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ICOM IC-745 HF All-Band Transceiver/General-Coverage Receiver

QSK 1500 High Power RF Switch

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ICOM IC-745 HF All-Band Transceiver/ General-Coverage Receiver

How many different things can a transceiver do? If there is an upper limit, I'm not sure what it is, but Amateur Radio equipment manufacturers appear to be in a race to find it or prove it doesn't exist. ICOM's latest contender in this "contest" is the IC-745. This radio has a number of features. In fact, there are 38 knobs and buttons on the front panel alone, and some of those control more than one function!

I used the review unit at my station over a period of two months. My uses ranged from ragchews on quiet bands to phone Sweepstakes (and quite a bit of listening during the CQWW CW). Since the review unit came with the FM option, I was able to use it on the local 10-meter FM repeater, and I checked into MARS nets on several occasions. Let's take a look at some specifics and see how the IC-745 measures up.

The Transmitter

Simply put, the transmitter works well. I used the '745 to drive my SB-220 amplifier. Even on 10 meters, the '745 provided more than enough drive power to bring the '220 up to full output. This has not always been true of other solid-state-final-amplifier transceivers I've used. What kind of signal reports did I receive? Other stations had nothing but praise for the quality of transmitted signal from the '745.

An internal electronic iambic keyer (optional) was included with the review unit. You simply connect a paddle to the radio via a stereo-phone plug and adjust the speed with a front-panel control. I estimate that the speed ranged from approximately 10 WPM to approximately 50 WPM. At around 20 WPM, there is a sharp knee in the speed adjustment. It is possible that this glitch could be eliminated by using a reverse log-taper potentiometer. Although there is no means to adjust weighting and spacing, the keyer should prove adequate for the casual user. When the front-panel keyer speed control is moved to the OFF position, the internal keyer is disabled and the rear-panel jack provides for on/off keying with a straight key or external keyer.

An accessory jack on the rear panel permits you to connect an RTTY modem or other terminal to the transceiver easily. Although my station is not equipped for these other modes, some tests were conducted in the ARRL lab. On the surface, the '745 seems ideal for the AMTOR forward-error-correcting mode, but the audio recovery time when switching from transmit to receive may be greater than the standard response delay from the other station, which means that the '745 might not "hear" the receipt acknowledgment during AMTOR ARQ operation.

The Receiver

In addition to covering all the HF amateur

ICOM IC-745 HF Transceiver, Serial No. 3101

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency coverage: Receive—0.1-30 MHz;	As specified.
transmit—1.8-2.0 MHz, 3.45-4.1 MHz, 6.95-7.5 MHz, 9.95-10.5 MHz, 13.95-14.5 MHz, 17.95-18.5 MHz, 20.95-21.5 MHz, 24.45-25.1 MHz, 27.95-30.0 MHz.	As specified.
Modes of operation: CW, SSB, FM, AM (receive only), RTTY.	As specified.
kHz/turn of knob: Not specified.	2/200.
Frequency display: 6 digit.	5/16-in-high, blue fluorescent digits.
Frequency resolution: 100 Hz.	As specified.
S-meter sensitivity (μV for S9 reading): Not specified.	Preamp in (preamp out): 160 m, 55 (94); 80 m, 44 (100); 40 m, 24 (67); 30 m, 21 (60); 20 m, 28 (88); 17 m, 28 (90); 15 m, 30 (81); 12 m, 30 (77); 10 m, 28 (76).
Transmitter power (input): All modes, 200 W. (Transmitter does not function in AM mode.)	Power output: 160 m, 118; 80 m, 119; 40 m, 125; 30 m, 126; 20 m, 127; 17 m, 126; 15 m, 127; 12 m, 132; 10 m, 135.
Harmonic suppression: More than 40 dB.	65 dB (see Fig. 1).
Spurious suppression: More than 60 dB.	65 dB (see Fig. 1).
Third-order IMD: Not specified.	35 dB (see Fig. 2).
CW keying waveform: Not specified.	See Fig. 3.
Receiver sensitivity: SSB, CW, RTTY (1.6-30 MHz)—less than 0.15 μV for 10-dB S/N; FM—less than 0.3 μV for 12-dB signal + noise + distortion/noise + distortion.	Receiver dynamics measured with optional filters installed.

	80 m Preamp In/Out	20 m Preamp In/Out
Noise Floor (minimum discernible signal) (dBm):	−140/−133	−144/−135
Blocking dynamic range (dB):	115/113	116/118
Two-tone 3rd-order intermodulation distortion dynamic range (dB):	92/94	94/97
Third-order input intercept (dBm):	−2/5.5	−3/8.5
Receiver quieting (μV for 12-dB signal + noise + distortion/noise + distortion):	0.29/0.64	0.74/1.6
Receiver turnaround, ms:	See Fig. 4.	

Squelch sensitivity: Less than 0.5 μV.	Preamp in: 0.082 μV min., 0.3 max; preamp out: 0.17 μV min., 0.72 max.
Receiver audio output @ 10% total harmonic distortion: More than 2.8 W.	3.0 W.
Color: Two-tone green.	
Size (height, width, depth): 4.5 × 12 × 14 in.	
Weight: 18 lb.	

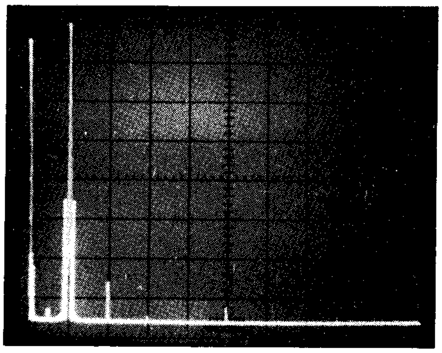

Fig. 1—Spectral display of the IC-745 output. Vertical divisions are each 10 dB; horizontal divisions are each 10 MHz. Output power is approximately 100 W at a frequency of 10.1 MHz. All spurious emissions are at least 65 dB below peak fundamental output. The IC-745 complies with current FCC specifications for spectral purity.

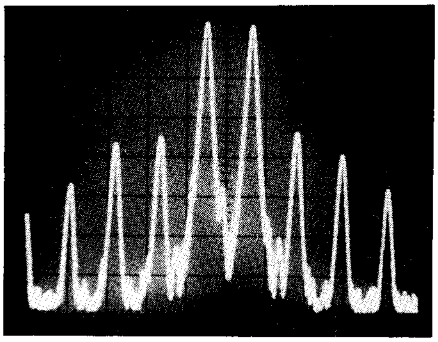

Fig. 2—Spectral display of the IC-745 output during transmitter two-tone IMD test. Third-order products are 34 dB below PEP, and fifth-order products are 40 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 1 kHz. The IC-745 was being operated at rated input power on the 10-meter band.

bands, the '745 functions as a general-coverage receiver from 100 kHz to 30 MHz. Triple conversion is used, with the first IF being at 70.4515 MHz; the second and third IFs are 9.0115 MHz and 455 kHz, respectively.

The operating modes are LSB, USB, CW, RTTY, AM or FM (if the optional FM unit is installed). As you push the MODE-SEL switch, the '745 switches from one mode to the next in the above order, and then from FM back to LSB. Although my initial reaction to this system was not totally favorable, I became quite fond of it before the end of the review period.

Band selection is achieved by locking the BAND switch in the "in" position and rotating the tuning control. In the HAM mode, rotating the tuning control clockwise moves the operating frequency to the next higher ham band; counterclockwise, to the next lower ham band. In the general-coverage mode, the frequency changes are in increments of 1 MHz. You must, of course, remember to move the BAND switch to the "out" position to tune within the band.

Within a given band, tuning is in 10-Hz steps. When tuning in a slow CW signal or a continuous carrier, I found the "step" effect

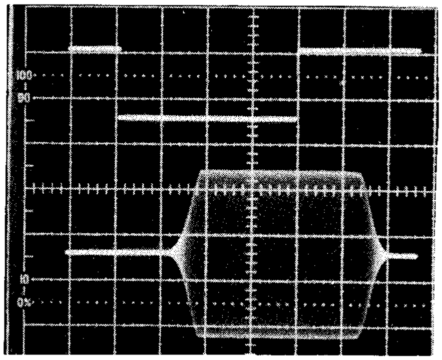

Fig. 3—CW keying waveform of the IC-745. The upper trace is the actual key closure; the lower trace is the RF envelope. Each horizontal division is 5 ms.

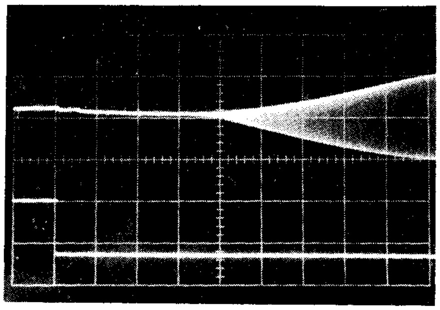

Fig. 4—Receiver recovery (turnaround) time. The upper trace shows the key opening; the lower trace shows receiver audio output. Horizontal divisions are each 20 ms. There is an approximate 80-ms delay before receiver recovery.

of this tuning system mildly objectionable. Pressing the TUNING RATE switch causes the '745 to tune in 1-kHz increments—which is most beneficial when moving from one end of the band to the other.

In SSB operation, the '745 performs admirably. It is a pleasure to use under normal conditions. Optional filters were installed in the review unit for SSB and CW use. The built-in notch filter does a good job of taking out annoying carriers. Two separate controls on the front panel allow selection of OFF, NORMAL and WIDE and LEVEL of the built-in noise blanker. The noise blanker is quite effective in dealing with ignition noise, and to some extent it is effective against the "woodpecker." Control of the AGC timing is achieved with a front-panel control that permits ON/OFF control and FAST—SLOW variation.

The receiver is not without faults, however. Although IF shift and passband tuning are both available, they are not available simultaneously: Because they are controlled by the same switch and potentiometer, you must select one or the other. I did not find either of them to be particularly effective in tailoring the passband to eliminate QRM. If I could have used them simultaneously, it might have improved receiver performance.

The '745 has a built-in receiver preamplifier that does its job very well, but I'm not sure its job is needed on the HF bands these days. Without the preamp turned on, the receiver exhibits more than enough sensitivity on all the bands and modes I tried. With the preamp on, the '745 front end tends to be overloaded by strong signals. Under crowded band conditions (contests), it exhibits this tendency even with the preamp off. ICOM might make better use of this control to switch an attenuator in and out of the receive circuit.

VFOs and Memories

The transceiver has two variable-frequency oscillators and 16 memories—which eliminates any need for an external VFO. Like most other synthesized transceivers on the market these days, the VFOs are simply memory locations. The memory contents are incremented or decremented with an optical interrupt device on the tuning control. The use and feel, though, is about the same as the now-archaic PTO.

Although ICOM has included both receiver and transmitter incremental tuning (RIT and XIT) in the '745, their effectiveness is limited by the range they can move from the displayed frequency: plus or minus 1 kHz. Additionally, the display frequency does not change with changes in either RIT or XIT.

ICOM has provided scan operation for the '745. The 16 memories may be scanned, or all frequencies between two limits can be scanned. This feature could be quite useful in some applications.

The Manual

Remember all the knobs and buttons on the radio? You may have guessed by now that it is not always obvious from casual observation just how to use each control effectively. What does the manual say? It is apparent that the manual was written by someone who lacked a real understanding of contemporary English as used in the Amateur Radio fraternity. Some portions might be confusing to anyone operating a transceiver for the first time.

If we were talking about an inexpensive, six-channel, crystal-controlled, 1-W-output FM rig, then almost anyone smart enough to pass a Novice exam could figure out how to use the rig in a few minutes. But this radio has 38 knobs on the front panel! Obviously, ICOM has spent a lot of money to engineer and produce such a complex and apparently well-made piece of equipment. Spending a little bit more to tell the purchaser how to make the best use of his or her investment would increase customer satisfaction.

Odds and Ends

The optional built-in IC-PS35 switching-type power supply was not reviewed; an external IC-PS15 supply was used instead.

The IC-HM12 scanning microphone was supplied with the review unit. It permits you to change frequency by pressing either of two switches located on top of the microphone housing. Mobile operators will appreciate this feature.

As this review was being completed, ARRL received word from the field indicating that the microcode for the microprocessor that controls the radio is stored in random-access memory (RAM). A built-in lithium battery is used to maintain the RAM when the unit is disconnected from a power supply. Once the battery fails or is disconnected, however, the '745 (and perhaps other contemporary transceivers) must be returned to the factory for reprogramming. We checked one of the

ICOM transceivers in the ARRL lab and found this to be the case.

Would I recommend this model to someone looking for a new transceiver? It really depends on the intended use. If the prospective user were a ragchewer or casual operator who also enjoys shortwave listening, the '745 probably should be considered. On the other hand, shortcomings in the receiver section would tend to limit its effectiveness in a contest setting.

The FM unit had two problems associated with it as it came out of the box. It was returned to the factory for service, which was done quickly and thoroughly at no cost.

Manufacturer: ICOM America, Inc., 2380-116th Ave., Bellevue, WA 98004. Price class: IC-745, $1000; IC-SM6 Microphone, $40; IC-PS35 Internal Power Supply, $160; IC-FL44A Filter, $160; IC-FL32 Filter, $60; IC-FL53A Filter, $100; IC-EX243 Keyer, $50; IC-EX242 FM Module, $40; IC-EX241 Marker, $20.—*Peter R. O'Dell, KB1N*

QSK 1500 HIGH POWER RF SWITCH

☐ Have you ever wished you could get rid of that big, slow relay in your amplifier? Wouldn't it be nice if you didn't have to wait for the relay to open and close each time you made a transmission? You could replace your old amplifier with one of the newer QSK types, or try separate antennas, but the QSK 1500 might be a better approach.

The QSK 1500 is an RF switching unit that bypasses the relay in your amplifier by using PIN diodes to route the signals. The unit is installed between your QSK transceiver and the amplifier. Instead of keying your rig, you key the QSK 1500, which then keys your rig, controls the relay in the amplifier and directs the RF signals through the system.

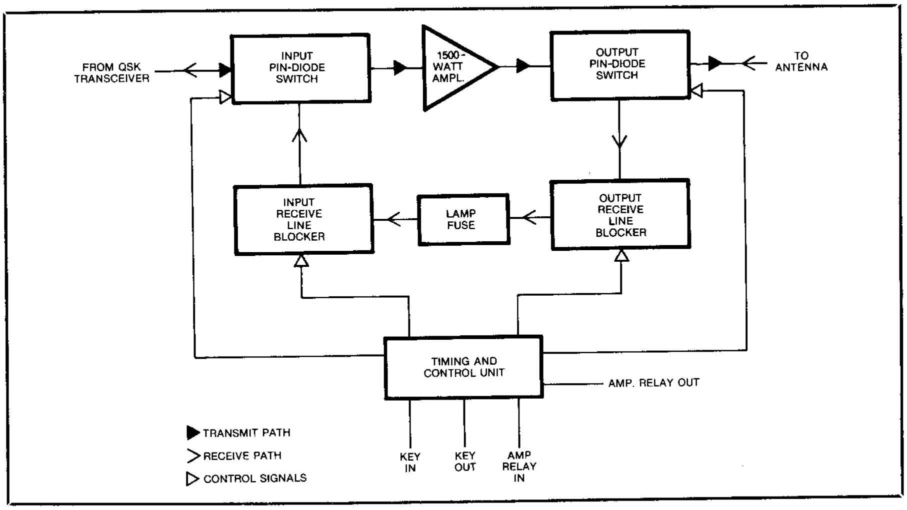

Fig. 5—Simplified functional block diagram of the QSK 1500 High Power RF Switch.

How Does It Work?

The functional diagram in Fig. 5 shows the signal paths in the unit. When you first start to transmit, the QSK 1500 closes the relay in the amplifier. Then, the PIN diodes switch on in the transmit direction. This allows drive to the amplifier and power from the amplifier to the antenna. Other PIN diodes switch off the receive direction when transmitting. When you unkey the transmitter, the bias to the various PIN diodes changes, removing the amplifier from the circuit and opening the receive path. These actions take place even though the TR relay in the amplifier is energized during the switching process. The relay in the amplifier remains closed for a little more than a second after unkeying, and only opens when you stop transmitting for more than this relatively long time. With the relay energized or not, the received signals pass through the QSK 1500 to the input of the receiver.

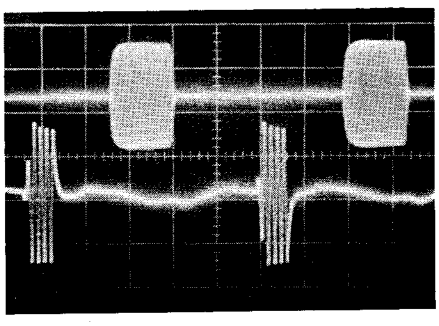

Fig. 6—Keying waveform of the QSK 1500. The upper trace shows the RF output of the amplifier; the lower trace shows the received audio. Horizontal divisions are each 10 ms.

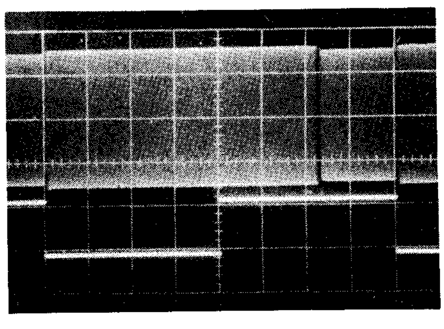

Fig. 7—The switching characteristics of the QSK 1500. The upper trace shows the RF from the signal generator; the lower trace shows the output of the electronic keyer. Each horizontal division is 5 ms. Measured insertion loss was less than 1 dB.

Laboratory Testing

During laboratory testing, the QSK 1500 was used with a Yaesu FT-980 QSK transceiver and a Collins 30S-1 linear amplifier. Fig. 6 shows the keying waveform during testing. The upper trace shows the CW waveform; the lower trace shows the recovered audio. The sweep time is 10 ms/div. So far, so good! The RF is driving the amplifier, and we can hear received signals between our transmissions.

Now let's look into the QSK 1500 a little closer and find out what it does. By connecting a signal generator to the QSK 1500 antenna port, and inserting a jumper between the AMP RLY IN and AMP RLY OUT connectors, we can view the signal generator output at the transceiver input. Fig. 7 shows what is really happening. The lower trace is the output waveform from an electronic keyer connected to the unit. When the key is closed, RF (upper trace) is received through the shorted amplifier loop. After the key opens, we still see RF through the amplifier loop for approximately 12 ms. Then we can note an abrupt change in the signal from the generator. We are now seeing the signal as it passes through the receive loop. The slight gap in the upper trace indicates the switching time between transmit and receive. The difference in amplitude between the two sections indicates losses in the receive circuit. This loss was measured at less than 1 dB. Receiver

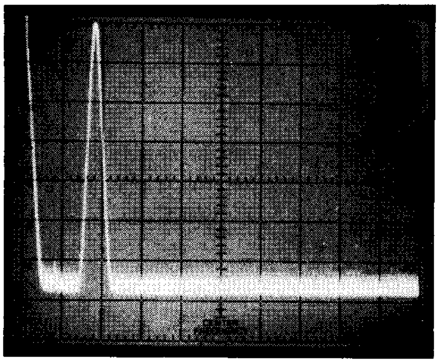

Fig. 8—Spectral display of the output of the test transceiver operating on 1.875 MHz without the QSK 1500. Vertical divisions are each 10 dB; horizontal divisions are each 1.0 MHz. All spurious emissions are at least 65 dB below peak fundamental output. The transceiver complied with current FCC specifications for spectral purity. This display is typical for all bands, 80 through 10 meters, when the QSK 1500 is used.

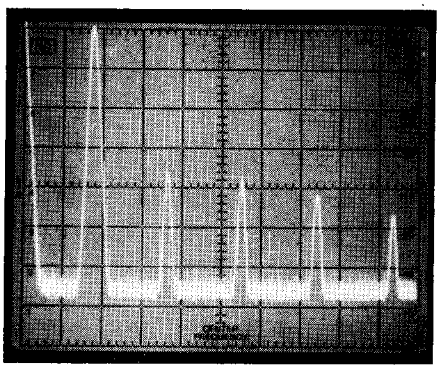

Fig. 9—Spectral display of the QSK 1500 output during initial testing. Vertical divisions are each 10 dB; horizontal divisions are each 1.0 MHz. The output waveform exhibits harmonics of the fundamental frequency that exceed the FCC requirements, (approximately −35 dB).

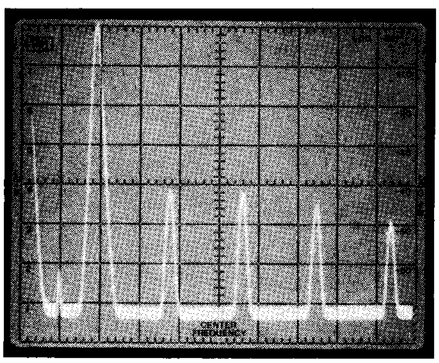

Fig. 10—Spectral display of the QSK 1500 output after replacement of D1. Test conditions are as shown in Fig. 9. Harmonics of the fundamental frequency are now at least 42 dB below the peak fundamental output power. The unit complies with current FCC specifications for spectral purity.

testing indicated about 1-dB degradation in the minimum discernible signal of a typical receiver when the QSK 1500 is used. This, of course, caused a small (approximately 1-dB) decrease in the two-tone intermodulation distortion dynamic range.

The output of the QSK 1500 was examined with the spectrum analyzer. On all bands, 80 through 10 meters, the unit worked well, meeting all FCC requirements for spectral purity. We did find some problems on 160 and 6 meters, however. On 160 meters, one of the PIN diodes was generating harmonics at a level greater than prescribed by the FCC. A call to the manufacturer solved the problem. A supplier had furnished a diode other than that specified, but supposedly better. Replacing the offending diode brought the unit output back into specification, and we were assured by the manufacturer that the diode problem was solved. Fig. 8 shows the bare transceiver output on 1.875 MHz. Fig. 9 shows the QSK 1500 output with the defective diode installed. Fig. 10 shows the QSK 1500 output with the defective diode replaced. Note that the installation of the correct diode lowered the harmonic level from 35 dB to 42 dB below rated output power, well within the −40 dB requirement.

The problem on 6 meters was caused because the RF chokes used in the unit are resonant at 6 meters. (The unit is rated only to 10 meters.) When the unit is operating on 6 meters, the fuse lamp glows during transmissions, indicating some stray currents in the system.

What Are Its Limitations?

The QSK 1500 is designed to work with a QSK transceiver. It will not work with a separate receiver/transmitter combination or make a non-QSK rig into a QSK rig.

Will It Work in Other Modes?

Yes. In particular, it allows the use of an amplifier with AMTOR, RTTY and SSTV, but at reduced power levels. The QSK 1500 is rated to operate with 1500-W PEP output at 40-WPM CW. Continuous-duty operation requires a reduction in output power (800-W PEP). It can also be used to operate SSB.

Conclusions

The QSK 1500 would be a fine addition to any shack. It can turn the average amplifier into state-of-the-art equipment without any modification. The unit is well built, with quality components. If you plan to build an amplifier, it could be designed into the project, eliminating any need for relay switching. It can even be used to switch between two separate antennas automatically (exciter only): for example, receiving on a Beverage and transmitting on a vertical. Also, the fuse lamp in the circuit provides protection from anything that could damage your sensitive receiver.

Manufacturer: Design Electronics Ohio, 4925 South Hamilton Rd., Groveport, OH 43125, tel. 614-836-3929. Price class, $300. —*Jon F. Towle, WB1DNL*

New Products

GENERAL MOTORS RADIO-INSTALLATION GUIDELINES

☐ General Motors Electrical Systems Center has published a brochure covering installation of RadioTelephone/Mobile Radio equipment in automobiles. Recommended installation schemes are shown, together with details on the use of the AC-Delco Side Terminal Adapter Package 1846855 with battery bolt (PN7803 Delco; 12004188 GM) and spacer (PN7804 Delco; 12004189 GM).

For more information, write to EMC Dept. MR, Bldg. 40, General Motors Proving Ground, Milford, MI 48042-2001.—*Bruce O. Williams, WA6IVC*