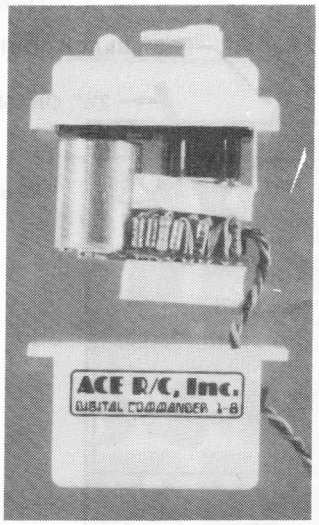
DIGITAL COMMANDER

SERVO

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

Q1 and Q2 are external PNP transistors for increased motor drive, which make a faster, more powerful servo with better resolution. 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

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.

Adjustment of these parameters is achieved with external resistors and capacitors at pins 6, 7, and 8. Deadband is controlled by resistor R_{DB}. Minimum Output Pulse is controlled by R_{MP}. 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 provide drive to the bridge output circuitry in proportion to the length of the error pulse.

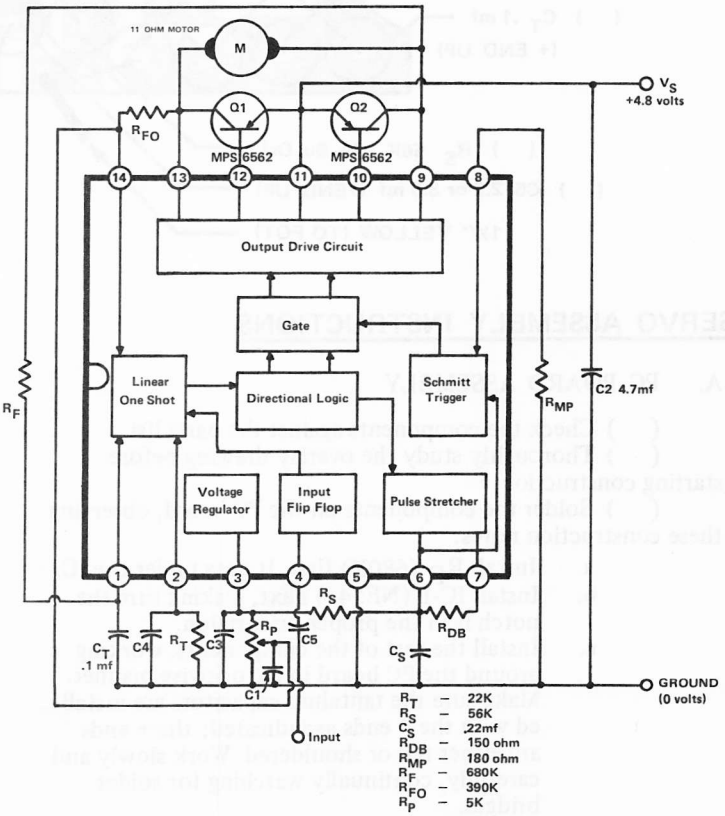


FIGURE 1
SCHEMATIC

SERVO PARTS LIST

SEMICONDUCTORS

( )	1	NE544 IC
( )	2	MPS 6562

RESISTORS

( )	1	150 ohm 1/4W (brown, green, brown)
( )	1	180 ohm 1/4 W (brown, grey, brown)
( )	1	22K 1/4 W (red, red, orange)
( )	1	56K 1/4 W (green, blue, orange)
( )	1	390K 1/4 W (orange, white, yellow)
( )	1	680K 1/8 W (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

11" Black	1½" White
8" Blue	1½" Yellow
8" Red	1½" Green
2½" Orange	18" Solder

MISCELLANEOUS

( )	1	Servo mechanics with motor, pinion gear and pot
( )	1	PC Board
( )	2 pcs.	1/4" foam rubber
( )	1/2"	Plastic sleeving

FIGURE 2
OVERLAY

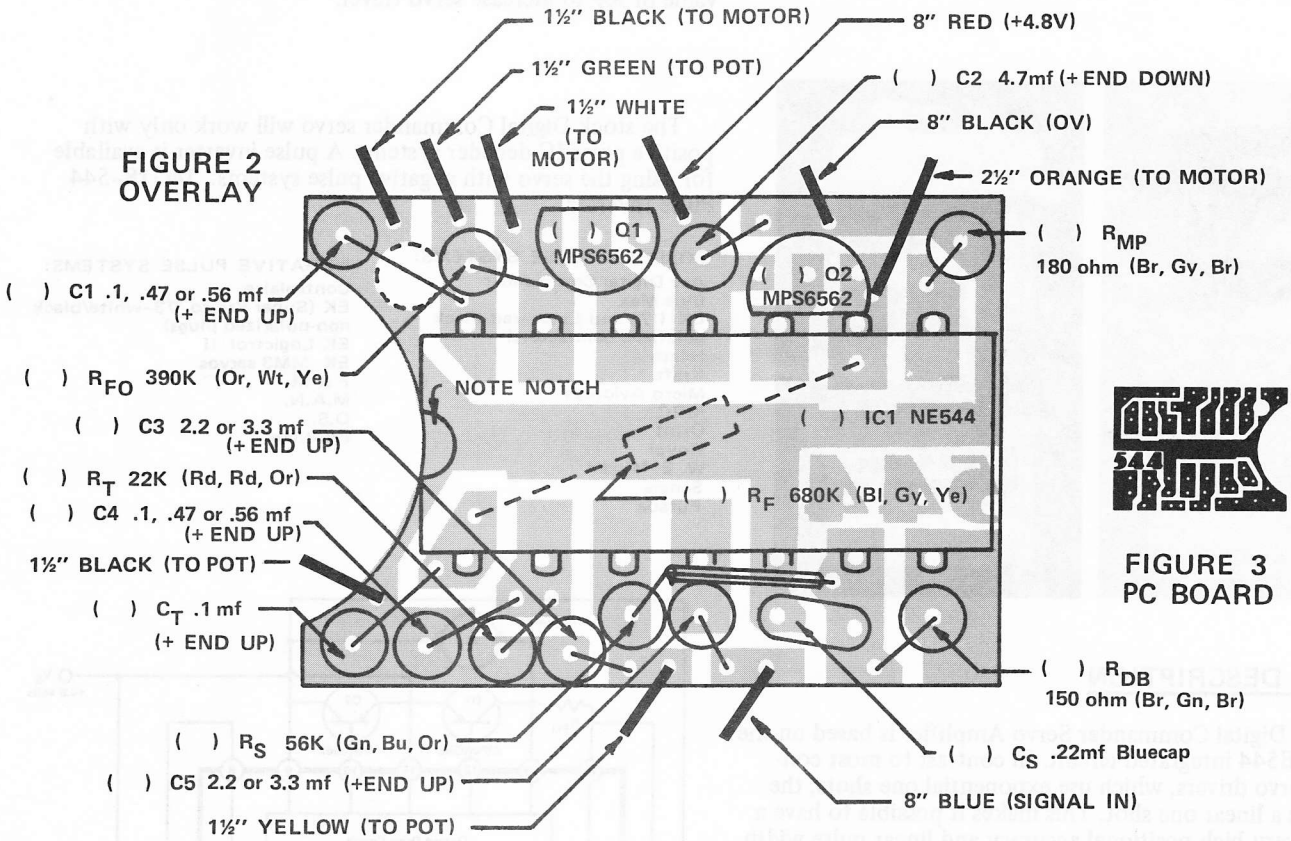


FIGURE 3
PC BOARD

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, observing these construction notes:

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

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

c. 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.

d. Note that R_S (56K) has plastic sleeving covering the exposed lead to prevent accidental shorting.

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.

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 which is opposite the half moon cut out. Twist them tightly together. Slip a rubber grommet over these wires. Clip the wires to the same length. If you are building the Dual Rack servo, thread this cable of wires through the slot in the case bottom.

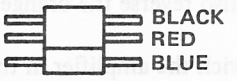
( ) Slip a 1/2" piece of 1/8 ID heat shrink tubing over these three wires.

( ) 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) needs to be added across signal input and ground (OV). This can be done by soldering the resistor on the bottom of the PC board between the land to which the blue wire goes and the land to which the black wires go.

E. ASSEMBLING THE MECHANICS

( ) If you are building the Bantam, it is necessary to assemble the mechanics. Begin by clipping the parts from the "trees" with a small diagonal cutters. Carefully trim the flash off the bottom of the gears using a razor blade--do not cut into the gear teeth or your finger.

( ) On a hard surface, press the knurl ended brass shaft into the No. 4 gear until it stops; about 5/16" should protrude out the bottom of the gear.

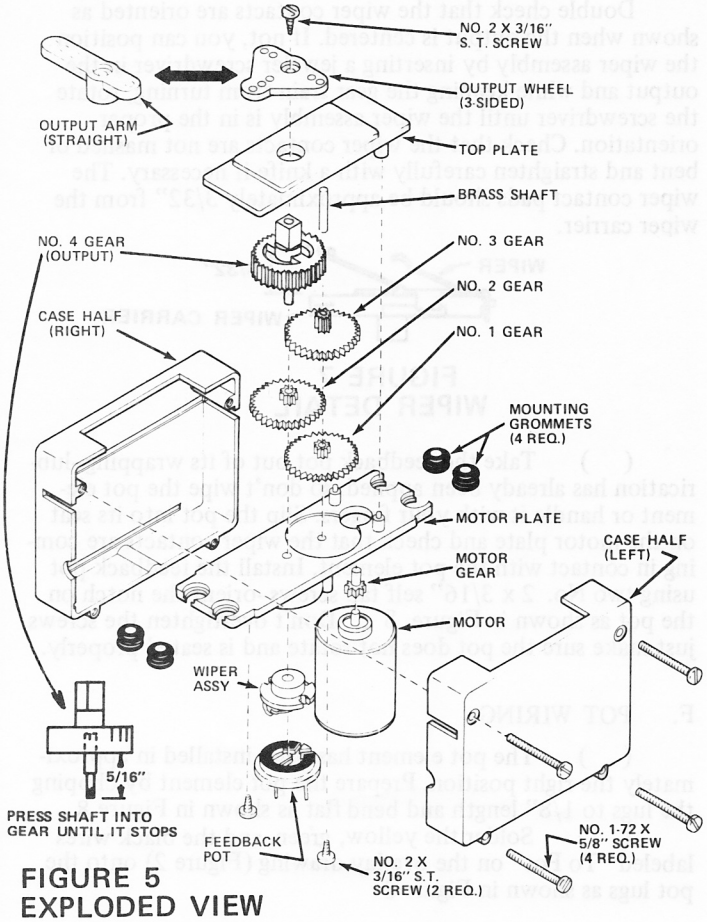


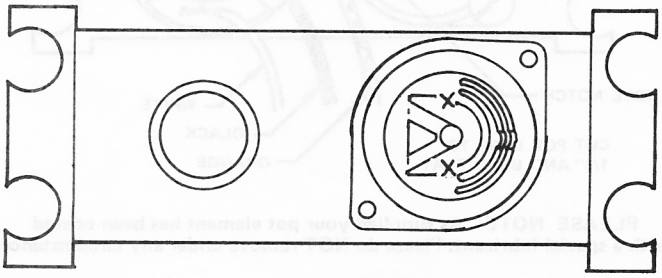
FIGURE 5
EXPLODED VIEW

( ) Insert the brass shaft into the hole in the motor plate and install No. 1 gear (the one with the small shaft hole and the short secondary gear) on the shaft. Put a drop of oil on the brass shaft.

( ) Place the No. 2 gear (large shaft hole, short secondary gear) on the output gear shaft. Slip the No. 3 gear (small shaft hole, tall secondary gear) in between the output gear (No. 4) and the No 2 gear and install this assembly on the motor plate with the No. 3 gear going on the brass shaft and the output shaft going through the hole in the motor plate.

( ) Slip the top plate on and wiggle it around until it snaps into position. Check for proper operation of the gear train--the output should move smoothly through approximately 120°. Center the output in the middle of its travel.

( ) Turn the mechanics upside down so the output is resting on the work surface. Lay the wiper assembly on the shaft and orient the wiper contacts as shown in Figure 6. Using a needle nose pliers spread slightly so the wiper contacts are not bothered, firmly press the wiper assembly on the shaft until it can't go on any further.



Press at the "X's" with needle nose pliers to install wiper carrier. Note orientation of wiper contacts when the output is centered.

FIGURE 6
WIPER ORIENTATION

Double check that the wiper contacts are oriented as shown when the output is centered. If not, you can position the wiper assembly by inserting a jeweler screwdriver in the output and while keeping the gear train from turning, rotate the screwdriver until the wiper assembly is in the proper orientation. Check that the wiper contacts are not mashed or bent and straighten carefully with a knife if necessary. The wiper contact pads should be approximately 3/32" from the wiper carrier.

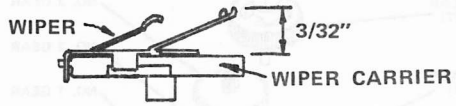


FIGURE 7
WIPER DETAIL

( ) Take the feedback pot out of its wrapping--lubrication has 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 No. 2 x 3/16" self tap screws--orient the notch on the pot as shown in Figure 8 . Don't overtighten the screws, just make sure the pot does not rotate and is seated properly.

F. POT WIRING

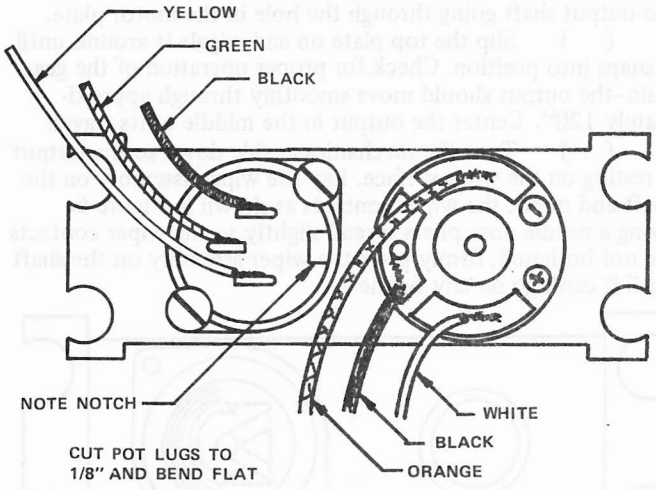
( ) The pot element has been installed in approximately the right position. Prepare the pot element by clipping the lugs to 1/8" length and bend flat as shown in Figure 8 .

( ) Solder the yellow, green, and the black wires labeled "To Pot" on the overlay drawing (Figure 2) onto the pot lugs as shown in Figure 8 .

G. MOTOR WIRING

( ) Thread the orange, white, and short black wires labeled "To Motor" through the 5/64" hole in the PC board and solder them to the motor terminals as shown in Figure 8 . Do not install the motor in the mechanics yet.

( ) Install the nylon or brass pinion gear on the motor shaft. Make sure there is no rub between the gear and the motor case.



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

FIGURE 8
POT AND MOTOR WIRING

H. CHECK OUT AND FINAL ASSEMBLY

( ) Be careful that the servo amplifier does not short on the pot or motor terminal, then 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 transmitter stick is moved in the opposite direction.

( ) Firmly press the motor into place in the mechanics. Insert a small jeweler 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. Lower R_T to increase travel and increase R_T to decrease travel.

For opposite servo rotation, reverse the yellow and black wires to the pot and also reverse the orange and white wires to the motor.

( ) Sandwich the amplifier in the foam provided and install in the case as shown in the photo. Make sure nothing shorts out between the amplifier and the pot terminal.

For the Three Servo Block, insulate the pot terminals by sticking a 1/2" Square piece of foam tape over the terminals. Cushion the amplifiers by trimming and placing the furnished piece of thin foam in the bottom of the case . . . if desired, cut out circles to clear the three motors. Disregard the two small squares of foam furnished in the electronics packages.

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 H, 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 8 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.