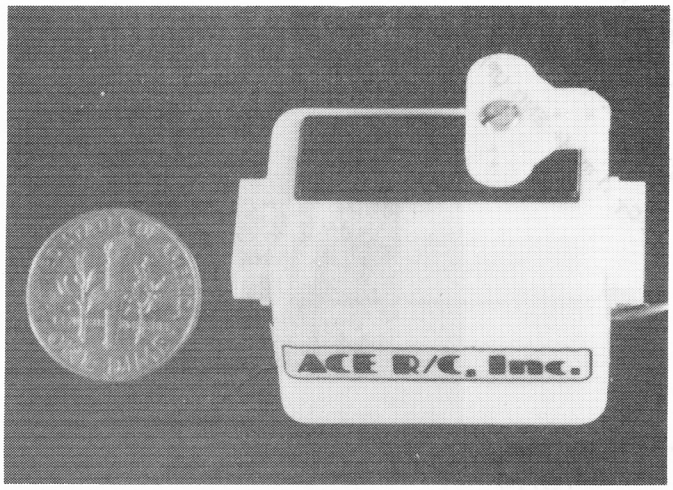
ACE R/C INC. DIGITAL COMMANDER

MICRO SERVO



CIRCUIT DESCRIPTION

The Ace Digital Commander Servo Amplifier is based on the Signetics NE544 integrated circuit. In contrast to most conventional servo drivers, which use exponential one shots, the NE544 uses a linear one shot. This makes it possible to have a servo with very high positional accuracy and linear pulse width to position transfer function.

A positive input signal applied to the input pin (4) sets the input flip flop and starts the one shot time period. The directional logic compares the length of the input pulse to that of the internal one shot and stores the result of this comparison in a directional flip flop. The exact difference in pulse width between input and internal one shot pulse, called the error pulse, is also fed to a pulse stretcher, deadband and trigger circuit. These circuits determine three important parameters:

(1) DEADBAND – The minimum difference between input pulse and internally generated pulse to turn on the output.

(2) MINIMUM OUTPUT PULSE – The smallest output pulse that can be generated from the trigger circuit.

(3) PULSE STRETCHER GAIN – The relationship between error pulse and output pulse.

The Deadband and Minimum Output Pulse are determined internally in the IC. The Pulse Stretcher Gain is adjusted by capacitor C_S and resistor R_S. The trigger circuit activates the gate for a precise length of time to drive the bridge circuitry in proportion to the length of the error pulse.

Resistor R_F determines the amount of feedback required for good closed loop damping.

The amount of servo travel is controlled by resistor R_T and can be varied to change the amount of servo rotation. If you find it necessary to change the amount of servo travel, increase the value of R_T to decrease servo travel or lower the value of R_T to increase servo travel.

The stock Digital Commander servo will work only with positive pulse IC decoder systems. A pulse inverter is available for using the servo with negative pulse systems: 14G18--544 Pulse Inverter.

POSITIVE PULSE SYSTEMS:
Ace Digital Commander
Blue Max
EK ('73 and Later--red/black polarized connectors)
Heath
Kraft
Micro Avionics
MRC
Orbit
Royal
W. E. Midget
Sanwa
Futaba

NEGATIVE PULSE SYSTEMS:
Controlaire
EK (Super Pro to '73--white/black non-polarized plugs)
EK Logictrol II
EK MM3 servos
F & M
M.A.N.
O.S.
Pro-Line

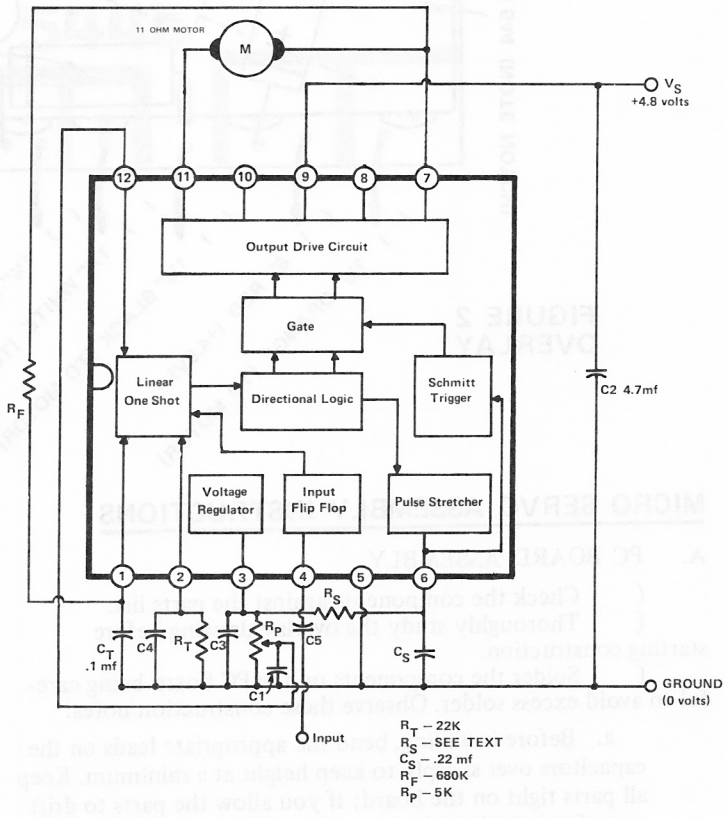


FIGURE 1
SCHEMATIC

SERVO PARTS LIST

SEMICONDUCTORS

( ) 1 NE544(S) IC

RESISTORS

( ) 1 22K 1/8W (red, red, orange)
( ) 1 75K 1/8 or 1/4W (violet, green, orange)
( ) 1 100K 1/8 or 1/4W (brown, black, yellow)
( ) 1 680K 1/8W (blue, grey, yellow)

CAPACITORS

( )	1	.1 mf Tantalum
( )	2	.1, .47 or .56 mf Tantalum
( )	1	.22 mf Bluecap
( )	2	2.2 or 3.3 mf Tantalum
( )	1	4.7 mf Tantalum

WIRE

9" Black	1½" White
6" Blue	1½" Yellow
6" Red	1½" Green
1½" Orange	18" Solder

MISCELLANEOUS

( )	1	Servo mechanics with motor, pinion gear and pot
( )	1	PC board
( )	1/16" X 1/2" X 1/2"	Foam tape
( )	1"	Plastic sleeving

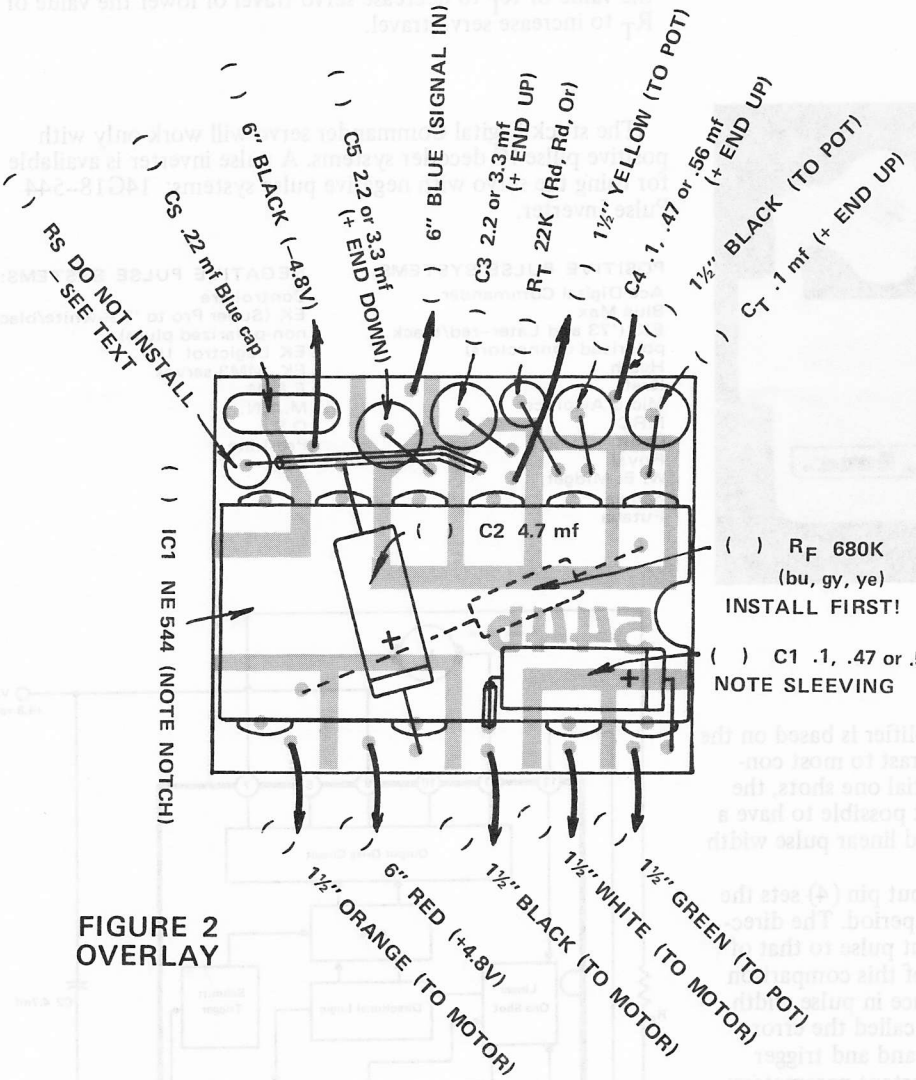
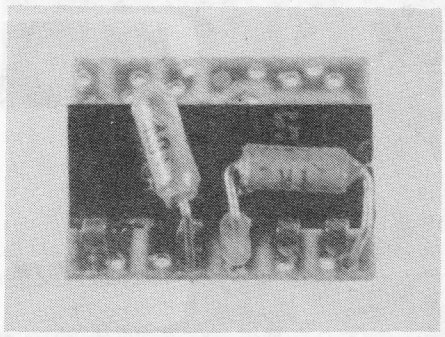


FIGURE 2
OVERLAY



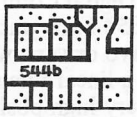


FIGURE 3
PC BOARD

MICRO SERVO ASSEMBLY INSTRUCTIONS

A. PC BOARD ASSEMBLY

( ) Check the components against the parts list.

( ) Thoroughly study the overlay drawing before starting construction.

( ) Solder the components on the PC board being careful to avoid excess solder. Observe these construction notes:

a. Before installing, bend the appropriate leads on the capacitors over sharply to keep height at a minimum. Keep all parts tight on the board; if you allow the parts to drift away from the board, you will have a clearance problem. Don't bend the leads over on the foil side of the board after insertion.

b. Install R_F (680K) first. It goes under the IC.

c. Install IC-1 (NE544) next, making sure the notch is in the proper orientation.

d. Install the rest of the components, working around the PC board in a clockwise manner. Make sure the tantalum capacitors are installed with the + ends as indicated; the + ends are either red or shouldered. Work slowly and carefully, continually watching for solder bridges.

e. When installing C1 bend the leads as shown in the photo so the capacitor rests on the top of the IC. Cover the negative lead with a short piece of sleeving.

f. Do not install R_S yet.

B. PC BOARD WIRING

( ) Cut to length, prepare, and install the wires as indicated in the overlay drawing. Refer to the "Kit Builder's Hints" for proper wire preparation.

( ) Using an old toothbrush and alcohol, scrub the solder resin from the bottom of the PC board. Inspect the board for bad joints or solder bridges with a magnifying glass, comparing it to Figure 3. Make sure all leads are clipped to within 1/16" from the bottom of the board.

( ) Gently file off the bottom of the board, eliminating the sharp points and smoothing out the connections. Clean again with alcohol.

C. CONNECTOR WIRING (For Digital Commander Flight Packs and systems using Deans connectors)

( ) Route the long red, black, and blue wires out the end of the PC board opposite the notch in the IC. Twist them together tightly. Clip the wires to the same length--you may want to shorten the length of this cable depending on your intended installation.

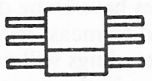
( ) Slip a 1/2" piece of 1/8 ID heat shrink tubing over these three wires.

( ) Slip one of the pieces of sleeving provided with connectors you are using over each wire after first untwisting one inch of the twisted cable.

( ) Strip 1/8" of the ends of the three wires and tin.

( ) Tin three of the pins of the male half of the connector. Note that one end of the pin is staggered off center--solder to this end. Refer to the "Kit Builder's Hints".

( ) Touch the wires and the soldering iron to their respective pins. Refer to Figure 4 for proper wiring sequence. The tinned joint will form quickly. Avoid excessive heat which may damage the plug. Perform this operation with the plug halves mated for a good heat sink.



DEANS 3-PIN CONNECTOR
MALE HALF

FIGURE 4
DEANS HOOKUP

( ) Slip the sleeving up over the pins and wires.

( ) Retwist the wires up to the sleeving and slide the heat shrink tubing up against them. Heat this tubing with the soldering iron to shrink evenly.

D. CONNECTOR WIRING (For systems other than the Digital Commander)

( ) Obtain the proper male connector for the servo to plug into your receiver.

( ) Determine the proper wiring between the receiver and the servo. If the system is a three wire positive pulse system (non-center tapped battery), simply determine polarity and wire together accordingly, using the connector. Do the same for a four wire positive pulse system (center tapped battery) but ignore the lead which delivers current from the battery center; usually a white wire.

The five wire MRC systems have two +4.8V leads (red and green) going to the servo connection. Ignore the green wire as well as the white wire when wiring this servo to the MRC receiver.

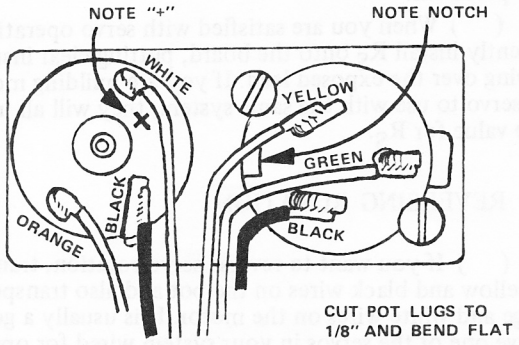
If you are going to use a servo with negative pulse systems, you need to obtain a 14G18-544 Pulse Inverter for each servo.

If you are using the servo with a Heath Eight Channel (405 series), an additional 10K resistor (not furnished) may need to be added across signal input and ground (OV). This can be done by soldering the resistor in the circuit at the connector--there's no room to do it on the PC board.

E. POT WIRING

( ) Take the feedback pot out of its wrapping--lubrication had already been applied, so don't wipe the pot element or handle it with your fingers. Slip the pot into its seat on the motor plate and check that the wiper contacts are coming in contact with the pot element. Install the feedback pot using two 2-56 X 5/16" screws--orient the notch on the pot as shown in Figure 5. Don't overtighten the screws, just make sure the pot does not rotate and is seated properly.

( ) Prepare the pot terminals by clipping the lugs to 1/8" and bend flat as shown in Figure 5. Tin the terminals with solder.



PLEASE NOTE: As supplied your pot element has been coated with a special lubricant. Please do NOT remove under any circumstances.

FIGURE 5
POT AND MOTOR WIRING

( ) Cut the yellow, green and black wires labeled "TO POT" to 1" length and strip, tin, and solder them to the proper pot terminals as shown in Figure 5. Watch out for stray or frayed leads or globby solder.

F. MOTOR WIRING

( ) Cut the orange, white and black wires labeled "TO MOTOR" to 1 1/4" length. Strip, tin, and solder them to the proper motor terminals as shown in Figure 5. Again watch for stray or frayed leads.

G. INSTALLATION OF R_S AND CHECK OUT

( ) Depending on the repetition rate of the transmitter you'll be using, the value of R_S can vary between 75K and 100K. The slower the rate, the higher the value required. In all cases that have been tried, either a 75K and 100K works the best. In order to determine which value to use for your particular set-up, take one of the servos and, leaving the resistor legs full length, tack solder a 75K (violet, green, orange) onto the appropriate lands on the bottom of the board.

( ) Being careful that the servo amplifier does not short on the pot or motor terminals, and with the motor removed from the mechanics, plug in the servo and turn on the transmitter and receiver. Rotate the servo output until the

motor stops, reverses direction, and pulses back and forth slightly. The motor should run one way when the transmitter stick is moved one direction and the other way when the stick is moved in the opposite direction.

( ) Press the motor into place in the mechanics. Insert a small jewelers screwdriver into the hole in the output shaft and gently rotate until the output is centered.

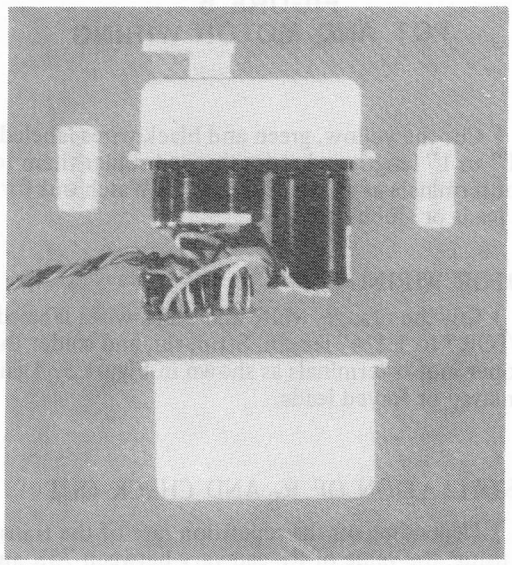
( ) If you move the transmitter stick throughout its travel, the servo rotation should be smooth and have a swing of about $\pm$ 45°. If the amount of servo travel is too great or too little, the value of resistor R_T can be changed in small increments (the next standard value). Lower R_T to increase travel and increase to decrease travel.

( ) Check the smoothness and speed of servo operation. If the servo is slow and sluggish, the value of R_S is too low--try the 100K furnished. You should see better transit time without the servo becoming jerky. In rare cases, you may find the servo jerky with the 75K; if so, decrease R_S to 68K. By the same token you may find the servo slow with the 75K but jerky with the 100K; if so, try an 82K for R_S. The 68K and 82K values are not furnished and will have to be obtained locally--a 1/4W resistor will fit in this slot without any clearance problems.

( ) When you are satisfied with servo operation, permanently install R_S onto the board, putting clear insulation sleeving over the exposed lead. If you are building more than one servo to use with the same system, they will all use the same value for R_S.

H. REVERSING ROTATION

( ) If you want to reverse servo rotation, transpose the yellow and black wires on the pot and also transpose the orange and white wires on the motor. It is usually a good idea to have one of the servos in your system wired for opposite rotation--it comes in handy when you install the radio in an airplane.



I. FINAL ASSEMBLY

( ) Cover the pot terminals with the 1/2" square piece of foam tape furnished.

( ) Press the component side of the amplifier up against this tape, routing the wires as necessary in order to achieve minimum distance between the amp and the pot. Make sure nothing shorts out between the amp and the pot terminals and that all connections remain secure. The bottom of the PC board should not be lower than the bottom of the motor.

( ) Slip this assembly into the case bottom, running the wire cable out the slot in the bottom. The case top and bottom should mate together with no gap. It may take a couple of trys to get proper fit. Note that the motor is offset in the mechanics--the wires can run down beside the motor on one side.

( ) Snap the plastic keepers onto the ears on the case top and bottom to hold the case together.

( ) Check for proper operation to see that you did not introduce any bind in the mechanics or lose any connections by assembling the case.

I. TROUBLESHOOTING

If after completion of your Ace servo it fails to operate, start troubleshooting by checking the servo connector to make sure that wires are installed so that they are mating properly with the receiver connector.

Double check the soldering job of your servo, compare the P.C. board to the photo of P.C. board in Figure 3, making sure there are no solder bridges or cold solder joints. Inspect all components to make sure they are installed properly. Most service work received at our service centers has failed due to improper solder connections or misplaced components.

If the servo operates as per the first step in section G, but then servo drives to one side when the motor is installed, the problem is caused by the feedback pot and the motor being wired out of phase, check figure 5 for wiring instructions.

The motor can be checked by connecting 2.4 volts across the terminals. The motor should run smooth and fast. Reverse the polarity to check the motor in the other direction. Resistance across the motor terminals should be 11 ohms. The feedback pot can be checked by measuring the total resistance of pot; it should be 5K. Wiper contact can be checked by measuring from the armature contact (green wire) to either side of pot element (yellow and black wire); the total of the two should be 5K. (The wires have to be disconnected.)

An ohmmeter can be used to measure the resistance of the in-circuit components. The readings will not be exact but will aid in locating shorts or opens in the amplifier.

If the above checks are all OK the problem is probably in the IC.

The servo is protected from reverse polarity by a diode in the IC, but if reverse polarity is applied for over 30 seconds, the diode will short and the IC will be damaged.

After extended periods of servo use, it may become necessary to inspect your servos, clean, and relube the feedback pot. Clean the pot with alcohol and apply only the Ace No. 37L84 Bourns pot lube. The use of any other type lube will degrade the performance of the servo. If the servo motor runs rough or noisy, apply a very small amount of good quality oil on the motor shaft. Do NOT apply oil or lube to the gear train.

ACE R/C, Inc.
BOX 511 116 W. 19TH ST. HIGGINSVILLE, MO. 64037