

# SPACE CONTROL

## PROPORTIONAL RADIO CONTROL

### *The Most Highly Developed R/C System in the Model World!*

Fantastic though it may seem, SPACE CONTROL is the unbelievable ultimate answer to the dreams of R/C Modelers. At your fingertips, in ONE control, are rudder, elevator, and ailerons, entirely proportional and simultaneous. Any degree of any or all of these movements is instantly achieved through the movement of ONE STICK. And these movements are not abrupt or jerky as with other r/c systems. All plane movements are as smooth as though there were a real pilot actually IN the plane. Any maneuver is now realistically possible. A second control knob at the fingertips of the hand holding the transmitter permits completely proportional and micrometric control of the throttle.

Ever since the beginning of Radio Control, modelers have dreamed of flying their planes with the same degree of precision with which an actual pilot can handle a prototype plane. Many phases of development have produced many different interpretations of the so-called "full house" installations. Each step forward has been heralded as "the answer". But, until the advent of SPACE CONTROL, there has never been a commercially produced fully proportional and simultaneous system available to r/c modelers.

Discarding all preconceived ideas, and eliminating troublesome reeds and relays, this factory-tuned and adjusted unit is so precise that it is SEALED after final inspection, a procedure that only the certainty of its excellence of design and performance would permit. Its compact package permits transfer from one plane to another in moments, and its crash-resistant construction protects the owner's investment.

SPACE CONTROL is the result of many years of engineering development, and each component has been designed for the job that it has to do, and each designed to complement the other. For that reason, SPACE CONTROL is sold only as a matched and balanced system, complete with the exception of the power supply, fully tested, adjusted and guaranteed.

Compared to the cost of a complete 12 channel, non-proportional radio control, with its relays, actuators, and odds and ends of equipment necessary for its assembly and operation, the price is indeed low. No other system can match the performance of fully proportional, wholly simultaneous, ready-to-fly SPACE CONTROL. This is what you've always wanted. This is what you will eventually own.

#### THE TRANSMITTER.

An F.C.C. approved, crystal controlled unit, available as standard in frequencies from 26.995 through 27.255 mc. (Custom frequencies optional). Single stick controls rudder, elevator, and ailerons. Separate knob controls throttle. All controls are proportional, and may be activated independently or simultaneously. Operation is precise, even to the slightest movement of the flying surfaces. Has proportional in-flight trim controls and battery condition meter. Uses 8 tubes, and functions ideally with the Ritchie Rechargeable Power Pack 6D135A. (Requires 1½ volt A and 135 volt B). Telescoping chromed antenna included.

#### THE RECEIVER.

Sealed superheterodyne chassis, fully transistorized, with rudder, elevator, and throttle servos built in. Aileron servo is connected by remote cable. Ruggedly built to withstand the most severe operating conditions. Incorporates "fail-safe" return to neutral upon loss of signal. Ritchie Rechargeable Power Pack #4542 fits inside case, and can be recharged without removing. Total airborne weight with Power Pack is only 26 ounces. Furnished ready to install, requiring no tuning or adjusting. Just fasten in, make pushrod connections and FLY. Receiver size 7½ x 3½ x 2 inches. May be mounted in any position.

#### THE SERVOS.

Weighing but 2 ounces, each has a built-in 5 transistor amplifier and an extremely low drain motor, the German "Micro Mo". Servo drive disc traverses a 90 degree arc in ¼ second, exerting 2 inch-pounds torque. Available separately at \$39.95 each, they may be used without alteration to replace relays and actuators in many other radio control systems.

SPACE CONTROL CORPORATION whose policy is one of constant development and improvement, reserves the right to change specifications and/or prices at any time, without prior notice, and without incurring obligations.

If you would like to learn more about PROPORTIONAL R/C, send for our new book, "PROPORTIONAL RADIO CONTROL", which will be off the press in early January, 1962. Complete technical and non-technical descriptions of this system, with schematics, diagrams, oscillograms, charts, and complete illustrations. Includes operating manual and servicing instructions. Price \$2.25, refundable on the purchase of a Space Control System. Worth-while information for ALL r/c enthusiasts.

ILLUSTRATED  
WITH 4542  
POWER PACK  
(Not Included)

**\$495<sup>95</sup>**



PROPORTIONAL  
RADIO CONTROL

Space Control





**SPACE  
CONTROL  
CORPORATION**

# **TRANSMITTER POWER PACK**

SPACE  
CONTROL  
**TRANSMITTER  
POWER PACK**

## **Ritchie Rechargeable Power Packs, Nos. 5D135A and 6D135A**

**Suitable for All Radio Control Transmitters in General Use Today**



These NEW Transmitter Power Packs contain carefully selected sintered-plate, sealed nickel-cadmium cells, which require no servicing, and a highly efficient transistorized power converter, as well as the NEW Ritchie Heat-Free Charger already built into the case.

The 5D135A provides 1.25 volts of filament power, and the 6D135A provides 1.5 volts. Both units supply 135 volts of B-plus power.

Dimensions of  $2\frac{3}{4} \times 2\frac{3}{4} \times 5\frac{1}{8}$  inches permit the Power Pack to be slipped into the Transmitter case in the space formerly occupied by ordinary batteries.

A completely assembly wiring harness, which includes a power and charging switch, is included, with very easy instructions for installation.

The permanently attached power cord requires no preparation for use. Simply plug into any convenient 110 volt a.c. outlet for recharging the Power Pack. Overnight charge insures complete readiness for the next day's use.

Ruggedly built and sealed for lifetime service. FULLY FACTORY GUARANTEED.

From the makers of the world's  
most advanced Electronics for  
the Hobby Industry.

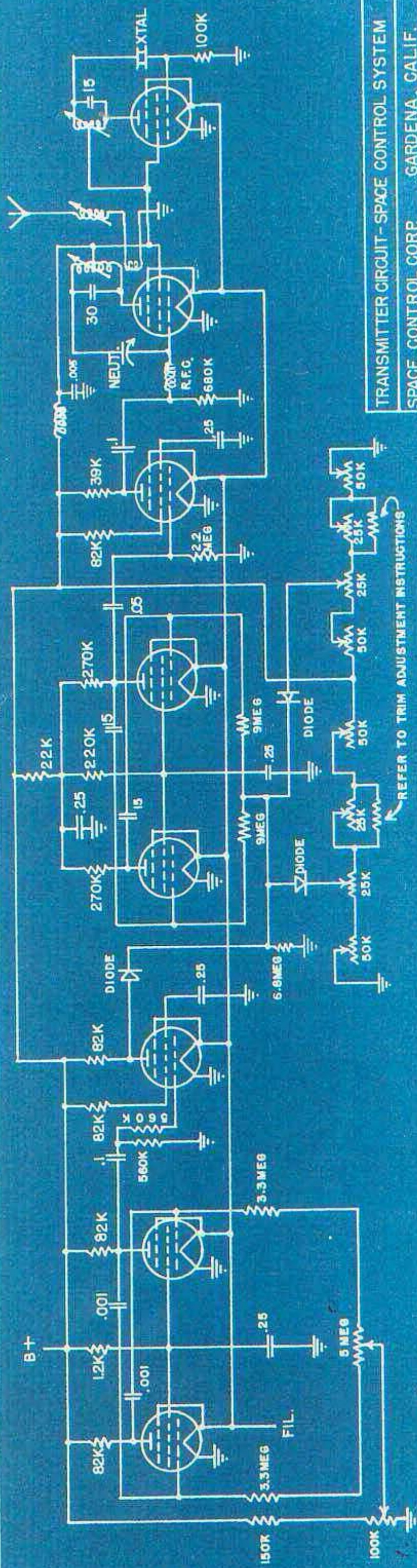
**Retail Price: 5D135A 89.95**  
**6D135A 99.95**

**See these and other Space Control Prestige Products at your Hobby Dealer's today.**

SPACE CONTROL CORPORATION, WHOSE POLICY IS ONE OF CONSTANT DEVELOPMENT AND IMPROVEMENT, RESERVES THE RIGHT TO CHANGE SPECIFICATIONS AND/OR PRICES AT ANY TIME, WITHOUT NOTICE, AND WITHOUT INCURRING OBLIGATIONS RELATING TO PRODUCTS PREVIOUSLY SOLD BY THEM.



1-100K-THROTTLE 2-S-MEG. KUDPER



TRANSMITTER CIRCUIT-SPACE CONTROL SYSTEM

SPACE CONTROL CORP.

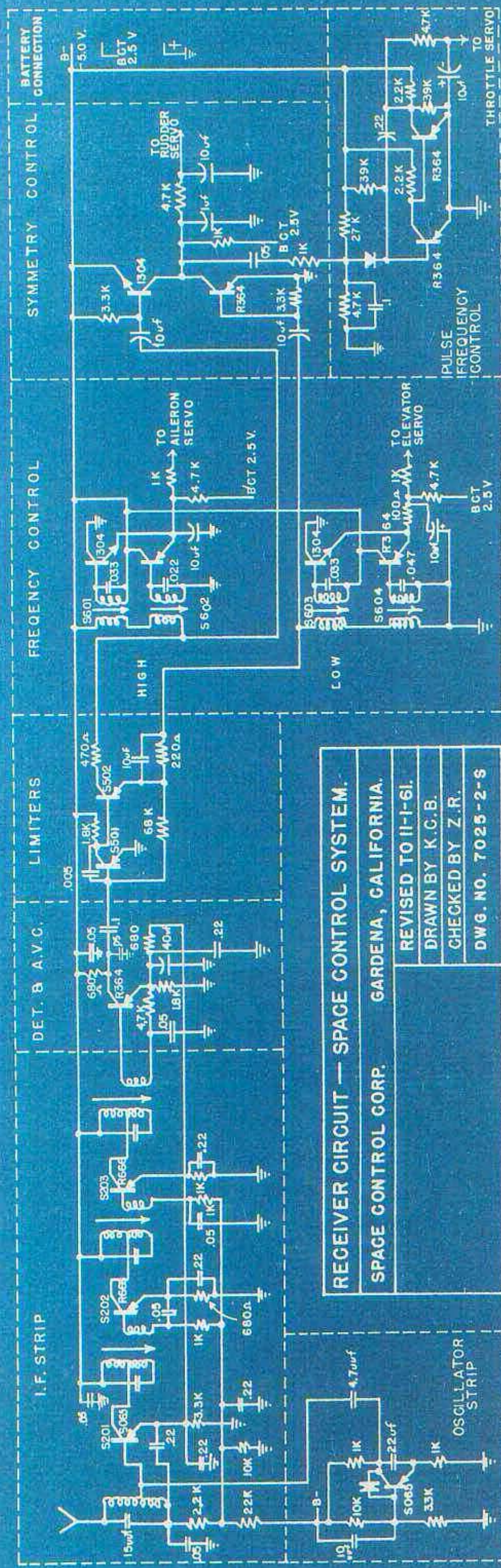
**GARDENA, CALIF.**

REVISED TO 11-1-61

DRAWN BY K.C.B.

CHECKED BY Z.R.

DRAWING NO. 7030-2-S



RECEIVER CIRCUIT — SPACE CONTROL SYSTEM.

SPACE CONTROL CORP. GARDENA, CALIFORNIA.

**GARDENA, CALIFORNIA.**

REVISÉD TO 11-1-61.

DRAWN BY K.C.B.

CHECKED BY Z.R.

DWG. NO. 7025-2-\$



A fast-acting, compact, light weight, exceptionally accurate unit consisting of a solid state servo amplifier, precision gear train, and high torque servo drive motor.

Overall cubic volume is 1.75 inches. Delivers a torque of 2 in/lbs at the actuating discs from an error voltage of .001 volt. Reaction time is extremely fast, with a speed of 270 degrees of rotation per second.

Subminiature high-torque motor has built-in 59:1 gear ratio. Operates satisfactorily over a voltage range from 2v to 4v. Draws 50 ma. no load current at 2 volts. Efficiency, with gears, of 50% to 60%. Exceptionally rugged motor unit will withstand adverse environmental conditions.

In order to obtain proper resolution, speed and torque adequate to operate the control surfaces of any size model aircraft, we have added an additional gear train with a 6:1 ratio, giving an overall gear ratio of 354:1, with a maximum torque of 2 in/lb. This is greater than the motor is ever called upon to deliver. Figure 1 illustrates the curve of deflection vs. torque output.

Space Control Corporation, whose policy is one of constant improvement and development, reserves the right to change specifications and/or prices without notice and without incurring obligations.

The most important design consideration was to have an extremely well damped servo action. It was required that it stop instantly on command, without hunting a neutral position. The simplest way to accomplish this was to connect a DC generator to the motor shaft.

The voltage developed by this generator would be exactly proportional to the speed of the motor. By feeding this voltage back to the amplifier supplying the signal to the motor, it would furnish the perfect braking action. But this method, besides increasing the weight and volume of the unit, would greatly increase the cost. A commonly employed technique uses lead voltage generating circuits consisting of resistors and capacitors. This is seldom satisfactory since insufficient damping usually results.

A DC motor is very similar to a DC generator in the one important design criteria with which we were concerned. It, too, develops a back voltage which is proportional to the speed of the motor. But added to this is the voltage drop across the motor windings. In other words, the terminal voltage of a DC motor is greater than the comparable DC generator by an amount equal to the drop through the motor windings. By incorporating an external circuit consisting of one adjustable resistor in the amplifier, we were able to generate a voltage equal and opposing the motor windings voltage. Feeding this voltage back into the system, we had available a DC motor terminal voltage which was exactly equivalent to the DC generator voltage — without having to resort to either an actual DC generator or resistance-capacitance circuit. Thus the motor becomes a damping generator.

Figure 2 shows the schematic diagram of the servo amplifier and damping system. In the neutral condition, the base voltage of T1 is set at a level which keeps the driver transistors, T3 and T5, in the turned-off condition. When a signal is imposed upon the input transistor, T1, which changes this neutral condition, either one or the other of the driver transistors turns on, causing the motor to rotate. As the motor rotates, the follower potentiometer also moves, creating a voltage signal to T1 which is in opposition to the input signal. As this voltage approaches the input signal in value, current through the motor ceases and the motor stops rotating.

The servo system will respond to an input signal by rotating proportionally to the value and polarity of the signal. It is designed to react to an input signal from 0 to  $\pm 0.75$  volts. Its maximum speed of operation through a 90° arc is 0.5 seconds. The new servo can be used directly, with no changes, to replace the relay and actuators of other control systems.

Note:

Reference and power batteries may be common for single servo installations. If more than one servo is operated from the common POWER source, a separate REFERENCE source should be used to prevent coupling between the servos through the impedance of the servo supply.

..... another  
**PRESTIGE  
PRODUCT**  
from



**\$39.95**

FIG. 1

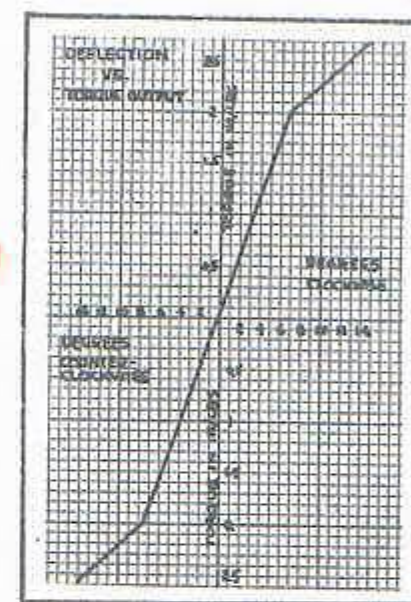
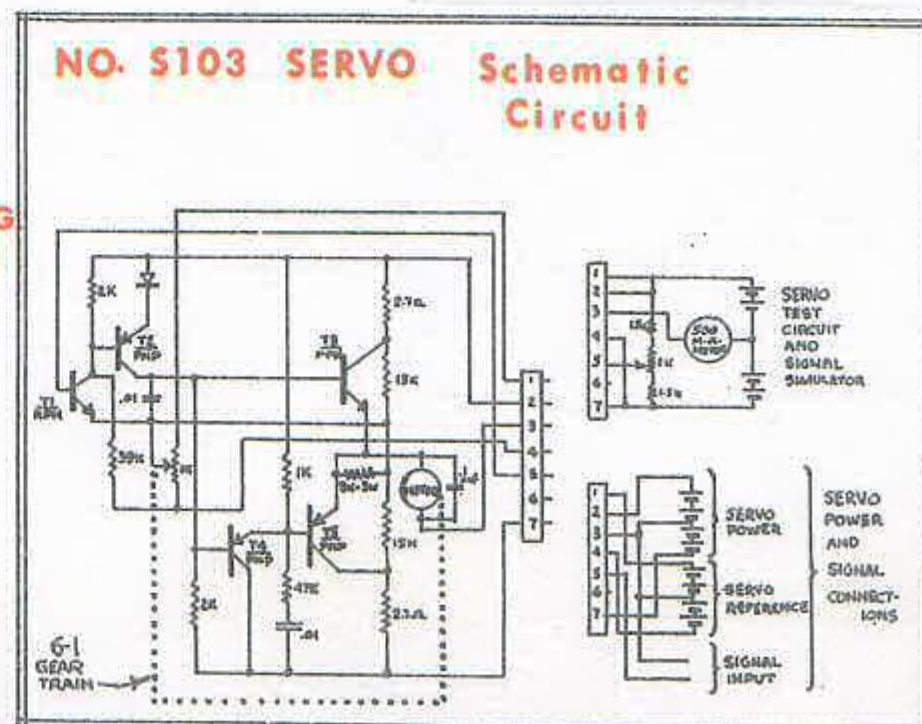


FIG. 2



SPACE CONTROL reserves the right to change specifications or design at any time, without notice and without incurring obligations.

**SPACE CONTROL Corp.**

1416 WEST 166TH STREET

GARDENA, CALIFORNIA



# SOLID STATE SUBMINIATURE SERVO DRIVE SYSTEM

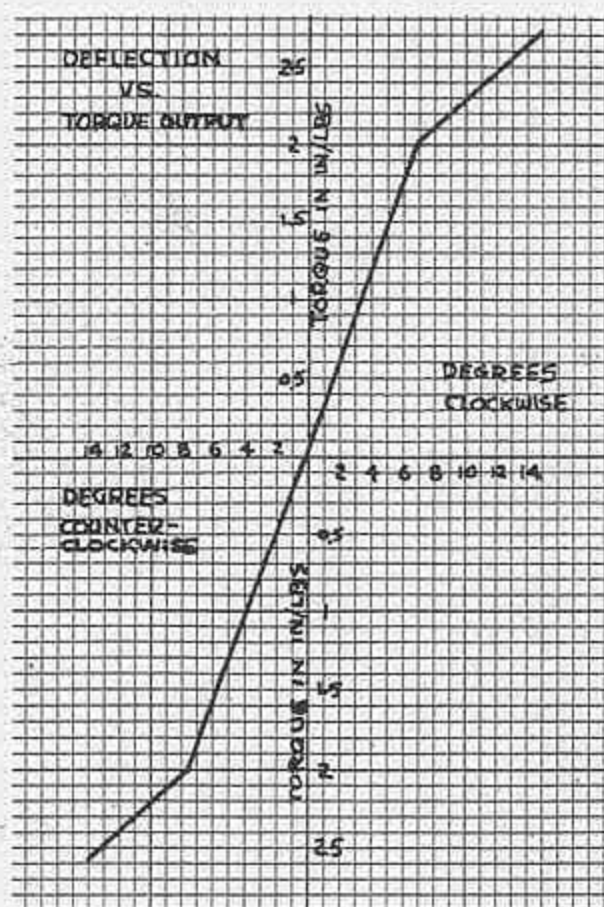


fig. 6

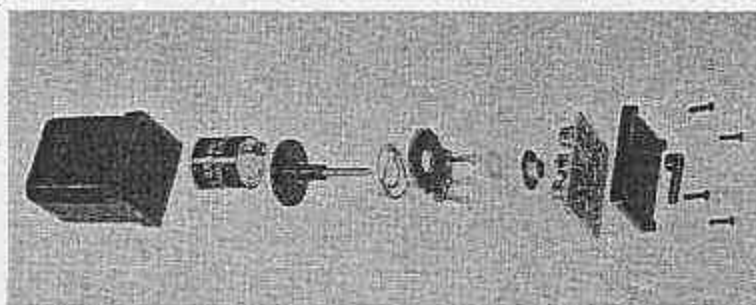


fig. 7

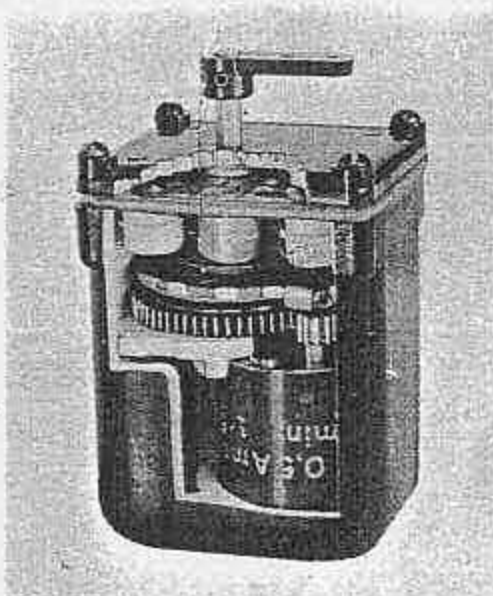


fig. 8

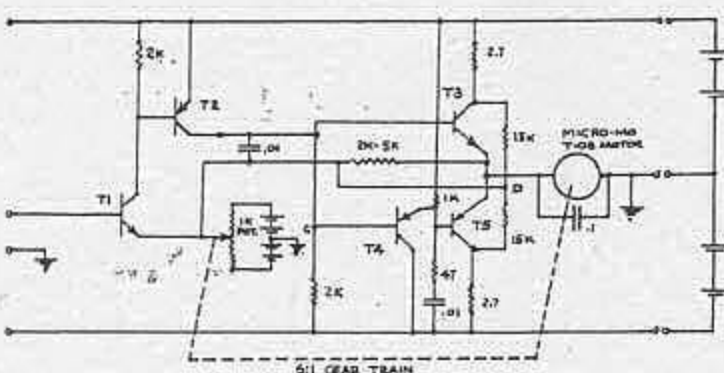


fig. 9

A fast acting, compact, light weight, exceptionally accurate unit consisting of a solid state servo amplifier, precision gear train and high torque servo drive motor. Overall cubic volume 1.75 inches. Delivers a torque of 2 in/lb at the actuating arm from an error voltage of 0.001 volt. Reaction time is extremely fast, with arm speed of 270 degrees of rotation per second.

Subminiature high torque motor has built-in 59:1 gear ratio. Operates satisfactorily over a voltage range from minus 2V to 4V. Draws 50 ma. no load current at 2 volts. Efficiency, with gears, of 50% to 60%. Exceptionally rugged motor unit which will withstand adverse environmental conditions.

In order to obtain proper resolution, speed and torque adequate to operate the control surfaces of any size model aircraft, we have added an additional gear train with 6:1 ratio, giving us an overall gear ratio of 354:1 with a maximum torque of 2 in/lb. This is greater than the motors are ever called upon to deliver. Figure 6 shows the curve of deflection vs. torque output.

Figure 7 shows the exploded view of the system. Starting at the left, in order, are the nylon case, motor with pinion gear, motor retaining plate, nylon drive gear and shaft, potentiometer contacts, (which are attached to drive gear), potentiometer, nylon space washer, retainer grommet, servo amplifier, nylon cover plate, nylon actuating arm, and assembly screws. The amplifier employs a printed circuit, and connections are made through a cable assembly.

Figure 8 shows a cutaway view of the entire servo assembly.

The most important design consideration was to have an extremely well damped servo action. It was required that it stop instantly on command, without hunting a neutral position. The simplest way to accomplish this was to connect a DC generator to the motor shaft.

The voltage developed by this generator would be exactly proportional to the speed of the motor. By feeding this voltage back to the amplifier supplying the signal to the motor, it would furnish the perfect braking action. But this method, besides increasing the weight and volume of the unit, would greatly increase the cost. A commonly employed technique uses lead voltage generating circuits consisting of resistors and capacitors. This is seldom satisfactory since insufficient damping usually results.

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We have made a good many servos to date, many of which have close to 500 hours or more of operating time on them. So far, every single servo is still reacting to signal and damping as it did the day that we bench checked it. With this resistor method of damping, we were able to maintain the same size and weight of the servo system at very insignificant increase in cost.

Figure 9 shows the schematic diagram of the servo amplifier and damping system. In the neutral condition, the base voltage of T1 is set at a level which keeps the driver transistors, T3 and T5, in the turned-off condition. When a signal is imposed upon the input transistor, T1, which changes this neutral condition, either one or the other of the driver transistors turns on, causing the motor to rotate. As the motor rotates, the follower potentiometer also moves, creating a voltage signal to T1 which is in opposition to the input signal. As this voltage approaches the input signal in value, current through the motor ceases and the motor stops rotating.

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## SOLIDTRONICS

DIVISION OF  
ELECTROSOLIDS CORP.

14751 KESWICK ST.

VAN NUYS, CALIF.



# SPECIFICATIONS

# Solid State Subminiature Servo System

Signal Input

0 to  $\pm .75$  volts.

Drift

1 millivolt input change per degree cent. with  $1000\Omega$  source impedance.

Torque

2 in. lbs. from error voltage of .01

Reaction

270 deg. per second

Power  
Requirements

6 volts

Voltage  
Variation

## ENVIRONMENTAL CHARACTERISTICS

Temperature  
Range

—55 deg. Cent. to +55 deg. Cent.

Vibration

MIL E 5272 — Procedure VI Sec. 4.7.6

Shock

Will withstand 300 G of 10 MS duration.

Humidity

Will meet or exceed MIL-E-5272

Altitude

To 100,000 ft.

## PHYSICAL CHARACTERISTICS

Size

Overall dimensions including rotor shaft,  $1\frac{3}{8}$ " x  $1\frac{3}{16}$ " x  $2\frac{11}{32}$ "

Standard shaft length  $17/32$ " (outside case)

Cubic  
Volume

1.75 inches

Weight

2.0 ounces

NOTE: Any of the above characteristics can be modified to meet the user's particular specifications.