Product Review Column from *QST* Magazine

March 1990

ICOM IC-725 MF/HF Transceiver

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ICOM IC-725 MF/HF Transceiver

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With the introduction of the IC-725, ICOM joins the entry-level transceiver battle with Kenwood and Yaesu. ICOM's budget-priced '725 should hold its own against its chief competitors: Kenwood's TS-140S; Yaesu's FT-747GX; and Heath's SB-1400 (a slightly reworked FT-747GX).

The '725 is a full-featured 100-W transceiver in a diminutive (3.7 × 9.5 × 9.4-inch) cabinet. Some of its advanced features include ICOM's direct-digital synthesis (DDS) frequency control (more on that later), 26 user-programmable memories, three scanning modes, band-stacking registers (to remember the frequency, mode and filters selected with each memory and band location), two VFOs, selectable 10-dB-gain preamp, 20-dB attenuator, computer interface, and the ability to control the ICOM AH-3 automatic antenna tuner (well suited for multiband mobile operation).

Controls and Connections

The front panel, which accommodates quite a few controls, does not appear overcrowded. The left third of the front panel contains the main **POWER** switch, the **TRANSMIT** switch and push buttons for the **N**oise **B**lanker, **ATT**enuator, **PRE**amplifier and **AGC**. There's also a backlit S meter and relative power-output meter, a headphone jack, an 8-pin microphone connector and two concentric controls—one for **AF** gain and **SQ**ue**L**ch, the other for **MIC** gain and **RF PO**W**E**R.

The center portion of the front panel is primarily occupied by the black-on-orange LCD and frequency-determining controls such as the VFO knob, the **kHz, MHz, BAND** and **LOCK** switches (used to set tuning speeds and to change bands; **LOCK** disables the main tuning knob and is also used to transmit subaudible tones in the optional FM mode). To the left of the tuning knob are the mode-selection switches: **SSB, CW** (wide and narrow), and **AM/FM**.

On the upper right are the six memory- and VFO-manipulation controls: **VFO** A/B, **SPLIT**, memory channel **UP/DOWN**, **MEMO**ry, and **M**emory **W**rite. These controls also have secondary functions: **P**rogrammed **SCAN**, VFO **A** = **B** and **M**emory > **VFO**. Under the memory controls are the **RIT** and **TUNER** controls (**TUNER** selects and deselects the optional AH-3 automatic antenna tuner).

The '725's rear panel has the following connectors: **DC 13.8 V, ANT**enna, computer interface, **TUNER** interface, **SEND** and **ALC** jacks (for controlling external amplifiers), two accessory sockets (for connecting external audio devices, RTTY or packet-radio terminals, automatic antenna tuners or selectors, etc), CW **KEY**, **EXT**ernal **SP**eaker, ground, and a switch to enable the semi-break-in feature in CW mode.

The supplied HM-12 hand-held microphone is equipped with **UP** and **DOWN** frequency-selection buttons, in addition to the PTT switch. The up/down buttons can also be disabled by a microphone-mounted switch.

Frequency Selection

The IC-725 uses the main VFO knob and several push-button switches to select the operating frequency. When the VFO knob is rotated, the VFO changes frequency in 10-Hz steps. If this is too slow for you, you can select alternate rates of 20 or 50 Hz per step. I found even the 10-Hz rate to be extremely fast—I used the faster rates only while tuning among shortwave broadcast stations. The fastest tuning rate makes the '725 feel awkward. Pushing the **kHz, MHz** or **BAND** keys while rotating the VFO knob results in accelerated frequency or band changes.

The '725 has two VFOs, allowing split-frequency operation. There are also 26 programmable memories. The first 22 are regular memories, each storing frequency and mode. Memory channels 23 and 24 each store a pair of frequencies and modes for commonly used split-frequency pairs, and channels 25 and 26 are used to set the upper and lower limits of the programmed-scan function.

I commend ICOM on the sensible, easy-to-use layout of its VFO and memory function controls. Whether quickly stepping through available memory positions, writing a new frequency to memory, or switching between the two VFOs or a memory position, the '725 makes it easy. Unlike many similar rigs, it's not necessary to enter memory mode to cycle through the available memory channels. In VFO mode, the up and down arrow keys cause the rig to cycle through the memory channels. This makes it easy to tune up and down the band and load the memory channels with the frequencies of several DX or contest stations without a lot of button pushing.

The '725 has three scan modes: (1) programmed scan, using the contents of memory channels 25 and 26 as limits; (2) memory scan, which repeatedly scans all programmed memory channels; and (3) selected-mode memory scan, which repeatedly scans the contents of all memory channels with the same operating mode. Certain scan functions can be changed by installing a diode on one of the internal circuit boards.

Although the '725 is an entry-level unit, ICOM's advertisements promote the rig's high-tech DDS frequency synthesizer. DDS is supposed to be the last word when it comes to synthesizer performance, offering improved lock-up times and providing excellent phase-noise performance. Sure, the

Table 1

ICOM IC-725 160- to 10-Meter Transceiver, Serial no. 02826

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency coverage: Receiver, 500 kHz to 30.0 MHz; transmitter, 1.8 to 2.0, 3.40 to 4.1, 6.90 to 7.5, 9.90 to 10.5, 13.90 to 14.5, 17.90 to 18.5, 20.90 to 21.5, 24.40 to 25.1, 27.90 to 30.0 MHz.	As specified.
Modes of operation: USB, LSB, CW, FM, AM.	As specified. FM and AM (transmit) optional.
Power requirement: 13.8 V dc, 20 A max on transmit, 1.5 A max on receive.	At 14.2 MHz and 13.8 V, 17.4 A max; 0.84 A in receive at min audio gain.
Transmitter	*Transmitter Dynamic Testing*
Transmitter output power: Max 100 W PEP on SSB, 100 W on CW and FM, 40 W on AM.	Typically 125 W PEP on SSB and CW. Power output varied slightly from band to band. (IMD performance rated only to 100 W.)
Spurious signal and harmonic suppression: Greater than 50 dB below peak power output.	See Fig 1.
Third-order intermodulation distortion: Not specified.	See Fig 2.
CW keying waveform: Not specified.	See Fig 3.
Transmit-receive turnaround time (PTT release to 90% audio output with an S9 signal): Not specified.	Fast AGC, 20 ms; slow AGC, 22 ms.
Transmitter AF response: Not specified.	420-2650 Hz.
Receiver	*Receiver Dynamic Testing*
Receiver sensitivity (preamp on): SSB and CW (bandwidth not specified): <0.15 μV for 10 dB S/N from 1.8-30 MHz.	Minimum discernible signal (noise floor) with 500-Hz filter: *Preamp on* 3.5 MHz, −137.5 dBm; 14 MHz, −137.5 dBm. *Preamp off* 3.5 MHz, −128.5 dBm; 14 MHz, −129.5 dBm.
AM: (6.0-kHz bandwidth) <2 μV for 10 dB S/N from 1.8-30 MHz.	6.0-kHz bandwidth (preamp on, test signal 30% modulated with 1-kHz tone): 1.0 MHz, 1.85 μV; 3.5 MHz, 0.51 μV; 14 MHz, 0.48 μV.
FM: (bandwidth not specified) <0.5 μV for 12 dB SINAD from 28-30 MHz.	FM module not tested.
Receiver dynamic range: Not specified.	Blocking dynamic range†: 3.5 MHz, noise limited; 14 MHz, noise limited. Two-tone, third-order intermodulation distortion dynamic range, preamp on:† 3.5 MHz, 91.5 dB; 14 MHz, 90.5 dB. Preamp off: 3.5 MHz, 92.5 dB; 14 MHz, 90.5 dB Third-order intercept, preamp on: 3.5 MHz, 0 dBm; 14 MHz, −2 dBm. Preamp off: 3.5 MHz, 10 dBm; 14 MHz, 6 dBm.
S-meter sensitivity (μV for S9 reading): Not specified.	Preamp off, 1.0 MHz, 150 μV; 14 MHz, 56 μV; 29 MHz, 78 μV.
Squelch sensitivity: <0.3 μV.	Min, <0.3 μV; max, >2.2 V.
Receiver audio output: >2.6 W at 10% THD (total harmonic distortion) with an 8-Ω load.	3.13 W at 10% THD with an 8-Ω load.
Receiver audio + IF response: Not specified	430-2090 Hz.
Other	
Color: Gray.	
Size (HWD): 3.7 x 9.5 x 9.4 inches; 10.1 lb.	

†Blocking dynamic range measurements were noise limited at all spacings; third-order IMD dynamic range measurements were made at the ARRL Lab standard signal spacing of 20 kHz.

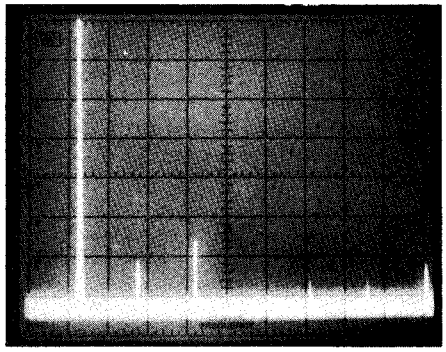

Fig 1—Worst-case spectral display of the ICOM IC-725. Horizontal divisions are each 10 MHz; vertical divisions are each 10 dB. Output power is approximately 134 W at 14.2 MHz. All harmonics and spurious emissions are at least 56 dB below peak fundamental output. The IC-725 complies with current FCC specifications for spectral purity.

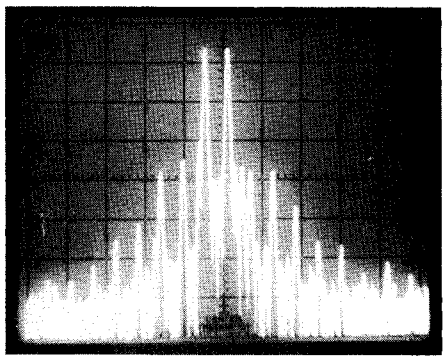

Fig 2—Spectral display of the IC-725 during two-tone intermodulation distortion (IMD) testing. Third-order products are approximately 35 dB below PEP output, and fifth-order products are approximately 38 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 2 kHz. The transceiver was being operated at 100 W PEP output on 14.2 MHz.

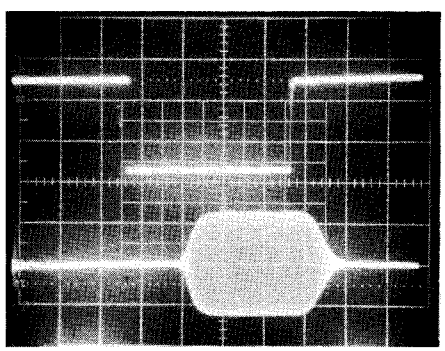

Fig 3—CW-keying waveforms for the ICOM IC-725 in the semi-break-in mode. The lower trace is the RF envelope; the upper trace is the actual key closure. Each horizontal division is 5 ms. The transceiver was being operated at 130 W output on 14.02 MHz. The IC-725's CW keying is good.

IC-725 is an entry-level rig—I had to remind myself of that fact when using the '725 in tough band conditions—but ICOM's inclusion of DDS hasn't (at least in the samples we tested) resulted in the phase-noise reduction hinted at in ICOM's advertisements.

The IC-725's frequency display is up to ICOM's usual standards. It's easy to read and prominently displays all the necessary information (band, mode, selected VFO, etc).

The **RIT** feature, although smooth and easily switched in and out, does not have much range. The review rig exhibited less than 3 kHz of RIT travel. (Of course, for wider excursions, split operation using both VFOs works very well.) Another unhelpful characteristic of the '725's RIT is that the offset frequency is not indicated separately on the frequency display. Pressing the second-function key and the RIT on/off key sums the RIT offset with the displayed frequency.

The feel of the IC-725's tuning knob is excellent. It is extremely smooth and has the right amount of weight. A slight flick of the wrist will send the VFO dashing up or down the band—unlike the detented tuning knobs on some other rigs. The IC-725 also has an adjustable knob brake so you can customize the feel of the rig's tuning knob.

The Receiver

The '725's front end is made up of eight automatically selected band-pass filters: 0.5 to 1.6, 1.6 to 2, 2 to 4, 4 to 8, 8 to 11, 11 to 15, 15 to 22, and 22 to 30 MHz. As you tune up and down through the MF/HF range of the receiver, the appropriate band-pass filter is switched in. Although its sensitivity is quite good (see Table 1), the IC-725's receiver performance under tough band conditions (lots of strong signals or a strong station close by) is far from top-notch. This is not uncommon in entry level rigs. Although the IC-725's third-order IMD dynamic range is good, broadband noise generated in the receiver thwarted all our efforts to measure the rig's blocking dynamic range.

The IC-725 comes equipped with a 2.3-kHz SSB filter and a 6-kHz AM filter; optional 250- and 500-Hz CW filters are available. The 500-Hz filter is just right for those who like a good CW filter, but one that's not extremely narrow. This filter provides an excellent middle ground, and significantly improves the rig's CW performance.

The IC-725 allows selection of only one bandwidth during AM reception: 6 kHz at −6 dB and "less than 20 kHz" at *−40 dB*. (The IC-725's SSB filter is not selectable during AM reception, and envelope detection of even communications-quality AM is suboptimal with an SSB filter, anyway.) A 6-kHz-wide filter, assuming that it has a good −60/−6 shape factor (2:1), is *acceptable*—although a kilohertz or two too wide—for reception of international broadcast stations (spaced 5 kHz apart) and amateur AM signals. The IC-725's AM filter is *far* too wide for good AM reception in Amateur Radio and shortwave-broadcast bands—and the '725 sounds as if audio rolloff has been built in to compensate for the filter's wideness. In on-the-air tests, the IC-725's 6-kHz-wide filter allows reception of strong SWBC signals *10 to 12 kHz away* from their carrier frequencies. Selectivity this broad is optimal only for mediumwave channel spacings (9 or 10 kHz). Remedy: Switch the IC-725 to USB or LSB and receive AM as SSB. The IC-725's SSB filtering is good. Selectivity on FM (with the optional FM unit [not tested] installed) is rated at 15 kHz.

Mode selection on the '725 is simply a matter of pushing a button (or two). Each of the three mode-selection push buttons serves a double duty. Pushing the **AM/FM** key switches the rig into AM mode; pushing it again engages FM mode, and so on. The **SSB** key toggles between USB and LSB, and the **CW** key toggles between wide and narrow modes (provided an optional CW filter is installed).

DXers and contesters will immediately notice the IC-725's lack of serious QRM-fighting controls. The optional CW filter and the noise blanker are about it! There's no IF shift or variable-bandwidth control. In casual operation, these features are usually not missed, and leaving them out keeps the cost of the '725 down, but I would have used them if ICOM had included them.

The noise blanker in the '725 is a mixed blessing. In my experience, the noise blanker works well on *some* pulsed (ignition-type) noise, but does not work well on *any* type of atmospheric noise, with one exception: Sometimes, the blanker would *totally* eliminate the Soviet over-the-horizon radar ("woodpecker")—even a 20-over-S9 woodpecker! At other times, because of propagation effects or other influences, the noise blanker does little to eliminate the woodpecker. The really frustrating thing about the noise blanker is its annoying tendency to chop and distort desired signals. This, a side effect of limited dynamic range, is commonly caused by noise blankers.

A 10-dB-gain preamp and a 20-dB attenuator can be switched into the receive line. The attenuator is useful in taming extremely strong signals. (The IC-725 has no RF-gain control.) Especially useful on 15 and 10 meters, the preamplifier really perks up marginal signals. Using the preamp at lower frequencies, however, usually causes more trouble than it is worth in terms of degraded strong-signal-handling capability.

The IC-725's audio output is a booming 3-plus watts into an 8-ohm load. That's power to spare—perhaps too much for fixed-station operation. The rig's audio-gain control is quite touchy. Rarely did I have to turn the knob past 9 o'clock (that means ¾ of the knob's range is never used!). I had a difficult time trying to find just the right setting for the AF-gain control with the internal speaker—it was nearly always a bit too high or a bit too low. Perhaps a more linear AF-gain control, or the use of an external speaker, would provide better performance.

Switchable AGC (fast or slow) adds to the IC-725's flexibility, although I did not notice a great deal of difference between the fast and slow settings. The AGC switch does not function in FM mode.

The Transmitter

Power output for the IC-725 is the industry standard 100 W PEP (40 W on AM with the optional UI-7 AM/FM unit). The review unit put out as much as 140 W on 12 meters, although our lab engineers are quick to point out that the '725's IMD performance is specified at 100 W output, and, according to ICOM, exceeding that level will degrade the unit's IMD performance and may damage or destroy the final-amplifier transistors. It's easy to reduce the IC-725's maximum power output, though.

The '725 has a transmitter-drive control. CW and SSB output power typically can be varied between about 10 and 100 W. That the '725 would not put out less than 10 W was a surprise to me; as an avid QRP operator, I expected the IC-725's output to be much less at the low end. Fortunately, the rig's minimum and maximum power output can be adjusted by means of separate internal controls. The locations of these potentiometers (R208 and R210) are shown on p 31 of the IC-725 owner's manual. The review rig is now set for 5 W at the low end and about 95-105 W at the high end. It takes only about 10 minutes to make these adjustments; all you need is a Phillips screwdriver for the bottom-cover screws, a slot-head screwdriver for the adjustments, a CW key, a dummy load and a wattmeter.

The broadband nature of the rig makes it easy to tune up—if that's the right term! Simply adjust the **RF PWR** control to obtain the desired power output and you're all set. For SSB or AM operation, you'll have to set the mike gain control to the point where the ALC-indicator LED lights to its brightest level on voice peaks. This is not as handy as having a separate meter scale for measuring ALC levels, but the LED arrangement seems to work well.

The duty cycle of the '725 is not mentioned in the operator's manual, so as a general precaution I did not operate the rig key-down for very long. When operating RTTY, the rig became quite warm, even at 25 W output. Normal CW and SSB operation (50% duty cycle) doesn't generate much heat. The rig's quiet cooling fan runs during transmission.

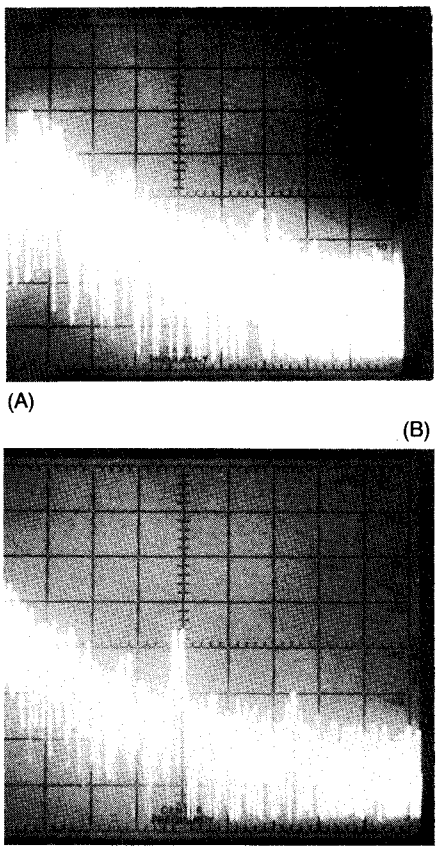

Fig 4—Spectral display of the IC-725 transmitter output during composite-noise testing. Power output is 130 W at 3.5 MHz (A) and 130 W at 14 MHz (B). Each vertical division is 10 dB; each horizontal division is 2 kHz. The scale on the spectrum analyzer on which these photos were taken is calibrated so that the log reference level (the top horizontal line on the scale in the photos) represents −60 dBc/Hz and the baseline is −140 dBc/Hz. Composite-noise levels between −60 and −140 dBc/Hz may be read directly from the photographs. The carrier, off the left edge of the photographs, is not shown. These photographs show composite transmitted noise at frequencies 2 to 20 kHz offset from the carrier.

The IC-725's CW shaping is good, and the transmit/receive turnaround time is fast enough to accommodate digital modes such as packet radio and AMTOR. The rig's semi-break-in circuits do not chop off the first CW character when switching from receive to transmit. The semi-break-in feature can be switched off by pushing a button on the rear of the '725. The break-in delay is also adjusted on the rear panel.

Owner's Manual

At 36 pages, plus a separate schematic, the owner's manual for the IC-725 isn't skimpy, but it's not too informative, either. Instructions for setting up the rig and those describing its operation are excellent—easy to read, logical, and supported by useful diagrams. The short section on maintenance and adjustment is limited mostly to instructions on opening the rig and installing optional filters and making minor adjustments. As I expected, the supplied schematic does not detail the '725's DDS circuit.

Accessories

Installing the 500-Hz CW filter gave me the perfect opportunity to look "under the hood" of the '725. Inside the rig I found three main circuit-board assemblies: one on the top of the chassis, one on the bottom of the chassis, and one just behind the front panel. Removing the top and bottom parts of the cabinet is easy, requiring only the removal of a few screws.

There are four main internal plug-in accessories: 250- and 500-Hz CW filters (only one at a time can be installed); the UI-7 AM/FM unit; the UT-30 programmable tone-encoder unit (it goes with the AM/FM unit); and the CR-64 high-stability oscillator unit. The installation of each of these units is a simple affair, completely illustrated in the manual. Installing the filter takes all of *five minutes,* start to finish.

The list of other accessories for the IC-725 is surprisingly extensive. Among them are the MB-23 carrying handle, the AH-3 automatic antenna tuner, the SP-7 external speaker, the CT-16 satellite interface, the IC-MB5 mobile mounting bracket, the CT-17 level converter and the EX-627 external automatic HF-antenna selector. The list goes on.

Operating Impressions

My satisfaction with the IC-725 varied over time: It depended greatly upon the type of operating I was doing. The '725 excelled during casual operation—it has a lot of things going for it: small size, a general-coverage receiver (that got a good workout on SWBC and nonbroadcast, nonamateur stations), and flexible, easy operation. The '725 worked well on RTTY and drove my 3CX800A7 amplifier without complaint. The rig never gave me a bit of trouble, and lived up to its design objectives in almost every way.

Still, I have mixed feelings about the '725. In addition to the *many* features and characteristics of the '725 that I like, it has several that I find disappointing. As I mentioned, I had a lot of trouble with the '725's receiver in strong-signal environments, like evening operation on 40 meters and during contests like the CQWW DX SSB event. That combination caused the receiver to generate a lot of garbage as it succumbed to strong, nearby (and sometimes not-so-nearby) signals, making copy difficult. The IC-725's receive-audio distortion and signal-intermod-with-noise effects limit the viability of the receiver during "CW narrow" operation.

The noise blanker's characteristic of blanking desired signals, and the extreme sensitivity of the **AF** gain control, made for a lot of knob turning and button pushing when I was trying to dig out the weak ones.

To be fair, I have to point out that the receiver maladies I experienced with the '725 (except the severe audio distortion) are common to other comparable rigs. Contests and evening operation on 40 meters in New England can be a challenge for any receiver!

All said and done, the IC-725 is a pretty neat little radio. It would make a fantastic mobile rig, and a nifty first rig. Actually, anyone but serious DXers and contesters will find the '725 to be extremely capable and easy to use.

The introduction of the IC-725 has certainly done one thing—it's made it darn difficult to choose between the latest entry-level radios. Even after using all of them I still can't make up my mind about which one I like best!

Thanks to Dave Newkirk, AK7M, for his contributions to this review.

Price class: IC-725, $950; 500-Hz CW filter, $77; 250-Hz filter, $74; AM-transmit/FM transceive module, $72. Manufacturer: ICOM America, Inc, 2380 116 Ave NE, Bellevue, WA 98004, tel 206-454-7619.

Feedback

☐ There's an error in Fig 3 of "Stable HEXFET RF Power Amplifiers," Technical Correspondence, *QST*, Nov 1989, p 39. As shown, the transformer acts as a step-up circuit, presenting an impedance of 200 Ω to the FET. To present the required 12.5-Ω load to the FET, the transformer should be connected as shown here in Fig 5.—*Tnx to Joseph C. Pinckney, WB2VNM*

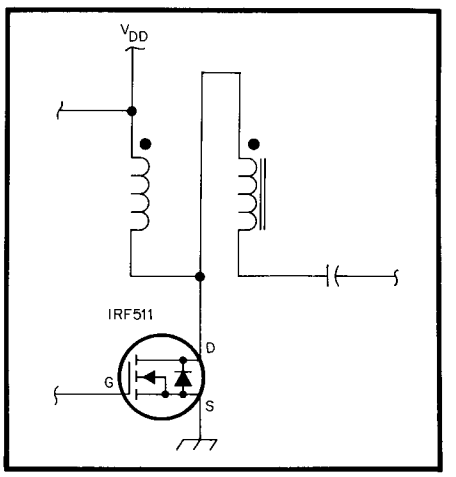

Fig 5—Correct connection for the transformer.

☐ In Fig 3 of "A Tester for Crystal F, Q and R" (D. DeMaw, *QST*, Jan 1990, p 23), the U2 terminal labeled **GND** should be **ADJ**, and there should be a 220-Ω resistor across U2's **ADJ** and **OUT** terminals. *(tnx Paul Parker, WB6DHH)*