Number 27 on your Feedback card

# Look, Ma — No Knobs!

*Exploring the revolutionary new Kachina 505DSP computer-controlled HF transceiver.*

Richard Lubash N1VXW
P.O. Box 311
Dublin NH 03444
[rlubash@poco.mv.com]

A few months back, when I received a call from *73 Magazine* asking me if I would be interested in reviewing Kachina Communications' first foray into the HF amateur marketplace, I jumped at the opportunity. I had heard about this revolutionary new concept in amateur communication equipment design at Dayton, and ever since, I had been dying to get my hands on one. So interested was I that I had even downloaded a demo software package from Kachina's Web site months before the rig was released.

The 505DSP, in case you haven't heard, is the first big step in the next generation of HF rigs. It not only incorporates Digital Signal Processing technology that meets or surpasses anything available today for ham equipment, but also provides front-end control of the transceiver via a computer-based software interface. Now, I'm not talking an HF rig bristling with knobs and buttons and an RS-232 port on the back with an available CAT program as an alternative to knob twisting. I'm talking a fully-featured state-of-the-art transceiver with just one button for on/off. Now *this* is different!

The beauty of this radio is that you have complete control of all transceiver functions via software. From an operating point of view, the 505DSP is a lot less cluttered and complicated than a 100+ knob radio, but has the capability of reaching any level of control depth the operator wishes.

Needless to say, when the big box labeled Kachina Communications arrived, I was excited. As fate would have it, I was one day away from leaving for a trip, but that didn't stop me from dropping everything and spending the next few hours engrossed in being a radio pioneer. The 505DSP comes well-packaged in a double box that contains everything needed to set the radio up. In my case, I would be operating the radio using a laptop, so it was necessary for


***Photo A.*** *The revolutionary new 505DSP looks more like a computer than an HF rig.*

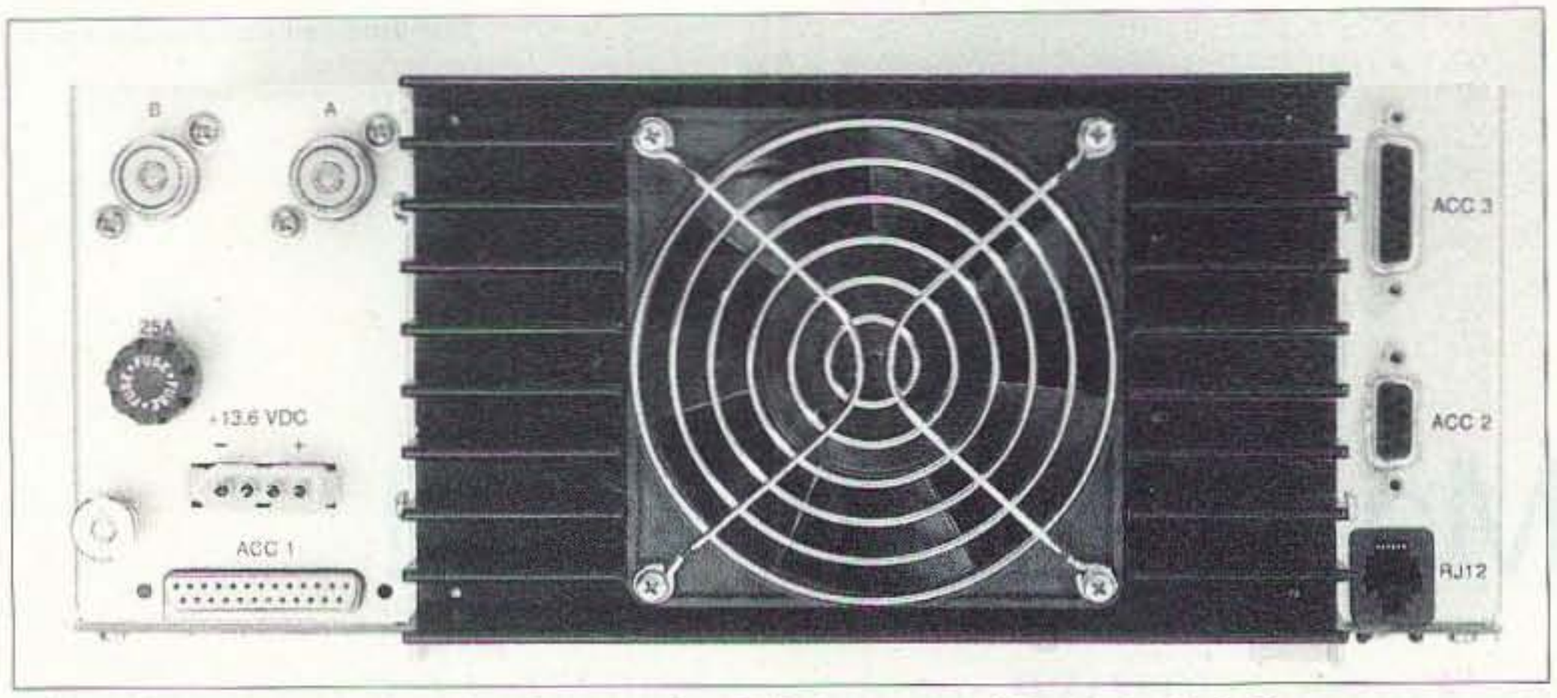


***Photo B.*** *Accessory input/output on the 505 is accomplished via Sub-D computer-type connectors. The large fan runs all the time but is extremely quiet.*

Kachina to supply an additional box that accommodated the control head cover and extra cabling. The basic transceiver comes with a hand microphone and all cabling and parts necessary for the control head to mount in a spare hard drive bay in your computer. If your computer also has a sound card and speakers, an external speaker is not necessary. The 505 also requires an external 13.8 volt DC supply capable of supplying 25 amps continuous power. A high speed antenna tuner is also available for the 505DSP, and was included in the model sent to *73*.

Computer requirements for the 505 are on the light side considering the functionality of the supplied Windows™-based software. For my operation, I used a 586 laptop with 8 Mb of RAM running Windows95™. The control software is compatible with Windows 3.1, 95, or NT and only requires a 386DX or higher processor and 4 Mb of RAM (8 Mb RAM recommended for Windows95). Other computer resources required are a spare serial port and 2 Mb of hard disk space.

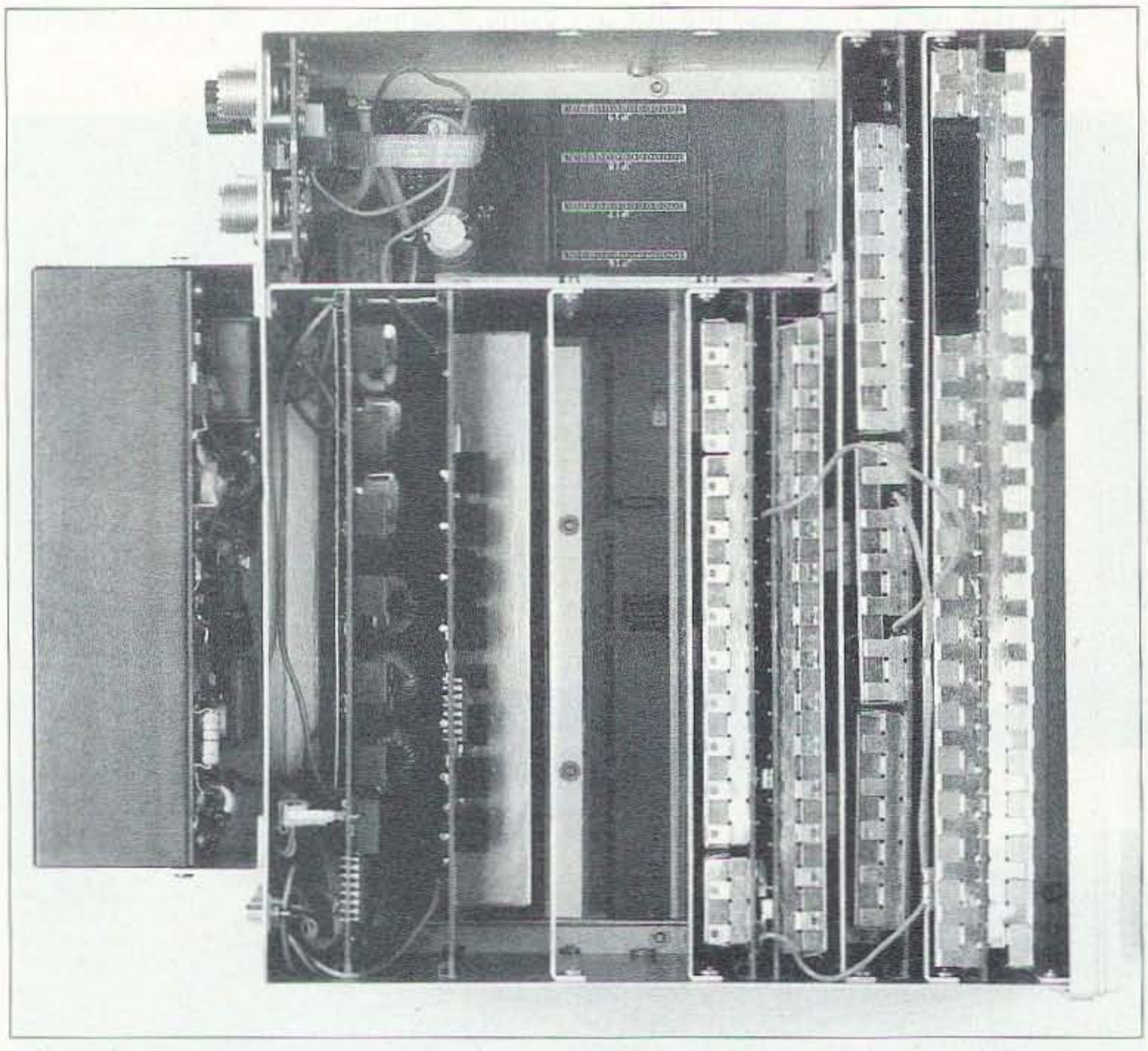

***Photo C.*** *The inside of the 505 is neat and uncluttered as a result of modular plug-in cards.*

Getting the Kachina 505 up and running was a breeze. It took all of 15 minutes to hook up the rig to the power supply and computer and load in the software with the aid of the well-written installation manual. (I was a little worried at the mere 16-page thickness of the installation and operation guide until I discovered that the main manual is virtual and contained just a mouse-click away in the operating software.)

The software interface was very intuitive, so I decided to take the rig for a spin with just a few glances into the manual. I tuned up to 10 meters using a 10-element log periodic. I was able to get a weak copy on OH8JSZ through the Arctic flutter and then turn around, and via the miracle of DSP noise reduction, get a readable copy on ZK1DI coming in from Cook Island on 12 meters.

The sound of the 505DSP running into a three-inch external speaker was pleasant, with excellent clarity. Weak stations were very readable, and the fidelity on strong stations down on 20 meters made copy comfortable without that traditional communications mid-range sound. Tuning is accomplished using the up/down arrows on the keyboard, with the left/right arrows choosing the tuning resolution from 1 Hz to 10 MHz.

The virtual control panel is uncluttered and easy to read, a departure from some of the newer high density front panels of the new generation of HF rigs. The main window consists of a current settings status box that gives a readout of most of the main transceiver operating parameters, including filters, IF shift, notch, power, antenna port, tuner status, AGC time, Tx Eq, input attenuation, squelch, CW offset, and RIT. Below that is Tx and Rx frequency, mode, receive volume, and two "soft" faders that are used to select settings for any of the transceiver's adjustable parameters. The "soft" faders can be selected through hot keys, menu selection, or clicking on the individual items in the Settings box. On the right of the control window is a date/time readout, two-meter modules,

**Inside the 505DSP (excerpt from Kachina's Web page)**

The 505DSP's first mixer is a high-level diode ring, followed by high-level, low-distortion amplifiers, and 20 kHz-wide 75 MHz roofing filters. The gain of the 75 MHz stages is sufficient only to overcome the mixer and filter losses, and gain-controlled to prevent overload of the second mixer and the following 40 kHz IF stages. Most of the receiver gain takes place in the 40 kHz IF amplifiers which, to prevent ringing, use minimal LC selectivity. The output of the 40 kHz IF amplifier is then fed to the DSP portion of the radio, where the digital selectivity and processing take place. In the case of the 505DSP, the center IF frequency is a 40 kHz signal. The receiver IF strip has a bandwidth of 15 kHz at the maximum attenuation points, which means that signals ranging from 32.5–47.5 kHz are presented to the A/D converter. If we now choose a sampling frequency of 31.25 kHz, the center frequency will be translated down to 8.75 kHz (40–31.25). The string of signals is analyzed and processed at the 31.25 kHz rate, which is lower than the 40 kHz signal frequency. But as SSB signals require only about a 3 kHz bandwidth, we can bandpass filter again and again, reducing the sampling rate to as low as twice the bandwidth. By reducing the passband width, so we can reduce the sampling rate. As a result, digital filters may be narrowed down to previously unheard-of bandwidths without the ringing associated with crystal and mechanical filters—as low as 100 Hz, in fact, as in the 505DSP.

Two synthesizers provide low phase noise injection voltages to the mixers, which translate signals to and from the 75 MHz and 40 kHz IF amplifiers. The first local oscillator is a state-of-the-art DDS/PLL hybrid with a basic tuning step of less than 0.5 Hz. Control software, however, limits the user to 1 Hz steps. The second local oscillator is a VCXO. It supplies fixed-frequency injection to the second mixer. Both local oscillators are phase-locked to a common, precision, reference oscillator.

The reference oscillator is microprocessor-compensated against temperature. A DC voltage supplied by the DSP part of the circuit allows the reference oscillator to be calibrated against a reference signal (WWV, for example).

Product detectors and balanced modulators are mixers (IF and BFO signals mixed to produce an audio signal; microphone and BFO signals mixed to produce an IF signal). These are further mixers in a chain of mixers. DSP uses the phasing method to produce SSB. One sideband of a double sideband signal is phase-canceled, the other reinforced—the method used in the old phasing rigs, except that in DSP, the phase shift is constant with frequency. No mechanical carrier balancing is involved. The opposite process takes place in the receive mode.

**General specifications**

Frequency coverage, Tx: 1.8–2.0, 3.5–4.0, 7.0–7.3, 10.1–10.15, 14.0–14.35, 18.068–18.168, 21.0–21.45, 24.895–24.995, 28.0–29.7 MHz
Frequency coverage, Rx: 0.1–30 MHz
Frequency stability, short term: Can be automatically calibrated to within ±10 Hz of WWV or other external standard
Modes: USB, LSB, AM, CW
Power requirements: +13.8 V DC nominal; 25 A maximum (Tx), 2 A maximum (Rx)
Operating temperature range: -10° to +50° C
Transceiver dimensions/weight: Length, 32 cm. Height, 29.5 cm. Width, 1.5 cm. Weight, 5.27 kg. (12.5 x 11.5 x 4.5 inches, 11.6 lbs.)
Control head dimensions/weight: Length, 17.5 cm. Height, 4.5 cm. Width, 5.0 cm. Weight, 0.58 kg. (6.8 x 1.75 x 5.85 inches, 0.26 lbs.)

**Receiver**

SSB sensitivity: 0.18 µV (2.4 kHz filter, 10 dB SINAD, preamp on), 0.35 µV typical (2.4 kHz filter, 10 dB SINAD, preamp off)
AM sensitivity: 0.6 µV (preamp on), 1.0 µV typical (preamp off)
Audio power (5 µV input): >2 W into 8 Ω, >4 W into 4 Ω
Spurious rejection: >80 dB
Image rejection: >80 dB
IF rejection: >80 dB
3rd-order intercept point: +18 dBm typical @ 20 kHz (preamp off)
3rd-order IMD dynamic range: 96 dB typical (preamp off)
2nd-order intercept point: +49 dBm typical
Blocking dynamic range: 115 dB typical @ 20 kHz (preamp off); 118 dB typical @ 50 kHz
Audio THD: <5% @ 2 W into 4 Ω
Manual notch depth: >-50 dB

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**Transmitter**

Output power: SSB, 100 W ±dB into 50 Ω; AM: 25 W carrier nominal
Spurious harmonics: <60 dBc @ q00 W into 50 Ω
Carrier, opposite sideband suppression: SSB: <-55 dBc
CW keyer speed: 5–80 wpm, adjustable

and a full list of keyboard shortcuts that can be turned on or off.

That's all there is to it. The whole rig can be controlled from this simple, easy-to-read control panel. To upgrade the control panel to the newest, most advanced version, all you need to do is download it from Kachina's Web site on the Internet.

The software that is used at present to control the Kachina 505DSP is 16-bit Win 3.xx-compatible. The reason for this is that Kachina wants the software to run on any machine down to a 386 with 4 Mb of memory. They are working with other developers, and it should not be difficult to have OS and hardware-optimized software for the 505. Kachina is also planning to work with third-party developers to create software linking with Logging and HF Data software to produce an integrated station software concept.

Firmware upgrades are fully accomplished by inserting PCMCIA type-2 cards into the two slots on the processor board. Kachina will provide these as part of their upgrade policy, which means you will be able to completely upgrade firmware for the cost of the


***Photo D.*** *For the hard-core knob twisters, Kachina offers an optional main tuning control.*

card. They chose this method to provide ease and control of upgrade installation, and ensure speed compatibility with the 21 MHz processor in the CPU. In addition, because the 505DSP is constructed more like a computer with its plug-in card bays than a traditional HF rig, even major replacements and repairs can be accomplished by swapping cards, instead of sending in the radio. Another aspect of the rig that brings to mind computers is the rear panel. All connectors other than the two antenna PL-259 connectors are either subminiature D-type computer or modular phone-type connectors. The ACC1 connector provides for TNC, phone patch, PTT, and related audio connections. ACC2 allows for an external automatic antenna tuner, and ACC3 provides for interface with a power amplifier. In addition, an RJ12 modular connector can be used to operate the rig with the computer and rig separated by up to 75 feet.

The 505DSP uses a double conversion receiver with IF stages at 75 MHz and 40 kHz. The DSP operates at 40 kHz before the AGC and is the highest frequency IF-based DSP on an amateur transceiver. The transmitter also uses DSP for phase-canceled sideband suppression. All filtering is DSP-based, thus eliminating the need for expensive optional crystal filters. Kachina does not supply a schematic with the radio, but a free one can be obtained by sending a request to the manufacturer. An explanation of the rig's operation can be seen in the sidebar "Inside the 505DSP."

Since the front panel of the 505DSP is your computer keyboard and screen, a short tour of the software is necessary to get the hang of things. The Help menu is adequate in getting you started. The only thing I missed was the ability to print out all or part of the menu, so I would not have to bounce back and forth between help windows. I have included an in-depth look at the supplied software (version 2.21) in the sidebar "On the Menu." I found the software easy to use, but was only able to operate the rig with the speed of a nonvirtual radio after I had taken the time to learn the keyboard commands.

Using the 505 to full potential takes a bit of learning. The curve is not high, but to get the speed and agility necessary for contests or jumping into a DX pileup, it is necessary to know what keys to press without having to refer to the help or shortcut menu. I found after I had mastered these skills, I was able to perform DSP, tuning, and split functions with a few key clicks that made operation actually faster than reaching out and twisting knobs or going into the arcane menu systems of conventional rigs.

The only operation that I found a little difficult to get used to was tuning without a knob. After years of having that large flywheel control to rock back and forth when trying to dig that elusive DX out of the noise, up/down arrows proved a bit difficult. The bottom line is, even old hams can learn new tricks, and by the time I sent the rig back I was up/down tuning on the Kachina with the best of them. Kachina, in recognition of the ham/tuning knob fetish, has developed an accessory tuning knob that sits on your operating desk and connects to a spare Com port on your computer. This accessory should be shipping by the time you read this review.

Operation of the 505DSP proved to be a joy. Though I was expecting a high-quality rig, I was still pleasantly surprised by how well the receiver performed. I was able to use the rig in the

## On the Menu
## (a look at the 505DSP control software)

Since the front end of the Kachina is your computer—instead of an array of knobs, buttons, and switches—to provide an effective discussion of the radio's functions it is necessary to include a software review to make this article complete.

Here are the basic Menu Bar functions (almost every Menu Bar function has an equivalent "hot key," so it is not necessary to go into the menus with the mouse to control the radio).

### Filters menu

The Filters menu provides access to DSP bandpass filtering at 3.5 kHz, 2.7 kHz, 2.4 kHz, 2.1 kHz, and 1.7 kHz for SSB; and 1 kHz, 500 Hz, 200 Hz, and 100 Hz for CW. This, plus two data filters, eliminates the need for costly crystal filters. IF shift, manual, and automatic notch with three variable notch widths are also available in the filter menu.

### Tx menu

The Tx menu allows you to vary transmit frequency, mike gain, power out, speech monitor, audio monitor, vox controls, amplifier on/off, and transmit equalization.

### Rx menu

The Rx menu includes direct frequency entry, a bandswitch, AGC speed, attenuator, squelch, noise reduction controls, and RIT.

### Ant menu

Ant menu allows you to retrieve and display your antenna impedance data in the form of a Smith Chart for each of the HF bands, engage the automatic antenna tuner, and select the antenna you wish to use for each band (antenna port A or B).

### CW menu

The CW menu gives operator access to the CW keyer functions of QSK or semi break-in, speed, dynamics, weight, and sidetone level. CW functions, including CW filter default, left/right/straight key options, nine transmit message buffers, and a "live type" CW feature which allows direct keyboard-to-CW entry.

### Meters

Meter selection of the two digital meters includes receive meter calibrated in S-units, volts, or dBm; and transmit meters calibrated in forward power, reflected power, ALC, and SWR.

### Channels

The Channels menu provides interface to the memory functions of the 505. The recall command will open a window with 100 memories capable of storing Tx/Rx frequency, mode, AGC setting, and filter settings. These memories are divided into five groups, and can be scanned using varying dwell time and squelch hold. Memories can be saved, printed, and cleared through menu choices, and a specified frequency range can be scanned in user-defined frequency increments.

### Special

The Special menu is the largest of the pulldown menus and allows access to a multitude of the 505's software features. The user can access the internal logging program and lock controls; change tuning and slider rates; set the clock; monitor heat sink temperature; calibrate the receiver; and do a selective frequency sweep. The last two functions are quite interesting. The frequency calibration allows the user to input a standard frequency (I used WWV) and then let the radio tune to that frequency and perform an internal calibration against the reference frequency. The frequency sweep allows the user to select a frequency and ± deviation and then do a signal or continuous sweep, creating a graph of band activity. The resultant graph can then be clicked on to move the receive frequency to any source of band activity.

### Help

The Help menu "is" the manual. It provides a complete on-line description of all radio functions and menus as well as a searchable index. The Help menu also allows for the continuous display of all shortcut keys, which makes learning

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keyboard commands a lot easier. Help selections are broken down into subcategories which include: tuning, buttons, slide bars, shortcut keys, main menu, function keys, user's guide, and Com port setup instructions. The function keys provide 16 user-definable settings.

**Quit**

Quit exits the 505 control program.





ARRL International DX SSB Contest, and was very impressed by the DSP filtering. The Kachina, with filters set to 1.7 kHz and tuning steps set at 100 Hz, allowed me to tune up and down the crowded 15- and 20-meter bands as if I were working a channelized rig. By using a combination of DSP filtering, IF shift, notch, widely variable AGC, and noise reduction, I was able to tune and work weak stations in the midst of the SSB chaos that occurs in a contest. I was very impressed with the rig's computer-based contest potential. The only thing lacking at this time to make the 505 a viable contest alternative is the need for third-party software to be integrated with the control software to automate contest data entry.

Day-to-day operation of the 505, away from the hubbub of a crowded contest weekend, proved to be pure joy. I made many QSOs with the rig and received excellent reports on audio and signal clarity. I spent a few Sunday mornings on my regular sked with Bob Moss W3GJQ (who is quite a bit more into SSB audio than your average ham) and worked to optimize the audio sound of the Kachina. Out of the box, with the supplied hand microphone and factory audio settings, the rig sounded good, but with a little fiddling, and constructive feedback from Bob, I was able to get the rig sounding *great*. We were only able to speculate about how the rig might have sounded with a high-end microphone driving it. I did, during the time I had the radio, speak to other Kachina operators, including Doug Smith KF6DX at the Kachina Club Station in Arizona, and was singularly impressed with the audio quality of the radio. My only complaint at the time of this writing is with the speech processor. Although the processor does perform its appointed function of increasing the apparent signal for working weak-signal stations or pileups, I found the audio quality with

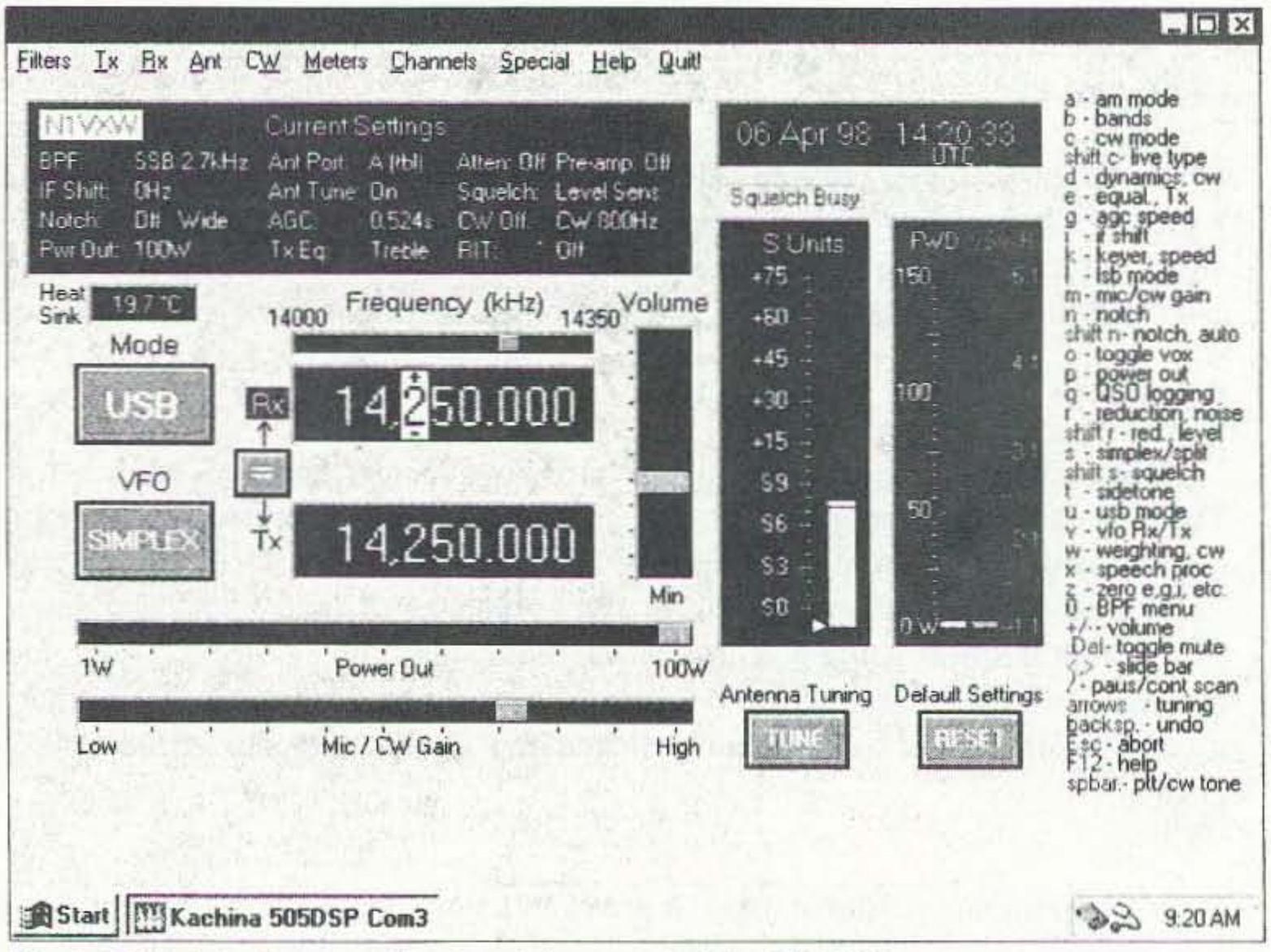


***Photo E.*** *This is the versatile virtual front end of the 505DSP.*

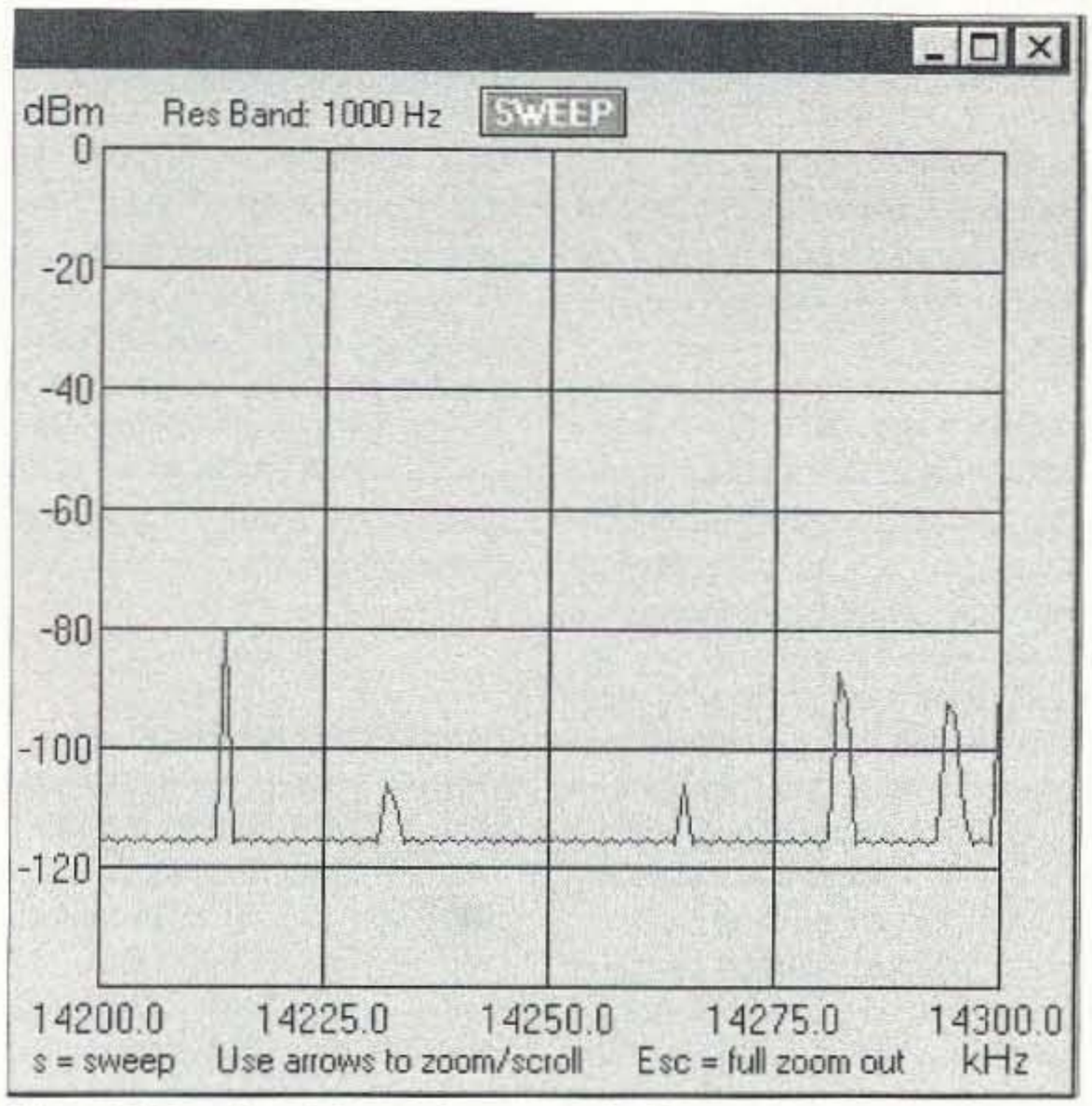


***Photo F.*** *Band activity is shown on the Sweep screen.*

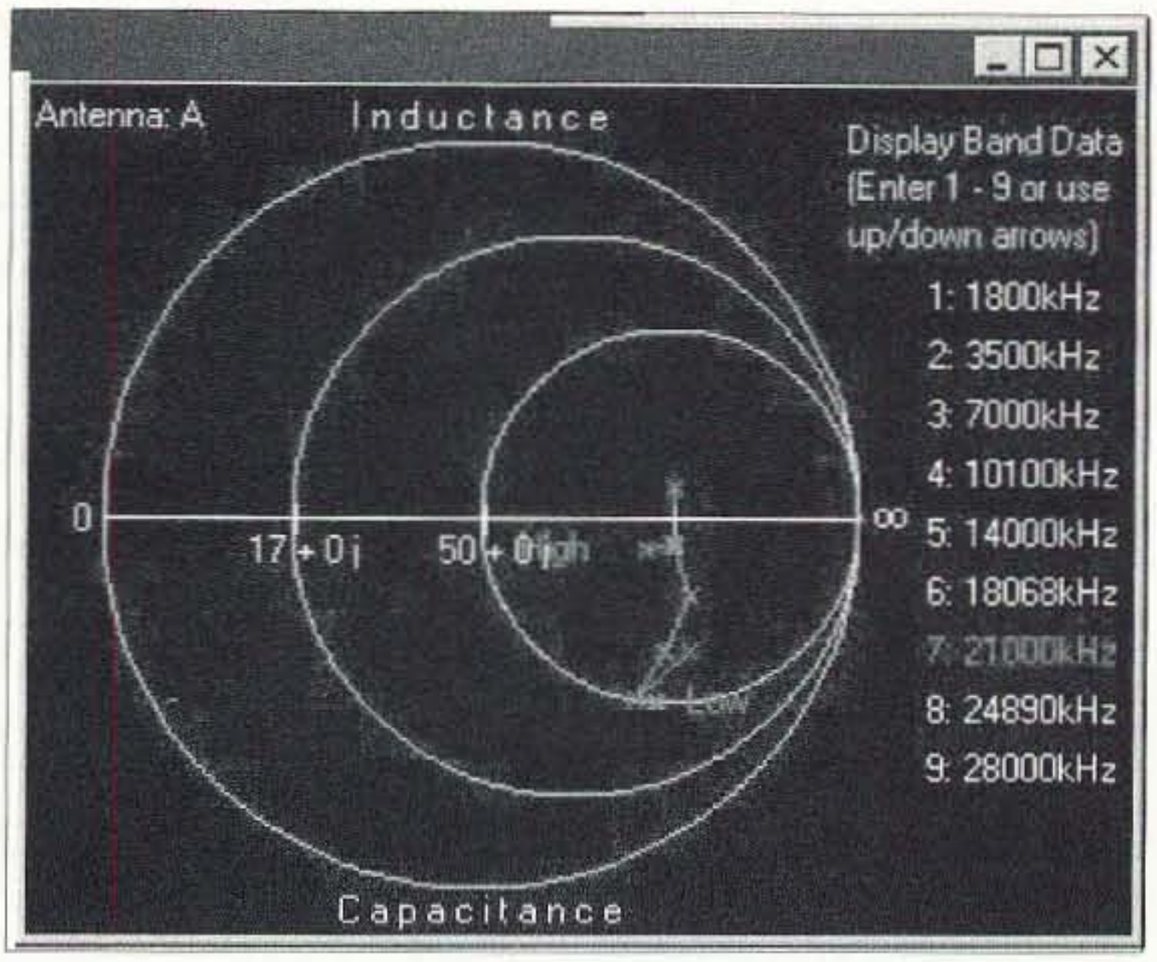


***Photo G.*** *Antenna LC data is displayed on a band-specific Smith Chart.*

the processor on to be a little rough, and left it off except when needed. Kachina informed me that they were working on this, and a modification was forthcoming.

CW operation on the Kachina proved to be a very pleasant experience. Menu selection lets you set up your paddle for left- or right-hand operation, speed, weight, and dynamics. All controls are accomplished from the two soft faders and allow the operator to tailor his CW signal to individual tastes. Sidetone frequency and level can be set from the menu, which I find a real plus (owning an 80-pound rig that requires picking up and the use of a screwdriver simply to adjust sidetone level). In addition, the software supplied with the 505 lets the operator type directly into the rig to produce CW. This feature is fun and also allows messages of up to 59 characters to be stored in nine memory buffers.

Other features of the Kachina include a band scope that will sweep a predefined portion of the spectrum for signal activity. Though the sweep requires a momentary muting of the receiver audio, the resultant graph allows the operator to jump from signal to signal by simply clicking the mouse on the graph. Refresh rates and sweep parameters are controlled by software; all in all it is the best software-based band scope I have seen to date for amateur equipment.

Another software plus is the Smith Chart feature. The antenna tune function on the radio not only remembers the tune setting for previous frequencies, but also applies the data to a band-specific Smith Chart that can be used to analyze the characteristics of any antenna connected to the 505. The antenna tuner is quick, quiet, and fast. Kachina rates it as being able to tune any antenna up to a 3:1 SWR, and that proved to be true with the antennas I connected to the 505. One of my favorite features was the Snapshot Keys. By pressing a combination of F1 through F8, shift and control, you are able to take 16 different memory snapshots of current receiver settings and assign them to "F" keys. This beyond-quick memory function has uses that are only limited by the imagination of the operator. Another plus is the backspace key. Imagine being able to undo the last 10 changes you made to the parameters of your radio!

When all is said and done, the Kachina 505DSP proves to be a very capable first effort from a company that has been supplying commercial and military communications equipment for a long time. The radio, in my opinion, provides a high value per dollar when compared to similarly priced radios, in that the front panel controls are in your computer, letting the manufacturer invest the cost difference in technology. The ability to upgrade control software or use or write custom software, combined with low-cost PCMCIA card firmware upgrades, makes this a rig that can grow and last into the future without being obsolete out of the box.

For more information, check out the Kachina Web site at [www.kachina-az.com]. The Kachina 505DSP HF transceiver is manufactured by Kachina Communications, Inc., P.O. Box 1949, Cottonwood AZ 86326. Telephone (520) 634-7828; FAX (520) 634-8053; E-mail [KACHINA@sedona.net]. Price, $1995. With antenna tuner, $2234. 73

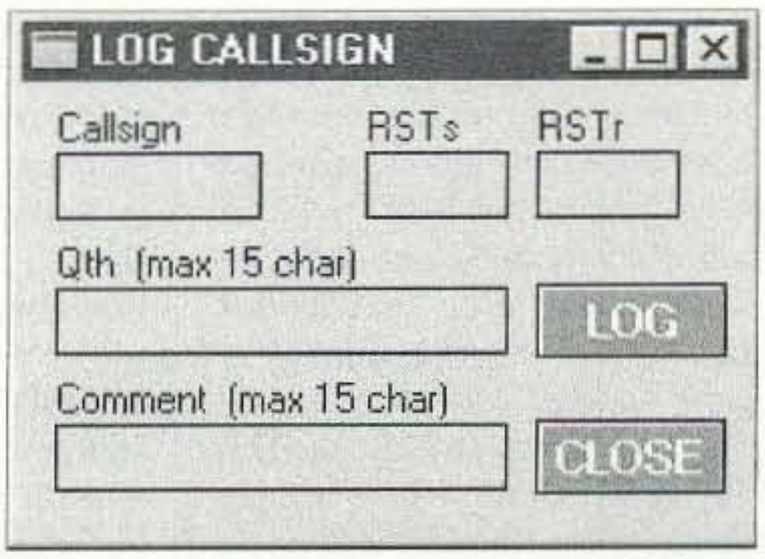


***Photo H.*** *The 505DSP software includes a basic logging program.*