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Patcomm PC-16000 HF Transceiver

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With the primary exception of Ten-Tec, US hams have gotten used to looking to the Far East—not the East Coast—for the latest HF transceiver. So it was no small surprise when an upstart Long Island company not previously associated with ham radio equipment and an unknown quantity within the amateur community showed up at the party with a new HF transceiver that offers considerable promise and a few features not available on the offshore rigs. This Patcomm gang has gotta be swimming upstream, right? Of course, the mere fact that the product is made in the US has attracted a certain degree of favorable attention from those who long for the likes of Swan, Heath and Hallicrafters.

We bought our first PC-16000 about a year ago, but we encountered testing problems with that and other early units, and the product seemed to be still under development. After checking out a couple of interim versions, we're back to the first one, refurbished and updated. Patcomm upgraded the firmware in our review unit last spring, partly in response to some anomalies we spotted during preliminary testing (mainly, that the earlier firmware would not permit split-frequency operation beyond about 90 kHz and would sometimes display the incorrect frequency).

In addition, Patcomm has done some other fine tuning on its first major ham radio product (a PC-1610 preceded the PC-16000). The company changed out the PA and LPF boards to increase power output on the high end of 10 meters and to improve harmonic rejection on 160 meters (two problems we'd noted in earlier versions of the radio). Patcomm also switched to a new frequency reference in its PLL board to increase frequency stability and accuracy. The manufacturer also redesigned the cover for a better "look." Earlier, the company added another decimal point to the frequency readout for ease of readability. The radio's firmware also was modified to allow the 500-Hz IF filter to be used in RTTY or ASCII modes. FM, which is to be offered as an option, still was not available as this review went to press.

We rescheduled the PC-16000 for a review in the hope that Patcomm now has a better handle on manufacturing quality and design issues, and that hardware and software development both have stabilized (although the company has continued to tweak the design). And, frankly, given the often fleeting lives of many new companies, we wanted to be sure Patcomm would still be around to support this product.

The PC-16000 certainly is an ambitious effort, especially for a company that's trying to break into the ham radio market and position its debut product among a field of fierce mostly overseas competitors. Let's see how well it works and explore its chances of success.

What is the PC-16000?

It's probably safe to say that the Patcomm PC-16000 is *not* like any other ham radio HF transceiver on the market today. For starters, it doesn't *look* very much like the ham gear most of us have come to expect. This is a fairly deep, low-profile box with a small heat sink on the rear apron. Many small, white pushbuttons (31 in all) occupy a good chunk of the front panel—about one-third of it. Among other things, these allow direct frequency entry and control most other transceiver functions such as changing bands and switching in DSP filters. Consensus was that the pushbuttons Patcomm used had an unfinished look, as though they were designed to have key caps applied. The front-panel legends that describe their functions are very tiny and difficult to read.

A smallish, machined aluminum **MAIN TUNING** dial with a spinner handle is located centrally, right beneath a two-line backlighted LCD display window that's smaller than the displays on many mobile transceivers now on the market. Engaging the **VST** (variable speed tuning) button just to the left of the **MAIN TUNING** knob means the faster you turn, the faster you tune. When **VST** is off, the radio returns to fixed 10-Hz tuning steps. A tiny, horizontal **S METER** is to the right of the display window. Below the meter are six identical rotary controls with small machined aluminum knobs to adjust common functions: **IF SHIFT**, **NOTCH**, **AF GAIN**, **RF POWER**, **SENSITIVITY** and **MIC GAIN**. We thought at first that the **SENSITIVITY** knob was an RF gain control; it's not. It's to set the input threshold level for digital modes—to minimize garbage during non-signal periods.

Convenient jacks for **PHONES**, **KEY**, **PADDLE** and **MIC** take up the extreme righthand side of the front panel.

The PC-16000 is microprocessor controlled. It covers all HF bands from 160 through 10 meters and has general-coverage receive. Mechanical IF filters for SSB and CW are standard. The PC-16000 also offers DSP filtering and noise-reduction.

BOTTOM LINE

A noble first effort from a US manufacturer, the PC-16000 offers some capabilities no other transceivers do. The latest version incorporates several changes that made significant performance improvements.

Table 1
Patcomm PC-16000, serial number 0617B0038

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency coverage: Receive, 1.5 to 29.9 MHz; transmit, 1.8-2, 3.5-4, 7-7.3, 10.1-10.15, 14-14.35, 18.068-18.168, 21-21.45, 24.89-24.99, 28-29 MHz.	Receive, as specified, transmit, as specified, except 28-29.7 MHz.
Modes of operation: SSB, CW, AM, FM (option), RTTY.	As specified.
Power requirements: Not specified.	Receive, 1 A; transmit, 21 A, tested at 13.8 V dc.
Size (height, width, depth): 4.25×14.5×15.25 inches; weight, 14.75 pounds.	
Receiver	*Receiver Dynamic Testing*
SSB/CW sensitivity, bandwidth not specified, 10 dB S+N/N: 0.25 µV.	Minimum discernible signal (noise floor), 500 Hz filter: 3.5 MHz –123 dBm 14 MHz –128 dBm
AM sensitivity: Not specified.	10 dB (S+N)/N, 1-kHz tone, 30% modulation: 1.5 MHz 7 µV (–90 dBm) 3.8 MHz 3.2 µV (–97 dBm)
Blocking dynamic range: 111 dB.	Blocking dynamic range, 500 Hz filter: 3.5 MHz 96 dB* 14 MHz 103 dB*
Two-tone, third-order IMD dynamic range, 20 kHz spacing: 103 dB.	Two-tone, third-order IMD dynamic range, 500 Hz filter: 3.5 MHz 79 dB* 14 MHz 86 dB*
Third-order intercept: Not specified.	3.5 MHz –4.0 dBm 14 MHz +1.5 dBm
Second-order intercept: Not specified.	+49 dBm.
S-meter sensitivity: Not specified.	S9 signal at 14.2 MHz: 50 µV.
Receiver audio output: 2.5 W at 10% THD into 8 Ω.	1.8 W at 10% THD into 8 Ω.
IF/audio response: Not specified.	Range at –6dB points, (bandwidth): CW-N (500 Hz filter): 546-1056 Hz (510 Hz) CW-W: 311-1821 Hz (1510 Hz) USB-W: 344-2026 Hz (1682 Hz) LSB-W: 312-1809 Hz (1497 Hz) AM: ±395-2768 Hz (4746 Hz)
Spurious and image rejection: Not specified.	First IF rejection: 55 dB. Image rejection: 79 dB.
Transmitter	*Transmitter Dynamic Testing*
Power output: SSB, CW, RTTY: 100 W; AM, 40 W.	As specified.
Spurious-signal and harmonic suppression: 45 dB.	43 dB. Meets FCC requirements for spectral purity for equipment in its power output class and frequency range.
SSB carrier suppression, 1 kHz tone: 40 dB.	As specified.
Undesired sideband suppression, 1 kHz tone: 45 dB.	37 dB.
Third-order intermodulation distortion (IMD) products: Not specified.	See Figure 1.
CW keyer speed range: 5-75 WPM.	As specified.
CW keying characteristics: Not specified.	See Figures 2 and 3.
Transmit-receive turn-around time (PTT release to 50% audio output): Not specified.	S9 signal, 60 ms. This unit is not suitable for AMTOR (see text).
Receive-transmit turn-around time (tx delay): Not specified.	SSB, 50 ms.
Composite transmitted noise: Not specified.	See Figure 4.

Note: All dynamic range measurements are taken at the ARRL Lab standard spacing of 20 kHz.
*Measurement was noise-limited at the value indicated.

The PC-16000 can operate on CW, FSK, SSB, or AM (FM is an option). It has an RF-level speech processor, something not often found in transceivers selling in this price range. Transmitter output is rated at 100 W PEP on SSB, 100 W carrier on CW, 75 W on RTTY, and 40 W on AM.

Unlike any other transceiver on the market today, the PC-16000 can be completely controlled via an AT-style computer keyboard *without* the benefit of a computer. It's also the first transceiver that lets you send and receive RTTY or CW from the keyboard without the need for either a computer or a TNC. Everything you need is built in. You can switch among three antennas connected to the rear panel. Auxiliary DIN jacks also let you connect external devices, including I/O to a computer or mark and space signals to an oscilloscope.

Inside the Box

Patcomm says the box contains two 8-bit microprocessors that control the transceiver. The unit combines direct digital synthesis (DDS) and phase-locked loop (PLL) techniques to generate VFO signals. CW and FSK signals are generated by a DDS VFO.

The receiver is an upconverting, dual-conversion design with IFs at 45 MHz and 455 kHz. The 45-MHz crystal roofing filter is 7.5 kHz wide. Patcomm uses 2.4 kHz and 500-Hz Collins mechanical filters in the second IF stage (an optional 1.8 kHz IF filter is available). A separate 4-kHz ceramic filter is used for AM. All DSP is at baseband (audio) level.

The transmitter uses two 100-W bipolar transistors in the power amplifier stage. Patcomm says there is no cooling fan because the finals are rated well above the transceiver's typical output power, and the chassis and heat sink can easily dissipate the heat.

Standard offsets are programmed into the radio's firmware. For CW, this is fixed at 800 Hz. In RTTY (FSK), the transmit

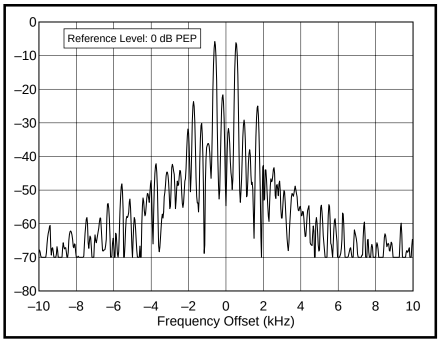

Figure 1—Worst-case spectral display of the PC-16000 transmitter during two-tone intermodulation distortion (IMD) testing. The worse-case third-order product is approximately 25 dB below PEP output, and the worse-case fifth-order product is approximately 43 dB down. The transceiver was being operated at 100 W output at 18.120 MHz.

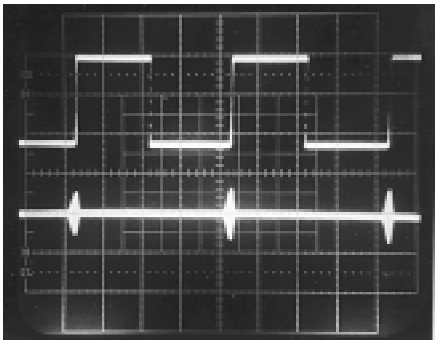

Figure 2—CW keying waveform for the PC-16000 showing the first two dits in full-break-in (QSK) mode using external keying. The equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output at 14.2 MHz. The CW waveform is practically missing at this speed.

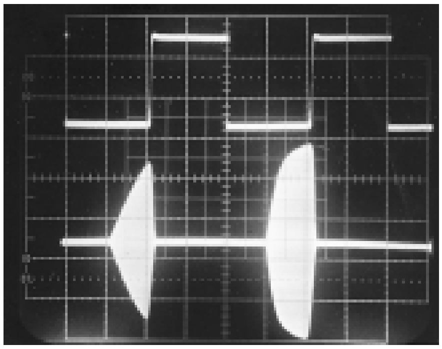

Figure 3—CW keying waveform for the PC-16000 with revised firmware installed to reduced the excessive delay. This shows the first two dits in full-break-in (QSK) mode using external keying at an equivalent keying speed of 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output at 14.2 MHz. Note some shortening of the first dit, which does not reach full output.

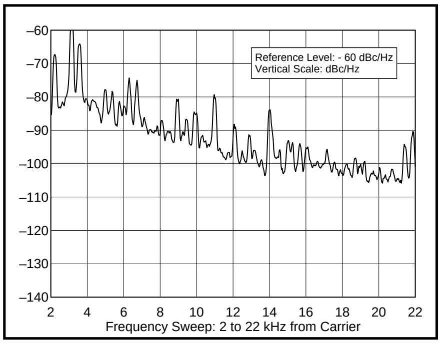

Figure 4—Worst-case tested spectral display of the PC-16000 transmitter output during composite-noise testing. Power output is 100 W at 3.5 MHz. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 2 to 22 kHz from the carrier. We tested a more recent unit, and it was greatly improved in terms of composite noise (see text).

frequency is 2290 Hz lower than the receive frequency. Of course, you can use the **RIT** or **SPLIT** buttons to temporarily customize offsets.

We took a peek inside the PC-16000. Construction seemed to be very clean, straightforward, and professional. Some of the boards included surface-mounted devices, but not all components were SMD. One interesting item was the speaker, which is attached to the sturdy top cover. It's a Delco five-inch, 4-Ω dual-cone unit rated at 90 W and designed for car stereo systems. While it's rather underdriven at approximately 2 W, it certainly sounds nice.

Controlling the PC-16000

You've got two main choices to control the PC-16000: the conventional method using the front-panel buttons and knobs or the keyboard, which is just like the one you'd find on a typical IBM-compatible PC. The keyboard will control just about anything you can adjust using a front panel control. The keyboard plugs in to the back panel and works as the *Instruction Manual* specifies, although we found ourselves using the front-panel buttons and knobs mostly. This is the kind of change that might grow on you, however. At times, we found ourselves wishing for custom radio-control legends on the keyboard—to save repeated trips to the manual. Perhaps Patcomm could work up a simple keyboard template of the sort that software companies used to ship with their word processing programs. Then, you could affix it to the keyboard for quick and easy reference.

If you're going the old-fashioned (ie, non-keyboard) route, you'll want to take some time to get familiar with the front-panel buttons on this radio before attempting to actually put it on the air. It's not terribly intuitive. We found we needed to spend some time with the *Instruction Manual* and, well, just pushing buttons to see for ourselves how they worked. Most buttons have two or three functions assigned to them. For example, one key serves as the 12-meter band select button, as the numeral "8" for direct frequency entry, and as the **KEY SPEED** button. The manual is oriented toward operating the radio from the keyboard, and does not include a diagram to explain how each of the buttons works. A separate, introductory brochure that Patcomm supplied us, however, does spell out the button functions. Patcomm says it now has made this helpful brochure part of the *Instruction Manual*.

Buttons are grouped by function. There's a **MODE** group and a **MEM** group, for example. Tiny LEDs light up to indicate which bandpass and mode selections the operator has made. The radio recalls these bandpass—and mode—settings when you return to a given band, too.

Filter Features

As on most other transceivers, the Digital Signal Processing (DSP) functions in this radio are at audio level. This is spelled out in the manual. DSP is always on in the PC-16000. It has five DSP bandpass filters with bandwidths of 2.4 kHz, 1.8 kHz, 500 Hz, 250 Hz and 200 Hz (for RTTY and ASCII). All are available from front-panel buttons or via the keyboard. The DSP filters work in concert with the two standard Collins Mechanical filters, and filters operate independent of mode. For example, when you push the button to engage the 1.8 kHz filter while operating SSB, the radio is using the 2.4 kHz Collins mechanical filter plus the 1.8 kHz DSP filter. Push the 250 Hz filter button on CW and you're using the 500-Hz Collins mechanical filter and the 250 Hz DSP filter. The narrow DSP bandwidth filters work well, but they can impart a hollow sound to the audio (not unusual among external DSP boxes). This is not true at the wider bandwidth settings.

There's also a DSP noise-reduction system, which Patcomm calls a "de-noiser." We found this to be effective some times, not so effective other times. The de-noiser worked well when listening to a moderately weak signal as compared to a stronger signal, for example.

The radio also includes an auto notch that's capable of notching multiple tones. We found it works well to kill those pesky carriers on 40-meter phone at night. As the manual points out, however, since the DSP is at audio, the receiver still reacts to the presence of any strong signals in its passband, and these will continue to show up on the S meter and in the AGC loop. There's also a manual notch that also operates at audio, not IF. It worked about as well as any other we've tried.

The DSP in the PC-16000 is seriously limited in comparison to other transceivers in this price class, however. The auto notch and de-noiser only work with the 2.4 and 1.8 kHz filters, and they cannot be used at the same time! You can still use the manual notch, but it is only available from the front panel, not via the keyboard.

CW and RTTY Decode

As we said, the PC-16000 can decode CW or RTTY right out of the box. You don't need a TNC or a computer. The decoded text shows up along the top of the 15-character display.

On CW, we found this works pretty well, provided you've tuned in a signal that has a good signal-to-noise ratio. Basically, it's up to the operator to tune the signal in properly, discern the approximate CW speed, and adjust the key speed accordingly. We were able to copy W1AW transmissions on 160 meters—once at 20 WPM and once at 30 WPM. Even on a strong signal, copy was not perfect, but that's also the case on some external TNCs we've tried.

At a distance of several miles from the transmitter, we found it necessary to use the transceiver's attenuator (push the front-panel **ATTENUATE** button) to get the CW decode function to work on the strong W1AW signal. It requires some perseverance to first tune in the signal, but the front-panel **MARK** and **SPACE** LEDs were a help. The idea is to get the **SPACE** to appear to blink while the **MARK** LED stays lighted longer. We used the 500-Hz filter setting at first, then the 250-Hz setting.

As the manual indicates, the CW decoder will lock onto a received signal in a range that's ±5 WPM of the sending station's speed. Once tuned in at 20 WPM, for example, we were able to change the key speed ±5 WPM and still be able to decode the CW sent by W1AW.

The trick, however, is to first center the signal in the receiver's passband, then press the **KEYSPEED** button and use the keyboard cursor (arrow) keys to adjust the displayed received speed to something that approaches the actual keying speed. This is sometimes easier said than done. But, once you discover the CW speed at which the radio will begin to decode the CW, you're all set.

By the way, the PC-16000 is capable of full-break-in (QSK) CW.

Similarly, the RTTY decoding function worked well when we tried copying W1AW RTTY bulletins. Tuning is critical, however, and requires patience. The **MARK** and **SPACE** LED's are helpful, but hooking up an external 'scope via the back panel connector would, no doubt, make life much easier when trying to properly tune RTTY signals to allow the decoder to do its work. (By the way, it would be nice if there was a way to turn off the **MARK** and **SPACE** indicators when using other modes. They can be distracting when you're just tuning around a band.)

About Patcomm

Who's Patcomm? That was the question of the day when this US manufacturer based in St James on New York's Long Island introduced the Patcomm PC-16000 just over a year ago.

Patcomm's President Frank Delfine, WB2UJS, has been a ham for more than 30 years now. The company he heads has been around for approximately six years. Before his company decided to enter the ham radio market, Delfine says, it was "basically a consulting company" for RF and digital design and development work. Previously, Delfine was the design engineer for Symbol Technologies, a well-known manufacturer of barcoding equipment.

Patcomm is a small operation. The company employs between seven and ten people. All of the product fabrication is done on Long Island, but Delfine says some of the work—such as surface mounting—is jobbed out to a local contractor.

As this review went to press, Patcomm had begun serious development work on a second product for the Amateur Radio market—the PC-9000 transceiver. This will be a smaller radio, suitable for mobile or portable use, that will cover all HF bands and, optionally, 6 meters. Delfine says it will put out either 40 W or 5 W and will be quite a bit smaller than the PC-16000. It will have the ability to send CW from a keyboard. CW and RTTY decode and RTTY transmit will be an option. Delfine says Patcomm hopes to offer the PC-9000 in the "under-$800 price class."*—Rick Lindquist, N1RL*

To send RTTY, the PC-16000 has nine message buffers (eight of them can be saved) that hold up to 256 characters each. You can use these or—by pressing the **T/R TUNE** button, send directly whatever you type on the keyboard. There is a main RTTY Menu function that allows you to change RTTY (and ASCII) settings—parameters such as shift and baud rate, for example.

The downside of the CW or RTTY decoding features is that you read the data off the small display. This is where connecting the unit to a computer would certainly be an advantage. The rear-panel connections let you send serial data to a terminal or a PC running a terminal program. Then, you can read the decoded RTTY or CW off the bigger screen and also see what you're transmitting. This works great, and it's much easier on the eyes.

The PC-16000 also can decode ASCII transmissions. Patcomm says it hopes to add AMTOR and PACTOR support to the PC-16000 in the future. Turnaround delays (see Table 1) on our PC-16000 were too great for AMTOR or similar handshaking modes, however. To correct this, the manufacturer says it's reduced these delays to 30 ms or less.

Other Features

This is the only HF radio we've run across that provides *three* antenna ports and also lets you transmit and receive on separate antennas (such as a Beverage for low-band DXing). This is a great feature, although you can't use QSK while employing separate transmit and receive antennas. In the ARRL Lab, we measured 66 dB isolation between the separate antenna ports.

The PC-16000 can display your power output and SWR. Unfortunately, you lose the frequency or decode display when you activate that function. The display shows peak power on SSB. The default display also can show 24-hour time—a nice touch.

The radio includes 100 memories, segmented into 10 memories per band and 10 set aside for general coverage use. There's also a scratchpad memory.

Pressing Alt+F from the keyboard will send the current transmit and receive frequencies in Morse code. There's also an ID timer (Alt+T from the keyboard) that reminds you to identify by sending four beeps every 10 minutes.

On the Test Bench

We ran into difficulty right away when setting up the PC-16000 for testing in the ARRL Lab. The radio appeared to be going into oscillation when we'd attempt to transmit on some bands. Patcomm came to the rescue here. It turns out that the radio needs to have at least 12.8 V dc to the back panel. Voltage drop in the manufacturer's power cable was enough so that just 12.1 V was showing up at the back panel at full load. Shortening the power cable cured this problem. Patcomm says it has experienced voltage drop related to its use of in-line fuses and has replaced them with automotive-type blade fuses.

Our Patcomm PC-16000 failed to meet some of its manufacturer's rather ambitious specifications, which Patcomm now concedes it should have called "typical" numbers instead of hard-and-fast specs. Some of the discrepancies were fairly minor ones—1.8 W of audio instead of the specified 2.5 W (Patcomm says 2 W is "typical"), for example, or –43 dB of spurious signal and harmonic suppression instead of the –45 dB that Patcomm specified. Other discrepancies between the specifications and our Lab results, however, showed up on parameters that discerning hams scrutinize closely when comparing one transceiver to another.

Patcomm set the bar pretty high with its dynamic range specifications. The actual numbers were much more mediocre, and all were noise-limited (we discovered that, from a phase-noise standpoint, our PC-16000 was pretty noisy; see Figure 4). What this means is that the synthesizer noise limited the receiver's dynamic range.

Patcomm specs 111 dB for blocking dynamic range. We measured 103 dB on 14 MHz (96 dB on 3.5 MHz). Not surprisingly, we encountered a similar gap between specifications and reality when we tested for two-tone, third-order IMD dynamic range. Patcomm specs 103 dB, a number we've measured only among some of the top-performing transceivers on the market today. The reality here was a much more modest 86 dB on 14 MHz, which puts the PC-16000 edging into the same league as the ICOM IC-706. But on 3.5 MHz, it was just 79 dB. Patcomm seems to have made big strides in this area in current production, however (see below).

Another missed spec involved undesired sideband suppression. Patcomm specs 45 dB while transmitting a 1-kHz tone. We measured 37 dB. Patcomm uses a phasing method to suppress the undesired sideband and uses a 1 kHz tone to test its units. In the ARRL Lab, we use 700 Hz and 1900 Hz for this test. Since a 90-degree phase angle is only valid for a specific tone, this could explain the discrepancy.

The CW keying waveform was not up to par either. We typically check keying by triggering the transceiver's keying line externally with a series of dits at a speed equivalent to 60 WPM. When we tested the keying on the PC-16000, we discovered the dits were nearly missing (see Figure 2)! We had to slow our keying down to around a 15 WPM character speed before the dits (ie, real output) appeared. An analysis of Figure 2 determined that the almost-missing waveform resulted from excessive delay built into the unit's firmware. It took nearly 20 ms after the key was closed before output appeared. We got far better results—a more normal looking waveform—by sending CW directly from the keyboard, but the keying clearly was something that needed Patcomm's attention.

We contacted Patcomm, the company was able to reprogram the PC-16000 firmware to reduce the excessive delay time, and it sent us a replacement EPROM for our unit. Figure 3 shows the results of this programming fix. Keying remained "softer" than that from the keyboard or while using the internal keyer, but it was greatly improved.

More Improvements

Patcomm has improved the synthesizer board to reduce phase noise, and the company sent us another PC16000 for follow-up testing. This unit was a *great* improvement over the first in terms of phase noise. Additional testing in the ARRL Lab showed much better numbers on the second unit. Now, the plot on the worst band (80 meters) began in the –90 dB region and dwindled downward from there.

Spurious signal and harmonic suppression also were improved, so the second radio did meet Patcomm's –45 dB spec with a few dB to spare.

Blocking dynamic range also rose significantly and handily met the company's 111 dB spec in the second unit. Two-tone third-order IMD dynamic range was decent—in the low 90s. This time around, the number was not noise-limited on 20 meters either. Patcomm has nothing to be ashamed of here. The company says it plans to revise these and other of its specifications to reflect "typical" performance off the production line.

Since the phase noise level on the factory-supplied unit was sufficiently low, we also were able to determine third-order intercept point by using the S5 method. These came out at a respectable +18 dBm for 80 and 20 meters. (For comparison, numbers calculated using MDS were +15 and +14.5 dBm on 80 and 20 meters respectively.)

Patcomm says it will upgrade existing units free of charge (owner must pay for shipping). Owners should contact Patcomm's service department to schedule this work.

On the Air

Once you get the hang of the pushbuttons (and the keyboard, if you choose that route), using the PC-16000 on the air becomes a bit more routine. Some of us never did take to the small tuning knob, and the little crank handle developed a squeak. It was deemed too small, and, at times—depending on its position—it was easy to bump the fast-tuning crank while adjusting the **IF SHIFT** control (which worked great, by the way).

During a regular SSB schedule, we were able to copy everyone just fine—about as well as on the regular station transceiver, a Kenwood TS-850S. The Patcomm's five-inch speaker added a bit of high fidelity to the proceedings, and the 1.8 kHz DSP setting helped eliminate some of the stuff slopping over from adjacent QSOs. We swapped radios unannounced midstream, and no one remarked on a change in audio quality when we used the PC-16000.

It was during this sked—where some stations were not quite on the same frequency—that we missed having a separate RIT knob on the PC-16000. The Patcomm transceiver uses the **MAIN TUNING** dial for RIT. Press a button, and it becomes an RIT knob—not terribly convenient.

Shining some light across the front panel made it much easier to see the little lettering on the little pushbuttons. The tiny LEDs that indicate the current bandpass filter settings were another matter. Patcomm needs to shroud these lamps so that the light from one does not appear to be illuminating its neighbor.

Speaking of bandpass filtering, the **BPF** selections double with **MODE** selections. This can be a real bother. For example, the **CW** button is also the **500 HZ** filter button. So, if you want to operate CW, you first have to make sure that the BPF LED is not lighted. Only then is it safe to press the **CW** button. Then, if you want 500 Hz filtering, you must first enable the secondary key function by pressing the **BPF** button, then the (now) **500 HZ** button.

Other moves are impossible because some functions lock out others. For example, you can't directly enter a frequency from the keypad or the keyboard if you're in decode mode. Occasionally, we managed to fumble our way into some mode where no key pressing did any good at all except turning off the transceiver and starting over again. You can usually back out of an incorrect keystroke, by just pressing **ENTER** (on the front panel or on the keyboard).

The modest dynamic range of our original PC-16000 showed up when the band was very busy (and it became more obvious when trying to listen to 40 meter SSB at night here on the East Coast). Strong signals can pretty easily take over the front end and start pumping the AGC, which cannot be disabled. When the band was not so busy, this was not much of a problem.

Unless you're in decode mode or accessing a menu, the little display presents both the transmit and receive frequency. This means that you'll always see your offset for CW or RTTY. The display also shows the current memory (if selected) and the current time. The dual display is great for split operation, since you always know your transmit frequency. Everyone who used the PC-16000 wished for a bigger, more prominent display, however. The display window should be the focus of the operator's attention on an HF transceiver. On the PC-16000 it's more of an afterthought.

Having the **PHONES**, **KEY**, **PADDLE** jacks on the front panel makes them readily accessible, but some operators would prefer that these also be accessible via the rear panel to eliminate clutter on the operating desk.

The really neat thing about this radio is being able to just plug in the keyboard and operate CW or RTTY. This is very simple and pretty painless once you find all the right buttons and keystrokes.

Summing Up

Equipment manufacturers are well aware of the extraordinary expense of bringing a product of this magnitude to market. Patcomm deserves credit for daring to jump on the bandwagon and for attempting to do something different.

While our original PC-16000 fell short of some expectations for a transceiver product in this price class, it certainly deserves a B+ for effort—especially for continuing to tweak this model to improve performance. The latest unit we looked at was a quantum leap from the first in performance terms. Patcomm plans to offer another transceiver product in the not-too-distant future—a project not quite as ambitious as the PC-16000. The company would be well-advised to enlist a cadre of experienced alpha and beta testers to advise on what typical hams want and need in terms of features and performance. This way, Patcomm would substantially up its odds of coming up with a winner.

Thanks to Glenn Swanson, KB1GW, and to Mike Tracy, KC1SX, and Ed Hare, W1RFI, of the ARRL Lab for their contributions to this review.

Manufacturer: Patcomm Corporation, 7 Flowerfield M100, St James, NY 11780; tel 516-862-6512; fax 516-862-6529. Manufacturer's suggested retail price: $1649, including AT-style IBM-compatible keyboard and hand mike.

Command Technologies Commander VHF 1200 6-Meter Linear Amplifier

Reviewed by Mark Wilson, K1RO
QST Editor

Six meters can be a QRPer's dream. When the band is wide open with sporadic-E or F-layer propagation, you can work stations hundreds or even thousands of miles away with 5 W and a modest antenna. So who needs a kilowatt amplifier? If you hang around 6 meters when the band is not wide open, you'll find the serious operators chasing DX during marginal E-skip or F-layer openings, or via more exotic propagation modes like aurora, meteor scatter, or troposcatter. Signals often are very weak. More power is a definite plus, and sometimes the barefoot operators simply can't get through.

Command Technologies is probably best known for building solid, trouble-free HF amplifiers, but they have been in the VHF amplifier business for a long time with their Commander II 2-meter amplifier. The Commander VHF 1200, for 6 meters, is a natural extension of the product line. It uses a single Eimac 3CX800A7 triode and is rated at 1200-W PEP output (750 W on CW, and 600 W on FM or RTTY). It comes complete with T-R relays and power supply in a convenient desktop package.

Table 2
Command Technologies Commander VHF 1200 6-Meter Amplifier, serial number 137

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency coverage: 50-54 MHz.	As specified.
Maximum power output: SSB, 1.2 kW PEP; CW, 750 W; FM, RTTY, 600 W.	As specified.
Driving power required: 15-25 W nominal; 35-40 W for full output.	32 to 45 W for full output, depending on frequency
Input impedance: 50 Ω unbalanced.	Input SWR 1.3:1 or less.
Spurious signal and harmonic suppression: >60 dB.	As specified. Meets FCC requirements for equipment in its power output class and frequency range.
Intermodulation distortion (IMD): –35 dB at full rated output.	Not tested.
Primary power requirements: 120, 200 or 240 V ac, 30 A max.	
Size (height, width, depth): 7.75 × 18 × 16 inches; weight: 75 pounds.	

Features

Construction is similar to other Command Technologies amplifiers. The tube and RF circuitry are mounted along the left-hand side of the cabinet, and the transformer, blower and control circuitry occupy the right-hand side. A tuned input circuit provides best linearity and a good match to the exciter. You can adjust the input circuit trimmer capacitors from the rear panel, but retuning probably won't be necessary. The output circuit is a pi network that makes the transformation to 200 Ω, followed by a 4:1 transmission line transformer to get to 50 Ω for the antenna. The pi network features a coil made from silver plated $^{1}/_{4}$-inch tubing, with a 30-pF piston capacitor for tuning and a 150-pF air variable for loading. A bandpass filter on the inside rear panel assures compliance with FCC spectral purity requirements.

The front panel features two analog meters. The meter on the left is dedicated to grid current. The one on the right can be switched to display plate current and plate voltage. Like other Command Technologies products, the VHF 1200 does not include an RF power meter. Switches for power **ON/OFF** and **OPERATE/STANDBY**, and LEDs for **POWER** and **TRANSMIT** round out the front panel.

Rear-panel connections include phono jacks for a T-R key line (ground to transmit) and ALC, and another phono jack supplies 12 V dc at 100 mA to power accessories. RF input and output connectors are standard SO-239 connectors. A ground post, fuse holder and access holes for input tuning and ALC adjustment round out the back panel.

Hookup and Operation

Our VHF 1200 arrived in two cartons—the transformer is shipped separately. The 3CX800A7 is shipped in its own box, packed inside the amplifier where the transformer goes. Installation of the transformer and tube takes less than half an hour. Just remove the cover, secure the transformer with four mounting bolts, mate a single multipin connector, carefully seat the tube and tighten its anode strap, and you're done.

BOTTOM LINE

Rugged, reliable and convenient, the Commander VHF 1200 offers near-legal-limit power for the serious 6-meter operator.

The Commander VHF 1200 comes from the factory wired for 120 V ac operation. You can select 200 or 240 V operation by changing jumpers on a terminal strip that's under an access cover on the rear panel. We changed it to 240 V and installed a suitable connector on the power cord.

The amplifier requires about 40 W for full output. If you're using one of the popular 100 W transceivers, it's a good idea to use the ALC feature to avoid overdriving the amplifier. The manual warns about keeping the grid current below 60 mA, and a protection circuit kicks in if you exceed 65 mA (you have to unkey the amplifier and reduce drive).

The manual offers thorough instructions on tuning and operating the VHF 1200. The

3CX800A7 requires a warmup period, and there's a built-in approximately 2 minute delay before you can key the amplifier (tube maker Eimac recommends waiting three minutes before applying anode voltage and RF drive—*Ed*). The tuning control takes a little getting used to. The manual warns that it takes 15 revolutions to tune the unit from 50 to 54 MHz, and there's no pointer or logging scale. Once you understand that you may have to crank it a bit (at low drive) everything falls into place. And once it's tuned up, you can use the amplifier anywhere in the bottom 300 or 400 kHz of the band without retuning. The manual also gives instructions for using the amplifier with 10 W radios and includes typical operating conditions at several drive levels.

I gave the VHF 1200 a good workout in the June 1997 ARRL VHF QSO Party. The rest of the station consisted of an IC-756, the VHF 1200 and a 6-element Cushcraft beam at 110 feet. We had only a few sporadic-E openings, and the VHF 1200 gave me a nice edge to "command" a run frequency. For the rest of the contest, 6-meters was largely working local stations and weak-signal scatter modes. I didn't have trouble working anyone I could hear, and the amplifier just sat in the corner and supplied power on demand.

The Commander VHF 1200 is rugged and reliable. With the uptick in the solar cycle and coming F-layer DX activities (see "The World Above 50 MHz," *QST*, Dec 1997), the VHF 1200 is worth considering for that extra edge in the pileups. In the meantime, you can use it to go after those really weak signals.

Manufacturer: Command Technologies, 1207 W High St, Bryan, OH 43506, tel 800-736-0443 or 419-636-0443; fax 419-636-2269; **http://www.bright.net/~cmdrtech**. Manufacturer's suggested retail price: $1995.

Brian Beezley's *RITTY* 2.0 RTTY/PACTOR Program

Reviewed by Larry Wolfgang, WR1B
Senior Assistant Technical Editor

A while back, we looked at Brian Beezley's *RITTY* 1.0 radioteletype program (see "Product Review, *QST*, Aug 1996). What is so significant about Version 2 (actually, it's up to Version 2.20) that makes it worthy of another review? The most noticeable advantage of this new version is the inclusion of PACTOR! But there are other significant enhancements as well.

If the thought of operating radioteletype and PACTOR using only your radio and computer sounds interesting, this software could be for you. And Version 2 makes it even easier. With Version 1, you had to have a genuine 16-bit Creative Labs *SoundBlaster* sound card. Now the program will work in RTTY mode with most *SoundBlaster*-compatible sound cards. Still, for PACTOR operation, you must have the real thing! Your computer must also be a 486 or better with a math coprocessor, VGA and DOS 3.1 or later. *RITTY* 2.0 is a DOS program, but it also runs under *Windows* 3.x or *Windows 95*. With the Version 1 software, I reported difficulty running it in a *Windows* session. With Version 2, Brian has apparently solved that problem. I installed the program on my *Windows 95* 486 DX-66 computer and had very few operating system-related problems!

If you would like to try *RITTY*, you can obtain a trial version of the software. The easiest way to do that is to visit the Web side of Dick Stevens, N1RCT at **http//www.megalink.net/~n1rct/rit2/rit_dl.html** and download the software. The trial version stops working after about 5 minutes. You can try virtually all the features, and you can run the program as many times as you like. You will soon want to register and obtain the special license file Brian creates for you, though. Just place your license file in the same directory as the program, and you have a fully functional version of *RITTY*. Once you have the license file, you can upgrade to newer release versions simply by downloading the new software. Twice during this review, Brian notified me of release updates. While the latest version is 2.20, the version we used for our review was 2.18, but it's clear that Brian has been working to improve the program and add desired features. For example, some of the updates have added a wideband detector, improved compatibility with WF1B's RTTY software, some minor bug fixes and improved packet repair algorithms that result in better copy.

Operating With *RITTY*

The program is easy to use. A series of menus allows you to control various transmit and receive parameters. You can call up the menu options by hitting any key that isn't used for some other purpose. The menu options direct you to the proper key to select the Receive Options, Transmit Options, Setup Menu, Color selections or to Quit the program. Any function key (F1 through F12) brings you to a message buffer that you can use to store a "canned" message or to use simply as a type-ahead buffer. Any buffer can call any other buffer, simply by using a percent sign followed by the buffer number. For example, suppose I set up the following buffers:

F1 = %9 DE WR1B; F2 = HELLO %10;
F9 = K6STI; F10 = Brian.

Then pressing F1 yields K6STI DE WR1B and F2, HELLO Brian. By inserting another operator's call sign and name in buffers 9 and 10, I can use the same F1 and F2 buffers to send a quick greeting to any new contact. The RTTY and PACTOR buffers are separate in Version 2, so you can have up to 12 "canned" messages for each mode.

In my review of Version 1, I complained that there was no receive buffer and no way to review text that had scrolled off the screen. That is still basically true, although *RITTY* now *saves* all received text to a file. It writes this file (aptly named "text") to the current directory. You can review, edit or otherwise manipulate this file after you quit *RITTY*. So now you *can* retrieve information that has scrolled off the screen. The program overwrites this file each time you run the program, however, but this also means there's little danger that the program will fill your hard drive with received text files. This doesn't quite answer the need to be able to look back a screen or two for some piece of information, but it is a step in the right direction.

One new feature that I found intriguing was the Auto Tune setting. No more fussing with the radio tuning knob trying to tune in the signal perfectly. With Auto Tune enabled, all you have to do is get *close*! The adaptive modem in *RITTY* tracks the signal and tunes it in. As long as you get within a few hundred Hertz of the signal, you will see text flow across your screen.

I had never operated PACTOR, so I monitored a few contacts before attempting to link with another station. PACTOR typically transmits text at about 30 characters per second, much faster than the 6 CPS of 45 baud RTTY. But the difference might be less obvious for keyboard-to-keyboard chats.

The PACTOR protocol allows *RITTY* to perform some pretty amazing demodulation, though. I soon noticed that much of the text appeared on the screen as white letters. Every once in a while some text was printed in light blue text, however. This blue text indicates that *RITTY* did not copy the packet perfectly, but was able to "repair" the damaged text. If the text changes to red, however, the displayed text is probably not correct. You can turn off the "Repair Packets" feature if you don't want *RITTY* to attempt to make the corrections. It speeds up the throughput, though, because fewer repeats are requested! Even

BOTTOM LINE:

Definitely a neat way to marry your computer and your transceiver to enjoy RTTY and PACTOR without the need for a TNC.

some of the red text appeared to be a pretty good attempt to "follow" the conversation.

Documentation

The zipped *RITTY* file comes with a number of documentation files. I found the RTTY and PACTOR manuals to be quite an improvement over the documentation that came with Version 1 of the software. There are also a number of other files, in which Brian shares his thoughts about some weighty operating matters. For example, one paper presents "The Case for Wide-Shift RTTY." Brian explores the history of Baudot RTTY to explain why amateurs gradually changed from an 850-Hz shift RTTY system to one of 170 Hz. He also explains why, under certain conditions, you should consider operating with a wider shift. Another paper presents a strong argument in favor of using the diddle feature of your RTTY system. Brian even provides an article with guidelines for using an external DSP filter. While this is something he does not recommend under "normal" circumstances, Brian says some users might wish to try an external DSP filter if their computer's CPU is too slow to run the program's built-in bandpass filter. The internal BPF is superior, however, because it automatically tracks signals on RTTY and has the proper width and shape for PACTOR.

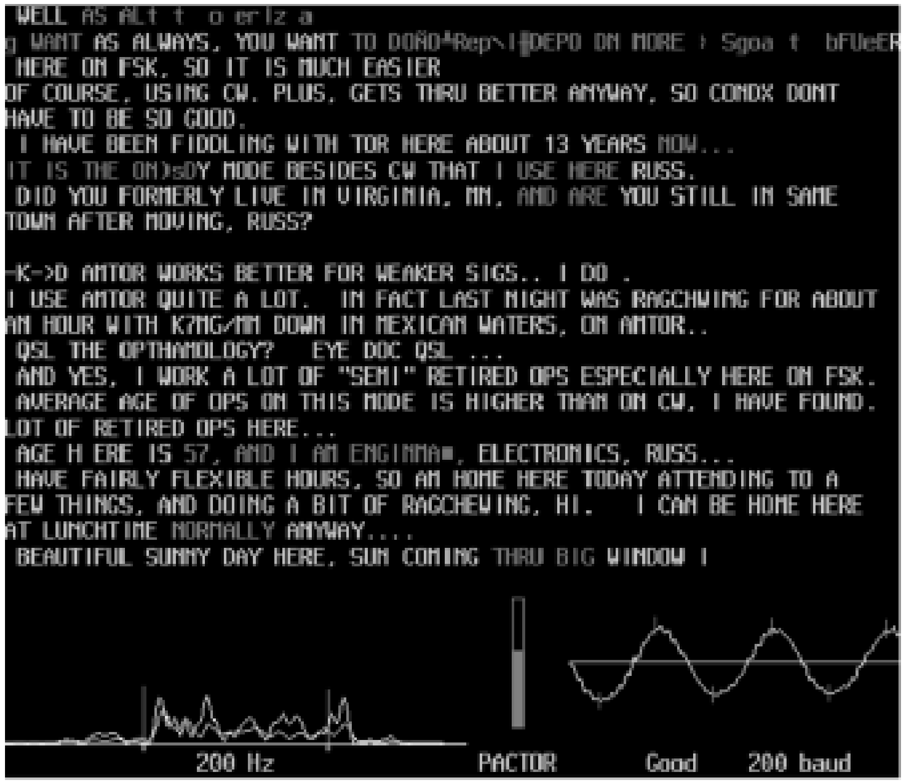

Figure 1—Monitoring PACTOR signals with *RITTY 2.0.*

Conclusion

While *RITTY* version 2 is only a two-mode program, it does those modes very well. It should be fairly simple to connect the audio output and input of just about any radio to your computer sound card. If you want an inexpensive, straightforward approach to getting on RTTY and PACTOR with your HF station—and if you have the necessary hardware—this program is worth a trial.

Manufacturer: Brian Beezley, K6STI, 3532 Linda Vista, San Marcos, CA 92069; tel 760-599-4962; e-mail **k6sti@n2.net**. Manufacturer's suggested retail price, $150.

New Products

A 50-2000 MHZ ACTIVE ANTENNA FROM DRESSLER

◊ Dressler's ARA 2000 active receiving antenna covers 50-2000 MHz without tuning and features ease of use, low noise characteristics, high sensitivity and 12-V power for portability. Mount it on your car, on a mast or in the attic. The ARA 2000 comes with 40 feet of RG-58 coax and two Type-N connectors. Accessories include the EWPA 5200 low-noise preamp and PS-120/PS-220 ac power supplies.

Dressler's other active antennas include the ARA 40 (40 kHz to 40 MHz) and the ARA 60 (40 kHz to 60 MHz). For prices and other information, contact Bill Wysock, N6UXW, at 2527 Treelane Ave, Monrovia, CA 91016; tel 626-359-1373, e-mail **wysock@ttr.com; http://www.bptec.com**.

POWER GENERATION GUIDE ON CD-ROM

◊ *Home Power* magazine has just released Solar 2, a two-disc CD-ROM set that contains the first 42 issues (4000 pages) of the magazine aimed at do-it-yourself homeowners, RVers and portable power users. Topics include solar power, generators, small hydro systems, batteries, inverters, instrumentation, solar heating and cooking, electric vehicles and more. Compatible with *Windows*, Macintosh and Unix PCs, the CDs feature information stored in Adobe's Acrobat "portable document" format.

Price: $29. For more information, contact *Home Power* at PO Box 520, Ashland, OR 97520; tel 800-707-6585; **http://www.homepower.com**.

AC/DC SURGE PROTECTORS FOR RV/MARINE SYSTEMS

◊ Innovative Technology has released a line of surge protectors for RV/marine/mobile applications. RV's, boats and autos typically have unstable power systems that can damage or destroy expensive radios, fuel injection systems and engine/navigation computers.

Innovative offers RV/marine units for 117/240 V ac and 12, 24 and 48-V dc service that feature internal fusing, enhanced transient-suppression and tracking circuitry, and weatherproof enclosures.

For pricing and information on its entire line of suppression products, contact Innovative at 15470 Flight Path Dr, Brooksville, FL 34609; tel 352-799-0713, fax 352-796-0316; **http://www.itvss.com**.

SPEECH ACCESSORY FOR GPS RECEIVERS

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ERIC, available as a 2×2.5-inch circuit board or fully enclosed, runs on 7-15 V dc and draws only 20 mA. Price: $89.95 (standard and ham radio models, circuit board only); $129.95 (standard and ham radio models with enclosure). For more information, contact Practical Technologies at 614-848-9444 (tel/fax); e-mail **ptech@ee.net**; **http://users1.ee.net/ptech**.