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Number 7 on your Feedback card

by Steve Katz WB2WIK/6

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The Azden PCS-7200

A solid 222 MHz Mobile FM transceiver.

The Azden PCS-7200 may be a little-known entity, but it is alive and well and putting out good signals on 135 cm FM around the country, and likely elsewhere. Azden is not one of the "big three" Japanese ham equipment manufacturers, and they don't make HF-SSB equipment. But like Alinco, they make some very usable VHF-FM gear that should not be overlooked when it is time to go shopping for that new rig.

Azden's "claim to fame," so to speak, is that they manufacture budget-priced mobile and portable transceivers for 50 and 28 MHz FM. Although Azden has been around selling 2 meter rigs for 19 years now, they have little competition in the 6 and 10 meter arena, which most manufacturers have chosen to almost ignore. But Azden also makes high-quality FM rigs for 144, 222 and 440 MHz, and the PCS-7200 is one of only two 135 cm FM mobile monoband transceivers currently on the market.

I don't know how things are where you live, but here in Southern California 135 cm is almost as popular as 2 meters. There is considerable simplex activity and a great number of high-level 222 MHz repeaters occupy every single available channel on the band. Many of these "machines" offer autopatch, almost unheard of on 2 meters in densely-populated areas; and coverage on 135 cm is almost exactly the same as it is on 146 MHz. This is the only popular amateur band in the U.S. where every class of licensee has voice privileges, and Novices cut their teeth on "phone" daily by making contacts on 222 MHz.

The Azden PCS-7200 is an excellent entry-level radio for newcomers and old-timers alike. With 25 watts output power and a sensitive, selective receiver, it's a "workhorse" radio that will serve a variety of needs from simplex to repeater, to autopatch, to packet work. It's a pretty radio, like the other Azden mobiles, and is a pleasure to just look at, with its deep orange-backlit LCD display and orange-illuminated microphone pad buttons.

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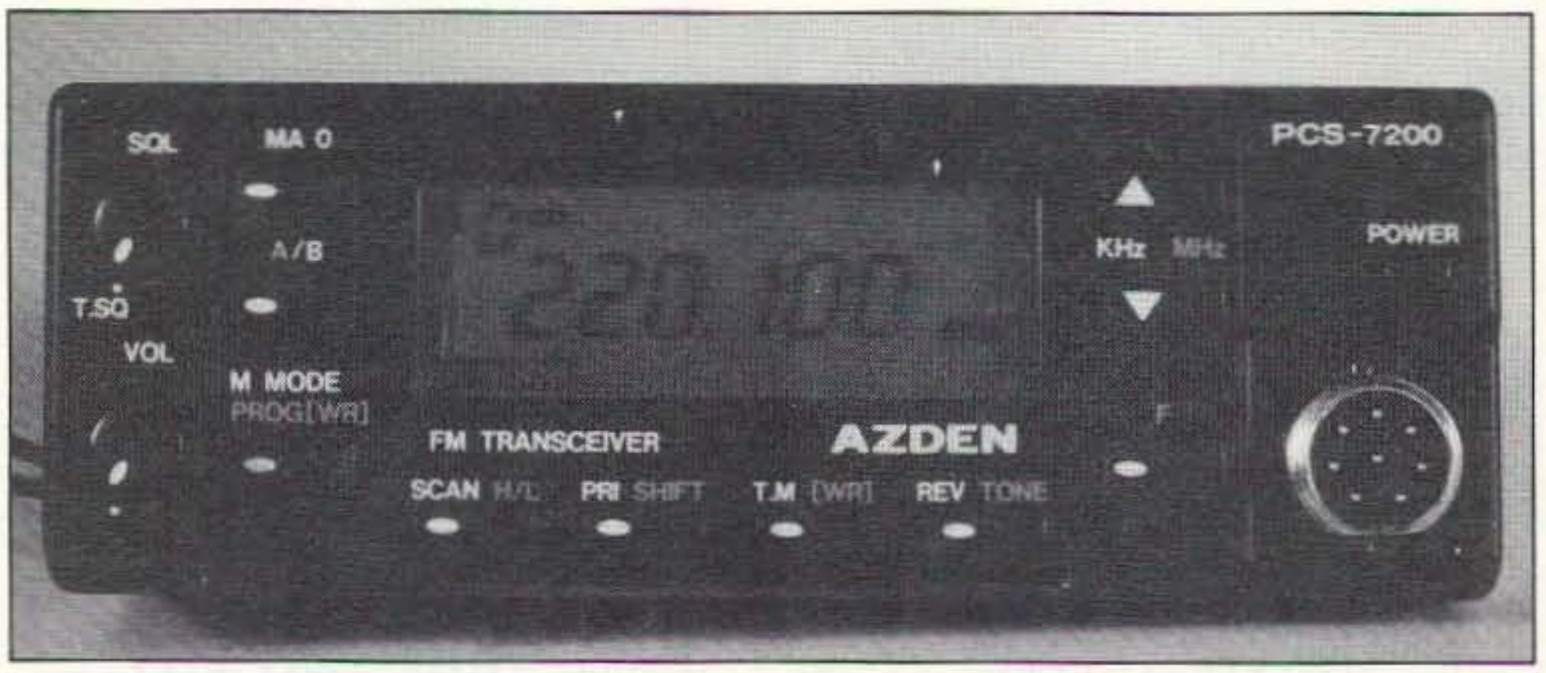
The PCS-7200 comes factory-equipped with a PTT/DTMF ("TouchTone") microphone, mike hanger, DC power cord and spare fuse, mobile mounting bracket and hardware, and owner's manual with schematic diagrams. Like most Japanese gear, the Azden does not come with any real service information, but Azden does offer a two-year limited warranty, where all repair costs are borne by the company for the first year and the cost of replacement parts (but not labor) are covered for the second year.



Initial Use and Programming

There are a couple of downsides to the Azden. One: The documentation is a bit lacking. The PCS-7200 does not have its own instruction manual, but uses the PCS-7000 (2 meter rig) manual, with an "Addendum" sheet to clarify the differences. The PCS-7000 manual has typographical errors and other mistakes, and using it with an "Addendum" sheet means referring back and forth between two papers to get things right.

Secondly, the Azden is not particularly "user friendly," and requires real study of the instruction manual. Probably the most important thing to know for FMers is how to program a transceiver's memories with frequency, offset and tone data. The Azden is surely programmable, and has 20 memories which do store all the important data—but the instruction manual uses a page and a half of text describing how to do it, and until you've programmed the radio a few times, it's a nearly incomprehensible task. As I've said in other product reviews, I rate new equipment for "user friendliness" based on whether I can figure out how to do everything required without ever referring to the instructions. With the PCS-7200, to program each memory you must push the PROG(WR) key six times, and make other keystroke entries as well. It's a task that only Superman could accomplish while driving the freeway, although I'll admit that once I had programmed the first few, the rest of the memory channel programming went quite well (at home, on the bench).

Like the PCS-7500H 6 meter rig, the PCS-7200 defaults to memory "A0" (the first of its possible 20 memory channels) on power-up and does not remember where it was last used. This can take a bit of getting used to, if you're accustomed to other popular brands of FM gear. Also like its 6 meter brother, the 7200's memory storage is only accomplished by turning the radio off at the end of the programming sequence. The following NOTE appears in the manual: "Be sure to turn off the power when you have completed programming. This procedure is required to get each setting programmed in and then to get

out of the programming mode." Weird, but it works.

The PCS-7200 is able to program any frequency offset ("split") on every single memory channel, which is a plus in my book. (Although all our local repeaters here use a minus 1.6 MHz offset, anyway. But that could always change, and it might be different elsewhere.) However, because the Azden lacks any preconceived "offset" of any kind, when programming for use, one must enter both the transmit and receive frequency for every single channel intended. This is quite different from other FM mobile rigs on the market, and takes a bit more time to accomplish. This isn't a big deal if you do all your programming at home and then intend to keep the memory channels as they are for a long time, but it could be an inconvenience for those who fiddle around a lot and like to change memories daily.

A "temporary memory" is also available, and does not occupy one of the main 20 memory channels. Unfortunately, using this feature is too complex to be of much use when driving, so its usefulness might be limited to fixed operation, where one could use the "temporary" memory like one additional channel.

Also, the PCS-7200, like the PCS-7500H, uses a "Tone Code Table" as a reference for CTCSS ("PL" tone) programming. That is, if you wish to program a "PL" tone of 156.7 Hz, this corresponds to Tone Code #25. When entering "PL" data into the Azden, the tone code display is a two-digit one, corresponding to the Tone Code Table printed on page 14 of the instruction manual. If you don't have the manual with you and need to enter some unique "PL" tone on the fly, you'll be hard pressed to remember which two-digit code corresponds to which tone. All the standard 38 CTCSS tones are in there, but it's nearly impossible to remember which one is which without the Table.

The Workhorse

The PCS-7200, for all its quirks, actually works very well. They call it a "MIL-STD-810" radio, which I assume means it is not actually military qualified, but is built to withstand the environmental extremes specified in this military document. I live in a "high-RF" environment that makes many inexpensive VHF/UHF rigs go bonkers with intermodulation products and receiver images: I'm up on a rise with a clear view for 20 or 30 miles in some directions, and that view is of a large city with countless high-powered transmitters populating every hilltop. I'm also just "under" a popular 3600'-high mountaintop bristling with so many transmitting antennas it appears much like a porcupine from here. While most handie-talkies and some mobile radios just roll over and die under the pressure of zillions of high-level signals pouring down the antenna feedline, the Azden doesn't. It just sits there, receiving even weak, distant signals, without a trace of "intermod." Its 25-watt transmitter is competitive enough (although some 222 MHz rigs run 35 watts, this is only 1.46 dB more power, hardly worth discussing) and is rock-solid. After 10 full minutes of continuous key-down time (OK, so I'm long-winded!), the Azden's power output doesn't fall off. Many of the "50-watt" 2 meter rigs start out running 50 watts or more when cold, but wind down to maybe 40 watts after several minutes of key-down time. The 25-watt Azden doesn't do this, and would probably make a good "remote base" unit capable of rather severe service.

Another "plus" in the Azden's favor is its remarkable receiver audio output stage and speaker. The rig is rated to produce 2 watts of audio power into an 8-ohm load at 10% maximum THD (total harmonic distortion), and it sounds loud, much like a commercial radio. I never had to crank up the volume control more than about halfway to produce room-filling (or car-filling) volume. The rig's top-mounted speaker is also top-notch and doesn't rattle the little rig's cabinet, even with the volume full up. This may sound insignificant, but I think it's a wonderful feature for a mobile rig—one I miss dearly when a rig can't provide enough receive audio to overcome road noise when operating mobile.

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Other Features

The memory and band scanning features of the PCS-7200 are as good as those found in any rig I've used. One can scan just the memory channels in "Bank A" (10, A0 through A9), "Bank B" (another 10, B0 through B9), or both A and B. When in the "direct" (VFO, non-memory) mode, the rig will scan between any two frequency limits; however, those limits must be stored in memories. For example, you could store 222.01 in memory A8 and 224.99 in memory A9 and scan between these two limits, thus covering the entire amateur band. You could store another set of lower and upper limits in memories B8 and B9, and scan just between those two. Pushing the PTT button on the mike, or depressing the UP or DOWN keys, the REV(erse) key, the M(emory) MODE key or the F(unction) key will stop the scanning, which may be immediately resumed by depressing the SCAN key again. The only problem is, if your scanning receiver stops on a repeater frequency which was not previously stored in memory, you can't just grab for the mike and start chatting on that channel. This is because the rig won't know exactly where to transmit: It does not have an automatic repeater offset function.

Like most modern FM rigs, the Azden also contains a PRIORITY mode feature. Activated by depressing the PRI(ority) key, this feature enables the receiver to look for activity on memory channel A0 (automatically the designated priority channel) every four seconds, regardless of where the receiver is actually tuned. If activity is present on the priority channel, a "beep" tone sounds in the speaker to alert you. A momentary press of the M A0 key on the front of the PTT hand mike immediately switches the rig from whatever channel it was on to the priority channel (A0). If you make this fast frequency change and then decide you didn't really need to, another momentary press of the same key will return you to the last channel you were on before switching to the priority frequency. I find this feature very handy, since I really do have a priority frequency around here—222.080 MHz, a popular simplex channel for the San Fernando Valley.

The factory-supplied PCM-499-23 dynamic hand mike contains a 16-key DTMF (TouchTone) encoder, as well as UP/DOWN (frequency selection) buttons, the "M A0" (priority channel) button described above, and a rugged coiled cord with attached 8-pin connector. The 16 keys are all softly lighted the same color as the Azden's panel displays, making buttons easy to find in the dark. (I wish all mobile microphones had lighted keys!) The TouchTone encoder produces an audible sound from the microphone itself, so you can tell if it is working. However, the PCS-7000 manual contains some misleading information regarding operation: It states, "To enable the DTMF encoder function, press the keypad keys correctly in the desired sequence. As each button is pressed, the LED will light. The transceiver is automatically put into the transmission mode when any keypad is pressed. The built-in 'hang timer' causes the transmitter to operate continuously if the delay between keystrokes is less than 2 seconds."

I didn't find any of this to be true. Depressing a key does not make the transmitter operate. I had to depress the PTT button on the side of the mike first. As for the "LED" lighting, there was no LED on the mike supplied with the review unit, so I don't know what LED they're talking about. Also, the "hang timer" doesn't exist on the review unit. If you release the PTT button, even if you're in the middle of a keying sequence on the tone pad, the rig stops transmitting. All these "faults" are forgiveable, but I wish Azden would update the manual to make it less confusing for neophytes who may actually become upset if the rig doesn't operate exactly as described. (In speaking with Azden since the review unit arrived, I determined that the new PTT mike does not function as described in the instruction manual, and that is normal. They say most users did not like the "push any button and you're transmitting" function, so they have revised this to be as I have described above.)

I like the mobile bracket Azden supplies with the PCS family of mobile rigs: uncomplicated, unobtrusive, sturdy and easy. Two of the four radio-mounting machine screws have attached plastic knurled surfaces which allow hand-tightening with no need for tools. The other two machine screws do require a Phillips screwdriver, but at least you can get the radio mounted temporarily, without it falling in your lap or on the floor, while you casually install the remaining two screws. This is a thoughtful touch. I also like the Azden schematic diagrams, which are large enough to read without an eye loupe and include a block diagram that clearly details (at least for the technically inclined) what's actually happening inside the rig.

Inside the Radio

Let me take a moment to describe the radio's "guts." Signals entering the receiver from the antenna jack pass through a diode T/R switch (hooray—no relay!) to a 215-230 MHz bandpass filter which is varactor-tuned to resonance by a special "loop filter" circuit programmed by VCO data. Signals are then amplified by a 3SK177 dual-gate MOSFET and bandpass-filtered once again by still another varactor-tuned circuit before driving the first receiver RF mixer. All this "track-tuned" bandpass filtering is probably what makes the Azden's receiver so immune to interference from outside the amateur band. The first mixer is another 3SK177 having LO injection at 200.4 to 203.4 MHz (for tuning 222.0 to 225.0 MHz), provided by a 2SC3838 "RX Lo AMP" buffer stage which receives its local oscillator signal from the VCO UNIT which is common to both the transmitter and the receiver. The receiver's first IF at 21.6 MHz is shaped by a 15 kHz bandpass crystal filter and this IF signal is then applied to "IC7," the receiver IF subsystem which contains a bipolar (2SC2715 common-emitter) IF amplifier, and an integrated circuit (MC33610) containing the second local oscillator, second mixer, second IF amplifier, discriminator and squelch circuit. The second LO runs at 21.145 MHz and produces a second IF at 455 kHz, which is bandpass-shaped by a 15 kHz multipole ceramic filter.

Demodulated signals from the IF subsystem are applied to a bipolar 2SC2712 audio preamp whose output is high-pass filtered by an integrated "HPF" 270 Hz rolloff filter (to strip away CTCSS "PL" tones from being heard) before being postamplified by a power integrated audio amplifier, IC5 (a TA7252). The receiver circuit contains other niceties like a three-stage "S METER AMP" circuit that amplifies then rectifies the 455 kHz filtered 2nd IF signal and an "AF MUTE" gate which switches off the drive to the final audio power amplifier on transmit. All in all, a good receiver design that results in sparkling performance under real-world conditions.

On the transmit side, speech from the microphone is first adjusted in level by a "MIC SENS" (mike gain) control VR2 before being applied to an integrated MIC AMP stage, IC11, which both amplifies and shapes the audio response before driving IC10, a 3.4 kHz integrated low-pass filter which rolls off noise and voice harmonics above the range of human speech. The speech audio from this filter is applied to the DEV(iation) control VR4 and then directly drives the integrated VCO UNIT (IC8), the same system which provides local oscillator injection for the first receive mixer. The voltage-controlled oscillator provides frequency-modulated signals directly in the 222 MHz range on transmit, so only RF power amplification, and no frequency multiplication, follows this stage. This surely reduces "phase noise" on the transmitted signal and helps assure close-in spectral purity.

The output from the VCO is amplified by three cascaded bipolar stages (Q11, Q12, Q13). The last of these stages (Q13, a 2SC2407) has "APC" (automatic power control) bias applied by the APC control circuit, which contains the HI/LOW power switching function and power output level adjustments for both HI (VR9) and LO (VR8) ranges. Bias from the APC circuit is also applied to the final RF power amplifier, IC501, a Toshiba S-AV15 hybrid ("brick") module located on the rear heatsink of the radio. The transmitter output from IC501 is filtered by two separate dual pi-section low-pass networks. Also located on the PA board is the transmit-receive (T/R) diode switch, which uses a pair of HI407s, one in series with the transmitter, and one in shunt with the receiver, to perform the switching function. I am unfamiliar with the HI407 and do not know if this is a P-I-N diode or not (but I hope so, as PINs are far better RF switches than conventional P-N

Table I. PCS-7200 Tests and Measurements

Specification	Measurement
Frequency range, 215-230 MHz (RX)	As specified
222-224.995 MHz (TX)	As specified
Transmitter output power: 13.8 VDC source, 50 ohm load	
25 watts (high)	24W
5 watts (low)	5.5W
Transmitter current drain: 13.8 VDC nominal source	
6.0 A (high)	5.5A
Unspecified (low)	2.3A
Transmitter overall power efficiency, Pout(W)/Pin(W):	
Unspecified	31.6% (high)
	17.4% (low)
Receiver sensitivity:	
<0.12 µV at squelch threshold	0.10 µV threshold
<0.35 µV for 20 dB NQ	0.45 µV 20 dB NQ
<0.19 µV for 12 dB SINAD	0.27 µV 12 dB SINAD
Receiver selectivity:	
12 kHz min (total BW) at -6 dB	12.3 kHz/-6 dB
30 kHz max (total BW) at -60 dB	28.5 kHz/-60 dB
IF rejection:	
Unspecified	1st IF (21.6 MHz), 102 dB
	2nd IF (455 kHz), >136 dB
Receiver current drain: 13.8 VDC nominal source	
0.6A	0.28A squelched
	0.55A unsquelched
Audio output power:	
>2W into 8 ohms, 10% THD	2.4W, 10% THD

S-meter and power output meter bargraph display:
PCS-7200 uses a 10-segment display but segments 9 + 10 illuminate together, making for 9 increments of resolution.
Bargraph reading for full (25 W) output power: 10 segments
Bargraph reading for low (5 W) output power: 2-3 segments
S-meter readings vs. input signal strength:
1 bar = 0.45 µV
2 bars = 0.55 µV
3 bars = 0.65 µV
4 bars = 0.75 µV
5 bars = 0.87 µV
6 bars = 0.95 µV
7 bars = 1.35 µV
8 bars = 2.00 µV
9 bars = 5 µV

Note: PCS-7200 receiver can detect very readible signals before its S-meter bargraph display indicates any signal present.

All data taken by WB2WIK 12/26/94.

junction diodes, having less loss and better distortion product performance). Between the first dual pi-section TX filter and the series RF switch diode (and the second set of dual pi-section filters) is the directional coupler sampling network, which uses a 1SS106 detector diode to drive the APC amplifier system.

Again, the transmitter circuit appears to be thorough, complete and designed with minimal adjacent-channel interference in mind. Although I pointed out some shortcomings in documentation and operator convenience earlier, I must admit Azden does a pretty good job of making radios that work, even when the going gets tough. The PCS-7200 contains circuitry not always seen in amateur gear and more frequently found in commercial two-way equipment. I applaud their RF engineering, and only wish they'd make this rig more "user-friendly," without the complicated channel programming sequence.

I got the review unit programmed with 20 channels of local simplex and repeater activity, made a few dozen contacts (including bringing up some repeaters more than 150 miles distant not bad for a 25-watt radio!) and then spent a few hours conducting "bench tests" for receiver sensitivity and selectivity, and transmitter output power and current consumption. The results of my testing are shown in Table 1.

One additional comment I might make regarding the PCS-7200's transmit modulation: When I first tried the review unit, I received reports of unclear sibilancy (harsh "S" sounds), and "popping" B's and P's. I reported this back to Azden, who promptly provided me with another microphone. The second mike sounds the same as the first. Azden's Communications Division Manager, Sid Wolin K2LJH, recommended I try speaking across the mike, rather than directly into it, because this is a noise-cancelling microphone designed for the "talk across" technique. I tried this, but still received reports of uncrisp modulation. Listening in a second receiver with headphones, I must admit the modulation is not as crisp and clear as I'd like it to be. Some of this is attributable to the noise-cancelling dynamic microphone; when I tried a different brand of "desk" microphone, it sounded better and more natural. I won't downgrade the PCS-7200 for this, but must relate the experience in the interest of accuracy. Azden boasts about their "true FM" modulation (as opposed to phase modulation, used by some other FM transmitters), but without a better microphone transmit audio isn't all that great.

In all, I like the PCS-7200. What it lacks in ease of setup and documentation it makes up for with good, solid RF performance. Azden used to sell their products only "factory direct" in the U.S.; however, I see that Amateur Electronic Supply now distributes Azden products, and perhaps others will follow. The company has a loyal following among 10 and 6 meter FM enthusiasts, and there's no reason for 135 cm (and probably the other VHF band) users not to take a serious look at their products. 73