Current Board of Directors

Charlie NN3V President
Joe K6JPE Vice President
Jim NE6O Director
Greg KI6RXX Director
Gary W6GDK Secretary
Richard KJ6WUY Treasurer
Dennis Baca KD6TUJ Repeater Site Chair
Glen KJ6ZQH Membership
Mark KF6WTN Repeater Technical Chair

Nominations for the 2016 Board were announced at the November membership meeting and are as follows.

Charlie NN3V President
Joe K6JPE Vice President
Kevin KK6FRK Director
John AC7GK Director
Sandy KK6EED Secretary
Tom W0NI Treasurer

There are three additional directors. These directors are selected from four appointed positions, which include Repeater Site Chair, Repeater Technical Chair, Membership Chair, and Newsletter Chair.

Elections for 2016 Board will be held at the December membership meeting.

In addition to the board of directors election, a ballot of YES or NO for "Shall Palomar Amateur Radio Club grant life membership to Mike Pennington K6MRP?" will be held at the December membership meeting.

Save the Date

Club Meeting	Board Meeting	Club Events
2 December 2015	**9 December 2015**	**5-7 December 2015**
PARC board elections for 2016 and our annual Holiday Potluck Party!	Palomar Amateur Radio Club board meeting at 7:00pm at Poway Fire Station on Community Road	Ft. Rosecrans Goes To War - special event station, vintage radios, and living history at Cabrillo National Monument.

Contents

Advertisements are free for members

Have items that need to find a new home? Advertise here! Send your ads to scope@palomararc.org

Club Members ONLY!
PARC has a tube bank that includes many 6 & 12 volt receiving tubes (and some transmitting types) for use by club members to repair their own personal equipment. Not for commercial use or resale. If we have your requests, we will pre-check the tubes and deliver them to you at the next club meeting.

Contact John WB6IQS WB6IQS@att.net

President's Corner

A joyous Merry Christmas and Happy New year to all! May Santa's sleigh come loaded with ham candy for you, and may you and all your loved ones have a healthy and wealthy New Year!

As we near the holiday season, and beginning of a new year, there are many thoughts upon which to reflect and plan.

The December club meeting will feature our traditional Christmas special social event, as well as the elections for the PARC 2016 Board of Directors. Bring some goodies to share with your fellow club members. It will also be the time for election of the 2016 PARC Board of directors, as announced at last month's meeting.

At the meeting you will also have the opportunity of voting for whether or not PARC should award an honorary life membership for Mike Pennington K6MRP, a PARC member now living far from San Diego (Montana…BRRR), who devoted a tremendous effort in technical work for PARC for many years while he lived here. The honorary life membership award is offered to Club members who have distinguished themselves in service to the ham radio community. I hope you will support the award.

As a preview of exciting things to come, in January we hope to host a unique club program. Gene Spinelli KG5S was a leader of the TX3X DXpedition to Chesterfield Island this year. Chesterfield Island is located 6600 miles West/Southwest from San Diego, midway between New Caledonia and Australia. The name "island" is somewhat of an aggrandizement. It is more specifically a rock reef in the middle of nowhere, but if you are a DX hound, it represents one of the most cherished DX entities in the world. Gene will describe the work that went into planning the DXpedition to Chesterfield, and talk about the fun of facing the pile ups on the receiving end of "CQ TX3X".

I hope many of you have the opportunity to participate in the Ft. Rosecrans Goes to War special event on December 5-7 at Cabrillo National Monument at Pt. Loma. This event, organized by PARC Club members Gayle K6GO and Mike NA6MB is likely to be an exceptional and fun filled event with ham radio and vintage WW-II radios on exhibit. You may contact Gayle and Mike at K6GO@rrl.net and NA6M@arrl.net. They are looking for voluntary assistance to operate some radio equipment (SSB, CW, and digital) on the 5th. and 6th. I will be thinking of the event while I commemorate the Pearl Harbor anniversary at Arlington National Cemetery in DC.

Ft. Rosecrans Goes To War Event Information

The Cabrillo National Monument Foundation in San Diego, CA is sponsoring an event called "Fort Rosecrans Goes to War" and the local amateur radio community is participating by operating a special event station, W6W, from Fort Rosecrans on December 5 and 6.

The amateur radio operators are setting up radios and antennas on Saturday December 5 and Sunday December 6 from 9:00 AM to 4:00 PM. The hams will commemorate the event by making as many radio contacts as possible and exchanging an event postcard with stations reached locality, nationality and internationally.

A special event call sign had been obtained from the FCC and the station will use W6W.

There will be vintage WWII radios on display and operating at the event!
Those visiting will see a hands on demonstration of amateur radio in action.
Please come by and visit, either in person or on the air. We will be on the circular drive just outside of the Cabrillo National Monument visitor center and operating on HF, VHF and UHF bands.
For more information or to volunteer for an operating time.

K6GO@arrl.net
NA6MB@arrl.net
(619) 494-1204

New Committee Chair

It's been a while since PARC had an active committee system. In the October 2005 Scope, the list included ARES Info, ARES Net, Attendance, ATV, Auction, Badges (New), Batteries, BBS Monitor, Billing Ads/etc, Contest Info, Control Ops, Del Mar Fair, EmComm, Field Day Tech, Inventory, New Member, Nets, Newsletter, Patch Info, Patch Electronics, Picnic, Power AC/DC, Programs, Publicity, QSL Cards, RACES Info, RED Flag, Repeater Site, Repeater Tech, SANDARC, Seller Table, Testing, VE, Trustee, and Web.

The club is reviving the committee system and will be welcoming new chairs. If you are willing to serve, or have an idea for a particular chair that you believe the club needs, please contact the board at board@palomararc.org.

Some of these positions are no longer relevant. For example, since we don't have a phone patch, we don't currently need a committee chair for that position.
It's our pleasure to announce a new Committee Chair for PARC. This chair reports to our club president, Charlie NN3V.

New Chair for Operating Day

An Operating Day Chair has been established for Palomar Amateur Radio Club. Tom Martin K6RCW has been organizing Operating Day for several years. He has generously agreed to be listed as PARC's Operating Day Chair. Tom welcomes volunteers to help make Operating Day bigger and better each time.

Operating Day is twice a year, once in the fall and once in the spring. Our most recent Operating Day was 7 November 2015, and was held from 9:00am to 4:00pm at both Fry's Electronics in San Diego and Fry's Electronics in San Marcos.

Committee	**Chair**	**Contact**
EchoLink	Bernie Lafreniere N6FN	n6fn@niftyaccessories.com
mesh	Phil Karn KA9Q	karn@ka9q.net
Operating Day	Tom Martin K6RCW	k6rcw@amsat.org

Tech Tip from Dennis N6KI

FYI - Besides an Emergency Car Starter, also great for a nice Phone or Laptop emergency charger and can power your 12 VDC devices like a 5 Watt QRP Ham Radio Transceiver or SDR etc.

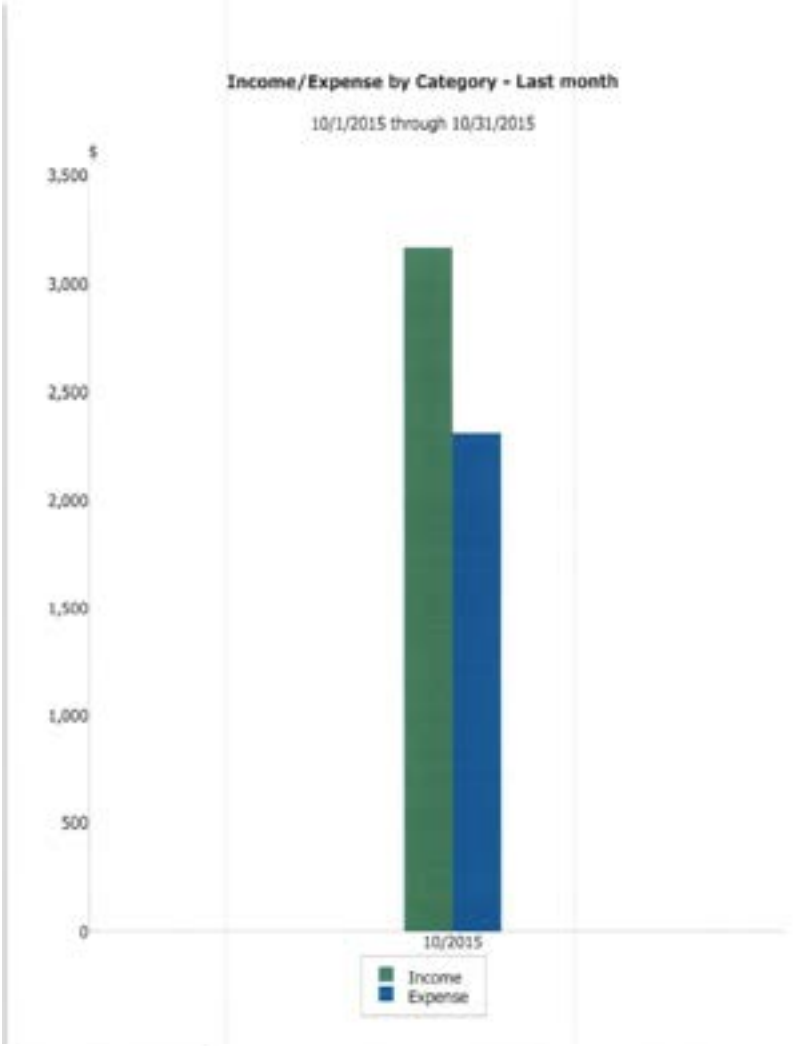
Also has a fairly good flashlight in it that can stobe and also send SOS for hours. I am testing right now to see how long it can send SOS with the fairly bright light.

I'll report back in a few days I imagine as it's been sending SOS for 5 hours and the #5 of 5 Blue LED battery charge indicator lamps has not extinguished!

http://www.tooltopia.com/rockford-8005.aspx

$50 with free ship from ToolTopia. Amazon wants $20 more for same device!

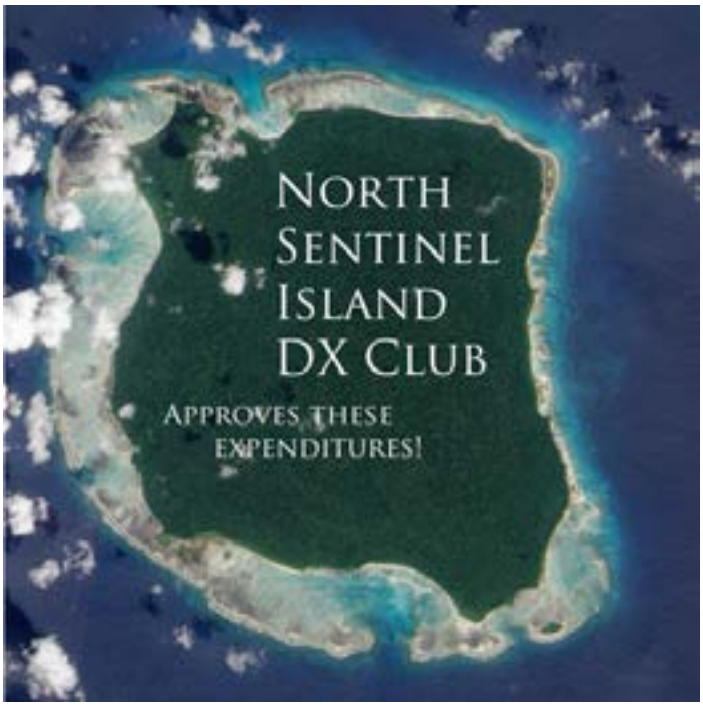
Club Financial Update



Income/Expense by Category - Last month

10/1/2015 through 10/31/2015

Category Description	10/1/2015-10/31/2015
INCOME	
501(C) (3)	729.17
Auction Incom	1,779.00
Dues	656.00
TOTAL INCOME	**3,164.17**
EXPENSES	
Auction Expns	1,337.40
Bank Chrg	47.00
Office Supplies	289.17
Operating Day	230.20
Rptr Electric	88.72
Rptr Phone	42.89
Taxes	272.38
TOTAL EXPENSES	**2,307.76**
OVERALL TOTAL	**856.41**



Please support our advertisers. Their support of the club is vital.

(special) THANKS to our sponsors

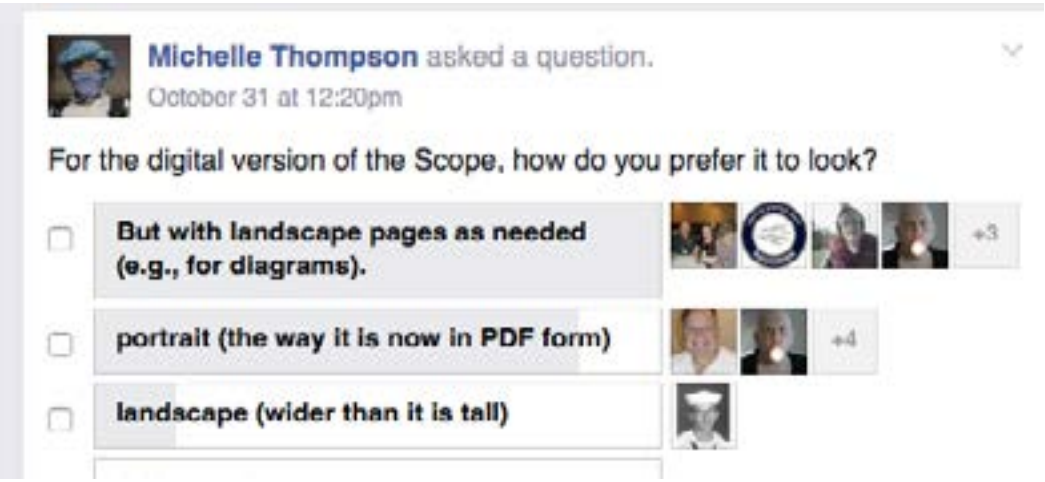
Club HF Remote Station? Proposal Time!

Current status: PARC has obtained 501(c)(3) status, and we have begun putting our HF remote station proposal in writing. This is an exciting time! We expect to complete our proposal by January 2016.

If you would be interested in helping write a club remote HF station proposal for Palomar Mountain, then please join up by writing me at scope@palomararc.org and I'll add you to the mailing list!

Mailing list archive located at
http://palomararc.org/pipermail/hfremote/

This special interest group for HF remote will write a proposal for the Palomar Amateur Radio Club board of directors to vote on. If the vote is successful, then fundraising will begin immediately.



What's your opinion?

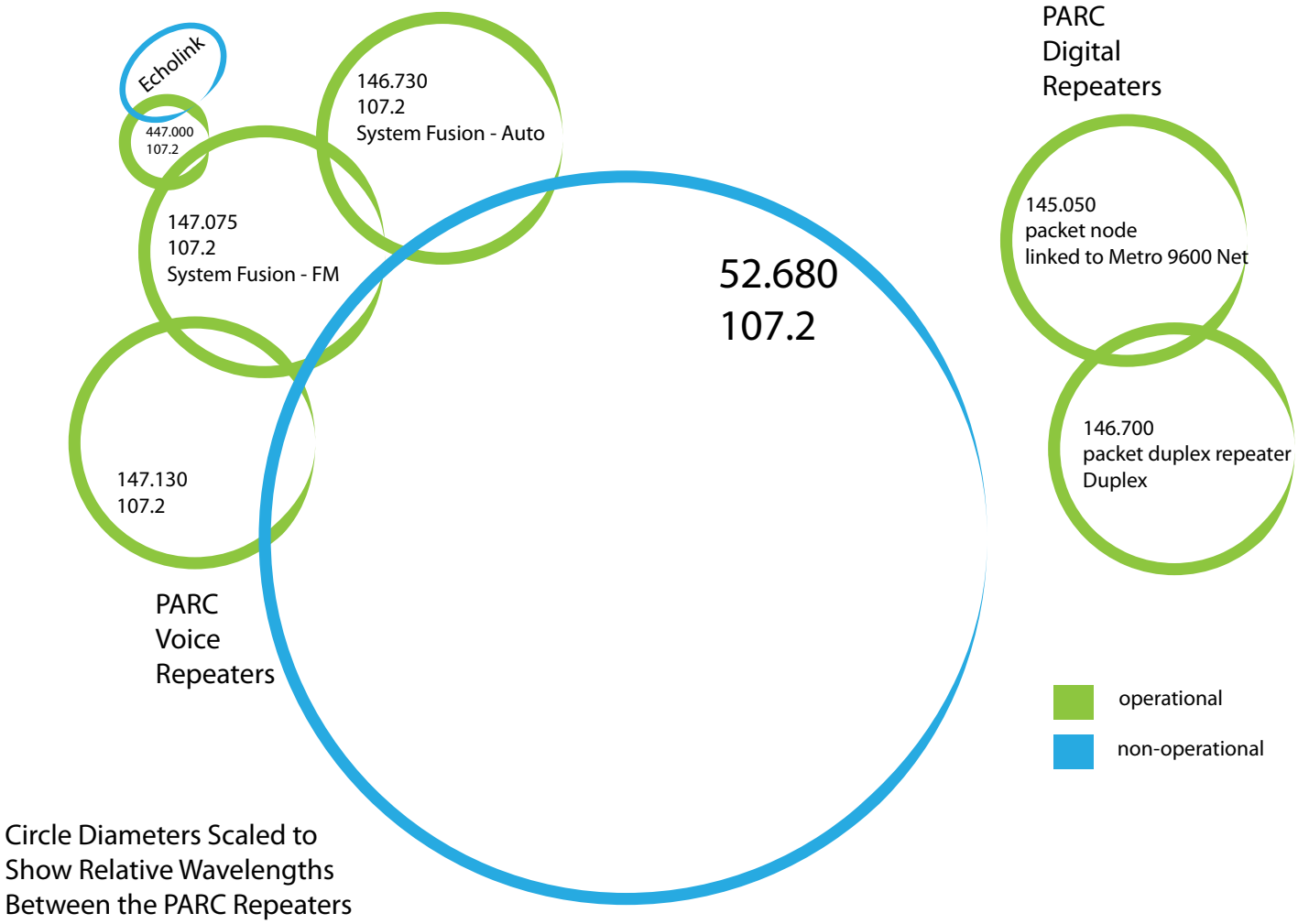
Portrait or landscape (or other option) for the digital version of the Scope?

Let us know at scope@palomararc.org

Portrait has taken a commanding lead!

Suggestion to make each page single-column for easier mobile reading has been implemented.

Reported Repeater Status as of 27 Nov



Circle Diameters Scaled to
Show Relative Wavelengths
Between the PARC Repeaters

Across

1 Economical (4)

3 Ocean of Guinness (5,3)

9 ____ Park (7)

10 Broadcasting (2,3)

11 Japanese-American (5)

12 Monopoly property (6)

14 often filled with lavender (6)

16 Siberian Lake (6)

19 View from Jidda (3,3)

21 Swiss capital (5)

24 Reddish brown (5)

25 Soft leather (7)

26 Not South Sea (5,3)

27 Greek cheese (4)

Down

1 Mysterious sea monster (4,4)

2 "Bye" (5)

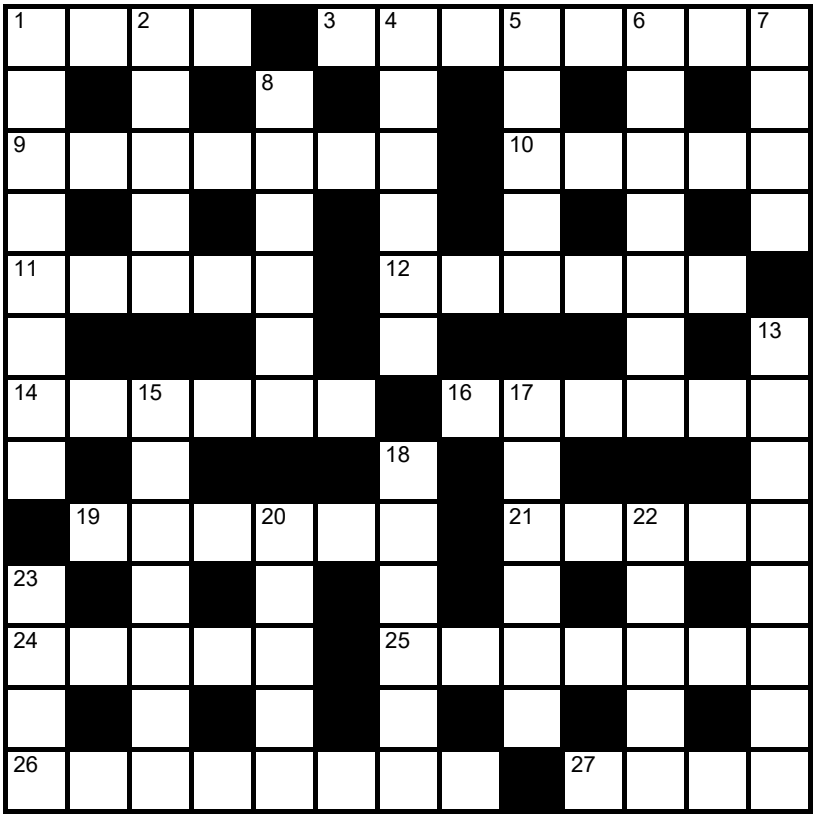
4 Plural of impractically large antenna (6)

5 Ribbon holder (5)

6 What you might suffer from on the ocean (7)

7 Breezy (4)

8 Kind of case (6)



13 Not White Sea (5,3)

15 Janitor (7)

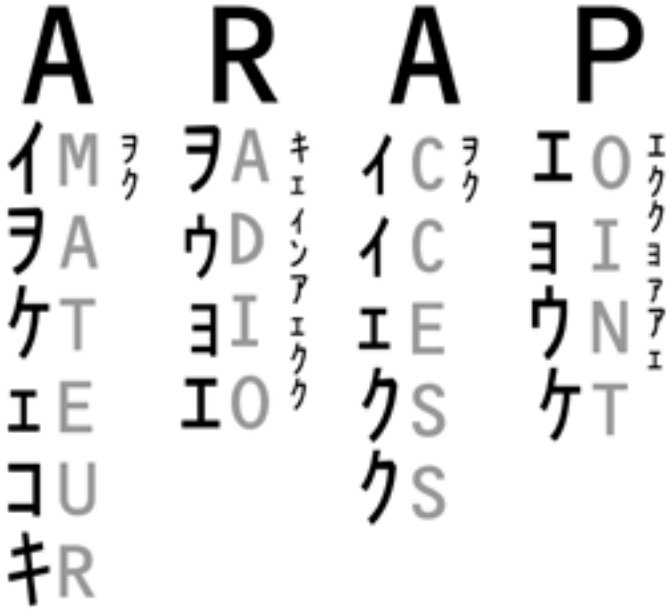
17 Brawl (6)

18 Not smooth (6)

20 #1 song (5)

22 Building block (5)

23 Top Tatar (4)



Decode the secret phrase in this logo above and win a patch. Answers to scope@palomararc.org

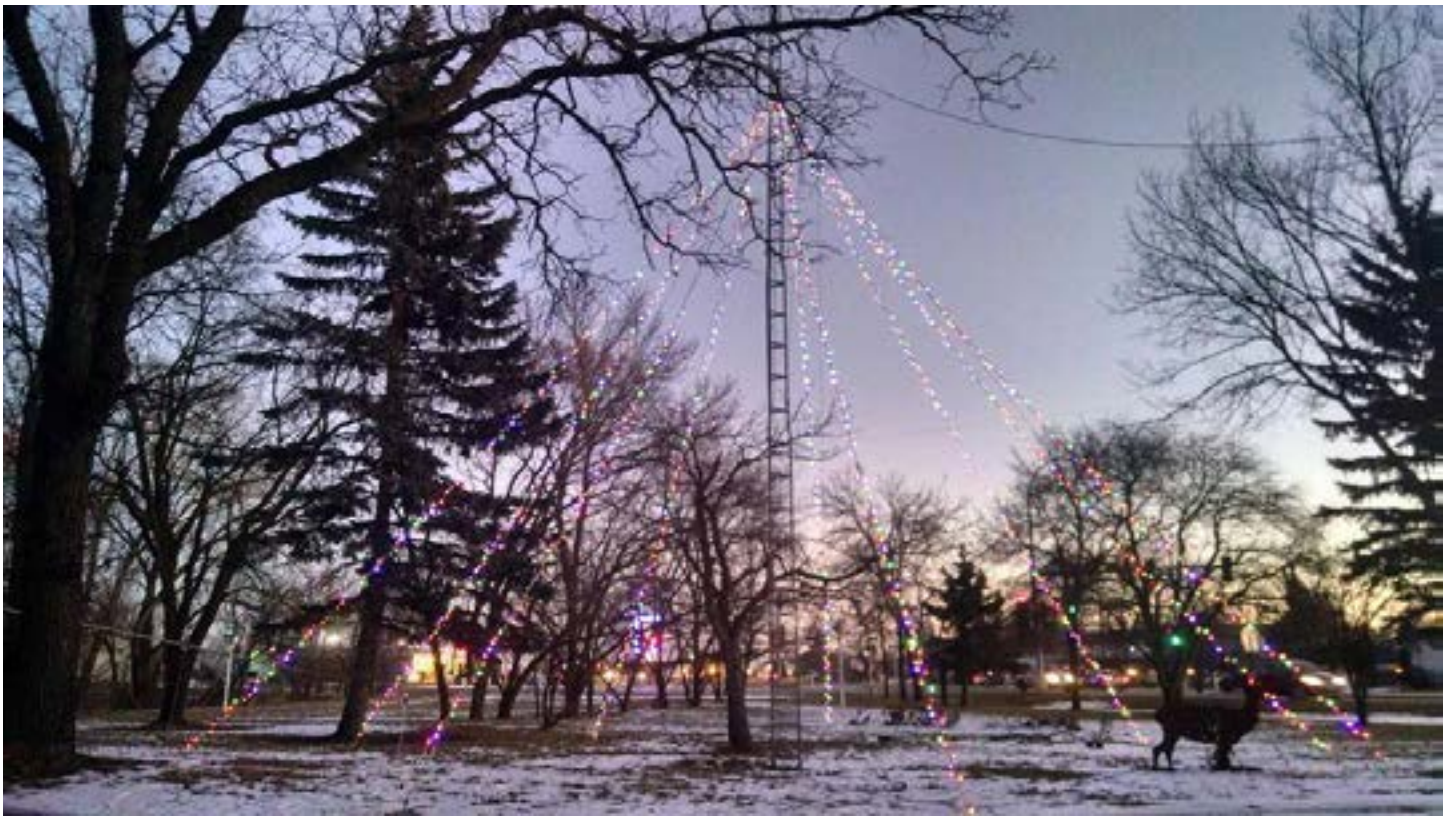
Callsign Confusion

Being new to the club and amateur radio, I knew enough about operating to know that you need to give your call sign every 10 minutes and at the end of a transmission. Imagine my outrage when I heard a regular contributor to 146.730 thumbing his nose at this rule! He'd always sign off with "Remember, remember, the fifth of November". The first time it was funny, but after a half-dozen of these flippant sign-offs I complained, straight to the trustee!

Then I went to my first in-person club meeting at the EOC. Now imagine my discomfort at realizing I was simply hearing the phonetic pronunciation of NN3V in his distinctive voice.

I wanted to slide under the table. I told the trustee "Never mind about that complaint. I figured it out."

-Totally Anonymous Forever



Do you decorate your tower or ham shack? Share your photos! scope@palomararc.org

PARC Members Support Education

by Glen KJ6ZQH

In September, 2015, the instructor of the Engineering Technician program at MiraCosta College, Kris Rolfson, contacted the Palomar Amateur Radio Club via email. He explained that because he is a Ham radio operator himself, he was using the ARRL Technician License Manual as the basis for introducing RF concepts to his students. His course covers a broad spectrum of subject matter; electronics, mechanics, pneumatics, automation, robotics, etc. His goal was to have his students take the Technician license test at the end of this part of the class.

Kris invited us to tour the facility and to speak to the class (for about 30 minutes) about Ham Radio. Charlie (NN3V) and I (KJ6ZQH) visited the school on September 28th. Charlie had created a slide set that covered what Ham radio is, some history, the requirements to obtain an operator license, hardware & antennas, what you can do as a Ham (including assisting in emergencies), etc. I think we spent well over a hour with the class as the students engaged us with questions. PARC gained a new member that day as Kris used the online application facility to join the club that afternoon.

Charlie NN3V and Glen KJ6ZQH in front of the class.

A few days later Kris asked if we would come back and talk about repeaters. Specifically those for VHF and UHF. Charlie and I returned on October 15th. We had a discussion with the entire class on line-of-sight propagation and repeater offsets and PL codes. Because it was the day of the California Great Shakeout practice drill, we took the class out to Charlie's car and made contact with Brian (AG6GF) in his role as net controller on the 145.180 MHz repeater. It was very helpful in demonstrating repeater offsets and operation in that I had a handheld radio and could explain that what I was receiving was NOT directly from Charlie's radio, but was what the repeater was transmitting from the top of Mr. Woodson.

After that we used Charlie's antenna analyzer on a antenna which one of the students had built and had been installed onto the roof of the school building. I believe the meter showed it was less than 1.4:1 over the entire 2 meter band. We broke the class up into two groups and Charlie and I each took a group for some hands on with radios. The students already had printouts of lists of SoCal repeaters. I made sure that each student got to input a repeater frequency, set the appropriate PL code and to verify the automatic offset matched the

picture of Charlie at this car during demonstration

published listing for that repeater.

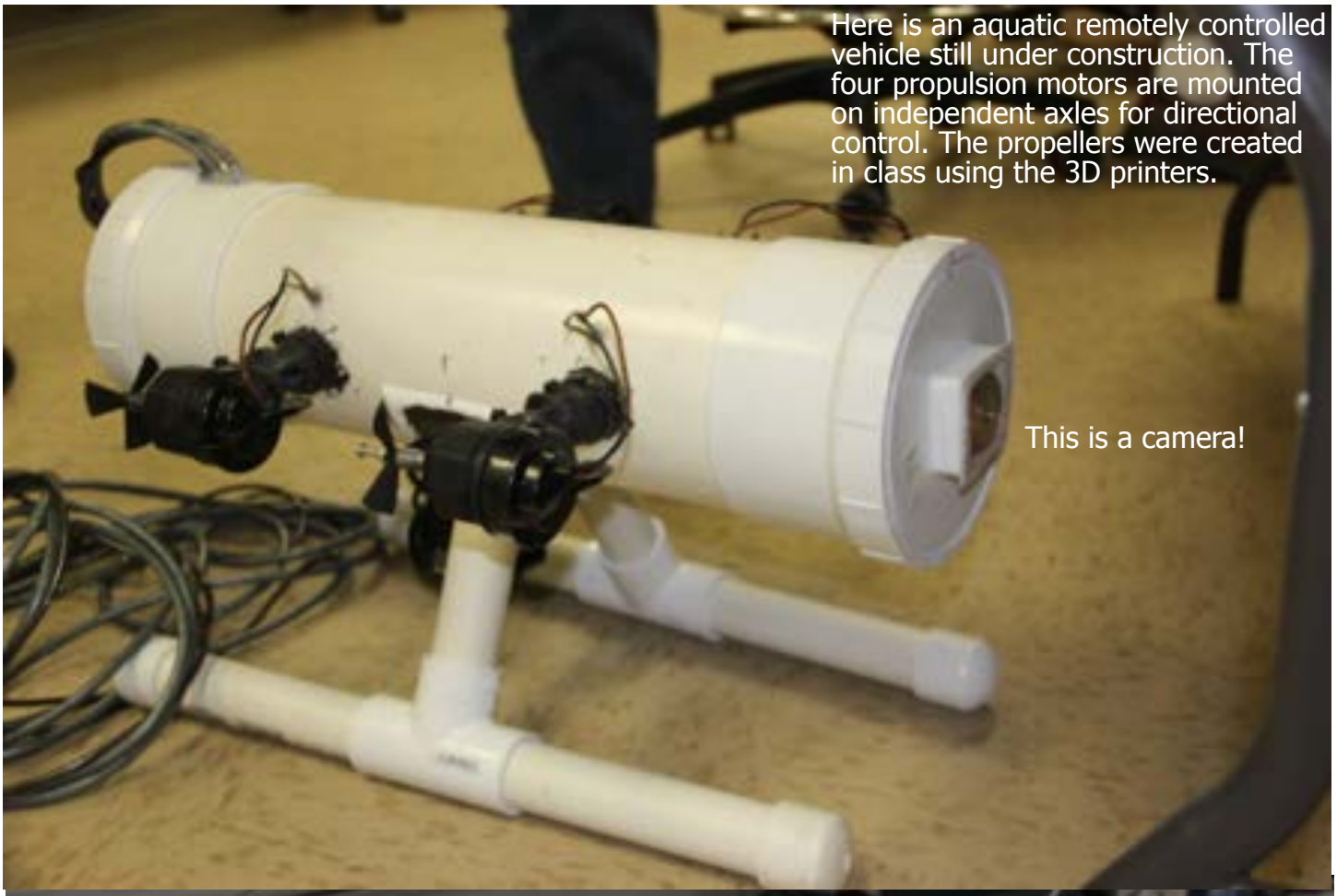
Jo Ashley (KB6NMK) coordinated getting herself, Charlie and five other volunteer examiners to the school on November 17th to administer Ham license tests. Six of the seven students earned their Technician Class licenses that day! Harry (W6YOO) spoke to the group about Ham Radio after the tests were completed.

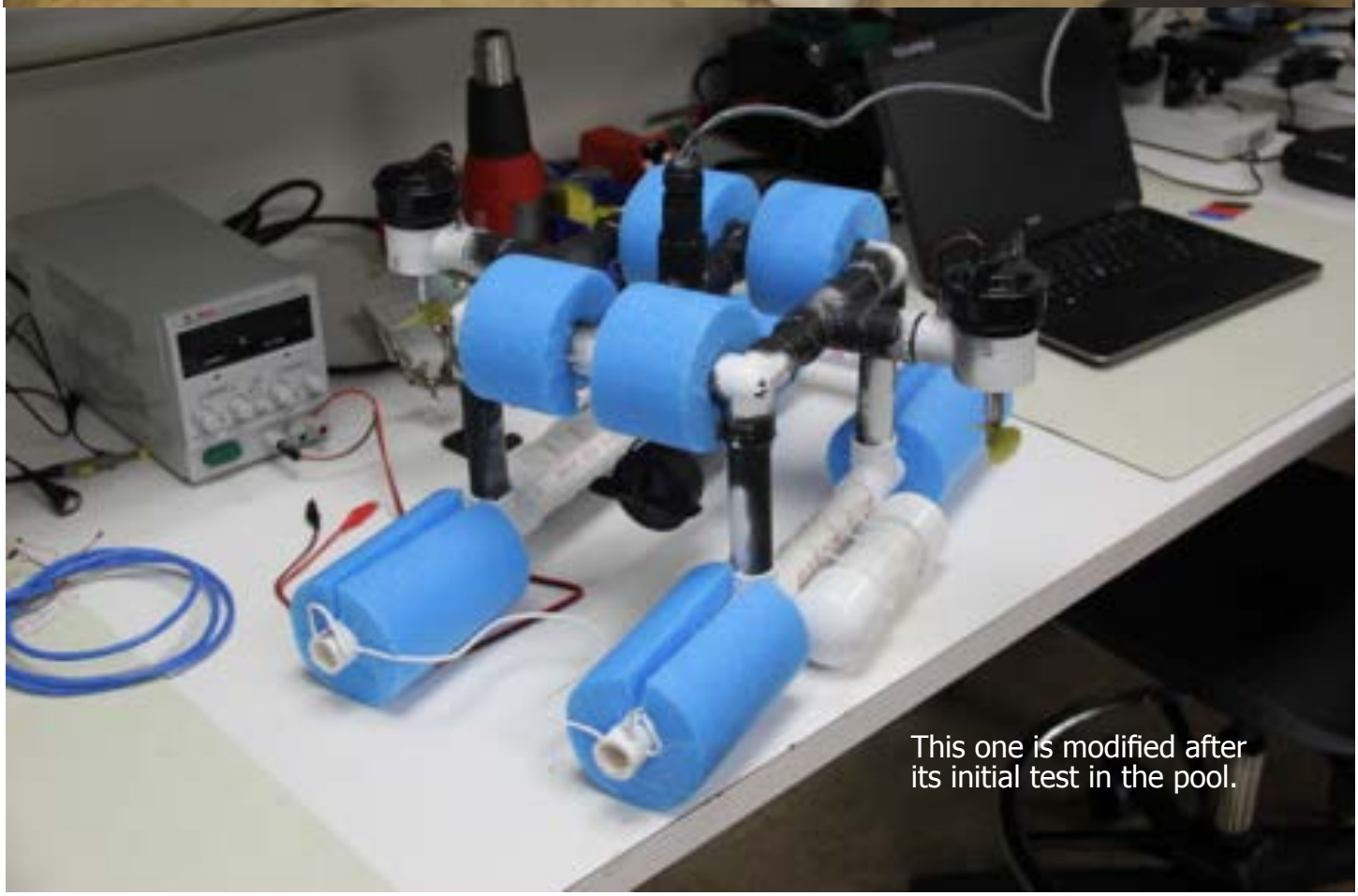
While the VE's were administering the test, I spent time with Kris on a cruise thru the lab area to get pictures of the equipment used by the class; a couple of robots, a number of automated manufacturing training stations (with PLC controllers), work areas with power supplies, meters, oscilloscopes, soldering stations, hot-air surface mount solder and desolder units. They also have four 3D printers.

The students are wrapping up their 15 week course by constructing their final project. One is using a Rasberry Pi to create a monitoring system for a nearby facility the sends email alerts if the temperature in a process refrigerator falls out of range. The other students are working in teams of two to build aquatic remotely controlled vehicles. Here is a short video of the initial testing of a couple the units. Detail photographs can be found on the next page.

https://youtu.be/ik3Qo7pGDZ8

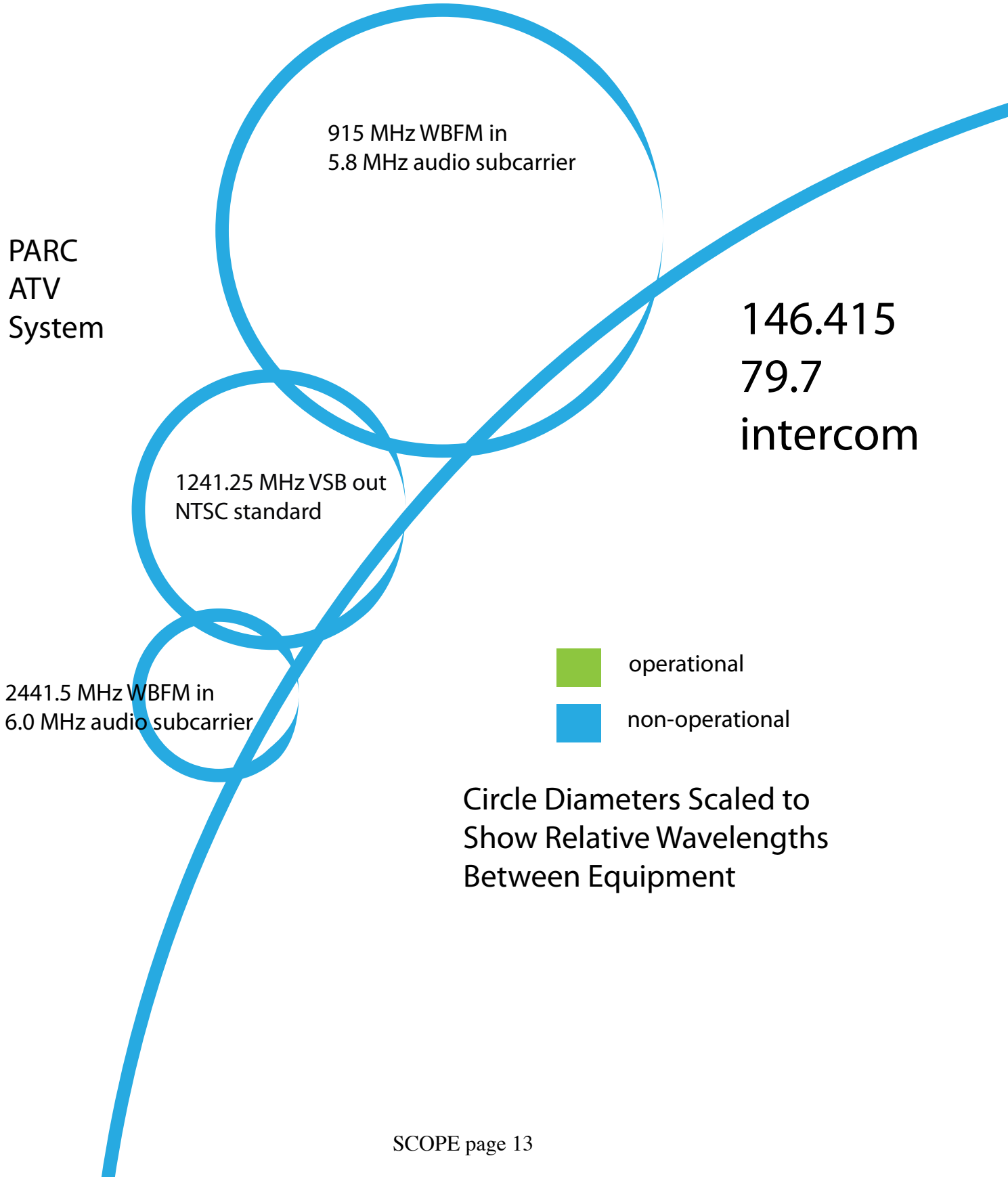
It was a great experience to visit the school and to interact with these very motivated students. I came away enthused by their engagement in the course material in their pursuit of a broad hands-on technical education. You can learn more about this course by writing to TCI@miracosta.edu to attend one of their weekly tours of the facility.


Here is an aquatic remotely controlled vehicle still under construction. The four propulsion motors are mounted on independent axles for directional control. The propellers were created in class using the 3D printers.
This is a camera!


This one is modified after its initial test in the pool.

Reported ATV Status as of 27 Nov

Would you like to help us revitalize our ATV system? We could use your help. Contact board@palomararc.org to volunteer.



2016 SW Division Convention

Yuma Hamfest

Yuma, Arizona

Feb. 19 & 20, 2016

Yuma County Fairgrounds
2520 East 32nd Street, Yuma, Arizona

www.yumahamfest.org

Check the Website for Additional Information

Gates Open for Camping Thursday, 2 pm Vendor Setup Friday, 7 am - Noon	Event Hours Friday, Noon - 5 pm Saturday, 8 am - 5 pm	Hamfest Dinner & Grand Prize Drawing Saturday Night 6:00 - 8:00 pm

Vendors & Exhibitors
Consignment Sales
License Testing
Hourly Door Prizes
On-site RV Camping
Hamfest Dinner
ARRL Speaker
Transmitter Hunt
$5.00 Admission
Tailgating (Swap Meet)
Full Seminar Schedule
DXCC Card Checking
Incredible Grand Prizes
Emergency Preparedness
Admission Prize
Hospitality Area
Near Space Balloon Launch
Antenna Clinic

Hamfest Talk-In Frequency: 146.840 (–) PL 88.5 Hz

Email Contact: ***info@yumahamfest.org***

We are proud to have the Amateur Radio Council of Arizona (ARCA) as a sponsor of our event.

The Yuma Hamfest is an American Radio Relay League (ARRL) sanctioned event.

Presented by the Yuma Amateur Radio Hamfest Organization

W6NWG Awarded Worked All States

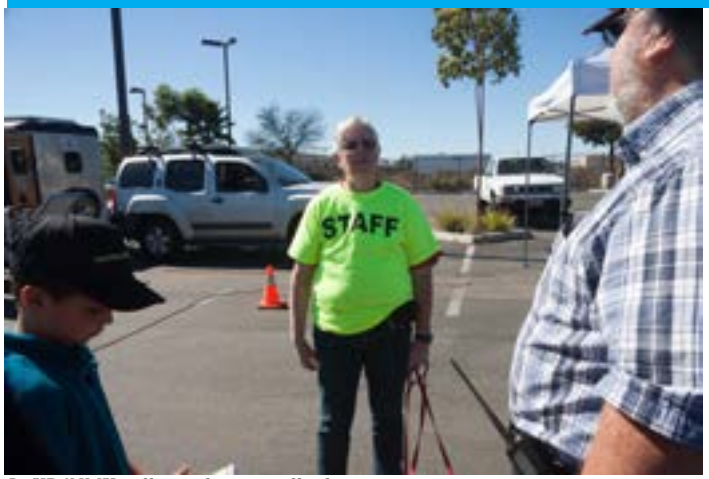
PARC recently submitted a number of Field Day logs to the ARRL's Logbook of the World, which automates the process of QSLing contacts and qualifying for awards. It's routine for the club's Field Day operation to contact all the states, but getting all the QSL cards and sorting them out for an award submission has been a bit harder. Not anymore! Here are the club's Worked All States certificates earned so far.

The Mixed mode certificate certifies that the club worked and confirmed contacts with all 50 states, using some combination of all bands and all modes. The 20 Meters endorsement sticker on that certificate shows that we worked all states on just the 20 meter band. Likewise, the Phone mode certificate shows that we worked all states using just the phone mode.

The club must be close to qualifying for a CW mode certificate, and for other band endorsements, from Field Day activity alone. We'll continue to submit logs to Logbook of the World. If you have any W6NWG logs (written or online) please send them to the trustee (w5nyv@yahoo.com) for submission.

ARRL put the trustee's name on the certificates instead of the club's name. We'll see if we can get that fixed.

Operating Day at Fry's San Marcos



Jo KB6NMK suffering from a staff infection.

Skywarn booth did a brisk business in conversations about the gorgeous weather.

Michelle W5NYV and Harry W6YOO talk DX.

Glen KJ6ZQH toured and talked.

Don WD6FWE models the System Fusion hats that were given away at the Red Cross booth at Operating Day

Henry and Rose check out SLEEP system, by Robert Todd KJ6RET. This is one of their favorites! They each got a System Fusion hat from Red Cross.

Not just System Fusion hats from Red Cross, but also donuts! Rose hears that they are actually ham vitimin pills.

Yaesu MH-85A11U Teardown

Camera Microphone used with FT1D, FT2D, and FTM-400 System Fusion Radios

Michelle Thompson W5NYV
Paul Williamson KB5MU

Introduction

Yaesu offers an optional camera-equipped microphone (MH-85A11U) for use with the company's newly introduced System Fusion radio line. Currently, the line includes the FT1D and FT2D handhelds and the FTM-400 mobile rig.

Taking photos with the camera microphone requires a properly formatted microSD card to be inserted into the radio. The photos and the files that manage the photos are stored on the SD card.[1]

The question that motivated this teardown was the nature of the interface between the camera microphone and the radio. The camera is referred to as USB Camera in the configuration menus. Could the interface simply be USB?
Inspecting the socket revealed what appeared to be a proprietary connector. See Figure 1 and Figure 11. No information about the pinout was included in any of the various manuals. No information about the pinout was available from Yaesu's USA sales staff.

Figure 1: Camera Microphone Cable

Figures 1 through 16 can be found following the text.

1 See Palomar Amateur Radio Club's April 2015 newsletter, Scope, for an introduction to the file system and basic photography functions. http://www.palomararc.org/Scope/apr15scope.pdf

Investigation

A camera microphone was purchased and tested. The microphone was connected to an FTM-400. Proper microphone function was observed, but the speaker function does not seem to be supported on the FTM-400. Photographs were taken and saved to the SD card. These photographs were successfully sent over the air.
The camera microphone has three buttons. The usual push-to-talk (PTT) button is located in the traditional place on the side of the handheld microphone. A button with an image of a camera on the front serves as the shutter button for the camera. A data transmission start button (marked D-TX) on the front sends the most recently taken photograph over the air. See Figure 2. The back plate of the microphone is held in place with four screws. These were removed. See Figure 3. Once removed, shielding on the inside of the back plate and the main board of the microphone were revealed. See Figure 4.

The back plate was set aside and the main board examined. See Figure 5.

We immediately marveled that there was an ARM processor onboard. It was marked "ARM STM32F207 ICH6", which identified the chip as a ARM Cortex-M3 based microcontroller manufactured by STMicroelectronics. ST describes this chip as featuring a "120 MHz CPU/150 DMIPS, up to 1 Mbyte of Flash with advanced connectivity and encryption, adding Ethernet MAC and camera interface to the STM32F205/215, and more GPIOs and features on larger packages." [2]

That's a lot of compute horsepower for a microphone! We speculated that the microcontroller was simply the cheapest solution for integrating a very small package camera via USB to a host device. There are two USB ports on the microcontroller.

To the left and slightly above the microcontroller was a chip marked CY62138EV30LL-45BVXI. That makes it a 256kB by 8 bit 45ns static RAM device from Cypress Semiconductor.

We believe the 8-pin package below the memory to be an audio amplifier.

The 5-pin device below and to the right of the microcontroller is a voltage regulator. It appeared to take in 5 volts (supplied by the radio, just as it would be supplied by the host in a standard USB device) and produce 3.3 volts (which is within the 1.8 to 3.6 volt range required by the microcontroller).

This board was marked "1489-04880(3)-10 PCB)AAJ40X main". We called it the main board.

Next, we examined the board where the camera was mounted. This board was mounted perpendicular to the main board. It was marked "1489-04870131-5 PCB)AAJ40X sensor", so we called it the sensor board.

The sensor board lifts out from a niche in the top of the opened microphone. It is attached to the main board by a copper foil ground strap (soldered to the main board and somewhat fragile) and a ribbon cable with 10-pin connector. See Figure 7. The front housing of the camera can be removed by removing the two screws visible in Figure 7. After the housing is removed, the camera body can be inspected. See Figure 8. It's a common webcam form factor. For example, it is visually very similar to, but not identical to, the Raspberry Pi camera. The length and width of the square body are the same, but the Raspberry Pi camera body is taller.

No useful part numbers were found on the camera board or body.sWe speculated that the camera lens focus distance might be adjusted by turning the lens, but we didn't attempt this.

---

2 This microcontroller family is discussed at http://www.st.com/web/en/catalog/mmc/FM141/SC1169/SS1575?sc=stm32f2

This camera doesn't seem to have autofocus. Since its focus is fixed, there is an ideal depth of field where photos will look sharpest. The camera was refitted to its housing and reinstalled in the niche at the top of the microphone.

Continuing with disassembly, the three screws that held down the main board to the front housing of the microphone were removed and the board lifted up and to the side. The microphone and speaker wires remained attached. See Figure 9.

Visible in this view was the back side of the D-TX and shutter buttons. The microphone was friction fit into a cylindrical housing. The speaker was installed in the front housing. Aside from the two pushbutton switches, no components were observed on the back side of the main board, so ws reinstalled it into the front housing.

The next area of investigation was identifying the signals on the pins corresponding to the microphone cable. We were looking for evidence that this interface was simply USB, or USB plus a few other signals. Having a standard interface available from the microphone would be desirable, as one could interface another camera or photo-serving device to the radio, or possibly improve or expand the performance and capabilities of the Yaesu MH-85A11U. Being able to use the Yaesu MH-85A11U with other devices was also raised as a possibility. These objectives could be more easily enabled if the interface could be defined.

The cable enters the bottom of the handheld microphone. The individual wires then go to an 11-pin connector with reference designator CN1. We called this connector 1. See Figure 10

Not all of the pins of the connector were populated in the cable. During the first pass, the following pins were identified and the cable wiring color code noted.

Table 1: Pins Identified with Multimeter

Pin	Cable Wire Color	Apparent Function
1	Green	5V
2	White	
3	Red	
4	No connection	
5	Black	Ground
6	Brown	
7	No connection	
8	No connection	
9	Yellow	
10	White	PTT
11	Black	Ground

With power provided to the radio, and the radio switched off, no signals appeared at connector 1. With the power switched on, signals appeared at the connector.

When the PTT button was pressed on the side of the microphone, the 3.3 volts normally observed at pin 10 (PTT) was pulled about halfway down. Obviously, this is not a standard USB pin. This signal is also connected to the microphone element itself.

Next, an oscilloscope was used to more closely examine the pins.

Table 2: Pins Identified with Multimeter and Oscilloscope

Pin	*Function*
1	5V
2	data burst every 1ms
3	data burst every 1ms, very close to differential of pin 2
4	nothing
5	Ground
6	8.2 volts DC
7	3.3 volts DC
8	3.3 volts DC
9	nothing
10	PTT normally 3.3 volts high pulled about halfway down by pressing PTT button
11	Ground

On the oscilloscope, busts of data at 1ms intervals were observed on pin 2. An image was made of the data burst. See Figure 12. Pin 3 also had bursts of data at 1ms intervals. This is very encouraging, since an idle USB Full Speed interface should always have Start of Frame (SOF) packets at regular 1ms intervals. A second oscilloscope probe was connected, so we could see the timing relationship between the signals on pins 2 and 3. See Figure 13.

Looking at the waveforms, the data rate was estimated at approximately 12Mbps, which corresponds to the Full Speed Data Rate of the USB standard. The signals on pins 2 and 3 wereymostly differential, meaning the same signal appears on two different wires, but with one wire going high when the other goes low, and vice versa. At the end of each burst, as shown in Figure 13, both signals go low together for about two bit-times. This is called a Single-Ended Zero (SE0), and is exactly what you'd expect to see as an End Of Packet (EOP) marker on a standard USB signal.

If this is indeed a SOF packet, it should consist of an 8-bit Sync pattern (constant), followed by 8 bits of Packet Identifier (PID, also constant), 11 bits of Frame Number (varying), 5 bits of CRC (varying) for error detection, and the EOP. That should take 34 bit times, plus overhead for NRZI encoding, for a duration of about 2.8 microseconds. That is completely consistent with our observations. We saw the first part of each packet remaining constant, and the later portion varying, followed by a consistent SE0.

With differential signaling, The receiving circuit responds to the voltage difference between the two signals, rather than the difference between a single wire and ground. This makes it more immune to common-mode noise induced on both wires, which can be a big advantage. Often differential signaling is used with positive and negative voltages, which maximizes this advantage, but requires a negative supply. Like standard USB, this interface uses only low (near zero volts) and high (about 3.3 volts) states.

When PTT was pressed, the data burst did not appear to grow in size. The part that stayed the same continued to stay the same, and the part that was rapidly changing continued to rapidly change. When a photograph was transmitted, no change in size or nature of the data burst was observed. Apparently no data is transmitted between the microphone and the radio for these two activities, which makes sense.

An additional amount of signaling was observed to follow the periodic (SOF) data burst. This second packet wasn't always transmitted, but when it was transmitted, it always followed the first burst and always occurred after the same amount of delay. See3Figure 14 for an image of both bursts. We have not decoded the second

packet, but it also appears to have the standard structure of a USB packet, including the sync pattern and SE0 EOP marker.

The FT1D handheld operated in a similar manner. The only difference discovered was that the speaker in the camera microphone worked as a speaker. When attached to the FTM-400, the speaker in the camera microphone was silent. With the FT1D connected, we probed the connector looking for the speaker audio, without finding anything. Since the audio doesn't come in as an analog voltage, We assumd that the audio was coming in through data on pins 2 and 3, but we have not verified that assumption

We decided that we would need a logic analyzer, or a USB protocol analyzer, to better study these signals. We had a basic logic analyzer on hand. This particular model is an FPGA-based open hardware design called the Open Bench Logic Sniffer. Of the several host programs designed to control and interface with that kind of logic analyzer hardware, we ran the recommended Java client "Logic Sniffer" on a Mac.

We attempted to solder some wire wrap wire to the connector in order to more easily connect the leads. The solder on the connector turned out to be very high temperature solder, and we were reluctant to risk damaging the connector by applying enough heat to melt the solder. Instead, we connected a ground wire on the large ground pad on the main board, and held the Logic Sniffer test leads to pins 2 and 3 manually to capture the data. Data was captured, and the SOF data bursts seen on the oscilloscope were also seen on the Logic Sniffer. The next experiment was to take a picture and see if image data could be captured by the logic sniffer. This was successful. When the shutter button is pressed, a large amount of data is transmitted over pins 2 and 3 to the radio. See Figure 14. When the review screen was zoomed out, it was observed that the data came in batches about 50 microseconds (about 600 bits) long. See Figure 15.

The Open Bench Logic Sniffer doesn't have a very large memory, so even with the camera ses to capture at the smallest size and lowest quality the entire transmission of data from camera to the phone could not be captured in full detail. We were able to confirm that the amount of data transmitted was about the same as the file size as stored on the microSD card, so presumably the JPEG encoding is being done in the microphone. The analyzer also has relatively primitive triggering features, so we weren't able to capture the beginning of the transfer, where the standard JPEG file signature would be readily identifiable. Ideally we'd like to capture the entire exchange, to confirm how the file is being transferred.

Next steps in this direction would require a more capable logic analyzer or, preferably, a dedicated USB protocol analyzer.

Software-based USB protocol analyzers are available, including some for free. It's possible we could learn more by using one, but they are really intended for use when a device is connected to a standard computer. In this case, where we have a proprietary device connected to a proprietary host, we really need to use a hardware based analyzer.

There are several USB hardware analyzers on the market. One relatively low cost unit is the Beagle USB 12 from Total Phase. It can handle the 12 MHz "Full Speed" interface used here, but no faster. It costs $400, and comes with software that is artificially limited in its ability to decode USB transactions. Most hardware analyzers are much more expensive. Purchase was put on hold pending the results of some inquiries about borrowing time on an existing USB protocol analyzer or logic analyzer.

There are also software-based USB protocol analyzers, including some for free. Of course, they are intended for the case where the device is connected to a standard host computer. They would not be directly useful for the case of the camera microphone connected to the transceiver, but they might be useful if the camera microphone's interface is close enough to standard USB to be recognized by a computer.

We had seen enough evidence to support our guess that the data interface on pins 2 and 3 might be standard USB. To put this theory to the test, we decided to try hooking up that interface to a computer's USB port and see if it would be recognized.

A standard USB cable was partially disassembled, and pins 2 and 3 and power and ground from the camera mic were connected to the corresponding pins of the USB cable. The USB cable was connected to a MacBook Air running Mac OS X 10.10.3 Yosemite. Nothing visible happened. The wires for pin 2 and pin 3 were reversed. A USB message was then captured from the console.

```
4/18/15 8:33:00.000 PM   kernel[0] USBF:    15721.218    The IOUSBFamily is
having trouble enumerating a USB device that has been plugged in.  It will
keep retrying.  (Port 2 of Hub at 0x6000000)

4/18/15 8:33:02.000 PM   kernel[0] USBF:    15723.357    The IOUSBFamily
was not able to enumerate a device.
```

These messages speak of difficulty "enumerating" the device. That refers to an essential step in the USB protocol that enables plug-and-play operation with many USB devices. Normally, a newly connected USB device will respond in a particular way that enables the host computer to recognize exactly what type of device it is, so that the right device driver software can be activated to use the device.

The error is a fairly generic one. It suggests that the computer was able to tell that something had been connected, but that it could not complete the basic handshake to find out what had been connected. This kind of error can be caused by cable problems (our pin-probing arrangement wasn't exactly according to USB standards) or it could be a software issue on either end. The next step here would be to make solid connections to the data pins and try to capture the attempted enumeration on a logic analyzer.

Despite the failure to enumerate the camera mic as a standard USB device, we think the chances that the interface is basically USB and can be made compatible with other devices are still pretty good.

Summary

The interface between the radio and the microphone does appear to rely on USB or USB-like signaling. Signals were identified, and data captured that does appear to be USB packets. USB allows for a variety of potential experiments and applications with System Fusion radios.

Figure 2: Front View of Camera Microphone

Figure 3: Removing the Back Plate

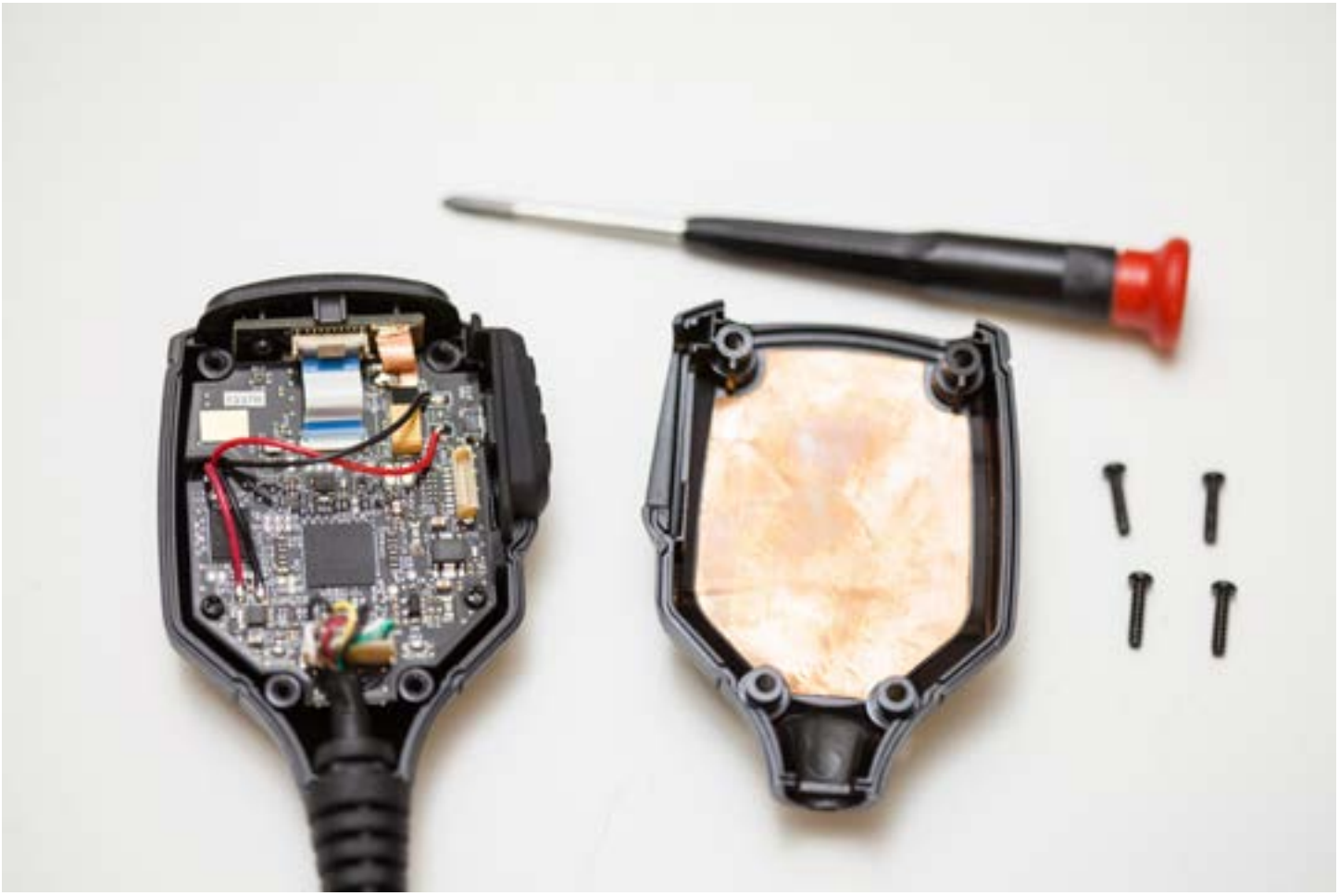


Figure 4: Back Plate Removed

Figure 5: Main Board

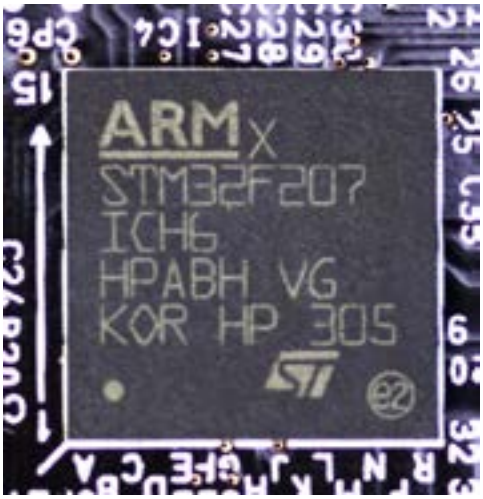


Figure 6: ARM STM32F207 ICH6

Figure 7: Sensor Board Lifted Out

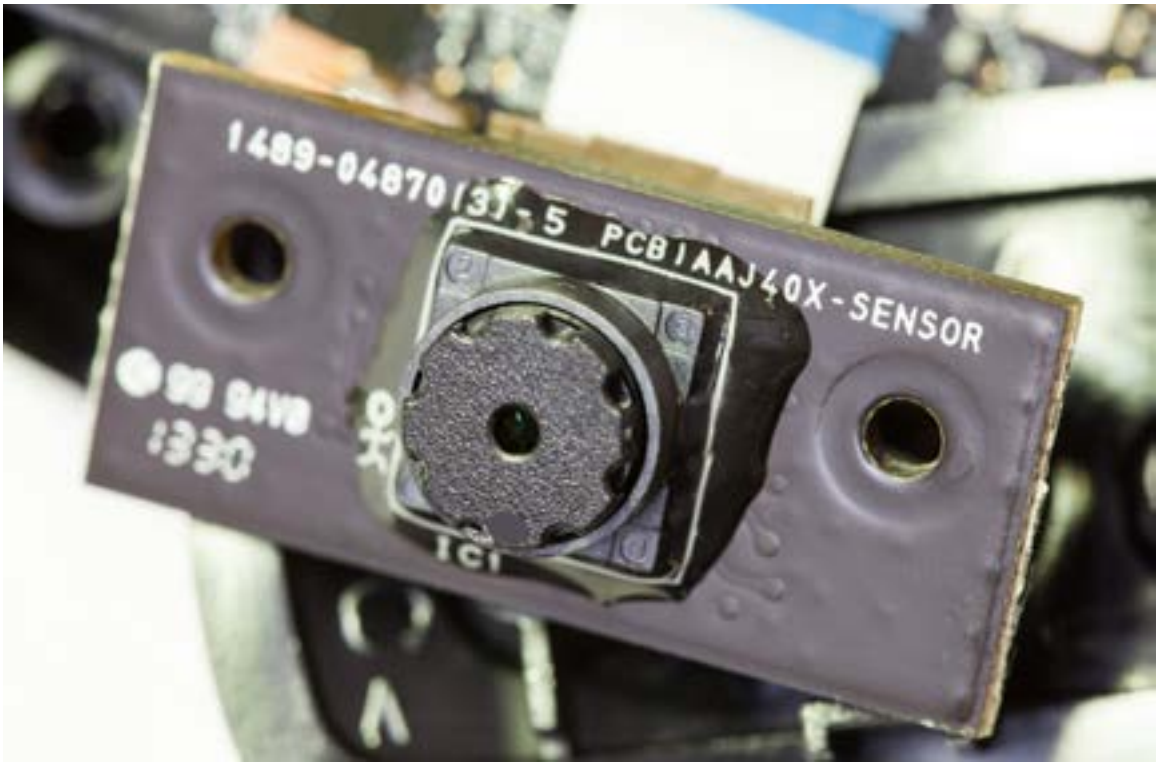


Figure 8: Camera Exposed

Figure 9: Back of Main Board and Speaker

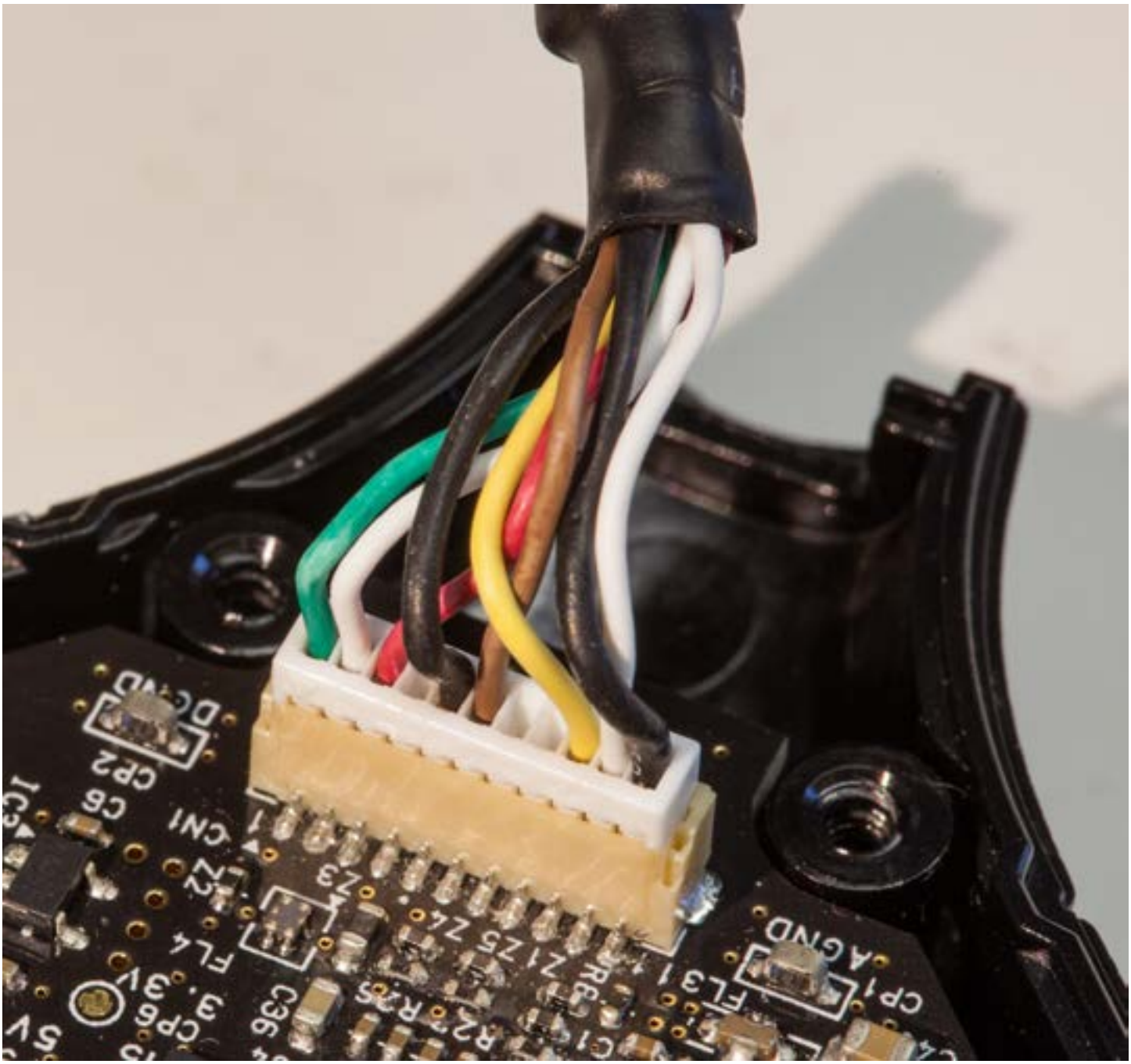


Figure 10: Connector CN1

Figure 11: Camera Microphone Plug Detail

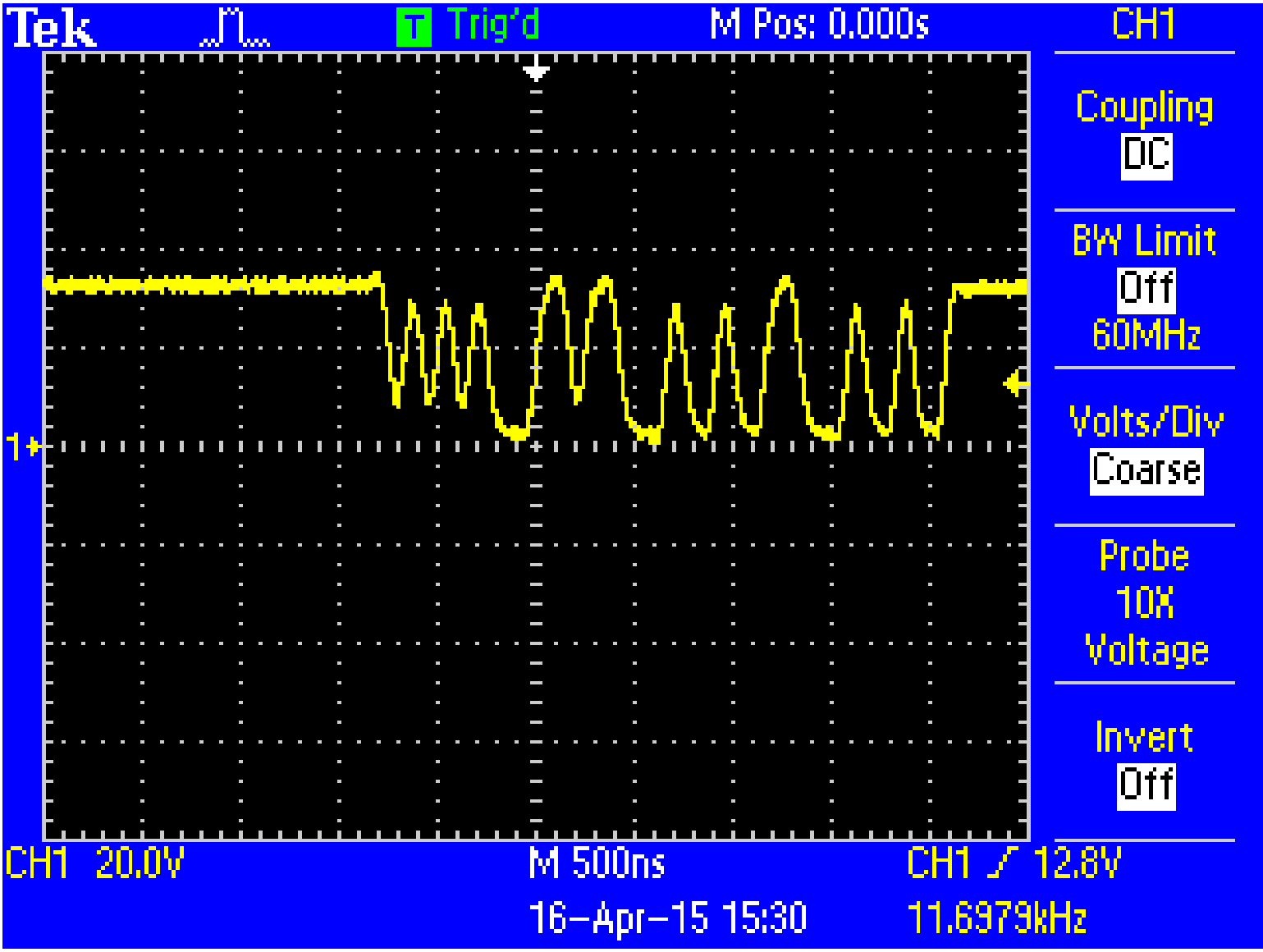


Figure 12: Pin 2

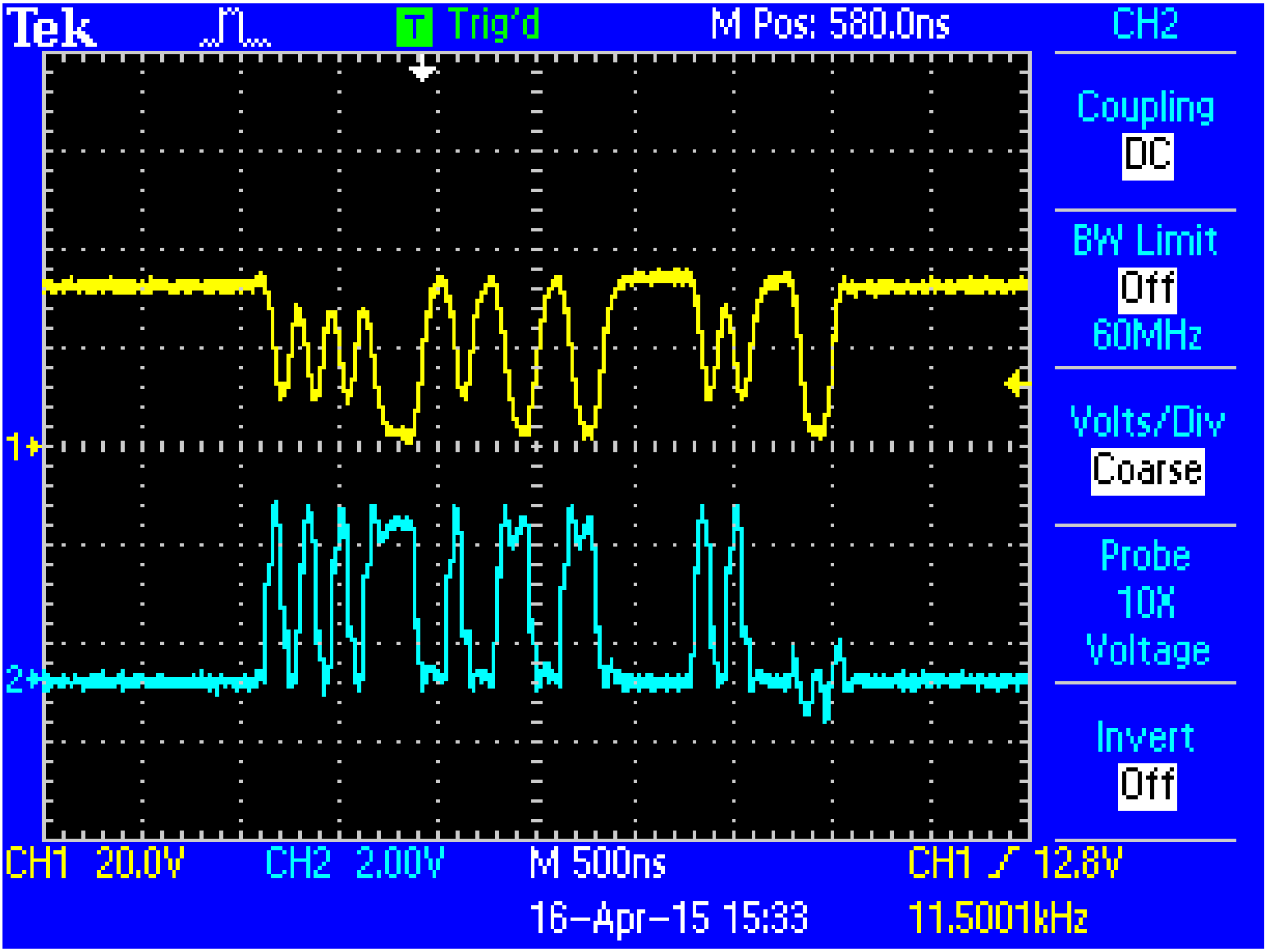


Figure 13: Pin 2 and 3 Comparison of Initial Data Burst Signals

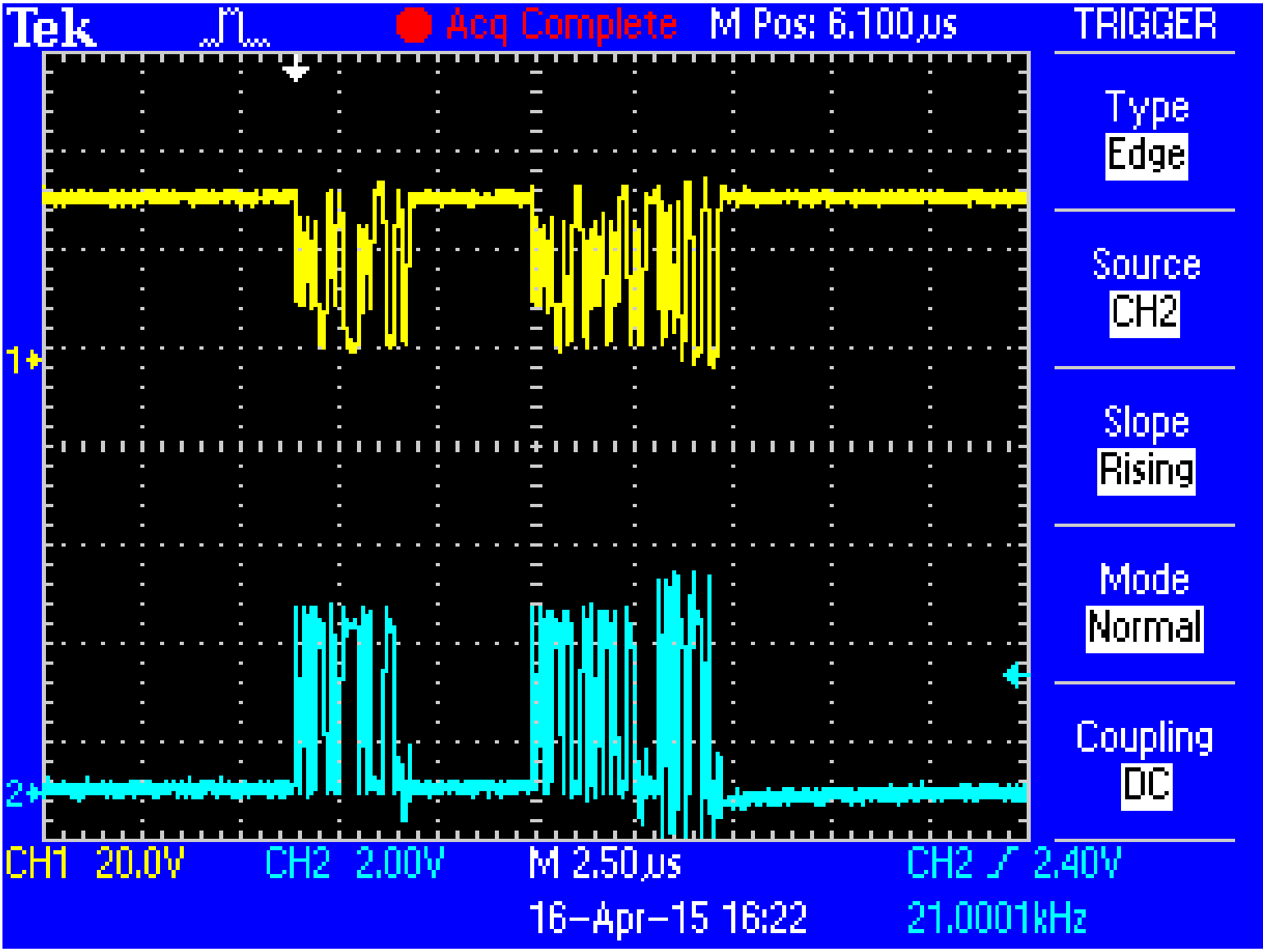


Figure 14: Pin 2 and 3 Initial Data Burst and Burst That Sometimes Follows Initial Data Burst

Figure 15: Data from Pin 2 and 3 During Shutter Press

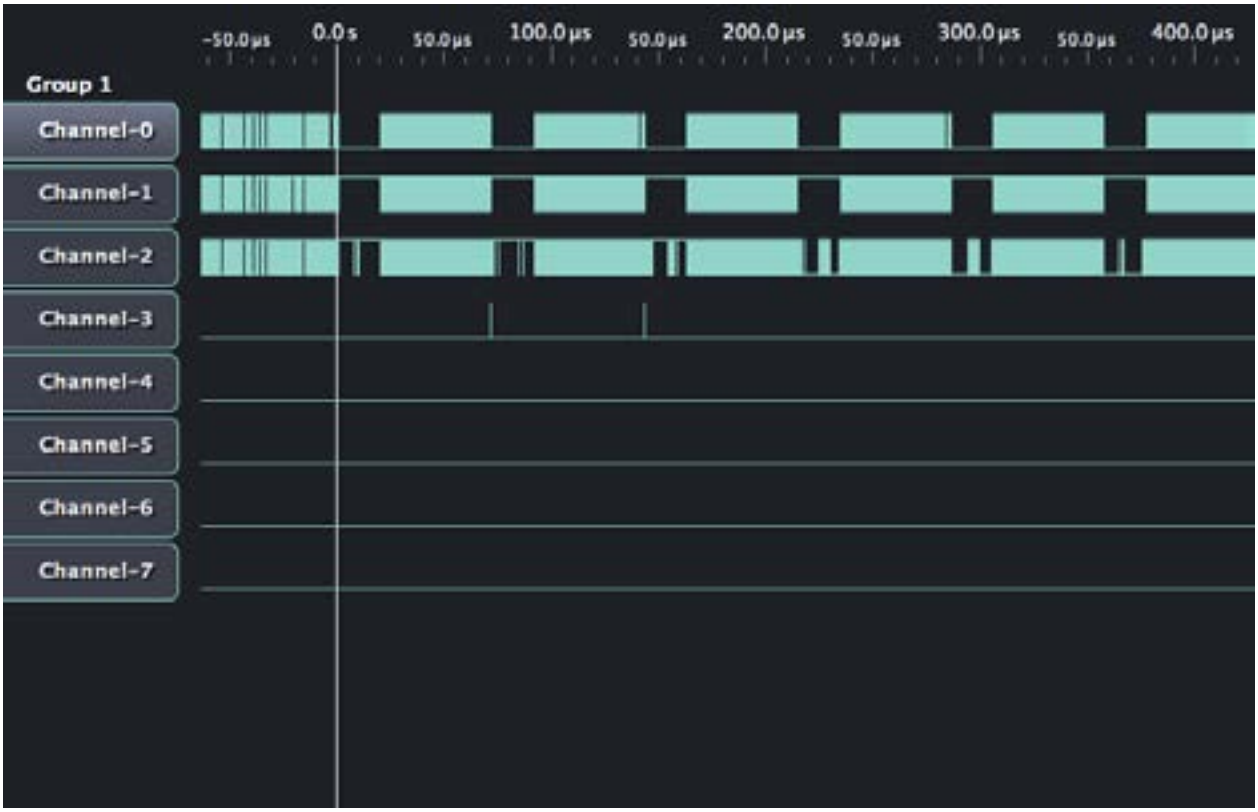


Figure 16: Data from Pin 2 and 3 During Shutter Press Zoomed Out

Signal Adventures: SigGens from China

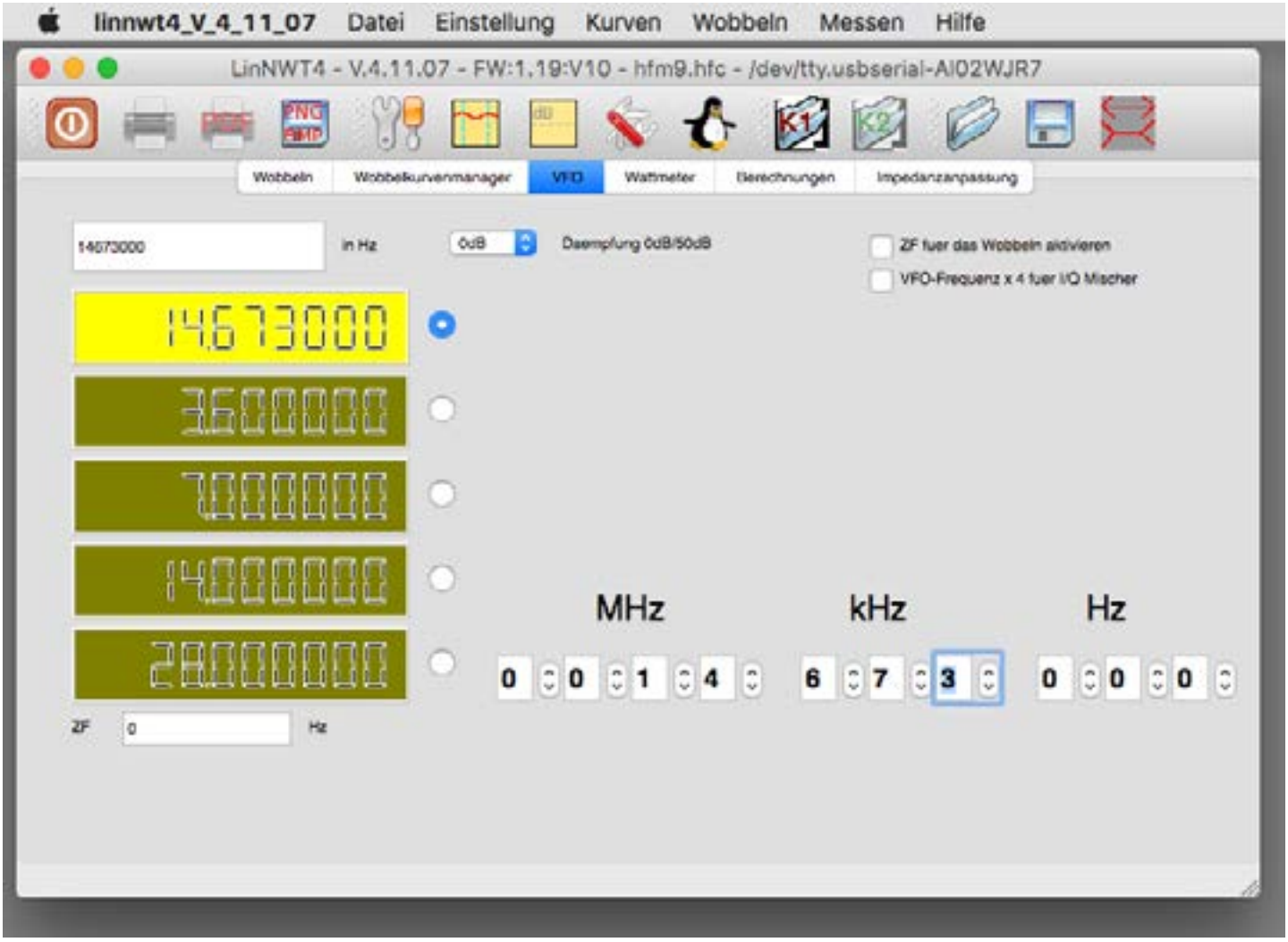
Article and photos by Paul KB5MU

At the November meeting of the San Diego Microwave Group, Kerry N6IZW showed a recent eBay purchase: a little black box described variously as something like "138MHz-4.4GHz USB SMA Source/ Signal Generator/Simple Spectrum Analyzer". It looked like a good deal, so I ordered one too. It cost $63.69 including free shipping from Shenzhen, China, and comes with a USB cable, two 12-inch SMA cables, and a mini CD of related software. There are other configurations available, including one with a wider frequency range (35 MHz to 4.4 GHz) for a bit more money, one without a box for a bit less money, and even one with a built-in ARM-based microcontroller (STM32F103) with a color LCD display programmed as a user interface for the device.

The BG7TBL signal generator and spectrum analyzer device.

The 3" mini-CD was the first challenge. These don't work in slot-loading drives, much less in modern computers that have no optical drive at all. I tend to keep old computers, so I didn't have much trouble finding one with a tray-loading drive that could read the disc. See the screen shot. The filenames are in both Chinese and English, and clearly some of the files on the disc refer to some other product (a GPS disciplined oscillator). I decided to set the disc aside and look for software on the internet instead. There's a callsign visible in the disc's directory listing (BG7TBL) so I decided to search for that.

The search was fruitful. I found out that BG7TBL was the original designer of the device, and that it is based on an Analog Devices ADF4350 wideband synthesizer with integrated VCO. It contains an FTDI USB-to-serial chip to provide the computer interface, which doesn't require a unique driver because it looks like a standard USB serial port. There was also a link to http://www.dl4jal.eu for software. The good news is that DL4JAL's LinNWT software runs on Windows, Macintosh, or Linux. The bad news (for me) is that it's in German. There's a manual that's "in English" but it appears to be a machine translation.

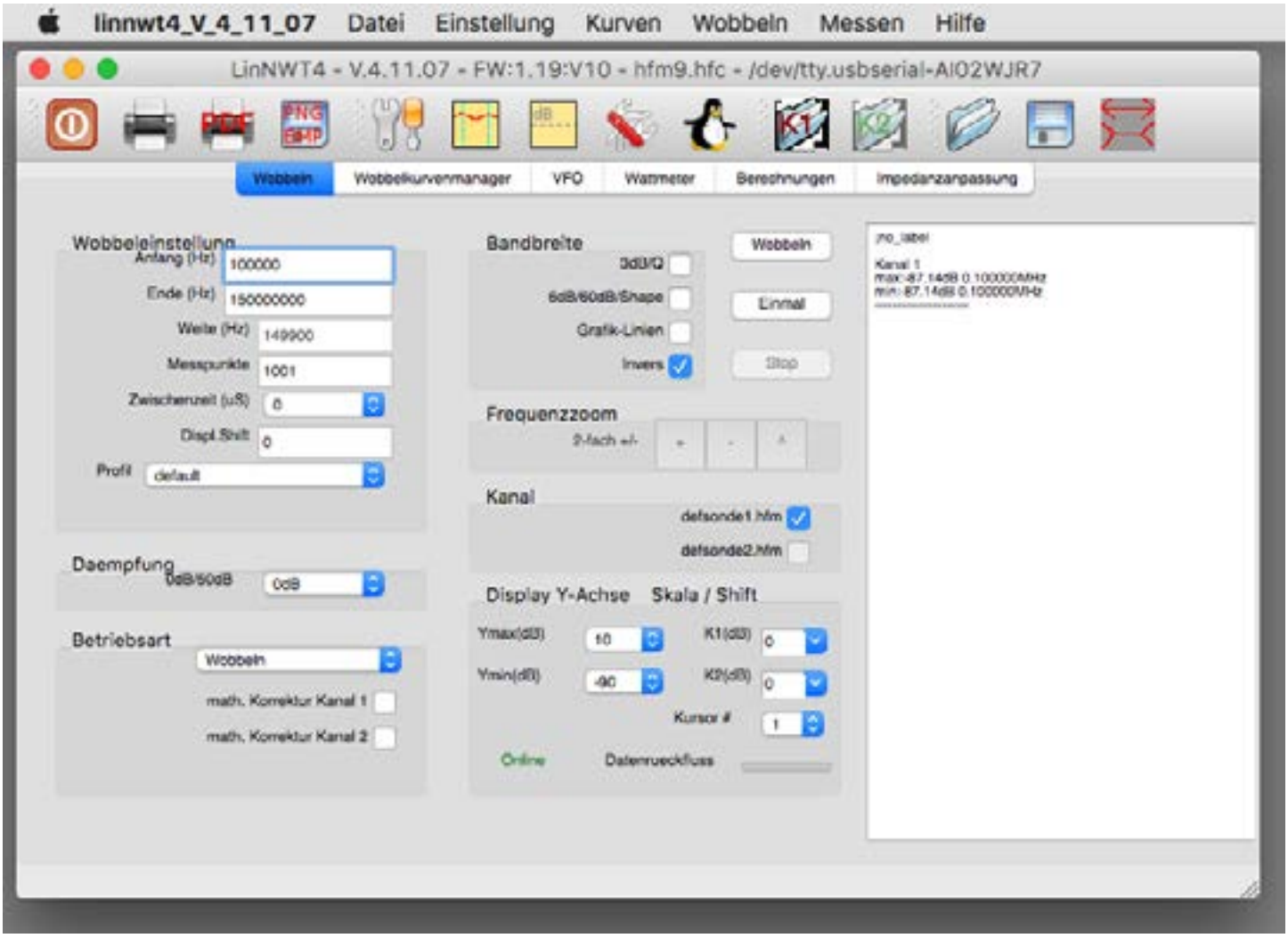


VFO screen of LinNWT running on the Mac, generating 146.730 MHz after the 10X multiplier.

OK, German is almost like English, right? I decided to try using the software first (though I usually prefer to read the manual). I loaded the Mac OS X version of the LinNWT software, found the "VFO" tab, configured it to generate a 1GHz signal, and hooked it up to W5NYV's Tektronix 492 spectrum analyzer. Setting up the spectrum analyzer to look in the vicinity of 1 GHz, I saw nothing. Tuned around, and still saw nothing. Did I get a bad unit?

Back to the web. I found an article on the device at http://dalbert.net/?p=219, which confirmed that the LinNWT software is only available in German with minimal English documentation. It reports that the signal source is pretty clean except for the third and higher order harmonics, which are not filtered, and that his unit showed about 7ppm of frequency error. Not bad for such inexpensive test equipment. The author compiled his own version of the software to run on Linux. The configuration settings he mentions appear to be in English. In particular, I noticed mention of a "frequency multiply" setting of 10. I couldn't find any such setting in the German OS X program, but I wondered if I was missing a factor of 10 in frequency. So, I tried setting the program to 100 MHz instead of 1 GHz. Sure enough, with the program set to one-tenth the desired frequency, I could see the signal on the spectrum analyzer.

I then wanted to see for myself just how bad the harmonics were, so I configured the unit to generate a frequency near its lower limit. Just for fun, I chose 146.730 MHz. Then I configured the spectrum analyzer to sweep from DC to 1.8 GHz, which is as far as it would go in a continuous sweep. See the photo. Sure enough, there are strong harmonics all the way up. For comparison, I hooked up a Yaesu VX-7R I had handy, and saw that it was very much cleaner. See photo.



Spectrum analyzer screen of LinNWT running on the Mac.

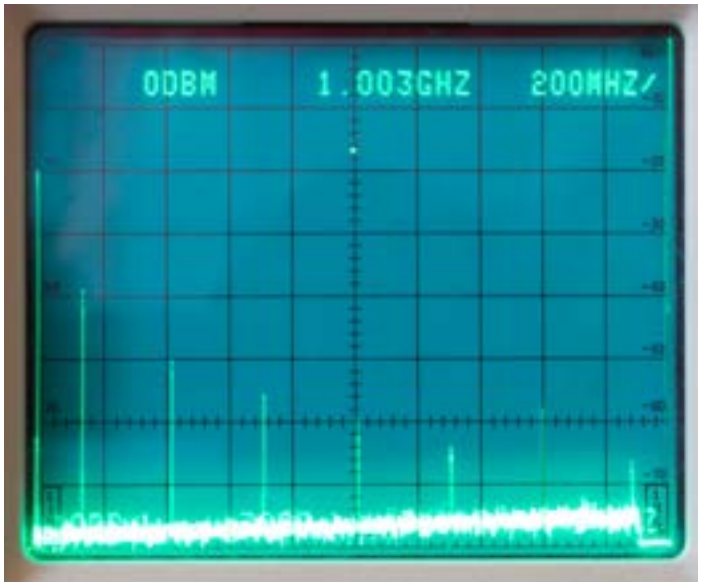
I also spent some time looking for higher harmonics. In the popular microwave ham band at 10 GHz, the harmonics were strong and easy to find, so this device will be useful as a marker generator in that range. With some fiddling, I was able to find harmonics up to 18 GHz, near the top of the spectrum analyzer's range.

I was originally interested in this device as a signal generator, but it also claims to work as a spectrum analyzer, though it doesn't have any resolution bandwidth filters. I wondered if it would be of any use. I connected a 2m whip antenna for an HT to the device's input connector, set it to scan from 140 to 150 MHz, and used the VX-7R to transmit a test signal, again at 146.730 MHz. See photo. Sure enough, there's a big signal from the nearby transmitter. You can also see a smaller signal, which appears to be around 148.5 MHz. That signal doesn't depend on the signal from the VX-7R; it's really there. See photo. I tuned the VX-7R to 148.5 MHZ and heard the signal on the HT as well. Searching around the room foxhunt-style, the signal seemed to be coming from the Mac. So the spectrum analyzer function has already proven its worth, by spotting a spurious emission from equipment in the shack. Once I knew the signal was there, I could find it on the Tek 492 as well. See photo.

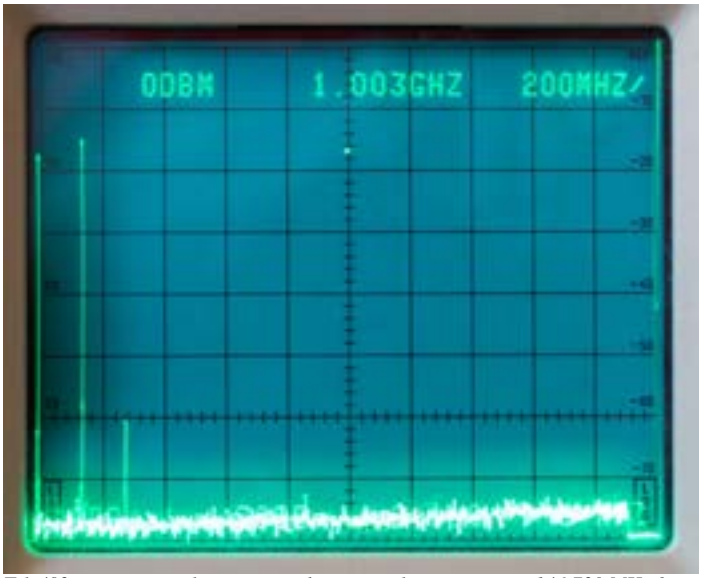
I wanted the English user interface, so I decided to compile LinNWT under Raspbian Linux on the Raspberry Pi. Following the instructions from the article, it built with no hassle, and ran with a mostly-English user interface when run as specified (using a command line argument of app_en.wm, which refers to the English localization file). The only catch was that the device wouldn't power up when connected directly to the Raspberry Pi's USB port, probably because there wasn't enough current available. Moving the device to a powered USB hub solved that problem. In the English user interface, I found where the frequency multiplier is set, and the same location in the German version

on the Mac did the same thing. Apparently it has to be set to 10 to make the frequency displays match reality.

Back on the Mac, I found I could get the same partially-English UI by copying the app_en.wm file out of the Linux distribution and starting the Mac program with the same command line argument as on Linux. I couldn't find a way to make that automatic, though, short of writing an Applescript. Windows users, you get the localized user interface automatically by choosing English when you install the program.

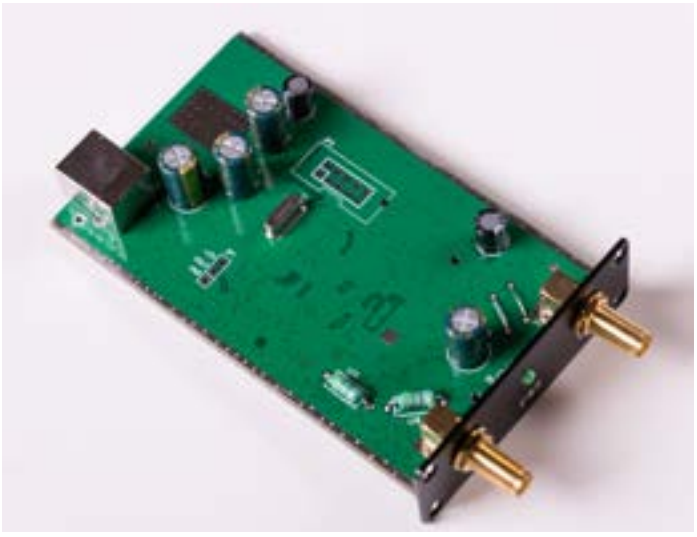


Tek 492 spectrum analyzer screen showing extensive harmonics generated by the device.

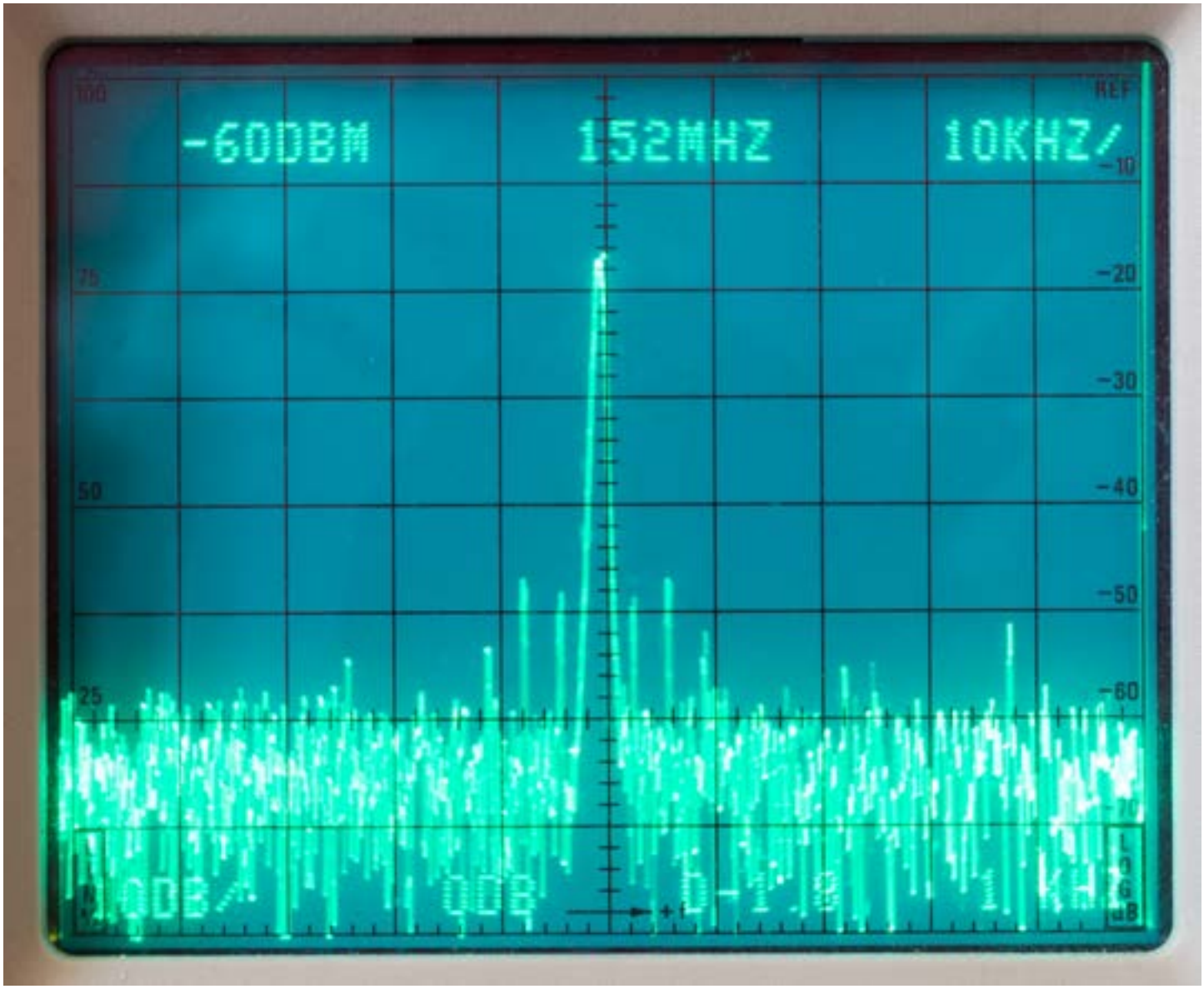


Tek 492 spectrum analyzer screen showing a clean carrier on 146.730 MHz from the VX-7R.

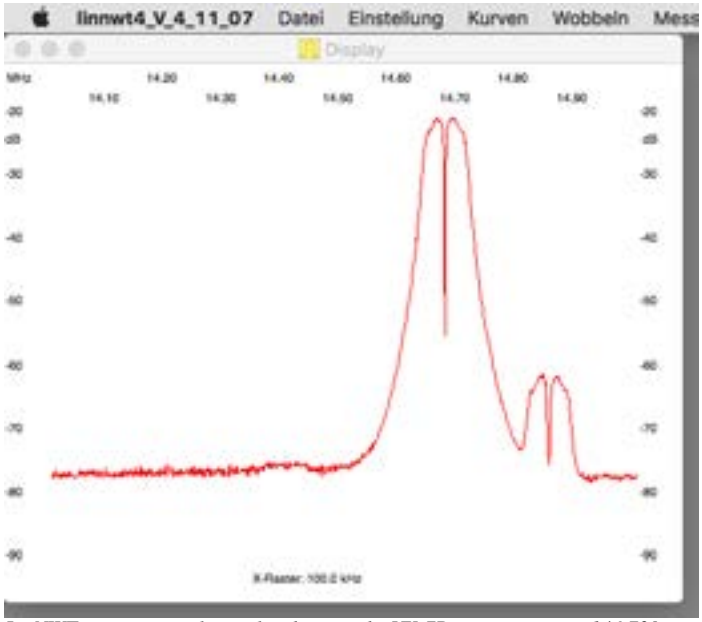
The BG7TBL signal generator and spectrum analyzer device, bottom of circuit board.



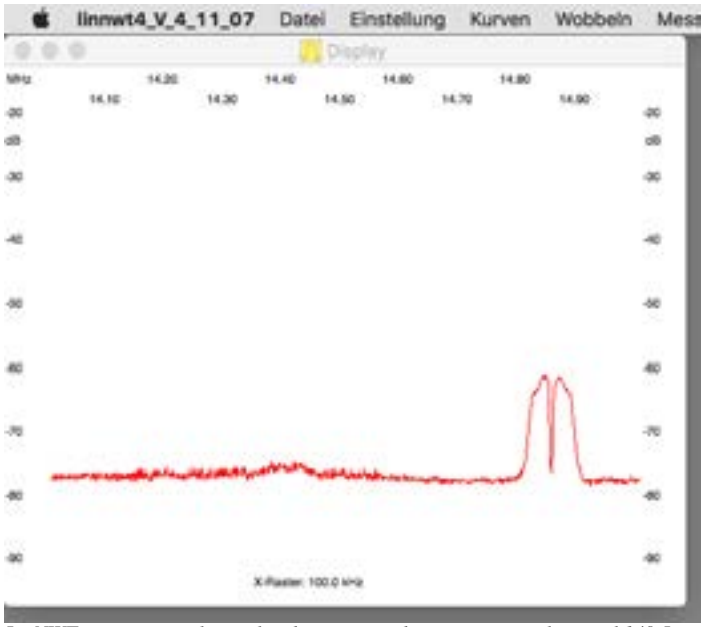
The BG7TBL signal generator and spectrum analyzer device, top of circuit board.



Tek 492 spectrum analyzer screen showing a close-up of the mystery signal at 148.5 MHz.



LinNWT spectrum analyzer plot showing the VX-7R transmitting on 146.730 MHz and a mystery signal around 148.5 MHz.



LinNWT spectrum analyzer plot showing just the mystery signal around 148.5 MHz.

Repeater Site Technical Video Report

Among other tasks, Repeater Technical Chair Mark KF6WTN and PARC President Charlie NN3V investigated a complaint about the 147.130 machine squelch level. With able assistance from Joe WB6IQS, Mark was able to adjust the squelch. Reports after the adjustment were good. Here's a video of the teamwork in action.

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Featured Program:

At 7:30pm on 2 December 2015, Palomar Amateur Radio Club will hold elections for the 2016 board of directors and whether or not to grant Mike Pennington K6MRP Life Membership in PARC. Come at 7pm to socialize and brng a dish to share. We look forward to seeing you at the Carlsbad Safety Center, 2560 Orion Way, Carlsbad, CA.

Sign up for the PARC Email Lists:

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