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Advanced Electronic Applications AEA PK-900 Multimode Communications Processor

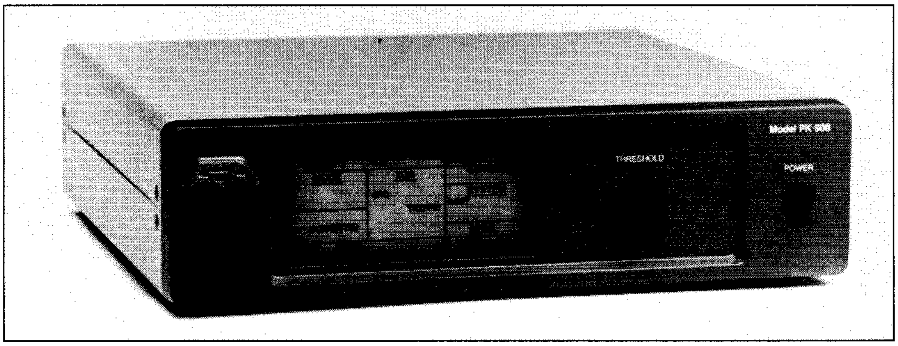
Ramsey Electronics FX-146 2-Meter Transceiver Kit

AEA PK-900 Multimode Communications Processor

Reviewed by Steve Ford, WB8IMY

The AEA PK-900 occupies the middle ground between "standard" multimode communications processors (such as the Kantronics KAM, AEA PK-232MBX and MFJ-1278), and more expensive digital signal processing (DSP) units, such as AEA's own DSP-2232 and DSP-1232.

One of the PK-900's most attractive features is its flexible dual-port capability. With the PK-900, you can operate VHF or UHF packet on one port, while *simultaneously* running RTTY, AMTOR, PACTOR or HF/VHF packet on the other port. The PK-900 also does CW, WEFAX, ASCII, TDM and NAVTEX, and includes AEA's Signal Identification and Acquisition Mode, or SIAM.



Setting Up

The PK-900 manual, like most AEA manuals I've seen, is outstanding. It's packed with useful information. The manual thoroughly describes the various PK-900 functions and even offers brief operating tutorials. Schematics, parts lists and PC-board layouts are included.

The PK-900 is bigger than the typical MCP. Its dimensions are 3½ × 11¹³⁄₁₆ × 12 inches (HWD), and it weighs more than 4 pounds. It draws slightly more than 1 ampere from a 12-volt power supply.

If you've ever struggled with a tightly packed PC board, you'll welcome the PK-900's open, uncluttered layout. Installing options—such as the 9600-bit/s modem board—is a breeze.

A 25-pin serial cable is provided to link the PK-900 to a computer or terminal. Two cables with 5-pin DIN plugs are included to connect the PK-900 to your transceivers. You have a choice of two radio ports: One is intended for packet operation, and the other supports the HF digital modes as well as 1200-bit/s VHF packet. This flexibility creates interesting dual-port possibilities, as we'll see later.

You have the option of feeding receive audio to the PK-900's radio ports via the DIN-plug cables, or by using separate audio cables equipped with ⅛-inch plugs on each end. Separate CW and FSK keying ports are also provided.

Of course, you must provide the connectors for your transceiver(s). The AEA manual makes this task *much* easier by including a comprehensive list of rigs and their corresponding microphone-connector diagrams. I've never before seen anything quite like this in an MCP manual. Soldering iron in hand, I wired connectors for my VHF and HF transceivers in about 15 minutes.

Getting Started

To those accustomed to traditional MCPs, the PK-900's most striking visual feature is its lack of LEDs. Instead, the front panel is dominated by a large, amber liquid-crystal display.

The PK-900's display was a refreshing change for me, since I'm accustomed to flickering, multicolored LED indicators, not plain-English messages! For example, if someone leaves a message in your PK-900 Maildrop, the word **MAIL** appears in large, bold letters. When you send a packet, the word **UNACKNOWLEDGED** appears, then changes to **ACKNOWLEDGED** when the packet "ack" is received. (This is much more intuitive for new users than the traditional **STA**tus indicator!) Display brightness is adjustable via your terminal program by using the **BRIGHT** command—a nice touch.

A 20-segment tuning indicator occupies the bottom of the display. If you don't like the way the indicator functions, you can change it—from your terminal software. The **BAR** command presents several tuning-indicator options. I prefer the "magic eye" selection, in which the display segments meet at the center of the bar when a signal is tuned correctly.

A word about software is appropriate. I tested the PK-900 with *Procomm* terminal software. *Procomm* is a terrific general-purpose communications program, but I thought I was going to lose my mind when I used it with the PK-900! Yes, it works, but I pulled out a substantial amount of hair while learning every quirk. (Let's see...which radio port is active? Oh, yeah. I have to enter **!A** to get to VHF packet...or was it **~A**?)

When you power up the PK-900 for the first time, its default data rate to the computer or terminal is 1200 bits/s. You can easily change the data rate. I used 4800 bits/s, but you can set it as high as 19,200 bits/s. If you intend to purchase a PK-900, I *strongly* recommend that you also buy AEA's *PC-Pakratt* (for IBM PCs and compatibles), *PC-Pakratt for Windows* or *MacRATT* (for the Macintosh) software. These programs greatly streamline communications between you and the PK-900.

When I turned on the PK-900, I was curious to see how my power supply was holding up. No need to get out the DVM, though—all I had to do was issue the **VOLTAGE** command. The PK-900 promptly showed the input voltage, along with a rough measurement of the supply regulation. How's that for convenience?

You can choose operating modes in two ways. Issue the **DIR** command and you're presented with a list of modem configurations for each radio port. With the **MODEM** command, you can activate individual modems. The easier method is to switch to the appropriate radio port and send the abbreviated command for the mode you want on that port. For example, if you want to work Baudot RTTY, switch to port 1 and enter **BAUDOT**.

But how do you know if you're operating RTTY with a 170-Hz shift or an 850-Hz shift? That's a good question and the PK-900 provides the answer. Several *Q* commands allow you to change the modem configuration (data rate and/or shift) selected when you enter a particular mode. If you always operate 170-Hz-shift RTTY, for instance, you can set up the PK-900 to select the 170-Hz-shift modem whenever you enter the **BAUDOT** command.

I found myself using the PK-900's default modem settings most of the time. In some instances, however, you may want to deviate from them. How about a configuration that sets up 1200-bit/s packet on port 1 and 9600-

The Bottom Line

For the advanced digital-mode enthusiast, the PK-900's extensive standard-feature set and optional support of 9600-bit/s operation raise its value, but it's overkill for more pedestrian applications.

bit/s packet on port 2? You could then configure a digipeater/gateway system that would allow 1200-bit/s VHF packet users to connect to you and access a 9600-bit/s UHF link. The same system could be used to permit 1200-bit/s VHF packet users to access 9600-bit/s packet satellites, such as OSCARs 22 and 23.

HF and VHF Packet Radio

The PK-900's VHF packet performance is comparable to that of other MCPs I've used. The PK-900's data-carrier-detect state machine feature (radio port 2 only) is a great help when you're communicating over difficult paths. You can turn your **SQUELCH** control off and the PK-900 will detect valid packet signals *only*, ignoring noise.

The PK-900 Maildrop supports an array of features including extensive editing options and local/remote sysop commands. Approximately 17 kbytes of memory are available to store messages. If you make the appropriate arrangements with your local PBBS, the PK-900 will receive and forward mail. Whenever mail arrives at the PBBS, the PK-900 will download it automatically. If you have outgoing mail in your PK-900 (originated by you or anyone else), it will be sent to the PBBS immediately.

Combine the PK-900's flexible Maildrop with its dual-port capability and you have the potential for some fascinating operating. Imagine an HF PACTOR or AMTOR operator leaving a message in your Maildrop, which is subsequently forwarded to your local VHF packet network. A VHF packet operator could also leave a message in your Maildrop for a PACTOR or AMTOR operator in another state or country! (The PACTOR or AMTOR operator would have to connect to your Maildrop to pick it up, though.)

The PK-900 supports the KISS protocol for TCP/IP and other applications. I had no difficulty using my version of NOS with the PK-900, although I had to be careful to select the proper radio port before sending the **KISS ON** command.

When I tried HF packet, I began to understand how the PK-900's performance differs from other MCPs. HF packet is not a *robust* mode. If a single bit of data is lost to noise or interference, the entire frame must be repeated. Being a glutton for punishment, I chose the noisy, crowded 20-meter band. To my surprise, the PK-900 demonstrated a remarkable ability to decode complete packet frames under less-than-optimal conditions. The limiter/discriminator demodulator used for the HF modes appears to be extremely selective. (This is no doubt enhanced by the 8-pole Chebyshev band-pass filter that precedes it.)

To give HF packet operators an extra edge, AEA offers *Packet Lite* in the PK-900. Packet Lite is basically an abbreviated form of the standard packet protocol. By sending frames with reduced overhead data, you reduce the chance of errors caused by noise or interference. The result is improved throughput. The only catch, however, is that both stations must be running Packet Lite for the protocol to work at maximum efficiency. In addition, you cannot communicate through digipeaters.

AMTOR and PACTOR

The PK-900's good HF demodulator/filter performance became even more apparent when I operated AMTOR and PACTOR. I enjoyed a number of conversations on both modes under a variety of conditions. In all cases, the communications reliability far exceeded MCPs I have used in the past.

During one test, I linked to the WA1URA/9 APLink system with the PK-900. A solar flare had just occurred and band conditions were abysmal. Noise levels were high and fading was deep and frequent. Even so, the PK-900 maintained the link with ease. After reading a few bulletins, I logged off the system and immediately connected my own MCP in place of the PK-900. I managed to relink to WA1URA/9, but my own MCP was unable to maintain the link for more than a minute or two at a time. I conducted a similar test on PACTOR with a ham in Venezuela. We enjoyed a long, comfortable conversation while I used PK-900. When I substituted my own MCP, it was a different story. We maintained the link, but throughput suffered noticeably.

The AMTOR and PACTOR *listen* modes exhibit similar performance. The manual warns against adjusting your IF shift while attempting to copy AMTOR or PACTOR signals in the listen modes. I found this to be true: Even a slight IF-shift adjustment effectively killed my ability to eavesdrop on AMTOR and PACTOR signals.

The PK-900's display is informative in the AMTOR and PACTOR modes. It indicates when errors have been detected, when phasing is taking place, and so on. In PACTOR operation, the word **COMPRESS** appears if Huffman data compression is active.

When operating AMTOR or PACTOR, each station takes turns transmitting and receiving. Therefore, it's important to know when you're the information-sending station (ISS) or the information-receiving station (IRS). The PK-900's display does not indicate whether you're in the ISS or IRS mode per se, although it does display **OVER** when the link direction changes.

If you're running sophisticated host software, such as AEA's *PC-Pakratt*, the link status is displayed on your monitor. Since I was running *Procomm*, however, I had to watch for the ISS/IRS changeover character (+?), or listen for a sudden change in the keying rhythm of my transceiver.

Baudot RTTY

The PK-900's Baudot RTTY performance is exceptional. Once again, it demonstrates a remarkable ability to provide clean copy under terrible conditions. On one occasion, I stumbled upon a station in Liberia on 15 meters. His signal was not very strong, and a substantial pileup had developed. With my own MCP, I was able to copy the stronger domestic stations in the pileup, but I had great difficulty printing anything from the Liberian station. I quickly hooked up the PK-900 and tried again. Now I could copy the DX station completely. (I never did manage to bust the pileup, though!)

Before anyone says, "I'll bet he's using a kilobuck transceiver with tight IF and AF filtering," I must point out that my rig is an old Kenwood TS-820S. During all of the HF tests I conducted with the PK-900, I used its 2.3-kHz SSB filtering—nothing more.

The PK-900 includes a feature that any RTTY operator is sure to appreciate. Most MCPs display "garbage characters" on your screen in response to noise or other signals. The PK-900 is no exception, but the AEA engineers thoughtfully added a command to detect *framing errors* in the RTTY and ASCII modes. A framing error occurs when the bit in the stop position is detected in the wrong polarity. The PK-900 stops copying whenever 4 out of the last 12 characters have framing errors. Copy resumes when the 12 most recent characters are framing-error free. By activating the **RFRAME** command, the random characters almost disappear.

CW

The CW section of the PK-900 manual begins with an emphatic warning about overinflated expectations. In other words, the manual cautions you not to expect solid CW reception unless the operator on the other end sends machine-perfect code. Indeed, the PK-900's ability to copy *average* CW is only fair. It does a much better job, however, during conversations with experienced operators. The PK-900's CW weakness isn't speed, it's spacing. The spacing of character components and the spaces between characters themselves must be precise for good copy. In fairness to the PK-900, I've yet to see an MCP that could copy real-world CW signals as well as a human. That day may eventually arrive, but it isn't here yet. On the other hand, the PK-900 does an outstanding job of *sending* CW. It keyed my TS-820S flawlessly. I'm not accustomed to sending CW from a keyboard, but the PK-900 makes it easy.

SIAM

Like other AEA digital products, the PK-900 includes the Signal Identification and Acquisition Mode, or SIAM. SIAM tries to identify signals that the PK-900 cannot copy in its selected mode. By using SIAM, you can determine the proper mode and copy the oddball signal with little difficulty. For example, I found a RTTY signal that sounded relatively normal, but the information would not print on my screen. I switched to SIAM and soon discovered that the operators were using upper sideband instead of lower sideband. By pressing a single key, SIAM switched the PK-900 to the *in-*

verted mode and coherent copy began to flow across the screen.

Using SIAM, I also found a TDM (time-division multiplex) transmission just outside the 20-meter band, and several NAVTEX signals at 518 kHz. (The PK-900 can copy both TDM and NAVTEX.) Without SIAM, I could only have guessed what these signals were; with it, I enjoyed *copying* them.

Weatherfax and the AEA *FAX 900* Software

The PK-900 supports an analog-mode decoding function on radio port 1. External software is required to decode the incoming information; the PK-900 simply translates the signals into data for the computer. You can use this function for a number of purposes, including HF facsimile transmissions. To test the PK-900's fax capabilities, I used the optional *FAX 900* software (for IBM PCs and compatibles). After loading and running the software, I began hunting the HF bands for weatherfax signals.

I soon found NAM in Norfolk, Virginia, on 8080 kHz. After adjusting the black-and-white threshold settings in the software, I saw an image developing on my computer screen. Within a couple of minutes, I had a highly detailed weather forecast map of North America. After about 10 minutes, the transmission was complete. Later that day, I copied a weather-satellite photo transmission from Mobile, Alabama. The thrill is not quite as great as seeing it sent directly from the satellite, but it's pretty close!

FAX 900 offers the ability to manipulate an image for easier viewing. You can shift it left and right, up and down. You can even zoom in on features of interest. *FAX 900* displays in black and white (for weather maps) and gray-scale images (for photographs). The software allows you to adjust the gray-scale settings (through the use of an on-screen gray-scale bar) to enhance a received image. Each image can be saved to disk for later viewing, or printed on a laser printer or an Epson 9- or 24-pin dot matrix printer.

9600-Bit-Per-Second Operation

AEA offers an optional modem board that permits the PK-900 to transmit and receive data at 9600 bits/s. This option is of interest to satellite enthusiasts who want to access the 9600-bit/s FM birds, such as UoSAT-OSCAR 22 and KITSAT-OSCAR 23. Terrestrial packeteers can also benefit from the high-data-rate capability.

Installing this option is very easy. You open the PK-900 cover, remove four screws from the PC board, add four spacers, plug in the modem board, and replace the screws. I'm clumsy with tools, and yet I had the board installed and ready to go in less than 10 minutes.

The installation instructions cover less than two pages. The rest of the modem manual discusses the sometimes difficult task of sending and receiving 9600-bit/s data with standard Amateur Radio equipment. Very few FM transceivers can accommodate 9600-bit/s signals without modification. As the AEA instructions state, you cannot simply connect the transmit audio to the microphone jack and pick up receive audio from the external speaker port: The transmit audio must be injected in the varactor circuit—*after* the microphone-amplifier stages. Receive audio must be tapped at the discriminator. Don't worry, though: The manual offers modification information for many popular transceivers.

The 9600-bit/s modem board provides a small potentiometer to set the transmit-audio level. Although this can be accomplished by ear, a deviation meter is strongly recommended. At 9600 bit/s, the transmit signal sounds very much like random noise (a high-pitched hissing sound). This makes it difficult to set the level reliably by simply listening to the signal.

For this review, I connected the PK-900 to a Yaesu FT-726R transceiver. The PK-900 performed well, transmitting 9600-bit/s packet bursts (which I monitored locally). I eavesdropped on several passes of OSCAR 23 and successfully copied data using the Microsat *PB* software with the PK-900 in the KISS mode.

Summary

The PK-900's enhanced performance and convenience come at a price substantially higher than most MCPs. If you add the 9600-bit/s options and the *Pakratt* software, its cost rises even higher.

Is it worth the money? If you're a die-hard digital aficionado or have an application well suited to the PK-900's capabilities, the answer is probably yes. You'll enjoy the PK-900's special features—especially its simultaneous dual-port capability—and you'll appreciate its superior performance. If you're a "digital dabbler" with less-demanding requirements, the PK-900's higher cost may not be justifiable. In making your buying decision, take a careful look at your present digital activities—as well as your plans for the future.

Manufacturer: Advanced Electronic Applications, PO Box C2160, 2006 196 St SW, Lynnwood, WA 98036, tel 206-774-5554. Manufacturer's suggested retail prices: PK-900, $549; AC-4 power supply, $32; 9600-bit/s option, $75; *FAX 900* software, $75.

Ramsey Electronics FX-146 2-Meter Transceiver Kit

Reviewed by Jon Bloom, KE3Z

Building amateur equipment from kits has long been a favorite activity of hams. It probably peaked in the 1960s, when companies such as Heath, EICO and AMECO sold thousands of kits, and many stations on the air used kit equipment. The advent of solid-state equipment that could be largely machine assembled eventually made factory-built equipment more economical than kits, and the companies that produced kits for the amateur market went out of business or dropped that product line. But kit-building lives, with a number of smaller companies producing equipment that's typically less complex than a modern amateur HF transceiver. One of those companies is Ramsey Electronics.

Along with test equipment and general hobbyist electronics kits, Ramsey has several amateur products, one of which is the FX-146 2-meter FM transceiver: a synthesized radio that covers 140 to 180 MHz in 12 channels, programmed by the user during assembly. The channel in use is selected via a 12-position rotary switch on the radio's refreshingly simple front panel, which contains additionally only the volume and squelch controls, an LED that indicates when the transmitter is keyed, and miniature phone jacks for the speaker and microphone. These jacks are spaced to accept ICOM-compatible speaker-microphone accessories. No microphone or speaker is provided with the unit, so I bought an MFJ speaker-microphone to use with it. You can buy the FX-146 with or without a case. We bought

The Bottom Line

Inexpensive and relatively easy to build, the FX-146 will get you on the air, but with less than factory-built performance.

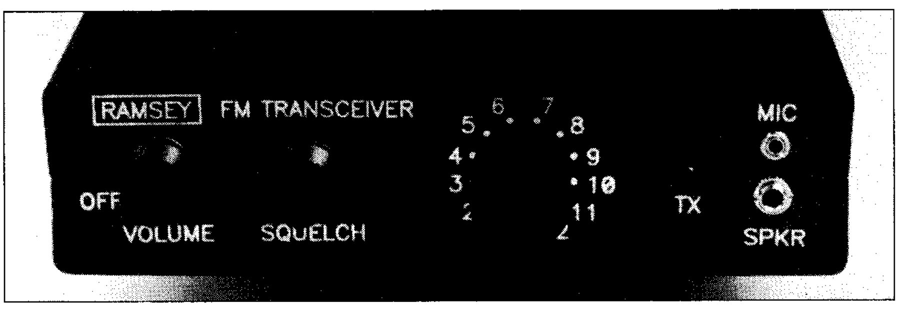


Table 1

Ramsey FX-146 2-Meter FM Transceiver (Serial No. N/A)

Manufacturer's Claimed Specifications	***Measured in the ARRL Lab***
Frequency coverage: Any 20-MHz segment between 140 and 180 MHz	Not tested outside of 2-meter amateur band.
Mode of operation: FM.	As specified.
Current requirement: transmit, (5 W RF output), 1.0 A; receive (no signal), 200 mA.	With 13.8-V supply: Minimum audio output, 140 mA; maximum audio output, 300 mA; transmit, 860 mA.
Transmitter	*Transmitter Dynamic Testing*
Power output: 4 to 6 W.	3.8 to 4 W.
Spurious signal and harmonic suppression: Not specified.	The Ramsey FX-146 meets FCC requirements for spectral purity for transmitters in its power-output class and frequency range.
Transmit-receive turnaround (PTT release to 90% of full audio output): Not specified.	Squelch off: S1 signal, 41 ms; S9 signal, 45 ms. Squelch on: S1 signal, 60 ms; S9 signal, 43 ms.
Receiver	*Receiver Dynamic Testing*
Receiver sensitivity: Less than 0.35 µV for 12 dB SINAD.	0.23 µV (−119.7 dBm) for 12 dB SINAD; 0.21 µV (−120.5 dBm) for 10 dB quieting; 0.61 µV (−111.3 dBm) for 20 dB quieting.
Two-tone third-order IMD dynamic range: Not specified.	Offsets from 146.514 MHz: +20 kHz, 53.7 dB; −20 kHz, 53.7 dB.
Adjacent-channel selectivity: Not specified.	Offsets from 146.514 MHz: +20 kHz, 56.5 dB; −20 kHz, 57.5 dB.
Squelch sensitivity: Less than 0.25 µV.	Minimum threshold, −128.1 dBm (0.09 µV); maximum threshold, >+20 dBm (2.24 V).*
Receiver audio output: More than 2.0 W (distortion and load impedance not specified).	1.28 W maximum (at 8.2% THD) with 8-Ω load.
Other	
Size: (H × W × D): 1.5 × 6 × 9¾ inches.	
Color: Black.	

*Maximum output of ARRL Lab signal generator. Receiver was still squelched at this level.

the case, which is a strong clamshell design that works well.

The FX-146 includes a rear-panel DIN connector for packet-radio use. An internal jumper allows selection of the received signal available at this jack from the speaker audio, the discriminator output, or a demodulated FSK output. However, there is no equivalent selection of the transmitter input; signals applied to the input pin pass through the same audio circuitry as do signals from the front-panel microphone jack.

Assembly Required

All of the radio's circuitry (except for the front-panel controls and connectors) is contained on a single printed-circuit board. Soldering the parts to this board is the principal job in assembling the FX-146. I have quite a bit of experience building kits, and it took me about 10 hours to assemble the FX-146. Inexperienced builders can expect to spend a bit more time building it.

For many builders, the key to successful assembly lies in the manual. A well-written manual can make kit-building a joy, but a poor one can make it a nightmare. The manual for the FX-146 is pretty good. Ramsey's approach is to allow the builder to assemble complete subsections of the radio and test them before proceeding with further assembly. Each section of the assembly instructions includes a partial schematic covering the stages being assembled and a brief description of the circuit operation. Where possible, testing instructions are included so the builder can check the work just done prior to moving onward.

This approach builds confidence and ensures that critical stages, such as the voltage regulator, are operating properly before adding more circuitry. The only downside is that you end up working on a board that has controls hanging from it at the ends of wires.

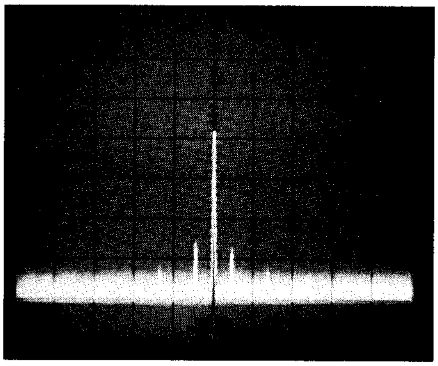


Fig 1—Close-in spectral display (±25 MHz) of the FX-146 transmitter's output during spectral-purity testing after modification (see text). Vertical divisions are 10 dB; horizontal divisions are 5 MHz. Power output was 3.7 W at 146.52 MHz. The fundamental was notched by 28 dB to prevent spectrum-analyzer overload.

Inexperienced builders may want to get some assistance in identifying the parts in the kit. There are many, and the manual provides only limited help in identifying them. The manual does, however, list the parts by type and value, and also in reference-number order. And a cross-reference is provided for some of the semiconductors and controls so that, should a component fail, you can more easily find a replacement.

Alignment is always an issue with kits. In the case of the FX-146, two main adjustments need to be made. One is the phase-locked-loop VCO tuning coil, which Ramsey has you adjust while measuring the voltage at a test point. I found it impossible to achieve the specified voltage while the unit was tuned to the specified test frequency. The loop did lock properly, but at a different voltage. The other adjustment, the reference-oscillator frequency, is best performed with a frequency counter, but tuning for "best sound" on a receiver is an acceptable starting point.

Programming the frequencies of the 12 channels is done by means of a diode matrix. You have to perform some calculations to determine which diodes to install in the matrix, and Ramsey provides both detailed instructions for doing so and a listing of a BASIC program you can use to figure out the diode arrangement. The board layout allows for four transmit/receive offsets: simplex, +600 kHz, −600 kHz and one user-selected offset. The limitation on the number of channels and offsets has to do with the board layout; a clever builder could easily add more channels or offsets on a perfboard.

Performance

Building the kit is fun, but how does the radio perform? The ARRL Lab test results are shown in Table 1. The receiver demonstrates acceptable sensitivity and squelch performance, but dynamic range is less than that of other common 2-meter FM receivers. This is in part due to the use of an MC3335 FM receiver integrated circuit. This device, which follows a preamp circuit in the FX-146, doesn't have particularly good

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strong-signal performance. That doesn't mean the receiver is useless; it means that in a strong-signal environment, you may experience spurious receiver responses.

One exacerbating factor is that the receiver's front end uses wide filters. This provides for operation across the broad range of 140 to 180 MHz, allowing use of the radio for listening to commercial frequencies or weather broadcasts. (Of course, you can't legally transmit on those frequencies!) Not only does this allow out-of-band signals to cause intermodulation distortion, it also limits the radio's image rejection. Some narrowing of the filter is possible using supplied components. Ramsey gives you the option of using different component values. But this only slightly improves the situation according to testing performed by the ARRL Lab. Ramsey is aware of this problem and provides a free filter-upgrade kit for FX-146 owners who ask for it. This kit narrows the input filter to reject some of the out-of-band signals. It does not, however, improve receiver performance with strong in-band signals.

A more serious problem that we encountered was that the transmitter's spectral purity did not meet FCC Part 97 requirements. Spurious outputs close in (about 2 MHz from the operating frequency) from the synthesizer and spurs at harmonics of the operating frequency were inadequately suppressed. We contacted Ramsey, and they provided two fixes for these problems. One modification adds a 0.001-µF capacitor across the VCO tuning line (from TP3 to ground), which somewhat tames the close-in spurs. The other modification is the addition of a 10-pF capacitor across L12, and stretching L12 to a length of about ½ inch. This change improves the harmonic suppression to FCC-allowable levels. Fig 1 shows the transmitter's close-in spectrum with these fixes applied.

The close-in spurs, even after the modification, are fairly significant. Although the transmitter meets the Part 97 requirements, it may still interfere with receivers tuned to the spur frequencies. And these spurs are present in the receiver local oscillator, too, making it possible for strong signals offset from the receive frequency by a couple of megahertz to be picked up by the receiver.

Summary

The overall performance of Ramsey's FX-146 is disappointing. Certainly the synthesizer spurs should be cleaned up. Better receiver strong-signal performance would be welcome, too. Still, the FX-146 is low in cost, and with the relative paucity of transceiver kits (especially for VHF) on the market, it's nice to see someone trying to fill the void. As long as you are willing to settle for less than factory-built performance, the FX-146 has possibilities. But I recommend looking at the output with a spectrum analyzer before connecting the transmitter to an antenna.

Manufacturer's suggested retail price: FX-146 kit, $149.95; clamshell case, $24.95; microphone, $24.95. Manufacturer: Ramsey Electronics, Inc, 793 Canning Pkwy, Victor, NY 14564, tel 716-924-4560, fax 716-924-4555.

Feedback

◊ Jim Hamlin, W7FKI, of Federal Way, Washington, points out that in the Up Front in *QST* section in the May 1993 issue, the photo caption on page 12 entitled "Citrus signals" mistakenly credited Jim with co-authoring the "Lemonized QSO" article by Wes Hayward, W7ZOI, and Bob Culter, N7FKI, that appeared in March 1992 *QST*, *QST* regrets the error.