HEATH COMPANY
BENTON HARBOR, MICHIGAN

MODEL **GDA-405-2 8-Channel Digital Proportional Receiver**

HEATHKIT®
ASSEMBLY MANUAL

HEATHKIT®

Price $2.00

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595-1407-02

Assembly

and

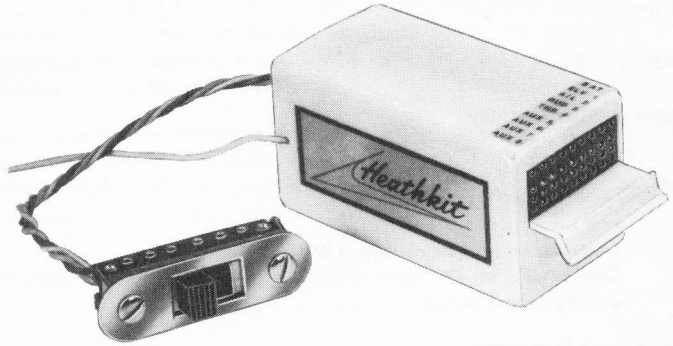
Operation

of the

HEATHKIT®

8-CHANNEL DIGITAL PROPORTIONAL RECEIVER

MODEL GDA-405-2



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

INTRODUCTION

The 8-channel Digital Proportional Receiver, Model GDA-405-2, can be purchased to operate on any of the two frequencies as they are listed.

27 MHz Band	53 MHz Band	72 MHz Band
26.995 MHz	53.100 MHz	72.080 MHz
27.045 MHz	53.200 MHz	72.240 MHz
27.095 MHz	53.300 MHz	72.160 MHz
27.145 MHz	53.400 MHz	72.320 MHz
27.145 MHz	53.400 MHz	72.400 MHz
27.195 MHz	53.500 MHz	72.960 MHz
		75.640 MHz (no second frequency)

A total of nine transistors, one integrated circuit, and three ceramic i-f filters are used in the Receiver. All parts are mounted on two glass epoxy circuit boards: the receiver circuit board and the decoder circuit board. The outputs for the eight channels are supplied to the individual servos by a space-saving connector block, located inside the receiver case.

Supply voltage for the Receiver and Servos is from a compact, rectangular, 4.8 volt, nickel-cadmium, rechargeable battery; Heathkit Model GDA-405-3. The completed Receiver is housed in an attractive, compact, molded nylon case. The receiver battery can be charged without disconnecting it from the Receiver.

A slide switch is also used to select one of the two operating frequencies.

Refer to the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

PARTS LIST

NOTE: If you have not yet assembled your Transmitter, do so before you assemble this Receiver. Also assemble the Receiver Battery before you assemble this Receiver.

Check each part against the following list. The key numbers correspond to the numbers in the Parts Pictorial.

To order replacement parts: Use the Parts Order Form furnished with this kit. If one 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	1-1-12	1	100 Ω (brown-black-brown)	.10
A1	1-37-12	1	150 Ω (brown-green-brown)	.10
A1	1-17-12	1	220 Ω (red-red-brown)	.10
A1	1-2-12	3	1000 Ω (brown-black-red)	.10
A1	1-99-12	2	1800 Ω (brown-gray-red)	.10
A1	1-4-12	2	2200 Ω (red-red-red)	.10
A1	1-5-12	3	2700 Ω (red-violet-red)	.10
A1	1-7-12	1	3900 Ω (orange-white-red)	.10
Resistors, 1/4-watt (cont'd.)				
A1	1-8-12	1	4700 Ω (yellow-violet-red)	.10
A1	1-26-12	1	5600 Ω (green-blue-red)	.10
A1	1-27-12	2	6800 Ω (blue-gray-red)	.10
A1	1-28-12	1	8200 Ω (gray-red-red)	.10
A1	1-9-12	4	10 kΩ (brown-black-orange)	.10
A1	1-10-12	1	15 kΩ (brown-green-orange)	.10
A1	1-52-12	1	18 kΩ (brown-gray-orange)	.10
A1	1-45-12	2	22 kΩ (red-red-orange)	.10
A1	1-46-12	1	27 kΩ (red-violet-orange)	.10
A1	1-11-12	2	47 kΩ (yellow-violet-orange)	.10
A1	1-31-12	1	68 kΩ (blue-gray-orange)	.10
Other Resistors				
A2	1-21	1	15 kΩ, 1/2-watt (brown-green-orange)	.10
A2	4-85	1	130 kΩ, 1/2-watt (brown-orange-yellow)	.15

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

CAPACITORS

Ceramic

A3	21-3	1	10 pF	.10
A3	21-22	1	220 pF	.10
A3	21-140	6	.001 μF	.10
A3	21-141	2	.0033 μF	.10
A3	21-147	2	47 pF	.10

The quantity of the following capacitors is in addition to the capacitors above and depends on the frequency band you selected to have your Receiver (and Transmitter) operate on: the 27 MHz, the 53 MHz, or the 72 MHz band. Refer to the following chart.

		QUANTITY		
Part No.	Description	27 MHz	53 MHz	72 MHz
21-3	10 pF	1	0	1
21-6	27 pF	0	2	3
21-11	150 pF	1	0	0
21-111	15 pF	0	1	0
21-147	47 pF	2	1	0

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

Ceramic (cont'd.)

A4	21-174	1	180 pF (brown-gray-brown-white)	.50
A5	21-182	3	.047 μF (473)	.45

Tantalum

A6	25-195	1	2.2 μF	.60
A6	25-197	1	1.0 μF	.70
A7	25-252	2	15 μF	.45

Mylar*

A8	27-64	2	.033 μF	.15
A8	27-74	4	.01 μF (.01 k)	.10
A8	27-129	1	.047 μF	.15

FILTERS-RF CHOKES

A9	404-399	3	Ceramic filter	.40
A10	45-73	1	2.2 μH choke (red-red-gold)	.70
A10	45-80	2	1.0 mH choke (brown-black-red)	1.40
A10	45-88	1	.17 mH choke (brown-violet-silver)	.50

*DuPont Registered Trademark

DIODES-TRANSISTORS-INTEGRATED CIRCUIT

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.

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
B1	56-26	2	1N191 (brown-white-brown) diode	.25
B1	56-27	1	GE S160 silicon diode	.25
B1	56-84	2	1N4148 silicon diode	.20
B2	417-91	1	2N5232A transistor	.85
B2	417-118	2	2N3393 transistor	.40
B2	417-164	2	16G2349 transistor	1.05
B2	417-201	2	X29A829 transistor	.50
B2	417-258	2	TIS87 transistor	.60
B3	443-52	1	SCUS0127D integrated circuit	10.00

WIRE-SLEEVING

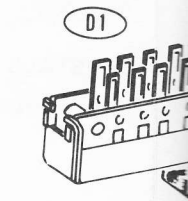
NOTE: For wire and sleeving, the price is per foot.

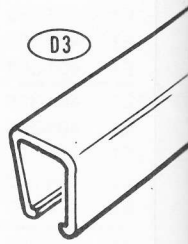
KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
	344-52	1	Red (solid) wire	.05/ft
	344-125	1	Black wire	.05/ft
	344-127	1	Red (long) wire	.05/ft
	344-128	1	Orange wire	.05/ft
	344-129	1	Yellow wire	.05/ft
	344-130	1	Green wire	.05/ft
	344-131	1	Blue wire	.05/ft
	344-134	1	White wire	.05/ft
	346-1	1	Black sleeving	.05/ft
	346-21	1	White sleeving	.30/ft
	349-3	1	String	.05/ft

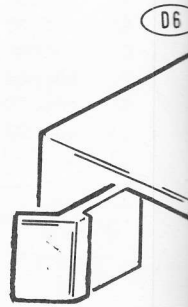
CABLE ASSEMBLIES-CONNECTORS

C1	238-31	1	Connector block	5.30
C2	238-34	1	4-pin cable assembly	3.00
C3	238-35	1	3-pin cable assembly	1.30
C4	432-103	2	4-pin socket (one may have been removed for the Receiver battery.)	.70
C5	432-104	1	4-pin plug	.70

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
MISCELLANEOUS				
D1	60-35	2	Slide switch	1.15
D2	73-53	1	Rubber grommet	.10
D3	75-183	1	Switch cover	.70
D4	85-1138	1	Receiver circuit board	.60
D5	85-1139	1	Decoder circuit board	.30
D6	95-43	1	Case top section	.30
D7	95-44	1	Case bottom section	.45
D8	205-559	2	Switch plate	.05
D9	250-49	4	3-48 x 1/4" screw	.05
D10	250-1112	1	2-56 x 7/8" flat head screw	.15
	390-244	1	Heathkit label	.20
	390-348	1	FCC label	.45
	390-919	1	Frequency label	.55
	390-958	1	Connector label	
	391-34	1	Blue and white label	
D11	490-109	1	Alignment tool	.10
	597-260	1	Parts Order Form	
	597-308	1	Kit Builders Guide	
		1	Manual (See front cover for part number.)	2.00
			Solder (Additional 6' rolls of solder, #331-13, can be ordered for 25 cents each.)	







CRYSTALS

Two of the following crystals are supplied with this kit.

KEY No.	PART No.	Receiver Crystal Frequency In MHz	Transmitted Frequency In MHz	PRICE Each
E1	404-384	26.542	26.995	4.00
E1	404-385	26.592	27.045	4.00
E1	404-386	26.642	27.095	4.00
E1	404-387	26.692	27.145	4.00
E1	404-388	26.742	27.195	4.00
E1	404-389	26.3235	53.100	4.00
E1	404-390	26.3735	53.200	4.00
E1	404-391	26.4235	53.300	4.00
E1	404-392	26.4735	53.400	4.00
E1	404-393	26.5235	53.500	4.00
E1	404-394	36.2665	72.080	4.00
E1	404-533	35.8535	72.160	4.00
E1	404-395	36.3465	72.240	4.00
E1	404-534	35.9335	72.320	4.00
E1	404-396	36.4265	72.400	4.00
E1	404-397	36.7065	72.960	4.00
E1	404-398	37.5935	75.640*	4.00

*Only one crystal is supplied if this transmitting frequency is selected.

TRANSFORMERS

NOTE: There are two variable transformers in this kit. The part numbers depend on the transmitting band you selected for your Receiver (27 MHz, 53 MHz, or 72 MHz).

For 27 MHz Band Receivers (26.995, 27.045, 27.095, 27.145, and 27.195 MHz)

KEY No.	PART No.	DESCRIPTION	PRICE Each
E2	40-913	4-lead variable transformer	1.15
E3	40-914	5-lead variable transformer	1.15

For 53 MHz Band Receivers (53.100, 53.200, 53.300, 53.400, and 53.500 MHz)

KEY No.	PART No.	DESCRIPTION	PRICE Each
E2	40-915	4-lead variable transformer	1.25
E3	40-916	5-lead variable transformer	1.25

For 72 MHz Band Receivers (72.080, 72.160, 72.240, 72.320, 72.400, 72.960, and 75.640 MHz)

KEY No.	PART No.	DESCRIPTION	PRICE Each
E2	40-917	4-lead variable transformer	1.25
E3	40-918	5-lead variable transformer	1.25

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 ADJUSTMENTS

If you do not obtain the proper results when you make a test or an adjustment, turn off the equipment and refer to the chart on the next page. For the physical location of parts on the circuit boards, refer to the Circuit Board X-Ray Views on Pages 51 and 52.

RECEIVER

In the following steps, the Receiver will be aligned for maximum sensitivity using the Transmitter as the signal source with the meter as a peaking indicator.

Refer to Figure 3 and Figure 4 (fold-out from Page 39) for the following steps.

( ) Remove the receiver case top section.

( ) Slide both circuit boards out of the case bottom section so test point 1 is exposed.

( ) Locate the 15 kΩ (brown-green-orange) resistor and cut 1/2" from one of its leads. Use this 1/2" lead in the next step.

( ) Solder a cutoff resistor lead to test point 2 on the receiver board.

( ) Carefully solder the short lead of the 15 kΩ (brown-green-orange) resistor to test point 1 on the foil side of the receiver circuit board (S-1).

( ) Clip the black (negative) meter wire to the free end of this 15 kΩ resistor.

( ) Clip the red (positive) meter wire to test point 2.

( ) Connect the battery on-off switch to the Receiver as shown.

( ) Be sure the receiver battery switch is in the OFF position.

( ) Connect the battery to the battery on-off switch as shown.

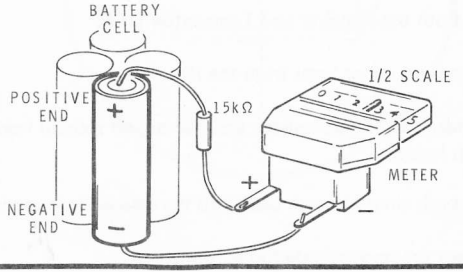
( ) Stretch the antenna (white wire) of the Receiver out straight; keep it away from any metal objects.

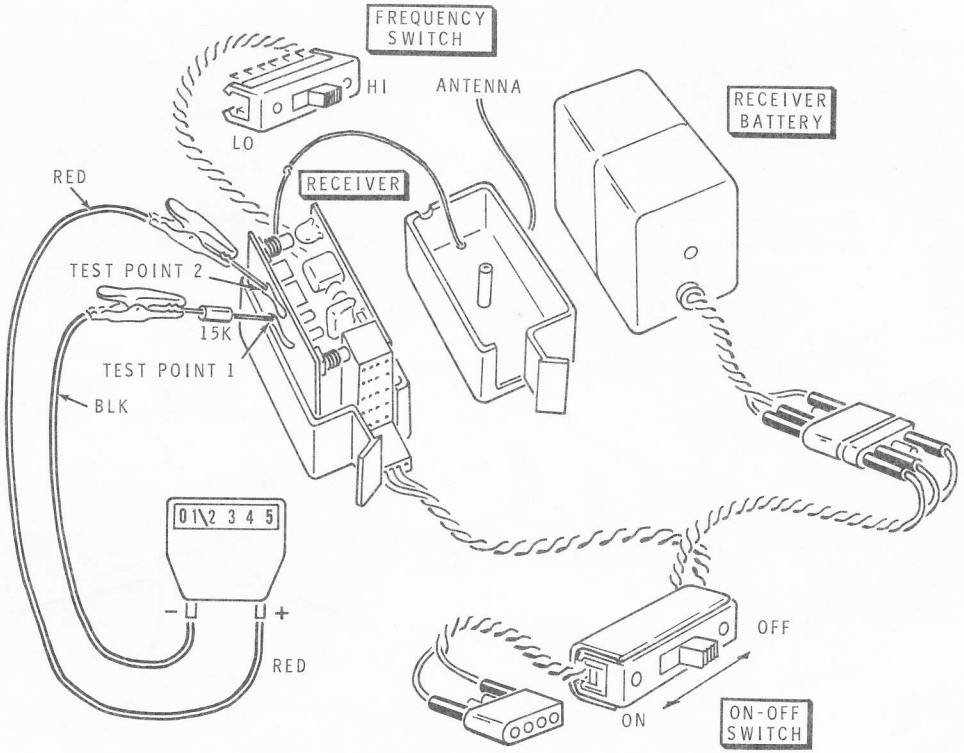
( ) Turn the receiver battery switch on. The meter should deflect only a slight amount. See the meter drawing in Figure 3. If the meter does not react in this manner, refer to the chart on the following page and investigate each of the possible causes until you find and correct your difficulty. Then continue on Page 40.

CONDITION	POSSIBLE CAUSE
Incorrect or no meter indication.	1. Weak battery (see "Battery Check" at the bottom of this page). This should not be the case at this time as the battery was just charged, unless the charging circuit in the Transmitter is not operating properly. See the Receiver Battery Instructions. 2. Battery on-off switch. 3. Transistors Q1 through Q5, and Transistors Q101 and Q102. 4. Diode D2. 5. Transformer T1 or T2. 6. Components associated with stages Q1 through Q5. 7. Frequency selector switch is in wrong position.

BATTERY CHECK

1. Remove the battery cell from the case.
2. Connect the 15 kΩ (brown-green-orange) resistor to the positive (+) meter lug and to the positive (+) battery cell terminal.
3. Connect the negative (–) meter lug to the negative (–) battery cell terminal. The meter should read 1/2 scale.




FREQUENCY SWITCH
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RECEIVER BATTERY
RECEIVER
RED
TEST POINT 2
15K
TEST POINT 1
BLK
0 1 2 3 4 5
- +
RED
OFF
ON
ON-OFF SWITCH

Figure 3

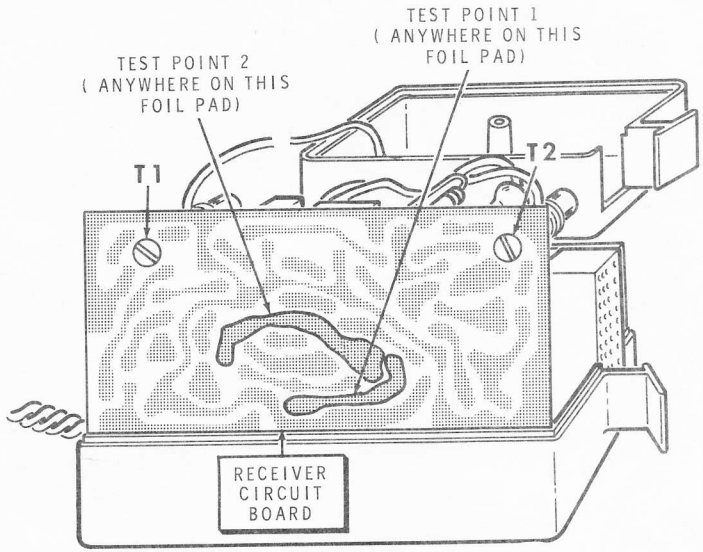
TEST POINT 1
(ANYWHERE ON THIS
FOIL PAD)
TEST POINT 2
(ANYWHERE ON THIS
FOIL PAD)
T1
T2
RECEIVER
CIRCUIT
BOARD

Figure 4

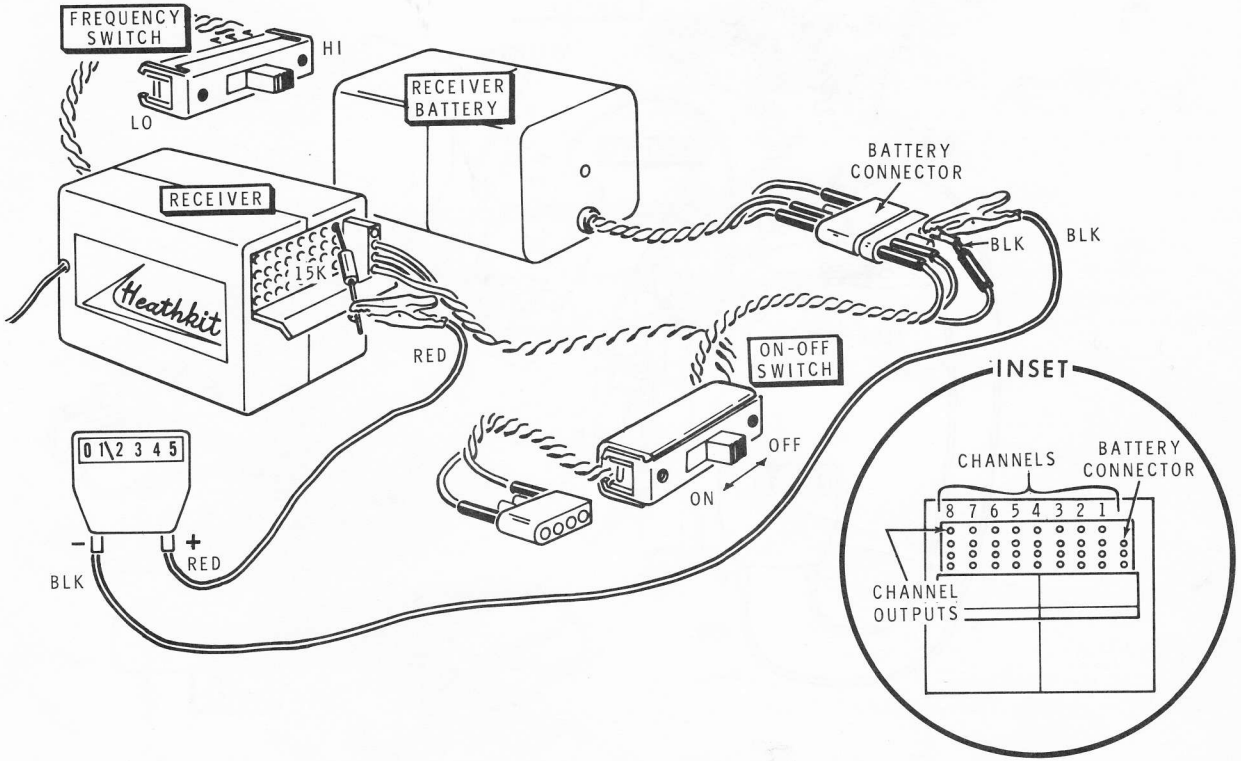

Figure 5

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NOTE: Us
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NOTE: As you perform the following steps, increase the distance between the Transmitter and Receiver to keep the meter reading between the 2 and 4. Do not touch the Receiver or any of its leads when making the following adjustments. Tape the Receiver to a nonmetallic surface to hold it securely in place. Do not use any metallic tape. Use the plastic alignment tool to make all adjustments.

( ) Push the transmitter antenna completely into the case. Then turn the Transmitter ON and move it to a location where the meter gives an indication of approximately 3.

NOTE: Use the screwdriver end of the alignment tool for the following steps. Do not turn any slug more than one turn in either direction.

Refer to Figure 4 (fold-out from Page 39) for the next two steps.

( ) 1. Adjust transformer T1 for a maximum indication on the meter.

( ) 2. Adjust transformer T2 for a maximum indication on the meter.

( ) Repeat the previous two steps until no further improvement can be made.

( ) Turn both the Receiver and Transmitter OFF.

( ) Unclip both meter leads from the Receiver.

( ) Unsolder the 15 kΩ resistor and the cut-off resistor lead from the receiver circuit board.

( ) Slide both circuit boards back into the case bottom section.

( ) Replace the receiver case top section.

NOTE: A high impedance voltmeter may be used to adjust T1 and T2. However, a 1000 Ω resistor must then be used in place of the cutoff resistor lead. If optimum range is desired, repeat the receiver alignment with all servos connected and installed in the model.

DECODER

Refer to Figure 5 for the following steps.

( ) Clip the black (negative) meter wire to the black wire in the battery connector. Pull the sleeving back to expose the connector.

( ) Clip the red (positive) meter wire to one end of a 15 kΩ (brown-green-orange) resistor.

( ) Turn the Receiver and Transmitter on.

( ) Touch the other end of this resistor to the Channel #1 output. Now operate the Channel #1 stick on the Transmitter. As the stick is moved one way, the meter should deflect slightly. As the stick is moved the other way, the meter should deflect slightly in the other direction. As the stick is returned to its center position, the meter should return to its original reading.

CONDITION	POSSIBLE CAUSE
No meter indication, or meter indication does not change when moving the Channel #1 control.	1. Transistors Q103, or Q104. 2. Integrated circuit IC101.

( ) Touch the resistor to the Channel #3 output and operate the Channel #3 control on the Transmitter. Repeat this procedure for the other channels except channels #2 and #5.

CONDITION	POSSIBLE CAUSE
No meter indication, or meter indication does not change when moving the Channel control.	1. Integrated circuit IC101.

( ) Disconnect the meter leads and turn off the Transmitter and Receiver. This completes the "Test and Adjustments." Proceed to the "Centering and Travel" section in your Transmitter Manual.

INSTALLATION

The Model GDA-405-2 Receiver can be used in model cars and boats as well as in model airplanes. But since the eight channels of this system are ideal for use in model planes, only this type of installation will be described. These same installation principles can also be applied to other types of models.

The main points for you to consider in your installation are: weight distribution and protection from mechanical shock, vibration, dirt, and oil. Many model manufacturers furnish complete data for mounting and connecting radio control equipment in their planes.

Figure 6 (fold-out from this page) shows a typical model airplane installation. Compare this Figure with your plane very carefully to determine the best location for the Receiver, Servo units, and Battery. Temporarily set the components in the chosen places to be sure they will fit. Allow enough space for foam rubber packing around the Receiver and Battery. After you have decided on the most suitable locations for all components, remove them from the plane and then install them one at a time.

The following instructions cover the most important considerations for the installation of each component.

BATTERY

The Battery should be wrapped in foam rubber and installed forward of a strong bulkhead, ahead of the Receiver. A battery compartment can be made by installing another bulkhead in front of the Battery. Be sure the Battery cannot shift, and that it does not interfere with any pushrod movement. A loose battery can shift due to vibration and break off the battery leads.

BATTERY SWITCH

Select a location for mounting the switch in the side of the fuselage that is away from the engine exhaust. This will keep exhaust oil and fumes from fouling the switch contacts. Cut a 1/4" x 3/8" opening in the fuselage to clear the switch slide; then mount the switch and switch plate with the two 3-48 x 1/4" screws that are supplied.

NOTE: When you connect the battery switch to the Receiver and Battery, note the polarization of the plugs.

For further information on the battery switch, refer to "Battery Charging" on Page 43.

SPECIFICATIONS

RF Carrier Frequency . . . . . One of the following, crystal-controlled:

27 MHz Band	53 MHz Band	72 MHz Band
26.995 MHz	53.100 MHz	72.080 MHz
27.045 MHz	52.200 MHz	72.160 MHz
27.095 MHz	53.300 MHz	72.240 MHz
27.145 MHz	53.400 MHz	72.320 MHz
27.195 MHz	53.500 MHz	72.400 MHz
		72.960 MHz
		75.640 MHz

Frequency Stability . . . . . .003% on 27 MHz band.
.002% on 53 MHz and 72 MHz bands.

Temperature Range . . . . . 0 to 160 degrees F.

Sensitivity . . . . . 5 μV or better.

Selectivity . . . . . 6 dB down at ±4 kHz.
30 dB down at ±9 kHz.

Current Drain . . . . . 10 mA typical; 14 mA maximum.

Intermediate Frequency . . . . . 453 kHz.

Power Supply . . . . . 4.8 V, Battery Pack GDA-405-3.

Controls . . . . . ON-OFF switch.
Frequency selector switch.

Dimensions	1-5/32" high x 1-3/16" wide x 2-17/64" deep.
Net Receiver Weight	2.5 oz.
Complete Airborn System Weight	With four subminiature servos, 11.3 oz. With four miniature servos, 13.3 oz.
Total Flying Time	4 hrs. fully charged.

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

GENERAL

A number series has been assigned to each of the two circuit boards used in this Receiver. This number series is used on the Schematic Diagram and in this "Circuit Description" to help you identify and locate circuits and parts. The part numbers are grouped as follows:

1- 99	Parts mounted on the receiver circuit board.
101-199	Parts mounted on the decoder circuit board.

The receiver circuit board contains a conventional crystal-controlled superheterodyne receiver with a power detector and an integrator circuit. The decoder circuit board contains a regulator, two pulse amplifiers, and a decoder integrated circuit.

Refer to the Schematic Diagram (on fold-out Page 55) while you read this "Circuit Description."

RECEIVER CIRCUIT BOARD

The transmitted rf signal is picked up by the antenna and fed to the tuned circuit of transformer T1 and capacitor C1. T1 and C1 are tuned to the transmitted signal frequency, and their values are selected for each band of frequencies. Diode D1 is used to limit strong signals and prevent overloading of the rf stage.

From the secondary of T1, the signal is coupled to the base of rf amplifier transistor Q1. The amplified signal from Q1 is applied to the tuned circuit of capacitor C5 and transformer T2, which are also tuned to the transmitted signal frequency. T2 is tapped to provide an impedance match to the collector of Q1. From the secondary of T2, the signal is coupled to the emitter of mixer transistor Q2.

Oscillator Q102 on the decoder board is used to supply a frequency which differs from the incoming signal frequency by 453 kHz. This oscillator signal is coupled to mixer Q2 through C101 and beats with the incoming signal to produce an i-f difference frequency of 453 kHz which appears at the collector of Q2. Regenerative feedback through one of the crystals causes the oscillator to oscillate at the desired frequency. On 27 MHz, Q2 uses the fundamental frequency of the oscillator. On 53 MHz and 72 MHz bands, Q2 uses the second harmonic of the oscillator.

The desired operating frequency is selected by the crystal switching network on the decoder circuit board. The desired crystal is selected by turning on the diode connected to it (D101 or D102) through resistor R103 or R104 and frequency selector switch SW101 to ground. This connects the crystal from the base of oscillator Q102 to the collector of Q102 through diode D101 or D102. Since the other diode is not connected to a source of dc voltage, it is not conducting and its crystal is effectively disconnected from the circuit.

As the i-f signal is applied to the input, it vibrates at the i-f frequency and passes the vibrations to the output. The ceramic filters will vibrate at, and pass only the frequency to which they are tuned; in this case, the 453 kHz i-f frequency.

The i-f signal is coupled through CF1, CF2, CF3, and resistor R9 to the base of the first i-f amplifier, Q3. The amplified i-f signal from Q3 is further amplified by second i-f transistor Q4 and coupled through capacitor C11 to the base of the power detector, Q5. Diode D2 is forward biased by resistor R15 so that about .5 volt is applied to the base of Q5 through L3, which will hold Q5 at cutoff. Since Q5 requires about .6 volt at its base to conduct, the additional .1 volt is supplied by the positive portion of the i-f signal. Thus, transistor Q5 conducts only on the positive peaks of the i-f signal.

When receiving an i-f signal, Q5 is conducting. Then when a transmitted pulse is received, which temporarily stops the i-f carrier, there is no i-f signal to make Q5 conduct. Therefore, Q5 stops conducting and its collector voltage rises. This then produces a positive pulse from Q5 that is equivalent to the pulses in the Transmitter.

Capacitor C15 bypasses the i-f frequency to ground and leaves a train of audio frequency pulses that are coupled through D3, R18, and C17 to the base of the pulse amplifier Q103 on the decoder circuit board. Diode D3 and resistors R17 and R19 eliminate noise pulses under strong signal conditions, and integrator network resistor R18 and capacitor C16 prevent noise from interfering under weak signal conditions.

An automatic gain control (agc) circuit that consists of resistors R20, R10, and R1 with capacitor C3, feeds back part of the Q5 collector voltage to the base circuits of transistors Q1 and Q3. The stronger the receiver signal, the more transistor Q5 conducts, lowering the voltage at its collector. This voltage is applied through R20, R10, and R1 to reduce the gain of Q1, Q3, and Q4. This agc action prevents the i-f amplifier and detector circuits from overloading and producing improper pulses when strong signals are received.

The output signal from the Receiver is a series of positive pulses that are spaced like the modulation pulses of the Transmitter. See the waveform in Figure 9. These signal pulses are coupled to the decoder circuit, which will be described next.

DECODER CIRCUIT BOARD

Pulse amplifier transistors Q103 and Q104 further increase the amplitude of the pulses from Q5 on the receiver circuit board. Q103 and Q104 are normally cut off until the pulses reach a high enough amplitude to turn them on, thus providing further noise immunity and producing clear sharp pulses at the collector of Q104.

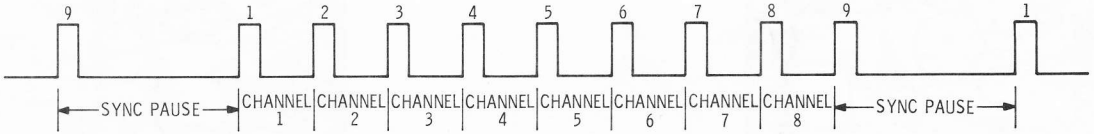


Figure 9

The signal pulses from the collector of Q104 are coupled to the input (pin 4) of the decoder integrated circuit, IC101.

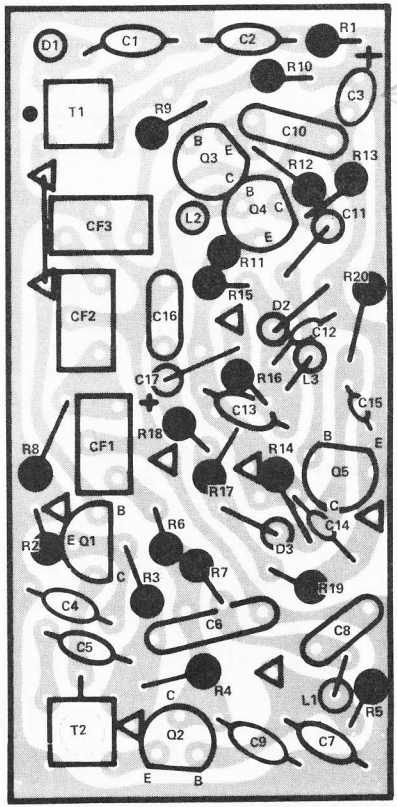
IC101 consists mostly of a 10 stage shift register counter. Assume the decoder starts out at reset. As soon as the first pulse of a frame begins, the counter advances one step and begins supplying a voltage pulse at the channel 1 servo connector. When the next pulse arrives at the input, the counter advances one step, terminates the pulse at channel 1, and begins a new pulse at channel 2. Each pulse at the servo inputs are therefore dependent on the spacing of the pulses in the pulse train arriving at the input of IC101. This process then continues through all eight channels. Pin 2 of IC101 is the reset terminal. Pin 2 is connected to an rc network whose time constant is set to detect the sync pause. As each input pulse from Q102 arrives, IC101 charges up capacitor C112. If the pulse spacing is approximately 3 milliseconds or greater, as is the case during sync pause time, the voltage will discharge through resistor R112. This voltage will discharge to a low enough value to reset IC101 and prepare it to decode a new frame.

Q101 is used as a capacitance multiplier to decouple the receiver board and decoder pulse amplifier from the battery. This eliminates any rapid fluctuations in battery voltage from upsetting the pulse widths at the servo outputs.

CIRCUIT BOARD X-RAY VIEWS

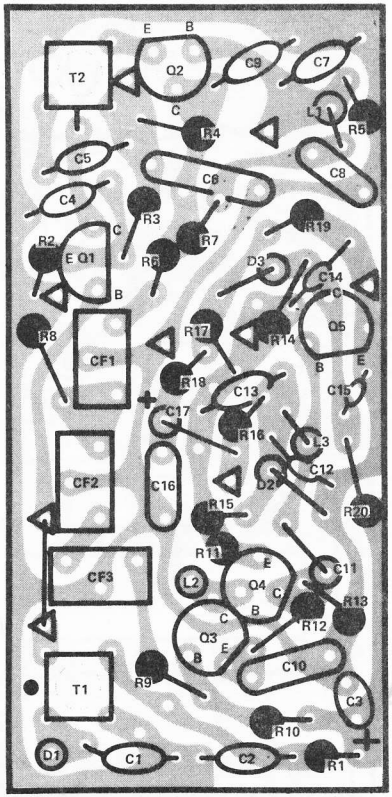
NOTE: To determine the value (22 Ω, 4 μF, etc.) of one of these parts, you may proceed in either of the following ways.

1. Refer to the place where the part is installed in the Step-by-Step instructions.
2. Note the identification number of the part (R-number, C-number, etc.). Then locate the same identification number next to the part on the Schematic. The value, or "Description," of most parts will be near this number.

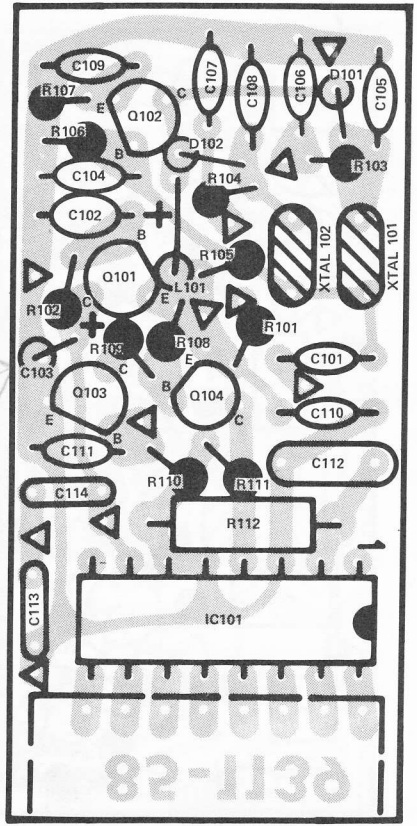


(VIEWED FROM COMPONENT SIDE)

RECEIVER CIRCUIT BOARD

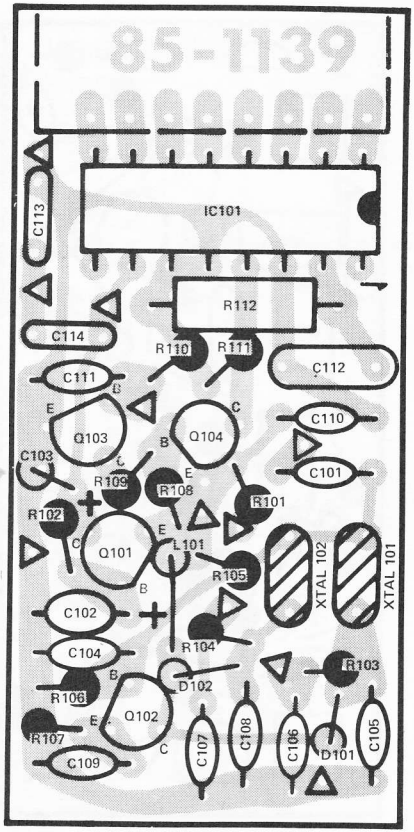


(VIEWED FROM FOIL SIDE)



(viewed from component side)

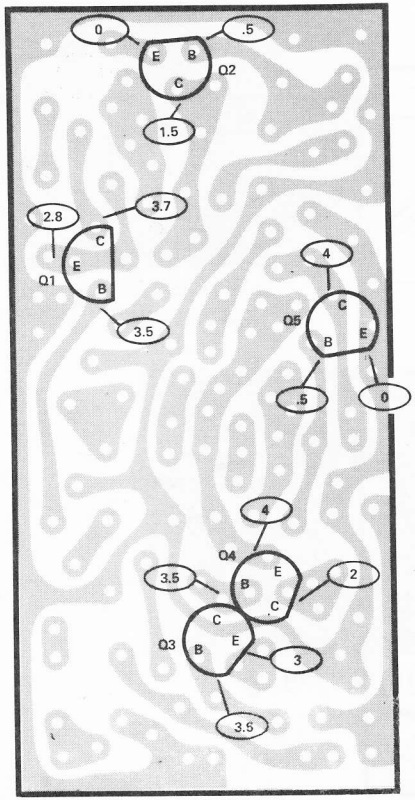
DECODER CIRCUIT BOARD



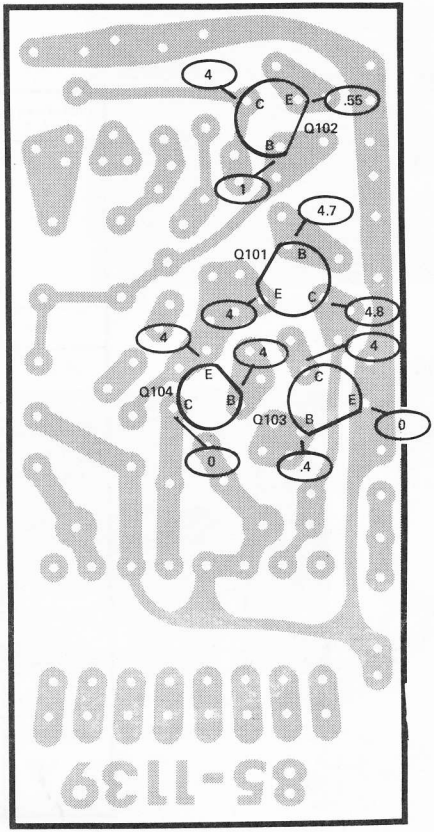
(viewed from foil side)

VOLTAGE CHARTS

(Viewed from foil side)

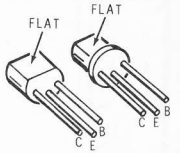
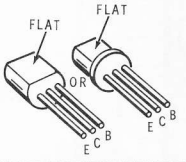
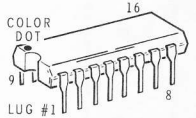
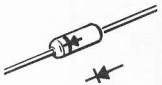
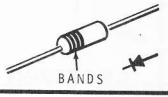


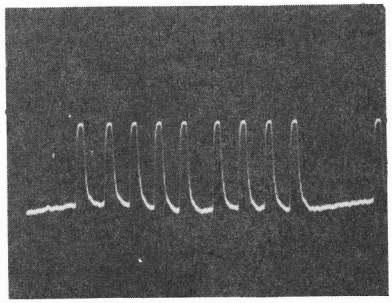
RECEIVER



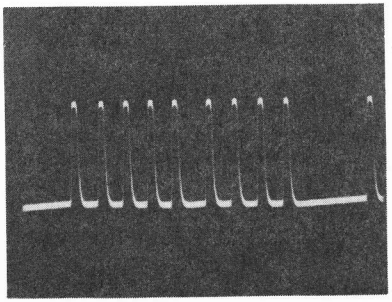
DECODER

SEMICONDUCTOR CHART

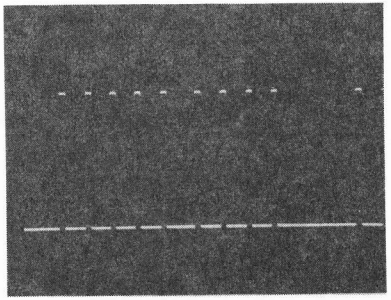
COMPONENT NUMBER	HEATH PART NUMBER	TYPE NUMBER	DESCRIPTION	LEAD CONFIGURATION
Q1, Q3	417-258	TIS87	NPN TRANSISTOR	
Q2, Q102	417-164	16G2349	PNP TRANSISTOR	
Q4, Q104	417-201	X29A829		
Q5	417-91	2N5232A	NPN TRANSISTOR	
Q101, Q103	417-118	2N3393		
IC101	443-52	SCUS0127D	INTEGRATED CIRCUIT	
D1	56-27	GES160	DIODE	
D2, D3	56-84	1N4148		
D101, D102	56-26	1N191	DIODE	



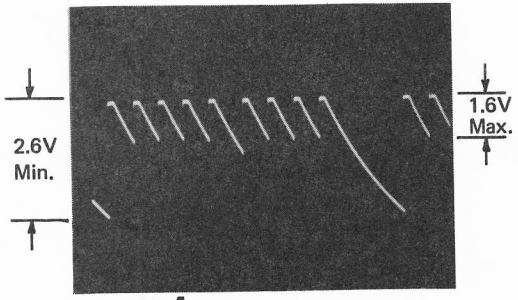
1 COLLECTOR Q5
.5 – 2.0V p-p



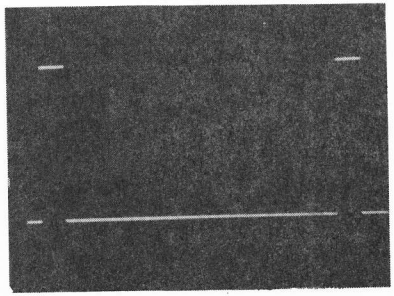
2 BASE OF Q103
.2V p-p



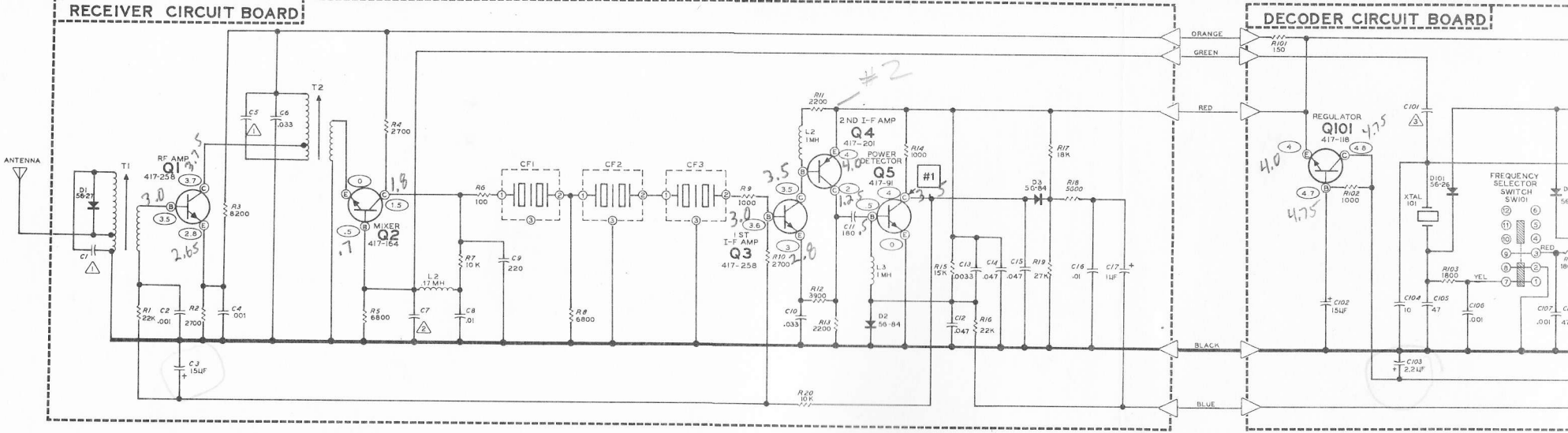
3 COLLECTOR Q104
5.0V p-p



4 PIN 2 IC101



5 IC OUTPUT PINS 9-16
(with servo connected)
5V p-p



SCHEMATIC OF THE HEATHKIT® 8-CHANNEL DIGITAL PROPORTIONAL RECEIVER MODEL GDA-405-2

NOTES:

1. RESISTOR AND CAPACITOR NUMBERS ARE IN THE FOLLOWING GROUPS:

   0-99 PARTS MOUNTED ON THE RECEIVER CIRCUIT BOARD.
   100-199 PARTS MOUNTED ON THE DECODER CIRCUIT BOARD.

2. ALL RESISTORS ARE 1/4 WATT UNLESS MARKED OTHERWISE. RESISTOR VALUES ARE IN OHMS (K=1,000).

3. ALL CAPACITOR VALUES LESS THAN 1 ARE IN µF. ALL VALUES OF 1 OR GREATER ARE IN pF UNLESS OTHERWISE MARKED.

4. ⬭ THIS SYMBOL INDICATES A POSITIVE DC VOLTAGE MEASUREMENT WITH NO SIGNAL BEING RECEIVED.

5. [#1] THIS SYMBOL WITH A NUMBER IN IT CORRESPONDS TO A WAVEFORM ON PAGE 55.

6. △ THIS SYMBOL IS USED WITH A PART THAT CHANGES VALUE DEPENDING ON THE FREQUENCY BAND USED.
   - △1 47 pF FOR 27 MHz, 27 pF FOR 53 MHz, OR 27 pF FOR 72 MHz OPERATION.
   - △2 150 pF FOR 27 MHz, 47 pF FOR 53 MHz, OR 27 pF FOR 72 MHz OPERATION.
   - △3 10 pF FOR 27 MHz, 15 pF FOR 53 MHz, OR 10 pF FOR 72 MHz OPERATION.

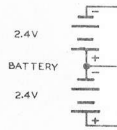
7. ALL VOLTAGES ARE MEASURED WITH A HIGH IMPEDANCE VOLTMETER. FROM THE POINT INDICATED TO COMMON GROUND. VOLTAGES MAY VARY ±20%.

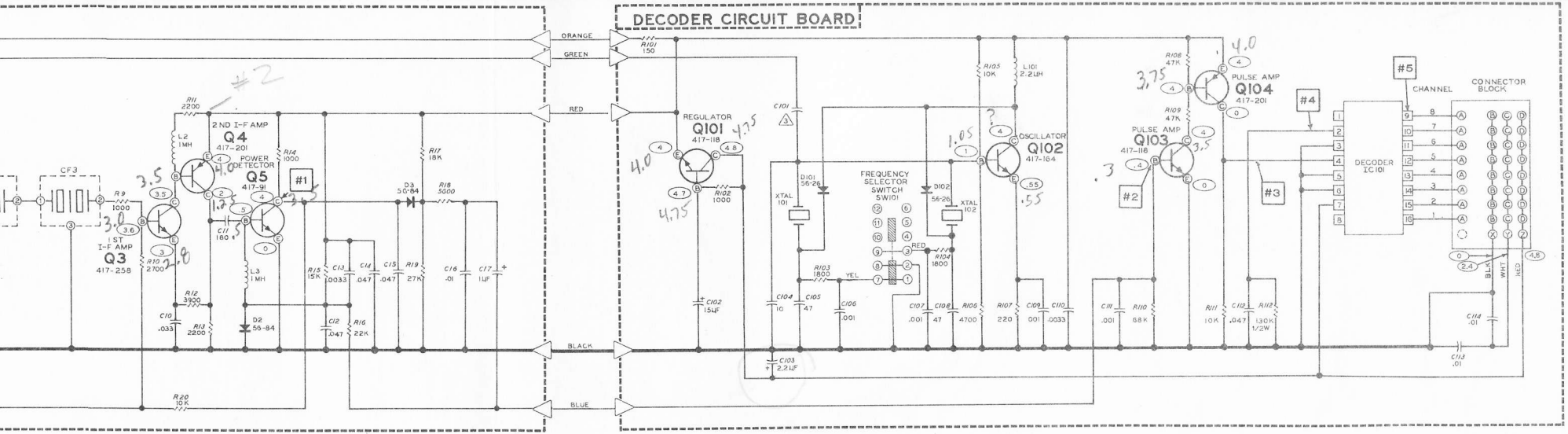
8. REFER TO THE CIRCUIT BOARD X-RAY VIEWS FOR THE PHYSICAL LOCATION OF PARTS.

CRYSTAL FREQUENCY MHz

	TRANSMITTER	RECEIVER
27 MHz BAND	26.995	26.542
	27.045	26.592
	27.095	26.642
	27.145	26.692
	27.195	26.742
53 MHz BAND	53.100	26.3235
	53.200	26.3735
	53.300	26.4235
	53.400	26.4735
	53.500	26.5235
72 MHz BAND	72.080	36.2665
	72.160	35.8535
	72.240	36.3465
	72.320	35.9335
	72.400	36.4265
	72.960	36.7065
	75.640	37.5935

INTERCONNEC





E

ORTIONAL

2

THIS SYMBOL IS USED WITH A PART THAT CHANGES VALUE DEPENDING ON THE FREQUENCY BAND USED.

1. 47 pF FOR 27 MHz, 27 pF FOR 53 MHz, OR 27 pF FOR 72 MHz OPERATION.
2. 150 pF FOR 27 MHz, 47 pF FOR 53 MHz, OR 27 pF FOR 72 MHz OPERATION.
3. 10 pF FOR 27 MHz, 15 pF FOR 53 MHz, OR 10 pF FOR 72 MHz OPERATION.

VOLTAGES ARE MEASURED WITH A HIGH IMPEDANCE TMETER. FROM THE POINT INDICATED TO COMMON GROUND. TAGES MAY VARY ±20%.

ER TO THE CIRCUIT BOARD X-RAY VIEWS FOR THE PHYSICAL ATION OF PARTS.

CRYSTAL FREQUENCY MHz

	TRANSMITTER	RECEIVER
27 MHz BAND	26.995	26.542
	27.045	26.592
	27.095	26.642
	27.145	26.692
	27.195	26.742
53 MHz BAND	53.100	26.3235
	53.200	26.3735
	53.300	26.4235
	53.400	26.4735
	53.500	26.5235
72 MHz BAND	72.080	36.2665
	72.160	35.8535
	72.240	36.3465
	72.320	35.9335
	72.400	36.4265
	72.960	36.7065
	75.640	37.5935

INTERCONNECTING SCHEMATIC DIAGRAM