Product Review Column from *QST* Magazine

February 1983

Advanced Electronic Applications, Inc. BT-1P Code Trainer

ICOM IC-3AT 220-MHz FM Transceiver

Telex Hy-Gain TH7DX Broadband Super Thunderbird

Yaesu FTV-901R VHF/UHF Transverter

Product Review

Conducted By Paul K. Pagel,* N1FB

Yaesu FTV-901R VHF/UHF Transverter

It wasn't too many years ago that a glance behind the equipment installed in a ham shack — *any* ham shack — made one wonder how radio could ever have been called "wireless." A maze of interconnecting cables, external relays, and add-on boxes and gadgets of all descriptions seemed as unavoidable as QRM on 20 meters. Things began to change with the advent of the transceiver, and especially with the appearance of rigs with lots of built-in "goodies," such as the Yaesu FT-902DM. However, that only took care of the hf side of things; for vhf and uhf the rule has remained separate rigs or transverters for each band, with *ad hoc* cabling and switching layouts. It's not uncommon for hams to have different rigs for different *modes* on the same band. OSCAR satellite operation has made things even more complicated.

With the FTV-901R, Yaesu strikes yet another blow for the full-featured, integrated "wireless" station. Designed for use with the FT-ONE, FT-102, FT-101ZD and FT-901/902 series of transceivers, the FTV-901R transverter system extends station capability to the 50-54, 144-148 and 430-440 MHz bands. With the addition of an external hf receiver, a carefully thought-out switching scheme makes it possible to shift from conventional to OSCAR operation at the flick of a wrist. All this is accomplished by one small box and three cables! Even the repeater user isn't forgotten: The transverter automatically offsets the transmit frequency by the proper amount for access to 6- and 2-meter repeaters, assuming that the hf transceiver has fm capability. If you don't need all three bands right away, you can buy the basic unit with the 144-MHz rf module installed and add the other bands later.

With the FTV-901R, ssb and cw operating on vhf/uhf is as easy as on hf. All the features of the basic hf transceiver are retained except transmitter power output, which is rated at 10 watts on each band. An ac-operated power supply is built in; there is no provision for connecting the transverter to a 12-volt dc supply, although all three modules operate at that voltage.

Front-panel features of the unit include a meter which shows relative drive level and relative power output; two rows of red LEDs to indicate which band is in use for both transmit and receive, and whether repeater offset or an external receiver are in use; an RF GAIN control which can be used to reduce the gain of the active mixers in the 50- and 144-MHz receiving converters; and a 12-position band switch for selecting the vhf/uhf band segment or the mode of satellite operation desired. A TUNE control peaks the transmitting sections of the 50- and 144-MHz transverters for operation in the desired portion of each band, but it is not needed on 430 MHz. The control tunes broadly and is simple to adjust.

The circuits used in the individual rf modules are worth mentioning. Input and output are at 28 to 30 MHz. The 6- and 2-meter units are almost identical: in the receiving converter each uses dual-gate FETs for the rf amplifier and mixer, and for the transmitting mixer, an MC1496G IC. Most of the rf selectivity in the receiving converter occurs between the rf amplifer and mixer. As one might expect, the 70-cm module is quite different in design. A common doubly balanced diode mixer is used for both transmit and receive, with two stages of bipolar rf amplification preceding it on receive. Once again, front-end selectivity is provided after, not ahead of, the rf amplifiers. The 430-MHz unit has a Type N output connector instead of the UHF connector used on the lower-frequency units.

The instruction manual for the FTV-901R is excellent, and provides sufficient information to permit most servicing that might be required. Especially useful are the instructions

Yaesu FTV-901R VHF/UHF Transverter

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency coverage: 50-54 MHz (optional), 144-148 MHz, 430-440 MHz (optional).	As specified.
Modes of operation: Ssb, cw, a-m, fm.	As specified.
I-f: 28-30 MHz.	As specified.
Transmitter rf power output: 10 W, 50% duty cycle.	As specified.
Receiver spurious responses: Below 1 μV equivalent to antenna input.	See Fig. 1.
Converter Noise Figure (dB): Not specified.	430-440 MHz, 2.9, except for 432-434, 2.8. 144-146 MHz, 4.4; 146-148 MHz, 4.8. 50-54 MHz not measurable because of LO signal feedthrough.
Converter gain (dB): Not specified.	450 MHz, 20; 145 MHz, 20; 53 MHz, 14.
Converter third-order intercept point (dBm); not specified.	450 MHz, −17.5; 144 MHz, −11; 50 MHz, −16.
Weight: 22 lb.†	
Size: 6.2 × 8.3 × 13.8 in. (HWD).	

†kg = lb. × 0.454; mm = inches × 25.4.

*Assistant Technical Editor

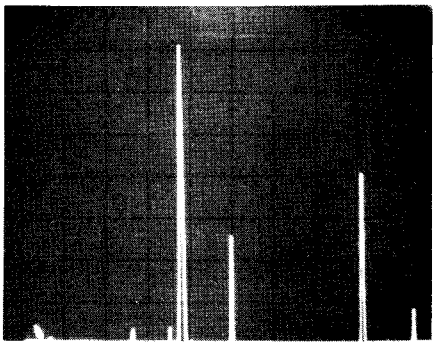


Fig. 1 — Spectral photo of the FTV-901R showing 22-MHz LO energy at the i-f port during reception on 50 MHz. The tall pip to the left of the display is the 22-MHz signal, followed by the 28-MHz signal at the center of the display. Three divisions to the right is the desired 50-MHz signal. Vertical divisions are each 10 dB; horizontal divisions are each 5 MHz.

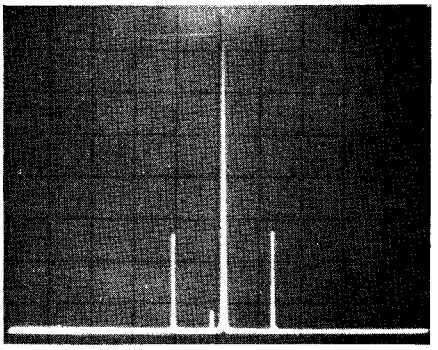


Fig. 2 — Worst-case spectral display of the FTV-901R operating at 50 MHz with a power output of 10 W. Vertical divisions are each 10 dB; horizontal divisions are each 5 MHz.

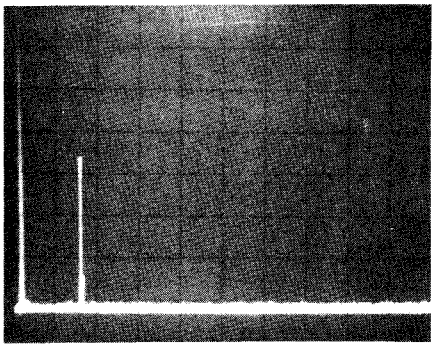


Fig. 3 — Spectral display of the FTV-901R operating at 144 MHz at a power output level of 10 W. Vertical divisions are each 10 dB; horizontal divisions are each 100 MHz.

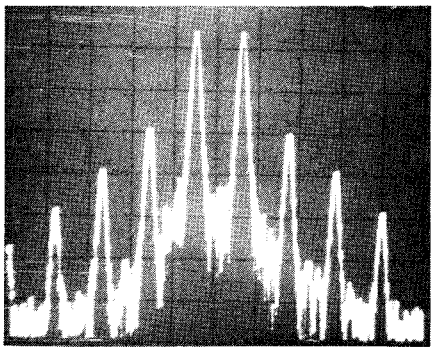


Fig. 4 — Spectral display of the FTV-901R output during transmitter two-tone IMD tests. Third-order products are approximately 30 dB below PEP and fifth-order products are about 39 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 1 kHz. The transverter was being operated at rated input power on the 50-MHz band.

for adjusting the local oscillators to exact frequency, which is essential if the frequency display of the hf transceiver is to be an accurate indicator of the actual frequency.

One inexplicable lapse in the design of the FTV-901R is the method used to switch between NORMAL and TRANSVERTER operation of the companion hf transceiver. The FTV-901R cuts the *filament voltage* on the final-amplifier tubes in the FT-101 or FT-901/902 when the transverter is switched on. Unfortunately, if the transceiver is already warmed up, the transmitting tubes will retain some emission for as much as a minute afterwards, and *damage to the transverter can result* if the operator attempts to transmit during this period. Some sort of automatic time-delay feature is needed to protect the transverter, or, better yet, a change in the design so a QSY from hf to vhf/uhf can be made instantaneously.

The only other problem encountered in use came to light during noise-figure measurements. Initial tests showed a noise figure of more than 8 dB on 432 MHz — a result that was difficult to understand, given that in on-the-air checks we had heard K8WW in Ohio on a flat band with no preamp and a single Yagi! Some additional poking around revealed that pressure on the Type N antenna connector in turn put pressure on the internal T-R relay in the transverter, resulting in an intermittent contact. The relay design is such that this problem might occur in other units as well, which is worth bearing in mind if 430-MHz performance seems to be below expectations.

Otherwise, the transverter leaves little to be desired in actual operation. In terms of versatility, the FT-902DM/FTV-901R combination has no peer. While the transverter obviously is not intended for mobile operation, the addition of a 12-volt dc power jack would make the pair suitable for battery-powered vhf/uhf hilltopping. If there was anything else overlooked in the designing of the FTV-901R, I couldn't find it! The FTV-901R is available from Yaesu Electronics Corp., 6851 Walthall Way, Paramount, CA 90723. Price class: $390 (with 2-m module installed); 6-m module $110; 70-cm module $255. — *David Sumner, K1ZZ*

ICOM IC-3AT 220-MHz FM TRANSCEIVER

This rig is truly amazing, because it still works after *I've* used it for nearly three months! That may not seem like much to some of you, but you see, I have this problem. I bought a 2-meter hand-held transceiver, but I had to ship it back to the factory, because it drains the battery while turned off. I have an hf transceiver I'm testing, but it had to go back to the factory for repairs. I assembled a kit recently, but it had to go back to factory because I put a transistor in backwards. All this happened in a two-month period, but the IC-3AT just keeps on working.

First Cousin of the IC-2AT

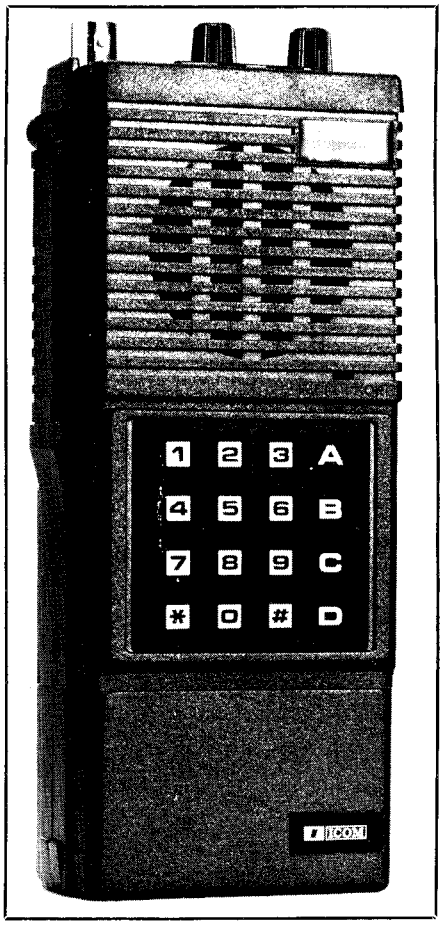
Above and beyond different operating frequencies, there are a few differences between the popular IC-2AT and the IC-3AT.[1] While the '2AT comes with a 12-button standard 2-of-7 tone pad, the '3AT has a 16-button 2-of-8 tone pad. Because of the standardized coherent bandplan for the 220-MHz band, there is no need for a switch to move the operating frequency up 5 kHz. ICOM, therefore, did not add this feature to the '3AT, but did leave the switch in place on the top panel. This switch is quite handy for adding a CTCSS pad or some similar device requiring an external ON/OFF switch. Because there is only one standard repeater offset in the 220-MHz bandplan, ICOM eliminated the third switch on the rear panel, which on the IC-2AT selects the +600 or −600 kHz offsets.

Operation of the '3AT is similar to that of the '2AT. The receive frequency is selected using the three thumbwheel switches on the top panel. Using switches on the rear panel, the operator chooses high or low power and simplex or duplex (repeater) modes of operation. The basic package is the same as for the '2AT; accessories are interchangeable, also.

On the Air

Operating the IC-3AT is a pure joy. In several months of steady use I have found nothing to complain about. Never once has there been an indication of malfunction. The receive audio is excellent; signal reports from others indicate transmitted audio is also superb. This is one radio the owner could repair, if there were a problem. The owner's manual contains voltage charts, block diagrams, a detailed schematic and an easy-to-

[1]"Product Review," *QST*, January 1981, p. 38.



ICOM IC-3AT, Serial No. 03376

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency range: 220.000 to 224.990 MHz.	As specified.
Mode of operation: Fm.	As specified.
Current drain at 8.4 V	
Transmitting (Hi): 550 mA	
Transmitting (Lo): 220 mA	
Receiving (max. audio): 130 mA	
Receiving (squelched): 20 mA.	
Size (HWD): 4.6 × 2.6 × 1.4 inches (without battery pack)†	
IC-BP3 dimensions: 1.9 × 2.6 × 1.4 in.	
Weight: 16.6 oz. (includes IC-BP3 and flexible antenna).	
Transmitter power output (at 8.4 V):	
HI — 1.5 W; LO — 0.15 W.	HI — 2.2 W; LO — 90 mW.
Spurious radiation: > −60 dB.	As specified. See Fig. 5.
Receiver 1st i-f: 16.9 MHz, 2nd i-f: 455 kHz.	
Receiver sensitivity: Less than 0.5 μV for 20 dB quieting.	0.24 μV for 20 dB of quieting.
Squelch sensitivity: Less than 0.4 μV.	0.26 μV.
Audio power output: More than 300 mW.	300 mW.

†mm = inches × 25.4; g = oz × 28.35.

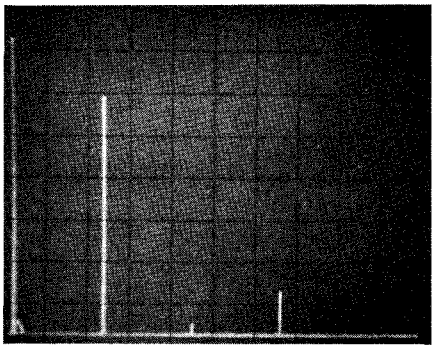


Fig. 5 — Spectral display of the IC-3AT. Vertical divisions are each 10 dB; horizontal divisions are each 100 MHz. Output power is approximately 2.2 W at 224.94 MHz. The fundamental has been reduced in amplitude approximately 20 dB by means of notch cavities; this prevents analyzer overload. All spurious emissions are approximately 66 dB below peak fundamental output. The IC-3AT complies with current FCC specifications for spectral purity.

read board-layout diagram. I think this is the kind of owner's manual that every manufacturer should supply with Amateur Radio equipment — few do, though. Heck, ICOM even provides a schematic for an external microphone — they sell one, too. The IC-3AT is available from: ICOM America, Inc. 2112 116 Ave N.E., Bellevue, WA 98004. Price class $300; IC-3A (without the tone pad) $270. — *Peter O'Dell, KB1N*

ADVANCED ELECTRONIC APPLICATIONS, INC. BT-1P CODE TRAINER

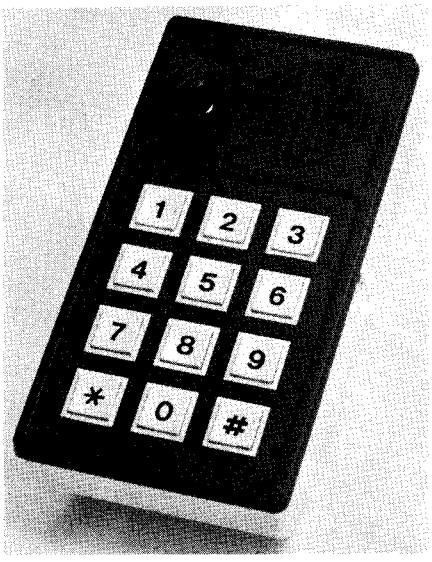
I was excited the day the AEA BT-1P Code Trainer arrived at ARRL Hq. for review! Finally, after many months of trying to increase my code speed, here was my big chance! Then I asked myself, how can this code trainer help? I have tried every conceivable code-learning method, with no luck.

How many of you have experienced the same thing? Well, now you can build up your code speed as I have done. With a previous code speed of 13 wpm, I can now copy 20 wpm with ease. I did it in eight weeks, practicing two hours per week. Even a beginner can learn the code with AEA's suggested two 20-minute sessions a day for four weeks.

Features

The BT-1P and its kin, the BT-1, are handy little gadgets that can easily be carried with you — they're about the size of a pocket transistor radio. The BT-1P is powered by means of internal NiCd batteries and is supplied with a 117-V ac-operated wall charger. The BT-1 operates from an external 12-V dc source or 117-V ac-operated ac/dc adapter. Both are computerized Morse code instructors that send random character groups and offer a total of 61 different characters. They are factory programmed to a minimum speed of 18 wpm and a maximum speed of 99 wpm. With the exception of the means of powering the units, they are identical.

The trainer is programmed by a 12-key pad to send one character continuously or in random groups of two to nine characters, with a pause between groups of 0.1 to 9.9 seconds. After you feel comfortable copying the code in groups, you then have the option of running the characters consecutively. When adding a new character, you have a choice of programming your BT-1P to have all characters equally probable, or have the new character occupy approximately 50% of the time, along with the previous characters.



The BT-1P power switch is on the volume control which may be adjusted to the listening level you prefer. The sidetone pitch can easily be increased or decreased by pressing and releasing a designated key several times until the desired pitch is reached.

I feel the AEA BT-1P Code Trainer would be valuable to instructors of Amateur Radio classes as well as to the individual who wishes to learn the Morse Code or increase his or her code speed. The BT-1P package includes a battery charger and an ear phone. Size (HWD): 2 × 2-1/2 × 4-3/4 inches; color: cream and brown; weight: 10 oz.[2] It is available from Advanced Electronic Applications, Inc., P.O. Box C-2160, Lynnwood, WA 98036. Price class: $80. — *Marian Anderson, WB1FSB*

TELEX HY-GAIN TH7DX BROADBAND SUPER THUNDERBIRD

What has over 700 parts, takes over 10 hours to assemble and attracts birds from all over the East Coast? If your answer is that it is just a TH6DXX with another element added, you are wrong, at least partially. Hy-Gain has added a second driven element, which significantly contributes to the broadband characteristics of the TH7DX. Adding the second driven element forced Hy-Gain to change element spacing and length, which caused some changes in gain and front-to-back ratio. It also forced them to change the matching network. Another improvement in the TH7DX over the TH6 is the switch to stainless-steel hardware.

Construction

The TH7DX comes from the factory in two boxes that are sized to permit UPS shipping — from the appearance and condition of the cartons, I surmised my antenna had arrived via the "Murphy Shipping and Demolition Service." Hy-Gain quickly replaced the few missing parts. A revised manual for the TH7DX suggests the builder read the manual three times before beginning construction. That is sound advice. With over 700 parts, the kit requires considerable care and attention during assembly. The manual could use more diagrams and improved explanations of some procedures.

According to the steps in the manual, the builder should first assemble the boom (four sections) and then construct the elements on the boom. If I were to assemble the antenna by the time AA2Z came to help with the erection, I would have had to leave the partially constructed beam in my yard for a few days. I chose to assemble the elements on my basement floor and then attach them to the boom as one of the last steps. This did not affect the assembly time or quality of work.

Hy-Gain instructs the builder to loosely assemble the beta match/phasing network to the boom before erecting the antenna. The driven elements straddle the mast; therefore, the phasing network is routed past the boom-to-mast clamp. Hy-Gain suggests rotating the network out of the way while attaching the boom to the mast. This is easier to write about than to do — particularly when you are

[2]mm = in. × 25.4; g = oz × 28.35.

clinging to a tower and wrestling with 70 pounds of swaying aluminum tubing.[3] I would like to see Hy-Gain modify the design so the portion of the phasing network located in front of the mast could be taken off easily during installation and removal.

Because of the broadband nature of the TH7DX, Hy-Gain provides only one set of element-length measurements. On each band (10, 15 and 20 meters) the SWR is below 2:1 from one band edge to the other. This eliminates the need to choose one mode of operation over another — it is also extremely helpful for those owning solid-state equipment.

AA2Z and I found it only moderately difficult to install the TH7DX. He placed a pulley on the mast and did the other tower work; I stayed on the ground to provide the "hauling muscle." Total elapsed time from flat on the ground to completed installation atop the 50-ft guyed tower would have been less than 20 minutes, if AA2Z had not experienced difficulty inserting two of the boom-to-mast-clamp bolts. The phasing network was in the way of the bolts. After several minutes he announced that the bolts were in. We then attached the coaxial cable to the BN-86 balun supplied with the kit.

Initial Difficulties

The first SWR curves bore no relationship to those that Hy-Gain suggested would be normal. I was up and down the tower several times in the next few days trying to discover the cause of the problem. Roger Cox at Hy-Gain thought the balun might be bad, so he sent a replacement. While on the tower to change the balun, I noticed the top boom-to-mast-clamp bolts were inserted from the wrong side. The bolt tips extended beyond the nuts, resulting in the bolts being closer to the matching network than the 3/4 inch specified by Hy-Gain. I loosened the matching network, turned bolts around and repositioned the network. Now the SWR checked closer to the specifications, but there still was quite a divergence.

After several phone conversations with Roger, and several futile attempts at curing the problem, I found out what was wrong with the TH7DX — nothing! I was using a moderately priced combination wattmeter and SWR bridge. Before resigning myself to the necessity of removing the TH7DX from the tower to check the problems, I decided to take a Bird Model 43 wattmeter home and check the SWR. With the Bird, the SWR curves were very close to those listed in the manual. I barely restrained myself from using a sledge hammer on my SWR meter!

Structure

The TH7DX is a seven-element beam antenna covering the 10-, 15- and 20-meter bands. Two of the elements are driven on each band and are fed with 50-Ω coaxial cable through a balun (included) and a combination beta match and phasing network. One reflector and two directors are active on 10 meters; on 15 and 20 meters, it is one reflector, two driven elements and one director. Boom length is 24 feet; diameter is 2 inches. The longest element measures 31 feet across, and the antenna has a turning radius of 20 feet. The TH7DX weighs 75 pounds and has a wind surface area of 9.4 square feet. It is rated to survive winds up to 100 mph; at 80 mph it presents 240 pounds of wind loading.

Hy-Gain is producing a conversion kit that will enable the user to convert a TH6 to a TH7. The kit consists of all new stainless-steel hardware and materials for the beta match/phasing network and the second driven element.

Performance

The TH7DX has been a superb performer during the months that I have used it. Good front-to-back and front-to-side ratios have been observed on local and DX signals. Received reports are also excellent. No "cold" numbers are available for these parameters, because ARRL does not have an antenna testing range to accurately measure them. Measurements performed at different station locations with the same antenna would likely produce varying results. My impression is that it performs at least as well as the TH6DXX that it replaced on my tower. In short, I am quite pleased with the performance and the broadbanded characteristics of the antenna.

Price class: TH7DX, $500; conversion kit, $200. Additional information is available from TELEX Hy-Gain, 9600 Aldrich Ave. South, Minneapolis, MN 55420. — *Peter O'Dell, KB1N*

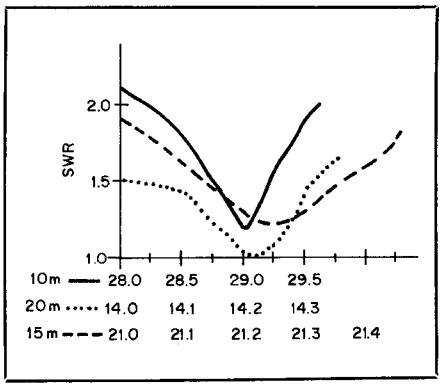


Fig. 6 — SWR curves for the Hy-Gain TH7DX installed at KB1N. The beam is mounted atop a 50-ft guyed tower. Inverted Vs for 40 and 80 meters are hung from the tower approximately 6 feet below the beam. Measurements were made with a Bird model 43 wattmeter.

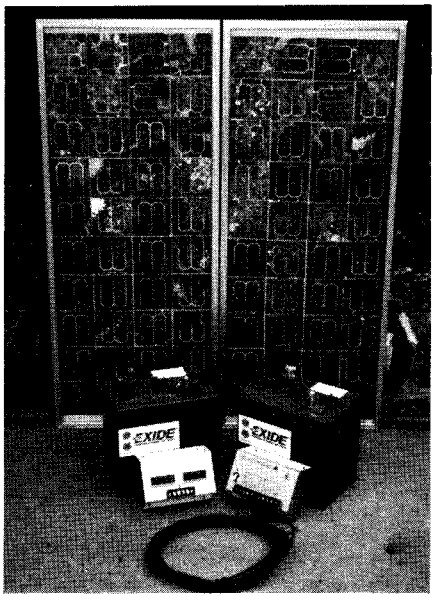
[3]kg = lb × 0.454

New Products

ENCON INC. PHOTOVOLTAICS

☐ The Solarex Corporation manufactured, tested and mounted the solar cells on four panels that power UoSAT-OSCAR 9. Supported by Solarex, ENCON assembles complete photovoltaic power systems for emergency and primary communications applications as well as residential, commercial and Amateur Radio packages. According to Paul DeNapoli, WD8AHO, a major priority had been to develop an emergency power supply package that ENCON is now offering to the Amateur Radio fraternity.

The SX series of photovoltaic panels offered by ENCON utilize semicrystalline silicon solar cells. These cells provide high reliability under shaded conditions because of high heat-dissipation capability and outstanding reverse-bias condition performance. Nickel-solder metallization provides excellent corrosion resistance and high-power performance. A patented tantalum-oxide anti-reflective coating ensures long-term stability and maximum cell efficiency.



Photovoltaic panels have no moving parts and require little maintenance. The Federal government offers a substantial tax credit for solar installations. Some states also offer such tax incentives.

A sample of the Amateur Radio oriented systems available (Systems I, II, III) shows capabilities of providing outputs of from 12-18 Ah to 36-54 Ah per day. Systems include the required number of solar panels, a voltage regulator, storage batteries and hardware kits. In the System III, meters and cables are included; these are optional items with Systems I and II. The price range for these systems runs from approximately $1770 for the System I to $4900 for the System III.

ENCON offers periodic free seminars on solar electricity. If you want to keep up with the latest advances in the photovoltaic industry, you might consider attending one of these seminars.

For further information, contact Paul DeNapoli, ENCON Inc., 27584 Schoolcraft Rd., Livonia, MI 48150. Tel. 313-261-4130. — *Paul K. Pagel, N1FB*