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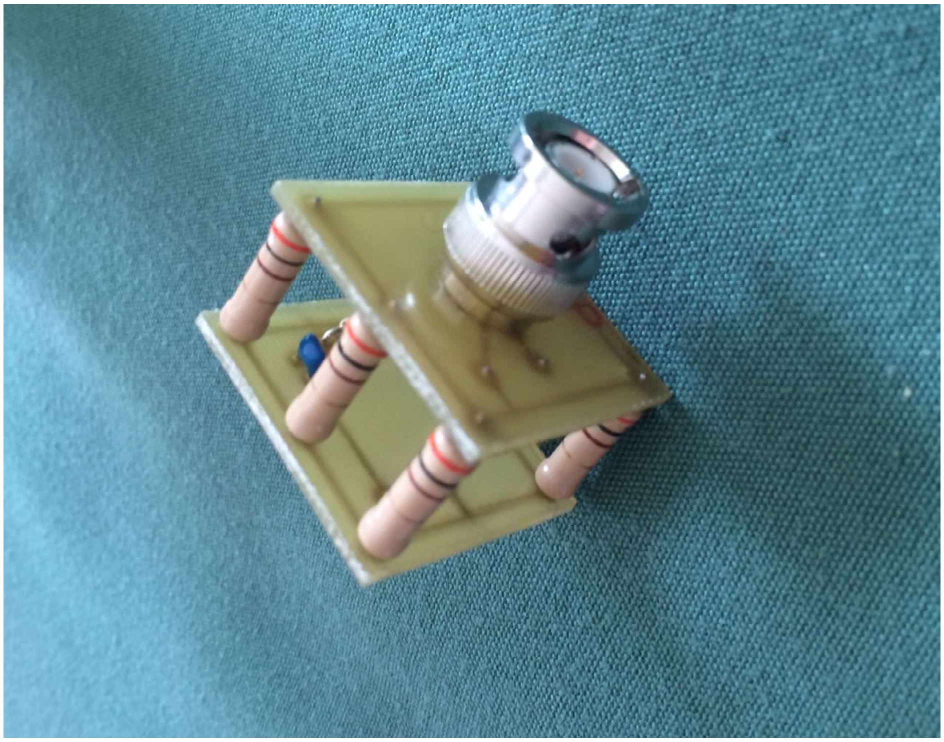

The 2016 Pacificon Special Edition Dummy Load

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From the Editor
by Doug Hendricks, KI6DS

The third issue of the rebirth of QRPp is here. It never ceases to amaze me of the quality of QRP articles that are out there, waiting to be printed. This issue is full of them, and I hope you enjoy the issue as much as I do editing it.

A quick note. On September 29th I suffered a very mild heart attack. I recognized the symptoms immediately and got right to the hospital. A stent was put in, and once again I am doing fine. Modern medicine is amazing. Thank you to all that sent good wishes. They are appreciated.

Pacificon will be here in just a little over two weeks. I am excited about seeing and talking to all the QRPers who will be there. We will have fun.

I would like to encourage you to build the MAS 80 transceiver designed by one of the all time great designers, Steve Weber, KD1JV. He graciously allowed me to reprint the article from his web page. The artwork is there to make the board, and all of the parts are readily available. If you build the rig, please send me pictures, and please talk about it on the lists. It is an ideal first time home brew project. Once you build a rig by sourcing all the parts, making your own board, you realize the power that you have.

Don't forget, if you have an article that you would like to see published, contact me at ki6ds1@gmail.com. It's fun and easy to do, and it is a way to share with other QRPers and increase the knowledge base.

Until next month, 72, Doug, KI6DS

The 2016 Special Edition Dummy Load Kit
by Doug Hendricks, KI6DS

This year we decided to have the Great Chinese Transceiver QSO Party. Basically, we would all bring our favorite Chinese Kit Transceiver that we had purchased from Ebay. I would supply crystals for 7.030, 10.116, and 14.058. The builder would supply a crystal on 7.023 MHz. as that was the one that came with the kit. Everyone would have 4 crystals. To keep the playing field level, I designed and laid out a pcb for a 12W dummy load. The dummy load would be used along with a clip lead, supplied by me, to be our antennas. I tested the set up with a Pixie that I had built, and recruited Kathy to push the key and transmit as I used another Pixie to listen. We successfully transmitted 60 feet, which was adequate for our event. The kits are donated by me, as I basically wanted to give something back to the hobby.

I know that lots of you are not going to be able to attend Pacificon and would like to have a dummy load. So, I am making the artwork available. The pcb patterns are ready to put on the pcb stock, single sided. You will have 2 boards that are duplicates of each other. Here is the artwork. You will need to make 2 boards.

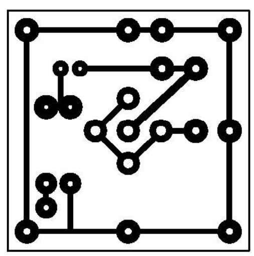


Fig. 1 PCB

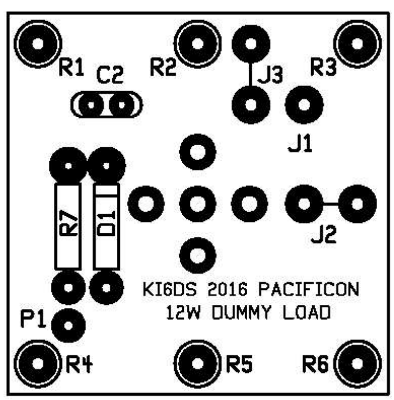


Fig. 2 Parts Placement Guide

Parts List:

R1	300 ohm 3 watt
R2	300 ohm 3 Watt
R3	300 ohm 3 Watt
R4	300 ohm 3 Watt
R5	300 ohm 3 Watt
R6	300 ohm 3 Watt
R7	430K 1/4 W
C1	.01 uF
D1	Germanium Diode
J	PCB Vertical Mount Antenna Connector (search for male pcb mount bnc on Ebay)
PCB A	
PCB B	

The first thing you need to do is get the parts. I ordered the resistors from Mouser and used metal oxide. The part number is 667-ERG-3SJ301. The germanium diode and bnc are available on ebay. The 430K resistor and .01 uF cap can also be ordered from Mouser or may be in your junk box.

Building the dummy load is pretty straight forward. First take PCB A and use a resistor lead to install J3. Then take PCB A and mount the bnc connector on the non copper side. Then mount R1 through R6 on the opposite side as the bnc. It is easy to see from the pictures below.

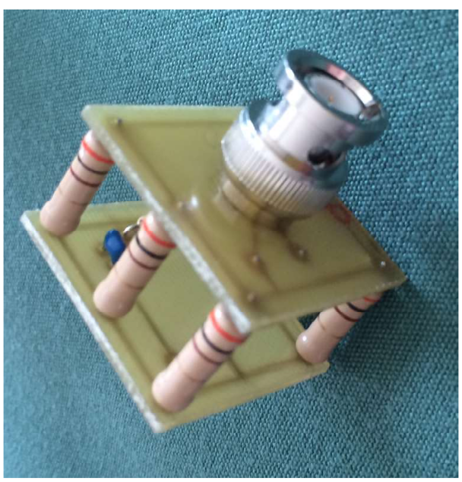


Fig. 3 Connector View

Fig. 4 Bottom View

Mounting the resistors is a little tricky. You insert the resistors from the copper side. I place them as close to the board as I can and still get the tip of my soldering iron on the pad. I get the solder to flow, and then push the resistor flush with the board before the solder solidifies. Do it quickly, but it will work After you mount the resitors on the Connector board A, trim the resistor leads. Next you will take 2 of the trimmed resistor leads and put one of the in the hole marked J1 making sure that the lead is longer than the body of the resistors.. Bend one end of the other lead into a circle and mount it on one of the outer 4 pins of the connector. Next put a resistor lead to jumper J3 and set that assembly aside.

Next you will mount the rf probe parts, R7, C1 and D1. Mount them on the non copper side of board B, the non connector board, so that you can solder them. Now trim and save the leads from the soldered components. You will use one of the leads to place a jumper at J2 as shown on the parts layout. Do this on the non conductor board B only. Solder. Now assemble the two boards, making sure that the copper side of the bottom board is facing out as shown in the pictures. Tilt the bottom board at an angle so you can insert the leads of the resistors R1 - R6, and the Jumper 1 lead and the ground lead of the connector to the unused outer connector hole directly above the lead.. When you have the leads inserted fully and the resistors are flush with the bottom solder the resistors and the two Jumper leads to the bottom board. Curl the lead at J1 to allow for an RF connection for an antenna radiator. Insert a lead at the base of the resistor R7. I curl mine into a circle. Solder. This will become the RF Probe out point of the Dummy Load. Curl 1 of the leads of the Resistors 1 - 6 on board B where you want a ground connection before you trim it. Trim the rest of the leads and you are good to go.

To use the dummy load, just attach it to the rig at the antenna connector. You do not need an adapter, as I chose a male bnc to avoid having to have an adapter.

The dummy load is rated at 18 Watts (6 x 3W). Hopefully you will enjoy building and using it. I would like to thank Ken Locasale, WA4MNT and Hans Summers, G0UPL for ideas on how to package the dummy load. Enjoy, Doug, KI6DS

RF Signal Generation and Detection: Part 3
by Chuck Adams, K7QO

Previously I have written about noise generation and its use to look at the receiver response to noise. Especially getting some idea of the passband width and the frequency range location, whether due to crystal filter and/or audio filtering.

This month we will look at the signal response of the receiver to different voltage levels at the antenna input.

An RF signal propagates from the energy source, across the universe via several paths and mechanisms, until it arrives at the antenna at your QTH. Your antenna system is very critical to the successful reception to your receiver and ultimately to you. I'm interested in CW communication, so I'll eliminate the digital modes involving some more expense and complexity to the equation.

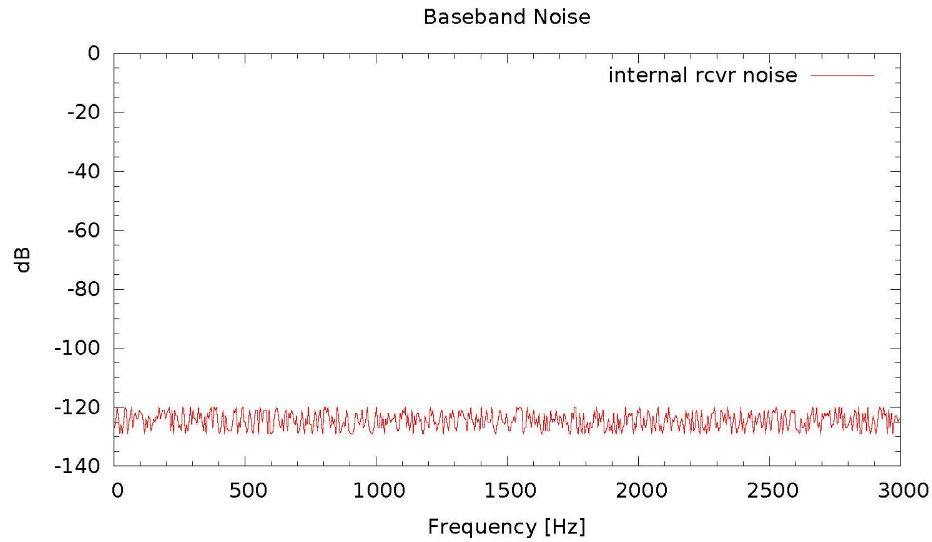
The electromagnetic wave that makes up the signal causes currents and voltages to be developed in the antenna and hopefully results in a voltage at two points at the antenna that is fed via a transmission line to the receiver input connector. We can determine and measure, for certain voltages at this connector, the response of the receiver. Hopefully the antenna has provided us with the maximum voltage response to a signal that we want to receive and rejects all the other signals and noise we want to ignore.

If you have been a ham for any time at all, you have some idea of what the voltage level is at the antenna terminal of the receiver. It is measured in microvolts. Due to historical reasons, an S9 signal level is 50 microvolts. If a receiver has an S-meter and it is calibrated, a 50 micro-volt RMS sine wave will register S9 on the meter scale. It is very important to use RMS values for power level calculations. The RMS value is 1/squareroot(2) or 0.707 times the peak value of the signal.

INTERNAL RECEIVER NOISE

Take any receiver you own, that is non-digital, and turn it on without any antenna connected. ALWAYS, have the volume set to a minimum when you plug anything in and turn it on. You know the drill. You only get one set of eardrums in your life.

I always use headphones, so forgive me if I am not a fan of the speaker. Put on your headphones and slowly turn up the volume. You will hear a hissing sound. This is usually white noise, meaning that the noise energy level at any small frequency range is equal. We'd call this a flat frequency spectrum. If you have a sound spectrum analyzer software package for your computer and you connect it to the audio out of the receiver you might see something like the following display. Like we saw last month, except I computer generated this graph.



All this audio energy is generated by the receiver just being powered on and the thermal and electrical energy generated by all the components. Transistors, resistors, diodes, amplifiers and all kinds of stuff help to generate this noise. Impedance mismatches and some bad electrical designs can help increase this noise level. We've all owned receivers that seemed to be more noisy than others and hams are good at badmouthing such things.

There is not much we can do to overcome this basic noise level. The dB scale on the above graph is completely arbitrary, so please don't try to read anything into it.

Now, with all things constant, attach an antenna system to the receiver input. At any time of the day you should hear an increase in the noise level. Why? Because the rest of the Universe generates random noise like crazy. You can do a mini study on this and learn quite a bit. Really.

If you do not hear an increase in the noise level, then you have a problem. I leave it to you to figure it out.

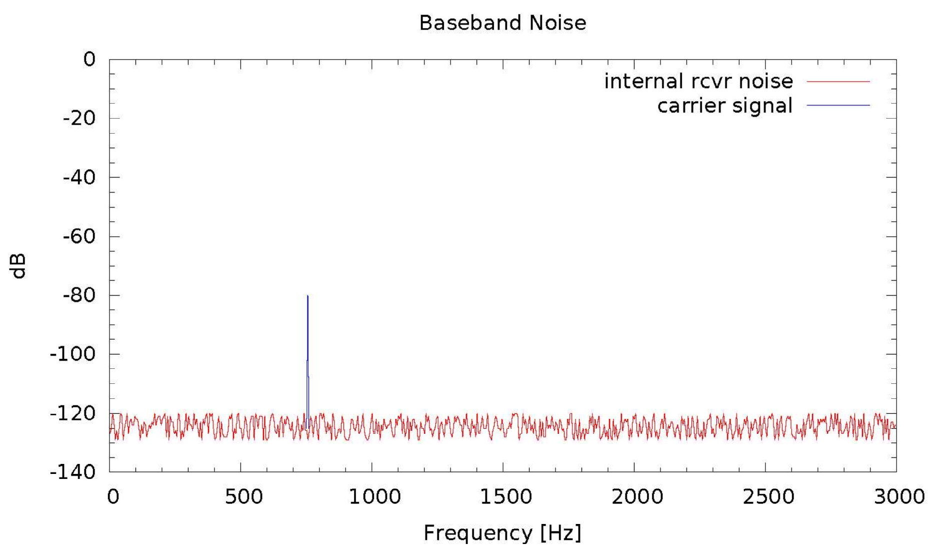
Over years of listening to HF bands, you have some idea of how propagation conditions are going to be, just by listening to the noise level, and of course, listening for signals by tuning across the band(s). The problem with this is that several hundred other people are doing the same thing and every one is thinking the band is dead, even when it is quiet. I always transmit. Always. I got a KH6 while I was living in Dallas at 2 AM local while I was running only a few hundred milliwatts of power tuning up a SWL-30+ connected to an OCF dipole.

I want you to think about this. Your antenna has a certain response pattern. We use NEC and other programs to determine what that pattern is going to be. Let's do a dipole. You know that in free space it looks like a donut. Put it at your QTH with the orientation you may have a dipole setup in. Extend the volume of the donut until it touches the Earths surface as far as you can. That is a large surface area. Any RF generated in that area and in the atmosphere also included should be heard at your end, if the signal is large enough and your receiver is sensitive enough. Part of that antenna capture volume includes the ionosphere.

When we say propagation is good, we usually mean that the ionosphere is 'reflecting' signals that would normally escape into space and never be heard again on the earth unless we are doing satellite or moon bounce work. This also means that noise, whether man made or not, also gets to the receiver. So, we judge the band activity in some part by the noise level that we hear. A side effect of this is that a good antenna gathers more of the noise in the volume at the same time we are searching for desired signals. You decrease the noise by using a more directive antenna and decreasing the antenna capture volume.

SIGNAL LEVEL DETECTION

Let's say that some QRPer located on the planet transmits a carrier by depressing a key on a transmitter. What do you hope to see. Maybe something like the following.



The peak shown at 755Hz is the result of such a carrier signal. You expect this signal to be easily heard above the noise level and would be a joy to copy.

For weaker signals we would like to have some mathematical figure of reference as to what signal level at the antenna we could copy. That figure of merit is the MDS or minimum detectable signal level. We are not going to spend a lot of time on defining it, as there is some conflict as to what it all means. It is just a concept that we use and a method of measuring it in a lab that every one uses as a standard.

The method of measuring the MDS level, given in dBm, is as follows. We need a calibrated signal source. Usually an S-9 or 50uV signal generator. The NorCal club sold one at one time and I still have mine. You may even have one unbuilt. Shame on you. Build it and let's do some measurements. Elecraft has several signal generators for sale also.

The cheapest way to do this, if you don't have a calibrated signal generator, is to build one. I highly recommend you go to Jim Kortge's web site, www.k8iqy.com, and look at his test equipment page. He has a -20dBm signal generator. I am going to build one in the first week of October as soon as a shipment of PCB material arrives from abcfab on ebay. I bought some CEM-1 material for Manhattan building this winter. It is easier to use for making pads than using FR-4 PCB material. I'll report back next month and have photographs.

I am going to add a 53dB attenuator made up of two 51 ohm resistors and a 11K resistor in a pi configuration. If you are not familiar, google for attenuators on the Net and there are a number of calculators for getting the attenuation you want. Be sure to do 50 ohms in and 50 ohms out on the impedances. This configuration will give you a -73dBm signal level, which is the 50uV level RMS.

The procedure goes as follows.

1. Disconnect the speaker and headphones.
2. Disconnect the antenna.
3. Increase volume to max.
4. Disable the AGC, if possible. If not, then set volume to medium. Also, increase RF gain to maximum level.
5. Using an AC DMM, measure the voltage at the headphone jack. Call this number A.
6. Connect a calibrated signal source to the antenna and turn it on. Be SURE to disconnect microphones and keys and paddles. You do not want to transmit at this time. Ever. This could be an expensive mistake on your part.
7. Again, using the DMM in the AC position, measure the audio output voltage. Tune for max reading. (I have to come back and do this to determine what the audio frequency is for this peak, just for grins.) Call this resulting DMM reading B for later calculations.
8. Now you have to get out the trusty dusty scientific calculator. Calculate the ratio of B/A and call the result C.
9. Take the logarithm (base 10) of C.
10. Multiply by 20 and that is D.

Here is the tricky part. The calculation will work as long as you know your signal generators signal level. A 50uV RMS signal source corresponds to -73dBm. If that is your signal source level, take -73dBm and SUBTRACT the result D. This is the MDS or minimum detectable signal of your receiver as measured using this technique.

If your signal source is at another level, then find a dBm chart online and use the value corresponding to your voltage level from your source instead of the

-73dBm above.

I hope that I have done a good job of writing all this down. It is a lot of pressure to get this done in hopes of providing the QRP community some useful information. Do this for several of your receivers and then go out on the Net and find what others have measured and what the manufacturer or designer published.

A side effect. Using the measurement with the DMM, you can peak the receiver chain (see the manual for the receiver as to which parts to tweek and how) to increase the performance level. You should do this from time to time any way as components age and change values after years of aging.

If you hear an increase in the noise level when you attach an antenna. then the receiver is sensitive enough to copy most signals on the band.

Isn't it funny as a QRPer. You are on the air and you are working a QRO station. Once you mention your power level, the guy gets irritated and says he doesn't have the patience to work hard at copying you. BS. Why did the guy spend all that money to get the best receiver he could and not use it. If you are only going to work stations that are 30dB over S9, then he wasted a lot of money getting one that is sensitive. IMHO. I just laugh and go on. The joke is on him.

HOMEWORK.

I have given you steps above. If you have different calibrated signal sources, do the measurements with different signal levels to see if the results are constant. I have done this and found that the level is pretty much non-critical as long as you are careful in your measurements and don't rush. Take plenty of notes.

A side note. If you know someone that has an HP or Wavetek signal generator that is in spec, you can use it to check your calibration. It is what I did with all my working S9 generators. Why are the S1 generator levels wrong on all the generators, like the NorCal S9 generator? Look at the charts.

Enjoy and see you next month. Come to Pacificon and I'll see you there. chuck adams, k7qo

Cheap, Fun and Perfectly Operable 40 Meter CW QRP Transceivers from China
by Hiroki Kato, AH6CY

History repeats itself. We can take advantage of it if we know what we are doing. Old timers remember the era when "made-in-Japan" was synonymous with "cheap but shoddy". The post-WWII Japan manufactured and exported lots of cheap toys, electronic and household goods to help rebuild its economy in a hurry. Many Japanese products indeed left quality desired. But the products were for the most part good enough, such that American consumers bought Japanese products in abundance. Things began to change in the mid-1960s as Japan's economy had recovered and, in a rapid order, the made-in-Japan label came to signify reasonably priced yet high quality products.

Chinese products today harken back to those earlier days of Japanese products. They are cheap and often shoddily manufactured with minimum quality control. But, things will likely change before we know it. The quality will improve but the price will also rise soon without doubt.

Among Chinese goods available today are mass manufactured copies or modified and improved versions of US high tech products, including unbelievably inexpensive HF QRP transceiver kits. A quick glance at eBay brings up Chinese versions of the Forty-9er, Frog Sounds, Rock Mite and Pixie, all originally of American and British ham ingenuity of the 1980s and 1990s. ***[Editor's note: The Forty-9er was a Wayne Burdick, N6KR design, Frog Sounds came from England and Sprat, the Rockmite was done by Dave Benson, K1SWL, and the Pixie was a Dave Joseph, WA6BOY design. All but the Froggy appeared in QRPp. None of the Chinese copies were authorized by the designers.]***

Here are some sample eBay listings.

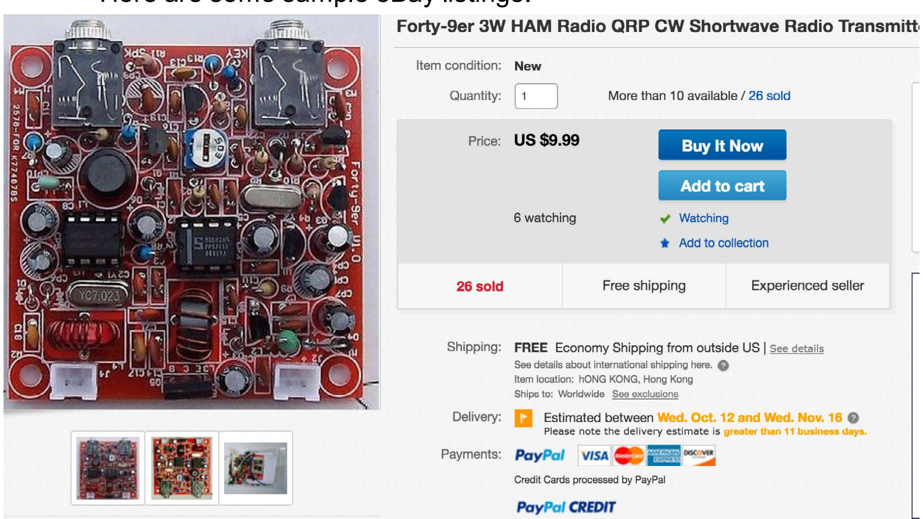


Fig. 1 Forty 9er

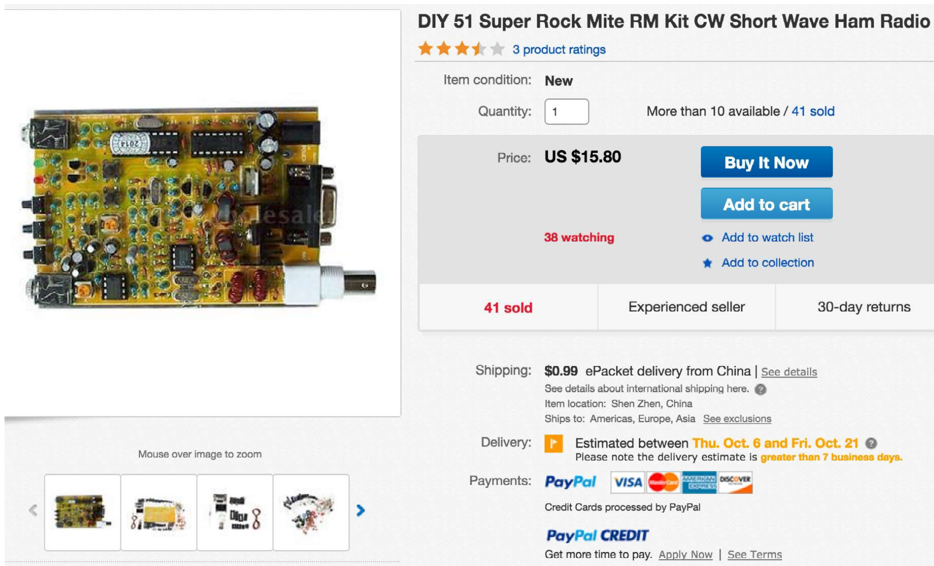


Fig. 2 Rock Mite

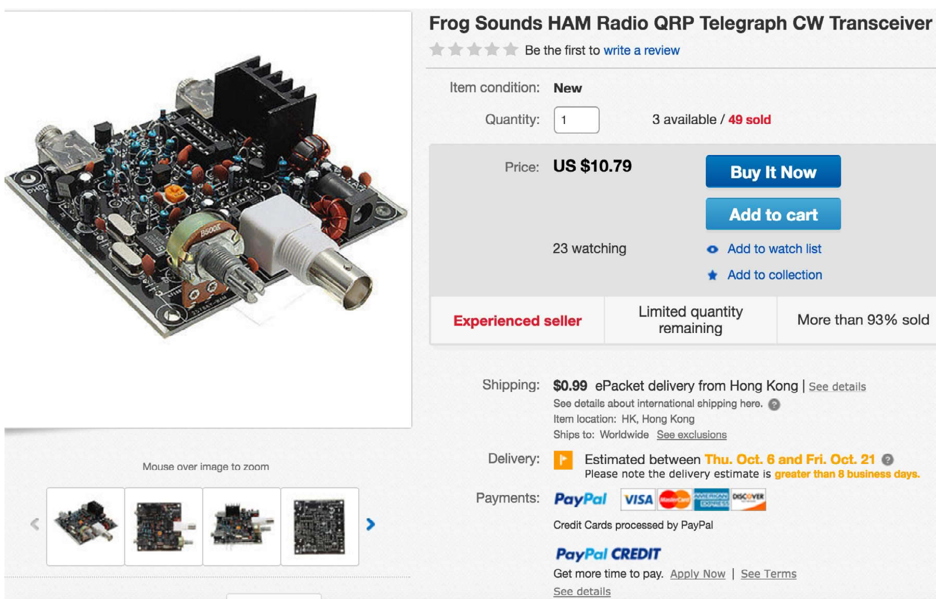


Fig. 3 Frog Sounds

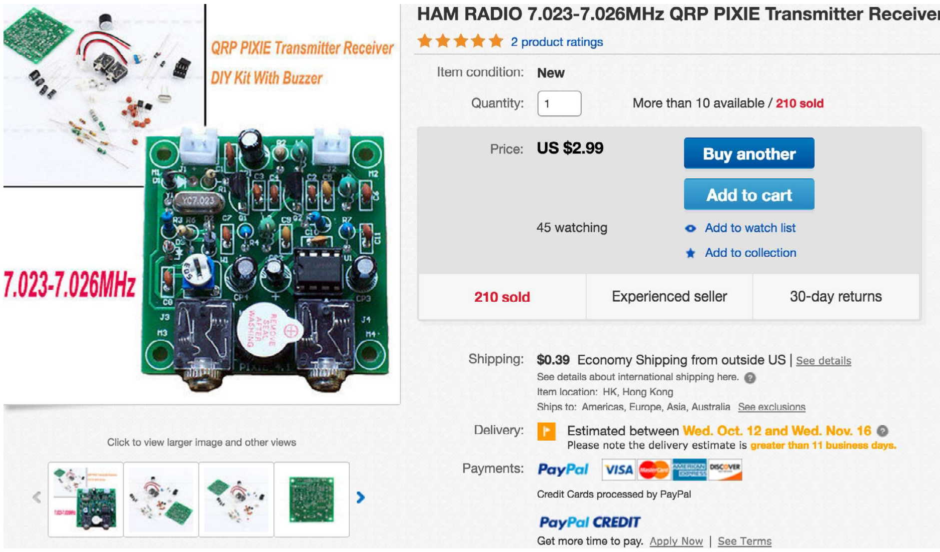


Fig. 4 Pixie

These are all rock-bound 1 to 3 watts fixed frequency minimalist transceivers. To operate, you need to have a resonant antenna, a headphone and 9-12 v DC power supply. The kits cost from $3 to $20, depending on sellers and are offered only online such as on eBay, Amazon, Banggood.com. You cannot find them at Fry's or Radio Shack. There are even assembled plug-and-play versions of the same radios available from similar Chinese vendors, costing anywhere from $10 to $50. The shipping cost is often free (yes, you read it right) or only a few dollars despite the fact that they are shipped from China (or Hong Kong, which is now a part of People's Republic of China).
Because of quality issues, some caveat in purchasing and building these kits is in order:

1. These kits are often shipped with no manual or with a manual written in poor English or in Chinese only. Some sellers of a same given kit may include a schematic but others may not. But if you search on the Internet, finding schematics is not difficult
2. They are all fixed frequency transceivers with 7023 kHz crystal(s) and have a direct conversion receiver. For some reason the Chinese distributors do not seem to be aware that this particular frequency is open only to extra class amateurs in the US, thus limiting their market considerably. There are ways to deal with this limitation as you see below.
3. It takes many weeks for your order to arrive. In some cases never. (It happened only once for me.) If you are in a hurry, there are some US or Canadian based distributors who can ship them faster but charge more for the same kits.

4. Be prepared that some parts may be missing or redundant parts are included. I have had a couple of capacitors and one inductor missing and have received too many capacitors at other instances. Usually these missing parts can easily be found locally or you may already have them in your junk box. Anchor Electronics in San Jose and JAMECO in San Carlos are my favorite local sources. The lesson here is that you would want to take inventory of parts before you start assembling and soldering.
5. Some components may be DOA; you may need to order the same thing again hoping that the next one will work right. (This happened to me twice.) Since these kits are so cheap, you may want to order two or three of the same kit to start with.

If there are so many potential problems, why would you bother with these kits, you may ask. Well, the answer depends on your philosophy. Let's have a right perspective. If you can have hours of fun for the price of one or two cups of latte at Starbucks, wouldn't you take the risk? If you have read this far, you are not likely an adherent of one school of ham philosophy: life is too short for QRP. If you are a QRO "appliance" operator of instant gratification school, these kits are definitely not for you. On the other hand, if you are the type, like me, who enjoy making things with your own hands, this investment has a very high ROI with the minimum investment. But I digress.

The limitation of the fixed frequency can be overcome by one of three ways: one, substitute a different frequency crystal for the original 7023 kHz crystal; two, get extra crystals along with a rotary switch. You don't have space to mount more than one crystals on the kit's own surface mount board, so you need to attach them externally. See the photo of what I did as one example.

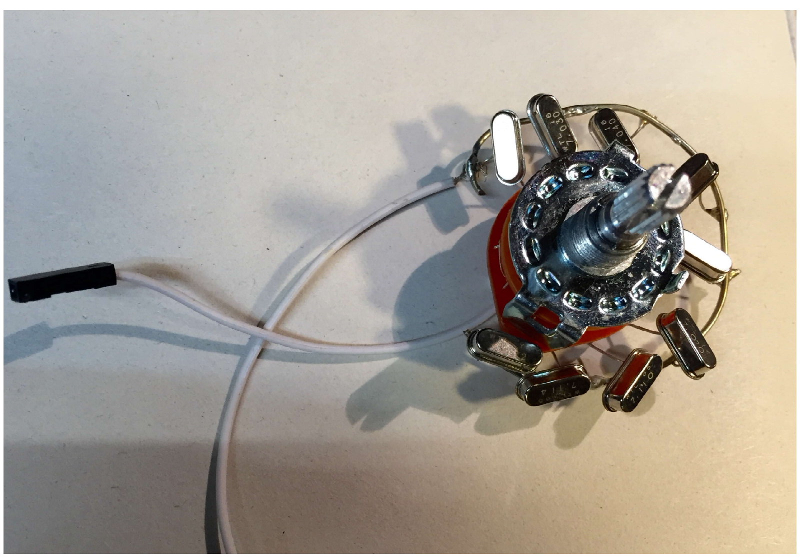


Fig. 5 Top View of 8 Crystals Mounted on Rotary Switch.

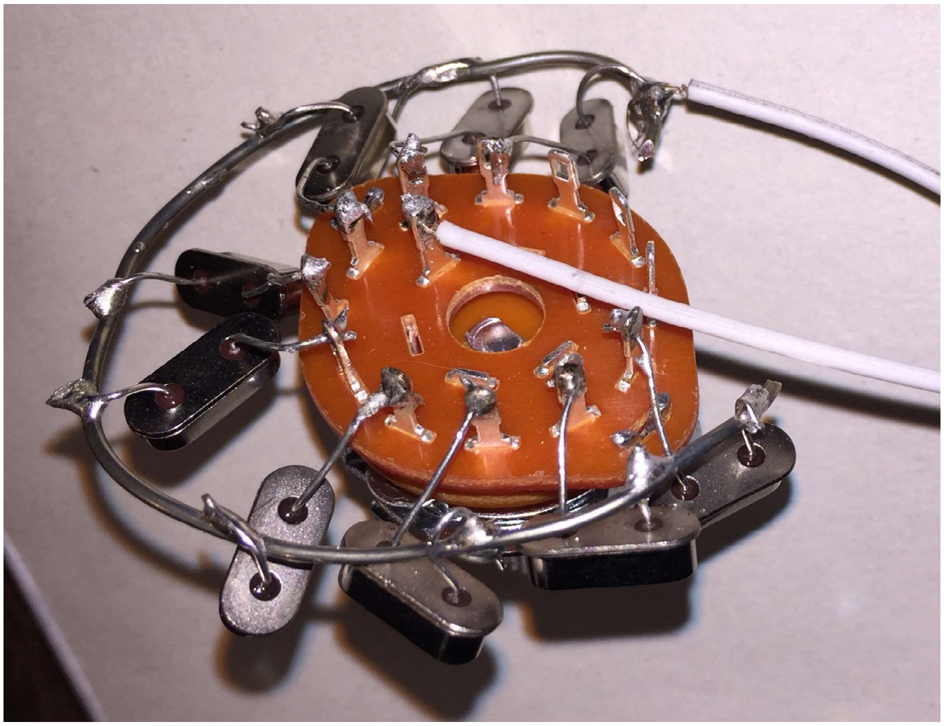


Fig. 6 Bottom View of Crystals and Switch

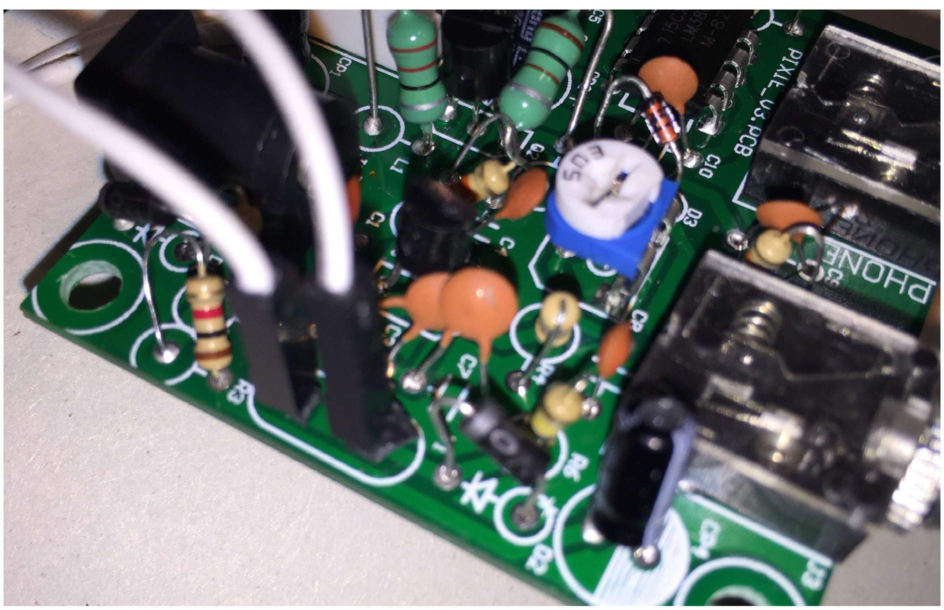


Fig. 7 Detail of connecting Crystals and switch to Pixie.

I bought a package of eight different 40 meter frequency crystals (type HC49) from KC9ON on eBay for $6.75 plus shipping. For some transceiver circuits you need two sets of same frequencies. My example is for the Pixie model which requires only one set.

In terms of construction, there is really nothing difficult or special. All it takes is placing parts into holes and soldering with a small tip solder iron. If your eyes are getting old, like mine, you may need a magnifier. Most of these kits do not come with an enclosure. Here, you have an opportunity to put the radio in your own creative housing. The regular size Altoids case and a small tuna tin are QRPers' favorite, but you can do something even more creative and interesting. I happened to have a Vietnam era handheld VHF transmitter (AN/PRT 4A). I took the original "gut" out of the case and put my new transceiver in it.

Fig.7 ANT/PRT 4A Repurposed as Pixie QRP Rig

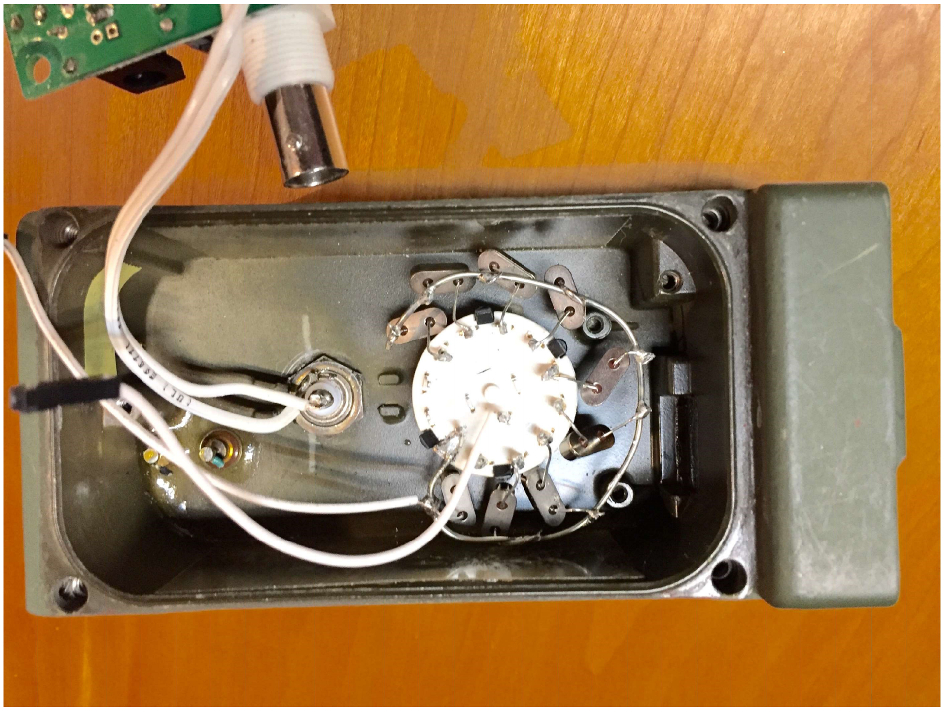


Fig. 8 Detail of Switch Mounting in AN/PRT 4A

You can see how the extra crystal switch is mounted. Notice also how simple micro switch based key (more later on this) is imbedded in the lower (originally for battery) compartment.

The third way of coping with the fixed frequency limitation is much more sophisticated and requires considerable experience and knowledge of using microprocessor. This approach involves replacing crystal control circuits with a VFO. An article in the March, 2016 QST, shows you one example of how it can be done*. (* "A Modular 40M Transceiver with VFO") It utilizes a DDS and an Auduino Nano microprocessor, both of which can be ordered cheaply from China from the same type of vendors who sell the transceivers. Hams who have put together this VFO modification report that you can have a perfectly workable VFO controlled QRP transceiver for under $50 total. This is not for the weak of heart, however. I found the QST article and an accompanying extra manual prepared by the same authors does not cover everything you need to know. In my experience, it requires a lot of trial and error in assembling the VFO and adjusting controls.

Accessories:

If you need a cheap, small and workable antenna tuner, China would again be a good source. For under $15, you can get a good DIY kit. Here is one example.

Fig. 9 Antenna Tuner Available from China

For a cheap, simple yet totally workable key, you cannot beat a home brew micro switch based key. A micro switch can be had under a couple dollars from Chinese vendors, although you may have one lying around in your junk box. A micro switch by itself can be used as a make shift key but you can easily add a base and add a button to make it easier to use as you see in my example. Old Erector toy pieces or grandkids' Lego pieces are handy parts for this purpose.

Fig. 10 Micro Switch Key

If you need a portable DC power source, here is another cheap Chinese deal. It is small and rechargeable and comes with a charger, all under $15. (Fig.

) 1800 ma capacity is very suited for micro transceiver operation.

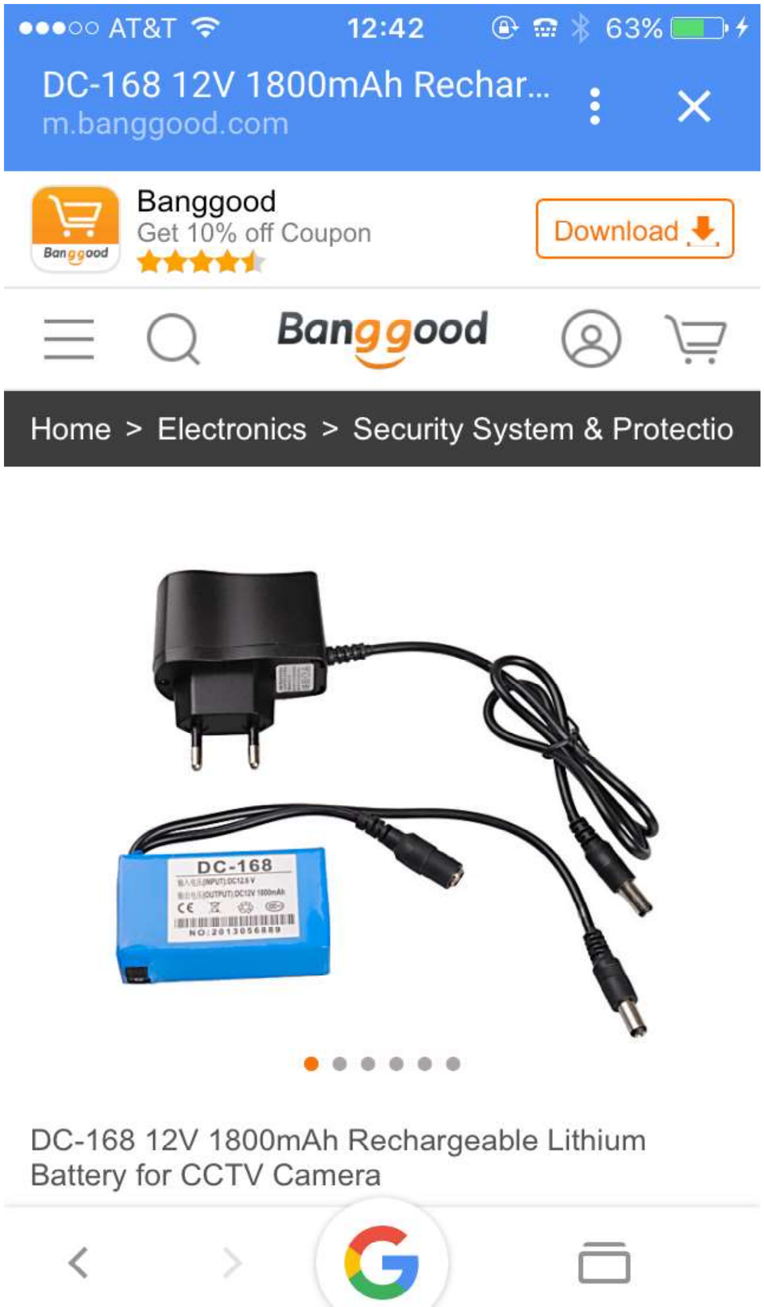


Fig. 11 1800 mAh Battery and Charger

How it performs:

On the air test shows that these are all perfectly workable radios, minimalist as they are. There is no frequency drift. Even with a low-hanging end-fed half wave wire antenna, I have worked, among others, with my Pixie a station in Chico from my QTH in Portola Valley, CA. about 200 miles distance during the day. The output was about 1 Watt. If you are at a good location, such as near the sea water with a better antenna, I have no doubt that you can work DX when the conditions are good just as I have done many times with the Yaesu FT817 and Elecraft's KX3. The beauty is that these micro QRPers cost less than one percent of these sophisticated brethren.

What's next:

As minimalist radios, there are a few things which you might find wanting. For example, there is no power switch; when you connect the power source that's when the radio is powered on. There is no audio volume control in most of these sets, but I haven't found a strong need for one. You use a head/ear phone and the maximum audio level doesn't blow out your ear drums. When needed, I attach a powered speaker, meant to connect to an iPhone et cet. My future plans for playing further with these micro toys include a conversion of these sets for other bands. Also, I would like to add a circuit to allow the use of an iambic key.

I hope many hams will enjoy building these kits. The availability of these cheap radios may not last long.

A Portable 20 Meter Two Element Wire Beam
by Bill Frantz, AE6JV

An article in QST peeked my interest in building a wire beam. I started playing with designs in cocoa NEC and ended up with a 2 element beam with good SWR over the entire 20 meter band. I have used several antennas based on this design since 2013. They have proven to be reliable and rugged. Photo 1 shows a view of the antenna set up using two photographic light stands in Ely, Nevada.

Design

The antenna consists of a driven element and a reflector. The driven element is 9.5 meters (31.2') long and the reflector is 11.12 meters (36.5') long. They are separated by 2.73 meters (9.1') using diagonal spreaders which are 2.84 meters (9.32') long. There is a common-mode choke at the feed point. It is supported from each end using a bridle made of nylon rope. It stretches about 17 meters (56') from bridle to bridle, so it takes a bit of space between the end supports. Figure 1 gives a schematic of the antenna design. When I take it to our summer place in New Hampshire, I use some spreaders cut from wooden poles found in the wood lot. It is supported by the house and a rope thrown into a tree. See photo 2. When there are no natural supports, I use two photographic light stands which are 10' and 12' tall respectively. With these supports, the antenna is much lower than is ideal, but it does make QSOs.

Photo 1 Antenna in Ely, NV

Photo 2 Antenna in New Hampshire

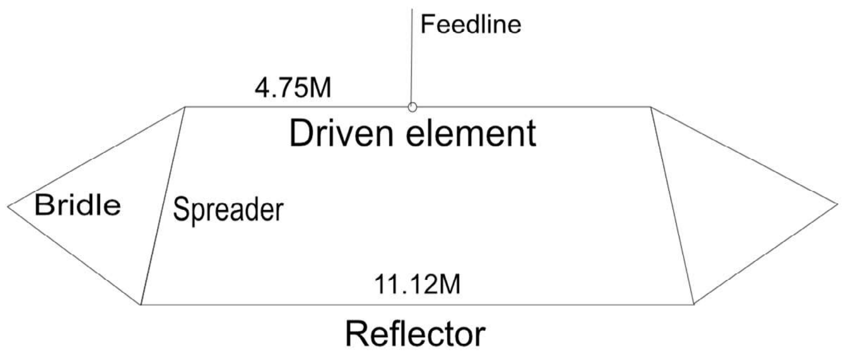
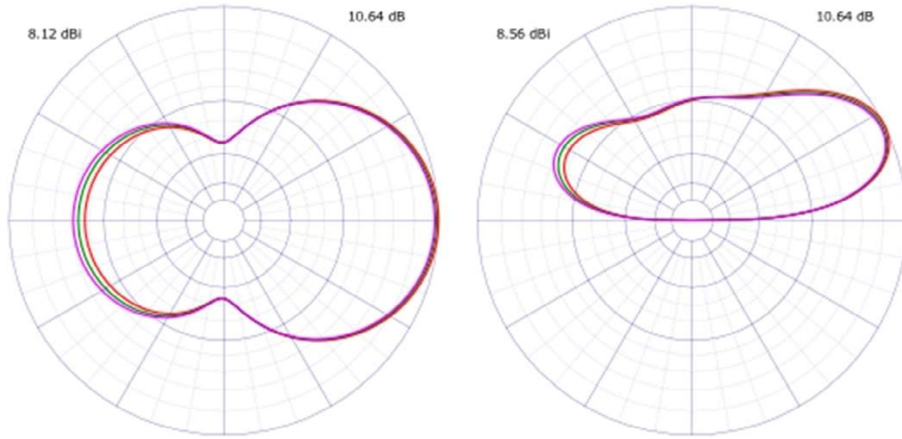


Figure 1 Diagram of antenna

Modeling Results

Figure 2 shows the modeling results when the antenna is at 10 meters over poor ground. The main lobe is relatively broad with good side rejection and usable rear rejection. Figure 3 shows the antenna with the driven element tilted 30 degrees up. Note that the pattern is slightly distorted but still quite usable. Figure 4 shows the antenna with the driven element tilted 30 degrees down. This pattern is even closer to the level pattern. It isn't essential to level the antenna when erecting it in the field. Figure 5 shows the antenna at 3 meters, about the height when using the two light stands. The pattern has been strongly affected and the takeoff angle is quite high. It is certainly not ideal, but it does still offer some advantage over a dipole. Modeling results show limited sensitivity to the separation between the elements. The most obvious effect is that the SWR becomes higher as you move away from the 2.5 to 2.75 meter range.

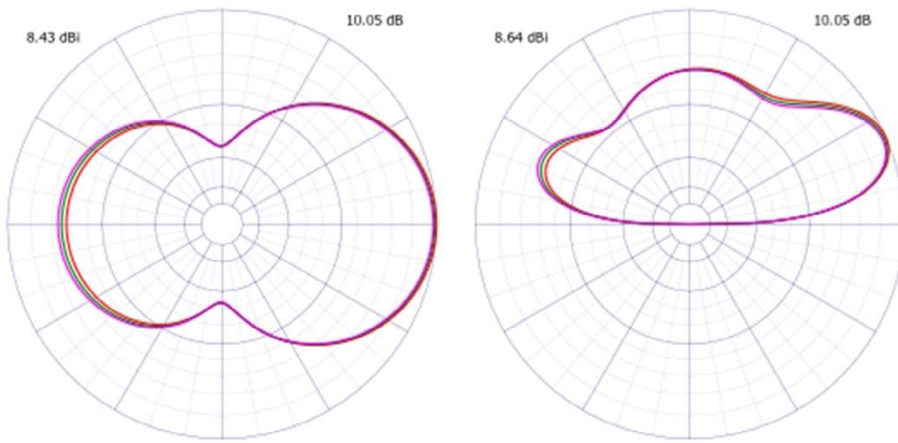


--------- 2016-09-04 17:17 ---- (nec2c) -----

Frequency 14.000 MHz
Frequency 14.150 MHz
Frequency 14.300 MHz
Feedpoint(1) - Z: (54.501 - i 19.013) I: (0.0164 + i 0.0057) VSWR(Zo=50 Ω): 1.5:1
Feedpoint(1) - Z: (59.087 - i 1.952) I: (0.0169 + i 0.0006) VSWR(Zo=50 Ω): 1.2:1
Feedpoint(1) - Z: (62.988 + i 15.205) I: (0.0150 - i 0.0036) VSWR(Zo=50 Ω): 1.4:1
Ground - Rel. dielectric constant 3.000, conductivity: 0.00100 mhos/meter. (NEC-2 ground)
Directivity: 10.64 dB
Max gain: 8.56 dBi (azimuth 0 deg., elevation 26 deg.)
Front-to-back ratio: 5.88 dB (elevation 28 deg)
Front-to-back ratio: 5.92 dB (elevation of front lobe)
Front-to-rear ratio: 5.88 dB
Average Gain: 0.6242 (2.047 dB)
Compute time: 0.12 sec

Figure 2: NEC results at 10 meters

Fig. 2 Antenna at a height of 10 meters over poor ground



--------- 2016-09-04 18:53 ---- (nec2c) -----

Frequency 14.000 MHz
Frequency 14.150 MHz
Frequency 14.300 MHz
Feedpoint(1) - Z: (51.076 - i 18.286) I: (0.0174 + i 0.0062) VSWR(Zo=50 Ω): 1.4:1
Feedpoint(1) - Z: (55.508 - i 0.713) I: (0.0180 + i 0.0002) VSWR(Zo=50 Ω): 1.1:1
Feedpoint(1) - Z: (59.345 + i 16.947) I: (0.0156 - i 0.0044) VSWR(Zo=50 Ω): 1.4:1
Ground - Rel. dielectric constant 3.000, conductivity: 0.00100 mhos/meter. (NEC-2 ground)
Directivity: 10.05 dB
Max gain: 8.64 dBi (azimuth 0 deg., elevation 24 deg.)
Front-to-back ratio: 4.66 dB (elevation 23 deg)
Front-to-back ratio: 4.67 dB (elevation of front lobe)
Front-to-rear ratio: 4.66 dB
Average Gain: 0.7294 (1.370 dB)
Compute time: 0.11 sec

Figure 3: Driven element tilted 30 degrees up

Fig. 3 Antenna with driven element tilted 30 degrees up