Model GDA-1205-2 8-Channel Modular R/C Receiver

HEATH COMPANY

BENTON HARBOR, MICHIGAN

MODEL GDA-1205-2 8-Channel Modular R/C Receiver

HEATHKIT®

ASSEMBLY MANUAL

HEATHKIT®

Price $2.00

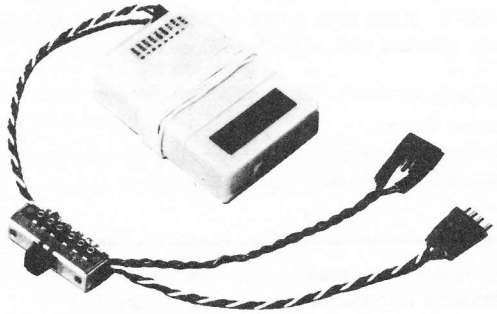
595-1729

Assembly and Operation of the

HEATHKIT

8-CHANNEL MODULAR R/C RECEIVER

MODEL GDA-1205-2



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HEATH COMPANY

BENTON HARBOR, MICHIGAN 49022

INTRODUCTION

The Heathkit 8-Channel Modular R/C Receiver, Model GDA-1205-2, features separate RF modules which allow you to operate on any of the 17 available R/C channels without buying complete receiver and transmitter systems. Quick changes in the field permit you to operate at almost any time, without the usual tiresome wait for a clear channel. The quick-change, plug-in, RF Modules come in all of the following frequencies, permitting you to change to a new band, or to an unused channel, in just a few seconds.

27 MHz Band	53 MHz Band	72 MHz Band
26.995 MHz	53.100 MHz	72.080 MHz
27.045 MHz	53.200 MHz	72.160 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

A total of eight transistors, one integrated circuit (low-current drain MOS IC decoder), and three ceramic IF filters are used in the Receiver. All parts are mounted on two glass epoxy circuit boards: the receiver module circuit board and the RF module 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 supplied by a compact, rectangular, 4.8-volt, nickel-cadmium, rechargeable battery pack, Heathkit Model GDA-1205-3. The completed Receiver and RF modules are housed in two small, attractive, molded nylon cases which occupy only 2.7 cubic inches of space. You can charge the Receiver battery without disconnecting it from the Receiver. The three ceramic IF filters assure you of trouble-free temperature stability without the need for adjustments.

The 8-channel R/C Modular Receiver was designed for use with the 5-channel transmitters GDA-505-D and GDA-505-S and 8-channel transmitters GDA-1205-D and GDA-1205-S. One RF module is supplied with 5-channel systems, and two with 8-channel systems.

IMPORTANT NOTE: If you have purchased either the GD-1205 or the GD-505 complete systems, assemble them in the following order:

1. Transmitter.
2. Receiver Battery.
3. Receiver.
4. Receiver RF Modules.
5. Servos.

Federal Communications Commission requirements prescribe maximum RF radiation from receivers operating above 30 MHz. This receiver will meet these requirements when constructed in strict accordance with the instructions in this Manual, using only components and materials supplied with the kit or the exact equivalent thereof. You will be instructed to sign and affix a label to the receiver certifying that you have constructed this receiver in accordance with the above mentioned instructions. In order to meet legal requirements, be certain to follow the instructions exactly as they are stated in this Manual.

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 into the envelop 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" (R1, C11, D21, 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.

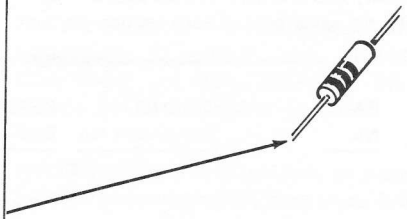
RESISTORS, 1/4-Watt

NOTES:

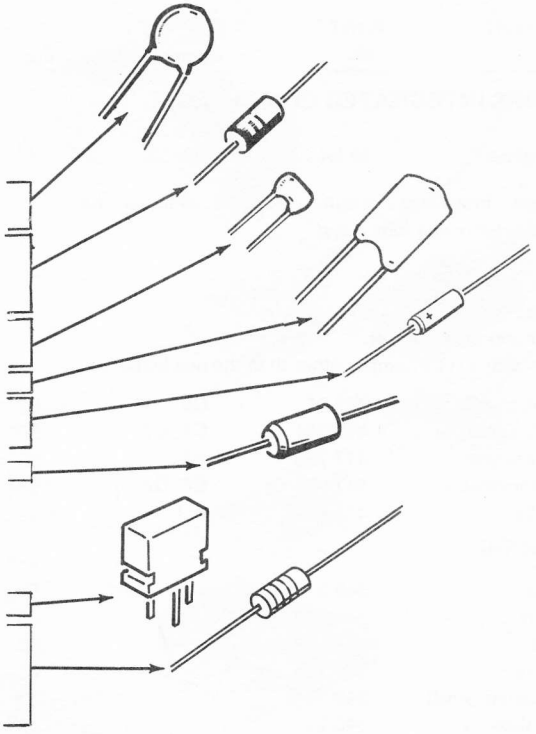
1. A silver fourth color band indicates 10% tolerance; a gold fourth band indicates 5% tolerance.
2. The resistors may be packed in more than one envelope. Open all the resistor envelopes in this pack before you check them against the Parts List.

	QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.	PRICE Each
( )	1	10 Ω, 5% (brown-black-black)	1-55-12	R32	.15
( )	1	100 Ω (brown-black-brown)	1-1-12	R3	.15
( )	1	150 Ω (brown-green-brown)	1-37-12	R11	.15
( )	1	820 Ω (gray-red-brown)	1-24-12	R5	.15

	QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.	PRICE Each
Resistors (cont'd.)					
( )	3	1000 Ω (brown-black-red)	1-2-12	R12, R19, R29	.15
( )	3	2200 Ω (red-red-red)	1-4-12	R14, R15, R16	.15
( )	2	2700 Ω (red-violet-red)	1-5-12	R2, R13	.15
( )	1	5600 Ω (green-blue-red)	1-26-12	R4	.15
( )	2	6800 Ω (blue-gray-red)	1-27-12	R6, R9	.15
( )	3	10 kΩ (brown-black-orange)	1-9-12	R17, R22, R28	.15
( )	2	15 kΩ (brown-green-orange)	1-10-12	R18, Test	.15
( )	2	18 kΩ (brown-gray-orange)	1-52-12	R8, R21	.15
( )	1	22 kΩ (red-red-orange)	1-45-12	R24	.15
( )	1	27 kΩ (red-violet-orange)	1-46-12	R23	.15
( )	1	33 kΩ (orange-orange-orange)	1-41-12	R7	.15
( )	2	47 kΩ (yellow-violet-orange)	1-11-12	R26, R27	.15
( )	1	68 kΩ (blue-gray-orange)	1-31-12	R25	.15
( )	1	150 kΩ (brown-green-yellow)	1-47-12	R31	.15



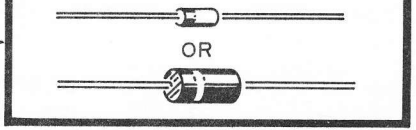
	QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.	PRICE Each
CAPACITORS					
( )	2	.001 μF disc	21-140	C7, C19	.15
( )	1	.005 μF disc	21-27	C16	.15
( )	1	180 pF tubular (brown-gray-brown-white)	21-174	C14	.75
( )	6	.047 μF (473) ceramic	21-182	C8, C9, C11, C13, C15, C18	.70
( )	1	.047 μF Mylar*	27-129	C22	.25
( )	2	1 μF tantalum	25-197	C12, C17	1.05
( )	1	2.2 μF tantalum	25-197	C23	1.30
( )	1	33 μF tantalum	25-211	C21	1.05
FILTER-RF CHOKES					
( )	3	Ceramic filter (SFB-455)	404-399	CF1, CF2, CF3	.60
( )	1	2.2 μH choke (red-red-gold-silver)	45-73	L1	1.05
( )	2	1 mH choke (brown-black-red-silver)	45-80	L2, L3	2.10



*Registered Trademark, DuPont Corp.

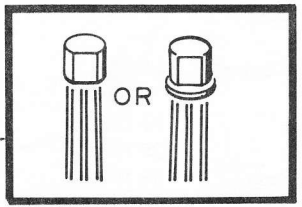
QTY.		DESCRIPTION	PART No.	CIRCUIT Component No.	PRICE Each
DIODE-TRANSISTORS-INTEGRATED CIRCUIT (IC)					
( )	2	1N4148 diode	56-84	D2, D3	.25

NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES.

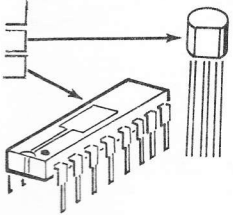


NOTE: Transistors and integrated circuits may be marked for identification in any of the following four ways:

1. Part number.
2. Type number.
3. Part Number and type number.
4. Part number with a type number other than the one listed.



( )	1	2N5232A transistor	417-91	Q5	.85
( )	2	X29A829 transistor	417-201	Q4, Q7	.50
( )	1	TIS87 transistor	417-258	Q3	.80
( )	2	MPSA20 transistor	417-801	Q6, Q8	.25
( )	1	SCUS0127 IC	443-689	IC1	15.45



WIRE-SLEEVING-CORD					
( )	12"	Bare wire	340-3		.05
( )	7"	Black wire	344-125		.05
( )	7"	Red wire	344-127		.05
( )	43"	White wire	344-134		.05
( )	7"	Black sleeving (small)	346-1		.10
( )	7"	Teflon* sleeving	346-21		.35
( )	1"	Heat-shrinkable sleeving (large)	346-35		.15
( )	24"	Nylon cord	349-1		.05

*Registered Trademark, DuPont Corp.

TEST AND ALIGNMENT

If you do not obtain the proper results when you make the following test or alignment, turn off the Receiver and refer to the chart on Page 42. For the physical location of parts on the circuit boards, refer to the Circuit Board assembly steps, or to the Circuit Board X-Ray Views on Page 54.

NOTE: In the following steps, the battery for your Receiver must be fully charged if you are to obtain proper test results. Before you proceed, you should charge the battery, if necessary, as directed in the "Battery Charging" section of the Manual on Page 48.

RECEIVER TEST

In the following steps you will align the RF Module(s) for maximum sensitivity. Use the Transmitter for a signal source with the meter (removed from the Transmitter) as an indicator. NOTE: If you have a sensitive voltmeter, you may wish to use it rather than the Transmitter Meter. If this is the case, special notes will be made on each separate step where necessary. For example, "( ) Clip the red (positive) meter wire to Test Point 2. (VOLTMETER: Connect the positive voltmeter lead to Test Point 2.)"

Refer to Figures 4 (fold-out from Page 41) and 5 for the following steps.

( ) Plug the RF Module onto the Receiver Module.

( ) Turn the Receiver top-side-down as shown.

NOTE: In the following steps, keep the RF Module plugged into the Receiver. Do not remove the receiver circuit board from its case top.

( ) Remove the four screws from the bottom of the Receiver Module. Set the screws and the case bottom aside temporarily.

( ) Remove the screw from the RF Module; then carefully remove the case bottom. Gently slide the case top off the connectors without disconnecting the connectors from the Receiver Module.

( ) Locate the 15 kΩ, 1/4-watt (brown-green-orange) resistor left from the receiver assembly. Cut approximately 1/2" from either one of the resistor leads. The cut-off lead and the resistor will be used in the following steps.

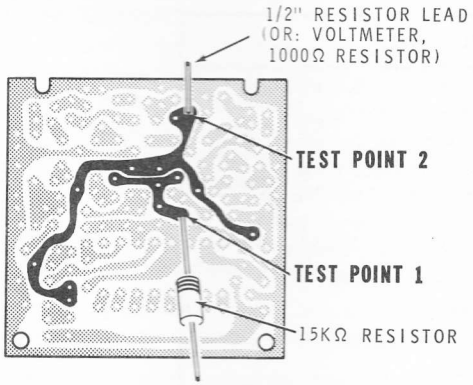


Figure 5

( ) Temporarily solder the 1/2" cutoff resistor lead to Test Point 2 on the foil of the receiver circuit board. (See Figure 5.) [VOLTMETER: Connect one lead of a 1000 Ω, 1/4-watt (brown-black-red) resistor (not supplied) to Test Point 2.]

( ) Carefully solder the shortened 15 kΩ resistor lead to Test Point 1 on the foil side of the receiver circuit board.

NOTE: You may wish to refer to the meter installation steps in your Transmitter Manual to best perform the following step.

( ) If necessary, temporarily disconnect the meter and meter leads from the Transmitter.

NOTE: In the following steps, you may use the test leads and alligator clips that were supplied with your Transmitter. As you connect these leads to the test points, be sure the alligator clips do not touch any other foils.

( ) Clip the black (negative) meter wire to the free end of the 15 kΩ resistor. (VOLTMETER: Connect the common, or negative, meter lead to the free end of the 15 kΩ resistor at TP1.)

( ) Clip the red (positive) meter wire to the 1/2" lead on Test Point 2. (VOLTMETER: Connect the positive meter lead to the free end of the 1000 Ω resistor at TP2.)

( ) Connect the battery switch to the Receiver as shown.

( ) Be sure the battery switch is in the off position as shown in Figure 4.

( ) Connect the battery to the battery switch.

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

NOTE: If you are using a voltmeter, turn it to a low range. In the following steps, if any problems arise, turn the battery switch off and refer to the "In Case of Difficulty" section of the Manual on Page 51.

( ) Turn the battery switch on. The meter should deflect slightly. 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 43.

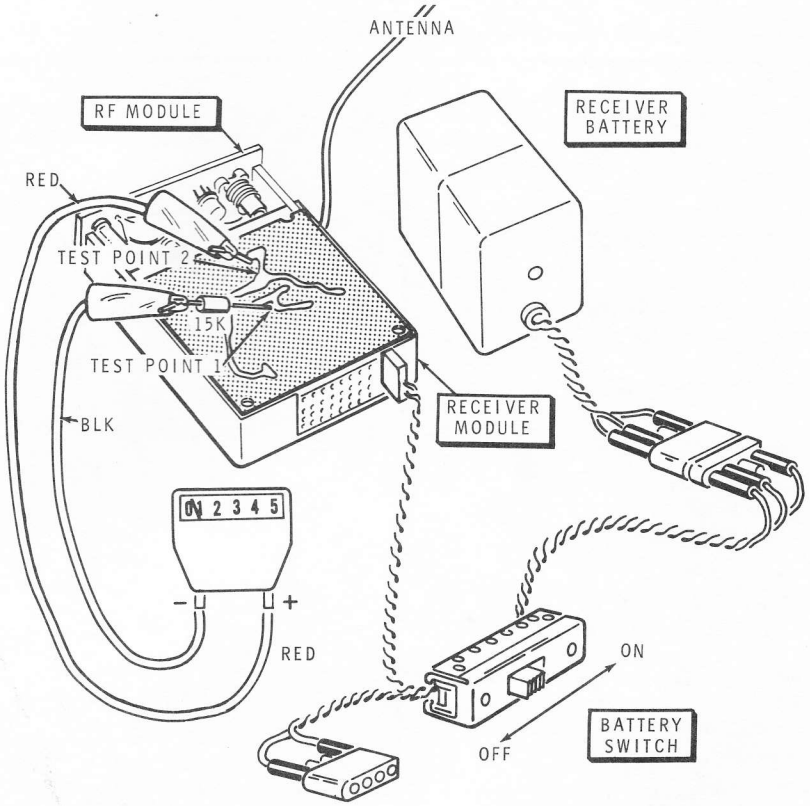
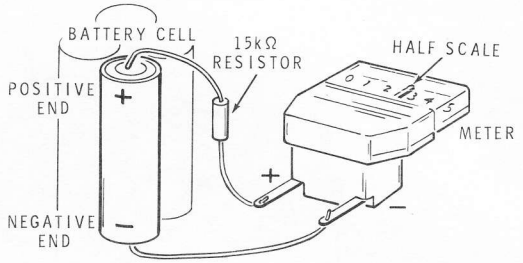
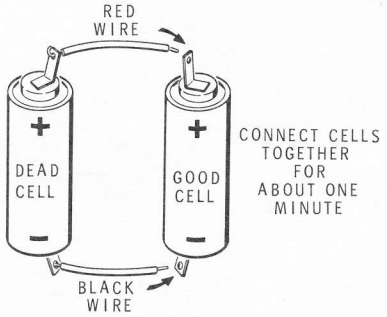

ANTENNA
RF MODULE
RECEIVER BATTERY
RED
TEST POINT 2
15K
TEST POINT 1
BLK
RECEIVER MODULE
ON 1 2 3 4 5
−
+
RED
ON
OFF
BATTERY SWITCH

Figure 4

BATTERY CHECK

1. Unplug the Receiver battery from the Receiver.
2. Remove the battery from its case. Tape the ends of the battery leads to prevent accidental shorting.
3. Connect the 15 kΩ (brown-green-orange) resistor to the positive (+) meter lug and to the positive (+) battery terminal of any one cell.
4. Connect the negative (–) meter lug to the negative (–) battery terminal of the same cell. The meter should read half scale.
5. Repeat steps 3 and 4 for each of the remaining cells.
6. If the cell is dead, proceed as follows:
   - A. Disconnect all the interconnecting battery jumpers.
   - B. Mark the dead cell. Then remove the dead cell and also a good cell from the pack circuit.
   - C. Temporarily solder a short red wire to the positive (+) tab and a short black wire to the negative (–) tab of the dead battery.
   - D. Connect the dead cell in parallel (+ to +, and – to – as shown) with the good cell for about one minute. Then disconnect the cells and remove the red and black wires. If the cell that was dead will "take a charge," it should now read up-scale on the voltmeter.
   - E. If it does, refer to the Battery Pack instructions and reassemble the pack; then charge the batteries.
   - F. If the cell is still dead, procure a new cell for the pack and again charge the batteries as described on Page 48.





CONDITION	POSSIBLE CAUSE
Incorrect or no meter indication.	1. Weak battery (see "Battery Check" on fold-out from this page). This should not be the case at this time as the battery was just charged, unless the Charger is not operating properly. See the Receiver Battery charging instructions on Page 48. 2. Battery switch. 3. Transistors Q5 and Q8. 4. Diode D2. 5. Components associated with stages Q5 and Q8.

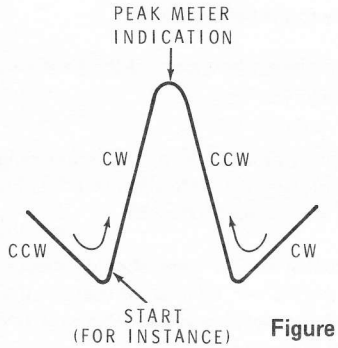


Figure 6

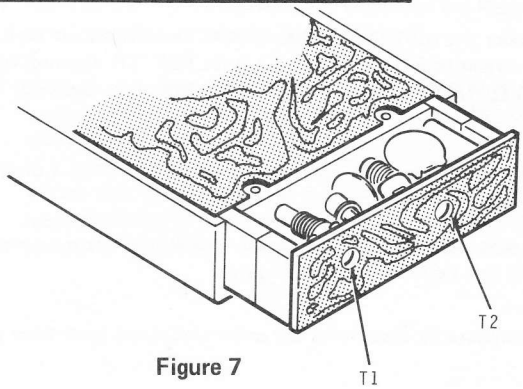


Figure 7

RF MODULE ALIGNMENT

NOTE: As you perform the following steps, increase the distance between the Transmitter and the Receiver to keep the meter reading between 2 and 4. To do this, you may have to place your Transmitter in some sort of metal container. Do not touch the Receiver or any of its leads as you make 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.

( ) If you checked the batteries, reconnect the meter and the 15 kΩ resistor as shown in Figure 4 on fold-out from Page 41.

( ) Place the matching frequency module into the Transmitter. Be sure the frequency agrees with the frequency of the Receiver RF Module.

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

( ) Turn the Receiver switch ON.

( ) 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 either transformer slug more than one turn in either direction.

CONDITION	POSSIBLE CAUSE
Meter pointer does not move upscale when the Transmitter is turned on.	1. Incorrect RF module in Transmitter. 2. Transistors Q1 through Q5. 3. Components associated with transistors Q1 through Q5. 4. Transformers T1 and T2.

IMPORTANT: As you make the following adjustments, the meter indication may move upscale, whether you turn the slug clockwise or counterclockwise. It is very important that you detect a definite signal peak within the maximum one turn allowance. If, at first, you do not see this peak on the Meter, return the coil slug to its starting point, and then turn it in the opposite direction. See Figure 6.

Refer to Figure 7 for the following steps.

NOTE: As you make the following adjustments, you may have to increase the distance between the Transmitter and Receiver to keep the meter reading near half-scale.

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

( ) 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 the Transmitter off.

( ) Carefully reinstall the RF Module into its case and secure the case parts together with the screw you previously removed.

NOTE: If you have ordered additional RF Modules for your Transmitter and Receiver, adjust each Receiver RF Module to the appropriate Transmitter module in turn. To do this, refer to "RF Module Alignment," above, and proceed to this point. Be sure to always use the RF Modules in matched-frequency pairs. If optimum range is desired, repeat the "RF Module Alignment" with all the servos connected to the Receiver and installed in the plane.

( ) Unclip both meter leads from the Receiver Module.

( ) Unsolder the 15 kΩ resistor and the 1/2" wire (or the 1000 Ω resistor) from the Receiver circuit board foils.

( ) Carefully reinstall the Receiver Module into its case with the four screws previously removed.

DECODER TEST

Refer to Figure 8 (fold-out from Page 47) for the following steps.

( ) Plug in the RF Module.

( ) Connect the Receiver components as shown.

( ) Connect the black (negative) meter wire or voltmeter lead to the black wire in the battery connector. Pull the sleeving back to expose the connector.

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

( ) Turn the Receiver and the Transmitter on.

( ) Touch the free end of the resistor to the Channel #1 output as shown. Operate the Channel #1 stick on the Transmitter. As you move the stick one way, the meter pointer should deflect slightly. As you move the stick in the opposite direction, the meter pointer should deflect opposite to the original direction. When you return the stick to the center position, the pointer should return to its original "at rest" position.

CONDITION	POSSIBLE CAUSE
No meter indication, or meter indication does not change when you move the Channel #1 control.	1. Transistors Q6 or Q7. 2. Integrated circuit IC1. 3. Diode D3.

( ) Touch the resistor lead to the Channel #2 output and operate the Channel #2 control on the Transmitter. Repeat this procedure for all other operating channels.

NOTE: When you perform the Decoder Test with 5-Channel transmitters, Channel #6 output will also indicate an output on the meter. Channels 7 and 8 will indicate zero.

CONDITION	POSSIBLE CAUSE
No meter indication, or meter indication does not change when you move the Channel control.	1. Integrated circuit IC1.

( ) Turn off the Transmitter and Receiver, and disconnect the meter leads.

This completes the "Test and Alignment" section of the Receiver.

If you are building a complete R/C System, refer to your Servo Assembly Manual and assemble ALL the Servos.

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	53.200 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.

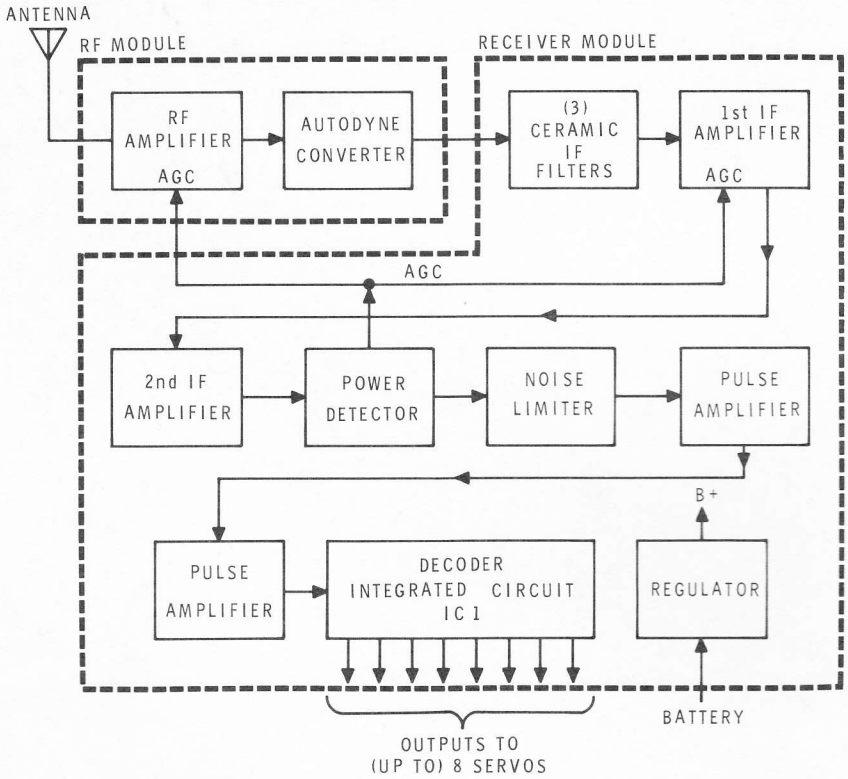
Sensitivity . . . . . 5 μV or less.

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

Current Drain . . . . . 6 mA typical; 8 mA maximum.

Intermediate Frequency . . . . . 453 kHz.

Power Supply	4.8 V, Battery Pack GDA-1205-3.
Control	ON-OFF switch.
Dimensions	
RF Module	1-3/4" wide x 5/8" high x 3/4" deep (4.45 cm x 1.59 cm x 1.91 cm).
Receiver Module	1-3/4" wide x 5/8" high x 1-3/4" deep (4.45 cm x 1.59 cm x 4.45 cm).
Net Receiver Weight	2 oz. (62.2 gm.).
Total Flying Time	3 hours fully charged (4 servos).



BLOCK DIAGRAM

4. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring or adhering to the circuit board foils.

5. Check very carefully (with a magnifier, if possible) to be sure there are no solder bridges between circuit board foils. Refer to Pictorials 1-14 and 1-15 on Pages 27 and 28.

6. If, after careful checks, the trouble is still not located and a voltmeter is available, check voltage readings in the circuits of the unit that you are having trouble with against those shown on the "Circuit Board Voltage Chart," and Schematic Diagram.

7. A review of the "Circuit Description" and Schematic may also help you to locate any difficulties in the kit.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual.

CIRCUIT DESCRIPTION

Refer to the Block Diagram on fold-out from Page 52 and to the Schematic Diagram (fold-out from Page 59) as you read this Circuit Description.

The AM superheterodyne Receiver has a tuneable, double-tuned front end with an RF amplifier and an autodyne converter in a separate plug-in RF Module package. The Receiver Module includes three ceramic filters and two transistor IF amplifiers. A power detector provides detection and the required AGC voltage for the RF and first IF amplifiers. The detected signal then passes through a noise limiter and two pulse amplifiers to the IC decoder. This part of the circuit operates as a shift register with a serial input and parallel outputs for eight channels of simultaneous control.

RF MODULE

The transmitted RF signal is picked up at the antenna and fed to the tuned circuit of transformer T1 and capacitor C1. T1 and C1 are tuned to the transmitted signal frequency. 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 C2 and Transformer T2, which are also tuned to the transmitter 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 autodyne converter transistor Q2.

Regenerative feedback through the receiver crystal causes the autodyne converter circuit to oscillate at the crystal's fundamental frequency on the 27 MHz band, or at its second harmonic on the 53 and 72 MHz bands. The input signal and the oscillator signal beat together in transistor Q2 to produce a 453 kHz difference signal that is passed through the module connector and into coil L1 in the Receiver Module.

RECEIVER MODULE

The 453 kHz difference signal from the RF Module is applied to coil L1. From L1, the signal passes through resistor R3 to the first ceramic (IF) filter (CF1). Capacitor C5 (in the RF Module) tunes with L1, near the crystal oscillator frequency.

Each ceramic filter contains an input and output filter. As the IF signal is applied to the input, it resonates at the IF frequency and passes the vibrations to the output, causing it to resonate at the same frequency. The ceramic IF filters will resonate at and pass only the frequency to which they are tuned, in this case, the 453 kHz IF frequency.

The IF signal is coupled through CF1, CF2, CF3, and resistor R12 to the base of first IF amplifier transistor Q3. The amplified IF signal from Q3 is further amplified by second IF transistor Q4 and coupled through capacitor C14 to the base of power detector, Q5. Diode D2 is forward biased by resistor R18 so that .5 volt is applied to the base of Q5 through coil L3, which will hold Q5 at cut off. Since Q5 requires about .6 volt at its base to conduct, the additional .1 volt is supplied by the positive portion of the IF signal. Thus, transistor Q5 conducts only on the positive peaks of the IF signal.

When it receives an IF signal, Q5 conducts. Then, when a transmitted pulse is received, which temporarily stops the IF carrier, there is no IF signal to make Q5 conduct. Therefore, Q5's collector voltage rises. This then produces a positive pulse from Q5 that is equivalent to the pulses in the Transmitter.

Capacitor C15 bypasses the IF frequency and leaves a train of audio frequency pulses that are coupled through diode D3, resistor R22, and capacitor C17 to the base of pulse amplifier transistor Q6. Diode D3 and resistors R21 and R23 eliminate noise pulses under strong signal conditions, and integrator network resistor R22 and capacitor C16 prevent noise from interfering under weak signal conditions.

An automatic gain control (AGC) circuit that consists of resistors R17, R13, R8, and R7, with capacitors C12 and C7, feeds back part of the Q5 collector voltage to the base circuits of transistors Q1 and A3. The stronger the receiver signal, the more transistor Q5 conducts and lowers the voltage of its collector. This voltage is applied through resistors R17, R13, R8, and R7 to reduce the gain of Q1, Q3, and Q4. This AGC action prevents the IF amplifier and detector circuits from overloading and producing improper pulses when strong signals are received.

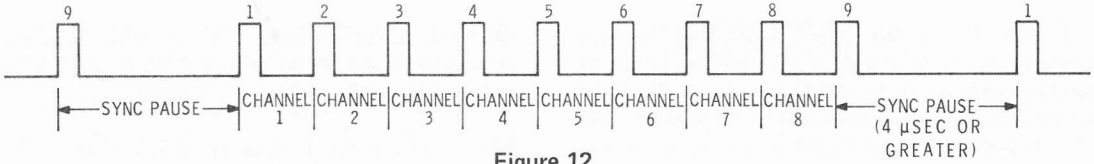


Figure 12

The output from transistor Q5 is a series of positive pulses that are spaced like the modulation pulses of the Transmitter. See the waveform in Figure 12.

Decoder Circuits

Pulse amplifier transistors Q6 and Q7 further increase the amplitude of the pulses from Q5. Q6 and Q7 are normally cut off until the pulses reach a high enough amplitude to turn them on and thus provide further noise immunity and produce clear, sharp pulses at the collector of Q7.

The signal pulses from the collector of Q7 are coupled to input pin 4 of decoder integrated circuit IC1.

Integrated circuit IC1 consists mostly of a 10-stage shift register counter. Assume the decoder starts out at rest. 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 IC1. This process then continues through all eight channels. Pin 2 of IC1 is the reset terminal. Pin 2 is connected to an RC network whose time constant is set to detect the sync pulse. As each input pulse from Q7 arrives, IC1 charges capacitor C22. If the pulse spacing is approximately 4 microseconds or greater, as is the case during sync pause time, the voltage will discharge through resistor R31. This voltage will discharge to a low enough value to reset IC1 and prepare it to decode a new frame.

Transistor Q8 is used as a regulator to decouple the receiver and decoder pulse amplifiers from the battery and servos. This eliminates any rapid fluctuations in battery voltage from upsetting the pulse widths at the servo outputs.

CIRCUIT BOARD X-RAY VIEWS

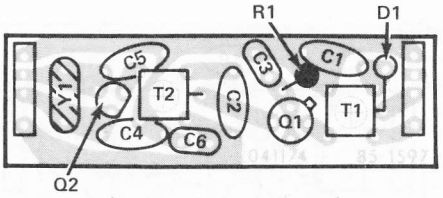
NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

A. Find the circuit component number (R5, C3, etc.) on the "X-Ray View" or "Chassis Photograph."

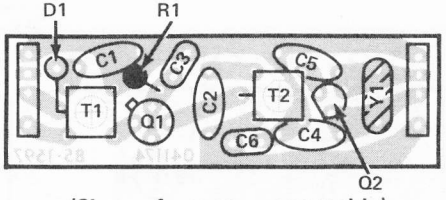
B. Locate this same number in the "Circuit Component Number" column of the "Parts List" in the front of this Manual.

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.

RF CIRCUIT BOARD

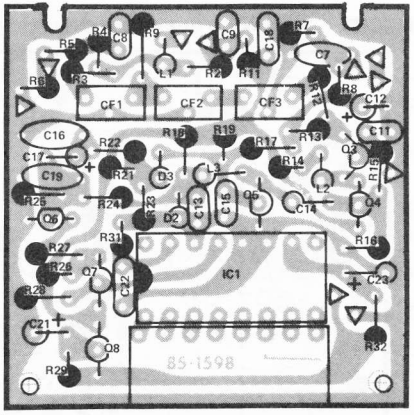


(Shown from foil side)



(Shown from component side)

RECEIVER CIRCUIT BOARD



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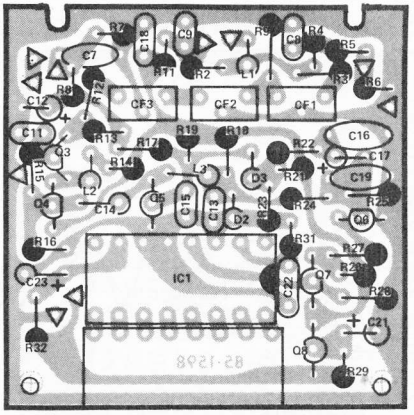
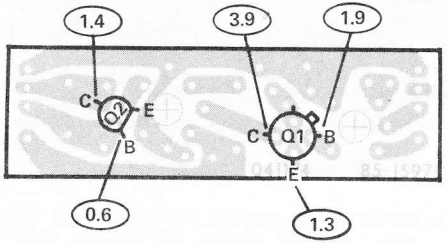


(Shown from component side)

CIRCUIT BOARD VOLTAGE CHARTS

RF CIRCUIT BOARD



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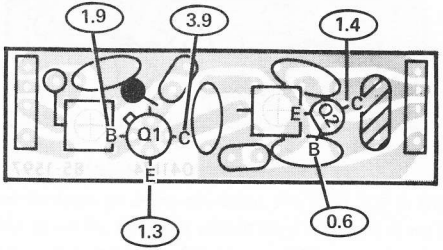
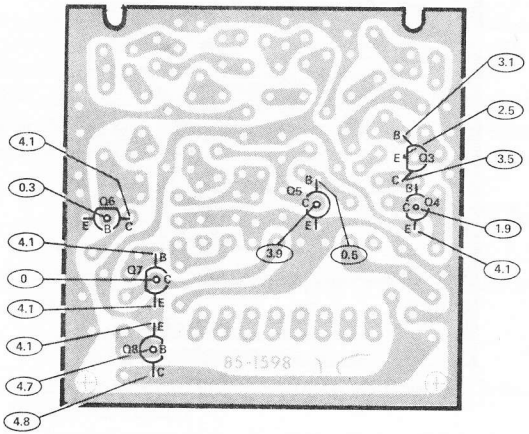


(Shown from component side)

RECEIVER CIRCUIT BOARD

(Shown from foil side)



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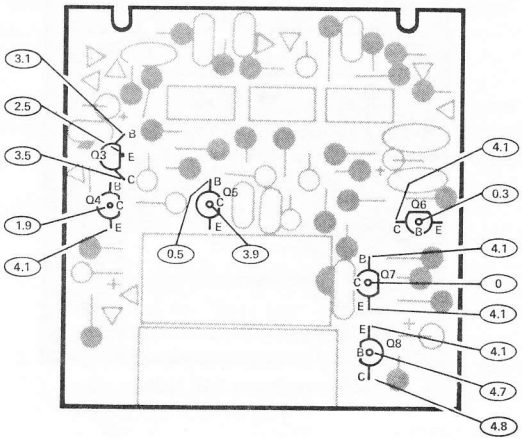
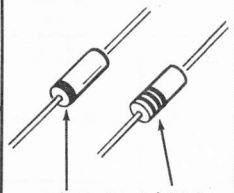
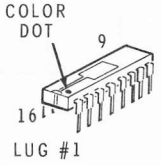
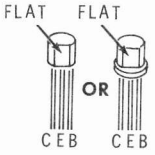
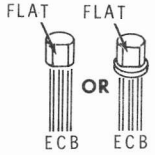
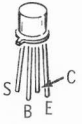


IDENTIFICATION CHARTS

Diode

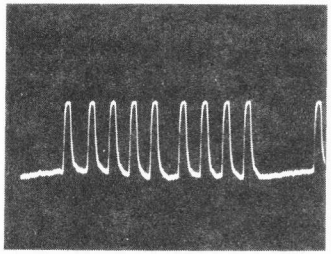
COMPONENT	HEATH PART NO.	MAY BE REPLACED WITH	IDENTIFICATION
D1	56-56	1N4149	
D2, D3,	56-84	1N4148	
Integrated Circuit (IC)			
IC1	443-689	SCUS0127	

Transistors

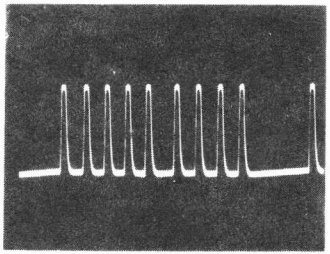
COMPONENT	HEATH PART NO.	MAY BE REPLACED WITH	IDENTIFICATION
Q3	417-258	TIS87	
Q5	417-91	2N5232A	
Q2	417-164	16G2349	
Q4, Q7	417-201	X29A829	
Q6, Q8	417-801	MPSA20	
Q1	417-228	SE5055	

ALTERNATE FREQUENCIES AND PARTS

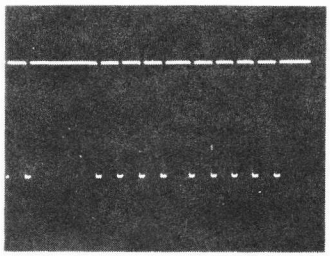
FREQUENCY BAND	TRANSMITTER FREQUENCY	RECEIVER CRYSTAL		RESISTOR VALUE	CAPACITOR VALUE			PART NO. TRANSFORMER	
		FREQUENCY	PART NO.	R1	C1	C2	C5	T1	T2
27 MHz	26.995 MHz	26.542 MHz	404-384	1500Ω	47pF	47pF	75pF	40-913	40-914
	27.045 MHz	26.592 MHz	404-385						
	27.095 MHz	26.642 MHz	404-386						
	27.145 MHz	26.692 MHz	404-387						
	27.195 MHz	26.742 MHz	404-388						
53 MHz	53.100 MHz	26.3235 MHz	404-389	2700Ω	27pF	27pF	47pF	40-915	40-916
	53.200 MHz	26.3735 MHz	404-390						
	53.300 MHz	26.4235 MHz	404-391						
	53.400 MHz	26.4735 MHz	404-392						
	53.500 MHz	26.5235 MHz	404-393						
72 MHz	72.080 MHz	36.2665 MHz	404-394	1000Ω	27pF	27pF	47pF	40-917	40-918
	72.160 MHz	36.3065 MHZ	404-560						
	72.240 MHz	36.3465 MHz	404-395						
	72.320 MHz	36.3856 MHz	404-561						
	72.400 MHz	36.4265 MHz	404-396						
	72.960 MHz	36.7065 MHZ	404-397						
	75.640 MHz	37.5935 MHz	404-398						



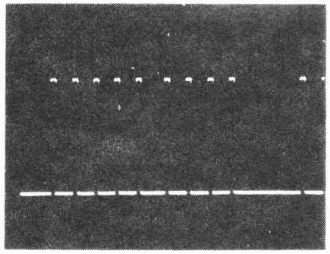
1 COLLECTOR Q5
.5 – 2.0V p-p



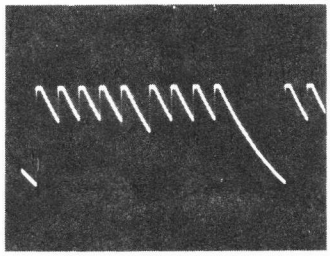
2 BASE OF Q6
0.4V p-p



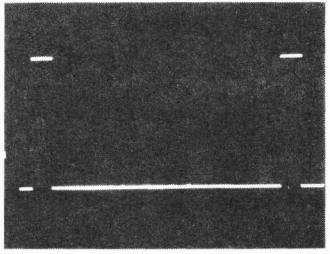
3 COLLECTOR Q6
4.0V p-p



4 COLLECTOR Q7
4.0V p-p



5 PIN 2 IC101



6 IC OUTPUT PINS 9-16
(with servo connected)
4.8V p-p