Product Review Column from *QST* Magazine

January 1982

Cubic Model MMBX "Matchbox", The

Hamtronics XV-4 Transmitting Converter

Kenwood TR-8400 UHF FM Transceiver

Yaesu FT-127 220-MHz FM Transceiver

Product Review

Conducted By Paul K. Pagel,* N1FB

Yaesu FT-127 220-MHz FM Transceiver

It's time to get a 220-MHz fm rig when your QSO on 2-meter fm is interrupted by that chap who makes auto-patch every evening at precisely the same time to let the family know he's coming home — and you feel guilty about inconveniencing *him*.

It's time to get a 220-MHz fm rig when you and several DXer buddies aren't able to use 2-meter fm simplex to coordinate an evening's DX activity. Why? Because one of your friends has to wait half an hour to tell you that VKØ (Heard Island), which you need in order to make the DXCC Honor Roll, is on 10-meter cw. This delay is caused by a couple of locals who are giving a blow-by-blow description of the 200th rerun of a 20-year old episode of "The Mickey Mouse Club" television show!

It's also time for a 220-MHz fm rig when you feel the first twinges of "mike-fright," as you wonder how many thousands of ears are tuned in to your QSO on 2-meter fm with one of those "oh-so-affordable" programmable scanners. Most of those scanners cover the 146- and 450-MHz amateur bands, but not usually 220-MHz. *Burglars have scanners and Callbooks, and know when you are mobile!* Get the picture?

Yaesu FT-127 220-MHz FM Transceiver Serial No. OHO10064

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency control: Crystal	Supplied with 223.50-MHz simplex.
Frequency display: 12-position channel selector.	As specified.
Receiver type: Double-conversion superheterodyne; 10.7-MHz 1st i-f, 455-kHz 2nd i-f.	As specified.
Receiver sensitivity (μV/20 dB quieting): Better than 0.35.	0.19.
Squelch sensitivity: Not specified.	0.1 μV.
Audio power output (8-ohm load): 1.5 W at 10% THD.	1.3 W.
Transmitter power output (50-ohm load): 10 W.	As specified.
Spurious emissions: At least −60 dB.	−60 dB.
Dimensions (HWD): 2.8 × 7 × 9.5 inches.	
Weight: 4.4 lb.	
Power requirements: 13.8 V dc (± 10%), negative ground; 80 mA standby, 180 mA receive, 2.5 A transmit.	As specified.

Note: mm = inches × 25.4, kg = pounds × 0.4536.

Problems

Okay, it is time to get a 220-MHz fm rig — no problem, right? Maybe or maybe not. The problem might be in trying to get the *right* rig. Of course, you could lay out some "big bucks," $400 and more, for a nice, synthesized 220-MHz rig. But for most of us who care to use only a couple of repeaters (and perhaps a simplex channel or two), that's overkill. A less expensive, crystal-controlled unit is just what the doctor ordered. Around here it takes a lot of looking to find a new 220-MHz xtal rig: A used one is just not available — they become family heirlooms and never make it to the used market! That's the problem.

A Solution

Enter Yaesu with a solution — the FT-127. [This transceiver should not be confused with the Yaesu FT-127RA 220-MHz *synthesized* radio that was reviewed in the August 1979 *QST* Product Review column. — Ed.] The Yaesu FT-127 is a 220-MHz, crystal-controlled fm transceiver, designed to operate within a 3-MHz spread in the 220- to 225-MHz band, factory aligned for the 222- to 225-MHz segment with a rated output of 10 watts. I guess most of us use 2-meter and 220-MHz fm for convenience; that is, the convenience of reliable communications and ease of operation. Also, there is the convenience of being able to use the rig in either a fixed- or mobile-station situation. The folks at Yaesu made sure that the FT-127 fulfills those needs.

Assuming you have a proper power supply, a 220-MHz antenna, and coaxial cable with a PL-259 connector, the FT-127 comes complete and could be put on the air very shortly after opening the shipping carton. No doubt the '127 was designed with some heavy-duty mobile use in mind. A deluxe mobile mounting bracket (which can be top or bottom installed) and mounting hardware are included with the transceiver. The mobile bracket slides into heavy-gauge metal channels on the sides of the FT-127, which allows the user about 4 inches of front to rear travel in which to position the unit. The mobile bracket also allows about 60° of up/down tilt positioning and a system for positively securing the rig in the position selected. That the FT-127 has, for the past several months, made the daily 50-mile round trip to work in my flivver, which is pushing 165,000 miles (original shock absorbers, too) and still functions perfectly, is in itself testimony to the ruggedness of the rig.

Description

The front-panel layout is simple and functional. There is a POWER ON/OFF toggle switch, VOLUME control and a SQUELCH control with full ccw detent to activate the Yaesu optional tone encoder/decoder feature. There is also a large, easy-to-grasp knob to select one of the 12 available crystal positions (the FT-127 comes with 223.50-MHz simplex crystals installed). The front panel of the '127 also sports three indicator lights as well as a back light for the channel selector, which are labeled: BUSY to show that squelch has been broken and a signal is being received, TONE SQ to indicate that the optional (if installed) encoder/decoder unit is in operation, and TX to inform you that the unit is in the transmit mode.

The internal speaker is on the front panel where it belongs, pointed at the user. I found that even while driving the highways with the windows open, the built-in speaker provided plenty of audio, although the FT-127 back panel has an external speaker jack, should it be needed. The audio has a "bassy" quality compared to the "tinny" audio quality of some other fm mobile rigs — an almost broadcast quality sound . . . very pleasant with a lot of *presence*.

Yaesu offers a TONE SQUELCH subaudible

*Assistant Technical Editor

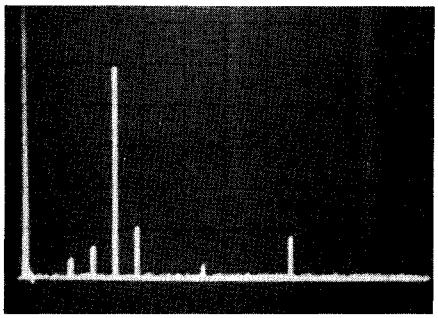


Fig. 1 — Spectral display of the FT-127. Vertical divisions are each 10 dB; horizontal divisions are each 100 MHz. The fundamental signal has been reduced in amplitude approximately 20 dB by means of notch cavities; this prevents analyzer overload. Power output is 10 watts at a frequency of 223.5 MHz. The close-in spur is approximately 60 dB below peak fundamental output. Tests were performed in the ARRL lab. The FT-127 complies with current FCC specifications for spectral purity.

tone encoder/decoder option for the FT-127. This assembly is on a small plug-in circuit board, which when installed and aligned will generate a subaudible tone on transmit and will allow the receiver squelch to be tripped only when receiving a signal with that same subaudible tone superimposed on it. Alignment of the tone option requires the use of an audio oscillator, a vhf signal generator and a frequency counter. Although the tone squelch unit was not supplied with the review model, there is no reason to believe that it would not perform as well as the transceiver.

The instruction manual included with the FT-127 is complete. There are sections on operation, circuit theory, transmitter and receiver alignment, TONE SQUELCH installation and alignment, component values and layout, and a schematic diagram.

From the time we took it out of the box and plugged it in several months ago, the FT-127 has seen almost daily service on simplex and the local repeater (WA1YHL/R) both from the fixed station and in mobile operation. The rig has worked flawlessly and gives every indication of working well for a long time to come. Since relative value is a question we all have to answer for ourselves, we'll simply say that if you want to go 220-MHz fm with a rig that looks good and works great, the Yaesu FT-127 is a way to go. The '127 is manufactured by Yaesu Electronics Corp., 6851 Walthall Way, Paramount, CA 90723. Price class: $350. — *Bill Jennings, K1WJ*

HAMTRONICS XV-4 TRANSMITTING CONVERTER

☐ If you've been thinking of working OSCAR Mode U (much akin to its earlier Mode-B ancestors) on the upcoming Phase III-B, or simply trying your hand at terrestrial 70-cm (432-MHz) communication, the Hamtronics XV-4 is one alternative. The XV-4 is a *transmitting* converter. Hamtronics produces a companion receive converter that can be hooked in tandem with the XV-4 for two-way communication, or 435-MHz downlink reception, but this review deals strictly with the transmitting converter.

Description

The XV-4 transmitting converter is a linear translator that converts 1 mW of 28-MHz rf energy to 1 watt of PEP ssb, or 1-1/2 watts of cw or fm at 435 MHz. The unit incorporates two oscillators: the first is equipped with a crystal suitable for 435- to 437-MHz operation, the region used for several OSCAR uplink passbands; the second oscillator can be equipped with the crystal of your choice. You may wish to cover the 432- to 434-MHz terrestrial portion of the band, some other segment in our 70-cm allocation, or even to order special crystals that will allow the XV-4 to be driven from a CB rig.

As this transmitting converter is linear, it can be used on any mode of transmission — ssb, cw, fm or even ATV. Before purchasing the crystal for the second oscillator, decide what you'll be using the unit for and select the crystal that will put you in the right portion of the band. For example, 70-cm fm is usually used between 440 and 450 MHz.

Most 10-meter transmitters, transceivers or other types of exciters put out more than the recommended drive power. You'll need to reduce the output of your exciter to provide the required input levels. There are several solutions. Many modern transmitters or transceivers include transverter output jacks on the rear panel, which provide a small portion of 10-m rf energy before the final-amplifier stage. These levels vary from rig to rig, but the XV-4 comes equipped with an on-board attenuator circuit that will handle inputs of up to 500 mW. The instruction manual provides information useful in selecting the value of resistor, if any, that should be installed in the attenuator to bring the drive down to the appropriate level. For input levels above the 1/2-watt maximum, you'll need an outboard attenuator, the design of which depends on the amount of power that must be dissipated.

Those familiar with 70-cm operation will realize that the XV-4 1-watt output may be adequate for local work (though some openings may extend your communications range farther), but effective terrestrial DX work or Phase III satellite uplink transmission will require considerably more power.

Construction

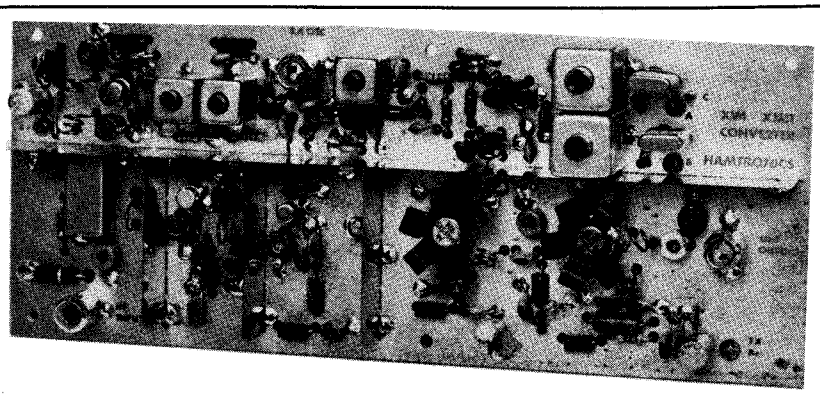
The XV-4 is available as a kit or wired and tested. The review unit was assembled from a Hamtronics kit. I found the kit unlike any I'd been accustomed to. You're not led by the hand, step by step; it's more like the procedure followed in magazine article construction projects. The manual is well written and provides more than enough guidance for the builder who reads the instructions at least once before plugging in the soldering iron. The kit consists of a double-sided, fiberglass circuit board, components (including the strips of metal used for shielding between stages), and a few incidentals such as a tuning tool. You'll need an enclosure (sold by Hamtronics and several other dealers) and a 13.6-volt dc supply, as well as a pair of coaxial cable patch cords to connect the unit to the exciter.

Despite the clarity of the instructions, Murphy can strike the builder who is "trying too hard." Don't make the mistake of winding the coils on the tuning tool handle when you are instructed to wind them on the thick portion of the tool shaft! You'll have trouble aligning the unit later. One very red face and countless disparaging comments from my Hq. compatriots later (something about a "short between my ears"), the coils were rewound and all tuned up as prescribed. The Hamtronics gang relayed that I was the first to have committed this "sin" (a dubious honor at best), and they have since changed the instructions for those who might suffer from a similar tendency to misinterpret clear directions.

The most common error in kit building is careless soldering: either "cold" solder joints

Hamtronics XV-4 UHF Transmitting Converter

Manufacturer's Claimed Specifications	*ARRL Lab Measurements*
Frequency coverage: 435-437 MHz (432-434 MHz with optional crystal), other portions of 70-cm band with suitable crystals.	As specified.
Rf input frequency: 28 to 30 MHz (27 or 50 MHz with suitable crystals.	As specified.
Input power: 1 mW to 500 mW with on-board attenuator.	As specified.
Output power: 3/4 W PEP on ssb, 1 W on cw and fm.	As specified.
Input/output impedance: 50 ohms.	Not measured.
Harmonic suppression: – 60 dB.	– 38 dB.
Third-order transmitter IMD: – 30 dB.	– 24 dB.
Oscillator frequency: 45.2222 MHz supplied for 435-MHz range; 44.8889 MHz optional for 432-MHz range.	As specified.
Size: HWD 1-1/4 × 7-1/2 × 3 inches (32 × 191 × 76 mm).	



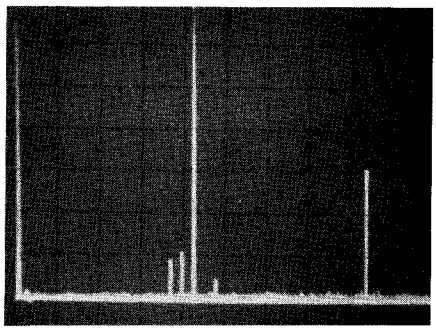


Fig. 2 — Spectral display of the Hamtronics XV-4. Vertical divisions are each 10 dB; horizontal divisions are each 100 MHz. Output power is approximately 1 watt at 432 MHz. The second harmonic is approximately 39 dB below fundamental output.

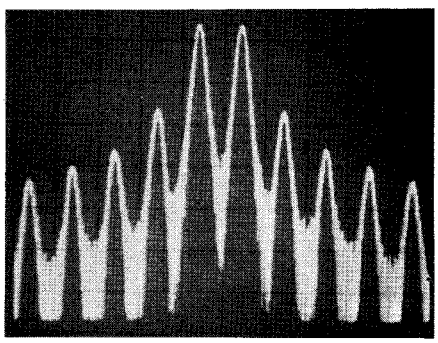


Fig. 3 — Spectral display of the XV-4 output during transmitter two-tone IMD testing. Third-order products are 26 dB below PEP output. Vertical divisions are each 10 dB; horizontal divisions are each 2 kHz. The XV-4 was being operated at 1/4-W PEP output at 432 MHz. H-P 8640B signal generators were used to supply the two-tone input.

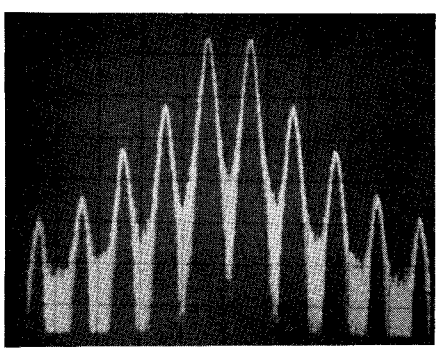


Fig. 4 — Spectral display of the XV-4 output while operating the unit at 3/4-W PEP output. Conditions of the test remained otherwise the same as that of Fig. 3.

or those insidious, almost invisible solder bridges between circuit-board traces. If worse comes to worst, factory service is available from Hamtronics for a modest cost; contact them before shipping any unit.

Alignment

When all the components have been loaded on the board and you've checked for shorts between circuit board traces, proper component placement and correct values, you'll be ready for the alignment procedure. For this you'll need the following equipment: a 2-watt, 50-ohm dummy load with low VSWR at uhf; a VTVM with a lowest dc range of at least 0.5 volt (0.15 V preferred); a relative rf output indicator (VSWR bridge or power meter); signal source at 28 MHz (a signal generator is not required — you can use 300 mV from your hf exciter); and a milliammeter capable of measuring 500 mA. A frequency counter, while handy, is not really needed.

The alignment procedure consists of adjusting a series of slug-tuned coils and variable capacitors stage-by-stage while monitoring the current level, checking various test points and component leads, and peaking the rf output. This procedure will pose little problem if you are careful and you complete each step successfully before going on to the next. Should the results not turn out as prescribed, consult the troubleshooting guide that is included in the manual. Typical beginners' mistakes and tables of nominal dc and rf voltages are listed.

The i-f input (28 MHz) is mixed with the output of a crystal oscillator multiplier chain in a doubly balanced mixer. For example, for 432-MHz coverage, a crystal oscillator at 44.8889 MHz is buffered, tripled twice to 404 MHz, then mixed with the 28-MHz signal from the exciter to yield 432 MHz. When the exciter VFO is tuned to 28.5 MHz the output of the XV-4 is at 432.5 MHz. This low level of 70-cm rf energy is then fed through a pair of rf amplifier stages, a driver stage and the final PA stage, yielding 432-MHz output.

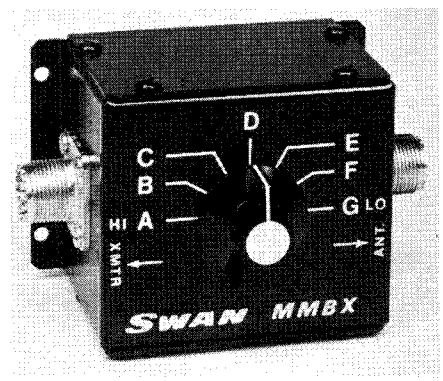
While using a frequency counter, we checked each step to determine that we hadn't tuned to the unwanted image frequency, 376 MHz. There are several ways to ensure that the transverter is tuned to the desired frequency, even without a frequency counter; they are clearly outlined in an addendum to the manual. Tuning to the image frequency is the most likely pitfall for the careless or impatient builder, though this problem can be avoided with caution.

As a transmitting converter, the Hamtronics XV-4 offers the potential 70-cm enthusiast an inexpensive alternative when equipping a station, and it will give the continuing satisfaction that comes from using a unit that you've assembled yourself. Price class: $100. Manufacturer's address: Hamtronics, Inc., 65 D Maul Rd., Hilton, NY 14468. — *Steve Place, WB1EYI*

THE CUBIC MODEL MMBX "MATCHBOX"

☐ Many hams, I'm sure, are excited at the prospect of working hf mobile, but run into problems when, try as they might, they can't get the VSWR of their mobile whips down to an acceptable level. This is especially frustrating if the transceiver has solid-state final-amplifier devices. A pi-network tube-PA rig is one answer, but it gets crowded in a small car when trying to use a rig such as the TS-820S! When I began using an Atlas 210X, the high-VSWR problem with my antenna was suddenly an enigma; however, the Cubic MMBX has provided an effective solution.

The MMBX is a multiple-tap, toroidally wound impedance transformer designed to match the typical lower impedance of a mobile hf whip to the nominal 50 ohms required by the transceiver. Cubic claims an rf power handling capability of 500 watts over a frequency range of 2 to 30 MHz. Under test in the ARRL lab, using a low-impedance load, Bird wattmeter, and a transmitter and amplifier capable of



1-kW dc input, the MMBX was subjected to 500-watts output. Cw and several minutes of key-down operation was attempted with no damage to the unit; heating of the toroid was only moderate. Certainly, the unit appears to be adaptable to high-power mobile operation, with ample reserve. The seven switched tap settings cover an impedance-matching range of approximately 3 to 50 ohms. The unit is wired in an unbalanced-to-unbalanced configuration.

Cubic suggests that the MMBX be mounted as close as possible to the base of the whip, using 18 inches of transmission line or less. This may be impractical for larger cars, but it has proved to be just right for my small car. Placing the unit just inside the trunk was ideal. The MMBX is housed in a durable steel box, but it's not weather-proof so outside mounting isn't recommended. SO-239 connectors on the unit make installation easy. Tuning is straightforward; once the mobile whip is tuned for lowest VSWR on the chosen band, the MMBX is inserted in the transmission line at the indicated point from the base of the whip, and the transmitter is keyed at low power on each of the seven tap settings. Log the position that gives the lowest VSWR indication, and the job is done. Cubic cautions against "hot-switching" the MMBX to avoid possible damage to the transceiver. If, by chance, the antenna impedance appears higher than that of the transceiver, the connections to the MMBX may be reversed to provide a step-up transformation. This I found was necessary for operation on 10 meters. I've kept a log of the tap settings for easy reference when changing bands and resonators.

The MMBX has taken care of my antenna mismatch difficulties, especially noticeable on 75 and 40 meters, and the small area of the unit — 2-1/2 × 3-1/2 × 2-1/2 inches HWD — takes up no appreciable space inside the car trunk. The MMBX is manufactured by Cubic Communications, 305 Airport Rd., Oceanside, CA 92054. Price class: $30. — *Sandy Gerli, ACIY*

KENWOOD TR-8400 UHF FM TRANSCEIVER

☐ Compact! It is synthesized? Ten watts output? Well, it must be a "bare-bones job," isn't it? No? How did they manage to put *so much* into such a small package?

Features

The TR-8400 uses a microprocessor-controlled PLL synthesizer and covers 440 through 450 MHz. The primary method of frequency selection is by means of the main tuning knob located on the front panel, with the

operating frequency displayed on an LED readout. This knob is connected to a rotary encoder shaft that permits the user to step the frequency up (clockwise) or down (counterclockwise). Two buttons (UP and DOWN) on the microphone can be used to change frequency without touching the front panel of the unit — a feature sure to delight the mobile operator.

The TR-8400 has what Kenwood calls a "two-VFO system" that functions as if there were two separate built-in oscillators. There are not really two VFOs, but rather two internal memories that control the oscillator. With the unit set for operation on VFO A, the user may select a particular frequency using the main tuning dial or the buttons on the microphone. Push one button, and the '8400 is operating on VFO B. The VFO B operating frequency is adjusted in the same manner as is the VFO A frequency. Pushing a button is all that is necessary to switch from VFO B to VFO A and back.

The TR-8400 has built-in repeater offsets of ±5 MHz, which makes it versatile. The operator sets the desired receiver frequency. Then the transmit offset switch is moved from S to − for transmitter operation 5 MHz below the displayed receive frequency or to + for 5 MHz above. This will handle most repeater requirements. However, Kenwood has provided a means for using the '8400 with a repeater having an "odd-ball split." One of the memory channels is specially equipped for this function.

Memory Channels?

It has memory channels, too? Four normal memory channels are included. A frequency from either VFO can be programmed into the memory at the touch of a switch. The user selects repeater or simplex operation for these memory channels with the transmitter offset switch, just as when using the VFOs. The fifth memory channel is different; the operator must program the receive and transmit frequency. Both may be any frequency in the range covered by the transceiver. (The microprocessor will disable the transmitter if an attempt is made to transmit outside the band.) This fifth memory channel will take care of any "odd-ball split."

The TR-8400 will scan the memory channels or the entire band. In either case, the transceiver will stop on any frequency at which the squelch opens, and remain there until the frequency is clear, when it will resume scanning. To retain a frequency that the scan function stops on, just press a front-panel switch (HOLD), or tap the PTT switch on the microphone. There are no provisions for the scan function to stop on an unused channel. It takes an appreciable amount of time to scan from 440 to 450 MHz in 25-kHz steps. We clocked it at 75 seconds! The time required to scan the five memory channels is much less. Perhaps a better method would have been to incorporate frequency limits on the bandscan function, as most repeater outputs are confined to the top or bottom 5 MHz of the band, depending on geographical area.

The '8400 does not have internal back-up batteries for retaining the memorized frequencies once the unit is completely disconnected from a power source. The memories require about 2 mA at 11 to 16 V to keep the stored information intact. Presumably, Kenwood felt that would make an internal NiCad back-up memory voltage source impractical. This would be of little concern to the mobile operator, but some operators are inclined to turn off everything, including power supplies, at the base station. The TR-8400 has an auxiliary jack on the rear panel for an external memory back-up supply.

Kenwood TS-8400 UHF FM Transceiver Serial Nos. 1060678 and 1060552

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency coverage: 440.000 to 449.975 MHz in 25-kHz steps.	As specified.
Mode of operation: Fm.	As specified.
Readout: 4-digit, red LED digital display.	0.375-inch digits.
S-meter: LED bar type.	As specified.
S-meter sensitivity: (Not specified).	3.2 μV for S9.
Receiver sensitivity: Better than 1 μV for 30 dB S/N.	0.28 μV for 20-dB quieting.
Audio power output (8-Ω load): 2.0 W.	1.3 W.
Transmitter rf power output: HI 10 W; LO 1 W (adjustable).	As specified.
Spurious suppression: Better than 60 dB.	As specified (see spectral photo).
Current drain: 0.45 A, squelched receiver; 3.4 A HI power transmit; 1.4 A LO power transmit.	As specified.
Size (HWD): 2 × 5-13/16 × 7-5/8 inches.	
Weight: 3.3 pounds.	
Color: Brown/gray.	

Tones

A rear panel jack is wired for tone-pad hookup. One jack pin has 9 V available when the transmitter is keyed. The '8400 has provisions for adding a Continuous Tone Coded Squelch System (CTCSS or PL as it is commonly called) encoder. A front-panel switch will turn the encoder on and off once it is properly installed. Some operators having no need for a CTCSS encoder have used the switch for other purposes.

Operating Impressions

Two transceivers were sent to Hq., and we reviewed both units. The authors agree on most points of the review. The '8400 is usually an enjoyable radio to operate. It is relatively simple to change frequency as one drives along, using the microphone-mounted switches. The area coverage is somewhat reduced from that of 144 or 220 MHz, but that is not a problem in this area, where there is an abundance of 450-MHz repeaters in close proximity. In other regions, operators may find it advantageous to add an external power amplifier.

Both transceivers would lock occasionally onto a phantom channel during band scanning. Each had a different symptom. On one unit the received signal sounded like that of a broadcast station (probably an intermod product), while the other just locked up on a full-quieting carrier (probably an internal spurious product).

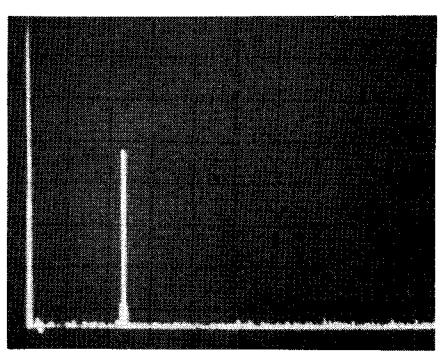


Fig. 6 — Spectral display of the Kenwood TR-8400. Vertical divisions are each 10 dB; horizontal divisions are each 200 MHz. Output power is approximately 9 watts at a frequency of 448.8 MHz. The fundamental has been reduced in amplitude by approximately 32 dB by means of notch cavities; this prevents analyzer overload. All spurious emissions are approximately 68 dB below fundamental output.

If you have been on 450 MHz for some time, chances are that you have a 40-lb "refugee" from the commercial service. The TR-8400 is an attractive alternative to the "boat anchors" of yesteryear. If you are thinking of moving up to 450 MHz, the TR-8400 is one way to travel in high style.

Price class is $500. Additional information can be obtained from Trio-Kenwood Communications, Inc., 1111 West Walnut St., Compton, CA 90220. — *Peter O'Dell, KB1N, and Gerald Hull, AK4L*