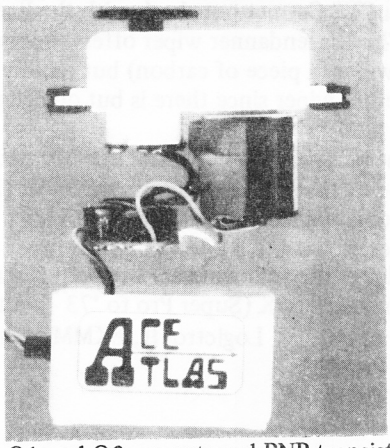
ATLAS

HIGH OUTPUT SERVO INSTRUCTIONS

Kit. 14G20A Assem. 14G20AC

Size: .937"x1.56"x1.75"
Weight: 1.82 oz.
Torque: Excess of 40 in/oz.
Transit Time: 90°; .5 sec. approx.
Idle current: 8 ma approx.
Stalled current: 735 ma approx.
Running current: 150 ma approx.



The Atlas servo is intended for use where high output is needed. A ball bearing (81K22) is available for extra heavy loads and "O" rings (81K21) for a waterproof seal.

CIRCUIT DESCRIPTION

The ACE Atlas Servo Amplifier is based on the Signetics NE 544 integrated circuit servo amplifier that reflects a three year program with Signetics in cooperative upgrade of design and fabrication techniques. The amplifier design incorporates the experience of ACE R/C with the NE544 servo amp IC (nearly four years longer than any other manufacturer, including collaboration with Signetics in the original development of the NE544). The designer is grateful to Mr. Bill Hershberger for many recent hours of experimentation with the IC that was of great assistance. The cooperation of the Signetics design team also gratefully acknowledged.

The NE544 in the 14 or 16 Pin DIP package has a massive heat sink; thus, with proper design of external control, damping, and drive circuitry, is capable of producing output drive previously available only by using an external bridge amplifier.

Figure 1 shows the schematic diagram. A positive input signal applied to the input pin (4) sets the input flip-flop and starts the linear one shot time period. It should be noted that the input pulse is capacitively coupled through C5. Most other servos delete this and couple directly, thus turning off the transmitter first causes those servos to run to the end of their travel. 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 error pulse, is also fed to the pulse stretcher, deadband, and trigger circuit. These circuits determine three important parameters:

1. Dead Band - - The minimum difference between the input pulse and internally generated pulse to turn on the output (the difference between the start of stick movement and servo movement).

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. Dead Band 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 error pulse. Control of these parameters maintain the servo in a stable and smooth operating range. The Schmitt trigger activates the gate for a precise length of error pulse. Q1 and Q2 are external PNP transistors that parallel internal PNP drive transistors thus increasing the load-carrying capability of the amplifier and reducing voltage drop to the motor. The combination of the external PNPs with the NE544 and the special feedback circuitry has been tested in a stalled condition at 750 ma current drain for over 10 minutes and appears capable of operating that way for extended periods without damage.

Unique feedback and switching control networks are formed by C_{M1}, C_{M2}, C_{M3}, C_{M4}, and R_{M1}, R_{M2}, R_{FO}, and R_F. These networks permit our amplifier to operate over a frame rate length of from 10 to 25 ms without buzz or instability while enhancing output torque and speed. Their purpose is to dampen the inductive feedback of the motor to insure proper switching of internal dampening circuitry in the NE544 and to provide a precision feedback to the inputs of the one shot timing circuit. The Atlas design still retains the original precision linearity of the NE544 but introduces temperature compensation in the form of diodes D1 and D2 combined with a stable Mylar capacitor C_T that negates any measurable drift with temperature over a range from 0° F to 150° F. Linearity of the unit is limited only by feedback pot linearity. For that purpose, we have chosen a Clarostat conductive plastic pot that utilizes a multi-finger wiper. Our experience and tests have covered the CTS Cermet; Clarostat pots; Giezendanner wipers and the like; in bench and flight tests. The Clarostat pot is clearly proven superior in terms of longevity of the pot element,the wiper fin-

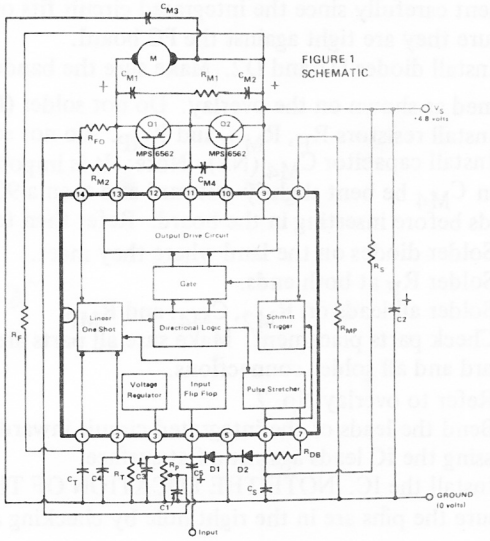


FIGURE 1
SCHEMATIC

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

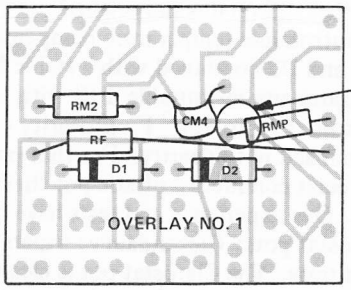
gers, and the center contact. Considerable problems were experienced with CTS Cermet pots both with the linearity and the wiper wear. The Giezendanner wiper offers superior performance of the wiper (a piece of carbon) but rapidly wears through the center wiper since there is but one contact point on dead center.

The Atlas servo amplifier will work directly with positive pulse IC decoders that comprise perhaps 90% of all decoders. A pulse inverter is available for using the amplifier with negative pulse systems: 14G18 - 544 Pulse Inverter
To our knowledge the following are the only Negative Pulse Systems: Controlaire, EK (Super Pro to '73 - white/black non-polarized plugs), EK Logictrol II, EKMM3 Servos, F&M, M.A.N., O.S., Pro-Line.

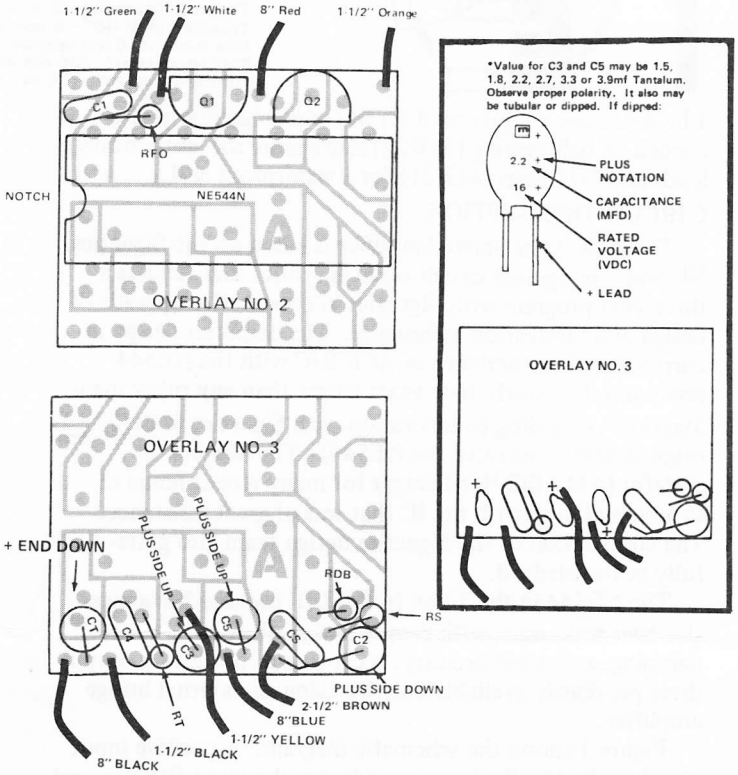
CONSTRUCTION

Before you start construction on your Atlas servo, we suggest you read the following: The Atlas amplifier is not difficult to build, but because it is so small, it is possible to make mistakes.

1. Make sure there are no solder bridges or open connections. Nearly every servo that Ace services can be traced to a short or poor connection.
2. Make sure that all polarities are observed and parts placement is correct.
3. Tools required are minimal (see construction tips) but one item that you should really have is a good magnifier. An eighth power loupe is excellent.
4. After each soldering step, clip the leads off to about 3/64" from the bottom of the board.
5. Do not solder until told to do so.



( ) Refer to overlay No. 1. In this sequence watch parts placement carefully since the integrated circuit fits over them. Make sure they are tight against the PC board.
( ) Install diodes D1 and D2. Make sure the banded ends are positioned as shown on the overlay. Do not solder (NS).
( ) Install resistors R_F, R_{M2}, and R_{MP}. Do not solder (NS).
( ) Install capacitor C_{M4} (NS). Note: It is important that the leads on C_{M4} be bent slightly outward and then a 90^o bend in the leads before inserting in the board. Refer then to overlay.
( ) Solder diodes on the land where they meet.
( ) Solder R_F at both ends.
( ) Solder all leads on R_{M2}, C_{M4}, and R_{MP}.
( ) Check parts placement. Make sure all parts are flat on the board and all solder connections.
( ) Refer to overlay No. 2.
( ) Bend the leads of the integrated circuit inward slightly by pressing the IC leads against a flat surface.
( ) Install the IC. NOTE THE LOCATION OF THE NOTCH. Make sure the pins are in the right hole by checking against the overlay.
( ) Strip 1/4 inch insulation of the 1 - 1/2 inch green, 1 - 1/2 inch white, 8 inch red, and 1 - 1/2 inch orange wires. Tin these ends. Note: Get just enough solder on the wires so they are bound together, otherwise they will not fit the holes in the PC board. Refer to the "Kit Builder's Hints" for proper wire preparation and installation.
( ) Insert the wires in their respective holes (NS).
( ) Install capacitor C1 and resistor R_{FQ} (NS).
( ) Install transistors Q1 and Q2 (NS). Note the position of the flat side of two transistors.
( ) At this point, solder all the leads on the PC board. Make sure the IC and all components are pressed close to the PC board.
( ) Inspect all parts placement and connection.



( ) Refer to overlay No. 3. This side is very crowded. Watch the following:
1. The polarity of capacitors C2, C3, C5 and C_T.
2. The negative lead on capacitor C2 stretches over capacitor C_S.

( ) Strip 1/4 inch insulation from one end of the 2 - 1/2 inch brown, 1 - 1/2 inch black, 1 - 1/2 inch yellow, 8 inch blue, and 8 inch black wire and tin.
( ) Double check all parts placement, polarities, and that all parts are against the board.
( ) Install resistor R_{DB}, R_S, capacitor C_S, C_2, (+ end down) 2 - 1/2 inch brown wire, capacitor C5 (+ end up) and 8 inch blue wire. Solder these connections.
( ) Install 1-1/2" yellow wire, capacitor C3 (+ end up), resistor R_T, capacitor C4, capacitor C_T (+ end down), 1-1/2" black wire, and the 8" black wire. Solder these connections.
( ) Check all solder connections. Make sure there are no solder bridges and that all leads are clipped to 3/64" of the board. After a thorough inspection, carefully file off the high points on the foil side of the board.
( ) Use alcohol and an old toothbrush to clean all flux and filings off the PC board.
( ) Use a magnifier and again check for good solder connections and for solder bridges. Compare closely with drawing of the bottom of the board. (Fig. 2)
( ) Correct any errors.

ATLAS PARTS LIST

SEMICONDUCTORS

( ) 1 NE544N IC
( ) 2 MPS6562
( ) 2 1N4446

CAPACITORS

( ) 1 .01 uf Bluecap
( ) 2 .047 uf Bluecap
( ) 1 .22 uf Bluecap
( ) 2 * uf Tantalum**
( ) 1 4.7 uf Tantalum
( ) 1 .22 uf Tantalum**

WIRE

( ) 11" Black
( ) 8" Blue
( ) 8" Red
( ) 1-1/2" Orange
( ) 1-1/2" White
( ) 1-1/2" Yellow
( ) 1-1/2" Green
( ) 2-1/2" Brown
( ) 18" Solder

RESISTORS (ALL ARE 1/8W 5% UNLESS NOTED)

( ) 1 47 ohm (yellow,violet,black)
( ) 1 270 ohm (red,violet,brown)
( ) 1 4.7K (yellow,violet,red)
( ) 1 8.2K (gray,red,red)
( ) 1 9.1K (white,brown,red) (Special Throw Adjust)
( ) 1 100K (brown,black,yellow)
( ) 2 330K (orange, orange, yellow)

MISCELLANEOUS

( ) 1 Servo Mechanics with pinion gear and pot
( ) 1 PC Board
( ) 2 Pieces 1/4" foam rubber
( ) 20 mm Motor with capacitor network and pinion gear.
( ) 1 5K Clarostat pot

*Value may be 1.5, 1.8, 2.2, 2.7, 3,3, or 3.9mf
**These may be tubular or dipped.

PARTS ID

TRANSISTORS

( ) Q1: MPS6562
( ) Q2: MPS6562

DIODES

( ) D1: 1N4446
( ) D2: 1N4446

CAPACITORS

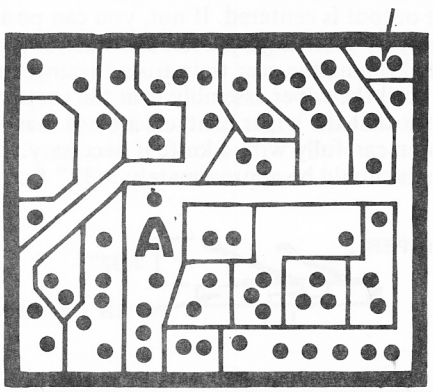
( ) C1: .047 Bluecap
( ) C2: 4.7 uf Tantalum
( ) C3: * Tantalum
( ) C4: .047 Bluecap
( ) C5: * Tantalum
( ) CM4: .01 Bluecap
( ) CS: .22 Bluecap
( ) CT: .22 Tantalum

* Value for C3 and C5 may be 1.5, 1.8, 2.2, 2.7, 3.3, or 3.9 mf Tantalum. Observe Proper Polarity.
C3, C5, and CT may be tubular or dipped.

RESISTORS

( ) RDB: 47 ohm (yellow, violet,black)
( ) RF: 330K (orange,orange,yellow)
( ) RFO: 100K (brown, black, yellow)
( ) RM2: 4.7K (yellow,violet,red)
( ) RMP: 270 ohm (red,violet,brown)
( ) RS: 330K (orange, orange, yellow)
( ) RT: 8.2K (gray,red,red)

FIG. 2 PC POSITIVE



( ) Before wiring the motor, take an emery board and file a slight bevel on the outer edge of the nylon ring around the bearing of the motor. DO NOT REMOVE TOO MUCH! The motor must be a tight fit in the servo mechanics.

( ) Make sure the bare ends of the filter network on the motor are pressed against the tape on the motor case. Cover this network with a piece of tape. Check to see that the tape does not run around the sides of the motor where it enters the case.

ASSEMBLING THE MECHANICS FIG. 4

( ) Begin by clipping the parts from the "tree" with small side cutters. Carefully trim the flash off the bottom of the gears using a razor blade. Do not cut into the gear or your finger.
( ) Install the steel idler shaft in the small hole on the top side of the motor plate and slip the No. 1 gear (small output gear and small hole) over the shaft. Put a SMALL drop of oil on the steel shaft. NOTE : Do not put any oil on the gears.
( ) Lay the No. 2 gear (small output gear large hole) on the top of the No. 1 gear.
( ) Slip the No. 3 Gear (tall output gear large hole) over the steel idler shaft.

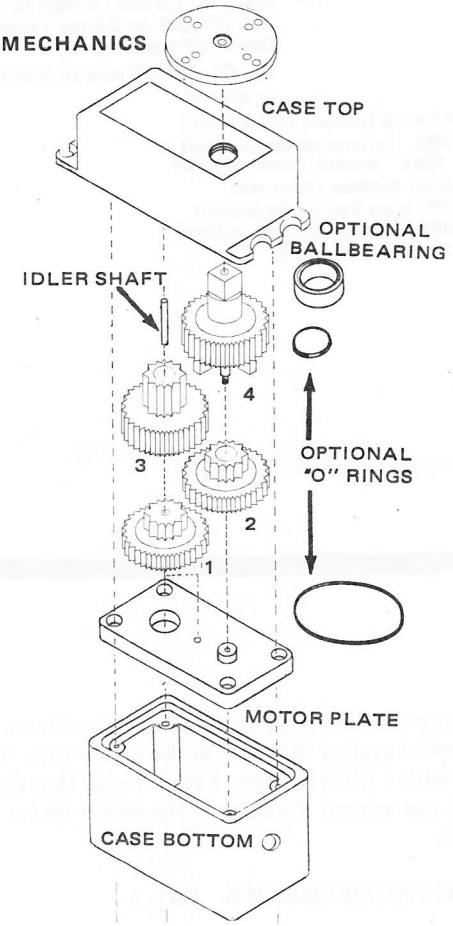
ASSEMBLING THE MECH. CONT.

( ) Slide the brass shaft of the No. 4 gear (output) through the hole in the No. 2 gear and through the motor plate. NOTE : the stops on the No. 4 gear face the end of the motor plate.

( ) Place the case top over the gear assembly until the square output shaft protudes. While holding the assembly together, press the output wheel onto the square shaft. Wiggle the mechanics until the plate snaps into the case top. The output wheel should rotate approximately 120° from stop to stop.

NOTE: If the optional ball bearing or "O" ring waterproof seal are used, install the ball bearing or small "O" ring in the hole on the inside of the case top. You cannot put both the ball bearing and "O" ring on the output shaft.

FIG. 4 MECHANICS



( ) Refer to Fig. 4. The output gear on the mechanics has end stops on it. Rotate the output wheel back and forth and note the stop positions. Rotate the output to approximate center.

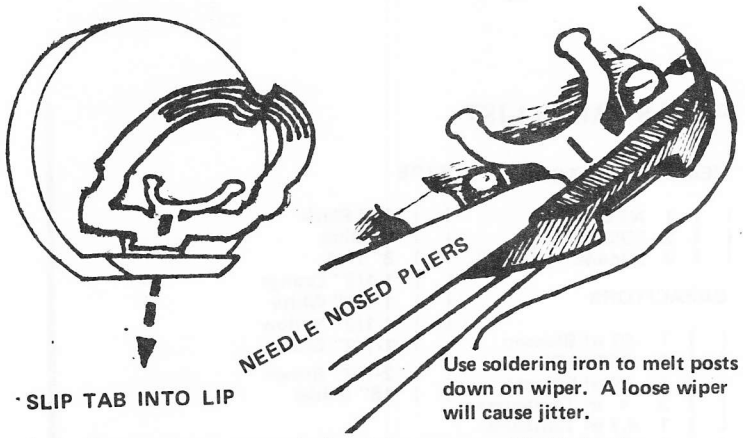
( ) Turn the mechanics upside down and place a fiber washer over the brass shaft.

CLAROSTAT POT INSTALLATION

Your servo has been supplied with a Clarostat pot. We feel that this is the best servo pot available for smooth and accurate operation and the least amount of maintenance.

( ) Mount the wiper on the plastic wiper carrier by hooking the tab on the wiper under the lip on the carrier. Use a needle nosed pliers to get the wiper by the plastic posts and down flat on the carrier--don't flatten any of the contacts. Make sure the wiper is centered on the carrier.

FIG. 5. WIPER INSTALLATION



( ) Rotate the output shaft of the servo until it is in the center of its travel. Install the wiper carrier assembly in the servo by pressing it on the shaft using a 1/8" dowel. Make sure the wiper orientation is as shown.

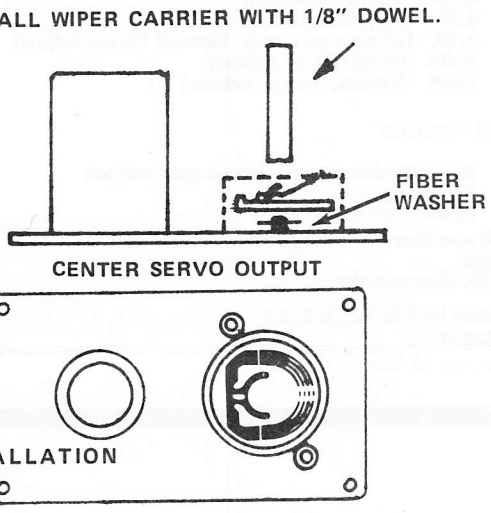
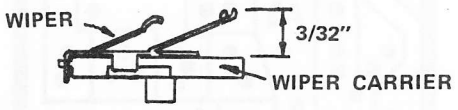
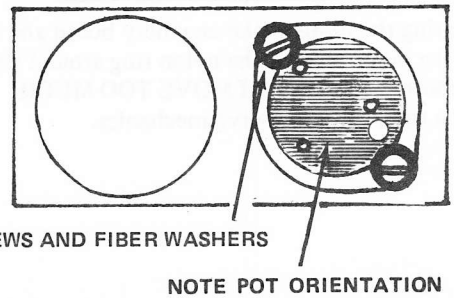


FIG. 5 WIPER INSTALLATION

( ) 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.





( ) Remove the pot from its protective wrapping. Lubrication has already been applied, so don't wipe it off.
( ) Install the pot in the mechanics making sure it is oriented as shown. Secure with 2 - 56X 5/16" screws and fiber washers. Don't over-tighten the screws. Just make sure the pot doesn't rotate and is seated properly.
( ) Bend the terminals over flat on the pot and cut off to 1/8 inch long as shown in Fig. 6. Tin the terminals with solder.
( ) Strip and tin the short black, green, and yellow wires coming from the amplifier and solder them to the proper pot terminals as shown in FIG. 6
( ) Strip and tin the orange, brown, and white wires. Solder these to the three terminals on the motor as shown in Fig. 6.

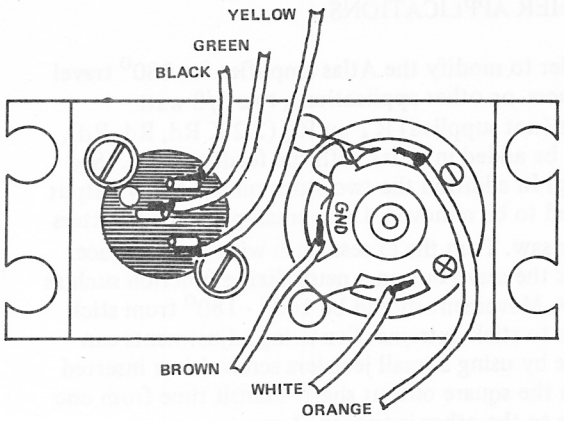
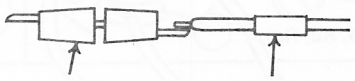


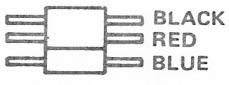
FIG. 6 POT/MOTOR WIRING

( ) Take the cone-shaped grommet and apply saliva to the cone. Insert this in the hole in the case from the inside. Pull it until it snaps in place.
( ) Twist the red, blue, and black wires into a tight cable.
( ) Thread this cable through the grommet far enough so you can strip and tin the three leads for a connector. Strip 1/8" insulation off each wire and tin.

CONNECTOR WIRING FOR ACE SYSTEMS AND FLIGHT PACKS



Use this method for soldering hookup wire to Deans connectors. Tin the wire before securing it to the connector.



DEANS 3-PIN CONNECTOR MALE HALF

FIG.7 CONNECTOR WIRING

( ) 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.
( ) 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 Fig. 7 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. A clothespin makes a good holding device.
( ) Slip the sleeving over the pins and wires.
( ) Retwist the wires up to the sleeving.

CONNECTOR WIRING FOR SYSTEMS OTHER THAN ACE

( ) 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 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.

CHECK OUT

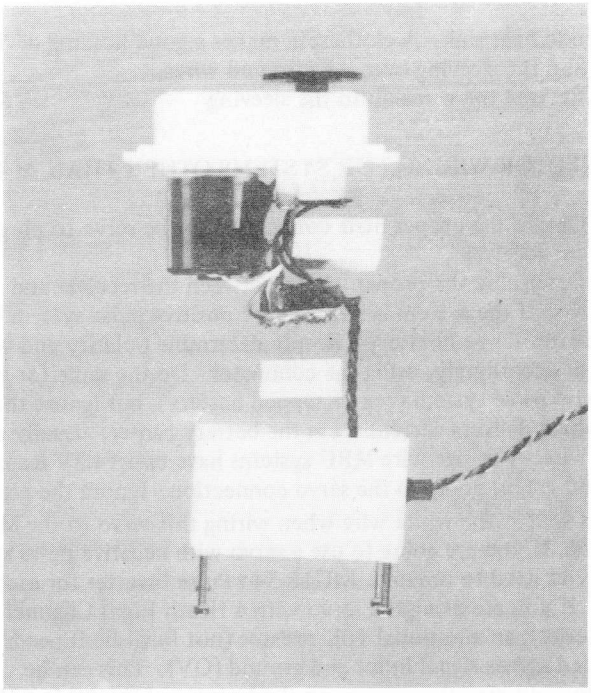
( ) Be careful that the servo amplifier does not short on the pot or motor terminals. Leave the motor out of the mechanics, then plug in the servo and turn on the transmitter and receiver. Rotate the servo output until the motor stops, reverses direction. and pulses back and forth slightly. The motor 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 transmiiter stick throughout its travel, the servo rotation should be smooth and have a swing of about $+45^{o}$.
FOR OPPOSITE SERVO ROTATION, REVERSE THE YELLOW AND BLACK WIRES TO THE POT AND ALSO REVERSE THE ORANGE AND WHITE WIRES TO THE MOTOR.

SPECIAL THROW ADJUSTMENT NOTE

An 8.2K resistor is called for R_T. In some systems this may provide too much servo throw. A 9.1K resistor is supplied to substitute for R_T if there is too much servo travel.

FINAL ASSEMBLY

( ) One of the 1/4" foam pieces goes between the amplifier and pot. The other piece of foam goes between the amplifier and case bottom.
( ) Make sure the motor is pressed all the way in and that no tape runs along the sides of the motor where it enters the case. Note: The amplifier fits into the case sideways with the transistors facing the motor.
( ) Slide the motor, amplifier, and foam pieces into the bottoms of the case. Keep pulling the cable, making sure the amplifier is crosswise and that no wires are shorting.
( ) Fasten the two case halves together with the four long screws.



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 PC board to the drawing of PC board in Fig. 2. Make 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, particularly solder bridges with the "Atlas" servo.

If the servo operates as per the first step in the check out section, 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 Fig. 6 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 about 6 ohms. The feedback pot can be checked by measuring the total resistance of the pot; it should be 5K. Wiper contact can be checked by measuring from the armature contact (green wire) to either side of the pot element (yellow and black wire); the total of the two should be 5K. (The wires have to be disconnected)

An ohmeter 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.

Due to variations in transmitter frame rates, the value of R_S may need to be juggled. The value supplied in your kit should give optimum performance in the majority of case, but if the servo "buzzes" either all the time or when the servo is first turned on, lower the value of R_S only as far as necessary to prevent buzzing. If the servo is sluggish and weak, raise the value of R_S, but not so far that the servo buzzes.

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. 50L516 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.

180° TRAVEL FOR RETRACTS OR OTHER APPLICATIONS FIG. 8

In order to modify the Atlas amplifier for 180° travel for retracts or other applications, two 1/8 watt resistors (not supplied) R_A an R_B (2.2 K Rd, Rd, Rd), need to be added in series with the feedback pot. (See Drawing) In addition the two stops on the No. 4 output gear need to be removed. Use a small pair of sidecutters or razor saw. Trim the excess flush with the gear face.

Check the servo out on a neutralizing function such as elevator. Movement should be 160° - 180° from stick extreme to stick extreme. Centering adjustments can be made by using a small jewelers screw driver inserted through the square output shaft. Transit time from one extreme to the other is approx. 1 sec.

TO REVERSE DIRECTION, TRANSPOSE THE YELLOW AND BLACK WIRES TO THE RESISTORS AND THE ORANGE AND WHITE WIRES TO THE MOTOR.

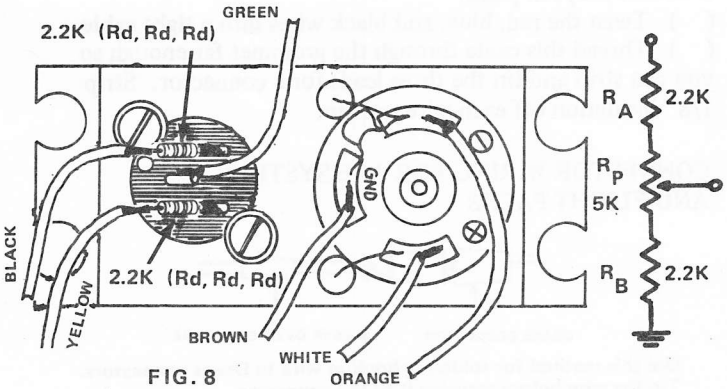


FIG. 8

ATLAS MECHANICS AND PARTS

14K200	Atlas Mechanics
PLA276	Case Top
PLA277	Case Bottom
PLA278	Gear Plate
GR009	Pinion Gear
GR351	No. 1 Gear
GR352	No. 2 Gear
GR353	No. 3 Gear
GR354	No. 4 Gear
GR355	Atlas Gear Set
MP111	Brass Shaft, Slotted
MP110	Steel Shaft, Idler
PL335	Adjustable Arm Set
PL336	Output Wheel
PL334	Long output Arm
RP010	Cable Grommet
HW050	Case Screw
PLA275	Clarostat Wiper Carrier
PLA275A	CTS Wiper Carrier
RV034	5K CTS Pot
RV038	5K Clarostat Pot
SM121	CTS Wiper
SM122	Clarostat Wiper
MR020A	20 mm 6 ohm Motor
MR020B	20mm 6 ohm Motor with Caps and Pinion Gear

ACE R/C, Inc.
BOX 511 HIGGINSVILLE, MO. 64037 816 584-7121