

OPERATING INSTRUCTIONS  
FOR  
AMECO VARIABLE FREQUENCY OSCILLATOR  
MODEL VFO-621

### DESCRIPTION

The Ameco VFO-621 is a Variable Frequency Oscillator to be used with the Ameco TX-62 Transmitter or any other 50, 144 or 220 Mc. transmitter that is designed to operate with 8, 12 or 24-25 Mc. crystals.

The Ameco VFO-621 uses the superior HETERODYNE principle. The variable frequency oscillator operates at a low frequency. It is then heterodyned to 24-26 Mc. by means of a crystal controlled oscillator and mixer. This permits operation of the oscillator with one-third of the usual multiplication. The lower multiplication, combined with the lower oscillator frequency, permit a STABILITY and keying quality almost non-existent on the three VHF bands.

There is no chirp with keying. The warm-up time is very short, as both oscillators use transistors. The internal AC power supply is Zener Diode regulated. The dial scale is calibrated for 50-52, 144-148 and 220-225 Mc. The scales are long, open and easy to read. For mobile operation, terminals are provided for external DC supplies (6 or 12 volts for the filaments and 100 to 150 volts for the plates).

The cabinet height and finish match the TX-62 transmitter. It is 6" high, 5" wide and 7-1/2" deep.

The transistors, tubes and their circuit functions are as follows:

2SC185 transistor	Variable oscillator
2SC185 transistor	Crystal oscillator
6KZ8 tube (1/2)	Buffer amplifier
6KZ8 tube (1/2)	Mixer
6KZ8 tube	Output amplifier
Silicon diode	Power rectifier
Zener diode	Voltage regulator

The controls are as follows:

- Power switch
- Band switch
- Tuning dial

**READ THE COMPLETE SET OF INSTRUCTIONS CAREFULLY BEFORE CONNECTING OR OPERATING THE VFO-621.**

### GENERAL INFORMATION

The frequency output of the VFO-621 is from 24 to 26 Mc. This is divided into three bands. When connected to a transmitter, the output frequencies of the system (VFO and transmitter) will be as follows:

- Band A - 50 - 52 Mc.
- Band B - 144 - 147 Mc.
- Band C - 147 - 148 Mc. and 220 - 225 Mc.

Most 6 meter transmitters use crystals between 8.333 and 8.666 Mc. to cover the frequency range of 50 to 52 Mc. The transmitter's first stage multiplies the crystal frequency by 3 to obtain 25 to 26 Mc. This frequency is later multiplied by 2 to get 50 to 52 Mc. 8 Mc. crystals are similarly used in most 2 meter and 1-1/4 meter transmitters. The first stage triples the frequency up to 24 Mc. The multipliers that follow bring the frequency up to 144 to 148 or 220 to 225 Mc.

There are no changes needed when hooking up the VFO-621 to a transmitter that uses 8 Mc. crystals. It is not even necessary to have a CRYSTAL-VFO switch, nor is it important to put the switch in the correct position when using the VFO-621 with 8 Mc. crystal transmitters that have this switch.

The above information that applies to 8 Mc. crystal transmitters also applies to transmitters using 12 to 13 Mc. and 24 to 26 Mc. crystals. Be sure that one side of the crystal socket is grounded, especially with transmitters that call for 24 to 26 Mc. crystals.

Some transmitters use 8 Mc. crystals and multiply by two instead of three in the first stage. In this type of transmitter, it will be necessary to modify the 16 Mc. coil in the plate of the first tube to make it tune to 24 to 26 Mc. This can be done by removing a few turns. Approximately 1/3 of the turns must be removed. Start off by removing about 1/4 of the turns. Then check the tuning and remove additional turns, one or two at a time, until the coil tunes satisfactorily. The tuning can be checked best with a grid dip oscillator. An all-band, general coverage receiver can also be used. This will not change the operation of the transmitter when the same crystals are used. It merely changes the multiplication in the first stage from 2 to 3 times. The next stage tuning remains unchanged.

If you have any question on modifying your transmitter, send in the operating instructions and schematic of your transmitter for further information. Include a self-addressed, stamped envelope for return mailing of your instruction book.

### INSTALLATION

1. The VFO must be connected to the common ground on the operating table or desk. Use a #14 or heavier wire for this purpose and connect it to any of the ground terminals at the rear of the VFO. The grounds of all the equipment in the operating room should be connected together and then brought to a cold water pipe. This is an important safety measure and should be completed before any power switches are turned on.

2. When the station is in "receive" position, the transmitter is actually turned off. Since the VFO is a part of the transmitting system, it, too, must be disabled in the "receive" position. We do this by connecting the "KEY" terminals on the back of the VFO to the key line or a relay contact on the transmitter. (Note that when we use the word "Key" we do not refer to CW Keying. The word "Key" is used to designate an "on-off" or a "make-break" contact used to turn the transmitter circuits on and put a signal into the antenna when the contact is closed.

#### CATHODE KEYING.

If your transmitter is a CATHODE KEYED type (such as the Ameco TX-62) remove the jumper from the "CATHODE-KEY" terminals on the lower terminal strip at the rear of the VFO. (See Fig. 2). Leave the jumper on the "BIAS-KEY" terminals of this strip. Then connect the lead from the hot "CATHODE-KEY" terminal to the transmitter key line or relay contact that is meant to be connected to the VFO. The transmitter instructions generally designate the point to which the VFO key line should be connected. This point may be at the microphone plug, at a connector at the rear of the transmitter, or a terminal strip or relay inside of the transmitter.

#### GRID BIAS KEYING.

If your transmitter is a BIAS-KEY type, then remove the jumper from the "BIAS-KEY" terminals on the lower terminal strip at the rear of the VFO. (See Fig. 2). Leave the jumper on the "CATHODE-KEY" terminals of this strip. Then connect a lead from the hot "BIAS-KEY" terminal to the transmitter key line. Transmitter instructions generally designate this VFO connecting point. This point may be at the microphone plug, at a connector on the rear or a relay contact inside the transmitter. Any transmitter using "BIAS KEYING" will have sufficient bias voltage to key the VFO-621. The VFO-621 will not affect the operation of the transmitter.

The VFO can be used without connecting the key terminals mentioned above. In this case, the jumpers across the four terminals of the lower terminal strip are left in place. However, with this arrangement, the output of the VFO may be sufficient at the signal frequency to interfere with reception on the same frequency.

3. The RF output of the VFO is fed to the transmitter at the transmitter's crystal socket. We do this by removing the transmitter crystal and inserting the plug at the end of the VFO output cable into the crystal socket. The grounded side of the plug MUST be put into the grounded crystal socket contact. Check for ground with an ohmmeter if it is not marked clearly on the transmitter panel. Note that one side of the crystal socket MUST be grounded. Some transmitters have a separate connector for the VFO. The VFO-621 can either be plugged into the crystal socket in such a transmitter, or, the dummy

crystal at the end of the VFO-621 output cable can be removed and the special plug substituted. NOTE CAREFULLY that in this case, a 100 ohm resistor must be connected across the terminals of the new plug. Out of band operation is likely if this resistor is omitted.

Also check the schematic of your transmitter for the hot side of the crystal socket; it must have a capacitor (the .001 mfd. disc supplied can be used) between this terminal and the grid of the tube.

#### OPERATION

After all connections have been made, turn the power switch to ON. Turn the BAND switch to the band desired. The warmup time is so short that within a minute it is satisfactory for phone operation. Tune the VFO to the approximate frequency by the VFO dial. Tune to the exact frequency by putting the transmitter on SPOT and tune to the receiver frequency. Do not depend on the VFO calibrations when working near the band edge. After the VFO has been tuned as above, tune and operate the transmitter as usual. It is not necessary for the transmitter to be switched to VFO or even for the transmitter to have a CRYSTAL-VFO switch. The switch can be in either position.

#### MOBILE OPERATION

The VFO-621 is readily adaptable to mobile operation by using the auto battery and the transmitter plate power supply. For AC operation, the four terminals of the upper terminal strip on the rear of the VFO-621 are all shorted to chassis. For DC operation all the jumpers from the four upper terminals are removed and 6 or 12 volts DC can be fed to the filaments, and up to 150 volts DC MAXIMUM are fed to the plates. If the voltage exceeds 150, the filter capacitor will be damaged and some other components may also be overloaded.

For 6 volt operation, connect the terminal marked 6V to the transmitter filament line. The VFO filaments will be controlled by transmitter filament switch. When using these terminals, the VFO power switch is disconnected.

For 12 volt operation, connect the terminal marked 12V to the transmitter filament line. Also, add a 5 ohm, 20 watt wire wound resistor between the 6V and 12V terminals. Be sure that a #55 pilot lamp is in the VFO and working. Do not operate if the light is burned out or the tubes will be damaged.

#### ALIGNMENT

The VFO-621, in normal service, will need an occasional touch-up on the oscillator trimmers to keep its calibration accuracy. Unless tampered with, the 24 to 26 Mc. broadband amplifier should not need any adjustment. Drift can be minimized by adjustment of the temperature compensating trimmers.



Fig. 1. Front view of VFO-621.

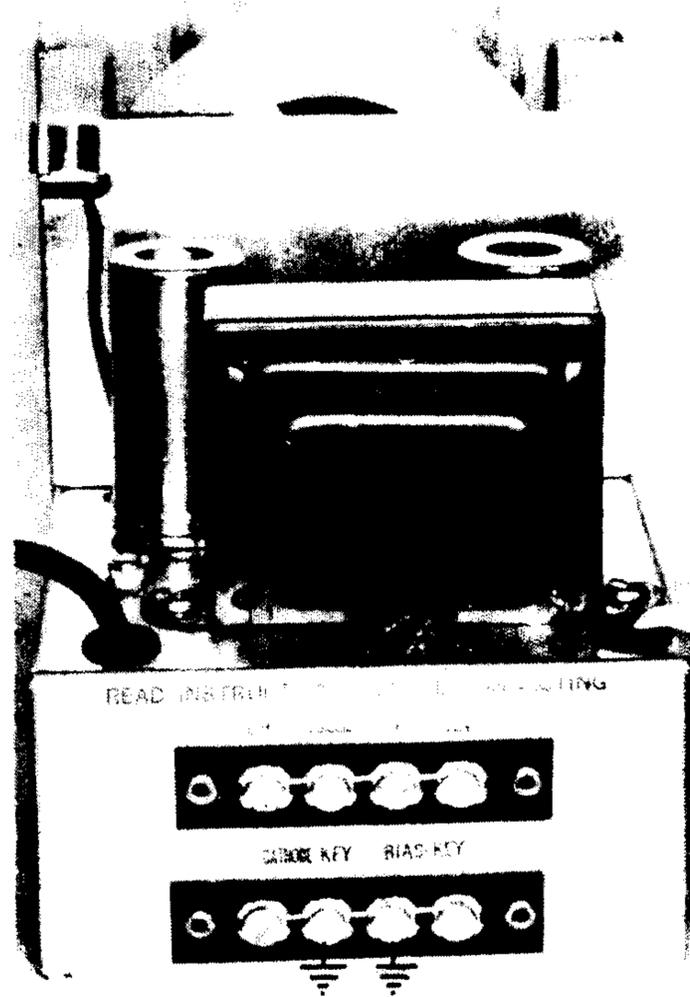


Fig. 2. Rear view of chassis.

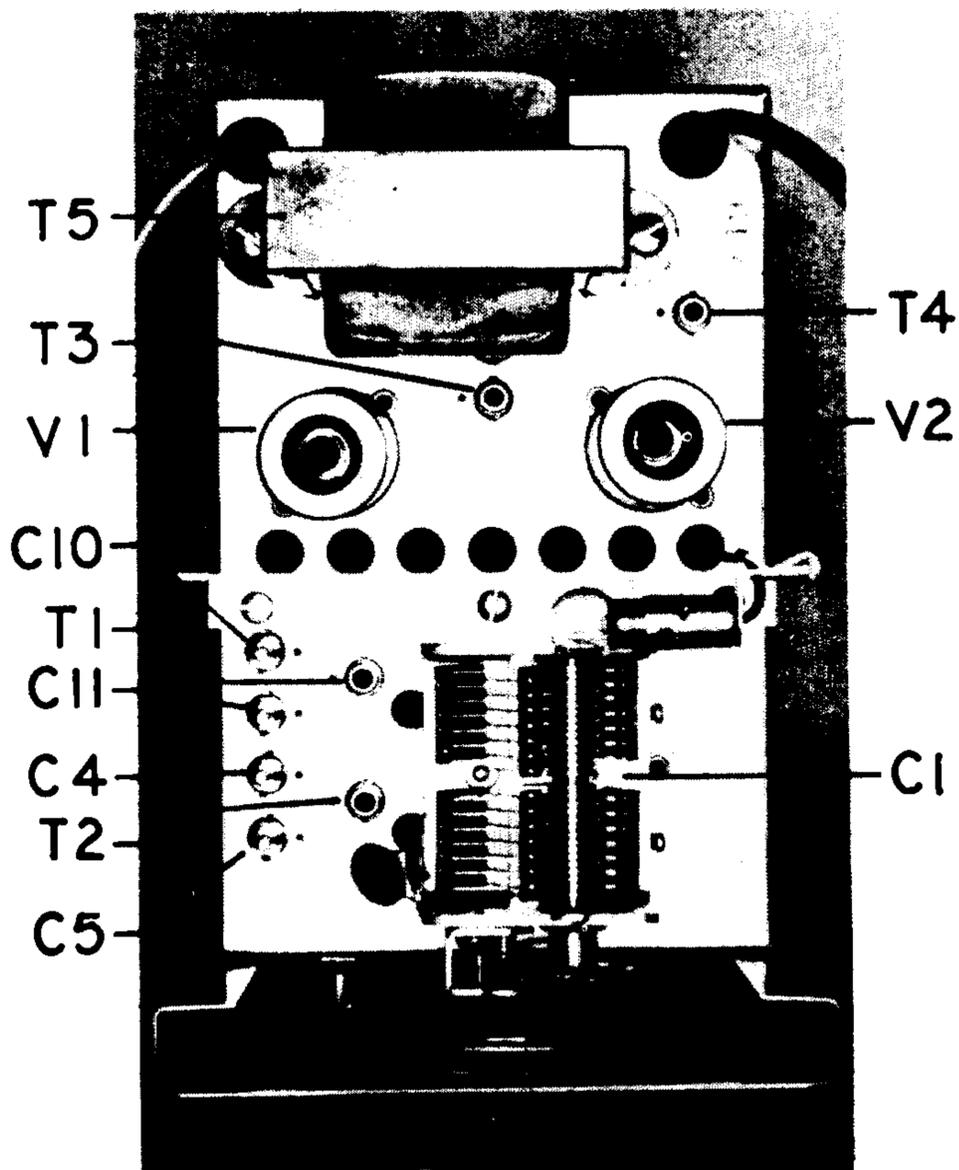


Fig. 3. Top view of chassis.

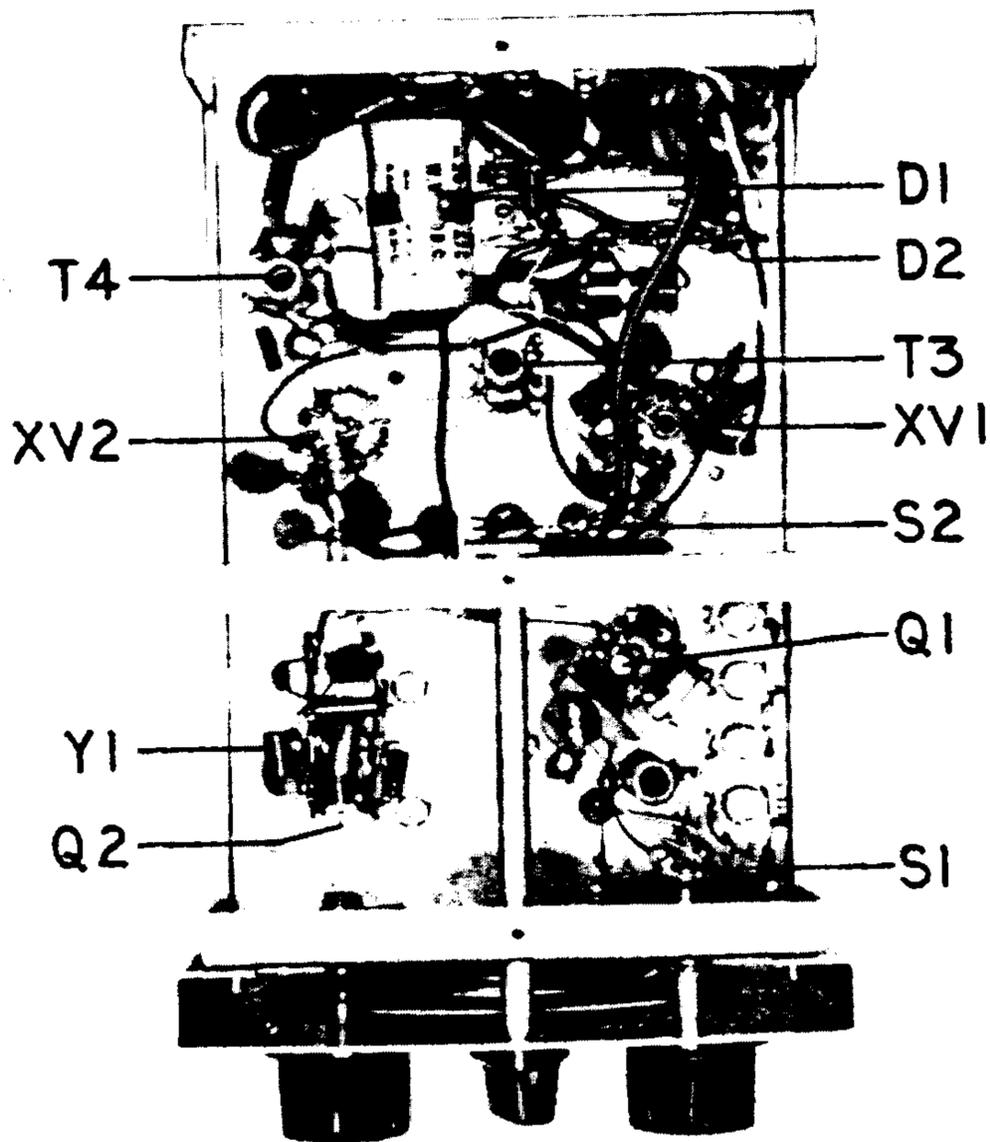


Fig. 4. Bottom view of chassis.

## ALIGNMENT PROCEDURE

### Equipment required:

Sweep generator with at least a 21 to 29 Mc. sweep width.

Oscilloscope with RF detector.

Tuning wrench, plastic, .100" hexagon, GC8606L or similar.

Marker generator.

Receiver covering 4 to 7 Mc. and 24 to 26 Mc., with calibration crystal oscillator.

Screwdriver, 1/8" blade.

Vacuum tube voltmeter with RF probe.

Hewlett Packard 410B or equivalent.

### NOTES:

Do NOT disturb the temperature compensation trimmer capacitors unless drift correction is desired.

All adjustments on the variable oscillator must be done in the order listed as there is interaction between adjustments.

The normal output voltage of the VFO into a high impedance RF VTVM is 1.4 to 3.0 volts.

Keep the output of the VFO to the oscilloscope below 1 volt.

### Alignment of the 24 - 26 Mc. Amplifier:

1. Remove the VFO from the cabinet and remove the bottom cover.
2. Disable the two oscillators by unsoldering the two 2.2K resistors (R4 and R8) from the feed-thru capacitor, C21, near the power switch.
3. Connect the output of the VFO (the dummy crystal) to the RF detector of the oscilloscope.
4. Connect the sweep generator, through a .001 mfd. capacitor to pin 2 (grid) of X2.
5. Turn the power switch on. The positions of the other controls will have no effect.
6. Align both cores in T4 for a flat response over 24 to 26 Mc.
7. Reconnect the sweep generator to pin 9 (mixer grid) of X1.
8. Align both cores in T2 in the same manner as in Step 6.
9. Touch up the alignment by repeating Steps 6 and 8.
10. Disconnect the sweep generator and oscilloscope. Reconnect R4 to C21.

Preliminary alignment of the variable oscillator. Put the bottom on the VFO with a few screws. See Figure 3.

1. Connect a piece of wire to the receiver antenna terminal. It should be long enough to pick up the signal from the variable oscillator.
2. Check the receiver calibration. The preliminary adjustments of the VFO should be correct to within 20 Kc.
3. On Band A, set the dial of the VFO to 50 Mc. Tune the receiver to 5.1 Mc. Adjust the core in T1 for maximum S-meter reading on the re-

ceiver. If the beat oscillator is used, tune for zero beat instead of watching the meter.

4. Tune to 52 Mc. on the VFO and 6.1 Mc. on the receiver, and adjust C5 as in Step 3 above.
5. Repeat Steps 3 and 4 until the dial is correct at both ends.
6. Switch to Band B and set the dial of the VFO to 144 Mc. Tune the receiver to 4.1 Mc. and adjust the top core (nearest to the chassis) in T2 for maximum S-meter reading (or zero beat).
7. Tune to 147 on the VFO and 4.6 Mc. on the receiver and adjust C11 as in Step 6 above.
8. Repeat Steps 6 and 7 until the dial is correct at both ends.
9. Switch to Band C and set the dial of the VFO to 220 Mc. Tune the receiver to 4.544 Mc. and adjust the bottom core in T2 for maximum reading on the S-meter or for zero beat.

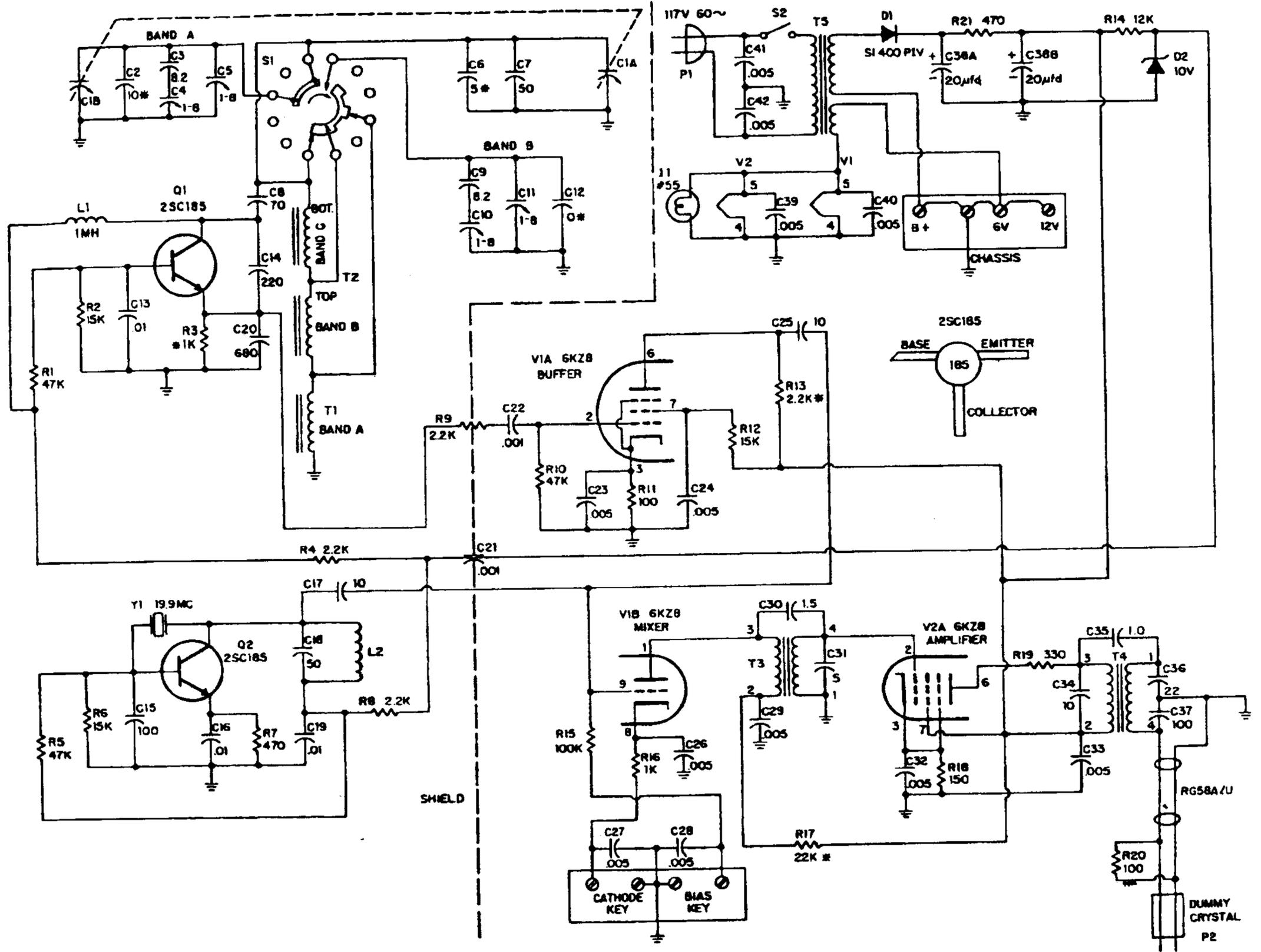
### Final alignment of the variable oscillator.

1. Reconnect R8 to C21.
2. Switch to Band A. Check the calibration at 50 and 52 Mc. with the receiver at 25 and 26 Mc. respectively. Readjust T1 and C5 as necessary.
3. Switch to Band B. Check the calibration at 144 and 147 Mc. with the receiver at 24 and 24.5 Mc. respectively. Readjust the top core in T2 and C11 as necessary.
4. Switch to Band C. Check the calibration at 220 Mc. with the receiver at 24.444 Mc. (If only 144 Mc. operation is desired, check at 147 Mc. with the receiver at 24.5 Mc.). Adjust the bottom core in T2 as necessary.

### Temperature Compensation Adjustments.

To check and correct VFO drift due to changing temperature, turn the VFO on for 10 minutes. Use a clock; do not use guesswork. Measure the frequency against a crystal oscillator. Do not trust receiver calibration as the receiver may also drift, thus giving erratic readings. Without touching the VFO, measure the frequency at the end of one hour and two hours. List the number of cycles change. Be sure to identify the direction of the drift. If the VFO is drifting higher in frequency, adjust the temperature compensation trimmer counter clockwise to decrease the capacity. The temperature compensating trimmers are C10 for 2 meters and C4 for 6 meters. There is no adjustment for 1-1/4 meters. Try two or three turns. Make a new warm up test the next day. It takes several hours to get back to the original temperature. The temperature adjustments are entirely independent on Bands A and B. There is no separate adjustment on Band C. Perfect stability is impossible - do not even attempt to obtain it.

After the temperature compensation is completed, the capacitor trimmer and possibly the core for that band may need some adjustment to correct the dial. See the alignment procedure.



Capacitors over 1 are in mmfd., less than 1 are mfd. unless shown otherwise.  
 Resistors are shown in ohms. K=x1000 M=x1000000.  
 Switches are shown in maximum counter-clockwise position.  
 \* Value selected in production. Typical value shown.

Fig. 5. Schematic diagram of VFO-621.

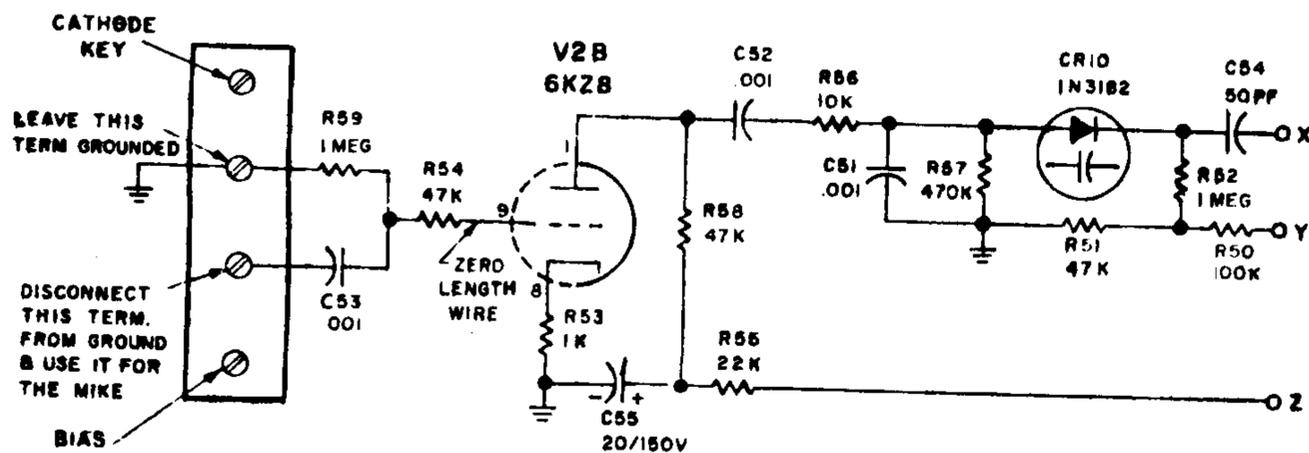
AVERAGE VOLTAGES, using a 20,000 ohms per volt VOM.									
	1	2	3	4	5	6	7	8	9
V1	76	0	0.8	0	6.3AC	100	85	2	-0.2
V2	--	0	1.8	0	6.3AC	110	115	--	---
	E	B	C						
Q1	1.3	1.4	7.2	D1 - R21 junction 130					
Q2	0.9	1.1	6.2	D2 - R14 junction 9.6					

Fig. 6. Voltage Table.

## ADDING NARROW BAND FM TO AMECO VFO-621

Narrow Band FM can be added to the AMECO VFO-621 if the following circuitry is added. All leads must be as short as possible. The parts shown in oscillator compartment must be put in the front section of the VFO. Take care not to disturb any adjustments or parts, other than the two major connections which must be made. The 50 pF disc capacitor which must be an NPO, goes from the diode shown, to the junction of R3 and the emitter of Q1. R60 goes to the junction of R4 and C21 which is the feedthru capacitor in the shield. C52 runs from R56 to pin 1 of V 2B. Connect one end to R56 and a piece of wire to its other end. Then run the wire between the center shield and the side of the chassis nearest to V2 in order to bring the wire into the tube compartment.

This circuit change is not available from the factory. All parts below can be bought over the counter at most electronic parts distributors.



### PARTS LIST

C-51-52-53	.001 mF Disc Capacitor
C-54	50 pF NPO Disc Cap.
C-55	20 mF/150 V Electrolytic
R-50	100 K 1/2 W Resistor
R-51-54-58	47 K 1/2 W Resistor
R-52-59	1 M 1/2 W Resistor
R-53	1 K 1/2 W Resistor
R-55	22 K 1/2 W Resistor
R-56	10 K 1/2 W Resistor
R-57	470 K 1/2 W Resistor
CR10	Amperex 1N3182 Diode

### NOTES.

1. UNLESS OTHERWISE SPECIFIED, CAPACITOR VALUES ARE IN MICROFARADS. RESISTOR VALUES ARE IN OHMS, 1/2 W.

81613002

SCHEMATIC DIAGRAM - NBFM MODIFICATION

## Warranty

AMECO, Division of AEROTRON, INC., Raleigh, N. C., warrants each new radio product manufactured by it to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part, in exchange for any part of any unit of its manufacture which under normal installation, use and service disclosed such defect, provided the unit is delivered by the owner to us or to our authorized radio dealer or wholesaler from whom purchased, or authorized service station, intact, for our examination, with all transportation charges prepaid to our factory within ninety days from the date of sale to original purchaser and provided that such examination discloses, in our judgment, that it is thus defective.

This warranty does not extend to any of our radio products which have been subjected to misuse, neglect, accident, incorrect wiring not our own, improper installation, unauthorized modifications, or to use in violation of instructions furnished by us, nor extend to units which have been repaired or altered outside of our factory, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith not of our own manufacture.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our radio products.



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