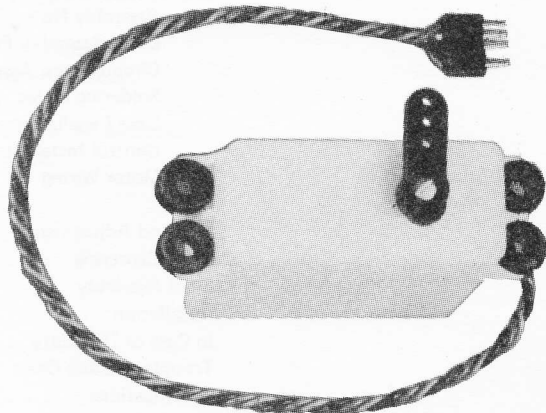


Heathkit® Manual

for the

**SUBMINIATURE DIGITAL
PROPORTIONAL SERVO
Model GDA-1205-5**

I-595-1718-01



**HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022**

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PARTS LIST

Check each part against the following list. Make a check (✓) in the space provided as you identify each part. Any part that is packed in an individual envelope with the part number on it should be placed back in the envelope after you identify it until it is called for in a step. Do not discard any packing materials until all parts are accounted for.

Each circuit part in this kit has its own "Circuit Component Number." (R2, C4, IC1, etc.). This is a specific number for only that one part. The purpose of these numbers is to help you easily identify the same part in each section of the Manual.

These numbers will appear:

- In the Parts List;
- At the beginning of each step where a component is installed;
- In some illustrations;
- In the sections at the rear of the Manual.

To order a replacement part: Always include the PART NUMBER. Use the Parts Order Form furnished with the kit. If one is not available, see "Replacement Parts" inside the rear cover of the Manual. Your Warranty is located inside the front cover.

<u>QTY.</u>	<u>DESCRIPTION</u>	<u>PART No.</u>	<u>CIRCUIT Component No.</u>	<u>PRICE Each</u>
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RESISTORS, 1/4-Watt

NOTE: The following resistors have a tolerance of 10% unless they are listed otherwise. 10% is indicated by a fourth color band of silver, while 5% is indicated by a gold fourth band.

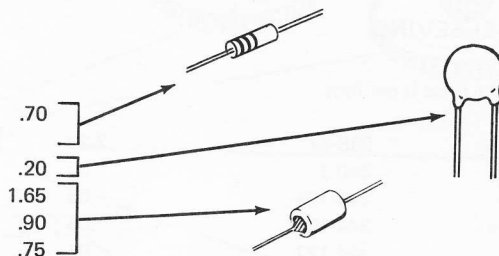
()	1	560 Ω (green-blue-brown)	1-13-12	R2	.15
()	1	1000 Ω (brown-black-red)	1-2-12	R5	.15
()	1	16 kΩ, 5% (brown-blue-orange)	1-112-12	R4	.15
()	1	150 kΩ (brown-green-yellow)	1-47-12	R1	.15
()	1	180 kΩ (brown-gray-yellow)	1-16-12	R6	.15



QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.	PRICE Each
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CAPACITORS

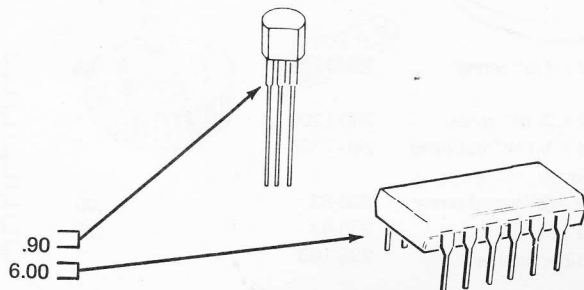
()	1	.001 μ F ceramic (brown-black-red-yellow)	21-175	C1
()	1	.05 μ F disc	21-94	C3
()	1	.22 μ F (.22 k) tantalum	25-255	C5
()	1	.47 μ F (.47 k) tantalum	25-256	C2
()	1	1 μ F tantalum	25-197	C4


TRANSISTORS-INTEGRATED CIRCUIT

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

1. Part number.
2. Type number. (On integrated circuits this refers only to the numbers. The letters may be different or missing.)
3. Part number with a type number.
4. Part number with a type number other than the one listed.

()	2	MPS6562 transistor	417-268	Q1, Q2
()	1	Integrated circuit	238-62	IC1



TEST AND ADJUSTMENT

If the Servo does not operate as described, refer to the "In Case of Difficulty" section on Page 35.

Refer to Figure 5 (fold-out from Page 30) that applies to your system.

- () Connect the Servo to channel #1 of the receiver.
- () Turn the transmitter and receiver on. The Servo may start to run and then stop. This is normal.
- () Move the channel #1 stick on your transmitter first one way; then the other. The Servo should rotate one direction; then the other.
- () Turn the transmitter and receiver off and disconnect the Servo from the receiver.

This completes the tests, proceed to "Centering."

CENTERING

Use the procedure titled "Centering with Servo Centering Standard" if you have one of the transmitters that supplied a Servo Centering Standard.

Use the procedure titled "Centering Without Servo Centering Standard" if you have some other transmitter.

Centering With Servo Centering Standard

- () Connect the Servo to your receiver through the Servo Centering Standard (supplied with the transmitter) as shown in Figure 6.
- () Turn the Transmitter and receiver on. The Servo rotary output post may rotate to some off-center position.

NOTE: When you use the Servo Centering Standard, the transmitter stick control will have no effect on the Servo. Also, the Servo may chatter when using the Servo Centering Standard.

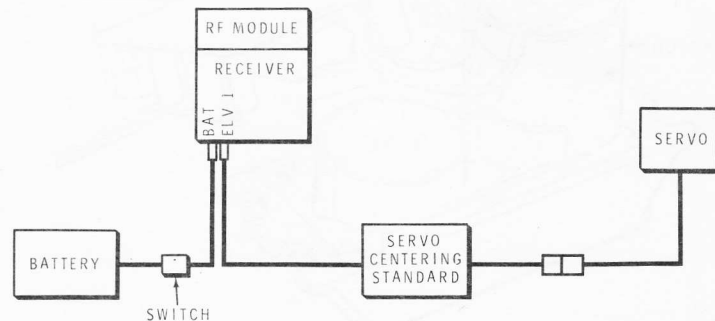


Figure 6

- () Refer to Figure 7, Part A, and loosen the two screws that hold the 1500 Ω control one full turn.

NOTE: Use a small pair of long-nose pliers when you adjust the control in the next step. Insert the tips of the pliers into the notches in the top of the control; then carefully rotate the control as required. If your pliers are not small enough, use your soldering iron and heat lug 1 of the control for about 15-seconds. This will temporarily expand the plastic and allow you to rotate the control. Reconnect the green wire to lug 1 before you adjust the control.

- () Rotate the control in the case center section slightly in either direction until the marked side of the rotary output post is parallel with the end of the case. See Figure 7, Part B.
- () Tighten the two screws that hold the 1500 Ω control.
- () Disconnect the Servo from the Servo Centering Standard.

NOTE: The Servo should never need readjustment unless it has been repaired. If at a later date you question the Servos centering, check it with the Servo Centering Standard.

This completes the "Centering;" proceed to "Final Assembly."

Centering Without Servo Centering Standard

NOTE: Before you perform the following steps, your Transmitter must be operating properly.

- () Connect the Servo to channel #1 on your receiver.
- () Turn the transmitter and receiver on. The Servo rotary output post may rotate to some off-center position.
- () Refer to Figure 7, Part A, and loosen the two screws that hold the 1500 Ω control one full turn.

NOTE: Use a small pair of long-nose pliers when you adjust the control in the next step. Insert the tips of the pliers into the notches in the top of the control; then carefully rotate the control as required. If your pliers are not small enough, use your soldering iron and heat lug 1 of the control for about 15-seconds. This will temporarily expand the plastic and allow you to rotate the control. Reconnect the green wire to lug 1 before you adjust the control.

- () Rotate the control in the case center section slightly in either direction until the marked side of the rotary output post is parallel with the end of the case. See Figure 7, Part B.
- () Tighten the two screws holding the 1500 Ω control.

This completes the "Centering;" proceed to "Final Assembly."

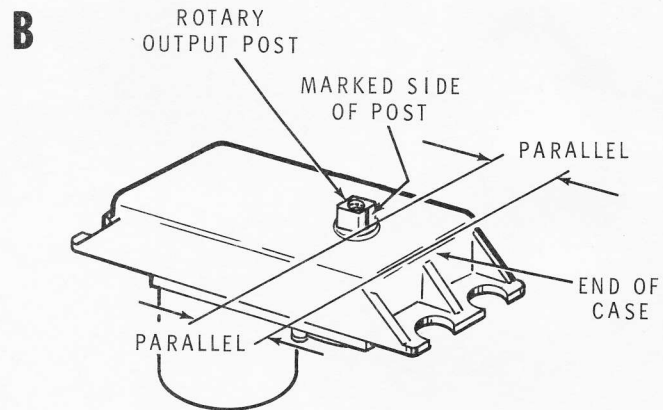
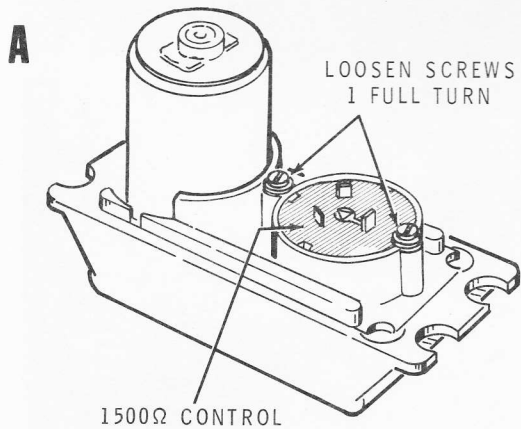


Figure 7

Troubleshooting Chart

CONDITION	POSSIBLE CAUSE
Servo completely dead.	<ol style="list-style-type: none"> 1. Dead battery. 2. Faulty solder connection. 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.	<ol style="list-style-type: none"> 1. Transistor Q1 or Q2. 2. Control R3 wired wrong or defective. 3. Motor wired wrong. 4. Resistors R2, R3, R4, or capacitor C5. 5. Solder bridge.
Servo operates in only one direction.	<ol style="list-style-type: none"> 1. Transistor Q1 or Q2. 2. Capacitor C2 or C5. 3. Resistors R2 or R4.
Servo unstable (hunts or chatters).	<ol style="list-style-type: none"> 1. Capacitors C1, C2, or C4. 2. Resistors R1, R5, or R6. 3. Dirty 1500 Ω control element or improperly formed wiper.
Servo slow (sluggish) low power.	<ol style="list-style-type: none"> 1. The gear train. 2. Weak battery. 3. Capacitor C4. 4. Motor.
<p>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.</p>	

SPECIFICATIONS

Input Signal	Pulse: 1-2 msec. wide; 4 volts p-p.
Thrust	3 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 offset rotary arm. 1 rotary wheel.
Position Accuracy	1.0%
Dimensions	1-11/16" high 3/4" wide x 2-5/32" long (length includes mounting ears. Height includes the outputs).
Net Weight	1.25 oz.

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products 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 41) 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 R3.

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 R3 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 C2 and resistor R1 sets the minimum duty cycle. Capacitor C5 and resistor R4 determine the pulse timing for the internal circuit in the IC. Resistor R6 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.

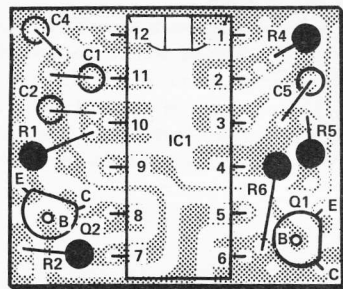
Capacitor C3 filters out motor brush noise. Capacitor C4 filters the power supply voltages.

CIRCUIT BOARD X-RAY VIEWS





NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

- A. Find the circuit component number (R5, C3, etc.,) on the "X-Ray View" or "Chassis Photograph."
- B. Locate this same number in the "Circuit Component Number" column of the "Parts List" in the front of this Manual.
- C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.

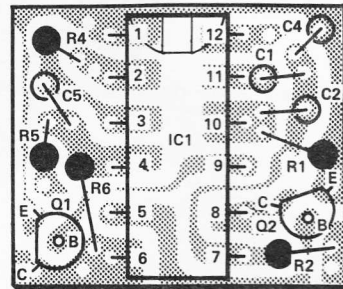
X-RAY VIEW
(FOIL SIDE)



COMPONENT DESIGNATIONS

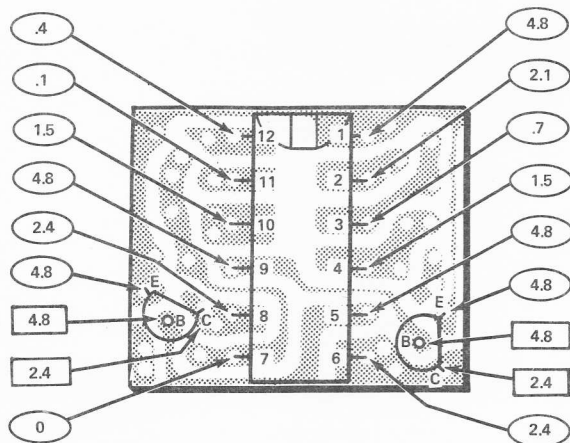
-  RESISTOR
-  CAPACITORS AND DIODES
-  TRANSISTOR
-  INTEGRATED CIRCUIT

X-RAY VIEW
(COMPONENT SIDE)



VOLTAGE CHART

(VIEWED FROM FOIL SIDE)



- DC VOLTAGE READING
 □ NOMINAL DC VOLTAGE READING
 WHEN A PULSE IS PRESENT

NOTE

1. A

2. A

3. ○

4. □

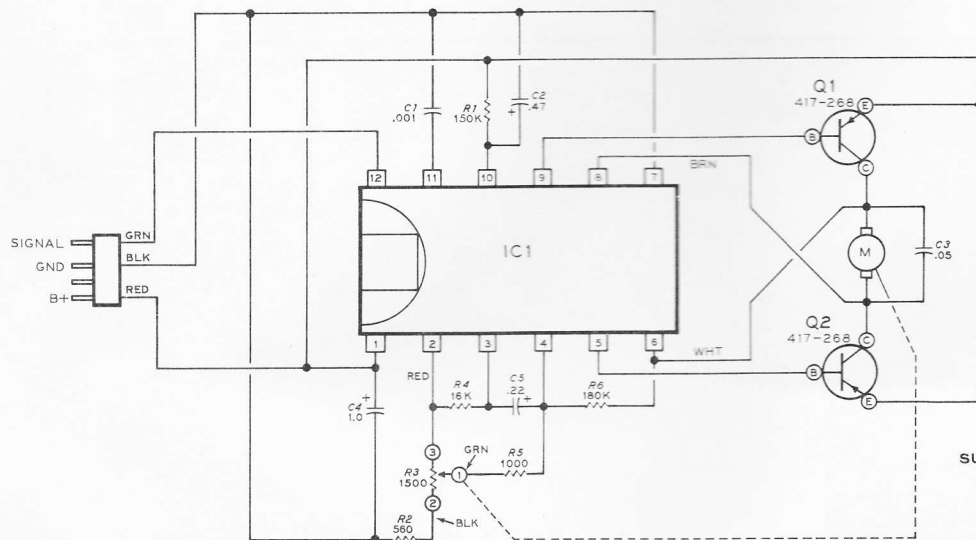
5. V

C

6. V



C

C



SCHEMATIC OF THE
HEATHKIT®
SUBMINIATURE DIGITAL PROPORTIONAL SERVO
MODEL GDA-1205-5

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.  THIS SYMBOL INDICATES THE NORMAL OPERATING VOLTAGE RANGE.
5. VOLTAGE ON PIN 2 OF THE IC IS VARIABLE FROM 0.2 TO 0.4, DEPENDING ON THE INPUT PULSE. VOLTAGE SHOWN IS WITH THE SERVO IN THE CENTER OF TRAVEL.
6. VOLTAGE ON PIN 6 OF THE IC IS VARIABLE FROM 1.5 TO 2.7, DEPENDING ON THE INPUT PULSE. VOLTAGE SHOWN IS WITH THE SERVO IN THE CENTER OF TRAVEL.
7. ALL VOLTAGES ARE MEASURED WITH A HIGH IMPEDANCE VOLTMETER FROM THE POINT INDICATED TO COMMON GROUND. VOLTAGES MAY VARY $\pm 20\%$.
8. REFER TO THE SERVO PHOTOGRAPH AND CIRCUIT BOARD X-RAY VIEW FOR THE PHYSICAL LOCATION OF PARTS.

FLAT SIDE



MPS6562