BLUE MAX SYSTEM

MANUAL

KIT
SEMI-KIT
&
FACTORY
ASSEMBLED

$2.95

4-5-6 CHANNEL DIGITAL PROPORTIONAL SYSTEM

THIS MANUAL FOR KIT, SEMI-KIT AND OPERATING INSTRUCTIONS FOR FACTORY SYSTEMS

This manual was sent to the printer on September 1, 1970 and the copy and some of the engineering differs slightly from the copy that was sent to Model Airplane News on July 1st. Originally, we used an indicator bulb in the charger to indicate transmitter charge. The transmitter and the charger have been changed so that the field strength meter on the transmitter indicates charge. Also, the differential steering is still in the experimental stage as of September 1, 1970.

BLUE MAX SYSTEM

DUAL STICK SYSTEM

POWERFUL 12v. Tx.

Tx The Blue Max transmitter in rich black vinyl is styled like an expensive camera. It is something you can really enjoy owning. The World Engines sticks have a nice feel. 12 volt nickel cadmium power supply assures a high power output. Charger with transformer is external. This transmitter is complete with Buddy Box outlet.

Rx We have a new receiver circuit that we have taken a year to develop. Fortunately, this receiver can be built on the same board that the older M.A.N. System receiver was built on. It would be possible for customers with M.A.N. Systems receivers to upgrade to this receiver if they like. The receiver has good range and sensitivity yet it is very predictible to manufacture and much easier to tune up than any receiver we have had to date.

DECODER The Blue Max Decoder is an IC decoder using the same 914 IC that we used in the S-4B servo. The IC gives a higher switching speed required by our new servo design.

SERVO We have devoted a full page to our servos — Page 5.

BLUE MAX SYSTEM

SAVE BUILD A SEMI-KIT

SEMI-KIT ASSEM. P.C.B.

In our semi-kits we assemble the printed circuit board but we leave the interwiring to the customer. This gives us a chance to pre-test the P.C. board assembly. Shown in the photograph are some parts for a semi-kit decoder/receiver. With each full semi-kit system we supply one completely assembled servo which becomes a time constant comparative device to set up the other servos and stick pots. This is necessary because of the Buddy Box. When using a Buddy Box it is best if all the servos are set up to the *same* time constant. The same for the transmitter pots.

FULL KIT!. For Experts

It is our opinion that the semi-kit is a much better value than the full kit. Regardless of this, we do offer a full kit. Notice in the photograph that parts are not assembled to the board. We would recommend this to the more experienced electronic type kit builder. Price schedules for kits and semi-kits are in the rear of the catalog.

BLUE MAX SYSTEM

DUAL STICK 4·5·6 CH.

BY: WORLD ENGINES INC. CINCINNATI

BLUE MAX SYSTEM

The Blue Max System was developed at World Engines, Inc., a Cincinnati based corporation. It represents their efforts to upgrade their previous Controlaire system and M.A.N. 2-3-4 system. This is a state of the art upgrading. More ICs are employed. The system uses a 12V base loaded antenna system. A new and highly tested receiver is used. Note — it is built on the M.A.N. P.C. board if anyone should want to upgrade their M.A.N. system.

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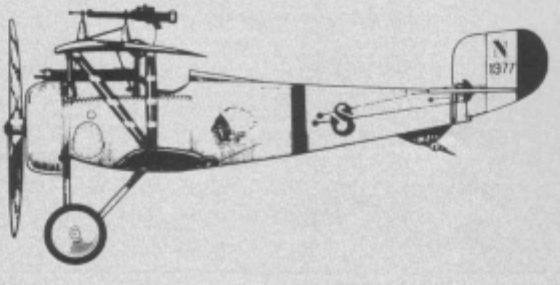
SEMI-KIT BUILDERS SEE PAGE 80.....

We wish to thank Walt Schroder, Art Schroeder, Al Novotnik, Charles Kenney, and Wittich Holloway of Model Airplane News for their help and suggestions on this manual. Also special thanks to Don Lowe, Bill Wuerth and Walt Sousa for their help in testing the system.

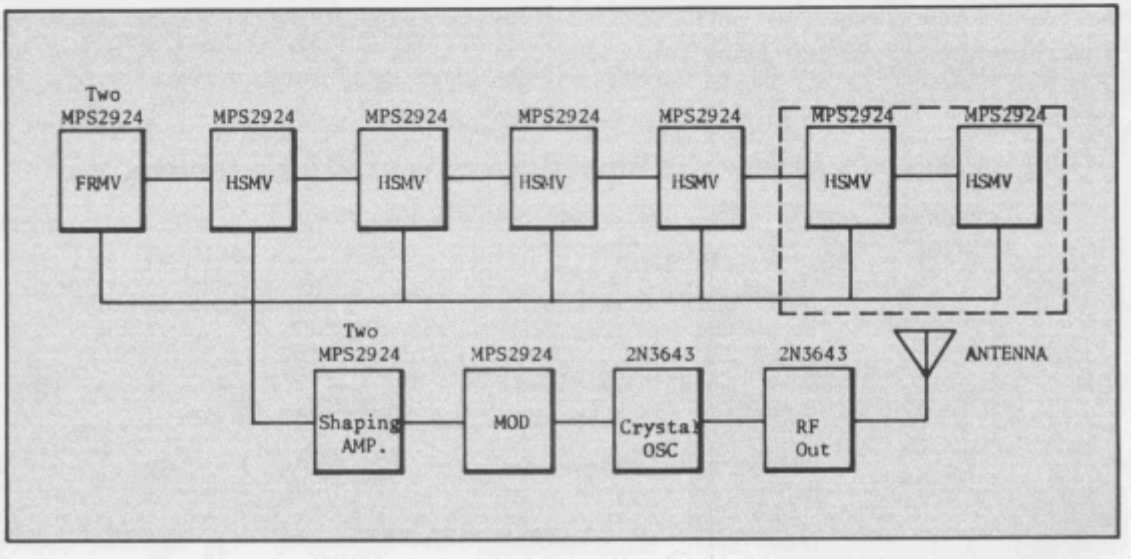


Theory of Operation

TRANSMITTER SECTION

Note the block diagram on the transmitter. In the first block FRMV means Free Running Multi Vibrator. This establishes the frame rate in the transmitter at approximately 60 cycles per second. Working in conjunction with the free running multi vibrator are as many half-shot multi vibrator sections as there are channels in the transmitter. Notice we have blocked off with a dotted line the fifth and sixth channels. The half-shots trigger each other like a row of dominoes falling over and knocking the next one down. The signals from the half-shots trigger the shaping amplifier. In the shaping amplifier, the pulse shape is established, the rise and fall time is controlled, and the pulse width is controlled. The shaping amplifier in turn triggers the ON-OFF modulator section which, in turn, keys the crystal oscillator. The RF amplifier, the last section in the transmitter, amplifies the signal from the crystal oscillator and the power leaves the transmitter via the antenna.

INCLUDES • CHARGER • ADD - A - CHANNEL



INSTRUCTIONS FOR ASSEMBLY OF WORLD ENGINES BLUE MAX SYSTEM TRANSMITTER KIT

In a discussion of the assembly of this transmitter, we would first like to comment that the transmitter for the Blue Max System has certain similarities to the M.A.N. 2-3-4 transmitter which appeared in a series of articles in Model Airplane News in 1968. The basic differences in the transmitter is that the M.A.N. System used a center loaded antenna system whereas the Blue Max System uses a base loaded antenna system. Other differences — M.A.N. — 9 volts, BMS — 12 volts, M.A.N. — Charger mounted in transmitter, BMS — Charger mounted externally.

The Blue Max System employs factory assembled World Engines stick assemblies whereas the M.A.N. System employed OS stick assemblies that required assembly by the kit builder. The Blue Max System employs a Buddy Box whereas the M.A.N. System did not. On the other hand, the M.A.N. System offered the option to go to a 9 volt dry battery and the Blue Max System does not. The effective range in power output on a Blue Max System is substantially greater than it was on the M.A.N. System because of the increase in voltage.

Before you start on your kit, we recommend that you look through your instruction manual completely — at the photographs and the diagrams and glance through the step-by-step instructions. If you purchased a semi-kit you will note that the circuit board is assembled.

SOLDERING

Soldering is an art that is the key to successful electronic work. The vast majority of all electronic kit malfunctions can be traced directly to bad soldering. The following rules, if followed, will result in good solder connections. Incidentally, the transmitter board is, because of relatively large size lands, an excellent training ground and should be assembled before the smaller receiver, decoder, and servos. Final transmitter tuning and stick pot adjustment will require an assembled flight pack. World Engines BMS kits come with an assembled servo so that you have a time constant reference. Do not change the brush setting on this servo. Also, the servo may be different from a kit servo — do not use it as a model to build other servos.

For soldering the transmitter connections, the 40 watt Ungar Imperial Iron is an excellent tool. The smaller Ungar Irons, such as the Princess Iron, are excellent for receiver and decoder work as well as servos, but they do not generate enough heat for the transmitter board. The Princess Iron is rated 15 watts. Keep a damp rag handy and wipe the tip of your iron off quite often. Solder the leads to the board by placing your iron tip against the lead *and the land* from which the lead emerges. Immediately apply solder which will flow instantly and immediately remove the iron by sliding up the lead and away from the board. Solder rapidly, heat is your enemy. Twist and tin all stranded wire ends before soldering to components and/or to the batteries. All solder joints and connections should be shiny and smooth. Grayish granular joints are cold and must be reheated until smooth and shiny since cold solder joints create high resistance.

INSTRUCTIONS FOR ASSEMBLY OF WORLD ENGINES BLUE MAX TRANSMITTER KIT

STEP	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 1	( )	Insert 1N4148 Diode into holes Banded end must go into hole 100	100, 101	.65
Step 2	( )	Insert 1N4148 Diode into holes Banded end in hole 80.	80, 81	.65
Step 3	( )	Insert 1N4148 Diode into holes Banded end in hole 58	58, 57	.65
Step 4	( )	Insert 1N4148 Diode into holes Banded end in hole 42	42, 43	.65

STEP	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 5	( )	Insert 1N4148 Diode into holes Banded end in hole 21	21, 20	.65
Step 6	( )	Solder parts installed in Steps 1 through 5 above.		
Step 7	( )	Insert 47K Resistor (yellow, violet, orange) in holes	22, 23	.12
Step 8	( )	Insert 47K Resistor (yellow, violet, orange) in holes	49, 50	.12
Step 9	( )	Insert 47K Resistor (yellow, violet, orange) in holes	64, 65	.12
Step 10	( )	Insert 47K Resistor (yellow, violet, orange) in holes	82, 83	.12
Step 11	( )	Insert 47K Resistor (yellow, violet, orange) in holes	98, 99	.12
Step 12	( )	Insert 4.7K Resistor (yellow, violet, red) in holes	104, 105	.12
Step 13	( )	Insert 100K Resistor (brown, black, yellow) in holes	106, 107	.12
Step 14	( )	Insert 10K Resistor (brown, black, orange) in holes	108, 109	.12
Step 15	( )	Insert 4.7K Resistor (yellow, violet, red) in holes	113, 114	.12
Step 16	( )	Insert 100K Resistor (brown, black, yellow) in holes	87, 88	.12
Step 17	( )	Insert 100K Resistor (brown, black, yellow) in holes	69, 70	.12
Step 18	( )	Insert 100K Resistor (brown, black, yellow) in holes	44, 45	.12
Step 19	( )	Insert 100K Resistor (brown, black, yellow) in holes	29, 30	.12
Step 20	( )	Insert 150K Resistor (brown, green, yellow) in holes	8, 9	.12
Step 21	( )	Insert 10K Resistor (brown, black, orange) in holes	16, 17	.12
Step 22	( )	Insert 150K Resistor (brown, green, yellow) in holes	18, 19	.12

STEP	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 23	( )	Insert 1K Resistor (brown, black, red) in holes	120, 121	.12
Step 24	( )	Insert 4.7K Resistor (yellow, violet, red) in holes	179, 180	.12
Step 25	( )	Insert 4.7K Resistor (yellow, violet, red) in holes	182, 183	.12
Step 26	( )	Insert 100 ohm Resistor (brown, black, brown) in holes	173, 174	.12
Step 27	( )	Insert 470 ohm Resistor (yellow, violet, brown) in holes	155, 156	.12
Step 28	( )	Check color marking all resistors.		
Step 29	( )	Check Resistors 7 thru 29 for proper board placement.		
Step 30	( )	Clip and solder leads from components installed in Steps 7 through 29 above.		
Step 31	( )	Insert .001 ceramic disc capacitor in holes	33, 34	.35
Step 32	( )	Insert .001 ceramic disc capacitor in holes	53, 54	.35
Step 33	( )	Insert .001 ceramic disc capacitor in holes	73, 74	.35
Step 34	( )	Insert .001 ceramic disc capacitor in holes	91, 92	.35
Step 35	( )	Insert .01 ceramic disc capacitor in holes	102, 103	.35
Step 36	( )	Insert .02 ceramic disc capacitor in holes	118, 119	.35
Step 37	( )	Insert .02 ceramic disc capacitor in holes	175, 176	.35
Step 38	( )	Insert .02 ceramic disc capacitor in holes	151, 152	.35
Step 39	( )	Insert .002 ceramic disc capacitor in holes	136, 137	.35
Step 40	( )	Insert .02 ceramic disc capacitor in holes	132, 133	.35
Step 41	( )	Install 33 pf ceramic disc capacitor in holes	142, 143	.35
Step 42	( )	Install 27 pf ceramic disc capacitor in holes	157, 158	.35
Step 43	( )	Clip and solder leads from parts installed in Steps 29 through 38 above.		
Step 44	( )	Insert transistor MPS 2924 in holes	E B C 93 94 95	1.50
Step 45	( )	Insert transistor MPS 2924 in holes	75 76 77	1.50

STEP	CHECK AS COMPLETED	DIRECTIONS	HOLE NO. E	B	C	COMPONENT COST
Step 46	( )	Insert transistor MPS 2924 in holes	63	62	61	1.50
Step 47	( )	Insert transistor MPS 2924 in holes	37	38	39	1.50
Step 48	( )	Insert transistor MPS 2924 in holes	3	4	2	1.50
Step 49	( )	Insert transistor MPS 2924 in holes	14	15	13	1.50
Step 50	( )	Insert transistor MPS 2924 in holes	112	110	111	1.50
Step 51	( )	Insert transistor MPS 2924 in holes	117	115	116	1.50
Step 52	( )	Insert transistor MPS 2924 in holes	166	167	165	1.50
Step 53	( )	Insert transistor 2N3643 in holes	171	172	170	1.50
Step 54	( )	Insert transistor 2N3643 in holes	150	149	148	1.50
Step 55	( )	Clip and solder leads from transistors installed in Steps 44 through 54 above.				
Step 56	( )	Install .0047 mylar capacitor in holes	184, 185			.60
Step 57	( )	Install .0047 mylar capacitor in holes	40, 41			.60
Step 58	( )	Install .0047 mylar capacitor in holes	59, 60			.60
Step 59	( )	Install .0047 mylar capacitor in holes	78, 79			.60
Step 60	( )	Install .0047 mylar capacitor in holes	96, 97			.60
Step 61	( )	Clip and solder leads from components installed in Steps 56 through 60 above.				
Step 62	( )	Install .047 mylar capacitor in holes	89, 90			.60
Step 63	( )	Install .047 mylar capacitor in holes	71, 72			.60
Step 64	( )	Install .047 mylar capacitor in holes	55, 56			.60
Step 65	( )	Install .047 mylar capacitor in holes	31, 32			.60
Step 66	( )	Install .15 mylar capacitor in holes	11, 12			.60
Step 67	( )	Install .15 mylar capacitor in holes	6, 7			.60
Step 68	( )	Clip and solder leads from mylar capacitors installed in Steps 62 through 67 above.				
Step 69	( )	Install .22 mylar capacitor in holes	164, 163			.60
Step 70	( )	Insert 4.7 ohm resistor (yellow, violet, gold) in holes	153, 154			.12

STEP	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 71	( )	Insert 56 pf silver mica capacitor in holes	159, 160	.60
Step 72	( )	Insert 100 mfd 15v electrolytic capacitor in holes. Positive lead must go in hold 128 as shown on component placement drawing.	129, 128	.90
Step 73	( )	Clip and solder leads from components installed in Steps 69 through 72 above. Refer to sketch showing identification of chokes before starting next step.		
Step 74	( )	Insert .82 uh choke into holes	161, 162	.65
Step 75	( )	Install 12 uh choke into holes	146, 147	.65
Step 76	( )	Install 12 uh choke into holes	168, 169	.65
Step 77	( )	Install 3.3 uh choke into holes	138, 139	.65
Step 78	( )	Install 3.3 uh choke into holes	144, 145	.65
Step 79	( )	Clip and solder leads from chokes installed in Steps 74 through 78 above.		
Step 80	( )	Install and solder #404 trimmer capacitor in holes	140, 141	.95
Step 81	( )	Install and solder crystal in holes	177, 178	4.95
Step 82	( )	Install 50K trimmer potentiometer in holes	26, 28, 27	1.20
Step 83	( )	Install 50K trimmer potentiometer	47, 48, 46	1.20
Step 84	( )	Install 50K trimmer potentiometer in holes	66, 68, 67	1.20
Step 85	( )	Install 50K trimmer potentiometer in holes	84, 86, 85	1.20
Step 86	( )	Install and solder 33 pf ceramic disc capacitor in holes	186, 187	
Step 87	( )	The eyelets which to through holes 134 and 135 to hold the antenna bracket onto the printed circuit board should be soldered both to the copper side of the board and to the brass antenna bracket. At this point your printed circuit board is completed to the semi-kit stage and you are ready to proceed with wiring of the chassis.		

If you have purchased a semi-kit transmitter from World Engines you should begin with the wiring instructions which follow:

STEP	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 88	( )	The DPDT Slide Switch should now be mounted on the copper side of the board into holes	122, 123, 124, 125, 126, 127	.50
		Care should be exercised when soldering this so as not to allow solder to flow up to the metal housing of the switch.		
Step 89	( )	Mount the two hex brass standoffs to the transmitter case with the 4-40 x 1/4" binder head machine screws supplied.*		.15
Step 90	( )	Temporarily, mount the printed circuit board to the transmitter case using the 4-40 x 1/4" binder head machine screws to hold the transmitter board in place with the switch.		
Step 91	( )	In Step 89 brass hex standoffs were mounted into the transmitter case. There may be some adjustment problem getting the holes in the printed circuit board to line up with the brass standoffs. If this is so, loosen the screws that hold the standoffs which will permit them to move around slightly and this will aid in getting the holes lined up. At this point, the transmitter PC board should be removed from the case by loosening the screws that hold the switch and the brass standoffs from the case front. The brass standoffs are now properly located on the back of the PC board. Now, solder the brass standoffs in place to the PC board copper lands.		

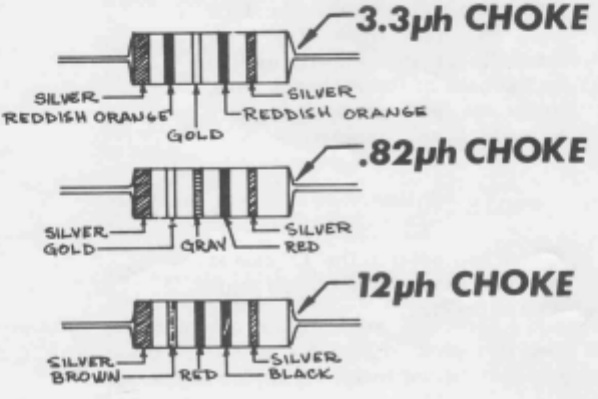
*NOTE

These two holes in the TX case are the two lower holes on the center line of the case.

WIRE REQUIREMENTS

Cut and tin as per this chart.

No. of Pcs.	Color	Length	Strip & Tin
4	Orange	8-1/2"	One end - 1/8"
4	White	5-1/2"	One end - 1/8"
1	Yellow	5-1/2"	One end - 1/8"
1	Green	5-1/2"	One end - 1/8"
1	Blue	5-1/2"	One end - 1/8"
1	Purple	5-1/2"	One end - 1/8"
1	Grey	7"	One end - 1/8"
1	Brown	7"	One end - 1/8"
1	Orange	7"	One end - 1/8"
1	Grey	8"	One end - 3/4"
1	Yellow	8"	One end - 3/4"
1	Brown	8"	One end - 3/4"
11	Heat Shrink	1/2"	-o-
1	Heat Shrink	5"	-o-
1	Heat Shrink	1"	-o-



SOLDERING OF WIRES TO BACK OF P.C. BOARD. SEE SKETCH.

STEP	CHECK AS COMPLETED	WIRE	SOLDER TO LAND CONTAINING HOLE NO.	THREAD OTHER END THROUGH HOLE NO.
Step 92	( )	5-1/2" Yellow	11	25
Step 93	( )	5-1/2" Green	40	35
Step 94	( )	5-1/2" Blue	60	36
Step 95	( )	5-1/2" Purple	78	51
Step 96	( )	5-1/2" White	31	25
Step 97	( )	5-1/2" White	56	35
Step 98	( )	5-1/2" White	71	36
Step 99	( )	5-1/2" White	89	51
Step 100	( )	5-1/2" Orange	Solder at hole 30	25
Step 101	( )	5-1/2" Orange	Solder between hole 30 and 44	35
Step 102	( )	5-1/2" Orange	Solder at hole 44	36
Step 103	( )	5-1/2" Orange	Solder between hole 44 and 70	51

NOTE: Put heat shrink 1" long over wires in Steps 104, 105, 106 before putting through hole 24.

Step 104	( )	7" Orange	127	24
Step 105	( )	7" Grey	121	24
Step 106	( )	7" Brown	Soldered to hole 169	24

Step 107 ( ) The 3 wires coming from each of the holes should be twisted together to form a cable. Onto each cable, slide two 1/2" pieces heat shrink tubing in order to cable the wires and hold them permanently.

Step 108 ( ) At this point the cable holes 51, 36, 35, 25 should be trimmed even and stripped and tinned 1/8" in preparation for wiring to the stick pots.

Step 109 ( ) Trim the Brown and Grey wires from hole 24 even, to length that is 1" shorter than the Orange wire from hole 24. Strip and tin these wires 1/8" to prepare them for wiring to the charging plug and battery box switch.

NOTE: This completes the wiring of the board. We have used step numbers for the board assembly. The full instructions are covered in paragraph form. There will be no more step numbers. As you read the final assembly instructions it will be apparent the way it must be done.

FINAL ASSEMBLY

The first step in the final assembly of the transmitter will be to install the meter. We are providing both a sketch to show you how to build up the meter assembly and photograph to show the assembly of the meter into the transmitter case. The meter is held into the case with two self-tapping 1/4" long screws.

INSTALLATION OF RUBBER BUMPERS

Install the rubber bumpers into the transmitter case. There are three bumpers in the transmitter case back. Four bumpers go on the transmitter front panel at the bottom of the transmitter. To install these rubber bumpers, press them into the holes manually as far as they will go and then pull them through with pliers and they will snap into position.

HANDLE

The installation of the handle into the case is accomplished with two nuts and a small wrench. This should be self-explanatory from viewing the photographs.

CHARGING PLUG

Viewing the transmitter from the back side, the charging plug should be installed with the notch "up", with the lugs "down", and with a ground lug on the left side. See sketch. Solder the ground wire from lug to case terminal at this time.

BUDDY BOX SWITCH

The position of the switch is controlled by keyholes in the case for the lug on the switch washer. The washer is mounted under the hex head screw that holds the Buddy Box switch to the case. There is a separate Buddy Box switch and cable Operations Manual which will describe the use of the Buddy Box in full. We might add here that you need not worry about the Buddy Box switch cutting out your transmitter in normal transmitter operations as it is inoperative in either position so long as the Buddy Box cord is not installed in the transmitter so do not hesitate to wire it in. We might add that your transmitter will not work unless you wire your Buddy Box switch in as per these instructions.

BUDDY BOX SOCKET

The Buddy Box socket is located through a hole in the bottom of the transmitter case front. It is necessary to install three washers and a nut to this plug and then put the remaining threaded mounting screw projecting through the bottom of the case, then catch it with still another hex head nut on the bottom. The reason for the spacers (the three washers and the nut inside) is to hold the Buddy Box socket up so that the transmitter will sit on the rubber feet without the Buddy Box socket projecting too far below the transmitter case. Notice in the photograph provided the proper positioning of the lugs with respect to the case.

BUDDY BOX WIRING

The Buddy Box wiring and color coding is covered in the sketch provided and also can be seen clearly from the photographs provided. Note the use of heat shrink tubing to hold the wires together when they travel under the P.C. board. This will keep them from getting in the way of the switch and other parts under the board. Leading from the Buddy Box socket to the Buddy Box switch are three wires; one brown, one grey, one yellow. Where these wires connect to the switch they should be stripped about 1/8" and tinned. This can be seen also in the sketch on page 16.

TEMPORARILY MOUNT P. C. BOARD IN TRANSMITTER

When you mount the printed circuit board in the transmitter case, you must slide it in to get it over the Buddy Box plug. Be careful not to pry the edge of the P.C. board against the lower stick pot on the right hand side. At this point just put a couple of screws in from the front to keep the P.C. board from moving.

INSTALL STICK ASSEMBLIES

Looking at the back of the transmitter the stick assembly with only one spring or the motor control stick assembly goes in on the right side. The other stick assembly goes in on the left side. This is for Mode-2 Operation. Notice the two trim rings on the front of the transmitter case. This clip is under the plastic front stick bezel plastic castings.

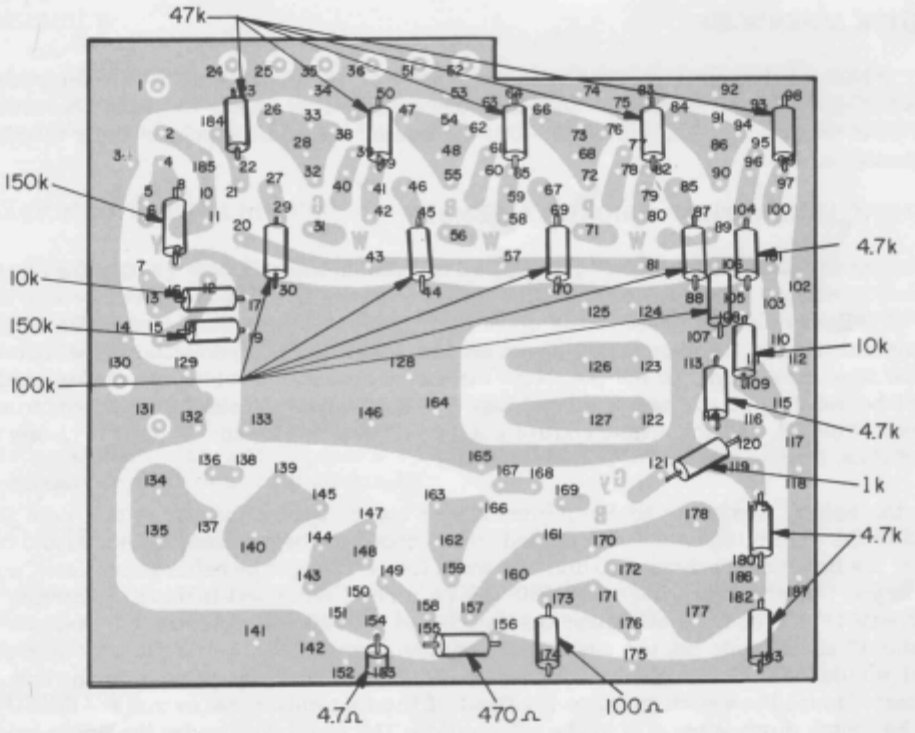
MOUNTING AND WIRING THE P.C. BOARD ASSEMBLY

Mount the P.C. Board into the transmitter. See page 15 and the sketches on page 16. Coming out of hole 24 are three wires — orange, gray, and brown. The gray and brown wires go to the buddy box switch (see sketch page 16). The orange wire goes to the upper right hand lug on the charging plug. Coming from hole 25 are the wires that go to the aileron pot. These are orange, white, and yellow and the sketch on page 16 illustrates how they are soldered to the pot. Note the use of heat shrink tubing as a cuff to hold the wires together right before they go to the various pot lugs. The wires from the elevator pot come from hole 35, the rudder pot - hole 36, and the engine control pot - hole 51. The diagram on page 16 clearly shows the disposition of these wires to the various pot terminals.

Next solder the battery box wires to the printed circuit board. Loosen the screws that hold the printed circuit board to the transmitter so that the printed circuit board can be withdrawn. The red and black wires may be hot if the batteries are charged so don't let them touch. It might be better to insulate the ends with a little tape as you thread them through hole 130, (see page 15) and connect them to the correct lands. The red wire connects to one of the lands under the switch and the black wire solders to a land near hole 130. Next your should check your printed circuit board over for any solder shorts. The switch in the printed circuit board should be in the down or off position. Now remount your printed circuit board into the transmitter case. Mount the switch guard to the front of the transmitter case so that the little lever swings in to hold the switch down when it is in the off position. The guard goes under the upper switch screw. Build your charger and then put your transmitter on charge for 24 hours. *It is now time to continue on with the manual and assemble the receiver-decoder and servos.*

TUNING THE TRANSMITTER

At this point the transmitter should be fully charged. Install and extend the antenna. With the antenna extended, turn the transmitter on. You should get some sort of meter reading. If you don't get a meter reading, it should not be in the charger or meter circuit as this has already been used in charging. Adjust the capacitor marked 404 in holes numbered 140 and 141 which is near the antenna bracket. Adjust this capacitor for a maximum reading. Turn the transmitter off. The next step is to set pots to the correct neutral. Adjust the trim levers so they are in the center of their slots. You will notice with your kit you received one assembled servo. This is set for a 1.5 millisecond time with the stick at the neutral position. Turn on your transmitter and turn on the switch for your flight pack. Plug the factory assembled servo into the aileron plug. Twist the aileron pot until this servo centers. Repeat this on rudder and elevator. Set your motor control stick in the center of the throw and repeat the process on the engine control. It is necessary that this pot centering be observed in the transmitter so that all the transmitters will be basically alike. This is particularly necessary when using your transmitter with other people's Blue Max System's transmitter as a buddy box. If the pots aren't set, switching from one transmitter to another will cause serious servo fluctuations that could lead to a crash. After you have completed the above operations put the back of the transmitter case in place and fasten with sheet metal screws. Do not tighten the screws up to tight or you will strip out the aluminum.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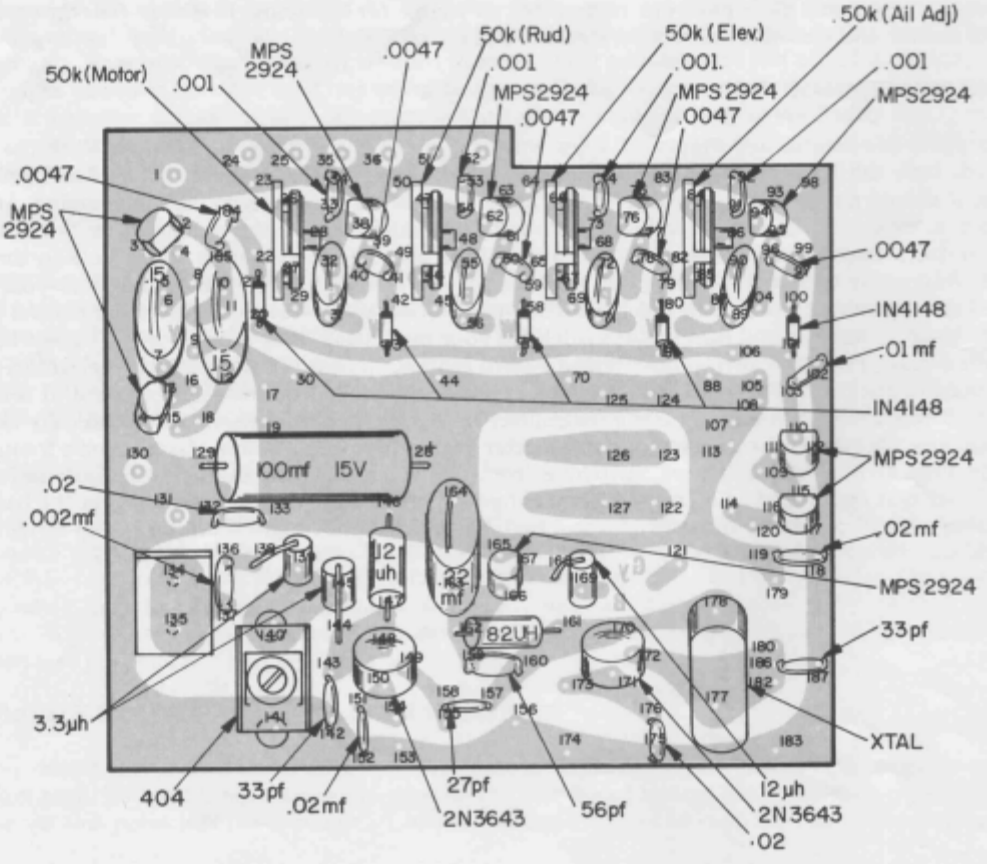
100Ω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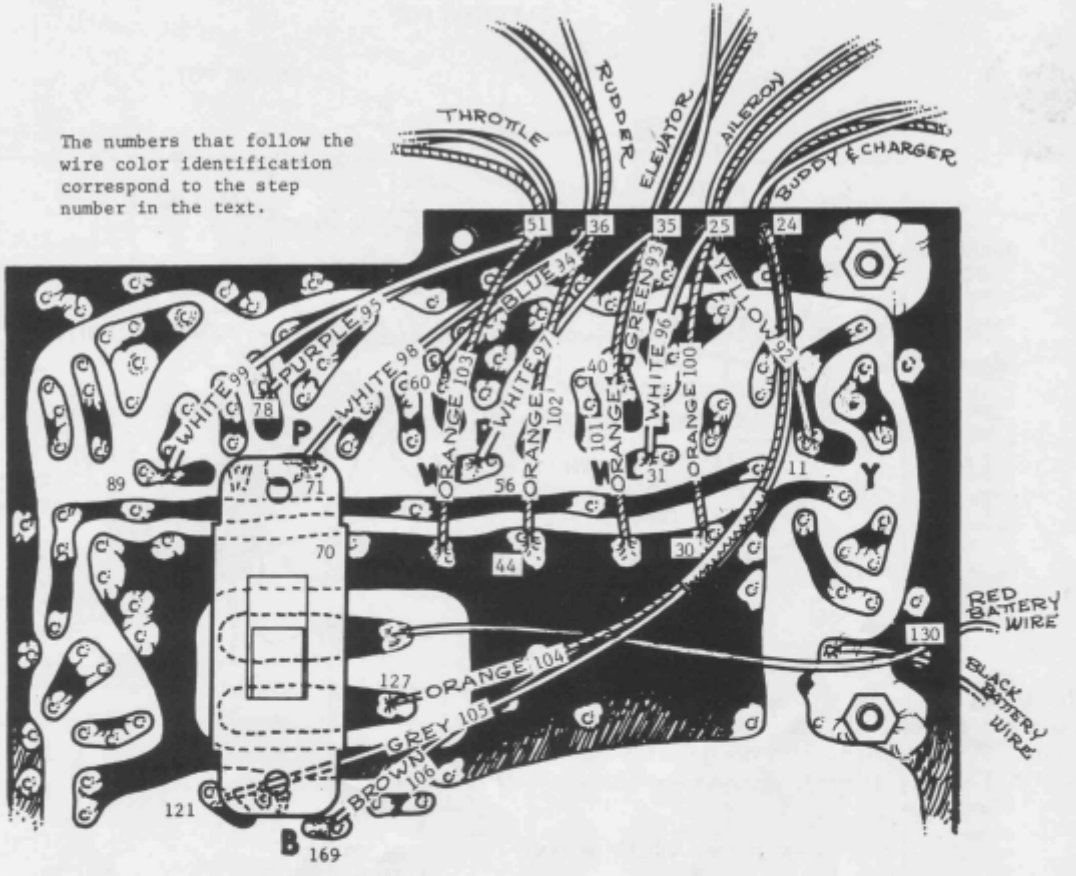
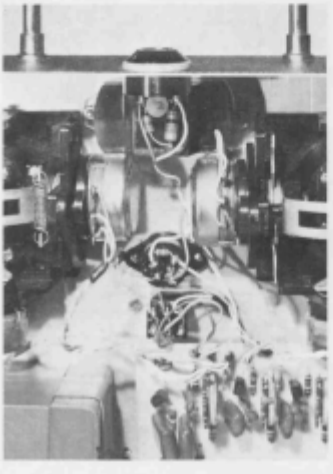
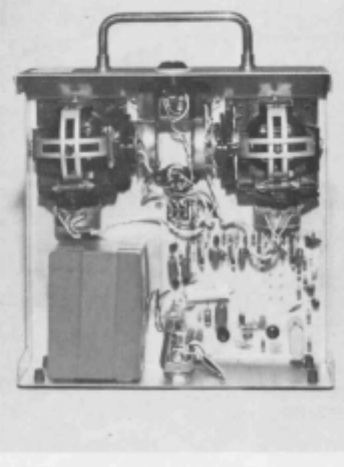
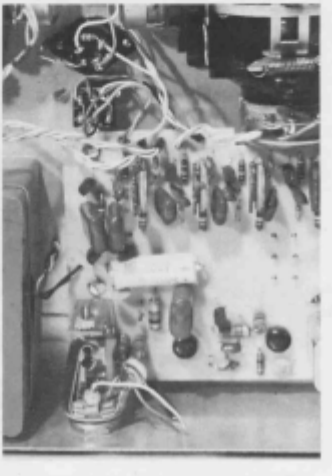
2N3643
.02

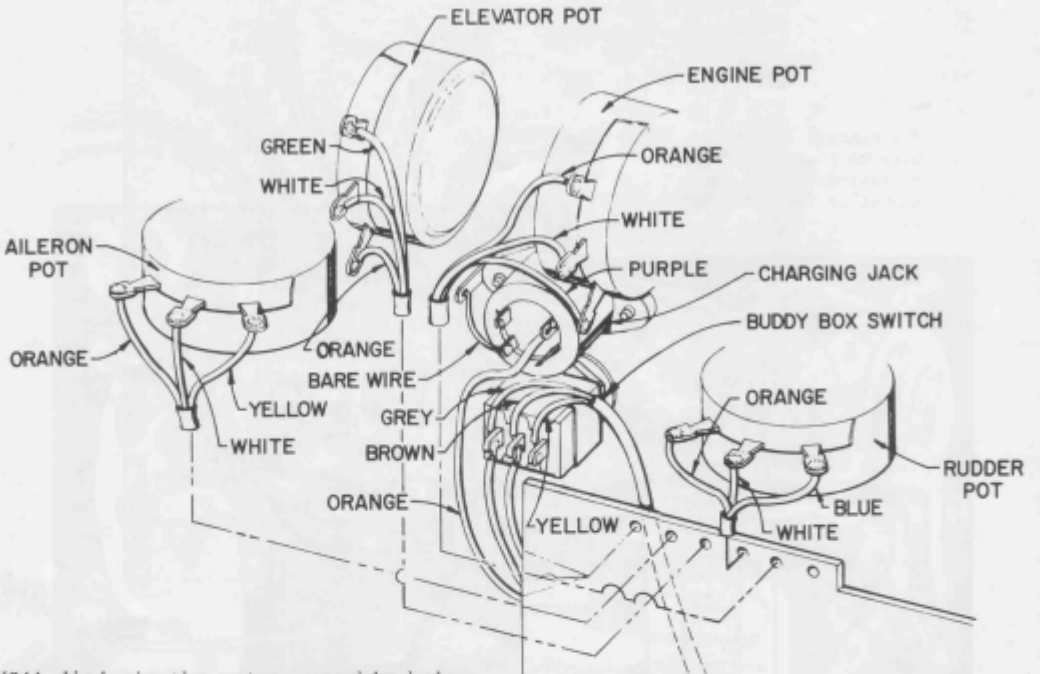
The numbers that follow the wire color identification correspond to the step number in the text.



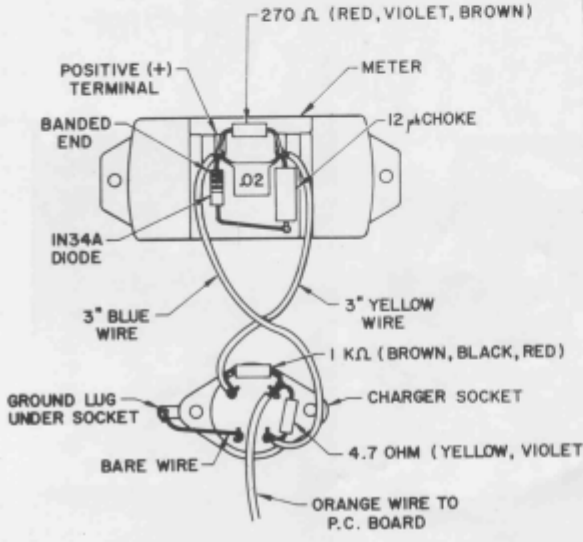


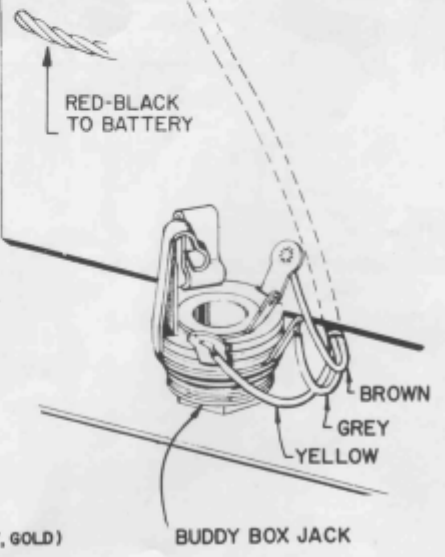


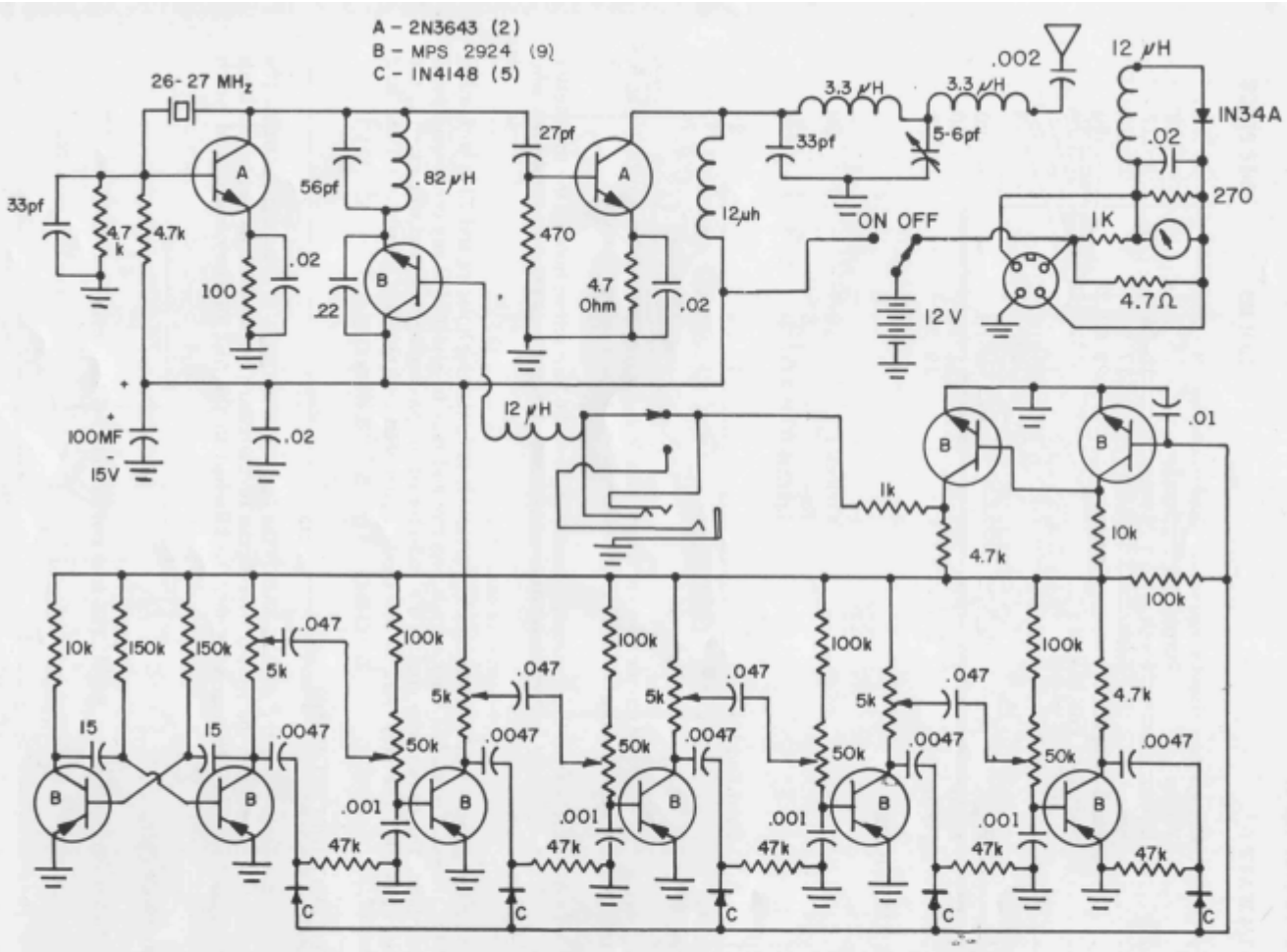




The 1N34A diode in the meter assembly below has a color band at the positive end of the diode. This connects to the positive meter terminal.







TRANSMITTER SCHEMATIC

ADD — A. CHANNEL — Tx 5th & 6th ch.

ASSEMBLY STEPS (Ref. fig. 1)

RESISTOR — 1/4 WATT				HOLES	UNIT PRICE
3.3K (R2)	Orange	Orange	Red	3 2	$ .12
47K (R6)	Yellow	Purple	Orange	6 7	.12
10K (R5)	Brown	Black	Orange	15 16	.12
120K (R4)	Brown	Red	Yellow	17 18	.12
5K (R1)	Small Trim Pot			22 23 25	.50
1.5K (R3)	Slide Trim Pot			1 24 21	1.70
CAPACITOR					
.001 (C2)	Disc			4 5	.20
.0047 (C3)	Mylar			11 12	.40
.047 (C1)	Mylar			19 20	.45
TRANSISTOR AND DIODE					
2N2924 (Q1)			Collector	10	.99
			Base	8	
			Emitter	9	
1N4148 (CR1)	Band End Up			13 14	.35
P. C. Board					1.70

Install the components on the printed circuit board in accordance with Fig. 1. Add wires as shown in Fig. 5. Mount circuit board on top of case using two 2/56 x 1" bolts, spacers, nuts. See Figs. 3 and 4.

Route the wires down neatly toward the transmitter board. Remove the four screws holding the transmitter board to the case front and refer to the transmitter component placement diagram to locate the wire attachment points.

The orange wire is the positive lead and attaches to the same land containing holes 44 and 70 as with other orange wires from the stick pots. The black wire is negative and may be attached at any convenient point on the perimeter land. The brown wire goes to the collector of the preceeding stage and will attach to the land containing hole 104. The grey wire is the diode signal lead and attaches anywhere on the land containing holes 43, 57.

SECOND AUXILIARY INSTALLATION

The second auxiliary is installed in the same manner as the first up to the point of attaching the wires. The orange, black, and grey wires may be routed over to the first auxiliary board and attached to the lands containing the same colors. The brown wire must be attached to the first auxiliary board land which contains holes, 10, 12, and 15.

NEUTRAL ADJUSTMENT

Set the knob of R3 to center of throw. Set R1 (5K trim pot) for neutral (1.5 ms) of servo.

BLUE MAX SYSTEM - TX ADD-A-CHANNEL

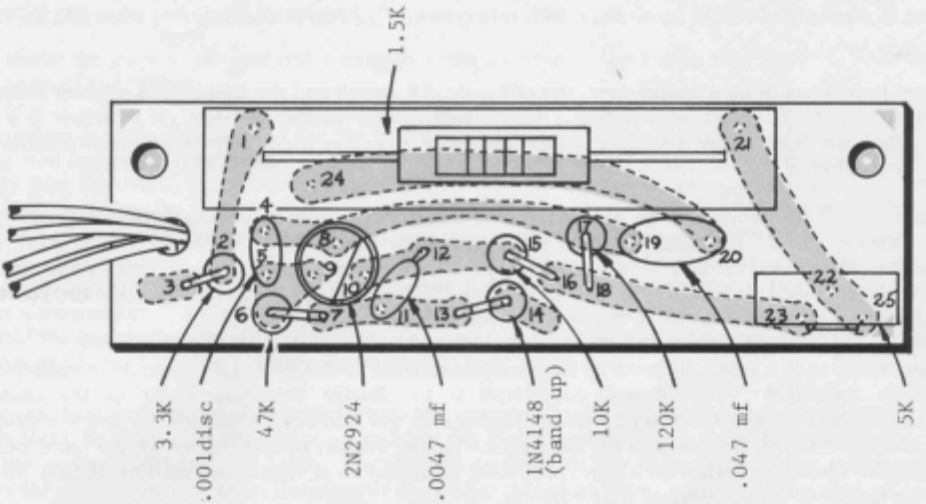


Fig. 1 Part Placement

WIRES
BROWN . . . . . LAND WITH HOLE 3
BLACK . . . . . LAND WITH HOLE 6
ORANGE . . . . . LAND WITH HOLE 16
GREY . . . . . LAND WITH HOLE 14

Fig. 5 - Copper side of board

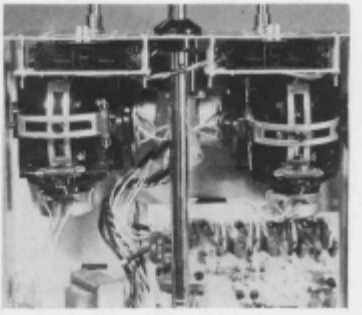
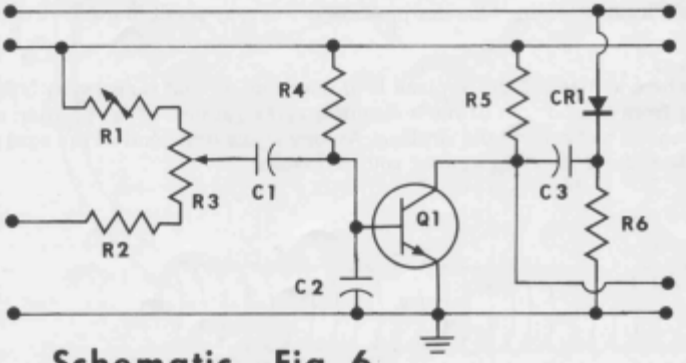


fig. 3



Schematic -Fig. 6

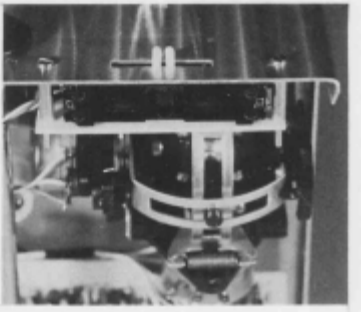


fig. 4

BUDDY BOX SYSTEM – OPERATION

This instruction has been kept to a minimum length. It is vital that you read and pay attention to these instructions. It is possible to crash an airplane with this system if you do not understand what you are doing with it.

1. There are two switches on a transmitter. The ON and OFF switch and the Buddy Box selector switch or the trainer switch. This trainer switch is a toggle switch whereas the ON and OFF switch is a slide switch. When the transmitter is being operated normally, it makes no difference in which position the Buddy Box switch is placed.

2. The trainer airplane should be an airplane which has previously been trimmed out. Preferably, the trainer airplane should fly with the trim adjustments on the transmitter pretty near neutral. Let's suppose you are the expert and another man brings a new airplane out for you to test fly for him. Get the airplane trimmed out first flying with his transmitter. Adjust the Kwik Links so that the plane flys correctly with the trim levers on the transmitter near the center positions.

   The transmitter that is normally used to fly the airborne pack in the airplane is generally considered the instructor's transmitter. The second transmitter is the Buddy Box transmitter or the student's transmitter. When the student transmitter is plugged into the instructor's transmitter and the sytem is set for student control, the surfaces on the airplane should remain in approximately the same location that they do when the instructor's control system is moved to a take over position. If they do not, adjust the trim lever on the student transmitter accordingly.

3. Please refer to Fig. 1. The transmitter that goes with the Flight Pak in the training airplane is the master or instructor's transmitter.

4. The wire that connects the two transmitters together has a red plug and a black plug. Plug the red plug into the instructor's transmitter and the black plug into the student's transmitter. Another word of caution — be sure to plug the cord all the way into the transmitters. Because of the way the plug is made, there is a feeling that the plug is all the way in when it is only partially in so make sure to give it a good firm push and feel it click into position. There are two toggle switches located in the center of the transmitter. For instructor-student use, start off by positioning both of these toggle switches to the right or to the blue dot indicator on the transmitter. Turn both transmitters ON. Turn the Flight Pak ON in the airplane to be flown. Without starting up the engine of the airplane, check out the control system. Check that the student's transmitter gives UP, DOWN, RIGHT, LEFT, etc. as it should for the mode transmitter that the student is using. Now, demonstrate to yourself that the instructor can take over operation. The instructor flicks his toggle switch to the LEFT and in doing this you will note that the instructor's transmitter now commands the control surfaces on the model. Again, check out for control action response.

5. The toggle switch on the instructor's transmitter can be moved from the blue dot position to the other position changing control from the instructor to the student at the wish of the instructor. The *student* should never move his toggle switch away from the blue dot position as this may result in no control of the airplane.

6. If there is ever a panic situation where control of the airplane is in question, all that is necessary is for the instructor to pull the red plug from the bottom of his transmitter and regardless of the position of his student-instructor selector switch, he will control the airplane. As long as the other end of the cord is plugged into the student's transmitter, the student transmitter will be disabled.

MIXING 4 CHANNEL WITH 5 and 6 CHANNELS

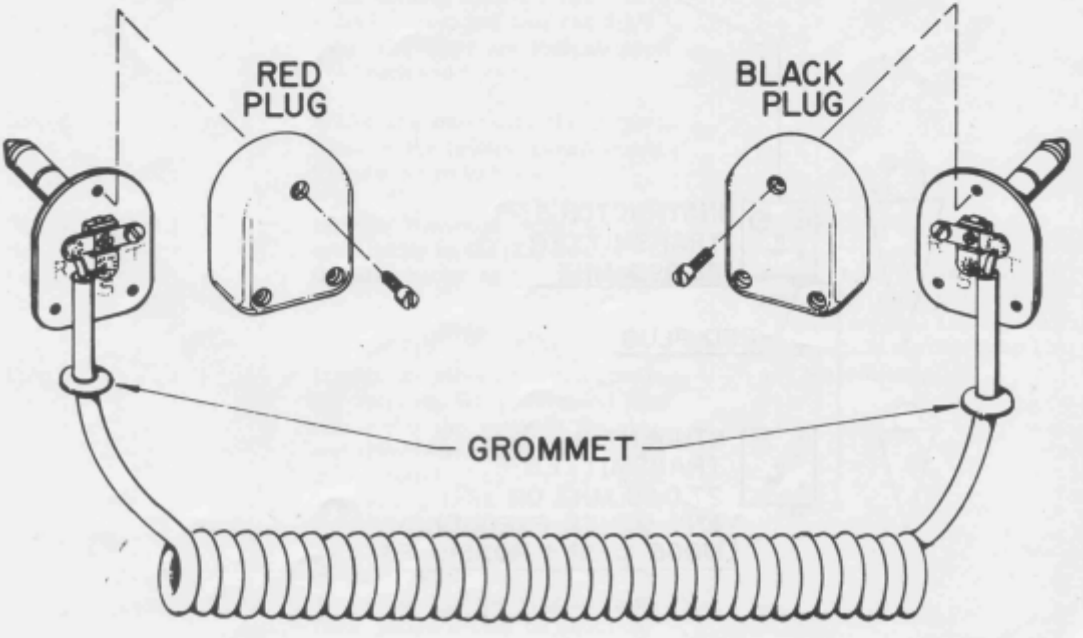
If one of the transmitters is 4 channel unplug the 5th or 6th channel servo from the decoder in the airplane otherwise the servo will try to go around.

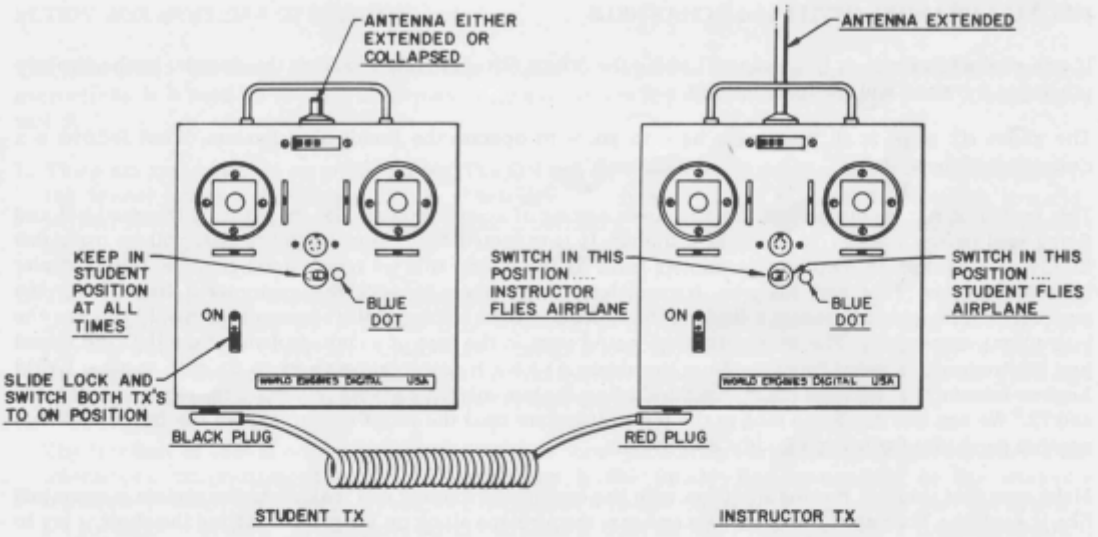
The above six steps is all you really have to know to operate the Buddy Box System. What follows is a discussion of the system.

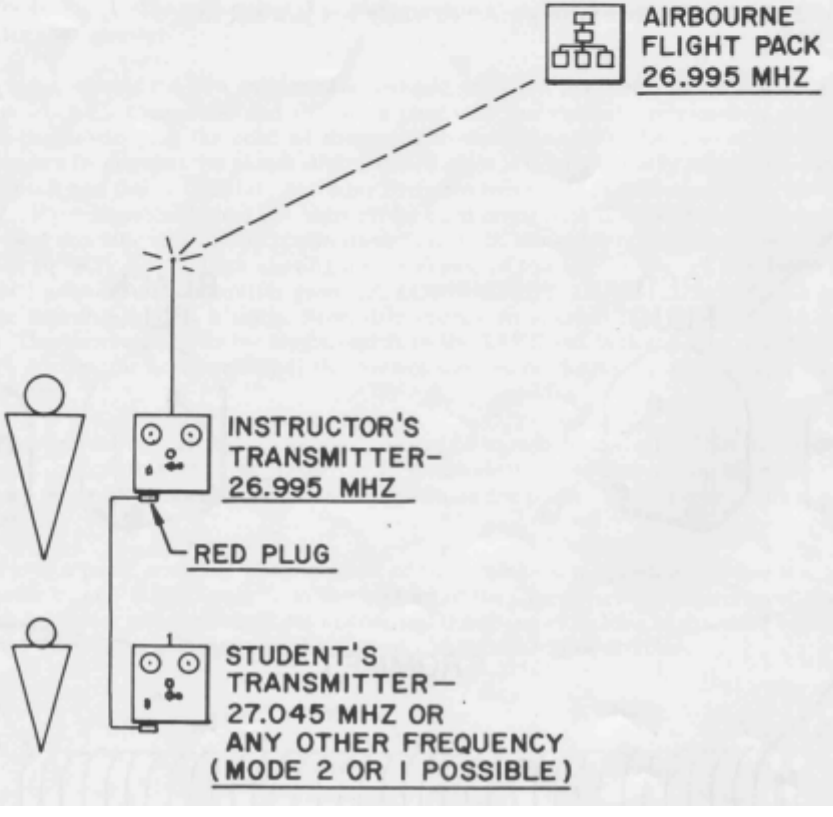
This system is not recommended for the flight testing of a new airplane. Get the airplane trimmed out and flying well before you try to use it as a trainer. It is expected that many hobby dealers will be using this Buddy Box System to help new customers learn to fly. To do this we recommend that the hobby dealer have his own airplane and his own transmitter. Then when he sells the customer a transmitter, the customer's transmitter becomes a student transmitter and the hobby dealer's transmitter would become the instructor's transmitter. The same situation would exist in the case of a club airplane where the club would buy the transmitter, get it flying, and use the airplane to teach new members how to fly with another World Engines transmitter. We have made this Buddy Box System interchangeable. We can mix frequencies 27, 52, and 72.* We can mix modes so long as the transmitters are used the way they came from the factory. Here is another good idea for using a Buddy Box System.

Make sure that you dry run the situation with the engine not running and make sure the system is operating like it sould be.Then start the engine up and taxi the airplane along on the ground letting the student try to taxi the airplane and practice taking the airplane away from the student and doing it yourself. Let the instructor get the airplane up in the air with some altitude before turning it over to the student.

* Only those 72 mhz sets that have factory installed buddy box jack and plug.




ANTENNA EITHER EXTENDED OR COLLAPSED
ANTENNA EXTENDED
KEEP IN STUDENT POSITION AT ALL TIMES
BLUE DOT
ON
SLIDE LOCK AND SWITCH BOTH TX'S TO ON POSITION
BLACK PLUG
SWITCH IN THIS POSITION.... INSTRUCTOR FLIES AIRPLANE
SWITCH IN THIS POSITION.... STUDENT FLIES AIRPLANE
RED PLUG
STUDENT TX
INSTRUCTOR TX


AIRBOURNE FLIGHT PACK 26.995 MHZ
INSTRUCTOR'S TRANSMITTER- 26.995 MHZ
RED PLUG
STUDENT'S TRANSMITTER— 27.045 MHZ OR ANY OTHER FREQUENCY (MODE 2 OR 1 POSSIBLE)

BLUE MAX SYSTEM — DUAL CHARGER KIT AND SEMI-KIT ASSEMBLY INSTRUCTIONS

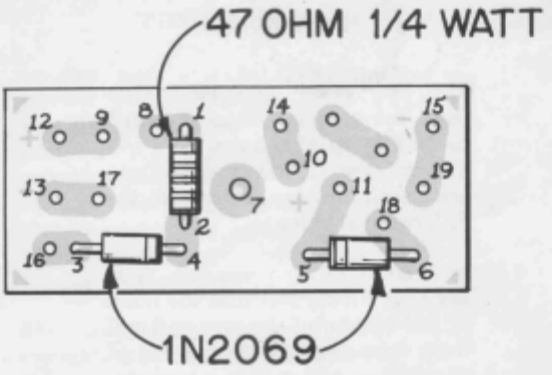
STEP NO.	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.
Step 1	( )	Solder 1/4 watt 47 ohm resistor (yellow, violet, black) into holes	1, 2
Step 2	( )	Solder 1N2069 diode in holes	3, 4 banded + end in hole 4
Step 3	( )	Solder 1N2069 diode in holes	5, 6 banded + end in hole 5
Step 4	( )	Run a No. 2 screw, 1/4" long, through the hole No. 7 on the P.C. board. Run this screw through until you have effectively tapped a hole in the board with the threads of the screw. Now, remove the screw and slip the eyelet over the screw, then screw the eyelet back down to the board. See the assembly sketch on this. This lines the eyelet up with the board. Now, solder the eyelet to the copper side of the board. Now, remove the screw.	
Step 5	( )	Prepare the light bulb for assembly to the P.C. board. We are providing an illustration showing that the wires coming from the light bulb should be twisted and cut 2-1/4" long. The wires are then stripped 1/4" back and tinned.	
Step 6	( )	Solder the bulb with the 2 green wires to the printed circuit board. These wires go to holes	8, 9
Step 7	( )	Prepare the cord with the end terminating to the plug that goes to the transmitter as per the sketch.	
Step 8	( )	Prepare the other cord that goes to the receiver. We recommend that you solder the wires to the plugs and then twist the wires as shown in the sketch. You can use a hand drill with a hook on the end for twisting these wires together. Note the strain relief details in the sketch on the wires that go to the transmitter and the plug assembly. These cables should be about 30" long.	

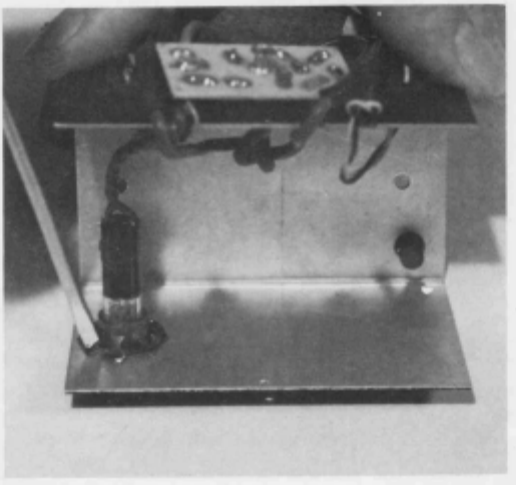
***Suggestions**

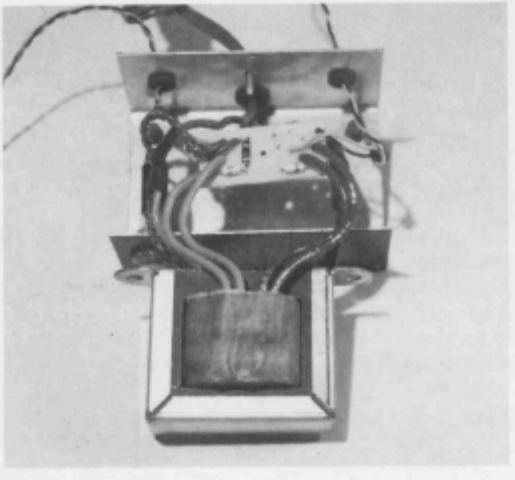
Before running the wires to the plugs thru the case we recommend installing grommets in the case (step 15) and the lens (step 16).

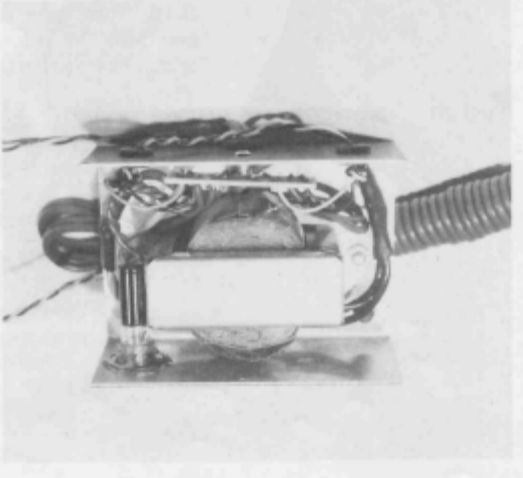
STEP NO.	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.
Step 9	( )	In this step you will wire the receiver plug to the board. First, you must run the wire through the heat shrink tubing, then the small grommet and then run the wires through the proper hole in the charger case. Then solder the red wire to hole the black wire to hole	12 13
Step 10	( )	The transmitter plug and wire assembly is soldered to the board in this step. First, slip the wires through the small grommet and through the proper hole in the case. The orange wire solders to the board at hole the black wire at hole	11 15
Step 11	( )	Prepare the transformer wires as per the sketch. It's very important that the wire color coding be observed and the connections made to the P.C. Board as per the sketch. It is necessary to slip the large grommet over the line cord and then thread the line cord through the proper hole in the charger case. After this the line cord is prepared with the strain relief knot as shown in the sketch. After threading the line cord through the case it is necessary to slip the heat shrink tubing over the primary leads so that after the solder connection to the line cord has been made the heat shrink tubing can be put in place and pulled down over the connection by applying heat. The secondary wires are shown somewhat out of position. These are cut to 2-1/2" long and stripped back 1/2" preparatory to connecting them to the printed circuit board.	
Step 12	( )	The secondary wires are then connected to the printed circuit board. Check the sketch in this manual showing these wires coming around the feet of the transformer. This applies to both the primary and the secondary wires coming from the transformer.	

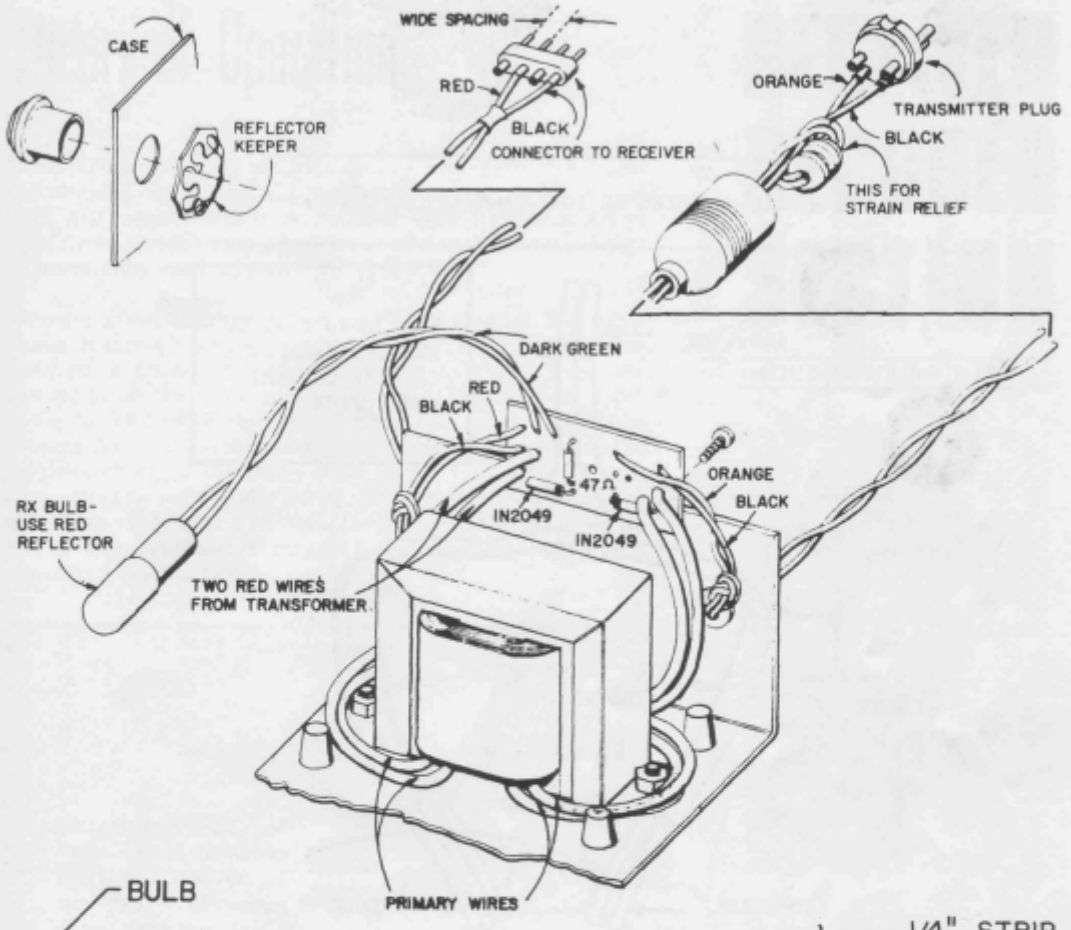
STEP NO.	CHECK AS COMPLETED	DIRECTIONS	
Step 13	( )	The two green secondary wires from the transformer are soldered to the P.C. board at holes	18, 19
		The two red secondary wires from the transformer are soldered to the P.C. board at holes	16, 17
Step 14	( )	Preparation of the lower case. Press the four rubber feet into the holes in the bottom of the case and pull these through gently with a pair of pliers. They will snap into position.	
Step 15	( )	The 3 grommets can now be fitted into the case. These already have the wires on the line cord ended charging plug wires going through the holes in the case.	
Step 16	( )	The lense is assembled into the one hole on the front of the case. A sketch illustrates how this lense is retained by a spring keeper.	
Step 17	( )	Mount the transformer to the case. The transformer is held to the case with two 4-40 screws and nuts.	
Step 18	( )	At this point the bulb is pressed into the lense in the case.	
Step 19	( )	Mount the printed circuit board to the case. The brass standoff comes up against the case, a No. 2 screw, 5/16" long goes through the case, and into the printed circuit board which has been pre-tapped.	
Step 20	( )	Case assembly. At this time, tuck the wires in properly and carefully put the case top on the assembly. The case top is secured to the case bottom with No2 sheet metal screws, 1/4" long.	

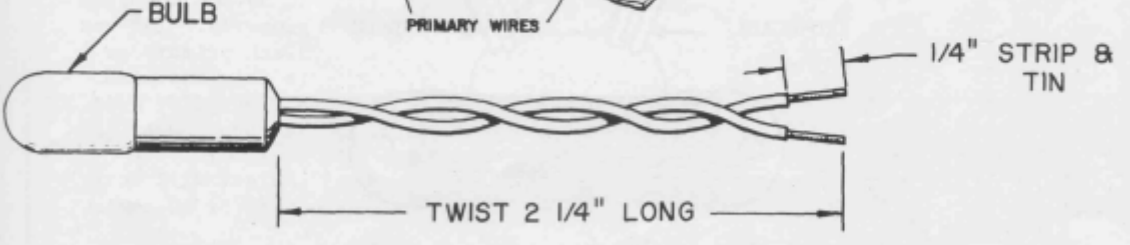

47 OHM 1/4 WATT
12
9
8
1
14
15
10
19
13
17
7
11
18
2
16
3
4
5
6
1N2069

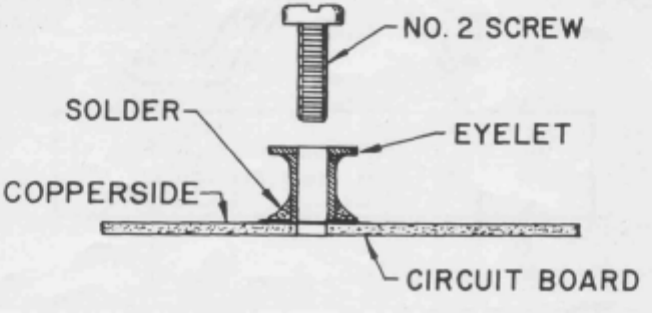


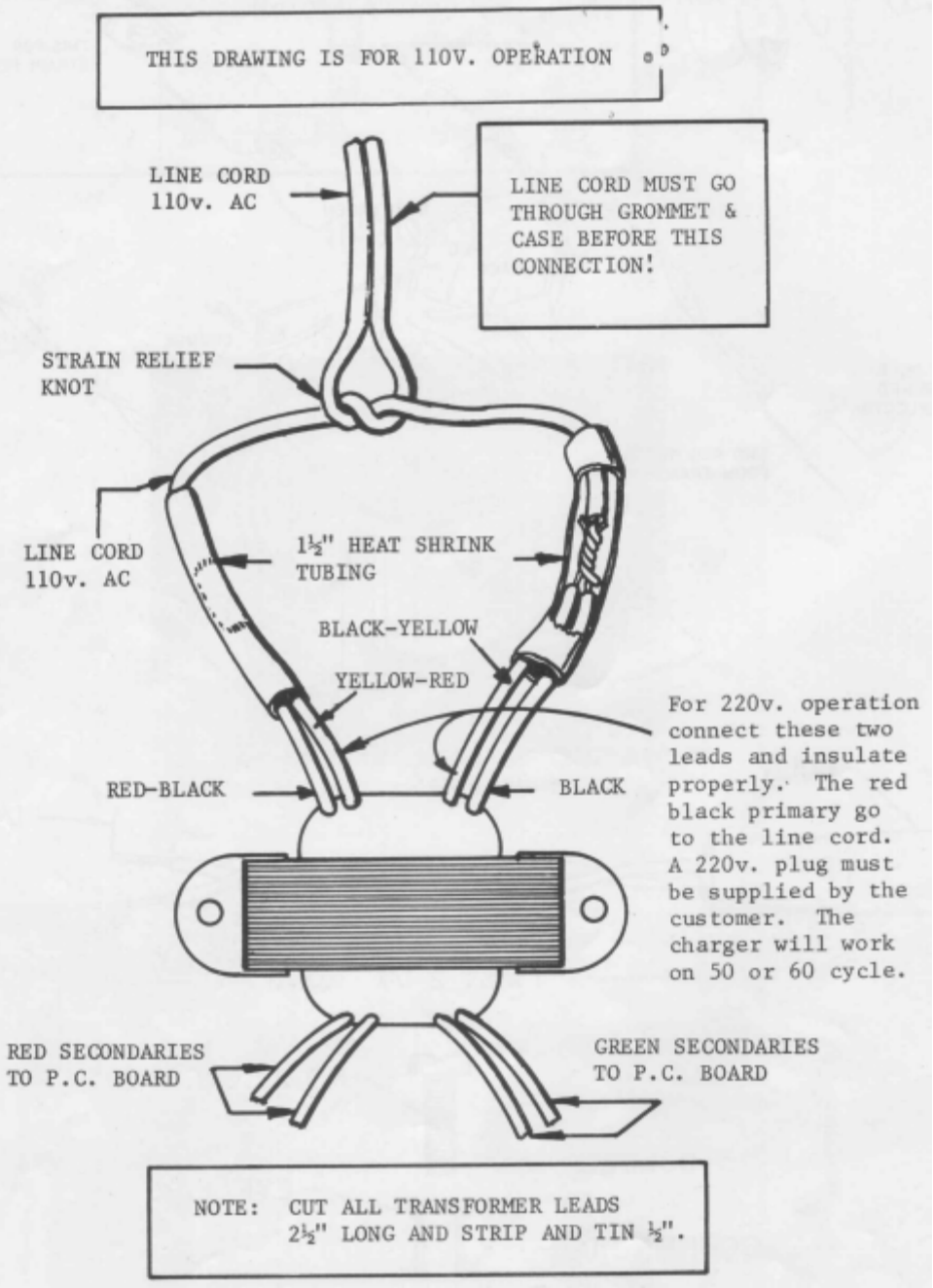





CASE
REFLECTOR KEEPER
WIDE SPACING
RED
BLACK
CONNECTOR TO RECEIVER
ORANGE
TRANSMITTER PLUG
BLACK
THIS FOR STRAIN RELIEF
DARK GREEN
RED
BLACK
47Ω
IN2049
IN2049
ORANGE
BLACK
RX BULB- USE RED REFLECTOR
TWO RED WIRES FROM TRANSFORMER
PRIMARY WIRES


BULB
1/4" STRIP & TIN
TWIST 2 1/4" LONG


NO. 2 SCREW
SOLDER
EYELET
COPPERSIDE
CIRCUIT BOARD


THIS DRAWING IS FOR 110V. OPERATION
LINE CORD
110v. AC
LINE CORD MUST GO THROUGH GROMMET & CASE BEFORE THIS CONNECTION!
STRAIN RELIEF
KNOT
LINE CORD
110v. AC
1½" HEAT SHRINK
TUBING
BLACK-YELLOW
YELLOW-RED
For 220v. operation connect these two leads and insulate properly. The red black primary go to the line cord. A 220v. plug must be supplied by the customer. The charger will work on 50 or 60 cycle.
RED-BLACK
BLACK
RED SECONDARIES
TO P.C. BOARD
GREEN SECONDARIES
TO P.C. BOARD
NOTE: CUT ALL TRANSFORMER LEADS
2½" LONG AND STRIP AND TIN ½".

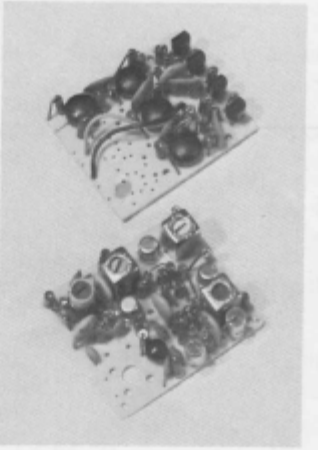
Theory of Operation

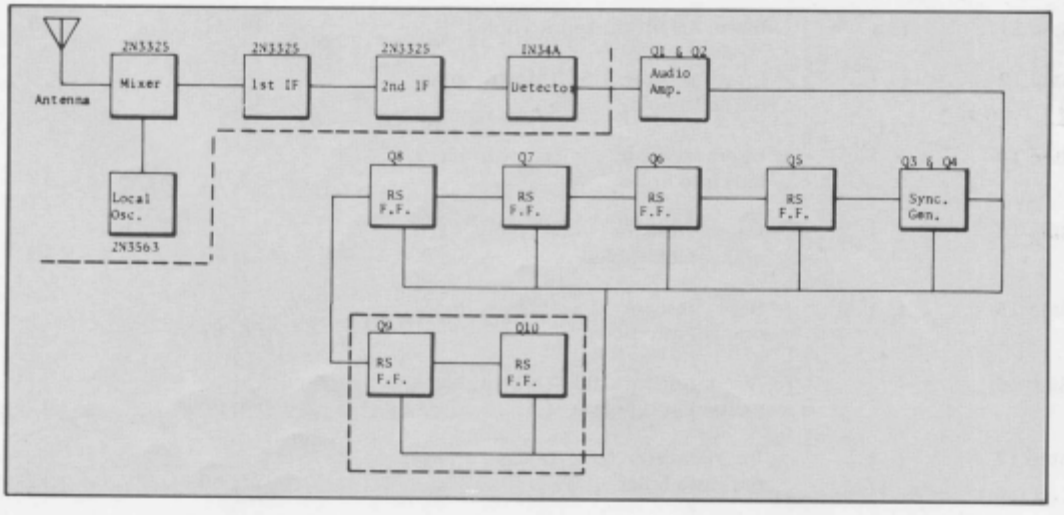
RECEIVER DECODER SECTION

INCLUDES • WIRING HARNESS

In our new receiver, we are practicing something that you might call clipping or limiting and it is a unique way to get around THE AGC requirement in the receiver. Over 100 test receivers were flown under a wide variety of conditions before the design of the receiver was finalized.

Here are a few words on the receiver block diagram. The signal comes in through the antenna to the mixer. The local oscillator develops a frequency 455 KHz lower than the frequency coming in on the antenna. The frequency coming out of the mixer to the first IF state is 455 KHz. This signal is amplified through the first and second IF stages and it is demodulated in the detector. All of the above steps are on the receiver board. Now, going to the decoder board, the audio amplifier amplifies and squares the signal. The audio then is fed to the RS flip-flops and the sync generator. The signal to the servo amplifier comes out of each RS flip-flop.





INSTRUCTIONS FOR ASSEMBLY OF WORLD ENGINES BLUE MAX SYSTEM RECEIVER KIT

STEP NO.	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 1	( )	Insert 18pf ceramic disc capacitor into holes	3, 4	.15
Step 2	( )	Insert 10pf ceramic disc capacitor into holes	38, 39	.15
Step 3	( )	Insert .05mf ceramic disc capacitor into holes	11, 12	.35
Step 4	( )	Insert 4pf ceramic disc capacitor into holes	45, 44	.15
Step 5	( )	Insert 18pf ceramic disc capacitor into holes	91, 92	.15
Step 6	( )	Insert 10pf ceramic disc capacitor into holes	93, 94	.15
Step 7	( )	Insert .001mf ceramic disc capacitor into holes	79, 80	.20
Step 8	( )	Insert .01mf ceramic disc capacitor into holes	9, 10	.15
Step 9	( )	Insert .05mf disc capacitor into holes Now solder components 1 thru 8 and clip leads.	36, 37	.35
Step 10	( )	Insert resistor 47k (yellow, violet, orange) into holes	1, 2	.12
Step 11	( )	Insert 3.9 uh choke into holes	40, 41	.65
Step 12	( )	Insert resistor 1.5k (brown, green, red) into holes	42, 43	.12
Step 13	( )	Insert resistor 1k (brown, black, red) into holes	13, 14	.12
Step 14	( )	Insert resistor 82k (grey, red, orange) into holes	51, 53	.12
Step 15	( )	Insert resistor 10k (brown, black, orange) into holes	86, 87	.12
Step 16	( )	Insert resistor 100k (brown, black, yellow) into holes	84, 85	.12
Step 17	( )	Insert resistor 3.3k (orange, orange, red) into holes	95, 96	.12

STEP NO.	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 18	( )	Insert resistor 4.7k (yellow, violet, red) into hole	99 (step 53)	.12
Step 19	( )	Insert resistor 4.7k (yellow, violet, red) into holes	100, 101	.12
Step 20	( )	Insert resistor 4.7k (yellow, violet, red) into hole	104 (step 52)	.12
Step 21	( )	Insert resistor 470 ohm (yellow, violet, brown) into holes	107, 108	.12
Step 22	( )	Insert 1N34A diode into holes	102, 103	.65
		The cathode or end with band around it goes into hole number 103.		
Step 23	( )	Insert resistor 1k (brown, black, red) into holes	61, 62	.12
Step 24	( )	Insert resistor 4.7k (yellow, violet, red) into holes	54, 55	.12
Step 25	( )	Insert resistor 100 ohm (brown, black, brown) into holes	57, 58	.12
Step 26	( )	Insert resistor 3.3k (orange, orange, red) into holes	59, 60	.12
Step 27	( )	Insert resistor 270 ohm (red, violet, brown) into holes	26, 27	.12
Step 28	( )	Insert resistor 15k (brown, green, orange) into holes	67, 68	.12
Step 29	( )	Insert resistor 1k (brown, black, red) into holes	119, 120	.12
Step 30	( )	Insert 1.0 mf tantalum capacitor into holes	105, 106	.70
		(The positive lead or the lead from the red end must go to hole number)	106	
Step 31	( )	Clip the leads on parts installed in steps 10 through 30 and solder in place		
Step 32	( )	Insert .05mf ceramic disc capacitor into holes	89, 90	.35

STEP NO.	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 33	( )	Insert .05mf ceramic disc capacitor into holes	109, 110	.35
Step 34	( )	Insert .1mf tantalum capacitor into holes	52, 35 (+ in 35)	.35
Step 35	( )	Insert 2.2mf tantalum capacitor into holes	63, 64 (+ in 64)	.45
Step 36	( )	Insert 47mf tantalum capacitor into holes	97, 98	.70
		Positive lead or lead from red end of capacitor must go to hole number	98	
Step 37	( )	Insert 47mf tantalum capacitor into holes	112, 111	.70
		Positive lead or lead from red end of capacitor must go to hole number	111	
Step 38	( )	Clip leads and solder parts installed in steps 32 through 37		

Refer to transistor lead identification diagrams when installing parts in steps 39 through 42, which follow:

Step 39	( )	Insert and solder transistor 2N3563 into holes	81(e), 82(b), 83(c)	1.50
Step 40	( )	Insert and solder transistor 2N3325 into holes	48(e), 49(b), 50(c)	1.50
Step 41	( )	Insert and solder transistor 2N3325 into holes	23(e), 24(b), 25(c)	1.50
Step 42	( )	Insert and solder transistor 2N3325 into holes	69(e), 70(b), 71(c)	1.50
Step 43	( )	Insert and solder L3 mixer IF can (yellow slug) into holes. Clip Lug — See Rx sketch page.	15, 16, 17, 18 19, 20	1.50
Step 44	( )	Insert and solder L4 first IF can (white slug) into holes — Clip lug	28, 29, 30, 31 32, 33	1.50

STEP NO.	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 45	( )	Insert and solder L5 second IF can (black slug) into holes — Clip lug	113, 114, 115, 116, 117, 118	1.50
Step 46	( )	Insert and solder L2 the tapped mixer coil into holes Using the detailed diagram rotation of this coil	5, 6, 7	.60
		At this point your Blue Max receiver kit is completed to the semi-kit stage. After you have finished these steps 1 through 46 or	if you purchased a semi-kit from World Engines proceed with the wiring instructions as follows:	
Step 47	( )	Solder 30" antenna wire to land containing hole 74 and thread out through strain relief hole 74.		
Step 48	( )	Solder 4" long black wire to hole 122. Run the wire in from the same	side of the board as the other components.	
Step 49	( )	Solder 4" long red wire to board through hole 123.		
Step 50	( )	Solder 4" long yellow wire to board through hole 124.		
Step 51	( )	Now, pull the wire Step 48, 49, 50 through hole 121; these wires will	be soldered to the decoder board. See Decoder instructions.	
Step 52	( )	Solder 6" orange tune-up lead to top of 4.7k resistor that is soldered at hole 104 (Step 20)		
Step 53	( )	Solder 6" black tune-up lead to 4.7k resistor that solders at hole 99. (Step 18)		
Step 54	( )	(Reference) red, black, and yellow wire Step 51. Measure the wire 2" from the bottom of the Receiver board and cut. Strip and tin the wires. Thread these wires through hole 33 on the decoder board. See Sketch. The black wire should be soldered to the land containing hole 2. The red wire to the land containing hole 38. The yellow wire to the land containing hole 5. Note — this step is repeated in the decoder instructions.		
Step 55	( )	Install and solder crystal into holes 46 & 47. ($4.95).		

RECEIVER CHECK-OUT AND TUNING

The preliminary check for general operation can be easily done by a few voltage measurements. Refer to the schematic for the voltage measurements you should obtain at the various points. Voltage readings that you get in checking your board may vary 20% from those listed on the schematic page. This is due to part tolerances and variations in measuring equipment (no cause for immediate alarm). These measurements should be taken with a VTVM (Vacuum Tube Voltmeter) or good quality Volt-Ohmmeter to keep from loading down the circuit and presenting erroneous readings. Notice that the voltage readings are taken with respect to the decoupled positive voltage. For these readings connect the meter ground lead to the black tuning lead and use your minus D.C. voltage scales.

If you have a Super-Regen Monitor you can check general operation of the oscillator by holding the monitor near your receiver antenna. If the oscillator is operating it will quiet the characteristic Super-Regen hiss of the monitor. This makes a good quick check after a "wipe-out" to see if the crash got to the crystal.

For this tuning sequence it will be necessary to use your completed and operating transmitter as a signal source. With the Receiver-Decoder case opened up and the battery attached but off, attach the test leads of a VTVM or good quality VOM to the orange and black tuning leads. The ground or negative lead of the VTVM should be attached to the black tuning lead. Set the meter on a low voltage scale (typically + 1.5 volts D.C.), and turn the receiver on. Without a signal from your transmitter, the needle of the meter will tend to move below zero in the negative direction. This is normal and is not enough to harm your meter movement but serves to indicate that the battery voltage is reaching the receiver board correctly. With the receiver antenna hanging down over the edge of your work bench, (we hope you do not have a steel work bench) and the main antenna of your transmitter collapsed, turn on the transmitter and note the meter reading. Under normal conditions, the meter indication should have jumped to 5 or 6 tenths of a volt which indicates general operation of the receiver. If your receiver is far out of tune, it may be necessary to bring the transmitter antenna within a foot of the receiver antenna to get a meter indication.

(Transmitter antenna collapsed). Place the transmitter on its side so that the antenna end of the transmitter is pointed away from the receiver. The transmitter should be about 4' — 5' from the receiver. Turn on the transmitter.

After you have peaked *(peaked = tuned for maximum meter reading)* the mixer coil and increased the meter reading, again move the transmitter away from the receiver a distance to get a .2 volt reading. Next, peak the yellow IF can, the white IF can, and then the black IF can. Your tuning is now getting close to a peak or optimum value. At this point in the procedure, remove the antenna from the transmitter. Now, point the hole in the transmitter from which the antenna was removed at the receiver antenna to the halfway point on the receiver antenna. At this point the receiver antenna is draped down over the work bench. The point we are referring to is about 15" from where the antenna is connected to the receiver. It will be necessary to hold the transmitter quite close to the antenna. Now, peak the antenna coils and your IF cans progressively move your transmitter back. The fartherest you will be able to get is from 8" - 10". Beyond this point your receiver will not pick up the transmitter and you will get a negative reading on the meter. We would like to make the point here that this should not be taken as an indication of range or sensitivity. All you have done at this point is that you have peak tuned the receiver.

RANGE CHECK

With your equipment installed in your aircraft and the antenna fed out through the fuselage and connected to the top of the rudder, you should get about 9' away from the airplane holding the transmitter up vertical with the antenna collapsed. Range varies a little bit from set to set. The ground range will vary with the antenna installation in your model.

RECEIVER SCHEMATIC

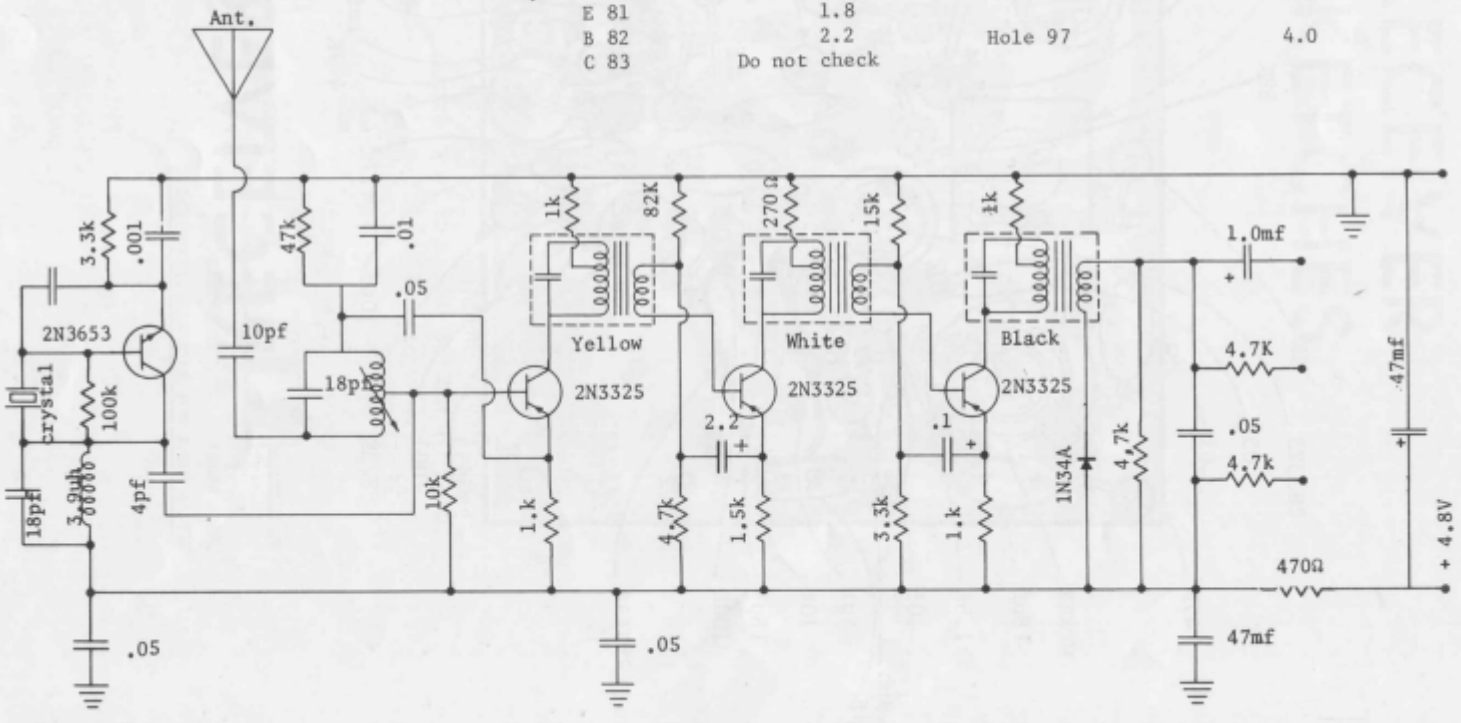
CHART FOR VOLTAGE CHECK

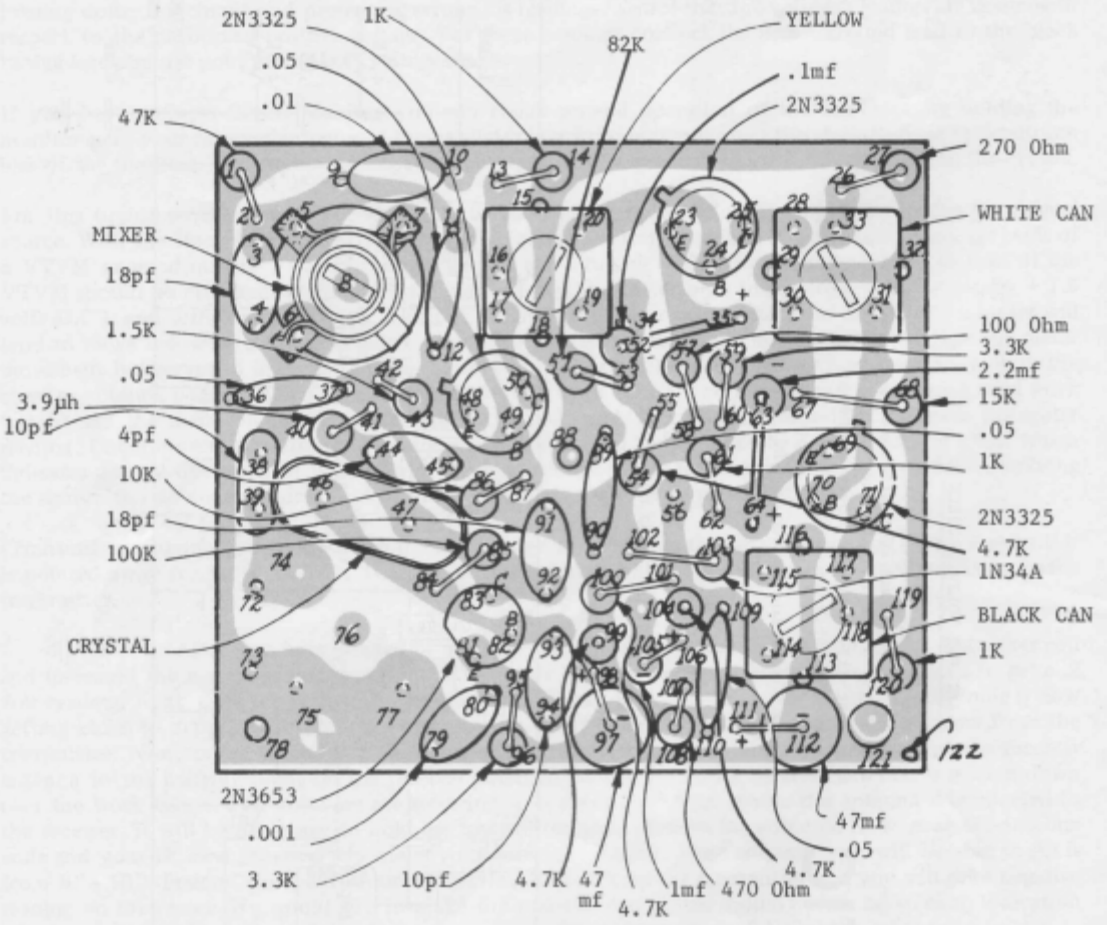
All voltage reading taken with the VTVM ground lead attached to the black tuning lead. A Heathkit (Model IM-13) was used. Switch settings were:

1.	Function Switch	DC
2.	Range Switch	5V

Q1		
	E 81	1.8
	B 82	2.2
	C 83	Do not check

Q2		
	E 48	.5
	B 49	.6
	C 50	3.7
Q3		
	E 23	0
	B 24	.2
	C 25	4.0
Q4		
	E 69	.4
	B 70	.6
	C 71	3.5
Hole 97		4.0

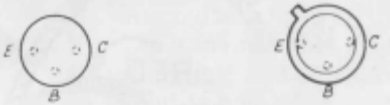



2N3325
1K
.05
.01
47K
MIXER
18pf
1.5K
.05
3.9µh
10pf
4pf
10K
18pf
100K
CRYSTAL
2N3653
.001
3.3K
10pf
4.7K
47 mf
4.7K
1mf
470 Ohm
4.7K
47mf
.05
82K
YELLOW
.1mf
2N3325
270 Ohm
WHITE CAN
100 Ohm
3.3K
2.2mf
15K
.05
1K
2N3325
4.7K
1N34A
BLACK CAN
1K
122

RECEIVER

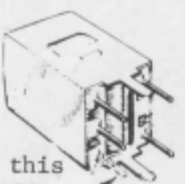
RECEIVER SKETCHES

TRANSISTORS



2N 3563 2N 3325

Top Views - Leads Extending Down



IF Can

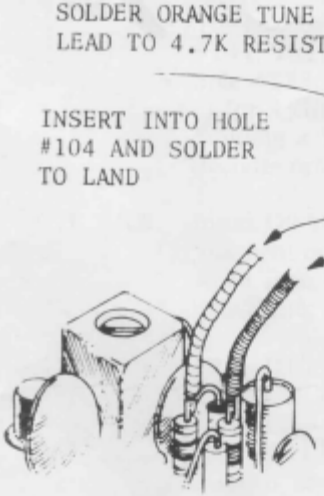
Top View
(Leads extending down)

SOLDER ORANGE TUNE UP LEAD TO 4.7K RESISTOR

INSERT INTO HOLE #104 AND SOLDER TO LAND

SOLDER BLACK TUNE-UP LEAD TO 4.7K RESISTOR

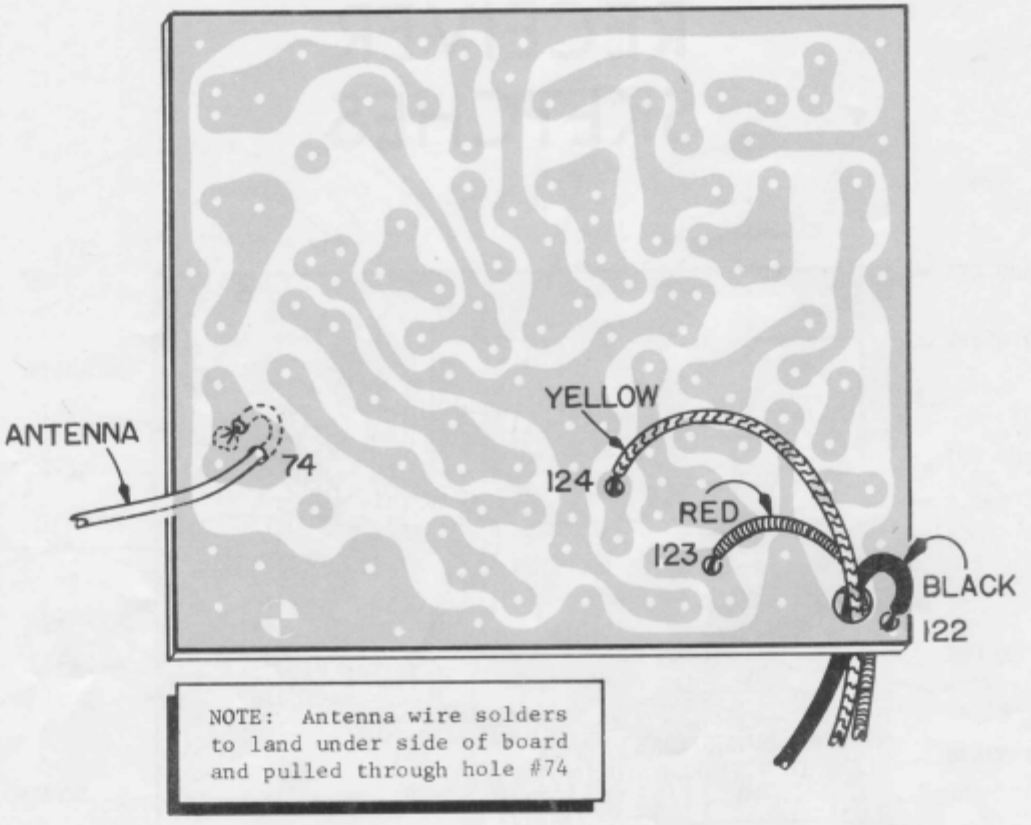
INSERT INTO HOLE #99 AND SOLDER TO LAND.

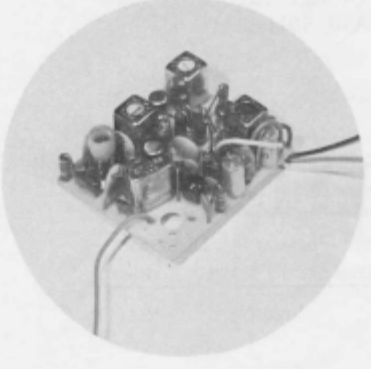


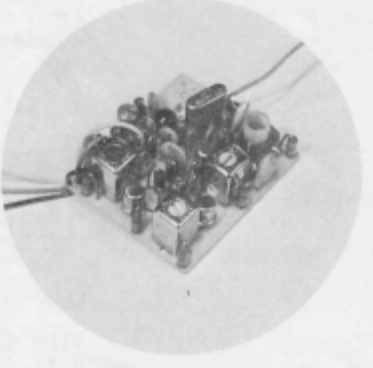
VIEW SHOWING
4.7Ks INSTALLED
ON P. C. BOARD.

IDENTIFICATION SKETCH FOR 3.9μh CHOKE

STEPS 47, 48, 49, 50, 51







PHOTOGRAPHS OF THE COMPLETED RECEIVER

(TUNE-UP WIRES TO RESISTORS NOT SHOWN IN PHOTOGRAPH)

ASSEMBLING BLUE MAX SYSTEM INTEGRATED CIRCUIT DECODERS

STEP NO.	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 1	( )	The ML914 integrated circuits which are the eight lead semi-conductor devices should have the lead opposite the flat side bent out at 90° to the other leads in preparation for insertion into the board.		
Step 2	( )	Insert Q5 ML914 into holes with the bent out lead going to hole #47. The flat side should point to hole #86.	80, 81, 82, 83 84, 85 & 86	$1.50
Step 3	( )	Insert Q6 ML914 should be inserted into holes The lead previously bent out should go to hole #43. The flat side should point to hole #74.	68, 69, 70, 71 72, 73 & 74	1.50
Step 4	( )	Insert Q7 ML914 into holes The bent out lead going to hole #40. The flat side should point to hole #62.	56, 57, 58, 59 60, 61 & 62	1.50
Step 5	( )	Insert Q8 ML914 into holes The lead bent out inserted into hole #144. The flat side should point to hole #138. At this point the IC are in for 4 channel version. If you are building a kit to a 5 or 6 channel decoder proceed with Q9 & Q10.	135, 136, 137 138, 139, 140 & 141	1.50
Step 6	( ) 5 Ch.	Insert Q9 ML914 into holes The bent out lead should go to hole #146. The flat side should point to hole #125.	122, 123, 124 125, 126, 127 & 128	1.50
Step 7	( ) 6 Ch.	Insert Q10 ML914 into holes The bent out lead going to hole #149. The flat side should point to hole #113. Refer to pictorial diagram for correct location of all the IC, Q5 through Q10.	110, 111, 112 113, 114, 115 & 116	1.50
Step 8	( )	Solder parts Q5 through Q10 in place, being sure they are flat against the printed circuit board.		

STEP NO.	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 9	( )	Insert C3 .01 microfarad ceramic disc capacitor in holes	26 & 27	.35
Step 10	( )	Insert C6 .02 microfarad ceramic disc capacitor in holes	22 & 49	.35
Step 11	( )	Insert C7 .02 ceramic disc capacitor in holes	76 & 77	.35
Step 12	( )	Insert C8 .02 ceramic disc capacitor in holes	64 & 65	.35
Step 13	( )	Insert C9 .02 ceramic disc capacitor in holes	96 & 97	.35
The next two steps apply only to 5 and 6 channel versions.				
Step 14	( )	Insert C10 .02 microfarad ceramic disc capacitor in holes	131 & 132	.35
Step 15	( )	Insert C11 .02 microfarad ceramic disc capacitor in holes	118 & 119	.35
Step 16	( )	Solder parts installed in Steps 9 through 15 above.		
Step 17	( )	Insert diode D1 (1N4148) into holes	5 & 6	.35
Step 18	( )	Insert resistor R5 47K (yellow, violet, orange) in holes	10 & 11	.12
Step 19	( )	Insert C4 1 microfarad tantalum capacitor in holes Lead from red end of case of tantalum or positive end must connect to hole 16.	15 & 16	.70
Step 20	( )	Insert resistor R1 220K (red, red, yellow) in holes	32 & 37	.12
Step 21	( )	Insert resistor R3 47K (yellow, violet, orange) in holes	31 & 38	.12
Step 22	( )	Insert resistor R4 3300 ohm (orange, orange, red) in holes	30 & 39	.12
Step 23	( )	Insert resistor R6 22K (red, red, orange) in holes	23 & 25	.12

STEP NO.	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 24	( )	Insert resistor R7 3300 ohm (orange, orange, red) in holes	21 & 24	.12
Step 25	( )	Insert resistor R8 100 ohm (brown, black, brown) in holes	36 & 150	.12
Step 26	( )	Insert resistor R15 47K (yellow, violet, orange) in holes	41 & 63	.12
Step 27	( )	Insert resistor R12 47K (yellow, violet, orange) in holes	45 & 75	.12
Step 28	( )	Insert resistor R20 10K (brown, black, orange) in holes	46 & 51	.12
Step 29	( )	Insert resistor R9 47K (yellow, violet, orange) in holes	48 & 50	.12
Step 30	( )	Insert resistor R17 3300 ohm (orange, orange, red) in holes	54 & 55	.12
Step 31	( )	Insert resistor R14 3300 ohm (orange, orange, red) in holes	66 & 67	.12
Step 32	( )	Insert resistor R11 3300 ohm (orange, orange, red) in holes	78 & 79	.12
Step 33	( )	Insert resistor R16 3300 ohm (orange, orange, red) in holes	94 & 95	.12
Step 34	( )	Insert resistor R13 3300 ohm (orange, orange, red) in holes	91 & 92	.12
Step 35	( )	Insert resistor R10 3300 ohm (orange, orange, red) in holes	87 & 89	.12
Step 36	( )	Insert resistor R19 3300 ohm (orange, orange, red) in holes	98 & 100	.12
Step 37	( )	Insert resistor R18 47K (yellow, violet, orange) in holes	142 & 143	.12
Step 38	( )	Insert resistor R21 3300 ohm (orange, orange, red) in holes	134 & 133	.12

This completes all the resistors for a 4 channel Decoder. If building a 5 or 6 channel Decoder, proceed with the following steps:

STEP NO.	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 39	( )	Insert resistor R22 47K (yellow, violet, orange) in holes	130 & 145	.12
Step 40	( )	Insert resistor R23 3300 ohm (orange, orange, red) in holes	102 & 103	.12
Step 41	( )	Insert resistor R24 3300 ohm (orange, orange, red) in holes	120 & 121	.12
The next three steps cover the resistors for building a 6 channel Decoder.				
Step 42	( )	Insert resistor R25 47K (yellow, violet, orange) in holes	117, 148	.12
Step 43	( )	Insert resistor R26 3300 ohm (orange, orange, red) in holes	105 & 107	.12
Step 44	( )	Insert resistor R27 3300 ohm (orange, orange, red) in holes	108, 109	.12
Step 45	( )	Solder all parts installed in Steps 17 through 45 above. Resistor bodies should be pushed down flat against the board while soldering, so that they maintain a minimum height above the board.		
Step 46	( )	Insert transistor Q1 MPS2924 in holes	E B C 2, 3, 4	1.50
Step 47	( )	Insert transistor Q2 MPS2924 in holes	7, 8, 9	1.50
Step 48	( )	Insert transistor Q3 MPS2924 in holes	12, 13, 14	1.50
Step 49	( )	Insert transistor Q4 MPS2924 in holes	17, 18, 19	1.50
Step 50	( )	Transistors installed in Steps 46 through 49 should be pushed down to the board so that they are level with the top of the resistors.		
Step 51	( )	Solder transistor Q1 through Q4 in place.		
Step 52	( )	Install and solder C5 .005 ceramic disc capacitor in holes	29 & 53	.35
Step 53	( )	Install and solder C2 .02 ceramic disc capacitor in holes	28 & 42	.35
Step 54	( )	Install 1-1/2" black jumper wire from hole 44 to hole 147.		

STEP NO.	CHECK AS COMPLETED	DIRECTIONS
Step 55	( )	Install 1-1/4" green jumper wire from hole 52 to hole 129. At this point the printed circuit board is completely wired to the semi-kit stage. If you have purchased a semi-kit for your World Engines IC Decoder you should begin with the next step which is the wiring of the board and plugs.
Step 56	( )	Included in the kit are 3 pieces of wire which are of a heavier gauge than are used for wiring to the servo plugs. There are pieces of red, white, and black #24 wire. These should be used for the power plug of the receiver. Cut the #24 red, white, and black wire to approximately 6" long and strip and tin 1/8" on one end.
Step 57	( )	If you are building a 6 channel version of this kit, each of the next three steps should have two pieces of 7" wire added to the step making it five pieces of red 7" long, five pieces of black 7" long, and five pieces of white 7" long.
Step 58	( )	Into hole 35 insert 3 pieces of 7", 1 piece of 9", and a 6" length of #24 red wire and then solder in hole 35.
Step 59	( )	Into hole 20 insert 3 pieces of 7", one piece of 9", and a 6" length of #24 black wire and then solder in hole 20.
Step 60	( )	Into hole 88 insert 3 pieces of 7", one piece of 9", and a 6" length of #24 white wire and then solder in hole 88.
Step 61	( )	Prepare a piece of yellow wire 9" long by cutting to length, stripping and tinning at approximately 1/8" and inserting through hole 90 and soldering to the land containing holes 81 and 89.

Prepare the balance of the red, white, and black wire which is #26 gauge for assembly to board by cutting 3 pieces of each 7" long, strip and tin on one end and one piece of each 9" long, stripping and tinning these on one end also.

STEP NO.	CHECK AS COMPLETED	DIRECTIONS
Step 62	( )	Prepare the green, blue, and violet wires by cutting 7" in length, stripping and tinning on one end approximately 1/8".
Step 63	( )	Insert the green wire through hole 93 and solder on bottom of board to land containing hole 69 and 92.
Step 64	( )	Insert the blue wire through hole 99 and solder to bottom of board containing holes 57 and 95.
Step 65	( )	Insert violet wire through hole 101 and solder on bottom of board to lands containing holes 100 and 136. At this point the wires are attached for a 4 channel version.
Step 66	( )	If you are building this as a 6 channel version you should cut 2 more lengths of wire 7" long, 1 brown and 1 orange stripped and tinned to approximately 1/8" on one end.
Step 67	( )	The brown wire should be inserted through hole 104 and soldered to the land on the bottom of the board connecting hole 103 and 123.
Step 68	( )	The orange wire should be inserted through hole 106 and soldered on the bottom of the board to the holes connecting 107 and 111.
Step 69	( )	At this point you are ready to connect the receiver and decoder board. The 3 wires, the black, yellow, and red wire coming from the receiver board should be pulled and cut 2" in length. These should then be stripped and tinned and threaded through hole 33 of the decoder board.
Step 70	( )	The black wire should then be soldered to the land containing hole 2.
Step 71	( )	The red wire should then be connected to the land which contains hole 38

STEP NO.	CHECK AS COMPLETED	DIRECTIONS
Step 72	( )	The yellow wire should be connected to the land which connects holes 3 and 32. These wires will supply power from the decoder board to receiver and the input from the receiver to the decoder which is the yellow wire.

The above interwiring steps from the decoder to the receiver are also repeated in the receiver instructions.

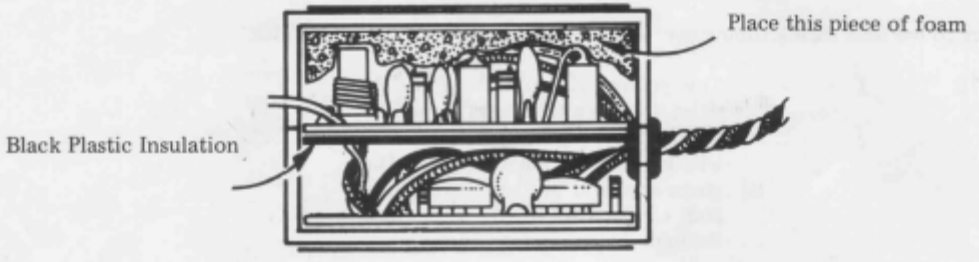
ATTACHMENT OF PLUGS TO WIRING HARNESS

Be sure to use heat shrink tubing over each connection when soldering to plug.

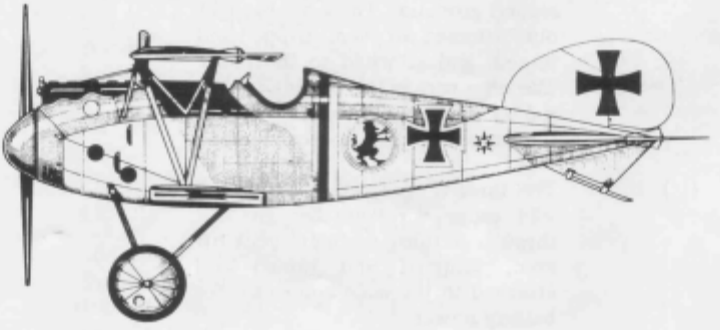
Step 73	( )	The yellow wire and the three 9" wires (red, white, black) should be threaded through a grommet. This will go to your aileron plug. The green wire and one each red, white, and black wire should also come through this grommet.
Step 74	( )	Trim the three 9" leads off even, strip and tin and solder to plug, following plug wiring diagram. The 7" wires should also be trimmed off even, stripped and tinned 1/8" and soldered to plug for the elevator output.
Step 75	( )	The remaining (4 channel only) 7" long red, white, and black wires, the violet wire and the blue wire should be threaded through a second grommet. These are brought out, trimmed off even, stripped and tinned, and attached to the plugs. The blue wire is the output for the rudder channel, the violet wire is the output for the motor channel.
Step 76	( )	The three 6" red, white, and black #24 gauge wires are brought out through a third grommet, cut off even, stripped and tinned and attached to the male connector for battery power. If you are building a 5 or 6 channel version, the remaining wires also come through this grommet.

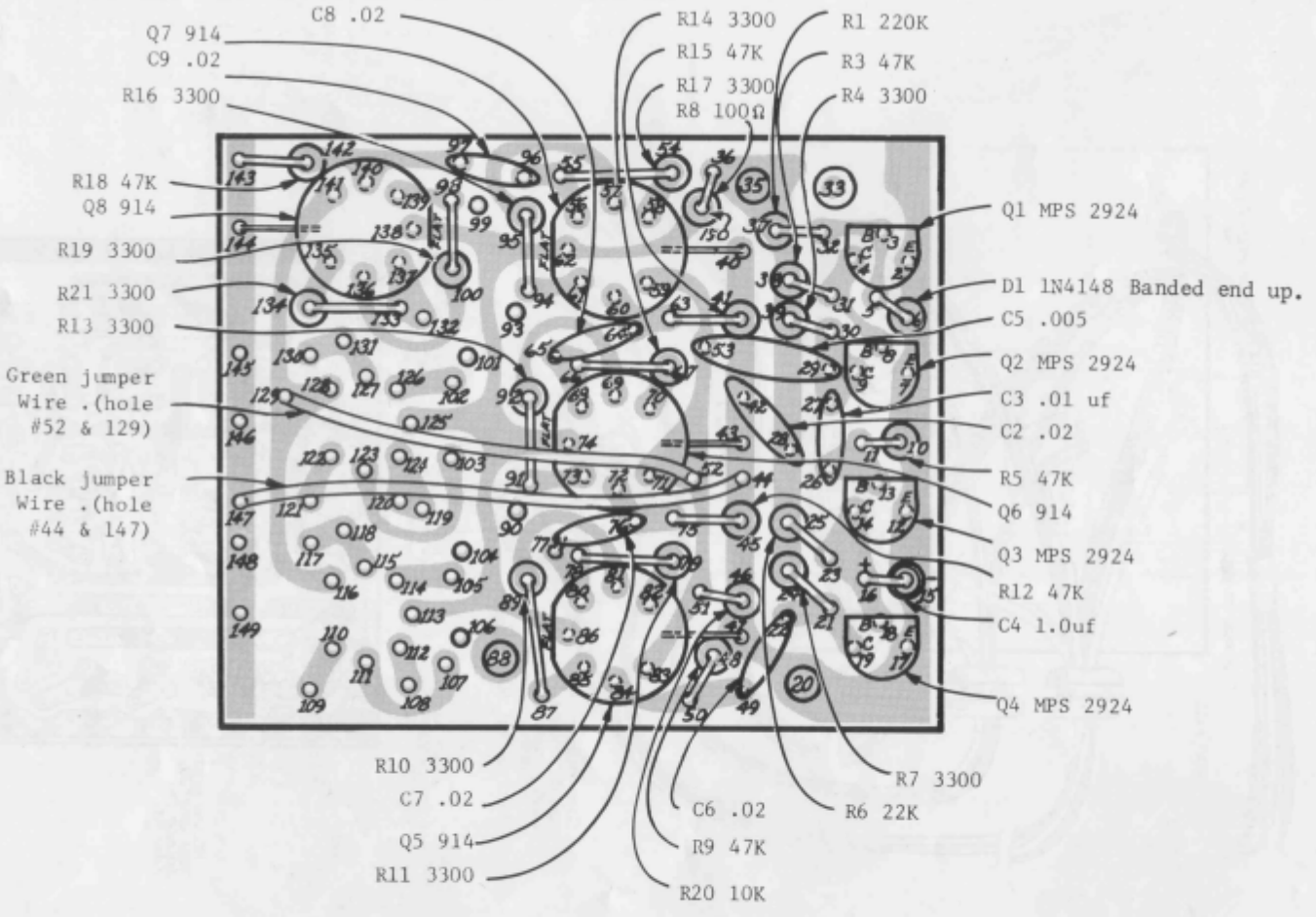
PLACEMENT OF RX & DECODER IN PLASTIC CASE

The decoder goes in bottom of case and receiver sits on top of the decoder. Place foam above the receiver. Between the receiver and the decoder install the plastic insulator. The corner is cut off to provide clearance for the wires connecting the receiver to the decoder. This will prevent the possible shorting of the decoder to the receiver bottom which could be disastrous. A direct short would unload the nickel cadmium batteries and burn up the flight pack.

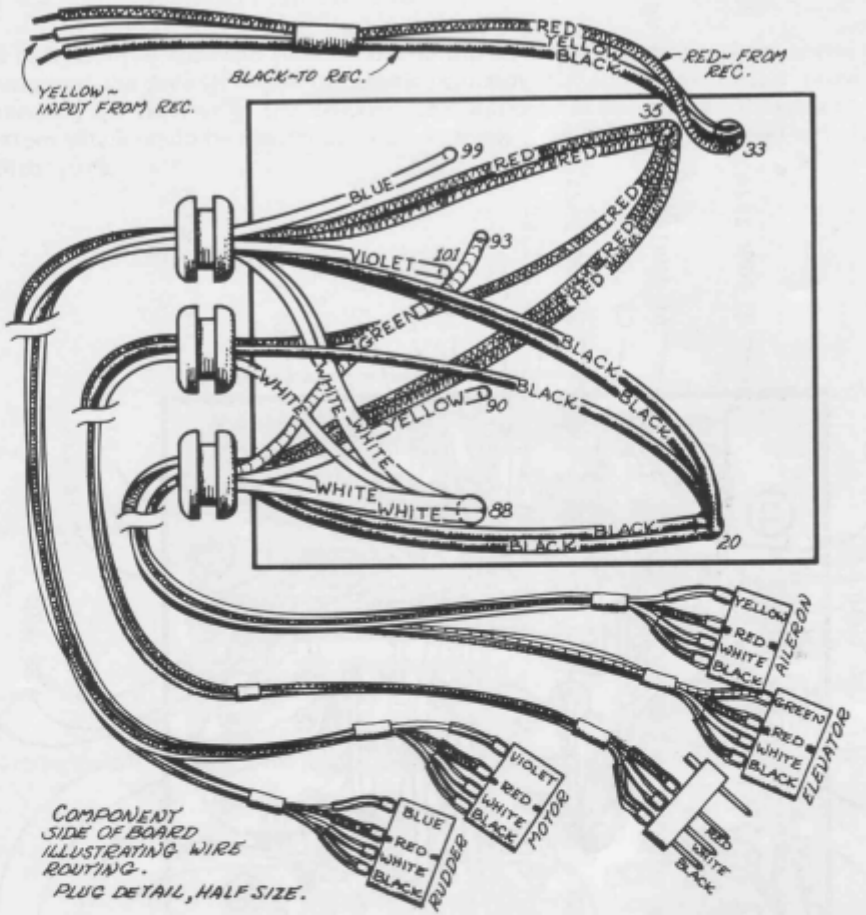


Note: Be sure to mount your receiver in foam before installation in the fuselage, boat, or car.

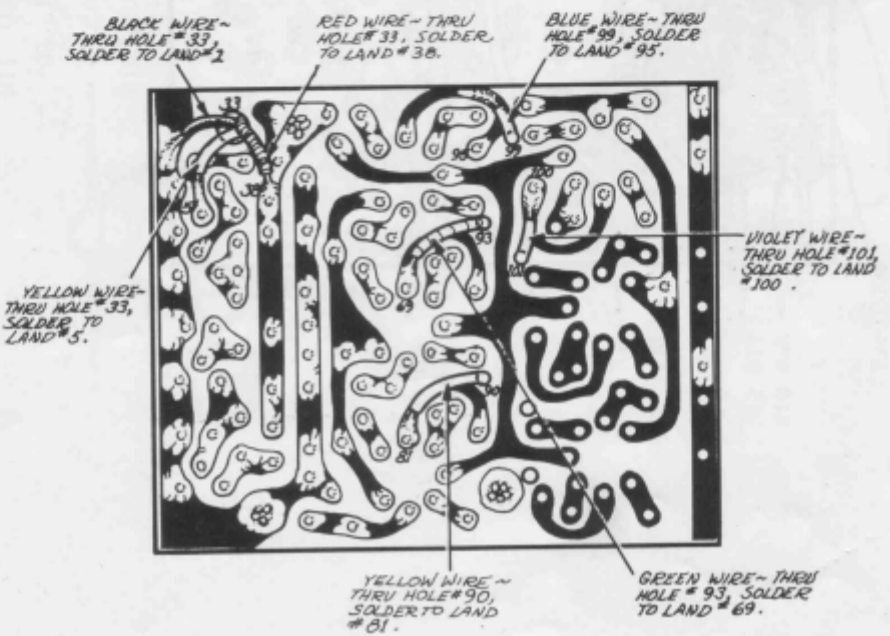


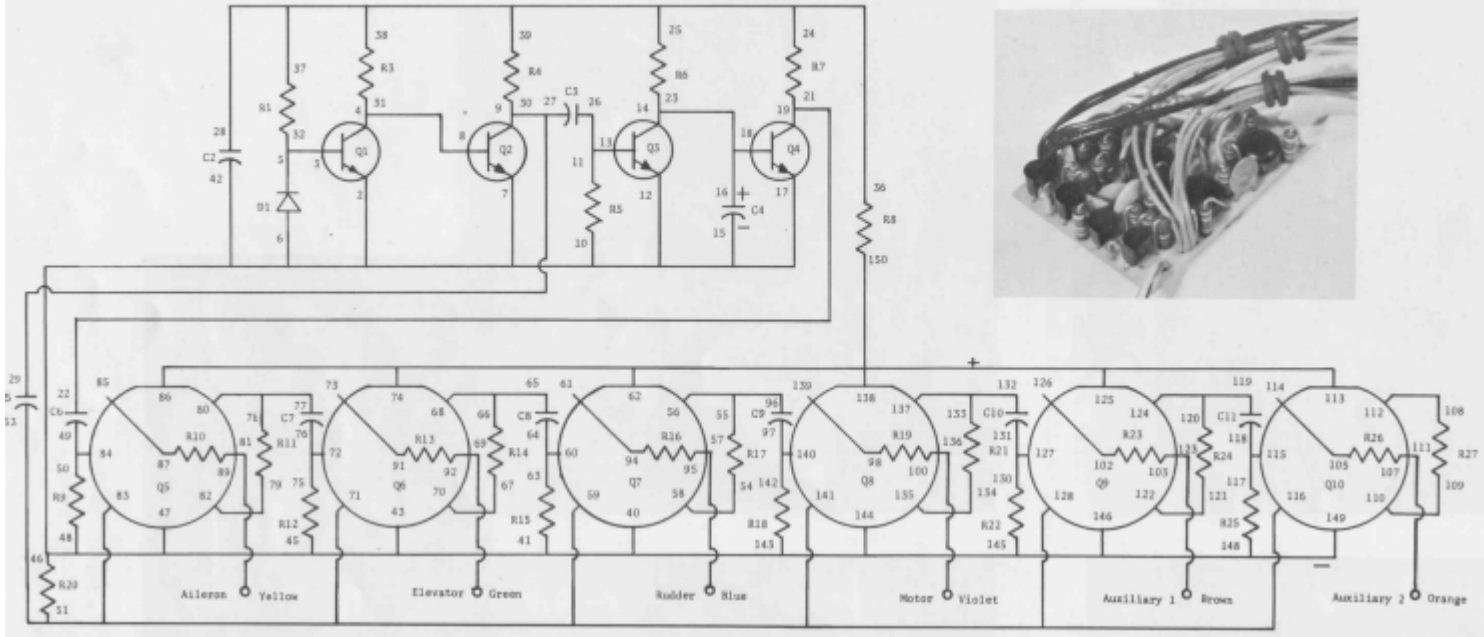

C8 .02
Q7 914
C9 .02
R16 3300
R14 3300
R15 47K
R17 3300
R8 100Ω
R1 220K
R3 47K
R4 3300
R18 47K
Q8 914
R19 3300
R21 3300
R13 3300
Green jumper Wire .(hole #52 & 129)
Black jumper Wire .(hole #44 & 147)
Q1 MPS 2924
D1 1N4148 Banded end up.
C5 .005
Q2 MPS 2924
C3 .01 uf
C2 .02
R5 47K
Q6 914
Q3 MPS 2924
R12 47K
C4 1.0uf
Q4 MPS 2924
R10 3300
C7 .02
Q5 914
R11 3300
C6 .02
R9 47K
R20 10K
R7 3300
R6 22K

DECODER



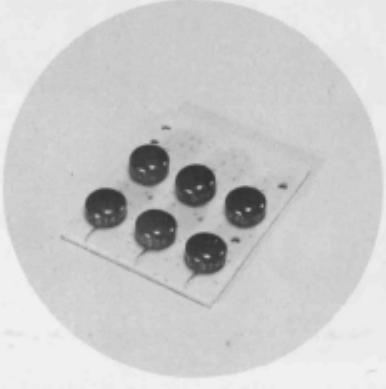
COMPONENT SIDE OF BOARD ILLUSTRATING WIRE ROUTING.
PLUG DETAIL, HALF SIZE.

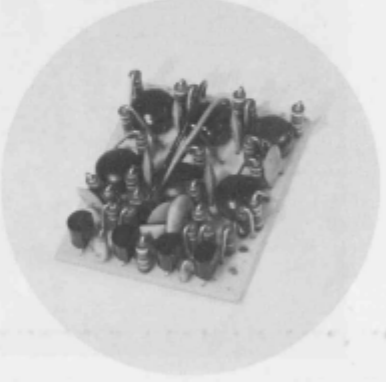


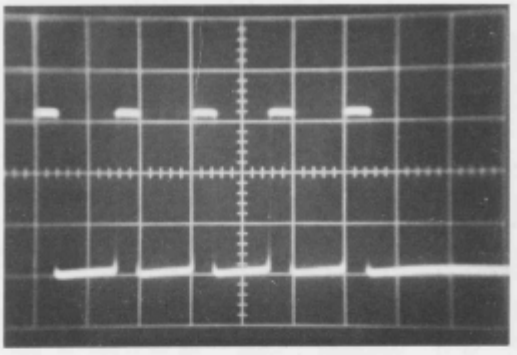


BLUE MAX SYSTEM

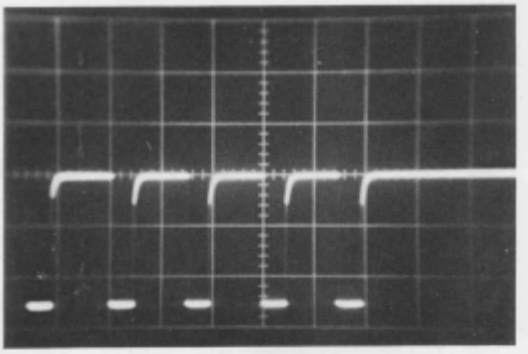
Decoder Schematic



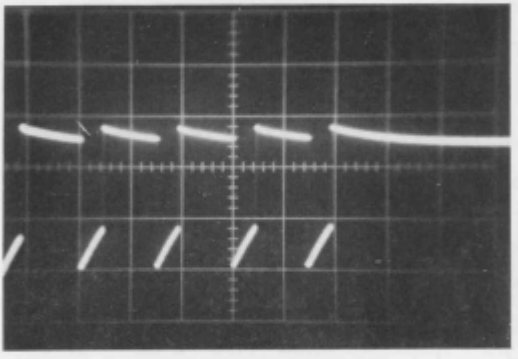




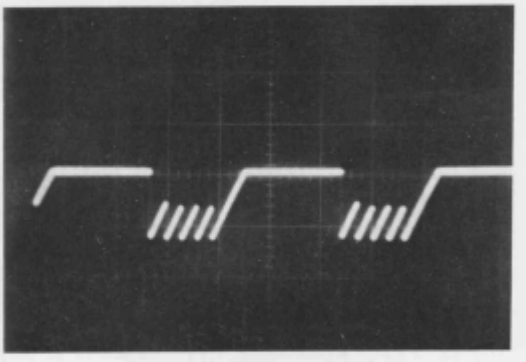
Output Collector Q1 (hole No. 4) Vertical gain set at 200 MV/Large Division.



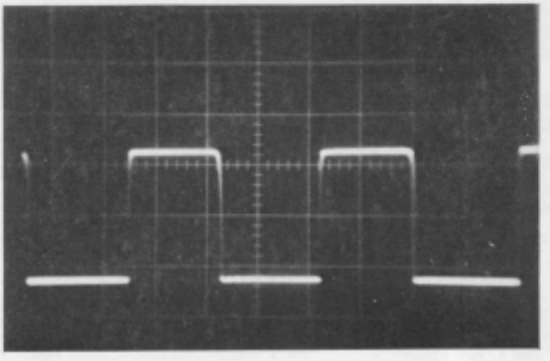
Output Collector Q2 (Hole No. 9) Vertical gain set at 2V/Large Division (signal to Decoder gates).



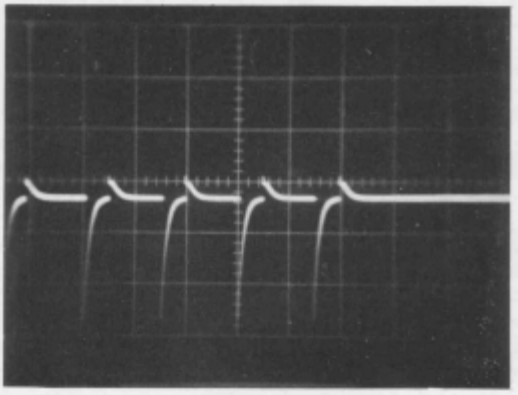
Base Q3 (hole No. 13). Vertical gain set at 2V/Large Division.



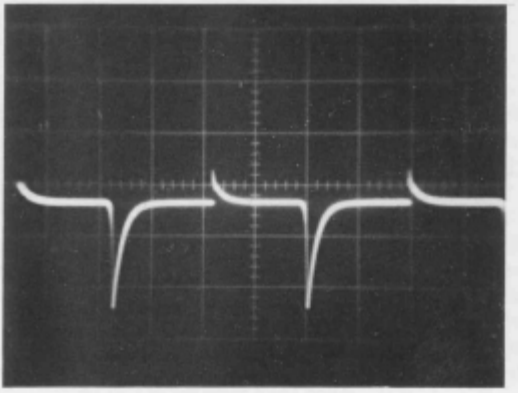
Output Collector Q3 (Hole No. 14). Vertical gain set at 500 MV/Large Division.



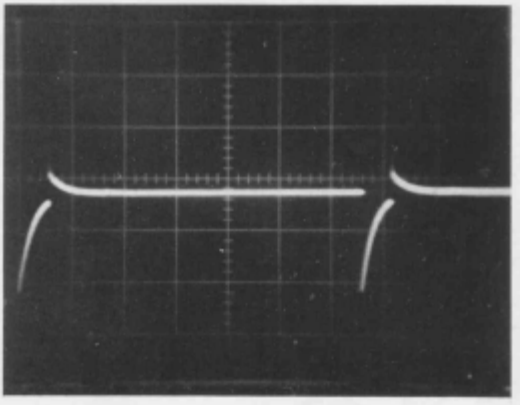
Sync Pulse (output collector Q4 (Hole No. 19). Vertical gain set at 2V/ Large Division.



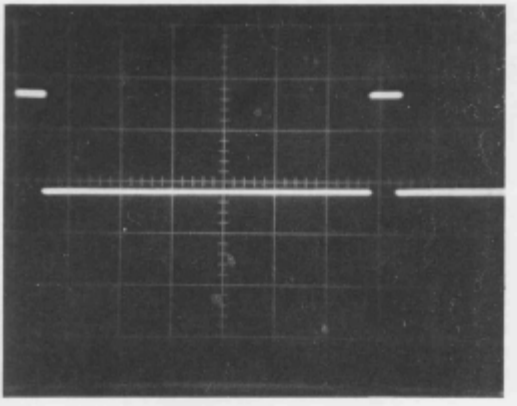
Differentiated signal to Decoder gates (Hole No. 51). Vertical gain set at 2V/Large Division.



Differentiated Sync Pulse (Hole No. 84) Vertical gain set at 2V/Large Division



Differentiated Sync Pulse (reset) at each successive IC (Holes 72,60,140,127) Vertical gain set at 2V/Large Division.



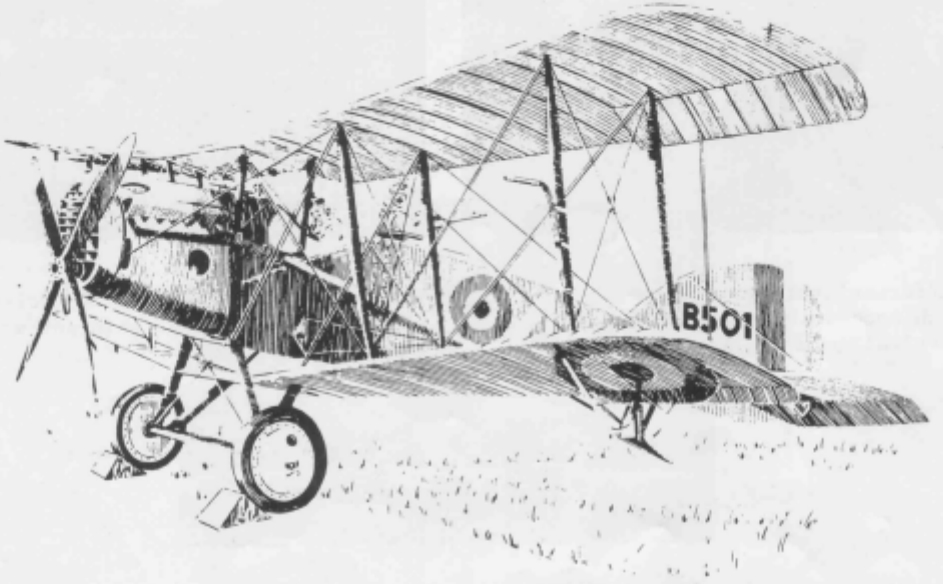
Decoded signal from each IC (Holes 81, 69,57,136). Vertical gain set at 2V/ Large Division.

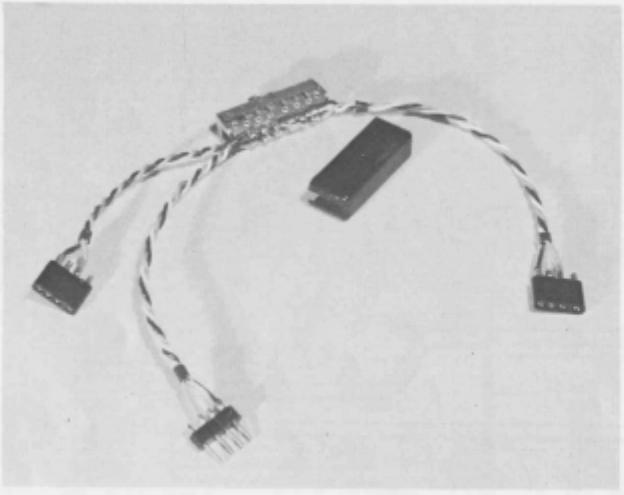
INSTRUCTIONS FOR WIRING HARNESS

We are providing a sketch and a photograph with this assembly. We are giving you the sketch so that you will be able to get the correct plug terminals to the correct switch terminals and to show you how to lace the wires through the switch so that the wires will tuck in properly for the placement of the switch card on the back of the switch. The photograph of the switch harness should also be helpful.

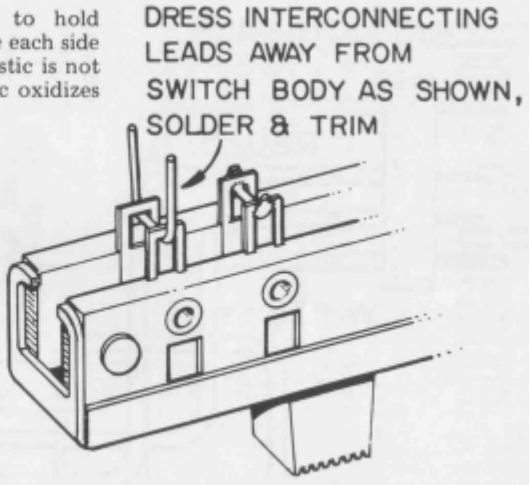
Special care should be taken in wiring to the OS connectors. The wires should be very carefully stripped and tinned about 1/8". Be sure to put the heat shrink tubing on the wire before soldering it into the connector. Reference to the terminals are by number. Also, the plug and pin connectors are numbered. The white wire does not wire to the switch but goes between the switch terminals on its way from one plug to the other. One sketch is a clarification on jumping across the pairs of switch terminals. To do this use scrap lead connectors. Do not try to strip the wire and run it through the two switch terminals. Sketch shows an end view of the 9F switch. The component wire is fed through the terminals and bent up and soldered to the terminals and then trimmed. This should be done as a pre-assembly step before wiring into the switch. The reason for this is that it keeps the sharp points away from the wiring.

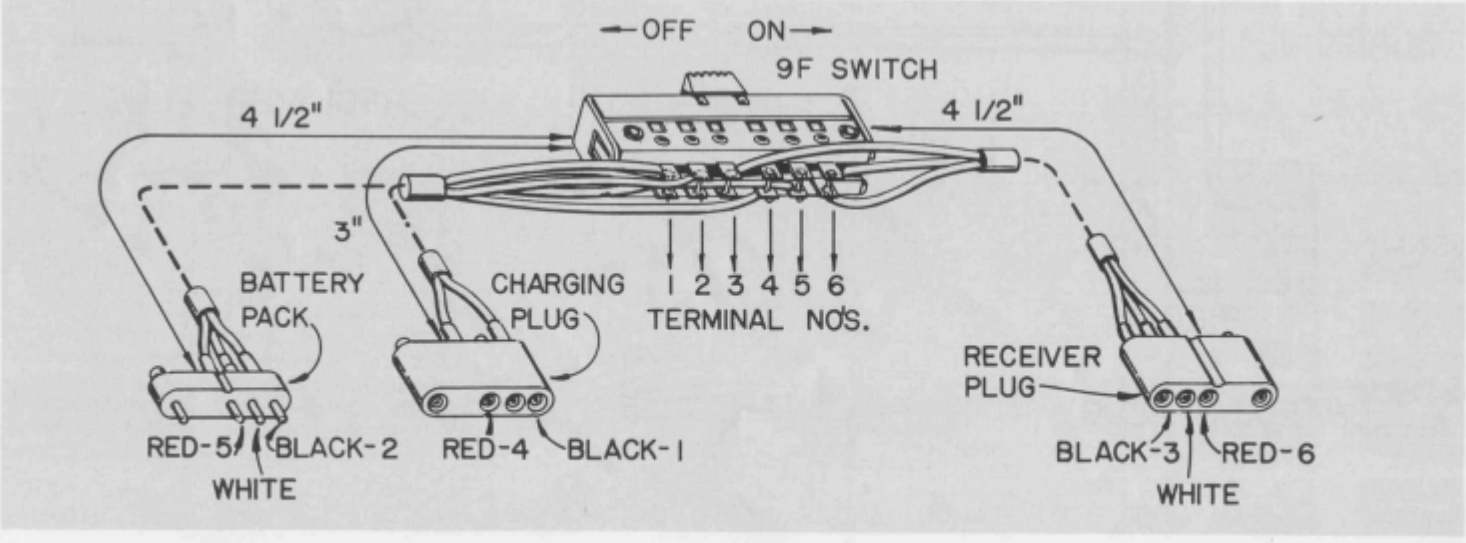
We are providing the battery packs completely assembled with the connectors in place. We do this so that we can pre-test the batteries before we ship them. We recommend that you cycle the receiver flight pack batteries through charge and discharge about three times before you fly your plane in the air. This will give you a knowledge as to about how much flight time you have before your batteries get too weak to operate this system. Also, we find that batteries that are used often and charged often give very little trouble. Batteries that endure long periods of storage are often unreliable. Also, it is not recommended that you put your batteries on charge for long periods of time. That is to say, for two or three weeks. We find that this usually damages the cells.

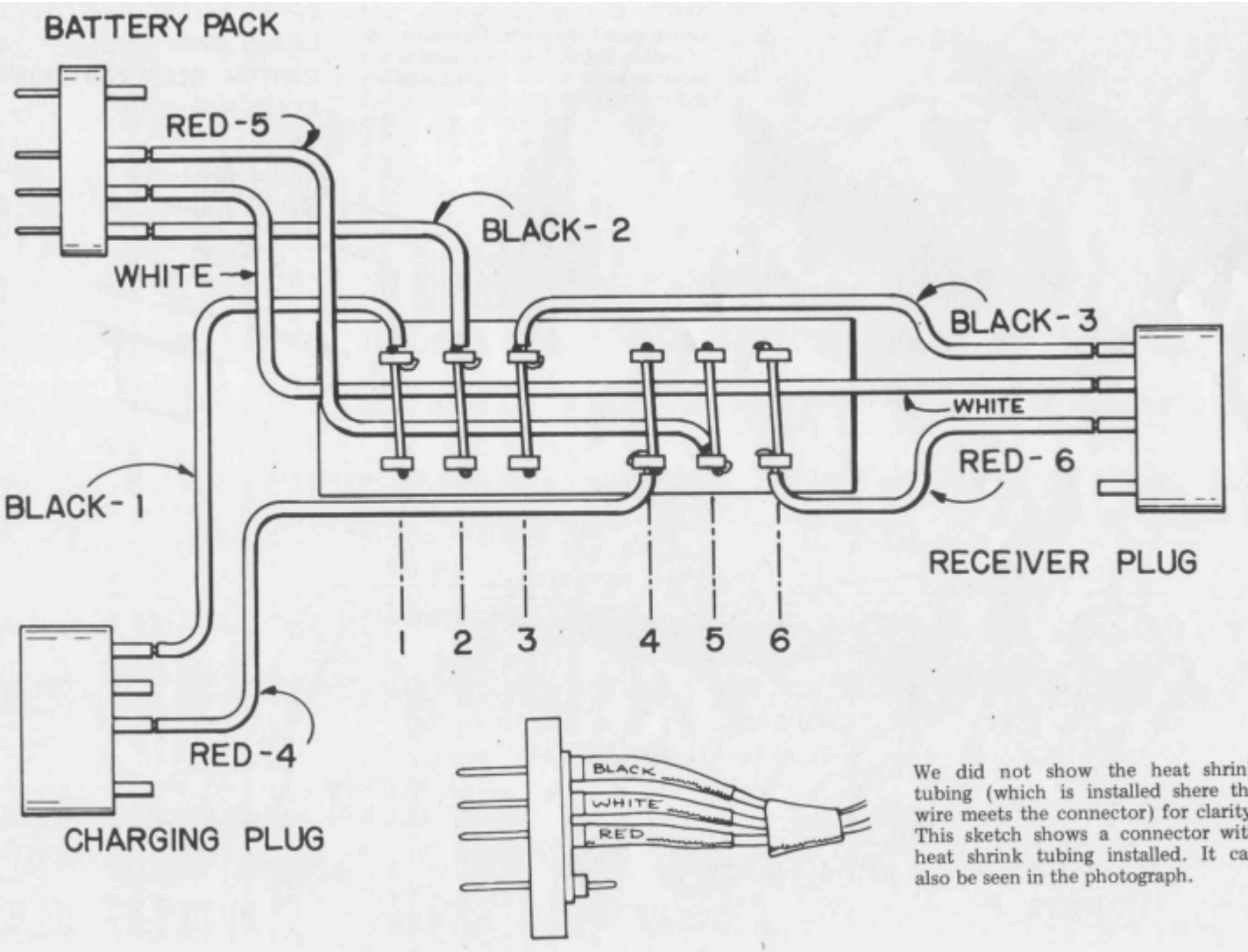




NOTE: Use narrow tape to hold switch guard to switch. Tape each side of switch throw lever. Celastic is not recommended as the celastic oxidizes and corrodes the terminals.







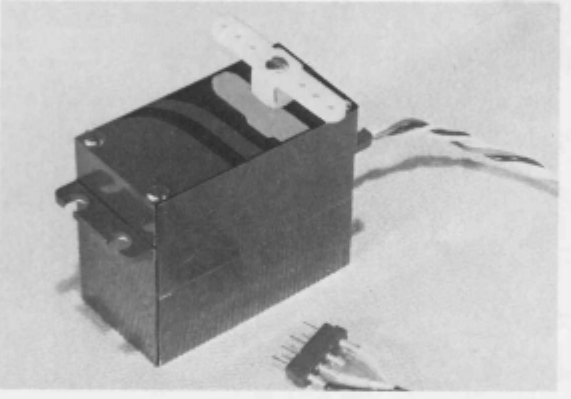
We did not show the heat shrink tubing (which is installed shere the wire meets the connector) for clarity. This sketch shows a connector with heat shrink tubing installed. It can also be seen in the photograph.

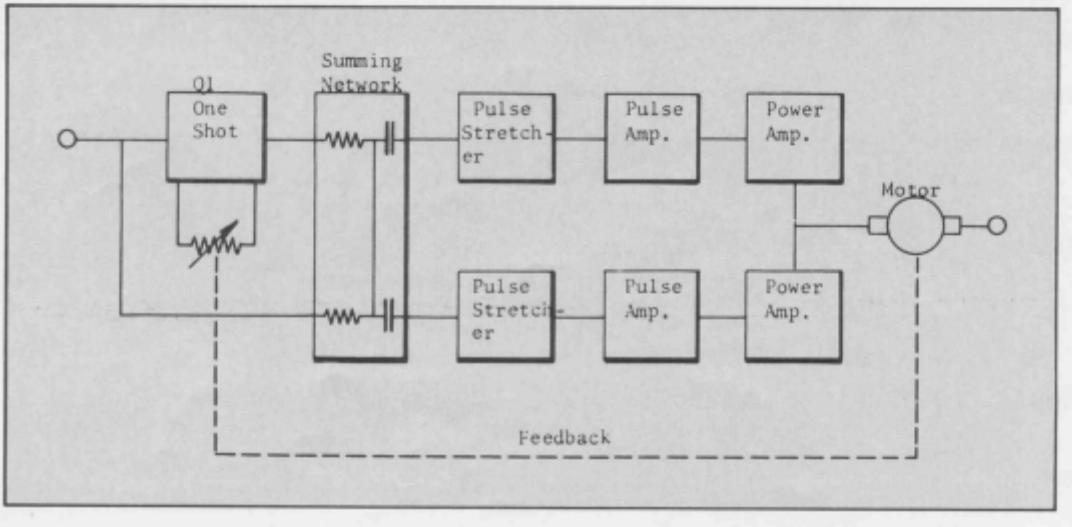
Theory of Operation

The signal comes into the amplifier and goes to the summing junction. At the same time it goes through the one shot and a signal of opposite polarity is created and this is also fed into the summing junction. The pulse width of the positive pulse is controlled by the transmitter and the pulse width of the negative pulse coming out of the one shot is controlled by the feedback pot in the servo. The signals are summed in the summing network and, depending upon which one is the longer, there is an output either plus or minus which is then fed into a pulse stretcher and from there to a pulse amplifier. From there the signal goes to a power amplifier which drives the motor in the servo and gives you your control.

SERVO SECTION

● PLUS PARTS CATALOG ●

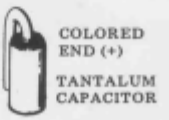




AMPLIFIER BOARD ASSEMBLY

STEP NO.	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 1	( )	ML9914, Q1 insert into holes (lead next to flat should go into hole No. 5, see photograph and drawings for detail) and solder	1, 2, 3, 4, 5, 6, 7, 8	$1.50
Step 2	( )	IN4148 Diode CR1 bend lead on end closest to band that encircles body of Diode and insert in holes and solder	9, 10	.35
Step 3	( )	.01 MFD disc capacitor C2 insert into holes	11, 12	.35
Step 4	( )	.001 MFD disc capacitor C8 insert into holes	13, 14	.35
Step 5	( )	.001 MFD disc capacitor C7 insert into holes	15, 16	.35
Step 6	( )	Clip leads and solder parts installed in three steps 3,4,5 above SEE PAGE 15 FOR TRANSISTOR BASING		
Step 7	( )	MPS 6560 Q6 insert into holes	19, 18, 17	1.50
Step 8	( )	MPS 2924 Q2 insert into holes	21, 22, 20	1.50
Step 9	( )	SKB 2710 Q4 insert into holes	25, 23, 24	1.50
Step 10	( )	SKB 2710 Q3 insert into holes	28, 26, 27	1.50
Step 11	( )	MPS 6562 Q7 insert into holes	29, 30, 31	1.50
Step 12	( )	MPS 2924 Q5 insert into holes	34, 33, 32	1.50
Step 13	( )	Clip and solder leads of transistors installed in steps 7 through 12 above		
Step 14	( )	Leads of tantalum electrolytic capacitors C1, C3, C4, C5 should all bend at the red end of capacitor body. Red end identifies the positive lead.		
Step 15	( )	.1 MFD tantalum capacitor C3 should be installed in holes	(+) 35, 36	.70
Step 16	( )	.1 MFD tantalum capacitor C4 should be installed in holes	(+) 37, 38	.70

Emitter	Base	Collector



STEP NO.	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 17	( )	2.2 MFD tantalum capacitor C5 should be installed in holes	(+) 39, 40	.70
Step 18	( )	1.0 MFD tantalum capacitor C1 should be installed in holes	(+) 41, 42	.70
Step 19	( )	Clip and solder leads from capacitors installed in steps 15 through 18 above		
Step 20	( )	Insert resistor R11 47K (Yellow, violet, orange) into holes	43, 44	.12
Step 21	( )	Insert resistor R7 10K (Brown, black, orange) into holes	45, 46	.12
Step 22	( )	Insert resistor R6 180 ohm (Brown, grey, brown) into holes	47, 48	.12
Step 23	( )	Insert resistor R10 47K (Yellow, violet, orange) into holes	49, 50	.12
Step 24	( )	Insert resistor R8 4700 ohm (Yellow, violet, red) into holes	51, 52	.12
Step 25	( )	Insert resistor R9 4700 ohm (Yellow, violet, red) into holes	53, 54	.12
Step 26	( )	Insert resistor R12 4700 ohm (Yellow, violet, red) into holes	55, 56	.12
Step 27	( )	Insert resistor R13 15K (Brown, green, orange) into holes	57, 58	.12
Step 28	( )	Clip and solder leads from resistors installed in steps 20 through 27 above		
Step 29	( )	Solder resistor R16 47K (Yellow violet, orange) on copper side of board connecting the lands which contain holes No.	15, 17 — 8, 42	.12
Step 30	( )	Solder resistor R5 3.9K 1/8 watt (Orange, white, red — small size) on copper side of board connecting the lands which contain holes Be sure resistor lays flat.	8, 42 — 5, 47	.20

STEP NO.	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
ASSEMBLY OF POT BOARD:				
Step 31	( )	Insert R1 470 ohm (Yellow, violet, brown) in holes 66, 67 and solder. This resistor is placed on the copper side of the board. After soldering in place clip leads flush with board.	66, 67	.20
Step 32	( )	Insert R2 470 ohm (Yellow, violet, brown) in holes 70, 71 and repeat step 31 with this resistor.	70, 71	.20
Step 33	( )	Pot assembly sketch shows the construction of the assembly consisting of the 1.5K pot and a small board which fastens to this pot. In the sketch you will notice that the pot is shown with the terminals clipped. Clip these terminals 3/32" high. There is a depressed arrow in the bottom of pot. This arrow should point away from hole 72 when assembled with pot board. Pot terminals are inserted into holes 68, 69, 72 and soldered.		
		At this point we want to tell you a little bit about the circuit. If you want to decrease the throw, decrease the value of R1 and R2 but keep both of them the same. The next step down would be 330 ohms and this would probably give you 15° less throw. We do not recommend trying for anymore throw than the 470 ohm resistors give you as you can get into trouble with the wiper running off the carbon on the feedback pot.		

POT. P.C. BOARD
COPPER & COMPONENT SIDE

CUT TABS TO 3/32 HIGH

ASSEM. SKETCH

STEP NO.	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST

WIRING OF MOTOR:

Step 34 ( )

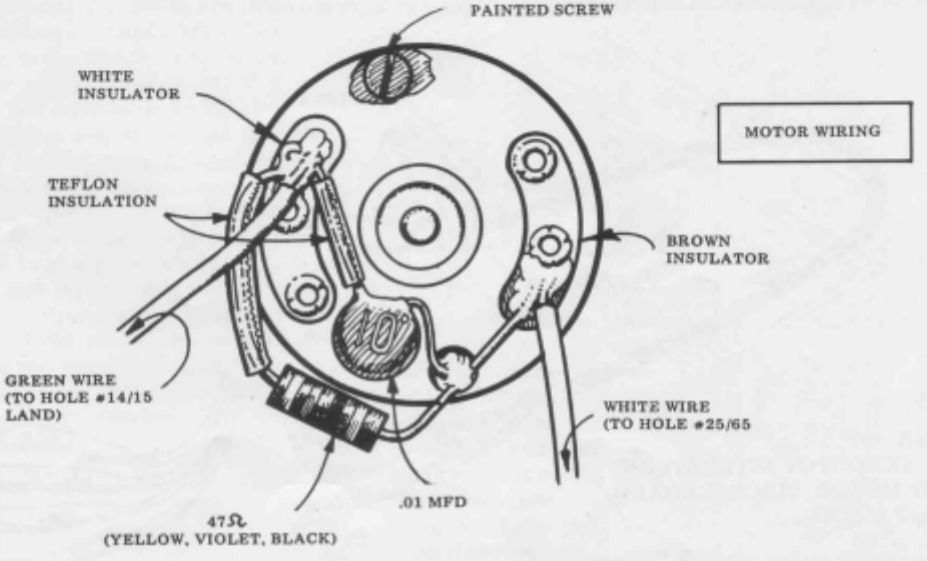
Install Resistor R15 47 ohm (Yellow, violet, black) & capacitor C6 .01 MFD capacitor on motor. Refer to sketch for details of parts placement.

Note that the teflon insulating tubing is used on the leads soldered to the motor terminal with the white insulator. The other leads of C6 & R15 solder to the ground lug on the motor with the resistor lead continuing to the motor lead with the reddish brown insulator. When attaching these parts be extremely careful of the physical placement. The .01 capacitor must lay flat and not extend above the bearing boss height. The body of resistor R15 is extended past the O.D. of the motor case.

As this point the kit is completed to the Semi-kit stage. If the Model S4B servo was purchased as a World Engines Semi-kit you should start with the mechanical assembly, which follows.

CAUTION

The installation of the 47 ohm resistor is very critical. See sketch on wiring the back of the motor below. Keep the lead of this resistor not covered by insulation as short as possible. The problem is that a short can occur between this bare wire and the P.C. board at the point on the board where the green motor wire is soldered on. This shorts out the motor wiring. Check this again in the final assembly of the servo.



MECHANICAL ASSEMBLY:

Flexible lead attachment:

Prepare the leads by cutting to length and stripping & tinning 1/8 inch on each end.

Green	1-1/2"	Blue	1-3/4"
White	1-1/2"	Orange	1-3/4"
White	9"	Brown	1-3/4"
Yellow	7"	Red	7"
Black	7"		

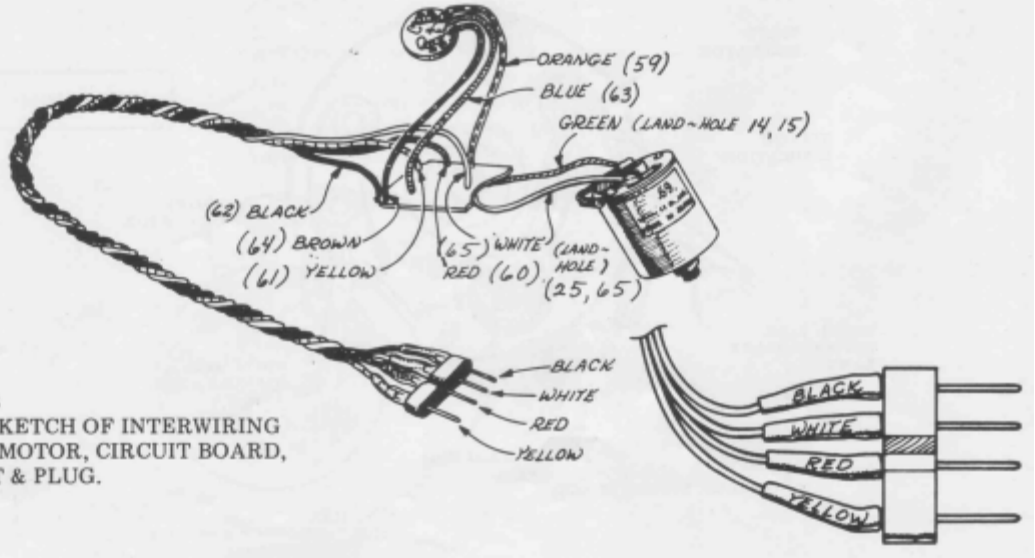
Attach the 3 1-3/4" leads to pot assembly referring to pg. 5 sketch for proper placement. Attach the green wire to the motor terminal with the white insulator. Attach the 1-1/2 white wire to the motor terminal with the reddish brown insulator.

POINT TO POINT WIRING:

Wire Color		From		To Hole No.
9"	White	Plug		65
7"	Black	Plug		62
7"	Red	Plug		60
7"	Yellow	Plug		61
1-3/4"	Orange	Pot Board		59
1-3/4"	Blue	Pot Board		63
1-3/4"	Brown	Pot Board		64
1-1/2"	Green	Motor	Land containing Hole No.	14, 15
1-1/2"	White	Motor	Land containing Hole No.	58, 65

Trim even the loose ends of the long wires, slide heat shrink tubing over end of each wire and solder to plug using sketch for connection detail.

Carefully go over the circuit side of the board and check for solder bridges and flux residue between the lands. Remove anything which looks suspicious and we would suggest that the point of an X-Acto knife be used to scrape between all adjacent lands to insure that there are no shorts.

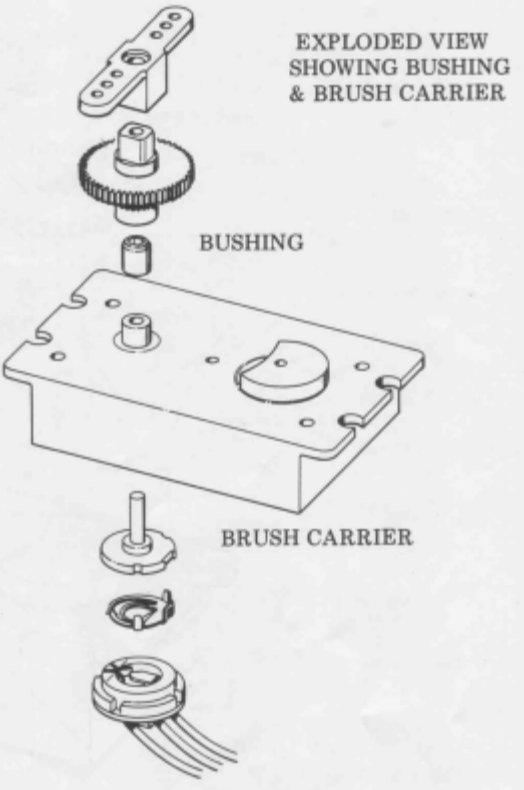


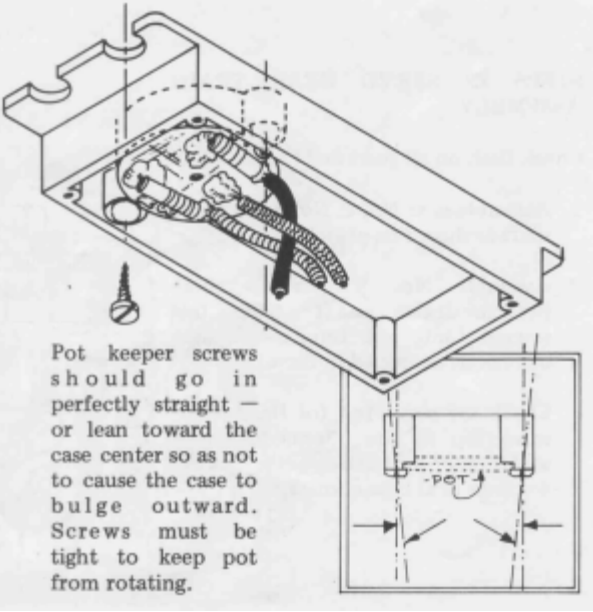
S4B
SKETCH OF INTERWIRING OF MOTOR, CIRCUIT BOARD, POT & PLUG.

Refer to photos and sketch at right and insert the feedback pot element into its cavity in the case center section. Install the 2 x 1/4" screws to hold the element in place.

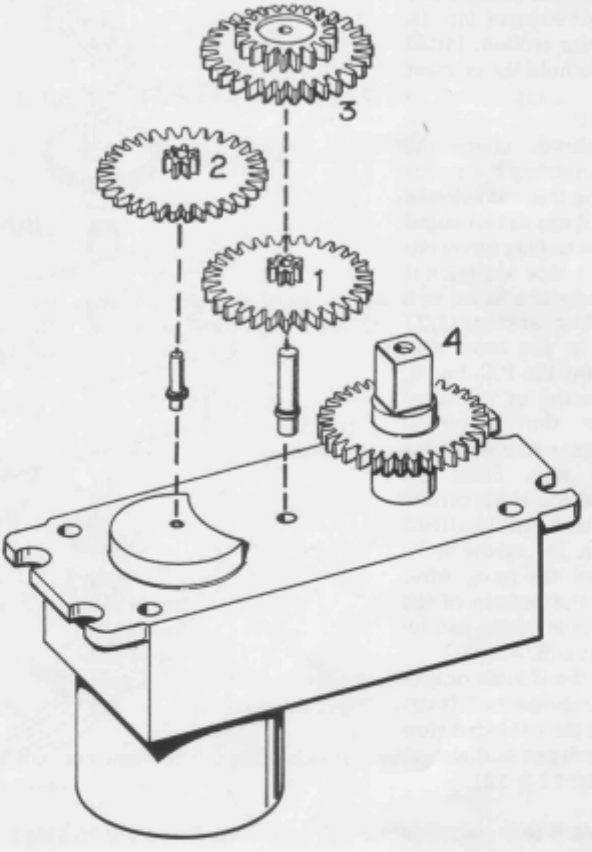
At this time you should check the general operation by inserting the motor in position and plugging the unit into the decoder. The servo will run to its neutral position and stop. Now unplug servo; cut a 1/2" length of foam tape and stick it to the pot element and wires to act as a pad of insulation. Place another 1/2" piece of foam tape in the servo case bottom to be a pad for the P.C. board. Do not cover the portion of the servo case bottom where the motor is installed. Notice the case is opened for the motor on one side. Place the amplifier board in position being careful not to trap any wires between the circuit board and the motor. Install the servo case bottom. Route the plug wires through the notch in the bottom of the case and tighten the case screws and install the double output arm.
The screw that holds the double output arm to the output gear should be left out at this point. Refer to the exploded view of the output gear and pot and also to the section drawing (pg. 11 & 12).

Notice that in the output gear assembly there is a bushing between the gear and the shaft that turns the pot brush. The top of this bushing contains a 1/16" hex head opening. In the sketch we show the hex head wrench in position entering this bushing. The servo is neutralized by holding the double output arm and very carefully and easily turning the wrench the approximate radial distance opposite to the desired travel to neutral of an output arm. We will state this another way for you. Looking down at the top of the servo, let's suppose that you want the double output arm to move clockwise 5°. Hold the double output arm and turn the wrench counterclockwise 5°. Then, replug the servo into the decoder and check it again.





Pot keeper screws should go in perfectly straight — or lean toward the case center so as not to cause the case to bulge outward. Screws must be tight to keep pot from rotating.



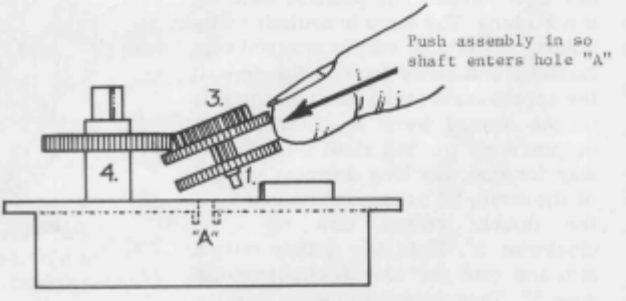
STEPS IN SERVO GEAR TRAIN ASSEMBLY

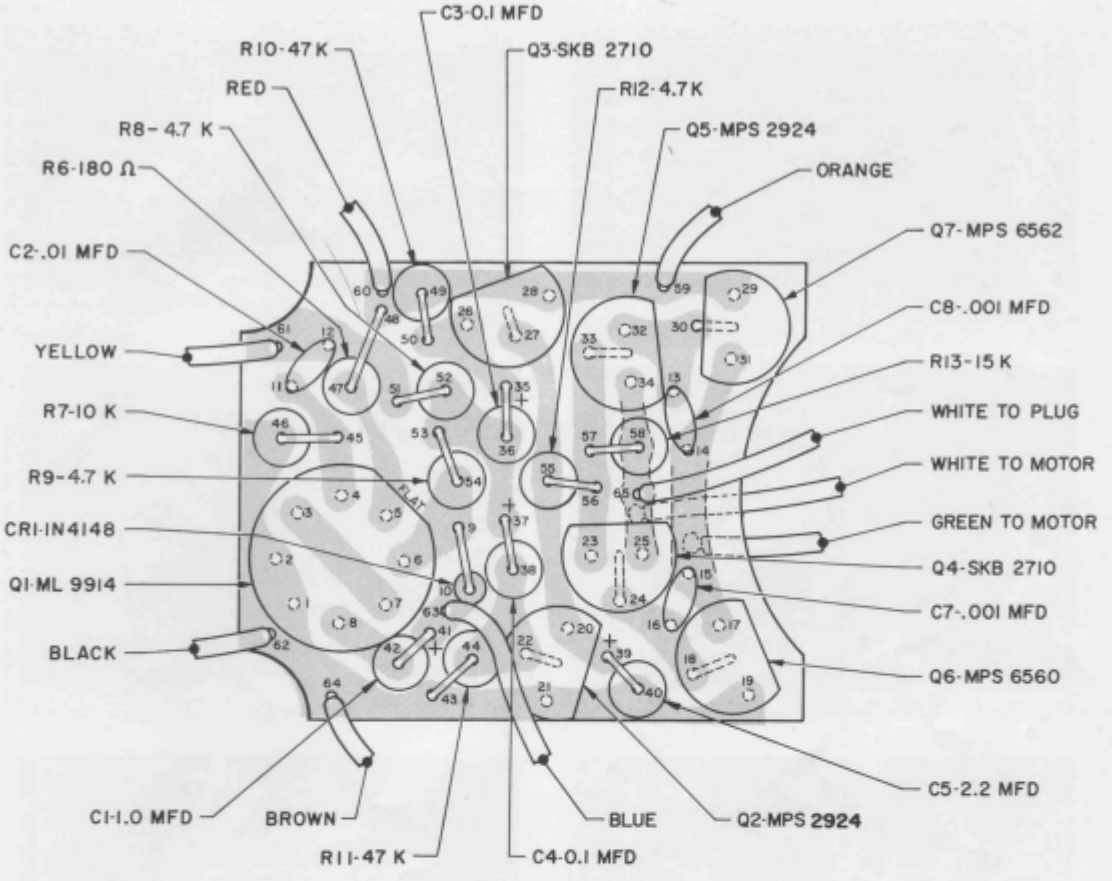
Check flash on all gears and case parts

1. Assemble gear No. 1, No. 3, and large shaft as shown on sketch at right.

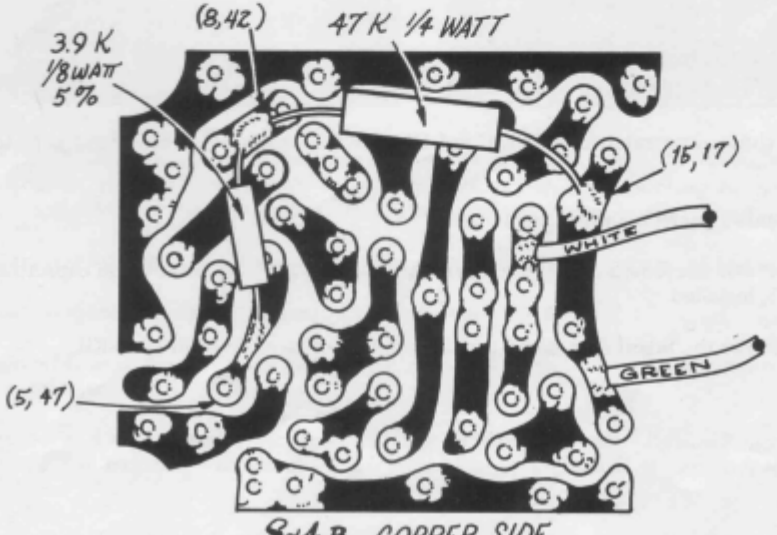
2. Assemble No. 2 gear to short intermediate shaft. Slide this assembly into gear train in the same manner as described in Step 1.

3. Check the servo top for flash. Place servo top so the intermediate gear shafts enter the bearing holes. Put the 4 screws in at case corners.

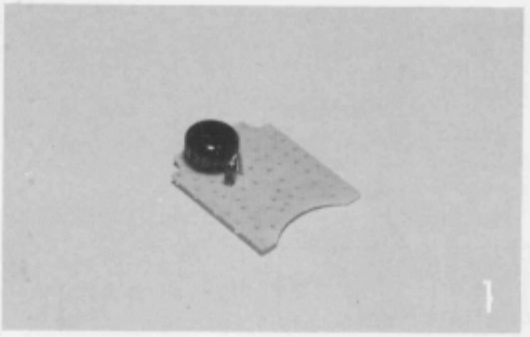


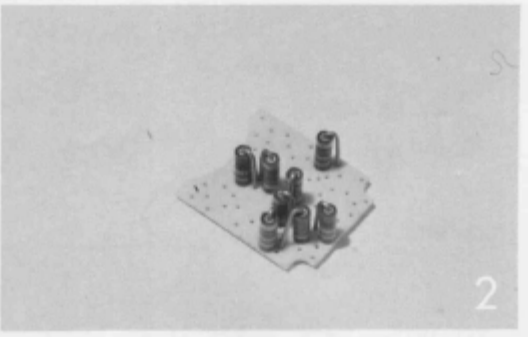


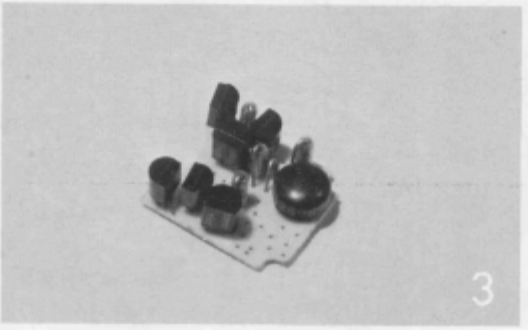
S4B COMPONENT SIDE



S-4B COPPER SIDE







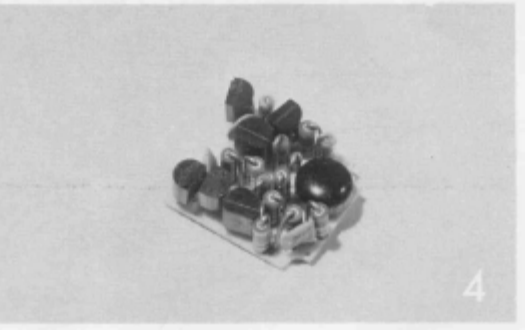


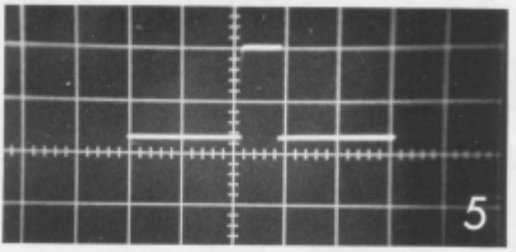
PHOTO INDEX & TROUBLE SHOOTING:

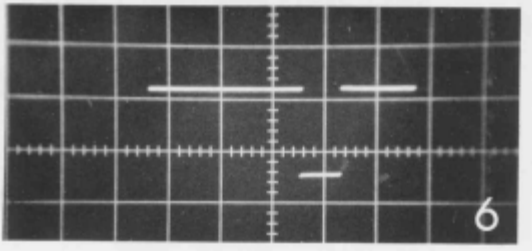
Picture 1 shows integrated circuit Q1 and Diode CR1 installed — Note: band is at top of diode.

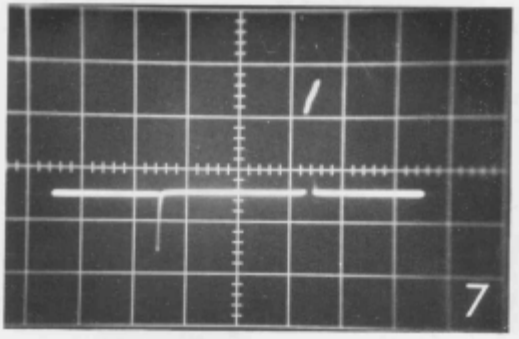
Picture 2 shows board with resistors in place.

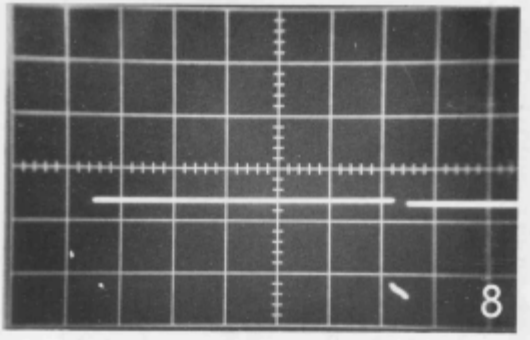
Picture 3 shows the board in Picture 1 with transistors Q2 — Q7 & tantalum capacitors C1, C3, C4, C5, installed.

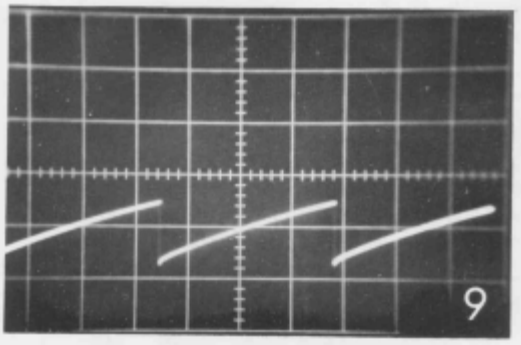
Picture 4 shows the board completed through step 30 or as received in Semi-Kit.

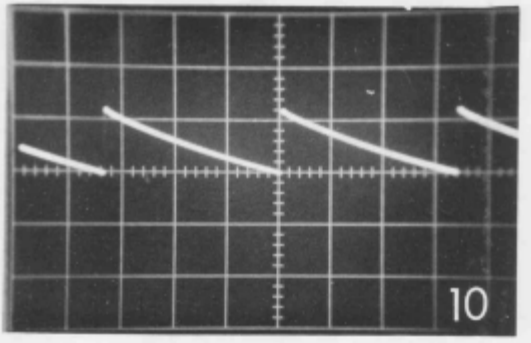












Pictures 5 through 10 are waveforms as seen on an oscilloscope. These can be used for comparison if you have access to a scope should trouble shooting be necessary. All measurements were made using the white wire or battery center tap as ground.

Picture 5 shows the scope trace at the input or yellow wire, this can be picked up at hole 61.

Picture 6 shows the monostable output as it appears at hole 6.

The next four pictures require that the motor be pulled from the case and stalled in order to get a stable trace.

Picture 7 & 8 were made at the summing junction which is hole 53 Picture 7 shows the pulse required for clockwise rotation of the output arm. Picture 8 is for counter clockwise rotation.

Picture 9 & 10 was made at hole 55 which is the output from the pulse stretchers. Picture 9 is waveform for clockwise rotation of the output arm. Picture 10 is for counter clockwise rotation.

SERVO AMPLIFIER S-4B

Resistors R1 and R2, 470 ohm (Yellow, violet, brown) and pot element R3 shown inside dotted lines are mounted on the small round printed circuit board.

Resistor R5, 3.9 1/8 watt, (Orange, white, red) is mounted on the copper side (bottom) of board and soldered to lands containing holes 5, 47 and 8, 42.

Resistor R16, 47K, (Green, blue, orange) is mounted on the copper side (bottom) of board and soldered to lands containing holes 8, 42 and 15, 17.

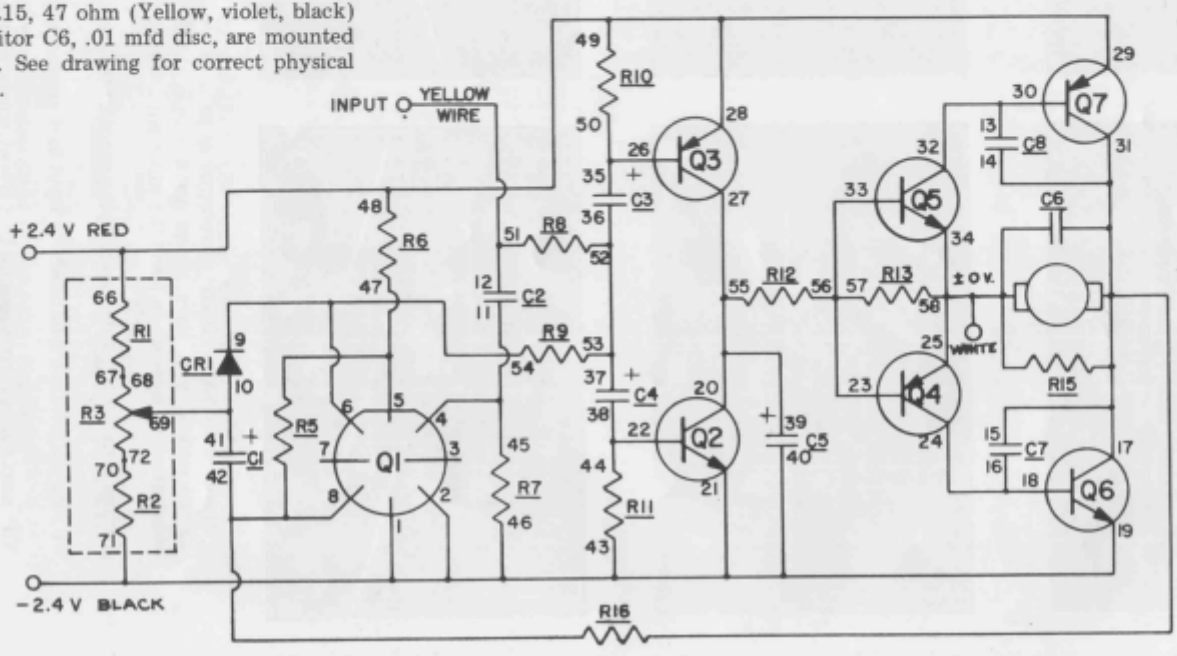
Resistor R15, 47 ohm (Yellow, violet, black) and capacitor C6, .01 mfd disc, are mounted on motor. See drawing for correct physical placement.

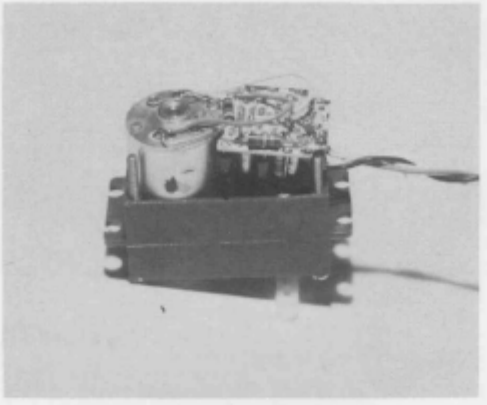
Transistors Q3, Q5, Q7 run the servo counter clockwise.

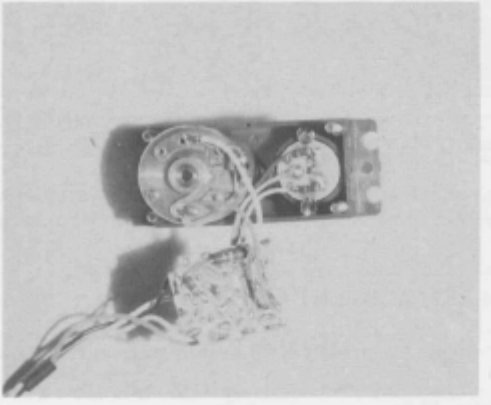
Transistors Q2, Q4, Q6 run the servo clockwise.

If servo runs round & round check to see that pot is making contact. Pot not making contact or a bad IC (Q1) can cause this.

If servo jitters or hunts around neutral be sure dampening resistor R16 is installed on copper side of board. This resistor may be changed to a 39K to dampen out the hunting.

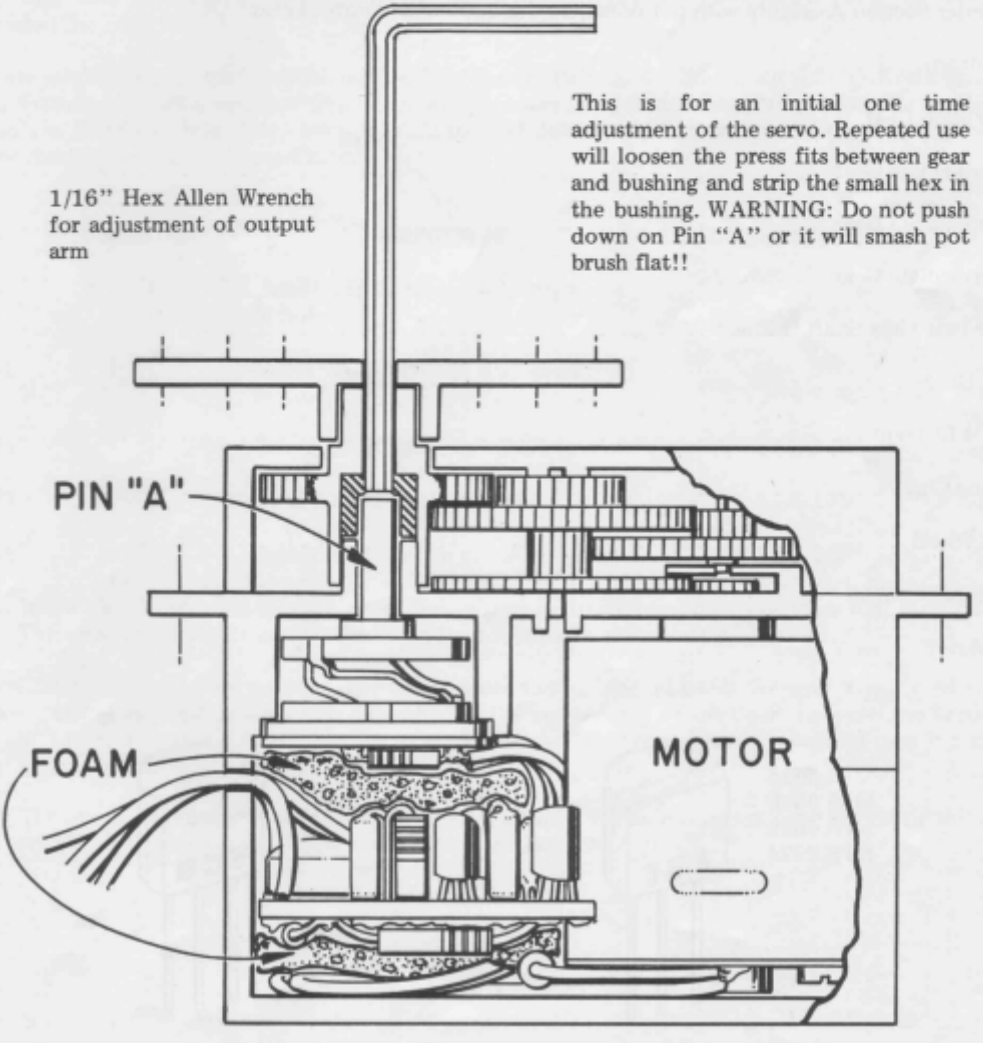






1/16" Hex Allen Wrench for adjustment of output arm

This is for an initial one time adjustment of the servo. Repeated use will loosen the press fits between gear and bushing and strip the small hex in the bushing. WARNING: Do not push down on Pin "A" or it will smash pot brush flat!!



REPAIR AND REPLACEMENT AT WORLD ENGINES:

Kit — rebuilt at factory	10.95
Semi-Kit — rebuilt at factory	8.95
Factory Assembled (turn around service)	6.98

The above applies only if you want immediate turn around service and you send your money in with the servo to be repaired. Advise if you will take a rebuilt replacement or if you want your own back.

S-4 REPLACEMENT PARTS LIST

Complete Mechanics with motor, pot, and hardware	9.95
Case Top	.75
Case Center Section Assembly with pot brush, holder bushing and output gear	2.95
Case Bottom	.75
Motor Pinion Gear	.25
#1 Intermediate Gear	.35
#2 Intermediate Gear	.35
#3 Intermediate Gear	.35
Intermediate Gear Shaft (Either)	.25
Output Gear	.50
1.5K Pot Element	1.50
Mounting Clip	.50
Output Wheel	.50
Double Output Arm	.70
Servo Motor	4.95

MPS 3638
MPS 6560
MPS 6562
MPS 2924

SKB 2710
2N 3702

6 METERS

53.1 MHZ
53.2 MHZ
53.3 MHZ
53.4 MHZ

52MHZ TRANSMITTER

This page concerns itself with the 6 meter or 52mhz version of the Blue Max system. We certainly do not recommend that a beginner build one of these sets with the minimum instructions that we have room for here in this book. Actually, people who fly on 52mhz must, of course, have a technician's FCC license and have passed the code test.

There are several changes that must be made on the transmitter. On the 52mhz kit sold by World Engines, it is their intention to sell a standard 27mhz kit with an extra parts complement to make up for the different parts in the 52mhz system. They are not going to send out two sets of crystals, however. Only the steps that are changed will be mentioned here.

STEP	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 41	( )	Install 18pf ceramic disc capacitor in holes	142, 143	.35
Step 71	( )	Insert 27pf ceramic disc capacitor in holes	159, 160	.35
Step 74	( )	Insert .33uh choke in holes	161, 162	.65
Step 77	( )	Install .33uh choke in holes	138, 139	.65
Step 78	( )	Install .47uh choke in holes	144, 145	.65

NOTE: In addition to the step changes as outlined above, there are two additional steps that must be taken. These are components that are added to the copper side of the board.

Install a 50pf disc capacitor between border land containing hole 141 and the land which contains hole 140. Also, install an 18pf ceramic disc capacitor on the copper side of the board between the border land near hole 131 and the land that contains holes 136 and 138. These lands are located near the antenna bracket on the board.

NOTE: The above changes are made for 12V operation only. We do not recommend operating this system on 9V. The tune-up procedure is the same for 27mhz version.

52MHZ RECEIVER

The changes between the 52mhz and the 27mhz receiver are as follows. We are just listing the steps affected.

STEP	CHECK AS COMPLETED	DIRECTIONS	HOLE NO.	COMPONENT COST
Step 1	( )	Insert 10 ceramic disc capacitor into holes	3, 4	.15
Step 2	( )	Insert 4pf ceramic disc capacitor into holes	38, 39	.15
Step 5	( )	Insert 50pf ceramic disc capacitor into holes	91, 92	.15
Step 10	( )	Insert resistor 33k orange, orange, orange into holes	1, 2	.12
Step 11	( )	Insert .33uh choke into holes	40, 41	.75
Step 16	( )	Insert resistor 47k yellow, violet, orange into holes	84, 85	.12
Step 17	( )	Insert resistor 1k brown, black, red into holes	95, 96	.12
Step 40	( )	Insert and solder transistor MM1139 into hole	48 (Emitter) 49 (B), 49 (C)	3.00
Step 46	( )	Insert and solder a new coil which is especially provided for use with the 52mhz receiver configuration. This coil will be provided in the accessory package for the 52mhz version.		
		NOTE:		

NOTE: The appropriate crystals are assembled both into the transmitter and the receiver. The receiver crystal in holes 46 and 47 and the transmitter crystal on the transmitter board at holes 177 and 178.

NOTE:

NOTE: Tune-up procedure is the same as for the 27mhz version.

GENERAL OPERATING INSTRUCTIONS

GENERAL NOTES

The World Engines Blue Max System digital proportional is the latest in the series of digital control systems produced by World Engines. There have been many changes made in this new model, circuit-wise and appearance-wise. The Blue Max System incorporates integrated circuit decoders, high resolution servos, World Engines new control sticks, a non-center loaded antenna, and a 12 volt power supply. This system is available on all 27mhz frequencies and will be available shortly on the 72mhz frequencies.

TRANSMITTER OUTPUT METER

The meter circuit in the deluxe Blue Max Systems is essentially a built-in field strength meter. It is not directly connected to the RF circuitry but receives its power through radiation from that portion of the antenna within the case. This reading is entirely arbitrary and should be used in a relative manner only; that is, to indicate operation and battery condition. The reading will change when you grasp the case — your body becoming part of the antenna system (counterpoise) and is entirely normal. This meter is also used as the charging indicator for transmitter batteries.

TRANSMITTER ANTENNA

Your transmitter has been factory adjusted for maximum radiation with the antenna fully extended. This antenna is base loaded and matched to the output circuitry of the transmitter circuitry of the Blue Max. Antennas should not be substituted. Use only those manufactured by World Engines for use with your Blue Max digital systems.

RECEIVER ANTENNA

Your receiver is supplied with a 30" flexible wire antenna which is sufficient for normal operation. It is suggested it be routed away from servos and noise sources and the end rubberbanded to a tail surface.

Supplied with your Blue Max System is a World Engine dual charger which is transformer isolated and is used to charge both the transmitter and airborne battery packs. The charger is completely wired with plugs to plug into the packs. Either set of batteries may be charged separately. The battery for the airborne pack is wired directly to the switch and there are two plugs coming from the switch; one plugs into the receiver, the other plug is for charging. It is not necessary to unplug the receiver from the battery pack in order to charge it. Simply plug the connector from the charger to the charging connector from the switch which is a plug that has on only a *red* and *black* wire attached to it. In order to charge the receiver battery packs using this connector, the ON-OFF switch of the flight pack must be in the OFF position. Illumination of the red pilot lamp in the charger will indicate that the battery pack of the airborne system is being charged. To charge your Blue Max transmitter, the round connector from the battery charger must be inserted into the socket directly above the Buddy Box switch on the front of the Blue Max transmitter. The transmitter ON-OFF switch in the lower left hand corner must be in the DOWN or OFF position. The transmitter meter will indicate that the transmitter battery pack is being charged. The batteries should be charged for a full 24 hours initially and overnight before each flying session. This way you are always assured of a fresh battery pack.

INSTALLATION IN AIRCRAFT

The Servos supplied with the Blue Max Digital Systems, (Model S-4B), are an extremely high revolution Servo. The Servo should be mounted on the supplied rubber grommets in order to damped out vibration. When tightening the grommets down they should only be secured to a snug fit. Use of a World Engines servo mounting tray will eliminate the problem of tightening the grommets too tight. Clamping the grommets tightly will destry the vibration protection of the grommets and will void the warranty. Vibration can cause extreme damage and catastrophic failures in flight at a later date when you least expect it. Use of

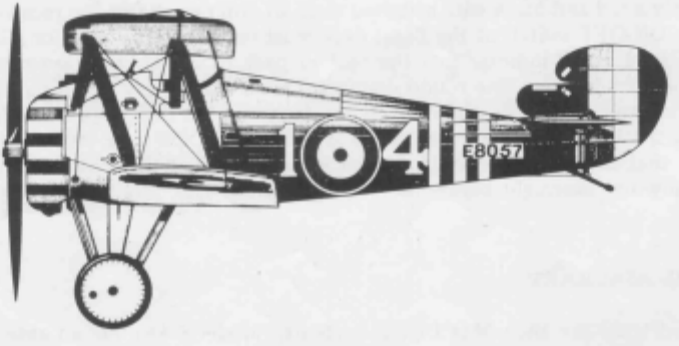
the World Engines servo mounting trays is strongly advised and will facilitate moving the airborne installation to use with several aircraft. The output arms can be rotated 90° by removing the retaining screw and lifting the output arm off and again inserting on the square output post in the direction desired. The retaining screw must be replaced in order to keep the output arm from working loose. By being able to rotate the output arm in relation to the servo body, this will enable you to mount the servos either lengthwise of the fuselage or across the fuselage.

CONNECTION OF RECEIVER TO SERVOS

All cables coming from the receiver contain a red, white, and black wire. The cable that has a male connector on it has only three wires and should be plugged into the connector from the switch assembly. This is a battery power cable. The other cables, in addition to the red, white, and black wires, have the color coded wire which is the output signal from the decoder. These are color coded in order to indicate the channel they operate. The yellow wire is the aileron output, green wire is the elevator output, blue wire is the rudder output, and purple wire is the motor output. These plugs are keyed with one offset pin and should be plugged in only so that the pins match. The receiver should be mounted in foam rubber at least 1/4" thick and allowed to float in the airplane.

SERVICE

When returning sets for service, please return directly to World Engines with full particulars on the nature of your problem. Equipment should be sent to World Engines, Inc., 8960 Rossash Avenue, Cincinnati, Ohio 45236. It generally takes a week for World Engines to get your set and a day or two to get it properly logged into the Service Department. If you call about a repair ask for Mary Coltz in the R/C Service Department. The phone number at World Engines is 513-793-5900. After we log in a repair it generally gets out in the following week, however, we have build-up of service work in the Spring of any year and also we do a lot of service work in the Summer months which, unfortunately, are vacation months for our service men so, be assured we will do everything we can to give you prompt repair service.

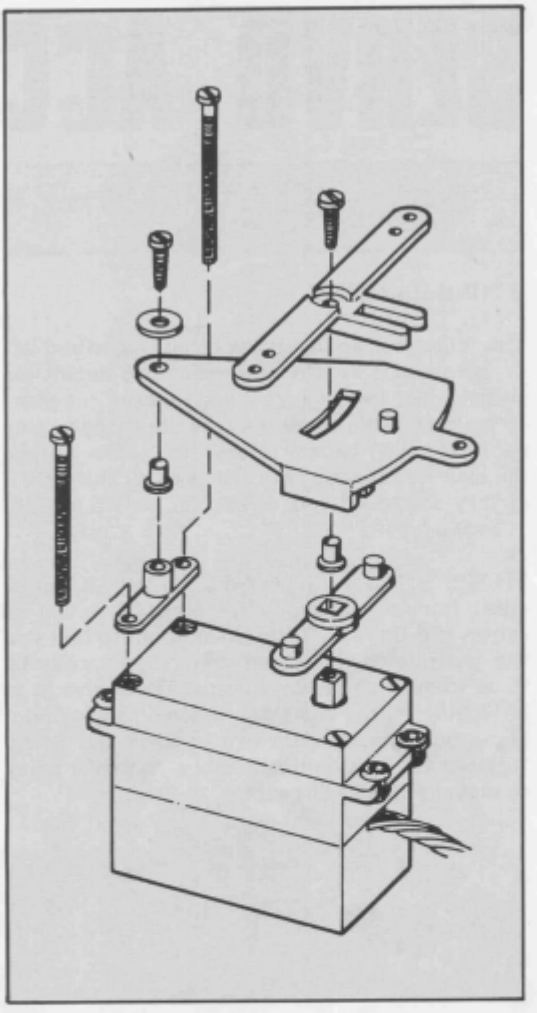


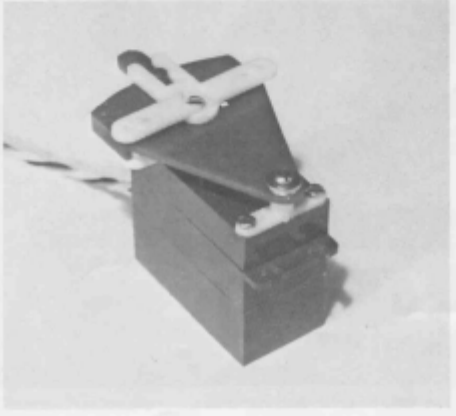
DIFFERENTIAL STEERING

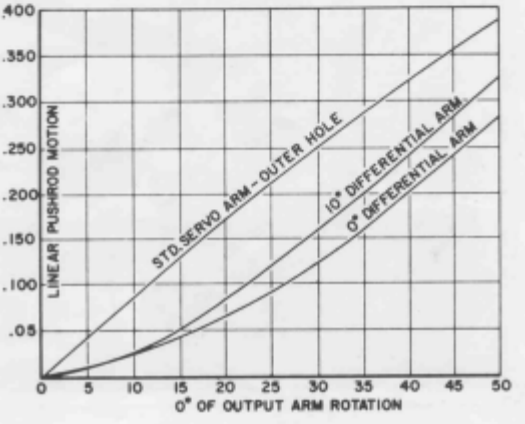
FOR THE S-4 SERVO

We offer this differential steering arm arrangement for people who want only a small amount of movement near the center of their stick travel and progressively more movement as the stick proceeds towards its limit. Several famous flyers have used a logarithmic potentiometer in order to accomplish the same thing in their stick assembly. These differential cam assemblies, both the 10° and the 0° are offered to be added to existing S-4 Servos. We do not sell the servos with these in place. It is also thought by many people that this will be a good item for race car steering. Differential steering is built into most automobiles and race cars so when you move the wheel with the cars wheels almost straight you get very little turn. We are including a graft showing the amounts of deflection for the 10° cam and an ordinary servo arm without any cam.

LAST MINUTE NOTE: Testing has proven the 0° cam to be much to soft around center and will be abandoned. Also the 10° cam is not recommended for heavy steering or elevator loads because mechanism deflects. World Engines will continue to develope this product and probably offer a 15° cam soon.







SERVO ACCESSORIES

WIRING HARNESS

This is designed so that it can be purchased and left in the airplane as it is inconvenient to unbolt the switch when removing your system from one plane to another. Also, there is a separate charging plug so that the battery does not have to be disconnected for use with the charger. This item is factory assembled and wired. The switch is a 9F. . . $4.95.

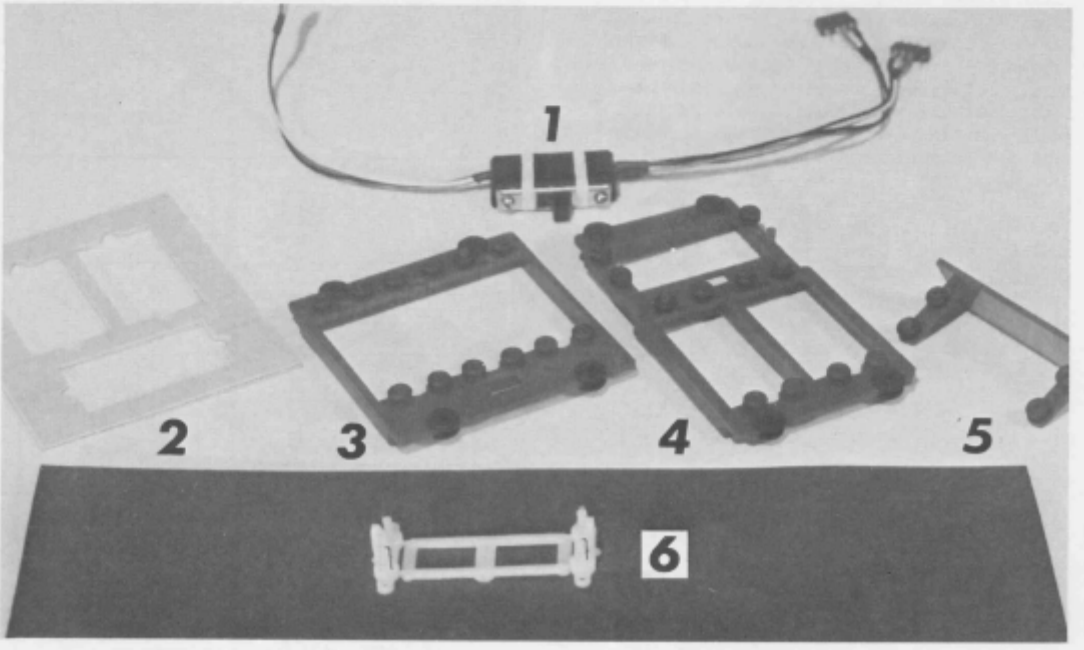
ITEM 2 — This is a plywood servo tray. It can be glued into an airplane. The plywood is cut as shown and there are little indentations so that you can pre-drill for your wood screws if you are using them to mount your equipment. These servo trays are a little on the thin side and some people find it more convenient to use two of them and epoxy together for best results. Really a convenient way to mount servos. 25¢ each.

ITEM 3 — This is a plastic servo tray that will accomodate three servos side by side. 12 small grommets and 4 large grommets are included with this servo tray. $2.95.

ITEM 4 — This is also a three servo servo tray, however, the third servo or motor control is mounted across the tray in front of the rudder and elevator servos. There is an accomodation for a 9F switch in this servo tray. (Same in Item 2.) $2.95.

ITEM 5 — Aileron Servo Mount. Complete with 4 grommets. $1.50.

ITEM 6 — S-4 Servo Clip. The plastic spider that holds the two clips apart is used for locating the clips in the airplane. After it is screwed down, the center section is cut away with an X-Acto knife. 50¢.

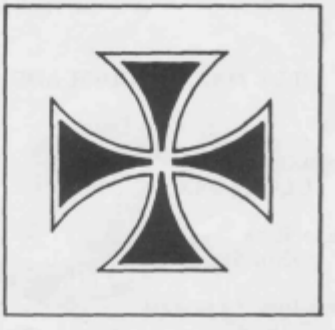


BLUE MAX TX (4 CHANNEL)

No.	Desc.	$ ea.
	Semi Conductors	
5	IN-4148	.65
9	MPS 2924	1.50
2	2N-3643	1.50
	Capacitors	
1	27 pf disc	.35
2	33 pf disc	.35
1	56 pf silver mica	.60
4	.001 disc	.35
1	.002 uf disc	.35
5	.0047 uf mylar	.60
2	.01 uf disc	.35
4	.05 uf disc	.35
2	.15 uf mylar	.60
1	.22 mylar	.60
1	100 uf Elect.	.90
1	Arco 404	1.00
1	.047 uf mylar	.60
	Resistors (1/4 watt)	
2	4.7 ohm	.12
1	100 ohm	.12
1	470 ohm	.12
2	1K ohm	.12
4	4.7K ohm	.12
2	10K ohm	.12
5	47K ohm	.12
5	100K ohm	.12
2	150K ohm	.12
1	270 ohm	.12
	Pots	
4	50K Trimmer	.65
4	5K	1.20
	Chokes	
1	.82 UH	.65
2	3.3 UH	.65
2	12 UH	.65
	TX Case	
1	4 Ch. Blue Max	8.00

No.	Desc.	$ ea.
1	TX Handle (2 nuts & 2 metal trim rings)	1.20
1	Antenna	3.00
1	Antenna Bushing (Plastic)	.75
1	Al. Bushing Trim Ring	1.00
1	Antenna Brack	.25
1	Rye Female Conn.	.50
1	Rye Plug Holder	.40
1	KKK Toggle Switch	2.00
1	DPDT on-off Switch	.50
1	Switch Guard (black plastic washer	.20
1	3 Conductor Buddy Jack (3 washers and 2 nuts)	1.20
1	TX Meter	5.00
1	12V Battery Pack	24.95
2	Brass Stand Offs	.15
1	Plastic Blue Dot	.04
1	TX P.C. Board	3.75
7	Rubber Bumpers (Black)	.06
2	Stick Assemblies	14.98
2	Stick Assembly Trim Ring	2.00
1	27 hmz TX crystal	3.95

No.	Desc.	$ ea.
	Screws	
8	4 x 1/4 STSM	.02
2	4/40 x 1/4 STSM	.02
8	4/40 x 1/4	.02
1	4/40 x 5/16	.02
24	2 x 5/16	.02
8	2 x 3/16 STSM	.02
1	Nut for 4/40 x 5/16 BHMS Screw	.02
1	Lock Washer for 4/40 x 5/16 BHMS Screw	.02
4	Metal Washers for 2 x 5/16" STSM Pan Head Screw	.02
	Labels	
1	World Engines Digital — USA	.50
1	Blue Max System	.50
1	Frequency Label	.05
1	Model/Serial Label	.50



4 CHANNEL BLUE MAX RECEIVER-DECODER

Receiver Electrical Components

Semi-Cond.		
1	IN-34A	.65
3	2N-3325	1.50
1	2N-3563	1.50
Capacitors		
2	4 pf disc	.15
2	10 pf disc	.15
2	18 pf disc	.15
1	.001 disc	.35
1	.01 disc	.35
4	.05 disc	.35
1	.10 tant	.70
1	1.0 tant	.70
2	47 tant	.70
1	2.2 tant	.70
Resistors		
1	100 ohm	.12
1	270 ohm	.12
1	470 ohm	.12
3	1K ohm	.12
1	1.5K ohm	.12
2	3.3K ohm	.12
4	4.7K ohm	.12
1	10K ohm	.12
1	15K ohm	.12
1	47K ohm	.12
1	82K ohm	.12
1	100K ohm	.12
Chokes		
1	3.9 UH	.65
1	27 MHZ crystal	4.95
1	Mixer Coil	.60
1	4100 IF can	1.50
1	4101 IF can	1.50
1	4102 IF can	1.50

Decoder Electrical Components

Semi-Cond.		
1	IN-4148	.35
4	MPS-2924	1.50
4	UL-9914-28X	1.50
Capacitors		
1	.01 uf disc	.35
5	.02 uf disc	.35
1	1.0 tant	.70
Resistors		
1	100 ohm	.12
10	3.3K ohm	.12
1	10K ohm	.12
1	22K ohm	.12
6	47K ohm	.12
1	22OK ohm	.12
	Case + blue mystic tape (1½" x 7")	2.50
1	Frequency label	.05
1	Black Plastic Sheet insert (1 9/16" x 1 5/16")	.25
1	Gray foam pad — sticking on one side only (1½" x 1¼")	.05 .05
3	Black rubber grommets for 3/16" hole	.03
1	RX P.C. Board	2.00
1	Decoder P.C. Board	2.50
1	OS Male Connector	.50
1	OS Female Connectors	.50

BLUE MAX DECODER ADD-A-CHANNEL

No.	Desc.	$ ea.
Semi-Cond.		
1	UL9914-28X	1.50
Capacitors		
1	.02 uf disc	.35
Resistors — 1/4 watt		
1	3.3K ohm	.12
1	47K ohm	.12
1	OS Female Connector	.50

BLUE MAX BATTERY SUPPLY

1	G.E. 4.8V Battery Pack	11.98
1	OS Female Connector	.50

BLUE MAX HARNESS

1	9F Switch + 2 BHMS Screws	.75
1	9F Switch Black Plastic Cover	.30
1	OS Male Connector	.50
2	OS Female Connector	.50

BLUE MAX CHARGER

No.	Desc.	$ ea.
Semi-Cond.		
2	IN-2069	.35
Resistor		
1	47 ohm (1/4 watt)	.20
1	OS Male Connector	.50
1	Rye Male Connector + white plastic covering	.75
1	110 V. Line Cord	.50
1	Case for Charger	1.50
4	Black Rubber Bumpers	.06
2	Rubber Grommets for 1/4" hole	.04
1	Rubber Grommets for 5/16" hole	.05
1	P.C. Board	1.50
1	Brass Rivit	.02
1	Blue Max Charger Transformer (CT564)	4.50
1	Lamp #230 + cover & lock washer	.75
1	Lamp #235 + cover & lock washer	.75

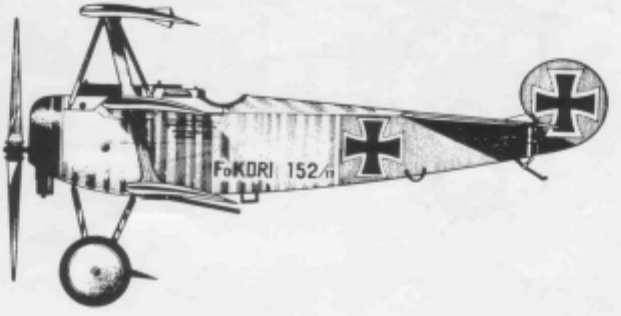
	Screws	
2	2 x 1/4 STMS Binding Head Type B Nickel Plated	.02
1	2 x 1/4 STSM Pan Head Type B Nickel Plated	.02
2	4/40 x 5/16 BHMS Head Nickel Plated	.02
2	Nuts for 4/40 x 5/16 BHMS Screws	.02
2	Lock Washers for 4/40 x 5/16 BHMS Screws	.02

SOLDER — .05/ft.
WIRE — .03/ft.
HEAT SHRINK TUBING — .20/ft.

BLUE MAX TRANSMITTER ADD-A-CHANNEL

No.	Desc.	$ ea.
Semi-Conductors		
1	2N-2925	1.50
Capacitors		
1	.001 disc	.35
1	.0047 mylar	.60
1	.047 mylar	.60
Resistors		
1	1.5K ohm	.12
1	3.3K ohm	.12
1	10K ohm	.12
1	47K ohm	.12
1	120K ohm	.12

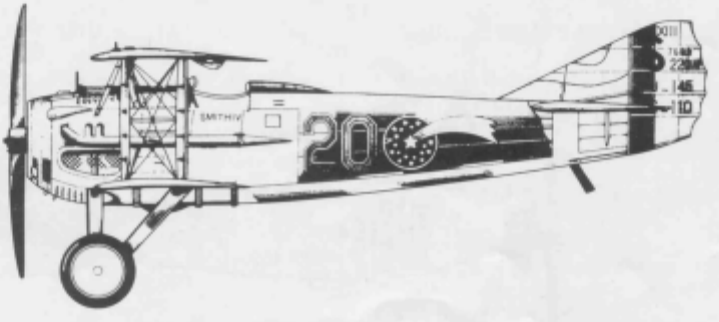
	Pots	
1	1.5K slide trol	.75
1	5K linear	1.20
	P.C. Board	1.50
2	Brass Stand offs	.15
	Screws	
2	2 x 1" Pan Head Machine Screws Nickel Plated	.02
	Screws Nickel Plated	.02
4	Metal Washers for 2 x 1" PHMS	.02
2	Nuts for 2 x 1" PHMS	.02



S-4B SERVO

No.	Desc.	$ ea.
Semi-Cond.		
1	IN-4148	.35
2	SKB 2710	1.50
2	MPS 2924	1.50
1	MPS 6560	1.50
1	MPS 6562	1.50
1	UL 9914-28X	1.50
Capacitors		
2	.001 uf disc	.35
2	.01 uf disc	.35
2	.1 tant	.70
1	1.0 tant	.70
1	2.2 tant	.70
Resistors		
2	470 ohm 1/8 watt	.20
1	3.9K ohm 1/8 watt	.20
1	47K ohm 1/4 watt	.12
1	180 ohm 1/4 watt	.12
3	4.7K ohm 1/4 watt	.12
1	10K ohm 1/4 watt	.12
1	22K ohm 1/4 watt	.12
1	39K ohm 1/4 watt	.12
2	47K ohm 1/4 watt	.12
1	Case-Bottom	.75
	Middle	.75
	Top Sections	.75
1	OS Male Plug	.50
1	Plastic Output Arm	.70
1	Motor	4.95
1	Small Brass Gear Shaft	.25
1	Large Brass Gear Shaft	.25

No.	Desc.	$ ea.
1	Gear	.35
	#1	.35
	#2	.35
	#3	.35
	Output	.50
1	P.C. Board — S4B	1.50
1	Pot P.C. Board	.50
1	CTS Pot Wiper	.25
1	CTS 1.5K Pot Element	1.50
1	White Plastic Wiper Nail	.25
1	Brass Cap for Wiper Nail	.25
1	Brass Pinion for Motor	.25
1	White Plastic Servo Tray	.50
1	Circular Output Arm	.50
4	Black Rubber Grommets (1/8" I.D.)	.02
S4B Label		.50
Screws		
1	2 x 3/16 STSM Pan Head Type B Nickel Plated	.02
2	2 x 1/4 STSM Pan Head Type B Nickel Plated	.02
4	2/56 x 1 1/4 Pan Head Nickel Plated	.02



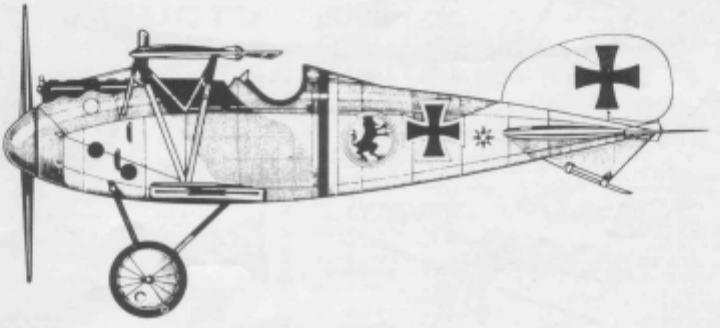
BLUE MAX SYSTEMS PRICE SHEET — MISCELLANEOUS

NOTE: Full systems prices on rear cover.

	FACT. ASSEM.	SEMI KIT	FULL KIT	SEMI KIT BOARD ONLY*
6 Ch. Tx. dual stick	157.98		113.98	
5 Ch. Tx. dual stick	148.98		106.98	
4 Ch. Tx. dual stick	139.98	114.98	99.98	49.98
Single stick assembly complete with pots	45.00			
Servo mechanics S-4 less amp., motor and pot			2.95	
S-4 B Servo	30.00	22.98	18.98	14.98
Buddy Box Cord	4.95			
Extra part package to convert 27 mhz to 53 mhz Rx.			10.98	
Extra parts package to convert 27 mhz to 53 mhz Tx Crystals are included in the above two items.			8.98	
Charger — Flite Pak only	7.98			

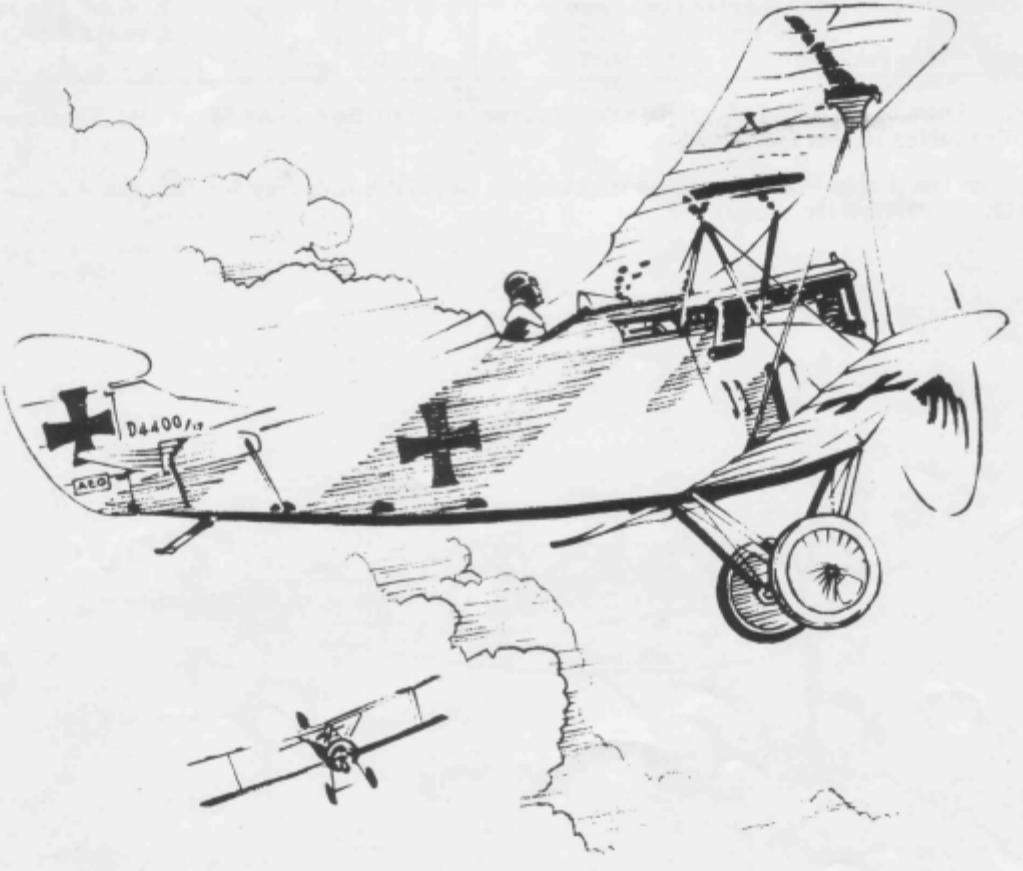
Miscl. All wire 5¢ per foot, W.E. special solder 10¢ per foot, 1/16 heat shrink 5¢ per foot, 1/8 diameter heat shrink tubing 10¢ per foot.

*Semi-kit board only — no wire, hardware, cases etc. Semi-kit boards only for decoders. 4 Ch. — $24.98; 5 Ch. — $27.98; 6 Ch. — $30.98.



SEMI-KIT BUILDERS

To those building semi-kits we cannot stress enough that you should read the introductory comments at the beginning of each section and look through the manual thoroughly. Below we have given you a list of the step numbers and pages where construction would start for the semi-kit version of the system.



OTHER QUALITY PRODUCTS FROM WORLD ENGINES

OS ENGINES

OS 10 R/C	$12.98
OS 15 R/C	16.98
OS 19 R/C	16.98
OS 30 R/C	21.98
OS 35 R/C	21.98
OS 40P R/C	18.98
OS 60 GP R/C	42.98
OS 80RV R/C	65.00

OS WANKEL .30 CU. IN.

OS of Osaka, Japan is manufacturing these engines in co-operation with Graupner of Germany. The first engine being produced is a .30 cu. in. engine. Notice that the engine in the photograph is equipped with a muffler which is an optional extra. Wankel engines are superior from a vibration standpoint to reciprocating piston engines. Price to be announced.

OS/RC

OS 1 STICK 5 CH. $325

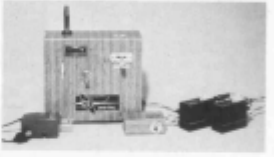
This is a deluxe system all the way. Nickel cadmium batteries both in the transmitter and receiver. The transmitter and receiver are five channels although we are only shipping the system with four servos. The transmitter is complete with a leather case. The servos are the new OS variety. If you want to pick up another servo you can either pick up an OS servo or a Controlaire S-4a servo will interchange. Plugs are the same. The extra servo would cost $30.00 retail. There are some areas that demand single stick equipment rather than dual stick. If you are living in one of these areas, you will appreciate this very deluxe 5 channel system.

OS DIGITAL

OS 2 ch. (2 servos)	$139.98
OS 3 ch. Deluxe (3 servos)	$199.98
OS 3 ch. Deluxe (2 servos)	$169.98
OS 4 ch. (4 servos) Cougar Series	$275.00
OS 5 ch. Single Stick (4 servos)	$325.00

OS 4 CH. (COUGAR) $275

Here from OS we have the new 4 Ch. Cougar Series System that is a real price breakthrough. The system includes four servos. These are the new, very small OS servo, about the size of the World Engines S-4a servo. The receiver is complete with nickel cadmium batteries and charger. The stick arrangement is aileron and elevator on the right stick, and motor and rudder on the left stick. The transmitter uses dry batteries.



2 CH. 2 SERVOS $139.98

The OS 2 Ch. has been available through World Engines for about one year as of January 1, 1970. This economy R/C system has been very popular, not only for airplane models, but particularly with model boating enthusiasts. The transmitter requires dry batteries. The receiver is supplied with a nickel cadmium battery supply and a charger. The servos are the S 620 series. These servos are slightly larger than the Controlaire S-4a servo or the new tiny OS servo.

OVERSEAS SERVICE MEN

We give a special discount to all service men based overseas with an APO address. This business is cash with order.

WILLIE BURNS TOOLING ARTF

We have for sale the tooling that Willie Burns used to produce his glider and his P-51. Also some wooden tooling for several other models. Vacuum forming machine not included.

NEW MINI-CATALOG 25c

We have a new mini catalog just printed August 1970. Send 25¢. Also we have a new bound manual for the Blue Max System for $2.98.

IM PRODUCTS

I. M. PRODUCTS

Clunk Tanks 2½ oz.	.98
Clunk Tanks 4 oz.	.98
Clunk Tanks 6 oz.	1.25
Clunk Tanks 8 oz.	1.25
Clunk Tanks 10 oz.	1.50
Clunk Tanks 12 oz.	1.50
Special 11 oz. Clunk	1.25
High Wing Main Gear 15 to 36	1.25
Corsair Canopy	1.25
Nylon Carb. Lever pr.	.50
Nylon Adj. Joint for Push Rods pr.	.50
Adj. Strip Aileron Horns	.39
Two Stage Fuel Line and Weight	.79
Engine Templates — All Sizes	.29
OS 10 Ringe 09 ST 40	
OS 15 Ringe 15 Veco 61	
OS 19 Ringe 60 K&B 40	
OS 40	
OS 60	
Control — All Sizes (Sm., Med., Lge.)	.19
Nose Gear Brace Set Replacement	.39
Nose Wheel Gate & Brake	.19
Pushrod Bubbles	.35
Hinge Pin (Toothpicks) Lge. Box	.49
Deluxe Prime Bottle w/cutoff	1.50
Std. Prime Bottle	.79
Motor Mounts w/hardware — Large	1.50
Motor Mounts w/hardware — Small	1.25
Silicone Fuel Line 36"	.99
Aileron B/Crank Set — Small	.39
Aileron B/Crank Set — Large	.49
Small Strip Aileron Horns	.49
Nylon Push Rods 18"	.79
Instruments — All Sizes — Sm., Med., Lge.	.98
Tube & Cable	.79
Taurus Tricycle Landing Gear, Med., Sm.	1.39
Taurus Tape Landing Gear — Lge.	1.49
Nose Gear — Med.	2.98
Nose Gear — Small	2.98
Control Horns — Med.	.39
Control Horns — Small	.29
Pilot — Small	1.50
Pilot — Medium	1.50
Pilot — Combat	1.50
Nylon Hinge — Med.	1.99
Nylon Hinge — Small	.59
Landing Gear Hold Down Set	.35

WORLD ENGINES NEW BLUE MAX SYSTEM

Add $25.[illegible] for Single Stick

FACTORY ASSEM.	$300.00
SEMI-KIT	249.98
FULL KIT	224.98

What does the new World Engines Digital —Blue Max System—have to offer? Plenty. 12 volt transmitter nickel cadmium power supply insures long range operation even at ground level. New servo circuitry for almost zero dead band. Each transmitter has Buddy Box plug. S-48 servos—smallest servo using large powerful motor. New World Engines sticks and transmitter case styling second to none.

SEMI-KIT

SEMI-KIT—features assembled and tested printed circuit boards. Assembled stick assemblies plus one fully assembled servo to act as time constant so your Buddy Box will be compatible with other sets.

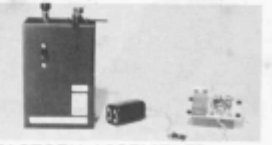
FULL KIT

FULL KIT—Now better than ever instruction manuals. Assembled sticks—one assembled servo for time constant. The full kit is for the expert—semi-kit is a better deal for the economy minded.

WORLD ENGINES DIGITAL

Blue Max 6 (4 servos) factory assembled 27 mhz	$330.00
Blue Max 5 (4 servos) factory assembled 27 mhz	$315.00
Blue Max 4 (4 servos) factory assembled 27 mhz	$300.00
Blue Max 4 Single Stick factory assembled 27 mhz	$330.00
Mule Digital 4 (4 servos) factory assembled 27 mhz	$340.00
Mule Digital 5 (4 servos) factory assembled 27 mhz	$355.00
Mule Digital 6 (4 servos) factory assembled 27 mhz	$370.00
Mule Digital Single Stick factory assembled 27 mhz	$355.00
Blue Max 4 Semi Kit Deluxe (4 servos) 27 mhz	$249.98
Blue Max 4 Full Kit Deluxe (4 servos) 27 mhz	$224.98

DIGIT MIGIT



FACTORY ASSEMBLED DIGITAL ONLY $69.00

This is a true DIGITAL PROPORTIONAL control system. The system is intended for steering the rudder on a model aircraft or boat or the wheels of a model car. Excellent for a sailplane.

The transmitter RF section is the same as used in the more expensive World Engines Propos. A trim control is also included.

The airborne system weighs 6½ oz. with batteries. The receiver servo combination unit mounts between rails spaced 2⅛" and it is 1⅝" wide. A motor control servo (sequencing) or a kick-up elevator servo will be available in kit form for $22.50 to operate as a second servo with DIGIT MIGIT. They use a 9V battery supply. The receiver and servo operate from four pencells; this battery box and switch are included and wired up ready for battery installation.

PLUS TRADE-IN PLAN

The outstanding feature of this single channel DIGIT MIGIT system is that it can be traded in on a four channel World Engines Digital system for full $69.00 value at a later time. All we ask is that the unit be operational and not physically damaged. This offer applies to our Blue Max System (factory assembled) and our MULE DIGITAL systems of four channels or better with a minimum of four servos.

SUPERTIGRE

G-40 ABC is winning in R/C Pylon

COMPETITION ENGINES

G.15 RV Diesel	$24.98
G.15 RV Glow	24.98
G.15 FI Glow	19.98
G.20/23 Std.	15.98
G.20/23 R/C Mag Throt.	19.98
G.21/29 RV ABC	31.98
ST 35PB Stunt	15.98
ST 35PB Stunt R/C	21.98
ST G.21/40 RV RR	25.95
ST G.21/46 R/C	26.98
ST 60 BB R/C	39.98
ST G.60 FI R/C	59.98
ST G.65 Speed ABC	54.98

BLUE MAX SYSTEM

COMPLETE BOUND INSTRUCTION MANUAL $2.95

Dual Stick
Blue Max System
Assembled with:

4 Ch.	$300.00
5 Ch.	315.00
6 Ch.	330.00

Blue Max System
Semi-Kit

4 Ch.	$249.95
5 Ch.	260.95
6 Ch.	271.95

Blue Max System
Full Kit

4 Ch.	$224.95
5 Ch.	234.45
6 Ch.	243.95

Note for
Single Stick—add
$-25.00
For 72mc—add 35.00

The Blue Max System is featured in the 1970 October November & December issue of Model Airplane News. The Single Stick Transmitter may be offered as a kit & run in the January 1971 issue of M.A.N. The 52MHS full kits or semi kits were included in the manual at the last minute prices same as 27 mhz. The Blue Max System is a new digital system. It is available from World Engines as assembled, semi-kit, or kit. A single stick transmitter is shown in the background. At the moment this is only available as an assembled item. The single stick version is very compact—4¾" wide, 6½" high, and 2¾" deep. From 4 to 6 channels. It weighs 2 lb. 6 oz. With nickel cadmium batteries.

Several years ago, World Engines offered the M.A.N. System in kit form and we manufactured essentially the same system under the brand name Controlaire as factory assembled equipment. The Blue Max System represents many state of the art changes that are possible because of new components being offered by electronic part makers. Also, there are many changes that were made by virtue of many hours of solid testing in the air both here at the World Engines factory and by co-operative model builders in other localities who have fed back the results of their testing to us. The voltage on the new transmitter is up from 9.6 to 12 volts. The new transmitter boasts a Buddy Box and a new black vinyl extra-thin case. The dual stick is available in either a 4, 5, or 6 channel configuration as is the single stick. Because of the extra load of batteries in the transmitter, we have now gone to an external charger with a big isolation transformer. We are particularly proud of our new receiver which, incidentally, can be built on the old M.A.N. System board but which is a radically different receiver. We are now using ICs in the decoder. The S-48 Servo is improved, particularly in the amount of dead band that is present.

Next month we are going to introduce a differential steering device that can be used on all S-4 Servos including the original S-4 and S-4A. The Blue Max System uses a Servo designated as the S-48.

The Wankel engine shown in the picture is a true rotary engine. Notice the muffler on this one. These engines are made by OS in Japan and will be available through World Engines shortly. Prices to be announced.

WORLD ENGINES INC. • 8960 ROSSASH AVE. • CINCINNATI, OHIO 45236