VFO RECALIBRATION PROCEDURE:
Central Electronics 100/200V

1.0 Introduction

The Central Electronics 100/200V uses a precision, permeability-tuned oscillator for output frequency control. The vfo tunes the range of 5 to 6MHz with 5MHz corresponding to the high frequency band end and 6MHz corresponding to the low frequency end.

The oscillator circuit is self-compensating for changes in tube transconductance as caused by line voltage fluctuation (affecting filament voltage and emission) and normal tube aging. The vfo tuning mechanism consists of a precision stainless steel lead screw, supported by a preloaded ball-bearing actuator.

A mechanical corrector is provided and permits vfo tracking calibration at 50KHz intervals throughout the 1MHz tuning range. This built-in calibration feature permits the user to accurately calibrate the vfo, without an accumulation of error, throughout the entire tuning range. In practice, the end-to-end tuning error can be maintained to less than 300Hz.

The transmitter's operating frequency is displayed in 1KHz intervals on the circular "Kilocycle" dial. A slide-rule "Megacycle" scale rotates with the bandswitch so that only the band selected appears in the vfo window. A two-speed tuning knob permits both rapid and "finely-tuned" frequency selection.

2.0 VFO Problems

Functionally, the 100/200V vfo is, electrically, an extremely reliable device. The transconductance equalizer so effective that tubes failing a transconductance test in a high performance tube tester routinely provide reliable vfo operation (just about any 6U8 that glows will function in this circuit).

Most vfo problems are mechanical, in nature. Some are field repairable whereas others require services beyond that of the normal repair service station.

Field repairable items include vfo tracking, dial slippage, external mechanical binding of parts and normal lubrication. Excessive vfo drag, as caused by permeability slug misalignment or defective bearings should be repaired by a specialist as full vfo recalibration, after the mechanical repair is concluded, would be necessary.

3.0 VFO Tracking

Vfo recalibration requires an electronic frequency counter, a precision screwdriver (No. 2 machine screw head) and a suitable test cable having an RCA plug ternination for interconnection to the 100/200V VFO Out jack.

Perform the following steps in the order indicated, after a 30 minute warm-up period:

1.0 Tune the vfo to 5000KHz, which corresponds to the high end of the vfo scale. The red pointer should be at the last 0.1 MHz integral marking at the high frequency end of the slide-rule scale. With the kilocycle hairline indicator set to its correct, vertical position, the kilocycle dial should read "0". In all likelihood, the observed vfo output will be some value slightly different from the desired 5000KHz reading.
2.0 Remove the small plug button between the two vfo tubes and observe the series of vfo corrector adjustment screws. The center (second) screw visible in the tuning window corresponds to the 5000KHz. The left screw corrects for the 4950KHz setting

5.0 Depot Level Maintenance

5.1 Introduction

After prolonged periods of use (measured in decades), the vfo drive may develop a "lumpy" feel as the device is tuned throughout its normal operating range. In extreme cases, the vfo tuning knob may be difficult or nearly impossible to rotate.

In these cases, the usual cause is a hardening of lubricant within the pre-loaded, ball-bearing actuator assembly. Repair requires the removal, cleaning and repacking of the two ball-bearing assemblies. This activity requires specialized service equipment and is not a recommended field procedure.

5.2 VFO Removal

The vfo may be removed for servicing via the following procedure:

1.0 Remove the 100/200V from its cabinet.

2.0 Lay the unit on its left-hand side.

3.0 Disconnect the vfo output (white coax) phono plug from the extension receptacle and the vfo power plug from the rf chassis.

4.0 Remove the vfo tuning knob. This is accomplished by first locating the aluminum dial hub on the back of the 100KHz circular dial. The dial hub contains two radial holes (approximately 1/4' deep) that allow access to the recessed tuning knob set screws. Loosen the two RECESSED set screws and pull the knob assembly out from the front panel.

5.0 Remove the ball-chain from the sprocket on the right side of the Megacycle dial drum.

6.0 Loosen, but do not remove, the four vfo screws which secure the square vfo mounting posts to the front panel.

7.0 Remove the bottom two vfo square mounting posts.

8.0 Remove the top two vfo front panel screws (loosened in step 6.0) and gently remove the vfo assembly from the top of the 100/200V.

Installation of the vfo is the reverse of the above described procedure.

5.3 VFO Actuator Rebuild Procedure
(see here for a pictoral step-by-step description)

The vfo actuator housing is a machined aluminum assembly, mechanically attached to the vfo front plate. This assembly consists of a tuning shaft, a front-located ball-bearing, load spring/distance tube and rear-located ball-bearing assembly. The tuning shaft is tapped to accept the threaded (1/4-20) vfo lead screw and includes an anti-backlash mechanism. The input end of the tuning shaft includes a press-fit brass gear which operates the dial-cord driven vfo Megacycle pointer.

The tuning shaft is 3/8" in diameter, except that a quarter-inch portion of the shaft, nearest the threaded end, is approximately 5 thousandths larger in diameter. This larger portion is designed so that the rear-located ball bearing is a press-fit, and therefore stationary after positioning. The front-located bearing easily slides onto the tuning shaft. A coil spring, located between the two bearings provides an outward force to keep the bearings separated. A distance tube, installed between the two bearings ensures a minimum separation distance is maintained.

whereas the third screw visible as the tuning dial is rotated lower in frequency corresponds to 5050KHz, etc.

3.0 With the vfo set to 5000KHz ("0" on the dial window), monitor the actual vfo frequency on the counter and adjust the center corrector screw as needed. It is recommended that once this initial correction is made that the vfo frequency be rocked slightly (+/- 5KHz), reset to the "0" point and the corrector screw readjusted as needed.

4.0 Continue the procedure described in step 3.0 in 50KHz steps up to the 6000KHz position.

4.0 Overall Frequency Calibration

While the above procedure accurately calibrates the vfo, transmitted frequency errors can still occur due to drift in the frequency calibration of the 8MHz single-sideband generator and the bandswitched heterodyne oscillator crystals.

To calibrate the 8Mhz crystal oscillator, proceed as follows:

1.0 Using an oscilloscope, observe the 8MHz crystal oscillator level at the jumpered connection, pins B and C, of the RF phase shift network. Adjust the 8MHz oscillator plate coil for maximum indicated output level.
2.0 Measure the frequency present at the test point described in Step 1, above. Adjust the 8MHz oscillator frequency corrector capacitor (chassis-top adjustment) to exactly 8000KHz.

To calibrate the heterodyne oscillator crystals, proceed as follows:

1.0 It is possible to measure the heterodyne oscillator crystal frequencies from the first and second mixer cathode test jacks, located immediately adjacent to the stage tubes. A convenient test-jack extender jig requires a 5-inch length of 20gauge bus wire. Starting from one end, form a 1/8th inch diameter circle such that the circle is approximately 3/8th inch from the beginning end. Slide a 3 inch length of spaghetti tubing over the long end and fashion a second 1/8th inch diameter circle to secure the insulating tubing. The remaining uninsulated wire length forms the balance of the extender.

2.0 Insert the jack extender in the first mixer cathode jack, set the bandswitch to 20 Meters and observe the 27.500MHz crystal oscillator injection signal. On 100V's, adjust the crystal trimmer capacitor for 27.500MHz. If the capacitor has insufficient range of adjustment, carefully adjust the corresponding oscillator plate coil (plug-in can) for proper frequency. Note that if this slug is detuned too far to obtain exact calibration, power output may drop to an unacceptable level or the Crystal may not oscillate reliably. If this problem occurs, it may be necessary to replace the crystal, itself, to achieve proper calibration and output level.

3.0 Repeat the above for 10 Meters and observe the 47.700MHz crystal oscillator injection.

4.0 Insert the jack extender into the second mixer cathode jack, set the bandswitch to 80 Meters and observe the 17.500MHz crystal oscillator injection signal. Adjust the crystal trimmer as described in step 2.0. Continue this procedure for 40 Meters (20.500MHz) and 15 Meters (34.500MHz). If the set is equipped for 160 Meters, 15.500MHz injection can be monitored at this same test jack location and correct if necessary.

5.0 Routine VFO Lubrication

In order to reduce friction within the vfo mechanism, the following internal vfo components should be coated with a high temperature Teflon grease:

The machined aluminum actuator housing is grooved to accept two locking clips, and so, secure the bearing/shaft assembly. The housing is somewhat shorter than the extended distance of the two bearings with the load coil spring uncompressed. Installation requires that the load spring be slightly compressed, thereby providing a controlled amount of separation force which ensures that the shaft bearings are properly located within the housing. Disassembly of the assembly is as follows:

1.0 Remove the Kilocycle dial from the shaft by loosening the two retaining set screws.
2.0 Remove the three housing assembly screws from the vfo front plate and unscrew the entire assembly from the vfo lead screw. Remove the anti-backlash washers and temporarily place the vfo aside.

3.0 Secure the housing in a vice (smooth jaws) with the brass gear upward.

4.0 Gently remove the brass gear. First, using a large, flat-blade screwdriver, lever the gear up the shaft, using the housing lip as a fulcrum. Once the gear is approximately 3/16" above the housing lip, use a gear-puller to fully remove the part from the shaft.

5.0 Remove the internal spring clip. Take caution as the front bearing will release and move upward due to action by the compressed load spring.

6.0 Remove the housing assembly from the vice and extract the shaft, front/rear-located bearings, spring and distance tube as one sub-assembly.

7.0 Separate the front-located bearing, distance tube and spring.

8.0 Press off the rear-located bearing. Do not apply force to the 1/4" portion of the tuning shaft. This part is press-fit into the shaft tube and will fall into the shaft if excessive force is applied to that area.

9.0 Disassemble the two bearings, clean out the old lubricant and replace with a mixture of high-temperature Teflon grease and synthetic 10W-40 motor oil.

10.0 Discard the original spring and replace with a 1/2 x 1-1/2 x .041 spring (Handyman SP-9706).

11.0 Reassemble the actuator using the reverse of the above described procedure. The rear-located bearing should be pressed onto the shaft until it is nearly flush (0.010" clearance) with the threaded housing-portion of the shaft.

Prior to installation of the rebuilt actuator onto the vfo, perform the following operations:
1.0 Remove all traces of old grease from the lead-screw, corrector screws and other bearing surfaces.
2.0 Lubricate these parts using the procedure described in Section 5, Routine VFO Lubrication.

3.0 Verify that the lead screw slides smoothly into the ceramic vfo coil form. If there is any sign of binding, it will be necessary to re-center the coil slug within the ceramic coil form. To do so, proceed as follows:

3.1 Remove the vfo cover.
3.2 Loosen, but do not remove the three screws which attach the coil form to the vfo chassis plate.

3.3 Gently slide the coil form until the slug appears centered.

Threads of the vfo lead screw shaft
Top of the corrector post
Bottoms of the 2-56 corrector screws
These parts are accessible by removing the U-shaped bottom cover of the vfo, below the corrector screw access plug. Normally, this level of service is recommended at four-year service intervals

Additionally, one or two drops of light machine oil should be placed on the Megacycle indicator drive/gear wheels and pivot points as part of this routine maintenance.

3.4 Tighten the three screws and test for proper centering.

4.0 Reassemble the anti-backlash washers and lubricate with high temperature Teflon grease.

5.0 Temporarily reassemble the actuator to the lead screw and secure, with one screw, to the front plate. Verify that the vfo tunes the entire 5-6MHz range, with at least 25 KHz overtravel at each end. If correct, complete the reassembly process and recalibrate per Section 3.0 VFO Tracking.