HOLLOW STATE NEWSLETTER

"For lovers of vacuum tube radios"

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HSN is produced and published by and for the community of those who appreciate the fine accomplishments of the manufacturers of 'top of the line' vacuum tube communication radios and auxiliary equipment. Originally created by a group of R-390 users, *HSN* has expanded to include industrial, military and consumer grade receivers by Collins, Hammarlund, National, Hallicrafters and others. *HSN* includes tips, modifications, alignment and restoration advice, product reviews, parts, tubes and service sources, and subscriber buy/sell information - all provided by subscribers and friends of *HSN*. All articles and information shared through this newsletter may be reprinted only with permission of the author.

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EDITOR'S AND PUBLISHER'S CORNER

As I am assembling #37, I've taken a close look at my backlog materials for future issues and am not pleased with the amount, and especially the quality, of what's remaining. #37 has just about used up the rest of the 'good stuff' and new submittals have been abysmally scarce! Remember: *HSN* is **your** newsletter... and I print what **you** send me... so let's hear from you soonest! On another note, I'm looking into creating another 'selected reprints' (otherwise known as 'the best of') covering issues 1 thru 12 or so. Much of the earliest material has been superseded or is obsolete and it's probably *[continued on page 8]*

USING A FUNCTION GENERATOR TO SWEEP-ALIGN CRYSTAL FILTERS

Alan S. Douglas

There's nothing like a sweep generator for aligning IFs and especially crystal filters. The usual method of aligning for a peak only tells you nothing about the filter's skirts or symmetry; you can get there by plotting point by point across the bandpass, but to do a plot every time you twiddle an adjustment would take forever. With a sweeper, you can watch the bandpass change as you work.

Unfortunately most readily-available sweep generators were designed for TV servicing. They're apt not to go down to 455 kHz, and if you feed a higher-frequency signal into the antenna input, you'll have a hard time knowing just where the center frequency is (though if you have a crystal filter, you start wherever it happens to be, and align your IF to suit it, so you don't necessarily need to know the exact frequency).

A more serious problem with the TV sweepers is their sweep speed, always set by the line frequency, 60 Hz or maybe 30 Hz. Even 30 Hz is too fast for a sharp filter, and will produce a distorted passband display on the scope. If the weep works in both directions, as it will if it's a sine wave sweep, the two traces will not be superimposed; this is an indication that what you're seeing is not the true response. You can align a filter under these conditions, but it would be better to slow down the sweep.

One possible solution is to use a modern function generator as a sweeper. Most of these instruments will put out 455 kHz with a sawtooth (linear) sweep and will run as slowly as you want (the limit is CRT phosphor persistence). Oddly enough, you don't want to use the "sweep" function on these generators. This works by sweeping between fixed "stop" and "start" frequencies, while what you want is a fixed center frequency and variable sweep width around this center point. Then you can always find your center frequency by reducing the sweep to zero temporarily and reading a frequency counter. It also makes a alignment of the different bandwidths much simpler when you can instantly expand the sweep width to completely fill the CRT screen.

What you want is the "FM" function, modulated by a triangle wave. Since this sweeps in both directions, you can see right away if you're sweeping too fast for the filter bandwidth (the two traces will no longer be superimposed). And your center frequency always remains the same. Now it turns out that not every function generator has FM capability. One that does is the Hewlett-Packard 3312, a fairly popular model that sold for $1000 new (their current model is the 33120 - $1500). I haven't made a search to see what other currently-available models have FM, but lots of companies make function generators and there have been articles in the electronics magazines on homebrew ones, too.

I bought a Texscan VS-50 sweeper at a flea market that will sweep at low speeds and does work at 455 kHz. Some of their models will not go down to zero frequency (look at the main tuning dial before you buy) so beware; they were really intended for VHF.

THE RACAL RA.17 COMMUNICATIONS RECEIVER

Terry Robinson

This is an English-made receiver designed to receive frequencies within the range of 0.98 - 30 MHz. It's about the size of the R-390A but it weighs up to 44 kg for the 'table' model. The circuitry consists of 23 valves, arranged in a "Wadly-Loop" configuration. The receiver is constructed of die-cast aluminum,

except for the front panel which is constructed of 0.32mm steel. As in all such receivers, the RA.17 is designed to last for decades under all conditions. Technical details are as follows:

Valves: Crystal oscillator - 6AM6; Harmonic generator - 6AM6; RF amplifier - 6688; Harmonic mixer - 6AS6; First and second VFO's - 6AM6; 3 - 37.5 MHz amplifiers - 6AM6; First and second mixers = 6688; third mixer - 6BE6; calibrator - 6BE6; First and second IF amplifiers - 6BA6; IF output - 6BA6; AVC - 6AL5; BFO - 6AM6; Detector/noise limiter - 6AL5; Audio output - 6AM6; AF output - 6AM6; rectifier - GZ33 *(the rectifier valve was replaced by semiconductor diodes in later production runs)*

Frequency readout is by means of a "digital" dial (for MHz) and a 'film' scale for kilohertz. The scale is approximately 152 cm long with 15.25 cm corresponding to 100 kHz. There are dial markings every 1 kHz. The 'dial' is calibrated every 100 kHz and the pointer is moved horizontally with the aid of a milled cursor slide. The kilohertz dial is lit with two, easily obtainable, torch bulbs.

Selectivity: Six bandwidths are offered. They are, at -6 and -66 dB: 100 Hz/1.2 kHz, 300 Hz/1.7 kHz and 750 Hz/2.1 kHz (crystal). 1.2 kHz/7 kHz, 3/12 kHz and 8/19 kHz (L/C). Bandwidths of 5, 6.5 and 13 kH were available on the receivers I used.

Sensitivity: The sensitivity (for 20 dB S/N) is 3.5 μV (AM) and 1μ (CW). Not as good as the '390A, but not too bad for a receiver designed in 1957.

Stability: After a three-hour warm-up, < 150 Hz at a constant temperature. Later designs achieved < 50 Hz after only 1½ hours.

There are two AVC times - short = 25/200mS and long = 200mS/1S. AF outputs of 3Ω (maximum 50mW) and 600Ω (maximum 10mW) are provided. A tiny (6.35cmm) loudspeaker is located on the front panel. A meter on the front panel indicates input or output signal levels.

Brief circuit details: An input signal between 0.98 and 30 MHz is fed, via an RF amplifier (and a low-pass filter), to the first mixer (M1) where the signal is mixed with the output from a variable frequency oscillator (VFO1). This oscillator covers a frequency range of 30.5 to 69.5 MHz. When mixed with the input ranging from 0.98 to 30 MHz, an output in the frequency band 39.5 to 40.5 MHz is obtained from M1. This band of frequencies passes thru the first IF bandpass filter.

The output from a 1 MHz crystal oscillator is connected to a harmonic generator. The harmonics derived from this stage are passed thru a 32 MHz low-pass filter and mixed with the output from VFO1 in a mixer stage (M4). This mixer provides an output at 37.5 MHz which is amplified before being passed thru a bandpass filter tuned to 37.5 MHz with a bandwidth of 300 kHz.

The first IF is mixed with the 37.5 MHz output in Mixer M2 to provide an output in the frequency range of 2-3 Mhz (second IF). VFO drift, within the limits of the 37.5 MHz filter bandwidth, does not affect the frequency stability of the receiver. A change in this oscillator frequency will alter the frequency within the first IF to the same extent and in the sense as the nominal 37.5 MHz output of the band-pass filter, the third and final IF of 100 kHz.

In use: The kilohertz knob has a silky, but dead, feel that puts the stiff R-390A gears to shame! Despite

the "poor" sensitivity figures I quoted earlier, the receiver is probably as sensitive as the R-390A. Connected to a good aerial, it is able to receive transmissions that most hobbyists (with their non-professional receivers) can only dream about. I've been told that the RA.17 is more sensitive than the R-390A but where the latter wins is in the tuneable front-end. Racal had to design band-pass filters for the RA.17 because of cross-modulation effects, etc. Audio quality is 'rough' (maximum distortion = 5%) - here, the R-390A wins hands down!

The SSB performance is abysmal. An adapter is required. The R-390A is superior. Adapters were also available to extend the coverage down to 10 kHz. Unfortunately, because of the final IF, only Racal adapters can be used.

The receiver is more difficult to service than the R-390A. The 'sub-chassis' type of construction is sorely missed. However, the front panel (and associated knobs) is particularly easy to remove. And the lack of all the R-390A gears helps. After a great deal of searching, we were able to obtain a manual from: Mauritron Technical Services, 8 Cherry Tree Road, CHINNOR, Oxfordshire, OX9 4QY, England. It's not nearly as comprehensive as the military ones but the photos of the interior are large and detailed. Many 'typos' were seen - doesn't anyone check these things? The reprint quality (a photocopy) was only fair.

Overall, the Racal RA.17 is an excellent set, but the R-390A is better!

HQ-180 SERIES RECEIVER SENSITIVITY TEST

Dallas Lankford

Here is an easy test to determine if your HQ-180 series receiver is performing well with regard to sensitivity. This test is similar to a test described in the NAVSHIPS 1970 manual for R-390A's. The basic idea is to use the built-in 100 kHz crystal calibrator as a standard signal source, and the S-meter as an indicator of sensitivity. The problem with this method for '180's is that there were at least four different S-meter circuits in various production runs of '180's, and that S-meters in individual '180's can be set to have different sensitivities. Fortunately, the AVC voltage is approximately uniform for all '180's in my experience, so that you can use a high impedance DC voltmeter (10 megohms or higher) to do the initial test, and calibrate your individual S-meter. It is not necessary to remove your '180 from its cabinet because the AVC voltage can be measured at one of the rear accessory sockets - consult your manual for the correct socket and pin location.

Control settings of your '180 can significantly effect readings, so be sure to take readings with controls set according to the chart following. Attaching an antenna or ground can substantially lower readings while using narrower bandwidths or UPPER or LOWER can greatly raise readings, e.g., in the 1 kHz bandwidth, AVC voltages on the lower bands can approach -10 volts DC. Remember that AVC voltage is negative, and connect your voltmeter accordingly. I generally connect the negative lead of my voltmeter to the receiver ground, the positive lead to the AVC line, and use the reverse polarity setting of my voltmeter. (Oops, out of order: the AVC SLOW and MEDIUM setting also effect AVC voltage.)

This test will often detect "bad" tubes which will test good on a tube tester. If the AVC voltage is not at least -6 volts DC, I would strongly suspect one or more bad tubes. I found a "bad" tube in one of my

'180's using this test, and when the tube was replaced, the '180 had much less overload problems. In fact, I would suspect that much of the '180's reputation for overloading is caused by "bad" tubes which test good on tube testers. Speaking of tubes, it is worth the effort to locate and buy seven and nine pin tube pin straighteners. GC makes a good, inexpensive 7/9 combination tube pin straightener. If you have never used one you will be pleasantly surprised. Tubes go back into their sockets much easier with straightened (aligned) pins. One more thing - I generally set my '180's S-meter so that the strongest signals give maximum S-meter readings. For late model '180's this is about 60 dB over S-9, and in earlier models about 45 dB over S-9. The S-meter readings in the chart below are for late model '180's. Finally, the test is really not correctly named because reading depend not only on the RF, MIXER, and IF circuits, but also on the 100 kHz crystal calibrator, AVC, and S-meter amp circuits. So when replacing tubes to try to bring readings up to where they should be, don't forget to first try replacing the 6BZ6 100 kHz calibrator, the 6BV8 and 6AV6 tubes of the AVC circuits, and the 12AU7 meter amp tube. When replacing tubes, first try replacing one tube at a time. This usually succeeds, but when more than one tube is "bad" you may have to replace two tubes at a time in all combinations, three tubes at a time in all combinations, etc., until you cure the problem. As the '180 manual states, "weak" or "bad" tubes are the cause of the vast majority of '180 receiver problems. And the test I have described here is often the only way to determine and cure such problems.

SENSITIVITY TEST

Controls must be set as follows for the sensitivity test:

NOISE LIMITER - OFF
AVC - FAST
SEND/RECEIVE/CAL - CAL
AF - comfortable listening volume (use either speaker or headphones)
RF (gain control) - fully clockwise (white pointer about 6:30 o'clock)
BANDSPREAD - 100
SIDE BANDS - BOTH
SELECT KCS - 3
AM/SSB/CW - AM
VERNIER TUNING - 0 (red pointer at 12 o'clock)
BFO - not applicable
SLOT FREQ - +5 KCS (red pointer at 9 o'clock)
TUNING RANGE MCS (band) - per chart following
MAIN TUNING - per chart below
ANTENNA (trimmer) - adjust for maximum S-meter reading

NO ANTENNA OR GROUND CONNECTED TO RECEIVER

For more accurate determination of sensitivity test, connect a FET VOM or other high impedance voltage measuring device as follows: positive lead to pin 2 of rear socket (AVC voltage), negative lead to ground screw on antenna terminal of receiver, set to DC voltage 10 volt maximum scale, and set reverse polarity switch to reverse (AVC voltage is negative).

HQ-180 SERIES RECEIVER SENSITIVITY TEST - SETUP CHART

BAND	MAIN TUNING	S-meter readings in dB over S-9	AVC voltage (negative)
1	0.6	about 60	6.4
1	1.0	about 60	6.6
2	1.1	about 60	5.0
2	1.9	about 60	5.5
3	2.3	about 60	5.9
3	3.8	about 60	5.8
4	4.4	about 60	5.2
4	7.6	about 60	5.8
5	8.8	about 45	4.2
5	14.7	about 50	4.4
6	17.3	about 5	2.5
6	28.8	about 10	2.8

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QUESTIONS AND ANSWERS FROM OUR READERS

This section will present questions from subscribers for which responses are solicited. If you can help in providing answers, suggestions or just plain good advice - please send them to the editor for inclusion in the next issue of HSN.

Ans. In response to George Ross' RF amp tube question in #36, veteran member Alan Douglas sent me some material on low RF tubes from the Feb 1966 *QST* (which, of course, I can't reproduce here). Alan also comments: "The 6EH7 seems to have been the preferred tube. It would take a socket change or an elaborate adapter to use one in the R-390A, and I've never tried it. I did use some of the others (6GU5, 6GM6, 6JK6) following suggestions in the June 1991 *Electric Radio*, but was not at all impressed; performance was little if any better, and the carrier-level meter calibration was all screwed up. I went back to the 6DC6. Incidently the recommended mixer modifications were even worse, severely degrading the off-channel signal rejection, and I went back to the stock mixer circuit, too. This was in a 1956 Motorola, checked in a 1954 Motorola by using plug-in adapters for the mods. Later contract R-390As might, of course, perform differently."

??? I have yet to hear of an SP-600 under serial 1130, and the next number is 3488. Where did all the early SP-600's go? [Alan Douglas]

SHORT SUBJECTS

PTO LINEARITY - 51J3 VS R-390A [Wally Chambers] The difference in linearity between the 51J3 PTO and the R-390A PTO comes down to one outstanding difference - the R-390A PTO has been cooked to death by the 45-watt heater that surrounds it (the heat loss from the R-390A PTO operated at a temperature of 100 o F surrounded by 0 o F in the lower R-390A chassis area is about 14 BTU/hr. The heater generates about 154 BTU/hr - if the thermostat sticks, the PTO can go up to 800 o F at room temperature.) The heat from this oven physically distorts the coil form. The heat also vaporizes the grease and oil in the two internal bearings, especially the exposed bearing down in the coil. When you open an R-390A PTO you will notice the oxidized oil deposited on everything. On the other hand, an opened 51J3 (or R-392) PTO, the surfaces will all be bright and new looking. Most R-390A's that I have seen are off by 4 kHz to over 16 kHz. You can adjust the end point but the PTO will still be far from linear.

I strongly believe that the oven should be removed from the R-390A PTO whenever you work on it, otherwise the PTO may be damaged by the accidental engagement of the heater switch. The best thing for HSN readers to do is cut and tape the heater switch wires at the rear of the chassis.

STRAIGHTENING A BENT R-390A KCS CHANGE SHAFT [Shawn Merrigan] An R-390A purchased "as is" from Fair Radio had a bent KCS (vfo) change shaft which wobbled visibly when rotated. This caused binding at the bushing in the gear plate and at the front panel bushing. The result was a hard to turn KCS change control. I could have simply loosened the front panel bushing lock nut slightly, allowing the shaft and bushing to float, but I decided to do the right thing and replace the shaft. This is a fairly straightforward job, but there are a couple of things to watch, and keeping them in mind will help:

1. A taper pin indexes the dial lock hub and gear to the KCS change shaft. This pin has to come out to remove the shaft. Drive the pin out from the narrow side! This is a small taper pin.
2. A larger taper pin holds the ten-turn stop assembly on the KCS change shaft. This pin must also be driven out from the narrow side. Look for the smaller of the two holes in the ten-turn stop end block (looks like a big thick washer) and drive the pin out from that side.
3. When driving out the pins, particularly the larger one, counterbalance the shaft with a large mass so you will not bend it. Use WD-40 to loosen the pin and tap gently.

In fact, I wound up straightening out the old shaft using machinist's V-blocks and a brass drift. I then polished the shaft to remove any burrs and blew out the taper pin holes with WD-40 to prevent binding. The runout of the straightened shaft was very small and, after re-assembly, there was no binding evident and the shaft turned smoothly.

R-390A PTO PARTS CHEAP [Shawn Merrigan] A good source of mechanical parts to repair an ailing R-390A PTO is the much cheaper T-195 VFO ($10.95 from Fair Radio); not all parts are directly interchangeable, but many are. I had a Motorola PTO which had very poor resetability, and was very jumpy when fine tuning. I came to the intuitive conclusion that the spring holding the follower assembly to the compensation stack was probably gone (this was found to be correct upon examination). When I opened up the PTO I found that all the mechanical parts were very badly corroded; the rubber o-ring at the top end of the can was so brittle it snapped into several pieces when I tried to remove it! Obviously the seal had gone years before and the salt air had done its damage. Well, I had a spare T-195 unit so I decided to see what parts I could put into the Motorola, just to make it useable. As it happens, the front and rear bearings fit right in, the o-ring fits, and the compensation stack roller assembly fits. You have to do a little work to get the old assembly off the slug and put the new one on, but it can be done. In fact,

I removed the compensation stack from the T-195 and tried it in the Motorola. It fits fine, but it is slightly longer than the Motorola, so you have to drill a hole in the aluminum member that the stack is attached to in order to mount it. I did this on a drill press to get a reasonably accurate hole. The rear plate (that mounts the rear bearing) bolts right in, and even has a hole to loosen the correction stack lock stud. The thread pitches of the two threaded shafts are different so the slugs cannot simply be swapped; this would change the inductance anyway, so you are better off to change the follower assembly as mentioned before. The quality of the parts in this T-195 unit was excellent and they were like brand new. After putting the whole thing together, I was pleasantly surprised at how well it worked. There is an endplay problem with the threaded shaft that results in some resetability troubles, but I feel this could be taken acre of by using the correct shims on the shaft. My main point in doing this was to see if an otherwise useless PTO could be made to function. With a bit more effort I could probably bring it up to spec.

PUBLICATIONS OF INTEREST

Nothing new this issue ... but we're always looking for your contributions.

WANTED TO BUY / SELL / TRADE / WHATEVER

This section is reserved for HSN subscribers in good standing (i.e., you're paid up according to Ralph) looking to connect with HSN readers for mutual benefit. All deals are between individuals; HSN does not evaluate the accuracy of any statements or claims herein. No 'business' ads, please. Items printed will be on the basis of available space. **Please send all 'ads' to the editor - Ralph just passes them on to me!**

WANTED - Hammarlund HC-10 converter in excellent or better condition. [Rick Krzemien; (510) 687-2719]

FOR SALE - 6688 tubes in military boxes, $2 each. Also an HC-10 cabinet, panel & chassis in decent shape, cheap if you've got a creative use for it. And two Sideband Slicers, an A and a B; offers entertained, reasonable or otherwise. Letters preferred over phone calls. [Alan Douglas, Box 225, Pocasset, Mass. 02559]

EDITOR'S AND PUBLISHER'S CORNER (CONTINUED)

time for a general housecleaning. Of particular interest is obtaining current sources of /URR manuals and reprints. If you know of current sources for the R-388, R-390A, R-392, SP-600 and other military gear manuals or you are willing to sell photocopies of your own manuals, please drop me a line. With the continuing aging of these venerable receivers, and the general tendency for suppliers to recycle stuff that isn't moving, the manual source issue isn't getting any better. Your assistance will be appreciated. And once again, my new phone number is (360) 786-6756. Prepaid, early evenings only please... otherwise leave a message and I'll get back to you ASAP.

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