



OPERATING INSTRUCTIONS
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 MHz transmitter designed to operate with 8, 12 or 24-55 MHz crystals.

The Ameco VFO-621 circuit consists of a solid state variable oscillator operating at 12 to 13 MHz. The oscillator signal is fed into a pentode buffer amplifier, a triode frequency doubler and an output amplifier working straight through. The two amplifiers and the doubler provide excellent isolation of the oscillator from the transmitter, which produces improved stability and keying, never previously available in a VHF - VFO.

There is no chirp with keying. The warm-up time is very short, as the oscillator uses a transistor. The internal AC power supply is Zener Diode regulated. The dial scale is calibrated for 50-52, 144-148 and 220-225 MHz. 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 transistor, tubes and their circuit functions are as follows:

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

The controls are as follows: Power switch; band switch; Tuning dial

NOTE

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 MHz. This is divided into three parts. When connected to a transmitter, the output frequencies of the system (VFO and transmitter) will be as follows: Band A - 50 - 52 MHz
 Band B - 144 - 147 MHz
 Band C - 147 - 148 MHz and 220 - 225 MHz.

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

There are no changes needed when hooking up the VFO-621 to a transmitter that uses 8 Mhz 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 MHz crystal transmitters that have this switch.

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

Some transmitters use 8 MHz 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 Mhz coil in the plate of the first tube to make it tune to 24 to 26 Mhz. 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 turned off. Since the VFO is a part of the transmitting system, it must be disabled in the RECEIVE position. Connect the KEY terminals on the back of the VFO to the key line or a relay contact on the transmitter. The word KEY does not refer to CW Keying, but designates an "ON-OFF" or a "make-break" contact used to turn the transmitter circuits on and put a signal in to 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 Figure 2.) Leave the jumper on the "BIAS-KEY" terminals of this strip. Then connect the lead from the end "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 Figure 2.) Leave the jumper on the "CATHODE-KEY" terminals of this strip. Connect a lead from the end "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. Remove the transmitter crystal and insert 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.

Check the schematic of the transmitter for the hot side of the crystal socket; it must have a capacitor (the .001 μ F disc supplied can be used) between this terminal and the grid of the tube. This part is in the AMECO TX-62 Transmitter.

OPERATION

After all connections have been made, turn the power switch 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 for 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-821, 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 MHz broadband amplifier should not need any adjustment. Drift can be minimized by adjustment of the temperature compensating trimmers.

Alignment Procedure

Equipment Required:

Sweep generator with at least a 21 to 29 MHz sweep width.
Oscilloscope with RF detector.
Tuning wrench, plastic, .100" hexagon, GC0606L or similar.
Marker generator.
Receiver covering 12 to 13 MHz and 24 to 26 MHz with calibration crystal oscillator.
Screwdriver, 1/8" blade, or GC8272.
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 MHz Amplifier:

1. Remove the VFO from the cabinet and remove the bottom cover.
2. Disable the oscillator by unsoldering the 2.2 k resistor (R4) from the feedthru 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 uF capacitor to pin 2 (grid) of V1, 6KZ8.
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 MHz.
7. Reconnect the sweep generator to pin 9 (doubler grid) of V1, 6KZ8.
8. Align both cores in T3 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

11. Connect a piece of wire to the receiver antenna terminal. It should be long enough to pick up the signal from the variable oscillator.
12. Check the receiver calibration. The preliminary adjustments of the VFO should be correct to within 20 kHz.
13. On Band A, set the dial of the VFO to 50 MHz. Tune the receiver to 12.5 MHz. Adjust the core in T1 for maximum S-meter reading on the receiver. If the receiver beat frequency oscillator is used, tune for zero beat instead of watching the meter.
14. Tune to 52 MHz on the VFO and 13.0 MHz on the receiver, and adjust C5 as in Step 13 above.
15. Repeat Steps 13 and 14 until the dial is correct at both ends.
16. Switch to Band B and set the dial of the VFO to 144 MHz. Tune the receiver to 12.0 MHz and adjust the top core (nearest to the chassis) in T2 for maximum S-meter reading (or zero beat).
17. Tune to 147 on the VFO and 12.25 MHz on the receiver and adjust C11 as in Step 16 above.
18. Repeat Steps 16 and 17 until the dial is correct at both ends.
19. Switch to Band C and set the dial of the VFO to 220 MHz. Tune the receiver to 12.222 MHz and adjust the bottom core in T2 for maximum reading on the S-meter or for zero beat.

Final alignment of the variable oscillator:

21. Switch to Band A. Check the calibration at 50 and 52 MHz with the receiver at 25 and 26 MHz respectively. Readjust T1 and C5 as necessary.
22. Switch to Band B. Check the calibration at 144 and 147 MHz with the receiver at 24 and 24.5 MHz respectively. Readjust the top core in T2 and C11 as necessary.
23. Switch To Band C. Check the calibration at 220 MHz with the receiver at 24.444 MHz. (If only 144 MHz operation is desired, check at 147 MHz with the receiver at 24.5 MHz.) Adjust the bottom core in T2 as necessary.

Temperature Compensation Adjustments:

NOTE

FOR THIS ADJUSTMENT IT IS NECESSARY TO BE ABLE TO MEASURE THE DRIFT IN CYCLES, NOT KILOCYCLES.

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 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, Steps 21 through 23.



Fig. 1. Front view of VFO-621.

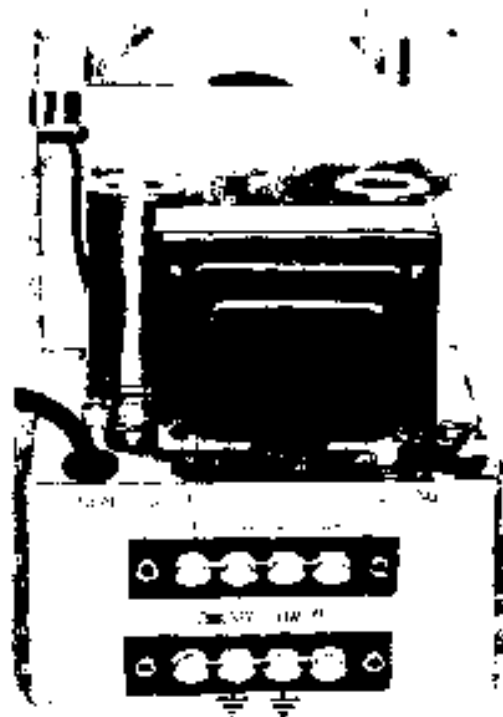


Fig. 2. Rear view of chassis.

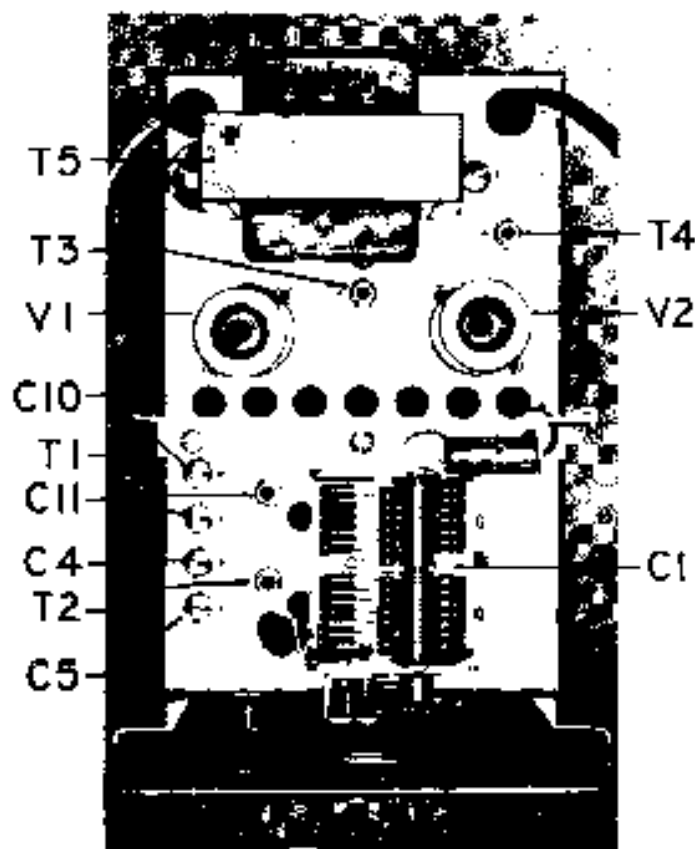


Fig. 3. Top view of chassis.

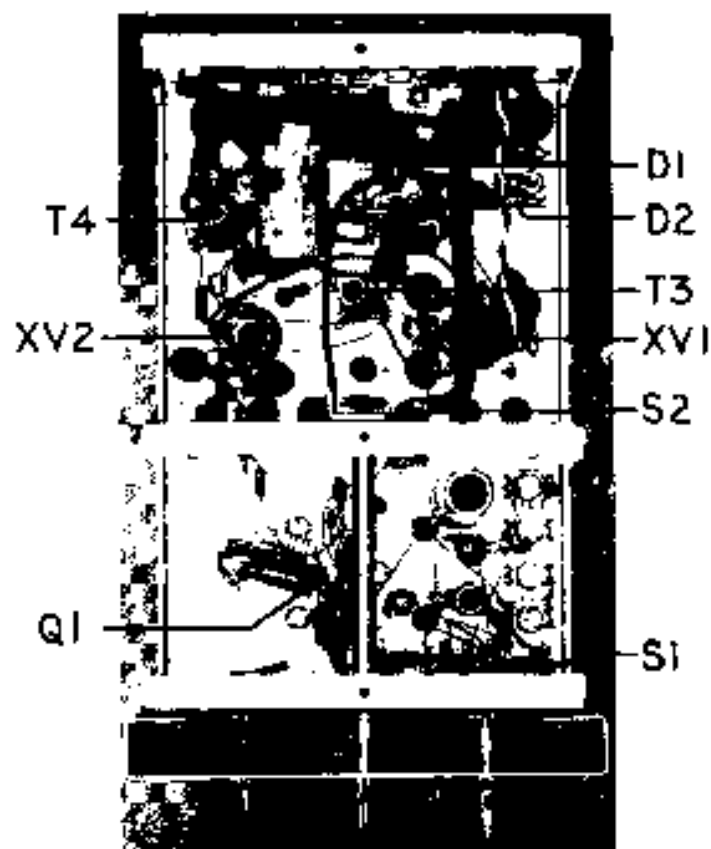
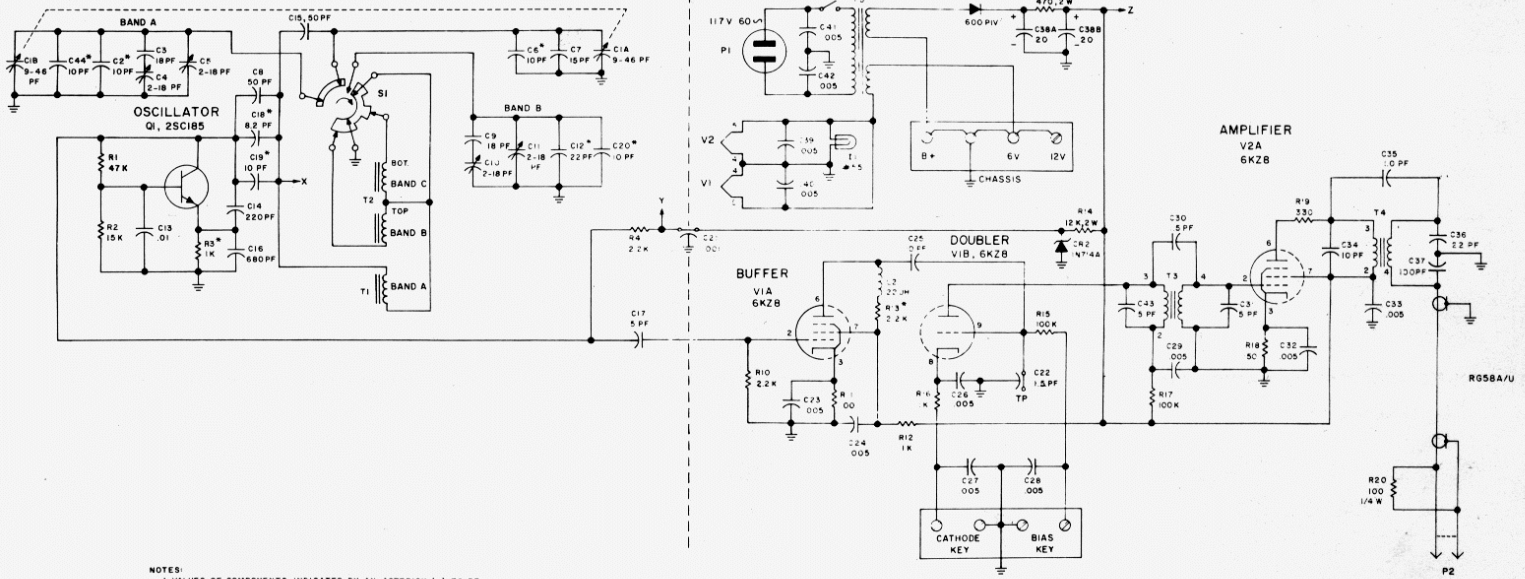


Fig. 4. Bottom view of chassis.



NOTES:
 1. VALUES OF COMPONENTS INDICATED BY AN ASTERISK (*) TO BE SELECTED IN PRODUCTION. TYPICAL VALUES ARE SHOWN.
 2. UNLESS SHOWN OTHERWISE:
 CAPACITORS ARE IN MICROFARADS;
 RESISTORS ARE IN OHMS, 1/2 WATT.

D1613001 Rev. A

PARTS LIST

Item	Description	Part No
VFO-621		
CAPACITORS		
C 1	2 gang, variable	79 60 01
C 2	10 pF, disc, $\pm 10\%$, NPO	1501 1002 007
C 3	18 pF, N5600 tubular	81 60 01
C 4	2-18 pF, trimmer	79 60 02
C 5	2-18 pF, trimmer	79 60 02
C 6	10 pF, N750, disc, $\pm 5\%$	1501 1002 003
C 7	15 pF, disc, $\pm 10\%$, NPO	1501 1502 007
C 8	50 pF, disc, $\pm 10\%$, NPO	1501 5002 007
C 9	18 pF, N5600 tubular	81 60 01
C 10	2-18 pF, trimmer	79 60 02
C 11	2-18 pF, trimmer	79 60 02
C 12	22 pF, disc, $\pm 10\%$, NPO	1501 2202 007
C 13	.01 uF, 50 V, disc, +80, -20%	81 00 18
C 14	220 pF, molded silver mica	81 00 13
C 15	50 pF, $\pm 10\%$, NPO	1501 5002 007
C 16	680 pF, molded mica	81 60 02
C 17	5 pF, disc, $\pm 10\%$, NPO	1501 5001 007
C 18	8.2 pF, N750, disc, $\pm 10\%$	81 60 03
C 19	10 pF, disc, $\pm 10\%$, NPO	1501 1002 007
C 20	10 pF, disc, $\pm 10\%$, NPO	1501 1002 007
C 21	.001 uF, feed thru	81 00 16
C 22	1.5 pF, feed thru w/hole	81 00 03
C 23	.005 uF, 500 V, +80, -20%, disc	81 00 18
C 24	.005 uF, 500 V, +80, -20%, disc	81 00 18
C 25	10 pF, $\pm 10\%$, NPO, disc	1501 1002 007
C 26	.005 uF, 500 v, +80, -20%, disc	81 00 18
C 27	.005 uF, 500 v, +80, -20%, disc	81 00 18
C 28	.005 uF, 500 v, +80, -20%, disc	81 00 18
C 29	.005 uF, 500 v, +80, -20%, disc	81 00 18
C 30	1.5 pF, tubular	81 00 26
C 31	5 pF, $\pm 10\%$, NPO, disc	1501 5001 007
C 32	.005 uF, 500 v, +80, -20%, disc	81 00 18
C 33	.005 uF, 500 v, +80, -20%, disc	81 00 18
C 34	10 pF, $\pm 10\%$, NPO, disc	1501 1002 007
C 35	1.0 pF, tubular	81 00 02
C 36	22 pF, $\pm 10\%$, NPO, disc	1501 2202 007
C 37	100 pF, $\pm 10\%$, N750, disc	81 00 110
C 38	2 x 60 uF, 150 v, electrolytic	1516 6008 003
C 39	.005 uF, 500 v, +80, -20%, disc	81 00 18
C 40	.005 uF, 500 v, +80, -20%, disc	81 00 18
C 41	.005 uF, 500 v, +80, -20%, disc	81 00 18
C 42	.005 uF, 500 v, +80, -20%, disc	81 00 18
C 43	5 pF, $\pm 10\%$, NPO, disc	1501 5001 007
C 44	10 pF, N750, $\pm 5\%$, disc	1501 1002 003

Item	Description	Part No
RESISTORS		
NOTE: All resistors are 1/2 watt, $\pm 20\%$ unless otherwise specified below:		
R 14	12 k, 2 watt, $\pm 20\%$	84 60 060
R 20	100 ohm, 1/4 watt, $\pm 20\%$	84 60 01
R 21	470 ohm, 2 watt, $\pm 20\%$	84 00 28
MISCELLANEOUS		
L 2	22 uH, coil	86 00 14
CR 1	800 PIV diode	4803 0000 006
CR 2	Zener diode, 1N9618	4831 0000 004
Q 1	2SC 185 transistor	97 00 35
V 1	6KZ8 tube	97 00 35
V 2	6KZ8 tube	97 00 35
T 1	16 turn ceramic coil	85 60 02
T 2	6 x 3 turn coil	85 60 01
T 3	T-62-0 Red dot coil	86 00 03
T 4	T-62-0 Red dot coil	86 00 03
T 5	PS1 Power transformer	75 00 02
S 1	Bandswitch, VP62-S1-1	87 60 01
S 2	Power switch VP62-S2	87 60 02
	Knob, no pointer	93 00 14
	Knob, with pointer	93 60 01

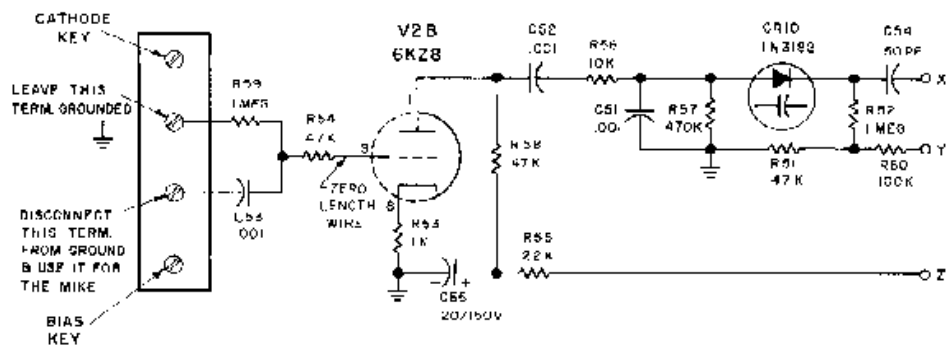
AVERAGE VOLTAGES, using a 20,000 ohms per volt VOM

	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	100	115	--	--
	E	B	C						
Q1	1.3	1.4	7.2	D1 - R21 junction 130					

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.



ITEM	DESCRIPTION
C 51, 52, 53	.001 uF, disc capacitor
C 54	50 pF, disc capacitor
C 55	20 uF/150 V, electrolytic capacitor
R 53	20 K, 1/2 W, resistor
R 54, 54, 56	47 K, 1/2 W, resistor
R 55, 59	1 meg, 1/2 W, resistor
R 57	1 K, 1/2 W, resistor
R 58	22 K, 1/2 W, resistor
R 59	10 K, 1/2 W, resistor
R 60	470 K, 1/2 W, resistor
C510	Approx. 113152 disc

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

B1610002

SCHEMATIC DIAGRAM - NBDP 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, initial, 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 this defective.

This warranty does not extend to any of our radio products which have been subjected to misuse, neglect, accidents, 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.



DIVISION OF
 AEROTRON, INC. RALEIGH, N. C.

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PARTS LIST

<u>ITEM</u>	<u>DESCRIPTION</u>
C 51, 52, 53	.001 uF, disc capacitor
C 54	50 pF, NP0, disc capacitor
C 55	20 uF/150 V, electrolytic capacitor
R 50	100 k, 1/2 W, resistor
R 51, 54, 58	47 k, 1/2 W, resistor
R 52, 59	1 meg, 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