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**. See page 8 for submissions, disclaimers, reprinting, copyrights, subscriptions, reprints, and the Editor's and Publisher's Corner.

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CALIBRATION OF THE COSMOS PERMEABILITY TUNED OSCILLATOR FOR THE R-390A

(Reprinted with Permission from Electric Radio Magazine)

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----Part 2 of 2----

To help visualize the corrector mechanism, picture if you will a Teflon disk laid onto the front face of the PTO. This disk acts as a cam. A cam follower contacts the slug of the third coil. The corrector disk rotates through a reduction drive as the PTO is advanced its ten turns. Under this disk is a series of screws which are laid out in a staggered fashion all along its circumference, forming a circle. The flat heads of the screws, which are adjusted to varying heights in close proximity to their neighboring screw, make up a (typically uneven) surface upon which the flexible Teflon disk rests. As the screws are adjusted in or out, the Teflon disk (formerly and initially flat) is shaped into a wavy surface (a cam) upon which a cam follower rides. You've seen the kiddy motorcycle rides at the carnival where the miniature vehicles go round and round, and also make a gentle up/down motion on the wavy surface of the merry-go-round floor. It is this slight vertical displacement of the vehicles that is analogous to the in/out motion of the core in the compensating coil as the PTO shaft is turned.

Calibration of the PTO

Note: One should refer to the R-390A service manual before attempting to service the PTO, and should be experienced with either R-390A or other Collins designs.

The two things needed to calibrate the PTO at 25 Kcs points are 1) an accurate means of measuring frequency, and 2) an accurate means of turning the PTO shaft exactly 90 degrees at a time. The author uses a frequency counter to measure the PTO output, and the Veeder-Root counter in the radio to measure the turns of the PTO. When using the radio's Veeder-Root counter to measure turns, take the time to tape exposed 120 VAC power and fuse connections to prevent electrical shock while performing the more than 40 PTO remove/install maneuvers. The frequency counter may be connected directly to the output connector of the PTO. A handy crossover connector from the mini BNC fitting to BNC can be found on the back bulkhead of the radio. Simply borrow the adapter that is present at the IF output jack. There are many alternatives to using the radio frame to measure turns, including using a sacrificial R-392 frame (credit Wally Chambers, K5OP), and various schemes featuring calibrated knobs.

Setting the endpoint on a Cosmos PTO is similar to the Collins PTOs. Test the PTO to see how many turns it takes to achieve an output starting at 3455 Kcs and ending at 2455 Kcs. Most aged PTO's that have not been recalibrated will typically require an additional 1-15 Kcs past the ten-turn mark to achieve the proper range. To bring it back to 1000 Kcs output in ten turns, adjust the endpoint screw (usually clockwise). If the proper output cannot be achieved within the adjustment range of the endpoint screw, one must open the PTO and remove one turn from the endpoint adjusting coil (item 32, Fig. 1). This change in overall inductance of the coil will bring the endpoint back 7 Kcs or so. Once this is accomplished, setting the endpoint can usually be achieved with the endpoint adjustment screw. While the PTO is open, the lead screw and bearing can be lubricated. The author usually takes this opportunity to bake an open PTO in an oven at 150F for several hours to dry it out and regenerate the desiccant. Perform the calibration only after baking, and keep the PTO in a zip lock bag if you plan to leave the adjustment window screws open for an extended length of time.

To enable linearization, the author finds it best to set the desired point on the Veeder-Root counter, and then physically uncouple the PTO from its coupler, tilting it up to access the adjustment screws. The screws are very small, and this technique will make insertion of the screwdriver onto the screw head true with minimal fuss. The steps for checking a calibration point are as follows:

1. set the Veeder-Root Counter to the desired calibration point (ex: 000).
2. note the frequency output and error, and record both on a calibration chart (ex: 3456 kcs, +1 kcs error). An example calibration chart will be developed below.
3. uncouple the PTO and tilt it up to access the adjustment screw (note this may jostle the output reading a bit, don't worry about that).
4. adjust the screw to remove the error (ex: -1 kcs, regardless of present reading which may have been jostled due to PTO uncoupling maneuver).
5. re-couple the PTO, and go to step one, adding 25 kcs to the Veeder-Root counter reading.

When setting the 25 Kcs calibration points, it is extremely important that the screw being adjusted is directly lined up behind the adjustment window. This need be checked only once, on the first screw being adjusted (the 25 kcs increments for the remaining screws will line them up automatically). To accomplish this proper starting point, set the PTO shaft such that the output is 3455 kcs. Then simply rotate the PTO shaft slightly (left or right in 5 kcs increments) until the screw nearest the window is lined up with the window. Note the indication on the frequency counter as a starting point for your calibration chart. The reason the initial starting point for the first screw is so important is that the cam follower which rides on the compensating cam is directly behind the window, and will thus be directly under this screw at this point. If

this caveat is not followed, apparent adjustment can still be made, but there will be interaction between the point that one is attempting to adjust, and its two neighboring points. This will yield poor results and will be very frustrating. Be advised that if the screw being adjusted is directly behind the window, the PTO position will likely not be at an exact 25 Kcs calibration point on the Veeder-Root counter dial, e.g. 000, 025, 050, etc. This is not a real problem, but it will be necessary to shift the starting point of the 25 Kcs check points (and the calibration chart) by 5, 10, or 15 Kcs up or down. Simply remember that the PTO must have an output of 3455 Kcs at dial indication 000, and 2455 Kcs at dial indication +000. Armed with this information, one can make a spreadsheet calibration chart for all 40 (or 42 if you prefer some lagniappe on the ends) calibration points in 25 Kcs increments. An example chart might look like this:

Frequency (Kcs)	Veeder-Root Counter	Error (Kcs)
3465	-010	
3440	015	
3415	040	
3390	065	

And so on . . . . . for 40 to 42 calibration points

The above example is for a PTO that has the nearest linearity alignment screw falling at a frequency of 3465 Kcs on the frequency counter. This corresponds to a starting point on the Veeder-Root counter of -010. Note that this starting point is not on an even 25 Kcs point, but that is OK as it is most important to start with the nearest screw directly lined up with the adjustment slug at the center of the window. To complete the chart, subtract 25 Kcs from the frequency counter reading and add 25 units to the Veeder-Root counter for each point out to or past (less than) 2455 Kcs.

Each screw will have an adjustment range of about 5 Kcs +/-. Clockwise rotation of the screws will reduce the PTO's frequency output at a given checkpoint. One should avoid adjusting the screws to near their full clockwise position as this will cause excessive drag in the PTO.

<u>Advanced Procedure for the Stout Hearted</u>

To remedy problems with excessive drag due to adjustment screws reaching their clockwise limits, back all of the adjustment screws out to their counter-clockwise stops, and then turn each screw one turn clockwise. This will give the cam an initial flat shape. Start PTO calibration at the point nearest 3455 Kcs as described above, moving up the dial (down in PTO output frequency) to 2455 Kcs (+000 on the Veeder-Root counter).

Remember to check each calibration point against the frequencies on the calibration check chart you made (it is not hard to get 5 Kcs off). Some check points may require a touch-up calibration after completion of the first pass. This will be especially true if the PTO calibration was re-started with the cam in the initial flat position as described above. Extreme adjustment changes (greater than 5 Kcs) at any given point may cause output changes at neighboring points. These can be worked out with multiple checks and further adjustments at problem checkpoints.

With this linearization procedure, it is possible to obtain checkpoint accuracies of +/- .100 Kcs with an initial dial calibration at 000 using the crystal calibrator. This exceeds the specifications listed in MIL-R-

13947B which require a +/- .300 Kcs with a dial calibration at the nearest 100 Kcs check point using the crystal calibrator.

In conclusion, the reader should be left with these points.
- the Cosmos PTO can be calibrated for both endpoint and linearity with the PTO cover in place.
- calibration can be done at 25 Kcs points, typically exceeding military specifications.

References:

- *Military Specification MIL-R-13947B, "RADIO RECEIVER R-390 ( )/URR", 26 October 1960*
- *TM 11-5820-358-35, "Field and Depot Maintenance Manual, Radio Receiver R-390A/URR", pp. 107-108.*
- *"Serially Connected Course and Fine Inductors with Continuos Adjustment", U.S. Patent number 3,098,989 awarded to Metzger and Goodman, 23 July 1963.*
- *Discussions with Wally Chambers, K5OP, Memphis, Tennessee, USA.*

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.

Nothing this issue

SHORT SUBJECTS

RESTORATION TOPICS – RESISTORS

Geoff Fors, PO Box 342, Monterey CA 93942-0342

Here's a topic you sure won't read much about in the few books and articles on vintage radio restoration. Quite a few of the vacuum tube receivers currently in use are now over fifty years old, and it's unwise to take many of the original parts for granted. Most people will replace leaky paper/wax capacitors and any weak tubes, but unless a resistor looks blackened or charred, the first time it actually gets tested is when the receiver continues to malfunction and tedious voltage measurements eventually lead the troubleshooter to it.

Unfortunately, the cheapest grade of carbon composition resistor, universally used up until the 1980's, has a nasty habit of changing value with age. Resistor manufacturers knew this at the time, and offered various grades of quality as well as closer specifications of tolerance, at corresponding increases in price. This was one area where the radio manufacturers could be counted on to scrimp; not many of them expected their products to still be around even twenty years later and fewer even cared! By the way, don't think because you have Collins gear you have been spared this problem; time has shown that resistors used by Collins can be just as bad as anybody else's!

Fortunately, such resistors nearly always change upward in value as they age, and Ohm's law comes to our rescue by allowing us to rapidly check nearly all of them without even disconnecting them from the circuit. It's fastest to use a digital autoranging multimeter directly across each resistor. We're looking for resistors higher than their marked value, beyond their rated percentage tolerance, especially ones considerably higher. Resistors above about 100K are the usual suspects. What about all the parts wired in that circuit along with the resistor, you ask? Ohm's law tells us that the only things that can affect our

readings are components in parallel with our resistor, so to start with, forget about whatever is in series with it. And as far as what is in parallel with it, we know that resistance added in parallel only gets lower in value, absolutely never higher. Therefore, if we measure a resistor in circuit, and it reads quite a bit higher than the marked value, it has to be bad, regardless of whatever else is wired in electrical parallel with it.

This testing routine can occasionally trick you, though. Resistors across inductors will give you a reading of nearly a dead short and can't be measured this way. Sometimes electrolytic capacitors will be charged up by your ohmmeter and then discharge through a different resistor when you measure that one, causing your meter to read higher than the actual value, but these situations are not common and can be recognized by an unstable, moving meter reading. With practice, you'll be able to notice when this is happening, and when you need to lift one lead of a suspect resistor to make sure it is satisfactory. It's possible to check almost every resistor in a receiver this way in a reasonable amount of time, and you'll often find faults which could have taken hours of frustrating traditional dynamic troubleshooting and voltage measurements to locate. It's also quite useful in repairing equipment without a schematic or service data, such as foreign sets. You may be surprised at how many "bad" resistors you will find, even in “mil-spec” equipment.

Replace any bad resistors with modern carbon film or metal film types, which do not drift and are far more accurate as well. These seem to be smaller than their composition ancestors for a given power rating, so wherever possible try to use a replacement of at least the next power rating. Even the modern 1-watt resistor has a voltage rating of only 500 volts, while the1/2 watt types are only rated to 250. You did know that resistors had voltage ratings, didn't you? Take a look at the amateur radio gear built in the 1950's and '60's and you'll see how many design engineers apparently didn’t!

Another thing to watch out for is the drifty carbon composition resistor. These can measure within tolerance, but as the equipment warms up, the value starts sailing upward, and all sorts of weird things result. I once had a Hallicrafters amateur receiver in which the S-meter would never stay zeroed. Zero it when the set was first turned on, and half an hour later, it would be resting at half scale. Reset it then, and the next time the receiver was used, the needle would be jammed against the left peg for the first half-hour. Drifty resistors in several spots along the AVC line were the culprits. By the way, don't overlook drifty tubes and bad capacitors of all types when this problem occurs. To check for a drifty resistor, leave the ohmmeter across it and heat it up slightly with a hand held hair dryer. You'll find that most carbon composition resistors drift somewhat, so it's a judgment call as to what is too much. I routinely replace all of them in the AVC circuitry with modern metal film types.

Finally, it often pays to check composition resistors for noise, using a signal tracer that offers a noise testing function. These place a high voltage across the resistor through their probe tip while amplifying any noise produced by the component. Ideally, everything should be silent, but you might be surprised how many composition resistors sound like a frying pan full of bacon!

I've found that the old radial lead “dogbone” resistors of the 1920s and ‘30s have held their values much better than the postwar “modern” carbon composition resistor. To be fair, many of those 1930's “dogbones” were actually metal film types. In any case, don't discard any of the old “dogbone” types should you find them out of tolerance. Instead, repaint them with their new value and put them back in the “antique” parts bin. This would have been heresy twenty years ago, but you can't buy that style of resistor anymore and someday they may turn out to be just what's needed for a perfect restoration.

EASY R390A AUDIO MOD

by Chuck Rippel - WA4HHG
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Some of you may know that I restore R390A receivers as a hobby. Here is an easy "soft " (reversible) modification that I came up with that really improves the R390A audio by mellowing it out a bit.

The audio tubes, V602A and V603 are coupled with 300V, .01mfd "Vitamin Q" type capacitors. These have been found to leak causing distorted audio. The values are also tending to make the audio amplifier somewhat restrictive. Changing these to .022 (or even .47 or .5 mfd) 400V (min) Sprague Orangedrops improves bass response and the increased voltage rating coupled with modern construction helps to keep the leaking problem from re-occurring. Do NOT use disc ceramic capacitors!

Parts needed:

3- .022mfd @ 400V Sprague Orangedrop Capacitors
1- 560 ohm, 2 Watt resistor

Unplug the receiver and remove the bottom cover. Locate the audio sub chassis (it's on the bottom of the radio and has 5 tubes on it). Remove the audio chassis by pulling off the 2 modular plugs and loosening the 4 green captive Phillips screws. Lift the audio chassis onto an appropriate workspace and turn it upside down. There is a 2" wide circuit board which runs 2/3 the long length of the audio chassis. Locate C-601, C-604, C-605 and R-614 that are mounted on that pc-board. Remove the two screws holding the board to the audio chassis then fold it with the cables off to the side in order to expose the bottom of the board.

Remove C-601, .01 mfd 300v Vitamin Q
Remove C-604, .01 mfd 300v Vitamin Q
Remove C-605 .01 mfd 300v Vitamin Q
Remove R614 560 ohm 1 watt resistor

Replace C-601, 604 and 605 with the Orangedrop capacitors. Be sure to first make sure the capacitors do not take up too much vertical space and not allow the audio deck to properly seat in the main chassis. If space is a problem, try mounting the capacitors on the opposite side of the pc board from which they were removed. This is especially true if you use .47's or .5's or when using 600V capacitors.

Replace R614 with the 560 ohm 2 watt resistor.

Replace the PCB, put the audio chassis back in the receiver and re-assemble the radio.

During operation, you will immediately notice that there is a more mellow sound to the receiver. This is due to the increased bass response allowed by the larger value capacitors. If you check the 560-ohm resistor, R614, you will probably see that it has changed value going higher in resistance. I have seen them go to 700-800 ohms. The receiver can be put totally back to "stock" in a matter of minutes by simply reversing the process.

BRISTOL OR BRISTO? MYSTERY SOLVED – *Geoff Fors* HSN readers have wondered in past issues why military manuals refer to the splined wrenches used in the R-390 series and most other military gear as "Bristo" wrenches while other references call them "Bristol". I did too, and finally found the answer in the original manufacturer's 1944 advertising. The design, intended to eliminate stripping common with conventional 'allen' hex-key socket screws, was created by the Bristol Company, Mill Supply Division, of Waterbury, Connecticut. Bristol called its unique product a "Bristo" multiple spline socket set screw, dropping the "L" off the end of the company name. So those military manuals aren't really misprints after all; "Bristo" screws were made by Bristol, and either term is technically correct.

PUBLICATIONS OF INTEREST

R-390A Video Set –A Review

HSN #43 contained a short blurb on the recently released R-390A video tape set from Hi-Res Communications. Subscriber and frequent contributor, Les Locklear, has provided us with his review ...

What has 4 video tapes and is 7 hours long? The R-390A video tape set. This video featuring Chuck Rippel WA4HHG was produced and filmed by Floyd Soo W8RO for HI-RES Communications, Inc. This company has also produced many videos for the Collins enthusiast.

The video set covers an enormous amount of information such as; "How to pick out a R-390A", "It's Modules", "Circuit Description", "Front and Rear Panel Details", "Mechanical and Electrical Alignment", "PTO's", "Performance Evaluation and Modifications", "Troubleshooting", and "Restoration".

What do you get for your money? Well, an incredible amount of information is discussed, much of it is "old hat" to those of us who are familiar with this complex receiver, but for the R-390A "novice" or someone considering purchasing one of these "Legendary Receivers", Chuck gives some very sound advice.

The camera work is beyond reproach, so clear that when showing removal of the anti-backlash spring on the Oldham coupler it becomes perfectly clear to the beginner on how easy much of the maintenance is to perform.

Many of the R-390A owners who have hesitated to attempt repairs on what can be an intimidating receiver might well be confident enough to "take the plunge". I would consider this video set a good learning-teaching tool.

Chuck explains many of the technical terms in plain language; this, along with the excellent audio makes what could be a very long and boring tape quite enjoyable.

Overall I would say that some improvements could be made, such as the section on PTO's. More information could have been shown on the linearity adjustments of the Cosmos PTO. I could not recommend any of the modifications that were in ER issues 25 & 26, but that might be nit picking. Yes, it's long, but necessarily so, with a receiver this complex it could not be done in much less time considering the subjects covered.

So, get the popcorn, cold drinks and a notepad and enjoy what is a very professionally produced video. This video set is priced at $109.95 plus shipping and is available from:

Electric Radio
14643 Country Road G
Cortez CO 81321-9575
Phone/Fax (970) 564-9185
E-mail er@frontier.net

HI-RES Communications, Inc.
8232 Woodview
Clarkston MI 48348-4058
Phone/fax 248) 391-6660
E-mail hires@rust.net

HI-RES's web site is http://www.rust.net/~hires. You can order through this site, Visa and Mastercard accepted. Note: European users ... PAL versions are available – contact HI-RES for further information.

WANTED TO BUY / SELL / TRADE / WHATEVER

Wanted: WWII vintage RBB & RBC receivers (about 500 kc to 27 mc together) with power supply, good working condition, manual, close enough to pick up or meet at a Ham fest in or close to Virginia. [Jim Toney, POB 902, Williamsburg, VA 23187. 757-229-5853. tcltd@widomaker.com]

Wanted: Zenith 6s222, 5s126 or 5s128. Military BC-652, BC-653, SSR-1. R-398 front panel. [Gary Cain, W8MFL, 202 West 5th Ave. Shakopee, MN 55379. 612-496-3794]

EDITOR'S AND PUBLISHER'S CORNER

It's between Christmas 1998 and New Year's Day 1999 and, before tax preparation time starts again, I can finally find a bit of time to work on HSN and get this issue ready for print. Lately, much of what I am putting in the "Article Reserve" file is based on information posted on the Internet – either on the Boatanchors or the R-390 mail lists. There are also several excellent Web sites for the R-390A enthusiast – one of the best is Chuck Rippel's site at **http://www.avslvb.com/R390A/index.html** The technical section has a great list of articles including modifications and the historical section provides an excellent 'capsule' history of the R-390A. Chuck also handles some parts and does restorations as well (although his site says he's booked up for the next 8 months – maybe by the time you read this, his backlog will be smaller.) If you don't yet have a computer with Internet access and e-mail, you may have no idea how much information and help is out there!

Also note that there is a new Index available from Issue 1 through 45. See below.

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