Chapter 9 – Supplemental Repair Information Section 2

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R390A CARRIER LINE AND VU METERS

Carrier level substitute from Leed's Electronics in New York

From: DCrespy@aol.com Date: Wed, 6 Jan 1999 20:20:56 EST
Subject: [R-390] Meter Specs

The Carrier meter is a 1 mA movement, but the key to getting it to work is the internal resistance.. From HSN, I've heard that the movement should be 17 ohms. I have measured new and used ORIGINAL meters around 17 to 20 ohms. I have had good luck making 35 to 40 ohm meters work. I could not get the most common 100 ohm one to work well. The Line Level meter is a regular AC Vu meter. Harry KG5LO Saline MI

From: Will Schendel <n8azw@megsinet.net> Date: Wed, 06 Jan 1999 22:13:34 -0500
Subject: Re: [R-390] Meter Specs

I just measured four ORIGINAL used Simpson carrier meters that seem to work well, they read 17.3 to 18.0 ohms resistance. Hope this helps to confirm the meter resistance question...

From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net> Date: Thu, 07 Jan 1999 10:14:05 -0600
Subject: Re: [R-390] Rebuilding meter faces

You might tape everything back in place with magic tape. Then xerox onto fine bond paper, several copies and glue the paper to the scale with none rubber cement. I've not found the perfect glue. I do that for the scale of my rotator to get it south centered. Trimming the paper at the edge around the movement is very important.

From: dma@islandnet.com Date: Thu, 07 Jan 1999 14:27:08 -0800
Subject: Re: [R-390] Meter Specs

I came across this problem when attempting to make some very nice brand new black faced 1 ma meters work, and they didn't. I first thought that I had a problem somewhere in the meter bridge circuitry, but finally decided that the meters were the problem. I had connected an HP410C in place of the meter, on the 1.5 ma scale, and it behaved the way I would expect. My meters were too high a resistance to work properly. I did fiddle with the circuitry a bit to see if it could be made to work without making permanent changes to the radio. But I finally concluded that I didn't want to mess with this part of the radio because so much depends on it working the way the designers intended.

So what I've done to make the higher resistance meters work (purists should cover their eyes at this point!!) is make a tiny little amplifier and mounted it on the back of the meter. I use a garden variety op-amp and take the power from the high end of the dial lamp resistor. It has a small trimmer that can match the thing to just about any meter that fits the holes and can be easily set up. It's not ideal, but it isn't very visible (especially when the radio's in the rack!) and the Mark II version that I'll build one of these days will be very much less visible. I won't pay the prices asked for new exact replacements, and even the used ones I've seen have been pretty grotty for the money being asked. Anyway, sooner or later we're going to have to make a lot of compromises to keep these classics running! At least that's my story and I'm sticking to it.

From: dma@islandnet.com Date: Thu, 07 Jan 1999 14:37:07 -0800
Subject: Re: [R-390] Meter Specs- Addendum

>The Line Level meter is a regular AC Vu meter. >Harry KG5LO, Saline MI

Just a warning. I've come across a couple of different possible replacements for the line level meter. Both are calibrated as VU meters, but neither works exactly the same as the original. For the two types I found, the adaptation was simple - but it's probably useful to check before you buy.

From: Glenn Finerman <glennfin@mjet.com> Date: Fri, 08 Jan 1999 01:01:35 -0500
Subject: Re: [R-390] Meter Specs

I agree with you 100 percent on all points!. I refuse to pay the not so nice prices I've seen on replacements. And I don't want radioactive originals. That's why I'm looking into having some new replacements made. That may turn out to be just as expensive as what's out there now but I won't know till I try! I really like your Idea for the Op-amp board to make the higher resistance meters work. Do you know of a source for these meters? I thought I could just slap in any old 1ma meter as long as it fit.. Thanks for the education!

From: Barry Hauser <barry@hausernet.com> Date: Thu, 21 Jan 1999 00:29:50 -0500
Subject: [R-390] Meter Matters

This is to start/resume another thread.

There was some discussion of how to replicate R-390(A) meters. It was mentioned at some point that the impedance was critical on at least one of them, so that even a meter with the same nominal range won't work in the circuit.

Someone else posted an item about making up a batch of repro meters.

I noticed that Fair Radio has at least one meter that is cosmetically identical to the R-390 style. Also have the impression that the mechanics - -- particular the armatures on many meters appears similar in size over wide ranges of scales and meter display size. Is it possible to mix 'n match components to make up new repro's that are functionally compatible? (i.e., by swapping armatures and trimming pointer needles if necessary, etc.)

Also ... while they're small with very fine gauge magnet wire, it doesn't seem to be prohibitive to rewind armatures. The only other parameters would seem to be spring tension and flux density of the magnetic frame. Or am I totally off base here?

Black scales could be made on a laser printer on good quality paper and then laminated and trimmed. (As with the badge/luggage tag laminator I have for trade show purposes.) Or probably better -- sprayed with fixative, such as "Blair Spray Fix" made by Loctite. I have used that to make ink-jetted signs permanent and water resistant. It's available in semi-gloss and matte from art supply stores. Whaddaya think? Barry
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From: "Tom Roddy" <tcroddy@lightspeed.net> Date: Wed, 20 Jan 1999 22:32:42 -0800
Subject: Re: [R-390] Meter Matters

Replacement meters are among of those things for which I am always on the look-out. And this is one that I just haven't seen any for. At the risk of offending the purists, I have been looking for meters that are a bit easier to read. Yea, I'll keep the originals in case the BA Police come to inspect, but I'd sure like to put some nice white readable meters in their place. Maybe even lighted!

As far as making new face for meters, the inkjet printer is the perfect tool. I have made new faces on the inkjet and spray over the paper with "Workable Fixative", a product available at any blueprint supply house. Another product available there that gives a glossier finish is called "Crystal Clear". Back when our drafting room had real draftsmen using real pencils on real paper, these products were everywhere.

The information that has been given here re: impedance, etc., shows me that I will never stumble on a box of perfect replacements.

I know that Hammond made up a batch of audio output xfmrs for the BA guys, and to have someone make up a bunch of meters would be great. Both meters are electrically identical, right? So it's only the faces that are different. Are you ready guys -- how about one of the many small manufacturers in Hong Kong, Taiwan, Korea, etc. I know that there are skads of little plants like this, and they advertise for small jobs. Lighted meters would be nice. We can always keep the "real" meters in a safe place.

From: Peter Worrall <worrallp@syntegra.bt.co.uk> Date: Thu, 21 Jan 1999 14:51:13 +0000
Subject: Re: [R-390] Meter Matters*WARNING*****

THE TWO METERS ARE NOT ELECTRICALLY IDENTICAL
The line meter is itself a sealed unit accepting audio (alternating current)as its input..... It is scaled 'Volume Units- VU' and responds between about 10c/s to 20kc/s

The signal meter is a DC instrument with sensitivity and resistance as quoted elsewhere...I don’t have the prints I made of the mails to hand at the moment.

From: "A. B. Bonds" <ab@vuse.vanderbilt.edu> Date: Thu, 21 Jan 1999 09:00:47 -0600
Subject: Re: [R-390] Meter Matters

I don't think so. The line level meter is a standard VU meter, which is an AC meter. The carrier level meter is a DC meter.

From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net> Date: Thu, 21 Jan 1999 11:07:43 -0600
Subject: Re: [R-390] Meter Matters

There are a FEW meter mechanics in the world, though a dying breed with digital displays, who might change an armature. I've never run into any willing to rewind an armature. My experience has been that most who would attack a meter in more detail than changing the scale have good and bad days and on the bad days there' nothing but scrap produced. I've successfully replaced whole movements, straightened pointers and balanced meters, but not repaired broken pivots, hairsprings, taut bands, or windings.

The last time I approached a good meter mechanic for meter work, it was far less expensive to purchase a replacement movement than hire him to try to repair the broken movement.

As for swapping armatures, there's intimate interaction between armature torque (ampere turns) and spring strength. Lower resistance probably means fewer turns and a more delicate hair spring set.

When installing a paper scale its very important to use a paper that won't yellow and an adhesive such as photo mounting spray that won't accelerate the yellowing.

All which is to say that reproduction meters with special movement resistance may be possible, may almost be practical, but almost sure won't be cheap.

From: "Richard McClung" <richard_mcclung@tcibr.com> Date: 21 Jan 99 09:23:23 -070
Subject: [R-390] METERS

The best I can come up with:

The Line level meter is:
A1A34M101
Ammeter
SM-C-283216 (80063)
OLD FSN: 6625-510-1815

The Carrier level meter is:
A1A34M102
Voltmeter
SM-C-283217 (80063)
OLD FSN: 6625-669-0769
OLD NSN: 6625-00-783-5145

A1 is the receiver assembly
M101 is the line level meter

A34 is the front panel assembly
M102 is the carrier level meter

The CAGE code 80063 is: US Army Communications and Electronics Material Rediness Command Fort Monmouth, NJ 07703 Voice Line: 732-532-5332

Someone with the CD (I'm now wishing that I have ordered one last fall) that has all the Signal Corps Drawings and Specifications, could look up the meters and get all the electrical specifications. Then a look through the several meter manufacturer's catalogs should find a suitable electrical replacement. The meter face problem was already solved with the laser printer idea earlier submitted.

From: "Lawrence R. Ware" <lrware@pipeline.com> Date: Thu, 21 Jan 1999 19:55:42 +0000
Subject: Re: [R-390] Meter Matters

Among the special tools/equipment required: A device to *demagnetize* the frames and related metal hardware. A device to increase or decrease the field strength of the PM's used in parts of the units. A set of "keepers" installed between the poles whenever the armature was removed to help prevent permanent change of the field strength. Complete sets of hairsprings, (about 30 different part numbers.) Sapphire replacement pivot assemblies, another 10 part numbers. Complete armature assys, another 40-50 part numbers.

Pointers, balance weights, blank scales, (for custom calibration,) NON-magnetic tweezers, micro-screwdrivers, and tensioning tools are all required.

And last but not least, the infamous "taut band kit." Two strips of phosphor bronze, two tension setting fixtures and about 1" of special solder... Hanging taut bands required no morning coffee, no air movement, good light, and the patience of Job.... All to often you did it three or four times before the tension was correct. Start to finish, two or three hours was typical before you had a unit that met all factory specs and was ready for return to the customer. GE charged about $250 each to refurbish those $800 meters.

>All which is to say that reproduction meters with special movement resistance may be possible, may almost be practical, but almost sure won't be cheap.

Without all the special tools and fixtures I would not even try.

From: "Tom Roddy" <tcroddy@lightspeed.net> Date: Thu, 21 Jan 1999 17:34:57 -0800
Subject: Re: [R-390] Meter Matters*WARNING***

THE TWO METERS ARE NOT ELECTRICALLY IDENTICAL OK, I got that straightened out! Them meters aren't the same. OK. I shoulda known. Also, are these meters so special that the movements can't be replicated at some Pacific Rim electronics plant? Is it worth the inquiry? I think I'll take the specs that were posted here and send them out to a few of these guys to see what they say.

From: john tatman <jtatman@tacomaclick.net> Date: Thu, 21 Jan 1999 17:49:35 -0800 (PST)
Subject: [R-390] R-390 meters

The early R-390 manual has this identification for the line level meter: Meter, audio level: panel mtd; 0 to +3 cw, 0 to -20 ccw, marked VU; sq aluminum, steel, or plastic; 1-27/32" sq mtg fl, 1.510"`dia barrel, 1" d to mtg surface; +/-3% accuracy at 0 reading; black self-luminous scale markings and pointer; white background; requires ext multiplier; four .125 holes spaced 1.312" c to c; 2 solder lug term; Collins Rad / dwg No. 481 0001 00.

And this identification for the carrier level meter:
Meter, milliammeter: panel mtd; dc; 0 to 100 cw, graduated in 10 scale division, marked DB; rectangular, steel; 1.510" o/a dia, 1-1/8" body d from mtg surface, excl term; +/- 3% accuracy; self-luminous pointer and scale markings; self-contained; mtd by four .125" dia holes spaced 1.312" c to c; 2 screw stud term; 1/8" lg; Collins Rad part / dwg No. 476 0066 00.

73 John WI7S

From: "Phil Atchley" <ko6bb@elite.net> Date: Thu, 21 Jan 1999 18:39:20 -0800
Subject: Re: [R-390] Meter Matters

In past times (a past life?) when I worked at a CB shop I would occasionally be asked to repair a meter for a radio in which a new meter was not available (or trucker needed it "today"). Those are cheap meters, the typical problem is the bearings bind. I was able to adjust maybe one out of two to work properly. If I loosened up the "pivot" too much and the armature fell off the bearings, forget it. I always told the customer on the ones I fixed...it's working now but nobody knows for how long!!! :-(

From: "Tom Roddy" <tcroddy@lightspeed.net> Date: Thu, 21 Jan 1999 19:07:21 -0800
Subject: [R-390] Fw: Meter Repair or Replacment

Here's some info on meter repair that I stumbled upon. And thanks to AB2ET for posting the original. And I remember, THE TWO METERS ARE NOT ELECTRICALLY IDENTICAL.

Standard Meter Laboratory 36 Rickenbacker Circle Livermore, CA 94550	These people know a lot about meters in general. They are able to reproduce meters of just about any style and shape. They can create meter face plates with a CAD program. They have a photographic machine that creates a negative and a method of creating a positive plate that can be inked to make an exact replacement.
Beede 175 South Main St. Penacook, NH 03303 800 451-8255	"will provide info but do not like the one or two meter deals"
Instrument Masters 1-973-948-4818.	They will work with you to get the best mix for the "repair" A long time in the Bud or Dick Ericcson "trade" a father and son team.
Ram Meter 1903 Barrett Troy, Mich. 48084 ph. 810-362-0990	All they do is Meter repair.
Ye Olde Meter Cellar Leonard W. Cartwright 879 Russet Drive Sunnyvale CA 94087 (408) 739-6025	

From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net> Date: Thu, 21 Jan 1999 21:52:00 -0600
Subject: Re: [R-390] Fw: Meter Repair or Replacment

How about Simpson. They seem to show up regularly. They might still have tooling...

From: Barry Hauser <barry@hausernet.com> Date: Thu, 21 Jan 1999 23:25:00 -0500
Subject: Re: [R-390] Meter Matters

Good News! We found a highly qualified meter guy! Seems that Larry might need a little encouragement though. ;-) It would be nice if there's some way to adapt (electronically) all those meters that are cosmetically identical (scales excluded- but not a problem). That may have to be a circuit that hangs on the back of them. I think someone mentioned that approach. The meters I keep looking at are those on the bottom of Pg2 of Fair's WS-98-1 catalog. I'm told they have lot's more of that 1 3/4" style in different values.

Also. It was mentioned that one is an ammeter, the other a voltmeter. Isn't an ammeter usually just a voltmeter hooked up across a shunt?

From: Barry Hauser <barry@hausernet.com> Date: Fri, 22 Jan 1999 00:18:46 -0500
Subject: Re: [R-390] Meter Matters

I seem to have kindled -- or rather rekindled this subject area. BTW, I just remembered what prompted me. Dave at Fair Radio said that as of now, they no longer even have the white-faced meters to sell with their checked R-390A's. This may signal a new low in availability, and an increased base of demand for making replica meters.

There otherwise lookalikes I mentioned seem to match up size-wise at 1 3/4" inches square with 1 1/2" barrels.

From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net> Date: Thu, 21 Jan 1999 23:30:34 -0600
Subject: Re: [R-390] Meter Matters

Encourage away. My averages with meters is on the low side of 1/4... I've looked at the 390(a) schematics. The signal meter is hooked between low value cathode resistors on two tubes with opposite polarity voltages applied to their grids, e.g. a bridge meter amplifier. The meter resistance is critical from those low value (<20 and 27 ohms) cathode resistors. The IF tube could stand ten time that resistance with little effect. The AVC tube could too as far as I can tell, so it would be worth the experiment to try to raise those cathode resistors to say 82 ohms to see if a more normal 1 ma meter with about 50 ohms resistance would work.

The audio level meter may be another problem. Typically there's more specifications on damping and sometimes they are rather nonlinear on the scale unless the pole pieces are shaped to correct for that non-linearity. Otherwise there's a need for a diode bridge and some series resistance. Likely a micro-ammeter would make a better basis than a milliamp meter or and ammeter with the shunt removed. Linearity may be adjusted with diode curve shaping but that's a pain, though far easier than making specially shaped pole pieces. Though a ammeter is often a voltmeter across a shunt, its often a low voltage voltmeter with more than a milliamp of current. Its a lot easier to wind the meter coil with a few turns of #32 than a bunch of turns of #42 (breaking strength about 2 ounces), so when the current can be supplied, the larger wire is chosen. Which means that the shunt has to be adjusted to accommodate the larger meter current, but that's practically trivial. I didn't see any audio VU meters in the Newark or Allied catalogs I looked through this evening. Just AC and DC. And Simpson 1 ma meters were consistently 47 ohms when their resistance was specified.

From: "Ronald Reams" <wa4mjf@worldnet.att.net> Date: Fri, 22 Jan 99 13:42:51 PST
Subject: Re: [R-390] Meter Matters

SS of NE has some meters (or did) they're pricey (isn't everything there), but probably cheaper than having custom made.

From: "A. B. Bonds" <ab@vuse.vanderbilt.edu> Date: Fri, 22 Jan 1999 09:04:44 -0600
Subject: Re: [R-390] Meter Matters

Quite the 'tother way round. A voltmeter is an ammeter with a series resistor. Works like this. Nearly all meter movements (e.g., D'Arsonval) are fairly low resistance (DC, mind you). As such they act as an indicator of series current, on the order of micro- or milliamps. To handle more current, you use an external shunt, and rely on current division.

To handle voltage, you use a series resistor, and rely on current limiting. The problem as I understand it with the 390 meters is to have a 1 ma (?) movement with a particular series resistance, which I have conveniently forgotten. If you find a 1 mA movement with less than that resistance, add some series resistance. Since the meter reads current, alles hunky-dory ist. However, a 1 mA meter with more than that resistance requires a parallel shunt to get to the proper load resistance. In this case all of the current will not go through the meter, which nicht so gut ist.

Now, the line level meter is a VU meter. This is indeed a voltmeter, but it is an AC voltmeter. It will have at its core a DC meter movement, but will also have a meter rectifier (usually copper oxide, so there is no voltage offset as found with sand-state stuff) and probably a series calibrating resistor as well. VU meters are made to an industry spec (0 VU is something like 1 mW across 600 ohms, or 0.775 v). They also have a carefully designed ballistic to "integrate" the changes in volume. I'll bet that VU meters are still being made, they are used on mixing boards and the like.

From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net> Date: Fri, 22 Jan 1999 09:13:18 -0600
Subject: Re: [R-390] Meter Matters

The 500-0-500 microamp meters are 1 ma with an offset zero. If their resistance isn't too wild they might be easy to modify, to the point of just using the electrical zero at an extreme position.

From: Rolf-Lutz@t-online.de (Rolf Lutz) Date: Fri, 22 Jan 1999 17:27:08 +0100
Subject: [R-390] R390A Meters

In HSN 22 Page 2 is a specification of those 2 meters. The R390A line meter is 250 microamps full scale, 3360 ohms internal resistance The R 390A carrier meter is 1 milliamp full scale 17,7 ohm internal resistance. Even a small error (high or low) in the internal resistance of a carrier meter will cause rather large errors in carrier meter readings (Dalles Lankford) Spring 1980

From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net> Date: Wed, 03 Feb 1999 19:59:45 -0600
Subject: Re: [R-390] Line Level Meter

If the meter is sticking above the mechanical zero, it can be a defect in the bearings, a steel filing obstructing the movement, dirt or static electricity. Try tapping the panel to see if it goes on down. That would indicate a sticky bearing. If that doesn't work, try wiping the meter glass with pure dish washing detergent. Its conductive enough to remove static charge that can cause a meter to not zero. That shows up most often around compulsive cleaners. An anti-static spray should also be effective. Don't wipe the meter face clean if its a static charge that's the problem.

I don't think there's a mechanical zero available front or back. In the audio meter there's sure no way electrically to get it go to zero if it doesn't do it mechanically with power off.

From: DCrespy@aol.com Date: Mon, 8 Feb 1999 21:18:16 EST
Subject: [R-390] Meters, been there - done that

You know, I have tried a number of the meter solutions.. including modifying the international brand 1 mA meters internally (which, while it works nicely, exposed me to any radioactive particles that might have been 'freed' by the process). In the end, all of the searching and other efforts have produced a box full of 'almost right' meters.

I have three radios. One radio has meters that are close (including the one international one above) and they look good and work nicely. The other two have original meters. I am SURE that I spent as much money collecting approximations and trying to cobble up a non-stock solution as I did just finding and buying the right meters for the other two. (Not to mention the potential health hazard..??)

I'd recommend posting a request to the list or just contacting one of the suppliers to the hobby (like Fair Radio or Surplus Sales of Nebr. or one of the individuals that might have parts.. like Dave Medley, John Bess or Chuck Rippel..). Mac McCollough sold (sold out) a lot of meter sets last year and I am sure there are some unused ones out there on the list...

In the end, I think you will appreciate the finished radio more. And you can spend your valuable time getting the best possible performance out of these great old sets!!

From: "iasckids" <iasckids@pacbell.net> Date: Mon, 8 Feb 1999 20:03:22 -0000
Subject: [R-390] Meters

Well I think Harry said it well. Speaking as one who spent a long three weeks trying every one I could think of on the subject of replacement meters for the R390A , I must confess to finally succumbing to the dreaded "GOTTA GET THEM D---METERITIS" and subsequently witnessed the darkening of the sun over Nebraska by a flock of 182.00$ bills, all so my R390A might have the correct meters. The phone bill and investigative time spent do not warrant (so far) not just getting the right meters in the first place. While I balked at the price, Surplus Sales of Nebraska did come through with a timely delivery of a quality product. They did solve that problem for me when no one else could. The rx works like the day it was made, however I do believe that a full detailing by Chuck Rippel would be money well spent.

From: Nv4t@aol.com Date: Mon, 8 Feb 1999 23:22:52 EST
Subject: Re: [R-390] Meters, been there - done that

Harry, the hazard occurs ONLY in very old meters with radium painted dials. Most modern meters don't contain any radioactive substance. Go ahead and modify them to your hearts content!!!!

From: "Tom Roddy" <tcroddy@lightspeed.net> Date: Tue, 9 Feb 1999 08:22:56 -0800
Subject: [R-390] Meter Matters

A while ago I posted an inquiry regarding the custom manufacture of replacement meters for the R-390A. Thanks to Craig, I'll soon have drawings to send off to three Asian manufacturers. One Japanese, one Taiwanese, and one Hong Kong(ese?). Just worked out like that. Then they can get back to me with prices. Instead of trying to post and ask who wants how many, I'll just make up an number (200 each?), get a price and then post. I would buy three sets, as I have two radios with original meters.

Instead of asking the "exact replacement" meters be made, I'm asking for electrically exact replacements that look more like contemporary panel meters. Clear plastic fronts with relatively large and readable scales. I just find those little unlighted black things hard to read (and can always put them back on when the purity cops stop by). Maybe even lighted. I have already received one set of catalogs that has some very nice looking meters. I can post a little scan if you folks want, and the rules allow it.

Interestingly, I found one factory that makes only the 'movements' for meters, and am not sure how to fit him into this. Any ideas on this? I don't know what the cost will be and will have to have that before I know if this is a good idea. I hope something comes of this and thanks for your help. Also, I "just happen" to be going to Van Nuys tomorrow and will stop in at All Electronics to pick up a few of their meters you guys talked about.

From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net> Date: Tue, 09 Feb 1999 11:31:57 -0600
Subject: Re: [R-390] Cheap Meters for R-390

The problem in the s-meter circuit is low voltage which means the original 1 ma meter has a resistance much lower than normal. Low current and low cost meters tend to need more horsepower to move the pointer and so have a greater resistance to get more voltage for the current. The low value cathode resistors may need to be increased as much as a factor of ten to get enough voltage to drive the meter.

From: "Phil Atchley" <ko6bb@elite.net> Date: Tue, 9 Feb 1999 10:02:36 -0800
Subject: Re: [R-390] Cheap Meters for R-390

Not to argue, but the meters I mentioned are 250uA so possibly have greater sensitivity. It is worth a try for the people needing one is all I said. And yes it is possible the resistors may need a slight "value change, but that is a far less drastic circuit change than some people suggested awhile back with perfboard "op-amp" circuits on the back of the meters Not needing any I can't try it out but thought it might help somebody who is desperate for meters and not able to pay ~170 or so. Incidentally at the present time I'm using a SS rig (Drake TR-7) with which I'm very pleased (it's a much needed transceiver) but hope to get into the BA game again with a R-390A or SP600, maybe a HQ180 or so ;-)

From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net> Date: Tue, 09 Feb 1999 13:43:34 -0600
Subject: Re: [R-390] Cheap Meters for R-390

Yes, greater current sensitivity. But poorer voltage sensitivity. The normal 1 ma meter takes about 50 millivolts full scale (50 ohms resistance). The typical 1/4 ma meter may do as well, though the knock off makers tend to be higher in resistance. That 1/4 ma meter will likely have a resistance of 200 ohms to still take 50 millivolts, though I'd not be surprised that its resistance was 500 or 1000 ohms to need 125 or 250 millivolts which the 390 s-meter circuit will not provide. The original 390 meter (which has its own mil spec from being used in a multitude of equipment apparently) has a specified resistance of 17 ohms which means its 17 millivolts full scale. A 250 millivolt meter won't deflect much at 17 millivolts full scale.

Probably the 68 ohm resistors in the meter circuit (there's something like that across the meter adjust pot and a fixed on to ground on the other side of the meter) will have to rise to 270 or 330 ohms to get full scale deflection with a 50 millivolt meter.

From: Stanley Wilson <microres@crl.com> Date: Tue, 9 Feb 1999 14:20:20 -0800 (PST)
Subject: Re: [R-390] Cheap Meters for R-390

Hey fellows remember Ohm's law. Also the meter works on current in one circuit and voltage in the other in the R-390A. Now for the S-meter which someone said is 1 ma meter, then you will have to parallel the meter with a resistor to use the 250 ua meter.

Take a 1.5 volt battery and a large resistor (about 6 k I think) in series and adjust the resistor for full scale reading on the meter that is 250 micro amps. now use a parallel resistor and trim the parallel resistor until the meter reads 1/4 scale. You now have a 1 ma meter.

Use a piece of copper wire about 22 or 24 ga to make your parallel resistor. I would start with about 6 ft. trim length of the wire until you get 1/4 scale reading with the battery and series resistor combo.

Now the line meter is different. You need to make up a diode bridge and then use a series resistor after the bridge. Not sure what the voltage is but remember the meter is micro amps and assume you have one volt out of the bridge then you will need r = 1.0/.000250 for full scale reading. DO NOT TRY TO READ THE VALUE OF THE METER RESISTANCE WITH AN OHM METER>

From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net> Date: Tue, 09 Feb 1999 17:10:04 -0600
Subject: Re: [R-390] Cheap Meters for R-390

Its going to take a LOT of 22 gauge copper wire to make that shunt! About 75 ohms of it if the 250 microamp meter is typical at 200 ohm resistance. More if its higher from being a cheap meter. The line meter will be more logarithmic if the diodes are right at the meter and the series resistor is on the AC side.

From: "Phil Atchley" <ko6bb@elite.net> Date: Tue, 9 Feb 1999 19:02:50 -0800
Subject: [R-390] Meter Substitution Experiments

Hello, back to the serious side, substitution of meters. At the present moment I'm R-390A-less and I loaned my "downloaded" schematics to a friend so this is purely from memory. May require a little scrutinizing of the schematic. But this method should work with perhaps slight modification.

First, the carrier meter is across the cathodes of two tubes, we all know that. If I recall correctly though (correct me if I'm wrong) it is only across part of the cathode resistance. Here is what I propose. It will require one R-390A receiver with a known "good" carrier meter for reference. (or borrow a meter from another set to temporally check out the "patient".

The following sounds like a lot of work but really not everyone should need to do all this. Once one or two are done "post" the results/resistor values for the rest. I'm sure that if the preliminary work is done on known good sets the parts values will fall in line for the rest of em. (They do for the present stock units) EXAMPLE:

1. Make sure the meter is "zeroed" with no signal. Tune in the calibrator at a "reference" frequency, say 10MHz, peak the antenna trimmer and make note of the reading, we'll say 70dB for the purpose of this example.

2. Remove the "reference" meter. Measure the total resistance of the two cathodes to ground. Don't recall the value now but say it is 250 Ohms. Remove all resistors (and pot) from the cathodes of the two tubes. Connect two "pots" of same value 250 Ohms (or 500 Ohms with a 470 Ohm resistor in Par) from cathode to ground, leaving the two "slider" connections unhooked. Now connect the two leads of the new "test" meter to the two slider connections. NOTE: This will have to be done with long enough leads to allow temp re-installation of the IF module.

3. Re-install the module, power up the receiver with same settings as you calibrated with. First adjust the two sliders for "zero balance" with no signal. Then turn calibrator on and adjust "both" pots for a reading of "7" (remember the 70dB above) on the meter. You're actual reading will of course be different. If meter reads backwards reverse the meter leads.

4. You will probably have to "balance zero" and adjust "level" several times as there will be interaction.

5. Remove power and IF Module, being careful NOT to change pot settings. Disconnect the "test" meter" Measure the resistance in the two legs of ONE of the pots. Remove that pot and replace it with two "fixed" resistors of the correct or closest value. (5% resistors should be close enough) Install the "other" pot where the original "carrier" pot was and mount/rewire the new meter.

6. Re-install the IF chassis and "zero" the new pot after warm-up.

7. Enjoy your R-390A with it's nice new meter.....

From: "Cal Eustaquio" <n6kyr@value.net> Date: Wed, 10 Feb 1999 21:10:27 +0000
Subject: [R-390] Cheap meters

Got them...yuk! Wasn't what I expected. Oh well. Eighteen bucks down the tubes. But no sweat. I can used them for other stuff. Don't expect to get mil style meters with ALL Elec. Not your fault, Phil. But I did take chance. Still, it will do until you can afford better meters. Cal, N6KYR.

From: "Tom Roddy" <tcroddy@lightspeed.net> Date: Wed, 10 Feb 1999 21:59:41 -0800
Subject: Re: [R-390] Cheap meters

I picked up a few of these at ALL Electronics today. You are right in that they are not mil-spec. But for $1.50 each, not bad. For those contemplating buying these for entertainment, let me relate my experience tonight:

There are no mounting screws, so I guess one is to glue or duct tape them to the front of his radio. Also, the movement well appears to be a bit low, and I suspect that the meter body may not cover the 1-3/8" hole completely once it's duct taped in place. Two small solder tabs are provided for connection. A small label on the back says "Made in Taiwan".

Notes on disassembly of these things:
This is a typical clear plastic meter with a black bezel fitted over the front. The bezel is attached with a bit of double sided tape (what else?) to the meter body. This piece of tape is right below the meter window, so you can't get to it directly. Carefully prying the bezel forward with a finger nail, along with some gentle heat (hair dryer) and pressure application, the bezel eventually pops off. I'm really surprised I didn't break the thin black plastic doing this.

Once the bezel is removed, one sees that the clear front of the meter is taped (what else?) to the back of the body with three small bits of clear tape. At least it isn't glued. Once opened, the meter face appears to be atomically welded to the meter back, but I have yet to try to pry it off. Could be another piece of double stick tape.

It appears that the meter face could be replaced by just gluing another over the existing face. Also, lighting this meter would be easy with grain of wheat lamps.

Mil-spec? Hardly! Worth $1.50 + tax? Definitely. Before you buy any and if you have any questions, let me know.

From: Nolan Lee <nlee@gs.verio.net> Date: Tue, 02 Mar 1999 00:28:00 -0600
Subject: Re: [R-390] More meter matters

At 09:34 PM 3/1/99 -0500, you wrote:

>We all prefer "original" meters -- I think. But what is truly original? My 1967 Contract EAC has a large windowed meter and a medium windowed meter. The line level meter has a number of 59.7290 in the lower right corner and the carrier level meter has the number 59.7289. As to who made them, I have no idea. But, they are original to this receiver and dated to it and each other.

Actually, the large faced line level meters have a rather distinctive looking face. I can spot one across a room or even on a fuzzy jpeg on a website.

My 1955 contract Collins ate a meter about twenty years ago and I replaced it with one from spares. It's on one of the benches in another part of the shop. I think that it currently has a GVS one and a Simpson one of I remember right. I think both of these use the painted sheet metal covers with a paper liner. I think that the Simpson was the replacement that I installed. It's been a long time and it didn't seem important so I didn't really pay it much attention, so I may be wrong on this and the GVS was the one I installed.

If anyone has the original meters in their Collins, I'd like to know what they are so I can install the correct one.

>have just come across three black metal audio and carrier level meters which all look alike at first glance, but: Among other things, the bezels are not the same thickness.

I guess that I've had a total of a couple of dozen sets of meters pass thru my hands thru the years, both in the receivers and as loose spares. There were lots of variations. Some used a thin rubber gasket, some used a quarter inch thick rubber spacer like the small windowed International brand ones with a hollowed meter bezel.

>The thinnest one is an audio meter that is 3/16" thick. I have a carrier meter that's 5/16's and another that's 3/8" -- twice as thick as the thinnest.

Yep. Some are also a bit less than the inch and three quarters square and used sheet metal covers that covered the face and the size too. If the size of the meter housing of the "thin" one is smaller than the others, it may have originally used a sheet metal cover.

>Only the two thicker ones have phosphorescent pointers and dial markings. Every original meter that I have or have had was phosphorescent. Naturally, as they get older, they aren't as bright. One of my spares has a bluish purple glow rather than the greenish glow. I don't remember which brand it is, but it's the only one of that color that I've ever seen. If anyone's actually interested, I'd grab a maglite to charge them and root around and see.

>The middle one must be a replacement as it says "Dejur" on the face.

Dejur is a legit meter. Been there, done that. I don't remember which contract receiver they came in but I had a pair of them that picked up in the 1970's, long before the fake/repo meters were even a gleam in some ones eye.

>Were there variations in the originals as they were first installed over the years?

Yes. I've seen at least two different style International brand ones as an example. One that had a solid cast aluminum face and one with a smaller face that used the stamped cover. I'm pretty sure that there were a couple of variations of the Simpson too, even though they were the same model number.

>Obviously there were replacements that varied as meters were changed out by the military. Now, from Gene, we learn of a white-faced one rescued from a destiny with the deep.

I've yet to see one of the white faced ones. If the Govt started using them it must have been later than the mid 1970's. Hundreds of surplus 390's were pawed over by me back then and I'd have remembered something as odd as a white faced meter on one.

I've got some white faced 1 ma Roller Smith brand meters that I picked up somewhere a while back but I don't think that they were originally for the R390A.

If someone has a white faced "Govt" one, I'd appreciate it if they'd post a description of it and the markings.

Barry, if you get a chance, email me a complete description of the meters that you have, both the spares and the ones in your receivers.

Actually I'd be curious to hear from anyone thats got an original radio as to the contract number of the receiver and which meters is equipped with.

Speaking of R390A meters, I need several of the left hand thread hollow screws/bushings that hold the mid 1960's version of the International branded meter housing to the bezel. The International ones out of the 1950's used right hand threaded ones. ;-) A dead water filled International with a broken lens is fine if someone has one, all I need is the bushings, IF they're lefthand thread! thanks, nolan

From: pbigelow@us.ibm.com Date: Tue, 2 Mar 1999 07:38:44 -0600
Subject: Re: [R-390] More meter matters

Nolan and group,

I believe the mismatched "window" size of the meters is correct for a 1967 EAC. Mine is equipped that way, also. The "Line Level" has the large face allowing viewing of the movement and the "Carrier Level" has the smaller face. In a conversation with Rick Mish a couple of years ago he indicated that those were the correct meters for the '67 EAC.

From: "Chuck Rippel" <crippel@erols.com> Date: Tue, 2 Mar 1999 12:29:12 -0400
Subject: Re: [R-390] More meter matters

The large ones are made by QVS and the best (most attractive to me, anyway) carrier meters are 181's by Simpson.

From: Nolan Lee <nlee@gs.verio.net> Date: Wed, 03 Mar 1999 13:28:49 -0600
Subject: Re: [R-390] More meter matters

At 07:38 AM 3/2/99 -0600, you wrote:
>I believe the mismatched "window" size of the meters is correct for a 1967 EAC. Mine is equipped that way, also. The "Line Level" has the large face allowing viewing of the movement and the "Carrier Level" has the smaller face.

Yes, they're correct for that contract. The receiver is in the rack the covers screwed down so I can't get the exact markings off of the back of them, but they're both inkstamped with the same 1968 date if I remember right.

>In a conversation with Rick Mish a couple of years ago he indicated that those were the correct meters for the '67 EAC.

It still seems strange that they'd have used two different sized openings like that though. :-)

From: Nolan Lee <nlee@gs.verio.net> Date: Wed, 03 Mar 1999 14:05:07 -0600
Subject: Re: [R-390] More meter matters

wrote: >The large ones are made by QVS and the best....

I'm guessing then that QVS (I thought it was GVS, I'm slipping) must have build both of the meters for the '67 EAC's then, correct?

>(most attractive to me, anyway) carrier meters are 181's by Simpson.

Yep, with the sheet metal cover. :-) Got one in my '55 Collins. It's got an "uncluttered" look.

>1968 Contract Dittmore-Friemuth R390A #38

What does the DF use for meters?

From: David Ross <ross@hypertools.com> Date: Wed, 03 Mar 1999 12:22:01 -0800
Subject: [R-390] meters for sale

I have some meters which were removed from scrapped PRC-47 military radio sets. They are an exact mechanical fit in all the R-39X radio front panels.

These have a 50 micro-amp movement and probably have an internal resistance different from the original R-39X meters.

These meters have a cast bezel, not the stamped sheet metal cover piece like some R-39X meters. The original bezel finish is a very durable semi-gloss black paint, but may have some OD paint over spray on it. I'll include used mounting hardware until it runs out.

All the meters have the same scale - 8 graduated divisions plus a white 'normal operation' area around 2/3 scale. The scale is silk-screened white on a black background.

I've seen several different manufacturers, but most of these are made by DeJur. I'll test the meters for basic functionality, and match them for bezel & scale cosmetics and manufacturer, and ship a pair of them to you (postpaid CONUS) for $15.

From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net> Date: Wed, 03 Mar 1999 17:51:50 -0600
Subject: Re: [R-390] More meter matters

Since the meters have their own military specification not unique to the R-390 and the details of the covers are not in that specification, they are likely to come from different vendors for different production runs. Likely they were also used in other radios of the day like aircraft radios, and there may be even more sources and variations than just seen in the assorted 390 contracts. With them being mil specifications, not Collins part numbers, the radio building contractor has to take what ever fit the mil spec at the best price whether they matched or not. Probably didn't always complete a contract with the same appearance meters as began the contract.

I was a little concerned that the shootin' irons I was issued along with the ammunition (clothes and food, too) was lowest bid, not necessarily highest quality when I was on active duty. I'm sure tank drivers and pilots get more concerned when they think about every thing their life depends on being lowest bid. Fortunately after basic training I never dirtied a rifle barrel again so didn't test other batches of M-14 and ammunition.

Subject: R390 Meter recap Tue Jan 02 09:57:45 1996
I got a couple of messages asking what R-390 meter removal had to do with safety.

Here's a recap for new list subscribers who weren't around when we beat the subject to death a year or so back. :-) Maybe it's time to redo this anyway, as some of the new folks might unknowingly encounter the hazardous stuff out there.

It seems that in the early 1950's military gear specs often called for the ability to operate the equipment in total or near total darkness. To that end, meter movements often had their calibrations and needles painted with materials that glowed in the dark, like old fashioned alarm clock dials did. The clocks were done with radium doped paint. I hesitate to say that the meters were done the same way, but some of them show definite emission of ionizing radiation; i.e., they're low level radioactive.

Because of the radioactivity, the meter movements were removed from some sets prior to the release of the radios to the surplus market. Presumably, the removed meters went to a radioactive waste dump somewhere. It now seems that these meters are no longer being pulled.

The hot meters are MOSTLY (but not all, by any means!) hermetically sealed units, and are probably perfectly safe if the seals remain intact, and the operator is a reasonable distance away from them. If the beast is sealed and the glass is intact I'd have no problem with having them in my shack.

Some of the units known to have this sort of meter (usually, but not always) are R-390, R-390A, R-389, R-391, R-392, T-195, and many of the VHF FM military sets. The movements are usually square, about 1.5" x 1.5" . There is usually no radiation hazard marking or sticker on the meter case; I've yet to see one. Checking to see if the meter you've got glows in the dark is not a reliable test to tell if you've got a hot one. Some of these were pretty dim to begin with, and they've lost light emission efficiency over the years. The easiest to tell for sure is with a Geiger counter.

For me, the rule of thumb is that ANY sealed meter is suspect until proven otherwise.

That's the good news. Now, here's the bad news.

During World War 2 a number of military radios got the same glow in the dark treatment, but in places where the paint wasn't sealed from exposure, wear and flaking. In addition, some of them were treated with paints that were REALLY hot as compared to their Cold War brethren. These things probably can and do release radioactive dust that can be accidentally inhaled or swallowed. It was in panel markings, on knobs, on switch levers, etc. In addition, the stuff was used on UNSEALED meter movements!

These things ARE NOT welcome in my shack under ANY circumstances! Two of the worst offenders are the TBY transceiver (low band VHF backpack, US Marine Corps issue), and the TBX transceiver (HF field set, USMC issue. Too bad, this is a really neat radio). Highly suspect is the meter movement in the APR-4 and APR-4Y electronic countermeasures receiver (38 - 4000 MHz with appropriate plug-in tuning heads).

Bear in mind that this list is NOT all inclusive. A more complete list of hot radios (and even that's not complete) is in a back issue of ELECTRIC RADIO. I don't mean to scare anyone, but forewarned is forearmed.
73's, Tom, K9TA

Sat Jan 07 11:56:48 1995
Subject: R390 Meters -- radioactive labeling

One short note: The reconditioned (like new) R-390 that I recently purchased from Fair came with meters, covers, spare tubes ... the works. And it must have sensitivity in the tenths of a microvolt -- cause it out performs everything I have.

BUT ... the meters were labeled as follows: \/ Radioactive Material| Controlled Disposal Required 1 micro Curie Ra226 or less

So ... from all that has been posted here, plus the above, as long as the meters are intact, everything is okay. Isn't that about where we are on this subject?
Regards, Tom KE4RHH Bridgers@Leaders.CCL.org

From: Nolan Lee <nlee@gs.verio.net> Date: Mon, 02 Aug 1999 14:45:33 -0500
Subject: [R-390] substitute meters...

Jan and I were discussing the calibration of an op-amp module that he built to drive the readily available and inexpensive 1 ma meters that have internal resistance values too high to normally us in an R-390A.

Can any of you make the following measurements of original R-390A carrier level meters and supply the test values as outlined in the following part of my message to him?

- -----<snip>-----
Actually, calibrating it wouldn't be difficult. All you'd have to do is slowly increase the voltage across an original or two and see what they are at full scale. Then measure the input voltage to the

SS gadget and calibrate the output accordingly for the meter that you're using. Nothing to it. Naturally, do to the low internal resistance of the original meters and their fragile nature, you'd want to limit the voltage across them when measuring to keep from frying them. Probably a 1.5 volt "N" cell battery and a ten turn 10K pot would do the trick. Hold on a sec....

OK, it only took about ten minutes to set up and measure. I didn't have a 10 K ten turn pot handy so I used a 1K one with a resistor sub box and a standard 100 ohm pot in series to determine the FS and 1/2 scale voltage requirements. I need to get an actual resistance decade box one day. ;-(

I took a NOS Simpson 182 carrier level meter out of it's box that I've been setting on for twenty years as the test subject. It's stamped as being made on Sept 27th of 1960. The mechanical zero of the meter is perfect as viewed thru a 16x eye loupe when the face is perpendicular to the floor. for what it's worth, it doesn't glow worth a damn any more. It did 20 years ago. ;-(

OK, I measured the resistance of the meter first. I slightly loosened each of the two nuts on the back and then re-snagged them to make sure that they were making good contact to the treaded posts and the solder eyes. After subtracting the resistance of the test leads, the meter movement itself, when measured from the center of the two tinned solder eyes, is 17.89 ohms.

The voltage measured across the two solder terminal eyes on the rear of the meter for precisely full scale deflection as viewed thru the 16x loupe with the tip of the pointer centered over the graduation for 100 db was .01692 volts. The voltage for mid-scale deflection to the center of the graduation for 50 db was .00879 volts. Hmmm, I see a .00066 volt error on the part of the meter movement. Cheap piece of crap...<grin> Those are some really low voltage levels. OK, that'll give you a good idea for adjusting the output levels of the SS gadget for the FS input voltage.
- -----<snip>-----

From: "A.B. Bonds" <ab@vuse.vanderbilt.edu> Date: Thu, 12 Aug 1999 20:36:58 -0500
Subject: Re: [R-390] zeroing meters...

The meters should be mechanically at zero for proper operation. Unfortunately, none that I have ever seen have an external adjustment--sealed, y'know. However, some of them can be disassembled. I have some "International" labeled meters on my sets that permit mechanical zeroing. By removing the meter, one sees on the back of the frame a thick rubber gasket. Gently pry out the gasket and you will find fittings that permit the case to be disassembled. Once free of enshroudment, the spring arms (either front or back) can be rotated by pushing with a very small screwdriver until zero is achieved. Note, of course, that by unsealing the meters you are exposing yourself directly to the vicious radioactivity, so this procedure cannot be recommended. Officially.

From: Nolan Lee <nlee@gs.verio.net> Date: Thu, 12 Aug 1999 23:13:41 -0500
Subject: [R-390] R-390A Line Level Meter FAQ...

After I cross posted my message to Jan on the Carrier Level meter full and partial scale voltage readings, I received a number of requests for similar information on the Line Level meters. I have a few extra minutes, so I'll hammer out a quickie FAQ on the R-390A line level meters. If I have time, I'll do one on the Carrier Level meter.

If you spot an error, holler back and I'll correct it and re-post.
- -----<snip>-----

Nolan's R-390A/URR Line Level Meter mini-FAQ

nlee@gs.verio.net Revision 0.1 BETA (8/12/99)

The line level meter for the R-390A is an AC meter with an internal resistance of 3900 ohms, plus or minus five percent at 1000 Hz. It's designed to be used with an external 3600 ohm, plus or minus one half of a percent tolerance, resistor giving a total circuit resistance of 7500 ohms. The meter housing is a standard one and three quarter inch square meter using four one eighth inch diameter mounting holes arranged in a one and five sixteenths inch square pattern.

This meter uses a standard "A scale" graduated meter face with the VU (100 on lower scale) graduation indicating 1 milliwatt into a 600 ohm load. In the event you ever wondered what VU actually stands for, it's "volume units".

If you want to check the calibration of one of the meters, odds are that you won't have the precision 3600 ohm resistor, but a carbon composition 5K linear pot adjusted to exactly 3600 ohms in series with the meter will work just fine. Optimum calibration is listed below. You'll need a stable audio signal generator set to 1000 Hz that has an adjustable output and a sensitive high input impedance RMS voltmeter that is accurate for measuring a 1000 Hz sine wave.

Make damn sure that you pay attention to the output control and set it to zero before you power it up to prevent smoking the meter. Also, as you advance the control to increase the voltage output, do it real slow to prevent slamming the meter movement or smoking it. If you're not sure of what you're doing, leave the meter alone. You won't damage it that way. ;-(

The meter and the pot, set to 3600 ohms, are wired in series with the output of the audio signal generator. Polarity is unimportant. The RMS voltmeter is used to measure the output of the signal generator directly from the output terminals and is used to measure the voltage across the meter/pot combination.

Here's what you should see for a perfectly calibrated meter:

-22 VU (0 on the lower scale) should be 0.000 volts RMS
25 on the lower scale should be 0.307 volts RMS
50 on the lower scale should be 0.614 volts RMS

-4 VU should be 0.775 volts RMS
-3 VU should be 0.869 volts RMS
75 on the lower scale should be 0.921 volts RMS

-2 VU should be 0.975 volts RMS
-1 VU should be 1.095 volts RMS
-0 VU (100 on the lower scale) should be 1.228 volts RMS
+1 VU should be 1.378 volts RMS
+2 VU should be 1.546 volts RMS
+3 VU should be 1.735 volts RMS

From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net> Date: Sat, 19 Feb 2000 23:31:37 -0600
Subject: Re: [R-390] R390A Meters

Yes, I've had meters repaired. Most often the meter shop would rather replace the movement than repair it. A few hours ago, I straightened a bent pointer on my best Simpson 260 that came from the movement mounting nuts working loose. Guess I shouldn't have laid it on that corn dryer plenum last year. I've changed scales on several meters and I've destroyed several trying to fix them. So I won't offer my services. I've fixed the movement in a junked out Weston clamp on ammeter good enough it was calibratable in a good meter shop. A couple times. Dropping it off the top of a corn bin wasn't GOOD for the movement but I was able to re-center the slug in the middle.

I did fix a bad solder connection on a surface mount transistor to make my CD-R work again this evening also.

R-390 meters with their radioactive scales and pointer and their hermetic seal are a lot harder to work on.

Working on meters is like working on women's wrist watches. Few ever could and those that could are getting old and shaky...

From: "Dr. Gerald N. Johnson" <geraldj@ames.net> Date: Fri, 21 Jul 2000 18:31:35 -0500
Subject: Re: [R-390] Use of non-standard carrier level meters

Since the carrier level meter is a bridge circuit with two tubes up top and two resistors to ground with the meter between the two tube cathodes (very much like that in VTVM's) I figure that by changing the two resistors to ground by the same ratio as the difference in meter resistance that the results will be quite similar. E.g. in the R390 schematic I just looked at, the AGC tube has a 27 ohm resistor to ground and the zero adjust pot is in the IF tube cathode and is 15 ohms. The original meter is 17 ohms 1 ma. A better meter would have been 50 ohms 1 ma (three times the horsepower, so more rugged). 50 ohms is a common resistance for a 1 ma meter. So I'd try a 91 ohm resistor on the AGC tube and a 50 ohm zero pot. I think it will work just fine. I'm talking about changing voltages around the meter in small amounts. The meter drop changes from 17 to 50 millivolts... Not enough to upset any tube. Last I remember looking at the R390A schematic the resistor values around the meter were similar. If the meter calibration wasn't quite the same not necessarily quite log curve, one could easily make a new calibration with the help of a calibrated signal generator.

From: "William L. Turini" <Turini@hamanuals.com Date: Sat, 21 Oct 2000 23:03:28 -0700
Subject: [R-390] Radioactive Meter Repair

I noticed that the line level meter on the '67 EAC I bought last weekend is not resting on zero. Other than that, it seems to work ok, i.e. it moves like it should, just doesn't come to rest on zero. I did not notice a zero adjust on it. Can anything be done to correct this? Will any of the commercial meter repair firms work on such deadly equipment ?

From: "Barry Hauser" <barry@hausernet.com> Date: Sun, 22 Oct 2000 03:06:42 -0400
Subject: Re: [R-390] Radioactive Meter Repair

I believe most of these meters do have the zero adjust screw -- but on the inside of the "containment" which protects you against the nuclear winter that lurks inside. Even if the meter is opened, the levels are not sufficient to cause radiation sickness and death within three days.
It may be possible to carefully open the thing, make the adjustment, close it up, wash everything down and dispose of the disposables somehow. Or, you may want to just live with it. Seriously though, how far off is the needle? Is the front cover metal or phenolic/bakelite? A slight off-zero might not mean much in terms of accuracy where the spring tension through the range is more influential as well as the bridge circuit that drives it. I ask about the cover because I've seen large meters develop static "stiction" after a trip wrapped in plastic and styrofoam. The static charge causes the needle to be attracted/repelled from parts of the case or window. This should be less likely if the meter has a metal front which is grounded via the mounting screws to the front panel. What I've done is to ground the meter face to drain the static - or ground myself and hold my hand over the face for a few seconds. Of course, it might not be that at all.

From: "Roger Gibboni" <gibboni@attglobal.net> Date: Sat, 18 Nov 2000 16:09:06 -0500
Subject: [R-390] Re: carrier meter level adj

Have an Imperial 390a, works great. Just checked sensitivity and it seems better than spec., however the carrier level meter appears to be insensitive. Went thru adj procedure, but can't get a full scale deflection and its practically useless on the air. Any ideas?-

From: tbigelow@pop.state.vt.us (Todd Bigelow - PS) Date: Sat, 18 Nov 2000 14:57:33 -0500
Subject: [R-390] Re: carrier meter level adj

Probably something as simple as a bad cap or out-of-spec resistor, Roger. I'm not at all up on the circuitry, and I, too, have an Imperial/Teledyne rig here. Mine looks new, but needs work as it only works on the BC band(will I *ever* get back to it? Stay tuned...). There are *many* on this list who know these rigs inside out, however, and I'll bet this issue has popped up before. Stay tuned, I'm sure you'll get some very good replies.

From: Tom Marcotte <courir26@yahoo.com> Date: Sat, 18 Nov 2000 14:55:43 -0800 (PST)
Subject: Re: [R-390] Re: carrier meter level adj

My first reaction is that the rig needs alignment. If the rig is aligned properly and you get a decent diode load voltage with a strong signal, then check resistor R548 in the IF module. This resistor has influence upon the full scale reading.

From: jan@skirrow.org Date: Sat, 18 Nov 2000 16:15:44 -0800
Subject: Re: [R-390] Re: carrier meter level adj

First question I'd ask is whether the meter is an original, or a look-alike? If it's an original then it should be lively assuming the zeroing pot works right. If it's a look-alike, then it probably isn't the right internal resistance (the R-390A meter is unusual) and probably won't be lively or reach FS. This issue has been thrashed to death on the list.

My website has a piece on a little amp to allow use of look-alikes w/o modifying the R-390A circuitry. Also, I do have Bristol wrenches for the R-390A. They are $3 for one, $5 for two - shipping anywhere included. If you only need the one for the R-390A this isn't a bad deal. If you need other sizes as well, better to buy a set (which I don't sell).

From: "Roger Gibboni" <gibboni@attglobal.net> Date: Sun, 19 Nov 2000 10:57:56 -0500
Subject: Re: [R-390] Bristo Wrench

Thanks- I found the page for "bristol" wrenches, I think they're the ones but I can't tie your part numbers to theirs- any help? PS: The meter appears to be a replacement- not radioactive but the range worked fine when I first got the rig so the impedance must be close enough I'm gonna have to pull that IF module and check the cathode resistor.

From: Nolan Lee <nlee@gs.verio.net> Date: Sun, 19 Nov 2000 12:01:34 -0600
Subject: [R-390] Bristo Wrench and Carrier Meter Resistance

Yep, I've had one of mine for twenty five years. It's about a half an inch shorter than it originally was. Something that you guys that use the bristol and Allen wrenches need to keep an eye on is wear.

After a while, the end of the wrench will wear and start to round. If you use a wrench like this on a really tight fastener, you run the risk of it slipping and stripping the head of the fastener. I use a bench grinder with a fine wheel to grind back the end of the wrench and then lightly hit in on a "soft" wire wheel.

Someone gave me a set of Allen wrenches a while back that had a "ball" on one end to allow you to use the wrench at angles other then perpendicular to the head of the fastener. After ruining a set screw and then having to anneal it and drill it out, I cut the "balls" off of that set of wrenches.

>Meters are 17 Ohms if I recall right.

Yep, here's a snip from a post I did on the subject back in mid 1999 that covers the resistance and voltage requirements for full and mid scale readings: - -----<snip>-----

I took a NOS Simpson 182 carrier level meter out of it's box that I've been setting on for twenty years as the test subject. It's stamped as being made on Sept 27th of 1960. The mechanical zero of the meter is perfect as viewed thru a 16x eye loupe when the face is perpendicular to the floor. for what it's worth, it doesn't glow worth a damn any more. It did 20 years ago. ;-(OK, I measured the resistance of the meter first. I slightly loosened each of the two nuts on the back and then re-snugged them to make sure that they were making good contact to the treaded posts and the solder eyes. After subtracting the resistance of the test leads, the meter movement itself, when measured from the center of the two tinned solder eyes, is 17.89 ohms.

The voltage measured across the two solder terminal eyes on the rear of the meter for precisely full scale deflection as viewed thru the 16x loupe with the tip of the pointer centered over the graduation for 100 db was .01692 volts. The voltage for mid-scale deflection to the center of the graduation for 50 db was .00879 volts. Hmmm, I see a .00066 volt error on the part of the meter movement. Cheap piece of crap...<grin> Those are some really low voltage levels.
- -----<snip>-----

From: "AI2Q Alex" <ai2q@ispchannel.com> Date: Sun, 19 Nov 2000 16:48:30 -0500
Subject: RE: [R-390] Re: carrier meter level adj

Although it's difficult to "DX troubleshoot," I'll offer a thought or two for you that might help.

If you study the block diagram, and then the schematic, you'll notice that the IF signal at the output of IF transformer T502 splits. One path feeds the grid of the 4th IF amplifier V504--and then the detector, limiter, etc.

The other signal route goes to the grid of cathode follower V509. The low impedance output signal at the cathode of the cathode follower is routed out J514 as "IF output." But, it also continues through C542 to the separate AGC strip for AGC and meter processing.

So, does adjusting the slug in Z503 peak the meter signal (it's p/o the fixed-IF alignment procedure, so if you have a steady signal source you should perform that step anyway)?

If Z503 peaks up, you may want to check tubes V508, V509, and V506 and look at that "downstream" AGC circuitry. This AGC/meter strip is separate from the main signal fixed-IF path.

To help yourself sectionalize, do you see AGC action? If you do, then look more closely at the metering circuit components themselves. If not, the gremlin may lurk in the dedicated AGC/IF path.

I hope that gets you started. Use colored pencils on a copy of the schematic to assist you in understanding the signal path--it's quite conventional. Also, the copy of the schematic from one of the original TMs (in .PDF) makes it easier to discern this as opposed to the "condensed" schematic in the "21st Century" reference.

By the way, I spent much of the weekend troubleshooting a TS-830S belonging to NX1F, Joe. The trouble was in the set's AGC feed. That ricebox was infinitely more difficult to troubleshoot than our venerable R-390As!

Working with those awful Japanese schematics and bad reference designations and poor access for service really makes me appreciate the creme-de-la-creme of American engineering embodied in the '390As. It's why I own one. (BTW: I got the 830S working FB, but not after a goodly amount of sweat and cussing).

From: "Dr. Gerald N. Johnson, electrical engineer" <geraldj@ames.net> Date: Wed, 29 Nov 2000
Subject: Re: [R-390] Level meter

The original meter is 1 ma 17 ohms so is 17 mv full scale and is in a low voltage, low impedance circuit. Your 50 ma meter probably is 1K and so a 50 mv full scale meter. You could try increasing the values of the resistors from each end of the meter to ground by a factor of 3 to get more voltage for the same tube currents.

From: "Dr. Gerald N. Johnson, electrical engineer" <geraldj@ames.net> Date: Sun, 03 Dec 2000
Subject: Re: [R-390] R725/URR and servo vs Se

Your meter is 300mv full scale while the circuit is 17 mv full scale. You can add gain (some use an op amp) but I'd change the resistor between each end of the meter and ground. I'd raise them by the factor 300/17. They still will be low compared to tube impedance. You can reduce the meter resistance with a shunt but you won't change the required voltage drop. The DB meter is a more common item, a VU meter from a recorder of broadcast console is appropriate. Its simple an audio meter made for monitoring the 600 ohm line output. It has little benefit to ordinary listening, it is important when setting the gains for feeding a radio repeater complex or some audio based signal processors as for RTTY or cryptography.

From: "Jim Miller" <jmille77@bellsouth.net> Date: Sun, 31 Dec 2000 13:44:03 -0500
Subject: [R-390] More R-390A Newbie Questions

<snip>
First, I noticed right off that the carrier meter seemed very "scotch". It is some kind of generic replacement by International Instruments. It's face bezel isn't as 'thick' as the line level meter. With the calibrate signal I could only get less than a eighth of full scale. Live signals weren't much better. The AGC didn't seem to be working well either. I tried an quick alignment and replaced a couple of weak tubes in the IF and that helped slightly. So I went for it...I removed the IF module and went through it checking resistance values, looking for burned or aged components. I replaced the killer capacitor in front of the mech. filters and some others (per Chuch Rippel's web page).

I found a 1K and a couple of 2200 ohm resistors that had fried or changed value. I also found a partial short to ground at a pin of Z503 which would account for poor AGC, and also for a blown fuse occasionally as it shorted B+ to ground. So after all that, and a quickie realignment of the IF, I now get a whopping quarter scale reading on the calibrator, which still seems scotch. The receiver seems to have a lot of gain and hot signals but the meter reading is very low. My question is: Has anyone seen this problem with replacement meters or should I look elsewhere for a problem? <snip>

From: "Dr. Gerald N. Johnson, electrical engineer" <geraldj@ames.net> Date: Sun, 31 Dec 2000
Subject: Re: [R-390] More R-390A Newbie Questions

A replacement meter may have a greater movement resistance than the 17 ohms of the original. That will make it scotch. You might check the meter resistance. 50 ohms is far more common for a 1ma movement than 17 ohms. You might get a great indication by replacing the resistors to ground with larger ones, say three times the existing size on each side of the meter. Shunting the meter won't help. <snip>

From: "Walter Wilson" <wewilson@knology.net> Date: Sun, 31 Dec 2000 16:44:40 -0500
Subject: Re: [R-390] More R-390A Newbie Questions

First, the AGC that the rig develops determines the carrier meter level. If your AGC is not right yet, your carrier meter will also be low. Tune in the strongest signal on the band (local AM broadcast) with the BFO off, and measure the voltage at the AGC terminals on the back. Something close the -9 VDC would be about right. If AGC is correct, the meter is probably the problem. Dr. Johnson has given you some good recommendations on this. <snip>

From: "Barry Hauser" <barry@hausernet.com> Date: Sun, 31 Dec 2000 20:52:39 -0500
Subject: Re: [R-390] More on Meters

Yup, that's so true. There are a lot of replacement meters around and some are more of a "reach" than others. I have some of the kind that Fair has been using on checked R-390A's supplied with meters.

These are Ideal/Dejur manufacture, nicely made with a thick cast bezel, 50 ma movement. The meter scale is "arbitrary" with 8 major tick marks with half ticks between, under which is a "Lo-Hi" scale and Input V. I measured the DC resistance at about 1.9K -- quite a way's off from 19 ohms. Dave at Fair says he replaces one or two resistors in the carrier meter bridge circuit to get them to work reasonably (i.e. deflection/not pegging etc.) Using the same as an audio meter replacement along with a diode. Any thoughts? What resistor value changes would be needed and would that really provide any degree of accuracy?

From: "Dr. Gerald N. Johnson, electrical engineer" <geraldj@ames.net> Date: Sun, 31 Dec 2000
Subject: Re: [R-390] More on Meters

I presume that you mean microamps when you say 50 ma and 1.9K. That means a voltage drop of 95 millivolts. The bridge resistors are set to give a voltage difference of 17 millivolts (1 milliamp, 17 ohms). To get 95 millivolts difference you need the two resistors from meter to ground (one at each end of the meter) to be increased by a factor of about 6. The resistance and voltage to ground will still be so low that it won't detectably affect the operation of the tubes.

There is a procedure in the manual to check the meter sensitivity for the radio sensitivity so one can check the effect of the mod and odd meter on the meter display.

I'd prefer a diode bridge to a single diode for the audio meter. And probably a capacitor across the meter to provide the hold typical of the VU type meter. The meter setting resistor should probably be on the AC side of the bridge to minimize the effects of the bridge rectifier on the audio.

From: DCrespy@aol.com Date: Mon, 1 Jan 2001 10:19:13 EST
Subject: Re: [R-390] More R-390A Newbie Questions (carrier meters)

A few years ago Tom Bowes was selling kits that consisted of two of these international meters, a special tool, new meter scales and instructions to convert them. The key to making one work in the carrier level slot was short circuiting the internal (to the meter) dropping resistor to drop the resistance of the meter from 100 ohms to 38 ohms. This is higher than the spec 18 ohms, but I have found every meter with 38 ohms or less internal resistance worked just like an original (side by side comparisons). The big disadvantage is that you have to open up the meter. There has been plenty of discussion about the hazards of radioactive material in the meter on this list. You'll have to weigh the risk against a new $79 original from SSN. I first would check the resistance on yours, though. Someone else may have already opened it up for you.

If the resistance reads about 40 ohms or less, your problem is not the meter. If you need some help on ways to check meter resistance, send me a note.

From: "Dr. Gerald N. Johnson, electrical engineer" <geraldj@ames.net> Date: Mon, 01 Jan 2001
Subject: Re: [R-390] More R-390A Newbie Questions (carrier meters)

If the meter says 100 ohms on the face and the DMM says 39 ohms, its been modified. DON'T EVER measure a meter movement with an ordinary VOM, the meter movement will be zapped if its sensitive. The safe way to measure a meter's resistance is to connect it to a supply through a fairly large series resistor and adjust the supply and/or resistor for exactly full scale deflection. Then add a shunt across the meter terminals and adjust it for exactly half scale deflection. (presuming the meter scale is linear which won't be true of meters for thermocouples and VU). The shunt resistor may then be measured after disconnection from the meter and is the same resistance as the meter.

From: "Dr. Gerald N. Johnson, electrical engineer" <geraldj@ames.net> Date: Tue, 02 Jan 2001
Subject: Re: [R-390] More R-390A Newbie Questions (carrier meters)

Alex, your DMM and my DMM have low current in their ohmmeter ranges. From this sample of three DMM, I don't consider it safe to say that ALL DMM in ALL ranges keep the current low enough to not peg or damage a sensitive micro-ammeter.

From: "Fraser Bonnett" <fraserb5@home.com> Date: Thu, 18 Jan 2001 01:37:22 -0000
Subject: [R-390] R523 and Carrier Level

Would the fact that I can't zero my carrier level meter (R-523) is CCW against the stops and the meter still reads 20dB) indicate a need to replace R523 or is there something else I should check?

From: "Walter (Volodya) Salmaniw, MD" <salmaniw@home.com> Date: Mon, 05 Mar 2001
Subject: [R-390] Radiation counts in meters

Don't recall this thread before. Thought I would check my original metered 390A for radiation. My Line level meter reads 0.7 mR per hour, while the carrier level meter reads only 0.3 mR per hour. Thought this might be an interesting thread. Pull out the old Geiger counter, and let's play "my meters are hotter than yours".....Walt.

From: Jim Miller <jmiller@iu.net> Date: Tue, 06 Mar 2001 12:39:43 -0500
Subject: Re: [R-390] Radiation counts in meters

For comparison, what are the official limits for safety currently on record?

From: Joe Foley <redmenaced@yahoo.com> Date: Tue, 6 Mar 2001 11:58:39 -0800 (PST)
Subject: Re: [R-390] Radiation counts in meters

My '67 EAC shows nothing above "background" radiation.

From: DuffyF56@aol.com Date: Tue, 6 Mar 2001 19:44:11 EST
Subject: Re: [R-390] Radiation counts in meters (information)

The radioactive material used in the R-390A is radium which is formed from the natural disintegration (radioactive decay) of uranium. When mixed with zinc sulfate, radium forms the luminous paint used on the meters. Radium releases primarily alpha and beta particles as well as some gamma. Not sure what kind of meter you used to detect the radiation you did but frankly I am somewhat surprised. The radioactive half life of radium is 1,620 years so perhaps I should not be. When radium radioactively decays it forms radon gas which almost exclusively an alpha emitter. Alpha and beta particles can be stopped with as little shielding as a piece of AL foil. Alpha is actually stopped by a dead layer of skin so unless digested presents no hazard what so ever. As far as the allowable exposure part of the question posed the Federal Regulations allow radiation workers to receive 3 rem per quarter up to 5 rem per year if memory serves.

While on the subject of radioactivity I am sure most of you are aware of the radioactive nature of your OA2WA tubes aren't you?

From: Glenn Little <glittle@awod.com> Date: Tue, 06 Mar 2001 20:04:28 -0500
Subject: Re: [R-390] Radiation counts in meters

The last time I checked, the radioactive meter faces and pointers on the R-390A were alpha emitters. From my radiological training, alpha will not penetrate something as thin as a sheet of paper. If you are reading anything above background on an R-390A meter someone has done something to it. You could get a reading if the glass front was broken, otherwise nothing from the stock meter.

From: "Walter (Volodya) Salmaniw, MD" <salmaniw@home.com> Date: Tue, 06 Mar 2001
Subject: Re: [R-390] Radiation counts in meters (information)

Great overview, Duffy. I'm assuming that the meter is indeed picking up gamma radiation. My premise was to get others to examine and measure the radiation, not rekindle the controversy over it's safety or not. As Jan Skirrow rightly pointed out, unless we plaster the meters to our foreheads for years on end, there is little to worry about, UNLESS, the meters are opened and tampered with and the contents ingested or inhaled. Then indeed, there could be big problems. Remember the inverse square law, and don't worry! .....Walt.

From: "Walter (Volodya) Salmaniw, MD" <salmaniw@home.com> Date: Wed, 07 Mar 2001
Subject: [R-390] Radioactive meters

There appears to be quite a bit of misinformation about radiation emitted by the original meters. The alpha and beta particles being of very low intensity would not be an issue as they would not pass through the glass enclosure. Period. However, gamma radiation is emitted by the radium source, explaining what my Geiger counter is picking up. If your meters don't pick anything up it can only be because, a/ meters are not original b/ radioactive source is depleted sufficiently to minimize radiation or, c/ defective Geiger counter, or I suppose d/ some meters were not "hot". I refer you to an excellent website explaining the process: http://physics.nist.gov/GenInt/Curie/1927.html

As you can see, radium decay has a high energy gamma component. The article has info on the "half thickness" of various materials - which is a measure of their stopping power for radium decay products. They suggest a 15mm piece of lead to shield the detector from soft gamma. Obviously hard gamma is gonna penetrate a piece of glass, and I would strongly expect some of the soft gamma to as well if it takes 15mm of lead to be sure of stopping it.

From: Joe Foley <redmenaced@yahoo.com> Date: Wed, 7 Mar 2001 21:31:56 -0800 (PST)
Subject: Re: [R-390] Radioactive meters

I remember someone mentioning that the later EAC contract didn't have "HOT" meters, mine doesn't show any radiation with my Geiger counter tested against the sample on the side of the counter. NOW, if we want a more accurate comparison: I went out to my 1952 GMC 6 X 6, that's a truck for those who don't know, and checked the speedometer, which still glows in the dark. THAT is one HOT little sucker! It measured 45 mr/hr on the scale of the Anton Electronics CD V-700 Model 6. That's 0.45 on the scale with the knob set to the X100 setting. That's with the glass intact, too, with the probe set tight to the glass.

There it is! The '67 EAC with original meters is NOT "HOT", but the truck,..... well,..... guess I gotta dig a BIG HOLE.

From: "Walter Wilson" <wewilson@knology.net> Date: Sat, 7 Apr 2001 13:00:56 -0400
Subject: Re: [R-390] Three 390 questions

> Can the (new) carrier meter I have be made to give a more "excited" reading than what I get? (Changed out w/non a meter, and it read 20 db higher on same sig.) Has this been common on these replacement meters?

You can change R548 from 27 ohms to 39 ohms to get slightly more response from the substitute meters. Going any higher does not seem to help. Fair Radio makes this mod on their radios with substitute meters. Even then, I've not seen a substitute meter ever give as much deflection as the original.

From: "Barry Hauser" <barry@hausernet.com> Date: Sat, 7 Apr 2001 13:30:26 -0400
Subject: Re: [R-390] Three 390 questions

I read somewhere about the idea of making up a small op-amp circuit to adapt the substitute meters. (Bill Lavick was planning on it, last we spoke.) Has anyone done that? Probably could be small enough to hand on the back of the meter or somewhere nearby and tap power from the lamp wiring. The problem is that some of the "replacement" meters being used now are a even longer reach away from the 17 ohm originals than the previous subs. Of course, we could start that "Hey gang, let's get some new meters made!" thread again <groan>.

From: "Kurt" <radiouser@uswest.net> Date: Sat, 7 Apr 2001 11:36:18 -0700
Subject: Re: [R-390] Three 390 questions

Look at http://www.skirrow.org/boatanchors/articles.htm and select "Adapting "Found " Meters to the R-390A". Jan has done a good job in solving this problem. The circuit is simple and works just fine.

From: "Bill Hawkins" <bill@iaxs.net> Date: Sat, 7 Apr 2001 12:53:15 -0500
Subject: RE: [R-390] Three 390 questions

"Can the (new) car. meter I have be made to give a more "excited" reading than what I get? (Changed out w/non a meter, and it read 20 db higher on same sig.) Has this been common on these replacement meters?"

This is a FAQ that ought to be on some web sites. The internal resistance of "replacement" meters is too high. It would take an active amplifier to restore sensitivity. To measure internal resistance of a 1 milliamp meter, hook it in series with a 12 K resistor to a 12 volt supply and adjust R or V so the meter reads full scale. Now connect resistors across the meter terminals until it reads half scale. The meter reads half scale when the resistance across the terminals equals the internal resistance of the meter.

From: "Kurt" <radiouser@uswest.net> Date: Sat, 7 Apr 2001 12:30:18 -0700
Subject: Re: [R-390] Three 390 questions

Lets try this again. John, you can get a solution to your meter problem by looking at: http://www.skirrow.org/Boatanchors/ . Select "Articles" at the top of the page. Then select "Adapting "Found" Meters to the R-390A". Sorry for the error.

From: Llgpt@aol.com Date: Sat, 7 Apr 2001 20:13:52 EDT
Subject: Re: [R-390] Three 390 questions (Original meter identification)

>It has a 0 to 100 scale labeled DB and has the name INTERNATIONAL on the dial.....

International was one of the original R-390A meter suppliers. I had them on an Amelco i had a few years ago.

From: "Paul H. Anderson" <pha@pdq.com> Date: Sat, 7 Apr 2001 21:06:04 -0400 (EDT)
Subject: Re: [R-390] Three 390 questions (Original meter identification)

I have seen reproductions, but mostly of Simpson or others. You can sort of tell an original meter - yellow or yellowing lettering, aged looking, but still crisp lettering. Reproductions that I've seen usually have "something" wrong with them - fuzzy letters, crisp white letters, "too clean" or obviously a hack job. You can make perfectly nice reproduction faces and find good movements, but it is kind of hard to reproduce that 50's look. I think you can usually see the raised letters (the paint sticks up a little), and that makes them different than the more recent computer printed ones. I'm sure more experienced people could tell you the vintage of different meters used on which approximate contracts, but even then, I would bet the military would swap meters in a second if they needed to get a unit working. There are later replacements made by ideal that have a newer appearance, but they are very professionally done, and it is hard to duplicate the crispness of them, too, in my opinion, but I'm sure someone seriously motivated could do it.

From: "john page" <n8blb@hotmail.com> Date: Tue, 26 Jun 2001 15:09:28 -0400
Subject: Re: [R-390] Broken meter

From the "for what its worth" dept. Awhile back I had a meter that was inop and would not deflect. I used an ohmmeter to test it. Took it apart and started making checks internally. Found the circuit open through the front bearing. I believe someone on here referred to it as the adjustment gizmo. What ever you call it, it should conduct, but it did not. A drop of De-Oxit and it has been working ever since. It worked for me and maybe it will for you.

From: "Scott, Barry (Clyde B)" <cbscott@ingr.com> Date: Tue, 26 Jun 2001 15:08:06 -0500
Subject: RE: [R-390] Broken meter

Hmmm, that's something I did not try. It certainly can't hurt. I have a feeling it might not help me, though, because I was able to get the meter lead onto the solder point of each side of the coil and was not able to get continuity there.

Along the lines of meter questions, this particular movement has a cylindrical object that is suspended inside the coil. Anyone know what this is for? The magnet is around the outside of the coil, so, while I'm sure it isn't useless, this part of the gadgetry appears to have no function.

From: Bob Camp <bob@cq.nu> Date: Tue, 26 Jun 2001 17:29:47 -0400
Subject: Re: [R-390] Broken meter

The meter coil sits in a magnetic field between two ends of a permanent magnet. It bytes a fairly large "chunk" out of the magnetic field at that point. I have always *assumed* that the part you are talking about was there to more or less complete the magnetic circuit as much as possible. This would increase the field in the vicinity of the coil and let you get away with a smaller magnet. I'm also sure it has a name .... haven't a clue what it's called. Sorry about that

From: "Roger L Ruszkowski" <rlruszkowski@west.raytheon.com> Date: Tue, 6 Nov 2001 08:39:38
Subject: [R-390] Carrier Meter TROUBLES ARE OVER

Final update. I changed R537 after all, after calculating that with a 60mV idle the meter theoretically can't reach full scale. It did, however. Hmm. 4th IF grid current? Anyway, I changed it from 22 ohms to 15 ohms. This gives me just a hair over FS without skewing the scale. Works great. All you who've cussed at R523, you really should try it. My previous post, that is, not just the R537 change; alone that will do nothing noticeable. Regards, Dave Wise

Dave, Thanks for putting you mind into this subject for us. I am about to put your circuit changes into my receiver I just knew the carrier meter circuit could be better. I did not expect the fix to be so easy. Roger KC6TRU San Diego

From: MICHAEL OBRIEN <mikobrien@excite.com> Date: Wed, 28 Nov 2001 02:12:21 -0800
Subject: [R-390] (2) r-390a meters

I did some checking on the 2 meters. They both are the same model and were used for both the vu and carrier meters. They have a 50 micro amp movement and measure aprox 1900 ohms. That is different from my original carrier meter (1 ma and 18 ohms) Fair did put a diode in line with the vu meter I do not know what changes they did for the other one. Maybe the r-390 list can help us out with more info.

From: "Walter Wilson" <wewilson@knology.net> Date: Wed, 28 Nov 2001 06:14:01 -0500
Subject: Re: [R-390] (2) r-390a meters

The substitute meters you reference do indeed give reasonable meter deflection both for the line meter and carrier level. But they perform differently from the originals in the following respects:

1. The line level meter requires the diode which you mention. The R-390A is able to drive these meters, but the fast action of the original VU meter is lost with the substitute meters. The substitutes have a much more damped meter movement than the originals. Not a problem for most, unless you've grown accustomed to the original ones.

2. The substitute carrier level meter will not get full deflection for the same level of input signal. I've seen about 70dB deflection on a 100dB signal change in one case where I took the time to measure it. You can increase the value of R548 in the IF deck to get more deflection (I've seen this a number of times on R-390As from Fair Radio). But changing R548 has some effect on the AGC circuit, and I've seen the AGC bias voltage decrease (more positive voltage, less negative bias) with these modifications. So full deflection with a substitute carrier meter is a trade-off.

From: David Wise <David_Wise@phoenix.com> Date: Wed, 28 Nov 2001 11:03:20 -0800
Subject: [R-390] RE: (2) r-390a meters

Walter Wilson beat me to it. It appears he's tried this model of meter before. I haven't, so my analysis is academic. Read it if you like: These meters will give useful but inaccurate displays.

1 (vu). The reading will be zero for all voltages that peak less than about 0.5 (silicon) or 0.2 (germanium). I believe real VU meters use a special type of meter movement that does not require rectification, or a rectifier that starts conducting from 0V. Hmm, I guess you could get close with a Schottky diode. Then some calibration would be in order to find at least 0VU and -10VU. Walter says the ballistics are off too.

2 (carrier). The AGC time constant tube puts about 0 to 2.5 mA through a 27 ohm resistor, yielding a delta of about 70mV for an infinite-impedance meter. 1900 is close enough to infinite in this context. 70mV/1900ohm is about 35uA or about 70% scale*. For a 50uA meter to reach full scale in an un-tampered R-390A, it has to be 1300 ohms or less.

If you drive the 4th IF into the positive-grid region, it will boost the meter further. This is how you can get a carrier deflection in MGC mode., but that won't happen when AGC is on unless the signal is in the Volts range.

Both of these meters could have an op-amp circuit grafted onto them to get realistic deflections. The carrier circuit has been analyzed in detail and the R-390 list archives contain two usable circuits (mine and Jan Skirrow's). I don't know a VU circuit but I'm sure one is possible. It could be tough to compensate the ballistics, but only the purists would care and they won't be buying these meters anyway.

The existing scales are inappropriate and should be replaced with R-390A VU or carrier reproductions.

Now that I've sandbagged you, let me compensate by saying that if I had a meter-less R-390A, I might buy them.

From: "Bill Smith" <billsmith@ispwest.com> Date: Wed, 28 Nov 2001 14:14:40 -0800
Subject: Re: [R-390] RE: (2) r-390a meters

Are there any replacement scales available for "real" meters? The carrier level meter on my R-390 must include quite a bit of phosphor and radium, for now it is brown and dull.

Also, on an R-390A, I have a VU meter that is a VU type, but with a slightly different scale.

Actually, if someone has a spare carrier meter that needs a VU meter, I would be willing to trade, as the R-390A is now blessed with two VU meters (the meter in the carrier position is just there to fill the hole) and needs a carrier meter. Note, as mentioned above, that the VU scale is ok, but the style not quite according to Hoyle.

From: "Kenneth Crips" <w7itc@hotmail.com> Date: Wed, 23 Jan 2002 17:39:52 -0700
Subject: RE: [R-390] Below 8mhz problem

RE: http://www.atc-us.com/ATCSHOP/

Check out the meters for 18.00 they look very much like the originals for the R390.

From: "Walter Wilson" <wewilson@knology.net> Date: Wed, 23 Jan 2002 20:00:04 -0500
Subject: Re: [R-390] Below 8mhz problem

> RE: http://www.atc-us.com/ATCSHOP/ Check out the meters for 18.00 they look very much like the originals for the R390.
>
I have some of those meters in the shop. They are 100 uA full range, instead of the 1mA for the R390 carrier meter. I have not measured in internal resistance.

From: "Alex McDonald" <amcdonald@toyodatrw.com> Date: Fri, 1 Feb 2002 11:56:34 -0500
Subject: [R-390] Line Meter wiring

I have a blue-striper which I received without meters. In attempt to hook up a meter I found that 3 wires were cut for the line meter. I can only find 2 wires listed to connect to the meter on a schematic that I have, (no wire color code specified).=20 My wires come out of a tightly bound pack. They are white wires with a single stripe each of black, red and orange. The black one seems to originate from somewhere low in the radio. I assume that 2 of the wires hook to a single post on the meter. Does anyone know the correct setup of these wires to the meter? Thanks, Alex

From: David Wise <David_Wise@Phoenix.com> Date: Mon, 4 Feb 2002 15:21:35 -0800
Subject: RE: [R-390] Line Meter wiring

<snip>
> My wires come out of a tightly bound pack. They are white wires with a single stripe each of black, red and orange. The black one seems to originate from somewhere low in the radio. I assume that 2 of the wires hook to a single post on the meter. Does anyone know the correct setup of these wires to the meter?

Download the Y2K R-390A manual from the FAQ site, Alex. page 6-83, Figure 6-35 Radio Receiver R-390A/URR, Main Frame Wiring Diagram (Sheet 1 of 2). The White/Red goes to meter minus, the two White/Black/Orange go the plus.

From: "Bill Riches" <bill.riches@verizon.net> Date: Thu, 4 Apr 2002 14:00:01 -0500
Subject: RE: [R-390] Wiring question

----- Original Message ----- I just replaced the original Carrier Level adjustment pot with a 10 turn pot and was interrupted..

White-orange-blue wire and white-green-blue to center terminal (which is connected to one of the end terminals) and the plain white wire goes to the other end terminal.

From: "Frank" <fstyron@nc.rr.com> Date: Thu, 4 Apr 2002 18:20:43 -0500
Subject: RE: [R-390] Wiring question

John, I took a picture knowing that I would be distracted before I completed the carrier adjust mod. Well, two days later, it came in handy ;-). If you would like to see the picture point your browser to: http://home.nc.rr.com/fs/r390a/390a.htm

Date: Sat, 18 May 2002 12:40:09 -0400 From: Helmut Usbeck <vze2gmp4@verizon.net>
Subject: [R-390] Carrier level meter

Has anyone used Jan Skirrow's, VE7DJX op amp circuit, that makes "replacement meters" useable in an R-390a? So far I've built two circuits using Jan's values but with a 741 op amp. Can't get the thing to work at all. Does someone have a circuit they've tried and gotten good results with it? Thanks.

From: "Walter (Volodya) Salmaniw" <salmaniw@shaw.ca> Date: Sat, 18 May 2002 22:10:57 -0700
Subject: Re: [R-390] Carrier level meter

Helmut, Jan's article can be found at his website:
http://www.skirrow.org/Boatanchors/TechTalk2.pdf Good luck!.....Walt.

PS: I have one of these meters installed thanks to Jan, in my 390A, and it works fine.

From: "Dulaff, Paul" <PDulaff@dpconline.com> Date: Tue, 30 Jul 2002 16:14:44 -0700
Subject: [R-390] Replacement Meters for the R390A

What are the alternatives to using SSN replacement meters on the 390 ? I understand that the SSN meters are an OEM replacements, but they are pricey. Thanks for you input. This list is great !

Date: Tue, 30 Jul 2002 19:20:21 EDT From: Llgpt@aol.com
Subject: Re: [R-390] Replacement Meters for the R390A

By SSN do you mean Surplus Sales of Nebraska? If so, their replacement meters are the late R-390A replacement meters. Exact matches. I believe that there was a thread that said they were out at one time, but not sure. I know someone who purchased a set, very nice NOS stuff. Les Locklear

From: Leigh <bipi@att.net> Date: Mon, 12 Aug 2002 21:07:35 -0700
Subject: [R-390] Line Level VU Meter

I am in the process of refurbishing an R390A. The carrier and line level meters are original and work fine. However, I have a NOS carrier meter (with the correct internal resistance) that I would prefer to use and I am looking for a replacement line lever VU meter of proper physical and electrical characteristics to match this carrier meter. If you have such a meter, I would be interested in purchasing it out-right or I would trade the 2 original meters for it. I have posted some photographs of the original and replacement meters on my Web site. The carrier meter is in very good condition but the glass on the line level VU meter is "foggy". They are both made by Internationl. Note that the open viewing area of the NOS carrier meter is larger than that on the 2 original meters, but all other dimensions are the same.

Link to picture of 2 original meters: http://home.att.net/~bipi/miscpix/mtrpair.jpg
Link to close-up picture of original VU meter: http://home.att.net/~bipi/miscpix/mtrvu.jpg
Link to picture of all 3 meters together: http://home.att.net/~bipi/miscpix/mtr3.jpg
Link to picture of NOS carrier meter that I want to match:
http://home.att.net/~bipi/miscpix/mtrnew.jpg

The literature I have looked at references a meter resistance for the line level VU meter of around 3360 ohms but mine measures 15.3k ohms on a Fluke 77. The carrier meter measures 18.1 ohms as it should. So let me know if anyone is interested in an exchange or sale of a replacement line level meter that matches the NOS carrier meter that I have. I guess the other question is if someone knows if these meters can be safely opened to clean the glass? They appear to be sealed. Thanks to all... 73 de Mike K7PI, Mercer Island, WA

From: Buzz <buzz@softcom.net> Date: Mon, 12 Aug 2002 21:22:06 -0700
Subject: Re: [R-390] Line Level VU Meter

Mike, I have opened many of the "sealed" meters with a special tool that I made. Send me a picture of the back of the meter then I can better tell you if I can open it.

From: Leigh <bipi@att.net> Date: Mon, 12 Aug 2002 21:43:30 -0700
Subject: Re: [R-390] Line Level VU Meter

Hi Buzz, Thanks for the quick reply... Here are some pictures of the backs of the original meters....let me know if they show what you need to see.

http://home.att.net/~bipi/miscpix/mtrbk21.jpg
http://home.att.net/~bipi/miscpix/mtrbk22.jpg
http://home.att.net/~bipi/miscpix/mtrbk11.jpg

Thanks Again...

From: "Glen Galati" <eldim@worldnet.att.net> Date: Tue, 13 Aug 2002 01:41:36 -0700
Subject: Re: [R-390] Line Level VU Meter

Hello Mike, I've got a lot of those small meters, however I'll have to study your pictures and compare with our to decipher. I'll post after I have a BRAIN DIGESTION.

From: "scott" <polaraligned@earthlink.net> Date: Tue, 13 Aug 2002 06:38:57 -0400
Subject: Re: [R-390] Line Level VU Meter

Yep Mike, those International meters can easily be opened. They are plastic not glass and you can easily replace lens if needed. First turn the meter over and pick out the rubber around the edges. It will come out in one piece. You will see 4 hollow screws at the corners where the mounting screws go through. Remove these screws and presto! the meter separates from the front. I did this to repaint my meters. Very easy I agree, your NOS meter there is quite a nice unit. Sure would be nice to find a matching pair.

From: DCrespy@aol.com Date: Tue, 13 Aug 2002 20:17:28 EDT
Subject: Re: [R-390] Line Level VU Meter

Scott, three added comments to the reply below.

1. Sometimes the International meters have left hand (vs normal right hand) threaded screws. If they do not come out easily, try turning the other way.

2. I have found them also with glass lenses.

3. The meters were painted with radioactive material that, in spite of no longer glowing, is still quite toxic. Particles are likely loose inside the housing. Let your conscience guide you on the health risk of opening one up. Protect yourself if you do. That $80 NOS meter from SSN doesn't look so bad, in this context.

From: rbethman@comcast.net Date: Tue, 13 Aug 2002 20:32:46 -0400
Subject: Re: [R-390] Line Level VU Meter

I don't know how "toxic" radium is after it has gone through several half lifes. Is it an alpha emitter? If so, the particles could probably be safely vacuumed out. Alpha particles won't go through paper or unbroken skin, BUT are VERY toxic if breathed in or otherwise ingested.

From: Joe Foley <redmenaced@yahoo.com> Date: Tue, 13 Aug 2002 19:03:37 -0700 (PDT)
Subject: Re: [R-390] Line Level VU Meter

If this is a '67 EAC it probably doesn't have hot meters anyway. If its older,..... well, when I was out playing with my Geiger counter I happened to check the speedometer on my 1952 deuce-and-a-half,...WOW was that one HOT!! So-o-o-o, if your radio was built with "hot" meters they are probably still HOT!

From: rbethman@comcast.net Date: Tue, 13 Aug 2002 22:15:12 -0400
Subject: Re: [R-390] Line Level VU Meter

My 67 EAC glows VERY well in the dark, thank you! My Collins - 52 - Definitely still does. As I dig through my archives - Radium IS AN ALPHA emitter.

Recommendation: DO NOT OPEN original meters. I suspect that this would be VERY detrimental to one's long term existence! Ingestion of alpha particles is not a NICE way to go!

From: rbethman@comcast.net Date: Tue, 13 Aug 2002 23:29:41 -0400
Subject: Re: [R-390] Line Level VU Meter

Could be replacement meters. They (67 EAC) do NOT have Radium dial faces

Date: Tue, 13 Aug 2002 22:42:07 -0500 (CDT) From: "Jim Shorney" <jshorney@inebraska.com>
Subject: Re: [R-390] Line Level VU Meter

These appear to be originals (58 date code on one), and the seller of the radio (whom I trust and who is knowledgeable about these things) assured me that they are.

From: rbethman@comcast.net Date: Tue, 13 Aug 2002 23:52:00 -0400
Subject: Re: [R-390] Line Level VU Meter

Do they glow if light is applied to them for a period of time - THEN look for a glow?

Date: Tue, 13 Aug 2002 22:59:19 -0500 (CDT) From: "Jim Shorney" <jshorney@inebraska.com>
Subject: Re: [R-390] Line Level VU Meter

Haven't tried that yet.

From: "scott" <polaraligned@earthlink.net> Date: Wed, 14 Aug 2002 06:50:04 -0400
Subject: Re: [R-390] Line Level VU Meter

> Radium IS AN ALPHA emitter.....DO NOT OPEN original meters.....
I DON'T want to downplay the health risk. But it takes a pretty sizeable exposure before the risk of cancer goes up. We all drink radium in our water every day. Some water supplies are worse than others. Opening the meters is not sure death. It just needs to be done with caution and with care. Radium sits in our bones and decays producing Radon. Back in the 20's people used to drink radium for it's "invigorating" properties and believe it or not, some of these people were around 50 years later to tell about it. Others who drank a lot, were often not around for more than several years and died of bone decay and cancers. Like an idiot I smoked for 18 years, being quit for 2 years now, and probably did a LOT more long term damage to my body. Not to say that it is OK to just open meters carelessly, but doing so outside and downwind, with a quality partical protective mask, is probably just fine. JUST MY OPINION. Don't sue me for your own stupidity.

From: "David Wise" <David_Wise@Phoenix.com> Date: Wed, 14 Aug 2002 10:55:49 -0700
Subject: RE: [R-390] Line Level VU Meter

Radium has a half-life in the thousands of years, so if it was hot, it's still hot. The phosphor, however, gets tired and quits glowing, I wouldn't be surprised if a radio-phosphor was also light-storing; you folks who see that aren't off the hook. Since it's an alpha emitter and alphas are stopped by just about everything, your Geiger counter will not register through the glass. Alphas may be easy to stop, but if you inhale or ingest a source, it will work on you from the inside for the rest of your life; high risk of cancer. If you open one, it's a good idea to wear a good fine-particle-filtering respirator, do it in a breeze-free place, don't kick up any dust or let a single speck fall on the floor, and treat the tools and debris as low-level radioactive waste.

From: rbethman@comcast.net Date: Wed, 14 Aug 2002 17:23:11 -0400
Subject: Re: [R-390] Line Level VU Meter

I was simply drawing from memory. I do not remember the half life. I sort of remember that it is an alpha emitter. My concern is folks exposing themselves to an open source of alpha emissions. This is not good practice at all. While some talk about radon exposure, it isn't concentrated as the radium on the face of the meter. Then there is the possible "flakes" or particles inside the enclosure. This should be handled with MUCH care. Any "Geiger" counter won't pick up the emissions with even a piece of paper over the particle(s), much less the glass or plastic meter cover/face. If folks, especially us older ones, remember the results of the women working at National Lead whom used to hand paint the faces of meters, they'd give a LOT of thought as to the care they take with this.

From: blw <ba.williams@charter.net> Date: Wed, 14 Aug 2002 18:41:50 -0500
Subject: Re: [R-390] Line Level VU Meter

I know that a lot of those ladies who painted our radium dials died an early death. They had a habit of wetting the points of the brushes in their mouths. A former factory in New York is still a hot zone after all these years. I would suggest that a no wind environment is the idea place to tinker with radium dials. I did some component changing on a larger clock face a few months back and took precautions. My wife says that she can see me better at night, but I never listen to her anyway. (g)

From: "Dulaff, Paul" <PDulaff@dpconline.com> Date: Mon, 19 Aug 2002 14:53:07 -0700
Subject: [R-390] Audio Level VU Meter Specifications

I am quoting a reproduction run of the VU meter for the R390A. The supplier needs the Collins drawing and specifications for the meter. The Collins P/N is 481 0001 00. Any of you folks know how I can get a drawing or the meter specifications ?

From: "Bill Smith" <billsmith@ispwest.com> Date: Mon, 19 Aug 2002 15:09:21 -0700
Subject: Re: [R-390] Audio Level VU Meter Specifications

M102 METER, CARRIER LEVEL: (55026) type no. 182; per (80063) dwg no. SM-C-283216

M101 METER, LINE LEVEL: Flange, panel mountings, (80063) dwg. no. SM-C-283217

Date: Thu, 22 Aug 2002 15:34:04 -0700 From: "Dulaff, Paul" <PDulaff@dpconline.com>
Subject: [R-390] VU Meter Drawing - SM-C-283217

I am investigating sourcing a reproduction VU meter for the R390A. The potential supplier of the meter needs the drawing for the meter in order to complete the quotation process. I understand that a CD of the R390A drawings exists. If anyone can supply me with a copy of the drawing (electronically or otherwise), I could then proceed to investigate the cost of reproduction meters and report my results here. As a side note, my research so far has determined that SSN is now out of stock of R390(A) meters. What was left were NOS replacement meters for the R390(A), but now are gone. I guessing that the source of meters has dried up and that there may be a need for replacement meters of 25 units or so (?) depending upon the price. Again, if anyone can supply the documentation, please let me know. Paul - WB2NMI

From: <jlap1939@yahoo.com> Date: Fri, 23 Aug 2002 08:34:43 -0700 (PDT)
Subject: [R-390] (no subject)

Friends, Short note: anyone need a carrier meter? Have one and would sell very cheap if you NEEDED it..(I replaced it as it was International, and I wanted Simpson... or I would trade... Also still have a nice lg. knob... (clamp, but no screw...) Trade both for what have you, or what do you offer in green stuff...

From: DCrespy@aol.com Date: Sun, 25 Aug 2002 08:54:02 EDT

One of my R-390A's is running that meter. I installed it. I got it at Fair radio years ago, along with my first R-390A. Unfortunately, I do not know what it came from. It was a loose meter in one of their bins when I picked it out. I have done side by side comparisons with both used original and correct NOS meters. The meter that you have reads correctly as installed in an R-390A. That is, a 3dB reading on that meter corresponds to a 3dB reading on an original/NOS meter, and so on. I'd clean it up, paint it and use it! If not, let me know, I'd be interested in buying it!

From: Mahlon Haunschild <mahlonhaunschild@cox.net> Date: Sun, 22 Sep 2002 18:06:36 -0500
Subject: [R-390] International meter disassembly

I have a pair of 1964-vintage R-390A International meters that need to have their bezels re-painted, and I'd like to remove the bezels to do this. It's not obvious to me how the bezels are removed, and I haven't pried up the rubber gaskets yet (for fear of tearing them up needlessly). Can anyone offer some advice on this?

From: Helmut Usbeck <vze2gmp4@verizon.net> Date: Sun, 22 Sep 2002 22:29:26 -0400
Subject: Re: [R-390] International meter disassembly

To remove the front bezel. Looking at the back of the meter there are 4 slots at the base of the bezel. I use a small screwdriver and tap at slots, top to the left. It should then unscrew easily. No need to mess with the rubber gaskets or remove terminal screws.

From: "scott" <polaraligned@earthlink.net> Date: Mon, 23 Sep 2002 07:10:35 -0400
Subject: Re: [R-390] IMPORTANT International meter disassembly

The MOST important thing that is what Helm forgot to tell you.

OPENING THE METER WILL POTENTIALLY EXPOSE YOU TO RADIUM DUST WHICH CAN HAVE LONG TERM HEALTH RISKS. ONCE YOU INHALE A SPECK, IT SETTLES IN YOUR BONES AND IS THERE TO STAY.

The meters can be safely disassembled but you must use common sense.

From: Dan Arney <hankarn@pacbell.net> Date: Mon, 23 Sep 2002 07:17:36 -0700
Subject: Re: [R-390] IMPORTANT International meter disassembly

Scott, Sounds like you must have been on the De-Mil board that caused all of the meters to go away. For the record please prove that any one person has ever been hurt by what radiation that might be emitted from any of the metros. You are exposed to more stuff everyday than the meters. Just send me all of the meters and I will keep them out of harms way for another one or two half life periods. You could scrape them and make an omelet and eat it with no harm.

From: "Bob Tetrault" <r.tetrault@attbi.com> Date: Mon, 23 Sep 2002 08:42:11 -0700
Subject: RE: [R-390] IMPORTANT International meter disassembly

If the population of meter dissaemblers were large enough there would be an increase in the incidence of radiation effects. The "for the record..." statement is exactly what the tobacco lobby said.

From: Jordan Arndt <jordana@nucleus.com> Date: Mon, 23 Sep 2002 09:50:21 -0600
Subject: Re: [R-390] IMPORTANT International meter disassembly

I would think that would depend on 'someone's' tendency towards developing any type of cancer, bone disease, liver problems etc... We are not all the same, and hereditary tendencies can be a big part of the risk. Adding "known" factors into the equation only heightens the risk...Avoiding things that add to the count of factors can only help. Why risk exposure to something that can increase the chance...? Perhaps the level is very low, and in 99.9% of the cases, "Harmless", but disregarding the risk should be left to the individual. Even OA2WA tubes emit radiation, but personally, I'd prefer cheese and mushrooms in my omelet.... 73 de Jordan....

From: "scott" <polaraligned@earthlink.net> Date: Mon, 23 Sep 2002 13:19:38 -0400
Subject: Re: [R-390] IMPORTANT International meter disassembly

I would love to see you do it. Please e-mail pictures. And that is just your humble opinion because you can produce no evidence contrary. Let's get back to the point here...it is not just a short exposure....it will be decaying in your bones for the rest of your life. I am NOT against taking apart the meters, hell, I just did mine. I am for warning people of the potential for hazard. I feel that it is a responsibility we have to tell someone who may be in the blind about possible radium exposure. Let them make the decision how to proceed. Nothing wrong 'bout being a good neighbor.

Date: Mon, 23 Sep 2002 22:39:55 EDT From: DCrespy@aol.com
Subject: [R-390] Re: R-390 digest, Vol 1 #401 - 8 msgs

If the gasket is the one that is square on the outside to match the meter outside dimensions and round on the inside to match the meter body, you will have to pry it out to get a look at the screws that hold the bezels on. They come off easily, especially if you use a little soap to help it slide off.

The screws are drilled through for the mounting screws, so there will be one at each mounting point. This will be clear when you get the gasket off. Some of the screws are conventional right hand thread, while some I have found are left hand thread! So, if they do not come out easily, try turning the other way! Finally a caution, the glass and its gasket will not be real secure in the housing, and will likely come loose after the bezel is removed. If you have the radioactive meters, you have to decide how important it is to you and your health to have a perfect paint job. If you have any doubts, I'd just clean it up with windex, as it sits, then mask it precisely and paint.
I hope this helps

From: Dave and Sharon Maples <dsmaples@comcast.net> Date: Sun, 06 Oct 2002 17:38:25 -0400
Subject: [R-390] R-390A meters

All: I thought Harry's note on the residual radioactivity of the meters was certainly useful to know. He mentioned a $50 cost-savings figure. Has someone made replacement meters for the R-390A in that price range? If so, who is the company? As much of a pain in the neck a typical meter repair job is (and with such little guarantee of success in the end), $50 is not anywhere near too much to pay to just replace the things. Presuming that there is NOT an easily-obtained replacement, I'm sitting here thinking about how to disassemble, clean, and reassemble the meters without letting any particulate matter loose. This sounds just like asbestos removal to me, and just about as much fun as a dental drill with no anesthetic! Thoughts run toward disassembling the meters in a bowl of Freon-TF or similar degreaser, cleaning out the movements, and then sealing up the debris in a suitable container and getting rid of it. Boy, that's a lot of work, and how do I deal with trying to find a place that will handle disposal of potentially radioactive waste (maybe the local radiology or nuclear medicine department at the hospital)? I've got a set of three Harris URC-94 SSB transceivers that use basically the same meter style. Since those are illuminated (and about 20 years newer) I suspect they DON'T have the same problems, but one never knows (sigh). Ah, well, when I was a kid I was the happy recipient of a number of science kits, courtesy of Mom and Dad. One of them had to do with a cloud chamber and radioactivity, and there was a bag of what I believe was pitchblende included in the kit, as well as some film. I never built the cloud chamber, but did manage to leave the bad of pitchblende on top of the film, and as I recall it got well and truly fogged. I have probably had more radioactivity from that than I will ever get from the R-390A meters...

From: Roy Morgan <roy.morgan@nist.gov> Date: Mon, 23 Dec 2002 10:20:13 -0500
Subject: Re: [R-390] METERS What To Do?

>...even if they no longer glow, they will still be "hot". Maybe the best route is to just leave them as is rather than risk inhaling any radium loaded dust. Jon AB9AH

>. I'm looking at those meters and thinking that I want to open them up and give the glass a good cleaning.

I concur. The radioactive stuff is *some* (not all) meters is harmless if left in the meter. If you ingest it, you are at risk for cancer. Morgan's rule for Glowing Meters and voltage regulator tubes with radioactive stuff: DON'T BREAK THEM OPEN AND EAT THE INSIDES. (Or the functional equivalent of trying to clean the inside of the glass)

From: tbigelow@pop.state.vt.us (Todd Bigelow - PS)
Subject: Re: [R-390] METERS What To Do? Date: Mon, 23 Dec 2002 10:20:22 -0500

Interesting that this subject has just come up. I'd always wondered about the meters in my R-390A and older R-390. Last night I'd been doing a little work in the radio room with lights on, then left for a while. I thought to take a small flashlight and go back in (thinking I'd need to charge the radium again) for a look. Well, the room was dark and the meters were glowing well enough that I could see the scale separations. The A model is a Teledyne, so I'm guessing early 60s for it. The R-390 is a Collins, probably early 50s? Whatever the case, the radium is still very active. Don't think I'd care to dig into them for the sake of glass-cleaning, either.

From: Richard Loken <richardlo@admin.athabascau.ca> Date: Mon, 23 Dec 2002 12:27:26 -0700
Subject: Re: [R-390] METERS What To Do?

The radium is used to activate the luminous paint, if you need a flashlight to make it glow then the paint is NOT radioactive. I repeat, the radium is used to activate the luminous paint - radium is not luminous and luminous paint is not radioactive.

Date: Tue, 24 Dec 2002 01:20:40 EST From: AB3L1@aol.com
Subject: [R-390] METERS

Did I say that I was going to take these apart? No way. Those babies look fine as they are and considering the age are beautiful. I'll have to make sure my eight year old doesn't get near them. We need to keep the family name going. I better keep this thing in the garage high up on a shelf.

Date: Sat, 28 Dec 2002 11:25:29 -0500 From: "Joel Richey" <richey2@mindspring.com>
Subject: [R-390] carrier level meter

Happy holidays to everyone, I just rebuilt a 390A and it works great except for an over active cxr meter, it reads full scale on average signals, AGC action is good and have tried all tubes associated with this ckt to no avail, voltage measurements are good and receiver plays very good other the meter pegging on average sigs, anyone had this problem before???

From: "Walter Wilson" <wewilson@knology.net> Date: Sat, 28 Dec 2002 11:34:31 -0500
Subject: Re: [R-390] carrier level meter

Check the resistor from pin 3 to ground on V506. It should be 27 ohms. Fair Radio changes out this resistor to give their substitute meters enough drive. It's possible your IF deck has had this resistor swapped out in its past life.

Date: Tue, 31 Dec 2002 11:00:39 -0600 From: "Ron H" <rnharsh@attbi.com>
Subject: [R-390] Meter question

Can someone please explain the whole meter thing? First off, why do they remove them? Maybe more important, can I buy "original meters" or at least remanufactured meters with the scale etc. or do I have to use the replacement meters which I understand work well but don't meet the "restored" criteria...

From: tbigelow@pop.state.vt.us (Todd Bigelow - PS) Date: Tue, 31 Dec 2002 12:45:43 -0500
Subject: Re: [R-390] Meter question

> Can someone please explain the whole meter thing?. Seems appropriate, almost like we were destined to go here next after the ballast tube flogging? (o:

The issue with the original meters in most all the R-390 and 'A' type radios is one of radium paint used to make the meters glow in the dark. Somewhere along they decided to remove the possibility that someone could become ill or die from exposure (Roy is the man for this explanation!), so they decided to remove them before surplussing the units. Then later they decided to just crush them all instead (radios) so a 'clever' adversary couldn't use them against us. Anyhow, many radios ended up hitting the market meter-less for this reason, the ones that survived. As a result, original meters are less plentiful. Simple, right? Well...yes and no. As far as replacement meters, they are available. As far as original meters, they are as well. But as far as the 'restored criteria' you refer to, please bear in mind that many/most of these radios went through gov't depot maintenance throughout their lives which resulted in the internal modules being swapped out and modules from other radios (made by other manufacturers) being replaced in the unit before shipping it back out. So, depending on the criteria you use for a 'restored' unit, it likely won't matter.

Some units never went through this type of a tear-down because they were used in different areas or by specific individuals. Some were even sold to civilians *new*. These radios have all the original modules they were shipped with as a rule, probably having a problem module serviced and reinstalled if the unit failed. Since these radios were not in the same equipment stream as the vast majority, chances are good that they still have their original meters too, though. Probably the original paint, tag, etc. as well.

If your level of restoration is defined by this, best thing to do is have an expert on these radios find one for you. They aren't plentiful, but they do exist. If you have one that you want to restore yourself, it depends more on whether you want to use it or display it, as well as how much you want to spend. Since the radio won't likely be restorable to 'factory' condition, why not just get the aftermarket meters? They'll plug the holes and work just fine, and cost less too. If you really want it to 'look' just like it originally did, it'll take more money and perhaps patience, but you can find the meters that were originally installed. I was fortunate to get an R-390 with the meters still in place, but of the two 'A' models I have, one has no eyes!

Hope this information helps. I'm sure others will add to it as well.

From: "Ron H" <rnharsh@attbi.com> Date: Tue, 31 Dec 2002 12:26:43 -0600
Subject: Re: [R-390] Meter question - reply address

Thanks for the info! I am not a purist, just thought it peculiar that most of the R- 390s and R-390As that I see FS have no meters. I am no expert but I would guess that you would have to eat a few dozen meters to actually have any ill effects. I've worn a radium dial watch for most of my adult life and I don't glow in the dark yet! Maybe I better check tonight... As usual, if I want pure all it takes is money.... As for the reply address thing the signature with the note about the reply address is attached automagically but I can't post to the list unless I actually change my address to the one that I used to subscribe... I guess it keeps out the spamers... hope so anyway.

From: "Bob Tetrault" <r.tetrault@attbi.com> Date: Tue, 31 Dec 2002 10:42:50 -0800
Subject: RE: [R-390] Meter question - reply address

Ron, Alpha particles are stopped by the glass or plastic of your watch face. I assure you that your children would deplore your untimely loss should you eat even a portion of a meter face. Exactly when they would feel the loss is a statistical question best answered by the tobacco industry, who successfully argued for years about causality versus epidemiology...

From: "pete wokoun, sr." <pwokoun@hotmail.com> Date: Tue, 31 Dec 2002 09:27:48 -1000
Subject: Re: [R-390] Meter question

On the missing meter question, if both were removed at depots there should be an equal demand for both the line and carrier level meters. Is this the case in the real world? As one who tries to recycle those little meters with the 'proper' scale added, the carrier meter is a lot harder to find and duplicate as a drop-in replacement. It's movement is a lot less resistance than your line level one and the replacements I've been able to find. Hence the increasing trend to tweek some of the resistors in the IF deck to allow others to work.

From: "Jerry Kincade" <w5kp@direcway.com> Date: Fri, 10 Jan 2003 06:27:27 -0600
Subject: Re: [R-390] Cleaning

I definitely qualify as an old salt, Pete - retired from the Navy 22 years ago. Heck, I've probably wrung more salt water out of my socks than most people have sailed over, as the old saying goes.

EPA rules do make a difference, I guess. They stocked 1,1,1 Dichloromethane in five gallon cans on my first ship. Nobody knew any better, they thought it was a safe alternative to carbon tetrachloride as a cleaning solvent. Ha.

BTW, I fixed my Line Level meter. It was easy to open (it's not one of the glowing types). The problem was an open 1180 ohm wire wound resistor. Bridged it with a 1200 ohm 1/8 watt carbon film type, works fine now. It's probably not perfectly calibrated any more, but it probably wasn't perfect before. Besides, it's just a VU meter. Thanks for the offer of help on it.

From: Bob Camp <ham@cq.nu> Date: Sun, 09 Feb 2003 19:38:06 -0500
Subject: Re: [R-390] Continuing on the R-390A .....

Hi, Odd thing about the 10 turn pot modification. You really need a different value pot. Strange but true .... If you take a look the pot has a 22 ohm resistor across it. When the pot is set to the high end the parallel combination comes out to 18 ohms. The combination is in series with a 680 ohm resistor so it's not like they had to do it to keep anything from burning up. I have checked a couple of radios and have yet to find one that comes up with more than 15 ohms for the combination of the pot and the 22 ohm resistor. Normally they seem to run around 7 ohms or so. If you can get your hands on a 20 or a 25 ohm pot that should improve the situation over the stock part 3 or 4 X. Of course you would have to change the 22 ohm resistor but that's pretty easy to do. Another way to do it would be 5 ohm pot with a selected resistor in series with it. Again you could use a small single turn pot rather than a big ten turn job. Getting the 10 turn pots under the bracket can be a pain.

From: "pete wokoun, sr." <pwokoun@hotmail.com> Date: Sun, 09 Feb 2003 21:34:36 -1000
Subject: Re: [R-390] Continuing on the R-390A .....

Mouser sells a 10 ohm pot that works perfectly. Xicon/Alpha 24mm Wirewound Potentiometer 24MM WIREWOUND 10 ohm Makes zeroing very easy.

R-390/R-390A Carrier Meter Zero Adjust Mod

David Wise September 2007 Revised 9/18/07

The R-390A Carrier Zero pot, R523, is very touchy. A popular mod is to replace it with a ten-turn unit. This works, but it doesn't solve the underlying problem, it only covers up the symptom.

I have developed a simple, reversible mod that makes the original pot work better than new. It spreads out the adjustment range and makes it linear. Only the IF deck changes, and you may not have to remove it from the radio. You don't even have to demount the pot.

This mod is very effective on the R-390A. It can be applied to the R-390 with more effort and lower expectations.

Pre-Requisites

1. This mod is for the original 17-ohm meter only.

2. If, like mine, your meter reads high (more than 100dB with 100mV of signal on the balanced antenna input), you can do this mod without removing your IF deck. Otherwise you will have to change a resistor inside.

There is another, more involved mod that also allows you to use a nonstandard meter, which I will write up later.

Theory

The R-390A Carrier Meter circuit places a milli-ammeter between an adjustable voltage and the variable voltage at the cathode of the AGC time constant tube V506A, whose grid is on the AGC bus. At zero signal, V506A is saturated and conducting a plate current of about 2.2mA . This current develops about 60mV across the 27 ohm cathode resistor R548. If the adjustable voltage on the other side of the meter is also 60mV, the meter indicates zero. As the signal level increases, the AGC bus goes negative, reducing V506A's current and hence the voltage on the minus end of the meter, and the meter goes upscale.

The adjustable voltage comes from a variable resistor in the 4th IF V504 cathode. This tube is not controlled by the AGC bus; instead it uses the "cathode bias" technique, where the cathode current goes through 680 ohm R524, pushing the cathode positive with respect to the grid in a way that tends to minimize change. The operating point is about 13mA and 9V*. The designers inserted a small variable resistor at the bottom of R524 and anchored the meter at the junction.

* Says the manual. In my radio, four different 6AK6 tubes yielded from 7.5V to 8.5V, so the average current is 11mA not 13mA. All my calculations below are based on 11mA.

Getting 60mV from 11mA takes 5.5 ohms*. The smallest pot available at the time of the R-390 was the 15 ohm wire-wound unit that they used. As the radios went into service it became apparent that the change as the slider moved from one turn of resistance wire to the next was objectionable, and in the R-390A they replaced it with a carbon pot (Cost Reduction Report, section 4.3.3, page 15). (There is new speculation that low-ohm pots were also regarded as unreliable and their use became discouraged.) The smallest unit available was 100 ohms, and the engineer unimaginatively tacked a 22-ohm fixed resistor, R537, across it to bring it down to approximately the same maximum value as before. This new pot did not suffer from the stepping effect of its predecessor, but the adjustment range is compressed into the last few ohms of R523.

Since the nominal setpoint is 7.3 ohms (7.3 in parallel with 22 is 5.5), the pot is normally at about 7% rotation, and it's really touchy. As the pot ages and gets scratchy, it becomes impossible to keep it stable.

* These values are for the R-390A. The R-390 needs about 70mV from 10mA. This is discussed at the end of the article.

As the pot goes from 0 to 100, the total cathode resistance seen by V504 goes from 680 to 698, essentially no change, so I simplified the calculations to assume constant current.

You can see how nonlinear this is. 35% of the output range is crammed into the first 10% of rotation. At nominal, 1% adjustment equals 10% change.

If we are allowed to increase the effective resistance in series with the meter (lowering its full-scale reading), we can improve this dramatically with a small wiring change.

Table 1.

V	R
.01	0.9
.02	2.0
.03	3.1
.04	4.4
.05	5.7
.06	7.3 <- nominal
.07	9.0
.08	10.9
.09	13.0
.10	15.5
.20	100

Voltage vs R 523 Ohms
(stock, 11mA, R 537 = 22)

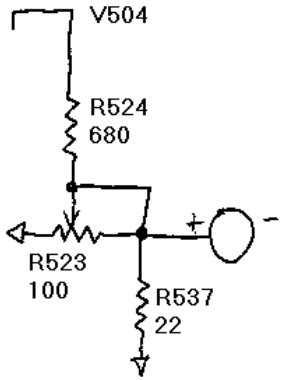


Figure 1
Original

The stock design sets up R523 as a rheostat; the slider and the CW end are connected together. The CCW end is grounded, and R537 goes across. These parallel resistors form the lower leg of a voltage divider. The upper leg is R524 inside the IF deck. See Figure 1.

If we modify this as in Figure 2, we get a current divider, analogous to the voltage divider you're all familiar with. When the pot is CCW, all the current flows straight to ground and the meter reference voltage is zero.

When the pot is CW, almost all the current flows through R537, supplying 100mV. In the middle, some current goes one way, some the other, and we get an intermediate voltage.

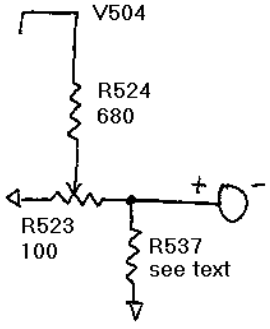


Figure 2
Modified

Let's derive the expression for reference voltage as a function of pot rotation x. Say I is the current in R524. It splits in R523. I1 goes to the left, and I2 goes to the right and down R523, which we set to arbitrary resistance R.

Then I2/I = x/((100-x+R)+x) = x/(100+R), I2 = xI/(100+R), and V = I*I2*R or x IR/(100+R). It's linear!

Table 2.

V	R	
.01	10	
.02	20	
.03	30	
.04	40	
.05	50	
.06	60	<- nominal
.07	70	
.08	80	
.10	100	

Voltage vs R523 Ohms
(modified, 11mA, R 537 = 10)

Notice that 10% rotation yields 10% voltage change, compared to 1% in Table 1. It is ten times easier to adjust. Scratchiness is ten times less obvious, and making replacement unnecessary in most cases.

This is how Collins should have done it. All I can figure is, the engineer assigned this task was new and naive, distracted by other matters, or (the Collins Collectors Association will burn me at the stake) just plain incompetent.

My '54 Motorola was wired like Figure 3. Your mileage may vary.

How To Do It

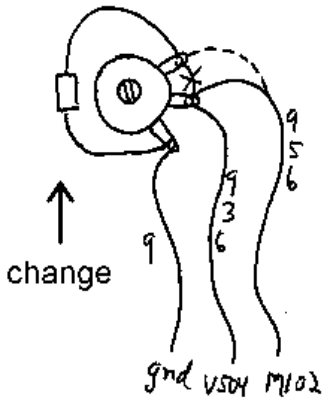


Figure 3
Pictorial
R522/R523

At R523, the slider and CW terminals are jumpered together; then there are two wires and R537. One wire goes to V504, the other to the meter. In my radio, the meter wire is white with green and blue tracers, and the V504 wire is white with orange and blue tracers. Both were on the slider. Remove the jumper and R537, move the meter wire to the CW terminal, and install the new R537 between the CW and CCW pins. That's it! Fire it up and revel in the smooth, easy adjustment. It should zero around 60%; if your 6AK6 is flat you'll have to turn it higher.

The soldering heat may change the old R537. You might as well replace it with a new carbon- or metal-film unit. The value, which can range from 5.6 ohms to 22 ohms, determines the full-scale reading, and depends on many factors.

To approach the original reading, use 5.6 ohms. To meet or exceed the original reading, you will also have to change R549, see the end of the next section. I'm using 10 ohms for R537 and the original R549.

Commentary And Experiments

There are three side effects, one innocuous, one beneficial, and one possibly detrimental. The latter can be neutralized by changing one resistor inside the deck.

First, the cathode resistance seen by V504 increases slightly. At the nominal operating point, the stock design was about 685 ohms. Now it is 705. This is less than 4% change, well within tolerance. I could not detect any change in IF gain.

Second, the meter full-scale reading is now independent of the zero adjust.

Third, the full-scale reading may be less than before. It depends on the cathode current of 6AK6 V504. Strong tubes make it worse, because you have to turn down R523 to get a zero. You can increase the full-scale reading by decreasing R537, until you run out of zero-adjust range. At worst case the stock circuit will show the meter just 4.5 ohms, which is unreachable with the mod as documented so far.

But you may not want the original reading; it may have been too high. Inject 100mV of signal into the balanced antenna connector and note the resulting AGC voltage. At this voltage, you want to read 100dB. I'm using 10 ohms, see Table 3 below.

Note that 10 ohms yields a Thevenin resistance of 9.1 ohms, somewhat larger than the stock value of 5.5 . At 5.5, my meter reads high; this is what enables me to use the simple version of the mod. If your radio needs 5.5 ohms, then you will have to change R549; see the end of this section.

The AGC voltage developed at a given input depends on the 6DC6's gain and its cutoff characteristic. Hot ones require more AGC. So do "wide" ones. I tried five different tubes. If you try this, it's essential that you measure the antenna voltage, because trim and choice of tube affects the input impedance.

The AGC also depends on the cutoff characteristics of 6BA6 IF amps V501, V502, and V503. Wide ones develop more AGC. It also depends on the gain of 6BA6 AGC amp V508. A hot one will develop more AGC.

I played with 6DC6 substitutes. I tried 6DK6, 6CB6, 6DE6, and 6BZ6. As you can see, they're either too sharp or too wide, but they're good enough to keep it glowing until you get the real thing.

Finally, the AGC depends on IF gain. Table 3 was compiled with IF gain set for best S/N ratio. The gain was 600uV, rather than 150, for -7V on the diode load. The Tung-Sol 6DC6 that got -13.3V in Table 3 gets -13.8V when the IF gain is reset to the standard value. In that situation, the perfect R537 would be 11 ohms.

IF gain also affects the 10dB point. At 600uV/-7V, 10dB input does not cause much deflection. At 150, the meter reads above 10dB. Somewhere in between, it's right on. If you don't feel like searching for the S/N sweet spot, this trick will probably get you closer than the stock setting.

The Carrier Meter reading for a given AGC voltage also depends on the no-signal V506A plate current, which in turn depends on B+ and the exact value of the load resistor R549.

TUBE	AGC	R537	Total R
Tung-Sol-13.3	9.6	8.8	
RCA #1	-12.7	8.8	8.1
RCA #2	-12.1	8.2	7.6
RCA #3 '68 JAN	-13.3		
RCA #4 '62 JAN	-13.6	12.2	10.9
6DK6	-8		
6CB6 #1	-9.1		
6CB6 #2	-9.6		
6DE6 #1	-11.1		
6DE6 #2	-12.3		
6BZ6 #1	-14.1		
6BZ6 #2	-15.4		

Table 3.

AGC voltage with 0.1V on balanced antenna input, and R537 setting to get 100dB reading (1450KC, trimmed, IF gain set for best S/N)

Raising B+, or lowering R549, increases the reading. The same 12AU7 that reads 100dB at -13V with an 82K pullup to 205V only needs -9V with a 56K pullup to 180V, the setup that obtains in the R-390. This opens the possibility of tweaking R549 to control the full-scale sensitivity. If you can't get a full-scale reading with my recommended R537 value, lowering R549 will get you there. Of course you have to remove the IF deck to do that, which I was trying to avoid.

The R-390

TM11-5820-357-35 is inconsistent regarding the 6AK6 final IF (V506) cathode resistor R536. All the schematics show it as 820 ohms, while the voltage/resistance diagram says 700 ohms, 8.2V. One owner reports 900 ohms and 9.4V, so the V/R diagram is probably wrong. In any case, the reference current is less. At the same time, the AGC time constant tube is driven harder (56K from 180V instead of 82K from 205) and therefore runs a higher cathode voltage, about 70mV nominal instead of 57. If you applied my technique to the existing 15-ohm pot, R537 would be 15 ohms, and the maximum reference voltage would be 90mV if R536 is 680, around 75 if R536 is 820. In the latter case, you'd find yourself setting the zero adjust around 95%; kind of close to the edge.

This mod reduces the turn-to-turn resistance jump by a factor of two. Not having any direct experience with the R-390, I can't say if this is enough of an improvement to be worth doing. You could always replace the pot with a 100-ohm carbon like the R-390A. The benefits are not so great and the effort and risk of side effect are larger. Still, it's easy to do and undo; I'd try it.

Date: Mon, 24 Feb 2003 17:26:23 -0500 From: "Drew Papanek" <drewmaster813@hotmail.com>
Subject: [R-390] Meter zero and AGC

<snipped> If you move the green/blue wire to the center tap .....

Making the pot a voltage divider for meter would change meter sensitivity as zero setting is varied. Maybe that wouldn't really matter - to most of us an "S" meter reading is just a relative indication anyway. Some list members have suggested keeping the original circuit configuration but changing 22 ohm resistor to 8.2 ohms. I use that setup and carrier meter zeroing is easy and stable (clean that pot). I, too, have opened up the carrier level meter to reset tension on the jewels, thereby eliminating stiction. I found (on my example anyway) that the four fasteners holding assembly together are tubular nuts and hollow screws with no "persuasion" necessary for disassembly. Jewel tension is easily adjusted after loosening a small jam nut. I cleaned inside of glass with lacquer thinner - perhaps the dull accumulation there is due to rubber gasket out gassing over the years. Caution: meter scale and pointer are usually coated with radioactive radium paint. Take care not to inhale dust. Perform operation outdoors, wipe up dust with damp cloth and dispose of appropriately. Scraping the paint and using some to decorate cookies whilst snorting the rest for a new kind of high is right out. On AGC time constant switching voltage spike and "The Moment of Silence": some have used a 24 volt zener to limit AGC line voltage and have reported it to be effective. The 2 diode fast attack / slow decay AGC (Dallas Lankford) modification is also a fairly good remedy.

Reconditioning the Veeder Root Counter Mechanism

by Nolan Lee

Note: The following article was posted by Nolan Lee on the R-390 list on 1998-May-18. Nolan's technical writing style is unique and can be best described as the language of 'Redneck Engineering'. Translations are available for those who are techno-colloquially challenged.

"rippin' apart the counter..."

The hammer I used for this was a 2oz one. This is one case where a "bigger hammer" ain't good bubba. Put that 4lb maul DOWN!.....NOW!

Also, your counter may be a different part/casting number and assembled differently. It's also been 20 years since I took mine apart. My memory might be faulty and your mileage may vary.....I accept no responsibility. I don't think they were made to be taken apart, but I liked the challenge.

I used a small punch to remove the small counter shaft. At least that's what I called it. It was the one with the little "10X" multiplier cogs on it. It was pressed in from one side and then the casting was peened over the end of the shaft. Oh, as you slide the shaft out, all of the little cogs will fall off. Watch where they come from. Some of them were different.

I then bored a couple of holes to intersect the bottom of the two rivets that held the cover to the body. This was the little cover plate that covered the gaps between the digits when viewing the counter from the front. I then drove them out with a small punch. The cover is real soft and will bend/kink/distort real easy. While I had mine off, I stripped it and repainted it and baked it in the oven.

Finally, the primary digit counter wheels of both the MC and KC segments are pinned to each of the drive shafts (the shafts that have the bevel driven gears attached). These pins were driven out. It's been a hell of a long time and I don't remember for sure but I'm pretty sure that those pins were tapered and had to be driven out from ONLY one direction. You'd want to inspect them VERY carefully and see if they ARE tapered before driving them out. If they are tapered and you attempt to drive them out from the wrong direction, you will probably bend the shafts and total out the counter assembly.

After pulling the two shafts, the entire assembly should "fall apart", either in your hands or into the shag carpet. Oh, watch where the little thrust washer/spacers fall from. They'll need to go back in the same spots. Don't ask, I don't remember..... I cleaned everything while I had it apart and actually waxed the counter wheels with automotive paste wax. I then reassembled it using an ultra- fine powdered graphite as a lubricant. Keep the graphite off of the digits or it can stain them. Suspecting that this could happen is the reason that I waxed all of the counter wheels BEFORE adding the graphite. 20 years ago, the paint on my counter wheels had more than enough adhesion to survive the waxing. I don't know about yours..... Best of luck and may the force be with you.

From: Gary Lee <tiresias@prodigy.net> Date: Thu, 27 Sep 2001 08:39:20 -0500
Subject: [R-390] counter questions on r-390a

I am currently doing an experiment with attaching Braille numbers to a counter for a 390a. I have a junk counter bought from fair radio. But now I have some questions.

1. is it mounted with the plate with the screw holes horizontal or vertical?

2. there is what looks like a metal shield on the front with little fingers sticking up. where do you see the numbers in relation to these fingers?

3. Is this shield really necessary?

4. I notice two wheels on the left end, I presume megahertz. Then 4 wheels. Is the last one numbered 0-9 for tenths of a mhz just like the others?

This should get me started. If I can get Braille on this thing, I will make up another set of labels and give this one to fair to use as a model for the 390 I plan to purchase.

From: mikea <mikea@mikea.ath.cx> Date: Thu, 27 Sep 2001 09:48:45 -0500
Subject: Re: [R-390] counter questions on r-390a

> 1. is it mounted with the plate with the screw holes horizontal or vertical?

The counter as a whole is mounted horizontally. I haven't taken one apart, and so don't know about the plate w/screw holes.

> 2. there is what looks like a metal shield on the front wi little fingers sticking up. where do you see the numbers in relation to these fingers?

> 3. Is this shield really necessary?
>
> 4. I notice two wheels on the left end, I presume megahertz. Then 4 wheels. Is the last one numbered 0-9 for tenths of a MHz just like the others?

The first two are MHz, yes. The next one is used to indicate below the-beginning of a band (red "-" on my R-390A), in-band (solid black), or above-the-end of a band (red "+").

From: "Scott, Barry (Clyde B)" <cbscott@ingr.com> Date: Thu, 27 Sep 2001 09:59:56 -0500
Subject: RE: [R-390] counter questions on r-390a

1. The screw holes are horizontal (perpendicular to the front panel).

2. The shields cover the "gear" fingers and provide a marker on the right-hand side for a witness line.

3. The shield is primarily for cosmetics, although the witness line is pretty much needed for sighted people if you want to get right on a kc position.

4. The wheel third from the left is only a +/- indicator. The last wheel on the right is marked in 1 kc increments with 5 smaller divisions between each major marking yielding 200 cycle resolution.

Tube Shield Dissipation Measurements

From: Tisha Hayes <tisha.hayes@gmail.com> Date: Fri, 17 Apr 2009 12:09:01 -0500
Subject: Re: [R-390] Black Tube Shields, IERC

A few years ago I went through the process of measuring envelope temperatures on a wide range of tubes in a SP-600 with different tube shields. It did turn out that the black IERC tube shields did make a difference in envelope temperature.

Generally speaking I was seeing 20-60 degrees F difference across the range of shields. I had tested with the following;

Factory default, silver cam-lock tube shields with the loading spring to keep the tube down it the socket

No shield at all, just using ambient air and radiative cooling from the tubes.

IERC tube shields

IERC tube shields with a dab of thermally conductive paste applied to the finger-stock grippies inside of the IERC shield (to improve thermal conduction between the envelope and the shield).

I had strictly controlled air-flow and room temperature and would let the radio stabilize for an entire day before making measurements. This was also in a room where I was not moving around in so there was a bare minimum of air movement. Room temperature was at 70 F. I measured temperature with an optical pyrometer and had put a dab of flat black paint on the top of the tube (so I could get consistent temperature readings without gluing thermocouples everywhere).

By far the worst was the silver tube shields. If anything these kept the heat on the envelope with some temperatures well above 250 F

When I used the IERC's I could get the temperatures in the 150 to 160 range. If I used the thermal paste it would knock the temperature down another 5-10 F on average.

Interestingly the chassis temperature went up when using the IERC shields due to the mechanical connection at the base of the IERC shield and the radiative cooling off of the shields. If you have a concern about capacitor/ resistor aging this may offset your worries about tube temperatures.

In every instance, the use of a small computer-fan to move air across the chassis really helped out in lowering the temperature of the tubes and the chassis. This does not need to be a gigantic fan.

If someone was really interested I could dredge up my notes and put them into a human- readable format. At the time I was doing my little experiment to justify the cost of the IERC shields. (I did end up finding IERC shields for every tube operated device I have)

Ms. Tisha Hayes

From: Tisha Hayes <tisha.hayes@gmail.com> Date: Fri, 17 Apr 2009 14:20:14 -0500
Subject: Re: [R-390] Tube Shields

I think what confuses many is the design of the IERC tube shield (and others of the same family) where the shield has a mechanical attachment (albeit by spring pressure) to the glass of the tube. Transferring heat by conduction cools the tube much more efficiently than trying to remove the heat by radiation. Whenever there is a tube shield that does not contact the glass, the only heat transfer mechanism is radiative with maybe a small amount of convective heat transfer by the random air currents inside of the shield.

Depending upon radiative cooling alone would be similar to disconnecting all of the cooling fans on your car's motor and sitting in traffic for a few hours. While some heat will be transferred by radiation (as the motor gets smokin-hot the hood heats up) the motor will seize up quickly (unless you believe Castrol television commercials). In a car, the cooling comes from moving a much cooler fluid through the hot motor, then giving that heat energy a place to go in the radiator (where it becomes forced convection transfer to the air) where the cooling fans or driving can dilute the heat into the atmosphere.

Air is a pretty good insulator of heat, look at how close your finger needs to get to a soldering iron tip before you get burned. You may feel the heat at less than an inch (radiative) but there is a dramatic temperature difference from being 1/4" away and touching the iron (conductive). Tubes suffer from the same problem where there is this tiny air-gap between the glass and the metal.

The IERC tube shields actually touch the glass in several places and the spring fingers are under slight compression. The heat transfer is from the contact. My crazy experiment was to slightly increase the thermal conduction of the spring contact area by using a small dab of thermal grease (what they use on CPU's, commonly sold at Radio Shack) to increase the contact surface area. Ideally the glass envelope and the IERC shield would be at the same temperature (yea, glass does not conduct heat evenly, that makes my brain hurt). BTW, the thermal grease idea makes a mess if you are constantly pulling tubes and has a tendency to remove tube lettering.

Where the IERC fingers come down and imperfectly "dock" with the bayonet-socket (from the silver shields) gives another conductive escape path for the heat to the chassis. To remove heat further would be to passively remove it from the radio by natural convection (heat rises) or forced convection (fans).

Ms. Tisha Hayes

Repairing R390 RF transformers

The rf transformers in the R390 and R390A receivers can be used for more than one band. The tuning ranges are: 0.5 to 1, 1 to 2,2 to 4, 4 to 8, and 8 to 16 MHz. If there is a loss of sensitivity on some bands, or there is difficulty in obtaining proper alignment, here is a trouble to look for. It is more common in the R390 but may also show up in an R390A. In several first rf transformers I have found that the tuning core sticks because of lumps on the inside of the coil form. This is quite easy to check for. *

Look carefully at the rf tuning-slug racks as the mechanism tunes through its complete range on the band in question (or check them all as a precaution). The racks should move up and down smoothly. Check several times from different angles. Also check by pulling them up and down by hand while at the bottom of their range. Look for one end pushing up or causing the rack to deviate from the horizontal.

If you think there is trouble, it is easy to verify. Carefully remove the springs from each end of the slug rack and hang them out of the way under tension (use a bent paper clip). If you let go of the spring it can drop down inside the set and will be difficult to retrieve and reconnect. Lift up on the rack and it will come out quite easily. (When putting the rack back, work slowly, as it is easy to chip the edges of the coil forms when reinserting the tuning cores). When the rack has been removed, shine a light down inside the coil form and look at the side. Lumps show up immediately.

If you have this trouble it is easy to fix, but it must be done with care or the coil form will break. To remove the rf transformer, insert a Phillips screwdriver into the two little holes on the top of the transformer case and loosen the two captive screws. Then wiggle the transformer loose as you pull up. It may help to pry gently with another screwdriver.

Don't back off on the captive screws any more than you have to. They can go past the point of releasing the transformer, come out of their mounting threads and rattle around loose inside the case. If this happens, take the top off the transformer and use a pair of needle nose pliers to hold the screws in position while you rethread them back.

To repair the coil form you have to remove the lumps from the inside. They appear to be bubbles of varnish or whatever finish was applied to the coil by the manufacturer. The first thing to do is to strengthen the coil form. To do this, spread several layers of *Elmer's Glue-all* on the outside of the form. Be sure each layer has plenty of time to dry; leave it overnight. This will give added strength to the form and coil and help keep either from breaking.

Next, go to work with your box of electric drill bits. Start with *13/64* inch (5mm). Gently insert it into the coil from and twist it by hand to begin removing the crud. When that cuts through, use a *7/32* inch (5.5mm) bit and do the same thing. Finish up with a *1/4* inch (6.5mm) bit. This will take most of it off.

Now make a tube of emery paper (fine sandpaper might work) long enough to reach to the bottom of the coil form and still leave a hand hold. Insert that into the coil form. Take a drill bit thin enough to slip easily inside emery paper but thick enough to give it support. Twist the emery paper around inside the coil form, moving it up and down at the same time. This will smooth off the inside again.

The thing to watch out for here is that you don't chip the top edge of the coil form. If it is chipped or looks about ready to go, it can be strengthened with a thin strip of typewriter paper, spread with *Elmer's Glue-all,* wrapped a few turns around the outside of the coil form top.

Every so often, remove the drill and emery paper and try the tuning core back inside. It should move up and down the entire length of the coil form without binding. When you have completed the operation, clean out the emery and coil form dust by blowing or using a pipe cleaner. Before you put the slug rack back in the set, give the inside of the coil forms and the tuning cores a squirt of silicon spray.

Alexander Maclean, WA2SUT

While the coils described are those for the Collins R390 and R390A series of receivers, there are many surplus and commercial receivers which use similar permeability-tuned mechanisms that might be susceptible to the same .problem. The repair technique described here could be easily adapted to other, similar tuning mechanisms.

august 1976 HR

Setting the PTO Endpoints Vs. 2

W. Li and Roger L Ruszkowski Mar 6 2009

Over the last 10 years, there have been many posts about the PTO. Half dealt with the non-linear PTO, which is clearly a challenging and time-consuming task. The others have been more elementary: dealing with setting end-points. Chuck Rippel correctly points out that setting the endpoints is probably the most important thing to do to get these receivers functioning as they were designed to operate.

Recently, I set the endpoints in my 62 Capehart PTO. What follows depends on using a counter, and avoids dropping the front panel.

The Y2K, Navy, and Army manuals use a different approach that does not require a counter, but I felt that approach was too cumbersome. Furthermore, they drop the front panel in their method.

I used the wisdom contained in previous postings to this list to try to get everything everyone said on one piece of paper. There were valuable tips contributed by all. To that end, I documented each step in my task... trying not to forget anything or goof it up. I managed to get my PTO to cover 1000.2KC over exactly 10 turns, so I was happy.

Hi. Have revised the previous post thanks to the comments received. Here is version 2.0

PTO End-point adjustment W. Li

1.) From top of receiver, disconnect mini-BNC plug P217 and drop it thru the chassis hole to the bottom side. This coax carries the PTO output.

2.) Disconnect P116 mini-coax from rear panel

3.) Remove J116 from rear panel

4.) Tune the MC dial to 7MC (I did this in anticipation of further RF work)

5.) Tune the KC dial up to (+) 000

6.) Turn receiver over so it is up-side-down on the bench

7.) Remove Oldham spring using a fine forceps clamp (may have to rotate the KC dial a few degrees so that you can get at both ends of the Oldham spring). Tie a string on the spring before it flies off.

8.) Do not touch the KC dial again until step 28. Consider locking it.

9.) Remove both stainless steel 6-32 screws off of the trapezoidal metal support bracket on the back of the PTO. This support secures the rear of the PTO to the chassis. Do not disturb the single green captive screw.

10.) Loosen both front green 8-32 captive screws. The entire PTO sub-chassis should now be free to slide aft.

11.) Wiggle the PTO subchassis and slide it aft about an inch to free it from the KC shaft. The Oldham coupler will come apart and the center disc will fall free... save it. You now have one Oldham disc attached to the KC shaft, and the other Oldham disc attached to the PTO shaft, and the middle one loose somewhere.

12.) 12.. Tilt PTO chassis upwards 45 degrees. Rest it on small plywood shelf so the rear bracket sits down in its compartment, and the front rests up on the chassis cable loom. This exposes the front of the PTO . Note: the cable in the back with the blue plug carries power to the PTO and is left attached.

13.) Use J116 to adapt the PTO's mini-BNC to a standard BNC jack.

14.) Hook up your frequency counter to J116 using a short BNC cable

15.) On the front face of the PTO, remove the large hexagonal adjusting screw cover behind Z702. This cover screw has a very shallow thread, and comes out in 2 turns. Store it with the small Oldham spring for later.

16.) Plug in the receiver and counter and allow an hour or longer to warm up and stabilize the electronics.

17.) Using your hand, slowly twist the Oldham disc on the PTO shaft until the counter reads exactly 2455. Look at the counter to figure out which way to turn. Note: the PTO has its own stop, which can be easily damaged. GO SLOW.

18.) Using the Oldham spring post as a point of reference, mark the front PTO plate with a pencil as your start point.

19.) Now manually rotate the Oldham disc on the PTO shaft exactly ten turns. Watch the counter readout rise as you turn. Stop at exactly ten turns lining up the spring post with your pencil mark. The counter now reads something fairly close to 3455KC.

20.) Without any further rotation of the PTO, turn the tiny PTO adjusting screw with a fine screwdriver until the counter reads exactly 3455KC.

21.) Go back about ten turns, stopping when the counter reads exactly 2455KC..

22.) Chances are your start point will not align with the spring post, so erase the old pencil mark and make a new one. Changing one end-point alters the other.

23.) Now hand rotate the PTO shaft exactly 10 turns the other way and see how close you end up to 3455KC. Chances are you will be off a bit.

24.) Readjust the PTO adjusting screw again, so that the counter reads exactly 3455KC

25.) Repeat steps 21-24 as often as necessary until 10 turns gets you from precisely 2455KC to 3455KC.(this took me 6 cycles of fooling around). Note all the PTO adjusting screw tuning is at the 3455KC end. All you do at the 2455KC end is redraw your pencil mark.

26.) OK, now the PTO has the correct frequency range of 1000KC in exactly ten turns of the PTO shaft

27.) Be sure the KC dial is unlocked. Gently turn the KC dial down as far as it will go until it is stopped by the 10-turn stop. The Veeder-Root should now read between -963 and -972. If it does not, adjust the ten-turn stop until it does (another issue entirely).

28.) Rotate the PTO until the counter reads exactly 3455KC

29.) Rotate the KC dial up a few turns until the Veeder-Root reads exactly (-) 000, and lock it in place.

30.) Stick the middle Oldham coupler disc to its mate on the PTO shaft with a blob of grease.

31.) Replace the large cover screw you took off in step 15.

32.) Now loosen the Bristo screw clamp nearest the KC dial, so that the Oldham coupler nearest the front may rotate on the KC dial shaft to mate precisely with the Oldham coupler disk of the PTO shaft. Since the KC dial is locked, only the Oldham disc and its clamp will rotate. Take great care NOT to rotate the PTO shaft. You can tell if you do inadvertently rotate it, because the counter will show a change in frequency.

33.) In some cases, there is no room to access the Bristo clamp on the KC shaft. Plan B is to loosen the Bristo clamp on the PTO shaft, so that it can rotate to mate with the other Oldham disc. Here again, you must not allow the PTO shaft to rotate whilst you fiddle with the Oldham disc. There is no way to lock the PTO shaft, so great care must be taken not to move it. Again the counter will detect any rotation of the PTO shaft at this time.

34.) Now you can slide the entire PTO subchassis forward to mechanically re-engage the Oldham coupler..... this step is to mechanically synchronize the PTO to the rest of the RF gear train. This will require minute fiddling of the now loose Oldham coupler disc as the fit is very close. Take your time in getting all the Oldham discs to mate.

35.) Loosely start both 8-32 green screws in, to stabilize the PTO chassis

36.) Now that the coupler is together, both the PTO shaft and the KC dial shaft will rotate together. The KC dial is at (-)000 and the counter shows 3455KC.

37.) Unlock the KC dial now.

38.) Rotate the KC dial up slowly and gently until the spring posts are accessible for you to replace the Oldham spring. Note that the PTO shaft will also rotate the same amount since the coupler is now mechanically engaged.

39.) Wiggle the PTO such that both PTO and dial shafts line up, and so that there is a small gap visible between the Oldham coupler discs. At this point, if things are tight, you can gain an extra mm by loosening the single rear green screw.

40.) Tighten the Bristol spline clamp on the shaft of the KC dial

41.) Secure things by tightening down both front green screws, and reinstalling both rear deck 6-32 screws.

42.) Now that the PTO is physically secured, do a final electrical check on the PTO with the counter. Turn the KC dial to (-)000. The counter should read exactly 3455KC. Now run the KC dial up to (+)000. The counter should read exactly 2455KC. This is the whole reason for setting the PTO endpoints.

43.) If you can not get exactly 1000 KC in ten turns, go back and redo things until you can.

44.) Disconnect the counter, and restore the mini-coax interconnections.

45.) Final check: tune in WWV, it should come in exactly at 5MC, 10MC etc

46.) You are done

From: "Tim Shoppa" <tshoppa@wmata.com> Date: Wed, 11 Mar 2009 12:16:28 -0400
Subject: Re: [R-390] setting the PTO endpoints (long)

Every PTO I've ever met needed a turn or two removed from the endpoint adjusting coil.

Maybe I'm being overly pessimistic but I thought that simple aging of the PTO pretty much guaranteed that any PTO would require this turn-sectomy.

HSN's #45 and #46 addressed the subject quite thoroughly.

Tim.

From: Barry <n4buq@knology.net> Date: Wed, 11 Mar 2009 12:27:56 -0400
Subject: Re: [R-390] setting the PTO endpoints (long)

Of the two R390As I rebuilt, neither needed this. Guess I was just lucky.

Barry - N4BUQ

From: David Wise <David_Wise@Phoenix.com> Date: Wed, 11 Mar 2009 10:07:50 -0700
Subject: Re: [R-390] setting the PTO endpoints (long)

My cut-down diddle stick is 3-1/4".

"Mechanic's creeper"... Need to warm up brain before engaging mouth. Turn the set over, duh. But it's still hard to see, and if your eyes can't handle the mirror and close quarters, then you have little choice but to remove the PTO. (I wouldn't drill an adjustment port in the front panel.)

My set has a Collins PTO. I bought a Cosmos spare a while back, and looking at it now, I can see that it would be harder to do in situ. (Mine needs repair first; the slug must have frozen, because the slot is completely chewed away.)

My Cosmos has the odd linearity screws. I didn't put a magnifier on them, but they look like Robertson (square) head. I'll put it under a microscope and report back.

From: "Tom M." <courir26@yahoo.com> Date: Wed, 11 Mar 2009 12:51:53 -0700 (PDT)
Subject: [R-390] setting the 51J PTO endpoints

The 51J PTO moves faster than kudzu weed. I have to lead mine like when bird shooting so that it is spot on at some random time in the future.

Attempting to keep the 51J3 PTO perfect is futile.

Tom

R-390 BFO Repair

I am indebted to Bob Herrendeen for this excellent presentation.

A common problem found in R390's is non tunable or non functional BFO adjustment. This problem was apparent on the unit I have just begun to restore. (S/N 61).

The variable oscillator is controlled by a variable inductance housed in sealed can located in the IF module. It is connected to the front panel through a clamped shaft and later a bellows link to the sealed module.

To center the BFO frequency to the 455 IF frequency, one must rotate the external shaft until it is zero beat, and then set the knob to center. If there is no end stop on the shaft, or one continues to rotate the shaft beyond the end point pressure washer, then the threaded shaft attempts to pull out of the core, crushing the core against the bottom of the internal shaft bushing. I also noticed that the threads are backwards from standard rotation, which can be confusing if you think you are actually screwing the core into the coil.

After opening the unit, it becomes obvious what the problem is when the core pieces fall out of the coil!

At first, I thought that it would be impossible to find a replacement. I later was able to purchase one from Fair Radio, but had already decided to attempt to repair the core since the core section that does most of the tuning was still intact. The section that was broken was the 30% that held the threaded shaft in place.

It is possible to fit the core back together and with compression, align the segmented boundaries. Having done this, I decided to assemble the four broken sections of the core into a half section, using a 3-minute epoxy designed to bond metallics. (Hardman Adhesive 04001). This was done on top of a flat surface of silicone rubber since the epoxy excess would not stick to the surface and I could get good surface flatness on the top of the core.

Great care must be taken not to get excess epoxy onto the area to be bonded to the remaining half because when cured, this will interfere with the alignment of the mating surfaces. Excess epoxy on the outside can be scrapped off with a razor blade and polished with emery cloth. The short 3 minute cure time was chosen so the I could easily hold the pieces in compression. The final step was to epoxy the two halves, taking care not to get excess epoxy in the center where the shaft must seat.

All this work must be done with the aid of some magnification can be seen from the picture, the threaded shaft must be inserted into the base of the coil prior to assembly onto the core. In addition, the flex washer and support plate must also be inserted prior to the core attachment. Prior to the final assembly the coil form was thoroughly cleaned and the threaded shaft was lubricated after being inserted so as to avoid contamination of the end to be epoxied into the core. In addition, since threaded shaft appeared to be cast onto the core, I thought it was important to orient the end of the shaft onto the core exactly as it was molded. This maintains good concentricity as the core moves up and down inside the coil form. Therefore, I marked the external shaft with a piece of masking tape that aligned with a mark on the core, before sliding the core down onto the shaft inside the coil. One only gets one shot at this, since the repaired core was to be epoxied onto the end of the shaft while inside the coil. By mating the core center with the correct orientation of the threaded shaft, it was somewhat self-aligning. (I tried all this without epoxy first.).

After assembly and cure, I measured the resonant frequency of the new coil assembly.

The repaired assembly resonance ranged from 443.274 to 462.130 kHz, while the replacement assembly measured 449.522-480.925 kHz. I believe that the difference is partly due to the fact that the repaired core sits slightly higher on the threaded shaft and therefore extends deeper into the coil at one extreme, and not as far out at the other extreme. I also noted that the replacement coil was a model 70J1, while the repaired coil was a model 70J3. The 70J1 had a longer shaft and somewhat different internal component placement. The circuit was the same, but had a different parallel capacitor value than the 70J3 and the schematic.

If I had a chance to do it again I would try to assemble the core in one activity with an epoxy that had a somewhat longer work time. That way I think a more precise fit of the pieces could be obtained

Repairing mechanical filters from an R-390A Vs. 1.3

Graham Baxter G8OAD

This account applies to the later style of filter where the outer barrel has a matt finish and the coil connections are diametrically opposed. The early type with a shiny barrel has a different form of construction but the principles are similar.

Many of these filters are failing. Apart from the obvious symptom where a filter winding is open circuit, they can also develop a leak to ground which spoils the operation of the AGC.

The body of the filter was originally supported within the outer barrel by a combination of stiff paper washers and foam doughnuts. Over time the foam breaks down and turns into a tarry substance which contaminates the filter. The paper becomes very brittle and crumbles.

The result of this is that the mechanical assembly is no longer supported within the case. This can either be bad, or very bad.

The mechanical assembly has a flat strip earth wire which is spot welded to the disk assembly, and is also trapped and soldered together with the end cap at the input end (nearest the flange). Once the foam has broken down, the earth wire is the only means of longitudinal constraint. There is no longer any lateral constraint and if you gently shake the filter from side to side you can probably feel the internal assembly flopping around.

Things get very bad when the earth wire breaks. Apart from causing an increase in filter blow-by, the entire weight of the mechanical assembly will now be supported by the leadout wires for the actuator coils. One bump in the right direction and the wire breaks. However, even before this happens, the filter will probably develop a leak to its case. They were originally rated at 300V dc. A leak of a few megohms will disturb the action of the AGC causing overloading on strong signals.

I had three faulty filters in my EAC. I guess I am just lucky like that. I decided to try to get to grips with the problems. I am passing on my experiences so that others will be able to improve upon my techniques and hopefully share their experiences.

Note that I had a filter which was both leaky and with an open-circuit coil. You might choose to be more conservative with your filter overhaul; I had little to lose.

There are three filters posing for photographs; one 16 kHz , one 8 kHz and one 4 kHz. This accounts for the differences in the disk structure between certain photographs. The 16 kHz and the 4 kHz had broken earth wires, the 8 kHz did not. The 16kHz was very leaky. The 8kHz was leaky and open circuit. The only symptom with the 4 kHz filter was blowby. This manifested itself as a vague twittering in the background when listening to SSB.

Repair procedure

Remove the faulty filter and salvage its mica capacitor. You will notice that the end caps are not identical. The lower cap, which is the driven end of the filter, has a pinched-off copper tube in the centre. Start by trimming off the pinched end and clearing the hole with a soldering iron. You are aiming to provide a vent to the atmosphere. I didn't do this to the first filter I opened. I was treated to a hot end cap hitting me in the chest like a rubber bullet!

You will need a source of controllable heat. I used a small butane torch; the type used to flambe tomatoes. Hold the filter horizontally by its flange in a vise.

We will remove the output cap first (the one furthest from the flange).

Try to arrange a metal sheet immediately beneath the filter so when the end cap comes out it has somewhere to land without pulling on the fine wires. I used a spring hook to gently pull the terminal hooks whilst playing the flame in circles around the cap.

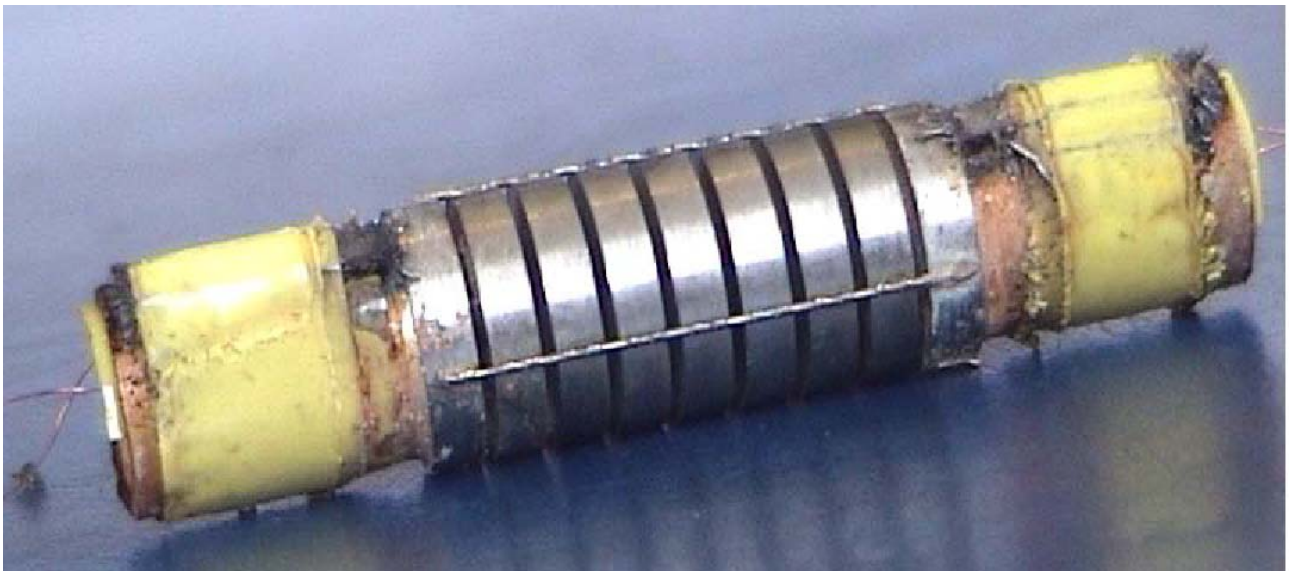
It is quite possible to do this without burning the label. Once you see the solder start to run, carefully put down the butane torch (something else I didn't do first time round) and then gently pull the cap. It should slide out with little resistance. Let it rest on the tray to cool.

When it is cool enough, snip the two fine wires from the solder tags on the end cap and place the cap out of the way. Turn the filter round in the vise and remove the second cap. This one may be slightly tighter since it should have the earth wire trapped between its periphery and the barrel. Disconnect the wires as before.

Remove the paper insulators from the end caps and examine the caps with an eye-glass. The ones I have examined have had a build-up of conductive detritus around the terminal insulators.

Now is a good time to remove the excess solder from the end caps. Hold each cap in pliers and heat it until the solder runs. With a swift flick of the wrist you can fling off the excess solder. Give some thought to where the solder will go before you do this.

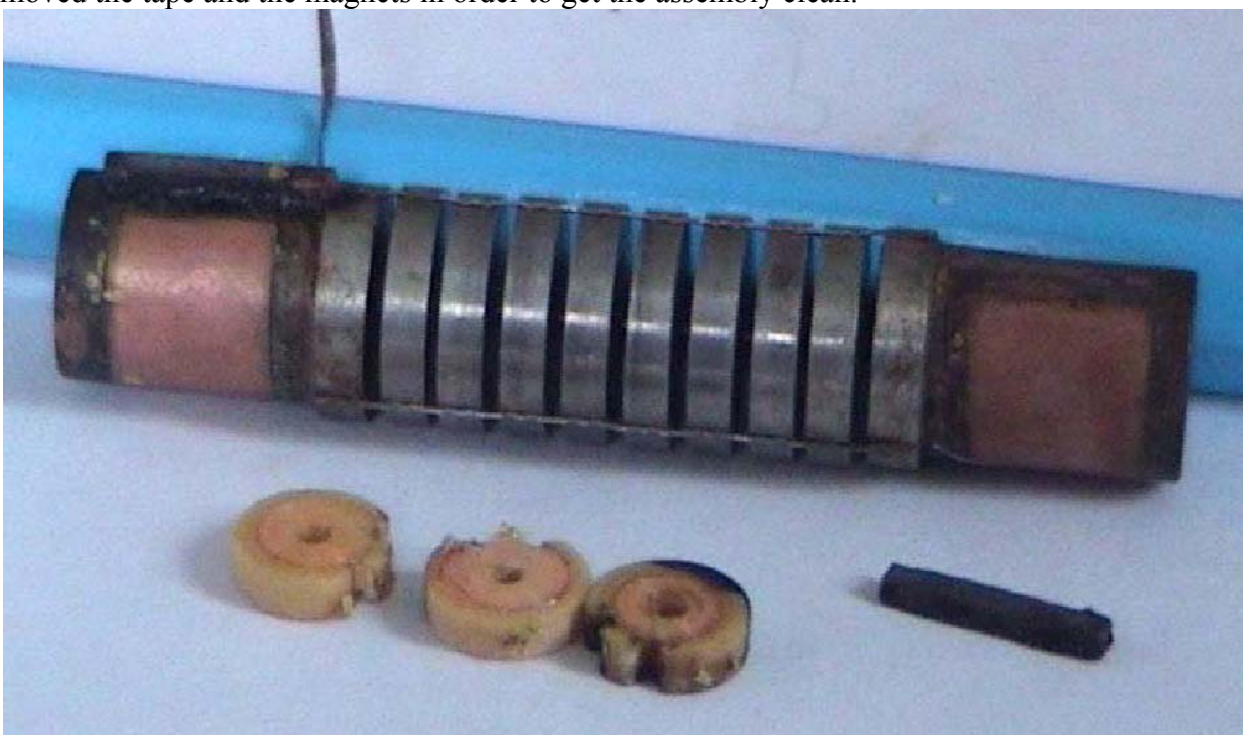
By now the filter will have cooled. You will probably see a dismal black powdery sticky goo. This used to be foam rubber. It is amazing that a substance can be both powdery and sticky. Keep it off your clothes. I scooped most of it out with a spring hook. Carefully withdraw the mechanical assembly.



You will see that the filter comprises a set of disks with a coil at each end. This assembly will almost certainly need to be cleaned. In my case the debris from the foam had gone between the disks. Fortunately it seems to clean off quite well in alcohol. Be careful not to bend any of the coupling rods whilst handling the assembly.

At each end of the filter, there is an actuator coil which sits inside a copper cup. In the centre of the coil there is a very fine magnetostrictive needle.

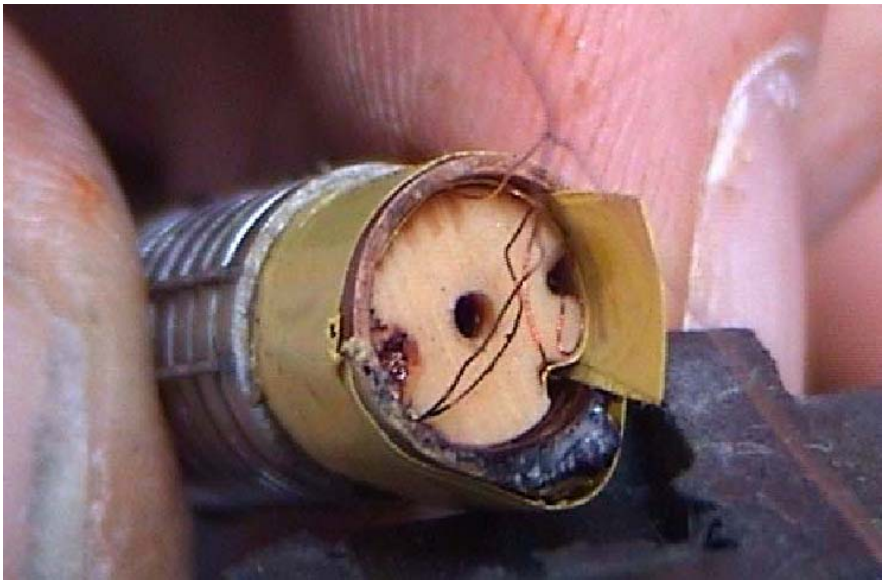
On the outside of the copper cup there is a bias magnet which is both glued and taped in position. I removed the tape and the magnets in order to get the assembly clean.



In the foreground of this picture are the three cheek pieces which form part of the coil. More about them later.

The coils are held in position with a blob of black glue. This can be removed by careful scraping with a pair of tweezers. There is a tail of yellow tape extending longitudinally alongside the coil. If you want to remove the coil, a gentle pull on the tape should do it. If it is reluctant to move you may be able to get it to rotate slightly using a pair of fine pointed tweezers. Be aware that the fine magnetostrictive wire is in the centre of the coil. It should not be in contact with the coil, it is self supporting and closely centred. You must make every effort not to kink it.

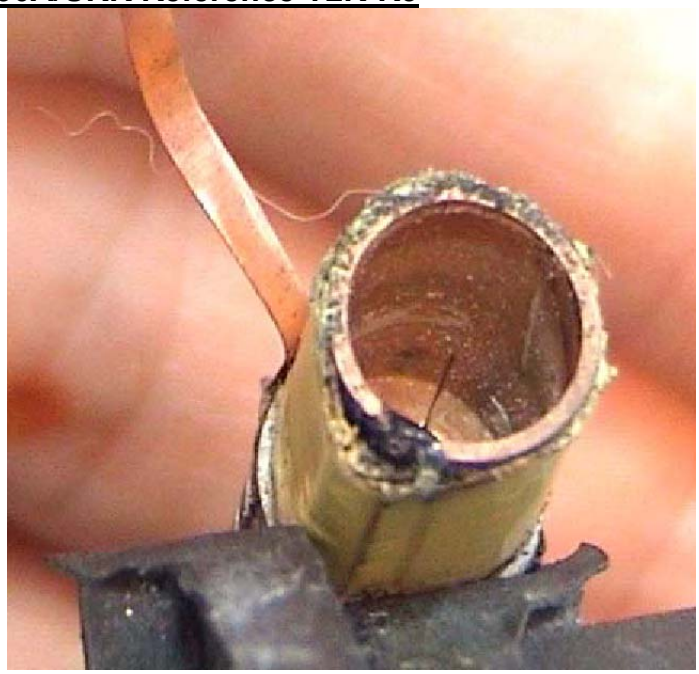
You can just make out the actuator wire in the centre of the coil. Here is a picture of the cup and the actuator wire with the coil removed. You can also see my replacement copper tape earth wire, which I soldered on top of the broken stub of the old one. Here is a picture of the coil in position. You will also see the bias magnet held to the outside of the copper cup with yellow tape.



Note also the helpful tape for withdrawing the coil.

This gives an idea of the delicate nature of the wire. Note for purposes of scale one of my dog's hairs is stuck to the tape! Although you should not bend this wire, if you accidentally do so it can be gently manipulated with hairspring tweezers to get it centred.

Use a pulling action rather than a kinking one.



Once the coils were removed I felt it quite safe to ultrasonically clean the filter in isopropyl alcohol. It is important that there should be no debris between the disks. I cleaned between the disks with a sliver of paper, trying hard not to distress the centre wire. The magnets had also collected magnetic debris. This is best removed with a rolled-up piece of sticky tape.

There are two causes of leakage. I had both in the same filter. One is a build-up of conductive rubbish on the glass feedthrough insulators. Needless to say these need to be cleaned until they glisten. The other is more serious and it appears to be a conductive film between the coil winding and the cupper cup. This necessitates rewinding the coil. Since one of mine was open circuit I was already resigned to that.

The coil is wound in two sections using three insulating washers, two as cheeks and one as the central partition.

There is no coil former; the coil is self supporting.

You may want to count the turns on your coil to see if you get the same answer as me. I think there are 610 turns of 0.071 mm (0.003") enameled copper wire per section. The real interesting thing is that the phase of the coil reverses at the centre. So you wind 610 turns, cross the centre partition and then wind 610 in the opposite direction.

In case you feel the need to make new washers, they are 6.35 mm (1/4") diameter, 1.59mm thick (1/16"), and the holes are 1.1mm (0.043"). In any event the washers need to be scraped clean and washed before re-use.

In order to wind a formless coil, you need to wind it on a mandrel which will be withdrawn when the coil is finished. But this is a tiny job. My first efforts failed because the mandrel damaged the wire as I withdrew it. My friend Mick Bignell, who is famous for thinking out of the box, came up with the answer. Use a piece of PTFE sieving as the mandrel, but stiffen it with a steel rod up the centre.

Here you see the three cheek pieces threaded onto the PTFE sleeving. There is a length of blue pivot steel inserted into the sleeving. The pin vice is gripping the sleeving in order to drive it. Note that the outside distance of the outer cheeks should be about 9.8mm. The centre cheek is centrally disposed between them.

I used a coil winder because I have one. This job does not need much torque, so an improvised winder and turns counter would do just as well. I did invest in a pair of surgical loupes. I often work with a watchmakers eyeglass but I got sick of burning my hair with the soldering iron. Plus I am getting old and I need all the help I can get.

The wire used was grade one solderable polyurethane enameled copper. Polyester enamel would be more thermally robust but slightly harder to solder.

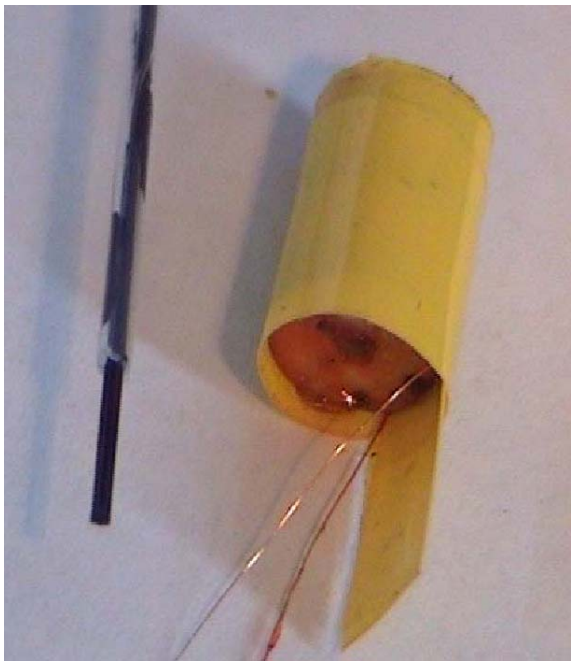
Winding the coil would be much simpler if it were not for the need to keep applying transformer varnish. You must keep doing this so that the inner coils can't cave in. The varnish is also the only thing that holds the cheeks in position. I tried to keep the coil wet with varnish as I wound it. My air drying transformer varnish comes in an aerosol can. With hindsight I should have decanted a little and applied it with a fine artist's brush. I am in big trouble regarding the shirt!

Don't forget to turn the job round half way through. The little magnetic wire is not working as a piston; it is being alternately stretched by one coil and compressed by the other. I am only guessing but I suspect that the spacing of the two coils is related to half a wavelength of bulk acoustic wave in the wire. So the phase reversal is the key.

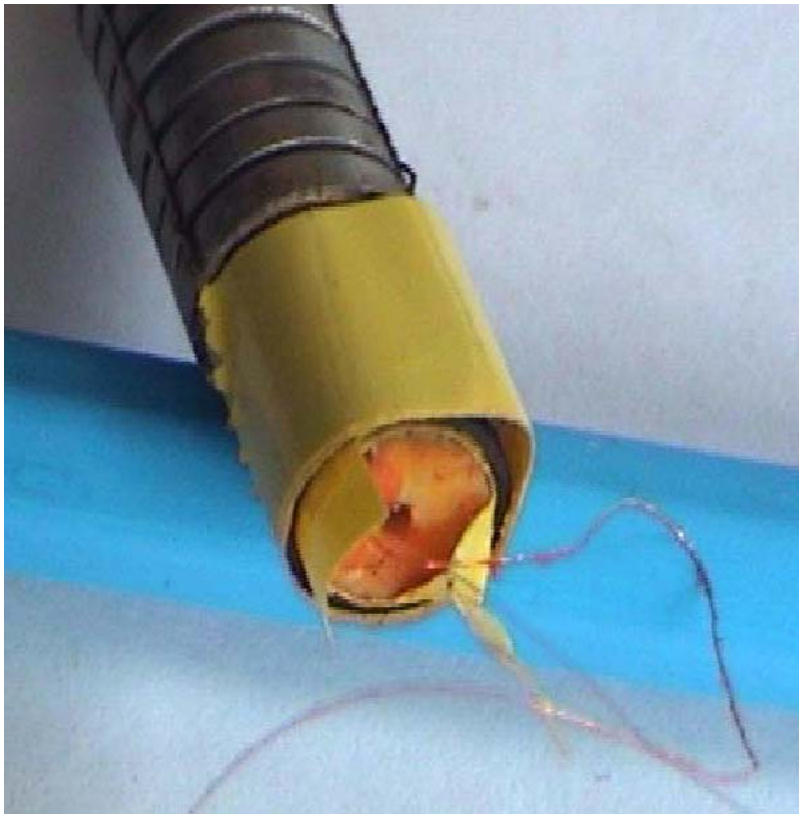
Once the coil is finished it should look like this. Give it a few hours for the varnish to get strong enough to hold it all together. A little warmth will facilitate the process. Interestingly, the varnish dries in two stages. First the solvent evaporates. Then the varnish hardens using oxygen as a catalyst. Of course I was impatient!

Affix a tape extracting tag as before, and secure it with one turn of polyester tape. There is only room for one turn and it produces a nice push fit. If when you try it, it still feels loose place another extracting tag on the opposite side.

Carefully remove the central steel pin from the mandrel. Then ease the sleeving out of the coil assembly. Tin the wires and measure the resistance. 50 to 60 ohms is good. Infinity is disappointing.



When inserting the coils avoid placing any compressive force on the filter as a whole. I found I was able to insert finger nails into the first gap between the disks so I could push against the copper cup assembly without crushing the coupling rods. If you look closely at the following image you will see the rod on the right has a small bulge. This was damage I inflicted but luckily I was able to pull it straight again



I cut a pair from some air-conditioning pipe self adhesive wrap lagging which I had to hand. A neater job would be to slice doughnuts off ready made tubular lagging. I was attracted by the air-con lagging because presumably it is good with extremes of temperature.

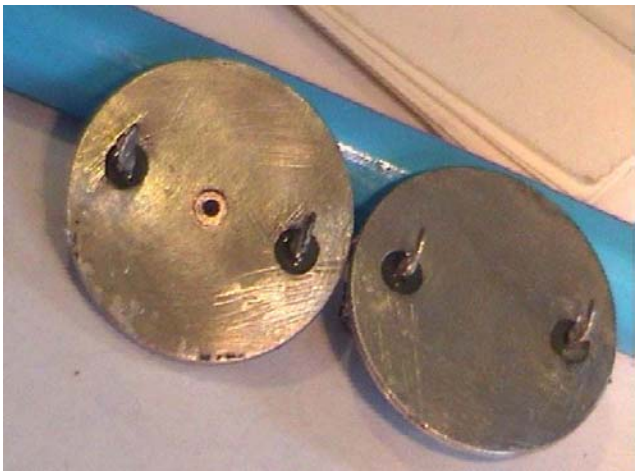
When you are happy with both coils, fifty to sixty ohms, no leakage to the metalwork and the little pin just visible in the centre of the hole, it is time to consider reassembly. You will need to replace the supporting doughnuts.

Place a doughnut over each copper cup, taking care not to damage the wires.

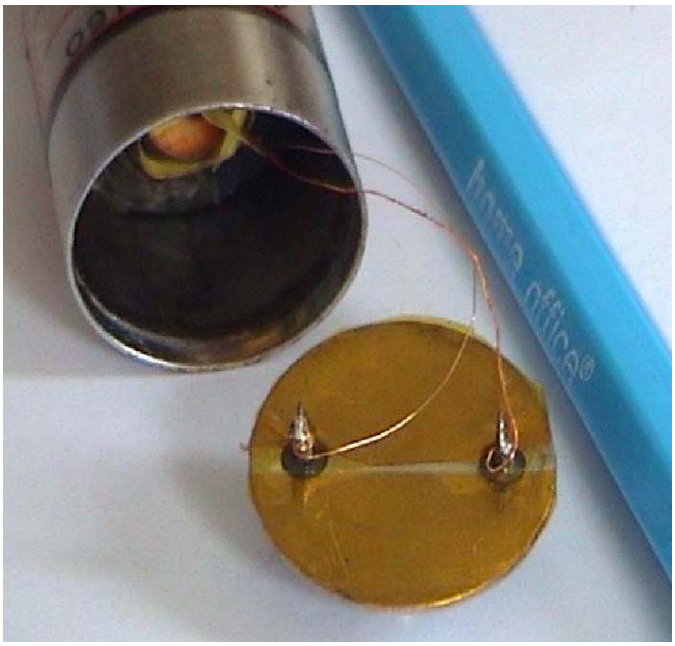
Clean inside the barrel with tissues moistened with alcohol. If you are fortunate the original piece of rolled up card which is inside the tube will pull out intact. This makes it easy to clean. Also remove the excess solder from the barrel. The last vestiges can be scraped out with the back edge of a blade. Take care not to spoil the label.

Carefully insert the filter assembly into the barrel. I used the spring hook to manipulate the foam rings as it slid down. The correct position is with the mechanical filter roughly at the longitudinal mid-point of the barrel. The foam rings were placed over the coil cups. I tried to avoid any contact between the foam and the filter disks. If you were able to remove the card tube

then you can wrap this round the filter assembly and slide the whole lot back in. Mine was too brittle for re-use.



Make sure that the end caps are spotlessly clean, especially around the insulators. I placed a layer of Kapton tape over the internal surface. This was just a precaution to protect the fine wires from heat when re-soldering the case.



Then carefully connect the wires to the tags. Wrap them several times so that they do not disconnect even if the pin is overheated from the outside.

Give it one final test of continuity and leakage before fitting the end caps and re-soldering them. You can do this with a soldering iron if you take your time for it to warm the entire cap. The terminals were in line with the flange mounting holes on my filters. Take care not to trap the wires. I left mine rather long in case any rework was needed. However, no rework was needed and now I am wondering if shorter leads would have improved the ultimate blow-by on account of reduced capacitive coupling.

I am quite pleased with the appearance of the re-soldered caps. I think I got lucky!

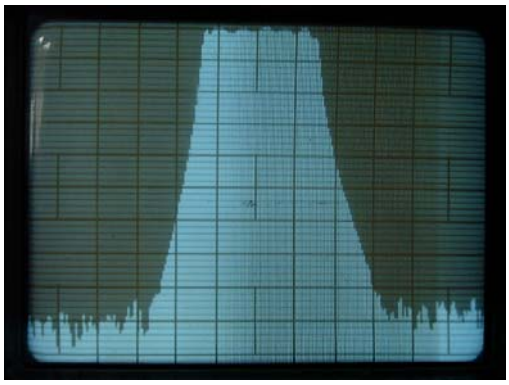
I measured the leakage with a variable voltage high resistance meter. I was getting better than 200 Megohms at room temperature, measured on the 250 volt range.

When I dismantled the 16 kHz filter, there was a load resistor fitted internally. It was wired in parallel with the coil at the output (top) end. The markings had all but gone but I think it was originally 56k. I elected not to refit this. This gave me the option of fitting an external resistor in order to balance my filter gains should the need arise. The 8 kHz did not have a resistor.

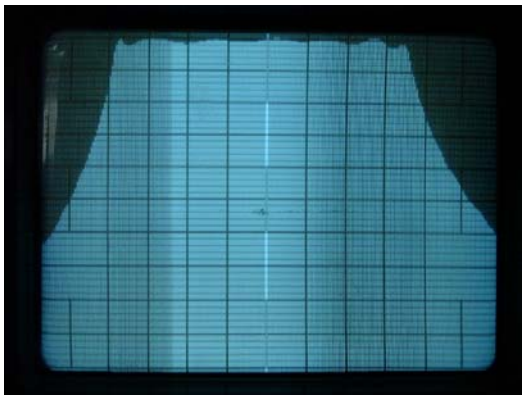
The filters are now back in the radio. My AGC problems have gone. The filters have slightly ripply flat tops and impressive skirt slopes. I don't know if they are as good as new ones, but they work and their losses are on a par with the other filters. I am still considering what to do about the capillary tube nipples. Were they originally evacuated or should we vac them down and then flood them with dry nitrogen? Until I found out I am leaving mine open to the atmosphere so that the varnish can well and truly go off.

Here are some frequency response plots of the four mechanical filters in the radio. They are all plotted at 10 dB per major vertical division. The 2 kHz filter has not been repaired. It doesn't look right to me!

16 k filter

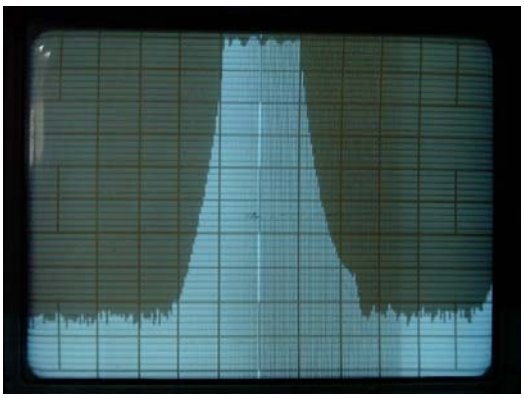


5 kHz per major horizontal division

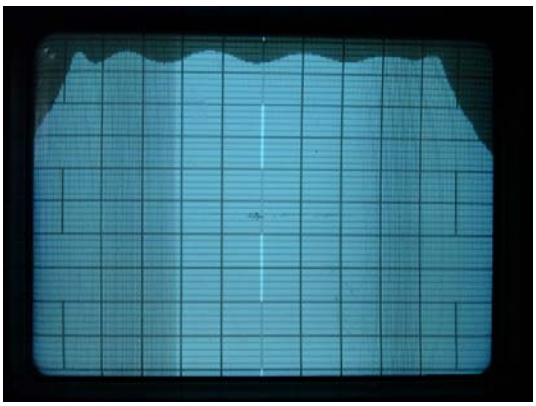


2 kHz per major horizontal division

8 k filter

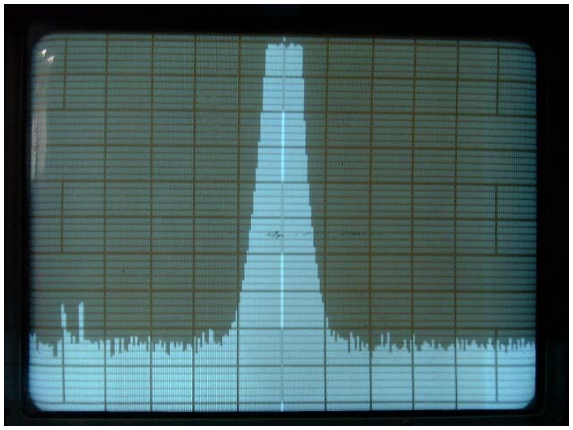


5 kHz per major horizontal division

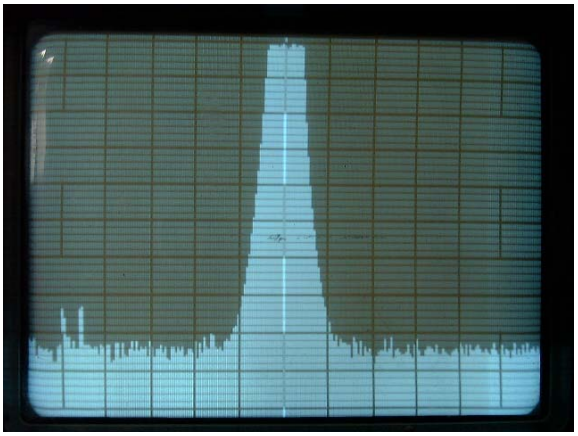


1 kHz per major horizontal division

4 k filter

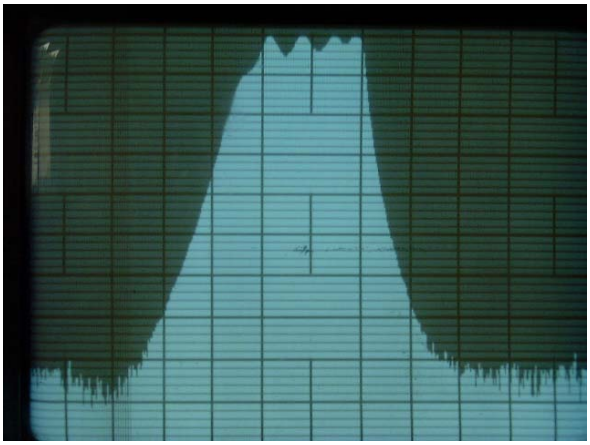


5 kHz per major horizontal division

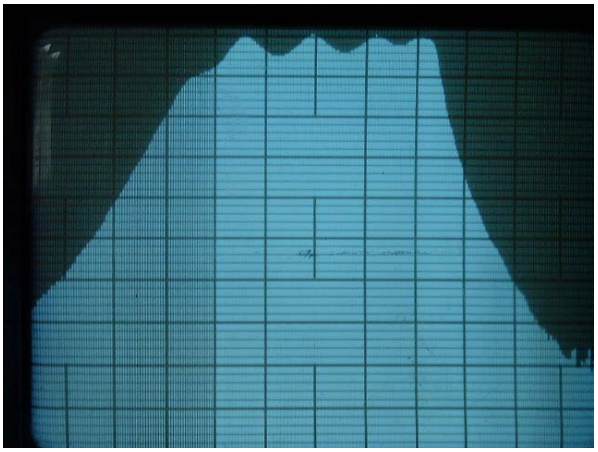


1 kHz per major horizontal division

2 k filter



1 kHz per major horizontal division



500 Hz per major horizontal division

In the introduction I mentioned that the early type of filter has a different mechanical construction. With this type, you proceed in a similar manner, but you need to heat both end caps at once. The entire assembly withdraws from the barrel from either end. The two end caps are attached to each other internally by a metal frame. The filter mechanism lies within this frame and can then be removed. Good luck with your efforts!

Checking for leakage **Addition Information Date: Sat, 18 Aug 2007**

With the radio cold (so the valves don't conduct) unplug the multi-pin connector from the IF module.

The pins are numbered with tiny numerals (at least the sockets are). Look for pin number six. Using your multi-meter on its highest resistance range, measure between pin six and ground. Ideally the positive lead should go to ground and the negative to pin six. You will see a low resistance reading initially. As the capacitors charge up it should go higher than a standard multi-meter can measure. (Usually > 10 megohms)

If it passes this test, you can either be happy, or if you are like me perform a more rigorous test. I measure mine using a high resistance meter which has a 250 v measuring potential. With this, I am seeing around 50 Megohms for the entire IF AGC line.

If you have a low resistance, less than ten megohms would probably start to have a noticeable effect, the next step is to remove the IF module. Disconnect R507. Pull V502. Measure between pin 1 and ground. Any leakage here can only be a filter or possibly C512.

If you have leakage, remove the filter can. C512 is easy to disconnect so it is worth checking first. It is the disk ceramic close to the 2kHz filter. If you still have leakage with it disconnected, it is down to one or more of the filters.

To decide which filter(s), you have to disconnect them one at a time and measure them individually. Individually I am seeing about 200 megohms at 250V .

The thing about the leakage is that it is not ohmic, in the sense that it might be 10 megohms at a volt, but 100 kilohms at 100 volts. So it is difficult to say what is a problem and what isn't, but there shouldn't really be much leakage at all.

To clarify, I am measuring between pin one of the socket for V502 and ground. This gives easy access to the output common to all filters.

Repairing an Audio output transformer from an R-390A "Slim" Revision beta 1.0

Graham Baxter G8OAD Steve Smith G8LMX

My most recent EAC R-390A did not have its original audio output transformer. It had long since been discarded in favour of an unsightly but none-the-less functional eight ohm transformer. Since it is always my ambition to preserve these receivers in the form that the designer intended, I asked around with the hope of buying a transformer. Spare parts are hard to come by in the UK. I also did not have much luck in sourcing one from the US. It would have been possible to buy an entire AF module, but breaking up a complete module was not an attractive proposition for me.

My friend John Branson offered me a transformer in good cosmetic condition but with an open-circuit primary. Of course I could not resist this interesting challenge! And since Steve was spending the weekend we could pool our capabilities.

Repair procedure

These transformers are potted in wax. I think the wax was originally introduced through holes in the top. The holes were subsequently sealed before the can was painted. We did not want to mar the paintwork unnecessarily. So it was decided to attempt to unsolder the base from the can. This process will lead to hot wax escaping from the can, possibly under pressure so the job was moved outside. The can was initially secured bottom side up in a suitable vise. Nuts were fitted to two of the four threaded spigots to enable the lid to be levered out of the can using robust pliers.

Heat was applied using a small butane torch. The flame was directed so that as far as possible neither the paint nor the feed-through insulators were in the direct path of the flame. Once a small section began to unsolder, molten wax started to bubble out of the can, thus clearing the solder from a small section of the seam. The can was then held horizontally with the newly created leak lowermost. A foil tray was placed beneath the edge to catch the liquid wax. Heat was then applied evenly to the whole of the seam by constantly moving the flame. Initially the liquid wax was dispersing the heat from the solder, but eventually the wax nearest the joint was exhausted and the temperature was able to rise. Once the entire bead of solder was molten it was possible to lever the cap away from the can.

I am sorry, we did not take a picture of this step. I think thoughts of self-preservation were uppermost in our minds!

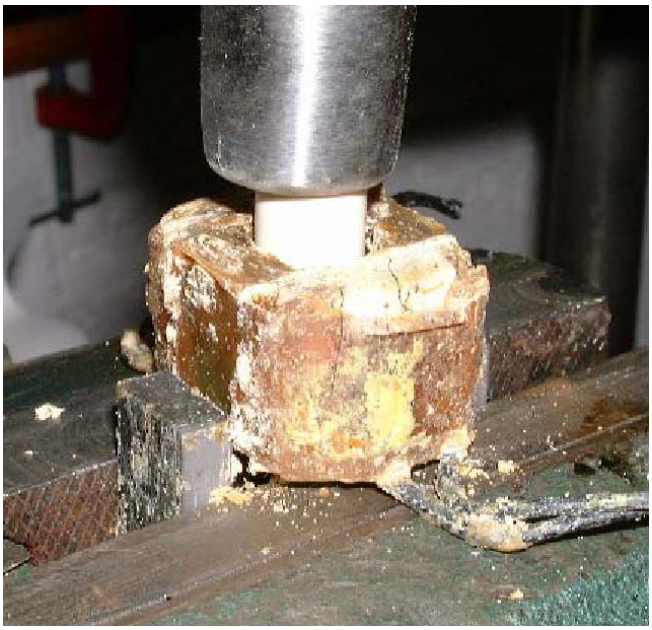
After allowing the assembly to cool, the internal wires were snipped from the feed-through terminals. In order to soften the remaining wax, the can was placed in a small saucepan of water. The water was brought to the boil on the hob and allowed to simmer for a few minutes. Eventually the wax softened sufficiently to allow the transformer to be withdrawn from the can using its lead-out wires. This was achieved by the careful use of two dining forks whilst one of us kept watch for the rightful occupant of the kitchen!

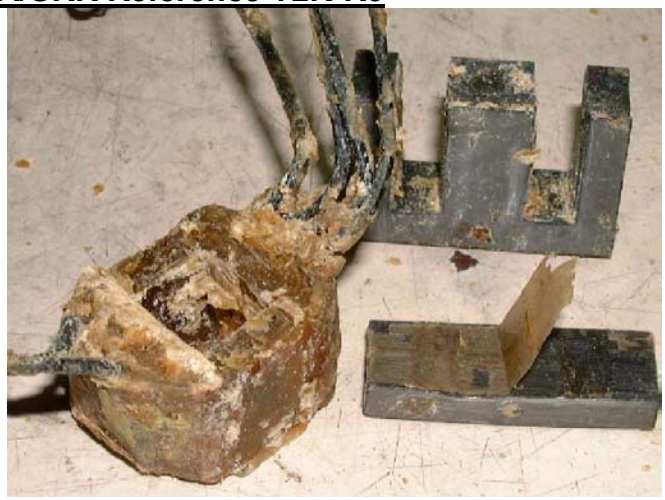
The wax was gently chiseled, using a plastic spatula, from the transformer and the can and was preserved for future use. The transformer turned out to be of conventional E and I construction with a folded steel clamp. I would estimate we recovered ninety percent of the wax. The clamp was opened and the assembly removed.

With the clamp removed it was a simple matter to separate the I and E laminations. In the case of a single ended output transformer it is necessary to introduce a small gap into the magnetic circuit. This prevents the net unidirectional current from causing a sufficient flux to allow saturation of the iron during the audio peaks. In this case the gap comprised a two thousandths of an inch paper shim between the E s and the I s. Not interleaving the laminations also effectively introduces a small gap.

You can see here the thin paper shim peeling away from the block of laminations.

Next the bobbin assembly, still within the E laminations, was gently staked between the jaws of a bench vise. The centre core of the laminations was driven out using a non marring plastic drift. The stack of laminations was removed, and subsequently replaced, as an entity. They were very effectively stuck together with wax.





This picture shows the laminations and the bobbin assembly separated.

The bobbin assembly was then dismantled. The lead-out wires were secured with cardboard and tape. These were removed first. Then the beginning of the outer winding, one of the secondaries, was located. We needed to count the turns. There were 417 turns on each secondary.

The primary winding was not counted. It was not practical to do this because there are thousands of turns, and the winding was rotten in several places. The original construction utilised a 0.002" paper insulator between each layer of primary winding.

The bobbin was a simple square waxed card cylinder with no end cheeks. It was felt that some temporary cheeks should be fabricated in order to provide lateral support for the windings. Once they were secured with tape and varnish, the cheeks would be removed.

The number of primary turns was calculated as follows. The secondary has two windings, each of 417 turns. The entire secondary when connected in series therefore has 834 turns (N2).

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The turns ratio is the square root of the impedance transformation ratio.

N1/N2=sqrt (14.32) = 3.78.

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The measured diameter of the primary wire including the varnish was 0.0037 inches. With the varnish removed it was 0.0031". I converted this to 0.08 mm, and chose to use the nearest I had in stock, 0.071 mm wire. However, when comparing the resistance of equal lengths of the old wire and my new wire, the new wire had nearly twice the resistance of the old. I used it anyway, but had I had any, I would have used 0.09 mm instead. I cannot account for the difference in dc resistance on the grounds of cross sectional area alone.

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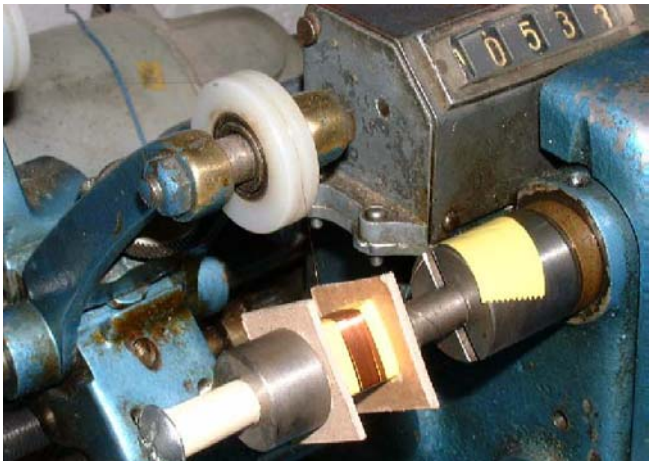
A generous amount of polyester tape was used to separate primary from secondary, and the tape was encouraged to ride up the sides of the cheeks so that the creepage distance between primary and secondary would be increased. The two secondaries were then wound. The first one to go on will have the lower dc resistance of the two; they are specified as 28 and 30 ohms. The secondaries were isolated from each other with a moderate amount of polyester tape.



On completion, the assembly was removed from the machine, taking care not to snag any of the
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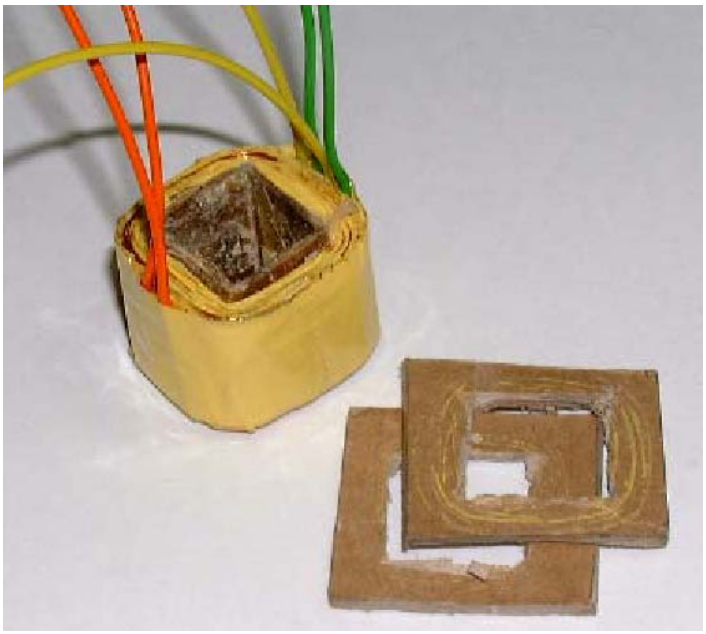
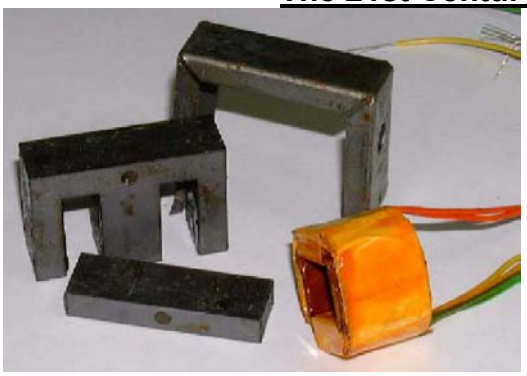
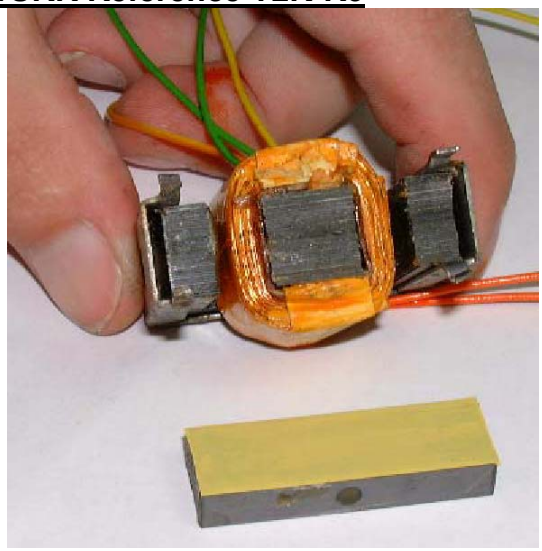
Then the temporary cheeks were removed.

In accordance with the style of construction of the original, the insulated lead-out wires were attached after the bobbin was finished and they were secured externally with tape.

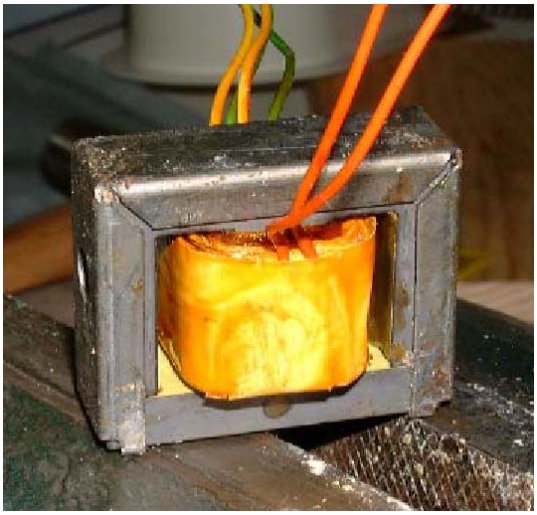




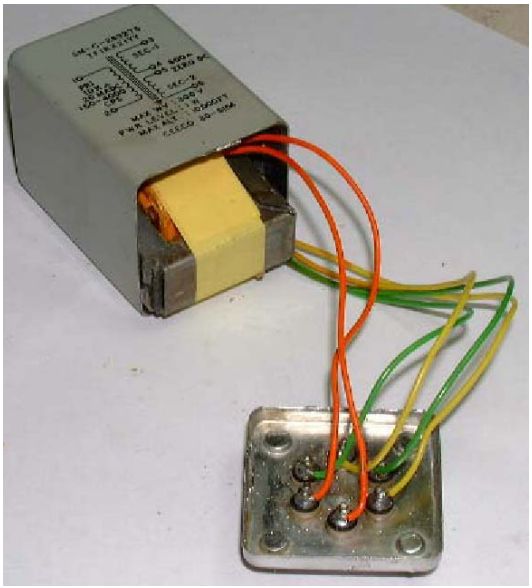
Then, a small amount of varnish was sprayed around the edges to provide environmental protection and a little more strength. A little tape was applied around the inside of the bobbin and over the edges where the laminations would sit.



The bobbin was reassembled into the lamination stack. One layer of polyester tape was interposed between E and I laminations to implement the de-saturation gap.



The clamp was closed by a combination of tapping and squeezing. Look at all that space ... I could have used thicker wire.

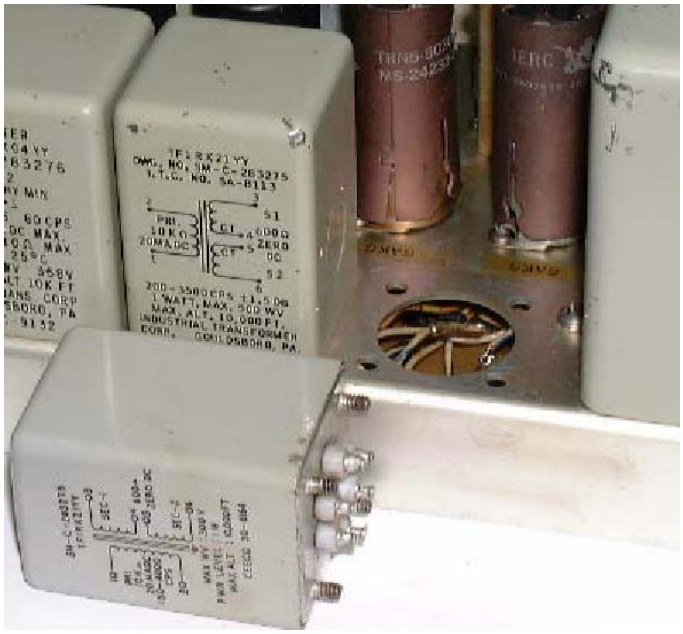


The transformer assembly was reunited with its freshly cleaned can.

Use was made of air conditioning pipe foam insulation to provide a securing cushion around and beneath the transformer.

The wires were carefully dressed to avoid pressure from the terminals. Note the very slight blistering of the paintwork.

We decided not to re-solder the base. It is a very tight push fit. I am considering the use of an adhesive. If in the future I acquire spools of wire of a closer gauge, I might pull it down and rewind it.



Here is the assembled transformer ready to fit..

Here it is in place. Not a perfect match but it is very close and I am extremely pleased with it. Thank you John and Steve!

The resulting sound quality is pretty well indistinguishable from the other EAC which has its original transformer. The transformer obviously gets warm, but to a similar degree as its "line out" neighbour and similar to the transformers in the other radio.

Graham Baxter G8OAD
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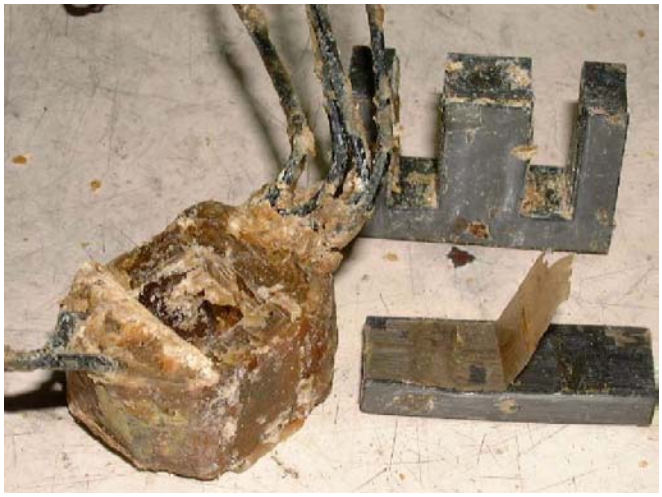

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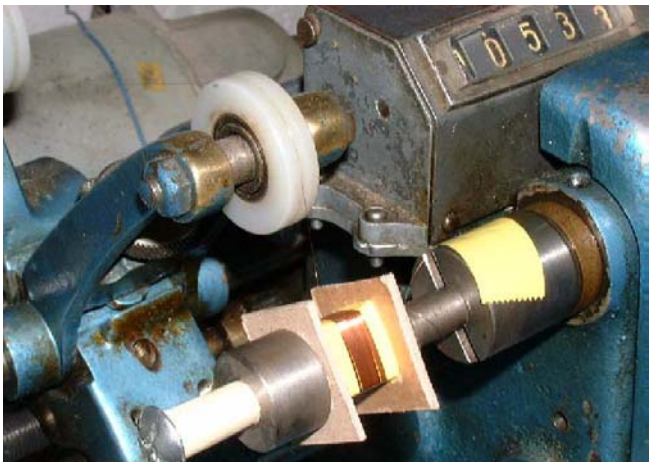

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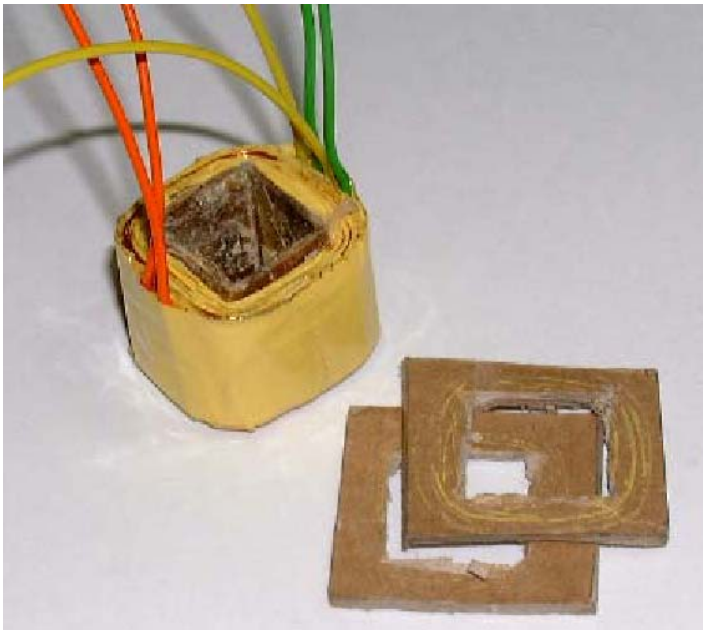
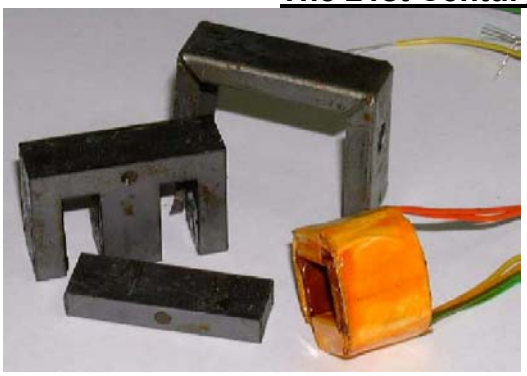
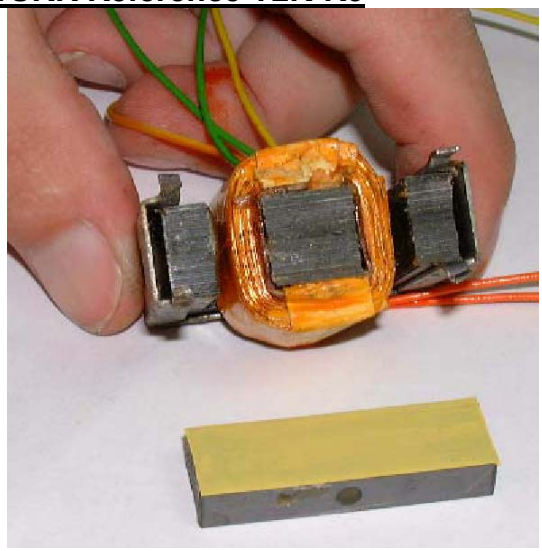
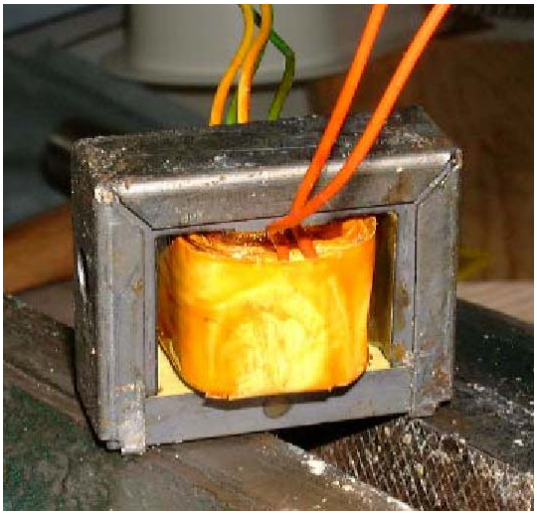




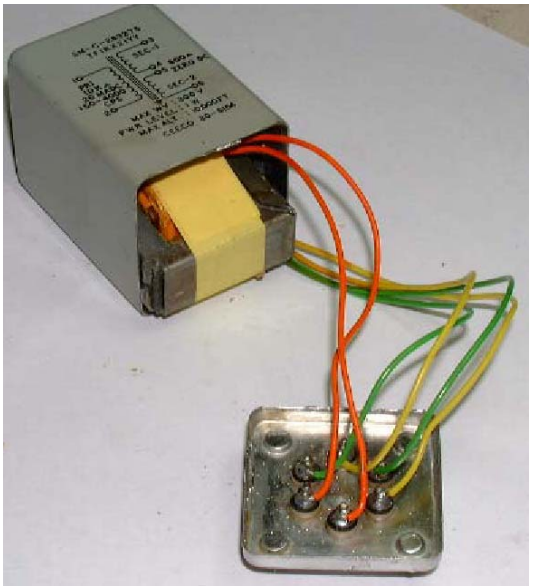
Then, a small amount of varnish was sprayed around the edges to provide environmental protection and a little more strength. A little tape was applied around the inside of the bobbin and over the edges where the laminations would sit.



The bobbin was reassembled into the lamination stack. One layer of polyester tape was interposed between E and I laminations to implement the de-saturation gap.



The clamp was closed by a combination of tapping and squeezing. Look at all that space ... I could have used thicker wire.

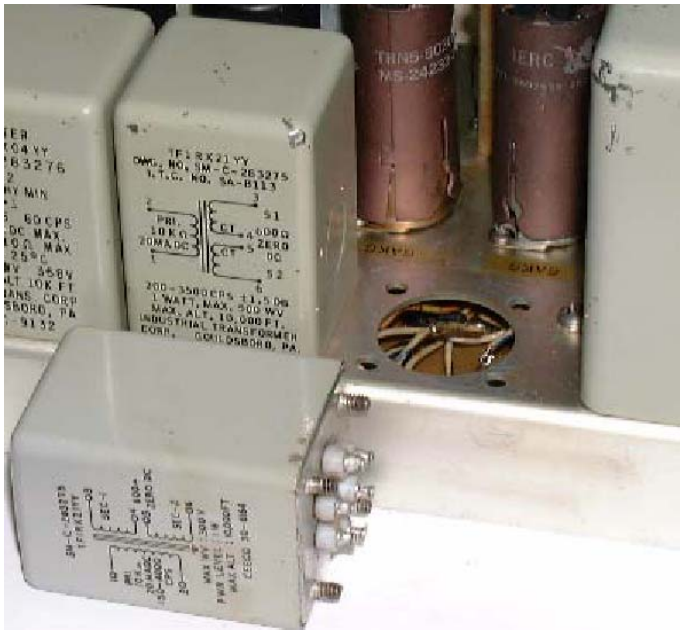


The transformer assembly was reunited with its freshly cleaned can.

Use was made of air conditioning pipe foam insulation to provide a securing cushion around and beneath the transformer.

The wires were carefully dressed to avoid pressure from the terminals. Note the very slight blistering of the paintwork.

We decided not to re-solder the base. It is a very tight push fit. I am considering the use of an adhesive. If in the future I acquire spools of wire of a closer gauge, I might pull it down and rewind it.



Here is the assembled transformer ready to fit..

Here it is in place. Not a perfect match but it is very close and I am extremely pleased with it. Thank you John and Steve!

The resulting sound quality is pretty well indistinguishable from the other EAC which has its original transformer. The transformer obviously gets warm, but to a similar degree as its "line out" neighbour and similar to the transformers in the other radio.

Graham Baxter G8OAD

Steve Smith G8LMX