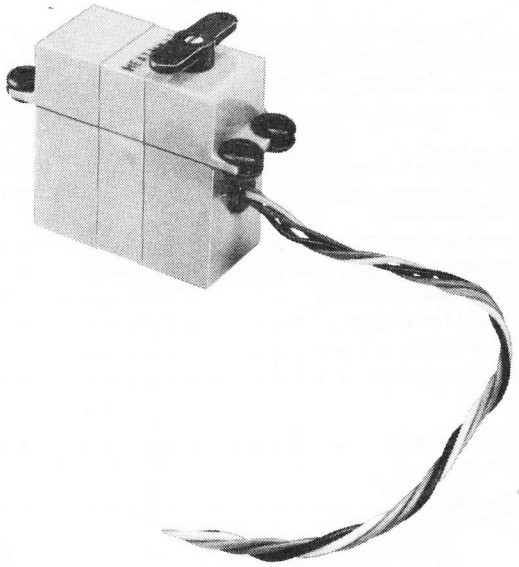
Assembly and Operation

of the

HEATHKIT

SUBMINIATURE DIGITAL PROPORTIONAL SERVO

MODEL GDA-19-42
AND
MODEL GDA-505-4



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

PARTS LIST

NOTE: This assembly Manual contains instructions for both the GDA-19-42 and GDA-505-4 Servos. Some parts will be found only in one Model and not in the other. These parts are marked as such.

Check each part against the following list. The key numbers correspond to the Parts Pictorial (fold-out from Page 9).

To order replacement parts, 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" in the "Kit Builders Guide."

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
RESISTORS				
1/4-Watt				
A1	1-4-12	1	2200 Ω (red-red-red)	.10
A1	1-9-12	1	10 kΩ (brown-black-orange)	.10
A1	1-94-12	1	18 kΩ (brown-gray-orange)	.10
A1	1-16-12	2	180 kΩ (brown-gray-yellow)	.10
A1	1-38-12	2	220 kΩ (red-red-yellow)	.10
A1	1-93-12	2	330 kΩ (orange-orange-yellow)	.10
Precision				
A2	2-20-11	1	14.3 kΩ	.40
CAPACITORS				
B1	21-94	1	.05 μF disc	.15
B2	21-175	1	.001 μF ceramic (brown-black-red)	.45
B3	25-211	2	33 μF tantalum	.85
B3	25-255	1	.22 μF tantalum (R22 μF)	1.10
B3	25-256	2	.47 μF tantalum (R47 μF)	.60

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

TRANSISTORS-INTEGRATED CIRCUIT-DIODES

NOTE: Transistors 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	417-267	1	MPS6560 transistor	.65
C1	417-268	1	MPS6562 transistor	.70
C2	443-75	1	Integrated circuit	5.50
C3	56-56	2	1N4149 silicon diode	.20
C4	56-74	1	MZ2362 compensating diode	.65

WIRE-SLEEVING

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

340-3	1	Bare wire	.05
344-125	1	Black wire	.05
344-127	1	Red wire	.05
344-130	1	Green wire	.05
344-134	1	White wire (Model GDA-19-42 only)	.05
346-1	1	Sleeving	.05

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	238-1	1	3/8" gear pin	.10
D4	238-29	1	Control drive shaft	.60

MOLDED NYLON PARTS

E1	238-19	1	Idler gear marked #1	.45
E2	238-20	1	Idler gear marked #2	.45
E3	238-21	1	Idler gear marked #3	.45
E4	238-18	1	Rotary drive gear	.45
E5	238-22	1	Rotary output wheel	.35
E6	238-23	1	Rotary output offset arm	.35
E7	238-24	1	Rotary output large arm	.35
E8	238-25	1	Rotary output small arm	.35
E9	238-26	1	Case bottom section	1.05
E10	238-27	1	Case center section	1.35
E11	238-28	1	Case top section	1.35

MISCELLANEOUS

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
F1	9-40	1	1500 Ω control	1.65
F2	73-64	1	Foam gasket	.25
F3	73-53	1	Small rubber grommet	.10
F3	73-100	4	Large rubber grommet	.10
	85-511	1	Circuit board	.25
F4	238-30	1	Control wiper	.75
F5	420-74	1	Motor	5.00
F6	432-104	1	4-pin male connector (Model GDA-19-42 only)	.70
F7	238-32	1	4-pin male connector assembly (Model GDA-505-4 only)	1.45
F8	390-360	6	Clear "Heathkit" label	.10

Miscellaneous (cont'd.)

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
	391-34	1	Blue and white label	
	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 15 cents each.)	

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 30.

CENTERING

Refer to the Figure 3 that applies to your Servo for the following steps.

( ) 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.

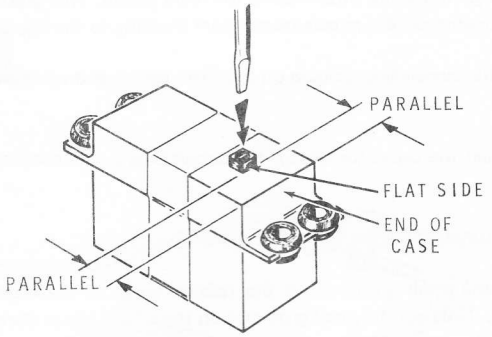


Figure 4

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 a small screwdriver 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.

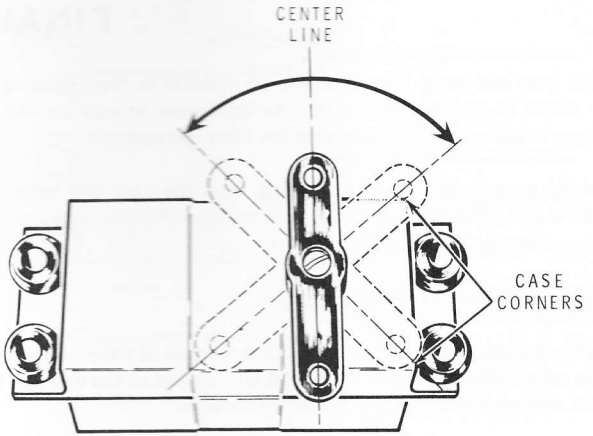


Figure 5

Troubleshooting Chart

CONDITION	POSSIBLE CAUSE
Servo completely dead.	1. Dead battery. 2. Faulty connections or miswired servo connector. 3. Transistors Q1 and Q2 interchanged or installed backwards. 4. Solder or wire bridges around the leads of the IC. 5. Check for proper component installation.
Servo travels to one end and stays there.	1. Transistor Q1 or Q2. 2. Control R7 wired wrong. 3. Motor wired wrong. 4. Resistors R2 and R3.

CONDITION	POSSIBLE CAUSE
Servo operates in only one direction.	1. Transistor Q1 or Q2. 2. Capacitors C1 and C2. 3. Resistors R2 and R3.
Servo unstable (hunts or chatters).	1. Capacitors C3, C5, and C6. 2. Resistors R1, R5, and R6.
Servo slow (sluggish) low power.	1. The gear train binding. 2. Weak battery. 3. Diode D1, D2, or D3. 4. Resistor R4.
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	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 CT battery. Idle Current: 15 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 41) while you read this "Circuit Description."

INPUT AND TIMING CIRCUITS

A positive input pulse is coupled from the receiver, through the servo connector, to pin 2 of the IC (integrated circuit), and through capacitor C4 to pin 1 of the IC. The pulse causes the IC to generate a negative reference pulse. The width of this reference pulse is controlled by feedback control R7, resistor R1, and capacitor C3.

The negative reference pulse is compared with the incoming positive pulse. If the incoming pulse is narrower than the reference pulse, then the difference between pulses is a small negative pulse that is inverted, shaped, and used to drive transistor Q2. However, if the incoming pulse is wider than the reference pulse, then the difference between pulses is a small positive pulse that is inverted, shaped, and used to drive transistor Q1.

Transistor Q1 drives the motor in one direction and transistor Q2 drives the motor in the other direction. The motor then turns the feedback control until the negative reference pulse is the same width as the positive incoming pulse. The pulses then cancel out and the motor stops. Resistor R5 couples the voltage from control R7 to pin 6 of the IC.

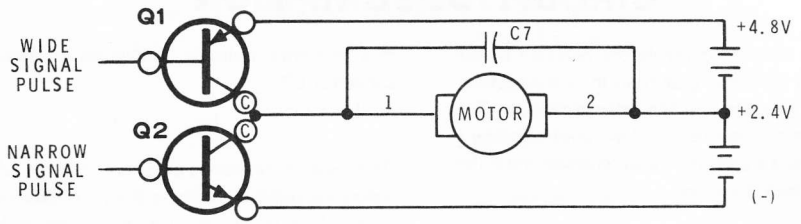


Figure 7

DRIVE CIRCUITS

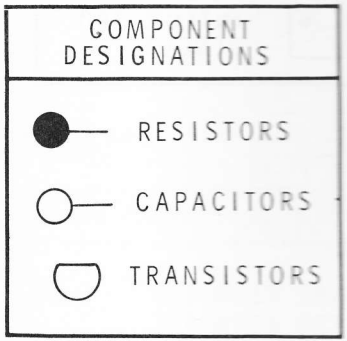
The number 2 pole of the reversible motor is connected to the center tap of the battery as shown in the simplified schematic of Figure 7. The motor runs in one direction when the number 1 pole is connected to the positive end of the battery (through transistor Q1) and reverses direction when this pole is connected to the negative (ground) end of the battery (through transistor Q2). Capacitors C5 and C6 round the sharp switching pulse at the bases of transistors Q1 and Q2 and capacitor C7 filters out motor brush noise. Resistors R2 and R3 provide bias for the IC and along with capacitors C1 and C2 modify the pulse shape to control the drive of transistors Q1 and Q2. Diodes D1, D2, D3, and resistor R4 limit the amount of drive to the transistors by limiting the voltage that capacitors C1 and C2 can charge to. This prevents excessive drive of the transistors under large error conditions. Resistor R6 is a damping resistor which prevents the Servo from overshooting.

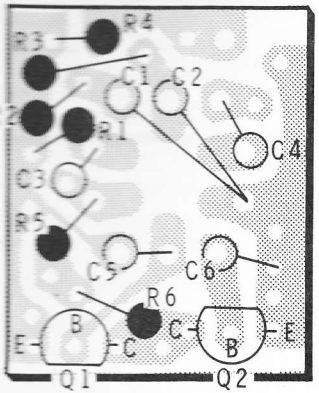
CIRCUIT BOARD X-RAY VIEWS

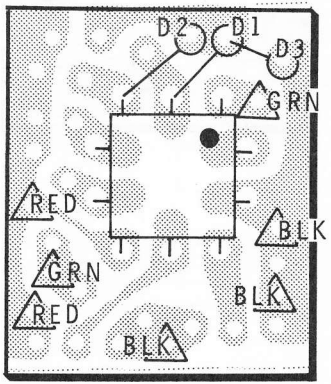
NOTE: To identify a part shown in one of these Views, so you can order a replacement, proceed as follows:

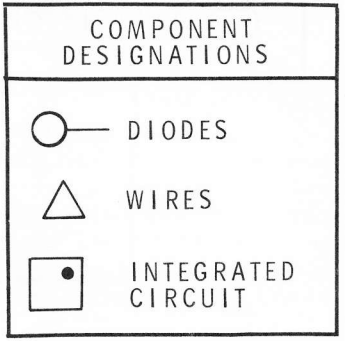
1. Note the identification number of the part (R-number, C-number, etc.).
2. Locate the same identification number (next to the part) on the Schematic. The "Description" of the part (for example: 10 kΩ, .47 μF, or MPS6560) will also appear near the part.
3. Look up this Description in the Parts List.

(SHOWN FROM COMPONENT SIDE)

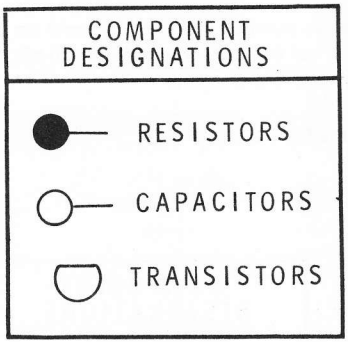


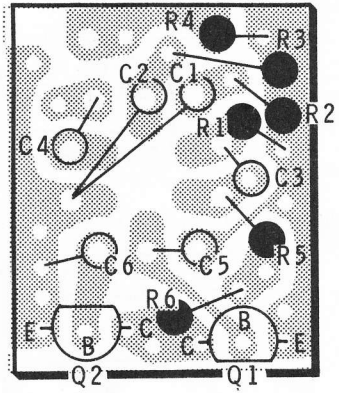


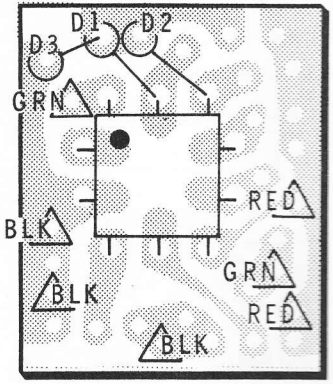


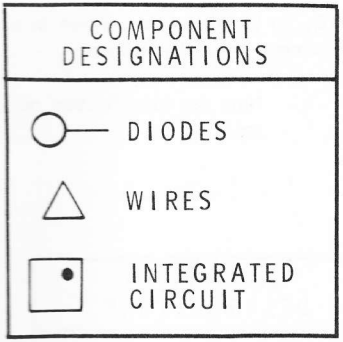


(SHOWN FROM FOIL SIDE)



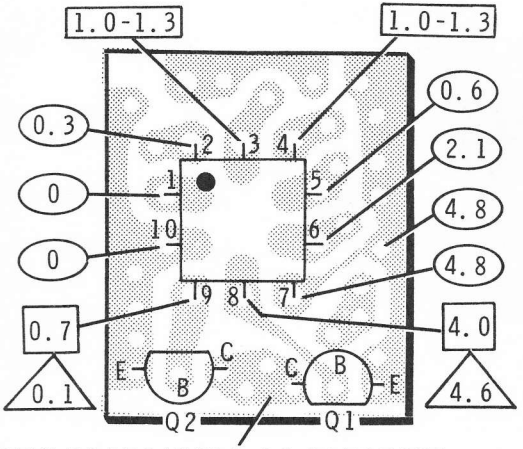




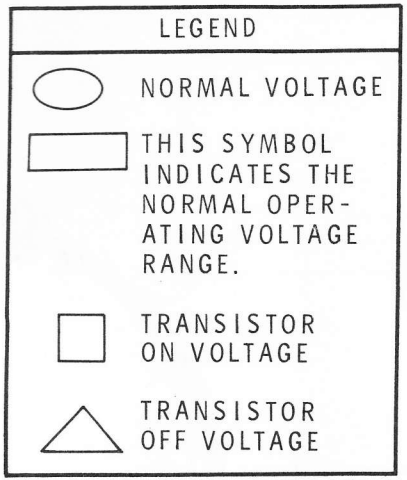


VOLTAGE CHART

(SHOWN FROM FOIL SIDE)



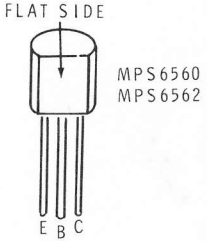
0.1 WHEN TRANSISTOR Q2 CONDUCTS.
2.4 WHEN TRANSISTOR Q1 AND Q2 CUT OFF.
4.7 WHEN TRANSISTOR Q1 CONDUCTS.

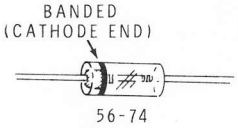


NOTES:

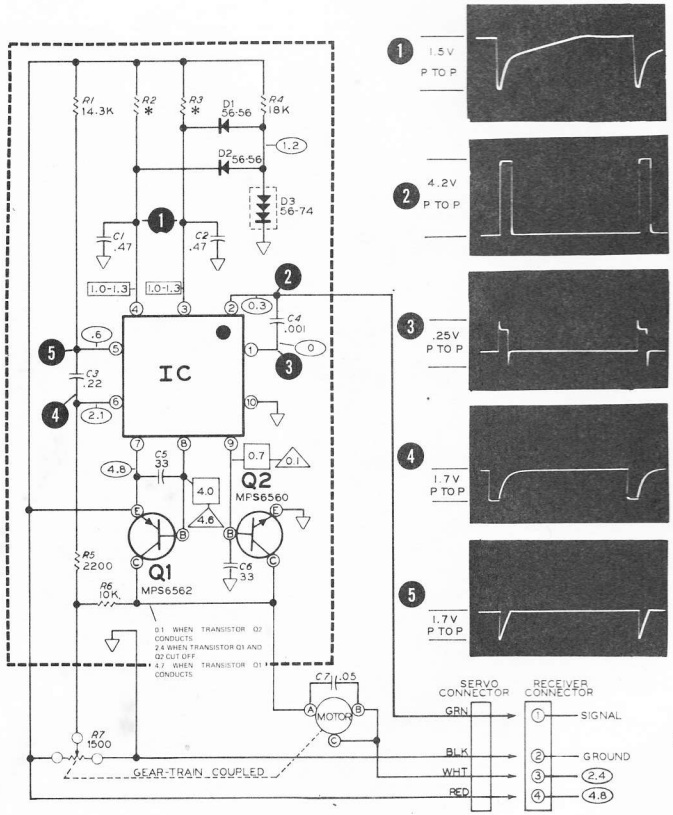
1. ALL RESISTORS ARE 1/4 WATT. RESISTOR VALUES ARE IN OHMS (K=1000).
2. ALL CAPACITOR VALUES ARE IN µF.
3. ⬭ THIS SYMBOL INDICATES A POSITIVE DC VOLTAGE MEASUREMENT.
4. ▭ THIS SYMBOL INDICATES THE NORMAL OPERATING VOLTAGE RANGE.
5. □ THIS SYMBOL INDICATES ON VOLTAGE.
6. △ THIS SYMBOL INDICATES OFF VOLTAGE.
7. ● THIS SYMBOL INDICATES A WAVEFORM DISPLAY AT THE POINT INDICATED, AS SHOWN NEXT TO THE SCHEMATIC.
8. 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.
9. 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.
10. ALL VOLTAGES ARE MEASURED WITH A HIGH IMPEDANCE VOLTMETER FROM THE POINT INDICATED TO COMMON GROUND. VOLTAGES MAY VARY ±20%.
11. REFER TO THE SERVO PHOTOGRAPH AND CIRCUIT BOARD X-RAY VIEW FOR THE PHYSICAL LOCATION OF PARTS.

56-56





56-74



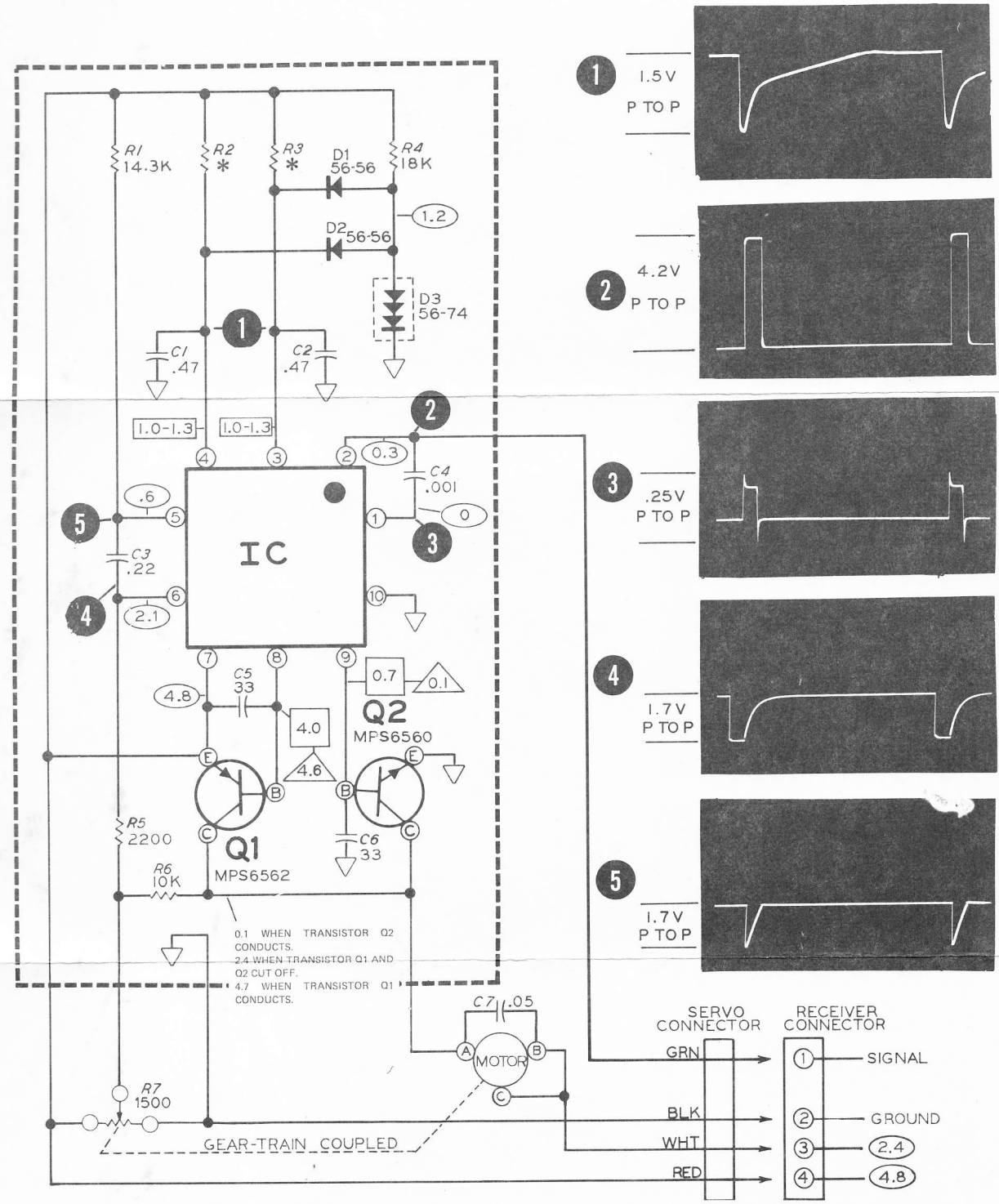
* THE VALUES OF R2 AND R3 DEPEND ON THE RATING OF THE INTEGRATED CIRCUIT (IC).

YELLOW DOT – 180 kΩ

GREEN DOT – 220 kΩ

BLUE DOT – 330 kΩ

SCHEMATIC OF THE HEATHKIT® SUBMINIATURE DIGITAL PROPORTIONAL SER MODEL GDA-19-42 AND MODEL GDA-505-4



* THE VALUES OF R2 AND R3 DEPEND ON THE RATING OF THE INTEGRATED CIRCUIT (IC).
YELLOW DOT – 180 kΩ
GREEN DOT – 220 kΩ
BLUE DOT – 330 kΩ

SCHEMATIC OF THE HEATHKIT® SUBMINIATURE DIGITAL PROPORTIONAL SERVO MODEL GDA-19-42 AND MODEL GDA-505-4