KRAFT
SYSTEMS, INC.

PCS-4 AND GOLD MEDAL SERIES TO series seventy-one

SERVICE MANUAL

TABLE OF CONTENTS

GENERAL SERVICING INFORMATION

In most cases, failures are due to defective components and cannot be located visually. However, when servicing a unit it is advisable to give every unit a thorough visual inspection. Even though the cause of the trouble may not be discovered visually, it can reveal future trouble: poor soldering, frayed wires, loose components, etc.

When the cause of the difficulty is located or is obviously in one portion of the system, check the entire system anyway. There may be other defects or weak spots which might cause trouble later.

In cases of crash damage, an even more comprehensive inspection should be undertaken. Check especially for damaged wiring, loose parts, cracked or otherwise damaged circuit board lands, and especially the battery pack and switch harness. The battery case should be unwrapped and each cell closely inspected for damage. Feel the cells under their sleeves for dents which may not be evident on the exterior by running a thumbnail along the sleeve using moderate pressure.

The airborne portion of the system is subject to use far more severe than the transmitter and as such, great care should be exercised when servicing any portion of the receiver, servos, and battery pack. Poor soldering techniques or inadequate care in assembly and testing can be magnified after being subjected to even moderate vibration.

Check component installation, wiring, and plugs carefully to ensure stable performance even under severe environment.

Where soldering on parts of the airborne package is necessary, extraordinary care should be used. Many of the circuit lands in the receiver and servos are quite small and as such should be worked on carefully. Excess solder should be removed with a bulb type solder sucker or wicking braid, rather than heating the joint and knocking the solder from the joint by rapping the board sharply on a table.

After all soldering has been done, the circuit board should be cleaned using a suitable solvent to remove flux and residue from the soldering operation. The board should now be closely inspected for solder bridges, bits of wire or other debris, and then sprayed using the aerosol listed in the "Materials Necessary" section.

When spraying transmitter boards, use care to keep the lacquer from hitting the padder capacitors, as this will cause detuning later when the spray has completely hardened.

Never perform any tuning procedure while a sprayed board is drying. Tune either before spraying or after the spray has dried for at least one hour or else the wet lacquer will cause inaccuracies in tuning.

When servicing equipment, do not fail to look at mechanical aspects of the system — gimbal action, hardware, clearances, and so on. A great deal of trouble can result from poor mechanical operation rather than electronic failure.

With regard to the transmitter gimbals, be sure all stick assemblies move freely without rough spots or excessive play. Notice trim action to see if there is any binding or looseness. Since much of the transmitter is mechanical in nature, checks should be made in such areas as antenna connector, battery mounting, board clearance around gimbals and the case, and proper circuit board insulation from the back of the case. Complaints of trim control loss are usually the result of loss of pressure between the plastic cups around the pot body. This problem can be cured by fusing the two pieces together with a hot soldering iron.

The other area of mechanical consideration is the servo. Check gear trains for missing, chipped or bent teeth, smooth operation, and proper clearance. All mounted components, motor, feedback element, and circuit board should be checked for proper fit. Servos are subjected to much of the aircraft's vibration level, and care should be used to ensure successful operation under all expected conditions.

EQUIPMENT AND MATERIALS

Acrylic Spray –
General cement type 8665 only – for spraying printed circuit boards.

Tuner Lubricant –
for cleaning switch contacts and pots. Brands such as Spra-Kleen, Admiral tuner lubricant, are recommended.

Component Cooler –
Such as Propellon "Instant Freez" – for checking temperature sensitive components.

Solder –
Ersin 60/40 5 core, Kester, Alpha, or any type with small diameter and high grade rosin flux.

Cloth and Plastic Tape –
1/2" wide black cloth – for wrapping battery packs; 3/4" wide, any color – for wrapping motors where necessary.

Mylar Tape –
for wrapping KPS-12 servos.

Heat-Shrinkable Sleeving –
1/8" I.D., 3/16" I.D. – for servo harnesses and some receiver components.

Trichlorethylene –
or equivalent solvent – for use in clearing flux from printed circuit boards.

Silicon Lubricant –
Dow Corning type FC-1290, or equivalent – for lubricating servo feedback potentiometers.

R.T.V. – 118 Translucent Silicone Rubber Adhesive Sealant –
for bondings, supporting crystals, and strain relieving wiring.

REQUIRED EQUIPMENT

Oscilloscope –
Must have a DC coupled vertical amplifier with calibrated attenuator from .1 V/CM to at least 2 V/CM, and frequency response must be flat to at least 500 KC. The time base must be calibrated.
Suggested Types:
Tektronix – 502, 503, 504, 450 series, or any in the 530's, 540, 550, 560 series with proper plug-in(s), or 7000 series.

Telequipment – Model S54A

Hewlett-Packard – 122A, 130, 175, 180, or 1200 series.

Voltmeter –
Any VOM with at least 20,000 OHM/VOLT sensitivity calibrated to within 3%, such as Simpson 260, or any VTVM.

Servo Tester -
Separate source of variable width pulse for operating servos independent of the normal R. F. system.

Servo Neutral Standard –
Supplies a fixed width pulse to a servo in order to check and set servo neutral to factory standards.

Alignment Tools –
General Cement No. 8276 "blade" type tuning wand, and General Cement No. 8606 "hex" alignment tool. For Series '72 and later systems, Ceramic bladed tools are recommended for transmitter R.F. coil slugs.

Heat Gun –
Small hair dryer type is sufficient if air temperature exceeds 150° F.

OPTIONAL EQUIPMENT

Signal Generator –
Must have a calibrated attenuator accurate to 1 uV. Instrument comparable to Hewlett-Packard 608B through F is recommended.

THEORY OF OPERATION

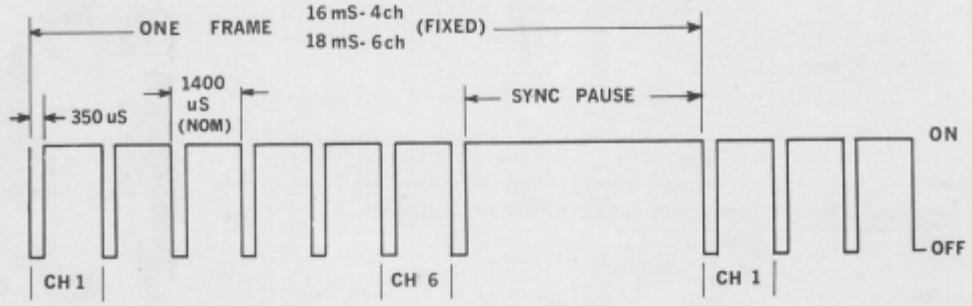
The transmitter produces a crystal-controlled R.F. Carrier which is pulsed off each time one of the encoder channels stops.

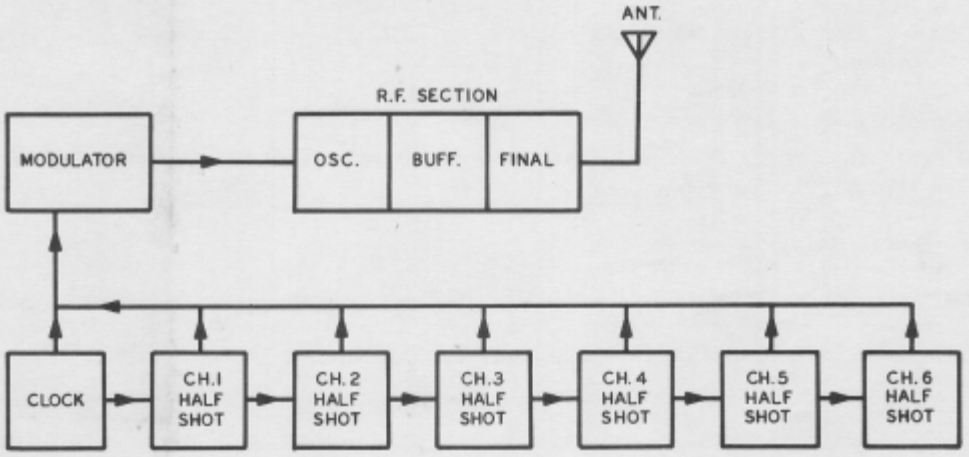
In the wave train shown below, each "off" pulse represents the beginning of an information channel.

The space between each pulse is variable, and is dependent upon the control stick position of the corresponding encoder channel.

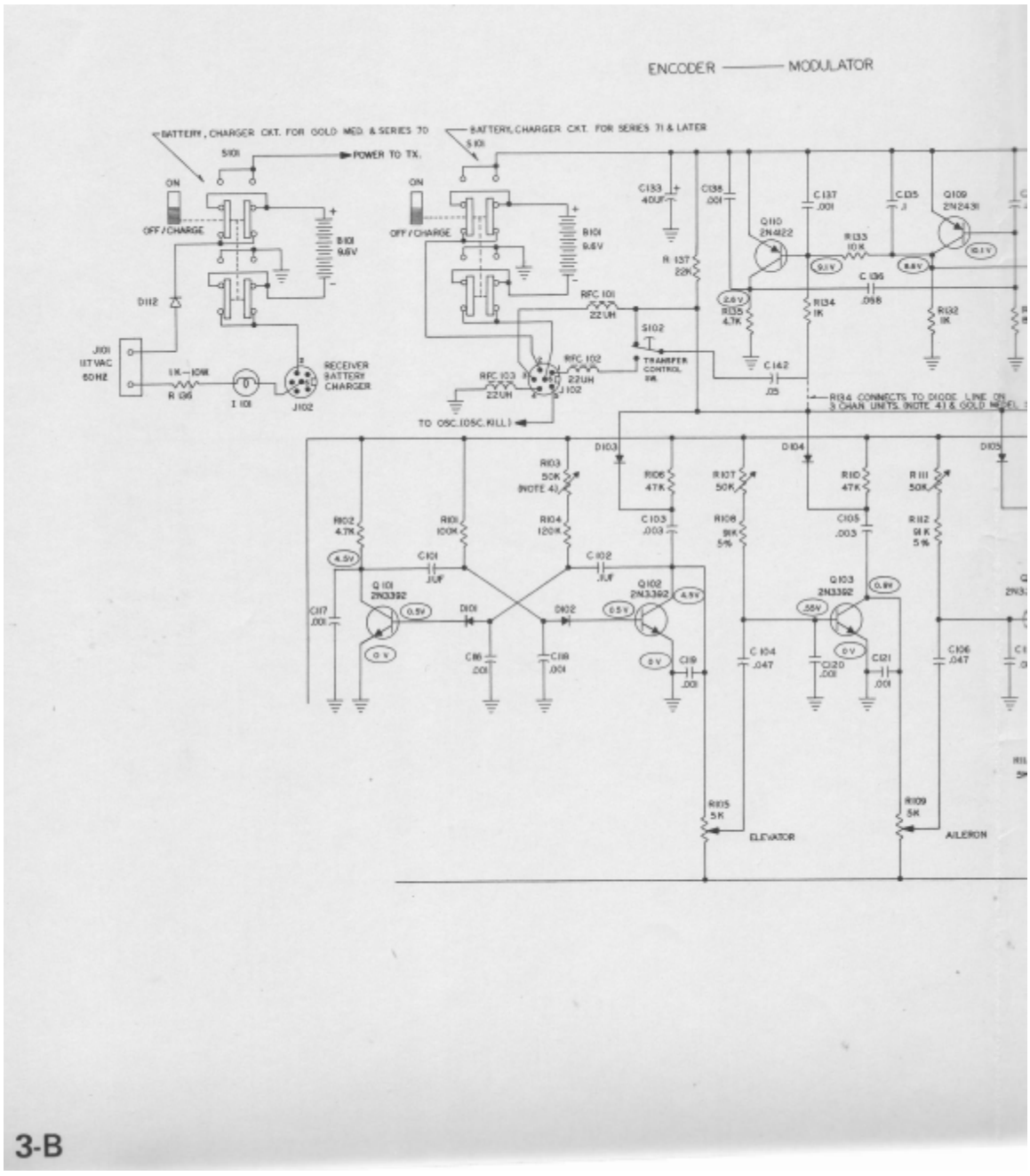
The time between the first encoder start pulse in one frame and the same pulse in the succeeding frame is fixed. Therefore, the period labeled "sync pause" varies as each control is moved. The sync pause carries no actual information as such, merely providing a long period during which the receiver decoder resets and readies for the first pulse in the next frame.

The start of each encoder channel is applied to the modulator which produces a 350 microsecond "off" pulse to an R. F. amplifier stage. The result is an amplitude modulated carrier which is transmitted to the receiver.





The receiver picks up the signal, amplifies and detects it, and then shapes the pulses and converts the serial train of pulses into separate pulses whose widths correspond to the interpulse time. These pulses are then passed to the servos and used to position the outputs on each servo unit in response to the position of the control stick on the transmitter.


ENCODER
MODULATOR
BATTERY, CHARGER CKT. FOR GOLD MED. & SERIES 70
BATTERY, CHARGER CKT. FOR SERIES 71 & LATER
S101
POWER TO TX.
ON
OFF / CHARGE
B101
9.6V
D112
J101
117 VAC
60 HZ
1K — 10W
R 136
I 101
J102
RECEIVER
BATTERY
CHARGER
RFC 101
22UH
S102
TRAINER
CONTROL
5K
RFC 102
22UH
RFC 103
22UH
J 102
TO OSC. (OSC. KILL)
C133
40UF
C138
.001
C137
.001
C135
.1
Q109
2N2431
Q110
2N4122
R133
10K
C136
.098
R137
22K
R134
1K
R132
1K
R135
4.7K
C142
.05
R134 CONNECTS TO DIODE LINE ON
3 CHAN UNITS. (NOTE 4) & GOLD
D103
D104
D105
R103
50K
(NOTE 4)
R106
47K
R107
50K
R110
47K
R111
50K
R102
4.7K
R101
100K
R104
120K
C103
.003
R108
91K
5%
C105
.003
R112
91K
5%
C101
.1UF
C102
.1UF
Q101
2N3392
Q102
2N3392
Q103
2N3392
C117
.001
D101
D102
C118
.001
C119
.001
C104
.047
C120
.001
C121
.001
C106
.047
R105
5K
ELEVATOR
R109
5K
AILERON

3-B

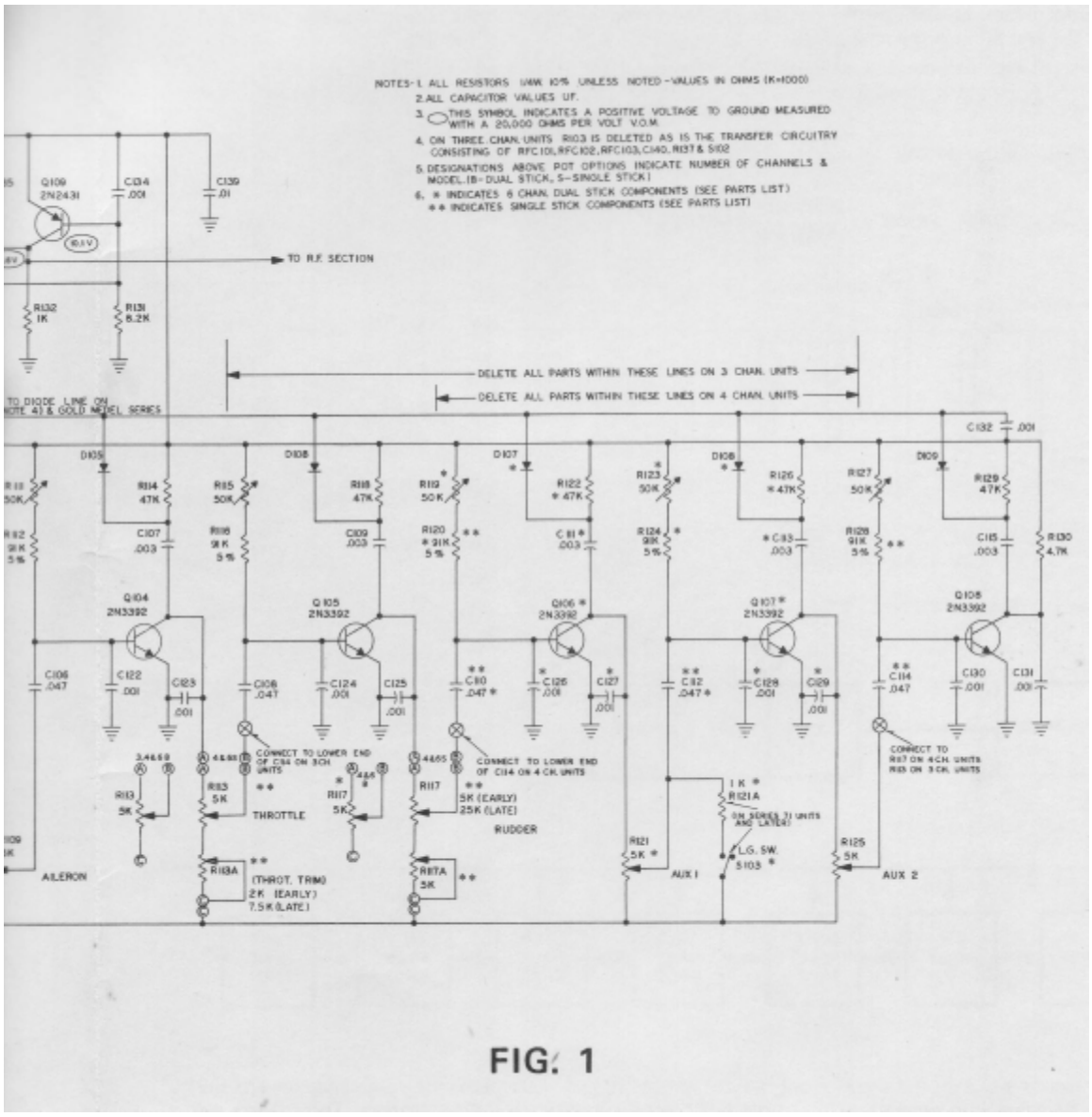

NOTES- 1. ALL RESISTORS 1/4W. 10% UNLESS NOTED - VALUES IN OHMS (K=1000)
2. ALL CAPACITOR VALUES UF.
3. THIS SYMBOL INDICATES A POSITIVE VOLTAGE TO GROUND MEASURED WITH A 20,000 OHMS PER VOLT V.O.M.
4. ON THREE CHAN. UNITS R103 IS DELETED AS IS THE TRANSFER CIRCUITRY CONSISTING OF RFC101, RFC102, RFC103, C140, R137 & S102
5. DESIGNATIONS ABOVE POT OPTIONS INDICATE NUMBER OF CHANNELS & MODEL. (B- DUAL STICK, S- SINGLE STICK)
6. * INDICATES 6 CHAN. DUAL STICK COMPONENTS (SEE PARTS LIST)
** INDICATES SINGLE STICK COMPONENTS (SEE PARTS LIST)
Q109 2N2431
C134 .001
C139 .01
10.5 V
TO R.F. SECTION
R132 1K
R131 8.2K
DELETE ALL PARTS WITHIN THESE LINES ON 3 CHAN. UNITS
DELETE ALL PARTS WITHIN THESE LINES ON 4 CHAN. UNITS
C132 .001
D105
D106
D107
D108
D109
R114 47K
R115 50K
R118 47K
R119 50K
R122 47K
R123 50K
R126 47K
R127 50K
R129 47K
R130 4.7K
C107 .003
C109 .003
C111 .003
C133 .003
C115 .003
R116 91K 5%
R120 91K 5%
R124 91K 5%
R128 91K 5%
Q104 2N3392
Q105 2N3392
Q106 2N3392
Q107 2N3392
Q108 2N3392
C106 .047
C122 .001
C123 .001
C108 .047
C124 .001
C125 .001
C110 .047
C126 .001
C127 .001
C112 .047
C128 .001
C129 .001
C114 .047
C130 .001
C131 .001
CONNECT TO LOWER END OF C134 ON 3CH UNITS
CONNECT TO LOWER END OF C114 ON 4 CH. UNITS
CONNECT TO R137 ON 4 CH. UNITS R103 ON 3 CH. UNITS
R113 5K
R117 5K
R117 5K (EARLY) 25K (LATE)
THROTTLE
RUDDER
R118A (THROT. TRIM) 2K (EARLY) 7.5K (LATE)
R117A 5K
1K
R121A
ON SERIES 71 UNITS AND LATER
L.G. SW. S103
R121 5K
R125 5K
AUX 1
AUX 2
AILERON
TO DIODE LINE ON NOTE 4) & GOLD MODEL SERIES

FIG. 1

ENCODER CIRCUIT (Fig. 1)

The transmitter encoder consists of a free-running multivibrator (Q101 & Q102) in conjunction with three to six "half-shot" or monostable timers (Q103 through Q108).

The free-running multivibrator sets the frame rate of the encoder and starts the chain of half-shots through the timing cycle. The trailing edge of the waveform at Q102 collector (Fig. **2**) drives the base of Q103 negative by an amount determined by the position of the wiper on R105 (Fig. **3**). C104 then starts charging through R107 and R108 toward the positive supply until the voltage at the base of Q103 reaches the turn-on point of Q103 (.6v) returning the collector potential to near ground (Fig. **4**).

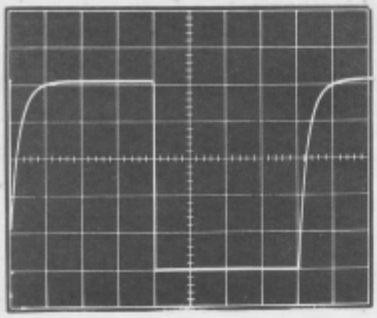


Fig. 2 Q102 Collector Waveform
(V=2v/Div. H=2ms/Div.)

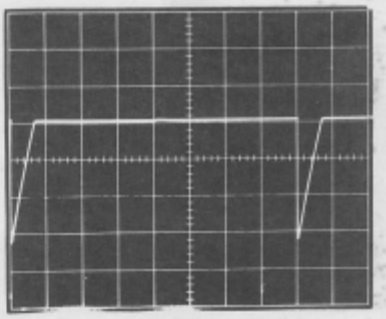


Fig. 3 Q103 Base Waveform
(V= 1v/Div. H=2ms/Div.)

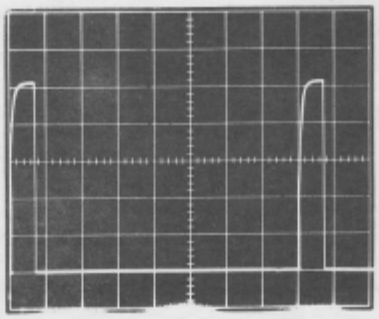


Fig. 4 Q104 Collector Waveform
(V= 2v/Div. H=2ms/Div.)

The trailing edge of Q103's collector pulse acts on Q104 in the same manner as Q102's collector upon Q103's base. This action continues on through the remainder of the chain until Q108 has concluded its timing cycle. The half-shot chain is now at rest for several milliseconds until Q102's collector again switches toward ground restarting Q103's timing cycle.

It is during this pause that the receiver decoder resets and awaits the beginning of the next frame of information.

Fig. 1 (fold out at left)

ENCODER SETUP AND ADJUSTMENT

To set up the transmitter encoder, it is necessary to have a D. C. oscilloscope with a calibrated time base. Before attempting to adjust the encoder, it will be necessary to disable the RF section in order to prevent stray radiation from upsetting the timing adjustments. This is most easily accomplished by temporarily grounding the base of the RF oscillator transistor.

With the circuit board lowered from the control sticks, all necessary adjustments can be made easily.

The frame rate should be checked first to insure that sufficient time is allowed for the receiver decoders to synchronize. Since this averages out at 3.5 milliseconds for a typical receiver, and allowing some leeway for voltage, component, and temperature variations at least 5 milliseconds should be allowed in the frame rate setting following conclusion of the last half-shot timing cycle. Assuming all controls at the widest extreme (1.9 milliseconds) the frame rate should be at least 13 milliseconds for a four channel encoder. Typical frame time for a four channel is 16 milliseconds and 18 milliseconds for a 6 channel.

The frame rate can be measured by attaching the scope signal lead to the collector of Q102 and measuring the time between successive portions of the waveform. To set each encoder half-shot, clip the signal lead of the scope to the junction of the differentiator capacitor and the pick-off diode (C103 & D103 respectively for Q103). Set the vertical sensitivity to 2v/div. and time base to 200uS/div. Trigger the scope on the leading edge of the positive pulse and position the trace to read the time to the tip of the negative pulse (Fig. 5).

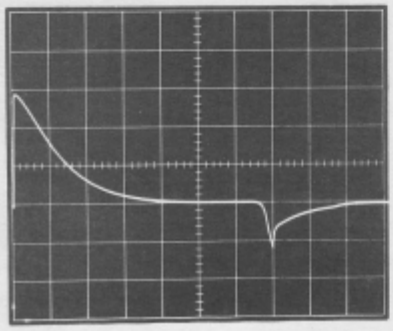


Fig. 5 Q103 Differentiator Waveform
(V= 1v/Div. H= .2ms/Div.)

Regardless of the stick mode, the first channel will always be the vertical stick on the left looking at the TX from the rear. The small tab to the rear of the stick potentiometer positions the potentiometer in the stick assembly. To adjust neutral, set the trim tabs to center on all functions. While holding the trim tab stationary with one hand, adjust the tab until the tip of the negative pulse is 7/div. from the leading edge of the positive pulse. This corresponds to 1.4 milliseconds. Now move the control stick being adjusted to its minimum pulse position and note the scope reading. If the range pot located on the circuit board is properly adjusted, the time base should read 1.0 millisecond or 5 div. If it reads less than 1.0 milliseconds, rotate this pot until it reads a bit over 1.0 milliseconds. Then allow the stick to return to neutral and re-adjust the tab 1.4 milliseconds.

Recheck the minimum pulse width for 1.0 milliseconds and adjust the range pot again if necessary. By alternately adjusting the neutral tab and range pot, it should be possible to obtain the pulse timing mentioned above. When this has been accomplished, check the maximum pulse width, still without trim. It should be very close to 9/div. or 1.8 milliseconds.

Follow the above procedure for the remainder of the channels, except throttle, landing gear switch, and auxiliary controls in the case of a six channel. To adjust the landing gear switch channel, locate R121 and R123 in the encoder section, and set both pots to mid-range. Observing the waveform, toggle the switch. The waveform should go narrow when the switch is pushed away from the front of the transmitter, and long when the switch is pulled to the front. With the switch in the long position, adjust R121 for 1.9ms, and toggle the switch to the narrow position. If the waveform is greater than 0.9ms, adjust R123 to widen the waveform one division. If the waveform is less than 0.9ms, adjust R123 to narrow the waveform one division. Readjust R121 to 0.9ms, and toggle the switch. It should be nearer to 1.9ms. By adjusting alternately between R121 and R123, it should be possible to obtain the pulse timing mentioned above.

In the case of the throttle and auxiliary controls, simply adjust the range pots and control stick tabs for the extremes of throw, or 0.9 milliseconds to 1.9 milliseconds.

Once all channels have been adjusted, the encoder setup is complete.

Remove the jumper between the oscillator base and ground.

SINGLE STICK KPT-4S and KPT-6S

ENCODER SETUP

Setting the encoder for this transmitter is very similar to the setup for two-stick models, with the exception of throttle and rudder controls.

These controls are provided with electrical trims rather than mechanical. Throttle trim is located to the right of the main control stick. Rudder trim is located above the main control stick.

Throttle control range is adjusted by holding the control lever and rotating the potentiometer shaft, or by holding the potentiometer shaft and rotating the control lever.

Adjusting neutral in the rudder assembly located in the housing beneath the knob is accomplished by loosening the set screw holding the knob on the potentiometer shaft and slipping the knob off the shaft. This exposes the potentiometer shaft and spring assembly. The potentiometer shaft is then rotated to neutral. The knob is then replaced and the set screw tightened. The range pot is adjusted in the usual manner.

Note: Rudder trim pot adjustment tab should be set fully left and throttle trim pot adjustment tab fully down prior to setting encoder channels. (The above refers to the adjustment tabs on the rear of the gimbal, not the trim control tabs on the front of the case.)

The trim pot positions are set in the same manner as main stick pots. Hold trim tabs on front of the transmitter case while rotating the pot tab on the rear of the gimbal.

MODULATOR

From each of the collectors in the timing chain is a differentiator and a pick-off diode. The diode passes only the negative portion of the pulse and applies it to the base of transistor Q110 through current limiting resistor R134. (Fig. 6) Transistors Q109 and Q110 form a monostable multivibrator or "one-shot". It has a period of from 300-400 uS, determined mainly by the value of R131 and C136. The output at Q109's collector is shown in Fig. 7 . It can be seen that the output pulses to ground potential from the supply voltage. This output is used to control supply voltage in one of the RF stages and thus serves to modulate the RF carrier. Proper operation of the modulator is indicated by observing the output waveform available at the "hot" side of R132.

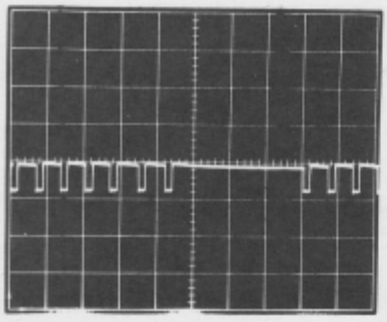


Fig. 6 Q110 Base Waveform
(V= 1v/Div. H=2ms/Div.)

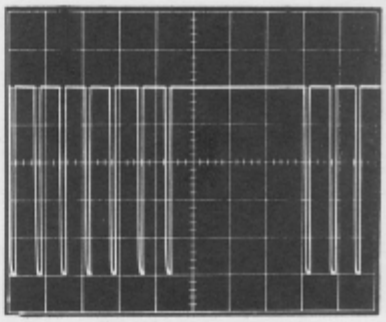


Fig. 7 Q109 Collector Waveform
(V= 2v/Div. H=2ms/Div.

SERIES SEVENTY KPT-4B, -6B & -4S, -6S TRANSMITTERS

Changes in the transmitter for 1970 are mainly internal. The Master-Slave feature described in the following section, and new 27 & 53 MHz RF sections described later are the only substantial revisions.

A new molded antenna post, P/N 901-193, and switch guard, P/N 200-049, are convenience items which may easily be added to Gold Medal Series equipment. If a new antenna post is installed on an older transmitter, it will be necessary to use the new antenna having a tapped hole in the base, P/N 200-033.

The Master-Slave feature may also be added to Gold Medal Series equipment, however, it is more involved and is best done by the factory or an Authorized Service Center.

The parts necessary to perform the conversion are listed below:

1 – Transfer Control Pushbutton			P/N	109-010
1 – Choke Mounting Board				010-152
3 – 22uh RF Chokes				103-022
5 – 12" Wire, stranded 26 AWG, one each - orange, blue, yellow, grey, grey/white				
1 – 22K	1/4w	10%	Resistor	057-223
1 – .05uf		Disc Capacitor		113-018
1 – .01uf		Disc Capacitor		113-016
Trainer Cable				200-030

The circuit board on the two-stick KP-4 & 6B transmitters has been altered slightly to accommodate the Master-Slave system and the new 27 MHz RF section. It is listed under the old part number, since the older circuit board assembly is no longer available.

KPT-3B TRANSMITTER

The Series Seventy 3 channel unit is electronically much like the 4 and 6 channel units already described. The encoder has one less channel and on 27 and 53MHz, a different modulator arrangement is used to achieve 100% modulation without three RF stages. The 72MHz version uses the standard three-stage RF section and buffer modulation.

In 27 and 53MHz units, the oscillator is the modulated stage. In practice, modulating the oscillator presents some potential problems since the circuit will begin to oscillate well below nominal supply voltage. In modulating the oscillator then, it is necessary to adjust circuit constants so that the oscillator doesn't start until nearly full supply voltage.

For the 3 channel, emitter modulation was chosen since it is easier to control the slope of the modulation over the narrow voltage range necessary to reverse bias the oscillator stage.

Tuning the 27 and 53MHz transmitters is very much like any other type except that when tuning the oscillator, some starting pulses can be seen on the trailing edge of the output waveform. These are normal with this type of modulation. The oscillator trimmer should be peaked then advanced very slightly clockwise, and the final tuning and loading trimmers peaked as usual. Fig. 16 and 17

SPECIAL PARTS FOR KPT-3B TRANSMITTERS

MECHANICAL PARTS

Control Stick	Single Axis w/pot		900-020
Case, Front	KPT-3B		904-074
Case, Back	KPT-3B		904-075
Bracket	Pot and PC Board Mounting		904-076
Bracket	PC Board – Antenna Ground		904-077

ELECTRONIC

Complete PC Assembly	27MHz	T-14	300-135
	72MHz	T-14	300-136
	53MHz – special order only – consult factory		
5K Control Pot for single axis stick			106-001

SERIES SEVENTY ONE

In 1971 on KPT-6B and 6S models we introduced a landing gear switch in place of the fifth channel auxiliary control potentiometer. On the KPT-6B model all necessary parts are mounted on a separate PC board including the switch which in turn is mounted to the TX case. The three wires from the switch board are then soldered to the TX board similar to pot wiring. (Fig. 8). The KPT-6S model, however, uses a different approach. The PC board is mounted to the TX board using through wiring, and in turn the switch is mounted to the TX case and wired to the switch board (Fig. 9).

Drawings showing switch location are after page 24

Encoder setup for the landing gear switch is covered in the TX encoder setup section.

In 1971 the KPT-3S transmitter was introduced. It is electronically the same as the KPT-3B transmitter. A different P. C. Board layout was used to accommodate the mounting of the stick assembly.

There was also a slight change to the R. F. Section, a .001uf Disc Capacitor was installed in series with the loading coil to remove the d.c. potential from the antenna. It is recommended that this be installed in the Series Seventy R. F. Section also. Tuning of the R. F. Sections is the same as the KPT-3B. Figs. 16 and 17 show the R. F. Section schematic.

SPECIAL PARTS FOR KPT-3S TRANSMITTERS

Mechanical Parts		
Control Stick	Two Axis w/pots	900-012
Case, Front		904-079
Case, Back		904-080
Case, Front and Back — Dual Frequency		904-090
Bracket, Board Mounting		904-082
Bracket, Pot Mounting		904-083
Electronic		
Complete P. C. Assembly	27 MHz	300-143
	53 MHz	300-144
	72 MHz	300-145

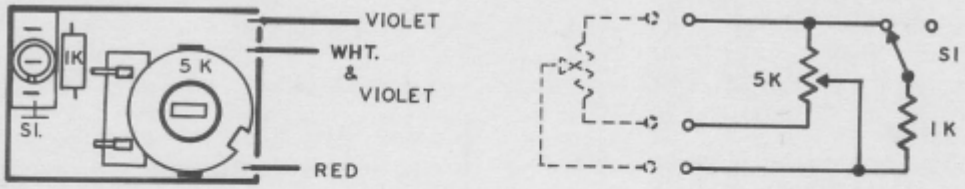


FIG. 8

FIG. 8

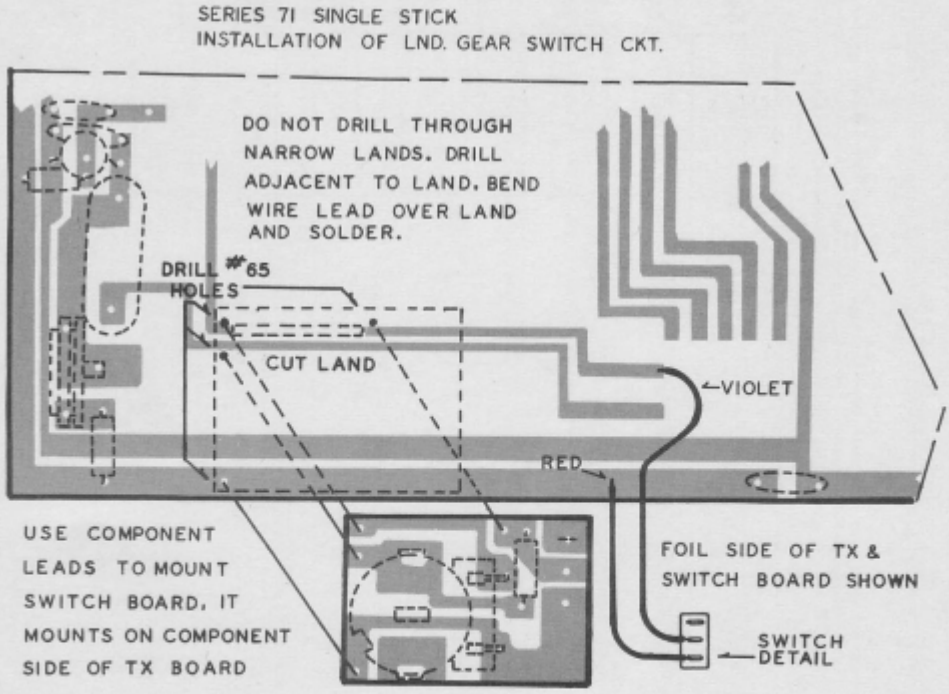
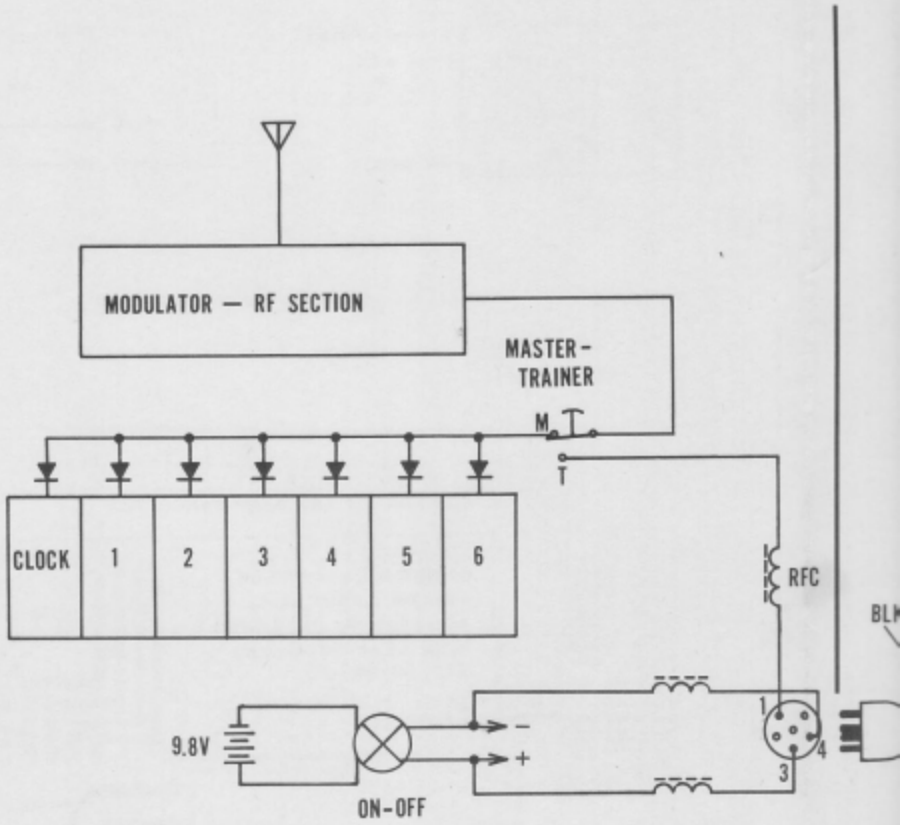


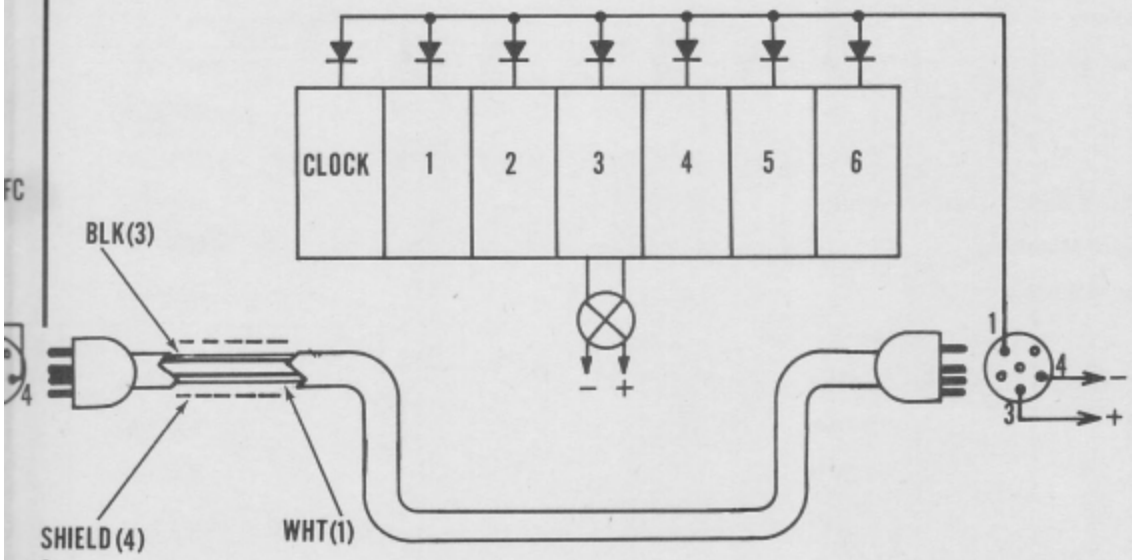
FIG. 9

TRAINER SYSTEM BLOCK DIAGRAM



MASTER

GRAM



NOTE: Black & White wires may be interchanged on some cables.

TRAINER

KRAFT TWO-STICK AND SINGLE STICK TRAINER TRANSMITTERS

Trainer transmitters are becoming more and more popular and, therefore, a brief word on Kraft Systems Trainer Transmitters has been included with this issue of supplementary information.

The Trainer Transmitters are basically complete transmitters less the RF transmitter portion and battery pack. They are made to be used with normal transmitters containing a master-trainer switch added at the factory. An interconnecting cable links the trainer to the master transmitter and derives its power from the master transmitter.

In operation, with the trainer box connected to the master, all encoder logic in both boxes is operative as long as both power switches are on. The master-trainer switch simply selects which control box is to modulate the RF carrier from the master transmitter. The master-trainer switch is spring loaded to return control to the master transmitter the instant the button is released. (See block diagram at left.)

The only requirements on trainer transmitter interchangeability is that both the master and trainer be of the same type, i.e., two-stick or single stick; and in the case of two-stick units, of the same mode. Other than that, a Trainer Transmitter is compatible with any master transmitter equipped for trainer unit operation.

Master transmitters which are regularly used with trainers should be checked and tuned with the trainer cabled in and on. RF output should be observed on a tuned wavetrap and oscilloscope while alternately switching back and forth between master and trainer.

NOTES:

Trainer System Block Diagram (fold out at left)

SERIES SEVENTY MASTER-SLAVE SYSTEM

All Series Seventy four and six channel systems feature a Master-Slave provision. This enables Series Seventy systems to be used with each other in the same way the Gold Medal Series "Buddy Box" system operated. One transmitter is used as the Master and one as the Slave or trainer.

When this system was introduced, it used a slide switch on the bottom of the transmitter to select the mode of operation. In these units, with the slide switch in the **Master** position, the unit operated normally. Depressing the Transfer Control button, the modulator selected the logic drive signal from the Slave unit. At the same time, power was being applied to Pin 3 of J102 to power a Gold Medal Series "Buddy Box" if this was used in place of another Series Seventy transmitter.

When the slide switch was set to **Slave** the RF oscillator was disabled and the logic output line was switched off the modulator and applied to Pin 1 of J102 to drive another Series Seventy transmitter in the Master position. At the same time, power was removed from Pin 3 to prevent both transmitter batteries from being on the same line.

In April 1970, the Master-Slave system was changed to eliminate the slide switch and use a coded connecting cable to select Master or Slave operation. Since the RF oscillator in the Slave unit must be disabled, it was necessary to shunt power away from the oscillator by returning a low value of resistance from the decoupled side of the oscillator tank to ground through a shorting wire in the slave end of the connecting cable. Because the modulator in the Slave unit is no longer disconnected from the logic output line, capacitive triggering was used on the modulator to prevent locking out the Master transmitter modulator if the battery voltage in the Slave unit is substantially higher than the battery voltage in the Master transmitter.

The existence of two types of Master-Slave systems presents a compatibility problem for the customer. The switch-type system can be easily modified for the new system by moving one switch wire and adding a resistor as shown on the schematic.

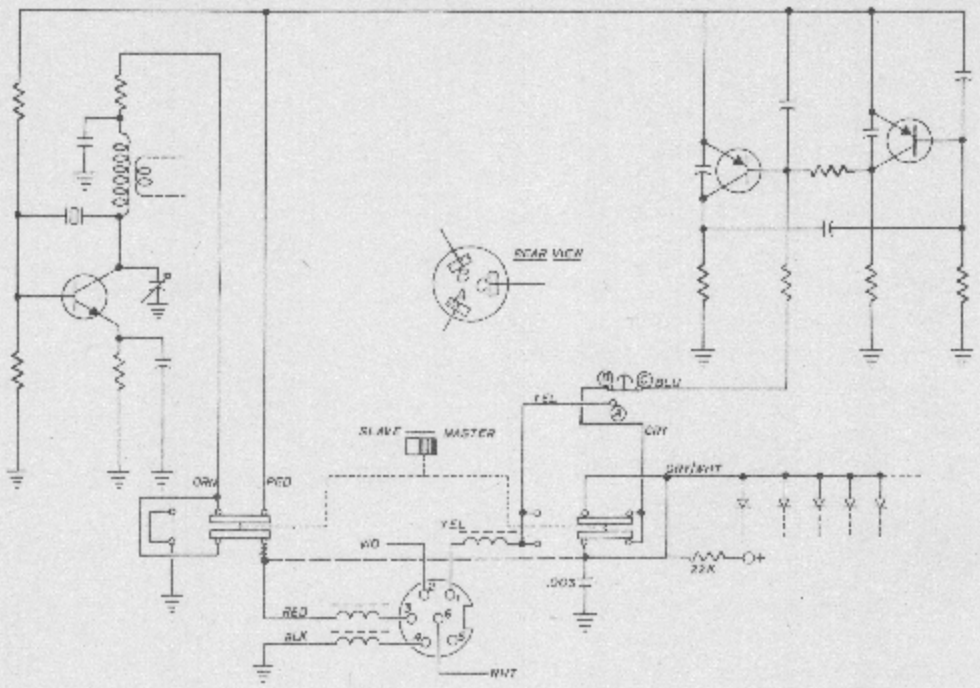
It is also necessary to modify the cable for the switch system if it is to be used on the later Series Seventy systems. The necessary changes are shown on the schematic. Gold Medal "Buddy Boxes" can no longer be used with the transmitter once it has been modified. It is still necessary to use the slide switch to select **Master** or **Slave** operation in addition to plugging in the proper cable end, due to the fact that the oscillator and modulator circuit changes are not present in the switch-type Master-Slave transmitters.

Operational checks on both types of Master-Slave systems are straight forward. Check the oscillator disabling to be sure the oscillator is indeed "off" in the **Slave** mode, either by throwing the slide switch to **Slave**, or shorting out Pins 4 and 5 on J102, depending on the type of system. Modulator operation may be checked by using a second transmitter and the interconnecting cable.

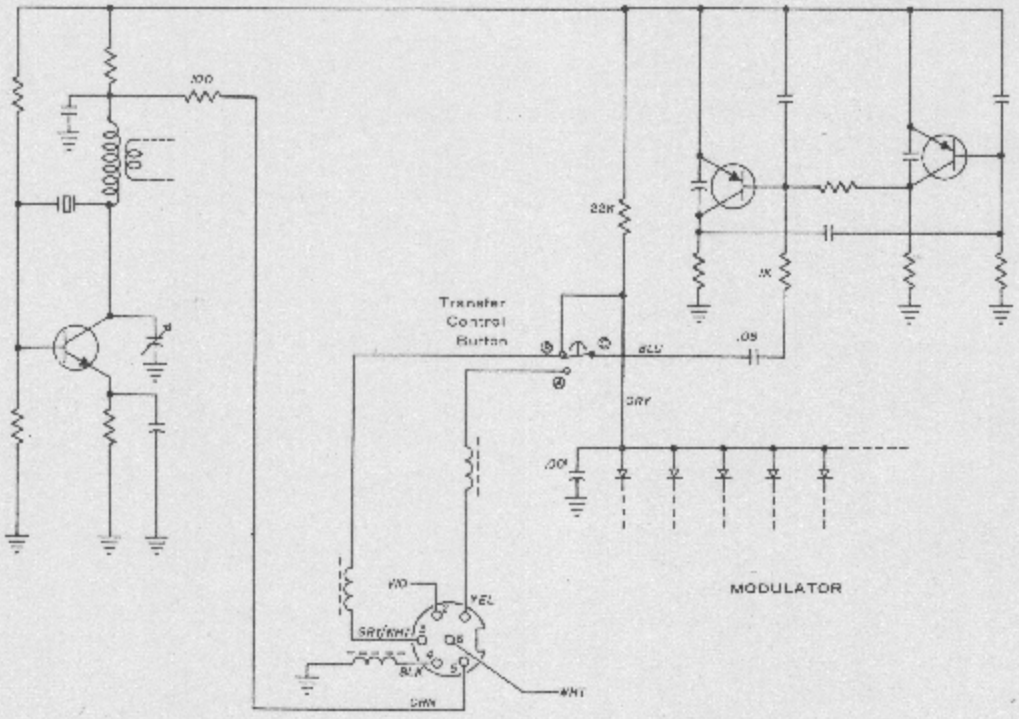
If a switch-type Master-Slave system is modified as shown on the schematic diagram, it is necessary to engrave "MOD-2" on the bottom of the transmitter near the switch to serve as notification that the unit is compatible with newer systems.

If you are ordering trainer cords for these systems, be sure to note which type of trainer system it is. Unmodified switch-type systems and Gold Medal Series units used with a "Buddy Box" will use P/N 200-010. Modified switch systems and newer Series Seventy systems use P/N 200-030.

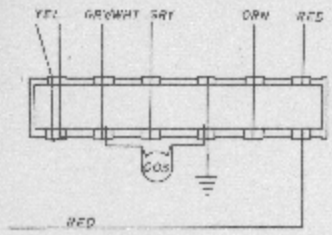
NOTES:



MASTER - TRAINER SYSTEM

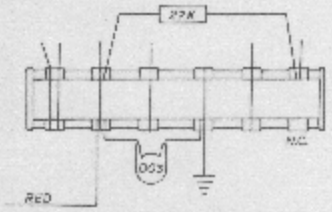


J102



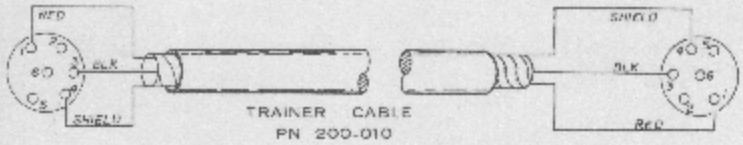
ORIGINAL WIRING

Note: THIS SYSTEM WAS USED ON EARLIER PRODUCTION WITH THE SLIDE SWITCH



MODIFIED TO OPERATE WITH NEW SYSTEM SHOWN BELOW

MASTER-SLAVE SWITCH



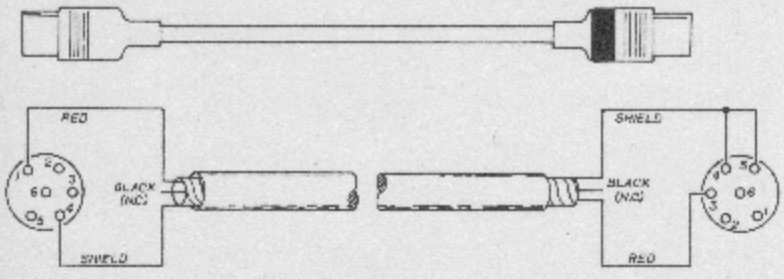
TRAINER CABLE
PN 200-010

Note:

THIS SYSTEM IS USED ON LATER MANUFACTURE WITHOUT THE SLIDE SWITCH ON THE BOTTOM OF THE TRANSMITTER

"MASTER" END

"SLAVE" END



TRAINER CABLE

PN 200-030

27 MHz

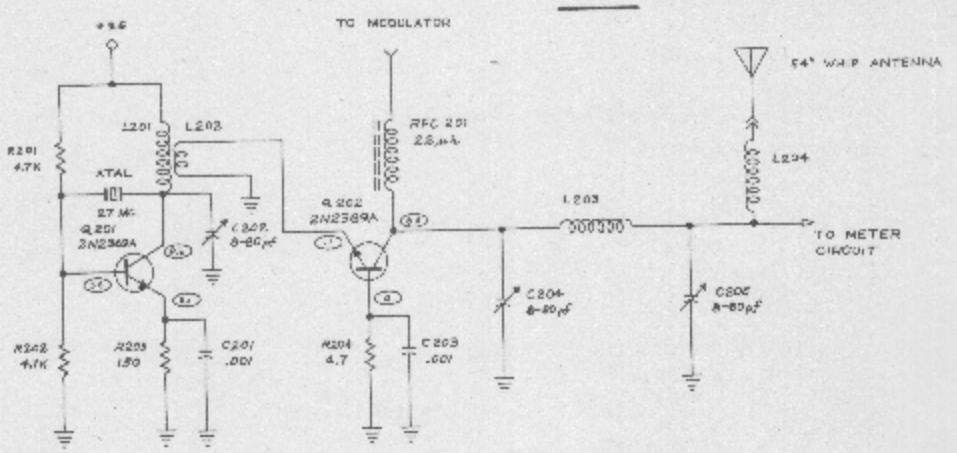


FIG. 10

72 MHz

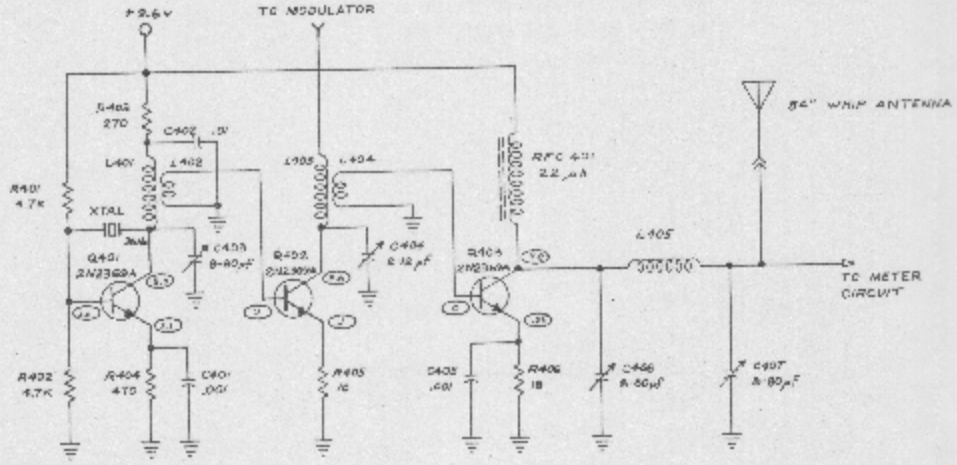


FIG. 10B

52 MHz

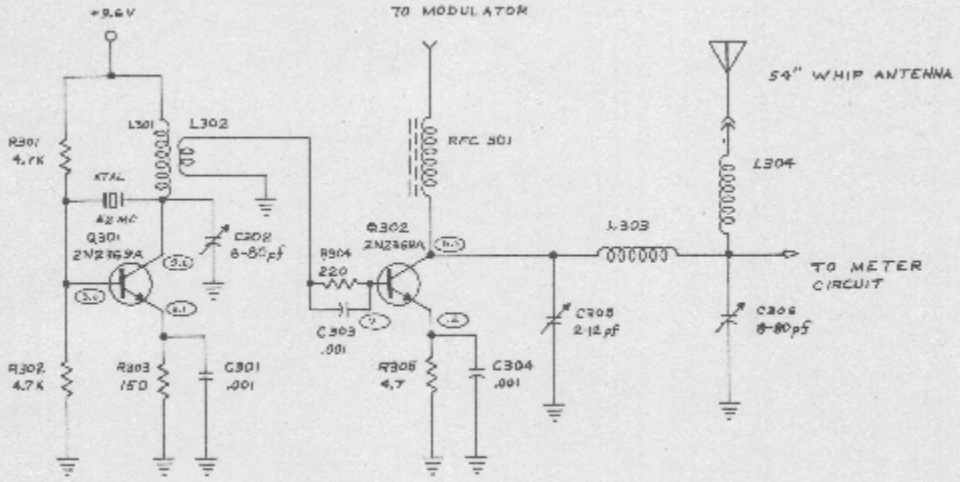
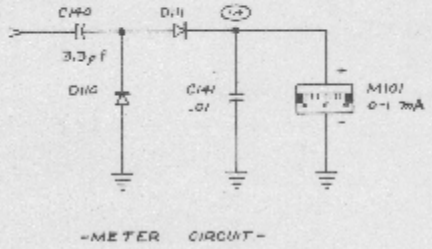


FIG. 10A

1. ALL RESISTORS ½ W. 10% VALUES IN OHMS (K=1000).
2. ALL CAPACITORS DISC CERAMIC EXCEPT VARIABLE TYPES WHICH AIR DIELECTRIC – VALUES IN μf UNLESS NOTED.
3. ⬭ THIS SYMBOL INDICATES A POSITIVE D.C. VOLTAGE REFERENCED TO GROUND TAKEN WITH A 20,000 Ω/V V-O-M.
4. SEE PARTS LIST FOR VALUES OF PARTS NOT SHOWN.



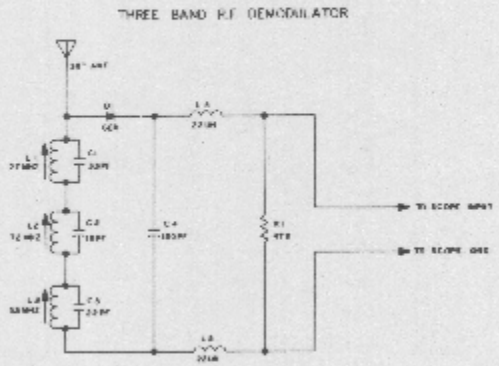


FIG. 11 (WAVE TRAP)

RF SECTION — OPERATION AND TUNING

NOTICE: IN ORDER TO TUNE TRANSMITTERS ON 27 OR 72 MHz YOU MUST HOLD A VALID SECOND CLASS OR HIGHER RADIO-TELEPHONE OPERATOR'S LICENSE ISSUED BY THE FEDERAL COMMUNICATIONS COMMISSION.
TUNING TRANSMITTERS ON 52 MHz REQUIRES THE OPERATOR TO POSSESS AN AMATEUR OPERATOR'S LICENSE.

27MHz — Fig. 10

The RF section consists of transistors Q201 and Q202. Q201 operates as a series mode crystal oscillator with output on 27 MHz.

Q202 operates as a grounded-base class "C" amplifier. Modulation is applied to the collector through RFC 202. Tuning is accomplished by C204 and C205 in a "PI" type configuration.

To tune the transmitter, it is necessary to use a tuned wavetrap in conjunction with an oscilloscope or sensitive DC meter. (Fig 11) Also a non-metallic tuning tool such as General Cement type 8276 is necessary for best results.

With a crystal installed, and the board in place on the control stick assemblies, rotate all timer capacitor screws counter-clockwise at least five full turns. While observing the output indicator, rotate C202 clockwise until the oscillator starts. Continue to rotate C202 until a peak reading is obtained. Slowly turn C202 until the peak reading is just passed and beginning down again.

Now begin rotating C204 clockwise until a decrease in output is noted.

C205 should now be rotated clockwise until a peak indication is obtained. C204 should be checked to see that it is tuned just to the point where the output begins to decrease, as there is some slight interaction between C204 and C205.

The on-off switch should be turned on and off several times to insure that the RF oscillator is starting reliably each time.

The RF tune-up is now completed.

52 MHz — Fig. 10A

The RF section consists of transistors Q301 and Q302. Q301 operates as a series mode crystal oscillator with output on 52MHz.

Q302 operates as a common emitter class C amplifier. Modulation is applied through RFC 301 to the collector of Q302. C305 and C306 in a "PI" configuration tune the transmitter output stage.

The tuned wavetrap shown in Fig. 11 should be used preferably with an oscilloscope.

Tuning is accomplished in the same manner as described in the 27MHz section. The only exception is that the PI-input trimmer, C305, should be adjusted for maximum modulation percentage. Using the tuned wavetrap and oscilloscope, note the position of the scope trace with the transmitter off. With the transmitter on, the tip of the pulses - or "off" time, should be as close to the zero reference line as possible. C305 will have the most effect in controlling the modulation percentage in the transmitted output.

72 MHz — Fig. 10B

Transistors Q401, Q402, and Q403 form the three stage RF section. Q401 operates as a series mode crystal oscillator operating at 36MHz.

Q402 operates as a buffer-doubler in a common emitter configuration. The collector tank is resonant at 72MHz and provides drive for the final amplifier stage Q403. Modulation is applied to this stage to suppress switching transients in the final tank.

Q403 is operated as a common emitter class C amplifier providing output power at 72MHz through a PI section tank tuned by C406 and C407.

A tuned wavetrap and an oscilloscope are mandatory for tuning this type of transmitter. continued

◁ (Figs. 10, 10a, 10b & 11 at left)

All trimmer capacitors should be rotated counterclockwise at least five turns. Begin rotating C403 clockwise until the oscillator starts, as observed on the oscilloscope. Tune C403 slightly beyond peak, and move down to C404. Rotate C404 clockwise until maximum output is indicated. Turn clockwise no more than 1/8 of a turn beyond peak, until output power begins to fall off.

C406 and C407 are now tuned clockwise to peak in that order. The observed waveform on the scope should look very similar to Fig. 12. If the output waveform appears more like Fig. 13 with the spikes rising above the waveform, the transmitter is not properly tuned. This particular symptom is generally the result of doubler mistuning. Rotate C404 clockwise until the waveform is free of overshoot. It is generally necessary to touch up C406 and C407 in order to obtain the peak reading mentioned above.

The transmitter is now tuned.

R.F. TRANSMITTER CIRCUIT – 27 & 53 MHz

Series Seventy 4 and 6 channel systems now use the three-stage transmitter circuit used on 72MHz units.

27MHz equipment with a three-stage RF section (Fig. 14) employs a modulated buffer-amplifier stage. Tuning of these transmitters is much the same as 72MHz.

Begin with the oscillator, then tune the buffer tank. The buffer tuning is fairly sharp, so it may be necessary to adjust the buffer tuning slightly in order to get a usable signal when tuning the oscillator. The next adjustment should be the final PI tank input. Turn the trimmer screw clockwise until a definite drop in output is noted. (Begin this adjustment with the trimmer screw fully counterclockwise.) Then tune the loading trimmer for maximum and repeak all prior adjustments. This procedure should be done while observing the transmitted waveform on a tuned wavetrap and oscilloscope as described on pages 11 and 12 under 72MHz transmitter tuning.

53MHz transmitters are tuned in exactly the same manner as above. (Fig. 15).

When tuning transmitters using a tuned wavetrap and oscilloscope, be absolutely certain that the wavetrap is tuned to the correct frequency, otherwise the observed signal can be on a harmonic or other product frequency and the transmitter will not seem to tune properly.

NOTES:

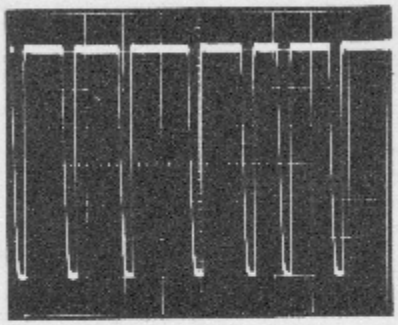


Fig. 12 Output Waveform (72mHz) (H=2ms/cm)

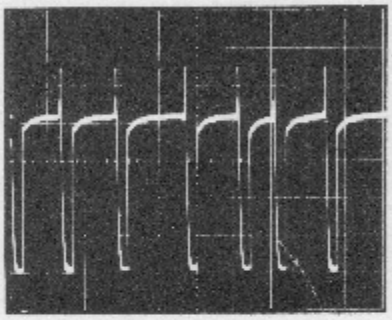
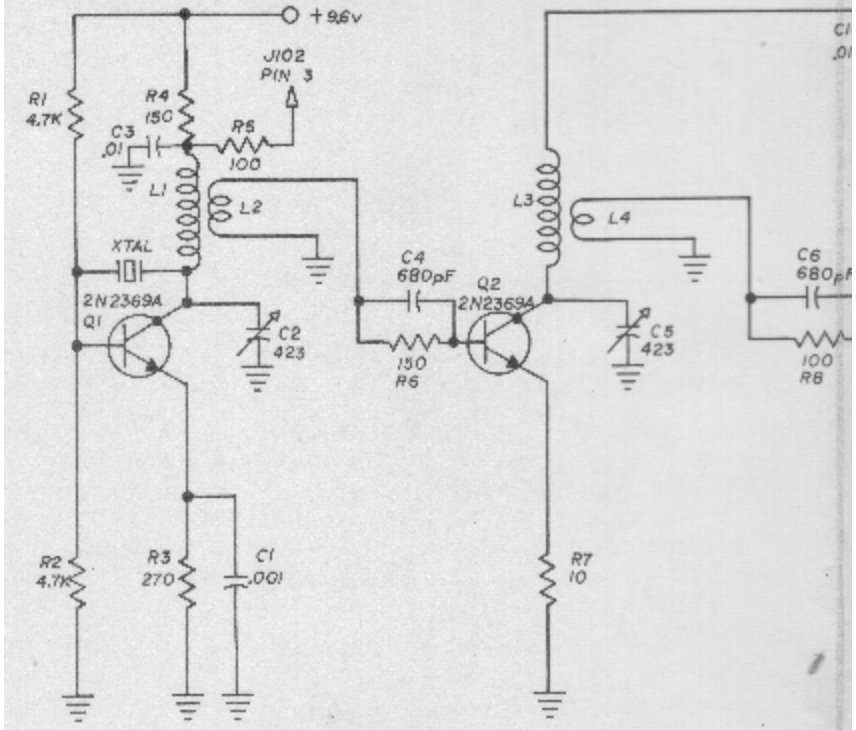
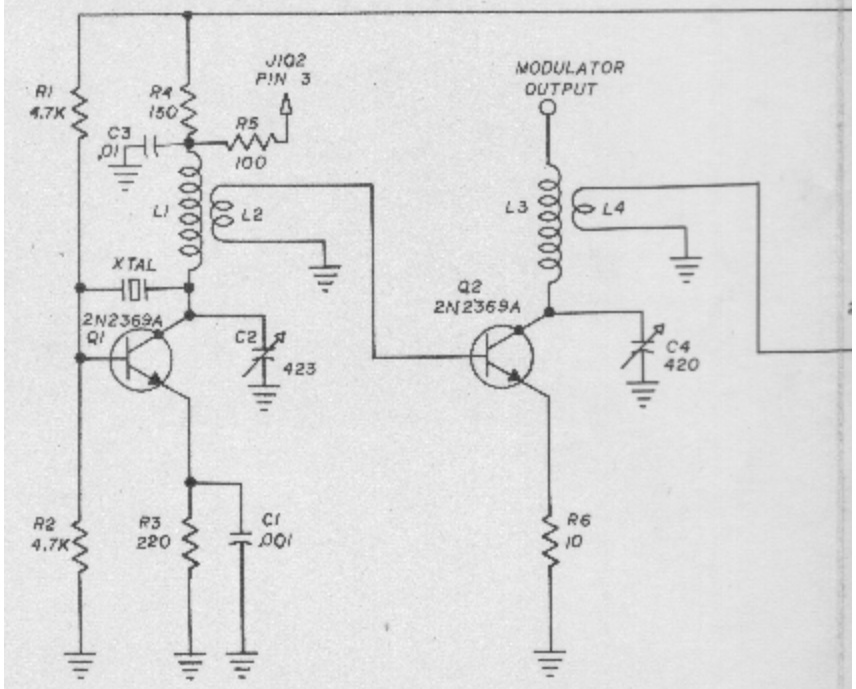


Fig. 13 Output Waveform (72mHz) (Detuned) (H=2ms/cm)

KPT-4&6B RF SECTION





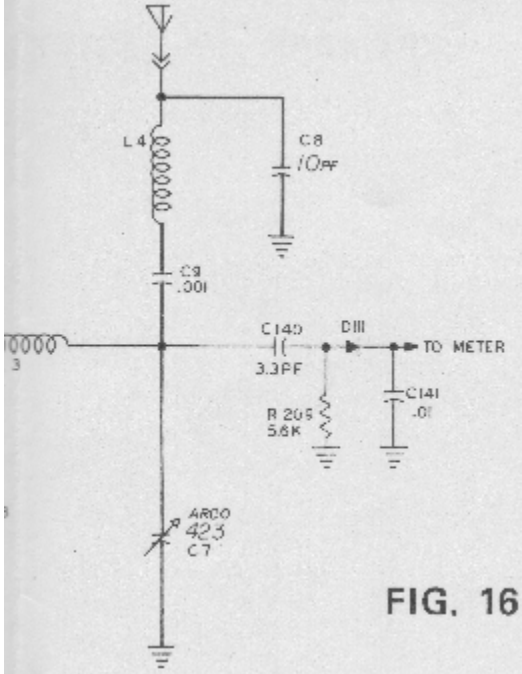


FIG. 16

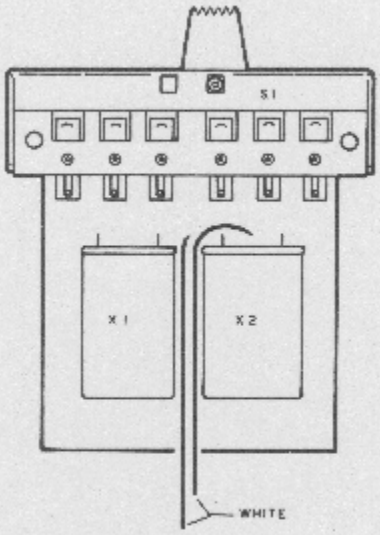
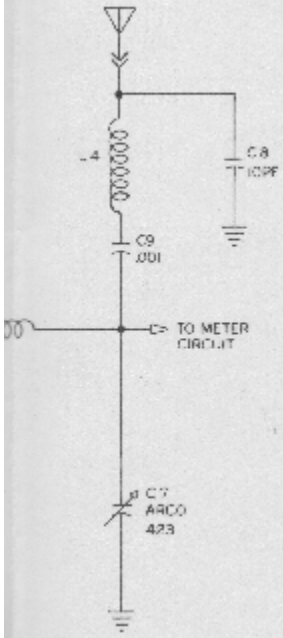
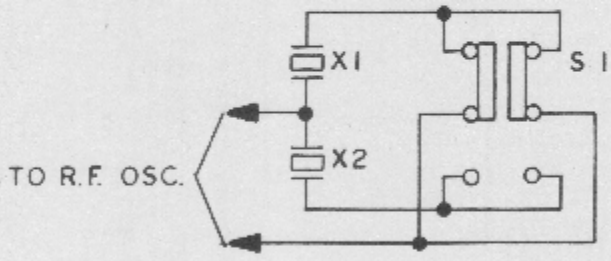


FIG. 17



TX. DUAL FREQ. SWITCH



DUAL FREQUENCY OPTION

Series Seventy-One systems are offered with an optional Dual Frequency system. The customer may select either of two pre-determined frequencies by operating switches located on both the transmitter and receiver. There is no retuning or any other adjustment required to change frequency.

Dual Frequency is available on any two adjacent frequencies on the 27 MHz band and any two adjacent frequencies on the 72 MHz band except 75.640 MHz. This option is not made available on 53 MHz equipment.

TRANSMITTER

Dual frequency transmitters contain a circuit board which holds the two crystals, mounted directly to the frequency select switch. The frequency select switch, in turn, mounts to the case itself. Two wires connect the crystal switching circuit to the main P. C. board in the holes normally occupied by the crystal on single frequency transmitters. (See schematic)

If an existing Series Seventy-One or Series Seventy system is to be converted to Dual Frequency, it is important to locate the switch in exactly the same location as factory-equipped units. A location drawing for KP-4 or -6B transmitters is given following the text on page 24 . Series Seventy-One KP-4S or -6S systems have the switch located on the bottom of the transmitter. Placement is not as critical as the two-stick system, however it is best to follow the diagrams as closely as possible.

Switch location on 3 channel models is shown along with the other drawings at the end of the text. The KP-2B switch location is identical to the KP-3B.

ALIGNMENT

Four crystals, closely matched, are used in Dual Frequency systems. Crystals are supplied in matched pairs, pre-aged and closely matched at the factory.

The transmitter tuning procedure is identical to that used on single frequency systems. The only difference is in observing the transmitted signal while switching the frequency-select switch between the two frequencies. The oscillator should be adjusted for best results with the weaker of the two crystals, if there is any noticeable difference in activity between the two. The one crystal which requires more collector capacity in the oscillator should be tuned up first, then the other crystal checked. The remaining stages can be tuned to either crystal, then check the output of the transmitter when the other crystal is switched in.

If a frequency counter is available, final output frequency can be checked to observe switching operation. The proper frequency labels should be affixed to the transmitter case next to the switch to indicate the operating frequency in each switch position.

PARTS LIST — DUAL FREQUENCY OPTION

TRANSMITTER

S1	Switch, 4.P.D.T.	109-007
—	P. C. Board only	010-155
—	Switch Guard Package	200-049
X1, X2	Crystals	as required *
—	Frequency Labels	as required *
—	Complete Tx dual frequency assembly less crystals and frequency labels	300-158

* Refer to Master Parts Index for Part Numbers and ordering information on these items.

◁ Figs. 16 & 17 (fold out at left)

TRANSMITTER – TROUBLE SHOOTING INFORMATION

Failures or defects in the transmitter are in general due to poor transistor performance. Do not overlook the possibility of other component failures; however, in general, most faults can be corrected by replacement of a transistor. Listed below are general difficulties which might be experienced along with the most common cause of the defect.

NO RF OUTPUT – ENCODER INOPERATIVE

Check voltage supplied to circuit board itself. If voltage is delivered to board, check for broken circuit lands.

NO RF OUTPUT – ENCODER OK – MODULATOR INOPERATIVE

Check signal at collector of Q110 for positive pulses, indicating Q110 is functioning. If Q110 seems to be OK, Q109 is most likely at fault.

NO RF OUTPUT – ENCODER AND MODULATOR OK

Check for proper adjustment of oscillator tuning capacitor. If adjusting trimmer does not restore operation, and oscillator voltages check OK, suspect crystal.

RF OUTPUT – NO PULSES ON CARRIER

Check encoder operation. If all encoders are operating but no modulator output pulses appear, suspect Q110. If no signal is present at the base of Q110, check free-running multivibrator Q101 and Q102.

RF OUTPUT OK, ONE OR MORE PULSES MISSING

Check half-shot timers for proper operation. If one stage fails, all successive half shots will be inoperative.

RF OUTPUT OK, MODULATING PULSES OK; MODULATION DISAPPEARS WHEN RF SECTION IS BEING TUNED.

Check to see that R134 and C132 and C137 are installed.

RF OUTPUT LOW

Batteries check OK, suspect crystal or RF amplifier transistor(s) if re-tuning does not restore output.

NOTES:

PARTS LIST – TRANSMITTER ENCODER

* Parts used on 6 channel only

** Parts used on single-stick units only

RESISTORS – All values in OHMS (K=1,000)

R101	100K	¼w	10%	057-104
R102	4.7K	¼w	10%	057-472
R103 *	50K	¼w	Potentiometer	106-018
R104	120K	¼w	10%	057-134
R105	5K	½w	W.W. Potentiometer	106-006
R106	47K	¼w	10%	057-473
R107	50K	¼w	Potentiometer	106-018
R108	91K	¼w	5%	040-011
R109	5K	½w	W.W. Potentiometer	106-006
R110	47K	¼w	10%	057-473
R111	50K	¼w	Potentiometer	106-018
R112	91K	¼w	5%	040-011
R113	5K	½w	W.W. Potentiometer	106-018
R113 **	2K	½w	W.W. Potentiometer	106-010 Spec
	Used on single stick throttle for units with S/N 5144 to 6058. Order by description given here and specify S/N of unit.			
R113A**	2K	½w	W.W. Potentiometer	106-010
	Used on single stick throttle trim for units with S/N 5144 to 6058.			
R114	47K	¼w	10%	057-473
R115	50K	¼w	Potentiometer	106-018
R116	91K	¼w	5%	040-011
R117	5K	½w	Potentiometer	106-006
R117 **	1.5K	¼w	Potentiometer	106-012-R
	Used on single stick rudder for units with S/N 5144 to 6058. Order by description given and specify S/N of unit.			
R117A **	5K	½w	W.W. Potentiometer	106-006-S
	Used on single stick rudder trim for units with S/N 5144 to 6058. Order by description and specify S/N of unit.			
R118	47K	¼w	10%	057-473
R119 *	50K	¼w	Potentiometer	106-018
R120 *	91K	¼w	5%	040-011
R120 **	68K	¼w	10%	057-683
	Used on 6 channel single stick units only – S/N 5144 tp 6048.			

R121 *	5K	½w	W.W. Potentiometer	106-006
R121 *Series 71	5K	½w	Trim Potentiometer	106-024
R122 *	47K	¼w	10%	057-473
R123 *	50K	¼w	Potentiometer	106-018
R124 *	91K	¼w	5%	040-011
R125 *	5K	½w	W.W. Potentiometer	106-006
R116 *	47K	¼w	10%	057-473
R127	50K	¼w	Potentiometer	106-018
R128	91K	¼w	5%	040-011
**	62K	¼w	5%	040-012
	Used on 4 channel single stick units only. S/N 5144 to 6058.			
R129	47K	¼w	10%	057-473
R130	4.7K	¼w	10%	057-472
R131	8.2K	¼w	10%	057-822
R132	1K	¼w	10%	057-102
R133	10K	¼w	10%	057-103
R134	1K	¼w	10%	057-102
R135	4.7K	¼w	10%	057-472
R136	1K	12w	5%	073-102
R137	22K	¼w	10%	057-223

ADDITIONAL

On single stick units S/N 6059 and up, the following resistors and potentiometers have changed value.

R113 **	5K	½w	W.W. Potentiometer	106-006
	Used on single stick throttle for units with S/N 6059 and above.			
R113A **	7.5K	½w	W.W. Potentiometer	106-021
	Used on single stick throttle trim for units with S/N 6059 and above.			
R117 **	5K	½w	Potentiometer	106-013
	Used on single stick rudder for units with S/N 6059 and above.			
R117A *	25K	½w	W.W. Potentiometer	106-006
	Used on single stick rudder trim for units with S/N 6059 and above.			
R120 and R128 are	9K		for single stick units with S/N 6059 and above.	
R116 becomes	62K	¼w	5%	040-012
	For single stick units with S/N 6059 and above.			

See also capacitor section for changes on single stick units S/N 6059 and above.

CAPACITORS

C101	.1uf/250v	Mylar	10%	115-018
C102	.1uf/250v	Mylar	10%	115-018
C103	.003uf	Disc Ceramic	20%	113-014
C104	.047uf/100v	Mylar	10%	115-008
C105	.003uf	Disc Ceramic	20%	113-014
C106	.047uf/100v	Mylar	10%	115-008
C107	.003uf	Disc Ceramic	20%	113-014
C108	.047uf/100v	Mylar	10%	115-008
C109	.003uf	Disc Ceramic	20%	113-014
C110 *	.047uf/100v	Mylar	10%	115-008
C111 *	.003uf	Disc Ceramic	20%	113-014
C112 *	.047uf/100v	Mylar	10%	115-008
C113 *	.003uf	Disc Ceramic	20%	113-014
C114	.047uf/100v	Mylar	10%	115-008
C115	.003uf	Disc Ceramic	20%	113-014
C116-125	.001uf	Disc Ceramic	20%	113-012
C126 * – 129 *	.001uf	Disc Ceramic	20%	113-012
C130 – 132	.001uf	Disc Ceramic	20%	113-012
C133	40uf/16v	Alum. Electrolytic		116-008
C135	.1uf/10v	Disc Ceramic	+80 - 20%	113-019
C136	.068uf/100v	Mylar	10%	115-012
C137-138	.001uf	Disc Ceramic	20%	113-012
C139	.01uf	Disc Ceramic	20%	113-016
C140	3.3pf	Disc Ceramic	10%	113-003
C141	.01uf	Disc Ceramic	20%	113-016
C142	.05uf	Disc Ceramic	10%	113-018
	For single Sticks S/N 6059 and above:			
C110 **	.022uf/100v	Mylar	10%	115-004
	Used on 6ch single stick units with S/N 6059 and above.			
C114 **	.022uf/100v	Mylar	10%	115-004
	Used on 4ch single stick units with S/N 6059 and above.			

CHECK SUB-PARTS LISTS CAREFULLY FOR SERIAL NUMBERS AND DATES WHEN ORDERING PARTS BY PART NUMBER.

TRANSISTORS AND DIODES

Q101-105	Transistor	2N3392	101-004
Q106 * – 107 *	Transistor	2N3392	101-004
Q108	Transistor	2N3392	101-004
Q109	Transistor	2N2431 or	101-005
		MPS-6562	101-012
Q110	Transistor	2N4122 or S2783	101-003
D101-106	Diode, Silicon DA-805 or IN4148		100-101
D107 * – 108 *	Diode, Silicon DA-805 or IN4148		100-101
D109 – 111	Diode, Silicon DA-805 or IN4148		100-101
D112	Diode, Silicon, Rectifier 200v @ 750 MA		100-100

CHOKES

RFC 101 thru 103	22 uhy RF Choke	103-022

MISCELLANEOUS

– – –		Choke Mounting board for master-slave-system		010-152
M1-1	0-1ma	Edgewise Meter		126-001
I 101	No. 1820	Lamp		400-003
S 101	4. P.D.T.	Slide Switch		109-007
S 102		Push Button Series "70 - 71"		
S 103	2PST	Toggle Switch Series "71"		
B 101	KB-8	9.6v	Battery with case	KB-8
J 101	2 pin	Interlock Receptacle		120-007
J 102	6 pin	Flush-mount Receptacle		120-004
T 10A		Complete T-10A PC Assembly		
		27MHz-4ch		300-100
		27MHz-6ch		300-103
		53MHz-4ch		300-101
		53MHz-6ch		300-104
		72MHz-4ch		300-102
		72MHz-6ch		300-105
1 GS		Landing Gear Switch Board complete with switch		300-154

27MHz RF SECTION

RESISTORS – All values in OHMS (K=1,000)

R201	4.7K	¼w	10%	057-472
R202	4.7K	¼w	10%	057-472
R203	150	¼w	10%	057-151
R204	4.7	¼w	10%	056-047

CAPACITORS

C201	.001mf	Disc Ceramic	113-012
C202	1 - 100pf	Mica Trimmer No. 423	112-002
C203	.001mf	Disc Ceramic	113-012
C204	1 - 100pf	Mica Trimmer No. 423	112-002
C205	1 - 100pf	Mica Trimmer No. 423	112-002

COILS

L201	Osc. Tank Coil	103-002
L202	Osc. Output Coil – Part of L201	
L203	Final Tank Coil	103-003
L204	Loading Coil	103-003
RFC201	22uhy RF Choke	103-022

TRANSISTORS

Q201, 202	Transistor	2N2369A	101-006
XTAL	27MHz	Transmitter Crystal	
	Order desired crystal frequency.		

53MHZ RF SECTION

RESISTORS – Values in OHMS (K=1,000)

R301, 302	4.7K	¼w	10%	057-472
R303	150	¼w	10%	057-151
R304	220	¼w	10%	057-221
R305	4.7	¼w	10%	056-047

CAPACITORS

C301, 303, 304	.001mf	Disc Ceramic	113-012
C302, 306	7 - 100pf	Mica Trimmer No. 423	112-002
C305	1 - 12pf	Mica Trimmer No. 420	112-001

COILS				
L301, 302		Osc. Tank Coil		103-004
L303		Final Tank Coil		103-005
L304		Loading Coil		103-006
RFC301		22uhy RF Choke		103-002
TRANSISTORS				
Q301, 302		Transistor	2N2369A	101-006
XTAL		53MHz Tansmitter Crystal		
		Order by crystal frequency desired.		

72NHz RF SECTION

RESISTORS				
R401, 402	4.7K	¼w	10%	057-472
R403	270	¼w	10%	057-271
R404	470	¼w	10%	057-471
R405	10	¼w	10%	057-100
R406	18	¼w	10%	057-180
CAPACITORS				
C401, 405	.001mf		Disc Ceramic	113-012
C402	.01mf		Disc Ceramic	113-016
C403, 406, 407		7 - 100pf	Mica Trimmer No. 423	112-002
C404		1 - 12pf	Mica Trimmer No. 420	112-001
COILS				
L401, 402			Osc. Tank Coil	103-007
L403, 404			Buffer Tank Coil	103-008
L405			Final Tank Coil	103-009
RFC401		22uhy RF Choke		103-022
TRANSISTORS				
Q401, 402, 403			Transistor 2N2369A	101-006
XTAL		36MHz	Doubler Crystal	
			Order 72MHz frequency desired.	

KPT-3B and 3S RF SECTION PARTS LIST – 27 MHz

RESISTORS – (K=1,000)

R1	2.2K	1/4W	10%	057-222
R2	4.7K	1/4W	10%	057-472
R3	150 ohm	1/4W	10%	057-151
R4	1.5K	1/4W	10%	057-152
R5	not used			
R6	2.2K	1/4W	10%	057-222
R7	1K	1/4W	10%	057-102
R8	4.7 ohm	1/4W	10%	056-047

CAPACITORS

C1	.001uF	Disc Ceramic	113-012
C2	.001uF	Disc Ceramic	113-012
C3	7-100pF	Mica Trimmer No. 423	112-002
C4	10pF	Disc Ceramic	113-004
C5	.001uF	Disc Ceramic	113-012
C6	7-100pF	Mica Trimmer No. 423	112-002
C7	7-100pF	Mica Trimmer No. 423	112-002
C8	10pF	Disc Ceramic	113-004
C9	.001uF	Disc Ceramic	113-012

COILS AND CHOKES

L1 & L2	Osc. Tank and Osc. Output	103-002
L3	Final Tank	103-003
L4	Load 2.2 uhy RF Choke	103-025
L5	22 uhy RF Choke	103-022

TRANSISTORS

Q2	2N3392	NPN	Transistor	101-004
Q1 & Q3	2N2369A	NPN	Transistor	101-006

MISCELLANEOUS

Heat Sink	904-050

KPT-3B and 3S RF SECTION PARTS LIST – 53 MHz

RESISTORS – (K=1,000)

R1	2.2K	1/4W	10%	057-222
R2	4.7K	1/4W	10%	057-472
R3	150 ohm	1/4W	10%	057-151
R4	1.5K	1/4W	10%	057-152
R5	220 ohm	1/4W	10%	057-221
R6	2.2K	1/4W	10%	057-222
R7	1K	1/4W	10%	057-102
R8	4.7 ohm	1/4W	10%	056-047

CAPACITORS

C1	.001uF	Disc Ceramic	113-012
C2	.001uF	Disc Ceramic	113-012
C3	7-100pF	Mica Trimmer No. 423	112-002
C4	10pF	Disc Ceramic	113-004
C5	.001uF	Disc Ceramic	113-012
C6	1-12pF	Mica Trimmer No. 420	112-001
C7	7-100pF	Mica Trimmer No. 423	112-002
C8	10pF	Disc Ceramic	113-004
C9	.001uF	Disc Ceramic	113-012
C10	.001uF	Disc Ceramic	113-012

COILS AND CHOKES

L1 & L2	Osc. Tank and Osc. Output Coil	103-004
L3	Final Tank Coil	103-005
L4	Loading Tank Coil	103-006
L5	22 uhy RF Choke	103-022

TRANSISTORS

Q2	2N3392	NPN	Transistor	101-004
Q1 & Q3	2N2369A	NPN	Transistor	101-006

MISCELLANEOUS

Heat Sink	904-050

SERIES '70 4B and 6B – SERIES '71 4B and 6B; 4S and 6S

27 MHz RF SECTION PARTS LIST

RESISTORS – All values in ohms (K=1,000)

R1	4.7K	1/4W	10%	057-472
R2	4.7K	1/4W	10%	057-472
R3	270 ohm	1/4W	10%	057-271
R4	150 ohm	1/4W	10%	057-151
R5	100 ohm	1/4W	10%	057-101
R6	150 ohm	1/4W	10%	057-151
R7	10 ohm	1/4W	10%	057-100
R8	100 ohm	1/4W	10%	057-101

CAPACITORS

C1	.001uF	Disc Ceramic	113-012
C2	7-100pF	Mica Trimmer No. 423	112-002
C3	.01uF	Disc Ceramic	113-016
C4	680pF	Disc Ceramic	113-020
C5	7-100pF	Mica Trimmer No. 423	112-002
C6	680pF	Disc Ceramic	113-020
C7	68pF	Disc Ceramic	113-009
C8	14-150pF	Mica Trimmer No. 424	112-004
C9	14-150pF	Mica Trimmer No. 424	112-004
C10	.01uF	Disc Ceramic	113-016
C11	.01uF	Disc Ceramic	113-016

COILS AND CHOKES

L1 & L2	Osc. Tank, Osc. Output Coil	103-026
L3 & L4	Buffer, Buffer Output Coil	103-027
L5	Pi-Tank Coil	103-028
L6	Final Loading Coil	103-003
L7	22 uhy RF Choke	103-022

TRANSISTORS

Q1 & Q2	2N2369A	NPN	Transistor	101-006
Q3	40081 RCA	NPN	Transistor	101-015

MISCELLANEOUS

Crystal	27 MHz	Specify frequency desired	– – –

53 MHz RF SECTION PARTS LIST

RESISTORS

R1	4.7K	1/4W	10%	057-472
R2	4.7K	1/4W	10%	057-472
R3	220 ohm	1/4W	10%	057-221
R4	150 ohm	1/4W	10%	057-151
R5	100 ohm	1/4W	10%	057-101
R6	10 ohm	1/4W	10%	057-100
R7	10 ohm	1/4W	10%	057-100

CAPACITORS

C1	.001uF	Disc Ceramic	113-012
C2	7-100pF	Mica Trimmer No. 423	112-002
C3	.01uF	Disc Ceramic	113-016
C4	1-12pF	Mica Trimmer No. 420	112-001
C5	.001uF	Disc Ceramic	113-012
C6	not used		
C7	not used		
C8	7-100pF	Mica Trimmer No. 423	112-002
C9	7-100pF	Mica Trimmer No. 423	112-002

COILS AND CHOKES

L1 & L2	Osc. Tank and Output Coil		103-029
L3 & L4	Buffer and Buffer Output Coil		103-030
L5	Pi-Tank Coil		103-031
L6	Loading Coil		103-006
L7	22 uhy	RF Choke	103-022

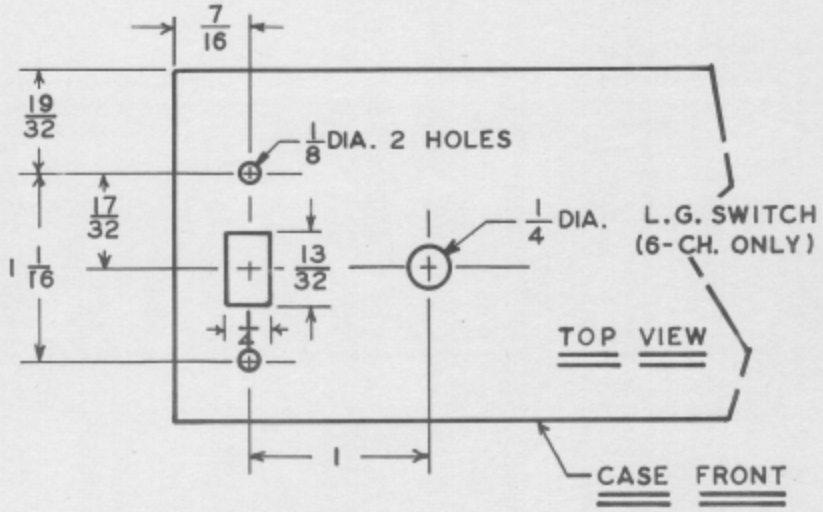
TRANSISTORS

Q1, Q2 & Q3	2N2369A	NPN	Transistor	101-006

MISCELLANEOUS

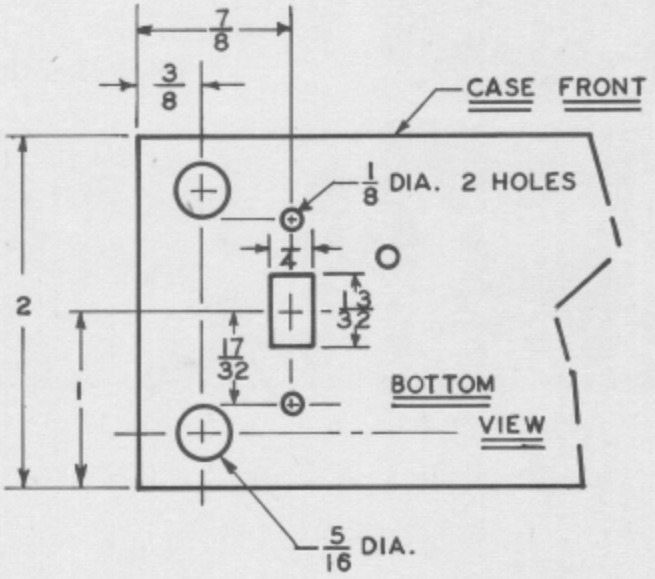
Crystal	53 MHz	Specify frequency desired	– – –

KPT-4&6

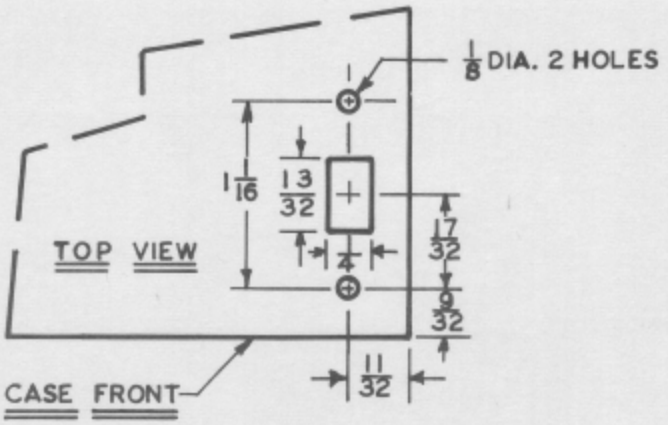


TX DUAL FREQUENCY SWITCH & LANDING GEAR SWITCH LOCATION.

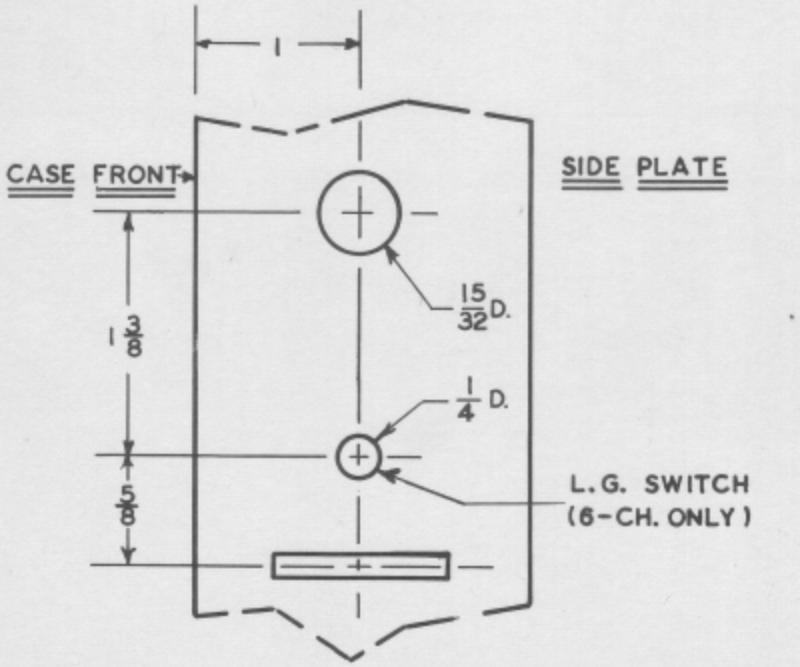
KPT-4&6S

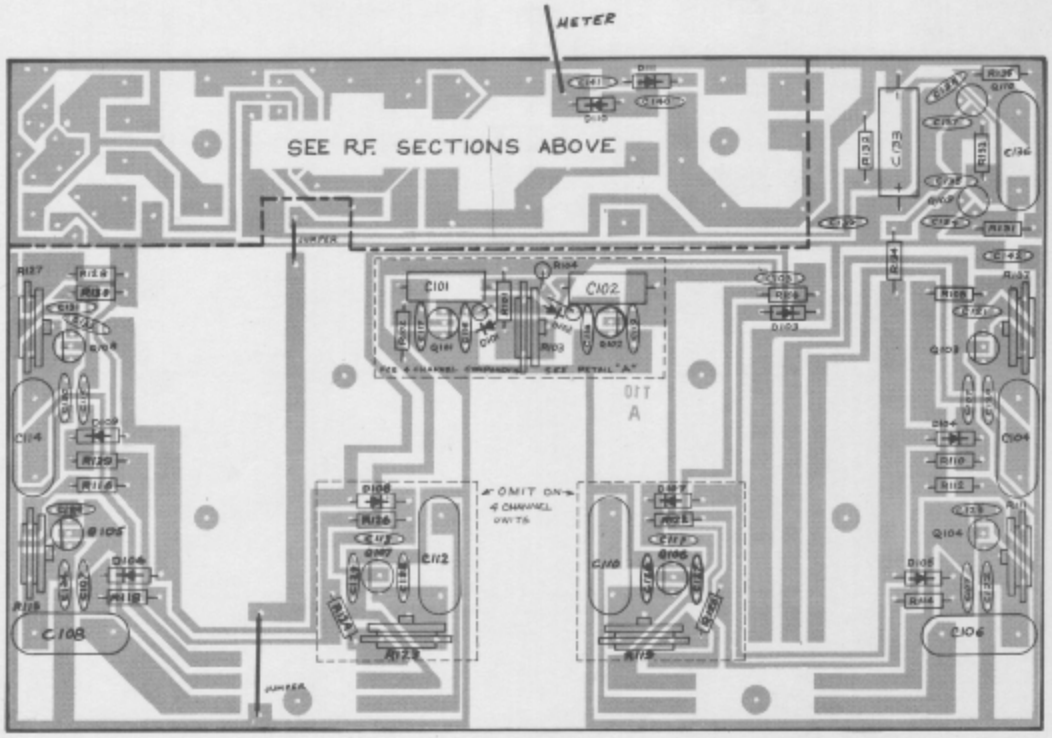


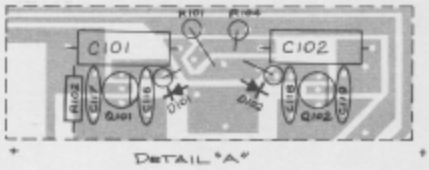
KPT-2B & KPT-3B&3S



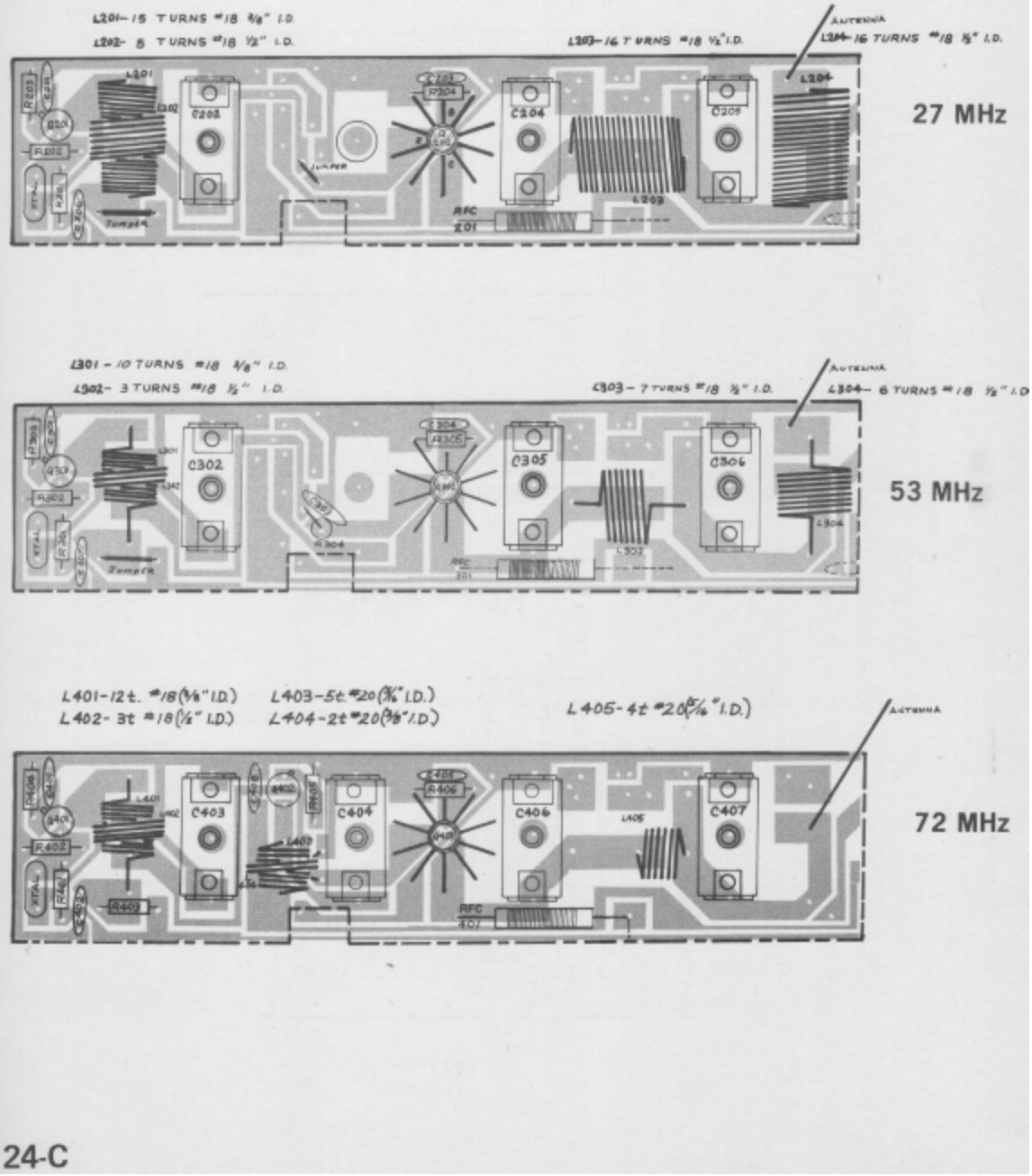
KPT-6S

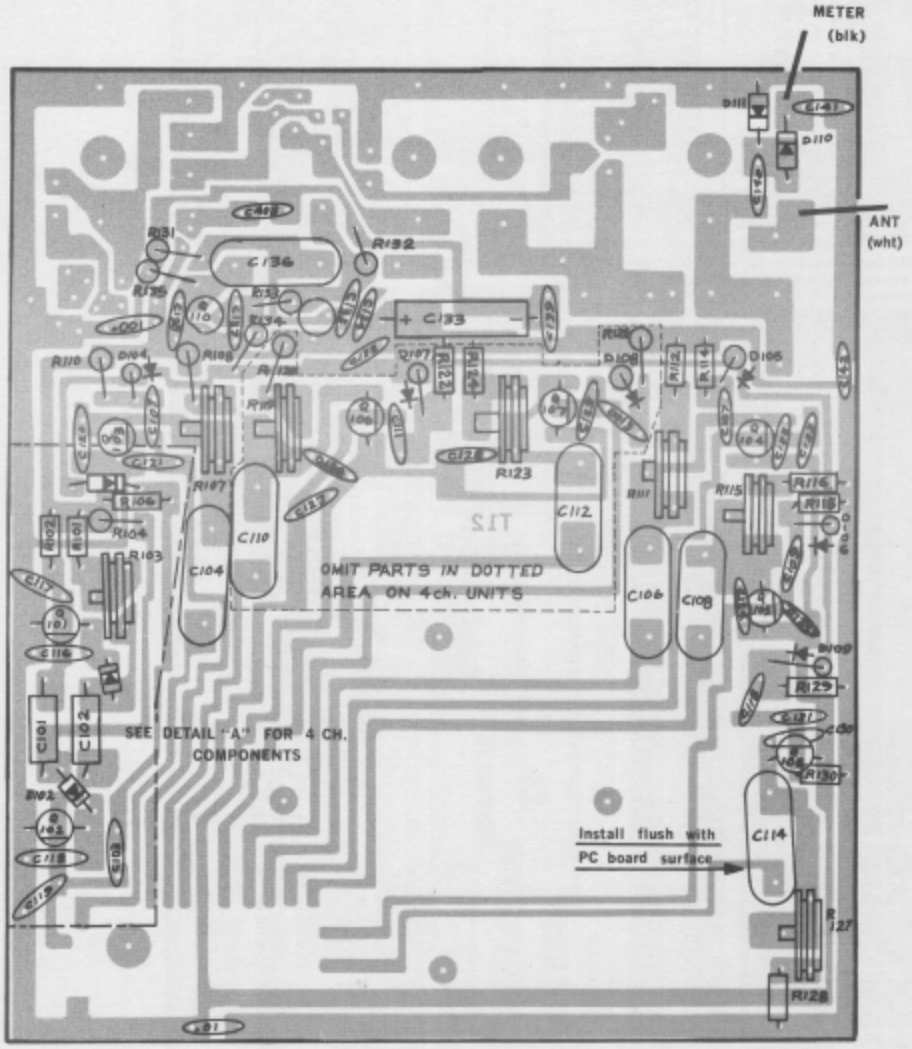


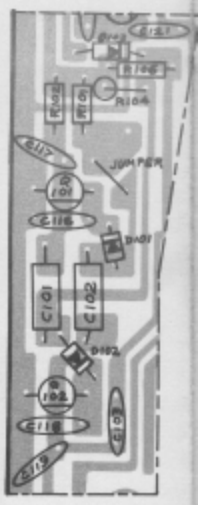

METER
SEE RF SECTIONS ABOVE
JUMPER
C101
C102
OMIT ON 4 CHANNEL UNITS
C108
C106
JUMPER


C101
C102

DETAIL "A"


L201- 15 TURNS #18 3/8" I.D.
L202- 5 TURNS #18 1/2" I.D.
L203- 16 TURNS #18 1/2" I.D.
ANTENNA
L204- 16 TURNS #18 1/2" I.D.
27 MHz
L301 - 10 TURNS #18 3/8" I.D.
L302- 3 TURNS #18 1/2" I.D.
L303- 7 TURNS #18 1/2" I.D.
ANTENNA
L304- 6 TURNS #18 1/2" I.D.
53 MHz
L401-12t. #18(3/8" I.D.)
L402- 3t #18(1/2" I.D.)
L403-5t. #20(5/16" I.D.)
L404-2t #20(3/8" I.D.)
L405-4t #20(5/16" I.D.)
ANTENNA
72 MHz

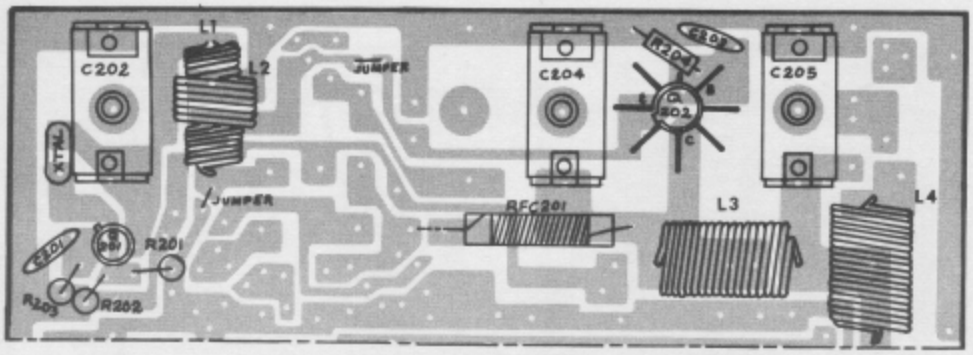

METER
(blk)
ANT
(wht)
C136
C133
R123
C112
C110
C104
C106
C108
C114
R128
OMIT PARTS IN DOTTED
AREA ON 4ch. UNITS
SEE DETAIL "A" FOR 4 CH.
COMPONENTS
Install flush with
PC board surface


JUMPER

Detail "A"

L1– 12 TURNS
L2– 5 TURNS

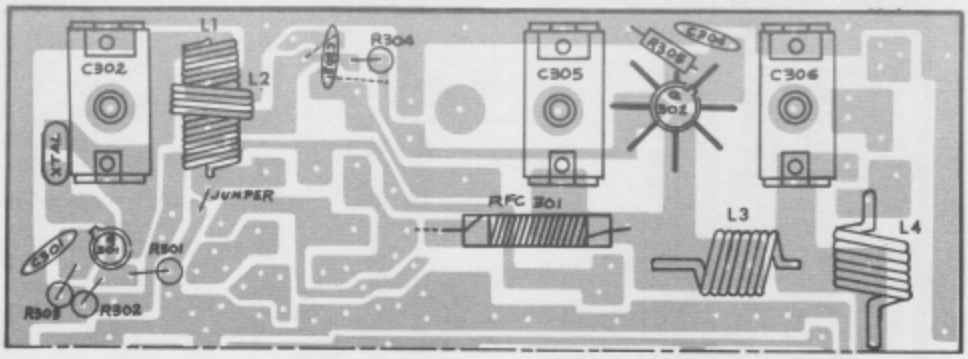
L3,L4 –16 TURNS



27 MHz RF SECTION

L1–10 TURNS
L2– 3 TURNS

L3–7 TURNS
L4 6 TURNS

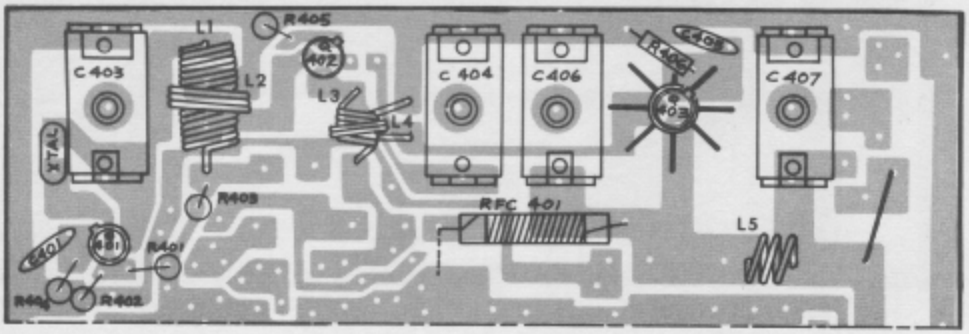


53 MHz RF SECTION

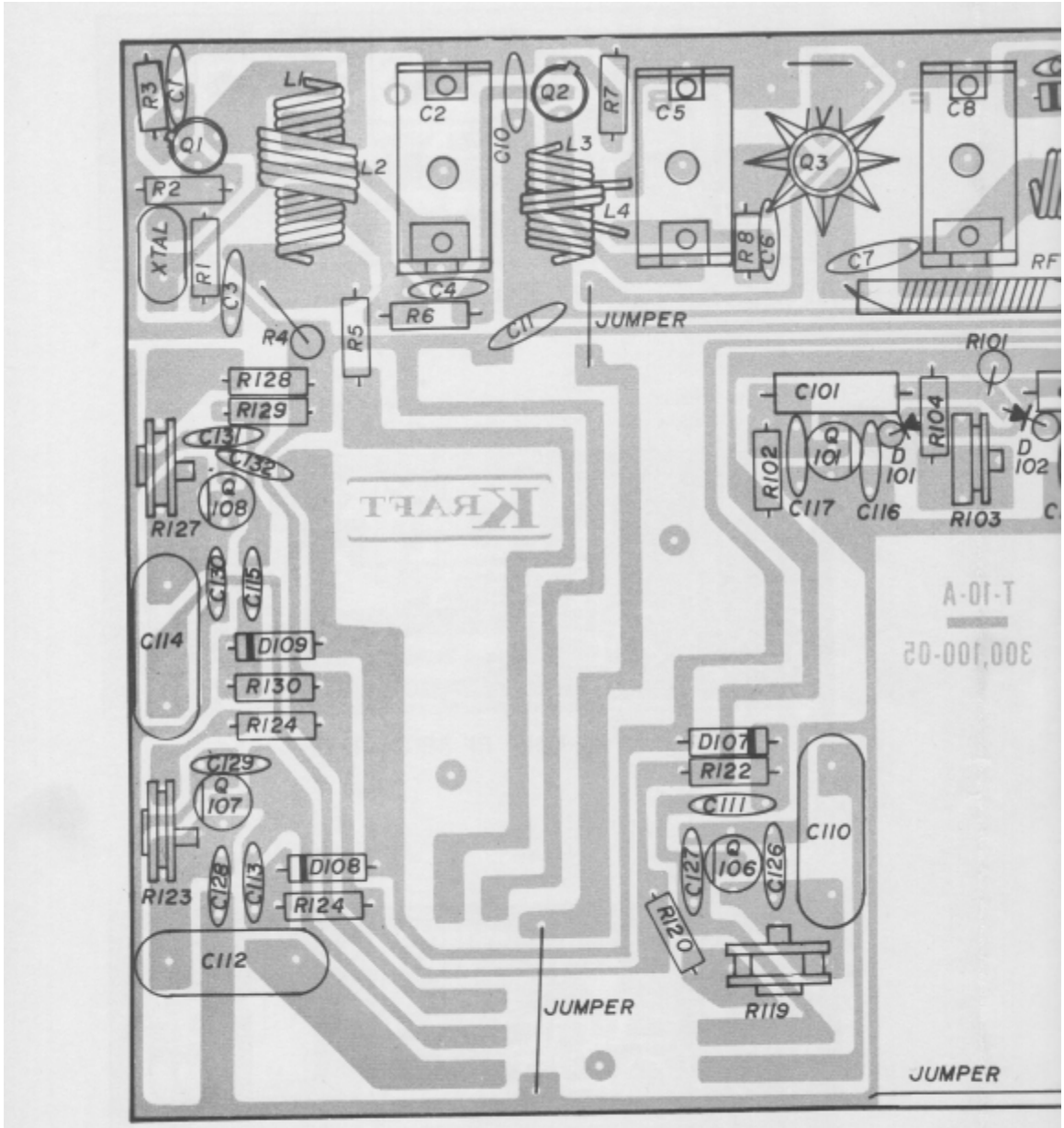
L1–12 TURNS
L2– 3 TURNS

L3–5 TURNS
L4–2 TURNS

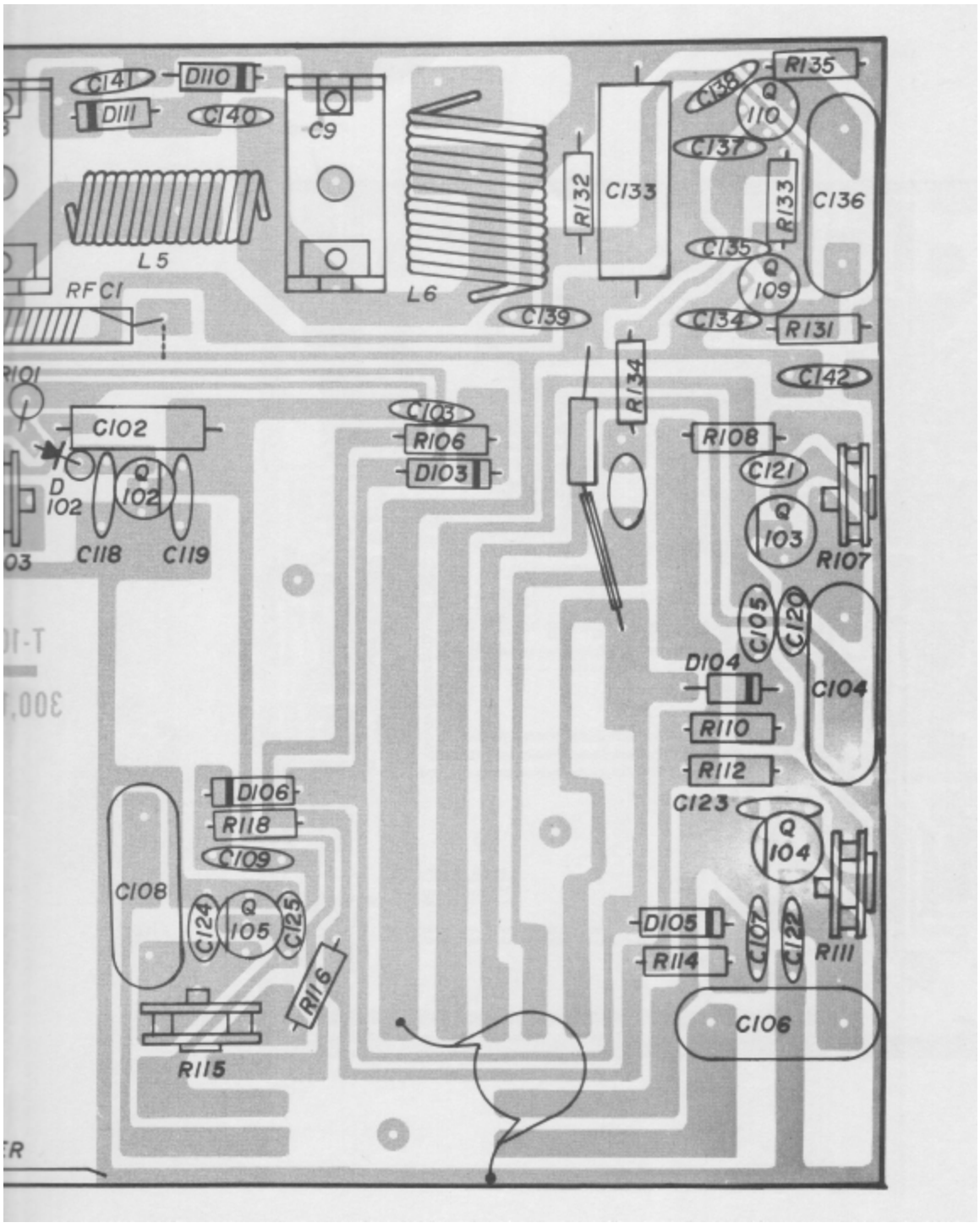
L5–4 TURNS

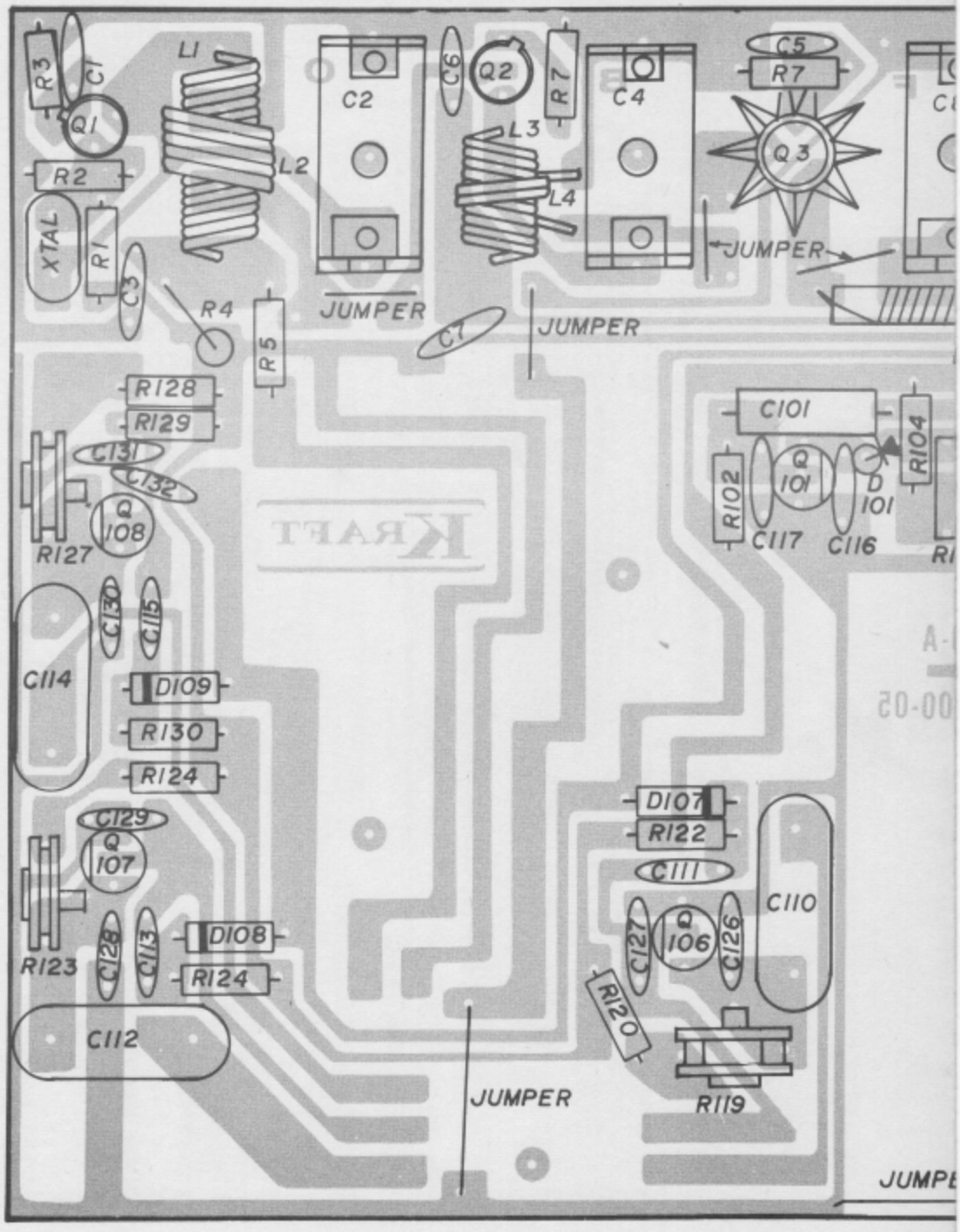


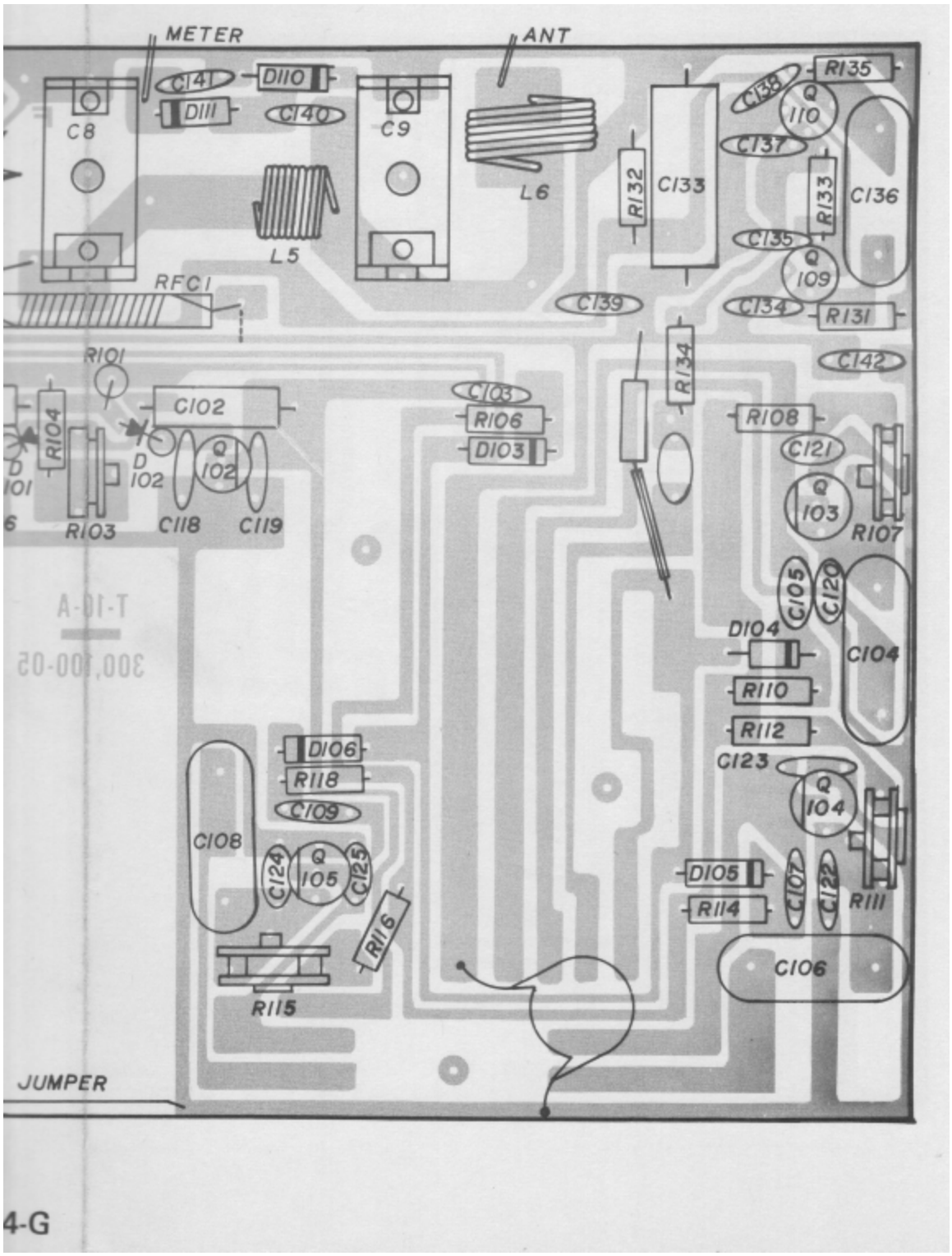
72 MHz RF SECTION

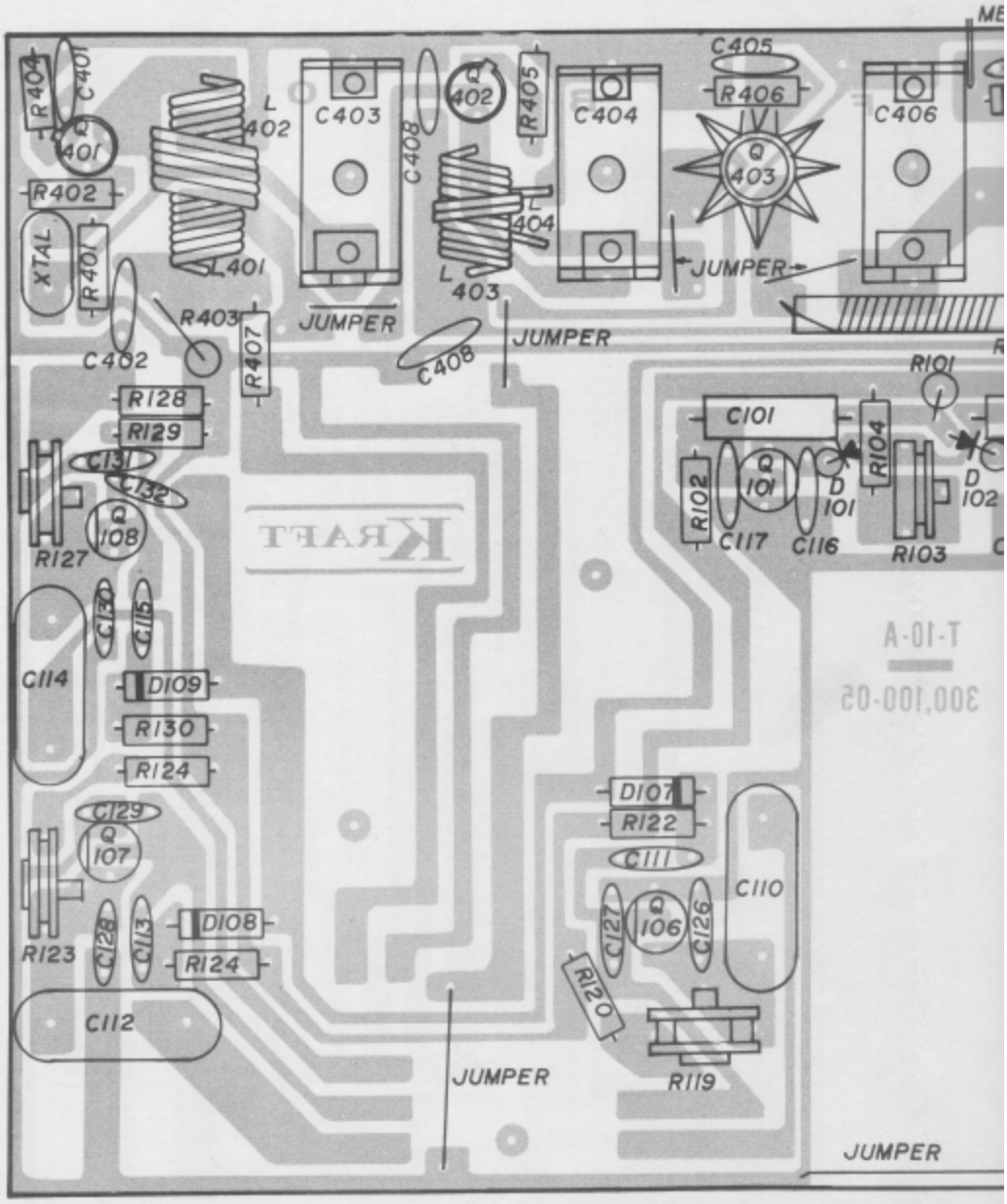

R3
C1
Q1
R2
XTAL
R1
C3
L1
L2
C2
C10
Q2
L3
L4
R7
C5
Q3
C8
R8
C6
C7
RF
C4
R6
R5
R4
C11
JUMPER
R101
C101
R104
R102
Q101
D101
D102
C117
C116
R103
R128
R129
C131
C132
Q108
R127
C130
C115
C114
D109
R130
R124
C129
Q107
R123
C128
C113
D108
R124
C112
D107
R122
C111
C110
Q106
C127
C126
R120
R119
JUMPER
JUMPER

24-F

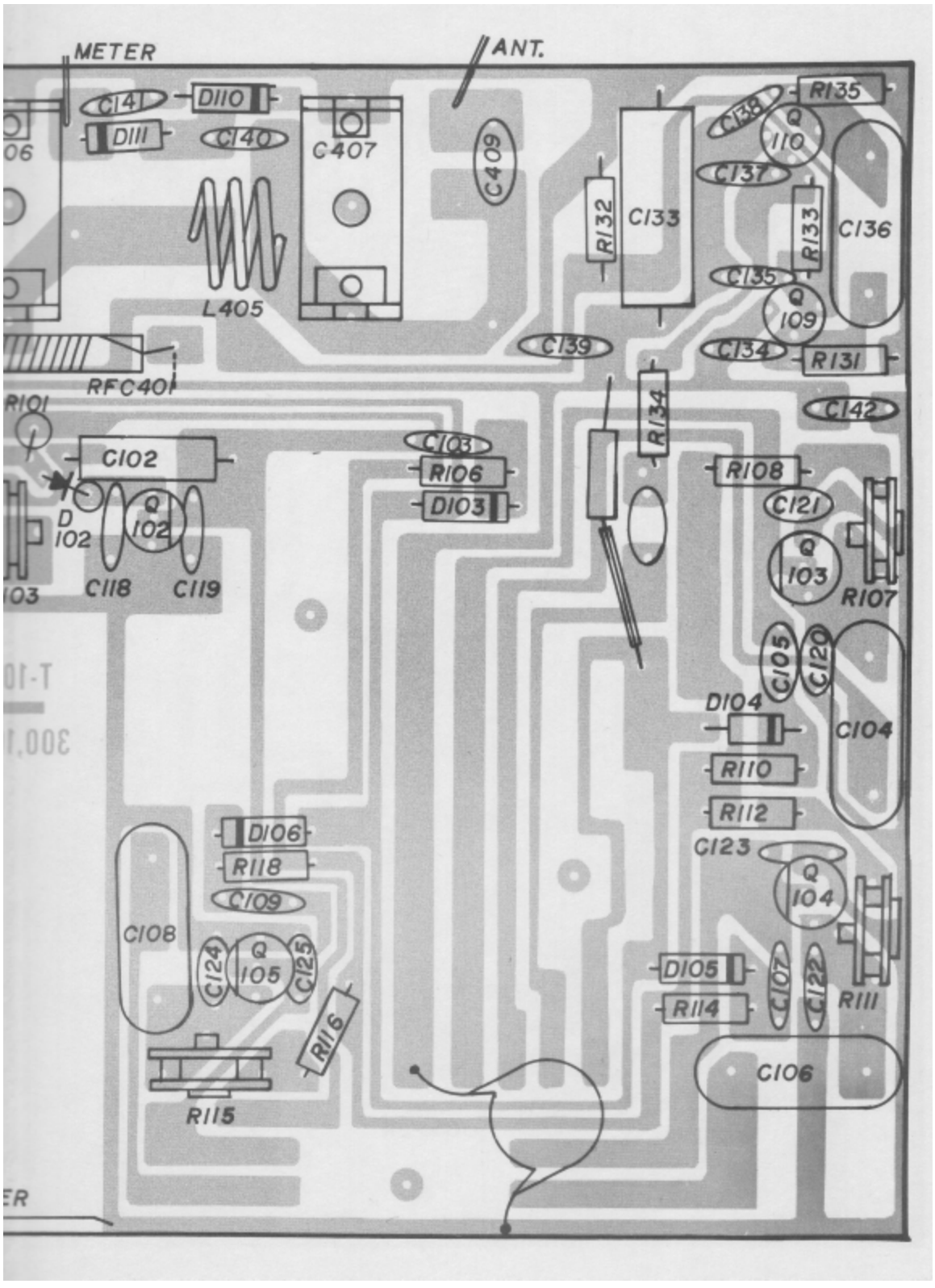

C14
D110
D111
C140
C9
L5
RFC1
L6
C139
C133
R132
C138
R135
Q 110
C137
R133
C136
C135
Q 109
C134
R131
C142
R134
C103
R106
D103
C102
D 102
Q 102
C118
C119
R108
C121
Q 103
R107
C105
C120
C104
D104
R110
R112
C123
Q 104
R111
D105
R114
C107
C122
C106
D106
R118
C109
C108
C124
Q 105
C125
R116
R115


R3
C1
L1
C2
C6
Q2
R7
C4
C5
R7
Q1
L3
Q3
R2
L2
L4
XTAL
R1
C3
JUMPER
JUMPER
R4
R5
C7
JUMPER
R128
R129
C131
C132
C101
R104
Q 101
D 101
R102
C117
C116
Q 108
R127
C130
C115
C114
D109
R130
R124
C129
Q 107
D107
R122
C111
C110
R123
C128
C113
D108
R124
Q 106
C127
C126
R120
C112
JUMPER
R119
JUMPE


METER
ANT
C141
D110
D111
C140
C8
C9
L6
L5
C138
R135
Q110
C137
R132
C133
R133
C136
C135
Q109
RFC1
C139
C134
R131
R101
R134
C142
C103
C102
R106
R108
R104
D103
C121
D101
D102
Q102
Q103
R107
R103
C118
C119
C105
C120
D104
C104
R110
R112
C123
D106
R118
Q104
C109
C108
C124
Q105
C125
D105
C107
C122
R111
R114
R116
C106
R115
JUMPER


R404
C401
Q 401
R402
XTAL
R401
L 402
L401
C403
C408
Q 402
R405
C404
C405
R406
Q 403
C406
L 404
L 403
JUMPER
JUMPER
JUMPER
R403
R407
C402
C408
R128
R129
C131
C132
Q 108
R127
C130
C115
C114
D109
R130
R124
C129
Q 107
R123
C128
C113
D108
R124
C112
JUMPER
D107
R122
C111
C110
Q 106
C127
C126
R120
R119
JUMPER
R101
C101
R104
R102
Q 101
D 101
D 102
C117
C116
R103
KRAFT
A-10-T
300,100-05

24-H


METER
ANT.
C14
D110
D111
C140
C407
C409
L405
RFC401
R101
C102
D102
Q102
C118
C119
C103
R106
D103
C139
R132
C133
R134
C138
R135
Q110
C137
R133
C136
C135
Q109
C134
R131
C142
R108
C121
Q103
R107
C105
C120
D104
C104
R110
R112
C123
Q104
D106
R118
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C108
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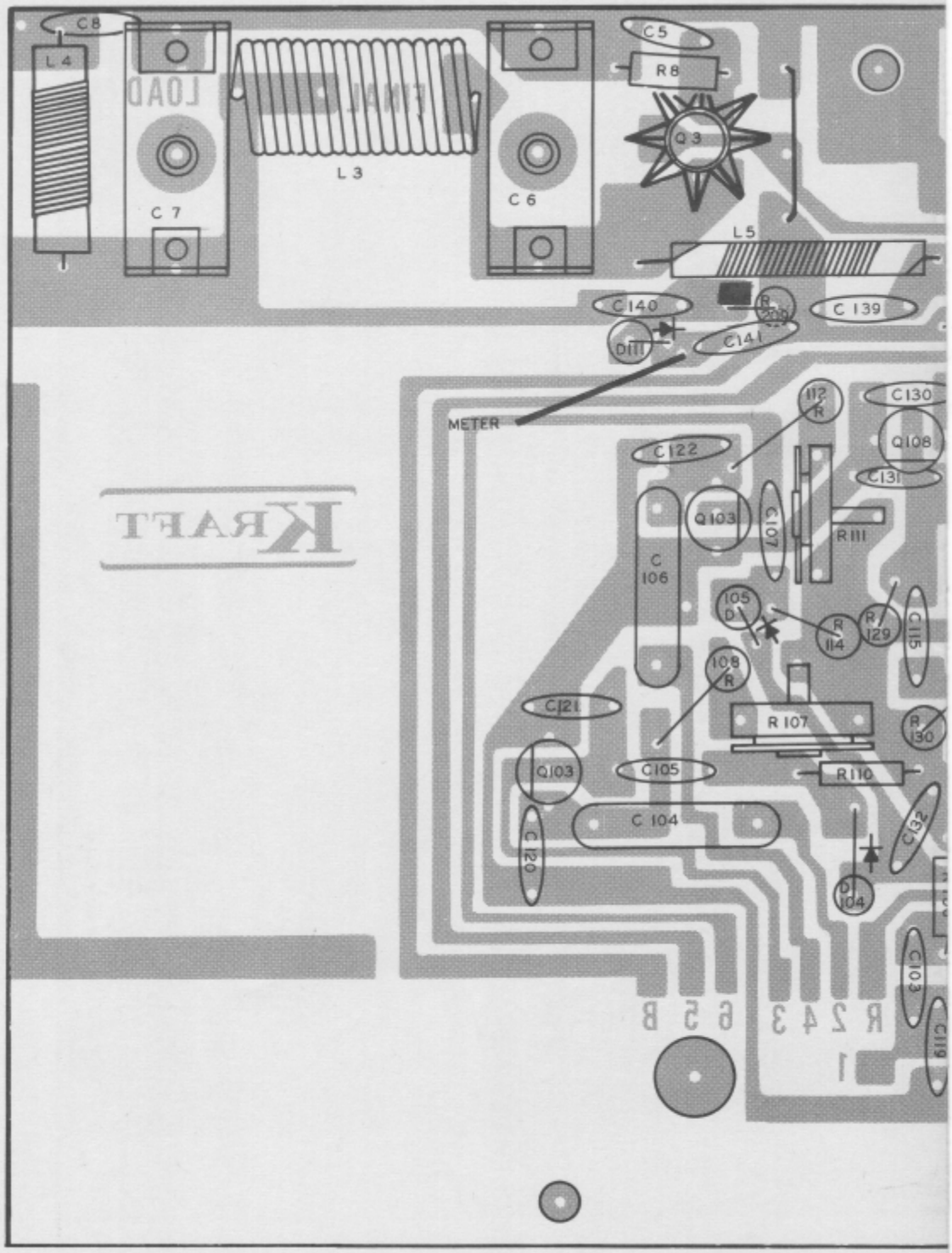
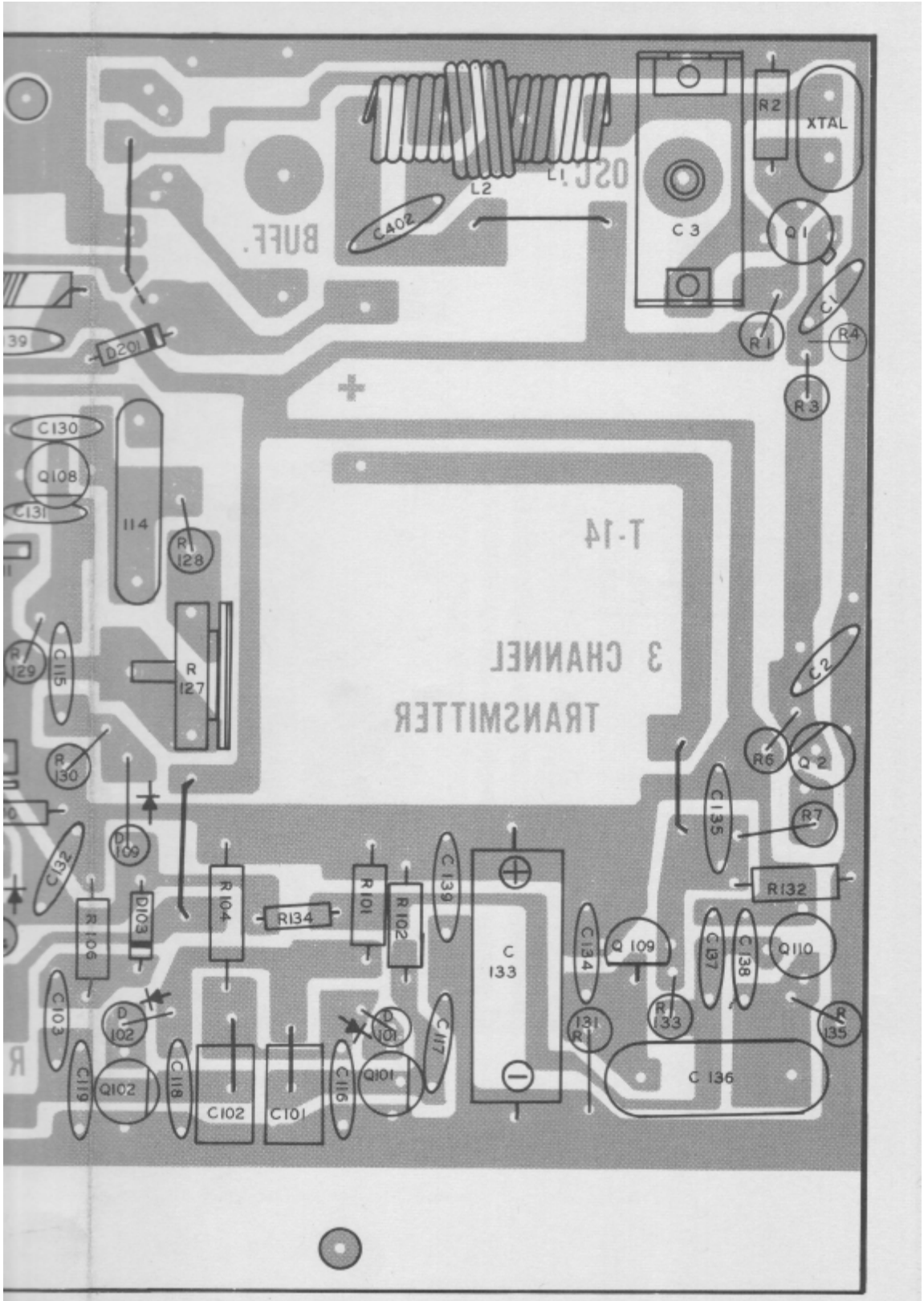
C125
R116
R115
D105
R114
C107
C122
R111
C106


C8
L4
L3
C7
C6
C5
R8
Q3
L5
C140
C139
D111
C141
METER
112 R
C130
Q108
C122
C131
Q103
C107
R111
C 106
105 D
R 114
R 129
C115
108 R
C121
R 107
R 130
Q103
C105
R110
C 104
C132
C120
D 104
C103
C119
KRAFT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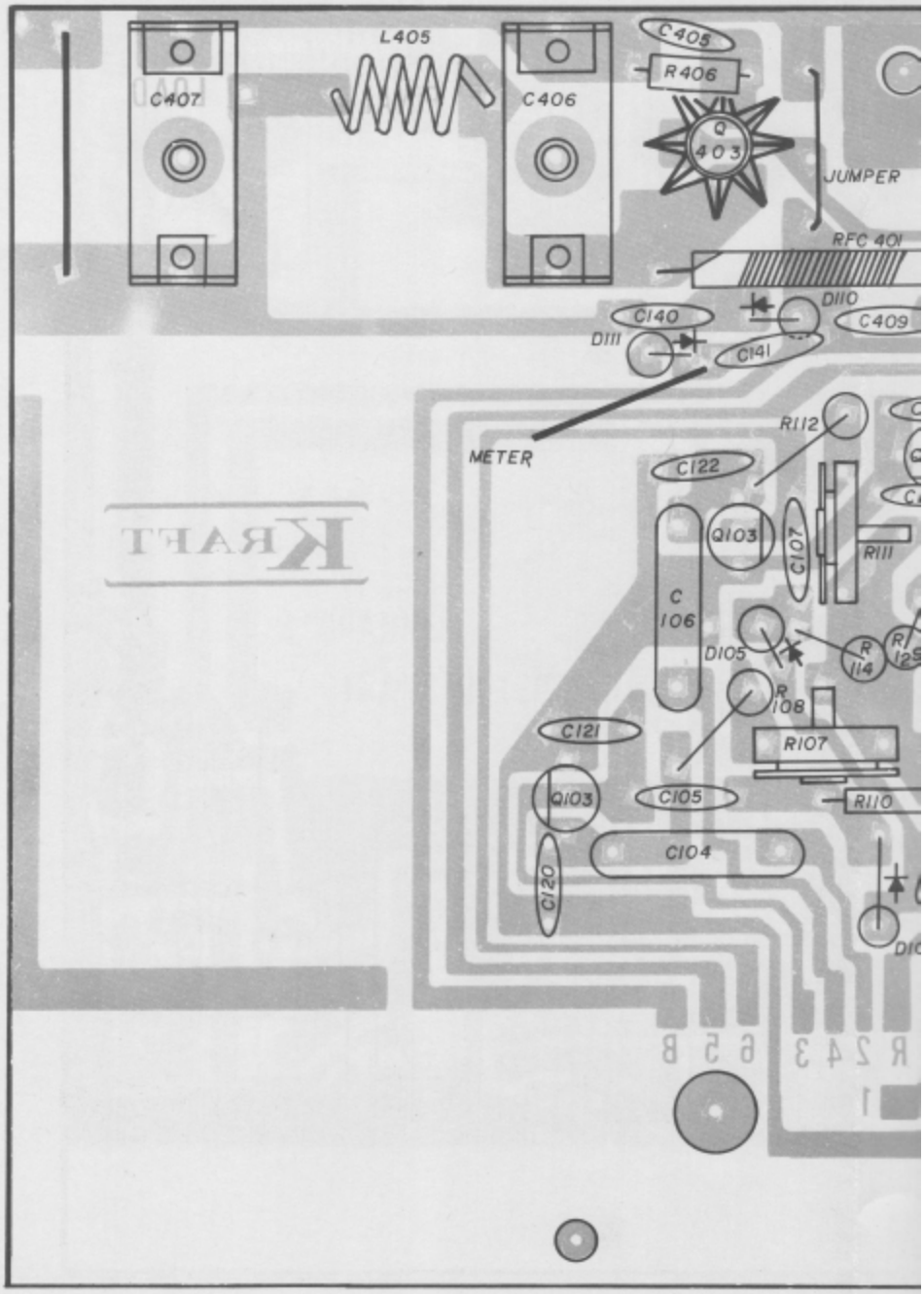
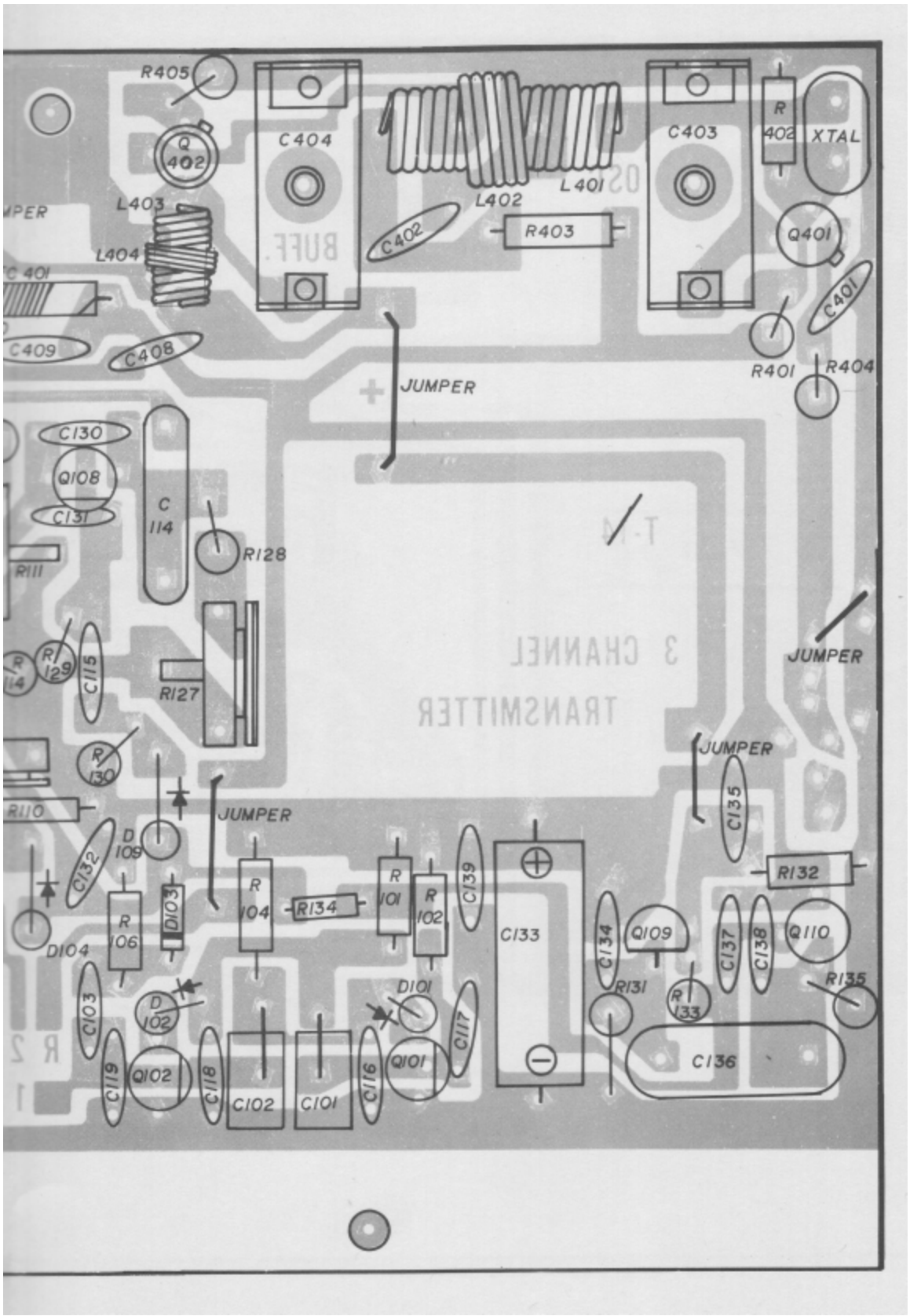
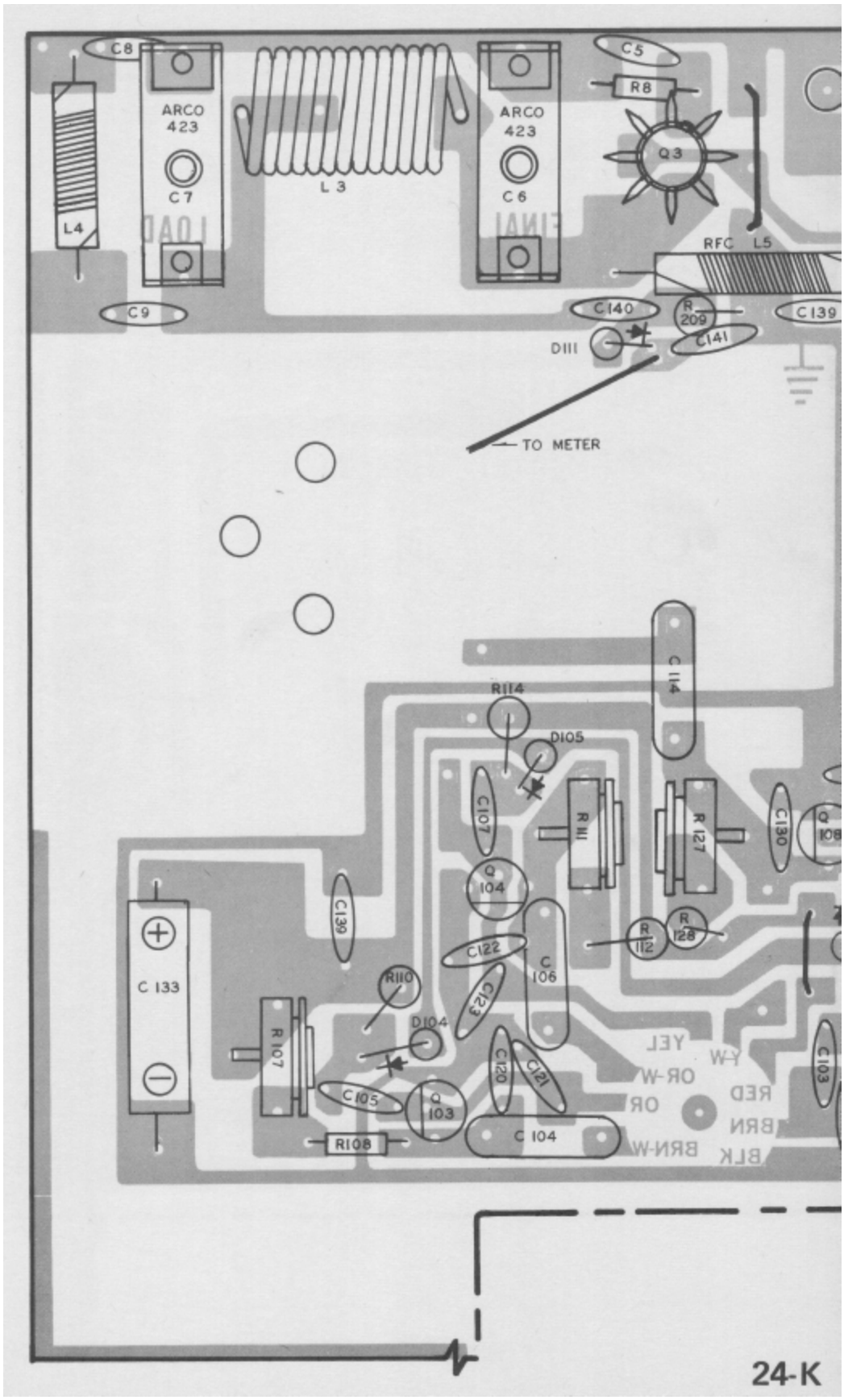
L1
C402
C 3
R2
XTAL
Q1
C1
R1
R4
R3
D201
C130
Q108
C131
114
R128
T-14
3 CHANNEL
TRANSMITTER
R129
C115
R127
C2
R130
R6
Q2
C135
R7
C132
D109
R104
R134
R101
R102
C139
C
133
C134
Q 109
C137
C138
Q110
R132
D103
R106
C103
D102
D101
C117
R131
R133
R135
C119
Q102
C118
C102
C101
C116
Q101
C 136


L405
C407
C406
C405
R406
Q
403
JUMPER
RFC 401
D110
C140
C409
D111
C141
METER
R112
C122
Q103
C107
R111
C
106
D105
R
114
R
108
C121
R107
Q103
C105
R110
C104
C120
KRAFT

24-J


R405
Q 402
C404
L403
L404
L402
L401
C403
R 402
XTAL
C402
R403
Q401
C401
C409
C408
JUMPER
R401
R404
C130
Q108
C131
C 114
R128
R111
R129
C115
R127
JUMPER
R 130
R110
D 109
C132
JUMPER
C135
R132
D104
R 106
D103
R 104
R134
R 101
R 102
C139
C133
C134
Q109
C137
C138
Q110
R131
R 133
R135
D102
D101
C103
C119
Q102
C118
C102
C101
C116
Q101
C117
C136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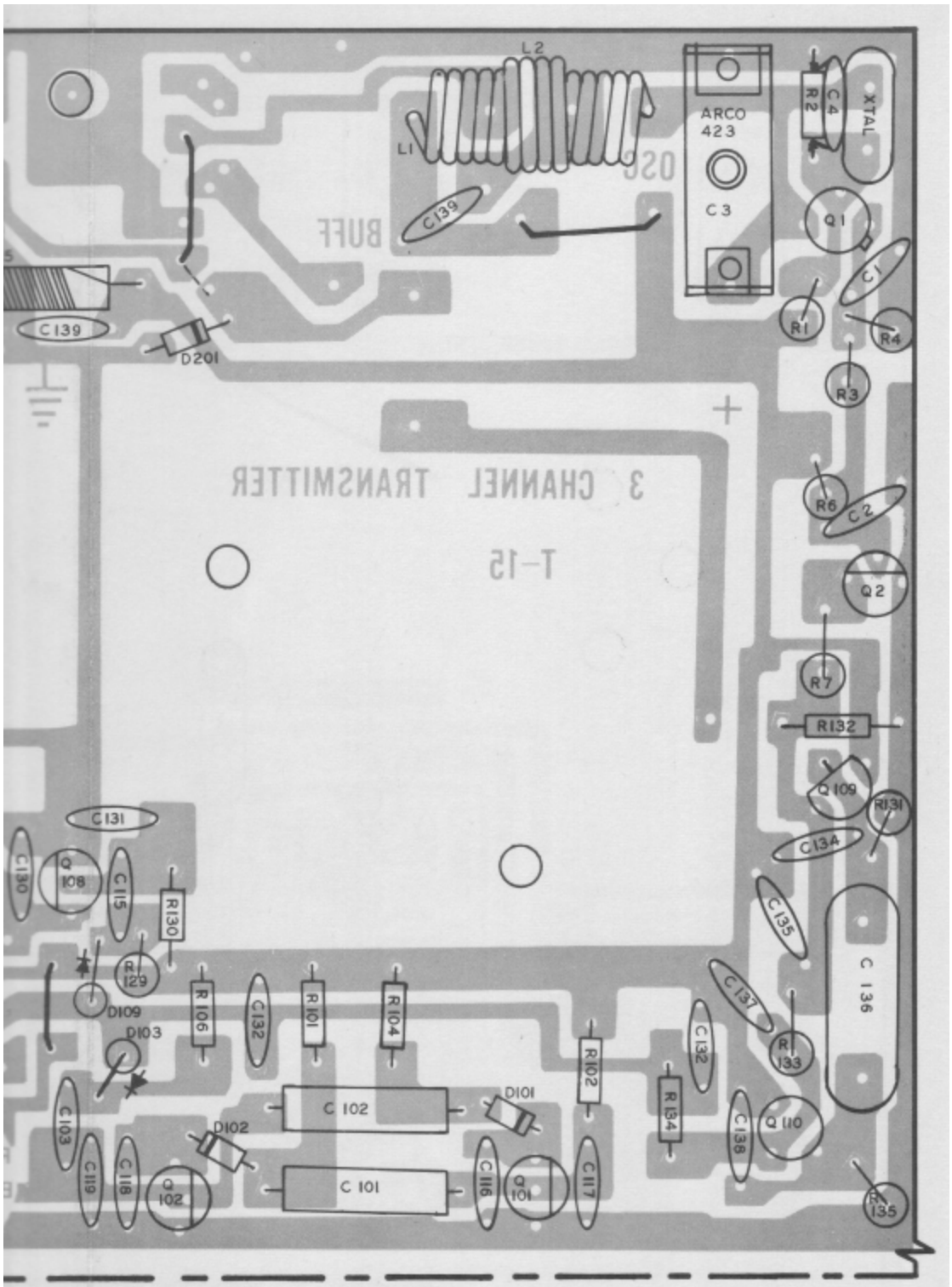
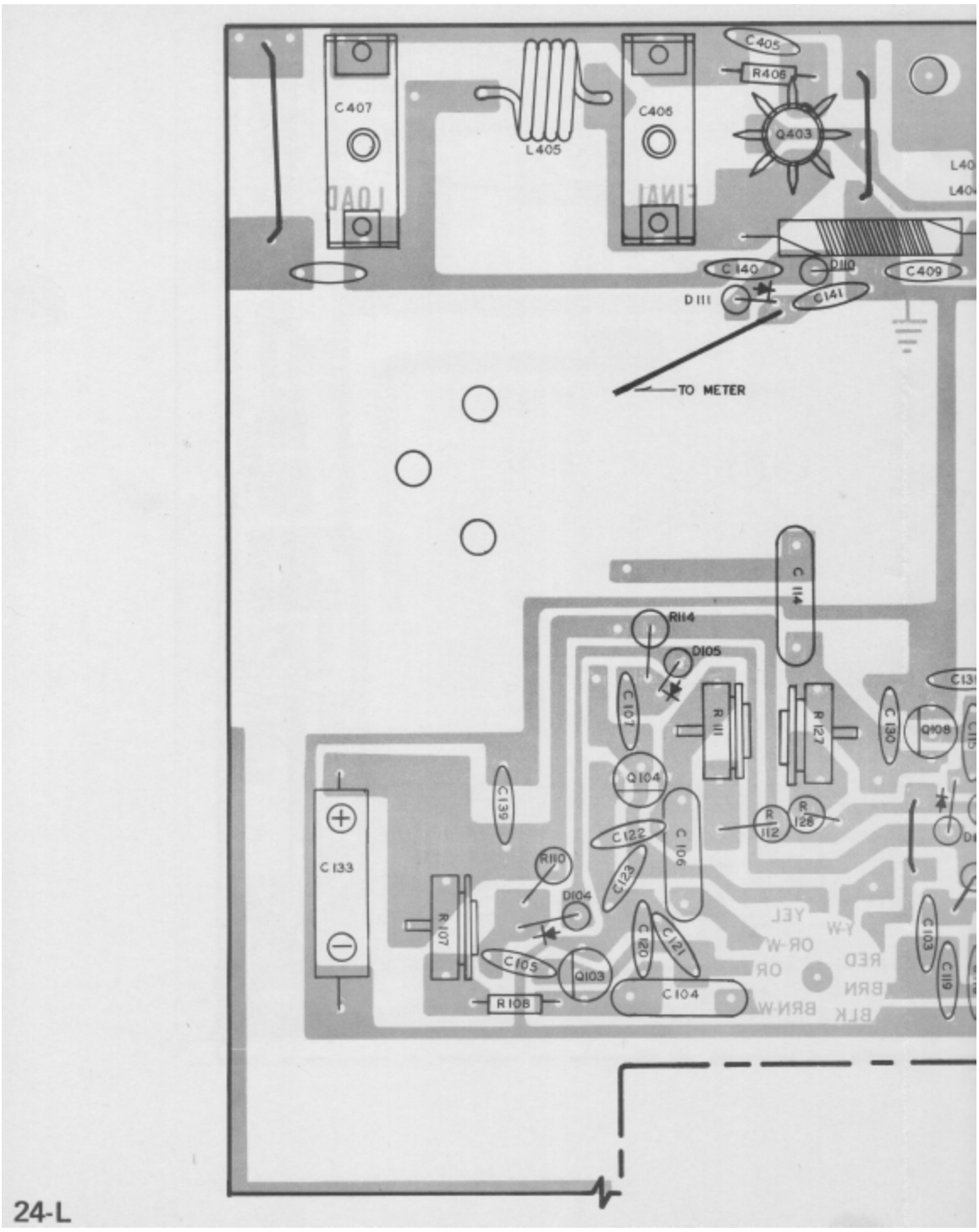
ARCO 423
C7
L3
ARCO 423
C6
C5
R8
Q3
L4
RFC
L5
C9
C140
R209
C139
C141
D111
TO METER
C114
R114
D105
C107
R111
R127
C130
Q108
Q104
C136
C133
R112
R128
C122
C106
R110
C123
D104
R107
C120
C121
C103
C105
Q103
C104
R108
YEL
OR-W
OR
RED
BRN
BRN-W
BLK

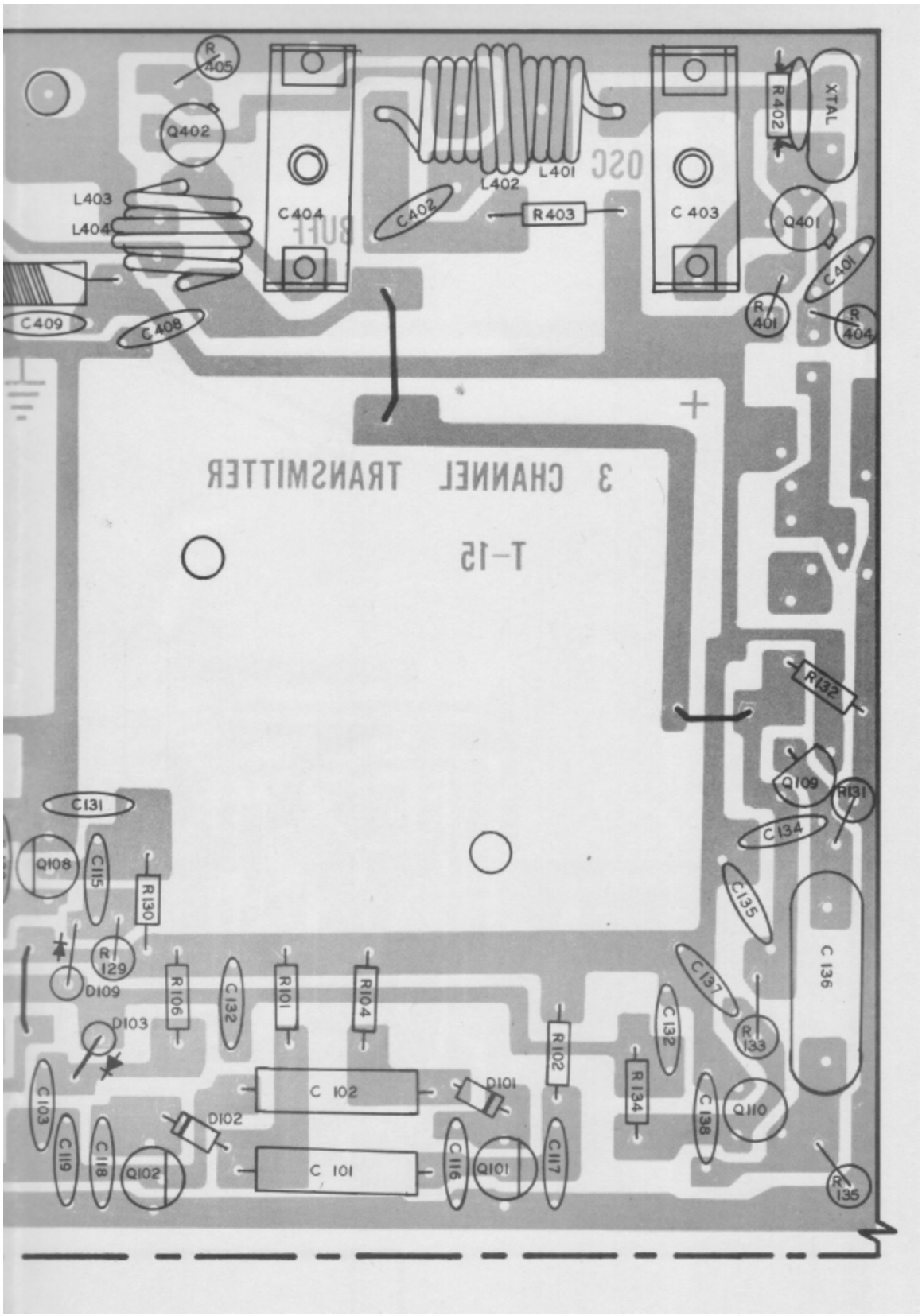
24-K


L2
L1
ARCO
423
C3
C4
R2
XTAL
Q1
C1
R1
R4
R3
C139
D201
R6
C2
Q2
R7
R132
Q109
R131
C134
C135
C136
C137
R133
C131
C130
Q108
C115
R130
R129
D109
D103
R106
C132
R101
R104
C102
D101
R102
C132
R134
C138
Q110
R135
C103
C119
C118
Q102
D102
C101
C116
Q101
C117
3 CHANNEL TRANSMITTER
T-15
BUFF
OSC

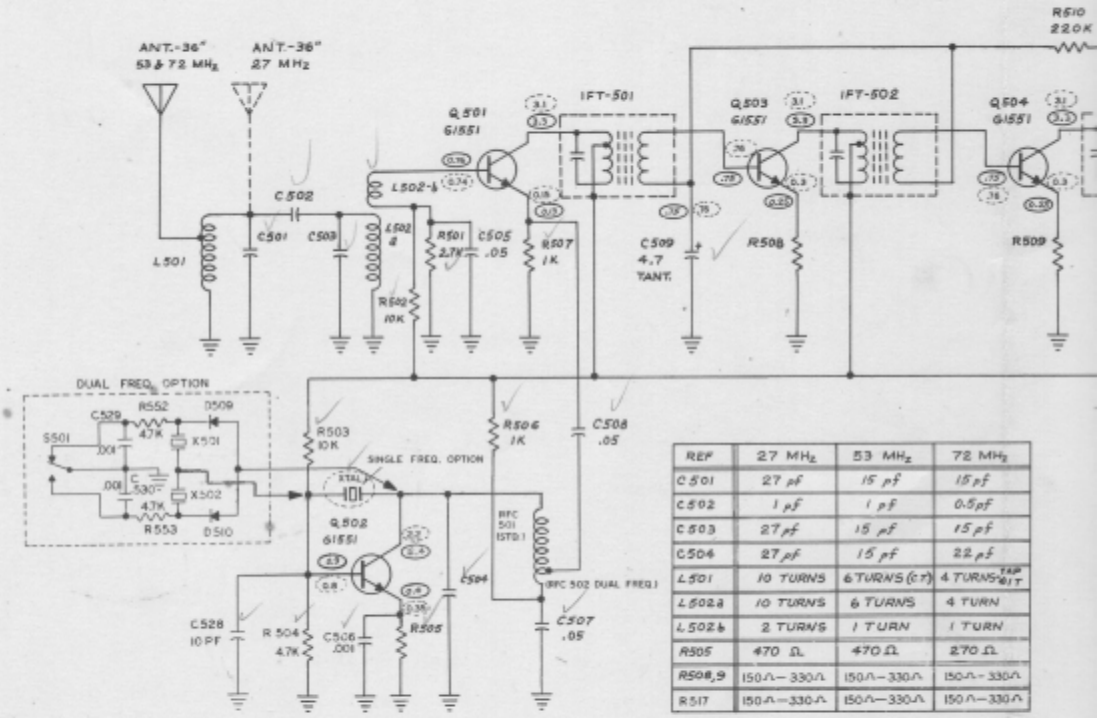
24-K


C405
R406
C407
L405
C406
Q403
C140
D110
C409
D111
C141
TO METER
C114
R114
D105
C107
R111
R127
C130
Q106
Q104
C139
C122
C106
R112
R128
C133
R110
C123
D104
R107
C105
Q103
C120
C121
C104
R108
C103
C119

24-L


R 405
Q402
L403
L404
C404
C402
L402
L401
R403
C 403
R402
XTAL
Q401
C401
R 401
R 404
C409
C408
3 CHANNEL TRANSMITTER
T-15
R132
Q109
R131
C131
C134
Q108
C115
R130
C135
C136
R 129
D109
R106
C132
R101
R104
C137
R102
C132
D103
R 133
C 102
D101
R 134
C103
C138
Q110
D102
C 101
C116
Q101
C117
C119
C118
Q102
R 135

RECEIVER — FRONT – END



REF	27 MHz	53 MHz	72 MHz
C501	27 pf	15 pf	15 pf
C502	1 pf	1 pf	0.5 pf
C503	27 pf	15 pf	15 pf
C504	27 pf	15 pf	22 pf
L501	10 TURNS	6 TURNS (CT)	4 TURNS TAP 0.1T
L502a	10 TURNS	6 TURNS	4 TURN
L502b	2 TURNS	1 TURN	1 TURN
R505	470 Ω	470 Ω	270 Ω
R508,9	150Λ — 330Λ	150Λ — 330Λ	150Λ — 330Λ
R517	150Λ — 330Λ	150Λ — 330Λ	150Λ — 330Λ

F

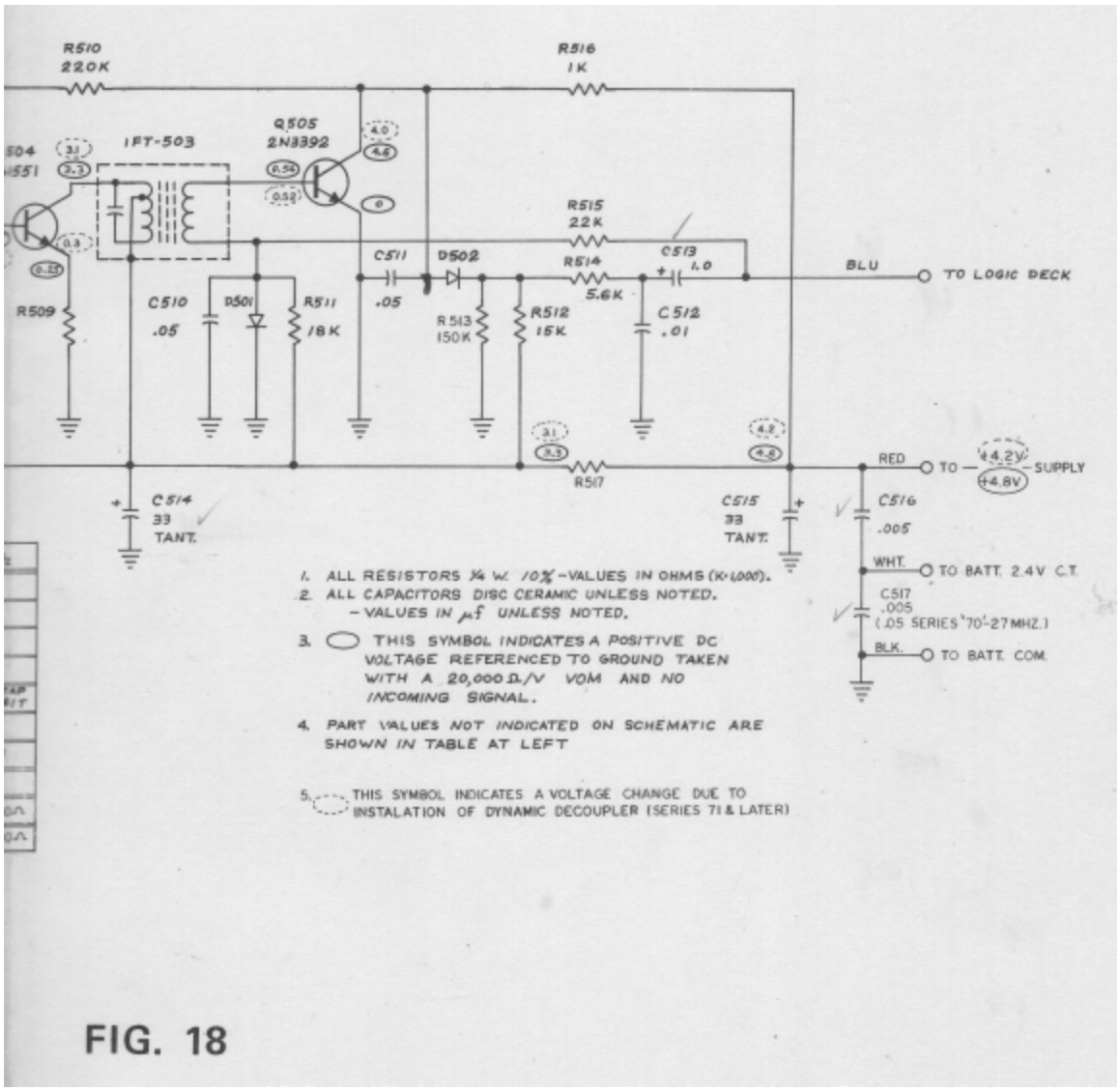

R510
220K
R516
1K
Q505
2N3392
IFT-503
R515
22K
C511
D502
R514
5.6K
C513
1.0
BLU
TO LOGIC DECK
R509
C510
.05
D501
R511
18K
.05
R513
150K
R512
15K
C512
.01
R517
C514
33
TANT.
C515
33
TANT.
RED
TO
4.2V
+4.8V
SUPPLY
C516
.005
WHT.
TO BATT. 2.4V C.T.
C517
.005
(.05 SERIES '70'-27 MHZ.)
BLK.
TO BATT. COM.
1. ALL RESISTORS ¼ W. 10% - VALUES IN OHMS (K=1000).
2. ALL CAPACITORS DISC CERAMIC UNLESS NOTED.
- VALUES IN μf UNLESS NOTED.
3. THIS SYMBOL INDICATES A POSITIVE DC VOLTAGE REFERENCED TO GROUND TAKEN WITH A 20,000 Ω./V VOM AND NO INCOMING SIGNAL.
4. PART VALUES NOT INDICATED ON SCHEMATIC ARE SHOWN IN TABLE AT LEFT
5. THIS SYMBOL INDICATES A VOLTAGE CHANGE DUE TO INSTALATION OF DYNAMIC DECOUPLER (SERIES 71 & LATER)

FIG. 18

FRONT END SECTION R-9A (Fig.18)

Transistors Q501 through Q505 form a conventional super-hetrodyne receiver. Q501 is used as a mixer in conjunction with Q502, the local oscillator. The IF output frequency of 455 KHz is tuned by IFT-501. Q503 and Q504 operate as IF amplifiers at 455KHz.

Transistor Q505 operates as a class B detector and also supplies AGC to the IF amplifiers. Diode D502 in conjunction with bias resistors R512 and R513 acts as a high level clipper to pass only the upper .7 volt of the detected waveform and feed it to the logic stages.

Under most conditions an interfering signal must reach 60-80% of the command signal in order for it to interfere with reception. Consequently, this network is highly effective in eliminating interference from noise or transmitted signals. However, if the clipping level is less than 0.7V, the receiver will be very sensitive to slight phase shifts.

ALIGNMENT AND TESTING

With the proper crystal installed in the receiver board and secured with RTV silicon rubber, alignment can be performed. A DC oscilloscope is necessary for best results.

Attach the scope signal lead (isolated by RF chokes – Fig. **19**) to the top of R516 which is the Class B detector. With a strong signal from the transmitter, observe the waveform on the oscilloscope. If the receiver IF stages and oscillator are operating, either the waveform shown in Fig. **20** or Fig. **21** should be seen.

If the waveform is similar to Fig. **20**, reduce signal strength and begin aligning IF transformers IFT501 through IFT503. Rotate the tuning slug in each IF transformer to maximum detected signal. Fig. 21 shows the signal at the detector when the IF transformers are not properly aligned.

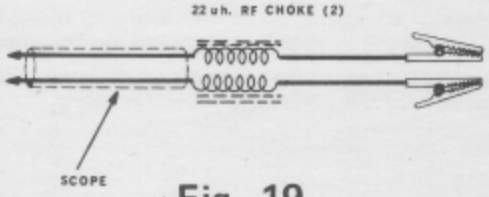


Fig. 19

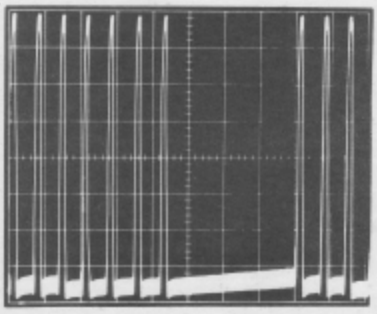


Fig. 20 Detected Waveform
(V= .5v/Div. H=2ms/Div.)

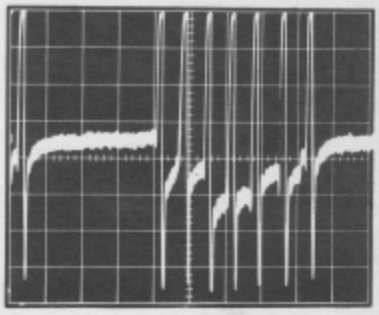


Fig. 21 Detected Waveform
I. F. cans misaligned
(V= .5v/Div. H=2ms/Div.)

Should no signal be obtained at the detector, check the collector of transistor Q504 for a waveform similar to Fig. **22**. If it cannot be obtained, trace toward the mixer until the collector of Q501 is reached. If no signal can be obtained here, suspect either a defective crystal or mixer transistor.

If neither component restores operation, check voltages in the mixer and oscillator circuits to locate the faulty stage.

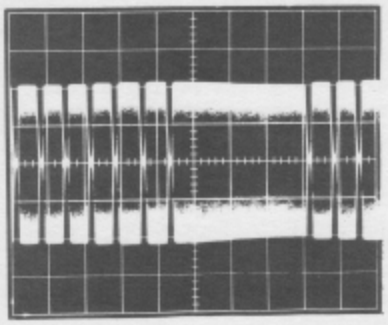


Fig. 22 455 KHz I. F. Signal
(V= .5v/Div. H=2ms/Div.)

With the IF transformers aligned, the mixer and antenna coils can be tuned. Insert a hex alignment tool in one slug and tune for maximum detected signal. Then move to the other slug and tune it for maximum also. Be sure the antenna wire is fully extended and trailing from the bench. When tuning is complete, seal RF coil cores with wax.

If a calibrated signal generator is available, the receiver sensitivity should be checked prior to final tuning. Couple into the receiver antenna coil through a two-turn loop on the generator output cable. (Fig. **23**).

Coil up the receiver antenna and adjust the generator for 400 or 1,000 Hz modulation. Reduce the output sufficiently to see the peak of the modulating waveform clearly.

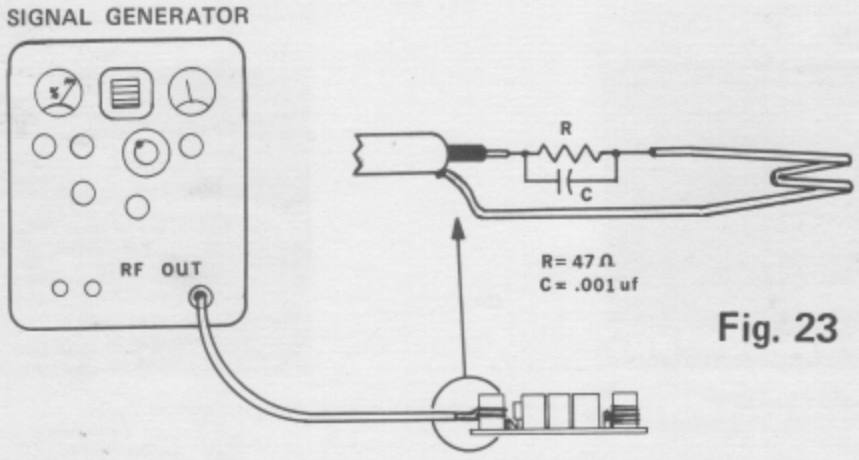


Fig. 23

Peak L501 and L502 for maximum if necessary. Reduce the generator output until the detected signal is 0.5v amplitude. The signal generator should read a maximum of 3.5uV. A reading under 2.0uV may show possible receiver instability. Under no circumstances should receiver sensitivity measure less than 1.0uV on any frequency. On 52MHz sets, the acceptable minimum is set at 2.0uV for best overall operation. If it was necessary to change the setting of L501 or L502, retune as above with antenna extended before sealing.

If adjustment of receiver sensitivity is necessary to bring the receiver within tolerance, it is best to raise or lower IF emitter resistors R508 or R509. Lowering the value will increase sensitivity and vice-versa. These resistors should be no lower than 120 ohms nor no greater than 330 ohms. If it is necessary to exceed these limits, investigate further in that most likely the receiver has a defective or low gain mixer of IF amplifier transistor.

If sensitivity checks are satisfactory, check clipper level. (Fig. **24**) The upper 0.7v of the detected waveform should appear at this point.

The clipping diode is forward biased by approximately 0.7V to 0.8V. This bias is obtained by the voltage difference between the collector of detector transistor Q505 and the cathode end of diode D502. To insure proper operation, first check the voltage at Q505's collector. This should be very close to the supply voltage (within 0.2V with no input signal). If it is not, check the voltage drop across diode D501 which should be approximately 0.54V. Since transistor Q505 requires 0.6V to conduct, if the voltage is correct at this point, Q505 collector should be approximately at the supply voltage. If the voltage is too high at diode D501 (the base of Q505), suspect a defective diode first; and second, check the value of resistor R511 which should be 18K. If this voltage is correct and the collector voltage of Q505 is still low, it will be necessary to replace transistor Q505. If the preceding stages are correct and the clipped signal observed at the cathode of diode D502 is still less than 0.7V, check to be sure that resistor R512 is 15K. Then, if necessary, reduce R513 from 150K to 100K. If the clipped signal is still not within tolerance, replace diode D502.

The next step is to check to see that the amplifier to the logic formed by transistors Q506 and Q507 is operating at the designed input level. Reduce signal input until the signal at the collector of detector transistor Q505 is approximately 0.35V. The signal amplifier stage should now be amplifying the signal near saturation and this may be checked at the collector of transistor Q507. It should then be checked at the gate outputs starting with the collector of Q511. If the logic is not operating with a detector voltage swing of 0.35V, troubleshoot in the normal manner suspecting a low gain transistor at Q506, Q507, or Q509.

Fig. **25** shows the output of the receiver board applied to the logic board.

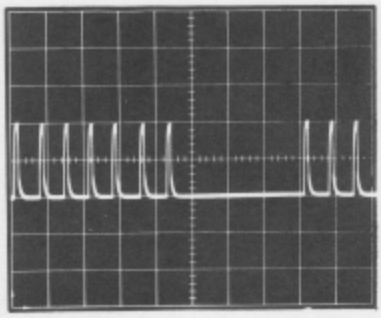


Fig. 24 Clipper Waveform
(V= .5v/Div. H=2ms/Div.)

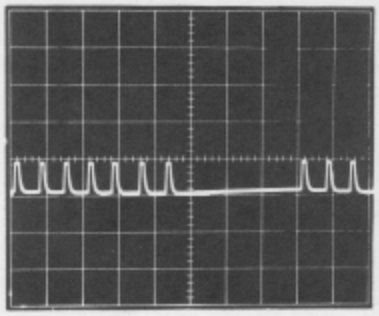


Fig. 25 Receiver Output to Logic
(V= .5v/Div. H=2ms/Div.)

DUAL FREQUENCY RECEIVER

Dual Frequency receivers use a separate P. C. board mounted in the receiver case which holds the crystals and the six other components necessary for this option. (This does not apply to KP-2B systems. See data on KP-2B for information.)

The frequency-select switch is wired to this board and is external to the receiver case itself. This permits mounting the frequency-select switch on the fuselage of the aircraft.

The crystals are switched indirectly by applying proper diode bias to the crystal desired. This is necessary to prevent R. F. leakage from the wires between the switch and the receiver. (See schematic.)

Due to the diode in series with the crystal, it was necessary to change the oscillator injection level to the mixer stage. A special oscillator choke (see parts list) is used on Dual Frequency models and must not be replaced by the choke used on single frequency receivers.

In converting a receiver to Dual Frequency, it is necessary to use a new receiver case, the frequency-select P. C. board, the new oscillator coil and the necessary crystals. Dual Frequency receiver cases are available only for Series Seventy and Seventy-One systems. Gold Medal receivers cannot be converted to dual frequency operation. The P. C. board assembly for the receiver is supplied from the factory with the switch and all components installed, less crystals.

RECEIVER ALIGNMENT (DUAL FREQUENCY)

Receiver alignment is performed in the usual manner, except that I. F. alignment must be performed while switching between the two frequencies to optimize alignment. The first and second I. F. transformers have the most effect on I. F. frequency, and should be centered somewhat between the two resultant I. F. frequencies. The last I. F. transformer should be tuned for maximum on one frequency, and the direction the slug is tuned when peaking to the other frequency remembered. Retune to the first frequency, then turn the slug 1/8 turn or so in the direction of the second I. F. frequency to center I. F. response curve.

If it is not possible to center I. F. alignment around the two crystals, it is possible one crystal is too far away from nominal. Replace one transmitter/receiver crystal pair and try re-aligning the I. F. stages. If no better results are obtained, change the other crystals and re-align.

The receiver frequency for each switch position should be indicated by placing frequency labels on the switch cover to indicate the proper switch position for each frequency.

RECEIVER

S1	Switch, 4.P.D.T.			109-007
–	P. C. Board only			010-156
–	Switch Cover			901-200
R1, R2	4.7K	¼w	10%	057-472
C1, C2	.001	Subminiature	Disc Ceramic	113-021
D1, D2	DA805		Silicon Diode	100-101
X1, X2	Crystals			as required *
–	Frequency Labels			as required *
–	Receiver Case, 3 & 4 channel (Dual Freq.)			901-203
–	Receiver Case, 6 channel (Dual Freq.)			901-204
–	Rx Oscillator Choke for Dual Freq. Rec.			102-032
–	Complete Rx Dual Frequency Assembly – less crystals, frequency labels, case and oscillator coil			300-157

* See note under "Transmitter"

RECEIVER TROUBLE SHOOTING INFORMATION

Due to its environment, the receiver may be subject not only to component failures, but can exhibit trouble under vibration or temperature extremes. Temperature variations can be checked on the bench with a hot air blower and a freeze type spray.

Vibration failures are much more difficult to track down on the bench. Some vibration problems are due to cracked components or loose wires in plugs and can be located on the bench. Gently rocking parts while monitoring the output on an oscilloscope will most often reveal the location of loose or cracked parts. If the source of vibration trouble cannot be located and has been definitely narrowed down to the one part of the system, try a replacement and see if the problem ceases. If so, it might be advantageous to simply replace that portion of the system and scrap the defective part. In dealing with vibration problems don't neglect to examine the switch harness as a possible source of trouble.

Some other causes of difficulty are listed below:

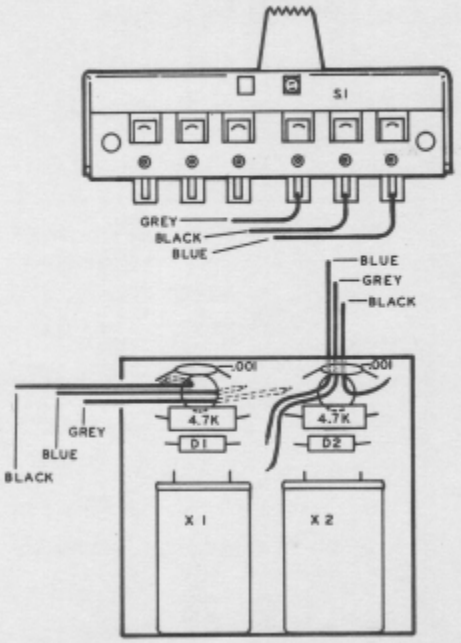
POOR RANGE – Generally lack of sufficient sensitivity, assuming model installation is correct. Check AGC voltage and part values in receiver. Often re-tuning is all that is necessary.

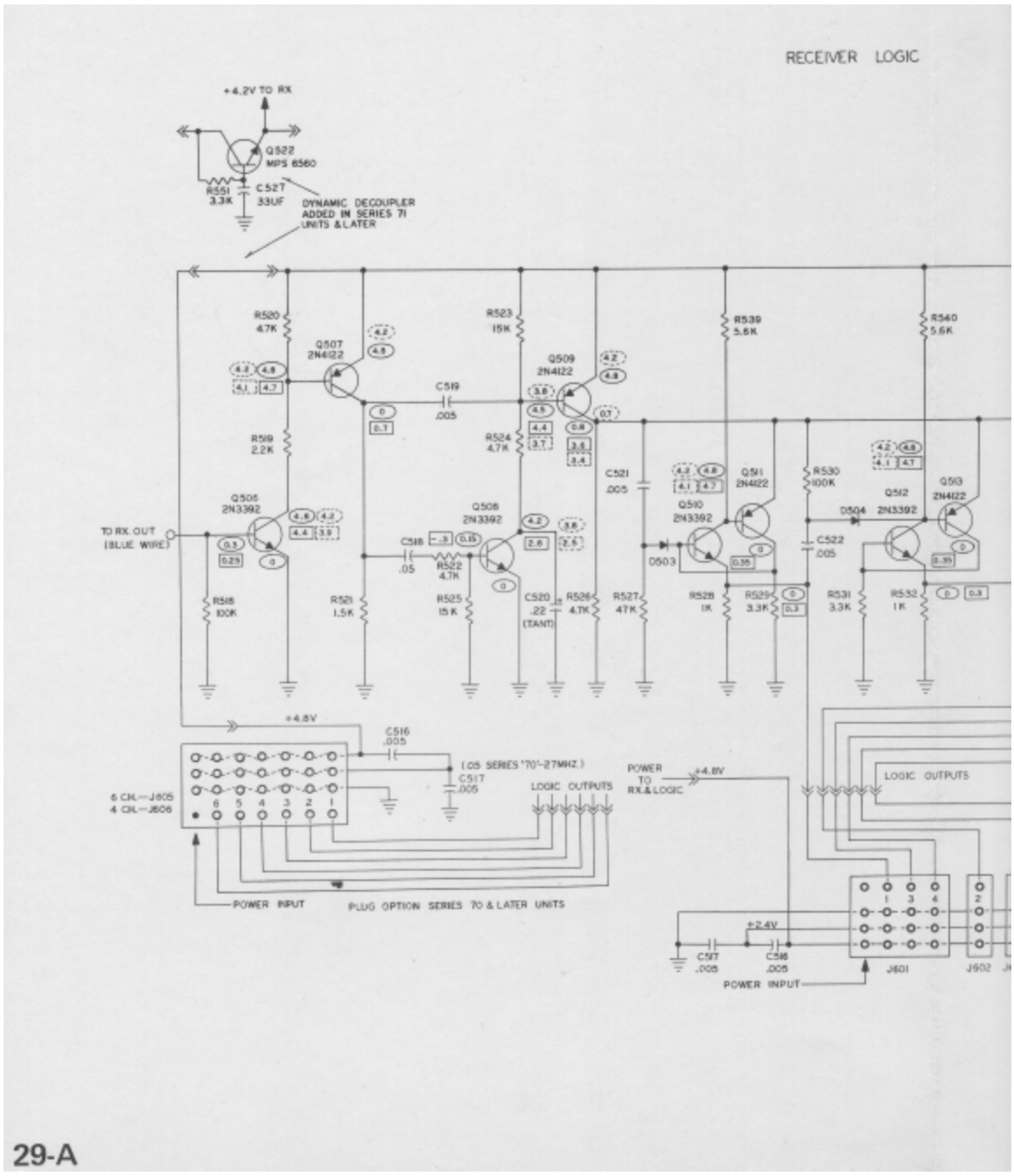
RECEIVER UNSTABLE – Oscillation or instability in a receiver is often the result of defective IF Transformers. Most often the input IF is the one at fault. Check also for proper AGC action to be sure that gain is being adjusted to suit signal conditions. On rarer occasions, a bypass capacitor opens in either the mixer or detector stages.

RECEIVER OK – No output to logic board – Generally, the cause lies in the logic board itself. If the signal at the clipper is OK, but there is no signal at the base of Q506, more than likely Q506 is defective. To check, lift the blue wire off the logic board and see if the signal appears now. If so, Q506 is defective. If not, re-check coupling from clipper to the blue wire on the receiver board.

RECEIVER OK – No output from logic board to servos – A stage by stage check will generally reveal the defective stage. If a failure occurs in any counter stage, all succeeding stages will be inoperative. Isolating the defective part can generally be accomplished by voltage checks.

RX DUAL FREQUENCY ASSEMBLY




RECEIVER LOGIC
+4.2V TO RX
Q522
MPS 6560
R551
3.3K
C527
33UF
DYNAMIC DECOUPLER
ADDED IN SERIES 71
UNITS & LATER
R520
4.7K
Q507
2N4122
C519
.005
R523
15K
Q509
2N4122
R539
5.6K
R540
5.6K
R519
2.2K
R524
4.7K
C521
.005
Q511
2N4122
R530
100K
Q513
2N4122
Q512
Q510
2N3392
D504
2N3392
Q505
2N3392
Q508
2N3392
TO RX OUT
(BLUE WIRE)
C518
.05
R522
4.7K
D503
C522
.005
R518
100K
R521
1.5K
R525
15K
C520
.22
(TANT)
R526
4.7K
R527
47K
R528
1K
R529
3.3K
R531
3.3K
R532
1K
+4.8V
C516
.005
(.05 SERIES '70'-27MHZ.)
C517
.005
LOGIC OUTPUTS
6 CH.—J605
4 CH.—J606
POWER INPUT
PLUG OPTION SERIES 70 & LATER UNITS
POWER
TO
RX & LOGIC
+4.8V
LOGIC OUTPUTS
+2.4V
C517
.005
C518
.005
POWER INPUT
J601
J602

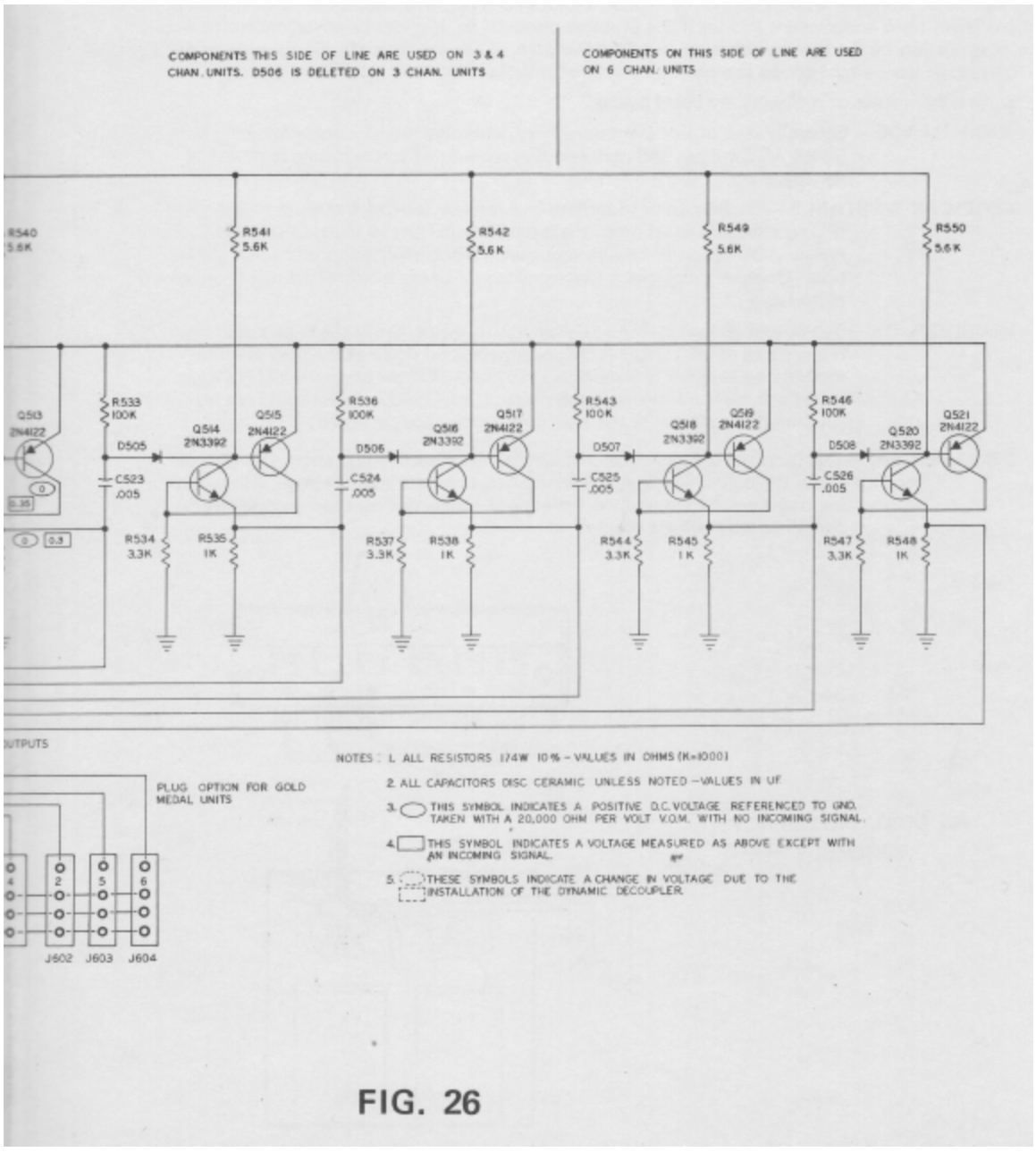

COMPONENTS THIS SIDE OF LINE ARE USED ON 3 & 4 CHAN. UNITS. D506 IS DELETED ON 3 CHAN. UNITS
COMPONENTS ON THIS SIDE OF LINE ARE USED ON 6 CHAN. UNITS
R540 5.6K
R541 5.6K
R542 5.6K
R549 5.6K
R550 5.6K
Q513 2N4122
R533 100K
Q514 2N3392
Q515 2N4122
R536 100K
Q516 2N3392
Q517 2N4122
R543 100K
Q518 2N3392
Q519 2N4122
R546 100K
Q520 2N3392
Q521 2N4122
D505
D506
D507
D508
C523 .005
C524 .005
C525 .005
C526 .005
R534 3.3K
R535 1K
R537 3.3K
R538 1K
R544 3.3K
R545 1K
R547 3.3K
R548 1K
PLUG OPTION FOR GOLD MEDAL UNITS
J602
J603
J604
NOTES: 1. ALL RESISTORS 1/4W 10% - VALUES IN OHMS (K=1000)
2. ALL CAPACITORS DISC CERAMIC UNLESS NOTED - VALUES IN UF.
3. THIS SYMBOL INDICATES A POSITIVE D.C. VOLTAGE REFERENCED TO GND. TAKEN WITH A 20,000 OHM PER VOLT V.O.M. WITH NO INCOMING SIGNAL.
4. THIS SYMBOL INDICATES A VOLTAGE MEASURED AS ABOVE EXCEPT WITH AN INCOMING SIGNAL.
5. THESE SYMBOLS INDICATE A CHANGE IN VOLTAGE DUE TO THE INSTALLATION OF THE DYNAMIC DECOUPLER.

FIG. 26

LOGIC OPERATION (Fig. 26)

Logic board assemblies contain the necessary circuitry to convert the pulse train into separate outputs to drive individual servos.

The waveform in Fig. **27** is seen at the base of inverter transistor Q506. Fig. **28** shows the resultant collector signal. Transistor Q507 further squares the pulses and provides driving signal to the pulse omission detector Q508 and counter trigger generator Q509. The waveform at Q507 collector is shown in Fig. **29**.

Transistor Q508 operates as the pulse omission detector providing logic reset between frames. The collector waveform at Q508 is shown in Fig. **30**. This waveform controls base bias on transistor Q509 which is also receiving narrow pulses from Q507 through a .005mf capacitor.

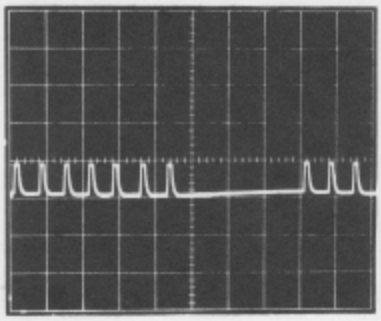


Fig. 27 Q506 Base Receiver Output to Logic
(V= .5v/Div. H=2ms/Div.)

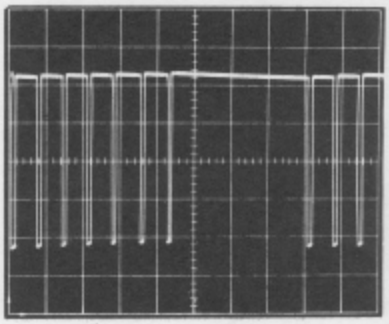


Fig. 28 Q506 Collector Waveform
(V= 1v/Div. H=2ms/Div.)

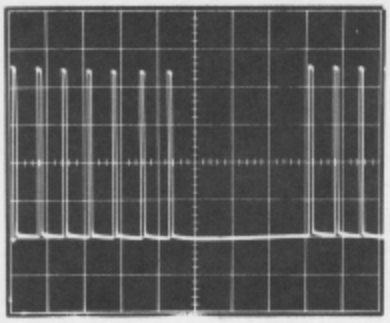


Fig. 29 Q507 Collector Waveform
(V= 1v/Div. H=2ms/Div.)

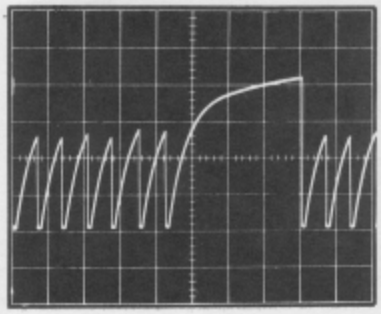


Fig. 30 Q508 Collector Waveform
(V=1v/Div. H=2ms/Div.)

◁ Fig. 26 (fold out at left)

Fig. **31** shows the base signal at transistor Q509. The ramp seen during the sync pause is the result of the rising collector voltage at Q508. The waveform at transistor Q509's collector is shown in Fig.**32** . It can be seen that at the initiation of the base voltage ramp, the voltage at the collector falls toward ground potential and remains there until the first pulse in the next frame. It is during this down time that the counter stages are reset and held off until the first pulse in the next frame. The signal at the collector of Q509 is applied to each of the emitters of the PNP transistors in the shift register. This connection serves as a shift command each time a negative going pulse appears at Q509's collector. During the sync pause, all counter stages are shut down ceasing the count.

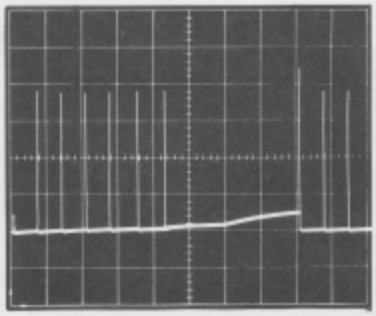


Fig. 31 Q509 Base Waveform
(V= 1v/Div. H=2ms/Div.)

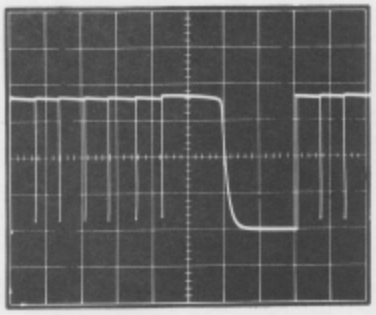


Fig. 32 Q509 Collector Waveform
(V= 1v/Div. H=2ms/Div.)

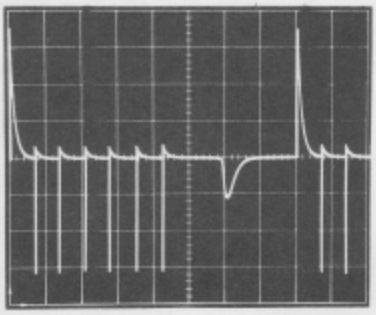


Fig. 33 1st Channel Trigger Signal
(V= 1v/Div. H=2ms/Div.)

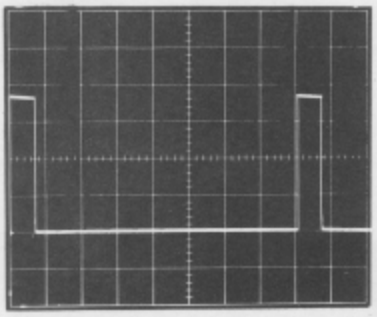


Fig. 34 Q510 Emitter Waveform
(V= 1v/Div. H=2ms/Div.)

A differerentiator is connected to this same point, with a triggering diode connected to the first counter stage. When the first pulse of the next frame drives the collector of Q509 positive, triggering diode D503 passes this positive pulse (Fig.**33**) to the first counter stage transistors Q510 and Q511. Q510 and Q511 latch on and the voltage at the emitter of Q510 rises to approximately 4V (no load) (Fig. **34**). The second pulse turns off all counter stages, thus terminating the positive pulse at Q510's emitter. This output pulse is fed to a differentiator and triggering diode connected to the second counter stage. This diode, D504, passes the negative going or trailing edge of the first channel output pulse. The time constant of the differentiator is set such that the second counter stage is still receiving a triggering signal after the second turn-off pulse has ended. Therefore, the second counter stage now latches on, until the third pulse occurs. The second stage is turned off with the others and passes a triggering signal to the third stage. In this manner,the counter cycles through all channels, converting the serial type information to separate parallel type information to supply positioning information to each of the servos.

SERIES SEVENTY RECEIVERS

The RF section has remained unchanged for 1970 production. The logic circuitry has been repackaged to take advantage of the board mounted block plug now used.

The accompanying layouts show the new logic assemblies and plug. The 3 channel receiver is actually a 4 channel receiver with the last stage of logic disconnected by clipping out diode D506. This was necessary to prevent the customer from plugging a servo into the unused block plug position and driving it hard over, since the sync pause appears at this last logic output.

Six channel receivers use a number of 1/8 watt resistors in order to take advantage of their decreased size and provide a more serviceable package. The 1/8 watt resistors are noted both in the layout and parts list.

NOTE: On 27 MHz Series Seventy receivers manufactured after May 20, C517 was changed to a .05uf disc capacitor from a .005uf disc capacitor to improve receiver noise immunity to servo motor brush arcing. This change is for repeatability only and not required on prior receivers unless bothered by motor noise.

SERIES SEVENTY-ONE

The R. F. Section of the receiver has remained unchanged for 1971 production. The logic board was charged to accept the dynamic decoupler and in doing so the 1/8w resistors were replaced by 1/4w resistors.

DYNAMIC DECOUPLER

In Series Seventy-One Receivers a dynamic decoupler was installed to isolate the receiver and decoder from the servos and supply.

Transistors Q522, R551, and C527 make up the dynamic decoupler. Q522 is used as a pass transistor while R551 and C522 make up the time constant at which the decoupler filters. C527, being in the base of Q522, takes advantage of the gain characteristics of the transistor and multiplies the capacitance at the emitter.

OPERATIONAL CHECK

This check is performed by checking the voltage drop from collector to emitter on Q522. It should be between .6 and .8 volts.

NOTES:

PARTS LIST – R-9A RECEIVER

RESISTORS – All values in Ohms (K=1,000)

R501	2.7K	¼w	10%	057-272
R502	10K	¼w	10%	057-103
R503	10K	¼w	10%	057-103
R504	4.7K	¼w	10%	057-472
R505	470 ohm (27 or 53 MHz)	¼w	10%	057-471
	270 ohm (72 MHz)	¼w	10%	057-271
R506	1K	¼w	10%	057-102
R507	1K	¼w	10%	057-102
R508	270 ohm (27 MHz)	¼w	10%	057-271
	150 ohm (52 MHz)	¼w	10%	057-151
R509	270 ohm (27 MHz)	¼w	10%	057-271
	150 ohm (52 MHz)	¼w	10%	057-151
R510	220K	¼w	10%	057-224
R511	18K	¼w	10%	057-183
R512	15K	¼w	10%	057-153
R513	150K	¼w	10%	057-154
R514	5.6K	¼w	10%	057-562
R515	22K	¼w	10%	057-223
R516	1K	¼w	10%	057-102
R517	470 ohm	¼w	10%	057-471
R552	4.7K	¼w	10%	057-472
R553	4.7K	¼w	10%	057-472

CAPACITORS

C501	(27MHz) 27pf	Disc Ceramic	113-007
	(53MHz or 72MHz) 15pf	Disc Ceramic	113-005
C502	(27MHz or 53MHz) 1pf	Tubular Ceramic	114-002
	(72MHz) 0.5pf	Tubular Ceramic	114-001
C503	(27MHz) 27pf	Disc Ceramic	113-007
	(53MHz or 72MHz) 15pf	Disc Ceramic	113-005
C504	(27MHz) 27pf	Disc Ceramic	113-007
	(53MHz) 15pf	Disc Ceramic	113-005
	(72MHz) 22pf	Disc Ceramic	113-006

C505	.05uf		Disc Ceramic	113-018
C506	.001uf		Disc Ceramic	113-012
C507	.05uf		Disc Ceramic	113-018
C508	.05uf		Disc Ceramic	113-018
C509	4.7uf/6V		Tantalum	116-004
C510	.05uf		Disc Ceramic	113-018
C511	.05uf		Disc Ceramic	113-018
C512	.01uf		Disc Ceramic	113-016
C513	1.0uf/35V		Tantalum	116-002
C514	33uf/6V		Tantalum	116-005
C515	33uf/6V		Tantalum	116-005
C516	.005uf		Disc Ceramic	113-015
C517	.005uf		Disc Ceramic	113-015
	(Series '70 - 27MHz)	.05uf	Disc Ceramic	113-018
C528	10pf		Disc Ceramic	113-004
C529	.001uf		Disc Ceramic	113-021
C530	.001uf		Disc Ceramic	113-021

COILS, TRANSFORMERS AND CHOKES

RFC-501	Oscillator Choke – tapped	103-023
RFC-502	Oscillator Choke – tapped Dual Frequency	103-032
IFT-501	455KHz IF XFMR – Input	103-013
IFT-502	455KHz IF XFMR – Interstage	103-014
IFT-503	455KHz IF XFMR – Output	103-015
L501	Antenna Coil 27MHz	103-016
	53MHz	103-018
	72MHz	103-020
L502 A, B	Mixer Coil 27MHz	103-017
	53MHz	103-019
	72MHz	103-021

SEMICONDUCTORS

Q501 to Q504	G1551 or D16G6 Preferred	NPN	Transistor	101-008
Q505	2N3392	NPN	Transistor	101-004
D501 to D502	DA805 or 1N4148		Diode	100-101

D509 to D510	DA805 or 1N4148		Diode	100-101
ELECTRONIC ASSEMBLIES				
R-9A	Receiver Front End		27MHz	300-106
	Receiver Front End		53MHz	300-107
	Receiver Front End		72MHz	300-108
R-9A	Receiver Front End	Dual Frequency	27MHz	300-175
	Receiver Front End	Dual Frequency	72MHz	300-176
	Dual Frequency Assembly with Switch Less Crystals			300-157

PARTS LIST – LOGIC BOARDS

L7, 14, 15, 16, 17, 16A and 17A

RESISTORS – All values in ohms (K=1,000)

* * Denotes 1/8w Resistors

R518	100K	¼w	10%	057-104
R518	**100K	1/8w	10%	053-104
R519	2.2K	¼w	10%	057-222
R519	**2.2K	1/8w	10%	053-222
R520	4.7K	¼w	10%	057-472
R521	1.5K	¼w	10%	057-152
R521	**1.5K	1/8w	10%	053-152
R522	4.7K	¼w	10%	057-472
R522	**4.7K	1/8w	10%	053-472
R523	15K	¼w	10%	057-153
R523	**15K	1/8w	10%	053-153
R524	4.7K	¼w	10%	057-472
R524	**4.7K	1/8w	10%	053-472
R526	4.7K	¼w	10%	057-472
R527	4.7K	¼w	10%	057-472
R528	1K	¼w	10%	057-102
R529	3.3K	¼w	10%	057-332
R530	100K	¼w	10%	057-104
R531	3.3K	¼w	10%	057-332
R532	1K	¼w	10%	057-102
R533	1K	¼w	10%	057-102

R534		3.3K	¼w	10%	057-332
R535		1K	¼w	10%	057-102
R535		**1K	1/8w	10%	053-102
R536		100K	¼w	10%	057-104
R537		3.3K	¼w	10%	057-332
R538		1K	¼w	10%	057-102
R538		**1K	1/8w	10%	053-102
R539		5.6K	¼w	10%	057-562
R540		5.6K	¼w	10%	057-562
R540		**5.6K	1/8w	10%	053-562
R541		5.6K	¼w	10%	057-562
R542		5.6K	¼w	10%	057-562
	ALL COMPONENTS LISTED BELOW USED ON 6 CHANNEL LOGIC EXCEPT AS NOTED.				
R543		100K	¼w	10%	057-104
R544		3.3K	¼w	10%	057-332
R545		1K	¼w	10%	057-102
R545		**1K	1/8w	10%	053-102
R546		100K	¼w	10%	057-104
R547		3.3K	¼w	10%	057-332
R548		1K	¼w	10%	057-102
R548		**1K	1/8w	10%	053-102
R549		5.6K	¼w	10%	057-562
R550		5.6K	¼w	10%	057-562
R551	3, 4, & 6 ch Series '71 only	3.3K	¼w	10%	057-332

CAPACITORS

C518	.05uF	10V	Disc Ceramic +80 - 20%	113-018
C519	.005uF	100V	Disc Ceramic 20%	113-015
C520	.22uF	25V	Tantalum	116-001
C521 to C524	.005uF	100V	Disc Ceramic	113-015
	ALL COMPONENTS LISTED BELOW USED ON 6 CHANNEL LOGIC EXCEPT AS NOTED.			
C525 and C526	.005uF	100V	Disc Ceramic	113-015
C527 Series '71 only	33uF	6V	Tantalum	116-005

D509 to D510	DA805 or 1N4148		Diode	100-101
ELECTRONIC ASSEMBLIES				
R-9A	Receiver Front End		27MHz	300-106
	Receiver Front End		53MHz	300-107
	Receiver Front End		72MHz	300-108
R-9A	Receiver Front End	Dual Frequency	27MHz	300-175
	Receiver Front End	Dual Frequency	72MHz	300-176
	Dual Frequency Assembly with Switch Less Crystals			300-157

PARTS LIST – LOGIC BOARDS

L7, 14, 15, 16, 17, 16A and 17A

RESISTORS – All values in ohms (K=1,000)

** Denotes 1/8w Resistors

R518	100K	¼w	10%	057-104
R518	**100K	1/8w	10%	053-104
R519	2.2K	¼w	10%	057-222
R519	**2.2K	1/8w	10%	053-222
R520	4.7K	¼w	10%	057-472
R521	1.5K	¼w	10%	057-152
R521	**1.5K	1/8w	10%	053-152
R522	4.7K	¼w	10%	057-472
R522	**4.7K	1/8w	10%	053-472
R523	15K	¼w	10%	057-153
R523	**15K	1/8w	10%	053-153
R524	4.7K	¼w	10%	057-472
R524	**4.7K	1/8w	10%	053-472
R526	4.7K	¼w	10%	057-472
R527	4.7K	¼w	10%	057-472
R528	1K	¼w	10%	057-102
R529	3.3K	¼w	10%	057-332
R530	100K	¼w	10%	057-104
R531	3.3K	¼w	10%	057-332
R532	1K	¼w	10%	057-102
R533	1K	¼w	10%	057-102

R534		3.3K	¼w	10%	057-332
R535		1K	¼w	10%	057-102
R535		**1K	1/8w	10%	053-102
R536		100K	¼w	10%	057-104
R537		3.3K	¼w	10%	057-332
R538		1K	¼w	10%	057-102
R538		**1K	1/8w	10%	053-102
R539		5.6K	¼w	10%	057-562
R540		5.6K	¼w	10%	057-562
R540		**5.6K	1/8w	10%	053-562
R541		5.6K	¼w	10%	057-562
R542		5.6K	¼w	10%	057-562
	ALL COMPONENTS LISTED BELOW USED ON 6 CHANNEL LOGIC EXCEPT AS NOTED.				
R543		100K	¼w	10%	057-104
R544		3.3K	¼w	10%	057-332
R545		1K	¼w	10%	057-102
R545		**1K	1/8w	10%	053-102
R546		100K	¼w	10%	057-104
R547		3.3K	¼w	10%	057-332
R548		1K	¼w	10%	057-102
R548		**1K	1/8w	10%	053-102
R549		5.6K	¼w	10%	057-562
R550		5.6K	¼w	10%	057-562
R551	3, 4, & 6 ch Series '71 only	3.3K	¼w	10%	057-332

CAPACITORS

C518	.05uF	10V	Disc Ceramic +80 - 20%	113-018
C519	.005uF	100V	Disc Ceramic 20%	113-015
C520	.22uF	25V	Tantalum	116-001
C521 to C524	.005uF	100V	Disc Ceramic	113-015
	ALL COMPONENTS LISTED BELOW USED ON 6 CHANNEL LOGIC EXCEPT AS NOTED.			
C525 and C526	.005uF	100V	Disc Ceramic	113-015
C527 Series '71 only	33uF	6V	Tantalum	116-005

TRANSISTORS AND DIODES

Q506	2N3392	NPN	Transistor	101-004
Q507	2N4122 or S2783	PNP	Transistor	101-005
Q508	2N3392	NPN	Transistor	101-004
Q509	2N4122 or S2783	PNP	Transistor	101-005
Q510	2N3392	NPN	Transistor	101-004
Q511	2N4122 or S2783	PNP	Transistor	101-005
Q512	2N3392	NPN	Transistor	101-004
Q513	2N4122 or S2783	PNP	Transistor	101-005
Q514	2N3392	NPN	Transistor	101-004
Q515	2N4122 or S2783	PNP	Transistor	101-005
Q516	2N3392	NPN	Transistor	101-004
Q517	2N4122 or S2783	PNP	Transistor	101-005
	COMPONENTS LISTED BELOW USED ON 6 CHANNEL LOGIC EXCEPT AS NOTED.			
Q518	2N3392	NPN	Transistor	101-004
Q519	2N4122 or S2783	PNP	Transistor	101-005
Q520	2N3392	NPN	Transistor	101-004
Q521	2N4122 or S2783	PNP	Transistor	101-005
Q522 Series '71 only	MPS6560	NPN	Transistor	101-013
D503 to D506	DA-805 or 1N4148		Diode Silicon	100-101
	COMPONENTS LISTED BELOW USED ON 6 CHANNEL LOGIC EXCEPT AS NOTED.			
D507 and D508	DA-805 or 1N4148		Diode Silicon	100-101

PLUGS AND CONNECTORS

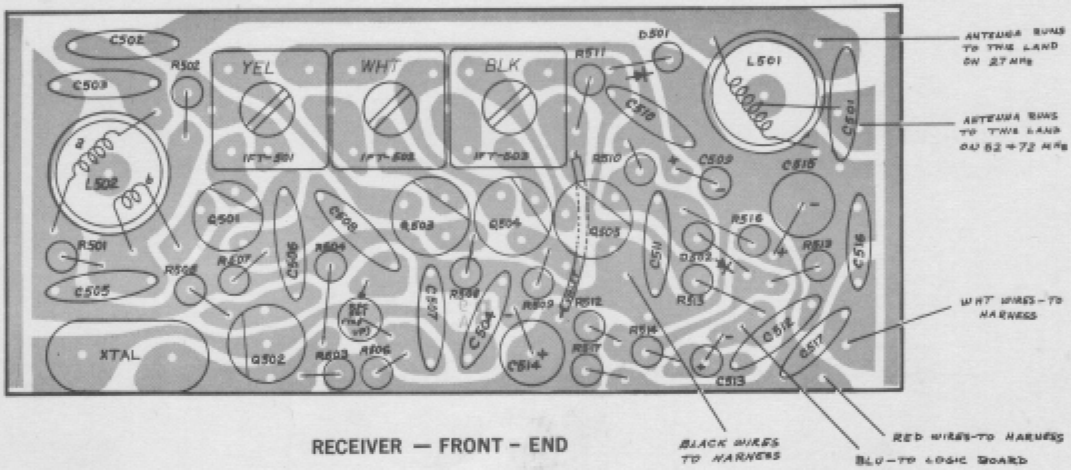
J601	4 x 4 Block Plug	120-013
J602	4 Pin Female Plug – Aileron	120-011
J603 and J604	4 Pin Female Plug – Auxiliary 6ch only	120-011
	Complete 4ch Rx Harness	200-015
	Complete 6ch Rx Harness	200-016
	The above harnesses are for 1968 and 1969 Gold Medal Series and PCS-4	
J605	6ch Block Plug Multicon	120-022
J606	4ch Block Plug Multicon	120-021

ELECTRONIC SUB-ASSEMBLIES

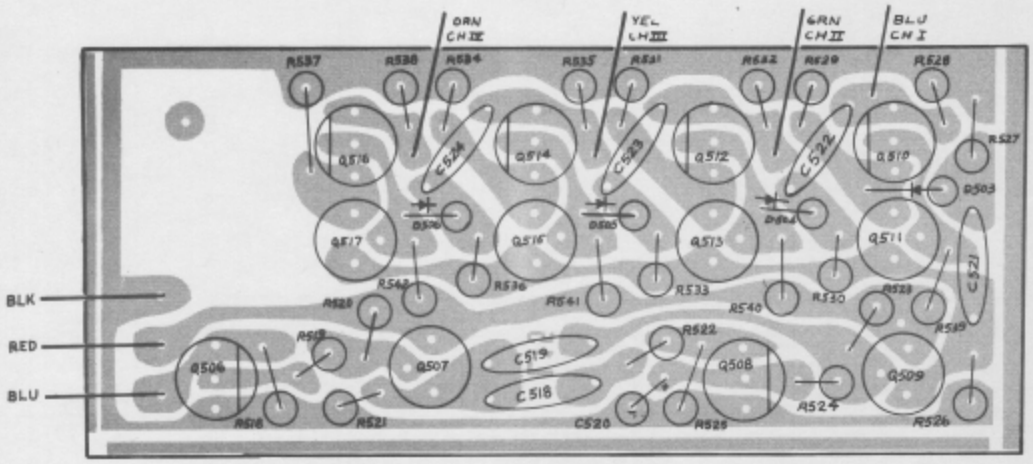
– – –	L-7P/N 300-109 – 6ch Decoder Gold Medal Series – Replaced by P/N	300-156
– – –	L-14 – 4ch Decoder Gold Medal Series	300-110
– – –	L-15 P/N 300-111 – 4ch Decoder 1968 - 1969 PCS-4 Replaced by P/N	300-155
– – –	L-16 P/N 300-141 – 4ch Decoder Series "70" with Plug Replaced by P/N	300-155
– – –	L-17 P/N 300-142 – 6ch Decoder Series "70" with Plug Replaced by P/N	300-156
– – –	L-16A – 4ch Decoder Series "71" with Plug	300-155
– – –	L-17A – 6ch Decoder Series "71" with Plug	300-156

MISCELLANEOUS

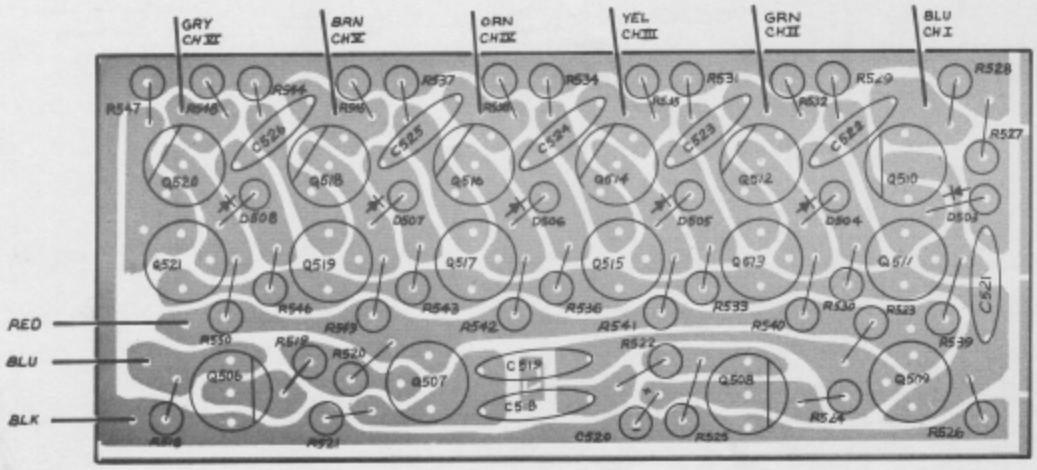
– – –	Rx Case 4ch '68 and '69 Gold Medal w/lid	901-152
– – –	Rx Case 6ch '68 and '69 Gold Medal and PCS-4 w/lid	901-153
– – –	Rx Case 3ch and 4ch Series '70 and later and PCS-4 w/lid	901-196
– – –	Rx Case 6ch Series '70 and later w/lid	901-197
– – –	Rx Case Dual Frequency 4ch Series '71 and later	901-203
– – –	Rx Case Dual Frequency 6ch Series '71 and later	901-204
– – –	Switch Harness – 4 Pin Flat Plugs, Gold Medal Series 1968-1969 and PCS-4	200-008
– – –	Switch Harness – 4 Pin Multicon Plugs, with charge Receptacle – Series '70 and later and PCS-4	200-029



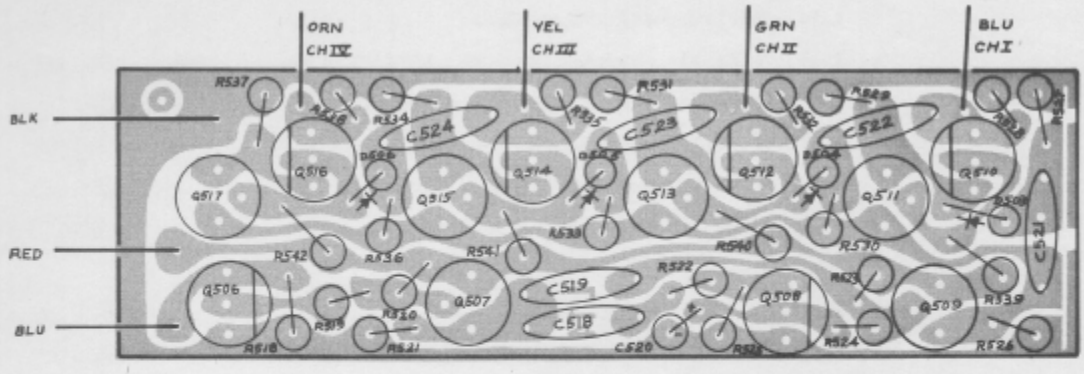
RECEIVER — FRONT - END



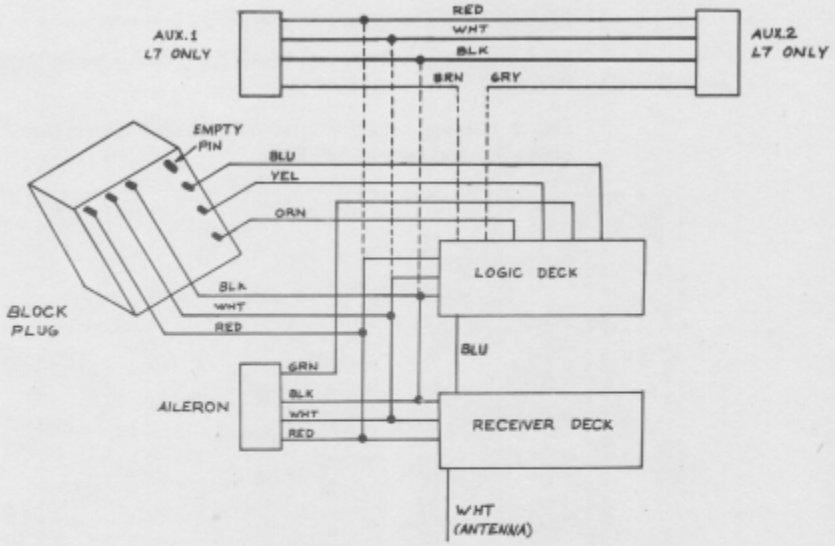
L15 LOGIC (PCS-4)



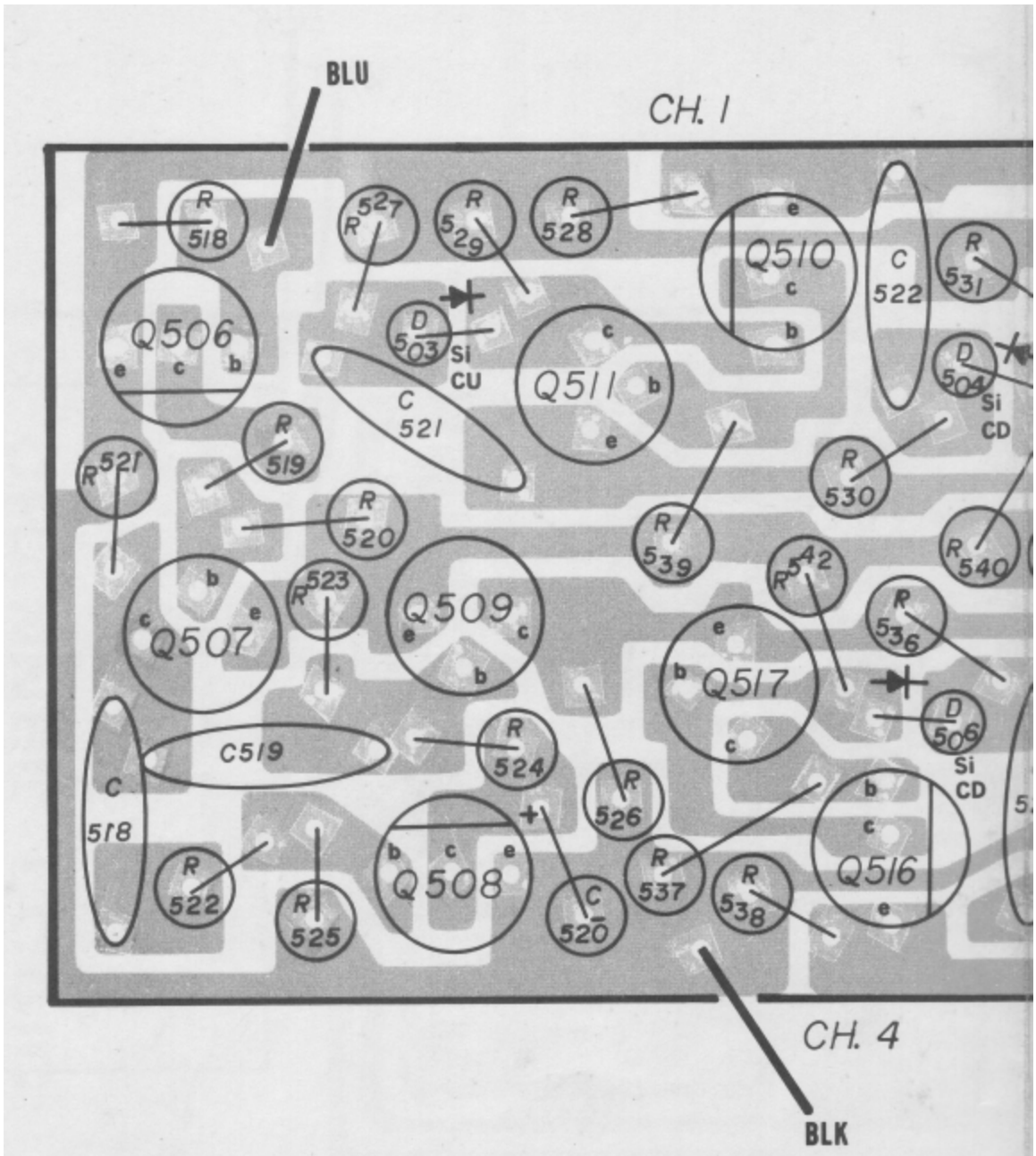
L7 LOGIC (6ch)

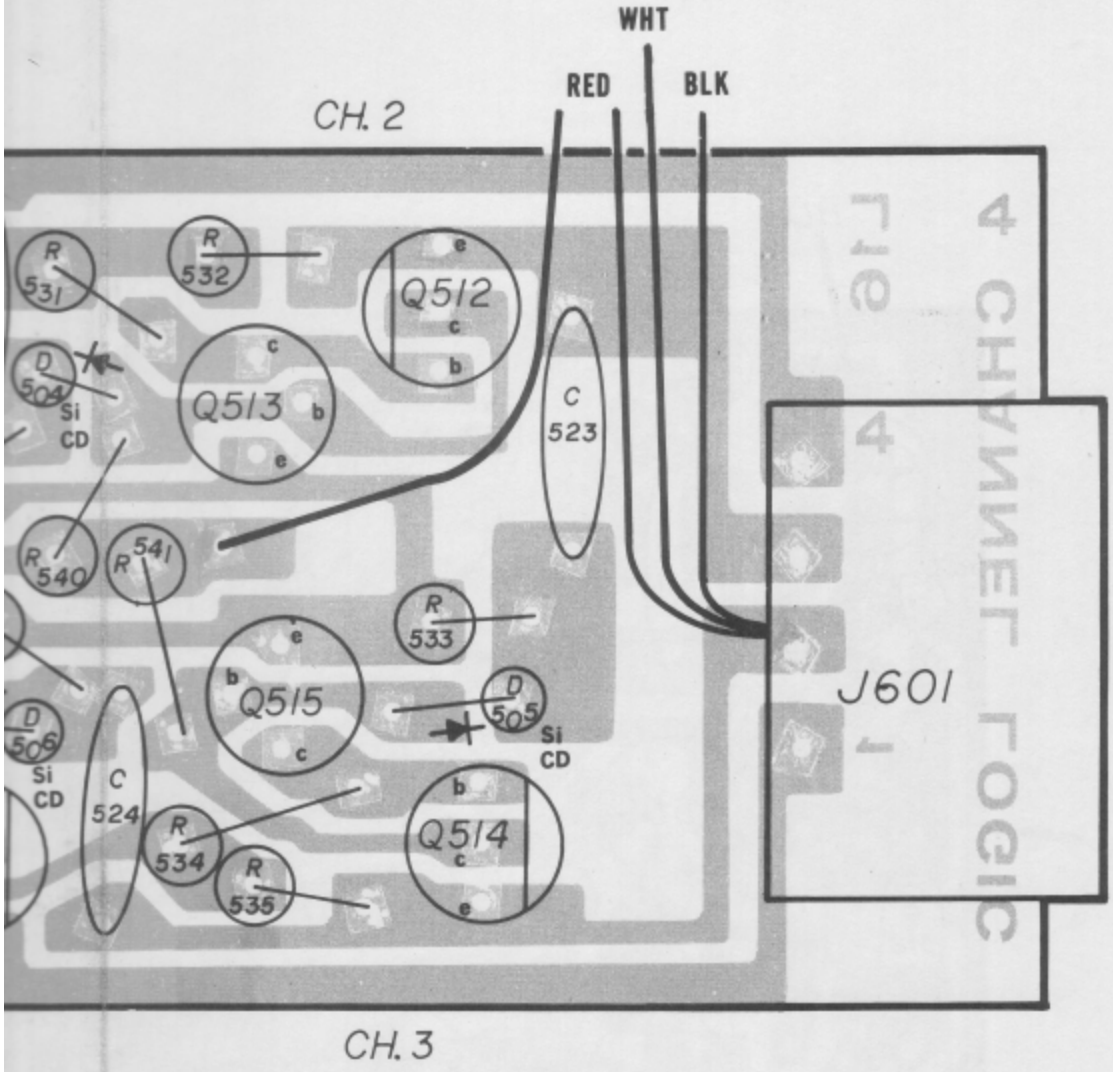


L14 LOGIC (4ch)

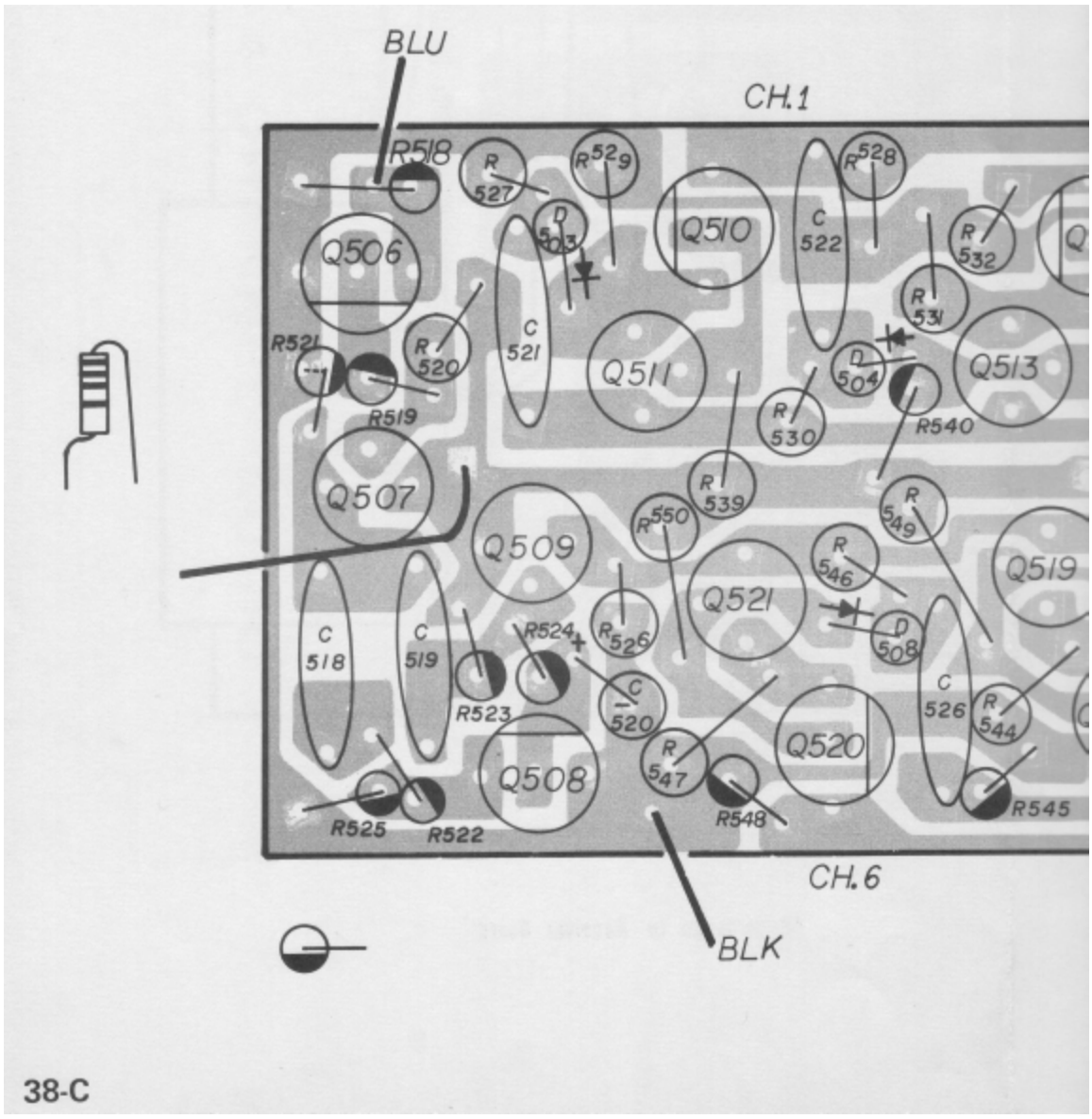


-RECEIVER WIRING-

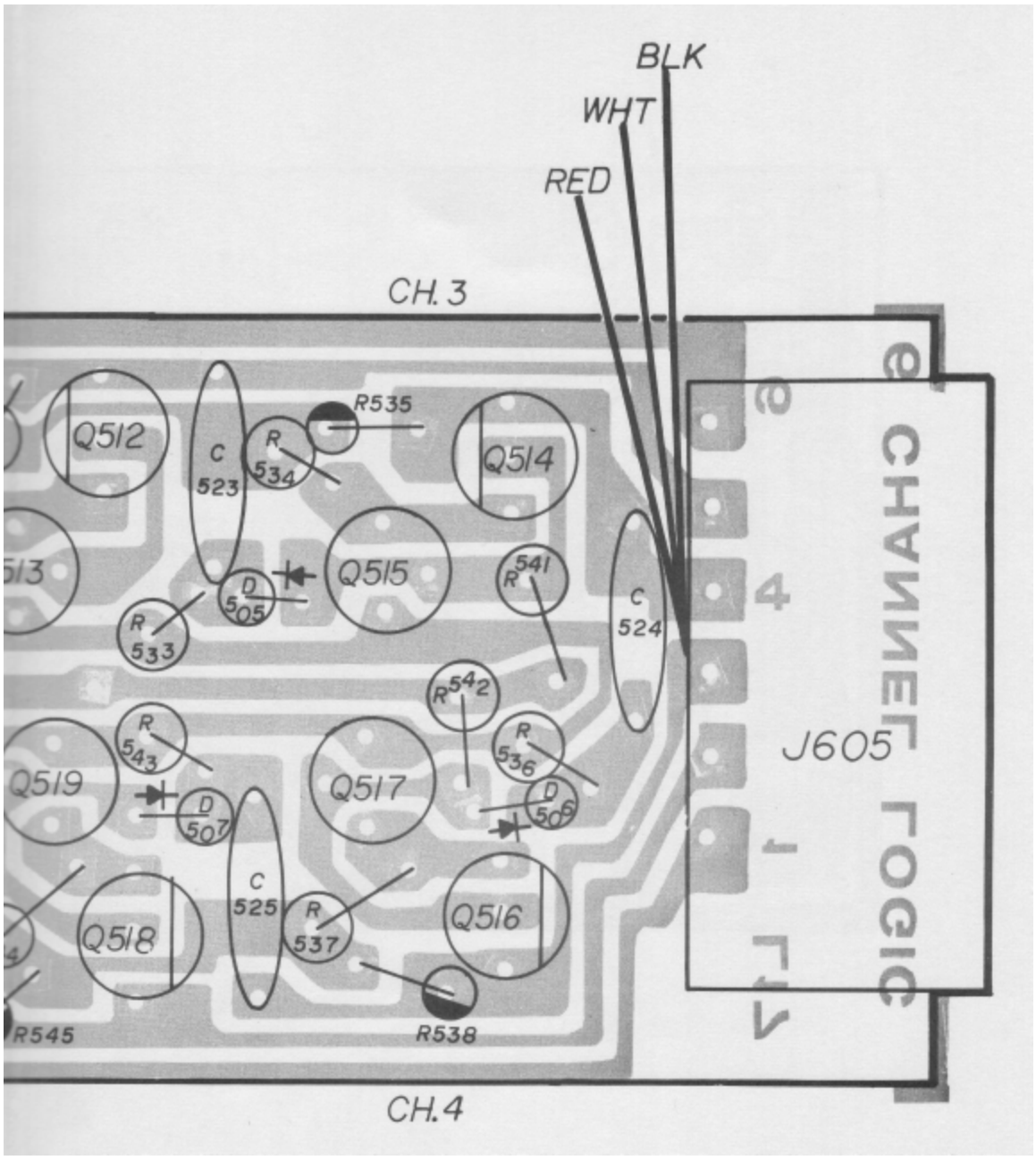

BLU
CH. 1
R 518
R 527
R 529
R 528
Q510
C 522
R 531
Q506
D 503 Si CU
Q511
C 521
D 504 Si CD
R 519
R 521
R 530
R 520
R 539
R 540
R 542
Q507
R 523
Q509
R 536
Q517
D 506 Si CD
C519
R 524
C 518
R 526
Q516
R 522
R 525
Q508
C 520
R 537
R 538
CH. 4
BLK

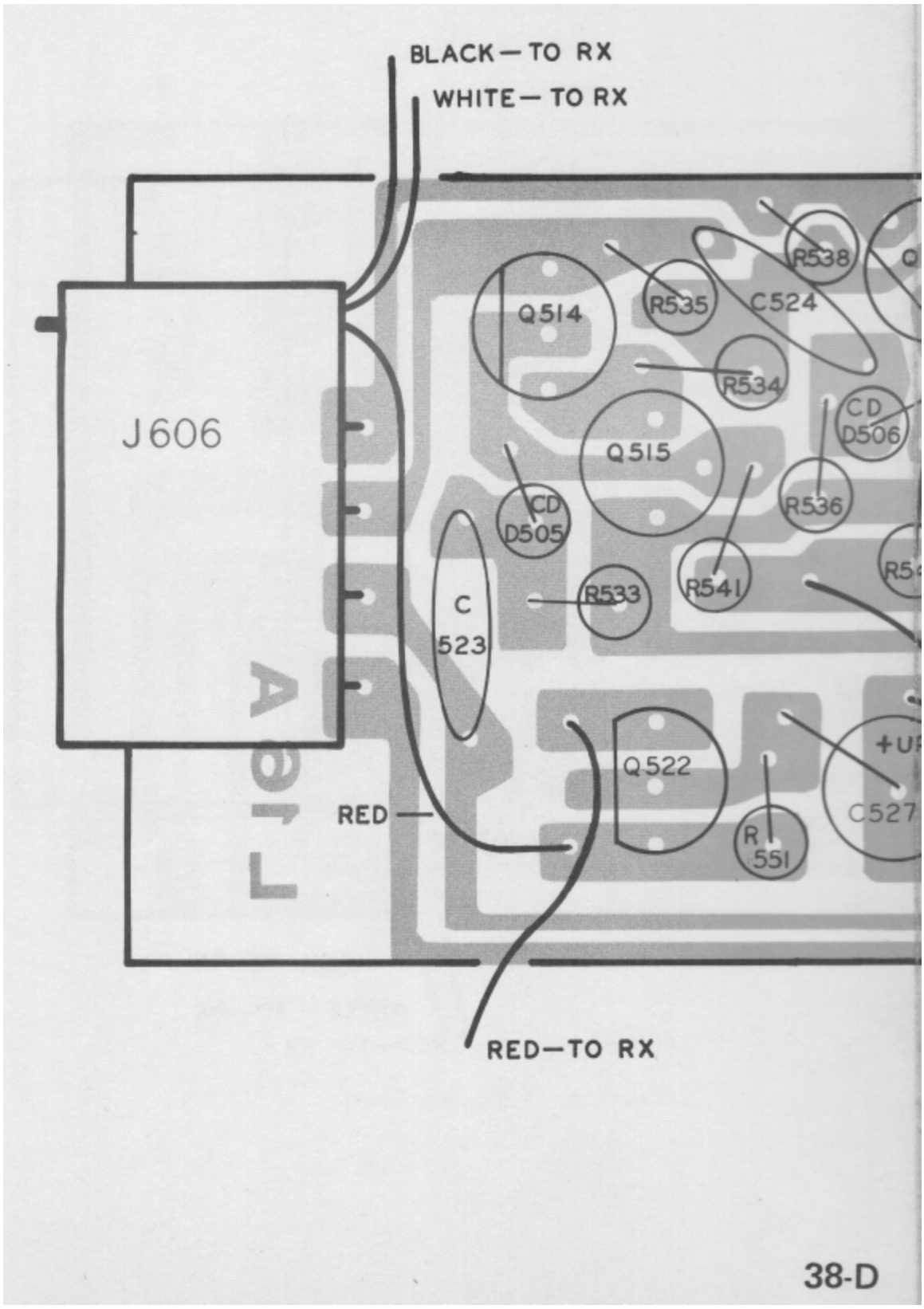


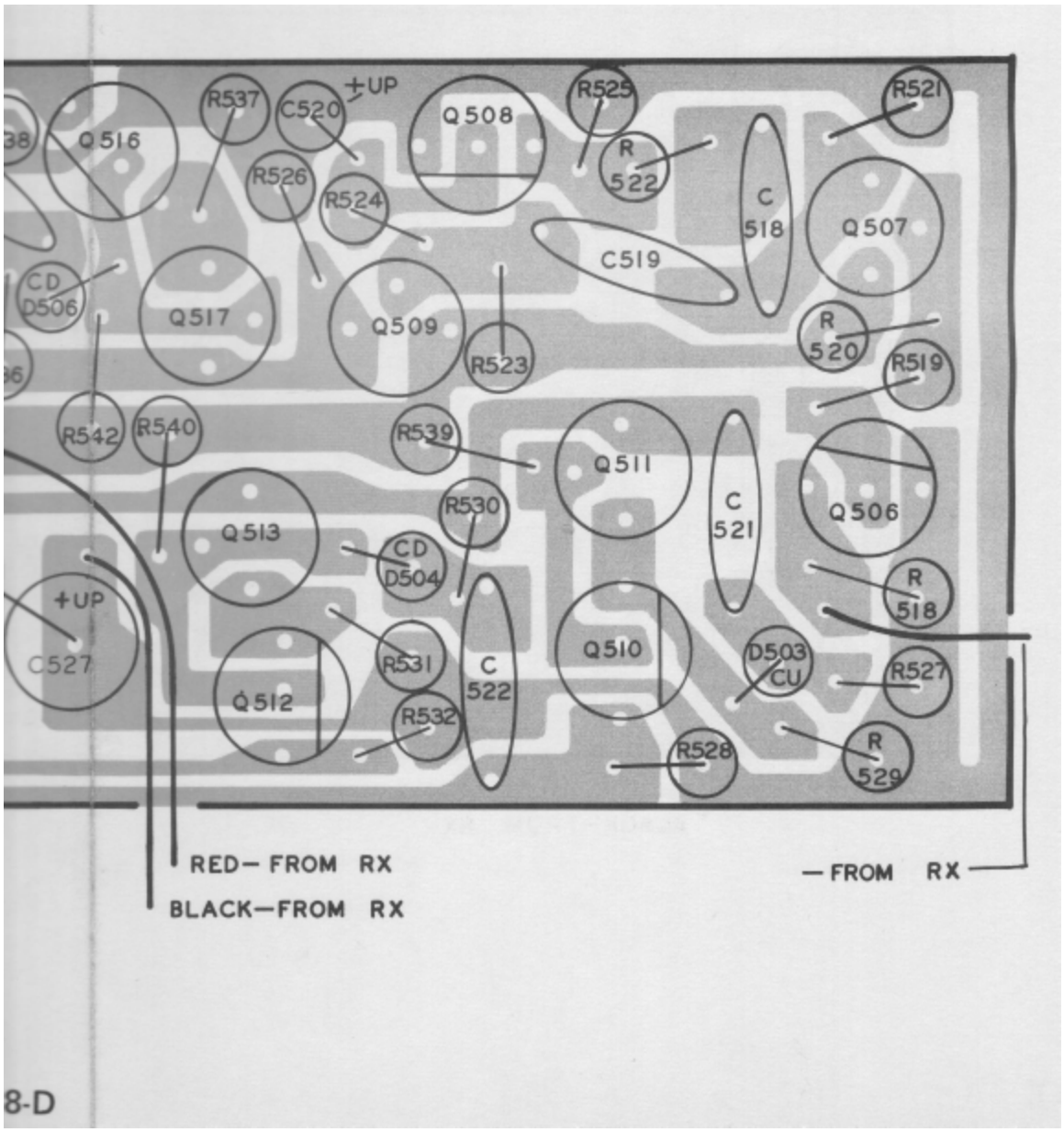
All wires go to Receiver Board

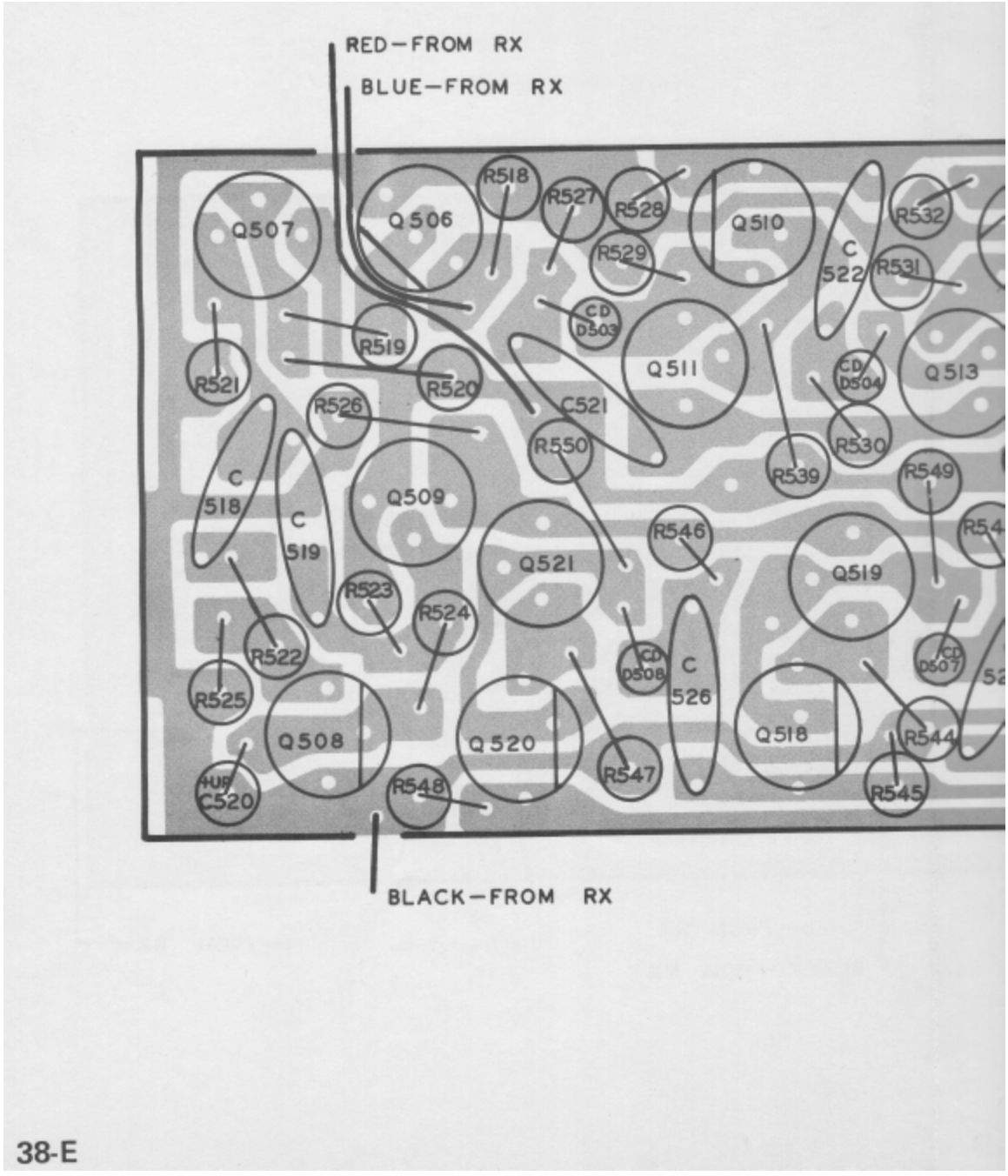

BLU
CH.1
R518
R 527
R 529
D 503
Q510
C 522
R 528
R 532
Q506
C 521
R 520
R521
R519
Q511
R 531
D 504
Q513
R 530
R540
Q507
R 539
R 549
Q509
R 550
R 546
Q519
Q521
C 518
C 519
R524
R 526
D 508
C 526
R 544
C 520
R523
R 547
Q520
Q508
R548
R545
R525
R522
CH.6
BLK

38-C

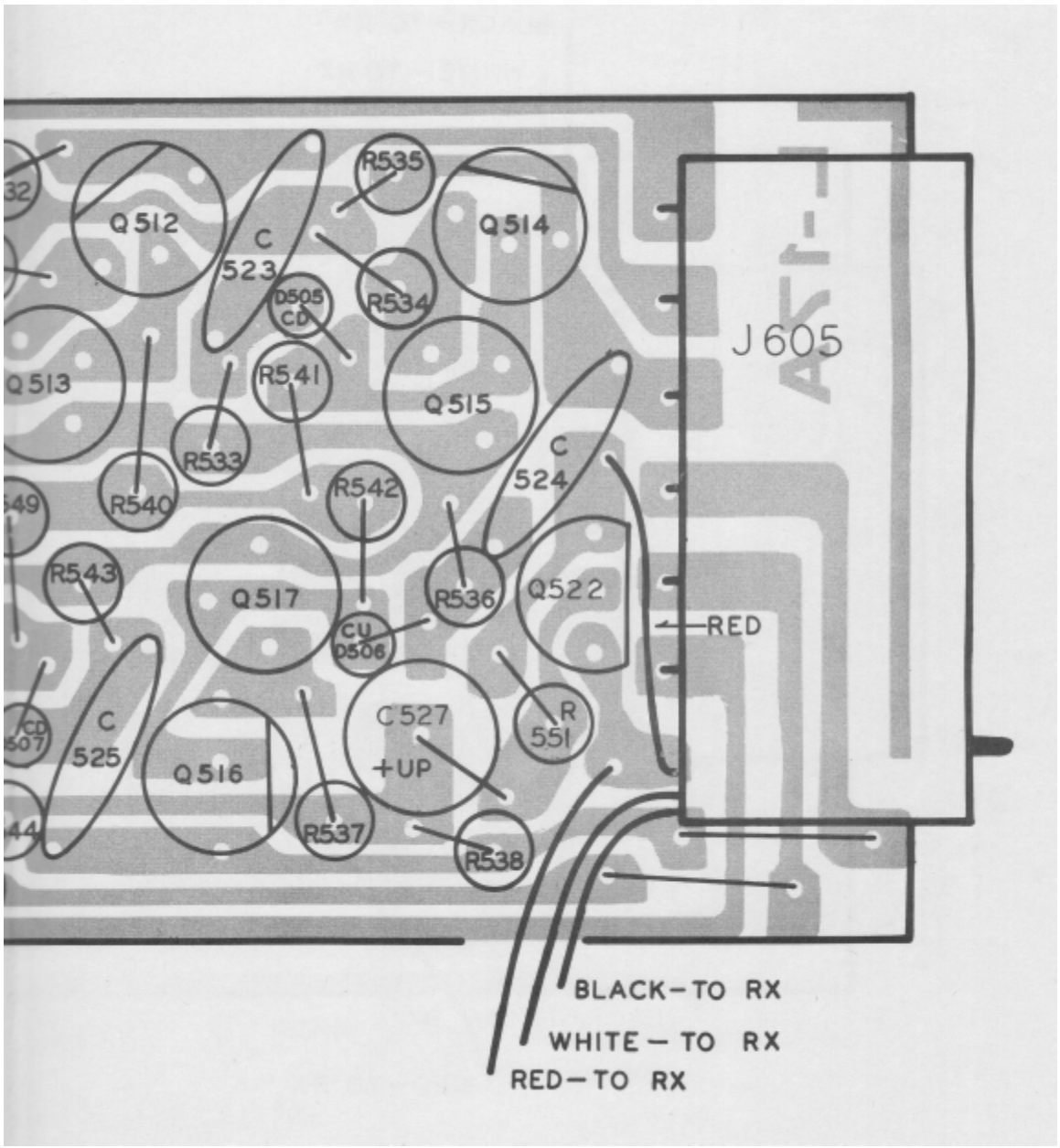

BLK
WHT
RED
CH. 3
Q512
C 523
R 534
R535
Q514
Q515
D 505
R 533
R 541
C 524
R 542
R 543
R 536
D 507
D 506
Q519
Q517
J605
C 525
R 537
Q518
Q516
R545
R538
CH. 4


BLACK — TO RX
WHITE — TO RX
J606
Q514
R535
C524
R538
R534
CD
D506
Q515
R536
CD
D505
C
523
R533
R541
Q522
R
551
C527
RED —
RED — TO RX

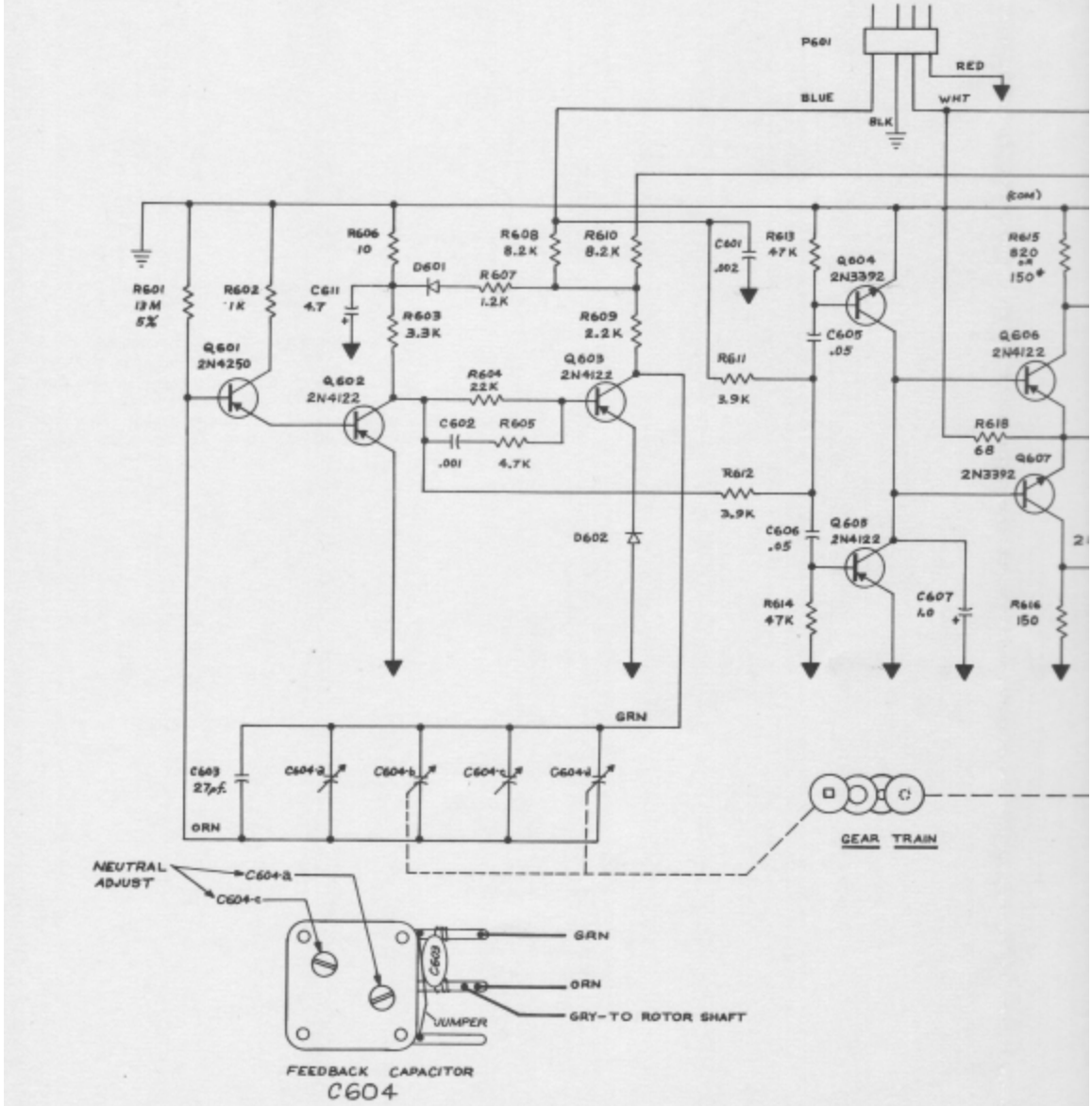

+UP
R537
C520
Q508
R525
R521
Q516
R
522
R526
R524
C
518
Q507
C519
CD
D506
Q517
Q509
R523
R
520
R519
R542
R540
R539
Q511
C
521
Q506
R530
Q513
CD
D504
R
518
+UP
C527
R531
C
522
Q510
D503
CU
R527
Q512
R532
R528
R
529
RED— FROM RX
BLACK—FROM RX
— FROM RX


RED—FROM RX
BLUE—FROM RX
Q507
Q506
R518
R527
R528
Q510
R532
C 522
R531
R529
CD D503
R519
R521
R520
Q511
CD D504
Q513
R526
C521
R550
R530
R539
R549
C 518
C 519
Q509
R546
Q521
Q519
R523
R524
R522
CD D508
C 526
CD D507
R525
Q508
Q520
R547
Q518
R544
+UP C520
R548
R545
BLACK—FROM RX

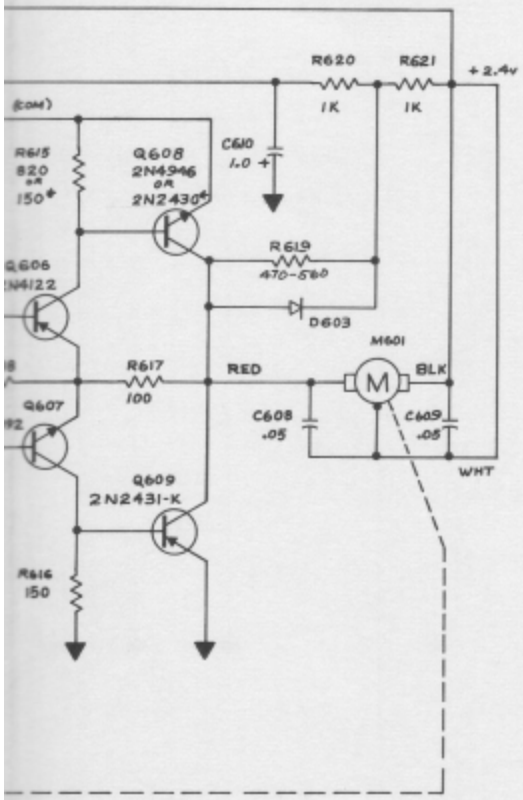
38-E


R535
Q512
C
523
Q514
D505
CD
R534
J605
Q513
R541
Q515
R533
C
524
R542
R540
R543
Q517
R536
Q522
CU
D506
RED
C527
+UP
R
551
C
525
Q516
R537
R538
BLACK-TO RX
WHITE - TO RX
RED-TO RX

KPS-9 SERVO AMPLIFIER

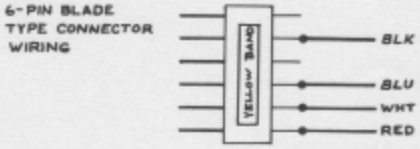


ER



1. ALL RESISTORS ½ W 10% UNLESS NOTED. VALUES IN OHMS (K=1,000; M=1,000,000).
2. ALL CAPACITORS DISC CERAMIC UNLESS NOTED. VALUES IN μf UNLESS NOTED.
3. * THIS SYMBOL DENOTES PARTS USED PRIOR TO 9-15-68 - SEE SERVICING TEXT.

FIG. 35



KPS-9 SERVO
(Fig. 35)

THEORY OF OPERATION

There are two versions of this amplifier in use at present. The two are quite similar. The major difference being in the reference generator, where two temperature compensating diodes were added on the S11 assembly, also in the electrical damping loop, the addition of a non-linear element. Other than these differences the circuit operation is identical.

The theory of operation is much the same as that of any servo amplifier of this configuration.

The reference generator (Q601, 602, and 603) is a one-shot multivibrator triggered from the leading edge of the input pulse. Triggering is applied at the junction of R607, R608, and R610, through R608. This pulse is commutated through C603 and C604 (feedback capacitor), to the base of Q601. The base impedance at this point is extremely high. Do not attempt to monitor this signal unless the instrument impedance is greater than 100 megohms shunted by less than 10pf.

The combination of Q601 and Q602 form a high gain stage to insure the voltage level at the base of Q603 is below 0.5v during down time of the reference generator. The operation of Q603 is typical.

Diodes D601 and D602 are used for temperature compensation of the reference generator. They compensate for the shift in base-emitter voltage in Q601 and Q602 with temperature. The output wave-form of the reference generator (fig. 36) is applied to summing resistor R612, with R611 receiving the input pulse. The two signals are thus added algebraically (fig. 37) and the resultant signal is applied to the bases of pulse stretcher transistors Q604 and Q605.

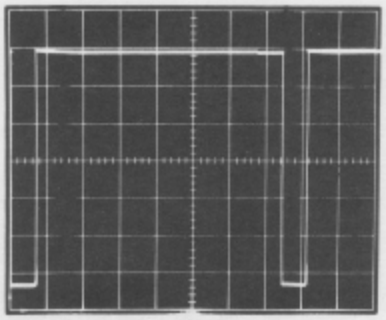


Fig. 36 Reference Generator Output
(V= .5v/Div. H=2ms/Div.)

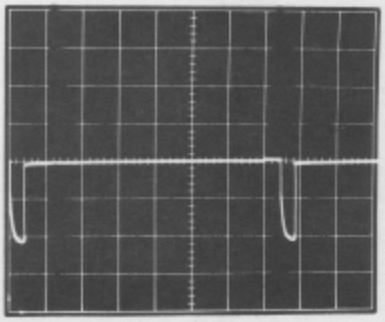


Fig. 37 Summing Junction
(V= .5v/Div. H=2ms/Div.)

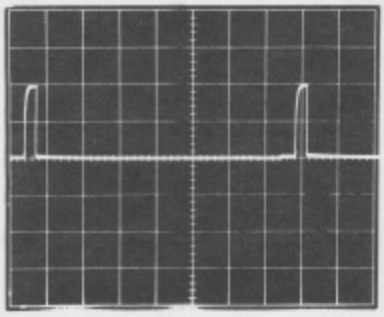


Fig. 37 Summing Junction
(V= .5v/Div. H=2ms/Div.

Fold Outs at Left

Any difference in pulse widths between the reference generator and the input pulse appears as an error signal at the junction of R611 and R612. Depending on the polarity of the error signal, either Q604 or Q605 will be turned on. The voltage level at the common collectors is normally near supply center tap. Q604 conducting will enable pulse stretching capacitor C607 to charge toward negative supply voltage for the duration of the "on" time. Upon conclusion of Q604 turn on, C607 slowly discharges toward center tap voltage (fig. **38**). The long time constant serves to smooth out the signal delivered to the motor.

When Q605 is turned on by a negative error signal, C607 is shunted out and discharges toward positive supply for the duration of the error signal. The pulse is "stretched" as before. (fig. **39**). The resultant collector signal is applied to the bases of Q606 and Q607. Q604 turning on thus turns on Q606 which then turns on Q608 (fig. **40**). The same is true for Q607 and Q609 when Q606 is turned on (fig. **41**).

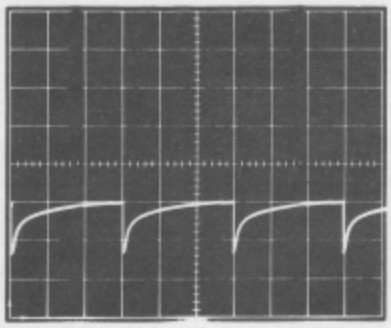


Fig. 38 Q604 & Q605 Collector Waveform
Positive Error
(V= .5v/Div. H=2ms/Div.)

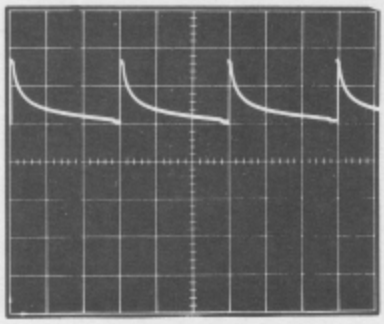


Fig. 39 Q604 & Q605 Collector Waveform
Negative Error
(V= .5v/Div. H=2ms/Div.)

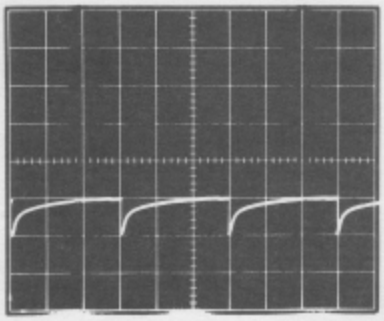


Fig. 40 Q606 & Q607 Driver Emitter
Positive Error
(V= .5v/Div. H=5ms/Div.)

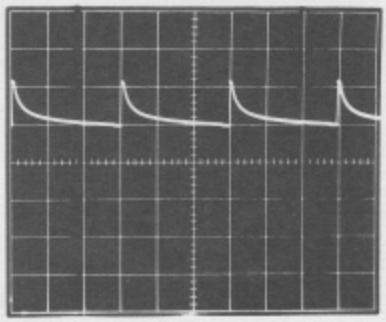


Fig. 41 Q606 & Q607 Driver Emitter
Negative Error
(V= .5v/Div. H=5ms/Div.)

Resistors R617 and R618 form a feedback network which acts to control servo dead band by applying negative feedback to the driver transistor emitters.

Electrical damping is provided by R619, R620, R621, and R610, C610 and D603.

R619 and D603 form a non-linear network to provide damping proportional to the servo direction.

NEUTRAL ADJUSTMENT

The only adjustment necessary on this servo is that for neutral position.

Two padder capacitors are provided on the rear of the variable capacitor with which to adjust the capacitance of C604 at neutral position.

To adjust these padders, it is necessary to have an accurate reference pulse such as supplied by a Kraft Servo Neutral Standard.

The servo's wheel output shaft should be aligned such that the sides of the square shaft are parallel with the case sides when the servo is at neutral.

If work on the servo has necessitated removing the top section of the case, the capacitor gear should first be set to its neutral position before the linear output arms are set in position. With the capacitor gear set as above and all other gears and the gear plate in place, set the output rack arms in place directly opposite each other and in such a position that the output tabs are aligned as near center in the top case slots as possible. The notches on one end of each rack should point toward the capacitor gear.

The top case should now be attached and the servo plugged into the Neutral Standard. If any change in servo position is noted, proceed to adjust each of the padder capacitors until the rotary output is aligned as mentioned above. This completes the adjustment of servo neutral.

SERVICING

Other than obvious transistor or other component failures, there is little trouble which is peculiar to this type of servo.

The reference generator configuration is somewhat unique in that a relatively small timing capacitor is used necessitating the high impedance of the input base.

Feedback capacitor C604, can give the same symptoms as any capacitor – i.e., open, shorted, or leaking. A short will evidence itself by both sides of the capacitor showing the same signal. Open sections will show up as a narrow output pulse from the reference generator, whose width changes with C604's shaft position.

Transistor failures are evidenced by checking for proper voltage levels at the various elements.

Electronic failures beyond the reference generator are fairly obvious and should require no explanation. A quick check with the oscilloscope will generally reveal the defective stage.

Operational troubles such as excessive chatter, hunting, drift, etc., are generally mechanical rather than electronic.

Capacitive feedback elements subjected to high vibration levels tend to lose shaft torque. This loss of pressure affects electrical damping in the servo. The servo will bounce one or more times returning to neutral position. In this case, the most expedient remedy is to lower the value of R610, thereby increasing the amount of damping signal to the reference generator.

Hunting or erratic response is most often the result of increased electrical motor noise. In motors with high noise levels, the hunting may become more pronounced under vibration as the brushes tend to bounce. Dead spots and loss of power are also symptomatic of poor motor operation.

Occasionally a servo will tend to "hang on" or buzz in extreme travel positions. If trouble is encountered in this regard, check for correct values of R617 and R618.

Thermal runaway in the output transistors (Q608 and Q609) is evidenced by charred cases in these transistors.

Where germainium output transistors are used for Q608 and Q609, 2N2430 and 2N2431 respectively, base "tie-back" Resistors R615 and R616 **must be 150 OHMS** to eliminate the likelihood of transistor runaway.

On newer versions of this amplifier, an epoxy packaged TO-18 style silicon transistor type 2N4946 or MPS-6560 has been installed. Where this transistor is used for Q608, the base tie-back resistor, R615, should be 820 OHMS. For Q609 an MPS-6562 may be used and R616 should be 820 OHMS.

When doing any work on the printed circuit board, be sure the board is **thoroughly** cleaned and dried. The leakage paths caused by flux or other residue remaining on the board, especially in the area of the reference generator, can cause serious problems with drift and intermittent reference generator operation.

After cleaning and drying, spray the entire P. C. board with the aerosol spray listed in the "Materials Necessary" section and bake dry with a small heat gun.

PARTS LIST – KPS-9 SERVO

S-11 PC ASS'Y

RESISTORS – All values in OHMS (K=1,000; M=1,000,000)

R601	13M	¼w	5%	055-136
R602	1K	¼w	10%	057-102
R620	1K	¼w	10%	057-102
R621	1K	¼w	10%	057-102
R603	3.3K	¼w	10%	057-332
R604	22K	¼w	10%	057-223
R605	4.7K	¼w	10%	057-472
R606	10	¼w	10%	057-100
R607	1.2K	¼w	10%	057-122
R608	8.2K	¼w	10%	057-822
R609	2.2K	¼w	10%	057-222
R610	6.8K	¼w	10%	057-682
R611	3.9K	¼w	10%	057-392
R612	3.9K	¼w	10%	057-392
R613	47K	¼w	10%	057-473
R614	47K	¼w	10%	057-473
R615	150*	¼w	10%	057-151
	820*	¼w	10%	057-821
R616	150	¼w	10%	057-151
R617	100	¼w	10%	057-101
R618	68	¼w	10%	057-680
R619	560	¼w	10%	057-561

* See Text.

CAPACITORS

C601	.002uf	Disc Ceramic	113-013
C602	.001uf	Disc Ceramic	113-012
C603	27pf	Disc Ceramic	113-007
C604 A-D	20-205pf	Variable PVC-2X	112-003
C605	.05uf	Disc Ceramic	113-018
C606	.05uf	Disc Ceramic	113-018
608*	.05uf	Disc Ceramic	113-018

609*	.05uf	Disc Ceramic	113-018
C607	1.0uf/25v	Tantalum	116-002
C610	1.0uf/25v	Tantalum	116-002
C611	4.7uf/6v	Tantalum	116-004

* Supplied with motor ass'y p/n 800-003

TRANSISTORS

Q601	Transistor	2N4250	101-010
Q602	Transistor	2N4122 or S2783	101-005
Q603	Transistor	2N4122 or S2783	101-005
Q605	Transistor	2N4122 or 2N4250	101-005
Q606	Transistor	2N4122 or 2N4250	101-005
Q604	Transistor	2N3392	101-004
Q607	Transistor	2N3392	101-004
Q608	Transistor	2N2430	101-002
		2N4946 *	101-007
		MPS 6560 *	101-013
Q609	Transistor	2N2431	101-003
		MPS 6562	101-012

* See Text.

DIODES

D601	Diode, Silicon	DA-805 or 1N4148	100-101
D602	Diode, Silicon	DA-805 or 1N4148	100-101
D603	Diode, Silicon	DA-805 or 1N4148	100-001

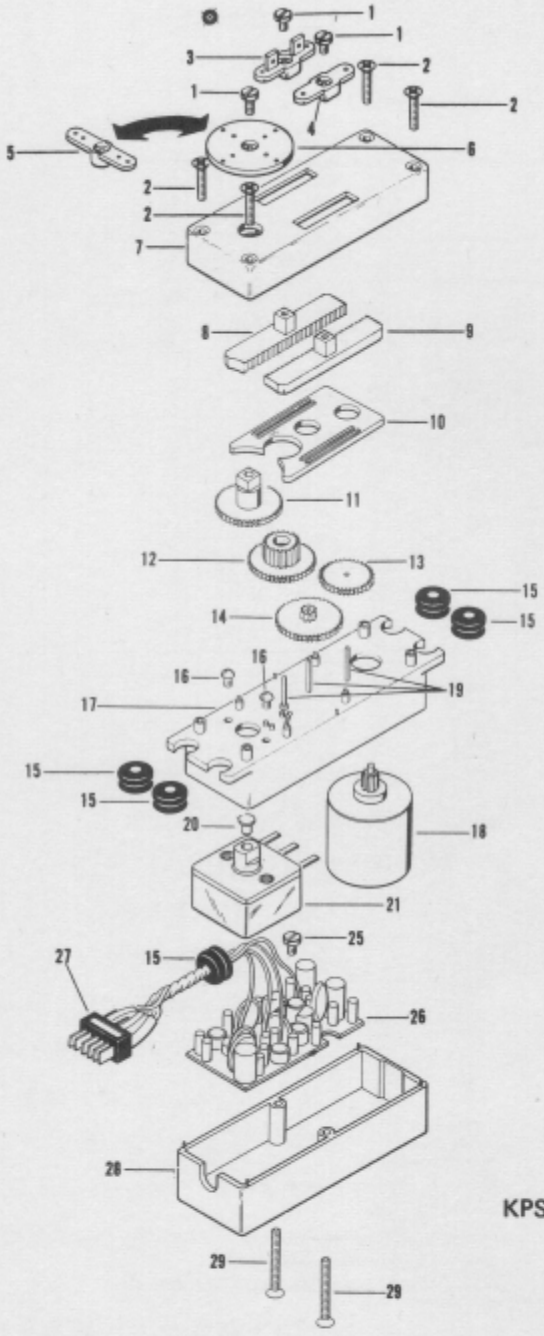
MISCELLANEOUS

P601	4pin Male plug or	120-012
	6pin Male plug	120-010
M601	Motor – only	800-000
	Motor ass'y with wires and C608 and C609	800-003

MECHANICAL ASSEMBLY KPS-9

(See exploded parts view – Fig. 42)

Key No.		
18	Motor, KPS-9 6 ohm	800-000
7	Case, Top	901-118
17	Case, Center	901-119
28	Case, Bottom	901-120
10	Rack Retainer	901-121
– – –	Case, Complete	901-122
13	Gear, Frist Intermediate	901-123
14	Gear, Second Intermediate	901-124
12	Gear, Drive	901-125
11	Gear, Capacitor	901-126
– – –	Gear Set	901-127
20	Plastic Wire Retainer	- - - - -
– – –	Output Rack Set	901-128
8	Right Output Rack	901-129
9	Left Output Rack	901-130
3	Arm, Linear – Straight	901-131
4	Arm, Linear – Right Angle	901-132
5	Arm, Rotary Output	901-133
6	Wheat, Output	901-134
– – –	Output Wheel & Arm Set	901-135
21	Capacitor, Variable	112-003
29	2-56 x 3/4" Flathead M.S. (pkg. of 20)	500-009
2	2-56 x 7/16" Flathead M.S. (pkg. of 20)	500-010
16	3-56 x 1/8" Round Head M.S.	- - - - -
1	No. 2 x 3/16" S.M.S. (pkg. of 20)	500-011
25	No. 2 x 1/8" S.M.S. (pkg. of 20)	500-008
15	1/4" O.D. Grommet (pkg. of 20)	500-003
19	1/16" x.420 Gear Pin	500-006
24	1-72 x 1/4" Round Head M.S. (pkg. of 20)	500-024
26	See Electronic Assembly	300-121
27	See Connector Assembly	120-010


1
1
3
2
1
2
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2
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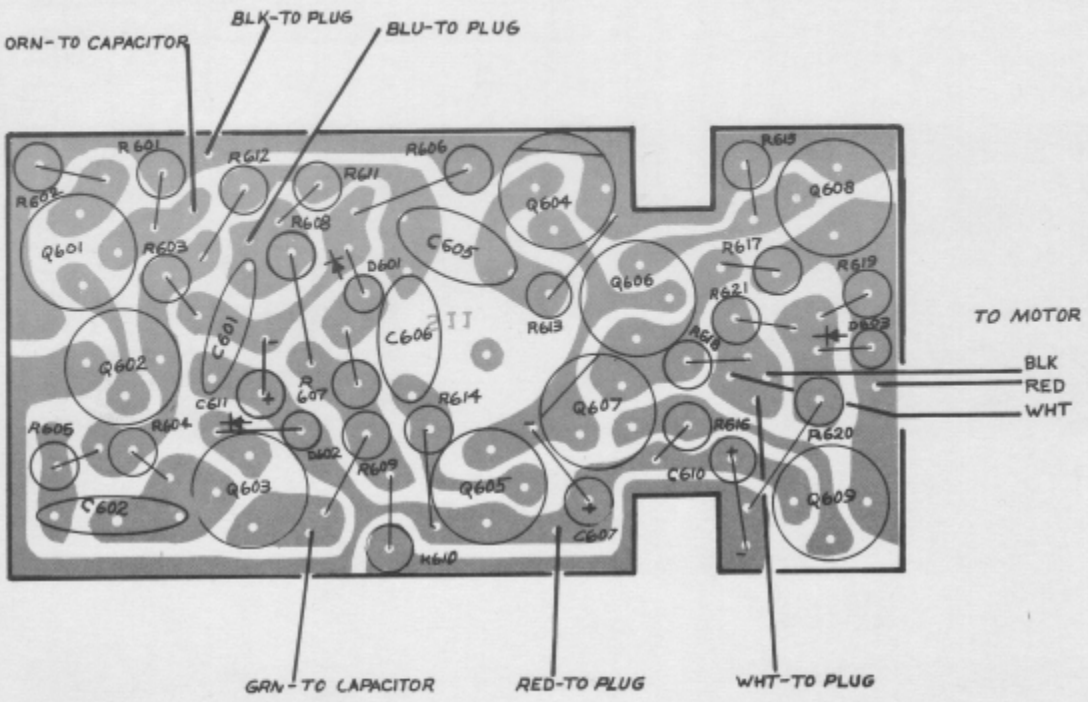
KPS-9

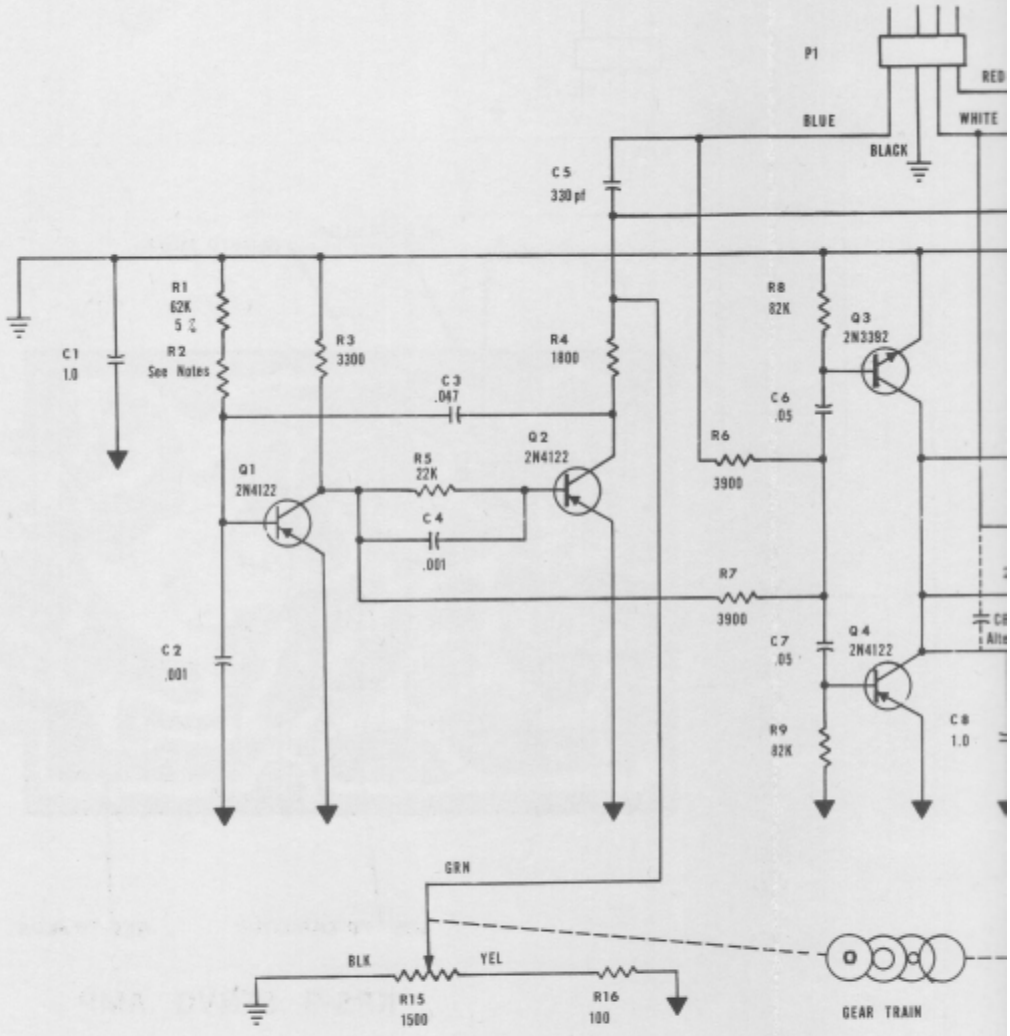
Fig. 42



KPS-9 SERVO AMP

45-A

KPS-9A SERVO AMPLI



NOTES:

All Resistors 1/4 watt 10 % Unless Noted. Values in OHMS (K=1,000)

All Capacitor Values in uf " " Values above .1 uf are Tantalum

R2 is selected at the factory for proper travel.

C8 is connected as shown by dashed lines on amplifiers using MPS 6534 at Q8.

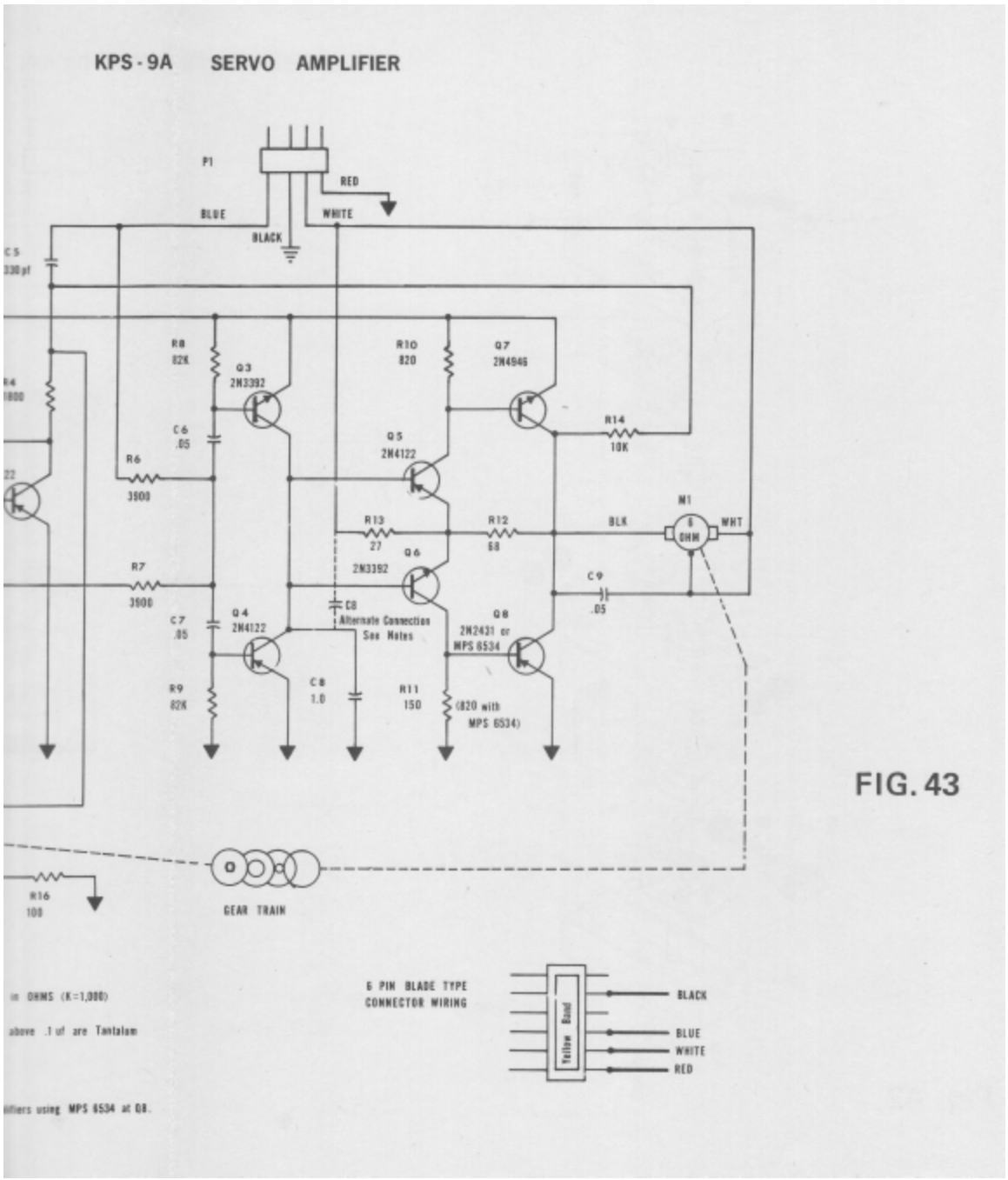

KPS-9A SERVO AMPLIFIER
P1
RED
BLUE
WHITE
BLACK
C5
330 pf
R8
82K
Q3
2N3392
R10
820
Q7
2N4946
R14
10K
C6
.05
Q5
2N4122
R6
3900
M1
6
OHM
BLK
WHT
R13
27
R12
68
Q6
2N3392
R7
3900
C9
.05
C7
.05
Q4
2N4122
C8
Alternate Connection
See Notes
Q8
2N2431 or
MPS 6534
R9
82K
C8
1.0
R11
150
(820 with
MPS 6534)
R16
100
GEAR TRAIN
in OHMS (K=1,000)
above .1 uf are Tantalum
ifiers using MPS 6534 at Q8.
6 PIN BLADE TYPE
CONNECTOR WIRING
Yellow Band
BLACK
BLUE
WHITE
RED

FIG. 43

SERVO AMPLIFIER
KPS-9A, 10, 11, 11A and 12
(Parts in Parentheses Refer to KPS-10 Servo)
(Schematic – Page 52 B)

THEORY OF OPERATION

Q1 (Q701) and Q2 (Q702) form the reference generator whose pulse width (Fig.44) is determined primarily by R1 (R701) and C3 (C703), and the voltage at the wiper of R15 (R714).

The reference generator is triggered by the leading edge of the input pulse through C5 (C705).

The resultant generator signals and input signal are added by R6 (R705) and R7 (R706) (Fig.45). Depending on the polarity of the error signal, either Q3 (Q703) or Q4 (Q704) will be turned on. The voltage level at the common collectors is normally near supply center tap. Q3 (Q703) conducting will enable pulse stretching capacitor C8 (C708) to charge toward negative supply voltage for the duration of the "ON" time. Upon conclusion of Q3 (Q703) turn on, C8 (C708) slowly discharges toward center tap voltage (Fig.46). The long time constant serves to smooth out the signal delivered to the motor.

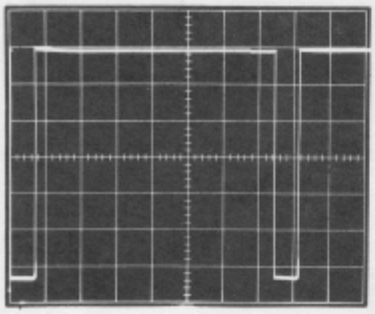


Fig. 44 Reference Generator Output
(V= .5v/Div. H=2ms/Div.)

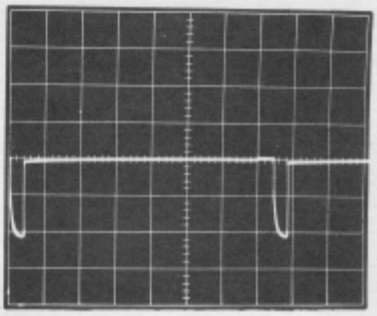


Fig. 45 Summing Junction
(V= .5v/Div. H=2ms/Div.)

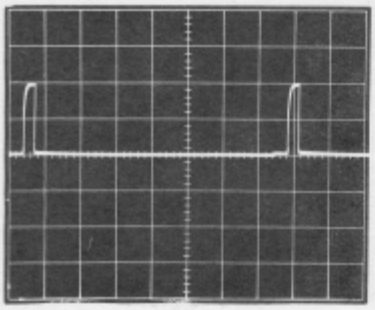


Fig. 45 Summing Junction
(V= .5v/Div. H=2ms/Div.)

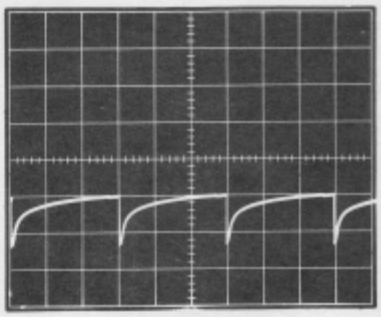


Fig. 46 Q3 (Q703) & Q4 (Q704)
Collector Waveform
Positive Error
(V= .5v/Div. H=2ms/Div.)

When Q4 (Q704) is turned on by negative error signal, C8 (C708) is shunted out and discharges toward positive supply for the duration of the error signal. The pulse is stretched as before. (Fig.47). The resultant collector signal is applied to the bases of Q5 (Q705) and Q6 (Q706), Q3 (Q703) turning on thus turns on Q5 (Q705), which then turns on Q7 (Q707) (Fig.48). The same is true for Q6 (Q706) and Q8 (Q708) when Q4 (Q704) is turned on (Fig.49). Resistors R13 (R712) and R12 (R711) form a feedback network which acts to control servo dead band by applying negative feedback to drive transistor emitters.

Electrical damping is provided by R14 (R713) and is proportional to the servo direction.

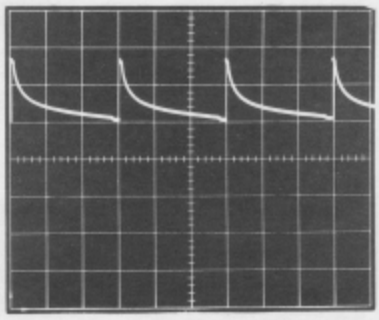


Fig. 47 Q3 (Q703) & Q4 (Q704)
Collector Waveform
Negative Error
(V= .5v/Div. H=2ms/Div.)

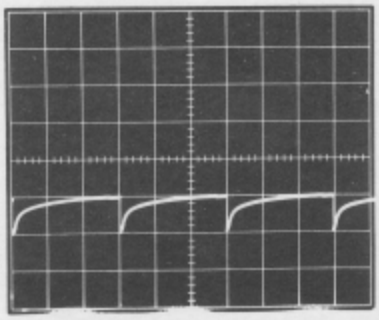


Fig. 48 Q5 (Q705) & Q6 (Q706)
Driver Emitter
Positive Error
(V= .5v/Div. H=5ms/Div.)

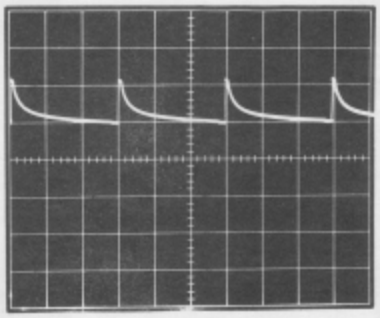


Fig. 49 Q5 (Q705) & Q6 (Q706)
Driver Emitter
Negative Error
(V= .5v/Div. H=5ms/Div.)

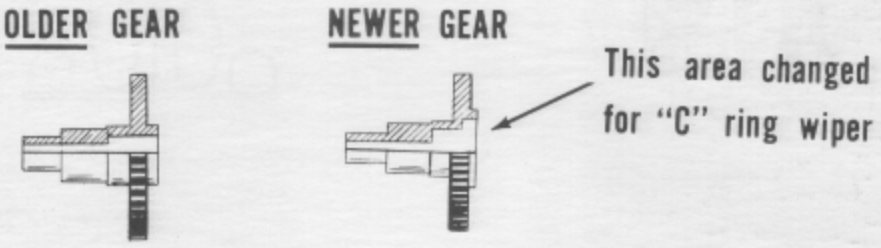
KPS-9A
(Fig. 43)

In order to standardize production, the KPS-9A servo has been introduced. Utilizing the same basic mechanical configuration as the KPS-9 Capacitive Feedback Servo, an adapter housing was added in the same location as the capacitor, which in turn holds the feedback potentiometer and its wiper. The other change in the mechanics is the final gear driving the potentiometer wiper shaft itself.

The amplifier is nearly identical to the KPS-10 servo, with the exception of the component layout and an additional resistor (R2) in the base of transistor Q1. This additional resistor is selected at the factory to equalize travel variations which are more critical in this servo due to the presence of the linear output arms.

Neutral in this servo is set just as in the KPS-10 servo, and the same precautions should be taken with the KPS-9A regarding the potentiometer element and wiper assembly.

The wiper assembly on both the KPS-10 and the KPS-9A has been altered during production on units manufactured after March 1969 to include a "C" ring on the wiper shaft itself. The addition of this device prevents crushing of the wiper fingers when the gear is pressed on the shaft. As a result of this change in wipers, it will be necessary on repairs to this servo to ascertain whether the older or newer type wiper assembly is present. Since the earlier components are no longer available, any damage to either the wiper assembly or the potentiometer gear will necessitate replacement of both these parts.



A further change has been made in the potentiometer housing itself which "keys" the housing to the case center-section. An additional two holes are drilled in the center-section and the holes which used to mount the housing become locating holes for two bosses on the housing. There is no change in either the wiper assembly or the potentiometer gear for the newer housing.

Servicing considerations on the remainder of the servo are similar to all other servos. Be especially careful that both housing mounting screws are tight or neutral drift may result in operation.

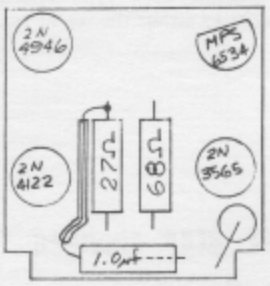
SERVICING NOTE ON KPS-9A and KPS-10 SERVOS

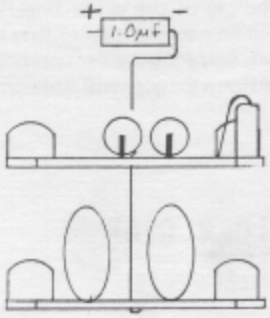
Due to the recent addition of a silicon output transistor to replace the 2N2431 Germanium type, an increase in high frequency gain under open loop conditions has necessitated returning the pulse stretching capacitor to battery center-tap rather than positive supply. Although the tantalum used here is reverse biased in one direction, the small amount of reverse voltage causes no noticeable leakage current to flow.

When servicing servos with the MPS-6534 transistor, note whether or not the modification has been made and modify if necessary. When replacing a 2N2431 with the new MPS-6534, modify the pulse stretching hookup along with the base resistor for the MPS-6534.

On the KPS-9A servo, the simplest method of modification is to replace the capacitor with a new unit, inserting one lead, with the body of the capacitor vertical, into the hole on the land the negative end went to before, and routing the upper lead over to the top lead of the 27 ohm resistor which is also battery center-tap, and soldering it there.

The KPS-10 servo presents more of a problem, since it necessitates separating the two decks in order to modify the upper deck. The easiest method is to replace the feed through wire at the notched end of the board with one lead of the pulse stretching capacitor, and laying the body of the capacitor parallel with the board. The other lead is then sleeved with teflon and routed to the end of the 27 ohm resistor connected to center-tap and soldered here. A diagram of this method is included.





KPS-10 MODIFICATION

PARTS LIST — KPS-9A SERVO

RESISTORS — All values in ohms (K=1,000)

R1	62K	¼w	5%	040-012
R2	Selected at factory — may be 2.2K to 22K ¼w		10%	
R3	3.3K	¼w	10%	057-332
R4	1.8K	¼w	10%	057-182
R5	22K	¼w	10%	057-223
R6	3.9K	¼w	10%	057-392
R7	3.9K	¼w	10%	057-392
R8	82K *	¼w	10%	057-823
R9	82K *	¼w	10%	057-823
R10	820	¼w	10%	057-821
R11	150 (820)	¼w	10%	057-151 (057-821)

R12	68	¼w	10%	057-680
R13	27	¼w	10%	057-270
R14	10K	¼w	10%	057-103
R15	1.5K	½w	Ceramic Potentiometer	106-012
R16	100	¼w	10%	057-101

* Was 47K on units manufactured prior to March 1969

CAPACITORS

C1	1.0uf/25V	Tantalum	116-002
C2	.001uf	Disc or Tubular Ceramic	113-012
C3	.047uf/200V	Mylar	115-009
C4	.001uf	Disc or Tubular Ceramic	113-012
C5	330uf	Disc Ceramic	113-011
C6	.05uf/10V	Disc Ceramic	113-018
C7	.05uf/10V	Disc Ceramic	113-018
C8	1.0uf/15V	Tantalum	116-002
C9	.05uf/10V	Disc Ceramic	113-018

C9 is mounted on motor – all other components mounted on P. C. board.

TRANSISTORS

Q1	2N4122		101-005
Q2	2N4122		101-005
Q3	2N3392		101-004
Q4	2N4122		101-005
Q5	2N4122		101-005
Q6	2N3392		101-004
Q7	2N4946	(May be replaced by MPS-6560 – P/N 101-013)	101-007
Q8	2N2431	(Germanium) or MPS 6562 – P/N 101-012)	101-003

MISCELLANEOUS

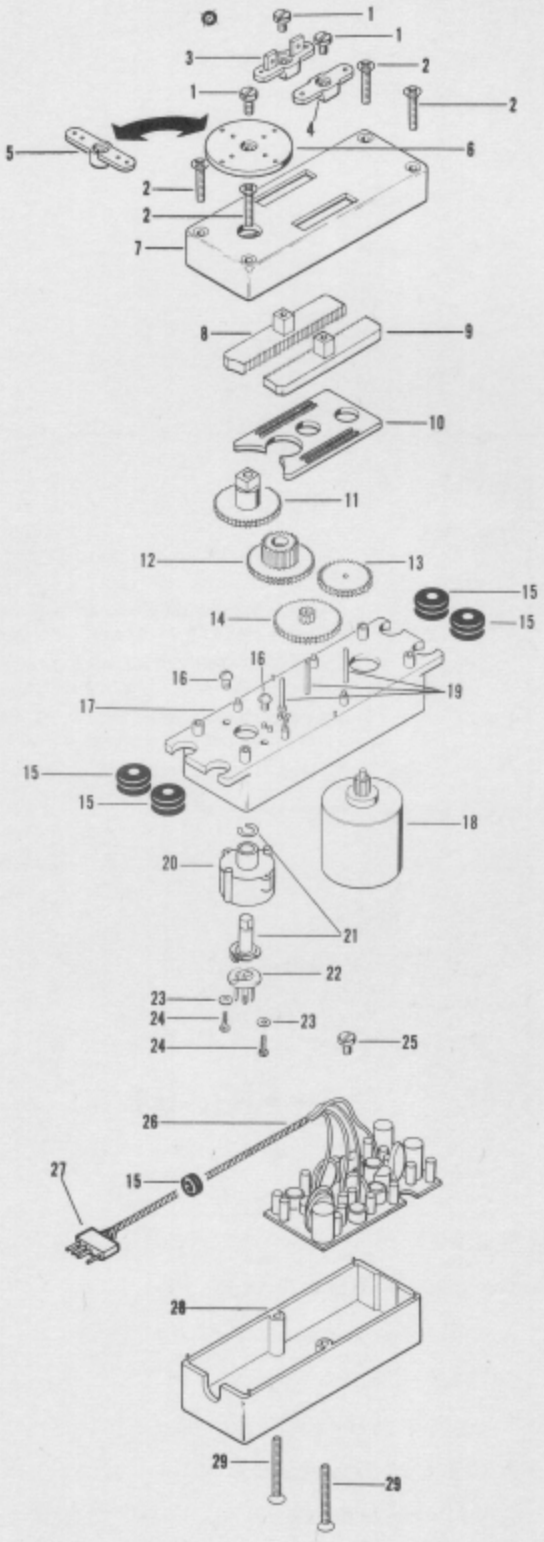
P1	4 Pin Male Plug	120-012
	6 Pin Male Plug	120-010
M1	6 ohms motor with standard pinion	800-000

COMPLETE AMPLIFIER ASSEMBLY 300-129

MECHANICAL ASSEMBLY KPS-9A

(See exploded parts view – Fig. 50)

Key No.		
18	Motor, KPS-9A 10 ohm	800-008
7	Case, Top	901-118
17	Case, Center	901-119
28	Case, Bottom	901-120
10	Rack Retainer	901-121
– – –	Case, Complete	901-122
13	Gear, First Intermediate	901-123
14	Gear, Second Intermediate	901-124
12	Gear, Drive	901-125
11	Gear, Pot	901-158
– – –	Gear Set	901-159
20	Pot Housing	901-157
– – –	Output Rack Set	901-128
8	Right Output Rack	901-129
9	Left Output Rack	901-130
3	Arm, Linear – Straight	901-131
4	Arm, Linear – Right Angle	901-132
5	Arm, Rotary Output	901-133
6	Wheel, Output	901-134
– – –	Output Wheel & Arm Set	901-135
21	Pot Wiper 1/8" Shaft	106-011
22	Pot Element 1.5K	106-012
29	2-56 x 3/4" Flathead M.S. (pkg. of 20)	500-009
2	2-56 x 7/16" Flathead M.S. (pkg. of 20)	500-010
16	1-72 x 3/16" Machine S. (pkg. of 20)	500-059
1	No. 2 x 3/16" S.M.S. (pkg. of 20)	500-011
25	No. 2 x 1/8" S.M.S. (pkg. of 20)	500-008
15	1/4" O.D. Grommet (pkg. of 20)	500-003
19	1/16" x .420 Gear Pin	500-006
23	Fiber Washer (pkg. of 20)	500-026
24	1-72 x 1/4" Roundhead M.S. (pkg. of 20)	500-024
26	See Electronic Assembly (for Series '71 300-139)	300-129
27	See Connector Assembly	123-010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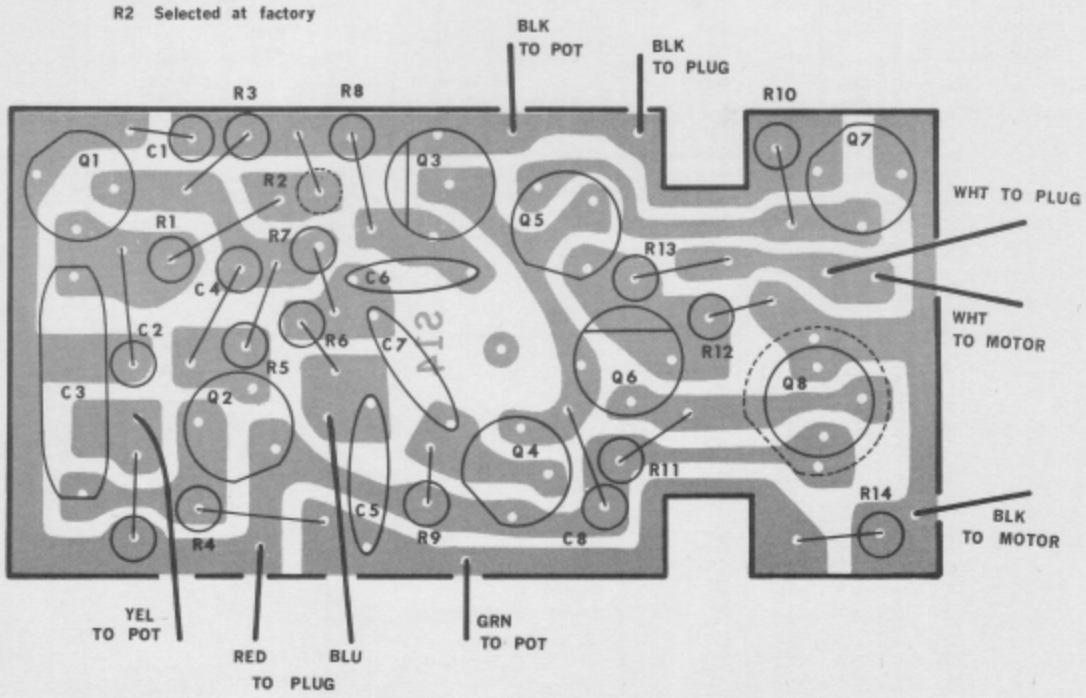
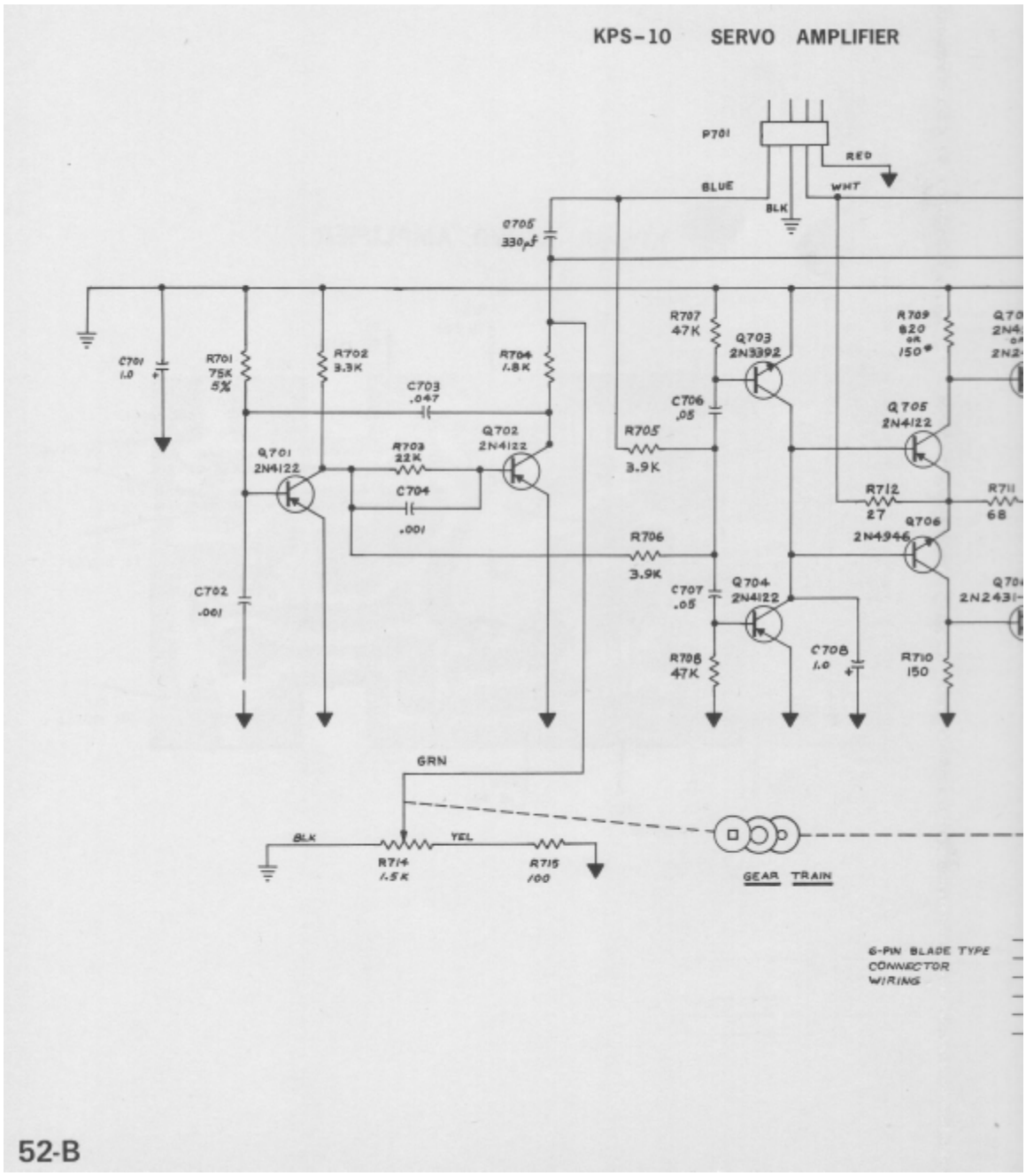
KPS-9A

Fig. 50

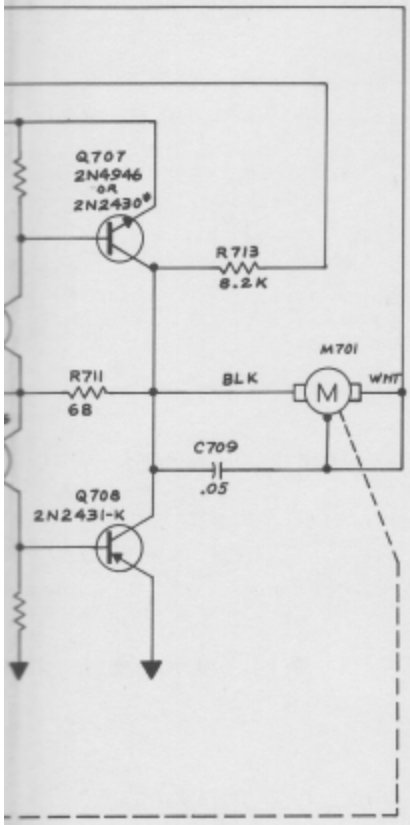
KPS-9A SERVO AMPLIFIER



52-A


KPS-10 SERVO AMPLIFIER
P701
RED
BLUE
WHT
BLK
C705
330pf
C701
1.0
R701
75K
5%
R702
3.3K
C703
.047
R704
1.8K
R707
47K
Q703
2N3392
R709
820
OR
150
C706
.05
Q705
2N4122
R705
3.9K
Q701
2N4122
R703
22K
Q702
2N4122
C704
.001
R712
27
R711
68
Q706
2N4946
R706
3.9K
C702
.001
C707
.05
Q704
2N4122
R708
47K
C708
1.0
R710
150
GRN
BLK
YEL
R714
1.5K
R715
100
GEAR TRAIN
6-PIN BLADE TYPE
CONNECTOR
WIRING

52-B



1. ALL RESISTORS ½ W 10% UNLESS NOTED. VALUES IN OHMS (K=1,000).
2. ALL CAPACITORS DISC CERAMIC UNLESS NOTED. VALUES IN μf UNLESS NOTED.
3. * THIS SYMBOL DENOTES PARTS USED PRIOR TO 9-15-68—SEE SERVICING TEXT.

FIG. 51

KPS-10
(Fig. 51)

Setting of the KPS-10 servo is limited to plugging the servo into a neutral standard, loosening the two small hold down screws at the rear of the pot element and rotating the element body until the wheel is centered. Care should be taken when moving the element, as ceramic is brittle and may chip if too much pressure is used. When the servo has been neutralized, re-tighten the hold down screws.

The KPS-10 amplifier, due to its compact package, should be handled carefully during any operation where it is exposed.

Should it be necessary to repair the amplifier assembly itself, it is recommended that the fault be located while the amplifier is still wired to the motor and feedback potentiometer. Once the area of difficulty has been located, remove the amplifier from the servo case by unsoldering all five wires from the amplifier to the motor and potentiometer.

With the amplifier now free, unsolder the five "feed-through" connections using small braid type strap soaked in flux and wicking the solder off the circuit land area. Straighten the feed through wires and gently pull the decks apart. Repairs may now be made easily and the boards rejoined and installed in the servo case.

The main areas of possible trouble in the KPS-10 amplifier lie in the motor and feed-back potentiometer. Motor failures evidence themselves as erratic control response, lack of power, and dead spots. Potentiometers used in this servo may exhibit poor wiper contact.

Complaints of wide dead band or drift in this servo are very often the result of poor mechanical fit in the wiper assembly, either between the wiper shaft and the pot gear or between the shaft and the wiper insulator disc. Complaints of this type may be observed by plugging the servo into the neutral standard or servo tester and rotating the output wheel in one direction by hand and noting if the servo shifts neutral. Very often, the servo will not return to the same neutral each time it is moved from neutral, if the above problem exists.

If there is excessive play between the shaft and the output gear, a thin coating of solder applied to the brass shaft will generally clear up the problem.

Cases of the shaft rotating in the insulator disc are best solved by replacing the wiper assembly completely.

The same considerations concerning germanium vs. silicon output transistors (see KPS-9 servicing information) applies to the KPS-10 amplifier. Where R709 is substituted for R615 in the text and Q707 is substituted for Q608, R710 is substituted for R616 and Q708 is substituted for Q609.

KPS-10 180° Servo

For 180° servo throw, the following parts differ from those shown in the parts list:

R701	Selected value for proper travel and centering. May range from 56K to 75K.			
R713	33K	1/4w	10%	057-333
R714	5K	Potentiometer Element		106-019
R715	1.8K	1/4w	10%	057-182

Special care is needed when adapting an existing servo to 180° operation. Besides the parts changes shown above, the stops on the top face of the potentiometer gear must be removed.

When selecting R701, use care to insure that the pot wiper falls very near center on the pot element itself when the servo is at neutral. This makes certain the resistance from either end of the element to the wiper is great enough in all positions to insure stable triggering of the reference generator.

◁ Fig. 51 (fold out at left)

SERVICING NOTE ON KPS-10 SERVOS

On **KPS-9A, -10** servos manufactured subsequent to February of 1969 , the potentiometer wiper has been changed to include a "C" ring locking device on the wiper shaft. This prevents damage to the potentiometer element and wiper fingers when the drive gear is pushed on the wiper shaft.

As a result of this new wiper, slight modification was necessary on the middle case section as well as the gear itself. The injection molding dies were changed accordingly, and as a result, older style gears and case middle sections are no longer being manufactured. Once the supply of older parts is gone, only the newer type case, gear and wiper can be supplied. Therefore, repairs to any one of these three items will require changing all three of these parts.

The part numbers of these newer style items will be the same as for the older style parts.

NOTES:

PARTS LIST – KPS-10 SERVO

RESISTORS – All values in OHMS (K=1,000)

R701	75K	¼w	5%	040-010
R702	3.3K	¼w	10%	057-332
R703	22K	¼w	10%	057-223
R704	1.8K	¼w	10%	057-182
R705	3.9K	¼w	10%	057-392
R706	3.9K	¼w	10%	057-392
R707	47K	¼w	10%	057-473
	82K	¼w	10%	057-823
R708	47K	¼w	10%	057-473
	82K	¼w	10%	057-823
R709	150*	¼w	10%	057-151
	820*	¼w	10%	057-821
R710	150*	¼w	10%	057-151
	820*	¼w	10%	057-821
R711	68	¼w	10%	057-680

R712	27	¼w	10%	057-270
R713	8.2K	¼w	10%	057-822
R714	1.5K	¼w	10%**	106-012
R715	100	¼w	10%	057-101

* See Text.
**Potentiometer element.

CAPACITORS

C701	1.0mf 25v	Tantalum	116-002
C708	1.0mf 25v	Tantalum	116-002
C702	.001mf 100v	Tubular Ceramic	114-003
C705	.001mf 100v	Tubular Ceramic	114-003
C703	.047mf 200v	Mylar	115-009
C705	330mf	Disc Ceramic	113-011
C706	.05mf 10v	Disc Ceramic	113-018
C707	.05mf 10v	Disc Ceramic	113-018
C709	.05mf 10v	Disc Ceramic	113-018

TRANSISTORS

Q701	2N4122 or S2783	101-005
Q702	2N4122 or S2783	101-005
Q704	2N4122 or S2783	101-005
Q705	2N4122 or S2783	101-005
Q703	2N3392	101-004
Q706	2N4946 or 2N4970	101-007
Q707	2N4946 *	101-007
	MPS 6560 *	101-013
	2N2430 *	101-002
Q708	2N2431 *	101-003
	MPS 6562 *	101-012

* See Text.

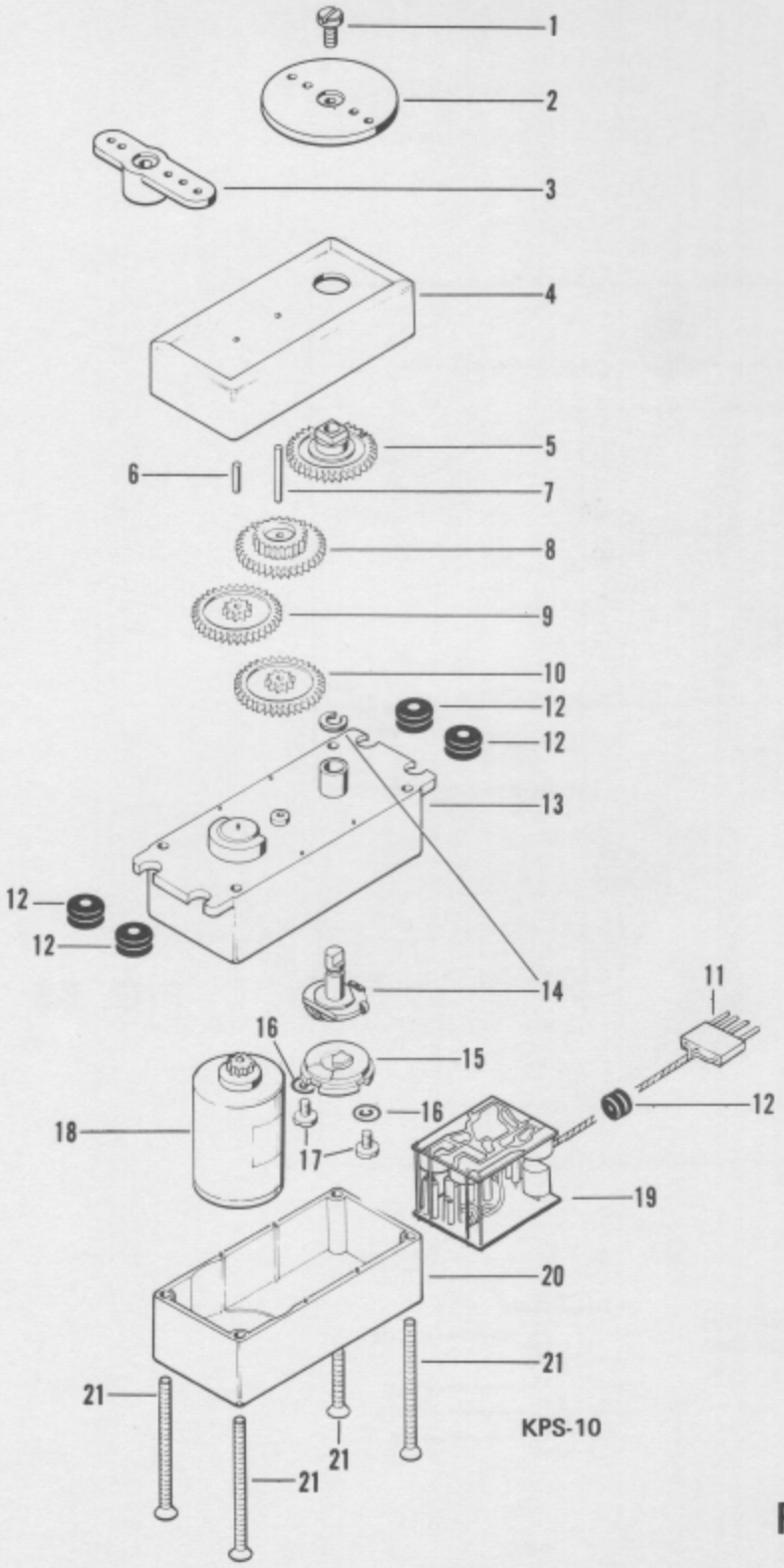
MISCELLANEOUS

P701	4 pin Male Plug	120-012
	6 pin Male Plug	120-010
M701	6 ohm Motor with thin pinion	800-002
	Complete Amplifier Assembly	300-122

MECHANICAL ASSEMBLY KPS-10

(See exploded parts view – Fig. 52)

Key No.		
18	Motor, KPS-10, KPS-11, KPS-11A 10 ohm	800-006
4	Case, Top	900-136
13	Case, Center	901-137
20	Case, Bottom	901-138
– – –	Case, Complete	901-139
10	Gear, First Intermediate	901-140A
9	Gear, Second Intermediate	901-140B
8	Gear, Drive	901-141
5	Gear, Pot	901-142
– – –	Gear, Set	901-143
2	Output Wheel	901-160
3	Output Arm	901-144
– – –	Output Wheel & Arm Set	901-145
14	Pot Wiper 1/8" Shaft	106-011
15	Pot Element 1.5K	106-012
1	No. 2 x 1/4" S.M.S. (pkg. of 20)	500-007
21	2-56 x 1-1/4" Flathead M.S. Phillips (pkg. of 20)	500-012
17	1-72 x 1/4" Roundhead M.S. (pkg. of 20)	500-024
16	Fiber Washer (pkg. of 20)	500-024
7	1/16" x .420" Gear Pin	500-006
6	1/16" x .205" Gear Pin, Drilled	500-021
12	5/32" Grommets (pkg. of 20)	500-002
19	See Electronic Assembly (for Series '71 300-160)	300-122
11	See Connector Assembly	123-002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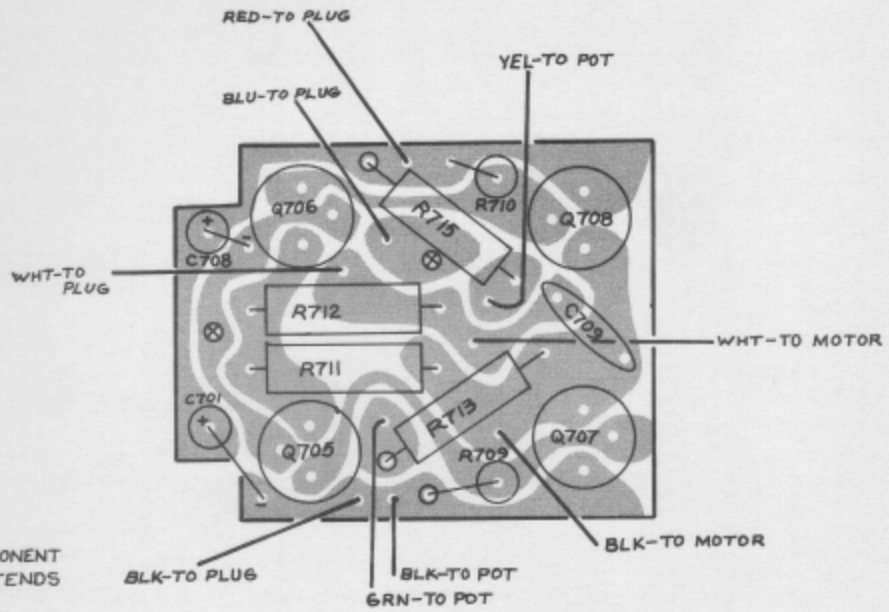
KPS-10

Fig. 52

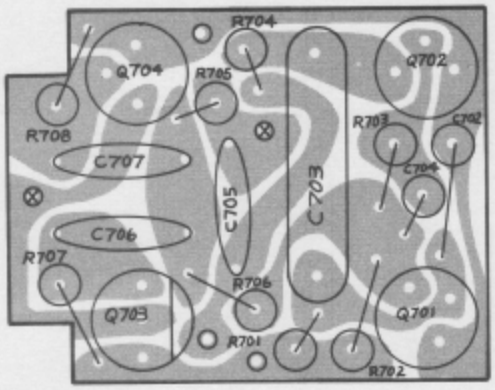
UPPER DECK

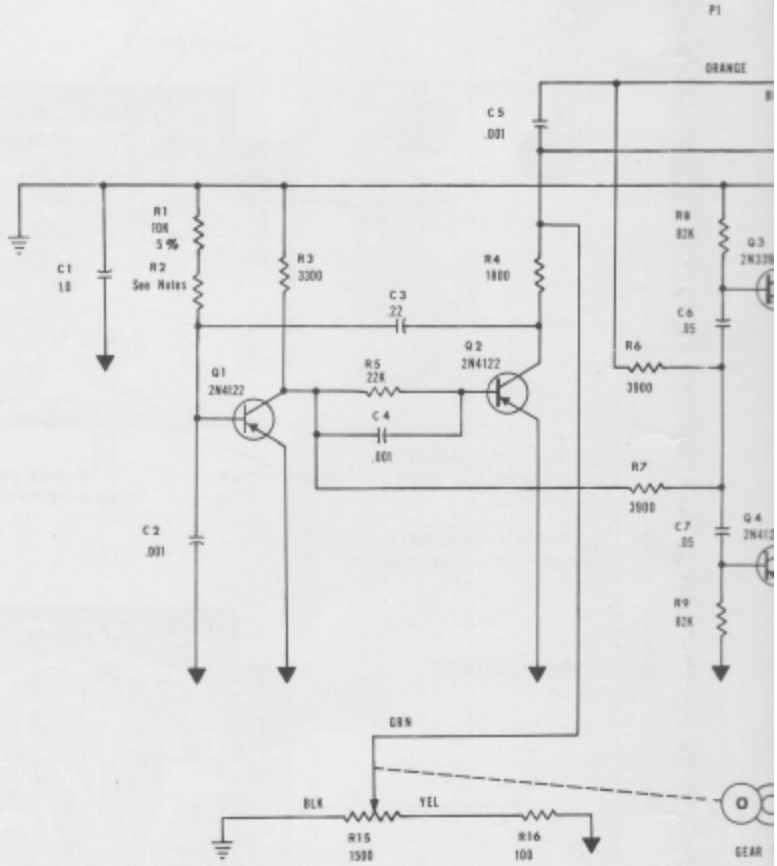


○ INDICATES COMPONENT LEAD WHICH EXTENDS TO LOWER DECK.

⊗ INDICATES FEED-THROGH WIRE BETWEEN DECKS.

LOWER DECK





NOTES:

All Resistors 1/4 watt 10% Unless Noted. Values in OHMS (K=1,000)

All Capacitor Values is of " " Values above .1 uf are Tantalum

R2 is selected at the factory for proper travel.

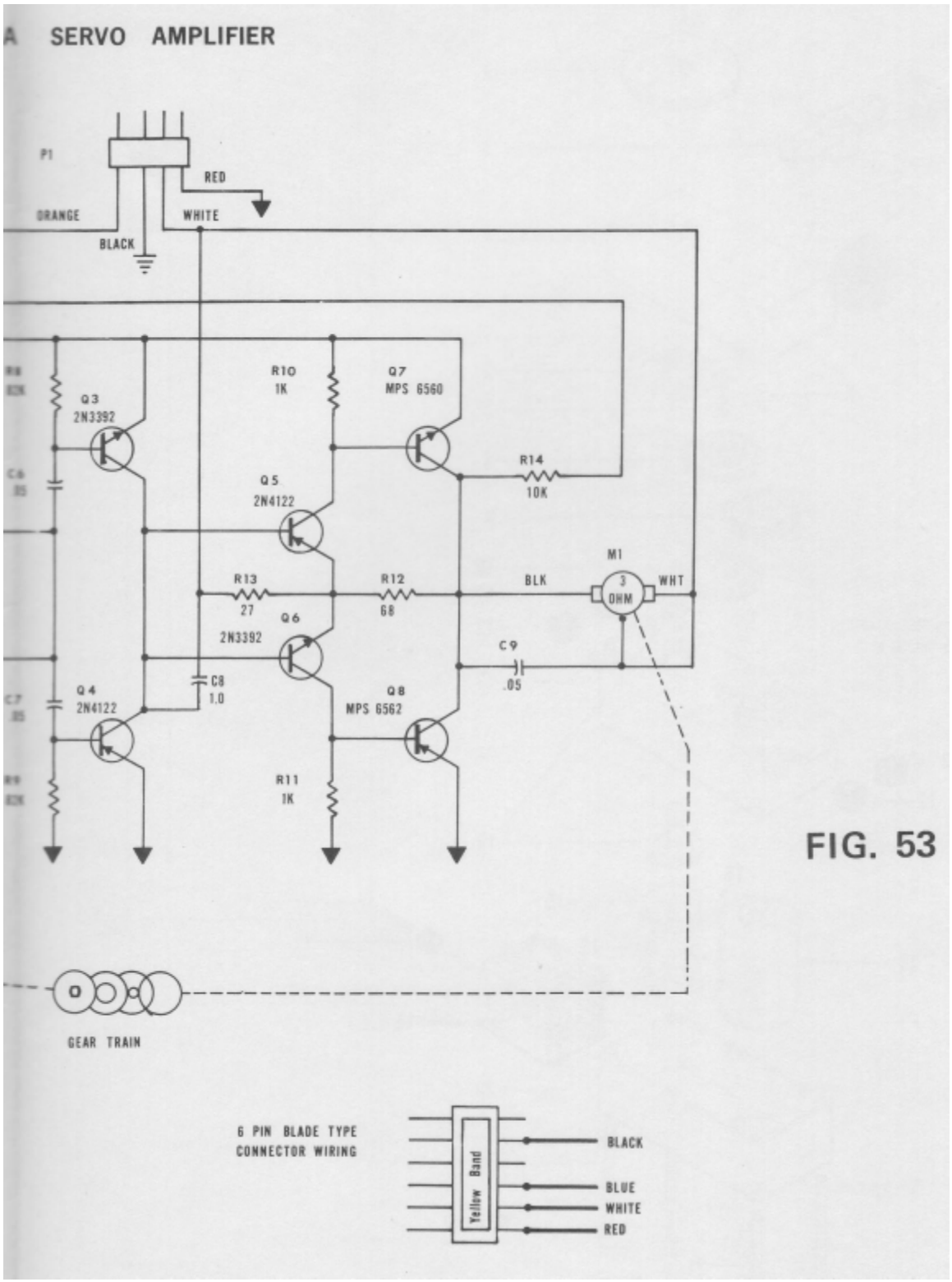

A SERVO AMPLIFIER
P1
RED
ORANGE
WHITE
BLACK
Q3
2N3392
R10
1K
Q7
MPS 6560
R14
10K
Q5
2N4122
M1
3
OHM
BLK
WHT
R13
27
R12
68
Q6
2N3392
C9
.05
C8
1.0
Q4
2N4122
Q8
MPS 6562
R11
1K
GEAR TRAIN
6 PIN BLADE TYPE
CONNECTOR WIRING
Yellow Band
BLACK
BLUE
WHITE
RED

FIG. 53

KPS-11 and KPS-11A SERVOS

Fig. 53

These Series Seventy servos use the same basic amplifier configuration as the Gold Medal Series KPS-9A and KPS-10.

Referring to the (KPS-10 Servo Amplifier, or the KPS-9A servo Amplifier), the circuitry is identical with the exception of the timing components in the reference generator. The 75K base resistor to the first transistor is now approximately16K and the .047uf coupling capacitor is now a .22uf tantalum P/N 116-009. Up to the output transistors, the circuitry is identical to the KPS-9A and KPS-10.

In 1970, a new silicon complementary pair MPS-6560 (NPN) and MPS-6562 (PNP) are used as output transistors. These transistors offer superior gain and low saturation at no increase in cost.

The KPS-11 servo with linear outputs must have its reference generator base resistor trimmed as was the case with the KPS-9A, in order to optimize linear output travel. This resistor is factory selected in the same manner as the KPS-9A.

Since the bottom case of the KPS-11(A) servo contains the mounting ears, crash damage usually resulting in snapped ears can be repaired without tearing the gear train out. It will be necessary, however, to unsolder the board wiring to the plug in order to remove the bottom of the case.

The mechanics of the KPS-11(A) servo are similar to earlier types, with the exception of the output racks and pot wiper shaft. The output rack gears have take-off tabs molded as an integral part of the gear. This has advantages over screw-on tabs such as those on the KPS-9, in that there is very little danger of an output tab ever coming off in the air due to a forgotten screw.

The pot wiper shaft used on this servo and the KPS-12 is designed to permit centering the servo while it is completely assembled. A molded wiper contact assembly holds one knurled end of the shaft, and the output gear fits over the opposite end. The screwdriver slot in the gear end of the shaft may be turned to center the servo while the servo is plugged into a neutral standard or receiver. It is not necessary, therefore, to rotate the pot element once it is installed in the mechanics, and wired to the amplifier.

If it is necessary to remove the PC board from the mounting posts during repair, be sure to note that the insulating washer beneath one of the mounting screws is replaced during re-assembly. There are two separate PC lands near one hole which may be shorted if this washer is not replaced. Later versions of this amplifier have a modified layout which does not require this washer.

It has come to our attention that some customers are using screws other than those supplied to attach the output wheel to the wiper shaft. Please check to see if any damage has been caused by improper use of screws on this shaft. If you note any damage, replace the shaft and inform the customer of the damage caused by sheet metal screws to the wiper shaft. A 1-72 x 1/8" binder head screw is the **only** proper screw to use on this servo.

During initial production, incorrect material was mistakenly used for several gear shots. In the field after a period of time, the pot shaft began slipping inside the gear. We are now supplying a rotary output cap with all KPS-11 servos to be attached when the linear outputs are used. By installing the cap and screw, the pot shaft cannot slip inside the fourth gear. Service Stations and dealers have been sent a supply of of these caps for the use of their customers. These caps are available direct from the factory by ordering P/N 901-201.

In August 1970, the KPS-11 motor was changed to a 3 ohm type from its present 6 ohm motor. Experience with the KPS-12 has shown the 3 ohm motor to have longer average life as well as increased torque output. The 6 ohm version will still be available in limited quantity for replacements, however, the 3 ohm type may directly replace the 6 ohm motor without modification and in most cases is preferable to the latter type.

PARTS LIST – KPS-11, A SERVO

RESISTORS – All values in ohms (K=1,000)

R1	10K	¼w	10%	057-103
R2	Selected – Value ranges from 2.2 – 8.2K			
R3	3.3K	¼w	10%	057-332
R4	1.8K	¼w	10%	057-182
R5	22K	¼w	10%	057-223
R6	3.9K	¼w	10%	057-392
R7	3.9K	¼w	10%	057-392
R8	82K	¼w	10%	057-823
R9	82K	¼w	10%	057-823
R10	1K	¼w	10%	057-102
R11	1K	¼w	10%	057-102
R12	68	¼w	10%	057-680
R13	27	¼w	10%	057-270
R14	10K	¼w	10%	057-103
	(may be 10K 1/8w 10% 053-103 on earlier versions)			
R15	1.5K	½w	Ceramic Potentiometer	106-012
R16	100	¼w	10%	057-101

CAPACITORS

C1	1.0uf/25v	Tantalum	116-002
C2	.001uf	Disc Ceramic	113-012
C3	.22uf/35v	Tantalum 10% only	116-009
C4	.001uf	Disc Ceramic	113-012
C5	.003uf	Disc Ceramic	113-014
C6	.05uf	Disc Ceramic	113-018
C7	.05uf	Disc Ceramic	113-018
C8	1.0uf	Tantalum	116-002
C9	.05uf	Disc Ceramic	113-018

TRANSISTORS

Q1		2N4122		101-005
Q2		2N4122		101-005
Q3		2N3392		101-004
Q4		2N4122		101-005
Q5		2N4122		101-005
Q6		2N3392		101-004
Q7		MPS-6560		101-013
Q8		MPS-6562		101-012

MISCELLANEOUS

P1	4 pin plug		Multicon Socket Contacts w/wires	123-002
M1	Motor	6 ohm		800-002
M1*	Motor	3 ohm		800-005
Complete Amplifier sub-assembly				300-139

* was made available after September 1970

NOTES:

MECHANICAL ASSEMBLY KPS-11, -11A

(See exploded parts view – Fig. 54)

Key No.		
17	Motor, KPS-10, KPS-11, KPS-11A 10 ohm	800-006
6	Case, Top KPS-11	901-161
4	Case, Top KPS-11A	901-162
16	Case, Center	901-163
25	Case, Bottom	901-164
– – –	Case, Complete KPS-11	901-189
– – –	Case, Complete KPS-11A	901-190
13	Gear, First Intermediate	901-165
10	Gear, Second Intermediate	901-166
12	Gear, Drive	901-167
9	Gear, Pot	901-168
– – –	Gear Set	901-172
7	Right Rack Gear KPS-11	901-169
8	Left Rack Gear KPS-11	901-170
– – –	Rack Gear Set KPS-11	901-171
28	Output Shaft Cap KPS-11	901-201
2	Output Wheel	901-173
3	Output Arm	901-174
– – –	Output Wheel & Arm Set	901-175
18	Pot Wiper Support Disc	901-176
11	Pot Shaft	500-033
29	Pot Wiper Contact	106-023
19	Pot Element 1.5K	106-012
15	Gear Pin .050" x .375"	500-029
14	Gear Pin .050" x .250"	500-030
24	0-80 x 1/4 Machine Screw (pkg. of 20)	500-022
5	2-56 x 3/16 Pan Head M. S. (pkg. of 20)	500-037
26	2-56 x 7/32" Flat Head Phillips (pkg. of 20)	500-031
27	1-72 x 1/4" Binding Head M.S. (pkg. of 20)	500-039
1	1-72 x 1/8" Binding Head M.S. (pkg. of 20)	500-032
22	1/4 O.D. Grommets (pkg. of 20)	500-003
20	Fiber Washer (pkg. of 20)	500-025
21	See Electronic Assembly	300-139
23	See Connector Assembly	123-002

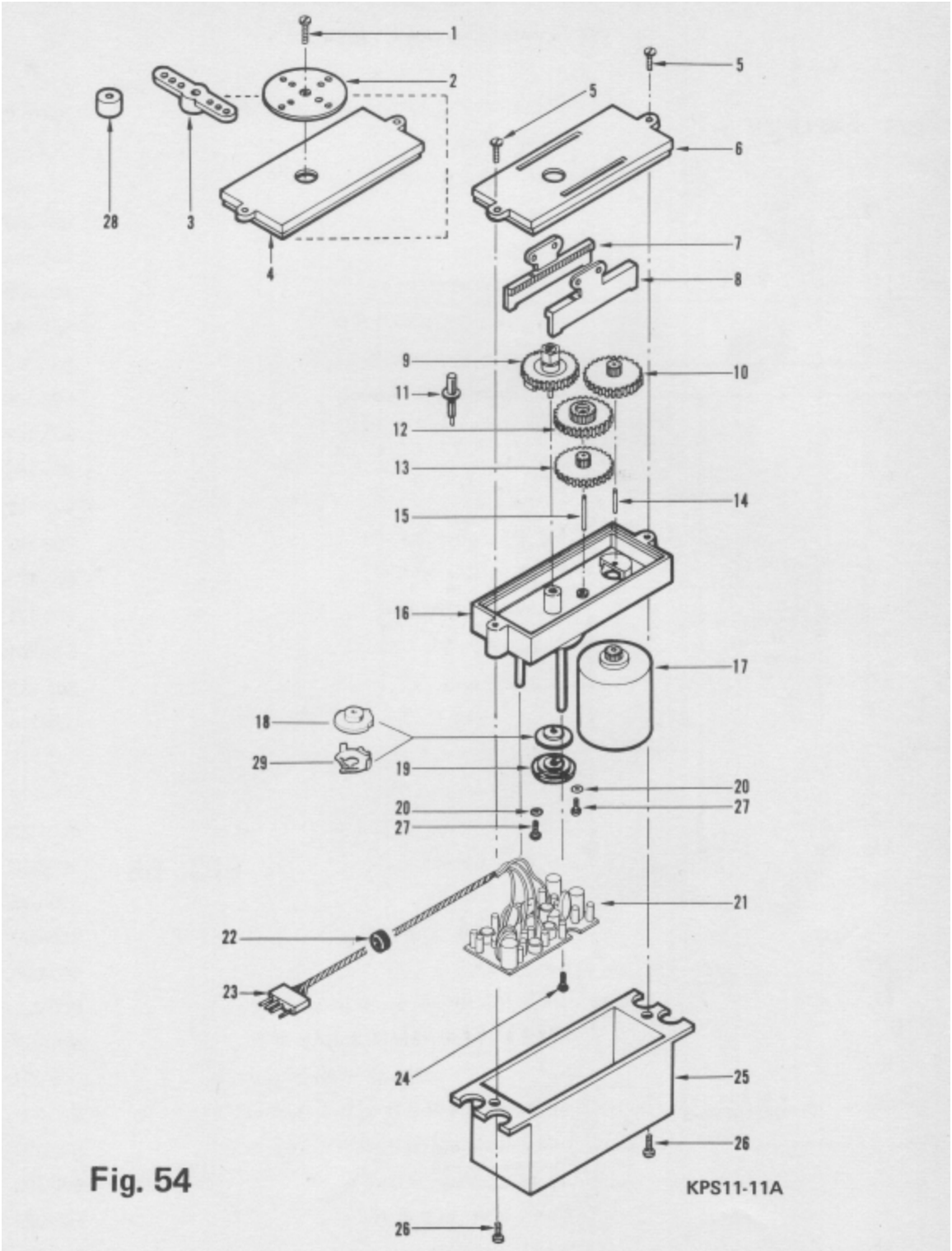
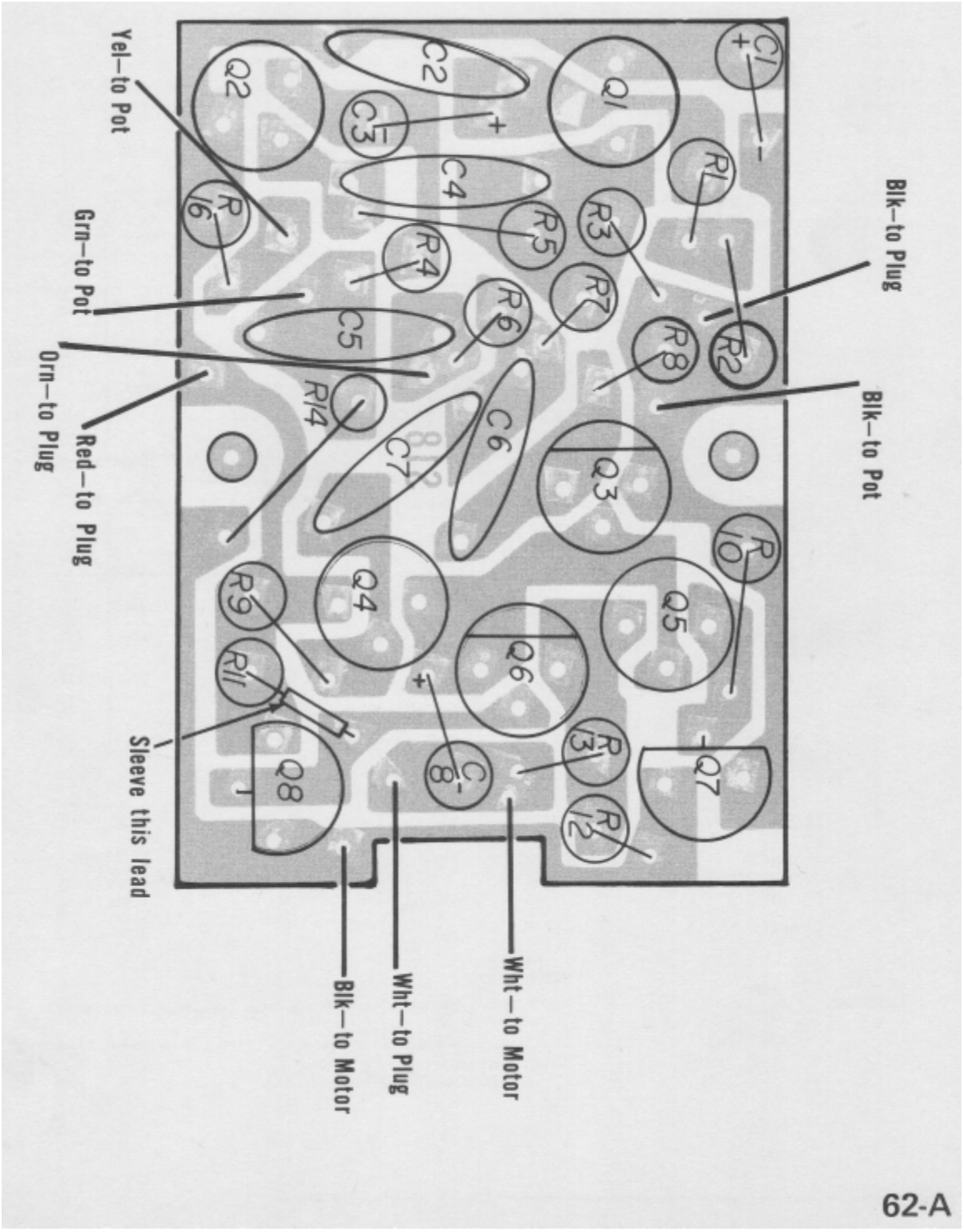
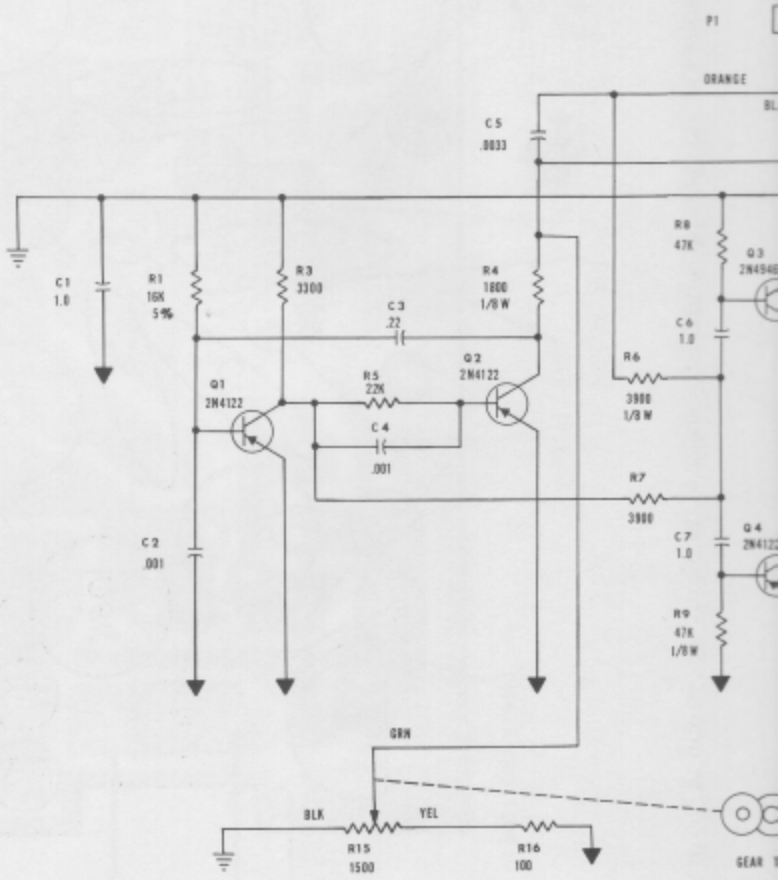


Fig. 54

KPS11-11A


Blk—to Plug
Blk—to Pot
Yel—to Pot
Grn—to Pot
Orn—to Plug
Red—to Plug
Sleeve this lead
Wht—to Motor
Wht—to Plug
Blk—to Motor
C1
R1
R2
Q1
Q2
C2
C3
C4
R3
R4
R5
R6
R7
R8
C5
R14
C6
C7
Q3
Q4
R9
R11
R10
Q5
Q6
C8
Q7
R13
R12
Q8
R16

62-A



NOTES:

All Resistors 1/4 watt 10% Unless Noted. Values in OHMS (K=1,000)

All Capacitor Values in uf " " Values above .1 uf are Tantalum

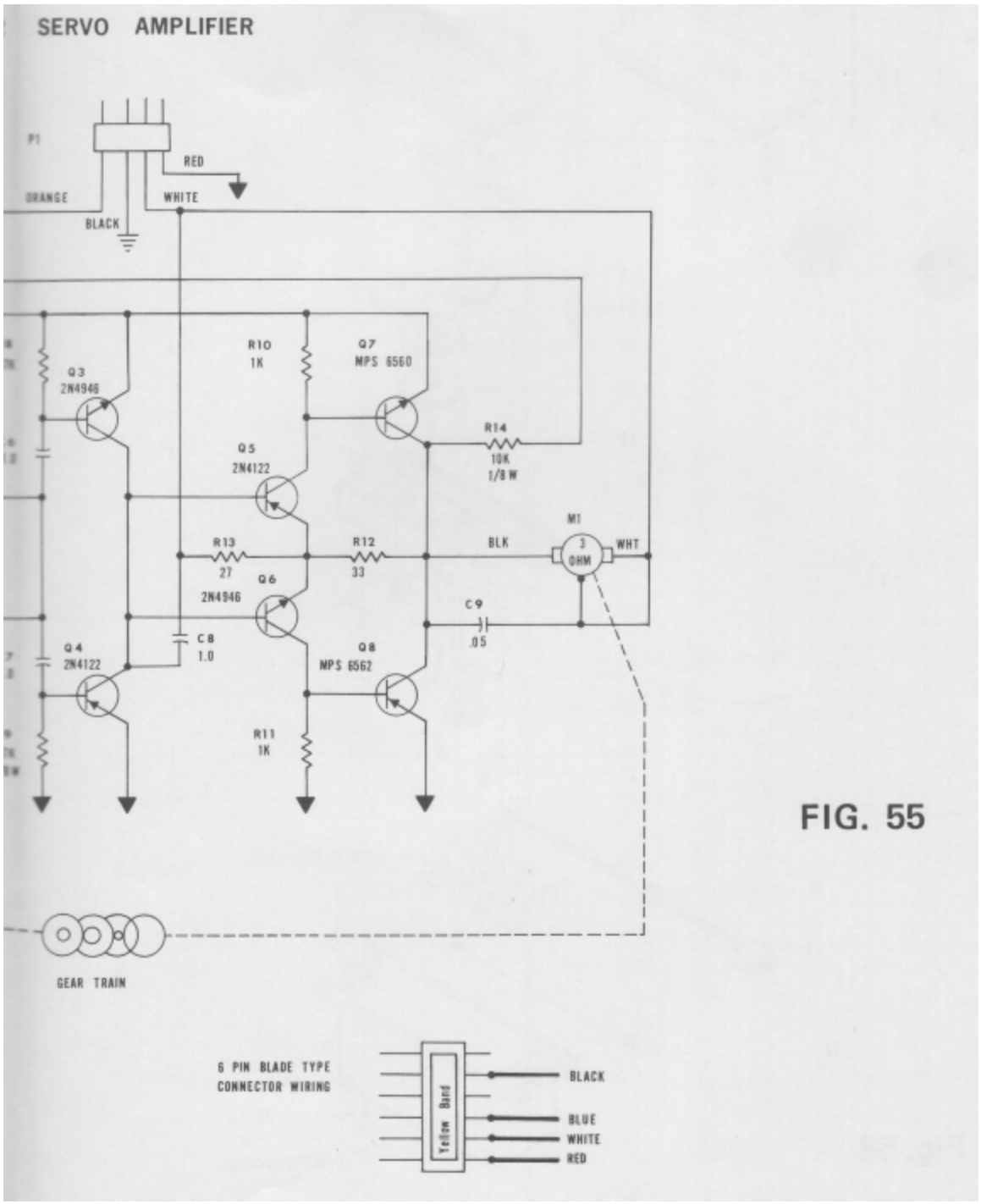

SERVO AMPLIFIER
P1
RED
ORANGE
WHITE
BLACK
R10
1K
Q7
MPS 6560
Q3
2N4946
R14
10K
1/8 W
Q5
2N4122
M1
3
OHM
WHT
BLK
R13
27
R12
33
Q6
2N4946
C9
.05
C8
1.0
Q4
2N4122
Q8
MPS 6562
R11
1K
GEAR TRAIN
6 PIN BLADE TYPE
CONNECTOR WIRING
Yellow Band
BLACK
BLUE
WHITE
RED

FIG. 55

KPS-12 SERVO

New in Series Seventy, the KPS-12 servo is the smallest servo in the line. A miniature 3 ohm motor and two-deck amplifier make this small size attainable.

The electronic package is very small and extreme caution must be exercised in handling it during repair. If it is necessary to repair one of these amplifiers, carefully remove the tape from around the package. Since both foil sides of the boards are exposed, preliminary trouble-shooting can be performed with the decks together. When the trouble has been isolated, simply spread the decks apart and replace the defective part. The two boards can then be folded back together and re-wrapped in the tape. When repairing amplifiers, be sure to watch component clearances, especially between decks, as well as lead dress on all wiring.

The amplifier circuitry is quite similar to that used on the KPS-11(A) except for a couple of values shown in the parts list for the KPS-12.

The mechanics is relatively simple, employing the outside centering capability explained in the text of the KPS-11(A) servo.

PARTS LIST – KPS-12 SERVO

RESISTORS – All values in ohms (K=1,000)

R1	16K	¼w	5%	055-163
R2	not assigned			
R3	3.3K	¼w	10%	057-332
R4	1.8K	1/8w	10%	053-182
R5	22K	¼w	10%	057-223
R6	3.9K	1/8w	10%	053-392
R7	3.9K	¼w	10%	057-392
R8	47K	¼w	10%	057-473
R9	47K	1/8w	10%	053-473
R10	1K	¼w	10%	057-102
R11	1K	¼w	10%	057-102
R12	33	¼w	10%	057-330
R13	27	¼w	10%	057-270
R14	10K	1/8w	10%	053-103
R15	1.5K	½w	Ceramic Potentiometer	106-012
R16	100	¼w	10%	057-101

CAPACITORS

C1	1.0uf/25v	Tantalum	116-002
C2	.001uf	Ceramic Disc or Tubular	113-021 or 114-003

◁ Fig. 55 (fold out at left)

C3	.22uf/35v	Tantalum 10% only	116-009
C4	.001uf	Ceramic Disc or Tubular	113-021 or 114-003
C5	.0033uf	Ceramic Disc (or .005uf Disc)	113-002 or 113-015
C6	1.0uf/25v	Tantalum	116-002
C7	1.0uf/25v	Tantalum	116-002
C8	1.0uf/25v	Tantalum	116-002
C9	.05uf	Disc Ceramic	113-018

TRANSISTORS

Q1	2N4122	101-005
Q2	2N4122	101-005
Q3	2N4946	101-007
Q4	2N4122	101-005
Q5	2N4122	101-005
Q6	2N5088 (may be a 2N4946 in some cases)	101-014
Q7	MPS-6560	101-013
Q8	MPS-6562	101-012

MISCELLANEOUS

P1	4 pin plug – Multicon Socket Contacts w/wires	123-002
M1	Motor, 3 ohm miniature	800-004
Complete Amplifier sub-assembly		300-140

MECHANICAL ASSEMBLY KPS-12

(See exploded parts view – Fig. 56)

Key No.		
20	Motor, KPS-12 12 ohm	800-007
5	Case, Top	901-177
13	Case, Center	901-178
21	Case, Bottom	901-179
– – –	Case, Complete	901-191
12	Gear, First Intermediate	901-180
11	Gear, Second Intermediate	901-181
10	Gear, Drive	901-182
8	Gear, Pot Output	901-183
– – –	Gear, Set	901-187
4	Output Wheel	901-184
1	Output Arm Short – two holes	901-185
3	Output Arm Long	901-186
2	Output Arm Short – one hole	901-198
– – –	Output Wheel & Arm Set	901-188
14	Pot Wiper Support Disc	901-192
9	Pot Shaft	500-034
16	Pot Wiper Contact	106-023
17	Pot Element 1.5K	106-012
15	Gear Pin .050" x .400"	500-061
7	1-72 x 1/8" Binding Head M.S. (pkg. of 20)	500-032
6	3/16" O.D. Grommets (pkg. of 20)	500-040
18	See Electronic Assembly	300-140
19	See Connector Assembly	123-002

MECHANICAL ASSEMBLY KPS-12

(See exploded parts view – Fig. 56)

Key No.		
20	Motor, KPS-12 12 ohm	800-007
5	Case, Top	901-177
13	Case, Center	901-178
21	Case, Bottom	901-179
– – –	Case, Complete	901-191
12	Gear, First Intermediate	901-180
11	Gear, Second Intermediate	901-181
10	Gear, Drive	901-182
8	Gear, Pot Output	901-183
– – –	Gear, Set	901-187
4	Output Wheel	901-184
1	Output Arm Short – two holes	901-185
3	Output Arm Long	901-186
2	Output Arm Short – one hole	901-198
– – –	Output Wheel & Arm Set	901-188
14	Pot Wiper Support Disc	901-192
9	Pot Shaft	500-034
16	Pot Wiper Contact	106-023
17	Pot Element 1.5K	106-012
15	Gear Pin .050" x .400"	500-061
7	1-72 x 1/8" Binding Head M.S. (pkg. of 20)	500-032
6	3/16" O.D. Grommets (pkg. of 20)	500-040
18	See Electronic Assembly	300-140
19	See Connector Assembly	123-002

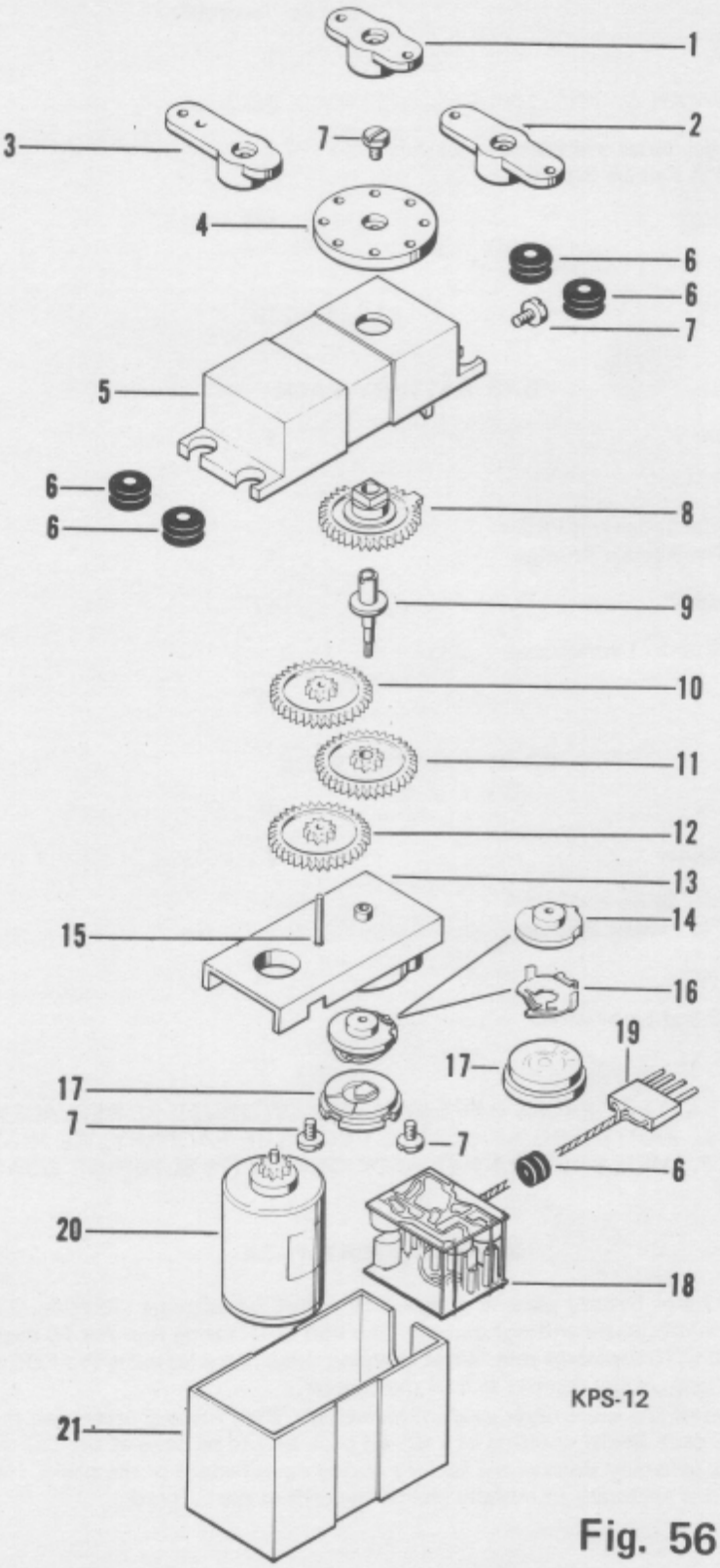


Fig. 56

KB-4A BATTERY PACK

Item	No. Per Assembly	Part Number
Case, Top and Bottm	1	901-195
Cell Stack 2.4V 500 MAH	2	130-004
Connector, Gold Medal Series and PCS-4 4 Pin Female Brunner	1	120-011
Wire - Red, White, Black	11"	990-019
Connector, Series '70 and '71 Wired		123-001
Tape, Cloth	12"	990-014

KB-4B BATTERY PACK

Case, Top and Bottom	1	901-150
Cell Stack 2.4V, 500 MAH	2	130-004
Connector, Gold Medal Series and PCS-4 4 Pin Female Brunner	1	120-011
Wire - Red, White, Black	11"	990-019
Connector, Series '70 and 71 wired		123-001
Tape, Cloth	12"	990-014

KB-4C BATTERY PACK

Case, Top and Bottom	1	901-151
Cell Stack 2.4V 225MAH	2	130-006
Connector, Gold Medal Series and PCS-4 4 Pin Female Brunner	1	120-011
Wire - Red, White, Black	11"	990-019
Connector, Series '70 and Later wired		123-001
Tape, Cloth	10"	990-014

THE KB-4A, B & C BATTERY PACKS HAVE BEEN DISCONTINUED AS REPLACEMENT PACKS, BUT REPLACEMENT PARTS ARE AVAILABLE FROM THE FACTORY. WE HIGHLY RECOMMEND THE USE OF THE KB-4E OR KB-4F PACK DUE TO ITS SUPERIOR QUALITIES. SEE KB-4E AND KB-4F.

KB-4E BATTERY PACK

The KB-4E fast charge battery pack is designed to withstand extreme vibration. The cells will accept charging rates to C/3 continuously without damage. The 550 MAH rating is at the 1C discharge rate, and increases to 600 MAH at C/10 discharge rate. When charging these batteries using the KBC transformer dharger, install a type 1815 lamp in the receiver side of the charger.

Due to the nature of the electrolyte used in this battery, shelf life is shorter with these cells than with the standard pencell ni-cads. Initial charging of a KB-4E pack should be done at the C/3 rate to help activate the electrolyte. This is generally done at the factory during manufacture of the packs. However, when buying replacement cells, it is necessary to initially charge the cells at the C/3 rate.

CELL FAILURE

Occasionally a cell will fail to take a charge even at the high rate. Since these cells are designed for heavy-duty use, they can also withstand instantaneous high charge rates without damage. In order to "clear"

a cell which has been reverse charged or will not accept a charge, a high current source is needed. Generally a power supply capable of 3-5 AMPS at 1-12 volts is all that is necessary. A 12 volt transformer and half wave rectifier will suffice. Current should be monitored during "clearing." Apply the power supply voltage across the cell and if the cell takes a charge at all, a decrease in current will be noted. Continue the clearing operation for 10-15 seconds. Charge the cell at the normal C/3 rate for 6-8 hours. Check cell condition by discharging into a known load.

KB-4E BATTERY PACK
PARTS LIST

Item	No. Per Assembly	Part No.
Case	1	901-211
Cell Stack, 2.4v/550 MAH	2	103-006
Connector, wired	1	123-001
Tape, Cloth	8"	900-014
Label	1	600-050

KB-4F BATTERY PACK

A higher capacity version of the KB-4E, the KB-4F, provides a 1 ampere capacity. The same construction is used in these cells as is used in the KB-4E, and the charging instructions are the same as for the "E" version, with the exception that all charging times should be doubled.

KB-4F BATTERY PACK
PARTS LIST

Item	No. Per Assembly	Part No.
Case	1	901-213
Cell Pack, 4.8v/1A.H.	1	130-008
Connector, wired	1	123-001
Tape, Cloth	10"	990-014
Label	1	600-050

KB-4D BATTERY PACK

The factory has received many sets for repair which were inoperative or erratic due to improper installation of batteries in the case or batteries other than those recommended in the instructions.

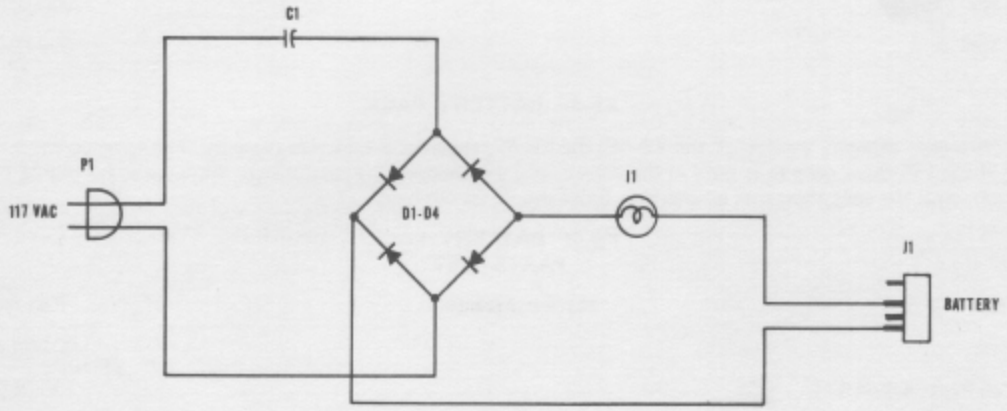
Customers with this type of trouble should be advised to pay particular attention to the instruction manual regarding batteries. Contacts should be cleaned regularly with an eraser, and **only** premium batteries such as Alkaline Energizers or Mallory Duracell batteries are to be used. Ordinary carbon-zinc standard batteries often have false bottoms which lose contact under even the slightest vibration. These batteries are not really capable of delivering the necessary power to operate the system reliably for any length of time as well.

The KP-2B receiver is designed to operate from either a dry-cell pack or rechargeable batteries. Since receiver sensitivity depends on supply voltage to a certain extent, units being converted to nickel-cadmium batteries should be checked for sensitivity. Most receivers will lose only 3/4 to 1uV sensitivity and will require no adjustment.

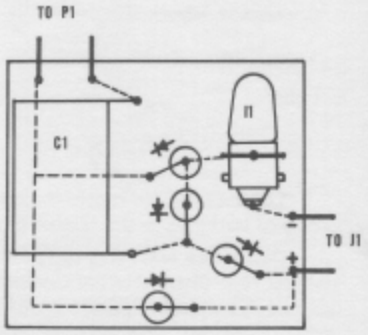
PARTS LIST
KB-4D

No. Required		
1	Case, Battery – Alkaline Pencell	901-206
1	Battery Connector W/3 wires	123-001
1	Rubber Grommet 5/32" (Pkg. of 20)	500-002

KB-4BC & 4CC BATTERY CHARGERS



	KB-4BC	KB-4CC	
C1	1.0	.47	uf
I1	1820	1819	Lamp
D1-4	200 V P/V	750 ma	



KB-4BC & -4CC BATTERY CHARGERS

These chargers employ the a-c impedance of a capacitor to provide a charge rate suitable to the battery being charged. Employing a full-wave bridge rectifier allows the use of smaller value capacitors than would be required for half-wave rectification.

In practice, about 40 MA is available per microfarad of series capacitance. This yields sufficient current to charge a 500 MAH nickel-cadmium battery of up to twelve cells series connected.

In order to properly charge the 225 MAH KB-4C battery pack, however, the charge current should be held below 22.5 MA. By halving the series capacitance, a charge rate of 20 MA will be obtained. The closest standard value is .47uf which yields close to 19 MA.

Due to the fact that the a-c impedance of the capacitor is being utilized rather than its d.c. blocking characteristics, it is necessary to employ a capacitor which is a-c RMS rated at more than 120 volts. Typically a good mylar capacitor is capable of handling an a-c voltage 40 per cent of its rated d.c. working voltage. This means the **minimum** d.c. rating should be 300 volts. The 400 volt capacitors used in these charges provide a safety factor of 40 volts RMS to prevent damage due to abnormally high line voltage and transients. It is clear from the foregoing discussion that the series capacitor used in these chargers should never be rated at less than 300-400 volts d.c.

The only service necessary should perhaps be the replacement of a burnt out lamp. When installing new bulbs, solder the tip connection as quickly as possible to prevent damage.

A word of caution when unplugging the charger from the wall: If the plug is pulled at the right moment, the capacitor can have a charge across it of **well over 100 volts.** To avoid the possibility of severe shock, always discharge the prongs of the 117 volt plug against a metal plate with the battery pack connected, before servicing the charger.

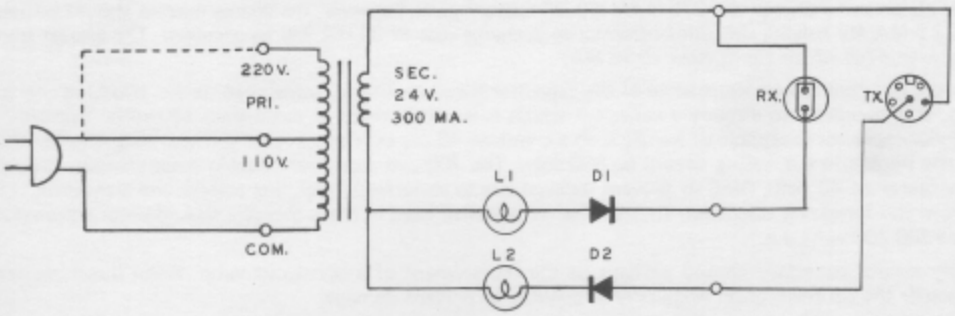
PARTS LIST — KB-4BC & -4CC BATTERY CHARGERS

CAPACITOR			
C1	1.0uf @ 400v	Mylar (KB-4BC only)	115-027
	0.47uf @ 400v	Mylar (KB-4CC only)	115-025
DIODES			
D1-D4	200v P.R.V. @ 750 MA	Silicon Rectifier	100-100
LAMP			
I1	GE No. 1820 28v	(KB-4BC only)	400-003
	GE No. 1819 28v	(KB-4CC only)	400-002
PLUGS and CONNECTORS			
J1	4 pin Female flat receptacle		120-011
P1	117VAC Line cord — made from part of a TV cheater cord		200-000
CASE			
	Charger case with jewel and lid		901-154

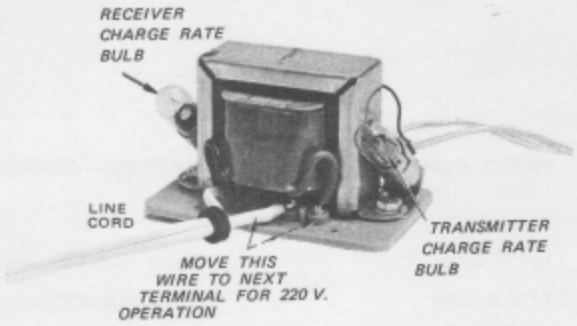
TRANSFORMER BATTERY CHARGER
Model KBC

In order to eliminate the danger of non-isolated battery chargers and provide a more flexible charger, the KBC Transformer Charger was introduced in 1971 models.

In addition to providing isolation from the A. C. line, the transformer used allows operation from both 110 and 220 volt power and by changing the lamps in each side of the charger a number of charge rates are obtainable. Separate leads are provided for both the transmitter and receiver battery packs and either or both may be charged as desired.



The illustration below shows the connections for 110 or 220 volt operation, and the location of both lamps in the charging circuit.



The lamp used in each half of the charger circuit determines the charge rate. Listed below are several charge rates and the lamps necessary to provide them:

Battery (MAH)	Charge Rate (mA)	Tx (9.6_v)	Rx (4.8_v)
450-550	45 mA	* 1820	* 1820
225-250	25mA	-----	* 1819
450-550 (FC) *	** 150 mA (fast charge)	* 1816	* 1815
225-250 (FC) *	** 75 mA (fast charge)	-----	* 1488

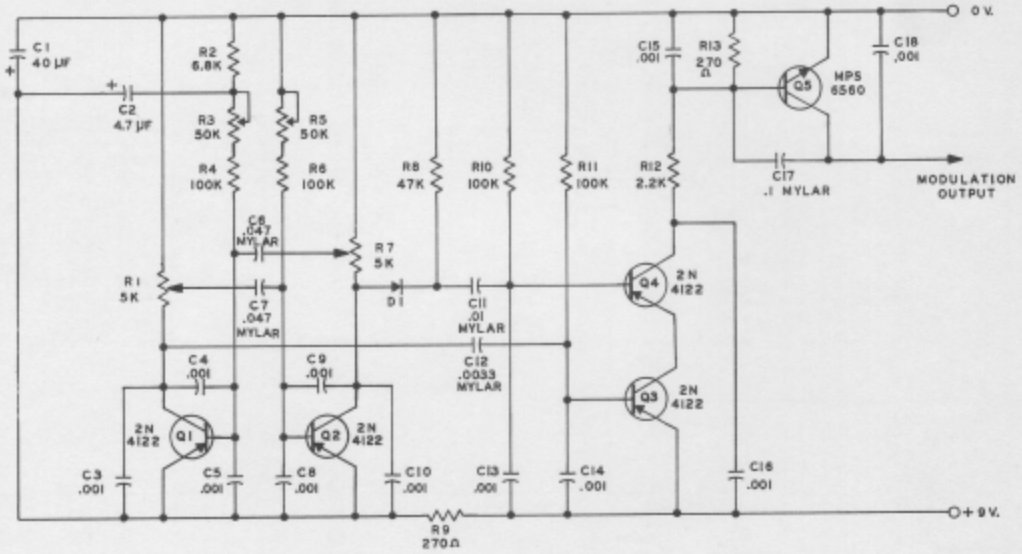
* (FC) indicates fast charge type batteries.

** Lamps required for 3-4 hr. charge rate batteries. Do not use with standard charge rate batteries.

PARTS LIST – KBC BATTERY CHARGER

		Part No.
Transformer		
T1	110/220 VAC 50-60Hz (Pri.) 24 VAC/300MA (Sec.)	103-033
Diodes		
D1, D2	200v/750MA Silicone Diode	100-100
Case Parts		
Charger Case		901-205
Red Lens		901-156
Decal		600-043
Misc.		
Lamp Socket (2 reqd.)		500-050
Case Screws (4) 2-56x 5/16"		500-053
XFMR Mounting Screws No. 4 x 1/2"		500-044
XFMR Mounting Nuts No. 4/40		500-045
Lamps		
No. 1488		400-004
No. 1815		400-005
No. 1816		400-006
No. 1819		400-002
No. 1820		400-003
Cables		
Line Cord		123-007
Tx Charge Cord		123-008
Rx Battery Charge Cord		123-000

TRANSMITTER ENCODER



ALL RESISTORS 1/4 WATT 10% UNLESS NOTED. VALUES IN OHMS (K=1000)

ALL CAPACITOR VALUES IN µF UNLESS NOTED. VALUES ABOVE .1 µF ARE TANTALUM

ALL DIODES SILICON

COIL DATA

27 MHZ	72 MHZ
L1- 15 TURNS	L1- 10 TURNS
L2- 3 TURNS	L2- 2 TURNS
L3- 16 TURNS	L3- 5 TURNS
	L4- 2 TURNS
	L5- 4 TURNS SPACED 1 TURN

FIG. 1

FIG. 2

TRANSMITTER R.F. SECTION

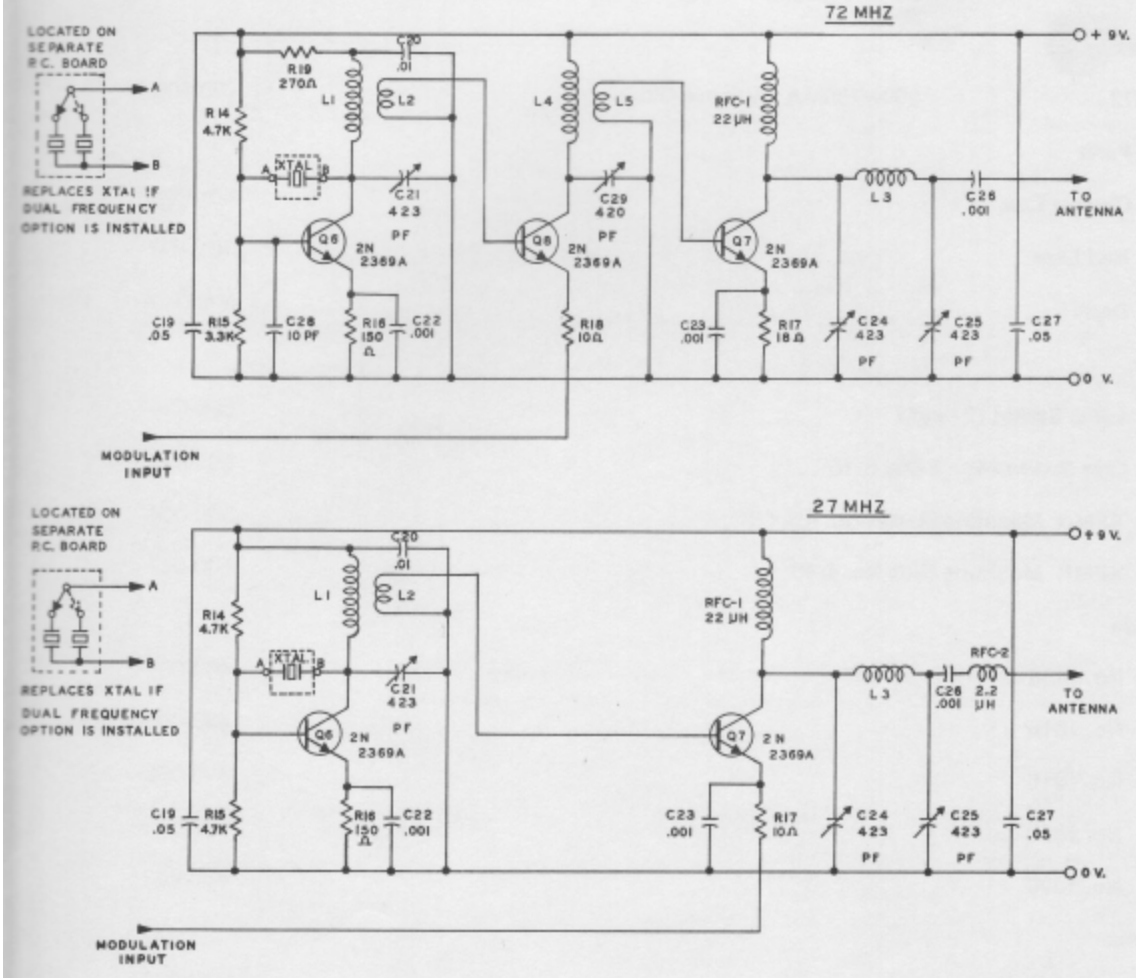


FIG.3

KP-2B TWO CHANNEL TRANSMITTER
(Fig. 1)

The KP-2B two channel system while using much of the same type of circuitry of larger systems, has several differences which require explanation. (See Fig. 1)

Q1 and Q2 with their associated components form a free-running multivibrator. R1 and R7 are control pots which each control the length of one half-cycle of the multivibrator. R2 and C2 delay turn-on of one side of the multivibrator to assure starting each time the power is applied.

C11 and C12 set the timing of the modulator pulses which identify each channel. Q3 and Q4 form an "or" gate which is alternately turned off, turning off Q5, for a length of time determined by the size of C11 and C12 and their respective return resistors. Since C11 is three times the value of C12, the turn-off pulse it produces is roughly three times that of C12.

In an actual unit, the modulator pulses are about 250uS and 750uS for C12 and C11 respectively. The absolute pulse width is not overly critical; a three-to-one ratio between the pulse widths however is critical.

Set-up of the transmitter is accomplished by connecting a scope to Q1 collector and adjusting R7 for 2 milliseconds neutral, and R3 to give a travel of 1.5 to 2.5 milliseconds over total control stick throw without trim. The other side of the multivibrator is set in the same way, by adjusting R1 and R5. The overall frame timing depends upon the setting of the control sticks and may be between 3 milliseconds and 5 milliseconds.

The modulator differs from that found on other Kraft sets, since the timing is actually not directly concerned with the output switching transistor, Q 5. Emitter modulation of either the R.F. Buffer or R.F. Final amplifier transistor (depending on frequency) is used on these systems. R.F. tuning is the same as that of other sets. Refer to tuning procedures on pages 11,12 of the Kraft Service Manual. R.F. Sections 72MHz (Fig. 2) 27MHz (Fig. 3).

Any servicing problems with the transmitter will generally be confined to transistor failures. Since the transmitter is dry-battery powered, some difficulties may be experienced due to weak batteries.
When a unit is returned for servicing first check the batteries regardless of how new the customer claims they are. Use only the type of battery specified in the instruction manual (Eveready No. 276 or equivalent). The transmitter is not designed to work on any other type of battery and faulty operation may result if this caution is overlooked.

PARTS LIST – ENCODER/MODULATOR

RESISTORS – All values in ohms (K=1,000)

R1	5K	½w	W.W. Potentiometer	106-006
R2	6.8K	¼w	10%	057-682
R3	50K	½w	Carbon Potentiometer	106-018
R4	100K	¼w	10%	057-104
R5	50K	½w	Carbon Potentiometer	106-018
R6	100K	¼w	10%	057-104
R7	5K	½w	W.W. Potentiometer	106-006
R8	47K	½w	10%	057-473
R9	270 ohm	¼w	10%	057-271
R10, R11	100K	¼w	10%	057-104
R12	2.2K	¼w	10%	057-222
R13	270 ohm	¼w	10%	057-271

◁ See Fold Out At Left

CAPACITORS

C1	40uf	16v	Alum. Electrolytic	116-008
C2	4.7uf	6v	Tantalum	116-004
C3-C5	.001uf	100v	Disc Ceramic	113-012
C6	.047uf	10%	200v Mylar	115-009
C7	.047	10%	200v Mylar	115-009
C8-C10	.001uf	100v	Disc Ceramic	113-012
C11	.01uf	100v	Mylar	115-001
C12	.0033uf	100v	Mylar	115-000
C13-C16	.001uf	100v	Disc Ceramic	113-012
C17	.1uf	200v	Mylar	115-018
C18	.001uf	100v	Disc Ceramic	113-012

TRANSISTORS AND DIODES

Q1-Q4	2N4122	PNP Transistor	101-005
Q5	MPS-6560	NPN Transistor	101-013
D1	DA-805 or IN4148	Silicon Diode	100-101

TRANSMITTER R. F. SECTION

27MHz

RESISTORS – All values in ohms (K=1,000)

R1	4.7K	¼w	10%	057-472
R2	4.7K	¼w	10%	057-472
R3	150 ohm	¼w	10%	057-151
R4	10 ohm	¼w	10%	057-100

CAPACITORS

C19	.05uf	10v	Disc Ceramic	113-018
C20	.01uf	50v	Disc Ceramic	113-016
C21	7-100pf	Variable Trimmer No. 423		112-002
C22	.001uf	100v	Disc Ceramic	113-012
C23	.001uf	100v	Disc Ceramic	113-012
C24	7-100pf	Variable Trimmer No. 423		112-002
C25	7-100pf	Variable Trimmer No. 423		112-002
C26	.001uf	100v	Disc Ceramic	113-012
C27	.05uf	10v	Disc Ceramic	113-018

TRANSISTORS

Q1-Q2	2N2369A	NPN Transistor	101-006

MISC

XTAL	Order by Crystal Frequency Desired	

COILS

L1/L2	27MHz Osc. Coil	103-026
L3	27MHz Pi Coil	103-003

TRANSMITTER R. F. SECTION

72MHz

RESISTORS – All values in ohms (K=1,000)

R14	4.7K	¼w	10%	057-472
R15	3.3K	¼w	10%	057-332
R16	150 ohm	¼w	10%	057-151
R17	18 ohm	¼w	10%	057-180
R18	10 ohm	¼w	10%	057-100
R19	270 ohm	¼w	10%	057-271

CAPACITORS

C19	.05uf	10v	Disc Ceramic	113-018
C20	.01uf	50v	Disc Ceramic	113-016
C21	7-100pf	Variable Trimmer No. 423		112-002
C22	.001	100v	Disc Ceramic	113-012
C23	.001	100v	Disc Ceramic	113-012
C24	7-100pf	Variable Trimmer No. 423		112-002
C25	7-100pf	Variable Trimmer No. 423		112-002
C26	.001uf	100v	Disc Ceramic	113-012
C27	.05uf	10v	Disc Ceramic	113-018
C28	27pf	NPO	Disc Ceramic	113-007
C29	1-12pf	Variable Trimmer No. 420		112-001

TRANSISTORS

Q6-Q8	2N2369A	NPN Transistor	101-006

MISC

XTAL	Order by Frequency Desired

COILS

L1/L2		72MHz Oscillator Coil	103-007
L3		72MHz Pi-tank Coil	103-009
L4-L5		72MHz Buffer Coil	103-008
RFC-1	22uf	RF Choke	103-022
RFC-2	2.2uf	RF Choke	103-025

ELECTRONIC SUB-ASSEMBLIES – Transmitter

27MHz	PC Assembly – Less Crystal	300-146
72MHz	PC Assembly – Less Crystal	300-148
Dual Frequency Board with Switch-less Crystals		300-158

MECHANICAL PARTS – TRANSMITTER

CASE PARTS

Front and Rear Case Complete – single frequency	904-084/085
Front and Rear Case Complete – dual frequency	904-088
Battery Bracket (2 required)	904-086

MISCELLANEOUS PARTS

Slide Switch	109-007
Battery Clip	120-008
Antenna Post Assembly	901-173
Switch Guard w/screws	200-049
Control Sticks – Assembled – Includes Potentiometer	900-022

HARDWARE

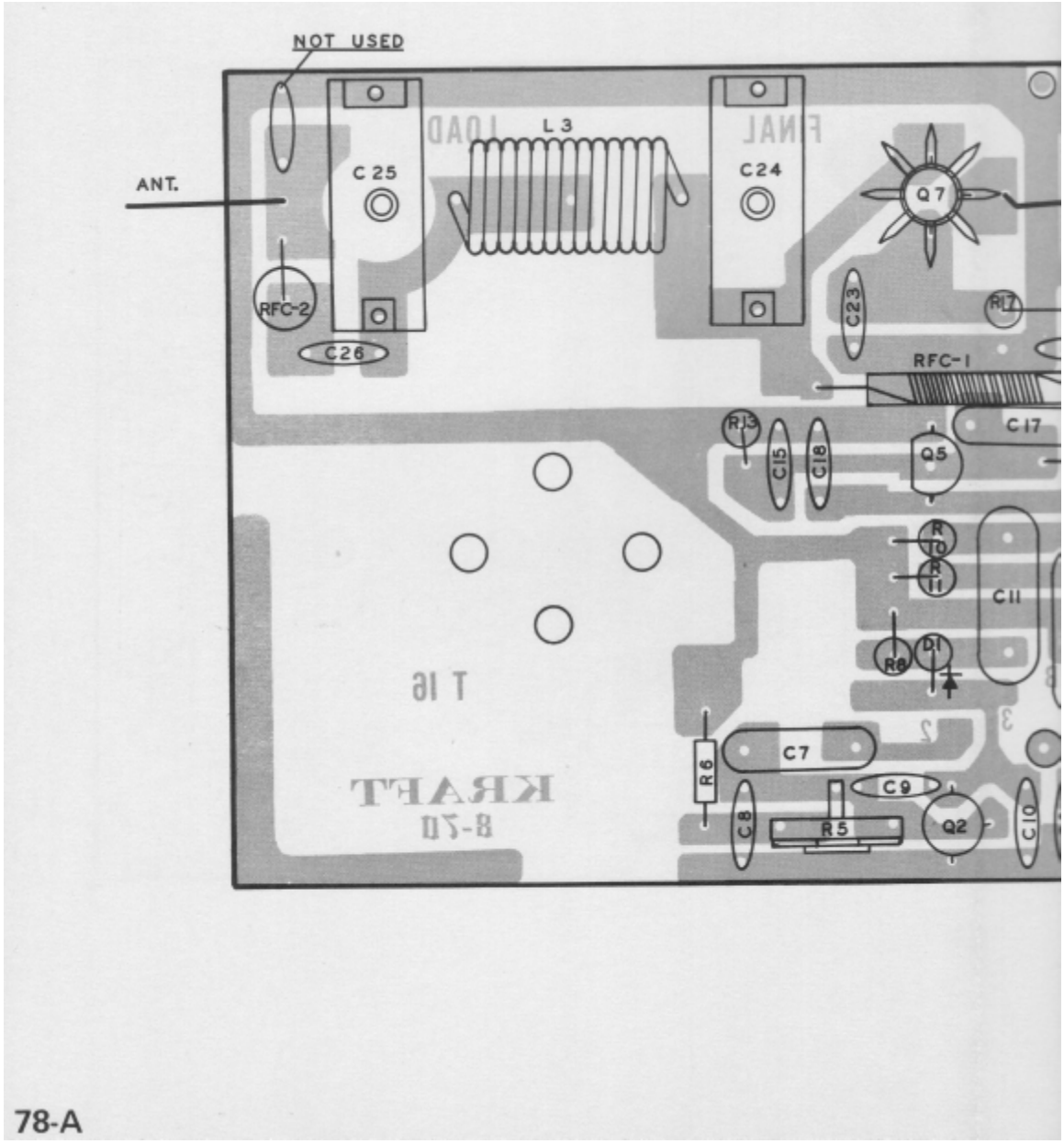
No. 4 x ¼"	Sheet Metal Screw	(2 required) Pkg. of 20	500-013
No. 2 x ¼"	Sheet Metal Screw	(4 required) Pkg. of 20	500-007
Rubber Feet		(8 required) Pkg. of 4	500-005
Fiber Washer		(2 required) Pkg. of 20	500-025

ACCESSORIES

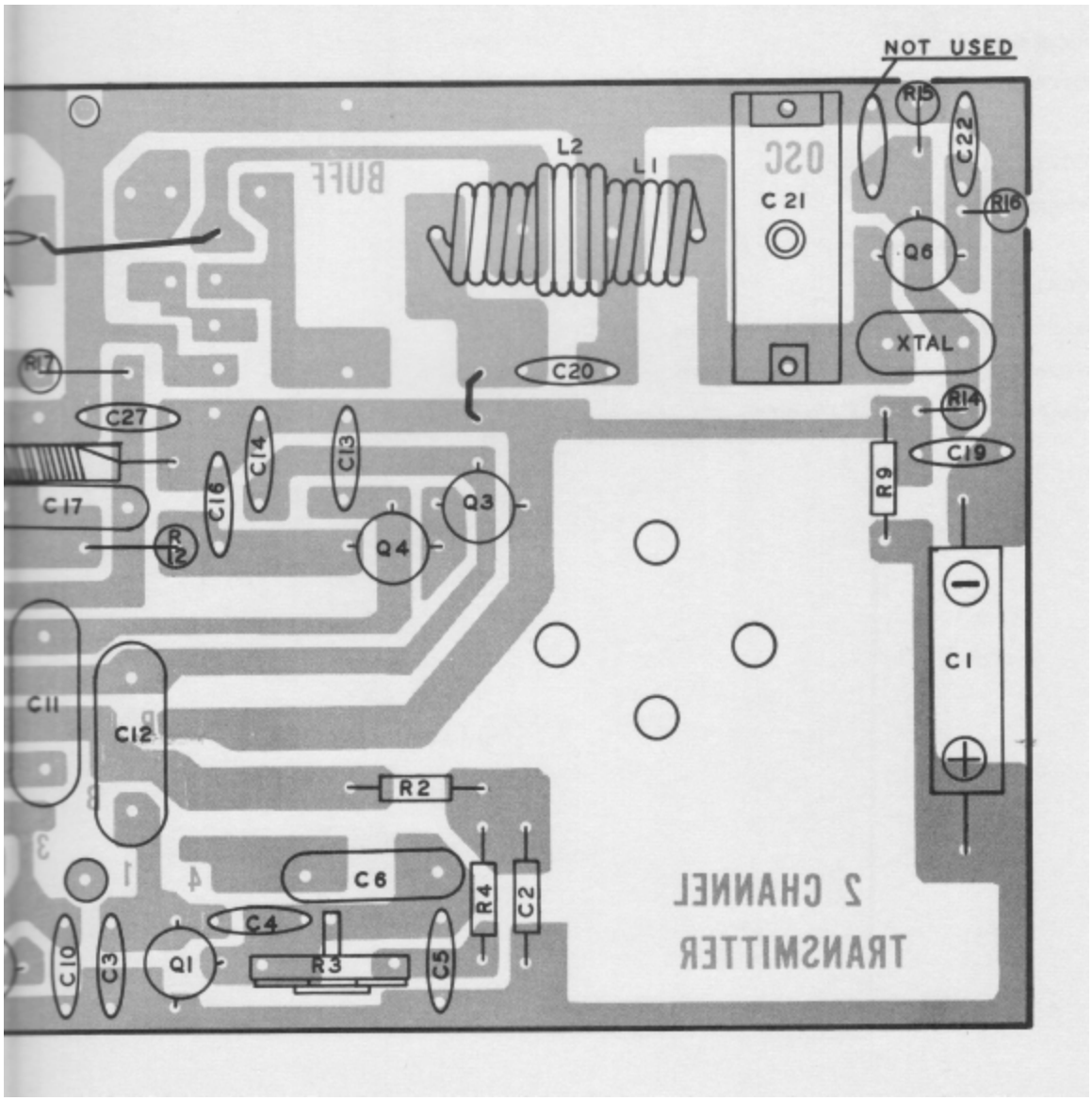
Antenna, Collapsable	200-057

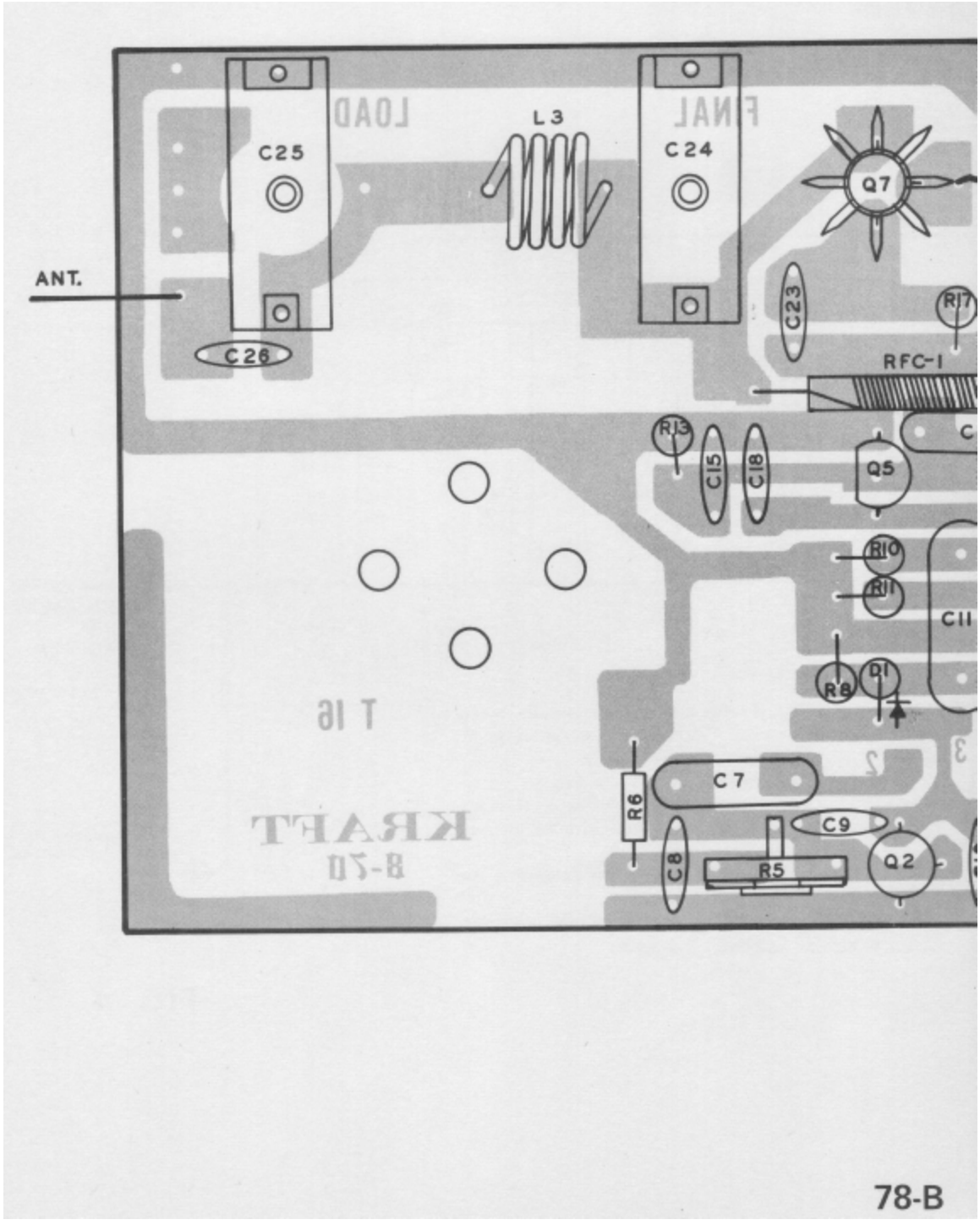
DECALS

Transmitter Name Plate – Series Seventy-one	600-039
Frequency Label – Order Frequency Desired	
Type Acceptance Plate (72MHz only) (Available only to authorized repair stations)	

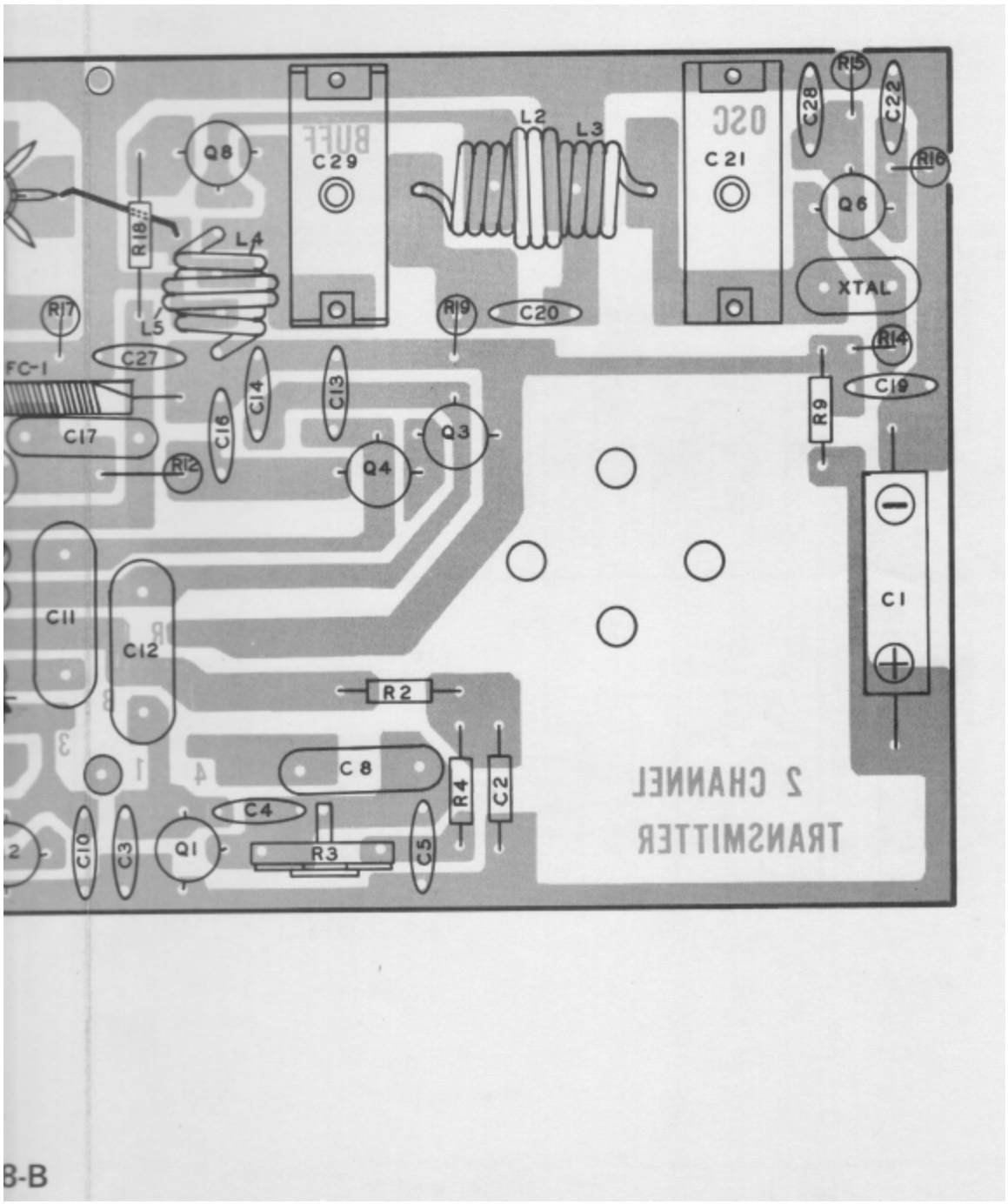

NOT USED
ANT.
C 25
L 3
C24
Q7
RFC-2
C26
C23
RFC-1
C17
R13
C15
C18
Q5
R
10
R
11
C11
R8
D1
C7
R6
C9
C8
R5
Q2
C10

78-A

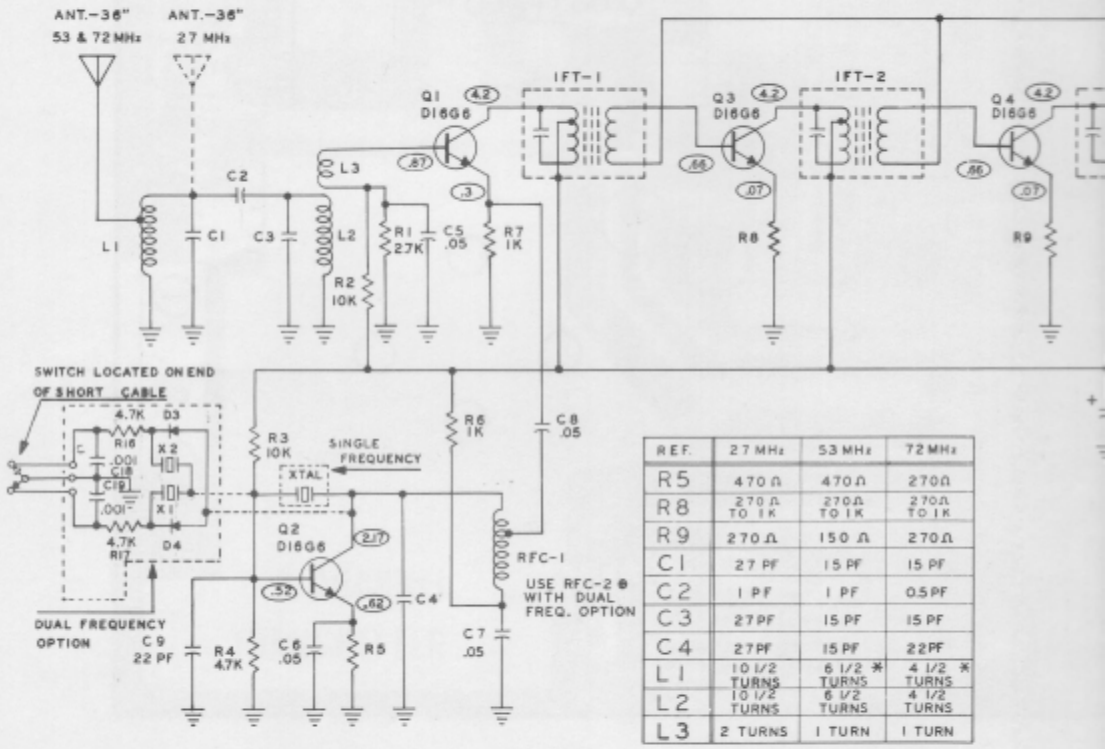

NOT USED
R15
C22
R16
Q6
XTAL
R14
C19
R9
C1
L2
L1
C 21
OSC
BUFF
C20
R17
C27
C17
C14
C13
C16
R12
Q3
Q4
C11
C12
R2
C6
R4
C2
C4
R3
C5
C10
C3
Q1
2 CHANNEL
TRANSMITTER


ANT.
C25
L3
C24
Q7
C23
R17
C26
RFC-1
R13
C15
C18
Q5
R10
R11
C11
R8
D1
C7
R6
C9
C8
R5
Q2
LOAD
FINAL
T 16
KRAFT
B-70

78-B

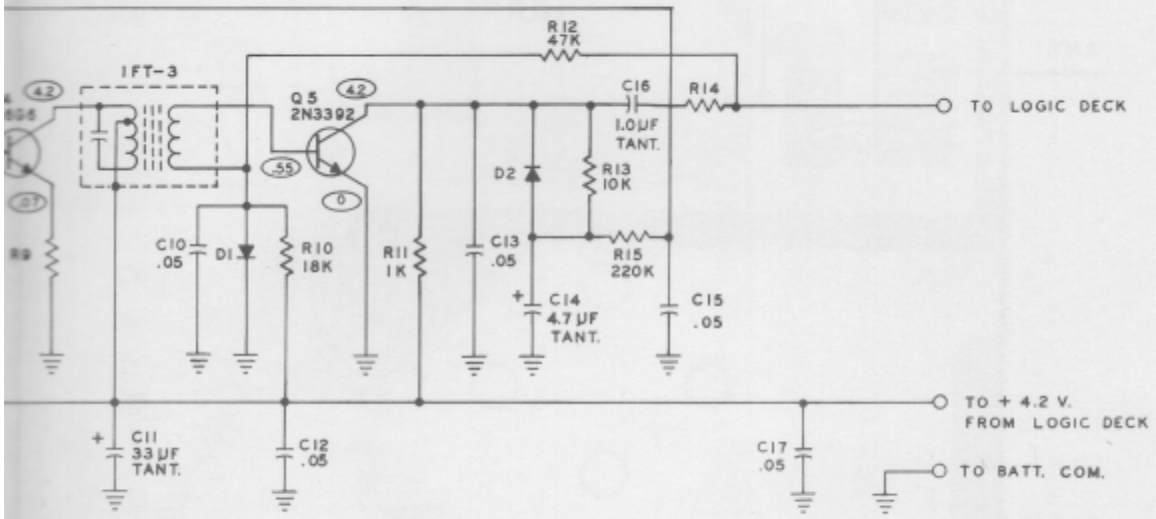

Q8
C29
L2
L3
OSC
C21
C28
R15
C22
R16
Q6
XTAL
R18
L4
L5
R17
C27
FC-1
C17
C16
C14
C13
R12
Q4
Q3
R19
C20
R14
C19
R9
C1
C11
C12
R2
C8
C4
R4
C2
C10
C3
Q1
R3
C5
2 CHANNEL
TRANSMITTER

B-B



REF.	27 MHz	53 MHz	72 MHz
R5	470 Ω	470 Ω	270 Ω
R8	270 Ω TO 1K	270 Ω TO 1K	270 Ω TO 1K
R9	270 Ω	150 Ω	270 Ω
C1	27 PF	15 PF	15 PF
C2	1 PF	1 PF	0.5 PF
C3	27 PF	15 PF	15 PF
C4	27 PF	15 PF	22 PF
L1	10 1/2 TURNS	6 1/2 * TURNS	4 1/2 * TURNS
L2	10 1/2 TURNS	6 1/2 TURNS	4 1/2 TURNS
L3	2 TURNS	1 TURN	1 TURN

ECEIVER



1. ALL RESISTOR 1/4 W. 10% – VALUES IN OHMS (K=1,000).
2. ALL CAPACITORS DISC CERAMIC UNLESS NOTED.
   — VALUES IN µF UNLESS NOTED.
3. ⬭ THIS SYMBOL INDICATES A POSITIVE D.C. VOLTAGE REFERENCED TO GROUND TAKEN WITH A 20,000Ω/V. V.O.M. AND NO INCOMING SIGNAL.
4. PART VALUES NOT INDICATED ON SCHEMATIC ARE SHOWN IN TABLE AT LEFT.

*. TAP AT 3 3/4 TURNS FROM COLD END.

● RFC-2 PART NO. ES-2515

FIG. 4

KP-2B RECEIVER

The receiver, decoder, and servo amplifiers are contained in a single unit which is economical but complicates servicing the unit somewhat.

The receiver front-end is located on the inside top of the case. The circuit is very similar to the R-9A front end used on other systems. The major differences are in AGC, the absence of a diode clipper and decoupling resistor. (See Fig. 4)

Receiver sensitivity is adjusted by means of the emitter resistors of Q3 and Q4 (R8 & R9). Better AGC response was necessary due to the fast information and lack of a sync period.

It should be noted that a different oscillator choke is used for single and dual frequency receivers. When converting a unit to dual frequency, check the parts list at the end of this section and use the appropriate choke.

All receiver boards are adaptable to dual frequency by adding a switch and the necessary components. No external circuit board is required. Refer to component layouts for location of components.

The Kp-2B receiver is designed to operate from either a dry-cell pack or rechargeable batteries. Since receiver sensitivity depends on supply voltage to a certain extent, units being converted to nickel-cadmium batteries should be checked for sensitivity. Most receivers will lose only 3/4 to 1uV sensitivity and will require no adjustment.

PARTS LIST – R-10 RECEIVER FRONT END

RESISTORS – All values in OHMS (K=1,000)

R1	2.7K	¼w	10%	057-272
R2	10K	¼w	10%	057-103
R3	10K	¼w	10%	057-103
R4	4.7K	¼w	10%	057-472
R5	270 ohm	¼w	10% (72 MHz only)	057-271
	470 ohm	¼w	10% (27 MHz only)	057-471
R6	1K	¼w	10%	057-102
R7	1K	¼w	10%	057-102
R8	270 ohm - 1K	¼w	10% adjusted for sensitivity	
R9	270 ohm	¼w	10%	057-271
R10	18K	¼w	10%	057-183
R11	1K	¼w	10%	057-102
R12	47K	¼w	10%	057-473
R13	10K	¼w	10%	057-103
R14	1K	¼w	10%	057-102
R15	220K	¼w	10%	057-224
R16	4.7K	¼w	10% used on dual freq. only	057-472
R17	4.7K	¼w	10% used on dual freq. only	057-472

CAPACITORS

C1	27pf	Disc Ceramic (27 MHz)	113-007
	15pf	Disc Ceramic (72 MHz)	113-005
C2	1pf	Tubular Ceramic (27 MHz)	114-002
	0.5pf	Tubular Ceramic (72 MHz)	114-001
C3	27pf	Disc Ceramic (27 MHz)	113-007
	15pf	Disc Ceramic (72 MHz)	113-005
C4	27pf	Disc Ceramic (27 MHz)	113-007
	22pf	Disc Ceramic (72 MHz)	113-006
C5	.05uf	Disc Ceramic	113-018
C6	.05uf	Disc Ceramic	113-018
C7	.05uf	Disc Ceramic	113-018
C8	.05uf	Disc Ceramic	113-018
C9	22pf	Disc Ceramic	113-006
C10	.05uf/10V	Disc Ceramic	113-018
C11	33uf	Tantalum	116-005
C12	.05uf/10V	Disc Ceramic	113-018
C13	.05uf/10V	Disc Ceramic	113-018
C14	4.7uf/6V	Tantalum	116-004
C15	.05uf/10V	Disc Ceramic	113-018
C16	1.0uf/35V	Tantalum	116-002
C17	.05uf/10V	Disc Ceramic	113-018
C18	.001uf	Disc Ceramic – Used in dual freq. only	113-012
C19	.001uf	Disc Ceramic – Used in dual freq. only	113-012

TRANSISTORS & DIODES

Q1-Q4	D16G6	NPN Transistor	101-008
Q5	2N3392	NPN Transistor	101-004
D1-D2	DA-805 or 1N4148	Silicon Diode	100-101
D3-D4	DA-805 or 1N4148	Silicon Diode (Dual Freq. only)	100-101

COILS & TRANSFORMERS

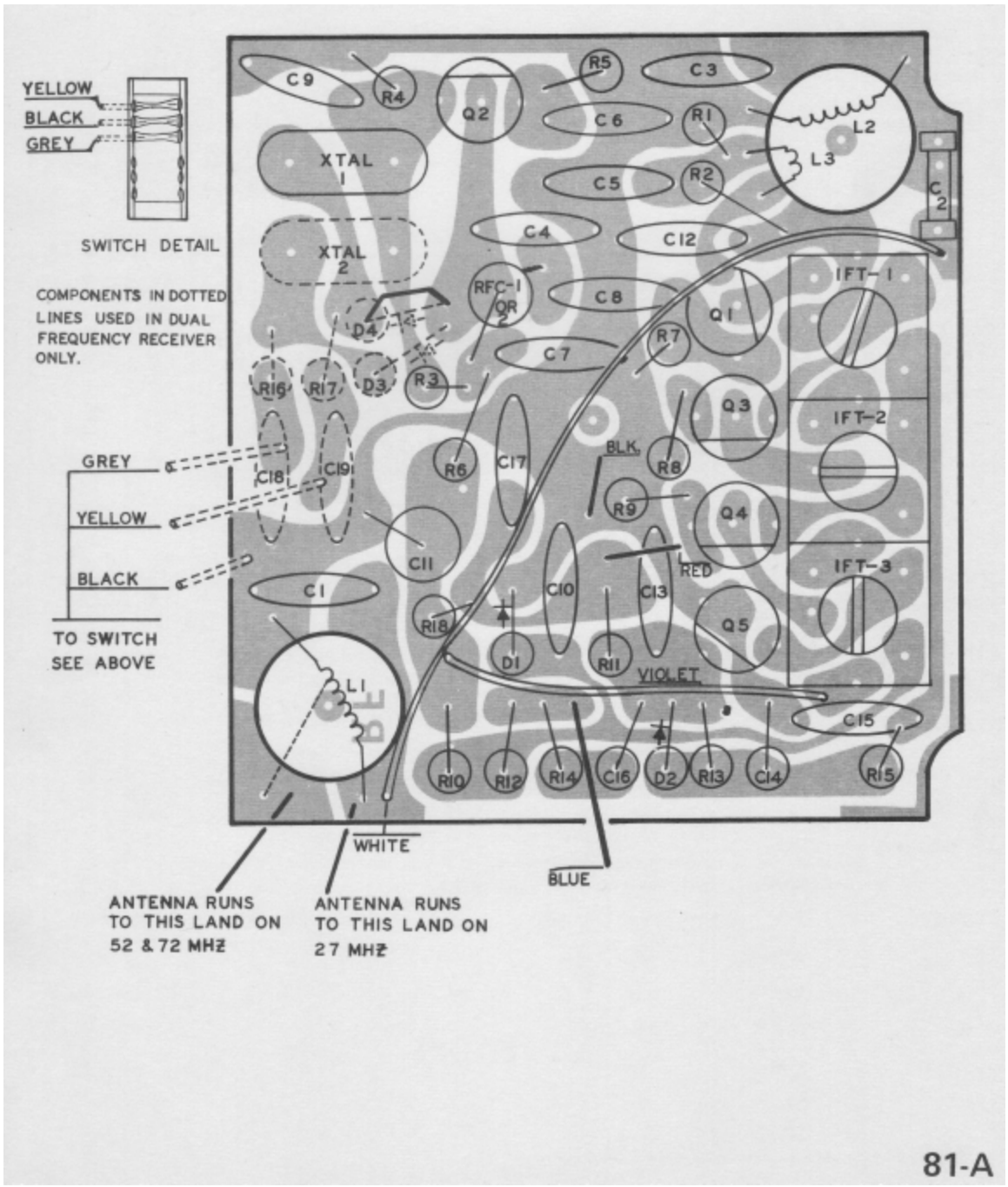
L1	27MHz	Antenna Coil	103-016
	72MHz	Antenna Coil	103-020
L2	27MHz	Mixer Coil	103-017
	72MHz	Mixer Coil	103-021
RFC-1	Oscillator Choke – Single Frequency – 3 Turn tap		103-023
RFC-2	Oscillator Choke – Dual Frequency – 6 Turn tap		103-032
IFT-1	Input I. F. Xfmr (yellow)		103-013
IFT-2	Intermediate I. F. Xfmr (white)		103-014
IFT-3	Output I. F. Xfmr (black)		103-015

MISCELLANEOUS

Xtal	Order by crystal Frequency desired	
Switch	Dual Frequency select switch	109-007

ELECTRONIC – SUB-ASSEMBLIES

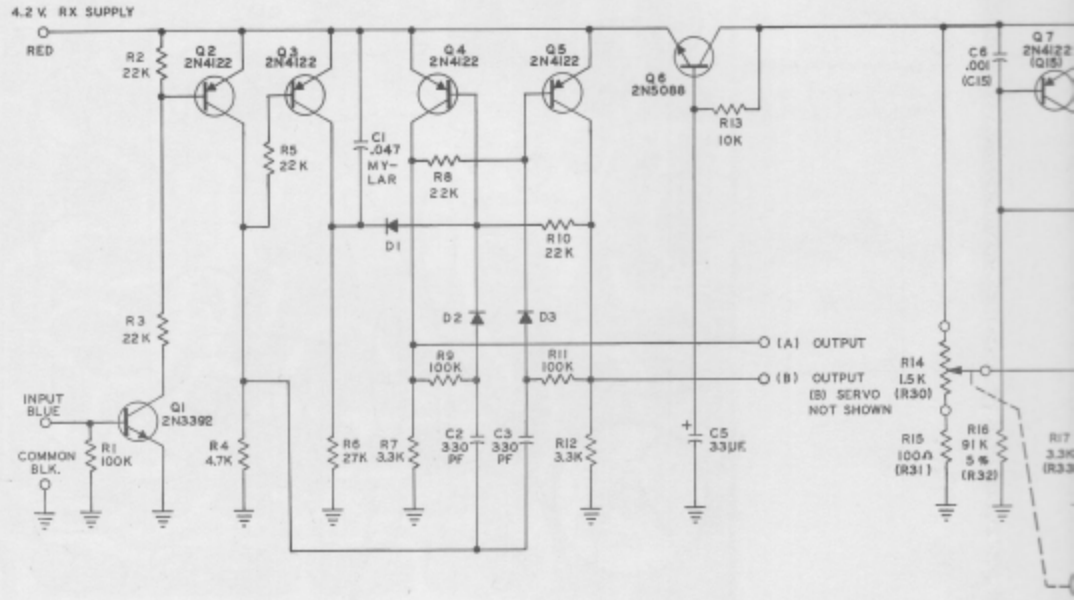
27 MHz	R-10 Front End – Less Xtal	300-149
72 MHz	R-10 Front End – Less Xtal	300-150
27 MHZ	R-10 Front End – Less Extals (Dual Frequency)	300-173
72 MHZ	R-10 Front End – Less Extals (Dual Frequency)	300-174


YELLOW
BLACK
GREY
SWITCH DETAIL
COMPONENTS IN DOTTED LINES USED IN DUAL FREQUENCY RECEIVER ONLY.
C9
R4
Q2
R5
C3
C6
R1
L2
L3
XTAL 1
C5
R2
C2
XTAL 2
C4
C12
IFT-1
RFC-1 OR 2
C8
Q1
D4
C7
R7
R16
R17
D3
R3
Q3
IFT-2
GREY
C18
C19
R6
C17
BLK.
R8
R9
Q4
YELLOW
C11
RED
IFT-3
BLACK
C1
C10
C13
R18
D1
R11
Q5
VIOLET
TO SWITCH SEE ABOVE
L1
C15
R10
R12
R14
C16
D2
R13
C14
R15
WHITE
BLUE
ANTENNA RUNS TO THIS LAND ON 52 & 72 MHZ
ANTENNA RUNS TO THIS LAND ON 27 MHZ

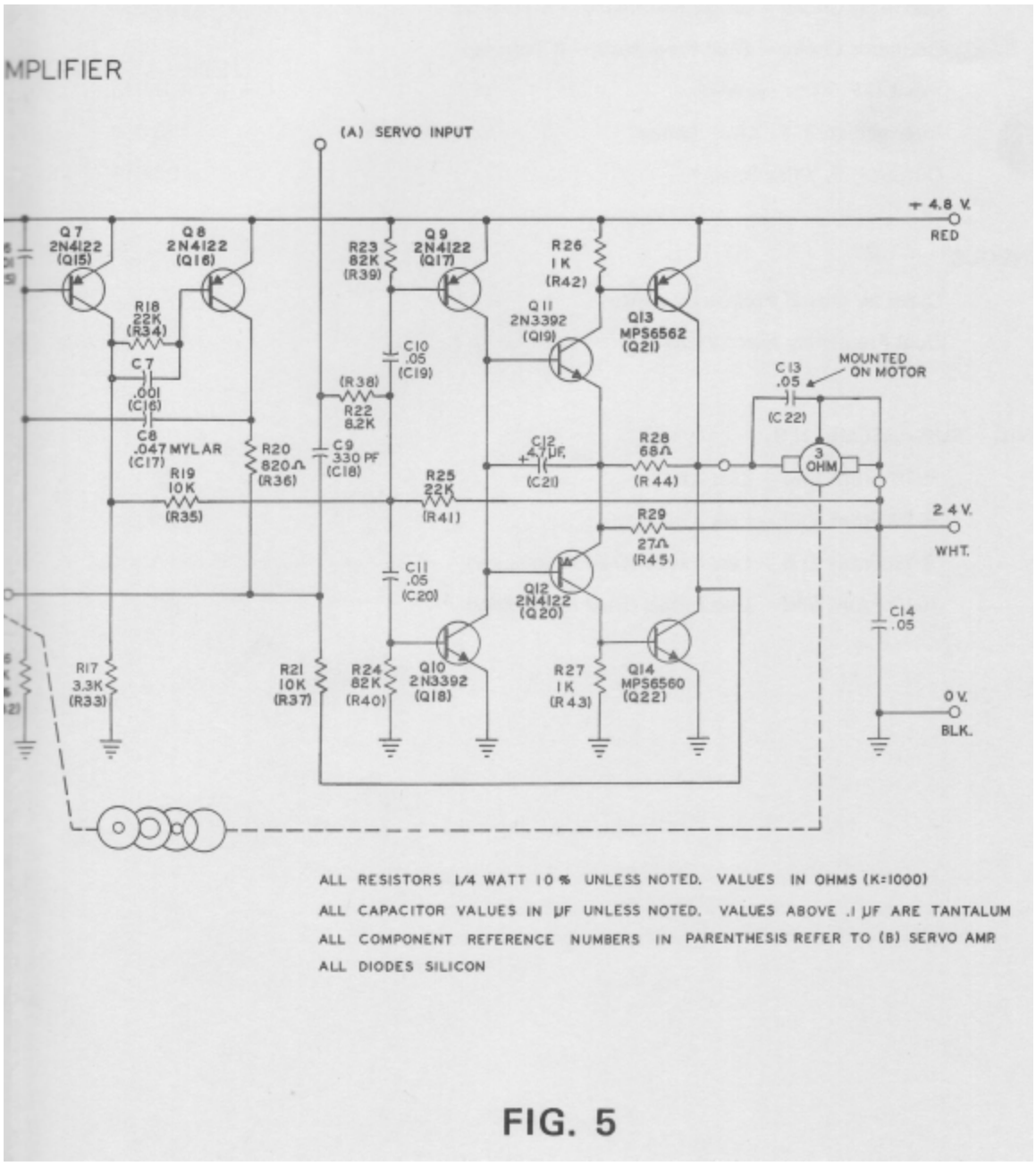
81-A

LOGIC — SERVO AMPLIFIE

LS-2A



81-B



ALL RESISTORS 1/4 WATT 10 % UNLESS NOTED. VALUES IN OHMS (K=1000)

ALL CAPACITOR VALUES IN μF UNLESS NOTED. VALUES ABOVE .1 μF ARE TANTALUM

ALL COMPONENT REFERENCE NUMBERS IN PARENTHESIS REFER TO (B) SERVO AMP

ALL DIODES SILICON

FIG. 5

LOGIC – SERVO UNIT

(Fig. 5)

The servo amplifiers are very similar to those found in the KPS-9A through KPS-12. Component values have simply been altered due to differences in pulse width and repetition rate.

Servicing of the receiver-servo unit should be mainly in replacing gears, motors, and other mechanical items. The servo machanics are, except for the case, the same as the KPS-12 servo. (Fig. 6)

The factory has received many sets for repair which were inoperative or erratic due to improper installation of batteries in the case or batteries other than those recommended in the instructions.

Customers with this type of trouble should be advised to pay particular attention to the instruction manual regarding batteries. Contacts should be cleaned regularly with an eraser, and **only** premium batteries such as Alkaline Energizers or Mallory Duracell batteries are to be used. Ordinary carbon-zinc standard batteries often have false bottoms which lose contact under even the slightest vibration. These batteries are not really capable of delivering the necessary power to operate the system reliably for any length of time as well.

The decoder and servo amplifiers are located on the printed circuit board at the bottom of the unit.

The decoder section contains two amplifiers (Q1 & Q2), a pulse-width detector Q3, and a flip-flop Q4 & Q5. Q3 detects the wide pulse and through D1 sets Q4 to sync the flip-flop to feed the proper channel to the servo amplifier connected to its collector. The waveform present at the collector of Q3 will show the longer pulse extending downward and flattening out as Q4 is set. Complaints associated with channels "reversing" should lead to an examination of Q3's collector waveform to verify that the wider pulse is in fact resetting the flip-flop.

Proper Waveform
at Q3 Collector

If a definite "bottoming" of the wide pulse is not apparent, check transmitted pulse width to see if the wider pulse is close to 750u Seconds. If it is, alter the value of R6 (27K) downward to speed up the charging rate of C1.

The KP-2B receiver incorporates a capacitive multiplier voltage filter located on the lower deck (Q6, C5, & R13). This filter stabilizes the supply voltage and provides clean drop out below minimum signal levels. This filter is not connected to the servo amplifiers, only the receiver and decoder. There is a slight lag in turn on due to the effective capacitance of the filter (3,000uf) but is of no inconvenience in most cases.

PARTS LIST – DECODER/SERVO AMPLIFIERS

RESISTORS – All values in OHMS (K=1,000)

R1	100K	¼w	10%	057-104
R2, R3	22K	¼w	10%	057-223
R4	4.7K	¼w	10%	057-472
R5	22K	¼w	10%	057-223
R6	27K	¼w	10%	057-273
R7	3.3K	¼w	10%	057-332
R8	22K	¼w	10%	057-223

Logic – Servo Amplifier (fold out at left)

R9	100K	¼w	10%	057-104
R10	22K	¼w	10%	057-223
R11	100K	¼w	10%	057-104
R12	3.3K	¼w	10%	057-332
R13	10K	¼w	10%	057-103
R14, R30	1.5K	½w Carbon Potentiometer		106-012
R15, R31	100 ohm	¼w	10%	057-101
R16, R32	91K	¼w	10%	040-011
R17, R33	3.3K	¼w	10%	057-332
R18, R34	22K	¼w	10%	057-223
R19, R35	10K	¼w	10%	057-103
R20, R36	820 ohm	¼w	10%	057-821
R21, R37	10K	¼w	10%	057-103
R22, R38	8.2K	¼w	10%	057-822
R23, R39	82K	¼w	10%	057-823
R24, R40	82K	¼w	10%	057-823
R25, R41	22K	¼w	10%	057-223
R26, R42	1K	¼w	10%	057-102
R27, R43	1K	¼w	10%	057-102
R28, R44	68 ohm	¼w	10%	057-680
R29, R45	27 ohm	¼w	10%	057-270

CAPACITORS

C1	.047uf	10%	200V	Mylar	115-009
C2, C3	330pf			Disc Ceramic	113-011
C5	33uf		6V	Tantalum	116-005
C6, C15	.001		100V	Disc Ceramic	113-012
C7, C16	.001		100V	Disc Ceramic	113-012
C8, C17	.056uf	10%	200V	Mylar	115-028
	.047uf	10%	200V	Mylar (May be either)	115-009
C9, C18	330pf			Disc Ceramic	113-011

C10, C19	.05uf		10V	Disc Ceramic	113-018
C11, C20	.05uf		10V	Disc Ceramic	113-018
C12, C21	4.7uf		6V	Tantalum	116-004
C13, C22	.05uf		10V	Disc Ceramic (Mounts on motor)	113-018
C14	.05uf		10V	Disc Ceramic	113-018

TRANSISTORS & DIODES

Q1	2N3392	NPN Transistor	101-004
Q2-Q5	2N4122	PNP Transistor	101-005
Q6	2N5088	NPN Transistor	101-014
Q7, Q8, Q9			
Q15, Q16, Q17	2N4122	PNP Transistor	101-005
Q10, Q11			
Q18, Q19	2N3392	NPN Transistor	101-004
Q13, Q21	MPS-6562	PNP Transistor	101-012
Q14, Q22	MPS-6560	NPN Transistor	101-013
D1-D3	DA-805 or 1N4148	Silicon Diode	100-101

MISC

Wiring Harness with switch		123-008
Electronic Sub-Assembly		300-151
Battery Pack	(See Battery Pack Section)	

MECHANICAL ASSEMBLY KP-2B

(See exploded parts view – Fig. 6)

Key No.		
17	Motor, KPS-12 12 ohm	800-007
26	Case, Top	901-208
16	Gear Plate	901-209
24	Case, Bottom	901-210
–	Case, Complete	901-207
14	Gear, First Intermediate	901-180
13	Gear, Second Intermediate	901-181
12	Gear, Drive	901-182
10	Gear, Pot	901-183
–	Gear, Set	901-187
3	Output Wheel	901-184
7	Output Arm Short – two holes	901-185
3	Output Arm Long	901-186
5	Output Arm Short – one hole	901-198
–	Output Wheel & Arm Set (one each)	901-188
18	Pot Wiper Support Disc	901-192
11	Pot Shaft	500-034
19	Pot Wiper Contact	106-023
20	Pot Element	106-012
15	Gear Pin .050" x .375"	500-029
6	1-72 x 1/8" Binding Head M. S. (Pkg. of 20)	500-032
2	2-56 x 1/4" Pan Head Screws (Pkg. of 20)	500-052
9	No. 2 x 1/8 S. M. S. (Pkg. of 20)	500-008
25	1/4" O.D. Grommets (Pkg. of 20)	500-003
1	2-56 x 3/4" Flathead M. S. (Pkg. of 20)	500-009
8	Receiver Electronic Assembly	– – –
23	Logic/Servo Assembly	300-151
22	Switch Harness	123-008

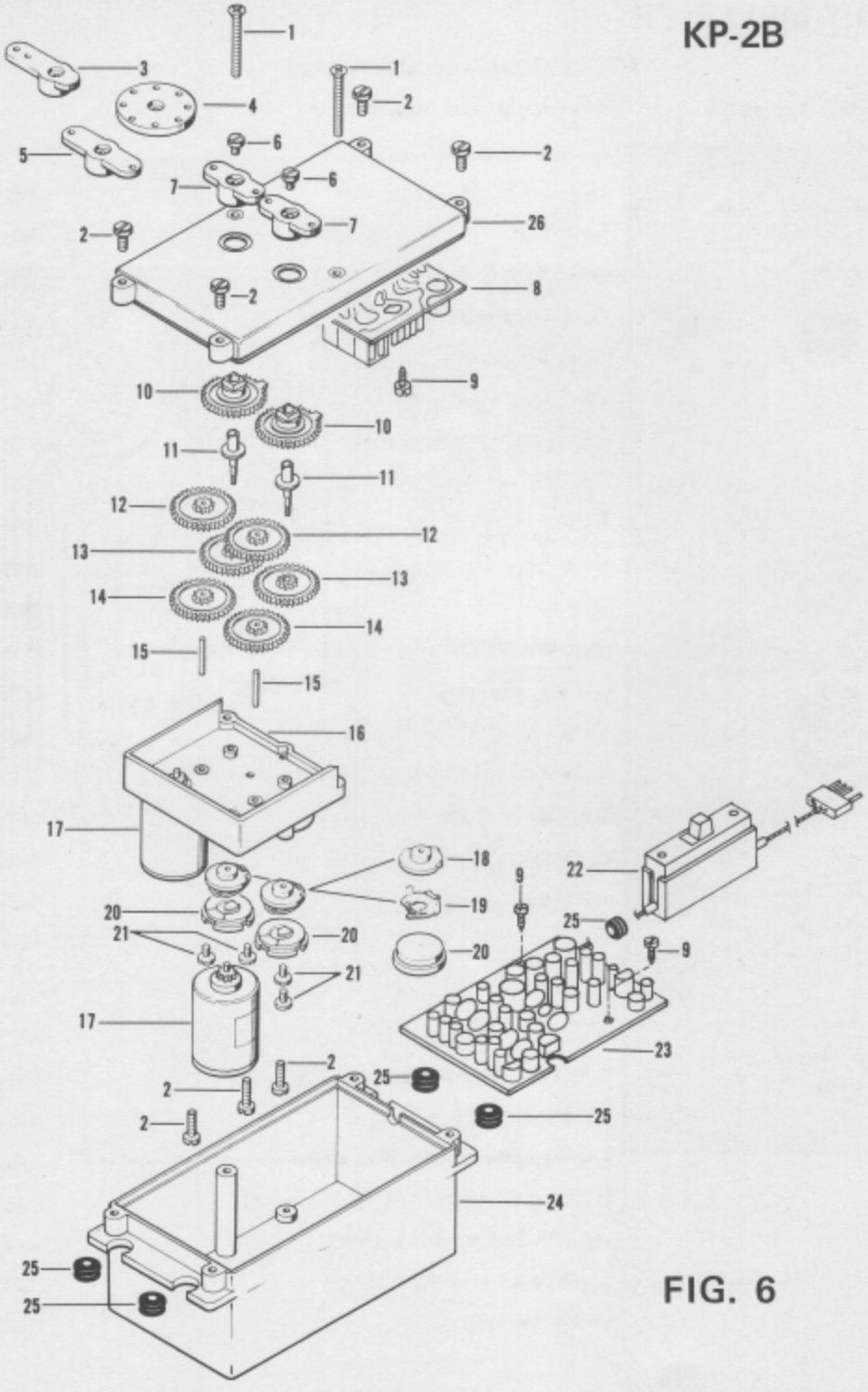
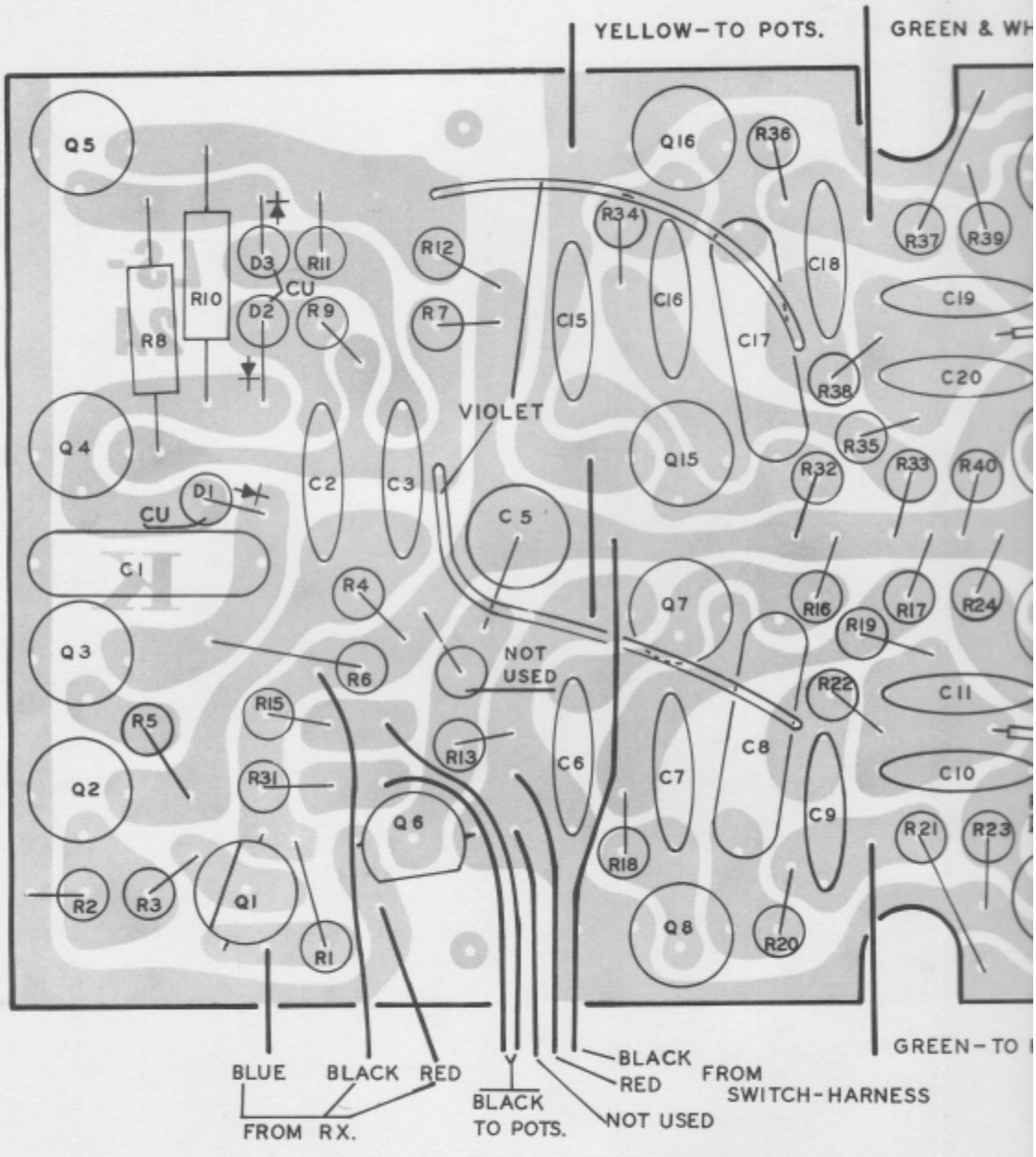


FIG. 6

2 CHANNEL LOGIC



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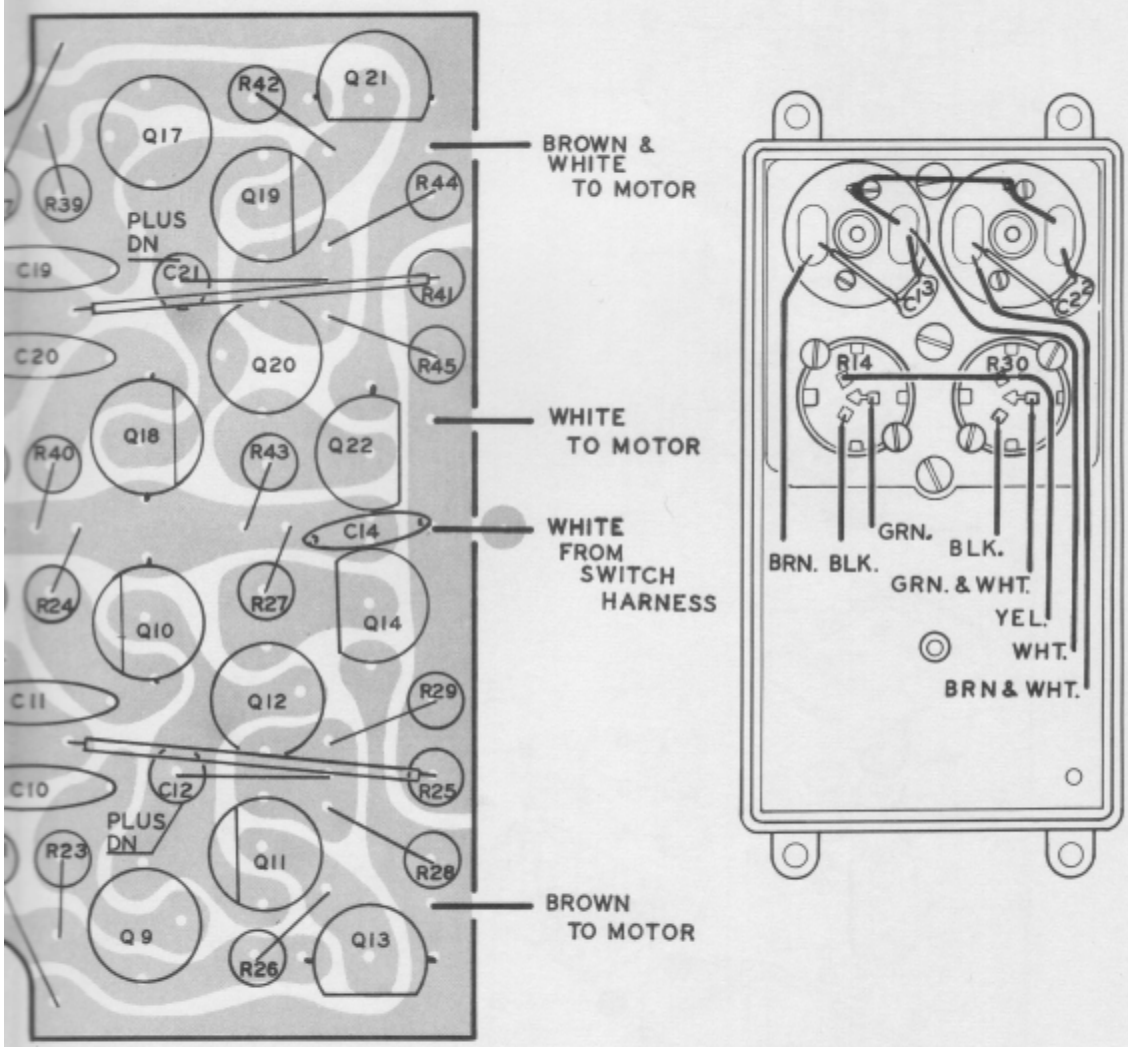
OGIC SERVO AMPLIFIER

EN & WHITE TO POT.



EN – TO POT.

6-A