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News, Updates

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Website installed.

The R-390A suffers from shortcomings which can be remedied using technology not available when the R-390A was designed.

How to Improve the R-390A

R-390A collectors today fall roughly into two groups. One group wants the R-390A to be restored as much as possible to its original condition. For them, the greatest value is for the R-390A to look and work like it did when it came out of the factory. The other group wants the R-390A to be a useful receiver in the 21st century. This website intends to support those users who want to continue using the R-390A and keep it working for as long as possible.

Keep in mind that the R-390A was used in many other applications that long outlasted its original mission. These applications did not utilize it only for its original design and they modified it as needed to suit their application. E.g., it was used by NASA on the Apollo program to connect tracking sites around the world.

The intent here is to upgrade the R-390A in a manner that the original Collins engineers might have used if they had had the technology that I have. My respect for those engineers grows every time I work on an R-390A.

Heat

The Current-Regulator

The current-regulator tube, a 3TF7 or RT510 located in the IF-module, was intended to stabilize the filament power to the PTO (V701) and the BFO (V505.) This was to help stabilize tuning in the presense of wide power variations that were typical of portable-generator power and shipboard power. There is no need for this stabilization when the R-390A is connected to normal power mains in the US and other industrialized countries.

This current-regulator tube generates a lot of needless heat which shortens the lives of other components in the receiver. The IF module can be easily modified to remove the current regulator tube and run the associated tubes, V505 and V701, from the normal 6 Volt filament power coming from the power transformer. This will eliminate a major source of heat and will not impair stability at all.

Do not substitute a solid-state current-regulator for the original current regulator. Doing so will not eliminate any heat and the current-regulation is simply not needed today.

Re-wiring in the IF-module to eliminate the current-regulator tube is the best solution and is not complicated at all. These 3 steps put 6VAC on the filaments of V505 and V701. Here are the steps:

1) remove the RT510/3TF7 tube;
2) add a wire from pin 7 of the RT510 socket to chassis ground; and
3) add a wire from pin 9 of V506 (6VAC) to pin 3 of V505.

The Ovens

The ovens in the receiver, for the crystal-bank and for the PTO, are not necessary any more. They were intended to stabilize the receiver's tuning in the event of large swings in ambient temperature. Most R-390A's today are operated in air-conditioned environments or other mild conditions. The oven accelerates aging in the PTO, which already has a limited lifespan due to non-linearity and end-point problems that are accelerated by heat. The "Oven" switch should be kept turned off whenever the R-390A is operated below the artic circle.

The Audio-module

The audio-module has four tubes which can be eliminated with a solid-state conversion. Two of these tubes are 6AK6s, which generate a lot of heat. The audio-module sits physically underneath the IF-module. Heat from the audio-module rises and bakes the poor IF-module.

The Rectifiers

The 26Z5 rectifier tubes, mounted with the power-transformer below the RF-deck, generate a lot of heat. I mention them last because most R-390As have already been converted to silicon rectifier diodes. If not, they should be.

Detector

The R-390A's original detector is a simple diode detector. It is inadequate for SSB and marginal for AM, owing to excessive distortion. A product-detector is the preferred alternative. IC balanced-mixer product-detectors, originally designed for demodulation in FM and TV receivers, today offer good performance at low cost.

An asynchronous-detector, as applied to AM demodulation, is a product detector which uses a "hard-limited" copy of the AM signal, in lieu of a BFO signal, to mix with the original AM signal from the last IF amplifier. This offers almost all of the advantages of true synchronous AM detection, without its complexity and expense. TV receivers (before the digital revolution) almost universally used asychronous-detection of the AM sound component of the NTSC TV signal, because of its simplicity and low distortion.

For many years, product-detectors have been used in NTSC TV receivers and as quadrature-detectors in FM receivers. There are many low-cost product-detector ICs that were originally designed and made for these applications and are still available today. Some of them are usable for SSB and AM detection in the R-390A.

Frequency Readout

The original mechanical frequency-readout is a gear-driven mechanism tied to the PTO tuning shaft. It only "predicts" the frequency the receiver is supposed to be tuned to. It is always wrong. There are several sources of error that cause it to be wrong.

The first-converter uses a 17MHz crystal which is never exactly 17MHz but differs by a slight amount which is an allowable, unavoidable manufacturing-tolerance error.

The second-converter uses a bank of crystals to enable band selection. Each crystal differs from its ideal frequency by a small percentage which is another manufacturing tolerance error. This error is different for every crystal and every associated band. This is the reason why the R-390A must be recalibrated after every band change. The receiver's 100KHz crystal calibrator is used as a work-around method to accomodate these and other sources of error.

Even after recalibration there are still errors causing the mechanical readout to be inaccurate. The PTO is unavoidably nonlinear, although the nonlinearity can be minimized with careful adjustment during overhaul. The nonlinearity can never be totally eliminated and it increases with age until eventually the PTO cannot meet its specification of maximum allowable nonlinearity. The PTO's endpoints must likewise be adjusted during overhaul and with age all PTOs eventually exceed their endpoint adjustment tolerance.

The BFO is not included in the mechanical frequency readout. Thus, when the BFO is turned on it does not affect the indicated frequency. This is a problem during SSB tuning, as the indicated frequency does not reflect the frequency of the SSB signal that is tuned in.

All of the mechanical readout's errors can be avoided by replacing it with an electronic readout that is driven by a frequency counter system that continuously measures all the frequencies used in the receiver and uses them to calculate and display the actual received frequency.

Noise Limiter

The R-390A's original noise-limiter design is simple, primitive and nothing like the noise-blankers that have come into common use in later years. Even worse, this original noise-limiter was designed for AM and does not work properly on SSB signals.

It is not reasonable to think of replacing this noise-limiter with a noise-blanker. However, there are some simple modifications that can free the R-390A's noise-limiter from its ties to AM and make it more functional for SSB. It will still be primitive, but at least it will be more useful and better than nothing.

The good news here is that the modifications are so simple that they can all be accomplished at the front-panel, where the "Noise-Limiter" potentiometer is mounted:

1) Disconnect the orange wire from the original potentiometer and cover the end with shrink wrap.
   This wire will not be used. The original 500K potentiometer R120 will be replaced with a 50K one.
2) Disconnect the white/blue/orange wire from the original potentiometer.
   Connect this wire to a switch contact of a new 50K potentiometer.
3) Disconnect the white (ground) wire from the original potentiometer.

Connect this white wire to the same terminal on the new potentiometer.

4) Connect the white/red/orange wire from the old potentiometer to this same, grounded terminal.
5) Connect a 10K resistor from the center terminal of the new potentiometer to the other switch terminal.
6) Mount the new potentiometer and test the noise limiter.