VANGUARD FOUR CH. RECEIVER

ASSEMBLY INSTRUCTIONS (REVISION "D") Revised Dec.'83

The Vanguard receiver was designed specifically for sport or competition flying on the 72-75 MHZ R/C frequency band. It's small, lightweight, easy to build and maintain and will work quite well with any good quality 72 MHZ transmitter as long as the first four channels transmitted are the ones you want to use.

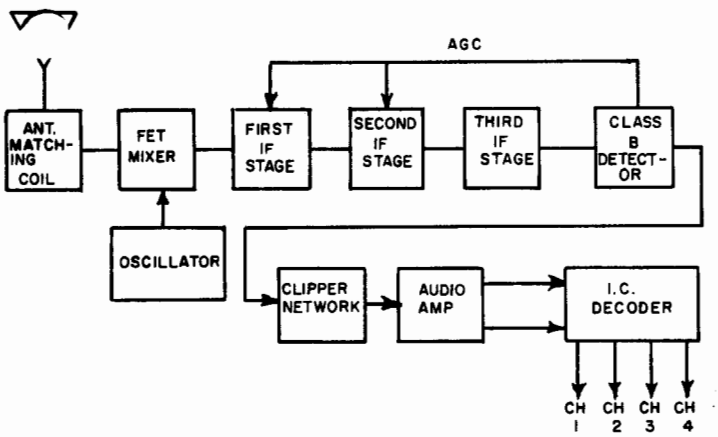
Servos: The Vanguard will work with most positive pulse 3-wire servos of your choice.

Battery Pack: Again this is up to you and your requirements. For 1/2A flying a 225mah or 100mah (fast charge) pack is suggested for weight reasons. For standard models 500ma pack is preferred.

Connectors: The receiver presented here is shown with a M'con connector block or Deans block available from Royal Electronics and for all practical purposes, is your best bet to minimize connector wiring. However, you may wish to use another connector to match your present system.

Electronically, the Vanguard is a superhetrodyne of very simple design. It exhibits good sensitivity, low noise, and maintains good stability. It's small size is accomplished by using a FET mixer, a very simple decoder and an efficient use of a printed circuit board space. The low component count also increases reliability and saves time when searching for any problem area.

RECEIVER BLOCK DIAGRAM



Referring to the receiver block diagram, the RF front end coil is tapped for 72 and 75 MHZ to better match the antenna impedance. No secondary winding is required to feed the FET because of it's high input impedence as is normally found in receivers which use transistor mixers.

The FET provides better mixing efficiency, a wider dynamic range, less mixing distortion and a lower noise input than most transistors. The secondary of the oscillator coil supplies the injection voltage to the drain of the FET. The source of the FET is connected to the first IF transformer in the same manner as a conventional transistor stage. The local oscillator is a Pierce oscillator which operates at the desired frequency 455KC below orabove the incoming transmitted frequency.

The I.F. amplifiers are standard and straight forward. The detector transistor operated as a class B detector and also supplies AGC to the I.F. amplifiers. The detected signal is passed through a high level clipper circuit to the audio amplifier transistor. This clipper circuit greatly reduces interference from unwanted signals.

The audio amplifier transistor shapes the signal into a negative going square wave to clock the shift registor integrated circuit decoder. Reset or sync of the decoder is achieved by way of a very simple circuit consisting of one diode and one capacitor. Reset occurs approximately 6 milliseconds after the last pulse in the transmitter train is received. Ouput at the decoder is a positive going square wave shich is fed to the servos.

Now then, if you haven't built an electronics kit or project before, use your own judgement as to whether you should try this one or not. Remember it's very small and tight. I have attempted to write the assembly instructions as simple and complete as possible . Do what I tell you, as the saying goes, and you should have little trouble .

When you've got everything required to build the receiver, organize your work area. No metal tables, PLEASE. spread a light colored towel directly in front of you and group the components near the top. Transistors together, resistors together, etc. This keeps everything in order. No parts lost on the floor. The 74C95 is supplied on protective conductive foam, leave it there until ready to install it in the P.C. board. DO NOT use this foam when installing your receiver in the case.

Tools needed:
1. Small Dikes
2. Soldering iron with a 1/16 in. dia. tip or smaller.
3. Needle nose pliers.
4. Pin Vise with #60 drill.
5. Cleaning fulid, such as 1,1,1-Tricholorethane.
6. Small brush.
7. Wire strippers.

If a change note is attached make changes in the instruction book.

Construction Notes:

A.( ) Check parts supplied against the parts list.

B.( ) Locate the P.C. Board and test fit it into the case. It should drop in with its edges just touching the inside walls. If not, carefully sand the Epoxy board edges down to the Clad until it does fit.

c.( ) Now check the board to be sure all the holes have been drilled. If not, use a #69 drill bit to complete the board. The holes for ihe I.F. can Case pins should be #55.

D.( ) Find the three I.F. cans. These look like little chrome cubes with colored slugs in one end. You should have one each: yellow, white, and black. Refer to figure 2 and snip one lead from each can. BE CAREFUL. Snip only the lead indicated.

E.( ) Refer to the component overlay. Figure 6. Test fit the I.F. cans in their respecitve locations. They should go down completely onto the board, If neede, carefully enlarge any of the holes to accomplish this. Remove the cans and set aside. DO NOT solder them in place at this time.

F.( ) Locate the crystal. Identify the solder seal. When installing the crystal DO NOT SOLDER THE GROUND LEAD TO THE CRYSTAL SEAL. If you do it will be a $7.50 mistake.
Not all crystalls have solder seals.

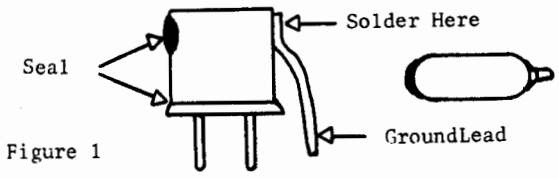


Figure 1

As you proceed with the assembly of the board it's important to remember to use only 60/40 resin core solder of #21 gauge or smaller diameter. **You do not need more solder than just enough to encircle the lead where it projects through the hole.** Excess solder is also one way to form a solder "bridge". This is where the solder flows from one circuit land to another causing an electrical short. If this does happen use solder wick or a desoldering bulb to remove it. As a last resort, carve it out with an X-acto knife.

When soldering, touch the iron to one side of the component lead and the circuit land at the same time. Quickly touch the solder to the other side of the lead and when the solder has flowed around the lead, pull the solder away and slide the iron tip up the component lead and away. The total time for this operation should NEVER take more than three or four seconds. If the time to make a bright and

Ref No.	Quant.	Description	Part No.	*Price
		Resistors		
R1,5,11	3	15K(brn,gr,org)	0045	$ .12
R8,15,21	3	100K(brn, k,yel)	0055	.12
R10	1	1K (brn,blk,red)	0031	.12
R9	1	18K(brn,gray,org)	0046	.12
R12,24,19	3	22K(red,red,org)	0047	.12
R13	1	5.6K(grn,blu,red,)	0040	.12
R16	1	3.9K(org,wht,red)	0038	.12
R17	1	4.7K(Yel,purp,red)	0039	.12
R18	1	180 ohm(brn,gray,brn)	0137	.12
R20	1	27K (red,purp,org.)	0048	.12
		capacitors		
C1	1	.047 to .luf-.047(473)		.85
		Mon. .1 (104)		.90
C2	1	.001 to .luf-.001(1n or 102) Disc		.50
		.047(473) Mon.		.85
		.1(104) Mon.		.90
C5	1	.47uf Tant.(.47K or R47)		.95
C7	1	4.7uf to 6.8uf-4.7(4.7K or 4R7)		.95
		6.8(6.8K or 6R8)		.95
C8	1	.1uf Dic (.12 or 104)		.60
C9,13,17	3	33uf ,black R.L.		1.20
C10,11	2	.047uf Disc(.047 or 473)	1049	.50
C12	1	1.5uf tant. (1.5K or 1R5)	1135	.95
C14	1	.001uf Disc (1n or 102)	1034	.50
C15	1	.001uf Mylar(102M100)		.75
C16	1	.22uf tant(R22 or .22K) A.L. OR R.L.		.95
C18	1	100pf disc	1027	.50

Ref No.	Quant.	Description	Part No.	*Price
		Transistors, Diodes		
Q1,3,4	3	MPS-3563 Motorola	0464	1.00
Q2	1	2N5457 FET Motorola	0453	1.50
Q5,6	2	M400,2N4124,2n3904,2N5088		.75
Q7	1	2N5088 or selected M400	0999	
D1,2	2	1N4148 diode	0405	.50
D3	1	1N34(large glass with band)	0401	.50
IC1	1	74C95 National	0645	2.50

Ref No.	Quant.	Description	Part No.	*Price
		Coils, Transformers		
T1	1	IF Can, Yellow	0897	1.80
T2	1	IF Can, White	0898	1.80
T3	1	IF Can, Black	0899	1.80
		Hardware		
2" pc.	1	#26 GaugeRed Wire		
36" pc.	1	#26 White Wire		
6" pc	1 ea	color-#26 G. Wire(red,blk, brn, wht,org, & yel.)		
	1	5/16" dia. Grommet		
3/4"pc.	1	small teflon tubing		
	1	Vang. PC Board	0647	2.50
	1	Receiver Case	5369	2.50
	1	Foam Packing		
1/4" pc.	1	1/8" Dia. Heat Shrink		
1½ " pc.	1	3/64" Dia. Heat Shrink		

*** These prices are for reference. If you order a spare part include $3.00 for postage and handling.**

Parts Used for 72/75mhz Receiver:

R2	1	27K Resistor	000055	.12
R3	1	270 Ohm Resistor	000019	.12
R4	1	390 Ohm Resistor	000029	.12
R6, 7	2	82 Ohm Resistor	000018	.12
C3	1	22pf Disc. Capacitor	001013	.50
C4, 6	2	15pf Disc. Capacitor	001919	.50
L3	1	1¼ -4¼ Plastic Coil W/Core	005377	1.35
L1	1	Ferrite Coil, 72 Rx L1	000902	1.30
	1	Receiver Crystal 5th OT		

Parts Used for 53mhz Receiver:

R2	1	27K Resistor	000055	.12
R3	1	270 ohm Resistor	000019	.12
R4	1	680 ohm Resistor	000028	.12
R6, 7	2	82 ohm Resistor	000018	.12
C3	1	33PF Disc. Capacitor	001018	.50
C4,6	2	22PF Disc. Capacitor	001013	.50
L3	1	3¼T - 4¼T Plastic Coil W/core		1
	1	Receiver crystal		

all Resistors for this receiver are 1/4W 10%.

complete solder joints takes any longer than this, either the soldering iron is inefficient and cold or the component lead is filmed or dirty. Improper type of solder could also be the culprit. It is always a good idea to wipe the component leads clean before inserting the part into the board. Once the component lead has been run through the P.C. Board, bend the lead over next to the Clad, clip the lead 1/32" to 1/64" from the bend. Use a good set of dikes or even a sharp fingernail clipper.

WHEN TO SOLDER AND WHEN NOT

When a component is installed, only solder the leads whose solder joint will not encompass another component lead. If two or more leads are going to end up in the same solder joint wait till all leads are installed before making that solder joint.

P.O. BAORD ASSEMBLY

Note: Assemble the components in the following order ONLY.

1.( ) Use an X-ACTO knife to scrape the coil form, L3, clean. Locate color dot and figure out proper orientation. Apply a small amount of "Super Glue" to bottom of coil, install coil and hold in place until glue sets.

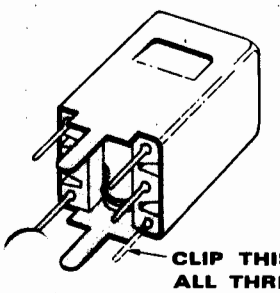


Figure 2

2.( ) Install the yellow I.F. can in place. NOTE: Do not solder the can lug which will share a hole with a white I.F. can lug.
3.( ) Install the white I.F. can into place. Remember to also solder the yellow I.F. can case lug not done in step 2.
4.( ) Install the black I.F. can.
5.( ) Install Q2, 2N5457 FET, orient it according to the overlay. Bend lead Fig 4A.
6.( ) Install C6 Disc. capacitor 15pf-72MHZ; 22PF-53MHZ.
7.( ) Install R5, 15K resistor (Brown, Green, Orange).
8.( ) Install C5, .47 Tant. Capacitor, Red end up. (R47 or .47 or 474).
9.( ) Install Q3 MPS3563 Transistor.Form lead, Fig. 4B
10.( ) Install R6, 82 Ohm (Grey, Red, Black).
11.( ) Install Q4, MPS3563 transistor. Note your proper orientation. Form leads, Figure 4B.
12.( ) Install R7, 82 Ohm (Grey, Red, Black).
13.( ) Install C8 capacitor .1MF Disc.(1z).
14.( ) Install Q5, M400 or 2N4124 transistor noting proper orientation. Form leads, Fig. 2B.
15.( ) Install IN4148 diode. Note the band position, D1.
16.( ) Install R10, 1K resistor (Brown, Black, Red).
17.( ) Install R8, 100K resistor (Brown, Black, Yellow).
18.( ) Install C7, 4.7UF Tant. Capacitor. Red end down. (4.7K or 4R7).

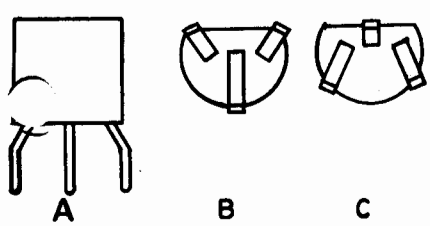


Figure 4

19.( ) Install C10, .047,.05 or .056
20.( ) Install C11, .047,.05 or .056
21.( ) Install C9, 33UF Elect. Plus (+) lead is longer.
22.( ) Install #26 Red jumper 1" long in hole next to black I.F.
23.( ) Install R4, 390 Ohm resistor (Orange, White, Brown) for 72MHZ; 680 Ohm (Blue, Grey, Brown) for 53MHZ.
24.( ) Install Q6, M400 or 2N4124 transistor noting proper orientation. Form leads, Fig. 4C.
25.( ) Install R9, 18K resistor (Brown, Grey, Orange).
26.( ) Install R11, 15K resistor (Brown, Green, Orange).
27.( ) Install D2, IN4148 diode. Band end up.
28.( ) Install 100PF Disc.
29.( ) Install R12, 22K resistor (Red, Red, Orange).
30.( ) Install R13, 5.6K resistor (Green, Blue, Red).
31.( ) Install R16, 3.9K resistor (Orange, White, Red).
32.( ) Install R14, 22K resistor (Red, Red, Orange).
33.( ) Install C12, 1.5uf Tant. Cap. Red end down.
34.( ) Install C14, .001uf Disc. Cap. (In)
35.( ) Install R15 100K (Brown, Black, Yellow)
36.( ) Install Q7, M400 or 2N4124 2N5033 transistor. Figure 4C.
37.( ) Install1R17, 4.7K resistor in place. (Yellow, Purple, Red, Silver).
38.( ) Install and solder D3, IN34 diode with the banded end up.
38a( ) Install R18, 180 ohm resistor (Brown, Grey, Brown).
39.( ) Install C17, 33uf Elect. Cap. Note plus lead is the longer lead.
40.( ) Install L1 ferrite coil. Note Postion of color dot. See Fig. 6.
41.( ) Solder a short length of resistor remnant to the end of the crystal case OPPOSITE THE END WITH THE SOLDER SEAL ON IT. The wire should be placed near the top of the case. Be sure the wire is long enough so that it will go thru the hole noted in the P.C. board. Then solder the crystal and case lead into position. Also be sure the crystal is placed as near to the P.C. board as possible. See figure 1 and 6.
42.( ) Install C2 .001 or .047 or .luf.
43.( ) Install R1, 15K (Brown, Green, Orange).
44.( ) Install R3, 270 ohm resistor (Red, Violet, Brown).
45.( ) Install C3, 22pf Disc. - 72MHZ; 33pf Disc - 53MHZ.
46.( ) Install C1 .047 or .luf. Leave the leads long enough so the cap can lay flat on top of L1/L2. Use teflon sleeve on its leads.
47.( ) Install C4, 15pf Cap - 72MHZ; 22pf - 53MHZ.
48.( ) Install Q1, MPS3563 transistor noting proper orientation. Form leads per figure 4C.
49.( ) Install R2, 27K resistor (Red, Violet, Orange). Put some teflon tubing on the lead adjacent to the crystal to prevent a possible short.
50.( ) Install C17, 33uf Capacitor. Note plus lead is longer.
51.( ) Install R21, 100K resistor (Brown, Black, Yellow).
52.( ) Install R20, 27K resistor (Red, Purple, Orange).
53.( ) Install C15 .001 Mylar(102M100).
54.( ) Install C16 .22uf Tant. Cap with red end up or beveled end up if black cap is supplied.
55.( ) Install R19, 22K resistor (Red, Red, Orange).
56.( ) Trim red jumper to correct length and solder free end in J1. Keep jumper as short as possible.
57.( ) Observing the indexing mark on top of the IC, snip off pins 2, 3, 5, 8 and 14. Be careful. See figure 3. This done, install and solder the IC.

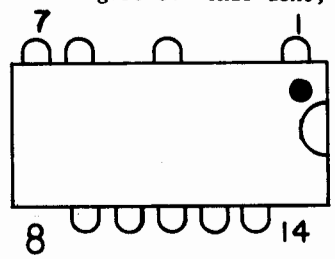
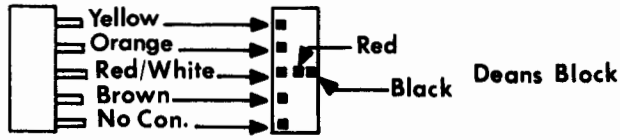


Figure 3

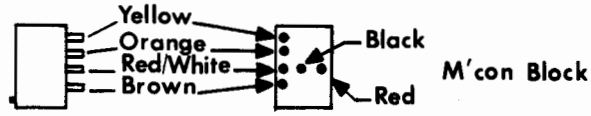
58.( ) Find the 36" white antenna wire. Strip off 1/8" of insulation from one end, twist the fine wire strands tightly together and pre-tin this end with a small amount of solder. Flip the receiver over so that the circuit side is up and solder the antenna wire to the circuit land as shown in the illustration. This is also noted by the small black "I" circle on the component overlay. Now pass the other end of the antenna wire through the hole drilled next to the yellow I.F. can. If the hole isn't quite large enough, use the sharp end of an X-acto blade to correct this by rotating the blade in the hole. Do not make the hole any larger than is necessary. Pull the wire snug.

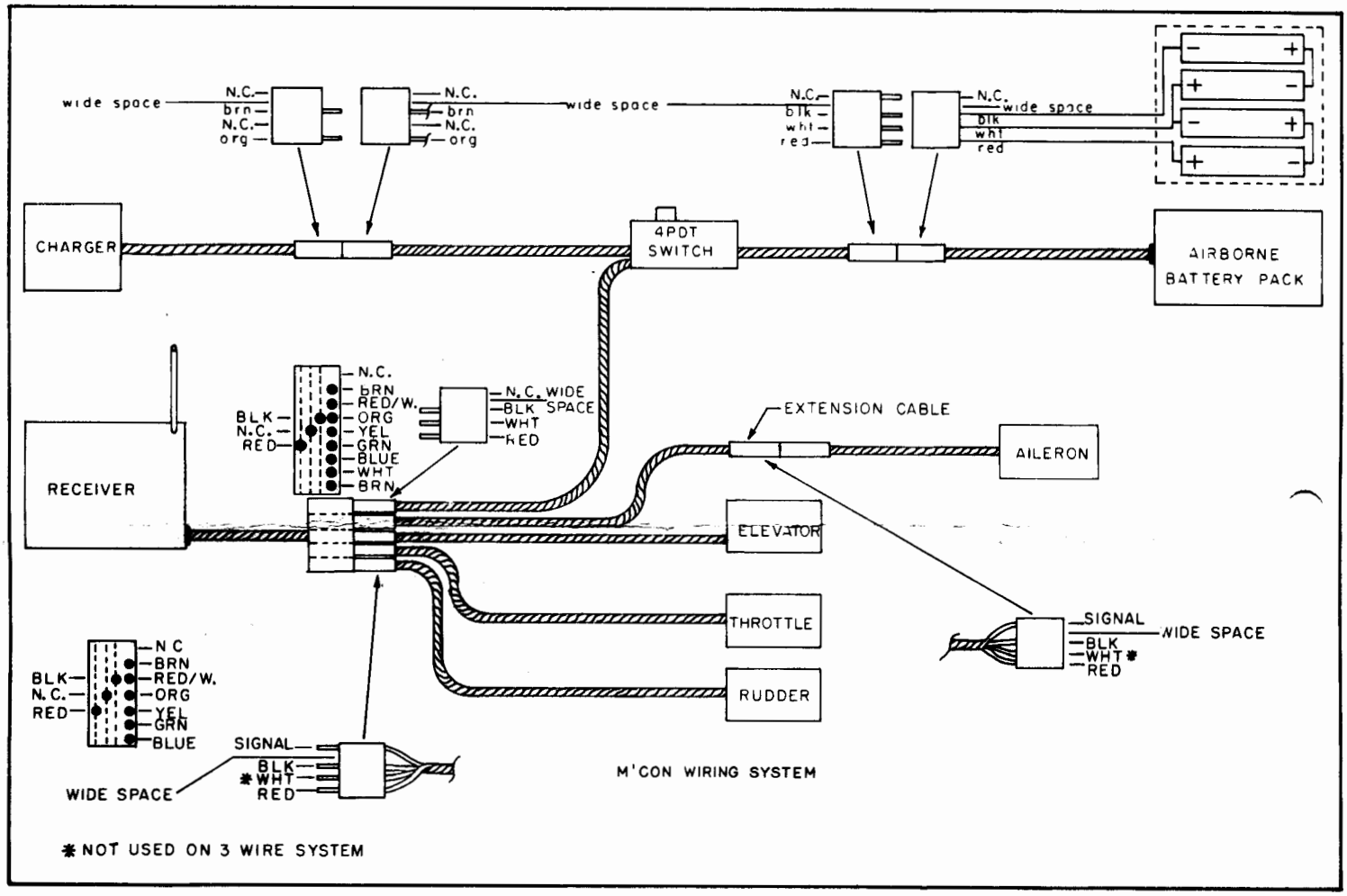
Above step is for 72-75mhz. See page 5 & 8 for 53MHZ.



Note: using a block connector is better electrically because the servo power does not enter the receiver board. We stock M'con and Deans blocks.

Figure 5





59.( ) Shorten pins on M'con block to 1/8" if necessary.

60.( ) You should have one each: red, black, orange, yellow, brown and red/white. Strip off 1/8" of insulation from each end of all 6 wires. Looking at figure 5, solder one end of each wire to the m'con block connector as shown. Slide 3/64" dia. 1/4" long piece of heat shrink tubing down each wire over the connection made at the connector block. Being sure the tubing doesn't move, procede to shrink the tubing by holding them about 1/8" from the heat gun on soldering iron tip. Shrink them slowly and uniformly. Avoid excess heating of the tubing and try not to touch the connector block or the wires with the soldering iron.
When this is done, pull the wires together and twist them into a neat bundle. Leave about one inch untwisted at the opposite end.

61.( ) Cut the 1/8" dia. heat shrink tubing supplied in half and slip both pieces over the cable.

62.( ) Slide the 5/16" grommet over the cable.

63.( ) Stretch the cable out straight and clip all the wire per figure 7.

64.( ) Solder the red wire to hole #3, the yellow wire to hole #2, the orange wire to hole #4, the red/white wire to hole #5, the brown wire to hole #6, and the black wire to hole #7. You may wish to re-twist the wire bundle at this point so that the wires look neat.

65.( ) Observe the unfilled holes in the P.C. Board. If they are correct then cover them with solder.

66.( ) Thoroughly clean the clad side of the P.C. board. Scrub with a tooth brush or acid brush using triclorethane, or dope thinner, or alcohol. Absolutely no trace of soldering resin should be left on the P.C. Board.

67.( ) Inspect the P.C. Board soldering and touch up if necessary. Reclean if necessary.

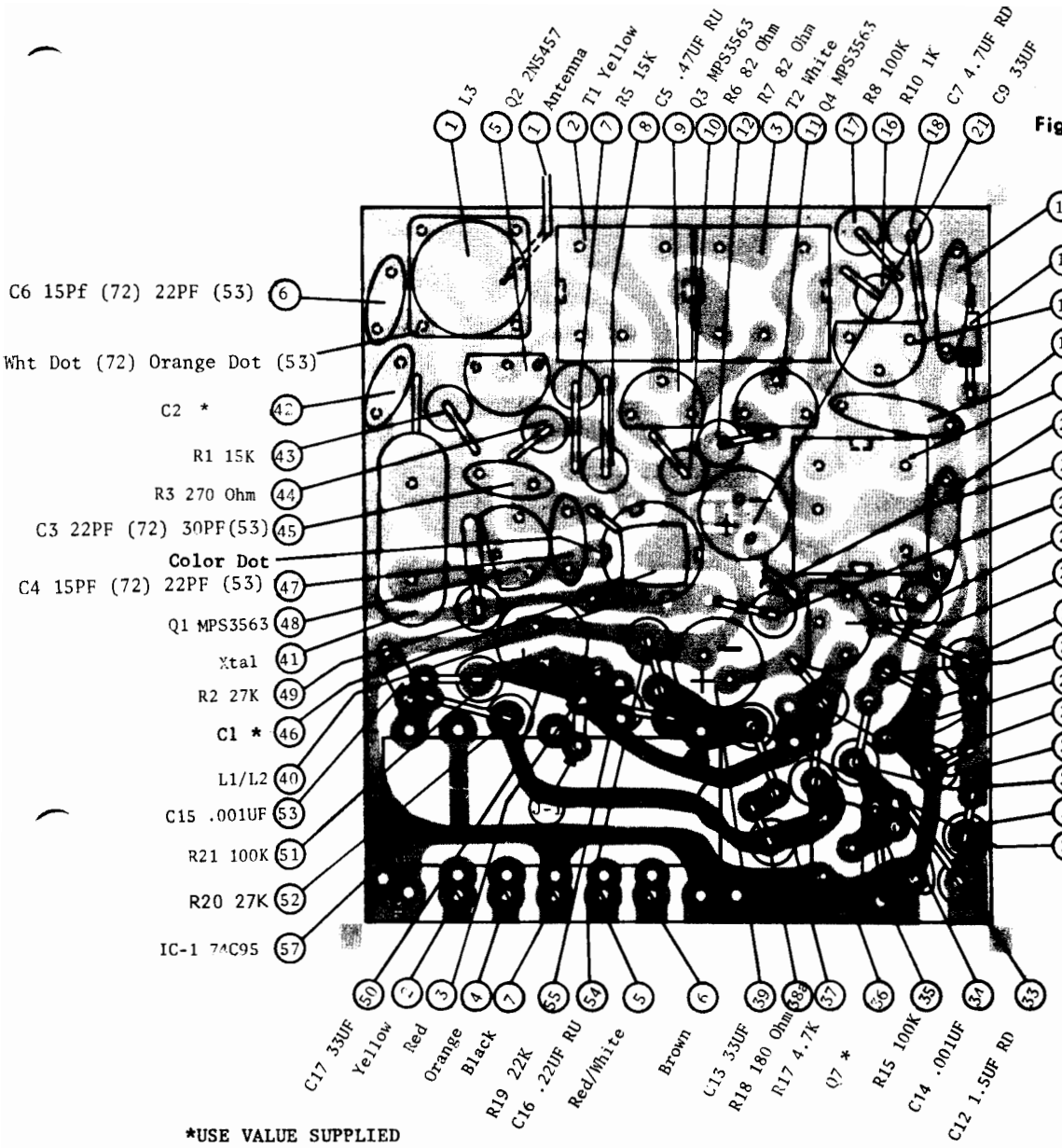


Figure 6

*USE VALUE SUPPLIED

BU-band up
RU-red up
RD-red down

The following crystal are available

72.08R	TEK00532D
72.16R	TEK00508D
72.24R	TEK00535D
72.32R	TEK00526D
72.40R	TEK00534D
72.96R	TEK00535D
75.64R	TEK00536D
CH12R(72.850)	TEK03612D
CH38R(73.005)	TEK03638D
CH40R(73.045)	TEK03640D
CH42R(73.085)	TEK03642D
CH44R(73.125)	TEK03644D
CH46R(73.165)	TEK03646D
CH48R(73.205)	TEK03648D
CH50R(73.245)	TEK03650D
CH52R(73.285)	TEK03652D
CH54R(73.325)	TEK03654D
CH56R(73.365)	TEK03656D

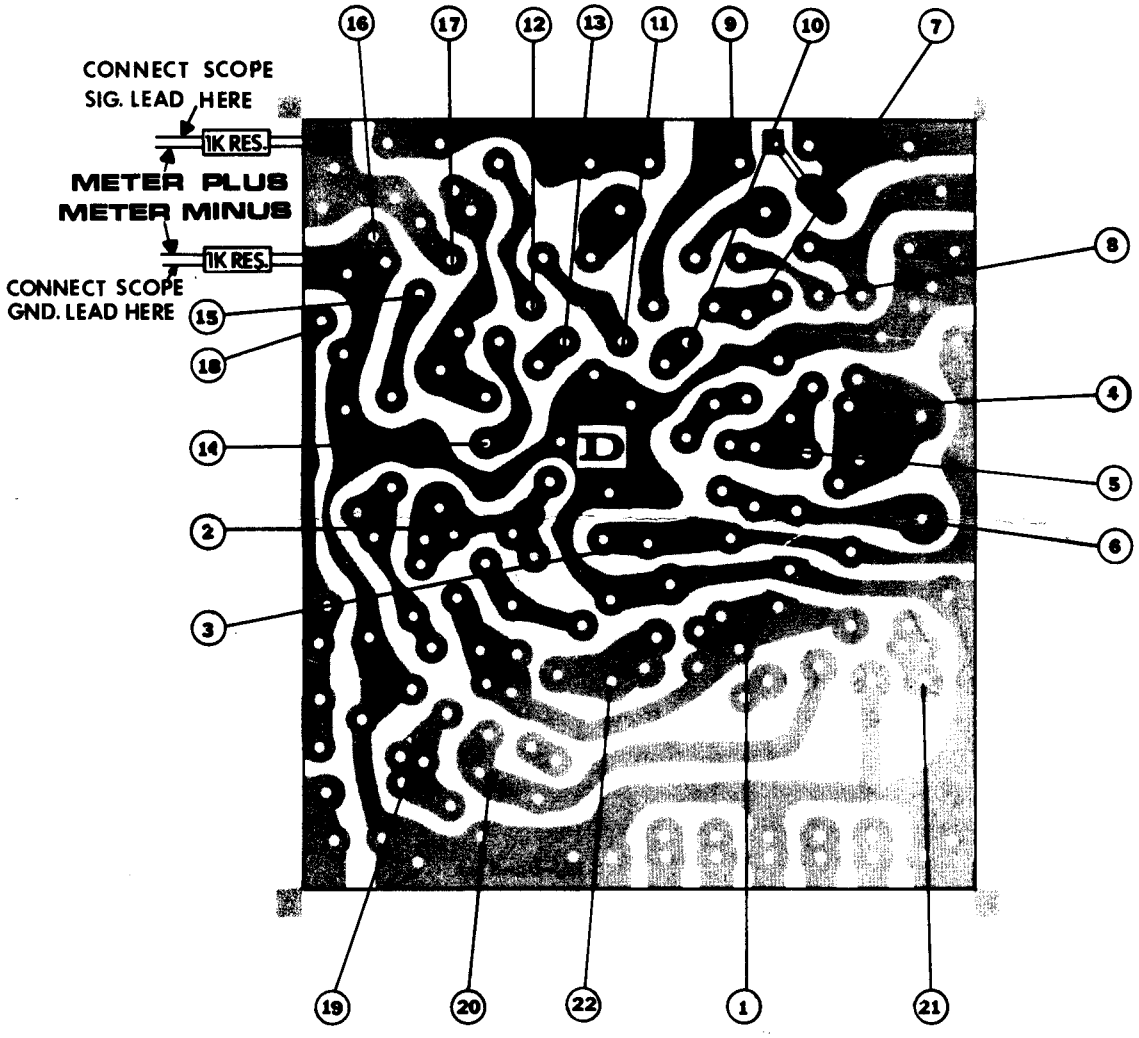


Figure 8

TX OFF

T.P.	Voltage
1	5.00
2	4.00
3	3.40
4	1.00
5	0.50
6	3.40
7	2.00
8	4.00
9	0.80
10	0.2[illegible]
11	4.00
12	0.80
13	0.25
14	4.00
15	0.50
16	0.00
17	4.00
18	3.40
19	0.30
20	4.80
21	4.50
22	4.50

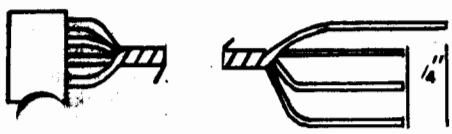


Figure 7

TUNING THE RECEIVER:

1.( ) Receiver tuning is not complicated if you will simply follow instructions. Remember, the receiver is useless if not tuned properly. Take your time and use only the equipment and techniques illustrated here.

2.( ) As noted before, this receiver is set up for a 72-75 mhz operation and will work beautifuly with any transmitter on the appropriate frequency. It does not matter what brand it is or how many channels as long as it has at least four. This receiver will pick off the first four information channels and disregard the rest.

3.( ) Before tuning be sure all battery packs are fully charged. Receiver pack 5.0-5.3VDC. This means the pack you are going to use with the receiver and the transmitter. Do not procede until they are charged!

4.( ) Flip the receiver over to the circuit side up and tack solder two 1K resistors as shown in figure 8. Lay a terri-cloth or towel down on the bench in front of you, and place the receiver on it, component side up. One word of caution: NEVER use a metal bench for this procedure. The massive amount of metal in the table will DE-TUNE the receiver or hamper proper tuning to an unacceptable level. You may even consider removing large metal objects from the table such as tool boxes.

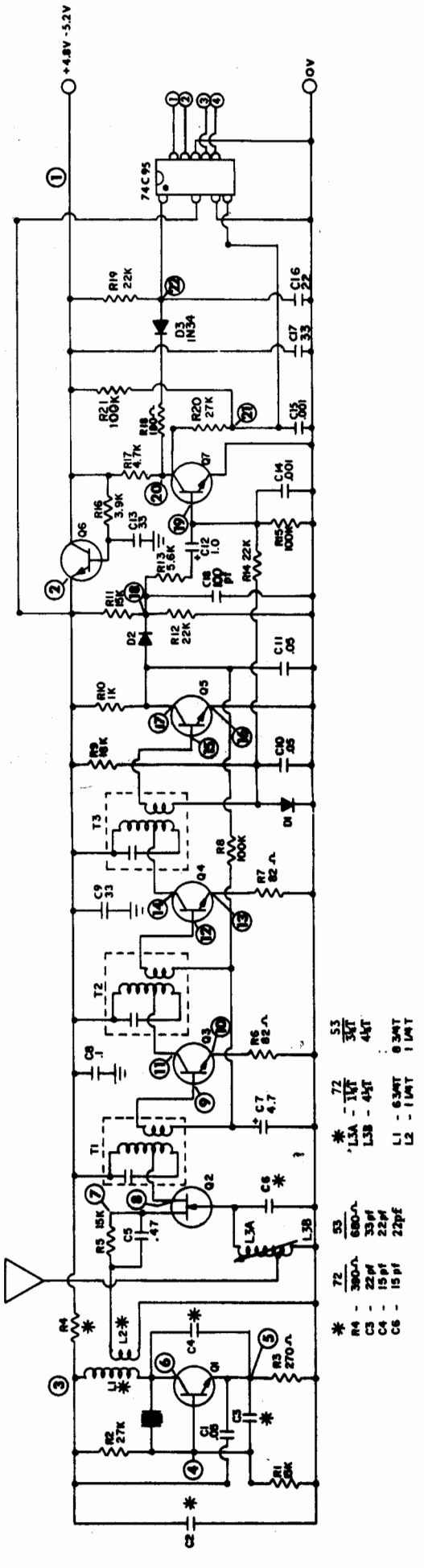
5.( ) If the scope tuning method is to be used go to step 6. If meter is to be used for tuning go to step 10.

SCOPE TUNING:

6.( ) Use a DC coupled scope with triggered sweep. Use a 10-1 probe - this means vertical attuation is set at .1 volts. Turn it on and set the vertical sweep for .1 volt per division and the horizontal sweep for 1.0 milisecond per division.

7.( ) Hook up the scope leads to the receiver, noting proper polarity on the illustration. Plug in the battery pack plug and turn the switch on. The scope signal sweep should pop up to the 4.0 volt level or slightly higher. This is the first indication that everything is normal. Unscrew the antenna from the transmitter and place the transmitter about three feet away. Stretch out the receiver wire on the table top away from all metal objects or wiring. Turn on the transmitter and you should see a detected wave form. Pick the transmitter up and move it around in all directions in the vicinity of the receiver, You should note that the scope signal will fluctuate as this is done. If no signal appears at all during this excercise recheck battery hook-up and scope attachment points, and install the transmitter antenna. If this fails to correct the problem it's an indication that something is amiss in the receiver. Go to step 16 before continuing if no signal is present.

8.( ) Turn the transmitter on and while observing the scope trace, rotate the coil slug for maximum sigal on the scope. Remember to keep the transmitter at least three feet away unless you ahve had difficulty making a scope trace appear. Move it closer if necessary in the beginning of the procedure to re-establish that you in fact do have a receiver that is operating. Once the fron end coil has been tuned; proceed to tune the yellow I.F. can slug for maximum signal amplitude. Repeat this with the white and finally the black I.F. can slugs.



9.( ) At this point you should have a nice crisp signal trace. Now move the transmitter to a new location, still without the antenna, about 10 to 15 feet away. and re-tune all slugs starting with the front-end coil. It won't take much to peak the reciver at this point. You will note that the further the transmitter is moved from the receiver, the touchier the tuning and how little the slugs need to be rotated to lose and regain the signal. Proceed to step 15.

METER METHOD:

10.( ) Use a Simpson Model 260 or 270. Set meter on 10V DC. Hook meter to resistor per voltage check chart.

11.( ) Turn on the receiver battery pack. Meter should read approximately 4.0 volts D.C. Turn on the transmitter. The meter should show a dip if a signal is coming through the receiver. If meter does not dip, install the transmitter antenna. This should cause the meter to dip. If so do step 12 first with transmitter antenna, then repeat without antenna. If there is no dip go to step 16 before continuing.

12.( ) Rough tune the antenna coil and the yellow, white and black I.F. cans. Notice as you turn the coils that the voltage drops to a certain point and then starts to rise again. You are not tuning to obtain a certain voltage, but rather for the point where the voltage hits a minimum and any further tuning causes a rise.

13.( ) Now you are going to fine tune. To make tuning more sensitive, you need to reduce the signal strength from the transmitter. You can do this by either moving the transmitter away from you, or by placing the transmitter in a metal can or bucket with a metal lid. The second method allows you to easily vary signal strength by changing the position of the lid on the can. Place the can on the floor. The most sensitive tuning can be accomplished if you attenuate the transmitter signal so that the voltage on the meter is about midway between the values read when the transmitter is right next to the receiver and when the transmitter is turned off. On the recommended meter this is between 2-3 volts.

14.( ) Now retune starting with the antenna coil and proceeding to the yellow, then white, then black IF cans. Notice now that it takes very little turning to get that meter needle to dip and start to rise again. Repeat tuning several times and then readjust signal strength and repeat. When you are satisfied with your work, it is time to range check it.

15.( ) Take your system outside to a nice flat area away from large metal objects. Place your system on the ground with the antenna wire at right angles to you. Hold the transmitter at about belt level and at about a 45° angle to the ground and pointed toward the system (antenna off). Back up until you no longer have positive control over the system. Range will vary with locations, but in any case if you get less than 50 feet it is time to retune or move on to trouble shooting. If all is okay, flip the receiver over and remove the two resistors. Then find a nice stiff brush (a tooth brush works well) and clean the board with dope thinner or acetone until everything is nice and shiny. Now you can install the receiver in the case using ordinary cellophane to secure the case halves.

16.( ) Trouble shooting is simple if you follow a systematic approach. The following applies to any radio control device whether it is a transmitter, receiver, or servo amplifier. First, go back to the assembly instructions and component overlay and recheck EVERY part for the proper location and orientation. You may be surprised to find that you did a no-no in construction. If not, are there any of the component leads touching each other? They are not supposed to. If everything on the board checks out as correct proceed to checki voltages. Use the chart and the circuit side illustration to accomplish this. Use a good quality volt meter and hook the common lead to the ground land on the receiver (black plug wire solders here). All voltages should be within about 10% of the value indicated on the chart. If you a find a voltage that does not correspond to a given value you may have found the problem. Remove and replace the components at this point where it occurs. As a rule, resistors and disc. capacitors can be ruled out as bad unless they show signs of being damaged. On this particular receiver, I would suspect that is any component is faulty, it would be one of the transistors or diodes. The only other parts that could fall under suspicion would be a bad crystal or an I.F. can that has an internal short or incomplete connection. If the voltage check procedure turns up nothing, re-hook the receiver to the scope, turn the power and transmitter on and begin wiggling the parts with your fingers. This will find a cold solder joint quicker than anything when all of a sudden the signal on the scope pops on and off. When you have found and repaired the problem, proceed with the tuning. One word of caution: while tuning, avoid leaving the transmitter on without it's antenna for periods exceeding three to four minutes. This can damage the ouput transistor in some transmitters. You can usually get all tuning done well within the first four minutes anyway.