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ICOM IC-720A HF Transceiver

Yaesu FT-680R 6-Meter Multimode Transceiver

Conducted By Paul K. Pagel,* N1FB

ICOM IC-720A HF Transceiver

☐ A compact, full-featured hf transceiver, the ICOM IC-720A covers all amateur bands from 1.8 through 30 MHz, including the 10-, 18- and 24-MHz WARC frequencies. It incorporates a general-coverage receiver tuning 0.1 through 30 MHz in 1-MHz segments. Cw, usb, lsb, a-m or RTTY (fsk) operation is selectable by front-panel push-button controls. The matching IC-PS15 ac-operated power supply provides 13.8 V dc at 20 A, and is connected to the transceiver by a 2-1/2 foot† cable. The power supply is switched by the transceiver.

The review unit included the optional SM5 electret-condenser desk microphone with a built-in preamplifier (powered by the transceiver) and the optional FL-32 500-Hz cw filter. Other options available include the SP3 external speaker (the '720 has a built-in 2-1/2 inch round speaker), HP1 headphones, an MB5 mobile mounting bracket, a BC-10A memory backup power supply and an FL-34 a-m filter.

Among the features standard on the '720 are a digital readout, an rf speech processor, a VSWR indicator, receiver incremental tuning, a noise blanker, band-pass tuning, an rf attenuator, VOX with separate cw and ssb delays, a selectable tuning rate and two built-in VFOs.

Frequency Control

The IC-720A operating frequency is determined by a microprocessor-controlled phase-locked-loop (PLL) local oscillator. Tuning is available in 10-, 100- and 1000-Hz steps, selectable from the front panel. Tuning in the 10-Hz-per-step mode is a bit slow (1 kHz per knob revolution), but it gets around the very noticeable frequency changes found in the 100-Hz-per-step mode. During normal operation, either the 10- or the 100-Hz setting is used, while a touch of the TS (tuning speed) button switches to 1-kHz steps for making larger frequency excursions. A dial-lock control locks the VFO at the displayed frequency, preventing unwanted frequency change through accidental operation of the tuning knob. Red LEDs indicate when the TS and the dial lock functions are in use.

One feature not found on most radios is the method of band selection. Instead of a conventional band switch, the '720A employs a multisection, motorized rotary switch controlled by front-panel push buttons. The band switch control circuit can be accessed remotely through a rear-panel connector. When power is first applied to the transceiver, the band switch steps around to 7.100 MHz (15.000 MHz in the general-coverage mode) from wherever it was when the rig was last turned off. The UP control will move the operating frequency to the next higher amateur band (10 MHz), while the DOWN button will move the frequency to the next lower band (3.5 MHz). In the general-coverage mode, the controls move the receiver frequency to the next higher (or lower) 1-MHz segment. Whenever the band is changed in the HAM mode, the transceiver will always arrive 100 kHz up from the bottom of the selected band (3.600, 7.100, 14.100 MHz, etc.). In the GENERAL-COVERAGE mode, the frequency will move up or down exactly 1 MHz; for example, if you are listening on 16.372 MHz, a touch of the UP button will change the frequency to 17.372 MHz. The motorized switch is loud enough to wake family members sleeping in the next room, so beware of the late-night DX chasing!

The '720A incorporates two separate built-in VFOs, both controlled by the main tuning knob. Through proper operation of the front-panel push-button controls, the following arrangements are possible: transceive on VFO A; transceive on VFO B; receive on A, transmit on B; receive on B, transmit on A. The VFOs may be set to frequencies on different bands, but split operation (selected by the SIMPlex/DUPlex push button) is available only on the same band; the rig will not transmit on one band and receive on another. Another push button will automatically set both VFOs to exactly the same frequency, eliminating much knob-twirling when split operation is needed in a hurry, as when you stumble across that rare DX station who has just announced that he's listening "up 5."

The RIT control, activated by a front-panel push-on, push-off switch, will vary the received frequency ± 800 Hz. A red LED above the frequency display indicates when the RIT is activated. As the rig comes from the factory, the RIT will pulse off each time the main tuning knob is moved, but this feature can be deactivated by an internal switch. Any receiver frequency change made with the RIT is *not* indicated on the display.

The displayed frequency does not change during transmit. In addition, indicators on the left-hand side of the display indicate which mode and which VFO (A or B) is in use. A thorough reading of the operating manual is encouraged because, in the GENERAL-COVERAGE mode and on the 28-MHz amateur band, the displayed frequency and actual operating frequencies are different at the band edges. For example, at the lower edge of the 15-MHz general-coverage segment, the display will read 15.000.8 in the lsb or cw mode, but the actual operating frequency will be 16.000.8 because of the way the frequency "rolls over" from 15.999.99 MHz at the high end and returns to 15.000.00 MHz on the display. By the same token, on the 28-MHz ham band, for a displayed frequency of 28.000.8 on cw, the transceiver is actually operating on 29.000.8. Don't be surprised if you hear ssb signals when tuning around the low end of 10 meters; they're perfectly legal ssbers operating around 29 MHz.

Receiver

The '720A uses a dual-conversion superheterodyne receiver with the first i-f at 39.7315 MHz and the second i-f at 9.0115 MHz. There are separate RF and AF GAIN controls. The PBT (passband tuning) control is moderately effective in eliminating adjacent-channel interference. Agc operation is selectable from the front panel. The slow or "normal" setting is intended for ssb operation, and features a

*Assistant Technical Editor

hang-agc characteristic, while the FAST setting is intended for cw work. The receiver also features an ATTenuator control. When the ATT switch is depressed, the rf amplifier is removed from the circuit and a 10-dB attenuator is inserted in the receive line. The built-in noise blanker (NB) is somewhat effective against pulse-type noise, such as ignition noise. Care should be taken when using the noise blanker, however, because strong signals tend to overload the receiver with it switched in.

Front-panel push buttons also provide for mode selection. The choices include CW with the 2.3-kHz ssb filter; CW-N with the optional 500-Hz filter; AM; SSB-N, which automatically chooses the proper sideband for the band of operation; SSB-R, which gives the reverse sideband; and RTTY. CW and CW-N are on the same push button, as are SSB and SSB-R. The function of each switch is controlled by the FUNC button, much like the function button on a calculator.

Shortwave listening with the '720 is a joy. Normally used amateur antennas provide satisfactory reception on all of the shortwave bands, and their sensitivity is every bit as good as on the ham bands. At lower frequencies, the receiver is somewhat picky about antenna impedance. A matching network is required on the a-m broadcast band. At my QTH, the receiver would pick up only the strongest local broadcast station, when using an 80-meter half-wave dipole without a matching network.

For serious SWLing, the optional a-m filter probably should be used. The standard 6-kHz filter is rather broad, making crowded-band reception difficult at times. The optional FL-34 5.2-kHz a-m filter has a better shape factor, providing better selectivity.

Transmitter

The '720 incorporates a solid-state broadband transmitter, providing about 100 watts of output on each band. No tuning is required. The finals are SWR-protected; if the load connected to the transmitter is other than 50 Ω, the transmitter power output is reduced. I found that the power output started to drop off at an indicated SWR of about 1.8 to 1. The input SWR on my linear amplifier is greater than that on some bands, so the '720 would not drive the amp to the full legal input power.

The finals are cooled by a quiet fan that runs whenever the rig is in the transmit mode. If the finals get hot during extended operation, the fan will run continuously until the temperature reaches an acceptable level. If the temperature reaches the point where it will hurt the '720, the fan shifts to a faster speed. Should this occur, the instruction manual advises that you stop operating and find the cause of the problem.

Front-panel controls include a MIC GAIN control and an RF POWER control, which also turns the built-in rf speech processor on and off. On cw and RTTY, the RF POWER control allows continuous adjustment of the output power from about 7 watts to maximum. On ssb and a-m, with the processor in use, the MIC GAIN control sets the clipping limits while the RF POWER control sets the drive level.

The '720 has a built-in VOX that also provides semi break-in on cw. The VOX GAIN, ANTI-VOX and separate DELAY controls for phone and cw are located under a panel on the top cover. VOX operation is smooth, and the T-R relay is quiet. The separate delays are nice because, once set, they don't require much adjustment.

When the review unit first arrived, I noticed a problem with the cw waveform: The transmitter would continue to generate rf after the keyer pulse stopped, effectively altering the ratio between the transmitted dots and dashes. Listening in another receiver, this made the cw sound "soft," and, at speeds of 20 wpm or more, the signal was extremely difficult to copy. ICOM recommends changing R15 on the main circuit board from 47 kΩ to 10 kΩ. This fix eliminated the problem. However, because of the crowded circuit boards and the vague board layouts, this modification would best be attempted by an experienced technician.

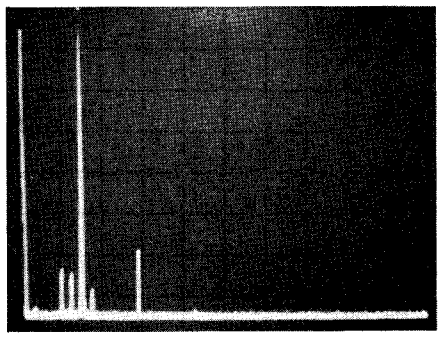


Fig. 1 — Worst-case spectral display of the IC-720A. Vertical divisions are each 10 dB; horizontal divisions are each 10 MHz. Output power is approximately 100 watts at 14 MHz. All spurious emissions are at least 58 dB below peak fundamental output. The IC-720A complies with current FCC specifications for spectral purity.

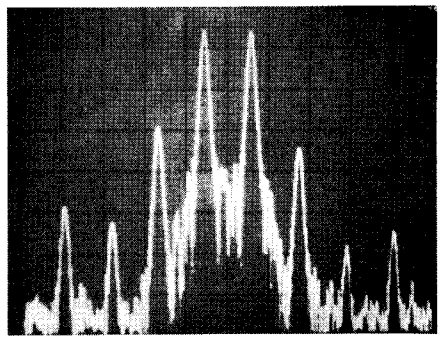
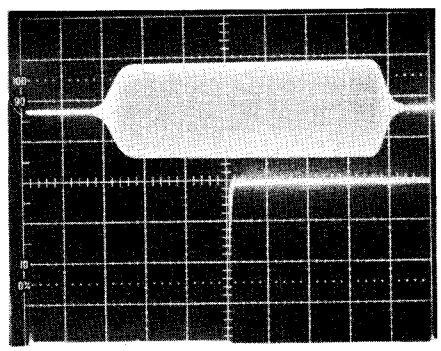
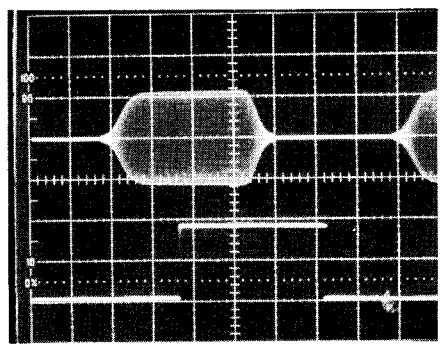


Fig. 2 — Spectral display of the IC-720A during the transmitter two-tone IMD test. Third-order products are 28 dB below PEP output and fifth order products are about 52 dB down. The seventh-order product is higher than the fifth at 48 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 1 kHz. The transceiver was being operated at rated input power on the 20-meter band.



(A)



(B)

Fig. 3 — At A, keyed cw waveform of the IC-720A prior to modification. Horizontal divisions are each 5 ms. The lower trace is actual key closure, while the upper trace is the rf output envelope. Heavy weighting is experienced by the elongated envelope. The rf output envelope, after modification, is shown at B.

Other Features

A large-scale, multifunction meter takes up a chunk of the front-panel space. In receive, this meter functions as an S meter. Because of the widely varying meter sensitivity (see specification table), this meter isn't too useful on 160 and 80 meters. Requiring only an 11-μV signal for an S9 reading, almost every signal is at least S-9, and many signals "peg" the meter. On transmit, the meter indicates ALC, relative power output or collector current, depending on the position of the front-panel RF/ALC control and the meter switch under the top-cover access panel. The meter also serves as an SWR indicator.

The rear panel, although primarily a heat sink for the final-amplifier transistors, contains an impressive number of input/output terminals. There is an SO-239 antenna connector, a 1/8-inch key jack, a 1/8-inch external speaker jack, a ground terminal, a dc power input and a fuse holder. The '720 includes receiver input and receiver antenna output RCA-type phono connectors for use with an external preamp or a separate receive antenna (e.g., a Beverage antenna for 80 or 160 meters). The MEMORY phono jack is for the connection of an exernal 9- to 12-V dc supply, to hold the operating frequency in memory in case of a power failure. The LOW BAND ANT (RL) phono jack serves two functions. By changing internal

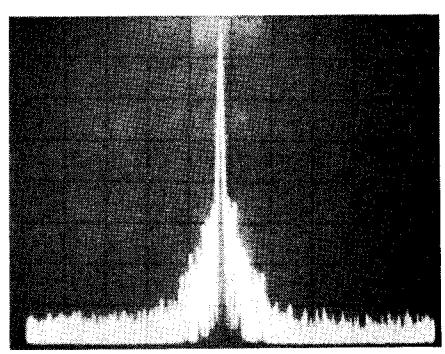


Fig. 4 — Synthesizer noise about the carrier. This photograph was taken with the IC-720A operating at 60 watts of output on 14 MHz. Vertical divisions are each 10 dB; horizontal divisions are each 1 kHz.

ICOM IC-720A HF Transceiver, Serial No. 05082

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency coverage: Ham band — 1.8-2.0, 3.5-4.1, 6.9-7.5, 9.9-10.5, 13.9-14.5, 17.9-18.5, 20.9-21.5, 24.5-25.1, 28.0-30.0 MHz; general-coverage receiver — 0.1-30 MHz in 1-MHz segments.	As specified.
Modes of operation: Ssb, cw, RTTY, a-m.	As specified.
Readout: 6 digit.	1/2-in. high, 6-digit fluorescent-blue display.
kHz/turn of knob: Not specified.	100/10/1.
Frequency resolution: 100 Hz.	As specified.
Backlash: Not specified.	Nil.
RIT range: ± 800 Hz.	As specified.
Receiver attenuator: 10 dB.	Not measured.
S-meter sensitivity (μV/S9 reading): Not specified.	160 m, 12; 80 m, 11; 40 m, 80; 20 m, 90; 15 m, 100; 10 m, 120.
Transmitter rf power input: 200 W, cw; 200 W PEP, ssb; adjustable.	Greater than 100 W output all bands.
Harmonic suppression: Better than 40 dB.	− 58 dB (see photo).
Third-order IMD: Not specified.	− 28 dB (see photo).
Spurious suppression: Better than − 60 dB.	− 63 dB (see photo).
Receiver sensitivity: Less than 0.25 μV for 10 dB S + N/N.	Receiver dynamics measured with optional FL-32 500-Hz i-f filter installed.
Color: Gray/green.	
Size (HWD): IC-720A — 4-3/8 × 9-1/2 × 12-1/4 inches;† IC-PS15 — 4-3/8 × 7 × 11-1/2 inches.	As specified.
Weight: 16.5 lb.	As specified.

	80 m	*20 m*
Noise floor (MDS) dBm:	− 132	− 132
Blocking DR (dB)	noise limited	
Two-tone 3rd-order IMD DR (dB), worst case:	97	92
Third-order intercept:	+ 13.5	+ 6

†mm = in. × 25.4, kg = lb × 2.2, and m = ft × 0.3048.

jumpers, this jack serves either as a T-R relay control (for an external amplifier) or as a low-band (1600 kHz and below) antenna input. The TRANSVERTER SCOPE (ALC) phono connector can be used for any one of the following by changing internal jumpers: either as the TX output for a transverter; or access to the 39.7 MHz i-f for observation on a scope; or ALC input from an external amplifier. A 24-pin ACCessory socket provides many input/outputs, including RTTY keying, transverter control and external band switching.

Operation

The first thing I noticed when getting ready to operate the '720 was its size. For such a small transceiver, the front panel contains many controls, and these controls take some getting used to. For example, I was so "tuned-in" to a conventional band switch that it took a long while to get familiar with the push-button scheme.

Initial hookup also posed some interesting choices. Should I set the LOW BAND ANTENNA (RL) jumpers for the a-m broadcast antenna or for the relay control? I often use an external amplifier for DXing and contesting, but I also like to DX the a-m broadcast band. Taking off the covers to change the jumpers each time is a chore, so I opted for the relay control.

On cw, I noticed that, although it was difficult to overload the receiver front end, the high synthesizer phase-noise level generated with strong signals in the passband made weak-signal copy difficult. Even with the optional cw filter installed, the selectivity could have been better. The rig just doesn't make it on the low end of 40 at night.

I like the ability to reduce the output power to just a few watts for QRP operation. I also liked the feel of the controls and switches. They have a definite "quality" about them that makes the '720 a pleasure to use. The cooling fan and the T-R relay are quiet.

In summary, the IC-720A is a nice radio for general-purpose use. It is small and quiet, and has just about any feature you would want built in.

Price class: IC-720A, $1349; IC-PS15, $229; FL-32, $60. Available from: ICOM, 3331 Towerwood Dr., Suite 307, Dallas, TX 75234. — *Mark Wilson, AA2Z*

YAESU FT-680R 6-METER MULTIMODE TRANSCEIVER

☐ As this review is being written, Ole Sol continues to stir up the ionosphere. The 50-MHz band is still producing worldwide DX in this late portion of cycle 21! When the F_2-layer DX finally dies, sporadic E (or E_s) will still provide DX excitement for many 6-meter operators. During the review period, a few of the Hq. gang used the '680R in conjunction with a 3-element home-built Yagi to earn an "almost" 6-meter WAC (missing only Asia!) for the Hq. operator's club station, W1INF.

The Yaesu FT-680R is a fully synthesized, microprocessor-controlled, 6-meter transceiver that operates on cw, ssb, a-m and fm. Maximum input power is specified as 20 watts, and frequency coverage is from 50 to 54 MHz. This transceiver is a 6-meter version of the Yaesu FT-480R, which appeared in this column in October 1981.[1]

Features

Microprocessor control in the '680R provides many features, and allows flexibility not found in the older 6-meter designs. The digital VFO system features discrete tuning steps of 0.01, 0.1, 1, 20 and 100 kHz, depending on the operating mode and tuning-rate selection. Four memory channels are available, and in the fm mode these may be scanned for a busy or clear channel. A priority function allows one memory channel to be used as a priority frequency. In the priority mode, the radio will "monitor" this priority channel and alert the operator when it is in use.

Probably the most important feature of the transceiver is the small size. It easily can be located under the dash of small cars, or be placed in a briefcase for a business trip. To ensure versatility, Yaesu has ganged many of the control functions together, which allows for the small front panel. A complete description of each function of the controls of the Yaesu FT-480R was given in the October 1981 review by Wilson. The '680R SAT switch allows the transceiver frequency to be changed while the unit is in the transmit mode. This feature is very useful when operating through an amateur satellite — but amateurs have no satellite allocation on the 50-MHz band!

Other Features

As in the 2-meter version, the '680R has an input for both tone-burst and Continuous Tone-Coded Squelch generators. An optional FTS-64E tone generator, which will synthesize 32 different CTCSS or tone-burst frequencies, is available. The tone input is located on the rear panel, which also has 1/8-inch jacks for the cw key, an external speaker and a 2-pin dc power connector along with an SO-239 antenna connector.

Installation and Operation

During the review period the FT-680R was operated in fixed, mobile and portable environments. Fixed operation was from W1INF, in conjunction with a 3-element homemade NBS Yagi.[2] This system worked well, and the receiver dynamic range was put to the test, as there are many 6-meter operators living very close to ARRL Hq.! Only the *very* strong local

[1] M. Wilson, "Yaesu FT-480R 2-Meter Multimode Transceiver," *QST*, Oct. 1981, pp. 46-47.
[2] D. Lusis, "Go for the Gain, NBS Style," pp. 34-38, this issue.

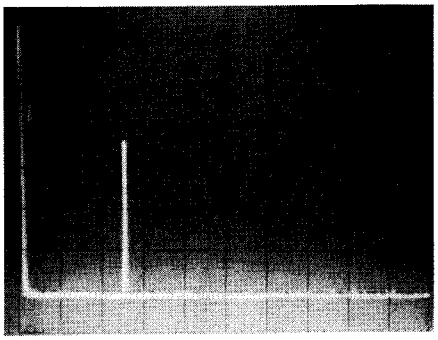


Fig. 5 — Spectral display of the FT-680R. Vertical divisions are each 10 dB; horizontal divisions are each 20 MHz. Output power is approximately 10 watts at 6 meters. The fundamental has been reduced in amplitude approximately 33 dB by means of a notch filter; this prevents analyzer overload. All spurious emissions are approximately 70 dB below peak fundamental output. The FT-680R complies with current FCC specifications for spectral purity.

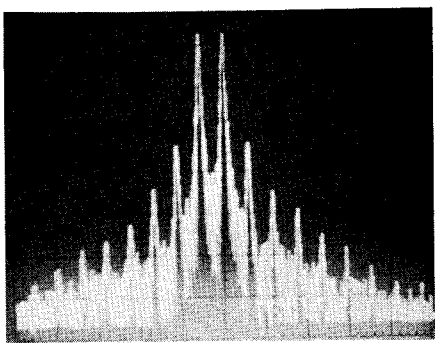


Fig. 6 — Spectral display of the FT-680R output during the transmitter two-tone IMD test in the SSB mode. Third-order products are approximately 33 dB below PEP and fifth-order products are approximately 45 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 2 kHz. The transmitter was being operated at rated input power on the 6-meter band.

Yaesu-Musen FT-680R 6-Meter Transceiver, Serial No. 020460

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency coverage: 50.000-53.999 MHz.	Same.
Operating modes: Usb, cw, a-m and fm.	As stated.
Frequency display: Blue-fluorescent digital display	As stated.
Power requirements: 13.8-V dc at 5A.	As stated.
Transmitter rf power output: Not specified.	Greater than 10 W on ssb, cw and fm; 4 W carrier on a-m.
Transmitter third-order IMD: Not specified.	Approximately −33 dB (worst case).
Spurious suppression: Better than 60 dB.	>−60 dB.
Harmonic suppression: Not specified.	>−60 dB.
Frequency stability: Not specified.	Less than 100 Hz from a cold start to one hour later.
Receiver audio power output: 2 W at 10% THD.	1.3 W into 8 Ω.
S-meter sensitivity: Not specified.	Relative type, 27 μV required for full scale deflection.
RIT range: Not specified.	± 10 kHz.
Receiver sensitivity: Ssb, 0.5 μV for 20 dB S/N; fm, 0.35 μV for 20 dB QS; and a-m, 1.0 μV for 10 dB S/N.	Receiver dynamics measured with a 2.4-kHz i-f bandwidth; Noise floor (MDS): −136 dBm Third-order IMD dynamic range: 81 dB Blocking dynamic range: 111 dB.
Size: (HWD) 2.4 × 7 × 9.4 in.†	
Weight: 6.4 lb.††	
Color: Not specified.	Tan body with gray front panel.

†mm = in. × 25.4. ††kg = lb. × 2.2.

signals overloaded the receiver front end. The one fault in the '680R that makes it difficult to use is the slow delay time of the receiver agc. Sometimes when DX stations were calling, the local splatter would cause the agc to decrease the sensitivity of the receiver enough to mask the DX station calling. Mobile operation of the transceiver was flawless, except for the noise-blanker performance. It never seemed to be of any help with ignition noise during use in several vehicles.

Portable operation with the FT-680R was done from several mountain tops in the Connecticut area. Power consumption is a little too much for a dry-cell battery pack to handle, so an automobile dc supply or an ac supply/generator is the best bet. As in base-station operation, the receiver was never really "crunched" by signals other than the strong local ones. I was impressed by the synthesizer in the transceiver; the lack of severe synthesizer noise was evident.

Conclusions

I found the transceiver to be a "workhorse." It was used as an exciter for lab testing, as a portable contest rig and as a source of excitement for the off-duty Hq. staff when working 6-meter DX. At one point during the review period the unit required major repair. A high-voltage spike from the optional FP-80 13.8-V supply destroyed a few semiconductor devices in the '680R, but the unit was soon repaired by Yaesu. Yaesu cautions that the power supply switch should not be used as the ON/OFF switch for the transceiver.

Strictly from an operator's viewpoint, I found the transceiver to be somewhat cumbersome to operate, but once the layout is understood the performance is appreciated. I would recommend to anyone looking for a new 6-meter "box" to take a serious look at the FT-680R. The FT-680R is sold by Yaesu Electronics Corp., 6851 Walthall Way, Paramount, CA 90723. Price class is $520. — *Gerry Hull, AK4L*

New Products

DUFFY ENTERPRISES TOOL-AID®

☐ A new product of possible interest to hams is Tool-Aid. It looks like candle wax and is intended to create a temporary bond between components of almost any kind during assembly. A common application is in starting small screws or nuts in tight places. The substance is applied to a screwdriver tip; when the screw is picked up, it sticks to the tip. If a small part is dropped inside a chassis, Tool-Aid can be used on a screwdriver tip or probe tip to retrieve the part. The material doesn't leave any mess, and only a small amount is needed to achieve a good grip. Tool-Aid is available from Duffy Enterprises, 2212 Bedford St., Johnstown, PA 15904. Price per package: $3.99. — *Sandy Gerli, AC1Y*

CERMETEK TELEPHONE LINE INTERFACE

☐ The Cermetek Microelectronics, Inc., CH1810 is a stand-alone, direct-connection device that was primarily designed to allow data terminal equipment to be connected directly to the telephone line. This device has received FCC approval under Part 68. FCC recertification is not required when integrated into systems, provided the included label is externally attached; it contains the registration number and ringer equivalence.

The CH1810 can be used as a telephone-line interface in a variety of environments. These include use with modems, answering machines, FAX machines, auto dialers, burglar alarms, remote metering devices, etc. Pc-board mountable, the DCPH (Direct Connect Protective Hybrid) occupies less than 5 square inches[1] of space. Connection to the DCPH is made by means of 0.1-inch-on-center pins. A ±12-V power supply is required.

These devices are manufactured by Cermetek, Inc., 1308 Borregas Ave., Sunnyvale, CA 94086, and are available from P and L Associates, P.O. Box 481, East Setauket, NY 11733. Price class in 1 to 9 quantities: $95. — *Paul K. Pagel, N1FB*

[1]$mm^2 = in.^2 \times 645.16$.