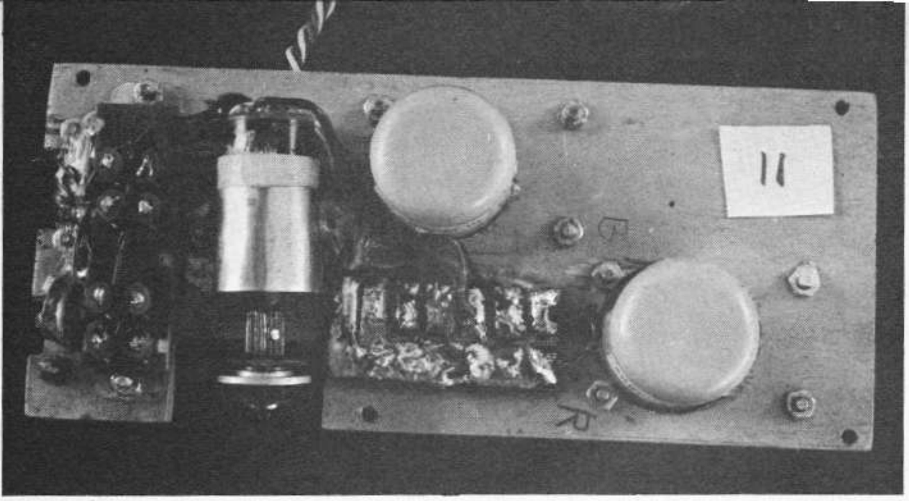
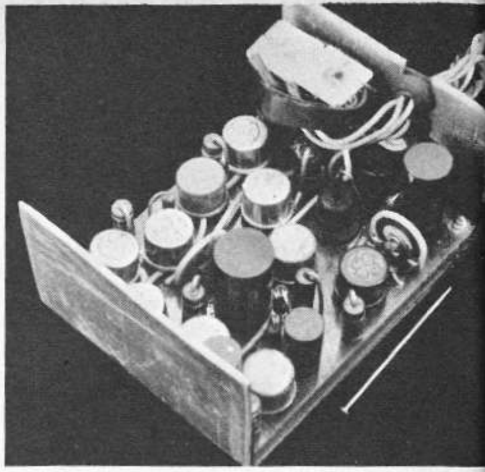
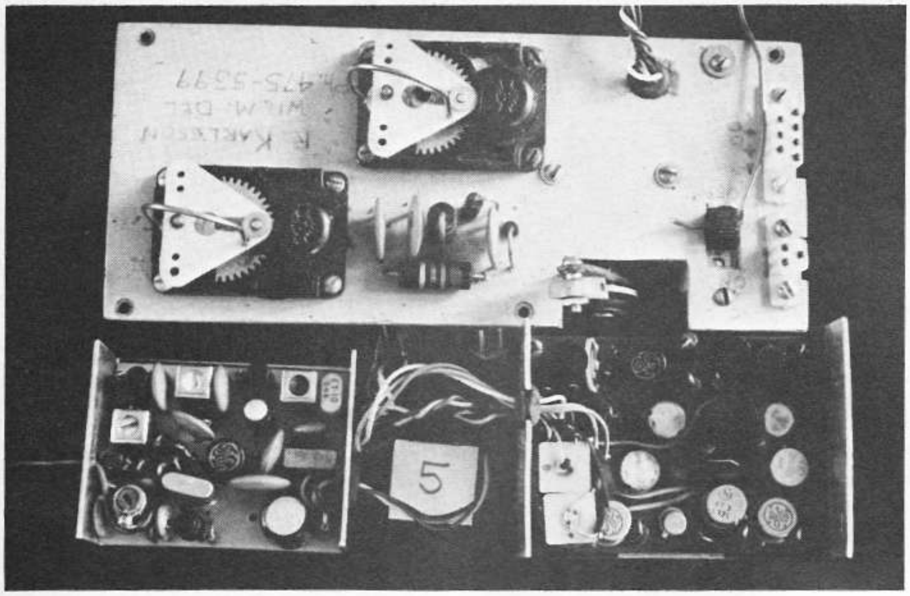


Underside of servo board showing T-05 Micro Mo motor with 485-1 gear case. Slip clutch made from Perfect needle valve epoxied to shaft, washers, 1/2A grommet and a four-forty bolt.



A view inside of the decoder. Straight pin is used to show actual size of the complete unit.



Servo board. Top: Controlaire SH-100 receiver, minus relay at left, and decoder at the right. Dee Bee 21 servos are shown and engine control output arm shown in notch on side of board.

TRANSISTOR RATE AND WIDTH DECODER

By BOB KARLSSON

► This system was developed using the Kraft K3VK for the receiver. After two seasons of use, the desire to use Superhet put the Controlair SH 100 into use. The aircraft used is a Falcon 56 with .35 power. Strip ailerons are mechanically coupled to the rudder servo. Total weight of the system using the superhet, and four 750 mah nicads is only 15 ozs.

Compared to a feedback system, it is fairly simple. The servo amplifier portion of the system has been used four seasons for rudder only and galloping ghost. A total of nine amplifiers has been built without changes in circuitry.

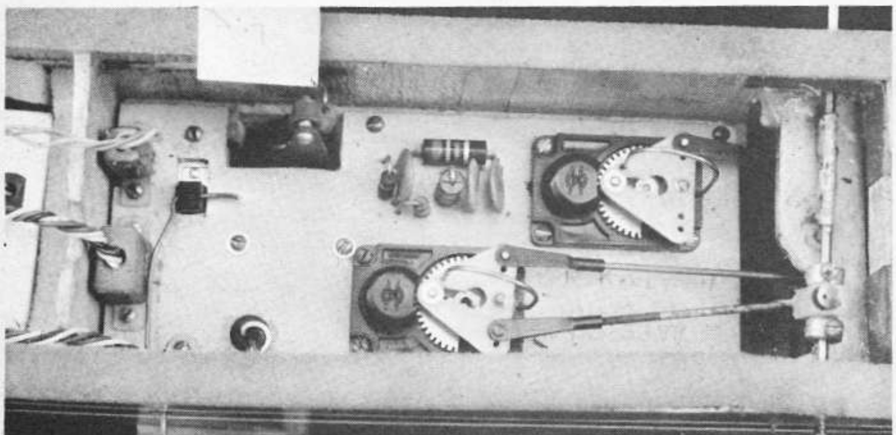
The rate detector first used for two seasons had relays. Any slight change in contact resistance, or contact bounce of the receiver relay caused erratic elevator operation around neutral. Substituting the transistor amplifiers for the relays eliminated these difficulties, and also problems of vibration. A rate change of 3 to 1 is required. Neutral is adjusted by the 10K pot and can be achieved over a wide range, to suit many pulsers.

The P.O.D. is from Grid Leaks by Bob Broadhurst. The relay pulls in during pulsing, unlike most others. The only difference in this application is that it is driven from the elevator output, and thus drops out with either full on or full off. Two reed relays are used, wired in parallel. They cut off current to rudder and elevator, and switch the full on or off to the motor servo. A Gem 100 ohm DPDT Relay has been used, but this takes more room.

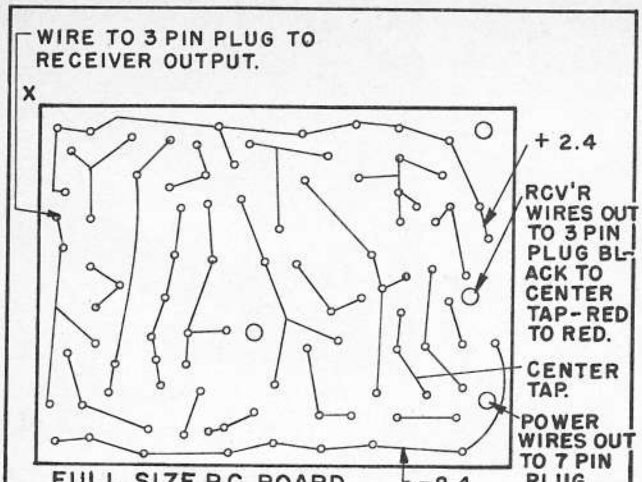
Servos have all been based on the Micro Mo" motor. Bellamatic, Dee Bee 21 and Reynolds servos use this motor. The pictures show the Dee Bee 21.

Some of the features of this decoder are:

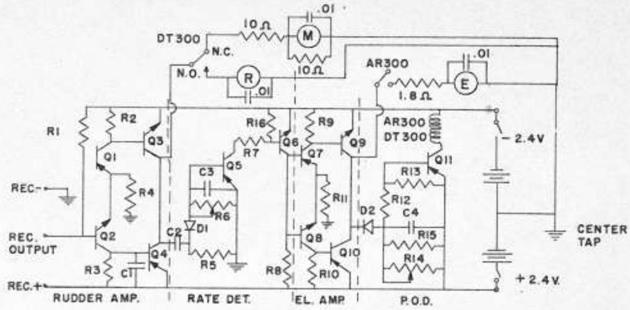
1. Size 2½" x 1⅞" x 1¼"
2. Weight 2.4 oz
3. Functions:



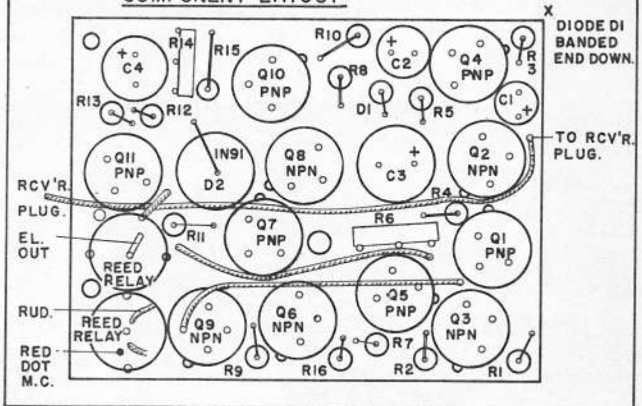
Servo board installation. T bar through slots in sides engages strip aileron, pivot in center and is coupled with rudder in this installation. Off-on slide switch mounted to board.



FULL SIZE P.C. BOARD



COMPONENT LAYOUT



SOLID STATE DECODER TO PROVIDE PROPORTIONAL OPERATION FROM SIMPL-SIMUL SYSTEM ELECTRONICALLY. CAN BE USED WITH MOST GALLOPING-GHOST PULSERS.

Proportional rudder and elevator
Trimmable throttle and fail safe

4. Works on pulse width for rudder; plus rate for elevator; solid on or off for motor
5. Can be used with many existing receivers
6. Can be used with many existing pulsers. It will operate within these ranges:
   Slow: 3 cps for up; 10 for down
   Fast: 10 cps for up; 30 for down
7. 4 Nicads are total airborne supply.
8. No relays to adjust or clean
9. Current drain 250 ma. average.

A Micro Mo T05 with 485-1 gear box is used for motor control. A slip clutch was fitted to prevent motor stall. A 10 ohm resistor across the motor acts as a brake and a 10 ohm resistor in series limits current. This arrangement is perhaps a little too fast for precise positioning. Another 2-1 reduction would help. Relay type multi-servos such as Annco or Duramite, require diodes between the relay and the two servo inputs.

P.C. plates were made, using the kit sold by Ace. The instructions are very clear, and a good job can be done using tape. The layout shown has only a line to indicate the lands. Tape the layout to your circuit board and lightly punch all holes. Try to use the wide tape and trim off a little where things get too crowded. Make sure to have all the copper bright and clean before attempting to solder.

If you don't have a transistor tester, a very simple circuit can be used with your multi tester. See "Grid Leaks" March-April 1962 or M.A.N. March 1963 in the B & D series (Reprints available.).

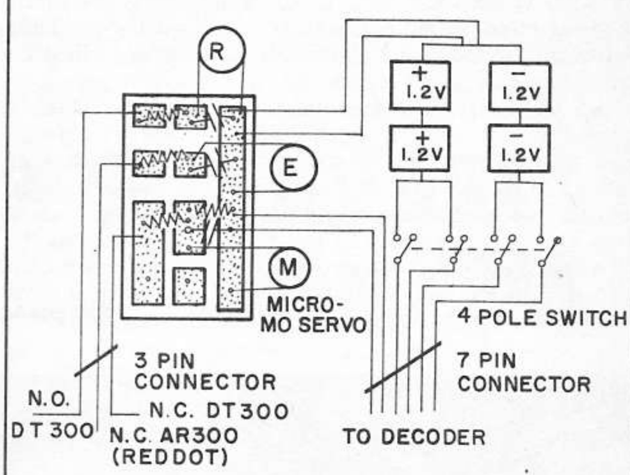
Each pair in the two amplifiers should be reasonably matched. 2N1302 and 2N1303 are not as uniform as 2N1304 and 2N1305. Both have been used, however. Pairs of the complementary symmetry drivers Q1 and Q2, Q7 and Q8 should be paired. Use lower grain here.

Highest gain pairs should be used for the outputs. Q3 and Q4, Q9 and Q10. Look for low leakage for Q5. Most anything will do for Q6 and Q11.

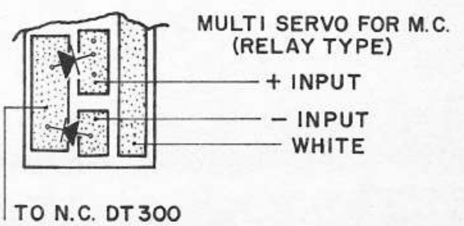
I do not feel a step-by-step explanation is needed. However, here are a few points.

1. Use a 3/16 drill on top of P.C. board and put a dimple in the hole where the 1N91 will fit, so that it will seat firmly on the board.
2. Use standard wire and run jumpers first. Glue them down. Epoxy (*Continued on page* 47)

SERVO BOARD WIRING



CEMENT P.C. PLATE TO UNDER-SIDE OF SERVO BOARD BEFORE INSTALLING COMPONENTS WHICH ARE ON TOP OF SERVO BOARD.



Transistor Rate and Width Decoder

(*Continued from page* 26)

works best.

3. Install all transistors and diodes first so that a heat sink can be used.
4. Install reed switches with round end down.
5. Do not install R15 and R16. They are used only if needed.

The power supply is double-wired through the switch and plug to the decoder. This necessitates a 4 pole switch. It also provides a very easy way to test switches and wiring by using an ohmeter at the open plug and measuring resistance across any pair of wires with switch on. Care must be taken to test *pairs* of wires, or you may ruin a meter. More than 1/5 ohm and you have trouble. If you don't want to double wire through the switches and plug, be sure to double the center tap to the servos.

A small P.C. plate can be made to simplify servo wiring. A 1.8 ohm resistor should be in series with the Dee Bee 21 servo, also a .01 mfd capacitor across the motor. Arrange your layout to have this close to the servos. A ⅛" plywood board can be made to mount servos, plugs and switch. Cement the P.C. plate under the plywood, drill through both and mount resistors and capacitors on top of plywood. This makes a very tidy installation that can be readily removed from your plane.

Initial testing can be done by hooking directly to the pulser relay, by-passing the transmitter and receiver. Put the input of the decoder to the relay arm, and plus to the N.O. contact. Set R14 to maximum resistance and R6 to center. You can use 10 ohm resistors in place of servos, if you wish. In this case, use a voltmeter and measure the voltage at the output. Adjust R6 to read 2.4 volts at the elevator output, or, if you have servos hooked up, the elevator should be set to neutral. If you have too much down, and R6 is getting too near the end of adjustment, try about a 1K resistor for R16.

With full up trim, and full up stick, adjust R14 until the motor control servo starts to pulse, then back off a little on R14. If the pot adjusts too close to the low resistance end, put in about 2.2K for R15.

If there is any contact bounce of the pulser relay, it may cause a drifting neutral of the elevator, or at worst full down. A reed switch in the pulser eliminates this. However, the pulsers used have had standard Gem relays, and the receiver filter corrects this when going through the receiver. By by-passing the receiver this way, you will know if the problem exists. Unless it is very bad, proper adjustment of the tone filter takes care of it.

The pulser now in service is the design of John Phelps. No special pots are required, and all components are readily available for this design. Ace also has a kit available. It can be adjusted over a broad rate range without changes and is highly recommended. If you decide to scratch-build the Phelps pulser, by all means use the reed switch.

This decoder has been used with several receivers. The Otarion 0-21 worked well, but this receiver swamps when close to the transmitter, with carrier on and it was used very little.

Three different Kraft K3VK have been used for over 400 flights. Recently, the desire to have superhet, put the Controlaire SH 100 in use, with relay removed. If you have a 3 Volt receiver that will reject noise, with or without relay, it should be compatible.

In general, most relayless units have a big electrolitic capacitor that usually needs to be changed. Start first with no changes to the filter. With a relay type, remove the relay and connect the coil leads directly to the input of the decoder. Most likely relayless receivers will be over-filtered and there will be a delay in the switch-off. This would not be objectionable if we were not going to change the rate.

These receivers were designed for escapement use, and 70 mfd filters out almost all of the tone at 700 cps audio frequency, but the slow discharge prevents a sharp cut-off. In all cases with the Kraft K3VK this capacitor was reduced to *about* 30 mfd. Unfortunately, an exact value to buy for this change is difficult due to the big tolerance of low cost miniature electrolitics. In some cases, "25 mfd" will work. If you don't have a scope to see the wave form at the receiver output, the way to make the change is by operating the entire system. *Providing there is no interaction of the pulser you are using,* as the rate is increased (down stick) the rudder will go to the right, if the capacitor is of too large a value. If the rudder servo gets sluggish to the right, or the elevator tends to have too much down, the tone is not filtered well enough and indicates the capacitor is too small. Reducing the 1K bias resistor to the base of the output transistor in the Kraft will work the same way, but don't go lower than 680 ohms. When this filter has the proper values, a pulse rate range as fast as 10 to 30 CPS can be used with this receiver. With the Kraft, R1 in the decoder is not critical, and 270 ohms works well.

A Controlaire 5 was tried, and worked well with no changes, as the filter is only 15 mfd. This receiver was bench tested only.

Two Controlaire SH 100 kits were built,

leaving the relay off. On one of the receivers, a 100 mfd electrolitic was put across the 2.4 V supply. New holes were drilled in the proper lands, and there was plenty of room left with the removal of the relay. The use of the capacitor is questionable, as the other receiver works as well without it. This was mentioned because you sharp-eyed readers will see it in the pictures.

The SH100, unlike most receivers, has the filter capacitor across the relay, or load, which makes it harder to obtain enough filtering without the addition of another stage between receiver and decoder. By adding C1 to the decoder, changing the 70 mfd in the SH100 to 20 or 25 mfd and finding the correct value for R1 excellent results have been achieved without the use of another stage. The capacitor you replace in the receiver must be rated at at least 6 volts.

With the SH100, R1 in the decoder will be something from 82 ohms to 1K. Try a 1K pot here and find proper value for R1. As R1 is reduced too far, the elevator will go to down. Keep as high a value as you can without the rudder reacting to rate change. Measure the resistance of the pot and substitute fixed resistor.

The SH100 is designed for 3-3.6 Volts. Not wanting another switch on a 3.6 volt tap, first attempts were to drop the 4.8 V to 3.1 with a dropping resistor and 100 mfd capacitor. Range was excellent, but with carrier off, noise rejection was bad enough to prevent fail-safe. Changing the receiver sensitivity to the point where carrier off fail-safe was achieved, resulted in poor range. When the receivers were tried on 2.4 volts and sensitivity changed to maximum as specified, the sensitivity controlling resistor to 100 ohms, excellent noise rejection and very good range resulted.

It is suggested that a 3 pin plug be used with the SH100 so that it can be removed for tuning. Remember, when not plugged in, there is no load, as the relay was removed, and a resistor of about 56 ohm should be used as a load when tuning. Also, when tuning, use 2.4 volts. You will not get the 40 ma, as specified, so just tune for maximum.

The Kraft 3KV is easily tuned in the airplane, tune for maximum right rudder at reduced transmitter output.

Two transmitters used have an audio frequency of 750 and 825 cps. Transmitters of lower audio frequency may require lower pulse rates, as the audio will be harder to filter. Transmitters of higher frequency will be to an advantage.

As most single channel receivers are not intended to be used on the servo battery supply, you can try this, to see if your receiver has sufficient noise rejection to be compatible with this system. All receivers used so far have passed this simple test. A milliammeter is put in the plus lead and the receiver connected to a 2.4 V supply. If it is a relayless type, a 50 to 100 ohm resistor will be needed for the output load, in place of the escapement.

Without carrier on, the idle will be unsteady. An electric motor, such as a Mighty Midget or Micro-Mo, is put across the *"battery terminals."* The idle current should not go up more than 10%. With carrier on, it should be the same with or without the motor running. Do not use any filter on the motor for this test.

Plans for the future include packaging the SH100 and the decoder in one case. It will save quite a bit of room. An electrically coupled aileron servo hookup is also in the test stages.

This decoder has also worked with a total supply of 2.4 volts, center tapped, using servos made from the smaller T05 micro-mos. Using this lower voltage requires careful selection of all components, and requires a great deal of adjusting, but it results in a complete airborne system that weighs in at 9½ ozs.—including two 500 mah nickle cadmiums! Minus the POD relays and motor control servo, airborne weight can be as low as 8 ozs, if you want a system for sailplanes. If you intend to use this at the lower voltage, high gain transistors for the amplifiers are a must, and you should have access to the proper test equipment and be willing to experiment.

For those who do not understand the schematic, these brief explanations may help in the case of trouble:

Q 1 and Q 3 drive the servo left
Q 2 and Q 4 drive right
Q 5 and Q 6 drive Q 7 and Q 9
Q 7 and Q 9 drive elevator servo down and also turn on Q 11 through D 1
Q 8 and Q 10 drive up
With no signal, the following transistors will be conducting Q 1, Q 3, Q 8, and Q 10

PARTS LIST

Resistors — all ¼ watt
R1 82 ohm to 1 K — see text
R2, 3, 9, 10 — 680 ohms
R4, 11 — 82 ohms
R5, 12 — 1.2 K ohms
R6, 14 — 10 K variable resistor, Ace
R7 — 100 ohm
R8 — 1 K ohms
R13 — 4.7 ohms
R15 — 2.2K — see text
R16 — 1 K ohms
C1 — 70 mfd 3V)
C2 — 2.5 mfd 50V) Ace
C3 — 20 mfd 50V) Radio Control
C4 — 80 mfd 8V)
Capacitor for receiver 15 mfd to 40 mfd — see text
Q1, 4, 5, 7, 10, 11 — 2N1303 or 2N1305 PNP
Q2, 3, 6, 8, 9 — 2N1302 or 2N1304 NPN
D1 — 1N 34, 1N66 etc.
D2 — 1N91
1 — 300 DT Reed Switch — Ace
1 — AR 300 Reed Switch — Ace
4JX 11C 1847 can also be used for Q3 and Q9
4JX 1C 1132A can also be used for Q4 and Q10

Ace Radio Control, Box 301, Higginsville, Mo. 64037, is putting the Karlsson Decoder into kit form. For further details, see new items in Bill Northrop's column, this issue.

VTO

(*Continued from page* 9)

to just one thing — the Finals at Lakehurst. Each model was built and tested with no unnecessary chances being taken, such as by trying for a record. A different model was used for each step of the qualification program, with all the previously tested models being re-tested as often as possible. This gave him six proven models which he felt were capable of winning. Due to his also competing in the Nats Indoor events only four of these FAI ships wound up in Joe's box for the trip, though.

The same careful and determined preparation can be expected now for the World Championships. If the big meet is held in a site with about a 100 ft. ceiling height (which is probable if Hungary is the host) Joe said he would probably just modify his present design by going to a thicker airfoil and using higher pitched props. These are the main modifications he used when attending the Nats in Chicago and Dallas.

Let the rest of the competing teams be forewarned that Joe Bilgri and his fellow U.S. teammates are not about to take the upcoming Championships lightly.

ANOTHER BOOST FOR INDOOR

Bud Tenny and the other Indoor enthusiasts who keep NIMAS (National Indoor Model Airplane Society) always moving to promote this phase of the hobby, have come up with what looks like another winner! This time it's attractively printed NIMAS Certificates of Perform-