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Digital Radio Systems PC*Packet Adapter

Hustler FX-2B 2-Meter Mag-Mount Antenna

Kenwood RC-10 Remote-Control Handset

Kenwood TM-721A Dual-Band VHF/UHF FM Transceiver

Conducted By James W. Healy, NJ2L
Assistant Technical Editor

Kenwood TM-721A Dual-Band VHF/UHF FM Transceiver

Reviewed by Rus Healy, NJ2L, and Kirk Kleinschmidt, NTØZ

The TM-721A looks like many other FM dual-band mobile rigs on the market—it has few external connections, multipurpose front-panel controls and display, and a conveniently small enclosure—but as we shall see, Kenwood has added several interesting features not found on most rigs intended for the same purpose. The TM-721A covers the amateur 144-MHz band and the 438- to 450-MHz segment of the 420-MHz band. Transmit power levels are 45 W on 2 meters and 35 W on 70 cm. The '721A's sister rig, the TM-621A (not reviewed), covers the 144- and 220-MHz bands at power levels of 45 W and 25 W, respectively. The TM-721A's operating specifications are detailed in Table 1.

The '721A is easy to install and get running. There are only five external connections: UHF connectors for 144 and 440 MHz, power supply, external speaker (optional) and the microphone. It took less than half an hour to install the rig in a car and program several local repeater frequencies into the rig's memory channels. Reports on the rig's audio quality were favorable.

Operationally, one of the better things about the '721A is the logical way in which it beeps—whenever a front panel button is pushed, that is. When selecting several of the rig's functions, a high- or low-pitched beep is emitted. The beeps allow you to keep your eyes on the road—not on what's happening on the front panel of your radio. (Some have voiced an objection to beeps such as these, but both of us find them unobjectionable and extremely useful.) It's a good thing that the '721A beeps, because its display is not very legible in bright sunlight. Adjusting the display-brightness control (a two-level high/low control) doesn't eliminate the problem.

Initially, the '721A seems intimidating. It looks as though there are too many controls to mess with. (After all, the rig can monitor two bands simultaneously, operate in crossband full-duplex mode, has multiple scanning functions and an optional handset remote control!) After using the '721A for a short while, however, it can be mastered enough to change frequency with the VFO, program and recall memory channels, set up repeater shifts and monitor a frequency in the sub band (discussed later).

To operate the '721A in crossband full-duplex mode, and/or to monitor two bands simultaneously without confusing you unduly, the rig's display window *has* to be laid out logically—and it is. To minimize confusion, Kenwood designed the '721A to provide all the operating features of the radio for one band, and limited control of the operating status for the second band, at any given time. The band for which full control is available is called the main band. The second band is called the sub band. To distinguish between the main and sub bands, the display on the '721A uses larger, orange characters on the left side of the display to indicate main-band status. The sub band's operating conditions are shown on a smaller, yellow display on the right side of the display window.

Swapping the main and sub bands to gain full control of the sub band's operational parameters (repeater offset, subaudible tone frequency, and so on), is as easy as pressing the BAND key. The sub band can also be turned off (by pressing the DUAL key), eliminating displayed information you don't need if you're only listening or operating on one band.

The rig's BALANCE control operates during simultaneous reception on both bands. This control is a slide potentiometer that is mounted near the bottom center of the front panel, and, as you would expect, sliding it to the left causes the volume of main-band signals to be louder than those from the sub band. Sliding the BALANCE control toward the right causes the sub-band signals to be more dominant in the speaker audio. The '721A also has dual S meters—one for each band.

One of the '721A's technical characteristics worthy of mention is spectral purity. As shown in Figs 1 and 2, the second harmonics of the 144- and 440-MHz signals are at least *−81 dBc* and −69 dBc, respectively. The key closure/RF output characteristics of the '721A are shown in Fig 3.

As you would expect from a flashy new dual-band rig, the TM-721A has a feature not found before in similar rigs: automatic band changing (ABC). An interesting feature, ABC swaps the sub- and main-band contents upon receipt of a signal in the sub band, if you're not transmitting on the main band at the time. This feature allows immediate and complete control of the radio's functions on the frequency on which there's a signal (only limited control of the sub band is available, as mentioned earlier). Essentially, ABC puts the sub band "in the foreground" by making it the main band when a signal is present. If you don't transmit after the '721A changes bands, the main and sub band frequencies are returned to their previous status three seconds after the squelch closes.

The TM-721A is easy to use and should pose no problems for those familiar with

Table 1

Kenwood TM-721A 144- and 440-MHz FM Transceiver, Serial no. 9042797

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency Coverage: 144 to 148 MHz and 438 to 450 MHz.	Transmitter: 144.0 to 147.995 MHz, 438.0 to 449.995 MHz; receiver: 138.0 to 173.995 MHz, 438.0 to 449.995 MHz.
Mode of operation: FM.	As specified.
Frequency resolution: 5 kHz.	As specified.
Power requirements: 13.8 V dc (±15%) at 9.5 A	13.8 V dc at 8 A on transmit (high power) and 3 A (low power); 510 mA on receive (at maximum audio output).
Transmitter	*Transmitter Dynamic Testing*
Power output (144/440 MHz): Low, 5W/5W; high, 45W/35 W.	Low, 5.5 W/6.6 W; high, min 44.3 W/34.7 W, max 47.5 W/34.7 W.
Spurious and harmonic suppression: Better than 60 dB.	See Figs 1 and 2.
TR turnaround time: Not specified.	See Fig 3.
Receiver	*Receiver Dynamic Testing*
Receiver sensitivity (144/440 MHz): Less than 0.2 μV/0.16 μV for 12-dB SINAD.	0.15 μV/0.18 μV for 12-dB SINAD; 0.20 μV/0.28 μV for 20-dB quieting.
Squelch sensitivity (144/440 MHz): Less than 0.09 μV.	0.05 μV/0.07 μV.
Receiver audio output: More than 2 W at 5% distortion (8-Ω load).	1.95 W at 5% total harmonic distortion (THD) with an 8-Ω load.
S-meter sensitivity (μV for S9 meter reading—144/440 MHz): Not specified.	2.0 μV/1.75 μV.
Color: Black.	
Size (height, width, depth; projections included): 5.9 × 2 × 8.6 inches.	
Weight: 4 lbs.	

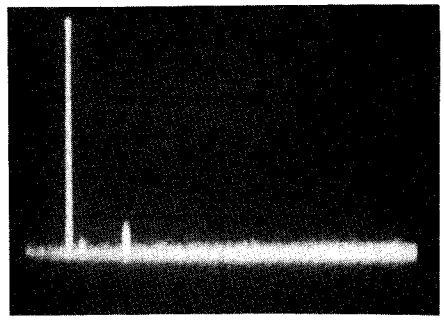


Fig 1—Worst-case spectral display of the TM-721A on the 144-MHz band. Horizontal divisions are each 100 MHz; vertical divisions are each 10 dB. Output power is 47.5 W at 145.13 MHz. The fundamental has been notched by 30 dB to prevent spectrum-analyzer overload. The log reference level (top line of the graticule) is −30 dBc. All harmonics and spurious emissions are at least 81 dB below fundamental output (−81 dBc). The TM-721A complies with current FCC specifications for spectral purity on the 144-MHz band.

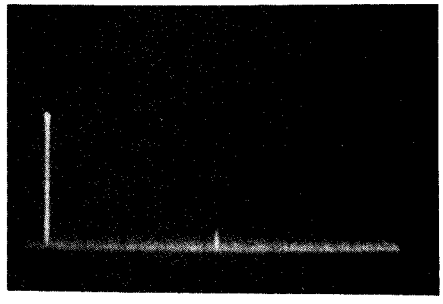


Fig 2—Worst-case spectral display of the TM-721A on the 70-cm band. Horizontal divisions are each 100 MHz; vertical divisions are each 10 dB. Output power is 34.7 W at 440.0 MHz. The fundamental has been notched by 40 dB to prevent spectrum-analyzer overload. All harmonics and spurious emissions are at least 69 dB below fundamental output (−69 dBc). The TM-721A complies with current FCC specifications for spectral purity on the 70-cm band.

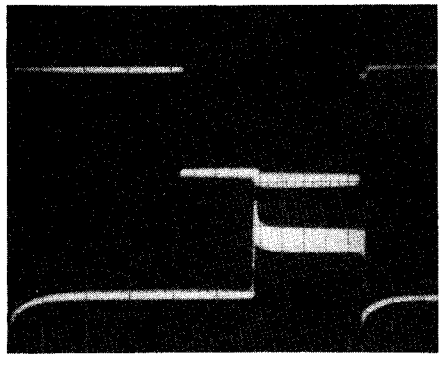


Fig 3—FM keying waveform for the TM-721A on 146 MHz. Each horizontal division is 50 ms. The upper trace is the actual key closure; the lower trace is the RF envelope.

modern VHF/UHF FM mobile rigs. As is increasingly common in modern rigs, the '721A combines control of multiple operating functions into single controls and function keys to conserve front-panel space. For instance, the rig has a wide variety of selectable frequency steps and subaudible tone frequencies (the optional CTCSS—continuous-tone-coded squelch system—encoder is required to obtain the use of the latter). To change the frequency steps (5, 10, 12.5, 15, 20 or 25 kHz), simply press the FUNCTION and STEP keys, and rotate the main tuning knob. The frequency step is shown in the main-frequency display window. When you reach the desired step, press any key to return the main frequency to the display. Simple! Selecting the subaudible tone frequency is a similar process.

Memory and Scanning Functions

The TM-721A has all of the memory and scanning functions common to the newer-generation FM mobile rigs: band and memory scanning, lockout of unwanted memory channels during scanning, priority and CALL channels, priority alert and so on. These functions are available on both bands. Memories for odd repeater offsets, band-scanning limits and normal repeater or simplex operations are available—there are 14 memories in all. The '721A also has a function that's common on HF transceivers, but not so common on VHF/UHF mobile rigs: the ability to write the contents of a memory channel *directly* into the VFO. Scanning can be initiated and terminated from the front panel of the radio, from the microphone or the optional RC-10 handset (described later).

The Manual

The instruction manual for the TM-721A is small but complete. In addition to the usual array of connection and operation descriptions, the manual contains information on installing the optional TSU-6 CTCSS board. Also included are descriptions and cautions for using the RC-10 remote-control handset with the '721A. An example of the completeness of the manual is the inclusion of a table of frequencies—and the corresponding scale notes—at which the beep tone (described earlier) sounds as the functions of the radio are changed. For instance, if the beep tone is enabled and you initiate the scan mode, the beep frequency will be 466.16 Hz (A#). If you then stop the scanning, the beep-tone frequency will be 493.88 Hz (B).

Complete block and schematic diagrams for the radio are provided on sheets separate from the manual. The documentation is clearly written and well prepared—much better than some manuals published in the past by offshore Amateur Radio equipment manufacturers.

If you're in the market for a dual-band rig that has high power and a relatively large number of bells and whistles, the TM-721A is a good choice. Price class:

$650. Manufacturer: Kenwood USA, 2201 E Dominguez St, Long Beach, CA 90801, tel 213-639-4200.

KENWOOD RC-10 REMOTE-CONTROL HANDSET

The RC-10 is a multipurpose remote-control handset. Costing more than $200, the handset is not an accessory that everyone will want, however. For certain applications, the RC-10 is quite useful. It is designed for use with either Kenwood's TM-621A or -721A dual-band radios, or for simultaneously controlling the functions of any *two* radios in the TM-621A/721A or TM-221A/321A/421A series. In the latter service, control cables are attached to each radio and the RC-10 provides full-duplex capability with two single-band radios. Another nifty function of the RC-10 is its ability to serve as a crossband repeater controller. You simply connect the controller to the radio(s), put the handset in repeater mode and let 'er rip. The controller has a built-in three-minute time-out timer and a three-second squelch-release timer, and local PTT control is automatically disabled during repeater operation. The RC-10 manual contains the appropriate cautions and references the FCC Rules' Part 97 sections pertaining to repeater operation.

The handset remote control is designed to be mounted in a convenient place—one that's close to you, such as on your car's center armrest, console or dashboard. Almost all of the '721A's functions can be controlled from the handset: AF gain, squelch, scanning, memory programming and recall operations, frequency selection, autopatch dialing and other functions. With the handset close by, you don't have to lean forward to manipulate front-panel radio controls; it also gives you the feeling of talking over a cellular telephone. For situations where privacy is desired, the handset is ideal. Remote mounting of radio(s) in compact cars, or in situations where you don't want a radio visible to prospective thieves, is yet another advantage the RC-10 provides.

As with the TM-721A, the RC-10 initially appears to be much more complicated than it really is. After 10 minutes or so of operation, using the RC-10 becomes almost second nature. A wide array of functions can be easily controlled from the relatively small number of keys on the handset. For example, the keys provide nine functions not operated by dedicated controls, volume levels for the main and sub bands can be set, and radios can be selected by pushing buttons. Main- and sub-band squelch levels are set by way of recessed potentiometers inside the RC-10.

Although the RC-10 is a relatively expensive option, there are some situations in which it is extremely useful. Price class: $210. Manufacturer: Kenwood USA, 2201 E Dominguez St, Long Beach, CA 90801, tel 213-639-4200.

HUSTLER FX-2B 2-METER MAG-MOUNT ANTENNA

Reviewed by Kirk Kleinschmidt, NTØZ

The Hustler FX-2B is a high-performance, magnetic-mount, 2-meter mobile antenna designed to stay put at vehicle speeds of up to 100 miles per hour. I can't personally attest to this claimed top-speed adhesion limit, but the FX-2B didn't move around at all during combined city and highway driving. Besides, who wants to risk a speeding ticket just to velocity-test an antenna's adhesion capabilities?

The 5/8-λ black whip is rather slender. When I first saw it in the blister pack, I wondered if the antenna would be sturdy enough over the long haul. The review antenna had a slight kink—probably incurred during shipping.

Setting up the FX-2B is easy. After removing the antenna from the blister pack (the most difficult part of setup), the upper portion of the antenna (the whip and matching coil) is screwed into the magnetic mount. A rubber gasket is provided to seal out moisture and debris.

With the antenna assembled, there's nothing left to do except put the thing on the roof of your car. A slippery Teflon® -like substance lines the underside of the magnetic mount. It's there to protect your car from scratches. Be sure to "plop" the magnetic mount squarely into position. Do not slide the mount around on the roof. Even though there's a protective coating, scratches can occur.

An Allen-head wrench is provided to allow you to adjust the antenna to resonance (adjustment of the review unit was not necessary). If you'd like to tweak the FX-2B for lowest SWR, loosening the setscrew allows you to adjust the length of the whip by about an inch or so.

I used this antenna when testing the Kenwood TM-721A. I made several repeater and simplex QSOs while driving around the suburbs of Hartford, and the antenna performed well. The FX-2B's workmanship and materials appear to be of high quality. The unit should provide many years of trouble-free service—even if you never test its 100-mile-per-hour-rated tenacity! Price class: $30. Manufacturer: Hustler, Inc, 1 Newtronics Pl, Mineral Wells, TX 76067, tel 817-325-1386.

DIGITAL RADIO SYSTEMS PC*PACKET ADAPTER

Reviewed by Jon Bloom, KE3Z

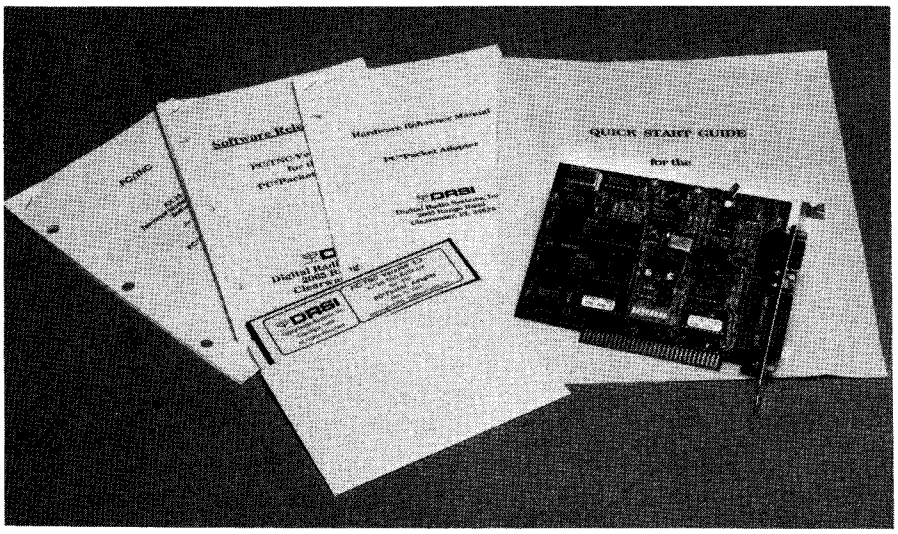
Amateur packet radio has blossomed into a widespread activity largely because of the availability of inexpensive terminal node controllers (TNCs). The use of a TNC separate from the station computer has become the norm, but a TNC isn't needed to run packet radio if some other computer can perform the TNC function. This was demonstrated in the early days of packet by Richardson, and is still true today.[1,2] Some hardware must be added to the computer, however. A modem is needed, and hardware to handle the lowest level of the protocol, called HDLC (for high-level data link control), is often desirable. For computers that easily can have hardware added, the prospect of a plug-on or plug-in board to allow packet-radio operation is attractive. It is this capability that Digital Radio Systems, Inc (DRSI) provides with their PC*Packet Adapter for the IBM® PC family of computers.

PC*Packet

The PC*Packet Adapter (let's call it PCPA for short) is a short board that plugs into a PC expansion slot. The board provides two packet-radio channels (or *ports*) that operate independently. One of the channels includes a modem for 1200-bit/s VHF FM packet operation; the other port terminates in an RS-232-C port to which an external modem can be connected. (DRSI has an HF modem available for use at this port, and expects to have a 2400-bit/s modem available as well. Neither of these accessories was reviewed.) The packet channels are implemented by way of a Zilog 8530 IC.

The hardware of a TNC is only one element of the package. The other element is the software. It is in the software that the concept of a plug-in TNC board differs from a stand-alone TNC. The software to operate a stand-alone TNC is contained in read-only memory (ROM) chips within the TNC (as *firmware*). Updating or changing the firmware requires disassembly of the TNC followed by removal and replacement of an IC. Because these ICs are static-sensitive devices, this procedure involves

[1]Robert M. Richardson, W4UCH, "Packet Radio—A Software Approach," Second ARRL Amateur Radio Computer Networking Conference (Newington: ARRL, 1983), pp 67-70.
[2]"New Packet Software: DIGICOM64," *Gateway*, July 31, 1987.



some risk: The IC may be destroyed. A plug-in TNC such as the PCPA, on the other hand, is controlled by a program read from the mass storage device (disk) of the computer. Updating disk-based software consists, at most, of copying the updated control program from one disk to another.

Operation

DRSI supplies manuals covering the hardware and software. The manuals are well written and helpful, but I was disappointed that a schematic diagram is not included. A floppy disk containing the software needed to use the PCPA is included.

Your only requirement in dealing with the PCPA hardware is setup and calibration. Normally, the default setup of the board will suffice, but if your system has an unusual hardware addition, you may have to reconfigure the PCPA. The instruction manual covers this eventuality. A *Quick Start Guide* is provided to help you get the PCPA up and running right away, and DRSI provides support via telephone and CompuServe® should you encounter any problems. (I ran into an interrupt conflict between the PCPA and my multi-I/O card. This situation is specifically covered in the manuals, so I had no trouble correcting it.)

Modem calibration is accomplished using the CAL program provided on the diskette. Although the modem is calibrated at the factory, the CAL program is useful for testing the cable between the PCPA and your radio. (You have to make this cable yourself; the DB-9 connector necessary for connection to the PCPA is not supplied, although a cable with DB-9 connector is available from DRSI.) You may need to adjust the transmit audio level control via a screwdriver adjustment on the PCPA card.

Because software is such an important element of a TNC system, the remainder of this review focuses on the software supplied with the PCPA. Because changing software is so easy with the PCPA, the folks at DRSI supply several programs. The TNC on which the DRSI software is modeled is the system designed by Ron Raikes, WA8DED (see sidebar, "The WA8DED TNC"). The basic DRSI software was written by Software 2000, the company that designed the NET/ROM networking firmware for the Tucson Amateur Packet Radio (TAPR) TNC 2. The WA8DED system is becoming a de facto standard for use with host-computer applications of packet radio, at least in some circles. By mimicking a WA8DED TNC, the DRSI software allows existing and new application programs to easily include the PCPA among their list of supported devices. The THS program supplied by DRSI is an example: It can run on the PCPA, or on a TAPR TNC-1 or TNC-2 that has WA8DED firmware installed.

A stand-alone program, called TNCX, is provided to make the PCPA work just like a WA8DED TNC. Most people, however, will use the *resident* software. This program, TNCTSR, is loaded into memory and stays there forever... well, at least until the computer is reset. The advantage of this is that a WA8DED TNC is capable of running in the unattended mode. In this mode, anyone connecting to your station will receive a text message (that you provide) and has the opportunity to leave you a message. When you return, you can read these messages. Although both TNCX and TNCTSR have this capability, using TNCTSR allows you to run DOS normally while TNCTSR continues to respond as an unattended WA8DED TNC. TNCTSR and TNCX each come in two versions, the difference among them being the amount of memory reserved for storage of messages received during unattended mode. The smaller version reserves about 48 kbytes, while the larger version expands to 110 kbytes.

The presence of the WA8DED host mode allows the use of intelligent terminal programs with TNCTSR. Two such programs are provided by DRSI. The SS program from Software 2000 is a split-screen terminal program with few features. If you like your TNC interface "raw," SS does a nice job. It doesn't get in the way; you have complete control of the TNC. At the same time, the split-screen feature keeps the transmitted and received data separate for easy operation.

The WA8DED TNC

For most uses, the TAPR-designed software (which is often called *firmware*, because it is contained in read-only memory) for their TNC 1 and TNC 2 is suitable. For use with a host computer, however, this software leaves something to be desired. After all, this software was designed for a human to use, not for a computer! The most famous packet-radio host-computer software—that for packet bulletin boards—is complex largely because the job of making the computer understand what the TNC is doing is so difficult.

Ron Raikes, WA8DED, has provided alternative TNC firmware for the TAPR TNC 1 and TNC 2. (Several of the currently marketed TNCs use the TAPR design and can run the WA8DED software. If in doubt, check with the manufacturer.) Ron's command system is much simpler than TAPR's. Most important, his software includes a host mode that allows the computer to have complete control of the TNC. Thus, the host computer will never be surprised by what the TNC is doing.

In operation, the host computer sends a stimulus to the TNC. This stimulus can be either a command or some data for the TNC to transmit. The TNC sends a response, which may include status messages or received data. Because the TNC sends to the host only in response to a stimulus, the host computer can easily maintain control of the TNC-to-host communication.

TAPR makes the WA8DED firmware available for both the TNC 1 and the TNC 2. For information, contact Tucson Amateur Packet Radio (TAPR), PO Box 22888, Tucson, AZ 85734.—*Jon Bloom, KE3Z*

The second terminal program provided is THS (TNC Hostmode Server), by Peter Heinrich, HB9CVV. This is a full-blown terminal program that provides terminal emulation, programmable keys, ASCII and binary file transfers, printer control and scads of on-line help information. This software was not written specifically for the PCPA, but for WA8DED TNCs in general. It can be easily configured to run either the PCPA or a WA8DED TNC that is attached to one of the PC's serial ports. You do this configuration by means of an ASCII text file, which also includes selection of printer port, display attributes (colors), TNC parameter settings and programmable keys.

THS uses pop-up windows for parameter selection and manipulation. (You can also issue commands directly to the TNC.) Using a 4.77-MHz IBM PC clone with a CGA display, I found the operation of the menu system somewhat sluggish, but acceptable. My computer configuration represents the worst (slowest) case, so just about any other computer in the IBM PC family should exhibit speedier performance.

The binary file-transfer protocol—invented by Jeff Jacobsen, WA7MBL, for his YAPP terminal program and used in the WA7MBL packet bulletin-board software—is supported by THS. This means that you can transmit and receive binary files as well as ASCII files.

Software, Anyone?

If you're a computer programmer, one exciting programming possibility is that of writing your own host-mode applications. The interface between an application program and TNCTSR is done via a single software interrupt. The most popular high-level language compilers for the PC, such as those for the Pascal and C languages, provide software-interrupt generation capability, making the writing of application programs that use the resident TNC quite straightforward. DRSI includes a sample file of C functions to demonstrate how a host program communicates with TNCTSR. The simplicity of the TNC command protocol allows a programmer to concentrate on the useful parts of the program, rather than the task of talking to the TNC.

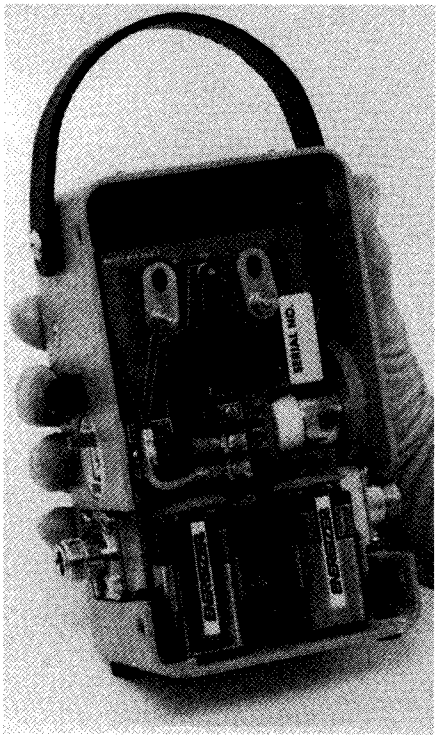
The PC*Packet Adapter seems to be a "board for all seasons." Operators who just want a compact, easy-to-use packet system will find what they need in the PCPA, as will software experimenters. DRSI plans to have a bulletin board program available soon to serve that application as well.

Manufacturer: Digital Radio Systems, Inc, 2065 Range Rd, Clearwater, FL 34625, tel 800-999-0204. Price class: $140.

New Products

BIRD MODEL 43 PEAK-POWER-READING WATTMETER AND 4300-400 ADD-ON KIT

☐ Bird has introduced a new version of their popular model 43 wattmeter. The Model 43P Thruline® meter measures peak power of SSB signals and some other varying-level signals. The peak-power measurement accuracy is 8% of the full-scale meter reading. The 43P uses the same elements as the standard Model 43—elements are available for measuring full-scale power levels from 0.1 W to 10 kW, over the range of 450 kHz to 2.3 GHz. The peak-power measurement circuit uses two 9-V batteries, which, according to Bird, should have a service life of about 48 hours.



Model 43 wattmeter owners can modify their units for peak-power measurement capability with the 4300-400 retrofit kit. For more information on the Model 43P and 4300-400 kit, contact Bird Electronic Corp, 30303 Aurora Rd, Solon, OH 44139-2794, tel 216-248-1200.—*Rus Healy, NJ2L*

SEM QRM ELIMINATOR

☐ SEM, of Isle of Man, UK, produces the QRM Eliminator: a device that allows you to reduce interference by using signals from a sense antenna to cancel offending signals. Some kinds of interference that the QRM eliminator should be effective in reducing are power-line noise, computer hash, and so on. The QRM Eliminator is connected to the receiving antenna and a second antenna (which can be, for instance, a 2-meter antenna, a long piece of wire, or another antenna for the same band), and uses RF-sensed switching for use with transceivers. SEM claims noise reduction of as much as 50 dB with the QRM Eliminator. For more information, contact SEM, Unit B, Union Mills, Isle of Man, UK.—*Rus Healy, NJ2L*

SPI-RO LINE FILTER/SURGE SUPPRESSOR

☐ The Spi-Ro SP-6-CB is a 6-outlet EMI/RFI filter and surge suppressor with a built-in circuit breaker and an indicator light. The unit is rated at 15 A at 125 V, and provides 1-ns switching response. It can handle 4500-A spike currents. Price: $29.95. Available from Spi-Ro Manufacturing, PO Box 1538, Hendersonville, NC 28793.—*Rus Healy, NJ2L*