



PCARA Update



Volume 21, Issue 3 Peekskill/Cortlandt Amateur Radio Association Inc. March 2020

Twenty ways

March 2020 is the 20th Anniversary for the *PCARA Update*. Twenty years of the newsletter are now available to be searched using the CUSTOM SEARCH TOOL available on the PCARA website, <http://www.pcara.org>. Thanks to Lou KD2ITZ for this powerful resource. [See pp 8-9 for more details -Ed.]

We ended January with a presentation entitled *Introduction to the BITX Transceiver* at the John C. Hart Memorial Library in Shrub Oak, NY. Todd N2MUZ and Mike N2HTT provided an excellent presentation on the assembly and operation of the microBITX Transceiver, complete with critiques. We had 17 in attendance including a walk-in who just happened to be at the library at the time. The PowerPoint slides have been provided in pdf format via PCARA Yahoo! Groups. A big THANK YOU to Todd N2MUZ and Mike N2HTT for their efforts in sharing their experiences with the μ BITX.



Mike N2HTT (foreground) and Todd N2MUZ demonstrate their radios at the January 27 presentation on the μ BITX.

At the February PCARA Membership Meeting we discussed ways of observing and celebrating our 20th Anniversary. Among suggestions were a Special Event Station, perhaps a picnic or even a Hamfest. Also, for the month of December 2019, PCARA had been selected to be part of the Stop & Shop Community Bag Program by our local Stop & Shop located in the Beach Shopping Center, 1831 Main Street, Peekskill, NY. Lou KD2ITZ reported receipt of \$66 from the Community

Bag sales for the month of December. PCARA would like to thank Stop & Shop for this most generous opportunity. In addition, we discussed possible alternate locations for 2020 ARRL Field Day due to the unknown future of our current Field Day home at Walter Panas High School from pending construction of the new baseball field and parking lot. More to follow.

Here are some upcoming events to mark on your calendars:

- Saturday March 14, 2020: PCARA Breakfast at Uncle Giuseppe's Marketplace in Yorktown Heights at 9:00 am.
- Saturday March 14, 2020: PCARA VE Test Session at the John C. Hart Memorial Library in Shrub Oak, NY at 11:00 am.
- Sunday May 3, 2020: Orange County Amateur Radio Club (OCARC) Hamfest (courtesy of Joe W2BCC).

Our next regularly scheduled Membership Meeting is on Sunday March 1, 2020 at 3:00 p.m. at New York – Presbyterian / Hudson Valley Hospital in Cortlandt Manor, NY. Bring along your suggestions for ideas on ways to celebrate PCARA's 20th Anniversary — PCARA 20 IN 2020! I look forward to seeing each of you there.

- 73 de Greg, KB2CQE

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PCARA Board

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products to be quite durable and reliable — highly recommended!

Before you sit down to build your project or complete your repair, a couple of accessories should also be in order. I would recommend three small plastic squirt bottles:

- To aid difficult soldering challenges, use a needle nose bottle containing rosin flux. This will allow the solder to flow with ease when you need a little extra help and persuasion.
- Another similar bottle should be filled with water to keep your solder station sponge moist. Wipe the tip of your soldering iron along the sponge after each action for a clean start every time.
- The third bottle should be filled with 99% isopropyl alcohol. Moisten a Q-tip® with a touch of alcohol and lightly scrub your work to remove brown and sticky left-over flux from completed joints.



Weller WLC100 40W soldering station.



Finally, purchase a set of 2CYX5 hole cleaner tools to clean out PC board component holes.

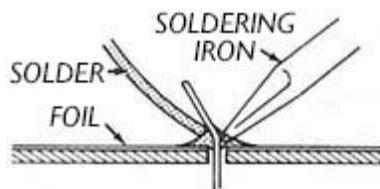


2CYX5 spiral tip cleaner set.

These are long and thin miniature files that will prepare PC solder holes before inserting a replacement part. Now you are all set!

Here is the cardinal rule of all soldering: When soldering components or wires to a PC board or chassis *cut the lead before you solder the joint!* If you cut the lead after you solder, the snip action will shatter the joint. Dissimilar metals (the solder and the wire) will be exposed to oxidation. It will not be a sealed joint! The correct method is to position the component, bend the leads that come through the board in the direction of the PC board 'pads' and 'lands' and snip both component leads before soldering. This makes a good physical connection before you seal your work with solder.

Place the hot soldering iron tip at the hole for a second or two to heat the joint. With your other hand touch the solder to the tip and turn the tip



Part of Heath instructions for making a soldered joint on a PCB. "As the solder begins to melt, allow it to flow around the connection. Then remove the solder and iron and let the connection cool."

very slightly as the solder melts over the joint. You should use just enough solder to fill the PC board hole without making a bead of solder apparent.

Similarly, when you are working on a chassis... wrap the wire once around the terminal strip or post to make a solid physical connection and snip it to fit. Then seal the exposed wire to the post with just enough solder to make a good joint. *Cut first — then solder!*

If you are making connections with stranded wire, strip the wire's insulation away to bare enough wire to make the connection with a wire stripper. Twist the wire gently in your fingers until the wrap is tight — then — seal the wire threads by melting a small amount of solder along the wire to 'tin' them in place. This approach makes the ends of your stranded wires just like a solid conductor — and — aids eventual soldering to the PC board or terminal connection.

The term 'tin' comes from the composition of the solder itself. Most electronic solders are a combined alloy of 60% tin and 40% lead — or — 63% tin and 37% lead. Examine a piece of solder cut with a wire cutter and you may see an amazing part of its formulation. Most all solders have built-in 'multicores' of rosin flux made from pine

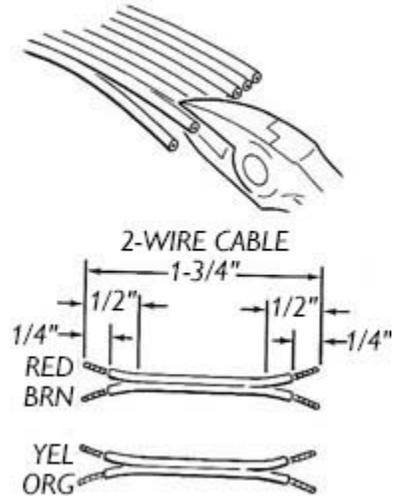


sap. Brown or golden in color, the rosin aids the solder to

melt and adhere to metal joints known as 'wetting.' Having the flux built into the solder saves you from applying the flux separately and will save you a lot of time as you build your project. So convenient!

How do you know you have made a good solder connection?

A fine solder joint should look shiny and smooth without creating a bead from too much applied solder. If you remove your solder tip too slowly, you may create an unsightly 'icicle.' If you move your component or wire before the joint has cooled it



Heath instructions for stripping stranded wire. "Remove 1/4" of insulation from each wire, being careful not to cut the fine wires. Twist together the fine strands of wire and melt a small amount of solder on them to hold them together."



Chemoloy™ 60/40 tin/lead activated rosin core solder.

will look porous, cracked or dull gray. Never, ever blow on a solder joint to cool it. You'll get one crusty solder joint in return! These 'cold' solder joints make a miserable connection and will just cause trouble. Always remember: Shiny and smooth = good!

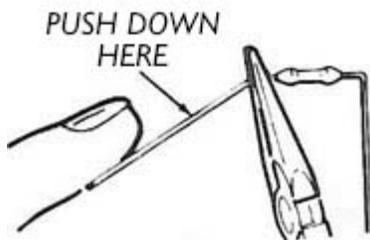


Cold-soldered joint. Note the dull gray color of the solder.

Get In Position

For a truly professional look you can be proud of follow these standards: When you build a circuit board or chassis, position all of your components in the same direction. Resistor color codes should run up to down with the tolerance band towards the bottom of the chassis — or — consecutive left to right. Similarly, capacitor positive side bands should be at the top or at the left with all the numbers (100 μ f 25VDC or whatever) all facing the same way and all easily readable.

When positioning components vertically, make a squared-off bend at the top. Again, this makes for a professional look and also provides a nice place to grasp the lead with a meter or test probe if ever necessary. Quick rounded-off ends are never the same twice and don't look like they were made formally. In all cases, try to position components uniformly across your project in a neat and thoughtful manner. Your project will look so much better when it is done!



"Bend the leads straight down to fit the hole spacing on the circuit board."

Should there ever be a point where component leads come too close to each other and they may possibly touch, a piece of tubing can provide insulation that may save you from catastrophe. If you don't have factory-made tubing available, a left-over piece of wire insulation may suffice. A piece of tubing can also cover points where wires have been spliced or otherwise repaired.



Paladin heat gun. [N2KZ pic]

Also available is 'heat shrink' tubing - the

deluxe material for insulating wires and splices. Heat shrink has a rubbery plastic feel and will conform to the shape of whatever is inside it. Cut an appropriate length to cover your wires or repair — then — apply heat using a heat gun (much like a hair dryer but higher in air temperature) and watch the tubing shrink-wrap itself tightly around your work. It's a miracle, I tell you!

Repair and Rework

Repair and Rework

Repairing circuit boards requires more advanced skills. If you need to remove and replace a component — maybe a burnt resistor or a shorted capacitor — you'll need to remove the solder from the solder joint as part of your 'rework.' There are three ways to skin this cat.

Some people prefer to use a woven braid of fine wire called 'Solder-wick.' When a solder joint is reheated, you can place a piece of Solder-wick on the joint



Desoldering wick.

and hope the now molten solder will migrate to the wick, pulling it away from the joint. This is troublesome because the wick adds a lot of surface area and the solder will require a great deal of heat to become molten. The PC board and the etched wiring lands and pads can also become overheated and come off the board. This isn't fun and it's difficult to do.

You can also use a 'solder sucker' such as the Edsyn 'Soldapullt®'. This is a long cylindrical manually



Soldapullt solder-sucker.

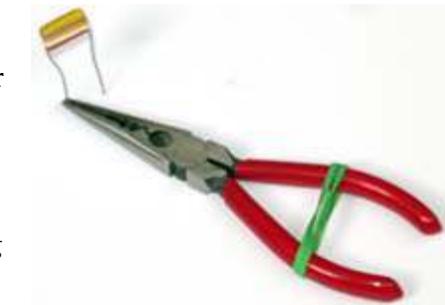
pumped suction device. You press a plunger down into the cylinder. Heat the joint with your soldering

iron until it becomes molten. Place the Soldapullt's point over the solder joint then quickly press the round button in the middle of the tool and you will create a powerful momentary suction that instantly removes the molten solder with grace and style. I prefer this method.

An expensive version of this concept is seen in professional rework stations. A hand-held metal nozzle heats to solder melting temperature. Place the nozzle over your joint and press down on a foot pedal switch. The nozzle will activate a small electric pump that provides suction to discreetly clean the joint. You have to constantly keep the nozzle clean to continue having good suction.

Conspire to Wire

While I am at it, let me please include some wiring tips. I have seen all sorts of ways, simple and complex, of holding wiring in place as you attempt to solder wires to a connector or whatever. People use desk vices, vices with alligator clip attachments, expensive pivoting frames and lots of other things! Being someone who spent a long time on the road, I developed very simple methods of getting repairs and wiring done with simplicity. One trick I like is to make a needle nose or other plier into a locking plier by just wrapping a rubber band around the handles. It will hold anything with a gentle touch so you can solder it without effort.



Needle-nose pliers hold a component in place with the aid of a rubber band.

I have also developed a similar technique by resting heavier tools like my large wire cutter over a wire or cable to hold it in place. It works like a charm! When you 'get the hang' of this, wiring can become quite rapid and easy. I use this for soldering all sorts of things especially audio XLR connectors or multi-pin 'mult' cables for connecting multiple audio circuits with one large cable.

Speaking of soldering cables that require multiple connections — try this: Always slide the collar or shell



Don't let this happen to you! Slide the shell/cover/coupling ring onto the cable before soldering.

of the connector onto the cable *before* you do all your painstaking soldering. Nothing is sadder than a beautifully built connector without its cover! The agony! Prepare the multi-wire

end by stripping and tinning each and every wire end before soldering. Remember the wires that go to the outside pins need to be slightly longer than the inside pins. Start by soldering the inside pins first and work your way out to the outside to finalize your job. It is much easier to do when your work is in the clear instead of trying to solder around wires you have already completed!

Learn to use just the right amount of solder to make a good connection. Don't overload a 'cup' with too much solder so it beads up and expands over the con-

nection point. Also, get to know the place to adjust your iron for the correct temperature. Too hot melts plastic and ruins connectors. Too cold makes for crystallized cold solder joints, lousy connections and peril!

Be very, very careful with PC boards that have connections inside the board layers. Multi-layer boards are best repaired at the factory and not at your bench. Realize that professional PC boards are often made by a process called 'wave soldering' where all the components are placed perfectly by automation before soldering. The boards then go precisely through a carefully heated and prepared bath of solder for pristine results. Similarly, SMT (surface mount technology) boards are fragile and require great care. Sophisticated expensive workstations and advanced skills are needed to enter the land of SMTs! High tech boards are hard to repair in the field. Beware!

Also very useful: Consider using the single conductor wire found in either CAT5 or CAT6 cable and/or wiring used for old-fashioned telephone 'telco' connections.



Scrap telecom wire is ideal for small projects. [N2KZ pic.]

These are all fine gauge single conductor solid wires with a variety of different color insulation. Grab this kind of wire whenever you can. It makes excellent wiring for your projects — or — PC board land and pad repairs. Very, very useful and usually free! Scraps can be gifts!

A note about safety: Solder for electronic use is an alloy combination of the metals tin and lead. Lead is considered to be a very toxic substance. Please make sure when you are done with your work to wash your hands thoroughly to remove all lead residues. You don't want to ingest lead when eating, drinking or smoking. Never put solder in your mouth! Also, don't wear synthetic fiber clothing when soldering. Hot solder splashes will not only melt through your fabrics — it may adhere to your skin and burn you! Similarly, solder will permanently damage carpeting and flooring. Pick your workplace and work clothes with thought and care! While you are working, try not to breathe in the fumes from rosin flux. These fumes will do you no good!

Finally, keep in mind that my experiences are my own and not to be thought of as universal. We all have developed habits and procedures for soldering and construction that are comfortable for us. I would love to hear your hints. You learn something new every day! Enjoy the coming of Spring and get on the air! 73s and dit dit de N2KZ 'The Old Goat.'



μBITX presentation

On Monday January 27, PCARA organized a presentation on the microBITX HF transceiver kit. Recent interest in this design began with a suggestion from Charles N2SO that the kit — manufactured in India — was worth looking at for old and new hands alike who might be interested in a low-cost radio with a home-construction element.

The meeting was held at the John C. Hart Memorial Library in Shrub Oak where Lou KD2ITZ had arranged access to the Community Room. This is a large, airy room in the center of the library, equipped with tables, chairs and projection screen. Seventeen members and friends came to the event to find out more about the Arduino-controlled μBITX, which covers 10 – 80 meters, SSB and CW with 5-10 watts output.

Todd's experience

First up was Todd, N2MUZ who had previously described his experience building the μBITX v3 in the April 2018 issue of *PCARA Update*. Todd explained how he had ordered his μBITX v3 kit from “HF Signals” in December 2017 for \$119, receiving the parts in January 2018.



Todd N2MUZ begins his presentation on the μBITX v3 kit in the Community Room at John C. Hart Library.

The circuitry was designed by Ashhar Farhan VU2ESE, whose company builds and tests the μBITX out of his basement in India, using local labor. At the time, the v3 kit consisted of a populated circuit board with external controls and connectors but no case or power supply. Todd purchased a plastic case on eBay then cut holes for the chassis-mounted components himself.

After completing construction, Todd's first contact was on 20 meters SSB with a signal report of 56 from Houston, TX. Unfortunately, the next event was less happy as the audio output disappeared with a crackle and bang. The audio output integrated circuit, a

TDA2822M, had failed, with a burnt area on the chip and the surrounding board. Todd unsoldered the 8-pin DIL IC and added a socket so that future replacements would be easier. He also attached a heat-sink to the new IC.



Todd's TDA2822M WX audio output IC which failed shortly after completion of the kit. [N2MUZ pic].

Todd's next unfortunate experience was when he accidentally reversed polarity of the 12 volt DC supply leads. A silicon diode is wired across the power input socket — this diode protected the subsequent circuitry, but had to be replaced as it sacrificed itself in the process.

Todd recommended the μBITX v3 for HF portable operation — combined with a LiFePO₄ battery, “clothesline” dipole, coaxial cable and a fishing weight to throw over a tree.

Mike's mods

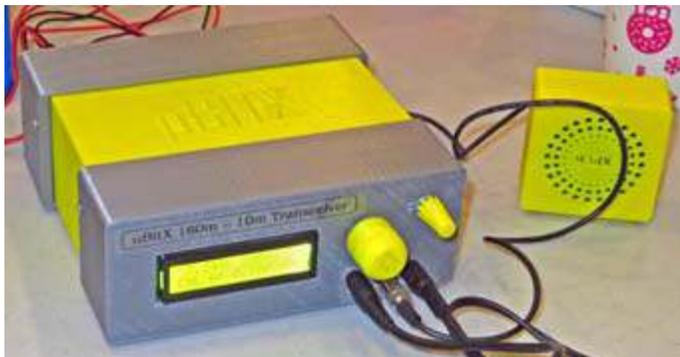
The second presentation by Mike N2HTT described a similar experience constructing his own μBITX v3, with additional modifications. After initial assembly, Mike *also* ran into a problem with high current draw, a bang, and a crack across the TDA2822M audio output IC. ICs marked with ‘WX’ appear to be a **Chinese clone** which is incapable of operating from +12V DC. The fix was to replace the bad chip with a socket and install a good IC.



Mike N2HTT continued the μBITX presentations at the John C. Hart Library, while Bob N2CBH (left) recorded the event on video.

In the early days of the μBITX, commercial cases were unavailable so Mike manufactured his own enclosure by 3D printing — he modified an existing design

from Thingiverse (<https://www.thingiverse.com/thing:2732866/>) using screws instead of snaps, with PLA filament (polylactic acid) replacing PETG. On the back panel, Mike added an inline fuse to protect the reverse-polarity diode. He also 3D-printed a hand-held microphone case and loudspeaker enclosure.



Colorful 3D-printed enclosure manufactured by Mike N2HTT for his μ BITX v3 transceiver. The loudspeaker case is also 3D-printed.

Mike wired his μ BITX to use a straight key for CW, though it is also possible to use a paddle. He recommended firmware made available by Ian KD8CEC with an improved feature set (RIT, speed-up tuning, channel memories) compared to the standard software provided by HF Signals. The KD8CEC firmware does not require any hardware modification. Control of the μ BITX's display and operation is based on an Arduino Nano which has a USB connector for updating. You would need Arduino's IDE (Integrated Development Environment) on a suitable computer to compile code and upload it to the Nano.

Mike's first QSO took place during a BITX QSO Day, every Sunday — 3:00 p.m. and 7:00 p.m. local time on 7277 kHz. For CW Mike uses an external NEscaf audio filter. His overall impression is that the μ BITX provides a great way to get on the air cheaply, a great second rig, a great portable rig but **not** suitable for contesting.



Mike N2HTT demonstrates CW operation of his μ BITX v3 at the end of the presentation.

The meeting concluded with a short presentation by Barry K2BLB on Westchester County's plans for updating its radio networks.

Suggested web resources:

Archived μ BITX v3 page:

<https://www.hfsignals.com/index.php/ubitx-r3-archived/>

To see modifications and complaints go to:

<http://ubitx.net/>

Mike's modified 3D printing file:

<https://www.thingiverse.com/thing:2823172>

KD8CEC firmware:

<http://ubitx.net/2018/02/09/kd8cec-software-version-1-release/>

uBITX v4 code:

<https://github.com/afarhan/ubitx4>

V.E. Test Session

A PCARA Volunteer Examiner (V.E.) Test Session is scheduled to take place on Saturday March 14, 2020 starting at 11:00 a.m. in the John C. Hart Memorial Library, 1130 E Main St, Shrub Oak, NY. The session follows immediately after the 9:00 a.m. PCARA breakfast at Uncle Giuseppe's in Yorktown on the same morning.

The cost for candidates is \$15.00 per exam or retest. A photo-ID is required and your Social Security Number will be needed if unlicensed. Please bring a copy of your current amateur radio license if upgrading.

All candidates are strongly advised to contact Mike W2IG before the test session, using e-mail address: w2igg 'at' yahoo.com.

If you are studying for the Amateur Extra examination, bear in mind that there will be a **new** Question Pool in effect from July 1, 2020. Here is a link to the NCVEC 2020 – 2024 Extra Class question pool: <http://www.ncvec.org/page.php?id=356>



PCARA member Rich KD2SNR (left) upgraded to General Class at the WECA VE Test Session on 2/20/20. He is pictured here with Stan WA2NRV. [Pic. credit Lou KD2ITZ.]

Twenty newsletter years

This edition of the newsletter marks a milestone in the history of Peekskill / Cortlandt Amateur Radio Association. The first edition of the *PCARA Update* — Volume 1, Issue 1 — appeared twenty years ago on March 14th 2000, so this is the **20th Anniversary Edition**.

Issue number 1 was produced by *Update* Editor Joe Ellman whose callsign at the time was KC2DWP, later to become KR2V. Here is the very first article from page 1.



Volume 1, Issue 1.

Welcome!!

On behalf of all the members of the PCARA, we would like to welcome you to the first issue of the *Update*! We have some great plans for the club in the works, including:

- Incorporating as a non-profit, tax-exempt organization.
- Registering for a club station call sign.
- Fundraising
- Upgrading our equipment to include autopatch.
- Marketing our club as a community service organization.

We have set ambitious goals for getting the above done, and in order to meet these goals we will need the help of our members. Positions that need to be filled as soon as possible include:

- Fundraising Coordinator
- Public Service Coordinator

Please let us know if you are able to offer help in any way as we work to make our club the best it can be! Also, please take a moment to look over the Club Roster on page 2 and let us know who we are missing.

73's

Bob Tarsio
N2CBH

Greg Appleyard
KB2CQE

Long ago

Cast your mind back to the year 2000, when several things we take for granted today were rare. There were home computers, but for the most part they were not connected together until you issued a command to your dial-up modem. There were cell-phones, but they were large, heavy and only good for phone calls and short messages.

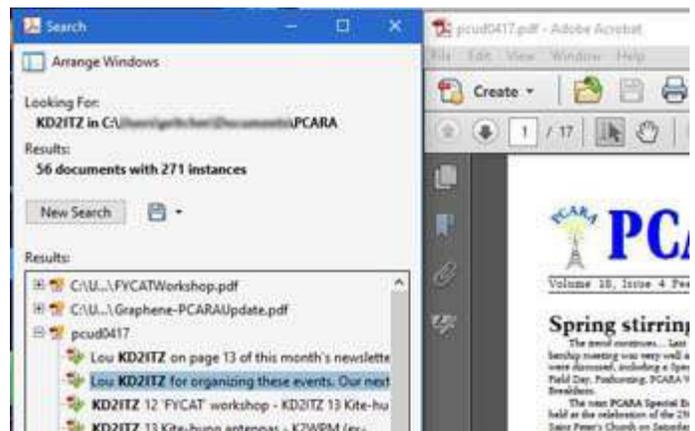
Our *PCARA Update* Editor Joe KC2DWP prepared the newsletter as a Microsoft Word document then printed out a master copy by LaserJet. He would take these originals to OfficeMax for photocopying, then return home with the pages. They had to be individually sorted by page number, stapled, folded, addressed, stamped and taken to the local Post Office for mailing.

The original Word documents from twenty years ago were believed lost, leaving only low-quality duplicates as mailed to members. Then in 2013 a folder full of paper originals was discovered by Greg KB2CQE and Joe WA2MCR in the PCARA document archive. These were scanned, converted to Adobe PDF format and placed in the electronic newsletter archive which is accessible *via* <http://www.pcara.org>.

To search or to index?

At the February meeting, Lovji N2CKD noted that there is a lot of material in past newsletters and asked about publishing an **Index** to the first twenty years. Your editor replied that printed indexes are a labor-intensive undertaking that predates electronic publishing. There are better ways nowadays, for example...

Maintain a copy of your *PCARA Update* PDF files in a single folder on your computer. If you have a copy of Acrobat Reader or Adobe Acrobat, from the program menu choose Edit→Search or Edit→Advanced Search, then specify the folder to search in (there is a 'browse' option). This allows searching for a word or phrase in all the PDFs in the folder, followed by viewing the contents of each document with the search term highlighted.



Using Acrobat Search/Advanced Search on a local folder.

Custom Search Tool online

You can also use the **Internet** to search the online archive of *PCARA Update* newsletters. A new page has been added to the PCARA web site, <http://pcara.org/> by Lou KD2ITZ and Greg KB2CQE. In the left margin, look for the option “PCARA Update Search Tool”. Click and you should see a new web page as shown below.



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Text on the Custom Search page is as follows:

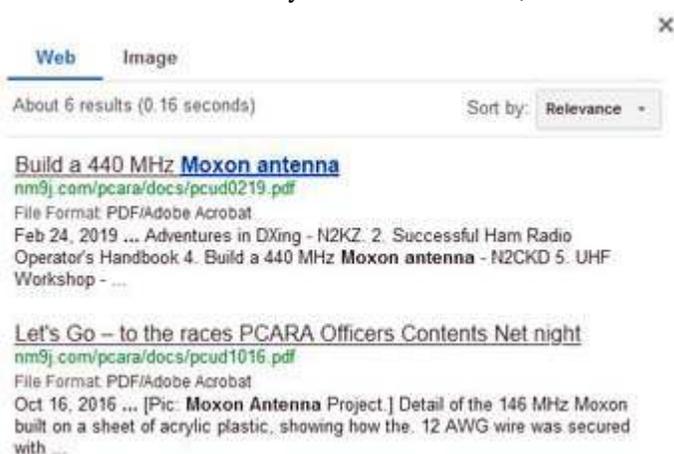
PCARA Update Custom Search Tool

Please use the Custom Search Tool* below to conduct searches on past issues of the PCARA Update. Enjoy!

*Courtesy of Lou KD2ITZ



Type your query into the “Custom Search” box and press <Enter> or click the magnifying glass. A new window should pop up with a list of items that meet your search requirements. For the most part these will be past issues of the *PCARA Update*. Text appears underneath each title with your search term(s) highlighted so you can assess relevance of the results. (This is known as KWIC or key words in context.)



Results of a Google Custom Search for “Moxon antenna”

Click on an item of interest and you should see a copy of the appropriate PDF file downloaded into your browser.

Depending on how your browser is set up to handle PDF's, you may then see the newsletter issue open automatically in the browser — or you may have to click the download icon in the menu bar then open the downloaded file in Acrobat.

Advanced search techniques

You can use Google Search techniques to refine or broaden your search. Here are some examples with a radio connection:

Search for multiple words

Type all the words you want to be in the search. This is equivalent to a Boolean ‘and’. For example:
meter power swr

Combine searches

Put "OR" between each search query. For example:
heath OR heathkit

Search for an exact match

Put a word or phrase inside quotes. For example:
"moxon antenna"

Exclude words from your search

Put - (hyphen or minus sign) in front of a word you want to leave out. Do not add space after the hyphen. For example:
taurus -hike

Search for a price

Put \$ in front of a number. For example:
radio \$1000

Search within a range of numbers

Put .. between two numbers. Include units if needed. For example:
transceiver \$80..\$1000

- NM9J

myBITX

An offer you can't refuse?

What would you say if someone offered you a portable transceiver that covers seven HF bands, operates SSB and CW, with built-in keyer plus press-to-talk microphone — and with a price of only \$150.00 for the basic kit? A full kit with aluminum case and loud-speaker would be only \$49.00 more (\$199 total).

I was tempted. With all the recent interest in **microBITX v3** transceivers — as described by Todd N2MUX and Mike N2HTT at PCARA's January 27 presentation — I decided to have a go myself. Was it a worthwhile purchase? Was it a rewarding experience? Read on for my own take on low-cost QRP, μ BITX style.

Order time

My first step was a visit to the **HF Signals** company web site: <https://www.hfsignals.com/>, run by Ashhar Farhan, VU2ESE out of Hyderabad, India.

I found that the μ BITX v3 transceiver built by Todd and Mike has been superseded several times over and the current version, released in December 2019 is now v6. Various improvements have been incorporated in these updates — the latest version v6 is **solder-free** as all input/output connectors are now mounted on the main circuit board. It has a color touch-screen in place of the two-line LCD, and comes with an optional custom-designed metal case.

I placed my order for a full kit on January 1st, aware that New Year deliveries would not start until January 20th.

My first hint that a unit was on its way was arrival of a DHL delivery truck, with the driver handing me a cardboard box. The unit had been shipped from India on January 27



The Full μ BITX v6 kit arrived in this medium-size cardboard box.

and arrived on January 30, 2020.

What's included?

The box was well-packed with components firmly held in plastic foam cutouts. A paper list gives a description of each part along with a picture and check-off box — echoes of Heathkit. Larger items included the shiny, black aluminum cabinet, the main circuit board and the **Raduino** board with color touch-screen

display. Smaller items included the control knobs, loudspeaker, Baofeng PTT microphone with 3.5 mm jack plug, rotary encoder, plastic stylus and all the mounting hardware — mostly M3-size (3 mm dia.) metric nuts and bolts.



All components were well packed inside the cardboard box.



Circuit boards and smaller components included in the μ BITX v6 Full Kit.

The only cause for concern was the **Raduino** assembly which had its LM7805 voltage regulator *twisted around*, probably when squashed into the plastic foam. I carefully straightened the leads so the regulator and heat sink were standing upright. The “Raduino” is an HF Signals innovation



Raduino assembly had the 7805 voltage regulator and heat sink twisted around.

incorporating an Arduino Nano controller, Silicon Labs Si5351A multi-synthesizer chip and the matching display.

Construction time

There were **no** written instructions included with the kit, but assembly notes and operating instructions are readily available on the HF Signals web site. See: <https://www.hfsignals.com/index.php/ubitx-v6-assembling-the-full-kit/>

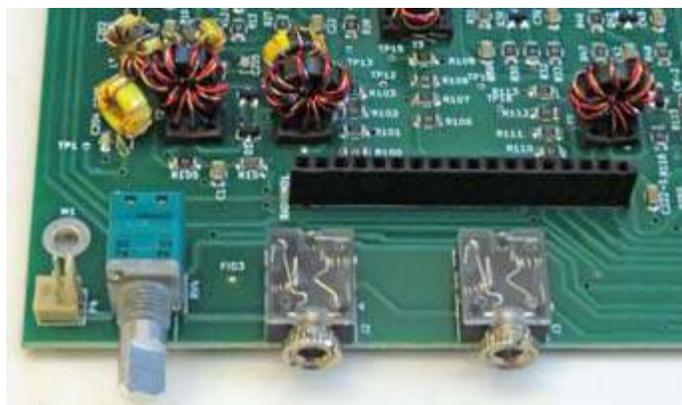
The online instructions step you through mounting the main circuit board inside the aluminum cabinet, installing the rotary encoder (VFO tuning control) on the front panel, mounting the Raduino to the main

circuit board and front panel then connecting the rotary encoder to the Raduino.



Raduino assembly has been plugged into the main circuit board and fastened to the front panel. Rotary encoder cable (left) is ready to be connected to the Raduino.

The front panel control knobs are installed, followed by BNC and USB connectors on the rear panel then the loudspeaker on the lid. The only doubtful points were — whether to remove mounting nuts from the three 3.5 mm stereo jack sockets that emerge from the main circuit board through the front panel (I did remove the nuts) and being careful to wire the rotary encoder cable to the connector on the Raduino board and *not* to the identical connector on the main board.



Volume control and 3.5 mm stereo jack sockets on the main board will protrude through holes in the front panel.

All components were already soldered to the main circuit board or to the Raduino board, so assembly went very quickly. One point to note is that heat sinks are *not* secured to the circuit boards — in fact one heat sink on an IRF510 power output FET had already shaken loose, so I tightened up its bolt. Another point to bear in mind is the lack of flat washers or shakeproof washers under the mounting hardware... a familiar feature on every Heathkit I've ever assembled. This Indian kit would never survive a space launch! At the end of assembly, there was some spare hardware left over as well as four cables intended for connection to

an optional speaker, rechargeable battery, external DC supply or audio component.

One hour after opening the cardboard box, I was ready to connect power and conduct an initial test. The only problem was — lack of a power cord. HF Signals supplies a 5 mm dia. coaxial power plug, but no wire. It took me another hour to locate suitable red/black cable, solder one end to the power plug then terminate the other end with Anderson Powerpoles® and a Bussmann ATC fuse-holder. I installed a 3 amp ATC fuse, knowing that normal current draw during transmit would be around 2 amps.



Remaining parts after completing the assembly instructions.



12V DC power cable constructed with coaxial power plug included in the kit, inline fuse and Anderson Powerpoles.

Switch-on

I switched on for the first time using the on/off switch incorporated into the rotary volume control. The color touch screen lit up and displayed two VFO frequencies, A: 14000.00, B:14150.00 LSB.



The μBITX v6 kit in its custom cabinet after first switch-on.

I connected my wire sloper antenna for 40 meters, adjusted the frequency to 7 MHz and took a tour of the

40 meter band. First impressions were *not good*. Reception of SSB signals on 7 MHz sounded terribly distorted. At first I thought this might be the internal loudspeaker, but an external speaker did not improve matters. It sounded as though carrier insertion for resolving the incoming SSB signals was either missing or at too low a level.

There is no mention of any adjustment or tune-up procedure in the on-line assembly instructions — after completing construction you are directed straight to the ‘Operations’ page. Fortunately, I found valuable advice in the BITX20 group on Groups.io. See: <https://groups.io/g/bitx20>. This is an excellent resource for all BITX projects, including the latest μ BITX v5 and v6.



The BITX20 group at groups.io/g/BITX20 is an excellent resource for support of all things BITX.

Setup

The clue from W0EB and others on Groups.io is that μ BITX models have a “Setup” mode which allows various settings to be adjusted, including BFO frequency, synthesizer reference offset and CW parameters. It took some further digging to find out how to get into “Setup” mode — on my μ BITX v6 you can either (a) press in the VFO encoder knob while powering up to start the calibration procedure or (b) during normal operation, press in on the VFO knob and keep it pressed for approximately eight seconds. This will bring up a new “Setup” screen which allows each desired parameter to be selected and adjusted.

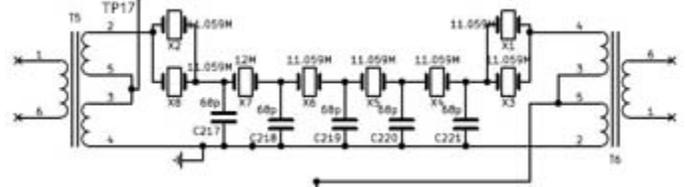


μ BITX v6 Setup screen.

Filter tip

The μ BITX v6 contains a six-section crystal filter which is used for both receive and transmit. Bandwidth is optimized for SSB. The ladder filter design employs

eight microprocessor crystals, all on 11.059 MHz — this frequency is a change from early μ BITX’s which employed 12 MHz crystals. 11.059 MHz is the *parallel* resonant frequency — crystal filters makes use of the *series* resonance which can be around 1 kHz lower.



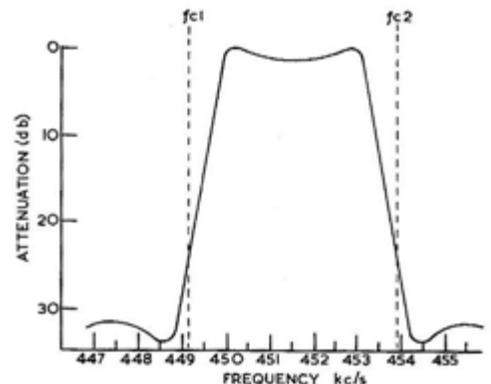
μ BITX v6 crystal ladder filter, based on 8 microprocessor crystals, marked 11.059 MHz.

For single sideband generation and for SSB reception the μ BITX has a carrier insertion oscillator / beat frequency oscillator (BFO) whose frequency should be on the lower edge of the filter passband, with an option to change this frequency from the “Setup” screen. Default BFO frequency is 11.053 MHz.

I tried adjusting the BFO frequency while listening to receiver noise as suggested on the HF Signals web site — there is an app available to visualize the results on a smartphone. But this led me to a situation where upper sideband/lower sideband (USB/LSB) reception and transmission were inverted. Help!

Old ways are best?

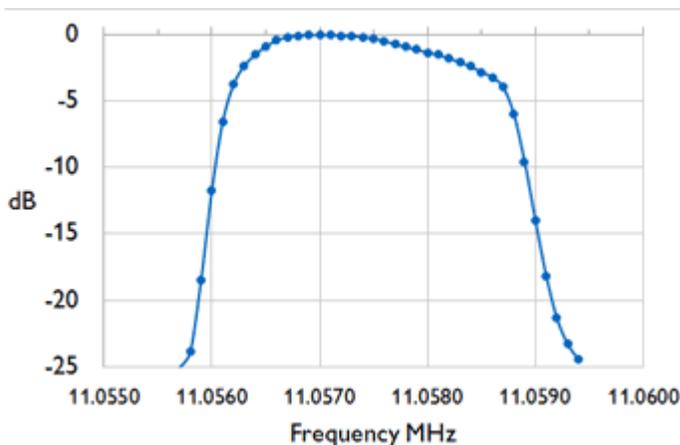
I dredged up memories from the time when radio amateurs home-brewed crystal filters for SSB using war-surplus FT241 and FT243 crystals. In those days, the carrier insertion oscillator (BFO) was generated by another quartz crystal positioned roughly 20 - 30 dB down the skirt of a 2.7 kHz-wide crystal filter. This would provide additional carrier suppression beyond that provided by the balanced modulator, with a resultant audio frequency passband of roughly 300 – 3000 Hz.



“Carrier placement with symmetrical passband crystal filter. Upper sideband output is obtained when the carrier is at fc_1 and lower sideband when it is at fc_2 .” [RSGB 1961]

In order to set the carrier oscillator accurately, I needed to measure the actual passband of the crystal filter in my μ BITX v6. This was accomplished by injecting a carrier from my JDS6600 DDS signal generator into test-point TP17 on the main circuit board, then

measuring audio output from the receiver (which has **no AGC**) while the oscillator was stepped through the filter's coverage. I used a digital oscilloscope, capable of continuously reading RMS voltage. The results after conversion from mV to dB are plotted in the Excel chart below.



Frequency response of the '11.059 MHz' crystal filter installed in the author's μ BITX v6, as plotted by Excel.

Response of the '11.059 MHz' crystal filter is actually centered on **11.0575 MHz**. In order to generate upper sideband we look for a point 25 dB down the skirt on the low frequency side. This suggests the carrier/BFO frequency should be approximately **11.0558 MHz**. In Setup mode, I used 'Set BFO...' to change the BFO frequency from its default value of 11.0530 to 11.0558 MHz — and the receiver suddenly sounded a whole lot better. As a bonus, USB / LSB switching was now working correctly, on both transmit and receive.

If you carry out this procedure yourself, be sure to **write down** the new BFO setting for future reference.

Standard frequency time

With the receiver now hearing over-the-air signals correctly, it was time for frequency calibration. The Raduino's SI5351A programmable clock IC relies on a 25.000 MHz crystal as its frequency reference, but this inexpensive crystal can also be off-frequency. Fortunately, the offset can be corrected in software and this is another option on the μ BITX v6 'Setup' menu.

The procedure has changed since the earlier μ BITX v5, which would transmit full carrier on 10.000 MHz while being calibrated! On the μ BITX v6, the recommended procedure is to connect an antenna and tune to 10.000 MHz in order to receive standard frequency and time station WWV. Call up the 'Setup' menu by pressing the VFO knob for 8 seconds then choose menu item "Set FREQ...". The instructions on-screen are shown in the photo below.

At the first nudge on the tuning knob, the current calibration is lost — the receiver jumps to the default

calibration, then a little box appears on-screen showing the offset, which you can adjust with the tuning control. The aim is to tune in WWV with the station's carrier **zero-beat** with the receiver's BFO.

Zero-beat means that frequencies of the two separate signals coincide, so their difference frequency (or **beat frequency**), $f_1 - f_2$ changes from some small number to zero. This point can be tricky to find if you have never tuned for zero-beat before — here's why.

In an SSB receiver, as you approach zero-beat between local BFO and incoming carrier, the carrier is being attenuated by the skirt of the crystal filter. Hearing the low frequency beats is not helped by this attenuation and by a lack of bass response in the 3" diameter speaker. WWV's AM signal is modulated by 440, 500 or 600 Hz audio tones for most of the hour, making tuning for zero-beat even more difficult.

One technique to overcome the problem is to tune in WWV on AM on a second receiver and listen for the modulating tone. Meanwhile tune the μ BITX to 10 000 00 kHz, LSB or USB. If the two separate radios are adjusted for similar audio output, you should be able to hear audible "beats" — a rapid flutter that slows down as the two audio tones approach the same frequency.

After waiting for the μ BITX v6 to warm up to a steady temperature, my own frequency calibration came in at a setting of +178500. Hint: **record** your own frequency offset, along with the BFO setting. If you have to go through calibration again, the previous settings are overwritten and you are back at the defaults.

Documentation?

μ BITX v6 kits are supposedly set to correct frequencies at the factory, but this was not the case with my radio. How did that happen? And why was there so little information about the 'Setup' procedure on HF Signals' web site? Perhaps because the μ BITX v6 is a new product, with software still under development by a busy organization? (My firmware shows v6.1 onscreen.) Perhaps Ashhar Farhan VU2ESE is encouraging kit buyers to carry out their **own** research, by studying the circuit description, poring over schematics, lurking around on Groups.io, perusing ubitx.net and reading through the Arduino code published on GitHub? Maybe a combination of all these factors?



Setting the μ BITX v6 frequency for accurate tuning of WWV on exactly 10.000 MHz.

Performance

Before you read on about my experiences using the μ BITX v6, bear in mind that this is a QRP radio kit costing \$150.00 - \$200.00. If you were to compare it with commercial transceivers, you would be looking at portable radios costing at least \$300 to \$800 more — for example the Yaesu FT-818, Elecraft K2 or Icom IC-705 (estimated price \$1000+). You can expect a lot more circuitry and capability for that much more money.



Icom IC-705 direct sampling QRP transceiver is expected in April 2020.

Touch screen

The first impression is that the color touch-screen display works quite well. Tuning slowly across the band, the VFO frequency is displayed, changing in 50 Hz steps. There is an option to “Fast tune” by tapping on the active VFO box on-screen, or pressing in the VFO knob. The frequency then changes in 50 kHz steps. To exit from “Fast tune” you need to press the VFO tuning knob in very carefully.



Close-up of the color touch screen.

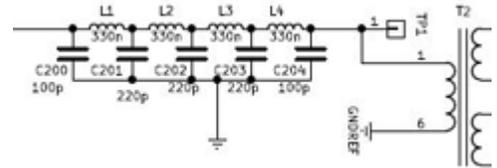
One turn of the tuning control knob moves the frequency by 2.5 kHz. If you turn the knob more rapidly, the frequency display seems to have trouble keeping up. Rotating the knob very quickly brings on fast tuning, with steps that are hard to control — you can suddenly find yourself out-of-band. The μ BITX v6 can transmit anywhere between 1.0 – 30 MHz (or higher), so make sure you keep the frequency within authorized amateur bands. You can select each band by pressing the appropriate on-screen button (80/40/30 etc.) or you can jump directly to a frequency by pressing “FRQ” then entering the kilohertz digits.

The touch screen also has buttons for selecting USB and LSB. The sideband change does not take effect until the tuning control has been nudged backward or forward.

Big signals

SSB reception is very clear, but tuning across an amateur band is a different experience from an expensive commercial HF transceiver. There is **no** RF gain control and **no** automatic gain control (AGC) — so strong signals can leap out of the noise and rattle the loudspeaker. If you are listening on headphones, there is no attenuation of output from the LM386 audio IC, which is capable of ~1 watt out. This can be hazardous for your hearing — when using headphones, keep one hand on the audio gain control and leave it at a low setting to avoid being deafened.

Receiver design for the μ BITX features up-conversion from the MF/HF frequency range of 1 – 30 MHz to a first intermediate frequency (IF) of 45 MHz where there is a two-pole roofing filter. The only filtering of incoming MF/HF signals is a single low-pass filter covering 0 – 30 MHz. The entire LF/MF/HF spectrum arriving at the antenna is applied to the first mixer without any bandpass filtering.



Receiver low pass filter is all that stands between antenna input and first mixer.

There is a recommendation in the μ BITX circuit description that any powerful medium wave or low frequency transmitters in the immediate vicinity should be excluded with a **high pass filter** cutting off at 1.6 MHz. At my location, the AM Radio station WLNA on 1420 kHz is less than 2 miles away and puts in a pounding signal. It generates nasty noises inside my μ BITX on harmonics such as 7100 kHz and on other frequencies such as 3500, 3670, 3740 kHz etc. My first cure was to insert an MFJ-948 tuner between radio and antenna. This tuner incorporates a **T-Match** circuit, which also acts as a **high-pass filter**. Unfortunately, this provides no protection when listening on 7 MHz while my near-neighbor WA2MCR is operating on, say, 14 MHz. A better solution is to add a 40 meter bandpass filter between radio and antenna — I tried one of the W3NQN-design bandpass filters that we use on Field Day — it worked very well.



40 meter Bandpass Filter from Array Solutions stands atop the μ BITX v6.

IF bandwidth

Bandwidth of the crystal filter after adjustment should be roughly 2.7 kHz (300 Hz – 3000 Hz) at the 6 dB points. Listening on the bands gives the impression of wider bandwidth. By tuning through a steady carrier, I estimated the ultimate skirt bandwidth at 5.5 kHz. This is a reasonable figure, though it might be improved by added shielding to prevent signals from leaking *around* the crystal filter. The practical result is that on a crowded band, you can hear some “spitch” from QSOs operating 3.0 kHz away from your own frequency.

Woolly mic

The μ BITX v6 kit includes a Baofeng press-to-talk speaker/microphone with curly cord and 3.5 mm stereo jack plug. (\$6.23 from Amazon). Use of a single 3.5 mm jack plug is not the best choice as the curly cord can pull on the plug and cause an intermittent connection. Initial quality reports were not flattering — so I opened up the pinhole over the electret microphone element with a small drill to improve matters. When ARRL tested a μ BITX v5, they used an MFJ speaker microphone. See *QST*, September 2019 pp 42-47.



Baofeng speaker/microphone with position of the electret element arrowed.

Power output

The μ BITX v6 is advertised as having “up to 10 watts on SSB and CW”. I decided to check power output of my own radio while running off a 13.6 volt power supply. I connected my Daiwa CN-801 SWR/Power meter (which has a 20 watt range available) and found the following CW power outputs:

Freq kHz	Power W
3700	10.4
7200	5.4
10120	9.2
14120	5.7
18100	5.0
21100	6.0
24900	2.6
28200	3.1



This ‘wavy’ nature of the power output as a function of frequency may be caused by response curves of the different low-pass filters that are switched in as the transmitter changes frequency. There are separate filters for 3.5 – 5 MHz, 7 – 10 MHz, 14 – 21 MHz and 21 – 30 MHz (that last filter is always in circuit).

In practice

Operating SSB is relatively straightforward once the antenna is connected, the ATU is adjusted and a station is tuned in. Pick up the microphone, press the PTT button and talk! There is a soft click as the transmit-receive relays spring into action and the red LED on the Baofeng microphone lights up. There is **no** S-meter to give a signal report and **no** power output indicator. You would need an external SWR/power meter to know whether any RF energy is going out.

I carried out an initial test with Karl, N2KZ on 3.5, 7 and 28 MHz using SSB and CW, but signals were weak in both directions. My first ‘real contact’ came on 40 meters on Feb 9th, 2020 when I called special event station WA1WCC, operating from Chatham Radio/WCC and celebrating the centenary of the Radio Corporation of America (RCA) taking over Marconi’s five radio sites in the USA, including Chatham, MA. OM Harry came back to my call with 59! (For details of the WCC Amateur Radio Association see: <https://www.wccara.com/> .)



Key down

The μ BITX v6 has good credentials for CW operation. It offers semi-break-in and has a built-in keyer, all courtesy of the Arduino Nano. The 3.5 mm stereo key socket can be programmed for <Hand Key>, <Iambic A> or <Iambic B> from the Setup screen. I chose ‘Hand Key’ and plugged in a straight key as this permits radiation of a steady carrier for tune up-purposes.

I ran into a few problems with CW operation. Monitoring CW output in a second receiver as the key is pressed, the beginning of each transmission was distorted. As the μ BITX changes over from receive to transmit, the first dit or dah is foreshortened.

The second problem came when attempting a CW QSO. The

μ BITX v6 can have its CW sidetone frequency set from the front panel by pressing the “TON” button on the screen. Values can range from 100 to 2000 Hz. With the

μ BITX tuned to 7100 kHz on LSB-CW mode and the side tone at 800 Hz, the receiver is automatically tuned to zero beat at a frequency of 7100.8 kHz — so when a carrier from



μ BITX v6 set up for CW operation with a straight-key.

a distant station appears on 7100 kHz, there is an 800 Hz beat note. So far so good.

By monitoring in a second receiver I found that the μ BITX CW transmit carrier was then on a frequency of 7099.2 kHz. A distant station on 7100 kHz with narrow receiver would never hear me! In order to make my transmission audible, I had to press the “RIT” button then set the μ BITX to transmit on 7100.80 kHz while still receiving on a frequency of 7100.00 kHz. What a pain! If you then tune the μ BITX receiver to find another station, the TX frequency does not track the RX frequency, but stays where it was.

The same crystal filter is used for CW reception as for SSB. This is fine on an empty band, but less pleasant when the band is crowded. Multiple CW signals are audible inside the 2.7 kHz bandwidth of the crystal filter. An add-on audio filter could then be worthwhile, for example a SOTABeams Laserbeam Dual (<https://www.sotabeams.co.uk/dual-bandwidth-filter-modules-ssb-cw/>) or the New England QRP Club’s NESCAF as suggested by N2HTT: <https://www.newenglandqrp.org/nescaf/>.



Glitches and fixes

This review of the μ BITX v6 has confined itself to the “Full Kit” as shipped from India in late January with standard software v6.1 and **no** hardware modifications. The CW problems could probably be fixed by an update to the Raduino’s software. An owner might wait for a software update from Ashhar Farhan or from the enthusiasts at Groups.io. Another approach could be to modify the code yourself. You would need to install the Arduino “Integrated Development Environment” (see: <https://www.arduino.cc/en/Main/Software>) on a desktop or notebook computer, bring in a copy of the Arduino sketch as published by Ashhar Farhan, make your changes, then re-compile and upload to the Raduino using the USB connector on the rear panel.

Hats off

One result of assembling and reviewing the μ BITX v6 is a new respect for RF and software engineers — whether that is Ashhar Farhan, VU2ESE at his small enterprise in India or the larger teams employed at companies such as Yaesu, Icom and Elecraft. Modern HF transceivers pack an awful lot of capability into a small space, and it all needs to be kept under control.

You might think I was disappointed with my μ BITX v6 transceiver, but I am not. Some online groups consider each BITX project as a **Development Kit**, rather than a finished article. Try out your own improvements in the shape of hardware modifications,

updates to the software or external add-ons such as audio filter, AGC or S-meter, then report your findings through Groups.io.

Another approach is to look at each μ BITX as an opportunity for **Further Education**. You might learn new things about RF filters, software control of synthesizers and generation of single sideband signals. You might pick up new skills for QRP operation and gain a fresh appreciation for those full-specification 100 watt HF transceivers that cost an arm and a leg.

Do you know how the μ BITX got its name? My theory is that the original BITX* design by Ashhar Farhan, with its free-running VFO, incorporated several **bidirectional** amplifiers that pass signals in one direction on receive and in the reverse direction on transmit — a **bidirectional transceiver** or **BI Tx**. When the design was upgraded to a synthesizer with **microprocessor** control, it became the **micro BI TX** or **μ BITX**.

* <https://www.phonestack.com/farhan/bitx.html>

So — Conclusions — the μ BITX v6 is a small, inexpensive radio, suitable for portable operation in quiet locations, but not really designed for heavy-duty contesting in the presence of powerful signals. It is also a platform for trying out new ideas and learning about radio. Thanks to Todd N2MUZ and Mike N2HTT for the introduction.

Is the μ BITX v6 a suitable kit for amateur radio beginners? I would say — **yes** — provided you have access to a friendly Elmer with some test equipment.

(And **NO** the μ BITX is *not* an SDR, though it is capable of CAT control over its USB port.)

- NM9J



Lovji N2CKD (center) and Joe WA2MCR (right) examine the μ BITX v6 transceiver during Show & Tell at the February 1 PCARA meeting. [Pic by Lou, KD2ITZ]

Peekskill / Cortlandt Amateur Radio Association

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Newsletter contributions are always very welcome!

Archive: <http://nm9j.com/pcara/newslett.htm>

PCARA Information

PCARA is a **Non-Profit Community Service**

Organization. PCARA meetings take place the first Sunday of each month* at 3:00 p.m. in Dining Room B of NewYork-Presbyterian/Hudson Valley Hospital, Rt. 202, Cortlandt Manor, NY 10567. Drive round behind the main hospital building and enter from the rear (look for the oxygen tanks). Talk-in is available on the 146.67 repeater. *Apart from holidays and July/August break.

PCARA Repeaters

W2NYW: 146.67 MHz -0.6, PL 156.7Hz

KB2CQE: 449.925MHz -5.0, PL 179.9Hz

N2CBH: 448.725MHz -5.0, PL 107.2Hz

PCARA Calendar

Sun Mar 1: PCARA meeting, NewYork-Presbyterian /Hudson Valley Hospital, 3:00 p.m.

Sat Mar 14: PCARA Breakfast, Uncle Giuseppe's, Yorktown Heights. 9:00 a.m.

Sat Mar 14: PCARA V.E. Test Session, John C. Hart Memorial Library, Shrub Oak. 11:00 a.m.

Hamfests

Sat Mar 14: Cherryville RA Hamfest, North Hunterdon Regional HS, 1445 State Route 31, Clinton, NJ. 8:00 a.m.

Sat Mar 28: New Jersey Antique RC Swapmeet, Parsippany PAL Building, 33 Baldwin Road, Parsippany, NJ. 8:00 a.m.

Sun Mar 29: Southington ARC Flea Market, Southington High School, 720 Pleasant Street, Southington, CT. 8:00 a.m.

VE Test Sessions

Mar 8: Yonkers ARC, Yonkers OEM, 789 Saw Mill River Rd, Yonkers NY. 11:30 a.m. Pre-reg. Walt, KD2D, kd2d@arrl.net

Mar 12: WECA, Westchester Co Fire Trg Center, 4 Dana Rd., Valhalla, NY. 7:00 p.m. S. Rothman, (914) 949-1463.

Mar 14: PCARA, John C. Hart Memorial Library, 1130 E Main St, Shrub Oak, NY. 11:00 a.m. Contact Michael Dvorozniak W2IG, (914) 488-9196.

Mar 16: Columbia Univ ARC, 531 Studebaker Bldg, 622 W 132nd St, New York. 6:30 pm, Alan Crosswell (212) 854-3754.

Mar 20: Orange County ARC, Munger Cottage, 183 Main Street, Cornwall NY. 6:00 p.m. Contact Joseph J. DeLorenzo (845) 534-3146.



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