By Michael Tracy, KC1SX

QRP Transceiver Kits: Six Reports from the Field

With the explosive growth in low power (QRP) hamming, reporting on the current state of the transceiver art is akin to shooting at a rapidly moving target. We have reviewed QRP transceiver kits in *QST* before, but this time we were looking for a totally different approach. Rather than follow the traditional path of buying a QRP kit and running it through the usual "Product Review" gauntlet, we decided to go into the field and contact hams who had recently built several of the most popular kits.

We asked these amateurs to give us their impressions, in their own words. We then had each transceiver shipped to Headquarters and performed a few measurements in the ARRL Lab. The results are shown with each unit. (When reading through the tables, note that the builder often determines the frequency range. Also, audio output was not measured for some radios because they were intended for use with headphones and their output impedance was not specified.)

Of course, we'll continue to subject new QRP rigs to our rigorous "Product Review" scrutiny, but I think you'll enjoy these grassroots reviews. In many ways, they are every bit as valuable and informative as full-fledged *QST* "Product Reviews."

EMTECH NW80/20

By Bob Kellogg, AE4IC
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I own a complete set of EMTECH NW80/20 transceivers for 80, 40, 30 and 20 meters—all built from kits. They have QRP power to spare. The RF output is a full QRP "Gallon"—variable from less than a watt to well over 5 W using an internal pot. The audio output will drive a small speaker. For me, they've been ideal single band rigs for working the QRP contests and general QRP operation.

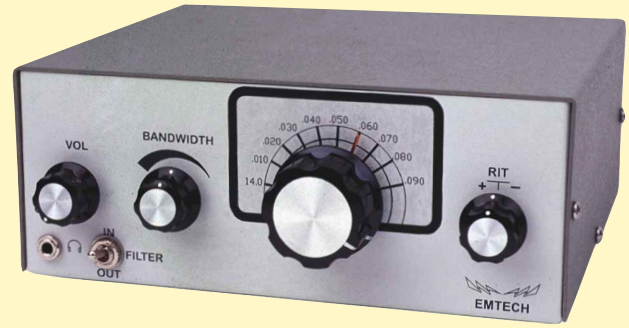
The EMTECHs have a very sensitive superheterodyne receiver. A variable bandwidth crystal filter is included in the IF chain. An optional fixed-width audio filter is available and recommended. The IF/audio filter combination allows good selectivity during crowded band conditions.

For me, the EMTECH step-by-step "build, then test" process was especially helpful. The instructions are not as detailed as the old Heathkit manuals, but they cover the necessary steps very well. In addition, the builder assembles a section of the transceiver, then tests that section. So, as more and more components were added to the board, I wasn't worrying that I'd made some mistake that would be difficult to find later. This "build a section and test" process also helped me understand how the transceiver works.

The audio filter option was included with my kit. The instructions include an explanation of how to vary the filter peak frequency and to add gain. I chose a center frequency of about 650 Hz with no additional gain. Actually, I played with this feature a little after the transceiver was completed. It was fun to change a few parts, then observe the results. The audio filter is a nice option.

Alignment and testing of the completed transceiver requires simple equipment. A tuner with a dummy load and

EMTECH NW80/20
Receive current drain: 40 mA (max vol)
Transmit current drain: 1.0 A at 5.3 W with 13.8V dc
Frequency range: 14.001 to 14.096 MHz
Spectral purity: 39 dB below the carrier
Receive sensitivity: –125 dBm
IF rejection: 69 dB
Image rejection: 124 dB
Blocking dynamic range: 100 dB
IMD dynamic range: 78 dB
IF/Audio bandwidth: 534 Hz
Audio power output (into 8 Ω): 1.5 W
2nd Order IMD dynamic range: 101 dB
2nd Order Intercept: +77 dBm



power meter, a volt-ohmmeter and a calibrated station receiver will do the job. I used a frequency counter instead of a calibrated receiver. Alignment required careful adjustment of the transmit frequency, since this is also the sidetone heard when transmitting. The instructions cover two methods for making this adjustment.

The NW80/20 rigs are designed to fit into the inexpensive Radio Shack 270-253 case. EMTECH also offers a fancier custom case. I have rigs in each.

Now it's confession time. The NW20 rig tested for this article was actually built by my wife, Ellen. She won the kit at Dayton and decided to build it herself, even though she had never used a soldering iron. I looked over her shoulder occasionally, and confirmed her test results as she completed each section. Her work passed the "Smoke Test" with no problems.

The EMTECH 80/20 rigs are fun and satisfying to build, and they work very well. They are the single-band workhorses in my shack. *You can contact EMTECH at 1127 Poindexter Ave W, Bremerton, WA 98312;* **www.emtech.steadynet.com/**. *$130, with audio filter and cabinet.*

SMALL WONDER LABS DSW-40

By Rod Cerkoney, N0RC
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The DSW-40 takes the classic monoband QRP rig to a new level with a keyer, RIT, full CW band coverage and a DDS VFO—all in a small package that draws only 40 mA in the receive mode! Building on the successful NE4040/SWL-40 legacy, Dave Benson, NN1G, of Small Wonder Labs gives us features found in the "Big Rigs" without the Big Rig price. Only $95 gets you the basic kit; add your own case and controls and you're on the air. Another $35 gets you a very attractive blue anodized case, controls, connectors, knobs, etc. The complete package is a hot little radio in a cool blue case.

Central to the design is a PIC chip to control the various features of the DSW-40. Dave also gives us a taste of surface mount technology in the rig; the DDS and most of its support components are surface mount, but they are pre-mounted for construction ease. Even so, you're required to solder two surface mount inductors to the board. The inductors are large by surface mount standards—about the size of 1/4-W resistors. This was my motivation to build the DSW—to get some exposure to surface mount construction.

If you're worried about how difficult the kit is to build, don't be. With modest tools, basic construction skills and a little patience, you'll have the rig on the air in a few nights. Even the novice kit builder shouldn't need more than a week or two to complete the DSW-40. The manual is excellent. Its step-by-step instructions and illustrations help you get the parts mounted correctly. A high quality silk-screened PC board further enhances assembly.

Once the kit is completed, alignment is a snap. A special power-up test mode generates an audio tone that you adjust via one trimmer capacitor for 800 Hz, the transmit offset. Tweak a transformer to maximize receiver gain, and that's it! The PIC/DDS combination eliminates receiver alignment required by other designs. If Murphy should pay a visit, don't panic. The manual has theory of operation and troubleshooting sections that should get you back on track. Beyond that, Dave Benson is available via e-mail to help out.

Expect about 2 to 2.5 W out of the DSW-40. Mine came in at 2.25 W, more than enough to join the QRP fun so popular today. In terms of receive performance, an RF sensitivity knob helps manage the strong signals, or brings the weaker ones up out of the noise. Tuning is accomplished by an optical encoder with mechanical detents. At first I didn't care for the detents, but in mobile situations, campsites, and backcountry operations, the detents are welcome. At power up the rig is tuned to 7040 kHz, the QRP calling frequency a full turn of the knob moves you up and down the band 6 kHz per revolution. To fine tune a station, press the tuning knob and the rig switches to 1.2 kHz per revolution. If the station you're working is a little off frequency, no problem. Turn on the RIT and the main tuning knob controls only the receive frequency.

The DSW's small size makes an ideal traveling companion in a backpack to your favorite hiking destination, or in your briefcase on a business trip. And, you won't need much power to run it. As a test, I ran mine for about 30-45 minutes from a 9-V battery, got 1/2-1 W out and had a nice QSO or two. With eight AA batteries I've run for two hours and still maintained 1 W out-

Small Wonder Labs DSW-40
Receive current drain: 40 mA
Transmit current drain: 0.35 A at 2.2W with 13.8V dc
Frequency range: 7.000-7.300 MHz
Spectral purity: 42 dB below the carrier
Receive sensitivity: –133 dBm
IF rejection: 72 dB
Image rejection: 88 dB
Blocking dynamic range: 103 dB
IMD dynamic range: 84 dB
IF/Audio bandwidth: 401 Hz

put. My "portable" station consists of the DSW, a small set of paddles, a dipole made from 22-gauge hook-up wire fed with RG-174 coax, and a pair of lightweight headphones. With eight AA batteries the whole station weighs less than 2 pounds!

If you're looking to join the QRP fun, and want to build a kit to boot, consider giving the DSW-40 a try. I think you'll like it. *You can contact Small Wonder Labs at 80 East Robbins Ave, Newington, CT 06111;* **www.smallwonderlabs.com/**. *$100, cabinet $35 additional.* [We're advised that the DSW series is not currently available due to a semiconductor supply issue. Check the Small Wonder Labs Web site for updates.—*Ed*]

OAK HILLS RESEARCH OHR-100A

By Christian O. Hunt, KF6IHU/9
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When I first built the Oak Hills Research OHR-100A, I had only been a ham for about 2 years. Other kits I had built at the time were the Wilderness SST-40, a Pixie II for 40 meters, and the OHR WM-2 QRP wattmeter. Aside from the QRP related kits, I have also built many simpler "educational" kits, as well as experimented with electronics and computers. Building kits and homebrewing is one of the aspects of Amateur Radio that appealed to me initially. I rediscovered something I enjoyed as a kid playing with computers.

The first thing I did after opening the kit was to look over the documentation. I was impressed with the clarity of the instructions. They were clear, concise and well laid-out. I found them very easy to follow. The parts were clearly labeled and easy to identify.

As with all kits, the first thing I did was to take a parts inventory. After completing this and finding all parts present and accounted for, I began to assemble the rig. Following the assembly order outlined in the instructions, I started stuffing parts and soldering. There are a few toroids to wind, which I actually enjoy doing. I don't find it nearly as horrible as other people do!

After I finished installing all the on-board components, it was time to install the panel mount controls and internal wiring. The wiring is very nice, accomplished using pre-assembled harnesses that need to be trimmed to length and soldered to the panel mounted controls. Installation was easy and resulted in a very clean internal appearance.

It was now time for the smoke test. When I initially applied power to the rig, it was very noisy, with a loud buzz being the predominant sound emanating from the headphones. I quickly discovered this was not a construction error, but rather a problem with the noisy power supply I was using. The problem was remedied by using a 12-V gel-cell. Everything sounded good, and nothing was smoking, so it was on to the initial adjustments.

I had a bit of trouble adjusting the zero-beat and the variable-bandwidth filter. They were not adjusted as well as I thought they should be, and that was a result of my inexperience with radio. The other internal adjustments were performed using a frequency counter and a DMM. Internal test points are provided in the form of jumper loops, making it very easy to attach test leads while adjusting. After the adjustments were complete, power output was approximately 4 W.

It was now time to put the rig on the air. I connected an antenna and started tuning around the band looking for stations. I noticed that the tuning pot was a little rough mechanically. You could hear the wiper scraping when you tuned. This is probably just a problem with the particular pot included with my kit, and not representative of the kit in general. The RIT control is very nice, and has a center detent, which makes it easy to return to the center frequency. Keying is smooth, with full-QSK making the rig a pleasure to use.

I was impressed with the sensitivity of the receiver, being able to hear stations I normally wouldn't with my QRO rig. The audio output was robust and very clear. A speaker output is also provided on the rear panel, in addition to the headphone output. I tend to prefer having the headphone jack on the front panel, but this is a minor inconvenience. The rig also has an oscillator output jack for connection to a matching OHR DD-1 digital frequency display or other frequency indicator. With the exception of the rough tuning pot, all the front-panel controls are well placed, smooth and easy to use.

The Oak Hills Research OHR-100 is a very nice rig for intermediate-level kit builders. It is terrific on the air and fun to build. For backpacking, I find the OHR-100A to be a bit bulky. The Wilderness SST is better suited for backpacking. But for portable use, the OHR-100A is ideal. *You can contact Oak Hills Research at 2460 S Moline Way, Aurora, CO 80014;* **www.morsex.com/ohr/**. *$129.95.*

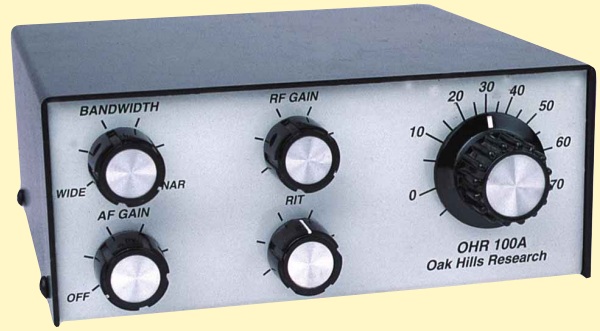
WILDERNESS RADIO SST

By John Harper, AE5X
ae5x@qsl.net

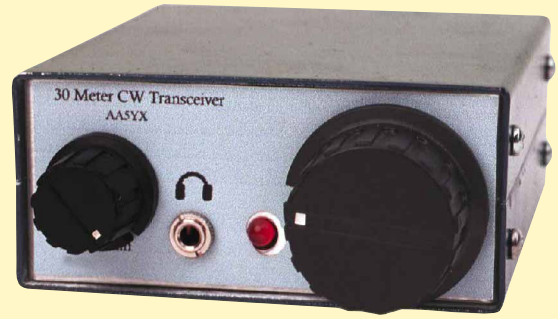
Recent camping trips with a borrowed rig, and then with my own Norcal 40A, were not only incredibly fun, they increased my appetite for more excursions into the woods with QRP gear. With this in mind, I ordered two SSTs from Wilderness Radio about 18 months ago, one for 30 meters and the other for 40 meters. I did this with the idea of taking the minimalist approach of doing more with less—the same way a QRPer might eventually become a QRPper (*very* low power operator)! I also wanted less weight, less bulk and a simpler rig, with the philosophy that the less there is, the less there is to go wrong. This is an important consideration when hauling the rig (in addition to the "normal" camping stuff) in a backpack and being away from test equipment and tools.

As with the Norcal 40A, I was impressed with the clarity of the SST's instruction manual and the quality of the kit. Parts placement is clearly marked on the silk-screened board, and all connectors—power, antenna, key and phones—mount directly to the circuit board, eliminating internal wiring and increasing reliability. One thing that sets Wilderness rigs apart

Oak Hills Research OHR-100A
Receive current drain: 90 mA (max vol)
Transmit current drain: 0.92 A at 5.1W with 13.8V dc
Frequency range: 14.002 to 14.080 MHz
Spectral purity: 36 dB below the carrier
Receive sensitivity: –124 dBm
IF rejection: 64 dB
Image rejection: 89 dB
Blocking dynamic range: 106 dB
IMD dynamic range: 87 dB
IF/Audio bandwidth: 963 Hz
Audio power output: 0.5 W into 8 Ω
2nd Order IMD Dynamic range: 89 dB,
2nd Order Intercept: +54 dBm



Wilderness SST
Receive current drain: 19 mA
Transmit current drain: 0.21 A at 2.3W with 13.8V dc
Frequency range: 10.1086 to 10.1190 MHz
Spectral purity: 34 dB below the carrier
Receive sensitivity: –139 dBm
IF rejection: 50 dB
Image rejection: 40 dB
Blocking dynamic range: 112 dB
IMD dynamic range: 92 dB
IF/Audio bandwidth: 111 Hz



is that they encourage modifications. The manual suggests several mods and the circuit board has pads to allow tapping into the audio chain, the dc bus, keyline, etc.

Both kits went together and tuned up with no problems. Tune-up is simple and involves adjusting one capacitor to peak receiver noise and another to peak for maximum transmitter output. Output power is then adjusted to your liking with a small board-mounted pot. That's it.

Receive selectivity is very sharp and transmitter power output is 1.8 to 2 W. Modifications to both of these parameters, as well as numerous other modifications, are widely published on the Internet. For instance, each kit comes with two varactors to allow the builder a choice in frequency coverage. One of the most common mods involves the installation of a SPDT switch to allow both varactors to be installed for increased frequency coverage. With both varactors installed, my 40-meter SST covers 7036-7048 kHz. The single varactor in my 30-meter version covers 10.109-10.119 MHz. Other modifications involve replacing the transmitter's final amplifier transistor with a variety of other types in order to increase the output power.

The next modification I intend to make to both of my SSTs is one that lowers the volume of the sidetone. This is a bit more involved than simply adding a resistor to the output of a sidetone generator since the sidetone in the SST is actually a sampled portion of the transmitted signal. But such a modification does exist and was devised by the SST's designer, Wayne Burdick, N6KR. For now, I just turn the AF gain down just a tad before I transmit.

Performing these and/or other modifications has three advantages:

1. I have a rig that is more tailored to my preferences—higher RF power output, more frequency coverage, built-in TiCK keyer and a slightly wider audio filter.

2. I have learned something from each modification, particularly the audio filter mod. Yes, these are still kits that I built from step-by-step instructions, but experimenting with various mods has given me the confidence to take on more ambitious projects.

3. There is more "me" to any radio that I modify. With each modification, the rig became a tiny bit less of a kit and more of a custom project. More than a year later, I'm still tinkering with my 40-meter version, just for the pure fun of it. I have even bigger plans for the 30-meter SST!

I've used these little rigs from home and during camping trips. My antennas have been dipoles, inverted Vs or random wires, with AA or C-cells being the usual power supply. I have never lacked for QSOs during these excursions—CQs are answered and a large percentage of the QSOs turn into rather long ragchews when other operators are surprised and ask about the details of such a small rig. What the SSTs lack in bells and whistles is made up for in elegant simplicity. If there is a bell or whistle you need, there's probably a mod for it. *You can contact Wilderness Radio at PO Box 734, Los Altos, CA 94023-0734;* **www.fix.net/jparker/wild.html**. *$85.*

SMALL WONDER LABS SW-40+

By Mike Maiorana, KU4QO
ku4qo@arrl.net

The SW-40+ is the 40-meter version of the SW series CW transceivers by Small Wonder Labs (also available in 80, 30 and 20-meter versions). I became involved with this radio when several hundred of the members of the QRP-L e-mail list and I decided to build it as a group project. I led the effort, and along with a great group of technical people, we built and documented the functions of the radio. This info can be found at **www.qsl.net/kf4trd**.

The radio as built will cover approximately 35 kHz of the 40-meter band and can be built to function in the Novice/Technician section if desired. It can be easily changed back to cover any section of the 40-meter CW band at a later date. The receiver is a superhet design with a 3-crystal IF filter. The receive bandwidth is "just right" at around 400 Hz—not too narrow, not too wide, and no noticeable filter ringing. The T/R switching is full solid state QSK that is silky smooth and very fast. The transmitter will put out a clean, chirp-free 3.5 W to the antenna. The output is SWR protected and filtered to easily comply with FCC regulations.

The kit comes with all the required on board components, but does not include the case and the controls. An optional enclosure kit is available that includes everything you need to finish the kit, including a high quality case, controls and knobs. I opted not to purchase the enclosure kit because I already had a suitable enclosure on hand.

All connections to the board are made with 0.100-inch locking headers and mating terminal housings. The main board can be easily disassembled from the enclosure. Also available is an optional RIT board that can add RIT function, and an audible frequency counter for those who need to know exactly where they are on the band.

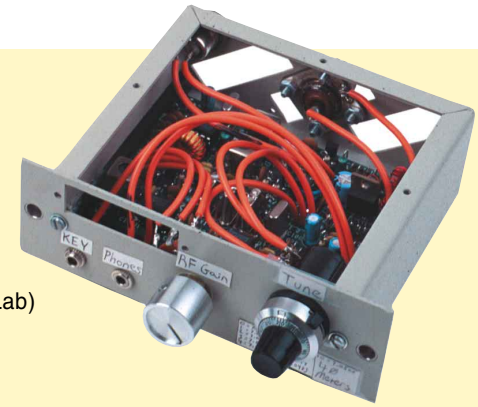
The PC board is 2.8 × 4.0 inches with plated through holes and full silk-screening. All resistors and diodes are mounted vertically to save space. Although the component spacing is fairly tight, there is plenty of room to solder the parts on the bottom, and the silkscreen keeps the solder neat. There are only five toroids to wind, and the instructions are very clear on how to do this. I personally think that the aversion to winding toroids is silly. They are really quite easy once you get the hang of it. The biggest problem I have is getting distracted and losing count.

The introduction in the instruction manual covers the basics like the required tools, test equipment, color codes and soldering basics. The parts list helps the builder clearly identify each component. The radio is built in sections, each with a very clear drawing of what parts should go where. When you follow the instructions, the assembly is easy and painless.

Alignment is also very straightforward. The only test equipment needed is a voltmeter and another transceiver (used for fine tuning). The whole process should take less than 10 hours from the time you start building to the time you are on the air.

Operating the radio is a pleasure. The first thing that struck me is the low power supply current requirements. The rig was pulling less than 16 mA on receive! That would give me 125 hours of listening time

Small Wonder Labs SW–40+
Receive current drain: 16 mA
Transmit current drain: 0.52 A at 3.5W with 13.8V dc
Frequency range: 7.017-7.052 MHz
Spectral purity: 34 dB below the carrier
Receive sensitivity: –134 dBm
IF rejection: 80 dB
Image rejection: >140 dB (not within the measurement capability of the ARRL Lab)
Blocking dynamic range: 104 dB
IMD dynamic range: 85 dB
IF/Audio bandwidth: 381 Hz



on a small 2 A/h battery. The transmitter is also very efficient, drawing around 1/2 amp on key down. The small size and low power requirements of this radio make it an excellent choice for a backpack or remote rig. The receiver is very quiet and extremely sensitive. As you tune around the band the signals just "pop up" out of nowhere. Strong nearby signals have never been a problem with this rig. On-air reports of the transmitted signal have always been outstanding, with no chirp or drift reported after a few minutes of warm-up.

You can contact Small Wonder Labs at 80 East Robbins Ave, Newington, CT 06111; **www.smallwonderlabs.com/**. *$55, enclosure $38 additional.*

RED HOT RADIO RH-20

By Mark Hogan, N5OBC
mhogan@email.msn.com

Well, the kit comes to you in a US Postal Service priority mailer, and right away you wonder if there is really a radio in there! Since I had already built an NC-20 (the club version of the rig from NorCal), I knew it was a radio. I had prepared the inventory sheets on Styrofoam and already poked two holes for each part.

Opening the box you find four case pieces, a manual and schematic and a bag of parts. The bag contains smaller bags that are strategically sorted by Red Hot Radio. Following the instructions, which are great, the parts descriptions are inclusive of resistor colors and cap markings. It took me about 2 hours to inventory the kit. I was missing one capacitor (which I promptly forgot to call for, and that would haunt me later). Noting its absence in the book, I started the kit.

The kit goes together very fast. Silk screening is excellent and parts placement is very clear. Using the inventory boards is the only way to go (for me at least). You end up with all the parts standing in a row waiting to be picked and soldered. By the way, I am not a seasoned builder; this is my second kit, the first was the NC-20. I go very slowly, checking that all the parts go in the right holes and making sure that there are no cold solder joints or pads that run together. Although this radio has a high parts count and a tight board, the way Red Hot Radio has the book and board laid out makes it easy to put together. Dave explains all the intricacies of radio assembly in the book and tells you how to wind and count the windings on a toroid, as well as how to bend the resistors and diodes to get them in the board. Pictures of the toroids are very good and you should have no problems.

Assembling is done section by section with testing at the end of each section. This is a great approach. When you finish a section you can see right away that it works. By the end of the assembly process you know the radio is going to make contacts because each stage has been tested and verified along the way (you did keep all the smoke in the little parts, didn't you?). If there is a problem Dave is available. The manual lists the hours and phone numbers, and he answers his e-mail pretty darn fast.

Receiver alignment is simple and requires only your ear and a tweaking tool. The book explains how to do the alignment very well and there was no problem.

Remember that missing capacitor? I forgot to e-mail Red Hot Radio about it and RadioShack did not have it. True to the ham radio spirit I pulled out the solder wick (I learned how to use this on the NC-20. Didn't I say go slow and make sure what hole you poke the part into? Don't work too late either!) and jerked C-66 out of my NC-20 and—poof!—a working RH-20 was born. The transmitter was even easier to align, and there was a great sigh of relief when I saw the wattmeter jump past 5 W before I turned it down to just below 5 W for my use.

All in all, this is a fun radio to build. I find it therapeutic to build radios, and I sure have fun using something I built to make contacts. I am not sure if these are beginner-level kits, but I did my RH-20 as a first-time kit, so I am sure that you could, too. I'm not an electronics technician, but I have soldered a resistor or two. All the parts make a whole and the whole thing is fun. [Red Hot Radios are now supplied with a new, low-profile enclosure.—*Ed*]
You can contact Red Hot Radio at 14730 Charmeran Ave, San Jose, CA 95124; **www.redhotradio.com/**. *$150.* QST

Red Hot Radio RH-20
Receive current drain: 200 mA (max vol)
Transmit current drain: 0.87 A at 4.7 W with 13.8V dc
Frequency range: 14.022 to 14.087 MHz
Spectral purity: 43 dB below the carrier for close-in spurs and 60 dB below for harmonics
Receive sensitivity: –129 dBm
IF rejection: 95 dB
Image rejection: 128 dB
Blocking dynamic range: 115 dB
IMD dynamic range: 83 dB
IF/Audio bandwidth: 260 Hz
Audio power output: 0.88W into 8 Ω
2nd Order IMD Dynamic range: 102 dB
2nd Order Intercept! +75 dBm