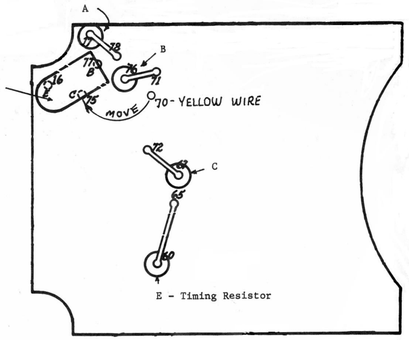
S4a SERVO

Mechanical Assembly Circuit Variations For Other Systems

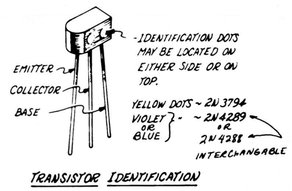


MODIFICATION #1
Omit the transistor 2N3794 (Q_1) that goes in holes 16, 77, 75. Also, omit resistors A-10K (17, 78); B-10K (71, 76); C - 1.5K (72, 67); and move yellow wire from hole 71 to hole 75.

BONNER 4 RS
ORBIT
MICRO

MODIFICATION #2
Same as Modification #1 plus change tuning resistor E (holes 60, 65) from a 3.9K to a 3.6K (orange, blue, red).

KRAFT
PCS
HEATHKIT
CLASSIC
CITIZEN-SHIP



TRANSISTOR IDENTIFICATION

POINTS OF INTEREST

At this point we want to tell you a little bit about the circuit. On the small board that attaches to the pot there are two 470 ohm resistors. If you want to decrease the throw, decrease the value of these resistors 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.

At the last minute on this manual we decided to show a picture which would be picture #10 showing an amplifier made up with Modification #1.

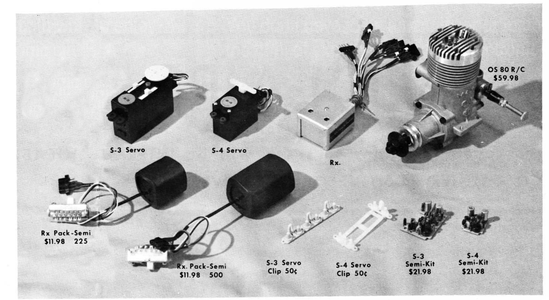
TROUBLESHOOTING (ASSUMING CORRECT ASSEMBLY)

1. Will not run at all in either direction - check Q-1.
2. Runs in one direction all the time (round and round) - pot not making contact or a bad MU-914.
3. Slow in one direction - low gain Q_3 or Q_5. This can be corrected to some extent by replacing 22K with 47K.
4. Runs in one direction - will not return. (Looking at top of servo.)
   Will not return clockwise - check C_2, Q_2, Q_5, Q_7
   Will not return counter-clockwise - check C_1, Q_4, Q_3, Q_6
   In all cases the parts would be open.

Repair and Replacement at World Engines

Kit Built $10.95
Semi-Kit Built . . . . . $ 8.95
Factory Assembled . . . . . $ 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.

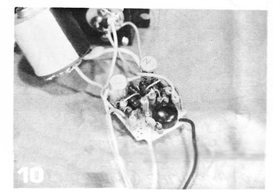


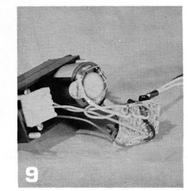
Controlaire scores another "FIRST" with the MAN 2-3-4 System. This "first" is the introduction of the Semi-Kit into the model aircraft radio control field. In a Semi-Kit the printed circuit boards are all the components mounted and tested. The fact that the board has been tuned and tested is a great improvement over a plain, ordinary kit because in most kits the parts are not tested. If the part is defective the kit builder generally has to dig up another part so that he can complete his equipment. In this way you can see that factory tuning and testing at least eliminates the problem of the board being at least as required on the order in a Semi-Kit is the correspondence between board and stick assembly and board and battery pak or charger. In short, the Semi-Kit is for the person who wants to save some money by donating his time to mechanical assembly and interwiring. For those who just plain enjoy doing everything, we have the Kit Built. We feel that the instructions are going to be valued brief as we expect only the experts will tackle the pure kit variety.

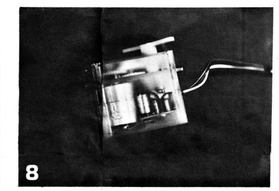
So much for the Semi-Kit. Let's take a look at the transmitter. Yes, the price is low but then Controlaire has always tried to offer good equipment at a good price through all of the 13 years that we have been in business. To start with, the stick assemblies are made by OS in Japan and we get our high quality antenna from the same source. The rest of the components, for the most part, are purchased here in the United States and assembled in our plant. Some of the real quality features of this transmitter are evidenced by the isolation transformer and the charger, the novel power plug in the front of the transmitter, and the trim pot through each channel so that the servo centering and throw can be adjusted from the transmitter. Joe Stanton, the brain behind Controlaire, appreciates the advantage of our system and that is that you cannot blow out the transmitter by inadvertently leaving the switch on during charging. The nickle cadmium batteries supplied with this system are 600 mah GE or Gould Nicads. The charger cord plugs into the front of the transmitter which can be charged standing up — and over to the receiver in the airplane.

One of the nicest features of every piece of Controlaire equipment is the spin finish on the case. It is about time we personally thanked Charlie Bassi of Angell Depcor who do this for us. The personal interest that he has taken in Controlaire has certainly helped us develop one of the most exclusive metal art identifications in the industry.

	DESCRIPTION	CONTROLAIRE ASSEMBLED	MAN 3-3-4 SEMI-KIT	MAN 3-3-4 KIT
1.	4 Ch. Deluxe System	$300.00	$239.98	$214.98
2.	4 Ch. Standard System	250.00	205.50	177.98
3.	3 Ch. Deluxe System	250.00	216.98	195.98
4.	3 Ch. Standard System	200.00	174.98	158.98
5.	2 Ch. Deluxe System	215.00	189.98	163.50
6.	2 Ch. Standard System	165.00	147.98	126.50
7.	4 Ch. Tx w/Power Pak	139.98	114.98	99.98
8.	4 Ch. Tx less Power Pak	110.75	88.50	77.50
9.	3 Ch. Tx w/Power Pak	112.25	94.50	79.50
10.	3 Ch. Tx less Power Pak	82.98	64.50	54.50
11.	2 Ch. Tx w/Power Pak	103.25	86.50	71.50
12.	2 Ch. Tx less Power Pak	73.98	56.50	46.50
13.	Decoder	34.98	27.98	23.98
14.	3 Ch. Decoder	30.98	24.98	21.50
15.	2 Ch. Decoder	26.98	21.98	18.98
	NOTE: All the following are common regardless of number of channels.			
16.	Rx less Power Pak	37.50	29.98	24.98
17.	Servo	30.00	22.9*	18.98
18.	Dual Charger plus Tx (Nickle Cadmium Batteries)	32.98	29.98	24.98
19.	Rx Power Pak Only (Nickle Cadmium Batteries & Switch)	16.98	11.98	11.98







PARTS LIST S-4

RESISTORS - 1/8 WATT EXCEPT AS NOTED

VALUE	COLOR CODE	QUANTITY	PRICE EA.
10 ohm	Brown,Black,Black	1	.20
47 ohm 1/4 W	Yellow,Violet,Black	1	.12
220 ohm	Red,Red,Brown	1	.20
1K	Brown,Black,Red	3	.20
2.2K	Red,Red,Red	1	.20
3.9K, 5%	Orange,White,Red	1	.20
4.7K	Yellow,Violet,Red	2	.20
10K	Brown,Black,Orange	2	.20
15K	Brown,Green,Orange	2	.20
33K	Orange,Orange,Orange	3	.20

CAPACITORS

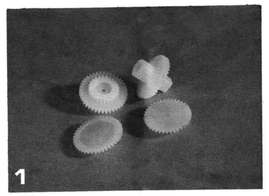
VALUE	TYPE	QUANTITY	PRICE EA.
62 pf	Disc	1	.15
.05 MF	Disc	1	.35
0.1 MF	Tantalum	2	.70
1.0 MF	Tantalum	1	.70
2.2 MF	Tantalum	1	.70

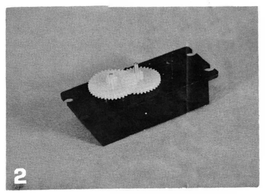
SEMICONDUCTORS

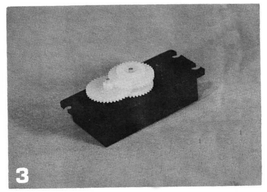
TYPE	QUANTITY	PRICE EA.
2N3794	3	.99
2N4289	2	.99
2N4105	1	1.50
2N4106	1	1.50
IN4148	1	.35
914	1	1.50

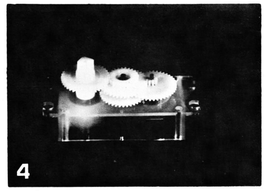
MISCELLANEOUS

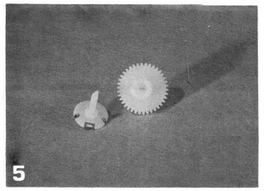
Printed Circuit Board	1	1.50
OS 4-pin Male Plug	1	.50
Wire & Heat Shrink Pkg.	1	.50
S-4 Servo Mechanics with motor, pot, and mounting hardware	1	8.98

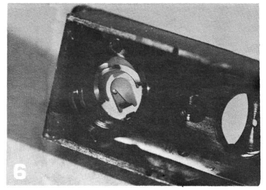


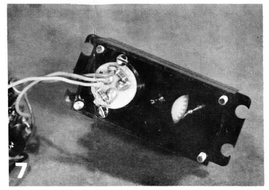












MECHANICAL ASSEMBLY

FLEXIBLE LEAD ATTACHMENT

Prepare the following leads by cutting them to length and stripping 1/8" of insulation from one end and pre-tinning.

1½"	Green	2"	Blue
9"	White	2"	Orange
7"	Yellow	2"	Brown
7"	Black	7"	Red

Install the 47 ohm noise suppression resistor and .05 Disc capacitor on the back of the motor taking care to orient the cut-off Blue lead as shown. Reversing the Green and White leads at the motor terminals usually causes the servo to rotate to one limit and oscillate when placed in operation. Scrape the paint from the case screw adjacent to the cut-off Red lead and ground the motor case by soldering the excess capacitor lead from the White wire side to this screw.

FLEXIBLE LEAD PLACEMENT

COLOR	FROM	TO LAND CONTAINING HOLES NO.
Green	Motor	31
Orange	Feedback Pot	21
Blue	Feedback Pot	56
Brown	Feedback Pot	11
Yellow	Plug	70
Black	Plug	12
White	Plug	3
Red	Plug	20

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 I 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.

GEAR TRAIN ASSEMBLY

Photo #1 shows the distinguishing features of the four large gears in the train. The #1 intermediate and the #2 intermediate gears are very similar in appearance, the difference being that the bottom or face of the #2 intermediate is undercut while the #1 is smooth. The #3 intermediate gear has a larger diameter pinion than the #1 or #2 and the output gear has a flatted shaft for attachment of the output arm or wheel. The two brass gear shafts have small flanges machined on them near one end. This end goes down, or into, the case center section.

Begin assembly by installing the #1 intermediate gear on the larger brass shaft. Check the little window in the raised plastic boss over the motor area for flash. The #1 intermediate fits in this area to engage with the motor pinion,so rotate this gear after installation to see that there is no interference. Install the small brass shaft in the #2 intermediate and place it in position on top of the plastic boss. Stack the #3 intermediate gear on top of the #1 on the large brass shaft.

Photo #5 shows a bottom view of the output gear and a side view of the brush holder. Notice that the brush holder has a screwdriver type end on its plastic shaft. This engages in a rectangular depression up inside the output gear. Check this blade end to see that it has no flash on the engagement area but do not get too heavy handed with your knife if you do have to trim any. Insert the wiper holder into the pot cavity and hold it in place with the blade end protruding from the output gear bearing boss. Orient the output gear so that the rectangular depression inside it will align with the blade of the holder and install it on the bearing boss. Press on the wiper holder near the center as you are doing this to cause the blade to engage. When properly engaged there should be very little allowable movement up and down of the output gear. Place the case top on the assembly and push the four case hold-down screws in place to hold the two sections together.

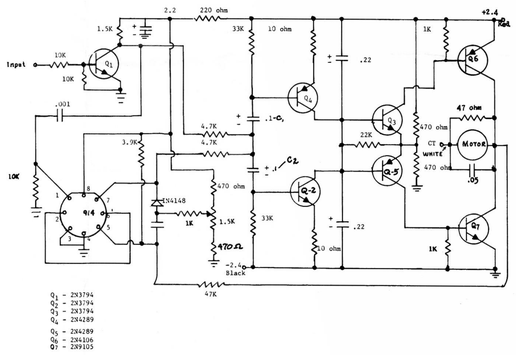
FINAL ASSEMBLY

Refer to Photo #7 and insert the feedback pot element into its cavity in the case centersection. Install the two 2 x 3/16" screws to hold the element in place.

At this time you may check general operation by inserting the motor in position and plugging the unit in. The servo will run to its neutral position and stop and it will be necessary to loosen the two screws holding the pot element and rotate it to obtain a neutral position with the flats of the output stub parallel to the case sides. Cut a 1/2" length of foam tape and stick it to the pot element and wires to act as a pad and insulation. Place the amplifier section in position being careful not to trap any wires between the circuit board and the motor. Notice the post cast in the bottom case section. Since the .05 capacitor on the back of the motor extends out into this area, the motor must be rotated to allow it to clear the post. Install the bottom, routing the plug wires through the notch in the bottom, tighten the case screws and install the output hardware of your choice.

S-4 REPLACEMENT PARTS LIST

Complete Mechanics with motor, pot, and hardware	8.95
Case Top	.75
Case Center Section	.75
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
Pot Brush Holder	.35
1.5K Pot Element & Wiper	1.50
Mounting Clip	.50
Output Wheel	.50
Single Output Arm	.50
Double Output Arm	.70
Servo Motor	4.95



CONTROLAIRE S4a SERVO

Instructions cover variations so servo will be INTERCHANGEABLE WITH ALMOST ANY 4.8v CENTER TAP SERVO - EITHER POSITIVE OR NEGATIVE PULSE.

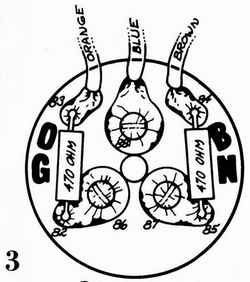


Fig. 3

POT. P.C. BOARD
COPPER & COMPONENT SIDE.

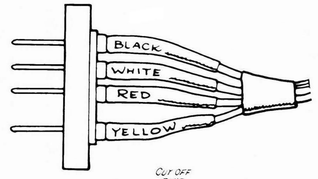


Fig. 5

Fig. 6

OTHER SIDE

1. Circuit Diagrams
2. Modifications For Other Servos
3. Mechanical Assembly

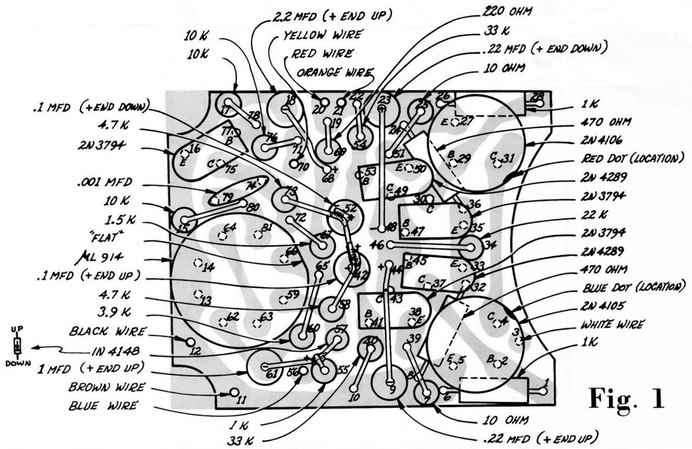


Fig. 1

S4 SERVO AMPLIFIER (UNIVERSAL) -COMPONENT SIDE

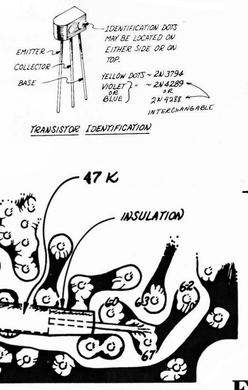


Fig. 2

S4 SERVO AMPLIFIER (UNIVERSAL)
-COPPER SIDE

TRANSISTOR IDENTIFICATION

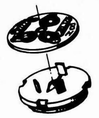
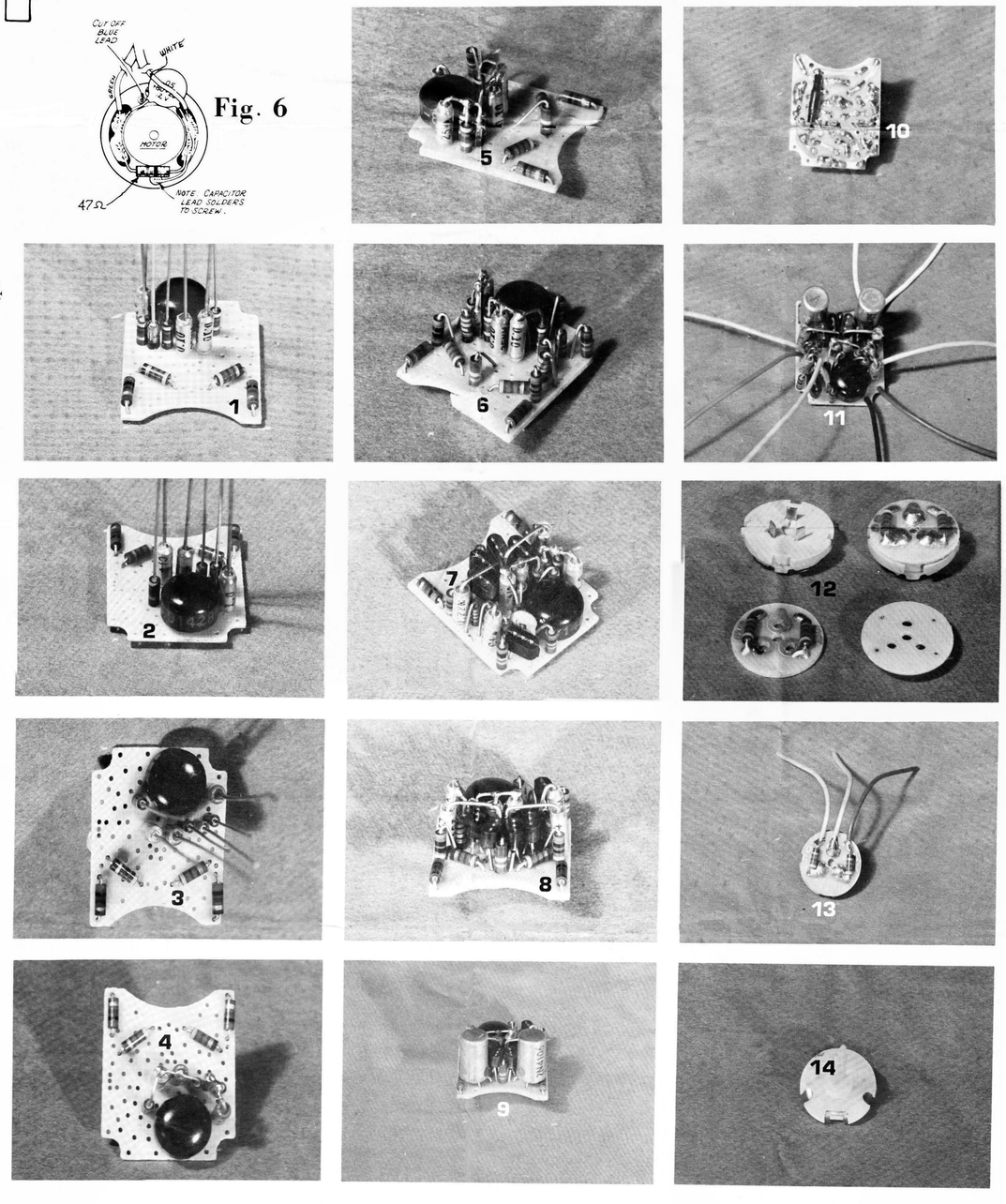


Fig. 4

ASSEM. SKETCH



BOARD ASSEMBLY INSTRUCTIONS

This is being written in December, 1968. At this time we have had experience on many thousand S-4 servos in assembly in our own shop and we have had a chance to talk with many customers who put the servo together from our kit.

We have rearranged the board of the S-4 Servo. We are now calling it the S-4a Servo. In the S-4a we have made more room on the board by making some of the connections topside. Notice the group of parts in hole 73, 52, 42, and 58. These are all joined on top. This can be seen both in the photographs and in Fig. 1. Another cluster of parts go in holes 61, 55, and 57. At Controlaire, in factory production of assembled servos, we use a Princess soldering iron with a needle point which runs about 15-18 watt. The solder that we are putting in our kits is a special solder produced by Alpha. This solder contains a flux that does not carbonize. Ordinary soldering flux on a board this small will form resistance bridges in between the copper lands. Carefully clean off the bottom of the board after you complete assembly. Please notice Photos #1 through #14. The progression of photographs #1 thru #8 show how we recommend building up the board with regards to what parts to put in first. Picture #10 shows the 47 K resistor which is placed in the back of the board and Picture #11 shows the attachment of the wires to the board. Picture #12 shows the construction of an assembly consisting of the 1.5K pot and a small board which fastens to this pot. In Photo 12 you will notice that the pot is shown with the leads clipped. We clipped these leads 3/32" high. The relative position of the little circuit board and its radio placement on the pot element is illustrated by the dotted line on Fig. 3 showing the position of the carbon element on the pot with respect to the little round board. Photo #13 shows this sub-assembly completed with wires. Photo #14 shows the holder for the little brass pot wiper. We did not get very explicit about this sub-assembly in the S-4 instructions and we find people assembling the copper pot wiper without crimping the ears over the plastic as we have shown in Photo #14.

The S-4a Servo is interchangeable with the S-4 Servo. It requires a 4.8 volt center tap nickle cadmium battery supply. The configuration shown in Fig.1 is for a negative information pulse of approximately 1.7M.S. As shown, the servo will not work with digitrio, with Controlaire systems that use 3 receiver batteries, or with hardly any other type of proportional.

On the other side of the page we are going to include information on the mechanical assembly of the servo, on the interwiring of the little board, Photo #13, with the main board, Fig. 1, and with the motor and plug, Figs. 5 and 6. Also, on the other side, we are going to show the modifications to this servo - which are really minor - so that the servo can be used with Kraft, PCS, Orbit, Citizen-Ship, Micro, Heathkit, and Royal Classic systems.

MOTOR

There is a 47 ohm resistor and a .05 mf disc capacitor soldered to the bottom of the motor along with white and green wires. See the wire chart on the other side of this sheet.

See Fig. 6 - 1/4 watt 47 ohm yellow, purple, black resistor plus .05 mf. disc capacitor.

RESISTORS - 1/8 WATT *INDICATES TOP CONNECTION

VALUE	COLOR CODE	HOLE NUMBERS	PRICE EACH
10K	Brown, Black, Orange	17, 18	.20
10K	Brown, Black, Orange	76, 71	.20
10K	Brown, Black, Orange	15, 80	.20
10 ohm	Brown, Black, Black	25, 51	.20
10 ohm	Brown, Black, Black	7, 39	.20
4.7K	Yellow, Violet, Red	73, *	.20
4.7K	Yellow, Violet, Red	58, *	.20
1K	Brown, Black, Red	55, *	.20
1.5K	Brown, Green, Red	72, 67	.20
3.9K	Orange, White, Red	60, 65	.20
33K	Orange, Orange, Orange	10, 40	.20
1K	Brown, Black, Red	1, 6	.20
22K	Red, Red, Orange	34, 46	.20
470 ohm	Yellow, Violet, Brown	24, 36	.20
470 ohm	Yellow, Violet, Brown	8, 32	.20
1K	Brown, Black, Red	26, 28	.20
33K	Orange, Orange, Orange	52, 54	.20
220 ohm	Red, Red, Brown	69, 19	.20
47K	Yellow, Violet, Orange on copper side of board	67, 4	.20

DISC CAPACITORS

VALUE		HOLE NUMBERS	
.001 mfd		79, 74	.35

TANTALYTIC CAPACITORS

.22 mf	Plus end down	23, 48 (-)	.70
1.0 mf	Plus end up	61, *	.70
.22 mf	Plus end up	9, 44 (+)	.70
2.2 mf	Plus end up	18, 68 (+)	.70
.1 mf	Plus end down	52, *	.70
.1 mf	Plus end up	42, *	.70

TRANSISTORS

TYPE	EMITTER	BASE	COLLECTOR	PRICE
2N3794	16	77	75	.99
2N3794	35	47	30	.99
2N4289	33	45	37	.99
2N3794	38	41	43	.99
2N4289	50	53	49	.99
2N4105	5	2	4	1.50
2N4106	27	29	31	1.50

DIODE & I.C.

Install (banded end) of diode IN4148 (80.35) in hole 57. The anode lead fastens to the 4.7K resistor hole 55. Install the I.C. lead adjacent to the case flat in hole 66 with the remaining leads going in holes 59, 63, 62, 13, 14, 64, 81.

Note: Also included is a 3.6K orange, blue, red resistor used in other servo configurations.

WORLD ENGINES
8980 ROSSASH AVE. CINCINNATI, OHIO 45236