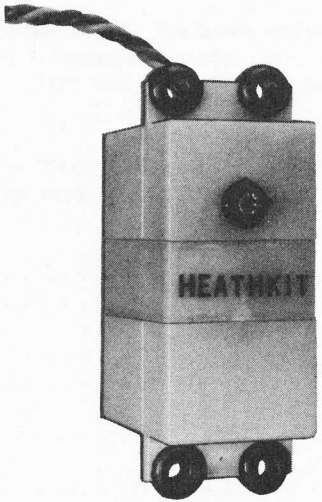
Assembly and Operation

of the

HEATHKIT

SUBMINIATURE DIGITAL PROPORTIONAL SERVO

MODEL GDA-505-44



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

PARTS LIST

Check each part against the following list. The key numbers correspond to the Parts Pictorial (fold-out from Page 7).

To order a replacement part, refer to the "Price Each" column and use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual.

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
RESISTORS, 1/4-Watt				
A1	1-13-12	1	560 Ω (green-blue-brown)	.15
A1	1-2-12	1	1000 Ω (brown-black-red)	.15
A1	1-99-12	1	1800 Ω (brown-gray-red)	.15
A1	1-9-12	1	10 kΩ (brown-black-orange)	.15
A1	1-112-12	1	16 kΩ, 5% (brown-blue-orange-gold)	.15
A1	1-32-12	1	100 kΩ (brown-black-yellow)	.15
A1	1-47-12	1	150 kΩ (brown-green-yellow)	.15
CAPACITORS				
B1	21-175	1	1000 pF ceramic (brown-black-red-yellow)	.70
B2	21-94	1	.05 μF ceramic	.25
B3	25-256	1	.47 μF (.47 k) tantalum	.90
B3	25-255	1	.22 μF (.22 k) tantalum	1.65
B3	25-197	1	1 μF tantalum	1.05
B3	25-211	2	33 μF tantalum	1.30

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each

TRANSISTORS-INTEGRATED CIRCUIT

NOTE: The transistors and integrated circuit are marked for identification in one of the following four ways:

1. Part number.
2. Transistor type number.
3. Part number with a transistor type number.
4. Part number with a transistor type number other than the one listed.

C1	417-268	2	MPS6562 transistor	.90
C2	238-62	1	Integrated circuit	6.00

CABLE-WIRE-SLEEVING

NOTE: For wire and sleeving, the price is per foot.

238-32	1	Cable assembly	2.20
340-3	1	Bare wire	.05/ft
344-125	1	Black wire	.05/ft
344-126	1	Brown wire	.05/ft
344-127	1	Red wire	.05/ft
344-130	1	Green wire	.05/ft
344-134	1	White wire	.05/ft
346-21	1	Sleeving	.35/ft

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each

HARDWARE

D1	250-536	5	1-72 x 1/8" screw (one extra)	.05
D2	250-82	4	#4 x 1/2" wood screw	.05
D3	238-60	1	Gear pin	.15

MOLDED NYLON PARTS

E1	238-19	1	Idler gear marked #1	.70
E2	238-20	1	Idler gear marked #2	.70
E3	238-21	1	Idler gear marked #3	.70
E4	238-18	1	Rotary drive gear	.70
E5	238-22	1	Rotary output wheel	.55
E6	238-23	1	Rotary output offset arm	.55
E7	238-24	1	Rotary output large arm	.55
E8	238-25	1	Rotary output small arm	.55
E9	238-26	1	Case bottom section	1.60
E10	238-27	1	Case center section	2.05
E11	238-61	1	Case top section	2.05

MISCELLANEOUS

NOTE: Avoid touching the circular, dark-colored surface of the 1500 Ω control (F2). This surface is covered with a film of lubricant that could be rubbed off in handling.

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
F1	238-29	1	Control drive shaft	.90
F2	9-40	1	1500 Ω control	2.50
F3	73-64	1	Foam gasket	.40
F4	73-53	1	Small rubber grommet	.15
F4	73-100	4	Large rubber grommet	.15
	85-1245	1	Circuit board	.85
F5	238-30	1	Control wiper	1.15
F6	238-63	1	Motor	7.75
F7	390-901	6	Clear "Heathkit" label	.25
	391-34	1	Blue and white label	.15

Miscellaneous (cont'd.)

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
F8	490-175	1	Centering adjustment tool	.15
F9	214-179	1	Wiper installing tool	.15
	597-260	1	Parts Order Form	—
	597-308	1	Kit Builders Guide	—
			Manual (See front cover for part number.)	2.00
			Solder (Additional 3' rolls of solder, #331-6, can be ordered for 25 cents each.)	

If you plan to use this Servo with a GDA-19-2 or a GDA-57-2 Receiver, it will be necessary to purchase the GDM-1957 Modification Kit for your Receiver. In addition to the Modification Kit, you will need one #432-104, 4-pin male connector for each Servo.

The above prices apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering from a Heathkit Electronic Center to cover local sales tax, postage, and handling. Outside the U.S.A. parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties, and rates of exchange.

TEST AND ADJUSTMENT

The following adjustments are only for the Servo. Do not attempt these adjustments unless the transmitter has been completely adjusted with a servo according to the instructions in your transmitter manual.

If the Servo does not operate as described, refer to the "In Case of Difficulty" section on Page 27.

CENTERING

Refer to the Figure 3 (fold-out from this Page) that applies to your system.

( ) Connect the Servo to channel #1 of the receiver.

( ) Turn the transmitter on. Be sure the channel #1 trim tab is in its center position.

( ) Turn the receiver battery switch on. The Servo may start to run and then stop. This is normal.

( ) Move the transmitter channel #1 stick in one direction and then the other. The Servo should move, stop, and reverse direction according to the stick position.

( ) Release the stick.

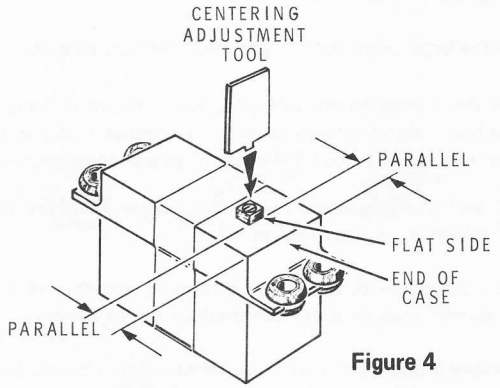


Figure 4

Refer to Figure 4 for the following steps.

NOTE: If the flat side on the rotary output post is parallel to the end of the case as shown, disregard the following step and proceed to the "Travel" section.

( ) Adjust the control drive shaft in the rotary output post with the centering adjustment tool until the flat side on the rotary output post is parallel to the end of the case.

NOTE: As you turn the shaft, the rotary output post will turn in the opposite direction. It may be necessary to repeat this adjustment several times to get the rotary output post properly positioned.

TRAVEL

Refer to Figure 5 for the following steps.

( ) Push the large rotary output arm onto the rotary output post.

( ) Move the transmitter channel #1 trim tab to one end and then the other while operating its stick through its entire range. Check to be sure that the center line on the output arm does not go past the corners of the case.

NOTE: If the rotary output travel is not proper, refer to your transmitter manual for proper transmitter adjustments.

( ) Check the Servo to be sure it is running smoothly and is not binding. Binding will cause excessive current drain on the battery.

( ) To ensure proper operation of the Servo, a 2 to 5 minute break-in period is recommended. Use your system to run the Servo from end-to-end.

( ) Turn the transmitter and receiver off.

This completes the "Test and Adjustment" section. Proceed to the "Final Assembly" section.

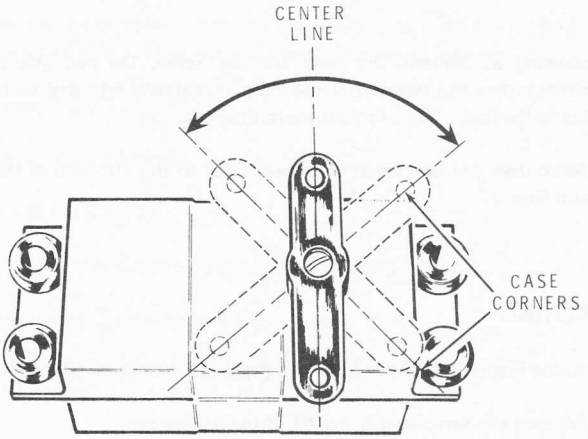


Figure 5

Troubleshooting Chart

CONDITION	POSSIBLE CAUSE
Servo completely dead.	1. Dead battery. 2. Faulty connections. 3. Transistor Q1 or Q2 installed incorrectly. 4. Solder or wire bridges around the leads of the IC. 5. Check for proper component installation. 6. Motor inoperative.
Servo travels to one end and stays there.	1. Transistor Q1 or Q2. 2. Control R4 wired wrong or defective. 3. Motor wired wrong. 4. Resistors R3, R4, R5, or capacitor C4.
Servo operates in only one direction.	1. Transistor Q1 or Q2. 2. Capacitor C3 or C4. 3. Resistors R3 or R5.
Servo unstable (hunts or chatters).	1. Capacitors C1, C2, C3, C6 or C7. 2. Resistors R2, R6, or R7.

CONDITION	POSSIBLE CAUSE
Servo slow (sluggish) low power.	1. The gear train binding. 2. Weak battery. 3. Capacitor C2. 4. Resistor R1. 5. Motor.
NOTE: The IC has been pretested and should not be an initial source of a problem. However a defective IC can cause any of the above conditions.	

SPECIFICATIONS

Input Signal	Pulse: 1-2 msec. wide; 4 volts p-p.
Thrust	4 lbs. at rotor.
Travel time	0.6 second.
Rotary Output Travel	90 degrees rotation.
Temperature Range	0 degrees to +160 degrees F.
Power Requirement	4.8 V battery. Idle Current: 12 mA maximum. Stall Current: 450 mA nominal. No Load Current: 80 mA.
Mechanical Output	1 large rotary arm. 1 small rotary arm. 1 offset rotary arm. 1 rotary wheel.
Position Accuracy	1.0%
Dimensions	1-17/32" high 23/32" wide x 1-7/8" long (length includes mounting ears. Height includes the outputs).
Net Weight	1.25 oz.

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

CIRCUIT DESCRIPTION

The width of the 4-volt pulses from the receiver controls the position of the servo outputs. Widening the pulses drives the servo gear-train in one direction, and narrowing the pulses drives the servo gear-train in the other direction. The pulse widths are variable from one to two milliseconds, and are controlled by a transmitter stick control. Therefore, moving a transmitter stick changes the pulse width, which in turn causes the servo gear-train to move.

Refer to the Schematic Diagram (fold-out from Page 37) while you read this "Circuit Description."

INPUT AND TIMING CIRCUITS

IC1 generates a negative (reference) pulse and compares it to the positive pulse from the receiver. The width of the reference pulse is controlled by feedback control R4.

If the incoming positive pulse is narrower than the reference pulse, the result is a small negative pulse that is inverted, shaped, and then used to turn on transistor Q2. At this time, the collector of Q1 is grounded through pin 6 of IC1. If the incoming positive pulse is wider than the reference pulse, the result is a small positive pulse that is inverted, shaped, and then used to turn on transistor Q1. At this time, the collector of Q2 is grounded through pin 8 of IC1.

Transistor Q1 drives the motor in one direction and transistor Q2 drives the motor in the other direction. The motor then turns feedback control R4 until the negative reference pulse is the same width as the positive incoming pulse. The pulses then cancel out and the motor stops.

Capacitor C1 determines the dead band of the system. Capacitor C3 and resistor R2 sets the minimum duty cycle. Capacitor C4 and resistor R5 determine the pulse timing for the internal circuit in the IC. Resistor R7 controls the damping of the servo.

DRIVE CIRCUIT

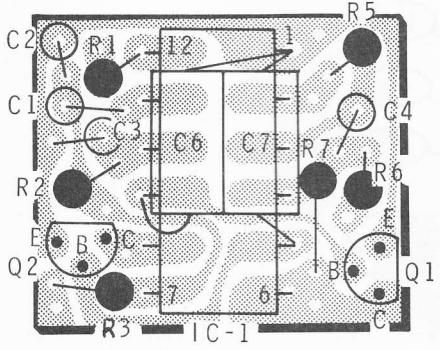
The servo motor is connected in the circuit in such a way that when transistor Q1 conducts, current passes through the motor windings in one direction and when transistor Q2 conducts, current passes through the motor windings in the opposite direction. This causes the motor to run in either direction depending upon which transistor is conducting.

Capacitor C5 filters out motor brush noise. Capacitor C2 filters the power supply voltages.

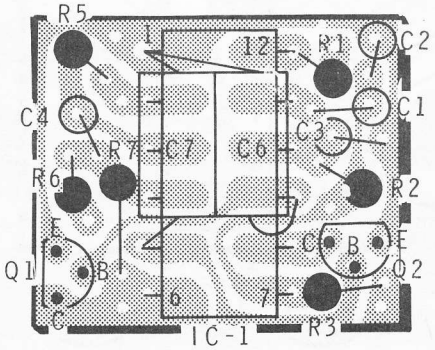
CIRCUIT BOARD X-RAY VIEWS

NOTE: To identify a part shown in one of these Views, so you can order a replacement, proceed as follows:

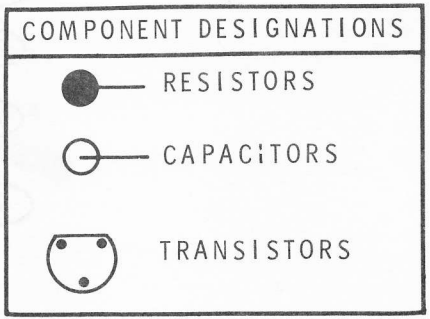
1. Note the identification number of the part (R-number, C-number, etc.).
2. Locate the same identification number (next to the part) on the Schematic. The "Description" of the part (for example: 10 kΩ, or .47 μF) will also appear near the part.
3. Look up this Description in the Parts List.



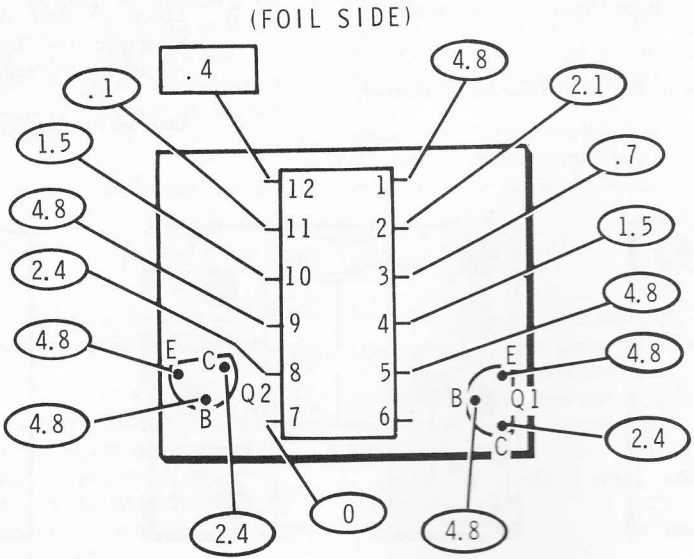
Shown from foil side



Shown from component side



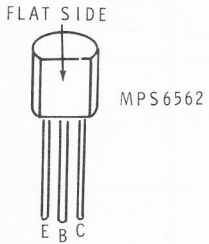
VOLTAGE CHART

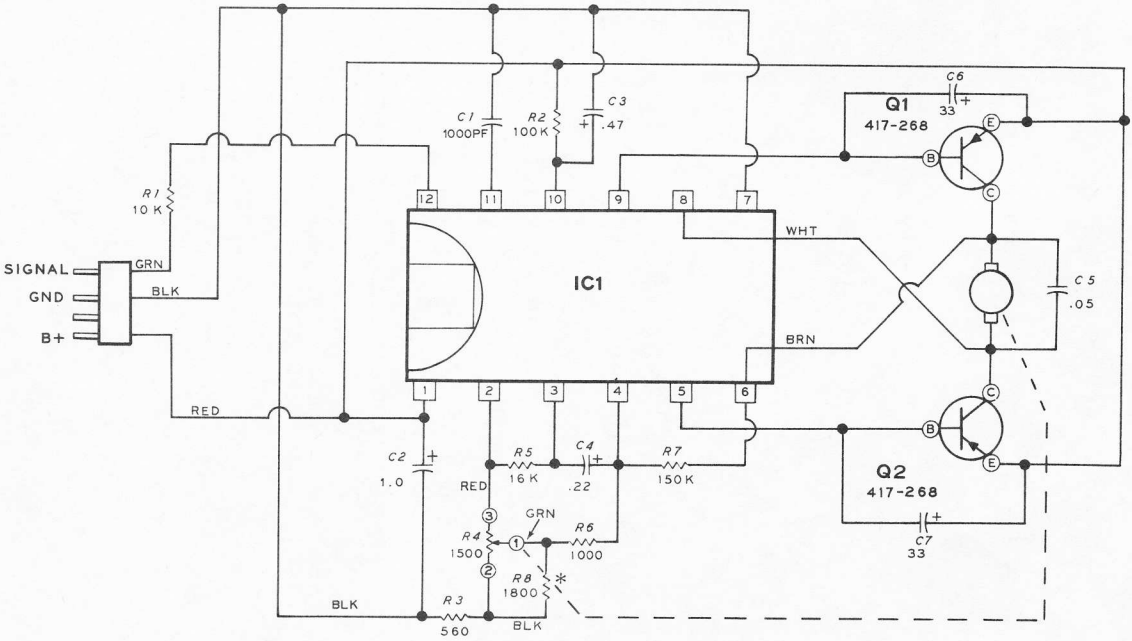


SCHEMATIC OF THE HEATHKIT® SUBMINIATURE DIGITAL PROPORTIONAL SERVO MODEL GDA-505-44

NOTES:

1. ALL RESISTORS ARE 1/4 WATT. RESISTOR VALUES ARE IN OHMS (K=1000).
2. ALL CAPACITOR VALUES ARE IN µF UNLESS OTHERWISE MARKED.
3. ◯ THIS SYMBOL INDICATES A POSITIVE DC VOLTAGE MEASUREMENT.
4. REFER TO THE SERVO PHOTOGRAPH AND CIRCUIT BOARD X-RAY VIEW FOR THE PHYSICAL LOCATION OF PARTS.
5. ALL VOLTAGES ARE MEASURED WITH A HIGH IMPEDANCE VOLTMETER FROM THE POINT INDICATED TO COMMON GROUND. VOLTAGES MAY VARY ±20%.





* THIS RESISTOR IS USED ONLY WHEN THE SERVO IS USED WITH THE GD-405 SYSTEM.

SCHEMATIC OF THE HEATHKIT® SUBMINIATURE DIGITAL PROPORTIONAL SERVO MODEL GDA-505-44