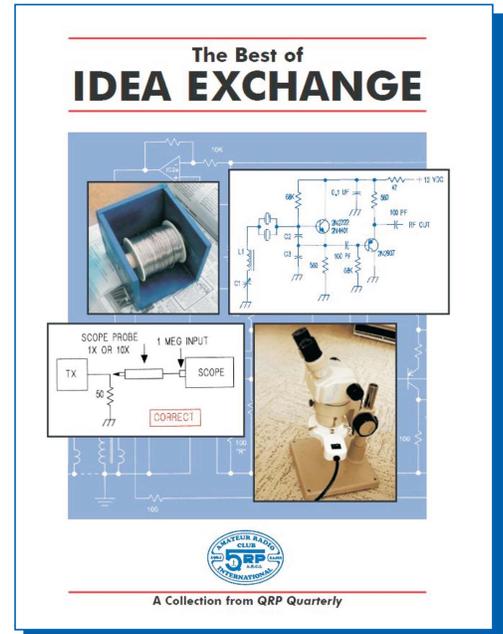
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Let's Build Something: Part 1

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This article is the first of a series designed to introduce newcomers to the wonderful world of home brewing your own equipment. Absolutely no experience is required beyond an ability to read simple schematics and do some basic soldering. If these two skills are new to you, there are many excellent resources on YouTube and similar sites, or in the *ARRL Handbook*.

The authors realize that building your first, homebrewed radio project can be very intimidating, especially if you don't have an Elmer in your neighborhood for ongoing guidance. We hope to provide the next best thing in the form of a series of supplemental YouTube videos which show the details of building many of the circuit blocks for this project. A listing of the URL's for the portion of these videos that relate to the first part of this project appears at the end of this article.

We have further simplified the overall project by using a very simple building technique that is as old as ham radio itself—breadboarding. Early radios were often constructed by fastening parts to a board meant for cutting bread. We will do something very similar. In our case, we will be constructing each stage on a small piece of PC board stock obtainable on the popular web auction sites and then mounting each stage on a board for interconnection. We will worry about packaging the total project later. “Al Fresco” construction greatly aids in understanding the circuit elements and most importantly for making changes or repairing modules. Later once everything is perking along you can think about optimized packaging and shrinking down the size. There is nothing wrong with a bread board radio—our ham forefathers operated exactly that way!

The stages will be built using an easy method of Manhattan construction. This involves gluing small pads of PC board stock to a larger blank board for use as

junction points. For ease of construction, we will be using MePads and MeSquares available from WIREX at www.QRPme.com. These boards take Manhattan construction way beyond super gluing copper squares to a PCB and enable the homebrewer to focus on building hardware and not removing super glue from their hands! Our goal: make this a fun experience without having to have years of tribal knowledge before soldering the first connection.

Where is this project ultimately going? We will tell you if you promise not to panic. When you finish this deliberately simple set of projects, you will end up with a fully functional QRP SSB transceiver. But don't worry as we promise to take it slow and easy. In the meantime, you will be building all of the modules that will eventually comprise the transceiver. You will find that, as the project progresses, you will finish intermediate, useful pieces of equipment at the end of each article in the series. The various modules will be reused at each stage, so nothing (or at least not very much) becomes a dead end.

For this Part I article, we describe a very, very simple receiver project, which takes advantage of the wide availability of the Arduino microprocessor and direct digital synthesizer (DDS) modules and couples that with a simple, homebrew double balanced mixer (DBM), a one transistor RF amplifier, a band pass filter made from commercial IF transformers and a few

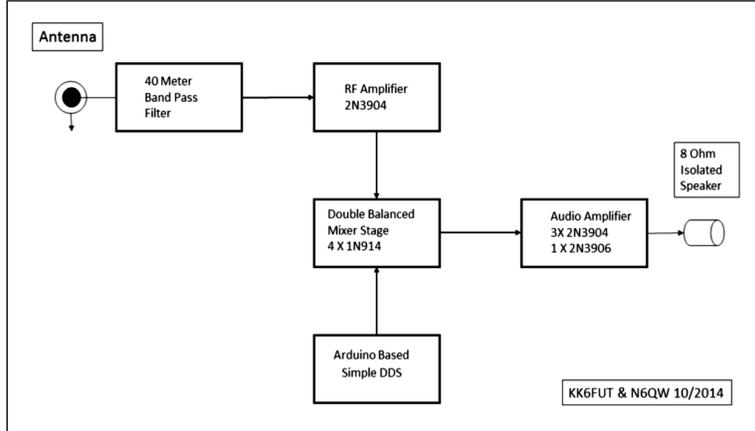


Figure 1—Direct conversion receiver block diagram.

simple transistors as an audio amplifier, which gives you the ability to listen to sideband (voice) [and CW] ham radio transmissions. It goes without saying that both of us were amazed at how good the receiver sounds and we you think you will be too!

Why Sideband?

Traditionally, the first ham radio homebrewing projects have been CW transmitters and receivers. However, with the removal of the code requirement to becoming a

ham radio operator in recent years, there has been a dramatic falloff in the use and proficiency in code. That lack of code ability means that there is an entire generation (or two) of ham radio operators for whom code is non relevant. Putting aside the politics and arguments over the loss of code in the ham radio community, this poses a huge problem for attracting prospective homebrewers to the hobby. Many new hams simply want to talk, using radios they built and not resort to pounding brass. This project sidesteps the CW code issue by going directly to SSB.

Unfortunately, coupled with the lack of CW proficiency, there has been a big loss of available kits for new homebuilders—the traditional entree into homebrewing for radio. Kits like the single band SSB White Mountain—a traditional entree into building your own SSB transceiver—are now discontinued, and projects like the BITX and Minima—although excellent designs—are a huge jump for the new builder. This project attempts to help the new builder along the path to building more complex projects or, hopefully, tackling their own radio designs from scratch!

How Direct Conversion Receivers Work

The first part of our project will be a direct conversion receiver. You'll see later how the parts to this receiver will be used in the final project. In a receiver of this type, an oscillator (in our case, a DDS)

operating at the exact frequency of the sideband signal is used as one input to a double balanced mixer. The desired sideband signal is the second input to the mixer and the difference frequency is the desired audio output. In this case, there is no intermediate frequency (IF) and the result is sometimes referred to as a zero IF receiver. Direct conversion involves, as its name implies, a direct conversion of off the air signals to an audio base band. A typical example would be a 40 Meter (7 MHz) SSB signal that is converted to audio directly via a mixing process. For this to happen, we need but a few circuit blocks, shown in Figure 1.

A double balanced mixer produces sum and difference frequencies of the signal coming from the antenna, and the local oscillator. For example, an incoming signal at 7.2 MHz would be mixed with either a 7.199 MHz local oscillator or a 7.201 MHz local oscillator—depending on what sideband (upper or lower) we want. In the first case, two frequencies would be produced: the sum which is 14.339 MHz and the difference is 1 kHz, which is the one we want. In the second case the sum is 14.401 MHz and the difference is 1 kHz, again this is the one. All mixers are capable of producing these sum and difference products. The term “double balanced” implies that the original signal and local oscillator frequencies are deliberately nulled out as part of the mixing process and do not appear at the output.

To clean things up a bit we do a bit of audio filtering following the DBM and top that off with an audio amplifier block.

As shown in Figure 1, there are five major blocks to this project: the local oscillator (Arduino with DDS); our homebrew double band mixer (DBM); the audio amplifier circuit, the input band pass filter and finally an RF amplifier block. All of these blocks will be used in the final SSB transceiver circuit.

We have found that building “backwards,” that is building projects from the output to the input, is a key to success in these projects. We will use that method here. This allows you to carefully debug the circuits, ensuring each block or stage is fully working before moving on to the next part. Most kits and construction instructions today tend to emphasize a “stuff and smoke” approach—stuff all the components, plug it in, and see if it smokes.

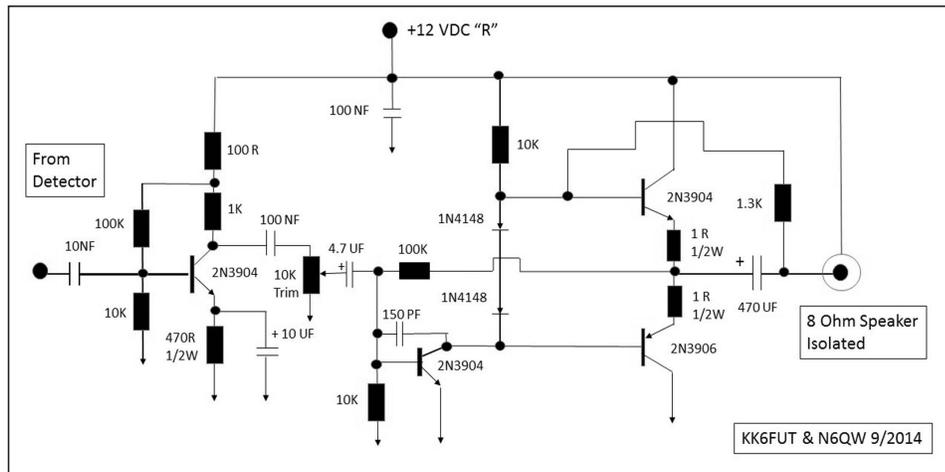


Figure 2—Audio amplifier schematic.

However, that approach means lots of smoked parts, and no understanding on what does or does not work in your circuit! We will start with the audio amplifier and work our way forward.

Before we begin, let’s talk a bit about construction. After you have built each stage, you will be attaching the stage to a large board (2 ft. x 2 ft.) using a few wood screws. Then, you will need to supply power for operation. A suggestion is to bring the power into terminal strips (available at Radio Shack) and then power can be distributed to the various modules where power is required. You might also want to cut all of the blank PC boards used for the various stages at once. The sidebar to this article shows a plan for efficiently cutting these boards. If you are not familiar with how to cut the boards, there are quite a few methods exhibited on YouTube videos. However, most of these methods release fiberglass dust into the air. For this reason, you should always wear a mask and safety glasses during this activity.

First Major Piece: The Audio Amplifier

It would have been a simple matter to pop in a packaged amplifier such as an LM-386 or TDA7052 for this project. But, we think you will learn more by working with discrete components. Figure 2 is the schematic. The audio amplifier consists of a 2N3904 pre-amplifier, a second 2N3904 as a pre-driver and a complementary pair 2N3906/2N3904 for the output. Word of warning here—The audio output jack is “hot,” so if you later install the amplifier in a metal box you will need to insulate any output connections from that box as you

cannot directly ground the output connector to the chassis.

YouTube Hint: If you want to see how the amplifier is laid out, just watch the corresponding YouTube video. You will be able to see how the pads are placed on the blank PC board and how the various components connect.

Testing of the amplifier once completed follows the rigorous N6QW amplifier testing process. Step 1: After checking for shorts, solder bridges, wrong connections, wrong part values or the wrong polarity of the power being supplied AND finally using an isolated phone jack with 8 ohm speaker attached, apply power. If it doesn’t smoke or your power supply trips proceed to Step #2 where you take a metal objects such as a tip of a screw driver and touch the input—if you hear a large hum in the speaker—the test is complete. If no hum, go back through step 1. How much more rigorous can you get?

Tribal Knowledge tip! A simple way to avoid hooking the wrong polarity to the circuit is to place a diode in series with the + lead to the board under test. The cathode connects to the circuit and the anode to the source supply. If you get the source leads reversed current will not flow. The arrow part (banded end) of the diode points the way!

Mixing It Up: The DBM

The Double Balanced Mixer (DBM) can be thought of simply as a frequency converter. In Part I we are converting signals in the 40 Meter ham band to an audio output. In applications such as a mixer stage which we will do in the final SSB

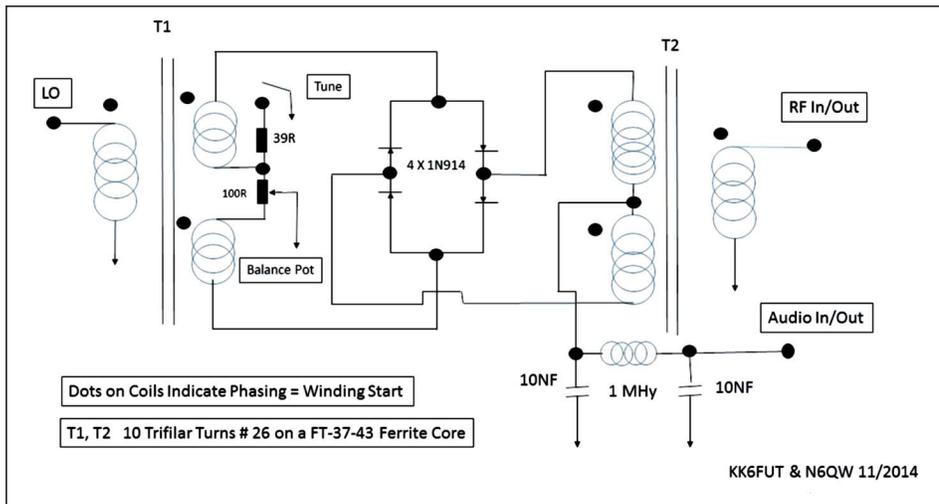


Figure 3—Double balanced mixer schematic.

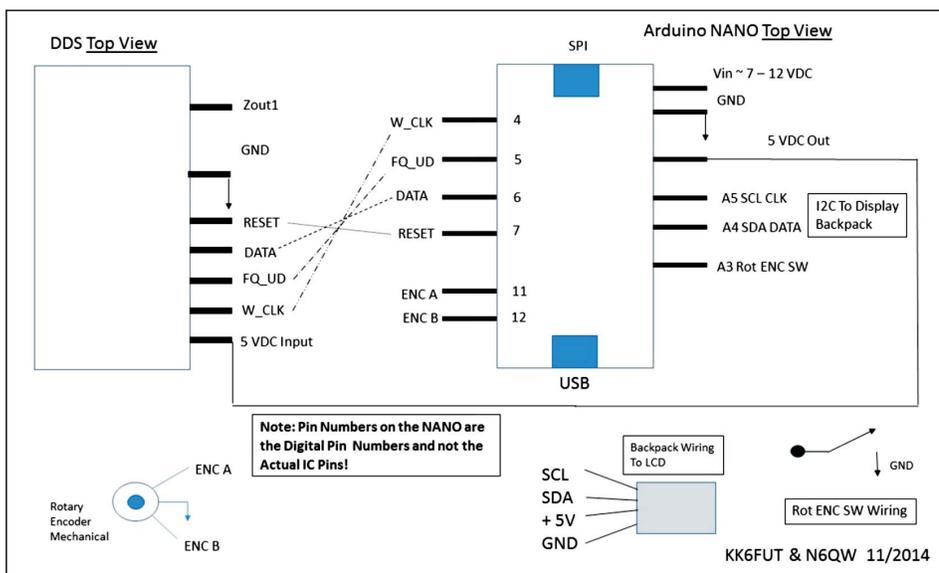


Figure 4—Arduino DDS schematic.

transceiver build, the DBM is employed as both a receiver and transmit mixer stage so that on the air signals are converted not to an audio based band but to an intermediate frequency (IF). Example: 40 Meter signals at 7.2 MHz are mixed in the DBM with an LO (VFO supplied by the DDS) of 12.1152 MHz and the difference frequency (which is what we want) is 4.9152 MHz. Our homebrew crystal filter will operate at this frequency where the signal will pass on to a second Double Balanced Mixer stage. Here, this DBM becomes a Product Detector on Receive and a Balanced Modulator on Transmit. The signal coming in at 4.9152 MHz is mixed with a BFO signal slightly above (or below depending on the sideband in use) 4.9152 MHz and the difference is audio. In the transmit mode,

the first mixer stage now outputs the signals back to the 40 Meter band. We'll describe this more in the rest of the series.

This is where the mental light bulbs should light brightly. Our Part I direct conversion receiver is nothing more than a product detector connected to an antenna and in lieu of a fixed BFO frequency we are making it tunable. So what is being built in Part I is the back end of the SSB transceiver. Notice we said light bulbs as the second bulb is that the DBMs are bidirectional! If we hook up a microphone amplifier instead of the audio amplifier, that same product detector circuit becomes a balanced modulator. So what was the input to the product detector is now the output of the balanced modulator. This means that Part I will give us much of the

circuitry needed for the low level transmit part of the SSB transceiver. The Double Balanced Mixer Schematic is shown in Figure 3.

YouTube Note: There are a series of three YouTube videos on the DBM that take you from the basics of the DBM through the final construction and these appear on the N6QW YouTube channel.

Tribal Knowledge Tip: The Importance of Heat Sinking any Diodes before soldering!

One of the keys to constructing a double balanced mixer (DBM) is proper construction technique. One of those techniques is making sure that sensitive components—in this case, your diodes—are properly heat sunk during the soldering process. The authors are a fan of using a hemostat, affixed between the point of soldering and the device itself, to make sure you do not overheat the diode. Soldering tips can reach an excess of 800 degrees, enough to render a diode (and other components) useless. Those hemostats are removed after the solder has cooled. We are now careful to mention this removal process for in an earlier article we failed to mention the removal of the hemostats. An email from a builder inquired how to fit that project into an enclosure with the hemostats dangling all over the circuit.

Modern Oscillator: The DDS

When we first started working on this project, we looked at a number of different options for an oscillator, including a VFO, varactor tuned oscillator, and a DDS. After building several versions of this oscillator, we decided that the easiest option—surprisingly—was to go directly to a DDS, due to the ease of soldering modules together, and the ability to directly use this DDS for our full fledged transceiver in the future.

There are three major parts to the DDS: the Arduino microprocessor to control the DDS, the DDS itself, and an LCD display and rotary encoder to allow us to change the frequency. Fortunately for us, there are only four lines we need to connect between the Arduino and the DDS, and only four lines between the Arduino and our LCD display. This actually makes using a DDS one of the simplest parts of this project.

The schematic for this oscillator is shown in Figure 4, which includes the hookup for the Arduino Nano and the AD9850 DDS Board. The Nano and the

AD9850 can be found on the major auction sites for very little cost. The Nano was chosen because of its small size. That said, the Uno R3 or even the Pro-mini can be used. The Uno is much larger physically and the Pro-Mini lacks the serial interface hardware. Moreover, no matter which Arduino device is used, just wire to the Digital and Analog pins for those respective boards. The other observance is that when loading the sketch you must select the device you are using and the appropriate COM Port. Most of the Arduinos like to see an input power to the Board in the range of 7 to 12 VDC. The easiest answer is a 9 VDC 1 amp regulator that is hung off of the main power supply rail (12 - 13.8 VDC).

We have NOT shown a booster amplifier on that schematic, which is optional for the receiver project, but may be required for full driving of the mixer stage when the transmit functions are added. The booster is a utility type amplifier stage employing a 2N3904 that is used in other parts of the radio—remember reusable blocks? Just build another RF amp as described later and insert it between the DDS and the mixer stage.

We've also included pre-built software (Simple DDS), which allows the use of the DDS on a single band, and handles input from the rotary encoder to change the frequency. You do not need to know how to write software on the Arduino to use this—we've already included everything you need, and all you need to do is load the software onto your Arduino using the Arduino IDE.

The software needed is on the N6QW Website under the Arduino Link. Use this link to find the software, http://www.jessystems.com/arduino_build.html. This link has the software in the section marked Sketches.

The RF Amplifier: So Much from a 2N3904

The signal levels coming from your antenna are pretty small, and running those through a DBM is not all without some penalties. For all of the good stuff about a DBM, such as rejection of the incoming and LO signal at the output and lower noise than active mixers, the offsetting penalty is that they are a gain loss device suffering up to 5 or 6 dB loss. (DBMs are what is known as passive mixers meaning they do not provide any gain.) That means

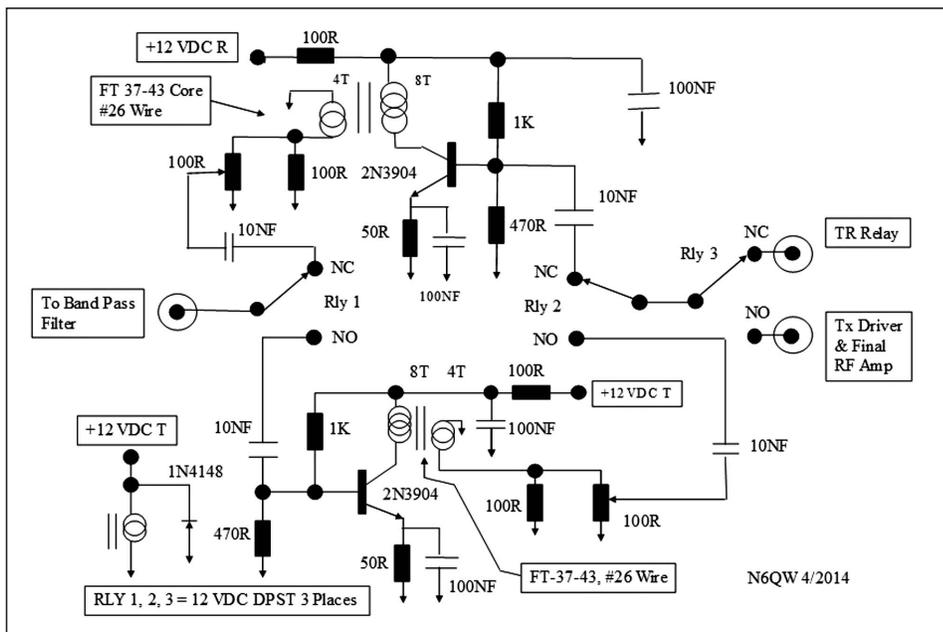


Figure 5—Bilateral Rx/Tx RF amplifier schematic.

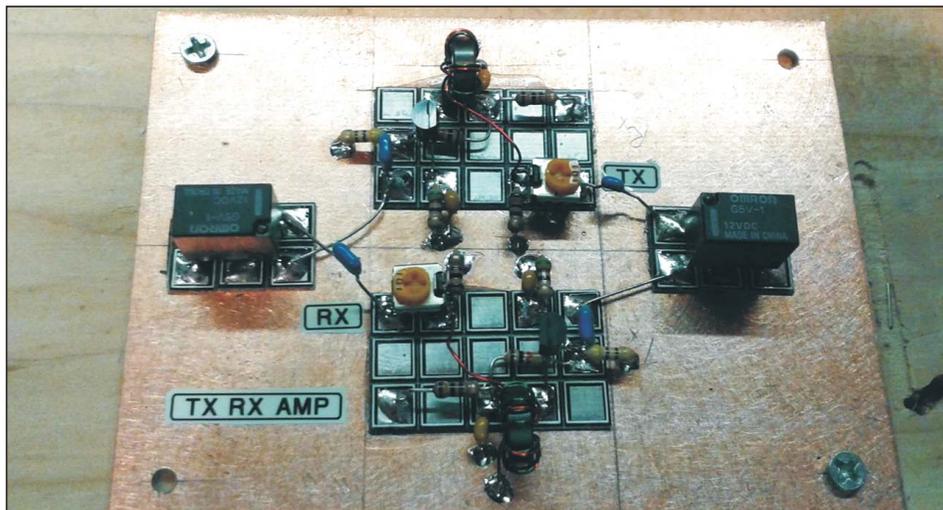


Figure 6—The completed Rx/Tx RF amplifier.

that off-the-air signal levels are further reduced in the mixing process. There are many ways to handle this, including tacking on a post mixer amplifier, using a high gain audio stage and adding an RF pre-amplifier to boost the signals ahead of the DBM. We did two of the three by adding an RF pre-amplifier stage and a high gain audio stage.

This pre-amp is un-tuned and thus broad banded, so everything coming into the antenna is amplified. Because of that, we need to include a band pass filter, which limits those signals to only the ones within our desired, 40m ham band. The Rx pre-amp stage provides better than 10 dB of gain which helps make up for the gain

loss in the DBM. The parts cost is low in comparison to the gain available. (Certain circuit configurations of a 2N3904 can result in 15 dB of gain—so quite a lot of uumph for a transistor that when bought in bulk can be had for 3 or 4 cents.)

This circuit block will be used in the final SSB transceiver serving the same purpose. In addition, the very same circuit will be duplicated and will serve as the Tx pre-driver circuit in the SSB radio. So, building two at the same time is probably a good idea, even though only one amplifier is used in the direct conversion receiver. Figure 5 shows the schematic for a two amplifier configuration with relay switching. The completed amplifier is shown in

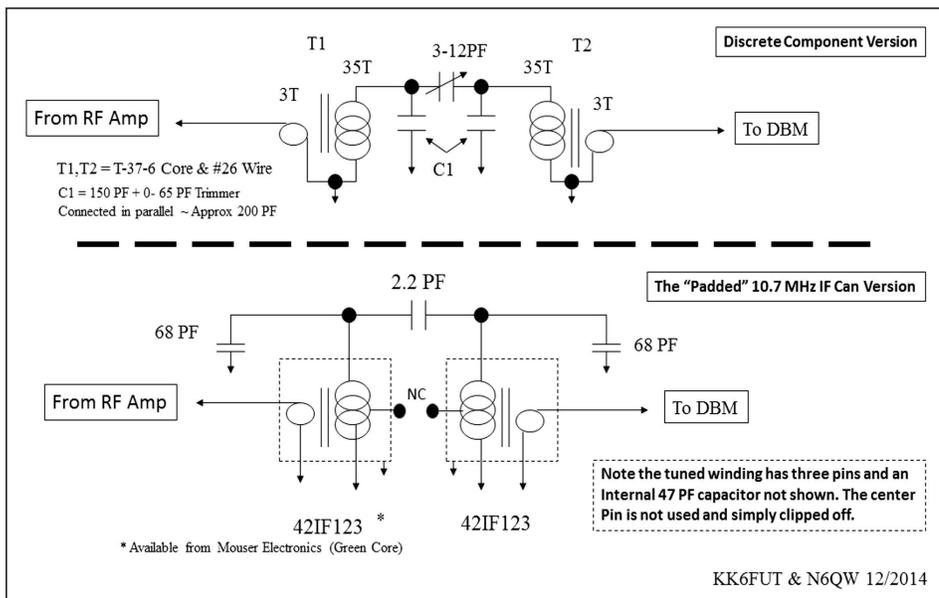


Figure 7—Bandpass filter schematic, with two options for building.

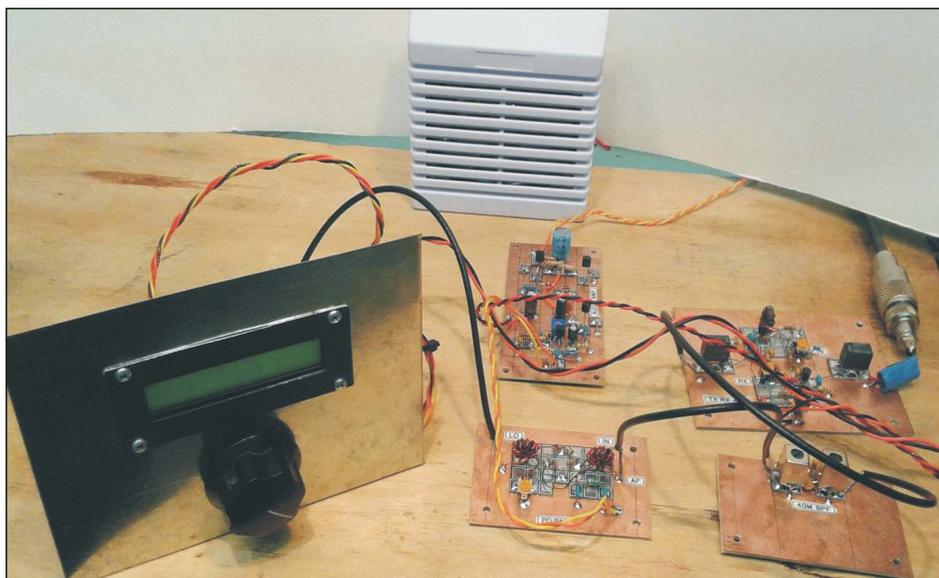


Figure 8—The finished direct conversion receiver.

Figure 6. Once again, when the circuit is completed follow Step 1 in N6QW’s rigorous test process before applying any power!

The Band Pass Filter: Nothing to do with Rock Music

As mentioned earlier, the RF pre-amplifier being broad band will amplify anything coming through the antenna. As we tested this, we found you can faintly hear WWV and nearby shortwave stations coming through the speaker, which is a testimony to as “broad as a barn”. The addition of a band pass filter helps keep most of the crud from being heard. The filter is a

critical part that will be used in the SSB transceiver so that is another block that will be re-used.

There are two ways to build the band pass filter, both of which are shown in Figure 7: one involves a hand calculation using discrete components (harder but worth learning about) and the other uses packaged IF transformers (Mouser P/N 42IF123) along with three fixed capacitors. Since our goal in this article is to get you up and running, we suggest you build the IF transformer version as we will describe here. In a later part of this series of articles, we will suggest and describe a hand calculated band pass filter.

Building the filters requires adding some capacitance to the packaged IF transformers to lower the tuning range from 10.7 MHz to the 40M band. The 68 pF capacitors in parallel with the transformers accomplish this function. The external 68 pF adds directly to the 47 pF capacitor inside the transformer and resonates with the 4.7 μH coil at approximately 7 MHz. The tunability of the inductance accomplishes a resonance inside the 40M band. The third capacitor (2.2 pF) establishes the degree of coupling between the two transformers. Simply connect the parts as shown in Figure 7 and proceed to the tuning process described below.

Alignment of the homebrew filter following the Step #1 process involves N6QW’s “Tune For Maximum Smoke” (TFMS) procedure. The circuit can be peaked for the loudest signal once installed in the radio. Or if a scope is available, feed the DDS signal operating at 7.2 MHz into the filter input and terminate the filter output with a 50 ohm non-inductive resistor. Next place the scope probes across the 50 Ohm resistor and observe the scope pattern. Adjust the pattern for a peak and note the value. Then tune at 7.1 MHz, and at every 25 kHz points, up to 7.3 MHz take similar readings. One can then plot a curve of the voltage reading versus frequency and thus characterize the filter. A flat response is what is desired and a bit of tweaking of the transformer tuning slugs will help improve that response. You will learn a lot about band pass filters using this method.

YouTube Hint: One of the “YouTube videos” that is referenced at the end of the article gives painful detail on how to do this.

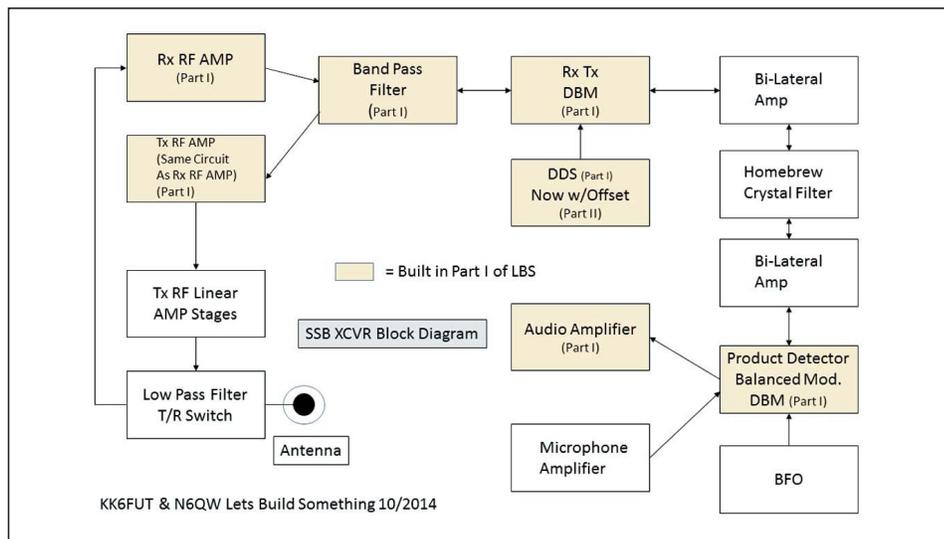
Incidentally, these transformers can also be used as filters on other bands. For instance, N6QW has used these modified IF transformers in his multiband KWM-4 transceiver project. However, the transformers are not suitable for coverage across the entire 75M/80M band. In that instance, a filter using the hand calculation method is more suitable. For 30M and below, the procedure is very similar to what is described above. Just add a different capacitor to resonate with each transformer coil. Once you go past 30M up in frequency, one must “carefully” remove the 47 pF cap on the bottom side and use smaller values of capacitors across the tuned winding

Conclusion and Next Steps

Figure 8 shows what your receiver should look like at this point. It should be working successfully and you should be hearing signals.

We'll continue this series with our next article, which will allow you to proceed with the transformation of this simple direct conversion receiver into a SSB transceiver. Figure 9 shows how the modules built in Part I will be used in the SSB transceiver.

See the table below for YouTube video URLs and content descriptions. Hopefully, they will help you build this project successfully!



●● Figure 9—SSB transceiver block diagram.

YouTube URLs & Description

https://www.youtube.com/watch?v=GFZL8avwD3Y&list=UU4_ft4-oTdCMIWIL4XXHScg — Let's Build Something Demo of the Prototype

https://www.youtube.com/watch?v=kzcvNzpMv3U&list=UU4_ft4-oTdCMIWIL4XXHScg — Homebrew Double Balanced Mixer Part I of 3

https://www.youtube.com/watch?v=86n5gjlmmmI&list=UU4_ft4-oTdCMIWIL4XXHScg — Homebrew Double Balanced Mixer Part II of 3

https://www.youtube.com/watch?v=lShnfyXzCcs&list=UU4_ft4-oTdCMIWIL4XXHScg — Homebrew Double Balanced Mixer Part III of 3

https://www.youtube.com/watch?v=BjqvzI1YLg&list=UU4_ft4-oTdCMIWIL4XXHScg — Building the 40M Band Pass Filter

https://www.youtube.com/watch?v=8p39-5Qcf3U&list=UU4_ft4-oTdCMIWIL4XXHScg — LBS Audio Amplifier Stage

https://www.youtube.com/watch?v=woFpYpSqzKA&list=UU4_ft4-oTdCMIWIL4XXHScg — Final Configuration

https://www.youtube.com/watch?v=b7BGB2oZNEo&list=UU4_ft4-oTdCMIWIL4XXHScg — Installing the Arduino/DDS in the Let's Build Something Direct Conversion Receiver

Mark Your Calendars for these QRP ARCI Contests:

14 March 2015 — Spring Digital Sprint
4 & 5 April 2015 — Spring QSO Party
31 May 2015 — Hootowl Sprint
14 June 2015 — QRP Shootout
5 July 2015 — Summer Homebrew Sprint
22 August 2015 — Slow Speed Sprint
5 & 6 September 2015 — The Two Side Bands Sprint
10 & 11 October 2015 — Fall QSO Party
3 December 2015 — Top Band Sprint
13 December 2015 — Holiday Spirits Homebrew Sprint

Visit www.qrparci.org for more contest information

On the Bench Today: A Kenwood TM-241A

Paul Signorelli—WØRW

w0rw1@msn.com

The Kenwood TM-241A is a small 50W/10W/5W 2 Meter FM Transceiver that was made in the 1990s era. I have had 4 of them used as mobile and base stations. All of the mobile radios have seen over 20 years of vibration and temperature cycling. And all of the mobiles have failed, while the base station is still working.

Here is how to repair the radio. (This also applies to the TM-441A and TM-541A). From this small sample of units I have seen, I suspect there are a lot of these radios out there in junk boxes and all failed because of this same problem. The problem is that the small 9 pin surface mount connector that connects the LCD Board (CN205) to the Front Panel Board (CN1) becomes open or intermittent. This is a blind mating connection and during disassembly I have found all of the connector pins of CN205 have pulled off the Front Panel Board. The connector should pull apart but it gets stuck together from friction or flux and when the LCD Board is removed it just pulls the female part of the connector off of the Front Panel Board. This connector is right in the center of the Front Panel Board.

My analysis shows that the plating of the pins on the female connector is poor which causes dewetting and subsequent solder fracture. The female part of the connector (CN205) must be removed and cleaned. The pins must be cleaned



The Kenwood TM-241A FM Transceiver.

mechanically and retinned, retinning isn't easy. Then the connector solder pads on the Front Panel Board must be cleaned or reflowed so there is a flat surface to resolder the connector. The connector pins should be flat (coplanar).

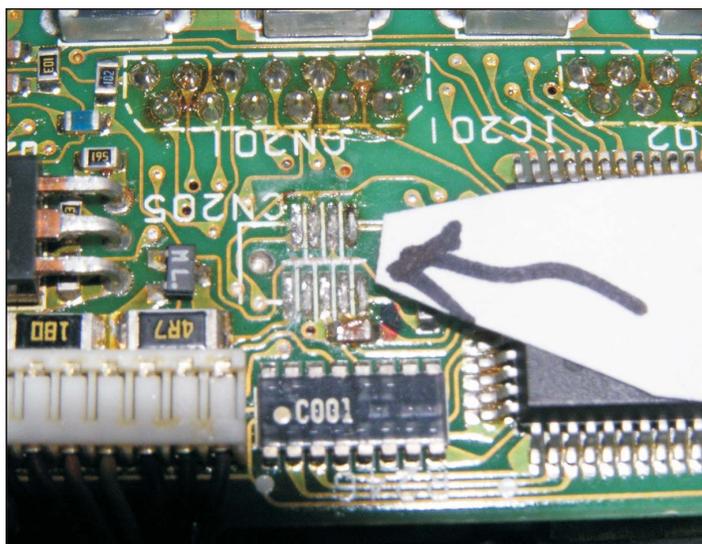
The first step is the Front Panel disassembly which is a little tricky. Remember you are now handling ESD sensitive parts and you must employ ESD Handling guidelines. If you need training go to <http://www.esda.org/onlinecourses.html>

Remove the knobs (4) by pulling straight out. Remove the power button and the Low/Dim button. Remove the mounting nuts on the rotary knob and the microphone connector. Then pry the black Front Panel Bezel up and off. This requires prying up 2 tabs on the top edge and 2 on the bottom and gently pulling the bezel off. Now the LCD Board will be exposed. The other 3 push buttons are held in place by

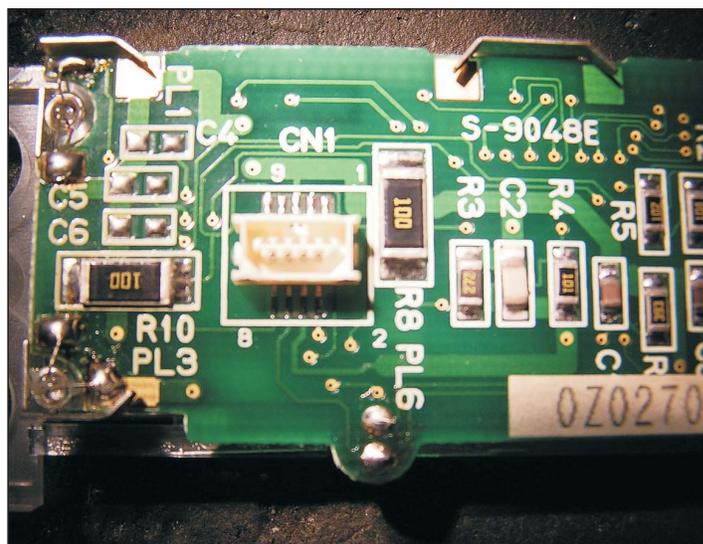
foam rubber that may be deteriorating. If it has crumbled, just hold the 3 clear buttons in place with your thumb until you can get the bezel flipped over. The LCD Board can now be gently pried off, side to side. This action is pulling the CN2/CN205 apart and it will either pull apart successfully or pull the solder joints off the Front Panel board. If the connector comes apart correctly there may be only a few cracked solder joints that need to be resoldered. If the female part is pulled off the board then it needs to be totally cleaned, retinned and replaced on the Front Panel board. This takes a 7x microscope and a very small soldering iron. The connector leads are 0.010 in width and spaced 0.030 inches. There is a keyway on the connector so registration is not too difficult but you must get it flat. Be careful not to damage the nearby chip capacitor. This assembly was reflowed in a solder machine, No one did any hand soldering here before. Make sure the solder joints are smooth and shiny and that there are no solder bridges.

Inspect the connector blades, they should all be protruding out beyond the plastic case. If not, gently push down on them so that the contact pin is in the channel.

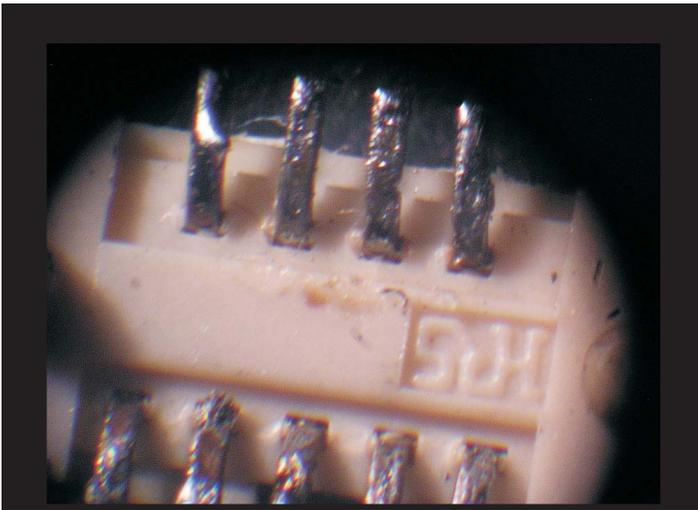
If you want to replace the Memory Battery while you have the unit open you have to remove the metal bezel. If it is down to 2V you probably should replace it.



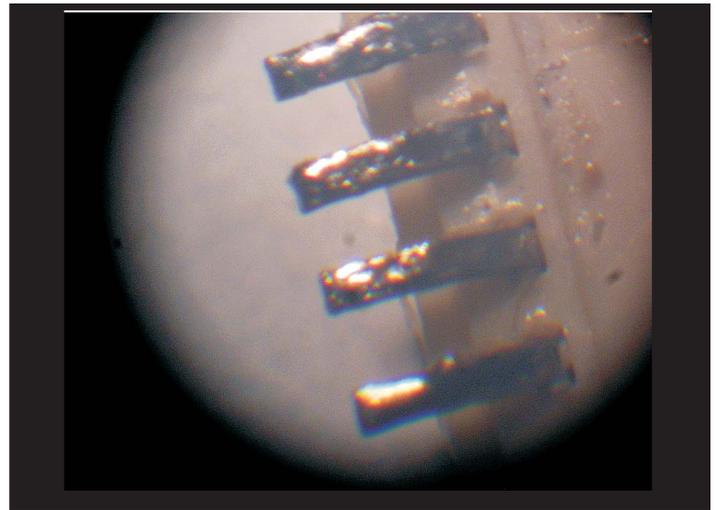
The Front Panel Board with the CN205 LCD Board missing.



The CN1 LCD Board.



CN205 LCD connectors seen through a microscope.



Closeup view of the CN205 pins.

The battery is on the back side of the Front Panel Board. Remove 4 screws on sides, top and bottom of the metal bezel, then remove the 2 screws on the Front Panel PCBA, One on the right and one in the TO-220 case. Then pull up the Front Panel Board straight up, disconnecting the two through hole connectors.

Reassembly is just as difficult but if the connector was the cause of the failure it may be repaired. You can check it before you completely reassemble the unit. This repair is a little tedious but it might save the whole radio from being junked. Unfortunately there are many other failure modes and there is no guaranty that this will fix the radio. The LCD has a 49 pin

elastomer connector which can become disconnected.

If the LCD still is blank you may have to do a factory reset. Push and hold VFO/M>V and then Power the unit on. If that is unsuccessful try Push and hold MR/M key and then turn the radio on. I have fixed several radios using this repair technique.

If that is unsuccessful the radio may still be usable. You just need to know how to push the buttons in the blind. Connect the radio to a 13V, 10A power source, Reset the microprocessor (Push and hold VFO/M), Turn radio On, Push PTT on dummy load with a power meter and frequency counter. You should see 50W at

144.000 MHz. Push the Power button and reduce the power to 10W (QRP). Then push the VFO button and just dial up the frequency you want using the rotary knob and using the frequency counter to select it. Then Lock the radio, Press "F" key and then MHz/Lock.

You can inject CTCSS by Pushing "F" and holding it for 3 seconds, Push "Tone", Rotate the dial knob 4 clicks for 100 Hz, and then push "Tone". Then push "Tone" again and you will get the "T" (which you can't see on the display), then push VFO and it will stay in Tone Transmit.

Now you can at least sit it in a corner and monitor 146.52 MHz.

—Good luck! Paul, WØRW

Don't forget FDIM 2015!

See the announcement on the next page, or the longer story on pages 24-25.

Everything you need to know is on the QRP ARCI website, too!

— www.qrparci.org/fdim —

FDIM 2015

May 14-17, 2015

Holiday Inn—Fairborn, OH

The 2015 event is our 20th !

We will be having some special attractions—check the FDIM webpage for details.

What happens at FDIM ?

• Wednesday 13th May

Check in at the hotel and collect your FDIM badge and goody bag in the evening.

This is a great time to meet up with old friends

• Thursday 14th May

A full day of seminars from 8am to 4pm. Draws are held during the seminars and prizes will be presented to the lucky winners.

An evening presentation (subject to confirmation).

Vendor Night—avoid the Hamvention crowds. Buy kits, antennas, books and components right in the hotel. We will provide a table if you have products to sell.

• Friday 15th May

Attend the Hamvention—use the buses that we run from the hotel direct to the Hamvention entrance.

Buildathon and Pizza Party in the FDIM hotel.

QRP Club Night—promote your local club and enjoy the hospitality of other clubs.

It's a lot of fun, with games, and music later in the evening.

Enter one of the Hombrew Construction competitions. Entries are displayed for all to see and everyone attending joins in with the judging.

• Saturday 16th May

Attend the Hamvention again. The buses to Hara Arena will be running.

The FDIM Grand Banquet is held in the evening. Food, drink and great company!

Door prizes are drawn (usually several THOUSANDS of dollars in value!).

Awards are made and speeches are short.

The QRP Hall Of Fame inductions are announced.



• Sunday 17th May

Attend the Hamvention if you want, then make your way home.

Who will speak at the seminars ?

This year we have:

George Dobbs, G3RJV
Mike Bryce, WB8VGE
Paul Darlington, MØXPD
Jay Slough, K4ZLE
Jim Everly, K8IKE
Glen Popiel, KW5GP

...and others to be confirmed

What about registration and reservations ?

Register for the Seminar (\$40) and Banquet (\$35) online on the FDIM page. Payment is by PayPal or credit/debit card

If you register online then you will be entered in the seminar drawings to win a prize. Registering by mail or at the hotel will not qualify for entry in the drawing.

To book a room call the hotel direct. The correct procedure is noted on the FDIM webpage and in the 'From The President' column in the January 2015 issue of *QRP Quarterly*.

FDIM 2015 · May 14-17, 2015 · Holiday Inn—Fairborn, OH

Be sure to check - www.qrparci.org/fdim - regularly for updates!



2014 is now in our rear view mirrors. As we look back, we should celebrate the successes and the winner, and we should also look for how we can improve. I have heard from some of you over the course of the year, and I can summarize your comments in this one statement that sums up 2014: The Year of Low Participation.

For 2015, let's all take a look at trying to increase the participation in our contests. If each participant was to refer one new participant there would be twice as many of us on the air for the events. I myself will vow to get on the air for some contests in 2015 after not participating at all in 2014. I also vow to increase the participation through greater promotion. In promoting our contests we need to be more self-centred. Talk to others about how much fun we are having, how many 2-way QRP QSOs we are completing, and how many QSOs that qualify for various awards we worked during the most recent event. Talk it up on the forums, among the local gatherings and any chance you can. I would like to see all QRP-ARCI Contest Operators become Contest Promotion Captains and tell everybody they can about our events!

This quarter saw three contests, and three different winners. The Two Side Band Sprint ran in September, and the winner was Harold Slack, VE5BCS. There was only one entry received for this contest but Harold's entry was impressive, with 11,760 Points. This is a contest format that I continue to receive the most requests for. The most frequent contest request is for SSB events. We run the Fireside SSB Sprint in February, the QRP Shootout in June and the Two Side Bands in September. All of these events are either SSB or feature a SSB segment of time. For all the requests for SSB activities, they remain the least participated in activities. Perhaps 2015 will be the year that they take off.

The Fall QSO Party participation was the lowest that I can remember. Of the 29

entrants that were received, Bob Patten - N4BP returned to the top of the standings with 224,812 points. Ric Morton, WO4O took second place honours with 142,345 Points and Richard Ferth, VE3KI rounded out the top three and took Top Score in Canada with the only other six figure entry with 101,745 points. Robert MacKenzie, VA3RKM took fourth place with 38,976 points and Andrew Measday, WA5RML rounded out the top five with 24,108 points.

A solid and hearty field of 19 entrants came out for the Top Band Sprint, and taking top honours was Brian Campbell, VE3MGY with 41,678 points. Mark Langenfeld, WA9ETW took second place with 15,561 points, and in a tight three way race, the rest of the top five were Larry Card, W9CC with 9,072 points, Tim Shoppa, N3QE with 8,918 points and Jeff Wilson, VE3CV with 7,546 points.

I look forward to 2015, and I hope to hear many of you on the air throughout the year during the QRP-ARCI events.

Until next time, keep your power down and your QSO rates up.

—73/72, Jeff, VA3JFF

Two Sideband Sprint Soapbox

I could not scare up a club member. But I was heard in JA and broke a pile up W6J so I'm happy. I hope to work the CW test in October. Turn those antennas north! —VE5BCS

Fall QSO Party Soapbox

Very disappointing turnout for the Party. Needs more promotion, suggest reminder notices sent to all ARCI members who have e-mail addresses listed in their membership profiles. Conditions were good on all bands, but never could raise a QSO on 10m. Managed an easy JA QSO on 20m. Thanks to those who showed up for the party. —N4BP

This is the "Big One" for QRPers? —WO4O

Even more dismal participation than last time. —VA3RKM

Activity was low, but still a fun event; Thanks to those who participated! —WA5RML

A lot of effort for very few points

because participation was very low—lowest I've seen. Participation has been declining over the past few years and if the Fall and Spring QSO Parties aren't publicized more effectively I fear they will disappear. —VE3EUR

Finished building the 20 dB attenuator just in time to enter the contest QRPppp! —AI2T

My first participation after a hiatus of several years for downsizing, retirement and QSY to WA. Conditions seemed rather poor to me, made worse by a rather noisy QTH, so my apologies to those who called and did not get through. Thanks for this contest and I hope to be more active in the future. —KL7IKV/7

Life got in the way this weekend of my ham radio hobby. Sorry I could not play more. My favorite event now gone for another year! —NØEVH

As many QSO Parties and Sprints that were going on, I sure didn't hear much for the QRP ARCI activity. I was doing the SKCC WES and also the Fists sprint and was just lucky to hear someone doing the ARCI. Hope for the Top Band Sprint & Holiday Spirits Homebrew Sprint that there won't be a lot of other sprints at the time. —KBØETU

Top Band Sprint Soapbox

Was it just me, or were conditions a little bit weaker for this year's Top Band Sprint than last? (I think I worked everything I heard in 2013, but I definitely missed a few this time around.) And, although the pace was brisk right out of the blocks, things slowed way down after 0300—only eight Qs logged during the last three hours! Where did everybody go?? Nonetheless, a bunch of great Top Band ops gave me a pretty good run overall, and I was very happy to tally a score within spittin' distance of last year's. Thanks to all for the points and fun! —WA9ETW

Conditions were terrible with rapid QSB. Missed a few callers in the fades. It was a struggle to get Member Numbers correct; probably messed a few up. Even my recently erected temporary Beverages didn't help much, but glad to work WY and AL with 4 watts. Need a Beverage at 265° for USA! Maybe next year. —VE3CV

2014 TWO SIDEBANDS RESULTS

Call	QTH	Bands	Class	Pwr	Qs	Pts	SPC	Mult	Bonus	Score
VE5BCS	SK	20	A1	< 10W	39	80	21	7		11760

2014 TOP BAND SPRINT RESULTS

Call	QTH	Pwr	Qs	Pts	SPC	Mult	Score
VE3MGY	ON	< 5W	71	229	26	7	41678
WA9ETW	WI	< 5W		117	19	7	15561
W9CC	IN	< 5W		72	18	7	9072
N3QE	MD	< 5W		91	14	7	8918
VE3CV	ON	< 5W	19	77	14	7	7546
VE3KI	ON	< 5W	22	86	12	7	7224
K4ZGB	AL	< 5W	16	62	14	7	6076
KN1H	NH	< 5W	9	45	7	7	2205
N5GW	MS	< 5W	9	36	7	7	1764
W2SH	NJ	< 5W	9	42	6	7	1764
AB8DF	MI	< 5W		41	5	7	1435
W9ZSJ	IL	< 5W	8	34	6	7	1428
AA5TB	TX	< 5W	7	32	6	7	1344
N8LJ	MI	< 5W	7	29	4	7	812
W2JEK	NY	< 5W	6	24	4	7	672
KB5JO	TX	< 5W	5	19	5	7	665
AB8FJ	OH	< 5W	2	7	2	7	98
W4IM	VA	< 5W	2	4	2	7	56
VE3WMB	ON	< 5W	1	2	1	7	14

2014 FALL QSO PARTY RESULTS

Call	QTH	Bands	Class	Pwr	Qs	Pts	SPC	Mult	Score
N4BP	FL	AB	A2	< 5W	125	518	62	7	224812
WO4O	FL	Hi	A2	< 5W	100	415	49	7	142345
VE3KI	ON	AB	A1	< 5W	72	323	45	7	101745
VA3RKM	ON	AB	A1	< 5W		192	29	7	38976
WA5RML	TX	AB	A1	< 5W		123	28	7	24108
WR4I	VA	AB	A1	< 5W	34	113	27	7	21357
N7RN	AZ	AB	A2	< 5W	30	135	22	7	20790
VE3EUR	ON	AB	A1	< 5W		101	19	7	13433
KN1H	NH	AB	A1	< 5W		92	18	7	11592
NQ9RP	WI	AB	A1	< 5W		93	16	7	10416
WA2JQZ	AL	20	A1	< 5W	19	86	15	7	9030
NX4N	FL	AB	A1	< 5W	18	74	15	7	7770
AI2T	NY	Hi	A2	< 55mW	9	36	7	20	5040
W2JEK	NJ	AB	A1	< 5W	12	50	10	7	3500
KL7IKV/7	WA	Hi	A1	< 5W	11	49	10	7	3430
KB5JO	TX	20	A1	< 1W		38	7	10	2660
VE5BCS	SK	20	A1	< 5W	10	50	7	7	2450
K4JPN	GA	Hi	A2	< 5W	9	42	7	7	2058
N9WAY	WI	20	A1	< 5W	9	42	6	7	1764
KIØJ	CO	Hi	A2	< 5W		34	7	7	1666
VE7KBN	BC	20	A1	< 5W	6	27	6	7	1134
W9CC	IN	20	A1	< 5W	5	22	3	7	462
NØEVH	MO	20	A1	< 5W	4	20	3	7	420
WA7BME	UT	AB	A1	< 5W	3	12	3	7	252
KBØETU	AL	20	A1	< 5W	2	10	2	7	140
ADØBI	MO	20	A1	< 1W	1	5	1	10	50

The band was unusually quiet considering it had been noisy only one day before due to a passing cold front. QRP signals were weak as usual on top band, and there did not seem to be a great deal of participation. However it was fun. —**N5GW**

Hellish noise in my Chicago NW suburban location. I hung around for about an hour and a half. But during the ARRL 160 CW there was virtually no noise and I could hear forever. Oh, well! —**W9ZSJ**

Worked the only station I could hear. Perhaps a better antenna for next year. —**VE3WMB**

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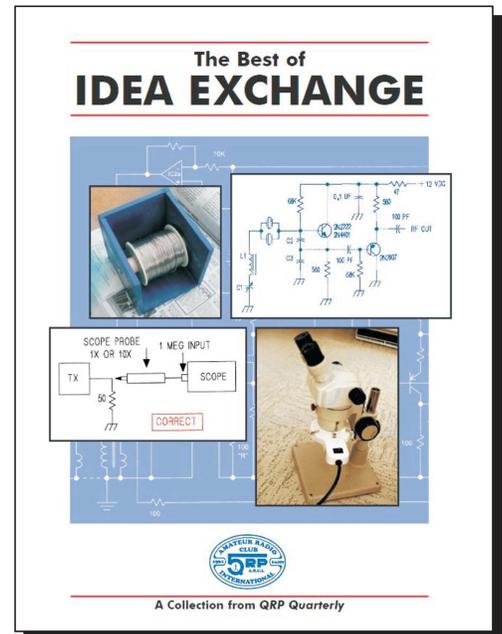
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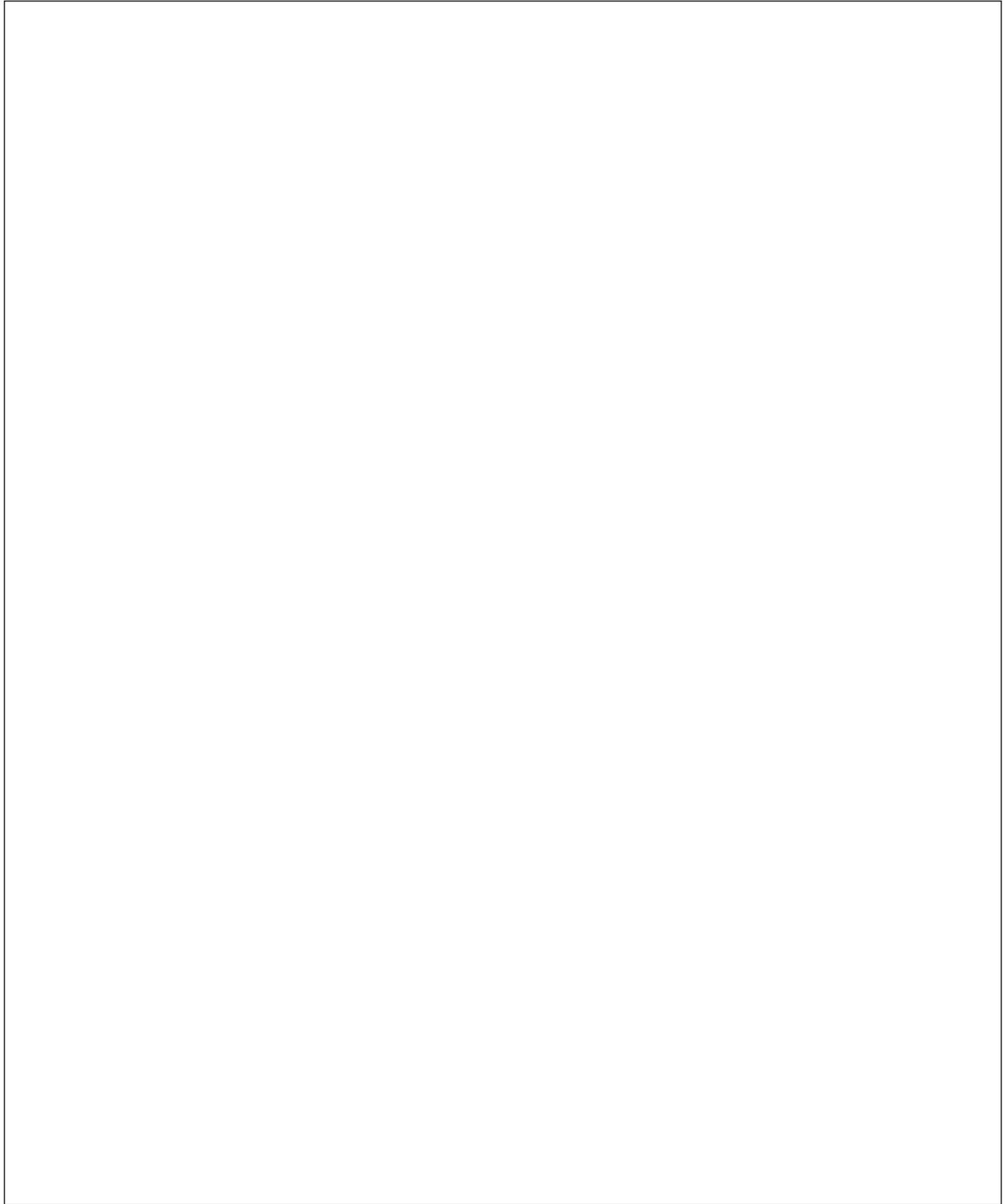
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(Don't forget — the Toy Store has lots of other QRP-related items for sale!)



My QRP Notebook

Take notes, doodle or sketch your QRP-related ideas in this bit of extra space we had for this issue!



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- Hardware hooks for user added features
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