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HAL Communications P38 HF Modem

Quantics W9GR DSP-3 Audio Filter

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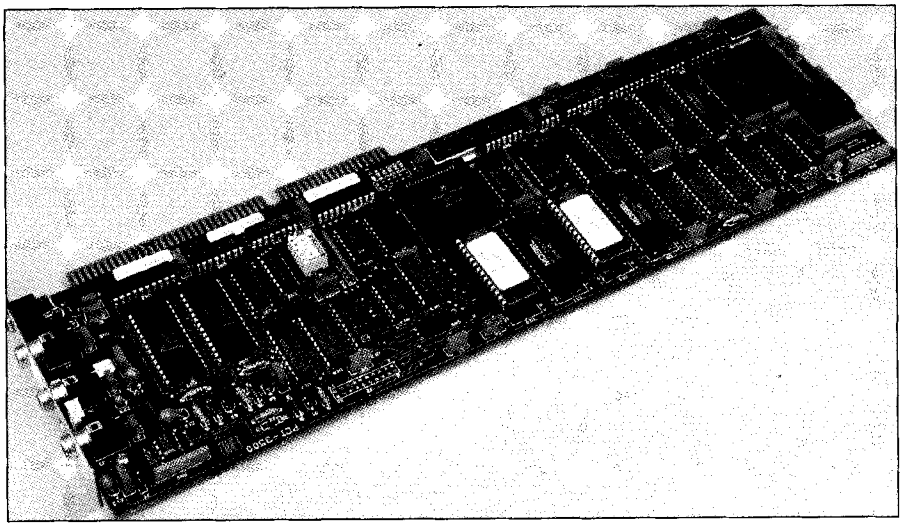
Reviewed by Steve Ford, WB8IMY
Assistant Managing Editor



Over the past five years we've seen an explosion in amateur HF digital communication. Prior to 1990 there was only packet, RTTY and AMTOR. PACTOR appeared on the scene in 1991, delivering much faster throughput than any of the "big three." It was quickly embraced by all of the major multimode-controller manufacturers. This helped speed PACTOR's ascendancy to the popular position it holds among HF digital enthusiasts today.

CLOVER also arrived in 1991. Although it is superior to PACTOR and occupies less bandwidth, CLOVER has not been as widely accepted. The main stumbling block has been cost. Hams who wanted to try CLOVER in 1991 faced an investment of nearly $1000 for the original HAL Communications PCI-4000 modem board. To make matters worse, the PCI-4000 was a CLOVER-*only* device. HAL later introduced the PCI-4000/M, which added AMTOR, RTTY and PACTOR, but the $800 price tag was still a bit too steep for many amateurs. CLOVER saw a slight increase in activity, but not as much as the mode deserved. The advent of G-TOR and, more recently, PACTOR-2, added more competitive pressure.

Are the fortunes of CLOVER about to change? The answer may be "yes." The new HAL P38 HF modem made a splashy debut at the 1995 Dayton Hamvention. Like the PCI-4000/M, the P38 offers CLOVER, AMTOR, RTTY and PACTOR, but it does so at a price that's competitive with other multimode controllers. Market forces being what they are, the P38 could represent a much-needed shot in the arm for CLOVER.

P38 versus PCI-4000/M

How does the P38 differ from the PCI-4000/M? Both modems support an identical list of modes, but there are substantial differences. The PCI-4000/M is designed for both amateur *and* commercial users. It offers the ability to choose various tones and frequency shifts, depending on the application. The P38, in contrast, offers only the standard amateur signaling speeds and shifts.

The DSP heart of the PCI-4000/M is the Motorola DSP56001 processor. To reduce cost, HAL opted to use a Texas Instruments TMS320C25-50 processor in the P38. The TI processor doesn't have enough horsepower to deal with the demands of the two highest-speed CLOVER modulation formats, so these are omitted in the P38. Because these two formats require extremely strong signals on both ends of the path, however, they aren't used often in the PCI-4000/M. The majority of CLOVER users probably won't notice their absence in the P38.

As I was surveying other differences between the two units, one disparity jumped out right away. Both the original PCI-4000 and the PCI-4000/M include *adaptive RF power control.* The P38 *doesn't.*

Adaptive power control means that the modems can adjust transmitter output power automatically according to the quality of the signal path. As signal-quality information arrives from the other station, for example, the PCI-4000 increases or decreases the transmit audio level to the transceiver, which raises or lowers the RF output. It's spellbinding to watch the modem drop your output down to QRP power levels when conditions are good, or boost it to 100% when the band gets marginal. It automatically fulfills the FCC mandate of using the lowest power necessary to maintain communication.

I spoke with Mike Broga, W9KVF, of HAL Communications and asked why this feature wasn't included in the P38. According to Mike, the amount of software processing necessary to implement adaptive power control exceeded the capacity of the TI chip. In addition, HAL surveyed PCI-4000 users and discovered that many of them preferred to control their RF output manually. Automatic RF control *is* preferred among commercial customers, but they're not the intended market for the P38.

Installation

Unlike other multimode digital controllers, the P38 is designed to be installed *inside* an IBM PC or compatible computer. Any PC of the 286 generation or later will do the job. Six hundred and forty kbytes of RAM memory is required, along with a hard disk and at least one floppy disk drive.

All the hardware is contained on a 13¼-inch card that plugs into an empty bus slot. The P38 card should fit inside most PCs with standard-size cases. It snuggled into my mongrel computer with a half-inch to spare—a tight fit, to be sure, but it work

Whenever you're dealing with devices that plug into PC bus slots, the compatibility bogeyman is often the greatest fear. Any PC hobbyist can regale you with war stories about device conflicts, endless searches for available interrupts and so on. I had reason to be apprehensive. My PC bus is loaded down with a CD-ROM drive interface, fax modem, sound card, IDE controller and a high-speed video card. Even so, I was pleasantly surprised when I installed the P38 and discovered that it didn't wreak havoc with the rest of my system. As the auto commercials say, however, your mileage may vary.

Once you have the card in place, there is little else to do. The software is provided on a 3½-inch diskette and you simply copy these files to your hard disk. You can run the program directly from DOS (as I did), or through *Windows* as a DOS application.

The P38 works its magic through a dual-microprocessor system. Keeping this system current with changing technology would normally entail removing and replacing the ROM chips that contain the operating software. Not so with the P38! Each time you start the P38 software, the necessary data is automatically downloaded to RAM memory on the card. So, making an update to the P38 may be as easy as copying a file to your hard disk. This ensures the flexibility of the P38 for years to come.

Connecting the P38 to your transceiver is straightforward. The card provides phono jacks for transmit audio, receive audio and push-to-talk (PTT) keying. The connection to the FSK port is made through a 1/8-inch stereo jack. The manual recommends that you operate AFSK by routing the P38's transmit audio and PTT lines to the radio's microphone jack (or auxiliary audio input) and PTT keying inputs. The FSK output is provided in case you wish to operate RTTY, AMTOR or PACTOR in this mode. CLOVER, however, is a four-frequency system, so you cannot operate CLOVER FSK unless you own a *very* unusual transceiver! For this review, I chose AFSK for all modes.

You'll enjoy greatest success with CLOVER if your transceiver is very stable. The manual drives this point home in no uncertain terms. Your radio must be capable of tuning in 10-Hz steps (1 Hz would be ideal). Once you're tuned in, your rig must not drift more than ±15 Hz during the conversation. Drift is deadly to most "burst" modes, and it's particularly lethal to CLOVER. Worse yet, CLOVER is unforgiving of hams who try to "touch up" the drift with an oh-so-small prod of the VFO knob. This well-intentioned nudge is all it takes to break the link completely.

CLOVER

I had the pleasure of using CLOVER for the first time when I reviewed the HAL PCI-4000 board in early 1993, so I was eager to try it again with the P38. I booted up the software, used the CODE menu to choose CLOVER (see Figure 1) and then selected the *listen* mode. (This mode was not available in the PCI-4000 when it was first released.) I found a couple of CLOVER signals lurking in the lower portion of the 20-meter digital subband, around 14.070 MHz. Unlike other HF digital modes that chirp back and forth in rhythmic fashion, a CLOVER signal often "twitters," and occasionally makes long *brrrrrrrr* sounds.

I tuned in one of the signals while watching the tone amplitude bars in the upper left corner of the screen. There are four bars shown, one for each tone. To tune in a CLOVER signal you must tweak your VFO until all four bars are roughly the same length. Then, you switch to the frequency offset display and *carefully* adjust the VFO again until the pointer is as centered as you can get it. This takes a little practice because it's easy to overcorrect and send the pointer skidding madly up and down the scale.

As I brought the rig on frequency, text began printing in the "receive" portion of the screen. Because I'm obviously not part of the link, the print wasn't perfect. There were gaps and errors. Despite this, I was able to copy a remarkable amount of the conversation, more than enough to follow the discussion.

Fishing for contacts on CLOVER is simple in the extreme. You just press the **ALT** and **F9** keys together. The P38 sends a CW ID and then starts calling CQ. You don't actually see the CQ text flowing across your screen. Instead, the P38 tells you that it's in the CQ mode and takes it from there. If another CLOVER operator tunes in my signal, he will see the message "CQ from WB8IMY" on his screen, not line after line of, "CQ CQ CQ CQ CQ CQ..." If the other station chooses to answer, he only needs to press his **CTRL** and **F9** keys and the link is established!

Once you're linked, there is no need to transmit an "over" command to allow the other station to send information. (Such is the case in AMTOR and PACTOR, for example.) Both stations swap information whenever they have data to send. This can result in some freewheeling conversations, and more than a little confusion! The trick is letting the other station know when it's his turn to comment on whatever you're saying. (I ultimately resorted to using ">>>" to indicate that I had reached the end of a thought.) Otherwise, you'll see his comments suddenly appearing between the sentences you're sending.

In addition to watching the flow of the conversation, it's easy to be distracted by the adaptive aspects of CLOVER. In the upper right corner of the screen you see a display that indicates the modulation format in use at the moment, the signal-to-noise ratio, the frequency tuning error, the phase dispersion and the error-correction capacity in use. Not only do you see your parameters, you see those of the *other station* as well!

During the conversation both stations exchange signal-quality and operating information automatically. (This is transparent to the operator. You're hardly aware of it.) As band conditions change, the modems will select the best modulation formats to achieve the highest throughput. My eyes were constantly drawn to this display as I watched the signal-to-noise ratio fluctuations at either end of the path.

All of the contacts I made were with CLOVER stations running PCI-4000 modems. During a conversation with a ham in Florida, I noticed that my P38 had suddenly decided to jump to the 8PSM (eight phase-shift modulation) format—the highest-throughput mode. (His signal was S9 + 10 dB on my end.) I didn't know which station "requested" the change. Did my P38 tell his PCI-4000 to switch, or did his PCI-4000 request a jump to 16P4A (16-phase, four-amplitude modulation), its "fastest" mode? I assume that if a PCI-4000 tries to command a P38 to go to a format beyond its capability, the P38 will say "no way" and default to 8PSM. Interesting!

The overall performance was exactly what you'd expect from CLOVER—outstanding. Large files flew across my monitor, even in less-than-marvelous band conditions. The data throughput rate was often so fast that I had to access the scrollback buffer and read the transmitted text after the fact.

A late-evening contact on 20 meters really put the system to the test. Propagation was mediocre when we started and it went rapidly downhill from there. I had just started to send a 5-kbyte file when I realized that we probably couldn't maintain the link much longer. To my astonishment, the data flowed smoothly to the other station, despite occasional pauses during the deepest fades. CLOVER isn't 100% bulletproof (our link failed soon after the test), but the combination of adaptive mode switching, Reed-Solomon error correction and other features make this the most efficient HF digital mode I've used to date. It was hot back in 1993 and it's still hot today.

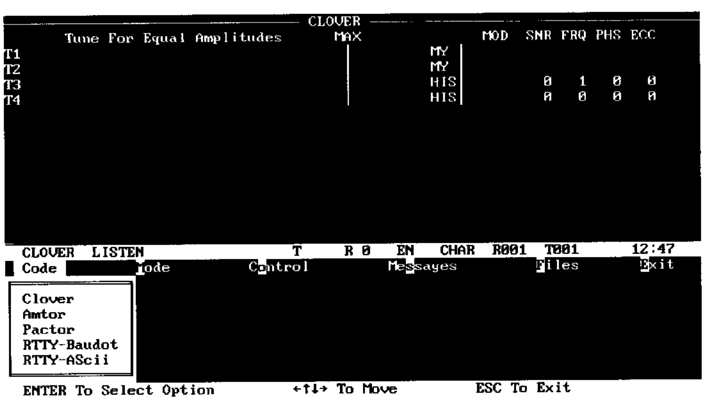


Figure 1—Switching from CLOVER to another HF digital mode is as easy as making a selection from the CODE menu.

AMTOR and PACTOR

Moving from CLOVER to AMTOR or PACTOR is a bit like slipping behind the wheel of a Geo Metro after you've been cruising the highways in an Alfa Romeo. On the other hand, there are more stations to contact on AMTOR and PACTOR.

The P38 does a superb job with both modes. Not only does it pull weak signals out of the noise, the friendly software makes operating a breeze. In AMTOR, for example, you send an FEC CQ by selecting AMTOR and "SEND FEC" from the command menu. Then, simply load one of the HERE IS buffers where you've stored your CQ message. Press **F10** and the P38 begins transmitting your CQ. When the buffer is empty, the P38 drops to the AMTOR standby mode, waiting for an ARQ call.

When you're using the AMTOR "LISTEN" mode and you stumble across someone sending a CQ, you press the **F9** key and type the other station's SELCAL. As soon as you press **ENTER**, the P38 will attempt to establish a link. By the way, if you're in AMTOR LISTEN and you receive a request to link on PACTOR, the P38 will automatically switch to the PACTOR mode and respond.

I was impressed by the P38's flexible AMTOR timing. Most multimode controllers allow you to change the TX delay (the delay between the time the transmitter is keyed and the audio is applied), but few, if any, allow you to modify the *control delay*. The P38 is the exception.

By fudging the control delay, you change the amount of time that passes between the reception of a data block and the transmission of an ACK or NAK (acknowledgment or nonacknowledgment) control signal. Why is this important? If the station you're working is thousands of miles away, you may need to shorten the delay so that the ACK or NAK is sent as quickly as possible. With luck, the control signal will arrive back at the sending station in time to be decoded and recognized, otherwise the link is doomed. At the opposite extreme, if you're linked to an AMTOR station at a short distance (say, 50 miles away), you'd want to *increase* the control delay. This will help ensure that the ACK or NAK arrives after the sending station has had sufficient time to switch from transmit to receive.

PACTOR operation with the P38 was just as simple and flexible. The software provides all the information you need at a glance, including the data rate (PACTOR switches rates according to band conditions). Tuning a PACTOR (or AMTOR) signal is a snap. You just tweak your VFO until the MARK and SPACE bars are at equal lengths on the screen. It's one of the best tuning indicators I've seen to date.

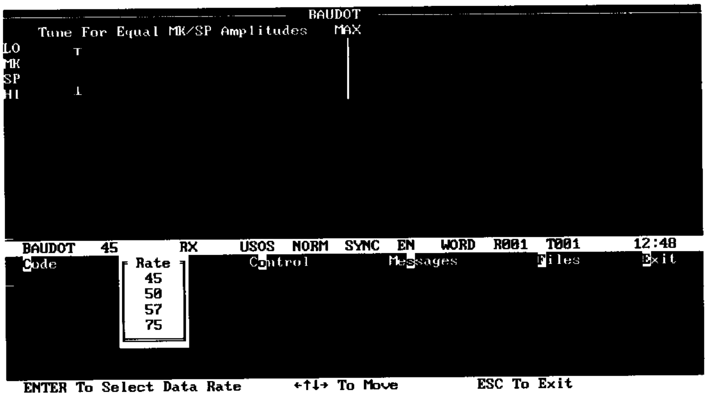


Figure 2—The P38 will send Baudot RTTY at any of four baud rates. You simply choose your baud rate and go.

The P38 uses a pure DSP implementation of PACTOR's "memory ARQ," temporarily storing the positions of corrupted bits in a data frame and "repairing" them in subsequent transmissions. The DSP design of the P38 also allows the modem to more easily discriminate between a corrupted bit that *might* be a "1," or bit that might represent a "0." This lets the P38 decode PACTOR data that might otherwise be lost in poor conditions. I noticed this aspect of the P38 while monitoring PACTOR conversations. I consistently enjoyed more reliable copy than I could normally achieve with my other multimode unit.

RTTY

The DSP performance of the P38 is most apparent when you're using it the RTTY mode. In my case, it was dramatic. On several occasions I was able to copy RTTY signals *that I could not hear!* In one instance I was tuning through what sounded like a very dead 15-meter band. The MARK/SPACE tuning bars bounced around in response to noise, but nothing else was detected. Suddenly, the bars jumped solidly to the right. The P38 had "found" a signal. I listened and thought I could hear something, but the phantom tones were buried in the noise. By adjusting my VFO I equalized the MARK/SPACE bars as best I could. You can imagine my surprise when fragments of text began appearing on the screen! (It was a Brazilian station talking to someone in Louisiana.)

As with the other modes, the P38 provides type-ahead buffers and the capability to send pretyped information. You can choose Baudot or ASCII code at several baud rates (see Figure 2). The friendly, flexible software, combined with the P38's remarkable performance, makes it ideal for RTTY contesters or DXers. According to the manual, the P38 is compatible with a variety of digital contest software.

Summary

It will be interesting to watch the development of CLOVER as more hams discover the affordability of the P38. When you factor in the cost of the software recommended for other multimode controllers, the P38 is highly competitive. (The P38 comes with its own software.) The only important mode it lacks is packet. From the standpoint of most HF digital enthusiasts, however, this is not a critical omission.

Previous PCI-4000 CLOVER users may be disappointed in the lack of adaptive RF power control and the elimination of two modulation formats in the P38. Their dismay will be short-lived, however, when they see that its on-air performance is virtually the same.

The P38 appeals to both ends of the digital spectrum: It offers high performance for serious contesting and DXing, while providing the benefits of CLOVER and other modes at a price that won't strain too many budgets.

Manufacturer: HAL Communications Corp, PO Box 365, Urbana, IL 61801, tel 217-367-7373. Manufacturer's suggested retail price: $395.

Quantics W9GR DSP-3 Audio Filter

Reviewed by Glenn Swanson, KB1GW
Educational Programs Coordinator

In keeping with the relatively fast-paced evolution of DSP-based (digital signal processing) audio filters, Quantics recently started producing the W9GR DSP-3 audio filter kit, a follow-up to the popular DSP-1. The DSP-3 offers several new features that, according to designer Dave Hershberger, W9GR, "incorporate many requests and suggestions made by the users of the earlier DSP-1 kit." (See Dave's September 1992 *QST* article for information on the DSP-1 and on DSP audio filters in general.)

New features include a 13-bit A/D (analog-to-digital) and D/A (digital-to-analog) converter (up from 8 bits in the DSP-1) and a software AGC algorithm that tracks the input level of a signal to allow the adaptive filter's performance to remain constant over a wide range of signals. There are more CW filters (with more bandwidths and tuning selections) and new filters for SSTV, European RTTY tones and narrow SSB (2.1 and 1.8 kHz). Other new features include DTMF and CTCSS tone decoders and an optional custom metal box.

Assembling the Kit

The foundation of the DSP-3 kit is a 5×5½-inch double-sided, silk-screened circuit board with plated-through holes. The balance of the kit consists of just over 100 assorted resistors, capacitors, jacks, ICs and other parts. The DSP-3 is designed around the Texas Instruments TMS320P15NL DSP chip, with firmware version 1.06 in the review unit.

The 12-page manual includes four pages of assembly information, troubleshooting tips, detailed information on using the unit, a description of the circuit operation and a schematic. The assembly instructions spell everything out in 24 steps. (There is a separate section about installing the kit in the optional enclosure). I assembled the kit over several evenings, completing it in about four hours.

The DSP-3 went together easily, although I agree with the comment in the instruction manual, "This is not a kit for beginners!", mainly because of the densely packed PC board. If you've built kits in the past, the closely spaced parts and circuit traces should not pose a problem. A couple of items mentioned in the assembly instructions are not provided—a small amount of thermal grease for mounting the voltage regulator to its heatsink and chemical solder-flux remover to clean the PC board after soldering. You should be able to find both of these at your local electronics store. I also purchased a set of "helping hands" to hold the circuit board. Finally, a lighted magnifying glass is useful for close-up inspections of your soldering job. (The instruction manual cautions that most DSP-1 kits returned for troubleshooting failed because of poor soldering.)

You can either supply your own cabinet or build the DSP kit into unused space in an accessory speaker cabinet. Unless you plan to use the DSP kit for just one or two functions, then I recommend that you spring for the extra $19 and buy the rugged gray-painted custom metal cabinet. With 16 separate functions (more on these later), all controlled by a single rotary **MODE** switch, you'll need to be proficient at labeling to fit all 16 labels around this relatively small switch! One op who put the review unit through its paces reported that reading the silk-screened labels on the **MODE** switch with his "older eyeballs was a real challenge."

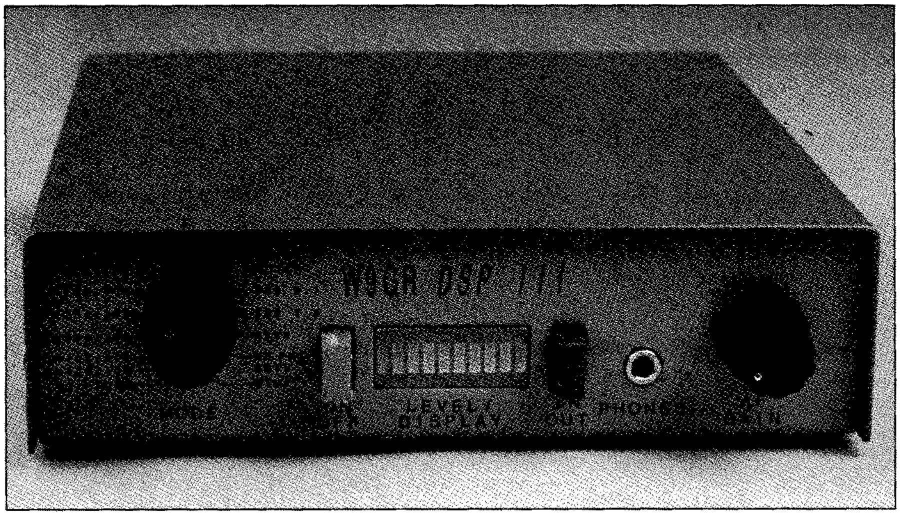


Table 1
Quantics DSP-3 DSP filter

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Power requirements: 12 V dc, 0.4 A.	12 V at 410 mA (full audio output).
Input-to-output delay: Not specified.	Voice filters, 7 ms max; CW filters, 15 ms max.
Voice filter 3-dB bandwidths: 2.1 and 1.8 kHz.	At –6 dB points: 246 to 2160 Hz and 246 Hz to 1860 Hz.
Voice filter shape factor: Not specified.	At –6 and –60 dB points: 2.1 kHz filter, 1.12; 1.8 kHz filter, 1.14.
CW filter 3-dB bandwidths: 50 Hz (400 or 750 Hz center frequency); 100 Hz (400, 600, 750 or 1000 Hz center frequency); 200 Hz (750 Hz center frequency). Center frequencies are tunable.	At –6 dB points (750 Hz center frequency filters): 50 Hz, 73; 100 Hz, 129; and 200 Hz, 227 Hz.
CW filter shape factor: Not specified.	At –6 and –60 dB points (750 Hz center frequency filters): 50 Hz, 2.26; 100 Hz, 1.99; 200 Hz, 1.53.
Other filter bandwidths: North American RTTY, 2125/2295 Hz; European RTTY, 1275/1445 Hz; HF packet, 1600/1800 Hz; SSTV, 1200-2300 Hz.	At –6 dB points: North American RTTY, 2010-2410 Hz; HF packet, 1480-1930 Hz; SSTV, 1010-2410 Hz.
Other filter shape factors: Not specified.	At –6 and –60 dB points: RTTY, 1.65; HF packet, 1.4; SSTV, 1.18.
Random noise reduction: Not specified.	15 dB typical.
Automatic notch filter depth: Up to 50 dB.	>50 dB with a single 1-kHz tone; >40 dB with two tones.
Time to notch: Not specified.	Undesired signal is notched by approximately 50% after 20 ms.
Audio output: Not specified.	980 mW at 10% THD into 8 Ω.
Size (height, width, depth): 1.5×5.5×6 inches; weight, 2 lb.	

Hooking it Up

After testing the voltage regulator, finishing the circuit board and mounting it in its metal case, I scrounged around in my parts box for a proper cable to go between my HF rig's speaker output jack and the DSP-3's **AUDIO IN** jack. When I turned the unit on, the 10-segment LED bargraph lit up, and I heard a rush of noise in my headphones. The review unit worked right away! If you do have a problem getting the filter to work, Quantics will correct such problems for you at a "flat rate of $40, unless the failure is caused by defective components" or unless it's a failure due to *their* workmanship, not yours.

The DSP-3 requires a well-filtered 12-V dc, 400-mA supply (you provide the coaxial power plug). The DSP-3 uses ⅛-inch phone jacks for its audio input and output. A couple of the hams who used the unit wished that Quantics had chosen the more common phono jacks for its audio I/O ports. You can hook up an external speaker to the rear panel **AUDIO OUT** jack, or plug in a pair of headphones via a front-panel **PHONES** jack.

The instructions advise you to set your receiver audio gain so that the strongest signals cause most, or all, of the front panel LEDs to light occasionally. Once the receiver audio gain is properly adjusted, you are instructed not to touch it. The manual states that you should use the **AF GAIN** control (located on the front panel of the DSP-3) for all audio gain adjustments. The DSP-3 has an internal AGC loop that, when enabled via the rear-panel-mounted **BIO** (binary input/output) switch, controls the audio output level from the DSP-3. To bring the DSP-3 on line, just press the front-panel button labeled **IN/OUT**.

Using the DSP-3

Okay, so what does the W9GR DSP-3 do, and how well does it do it? The filter offers 18 functions (accessible with the **MODE** and **BIO** switches), several of which are rather specialized. For example, the manual devotes several paragraphs and two charts to the DTMF and CTCSS tone decoders. When using the DTMF or CTCSS decoder, the patterns displayed by the LED bargraph can be interpreted from a chart to determine the tone(s) in use. The DTMF (touchtone) decoder can be used for such things as testing DTMF *encoders* and for troubleshooting autopatches. The CTCSS decoder will interpret any of the 38 standard subaudible tones (also known as CTCSS or PL tones), and it has a 16 tone memory that will play back previously detected CTCSS tones. Neat stuff, indeed!

I was particularly interested in the SSB and CW filters, the automatic notch filter, and the noise-reduction function. The SSB filters work well and are handy if your radio doesn't have narrow SSB IF filters. I found the 2.1 and 1.8 kHz SSB filters to be quite useful while using my ICOM IC-735 HF rig (which doesn't have optional SSB filtering) for some casual DXing. Those who own radios that *have* internal narrow filters can still use the DSP-3 narrow filters to improve their filtering. However, one op who used the DSP-3's SSB filters felt that his TS-850S's built-in interference-combating features gave him just as much, if not more, interference-fighting ability as the DSP-3.

For CW operation, the DSP-3 offers three bandwidths (50, 100 and 200 Hz) at four preprogrammed tunable center frequencies (400, 600, 750 and 1000 Hz; see Table 1). There's one snag, though. When you turn the unit off, any center frequencies settings you have made go away, with the filter reverting to default settings. It would be nice if the selection you've made were retained in some sort of memory.

The CW filters can be handy, especially if you don't have—or your radio won't allow for—narrow IF filtering. One ham who used the DSP-3 noted that the narrow CW filters worked well, with no ringing. He thought that the narrow filters would be especially useful for very-weak-signal VHF/UHF CW work.

The DSP-3 includes a noise reduction filter, or "denoiser." This filter does a nice job of reducing background band noise, which helps reduce listener fatigue—especially during long-term listening.

The automatic notch filter does an good job of eliminating multiple carriers, CW interference (or tuner-uppers) and other audio tones. It works very quickly. When a carrier comes onto the frequency you're tuned to, you'll only hear a slight "click" as the DSP-3 latches onto, and eliminates, the offending tone(s).

You can combine the notch and noise filters by selecting the **NOISE/NOTCH** switch position. The manual suggests using the combined mode for most HF SSB operation. The manual goes on to explain that the denoiser and notch filters are more effective when used separately, so you may want try the individual filters for problem interference.

There are separate filters tailored for HF packet and SSTV, but I did not try these during the review.

Although the DSP-3 offers a variety of filters, it would be great to be able to use some of them in combination, like the noise/notch mode. For example, it would be helpful to be able to use the automatic notch filter and 1.8 kHz SSB filter at the same time. Even if it were done via user-selectable jumpers inside the unit, it would make for a much more flexible system. According to Dave Hershberger, W9GR, the design is the result of a performance tradeoff between best filter performance and use of simultaneous filtering functions in a filter that uses low-cost DSP chips. He decided to design the filter for extremely sharp skirts on the narrow SSB filters to provide maximum effectiveness in reducing adjacent-signal QRM, rather than go with compromised performance in a simultaneous narrow filter and notcher.

Several users noted weak false signals and noise in the output, including a high-pitched whine in the CW modes, when there are only weak signals in the passband or when the band is quiet. These artifacts are not apparent in some of the other DSP audio filters we've tested, except in the most aggressive noise-reduction modes. They're easily masked by strong signals in the passband, but they're a bit distracting when you're listening on a quiet band.

Conclusions

The W9GR DSP-3 is a quality kit, and when you include the optional metal case, it makes for nice, solid, stand-alone unit. You could also build the filter into an existing speaker cabinet or your next transceiver project. If you don't need all of the functions, you always have the option of wiring a switch for just a few of the many functions (notching carriers, for example).

The documentation does a fine job of getting you through the building process and into the operation of the unit. Although it's not as polished as some of the more-expensive assembled units from other manufacturers, the DSP-3 kit holds up well in the crowded DSP audio filter market place and is a worthy successor to the popular DSP-1. Audio filtering works as an extension to good IF filtering, and the W9GR DSP-3 kit offers many useful features.

Thanks go to the following hams for their contributions to this review; Dean Straw, N6BV; Bill Kennamer, K5FUV; Dave Newkirk, WJ1Z; and Mike Gruber, WA1SVF.

Manufacturer's suggested retail prices: W9GR DSP-3 Kit $149; Custom metal cabinet, $19. Shipping is $7 in the USA and Canada, $20 overseas. California residents should add 7.25% sales tax. Manufacturer: Quantics, PO Box 2163, Nevada City, California, 95959-2163. (*Note: QUANTICS does not take charge cards, nor do they have a business telephone number.*)

SOLICITATION FOR PRODUCT REVIEW EQUIPMENT BIDS

[In order to present the most objective reviews, ARRL purchases equipment off the shelf from dealers. ARRL receives no remuneration from anyone involved with the sale or manufacture of items presented in the Product Review or New Products columns.—*Ed.*]

The ARRL-purchased Product Review equipment listed below is for sale to the highest bidder. Prices quoted are minimum acceptable bids, and are discounted from the purchase prices. All equipment is sold without warranty.

Alinco DJ-582T dual-band H-T (see Product Review, July 1995 *QST*). Minimum bid: $260.

Azden PCS-9600D 440-MHz voice/data transceiver (see Product Review, May 1995 *QST*). Minimum bid: $412.

ICOM IC-Z1A dual-band H-T (see Product Review, July 1995 *QST*). Minimum bid: $330.

JPS SSTV-1 DSP filter (see Product Review, November 1994 *QST*). Minimum bid: $60.

Kenwood TH-79A(D) dual-band H-T (see Product Review, July 1995 *QST*). Minimum bid: $310.

Kenwood TM-255A 2-meter multimode transceiver with PG-5A packet data cable (see Product Review, June 1995 *QST*). Minimum bid: $597.

Standard C568A tri-band H-T (see Product Review, July 1995 *QST*). Minimum bid: $390.

Yaesu FT-51R dual-band H-T (see Product Review, July 1995 *QST*). Minimum bid: $320.

Sealed bids must be submitted by mail and must be postmarked on or before August 27, 1995. Bids postmarked after the closing date will not be considered. Bids will be opened seven days after the closing postmark date. In the case of equal high bids, the high bid bearing the earliest postmark will be declared the successful bidder.

In your bid, clearly identify the item you are bidding on, using the manufacturer's name and model number, or other identification number, if specified. Each item requires a separate bid and envelope. Shipping charges will be paid by ARRL. Please include a daytime telephone number. The successful bidder will be advised by telephone with a confirmation by mail. No other notifications will be made, and no information will be given to anyone other than successful bidders regarding final price or identity of the successful bidder. If you include a self-addressed, stamped postcard with your bid and you are not the high bidder on that item, we will return the postcard to you when the unit has been shipped to the successful bidder.

Please send bids to Bob Boucher, Product Review Bids, ARRL, 225 Main St, Newington, CT 06111-1494. QST