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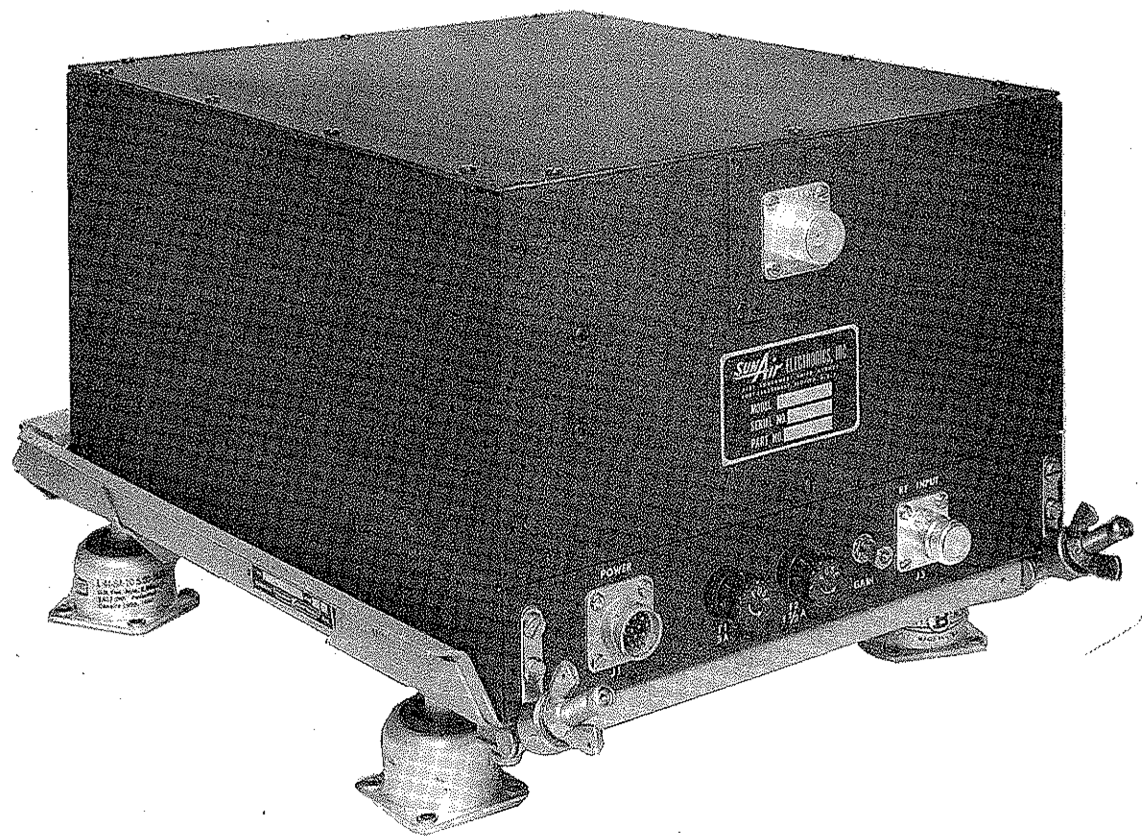

Maintenance Manual

AUTOMATIC ANTENNA TUNER

SAC-69( )

NOTICE
Important equipment information may be contained in the addendums located in the last section of this manual.

3rd Edition 1 Feb. 1974
Serial Number 3256
Manual Part No. 99413

WARRANTY POLICY

AVIONICS DIVISION

Sunair Electronics warrants each equipment manufactured by it to be free from defects in material or workmanship, under normal use for which intended, for one (1) year from date of installation. Sunair will hereunder replace or repair (at Sunair's discretion) any defective components (EXCLUDING TUBES AND SEMI-CONDUCTORS).

Any such defective equipment (or component) shall be returned, transportation charges prepaid, to Sunair or to a Sunair authorized warranty station. Provided that the failure is within the terms of this warranty and is not due to damage, misuse, improper installation or unauthorized modification or repair, Sunair will, in addition to replacing component parts within specified periods, also assume warranty labor costs for ninety (90) days from date of original installation. Any such charges must be reasonable and for actual bench repair only and limited to a maximum of four (4) hours. Labor not directly related to correcting the defective condition cannot be honored.

THIS WARRANTY IS ESPECIALLY IN LIEU OF ANY AND ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. The obligation and responsibility of Sunair shall be limited to that expressly provided herein and Sunair shall not be liable for consequential or other damage or expense whatsoever therefore or by reason thereof.

Sunair reserves the right to make changes in design or additions to or improvements in its equipment without obligation to install such additions or improvements in equipment theretofore manufactured.

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IMPORTANT NOTE

SAC-69( ) serial numbers 3156 to 3256 have been modified to increase their tuning capability and reliability. The new schematic diagrams and parts lists are included in the addendum section of the manual. Brake assembly 97943 will not be incorporated until Serial #3256 and consequently, use Figures III-2 and III-3 for the wiring of the brake assembly for serial numbers below 3256. A new edition of the manual will be published for serial numbers 3256 and above.

CONTENTS (cont'd)

ILLUSTRATIONS

ILLUSTRATIONS (cont'd)

SECTION 1

GENERAL INFORMATION

A. SYSTEM DESCRIPTION

The Sunair Model SAC-69 ( ) antenna tuner is a fully transistorized automatic tuner used to couple rf power from a transmitter to an antenna. The antenna impedance is transformed to a 50 ohm resistive load for the transmitter, with a VSWR of 1.3 to 1 or better. Tuning can be initiated with the selection of a different channel by the associated transmitter or by keying the transmitter after channeling. A variety of antennas may be used with the SAC-69 ( ). Table A of Section II lists a number of antennas and the best SAC-69 ( ) configuration for each antenna.

<u>IMPORTANT NOTE</u>

> Read pages II-3 through II-20 <u>prior</u> to installation as the installed antenna configuration may require that the tuner networks be modified as shown.

The tuner is housed in an ATR size 10.125" W x 12" L x 6.5" H and mounted in a shock rack. Weight of the unit is 17 lbs. with shock rack and 14 lbs. without shock rack. The unit is composed of two major subassemblies, the electronics drawer that contains all the control circuitry and the r.f. compartment which contains all of the r.f. matching components.

B. SPECIFICATIONS

Input Current Requirements: (27.5 VDC nominal)	Standby	0.3 Amps
	Tuning	2.0 Amps
	Transmitting	0.3 Amps
Frequency Range:	2-18 MHz	
Input Impedance:	50 Ohms	
Antenna Types:	See Table B, page II-11	
R.F. Power Capability:	5-130 watts	
Tuning Time:	20 seconds maximum (5 seconds average)	

(Tuning sequence begins with a ground pulse supplied by the associated transmitter when a new channel is selected.)

Cooling:	None Required
FAA Approval Basis:	TSO-C31c, C32c, Category BAAAAX
Environmental Categories:	For Category A Vibration environment, Sunair shock rack 99405 must be used. The tuner may be used without shock isolators when fastened directly to the fuselage in multiengine or single engine fixed wing aircraft under 12,500 pounds. (Category BCAAAX) Temperature -54°C to +55°C Altitude 35,000 feet

Associated Transmitter Requirements:

R.F. Power Output	5-130 watts (Maximum)
Frequency	Any in 2-18 MHz Range
Compatible Transceivers	T22RA, ASB-100A, ASB60/125, ASB130, ASB-320

C. EQUIPMENT SUPPLIED

	SUNAIR PART NO.	WEIGHT
1. SAC-69 ( ) Antenna Tuner	99400	14 lbs.
1. Indicator Light Assembly	99467-1(6V) 99467-2(28V)	0.1 lb 0.1 lb
(Supplied when indicating lamps are not installed in the control head of the transceiver)		
1. Shock Rack with pads	99405	3 lbs.

D. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1. Installation Cable (Custom Made)
2. The SAC-69 ( ) Antenna Tuner is designed to be used with a variety of transceivers and transmitters. Interconnect diagrams are shown for the SAC-69 ( ) used with the Sunair ASB-125/60, ASB-130, ASB-320, ASB-100 and T-22-RA. For use with other systems, Sunair should be consulted.
3. The SAC-69 ( ) (Serial #3256 and above) is provided with a wire post antenna output and a coaxial antenna output

for RG-8 coax feed if desired or required. The connector is supplied but the coax cable is not. Refer to Table B of Section II to determine when the use of coaxial cable between the tuner and antenna is recommended.

SECTION 2

INSTALLATION

A. GENERAL

Adherance to the suggestions and instructions contained in this section will assure an easier and more satisfactory installation of the SAC-69 ( ) Antenna Tuner.

B. UNPACKING

Unpack and inspect all parts and equipment as soon as received. Do not accept a shipment where there are visible signs of damage to the cartons until a complete inspection is made. If there is a shortage or if any evidence of damage is noted, insist on a notation to that effect on the shipping papers before signing the receipt from the carrier.

If concealed damage is discovered after a shipment has been accepted, notify the carrier immediately in writing and await his inspection before making any disposition of the shipment. A full report of the damage should also be forwarded to Sunair. Include the following:

(a) Order number
(b) Model and serial number
(c) Name of transportation agency

When Sunair receives this information, arrangements will be made for repair or replacement.

C. ANTENNA SELECTION

1. Grounded VS. Ungrounded - the SAC-69 ( ) Automatic Antenna Tuner was developed to fulfill a growing need for the use of shorter antennas on higher speed aircraft. The longer, ungrounded type antennas are satisfactory on aircraft where they can be installed. However, higher speed aircraft require antennas that do not produce undesirable air friction drag.

   Considerable research was conducted to determine the relative efficiency between the conventional longer (22-45 ft.) ungrounded antennas and the short (5-14 ft.) grounded types. Sunair has found that the longer (22-45 foot) type grounded antennas are more efficient than the short grounded types for frequencies below five (5) MHz. For frequencies above 5 MHz, the shorter antennas are equal in performance to the longer antennas, and in most cases, are superior. In all cases investigated, with a given antenna length or configuration, the grounded antenna was superior to the ungrounded type. Flight test conducted with short grounded antennas have resulted in excellent communications.

2. Factors to be considered before selecting and installing an antenna. - The selection of the optimum H.F. antenna for a given aircraft will be a compromise between factors such as air friction drag, appearance and efficiency desired. Generally, the most efficient antenna will be the longest antenna (up to 45 feet in length), especially where operation below 5 MHz is anticipated. If the short grounded antenna must be used, it should be placed on the aircraft in such a manner as to have the antenna as far as possible removed from the aircraft skin. If possible, the antenna should be grounded to the wing, an engine mount or the horizontal stabilizer. Grounding to the vertical stabilizer is satisfactory but slightly less efficient than grounding to the wing or horizontal stabilizer on some type aircraft.

3. Types of Antennas and Installation - Figures II-3 and II-4 illustrate typical antenna configurations. Figure II-5 lists some of the installation accessories available.

   It is important to have a good antenna installation. Be sure the antenna has adequate tension and secure mountings so as to be aerodynamically stable. Slack in the antenna will cause impedance change and will require rechanneling and tuning of the antenna tuner during flight. Because of the high currents in grounded antennas, especially at lower frequencies, grounds should be adequate, with paint and corrosion removed, before mounting the ground anchor. Wire size should not be smaller than 16 gauge, preferably anti-precipitation, insulated wire.

4. Recommended Types of Antennas. - One fixed antenna of exact electrical characteristics is impossible to recommend due to the variation in aircraft design. The antenna configurations shown in Figures II-3 and II-4 have all been evaluated and the results are tabulated as follows.

	ANTENNA TYPE (ALL GROUNDED)				
Frequency MHz	22'-45' "V"	8'-14' to Vert. Stab.	5'-12' to Wing	5'-12' to Hor. Stab.	22'-45' Straight to Vert. Stab.
2-5	G	P	A	A	A
5-8	G	A	G	A	A
8-11	G	G	G	G	G
11-14	G	G	G	G	G
14-18	G	G	G	G	A

G=GOOD; A=AVERAGE P=POOR

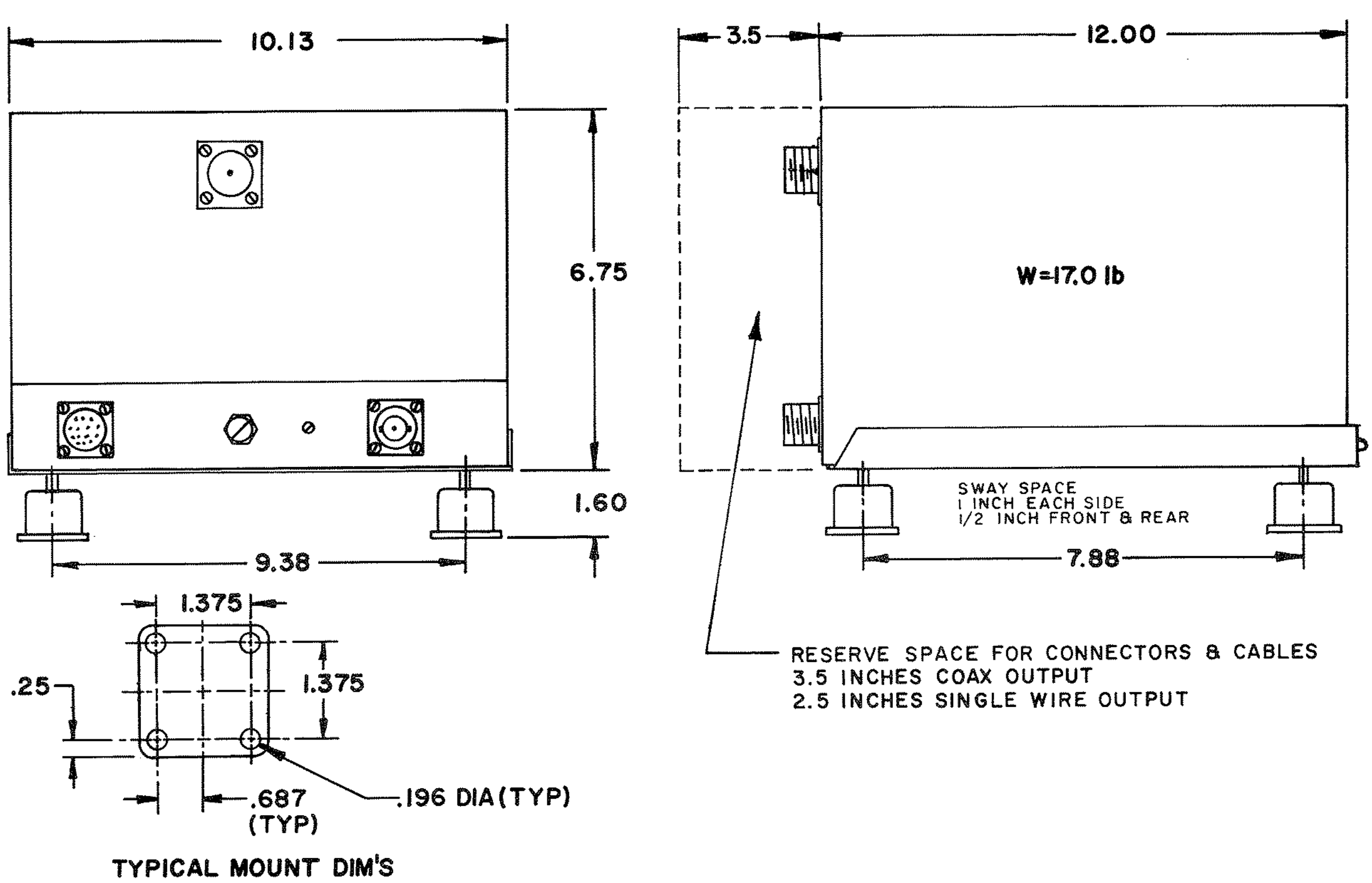
TABLE A

Considering the entire band of frequencies, 2-18 MHz, Sunair would rate antennas in the following order based on overall performance:

First-Grounded V, 22-45 foot (Figure II-3, (b))
Second-5-12 foot Grounded to Wing (Figure II-4 (b))
Third-5-12 foot Grounded to Horizontal Stabilizer (Figure II-4, (a))
Fourth-Straight, Grounded to vertical Stabilizer 22-45 foot long (Figure II-3 (c))
Fifth-Straight, Grounded to vertical Stabilizer 8-14 foot long (Figure II-3 (a))

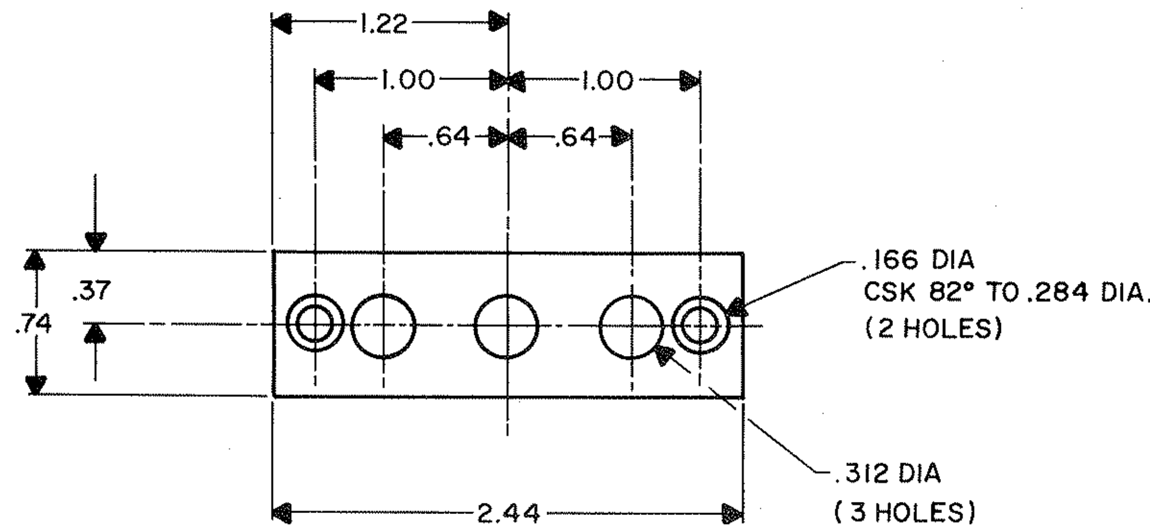
D. RF NETWORK MODIFICATIONS AND CONFIGURATIONS

The SAC-69( ) standard configuration (as shipped from the factory) will tune the impedances of most aircraft antennas over the range of 2-18 MHz. For some antennas longer than 20 ft., grounded or ungrounded, some internal changes might be required to the matching networks if some frequencies will not tune. It is recommended that the SAC-69( ) be installed and the antenna connected to the wire post output. All frequencies should be checked for proper tuning with a watt-meter installed between the transmitter and the SAC-69( ). If some frequencies do not tune, refer to Table B and find the antenna nearest in length and configuration to the installation being made. Note the configuration that provides the required frequency tuning range. Then refer to Figures II-7 thru II-12 and note the changes that must be made internally to change to the proper configuration.



SAC-69 ( ) AUTOMATIC ANTENNA COUPLER
FIGURE II-1

INDICATOR ASSEMBLY MOUNTING



Indicator assembly is supplied when indicating lamps are not installed in control head.

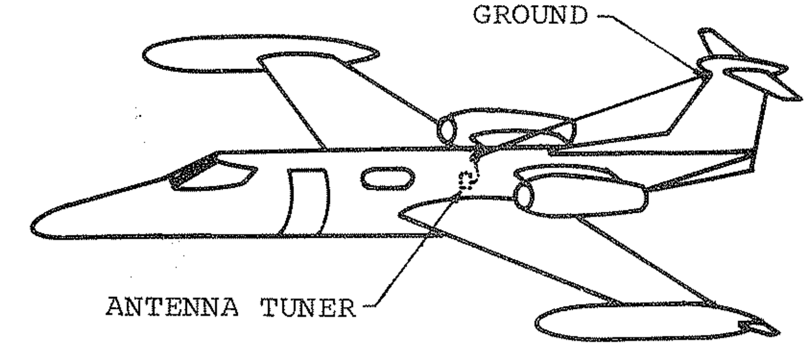
NOTE: Reserve at least 0.5" behind light panel for lamps and wires.

Description	Sunair Part No.
Indicator Assembly (complete)	99467
Indicator Lamp Red 4-6V	84034-1
Indicator Lamp Green 4-6V	84034-2
Indicator Lamp Amber 4-6V	84034-3
Indicator Lamp Red 22-28V	84034-4
Indicator Lamp Green 22-28V	84034-5
Indicator Lamp Amber 22-28V	84034-6

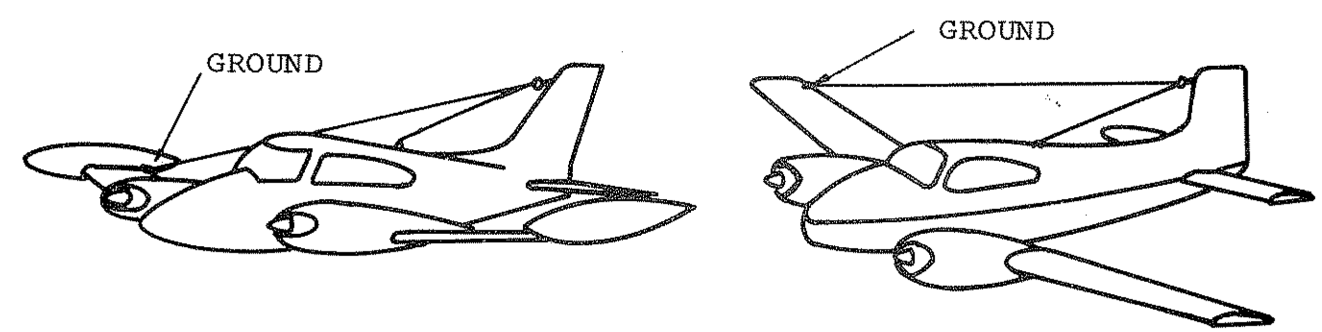
INDICATOR ASSEMBLY, LIGHT PANEL

Figure II-2

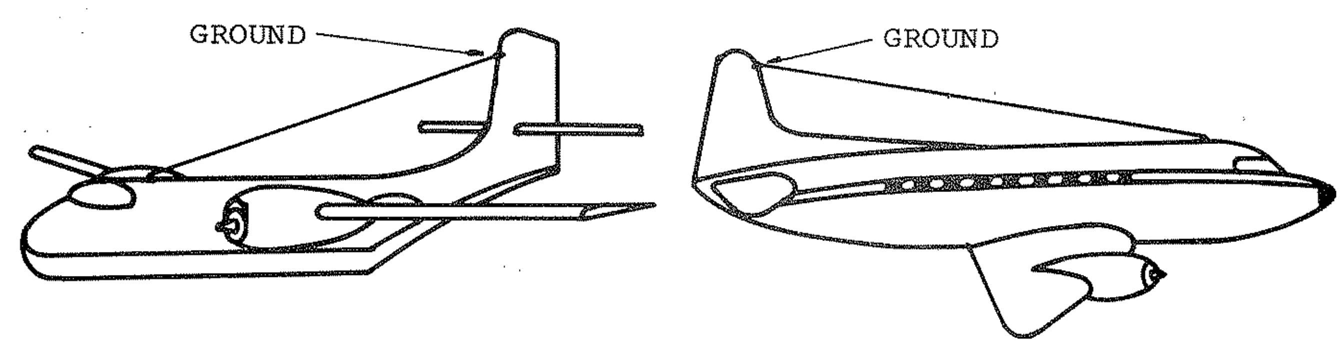
TYPICAL ANTENNA CONFIGURATION



(a) 8 TO 14 FOOT GROUNDED TO VERTICAL STABILIZER



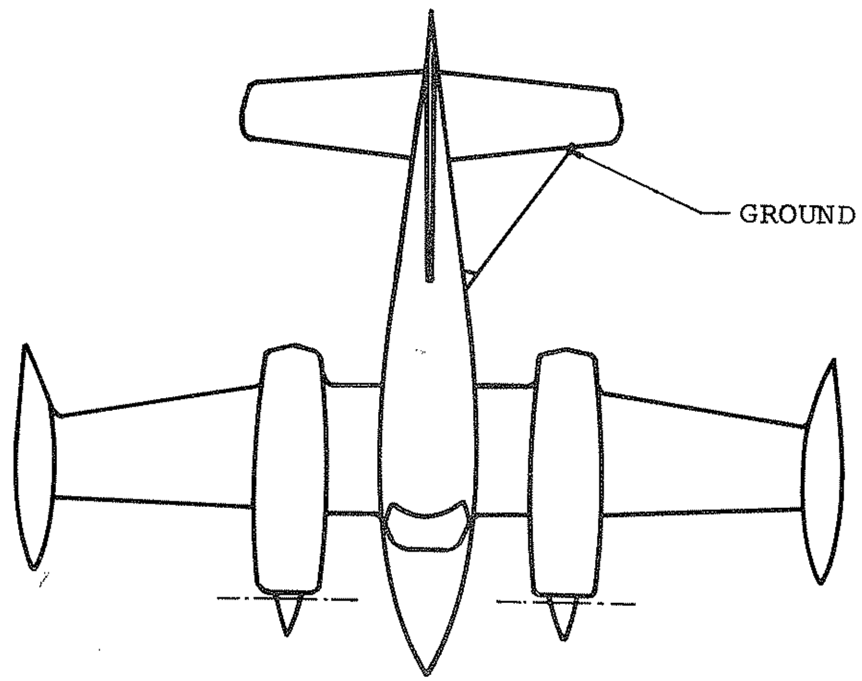
(b) 22 TO 45 FOOT "V" GROUNDED ANTENNA



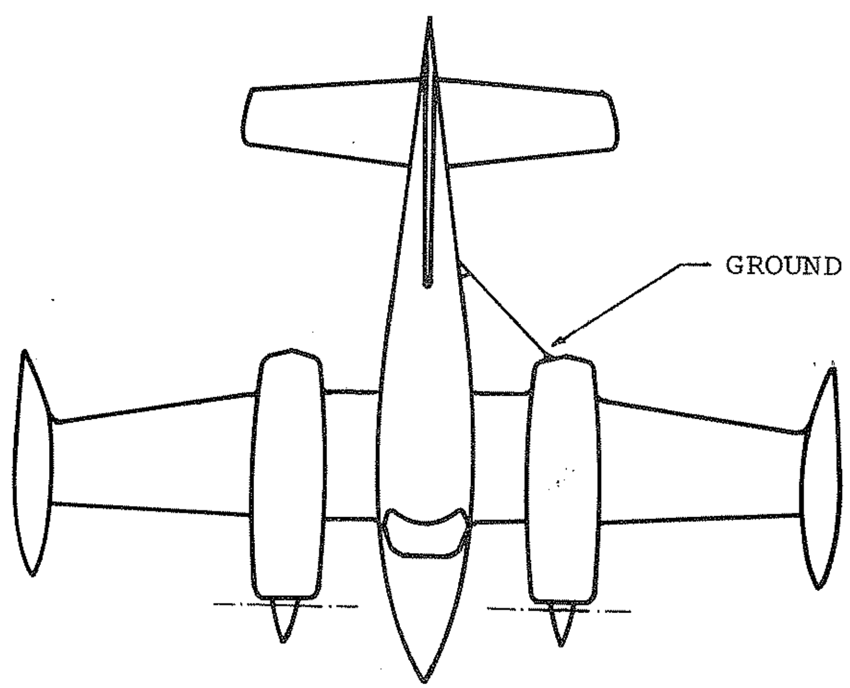
(c) 22 TO 45 FOOT "STRAIGHT" GROUNDED ANTENNA

FIGURE II-3

TYPICAL ANTENNA CONFIGURATION

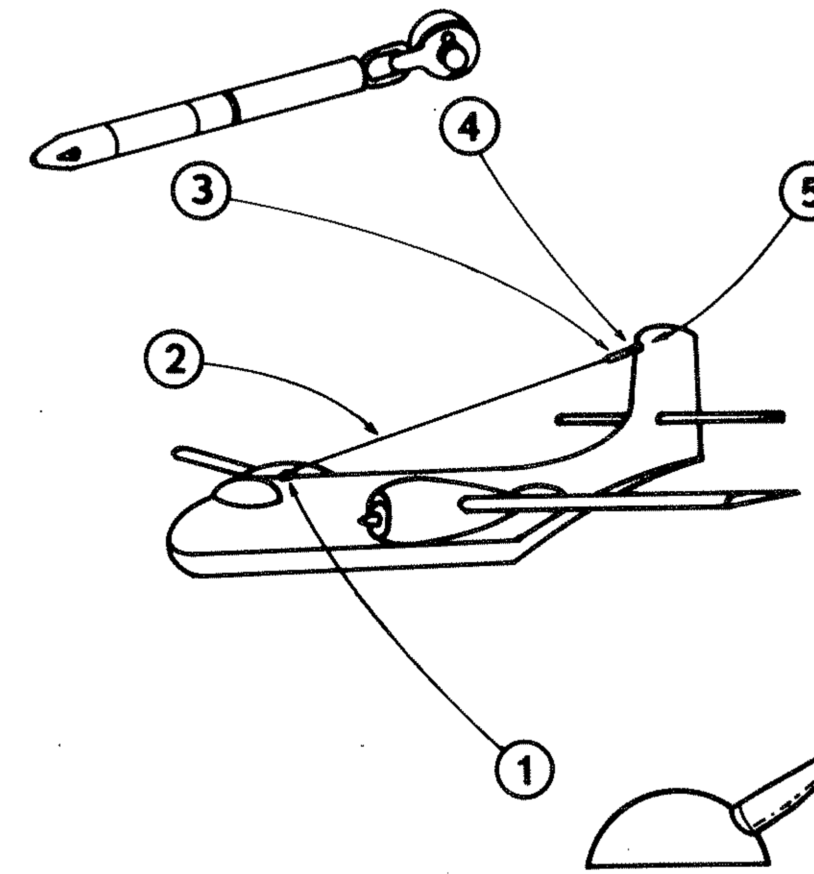


(a) 5 TO 12 FOOT TO HORIZONTAL STABILIZER



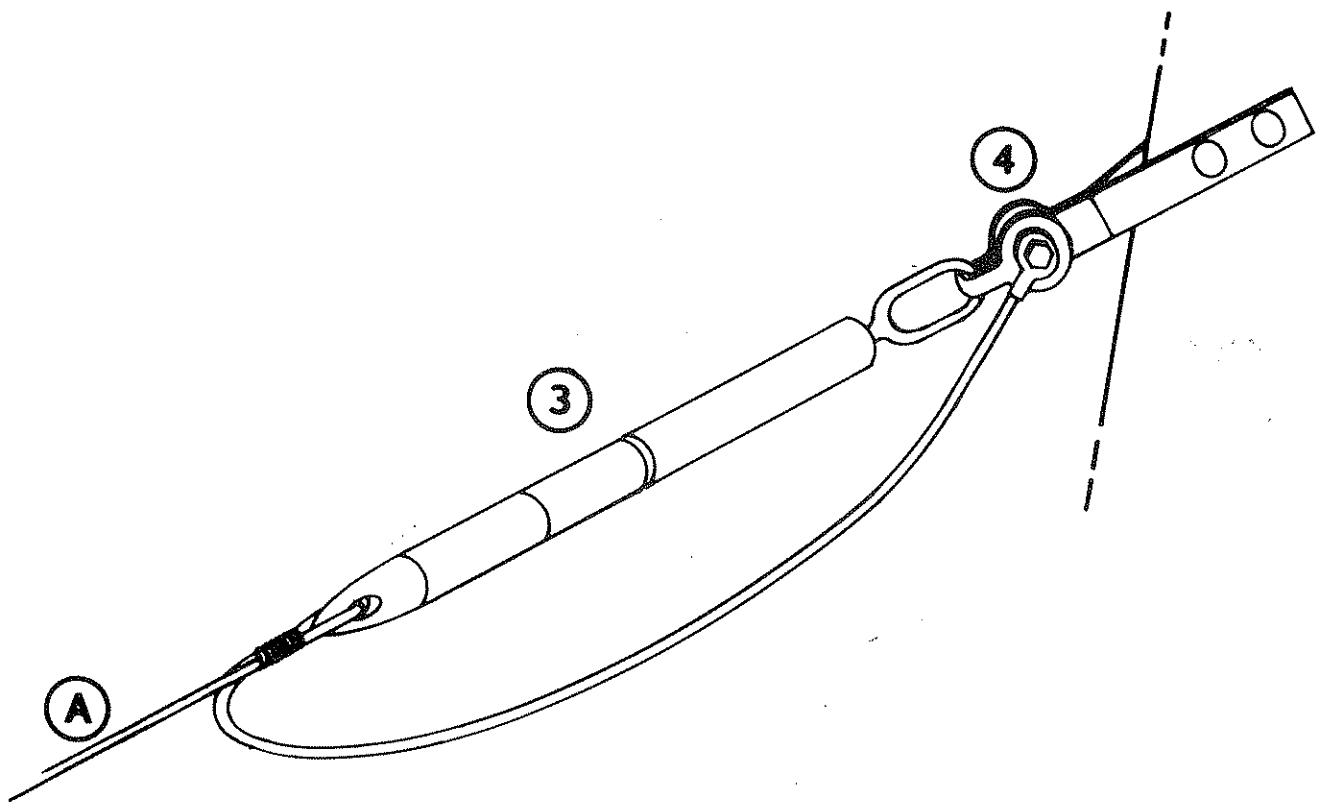
(b) 5 TO 12 FOOT TO WING

FIGURE II-4



ANTENNA INSTALLATION ACCESSORIES		
ITEM	DESCRIPTION	PART NO.
1	FEED THROUGH INSULATOR	71308
2	60 FEET INSULATED ANTENNA WIRE	71310
3	INSULATED TENSION UNIT	71322
4	SHACKLE AN115-B	71542
5	VERTICAL FIN ANCHOR (NOT SUPPLIED)	
6	WIRE RETRACTION TOOL	71346
7	INSTALLATION SUGGESTIONS	71285

FIGURE II-5

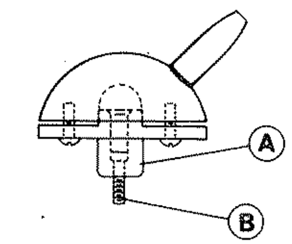


ANTENNA GROUNDING METHOD

FIGURE II-6

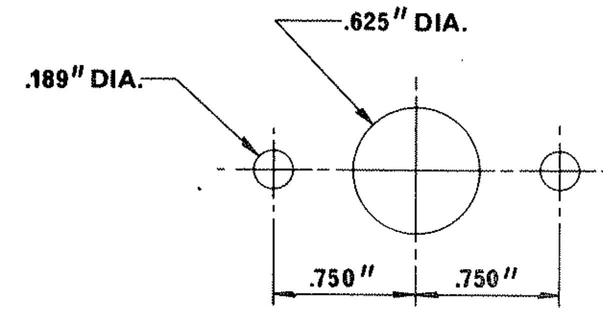
FOR STRAIGHT GROUNDED ANTENNAS THE ANTENNA (A) FROM FEED THROUGH INSULATOR (ITEM 1) IS FED THROUGH THE INSULATED TENSION UNIT (ITEM 3) AND CLAMPED OR TIED WITH NYLON CORD (AS SHOWN) TO PROPER LENGTH. GROUND ANTENNA WITH GROUND LUG TO ITEM 4 (SEE FIGURE 4).

FEED-THROUGH INSULATOR 71308



(Item 1)

A Nylon Base Plate
B Antenna Wire Connector Bolt
C Antenna Wire
D Washer
E Terminal Lug
F Lock Nut



Mounting Dimensions

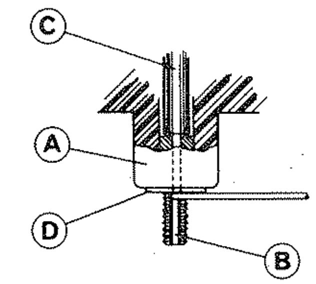


Fig. 1

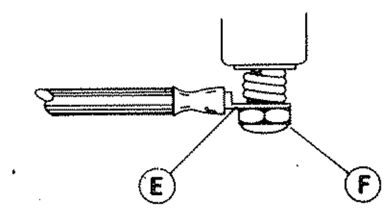


Fig. 2

Strip back polyethylene shield (C) to expose approximately 4" of antenna wire core. Insert core into connector bolt (B) and extract from slot. Insert washer "D" as shown in Fig. 1.

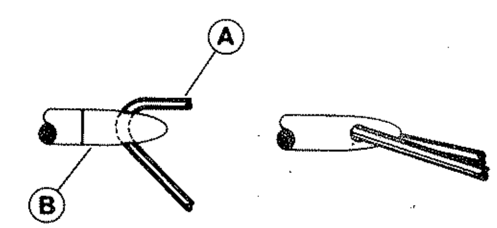
Wind wire around connector bolt (B) 3 1/2 to 4 turns. Install terminal lug (E) of antenna lead and secure with lock nut (F), as shown in Fig. 2.

INSULATED TENSION UNIT 71322

(Item 3)

A Insulated Antenna Wire
B Insulated Tension Unit

Fig. No. 3



Application - (a) For "V" type antenna: The Antenna (A) is connected to the feed-through insulator item 1, and routed via the vertical stabilizer by the use of the insulated tension unit (B), as shown in Fig. No. 3. The end is grounded at the wing tip.

ANTENNA	SAC 69( ) CONFIGURATION						
	SAC 69( ) STD	SAC 69( ) STD 3'COAX	SAC 69(A)	SAC 69(B)	SAC 69(C) 100pf	SAC 69(C) 200pf	SAC 69(D)
JETSTAR	2-15	2-14	2-14	2-13		2-17	2-13
GULFSTREAM II	2.2-18	2.2-18	2.2-18	2.2-10 11-18			2.2-18
707 TAIL PROBE	2.2-18	2.2-13					
8 FT. GNDED	2-18	2-17	2-16	2-8 9-14			2-8 9-18
9 FT. GNDED	2-18	2-17	2-16	2-13			2-17
10 FT. GNDED	2-18	2-16	2-15				
12.3 FT.GNDED	2-18	2-15	2-14				
20 FT. GNDED	2-18	2.8-16	2.8-15				
20 FT. UNGNDED	2.2-18	2-8 9-17	2-17				
23.5 FT. GROUNDED	2.2-14	2-14	2-14		2.2-18		2.2-18
23.5 FT. UNGNDED	2.2-18	2-16	2-15				
29 FT. UNGNDED	2.2-18	2-7 8-17	2-7 8-17	2.2-18			2.2-18
30 FT. GNDED STR	2.4-18	2.4-18	2-18	2.4-18			2.4-18
30 FT. UNGNDED STR	2.2-18	2-18	2-16	2.4-18			2.2-18
30 FT.GNDED V	2.4-18	2-18	2-18	2.4-18			2.4-18
30 FT. UNGNDED V	2.2-7 9-18	2-8 9-17	2-8 9-17	2.2-18	2.2-18		2.2-7 9-18
34 FT. UNGNDED V	2.2-17	2-17	2-16	2.2-17	2.2-18		2.2-17
40 FT. GNDED STR	2.2-9 10-18	2-16	2.4-16	2.2-18			2.2-10 11-18
40 FT. UNGNDED STR	2.2-4 5-18	2-18	2-4 5-17	2.2-18			2.2-18
41 FT. HS-125 UNGNDED	2-18	2-18					
50 GNDED STR	2-8 9-17	2.4-15	2.4-15	2-17			2-8 9-17
50 FT. UNG STR	2-3.5 4-18	2-3.5 6-17	2-3.5 6-16	2-18			2-4 5-18
60 FT. GNDED STR	2-18	2.2-6 7-17	2.2-17	2-17			2-17
60 FT. UNGNDED STR						2.2-17	
79 FT. GNDED STR	2.2-5 6-18	2.2-5 6-18	2.2-5 6-18	2.2-18	2.2-18		2.2-5 6-18
79 FT. UNGNDED STR	2-2.8 3.5-17	2-2.8 3.5-18			2.2-17		

TABLE B

TUNING RANGE OF SAC 69( ) CONFIGURATIONS

(THE ABOVE TUNING RANGES ARE CALCULATED FROM AVERAGE IMPEDANCE VALUES. RESULTS WILL VARY BETWEEN DIFFERENT AIRCRAFT AND ANTENNA INSTALLATION.)

For example, if a 30 ft. V ungrounded antenna were being used (already on aircraft) and the standard SAC-69 ( ) configuration resulted in tuning problems at 7-8 MHz, Table B shows the SAC-69 (B) configuration would yield a coverage of 2.2-18 MHz. Referring to Figure A4 shows the addition of (2) jumpers to convert to the B configuration. However, by grounding the antenna and using 3 ft. of coax (refer to Table B) the range would be 2-18 MHz. Also, it can be seen that by using a 100pf in series with the antenna the tuner will give the same coverage as the B configuration. C74 can be removed from the tuner and mounted externally in series with the antenna.

It is important to note that Table B was developed by using measured impedances from several different types of aircraft. Aircraft antennas of the same length and configuration (V or straight) will exhibit different impedances. This, of course, is caused by the proximity of the antenna to wings, skin and other capacitive effects. In general, antennas shorter than 20 ft. should be grounded. Those 20 ft. and longer should be evaluated for best communications capability in the grounded and ungrounded configurations. On some aircraft, grounding the antenna will result in increased receiver noise (due to motors, alternators, etc) over that using the ungrounded antenna.

Grounding of the SAC-69( ) shock rack and the companion transceiver is important. Make sure the ground straps attached to the shock rack are grounded to the airframe. Remove carpet, paint or other insulating material before attaching the ground strap. The wire from the SAC-69( ) to the feed through insulator should be kept as short as possible to prevent radiation inside the aircraft and possible interference with other electronic systems. Radiation inside the aircraft can be reduced or eliminated by the use of the coaxial output. However, check Table B to determine the effect of coax on the tuning range.

E. TUNER OPERATING MODES

The tuner unless specified otherwise on the factory order will be wired for push-to-talk (PTT) operation. That is the transmitter will not key and initiate the tuning cycle until the microphone button is momentarily operated. If it is desired to have the transmitter keyed automatically when the radio channel is changed, (channel pulse actuate), the wiring on TS-1 terminal strip in the electronics drawer must be changed. Connections for both operating modes are shown in Figure IV-2 Page IV-10 (PTT) and Figure IV-4 Page IV-12 (Chan. pulse)

F. CABLING AND MOUNTING DATA

Mounting dimensions and space requirements are shown in Figure II-1. Particular emphasis is placed on the following:

1. The antenna tuner should be located as close to the antenna feed-through insulator as possible. The antenna lead from the feed-through to the antenna tuner should be as short as possible, preferably not in excess of 6 inches. Longer lengths can be used but will result in more radiation inside the aircraft. If the coax output is used, check Table B page II-11 for its effect on the tuning range. On some antennas the coax tends to decrease efficiency for frequencies above 12 MHz.

2. The location of the antenna tuner should offer easy access to the lower front panel (electronics drawer) to permit adjustment of the gain control.

3. The antenna tuner should be securely grounded to the airframe with the ground straps provided. Any paint, insulation or carpeting should be removed in order to provide a good contact surface for the ground strap.

4. The wire size required for the interconnecting cable between the transceiver and the antenna tuner should be as follows:

SIGNAL LEADS	POWER LEADS
#22 wire for lengths to 14'	See chart on interconnect diagram
#20 wire for lengths 14' to 24'	
#18 wire for lengths 24' to 40'	

G. CHECKS AND ADJUSTMENTS AFTER INSTALLATION

The antenna tuner is fully automatic and has no operational controls. All inputs and control voltages for the tuner are obtained from the associated transceiver. The only adjustment on the tuner is the setting of the gain control. The associated receiver is always connected to the antenna via the antenna tuner. For operation of the associated receiver directly to the antenna, by-passing the tuner, an auxiliary relay must be provided.

After the antenna tuner is installed in accordance with the proper interconnection diagram, a wattmeter should be installed between the transmitter and the antenna tuner. Turn on the transceiver, the RED light should be illuminated. Select the desired channel, it will have to be channeled to the next and back in order to generate a channel pulse to condition the tuner. If the tuner is wired for channel pulse activate, the transmitter will be keyed on in the AM mode and tuning will begin. However, if TS-1 is wired for PTT actuate, the microphone switch will have to be depressed to initiate tuning. As soon as the transmitter is keyed on, the red light should be extinguished and the AMBER light should be illuminated, indicating tuning in process. As soon as the proper network is reached, the green light will be illuminated, and the AMBER and GREEN lights will alternately be illuminated and extinguished indicating the slow tuning or hunting mode. After the green light remains on for approximately 1 second, the transmitter will unkey and the receiver will come on, indicating the end of the tuning cycle.

At the conclusion of the tuning cycle, key the transmitter on AM and check the reflected power. If the reflected power is more than a VSWR of 1.5 to 1, (approximately 1 watt), increase the gain slightly by turning the gain control CLOCKWISE 15 degrees and initiate another tuning cycle and check the reflected power. NOTE: The gain control has been set at the factory for best operation. However, due to the variation of impedance of the same basic antenna on different aircraft, minor adjustments might have to be made after installation. The gain control should never be adjusted fully counter-clockwise because in this position the unit will not tune.

Check the tuning of all channels and note the reflected power. If some channels will not tune, i.e., the time delay runs out, reduce the gain control counterclockwise, (15 degree increments) until tuning is accomplished. (Time delay running out is indicated by a RED light at the conclusion of a tuning cycle. The time delay is adjusted to 45 seconds.

Continue checking all channels until they all tune with the maximum gain setting possible as this will result in less reflected power on all channels.

If the antenna tuner fails to tune on one or more channels, check all grounds to be sure they are adequate. Also make sure there is no amplitude modulation on the AM carrier during

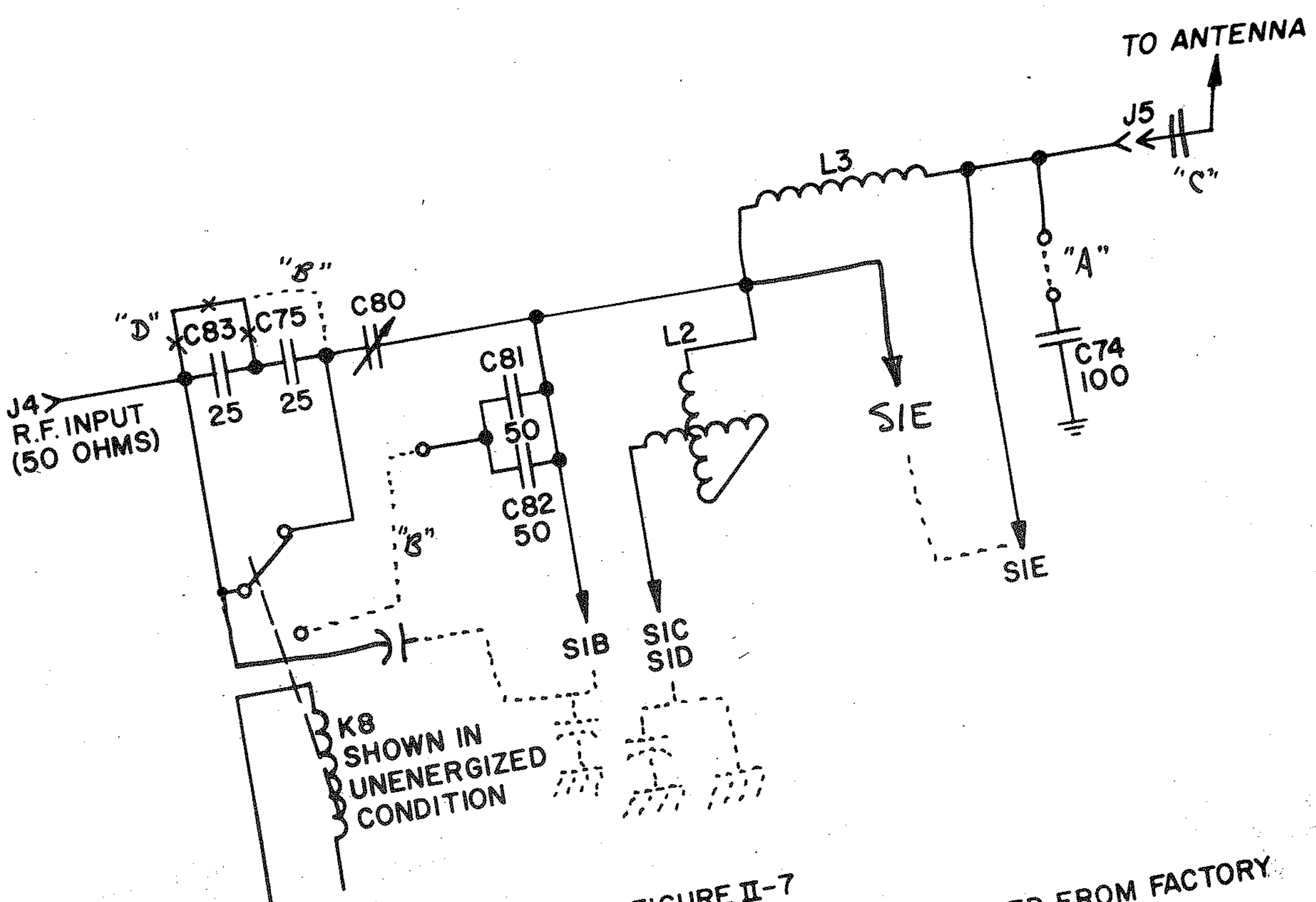


FIGURE II-7

SAC 69 ( ) STANDARD CONFIGURATION AS SHIPPED FROM FACTORY
SIMPLIFED CIRCUIT

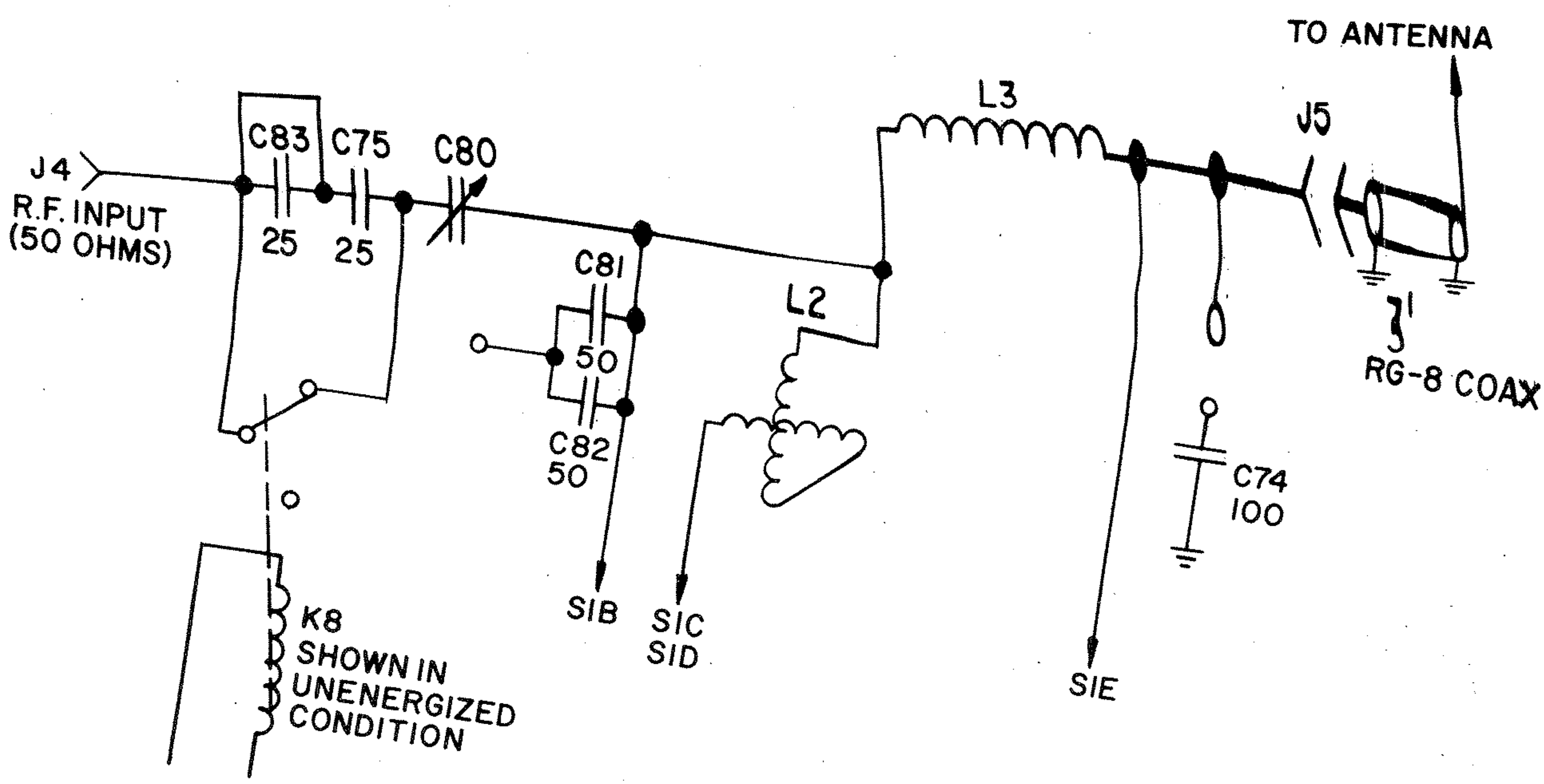


FIGURE II-8
SAC 69( ) STANDARD CONFIGURATION
WITH COAX OUTPUT
SIMPLIFIED CIRCUIT

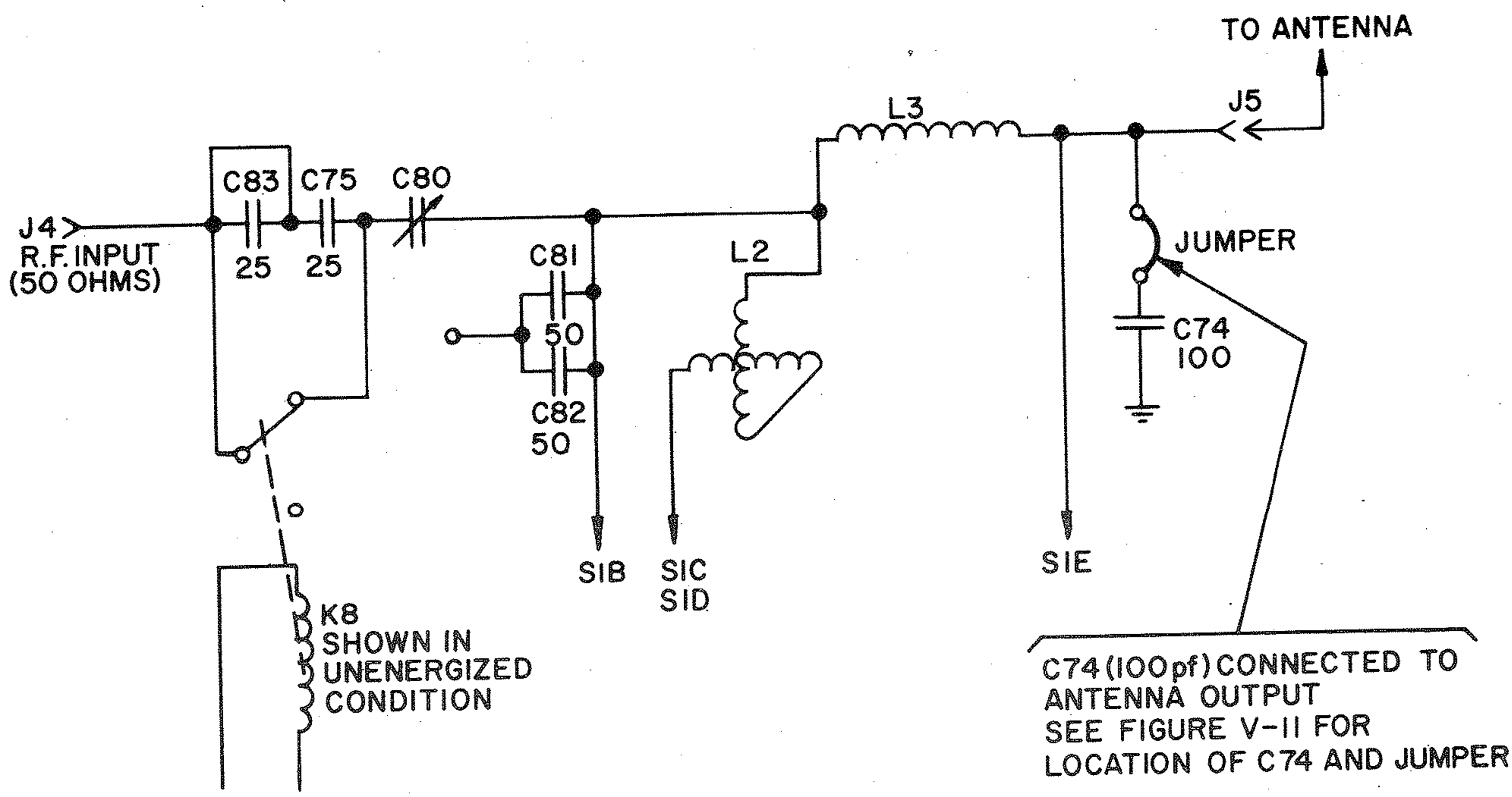


FIGURE II-9

SAC 69(A) CONFIGURATION WITH C74(100pf) CONNECTED TO ANTENNA OUTPUT.

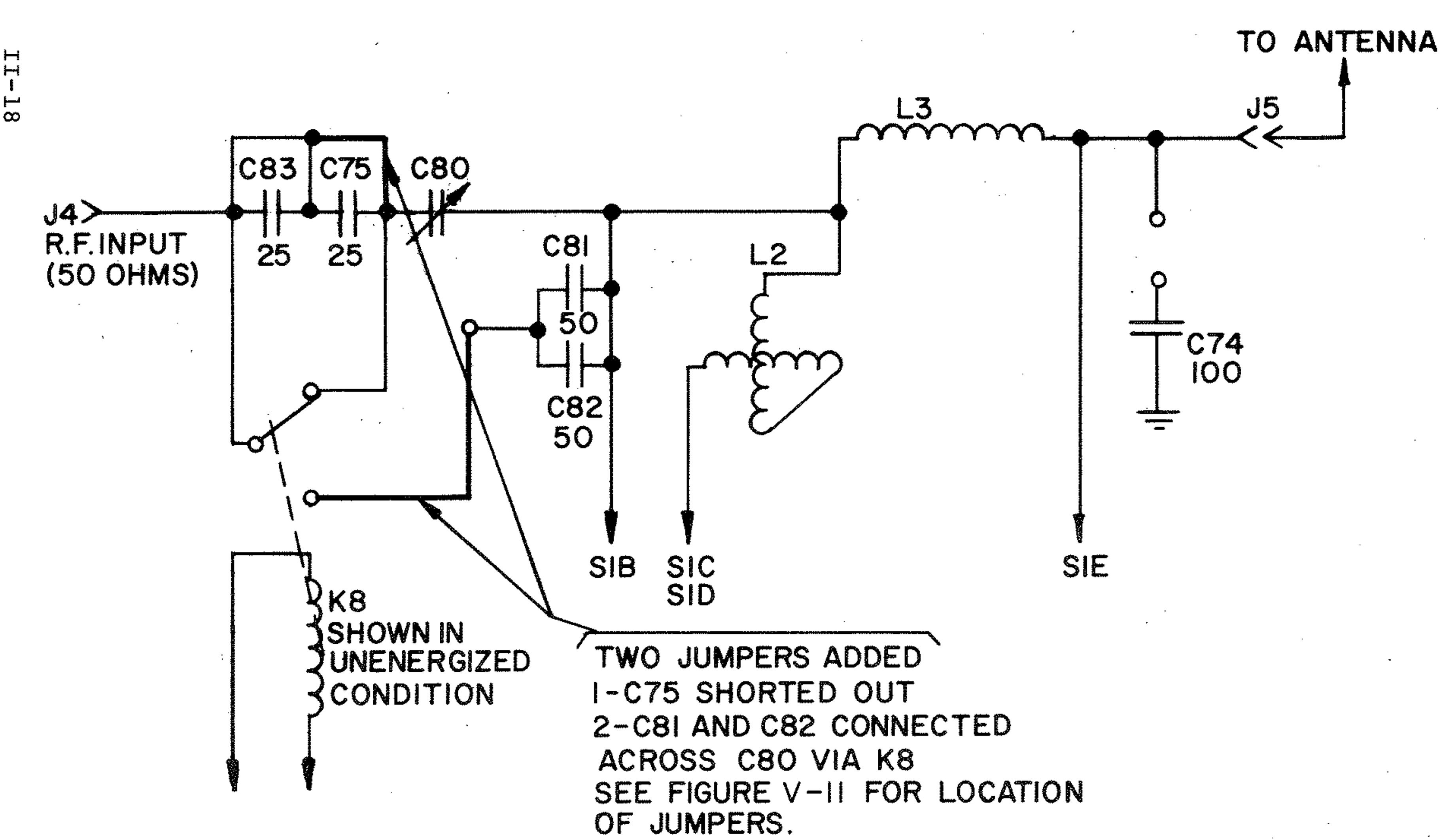


FIGURE II-10

SAC-69 (B) CONFIGURATION

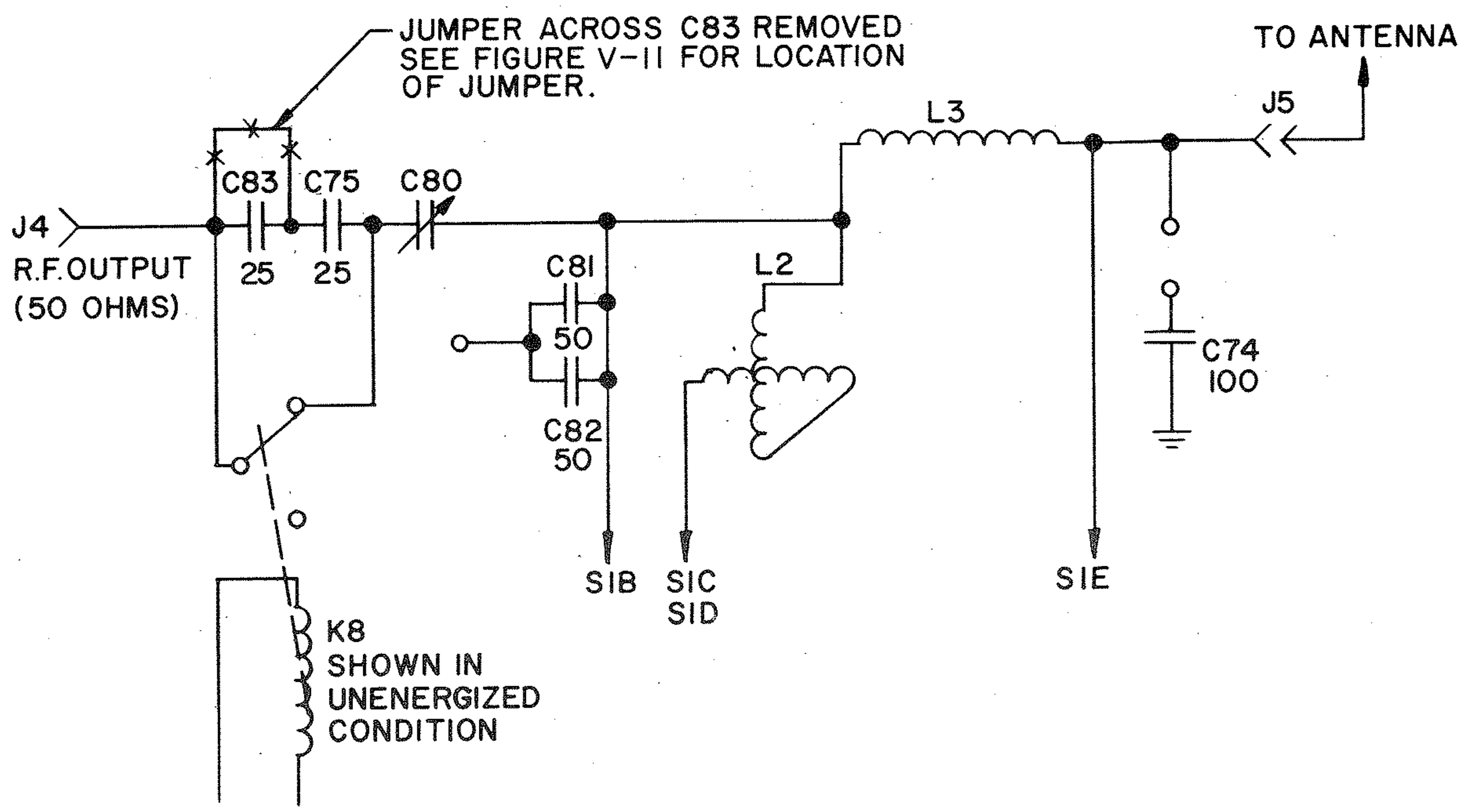


FIGURE II-11

SAC69(D) CONFIGURATION

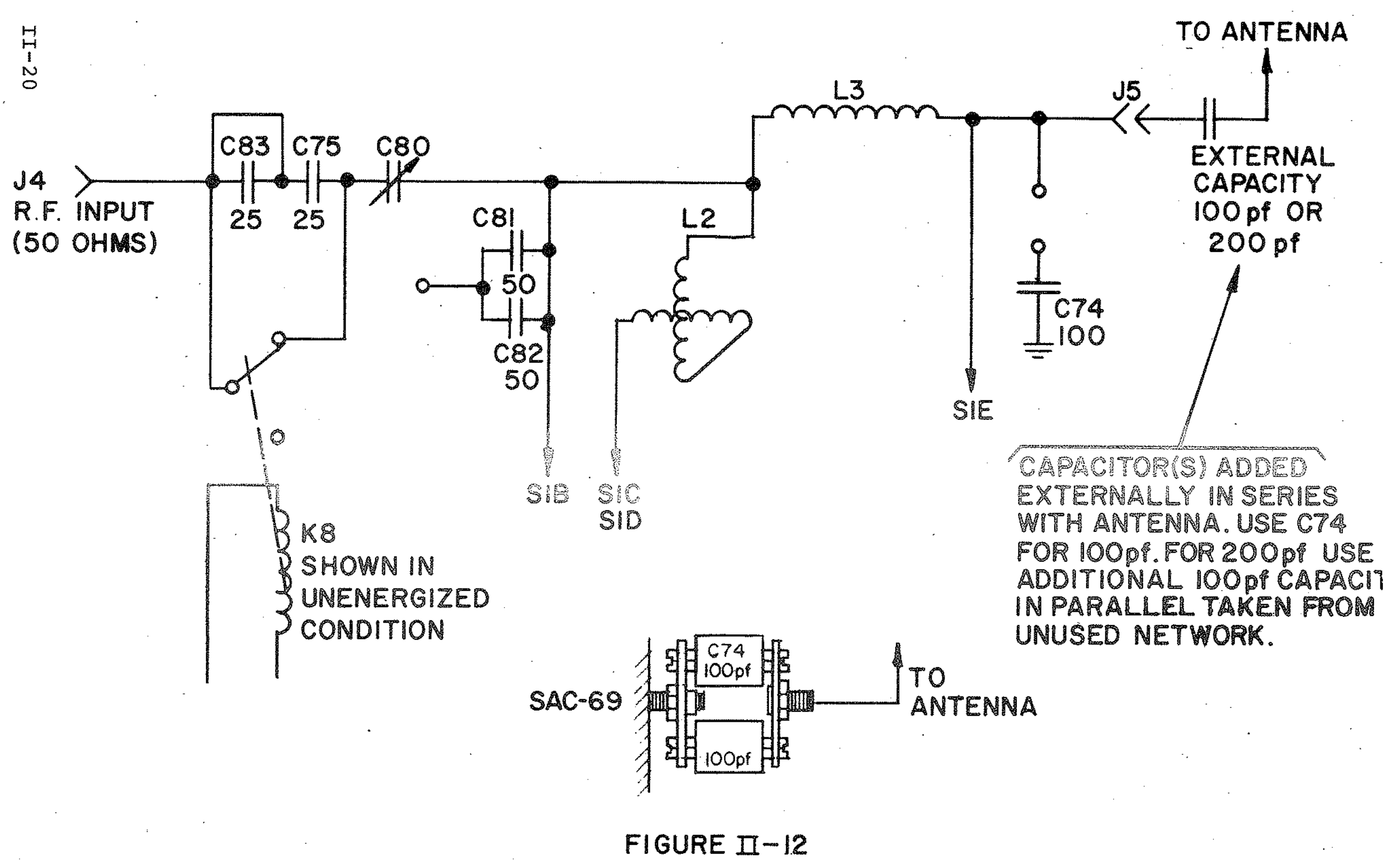


FIGURE II-12

SAC 69 (C)

CONFIGURATION WITH EXTERNAL CAPACITOR(S)

SIZE	LENGTH	SIZE AWG
A	LESS THAN 12 FT	# 20
	MORE THAN 12 FT / LESS THAN 20 FT	# 18
	MORE THAN 20 FT / LESS THAN 31 FT	# 16
	MORE THAN 31 FT	# 14
B	LESS THAN 10 FT	# 16
	MORE THAN 10 FT / LESS THAN 18 FT	# 14
	MORE THAN 18 FT / LESS THAN 35 FT	# 12

NOTES:

1. UNLESS OTHERWISE INDIC (INCLUDING SHIELDED) SH AWG # 24 OR LARGER.
2. ALL SHIELDED WIRE INSU
3. COAX CABLE RG-58 A/U
4. SAC-69 STANDARD MODE THRU STUD RF OUTPUT. CONNECTOR OPTION HAS CONNECTOR TO BE USED COAXIAL CABLE.
5. PA-1010 B MODIFIED TO BE SAC-69 AUTOMATIC ANTEN SEE SEC II-12 SAC-69 MA MANUAL FOR CHANNEL PU

	SYM	TYPE	PART NO.
[illegible]	P8	34 PIN RECTANGULAR	74740
	P9	"BNC", TYPE UG-88/U	74403
	P10	"BNC", AMPH NO. 14625	75263
PA-1010B	P1	"N", TYPE UG-536B/U	74702
	P2	"UHF", TYPE PL-259	90873
	P3	"BNC", TYPE UG-88/U	74403
	P4	CANNON "SK" SERIES, 16 PIN	74726
[illegible]	P201	34 PIN RECTANGULAR	74740
SAC-69	P1	AMPH. NO. 165-10	74362
	P5	(OPTIONAL) "HN", TYPE UG-59A/U	75316
	P3	"N", TYPE UG-536B/U	74702

INTERCONNECT DIAGRAM

ASB-130/SAC-69 SYSTEM

FIGURE II-13

IZE AWG

#20

#18

#16

#20

#18

#16

#14

RES
AWG

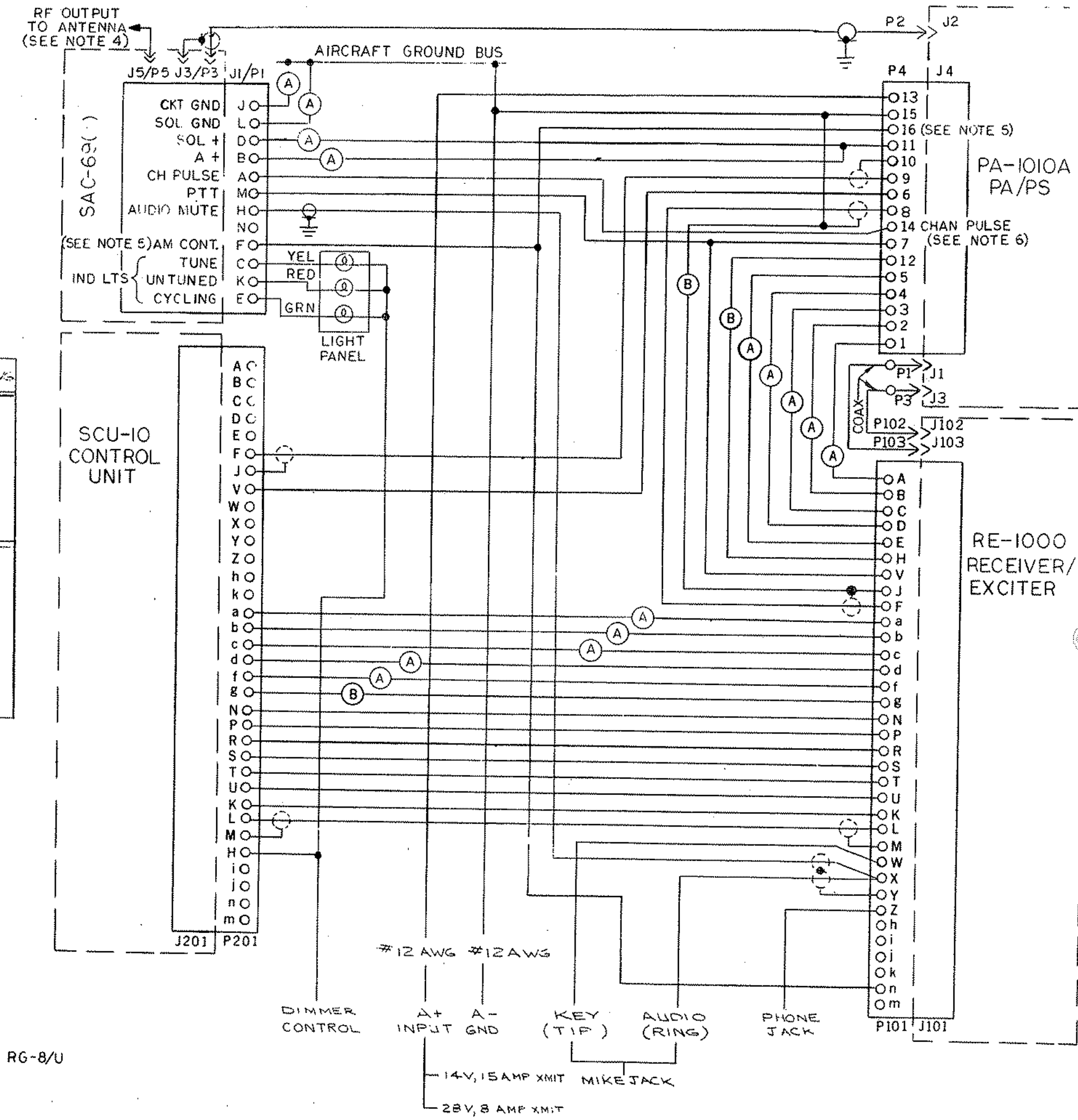
PE

U

EED-
UT
R FOR RG-8/U

) FOR

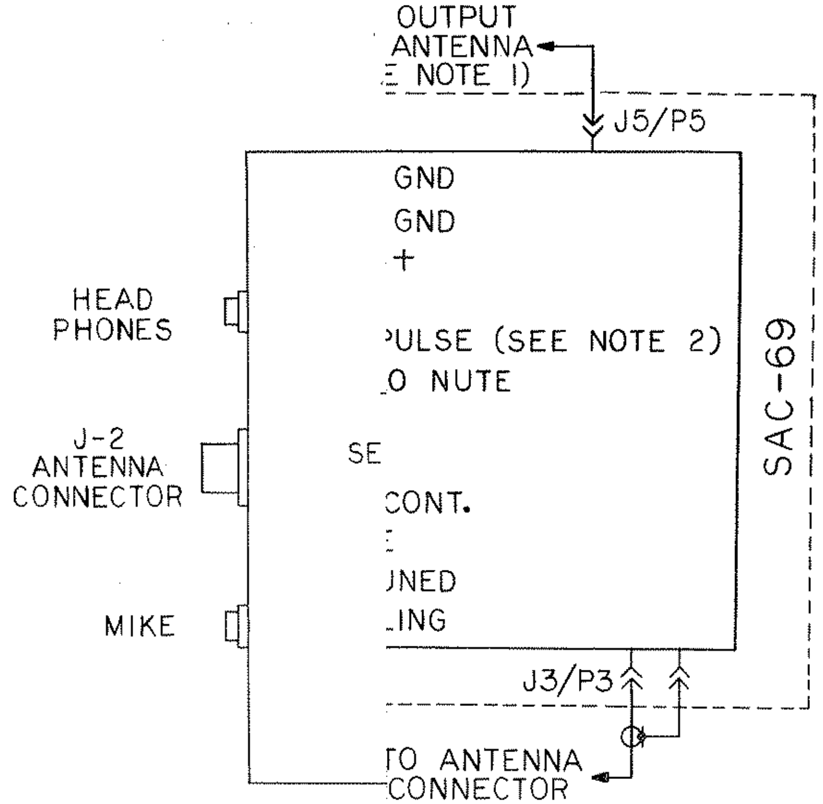
L) FOR

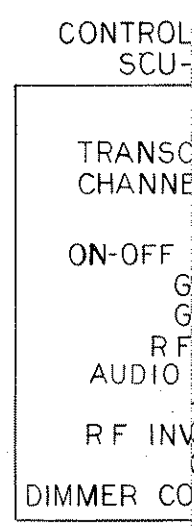


INTERCONNECTION DIAGRAM, ASB-100 SYSTEM/SAC-69( )

CABLING INTERCONNECTION DIAGRAM

FIGURE II-14





WIRE	LENGTH	SIZE AWG
A	LESS THAN 24 FEET	#20
	MORE THAN 24 FEET LESS THAN 39 FEET	#18
	MORE THAN 39 FEET LESS THAN 62 FEET	#16

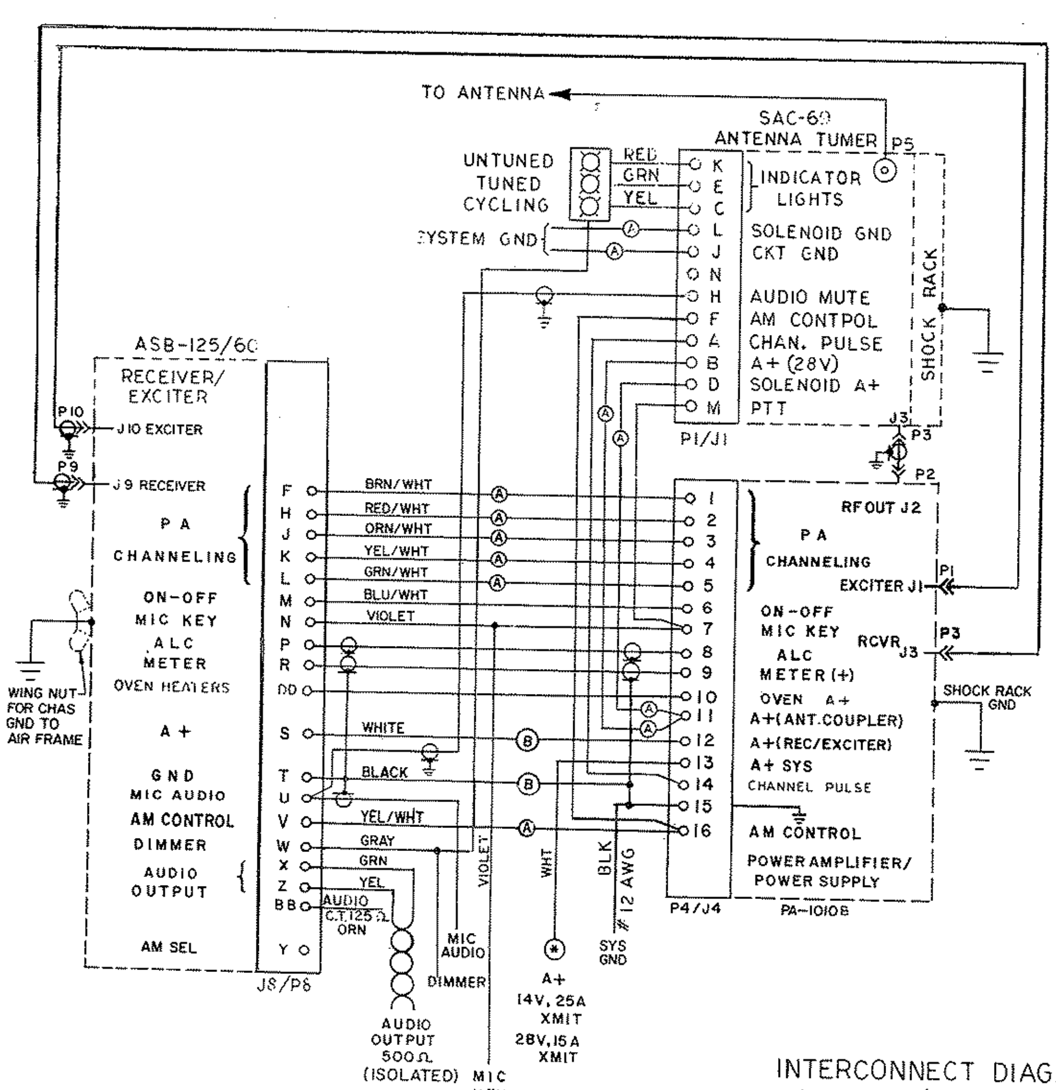
-69( ) STANDARD MODEL HAS FEED THRU STUD OUTPUT. COAX OUTPUT OPTION HAS A TYPE CONNECTOR FOR RG-8/U.

FIGURE II-13 (SAC-69 MANUAL) FOR CHANNEL SE MODIFICATION.

T-22-RA/SAC-69

INTERCONNECT DIAGRAM

FIGURE II-15



INTERCONNECT DIAGRAM,
ASB-125/60 SYSTEM
SAC-69 AUTOMATIC ANTENNA TUNER

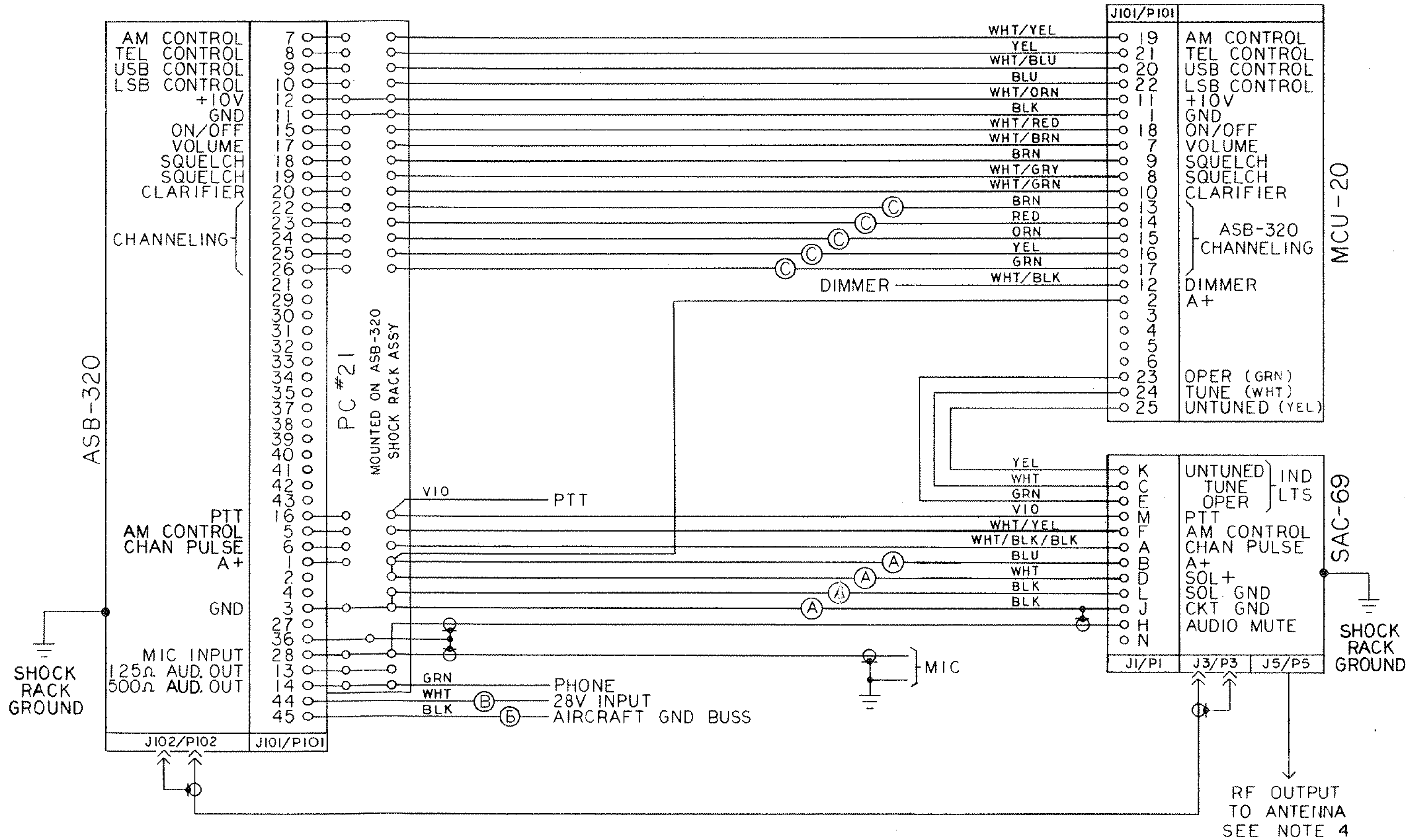
SIZE	LENGTH	SIZE AWG
A	LESS THAN 24 FT.	# 20
	MORE THAN 24 FT. LESS THAN 39 FT.	# 18
	MORE THAN 39 FT.	# 16
B	LESS THAN 12 FT.	# 20
	MORE THAN 12 FT. LESS THAN 20 FT.	# 18
	MORE THAN 20 FT. LESS THAN 31 FT.	# 16
	MORE THAN 31 FT.	# 14
C	LESS THAN 10 FT.	# 16
	MORE THAN 10 FT. LESS THAN 18 FT.	# 14
	MORE THAN 18 FT. LESS THAN 35 FT.	# 12

	SYM	TYPE	PART NO.
PA-1010C	P 1	COAXIAL TYPE N UG-536 B/U	74702
	P 2	COAXIAL UHF PLUG	90873
	P 3	COAXIAL BNC PLUG UG-88/U	74403
	P 4	16 PIN CABLE PLUG	74726
ASB 125/60	P 8	26 PIN RECTANGULAR	74996
	P 9	COAXIAL BNC PLUG UG-88/U	74403
	P10	COAXIAL BNC PLUG UG-88/U	74403
SAC-69	P1	AMP NO. 165-10	74362
	P3	"N" TYPE UG-536 B/U	74702
	P5	SEE NOTE 5 HN TYPE UG-59 A/U	75316

NOTES

1. UNLESS OTHERWISE INDICATED WIRES (INCLUDING SHIELDED) SHOULD BE AWG #24 OR LARGER.
2. ALL SHIELDED WIRE INSULATED TYPE.
3. COAX CABLE RG 58A/U.
4. ⊛; USE WIRE LIST "C".
5. SAC-69 MODELS A & C HAVE FEED THRU STUD RF OUTPUT MODELS B & D HAVE TYPE HN REQUIRING PLUG UG 59 A/U.
6. SEE FIGURE II-12 (SAC-69 MANUAL) FOR CHANNEL PULSE MODIFICATION.

FIGURE II-16



SIZE	LENGTH	SIZE AWG
A	LESS THAN 12FT	#20
	MORE THAN 12FT LESS THAN 20FT	#18
	MORE THAN 20FT LESS THAN 31FT	#16
	MORE THAN 31FT	#14
B	LESS THAN 10FT	#16
	MORE THAN 10FT LESS THAN 18FT	#14
	MORE THAN 18FT LESS THAN 35FT	#12
C	ALL LENGTHS	#20

SYM		TYPE	PART NO.
ASB-320	P101	45 PIN CONNECTOR	74013
	P102	"UHF" TYPE PL-259	90873
MCU-20	P101	25 PIN CONNECTOR	99828
SAC-69	P1	AMPH. NO. 165-10	74332
	P3	"N" TYPE UG-536B/U	74702
	P5	"HN" TYPE UG-59A/U (OPTIONAL)	75313

NOTES:

1. UNLESS OTHERWISE INDICATED WIRES (INCLUDING SHIELDED) SHOULD BE AWG #24 OR LARGER.
2. ALL SHIELDED WIRE INSULATED TYPE.
3. COAX CABLE RG-58A/U
4. SAC-69 STANDARD MODEL HAS A FEED-THRU STUD RF OUTPUT. RF OUTPUT CONNECTOR OPTION HAS A TYPE "HN" CONNECTOR TO BE USED WITH RG-8/U COAXIAL CABLE.

INTERCONNECT DIAGRAM

ASB-320/SAC-69 SYSTEM

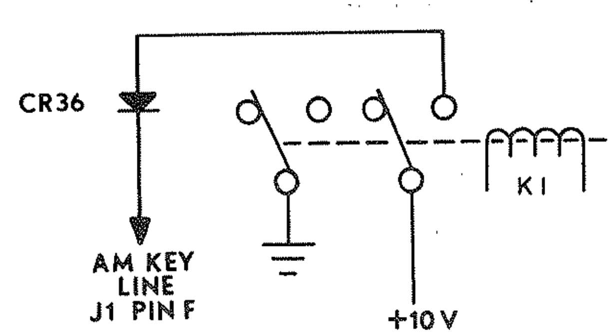
FIGURE II-17

the tuning cycle because any modulation can cause the phase detector in the electronics drawer to sense false indications of tuning. If the tuner still does not tune all frequencies see Table B, page II-11 as it may be necessary to change the basic r-f tuning network configuration.

H. FIELD MODIFICATION, SAC-69/RADIO COMPATIBILITY

The modifications shown in this paragraph are required whenever a SAC-69 tuner is used with a radio that originally used a channelized fixed tuned coupler. If the SAC-69 and radio were originally ordered together as a system the modification has already been made at the factory.

1. ASB-100A AM Control
   For operation with the ASB-125, ASB-130, ASB-320, 10 volts must be switched onto the AM key line in order to force the transceiver to be in the AM mode while tuning. For operation with the ASB-100, 28 volts must be switched onto the AM control line. This is easily accomplished by removing the wire from the ungrounded side of R73 (10 V) gain control that goes to the pole of K1 that controls the AM key line. This wire can then be connected to 28 volts, anode of CR21, or the circuit side of the fuseholder for F1.



ASB-100A AM CONTROL MODIFICATION
FIGURE II-18

2. PA1010, PA1010A, PA1010B Power Amplifier (ASB-100A, ASB-60/125/130)
   On the power amplifier chassis, a pin on J4 must be made available in order to get a channel pulse to the Antenna Tuner. Pin 14 is used. The ground must be removed from

pin 14 of J4. A wire is installed in pin 14 and connected to the channeling wafer side of the interrupter. This is shown schematically below. The wire in pin 14 of P4 is removed and moved over to pin 15, P4. The schematic shown below illustrates the wiring after the wiring modification.

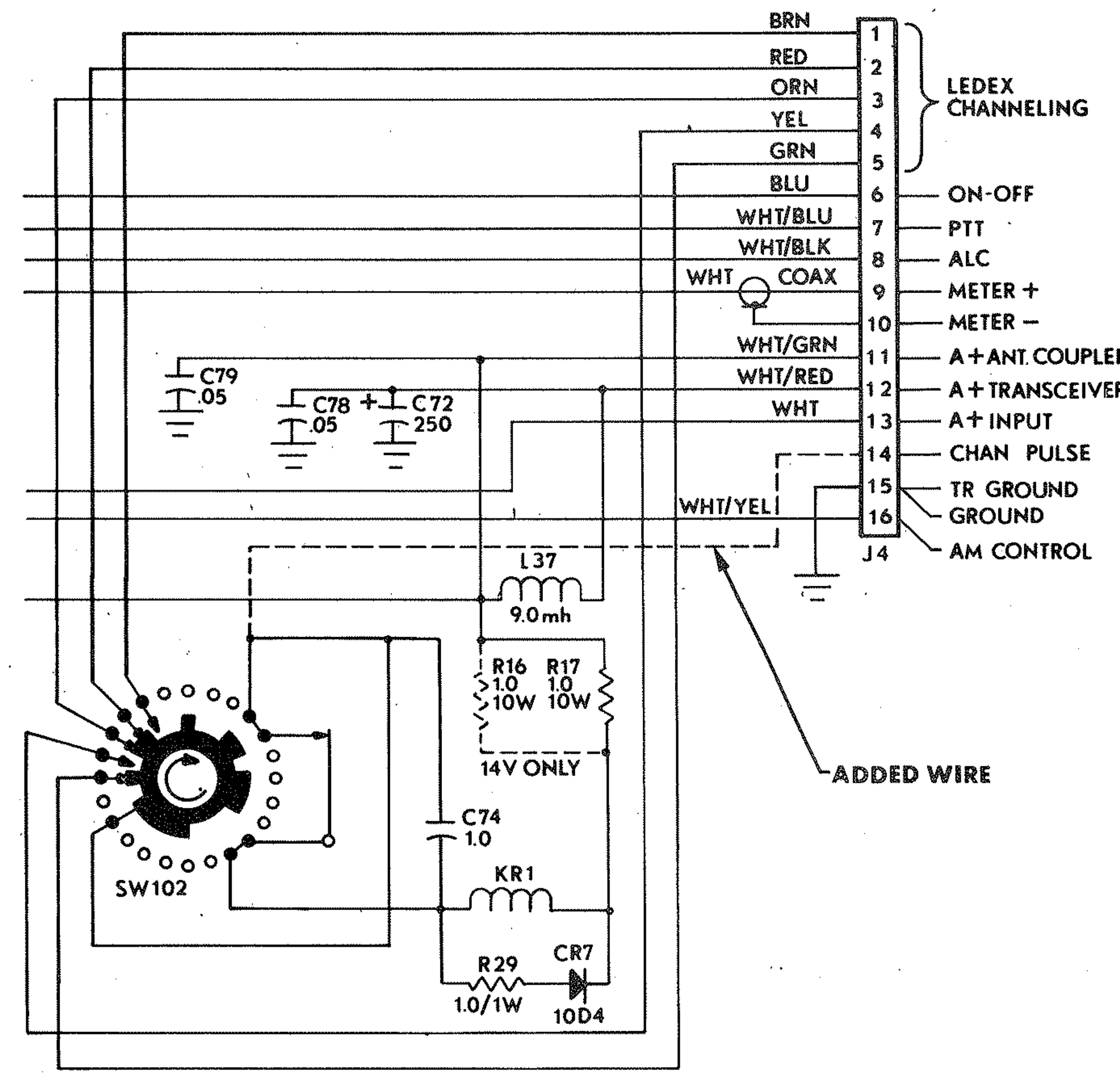


FIGURE II-19

CHANNEL PULSE MODIFICATIONS
FOR PA-1010, PA-1010A AND PA1010B

3. T-22RA
In order to generate a channel pulse for the SAC-69( ) a wire must be brought out from the rotary solenoid. A wire is added from the interrupter side of C192 to pin 23 of J1. This is shown schematically below. The dotted line is the added wire for the channel pulse.

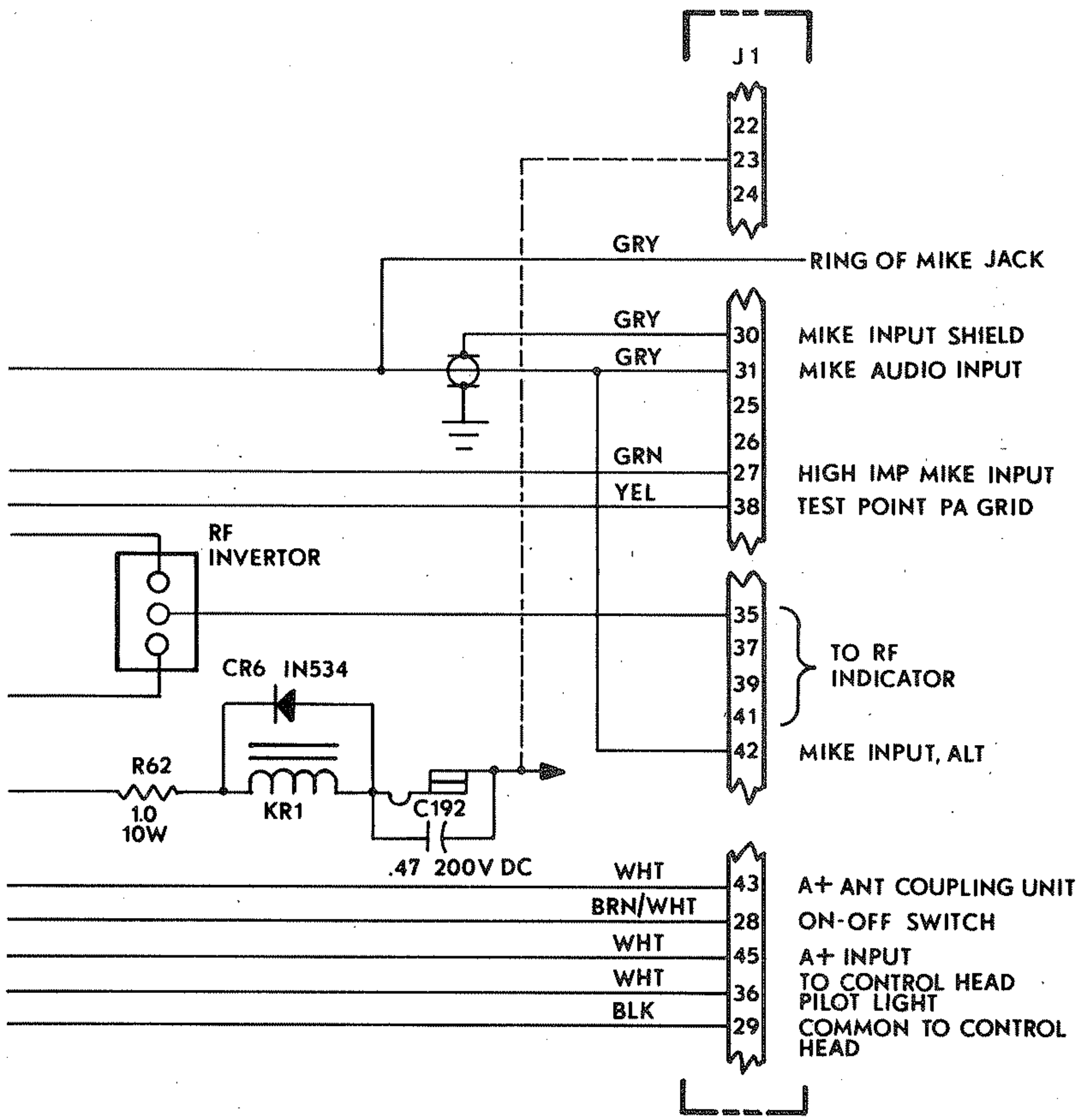


FIGURE II-20
CHANNEL PULSE MODIFICATIONS FOR T-22-RA

SECTION 3
OPERATION

A. OPERATOR INSTRUCTIONS

Turn on the associated transceiver. The red light should be illuminated. Channel the transceiver to the desired frequency of operation. If the transceiver is already set to the desired channel, it will have to be changed in order to generate a channel pulse to initiate a tuning cycle. If the antenna tuner is wired for channel pulse actuate, the transmitter will key on after the channeling has been completed. The receiver will go off and the amber (tuning) light will come on. If the antenna tuner is wired for PTT actuate (push-to-talk) the microphone button will have to be depressed in order to turn on the transmitter. (If the channel is being used by another station, tuning can be initiated because there is a negligible amount of power radiated during the tuning cycle.) The microphone button does not have to be held depressed because circuitry in the antenna tuner will keep the transmitter keyed on until the tuning cycle is completed.

Once the tuning cycle is initiated (PTT actuate or channel pulse actuate) the amber light will be illuminated and the receiver will be silenced. After a maximum time of 30 seconds (typical 5 seconds) the amber light will extinguish and the green light will come on. The amber and green lights will alternately come on and off, signaling the slow tuning mode. After the green light remains on for one second, the transmitter will unkey and the receiver will come on. This indicates that the antenna is tuned and the transmitter is ready to use.

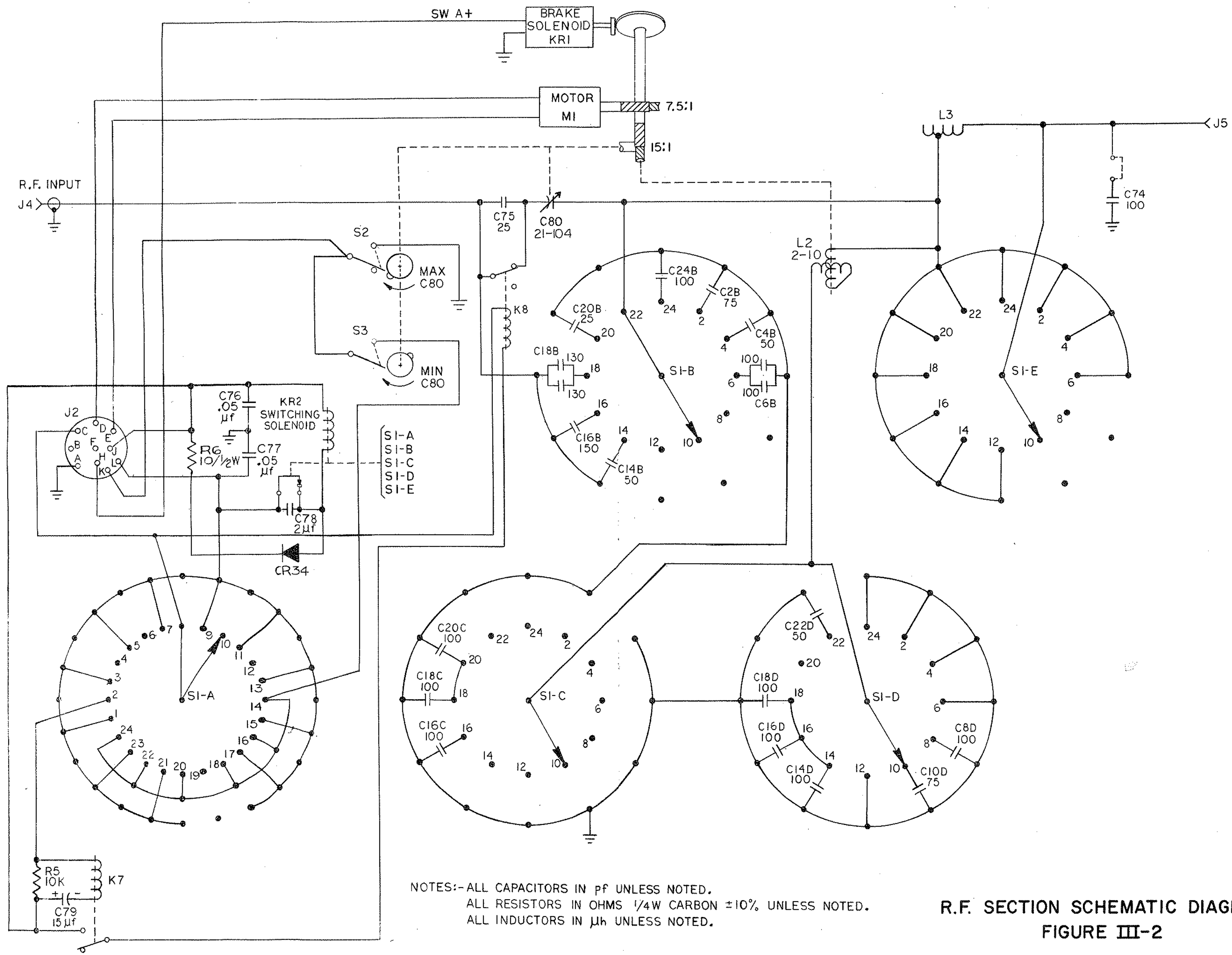
If, while using the transmitter, the amber light occasionally comes on, the antenna should be retuned. This can be caused by the characteristic of the antenna changing from the ground to airborne or due to weather conditions.

B. THEORY OF OPERATION

The SAC-69( ) antenna tuner consists of two basic modules, the r.f. tuning section and the electronics control drawer. Figure III-1 illustrates the basic system operation. R.F. power from the transmitter is fed to the phase detector input of the electronics drawer, through the phase detector and into the r.f. tuning section. An error voltage developed in the phase detector is fed to the motor drive circuitry to cause the motor to operate, changing the values of a variable capacitor and a variable inductor, both located in the r.f.

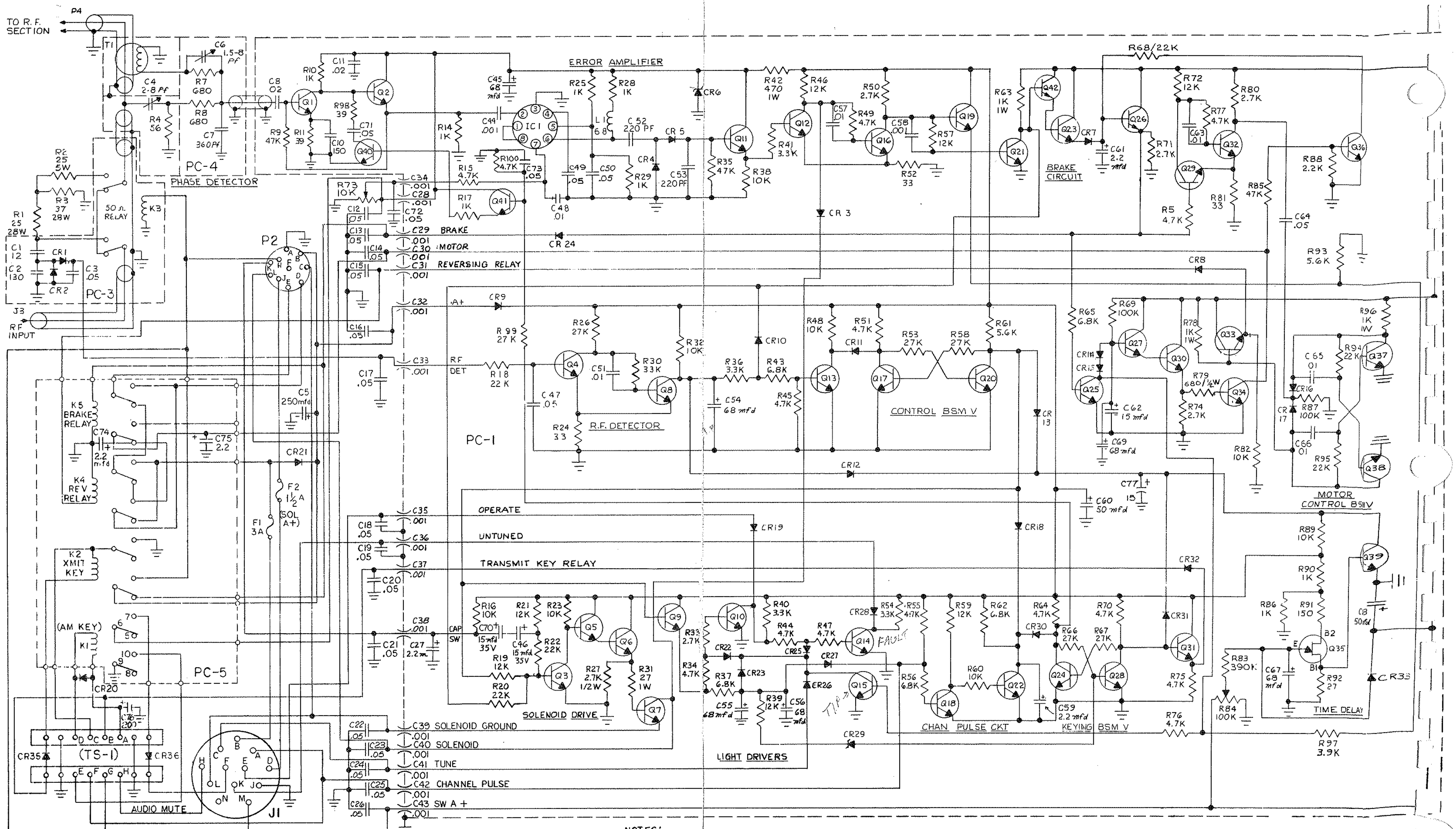
tuning section. The variable capacitor is equipped with switches that cause the network configuration to change each 1/2 or full revolution of the variable capacitor. There are 24 total networks used for tuning and a maximum time of 18 seconds is required for scanning all networks.

When the proper combination of variable L and C, along with other fixed components is obtained, the error voltage from the phase detector is reduced to near zero and the tuner stops channeling. A braking pulse is applied to the motor, and a fine tune mode begins. The fine tuning mode allows the motor to reverse very slowly and drive the variable components in the reverse direction until the 50 ohm matching point is again found. At this time, another braking pulse is applied to the motor, it is again reversed, and the action continues until there is no error voltage from the phase detector. This reversing or hunting allows a very fine tune to be achieved.



NOTES:- ALL CAPACITORS IN pf UNLESS NOTED.
ALL RESISTORS IN OHMS 1/4W CARBON ±10% UNLESS NOTED.
ALL INDUCTORS IN µh UNLESS NOTED.

R.F. SECTION SCHEMATIC DIAGRAM
FIGURE III-2

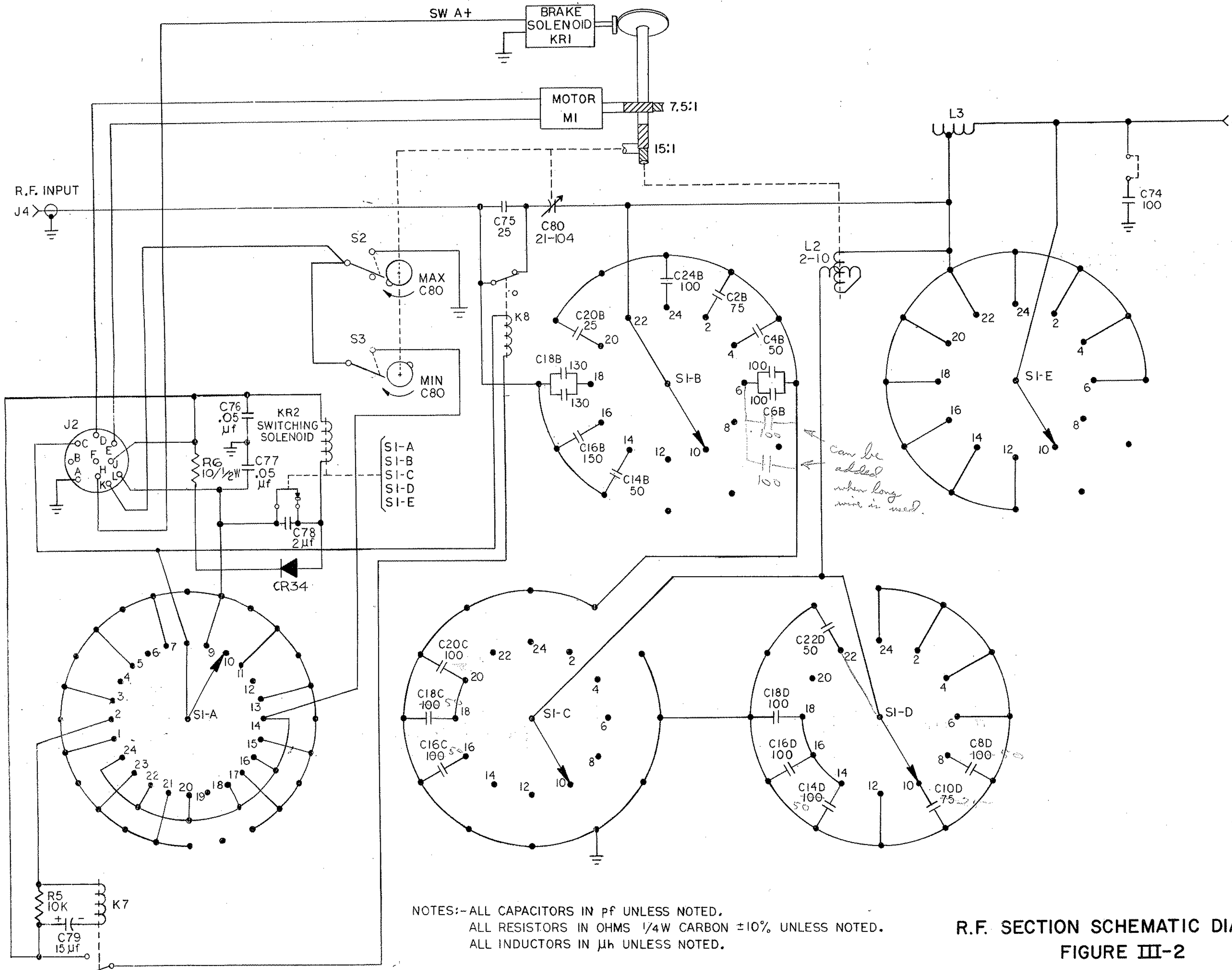


PTT ACTUATE
A CONNECTED TO GND
B CONNECTED TO D
C CONNECTED TO G
E CONNECTED TO H
F NO CONNECTION

CHANNEL PULSE ACTUATE
A CONNECTED TO C
B NO CONNECTION
F CONNECTED TO D
E CONNECTED TO G
H NO CONNECTION

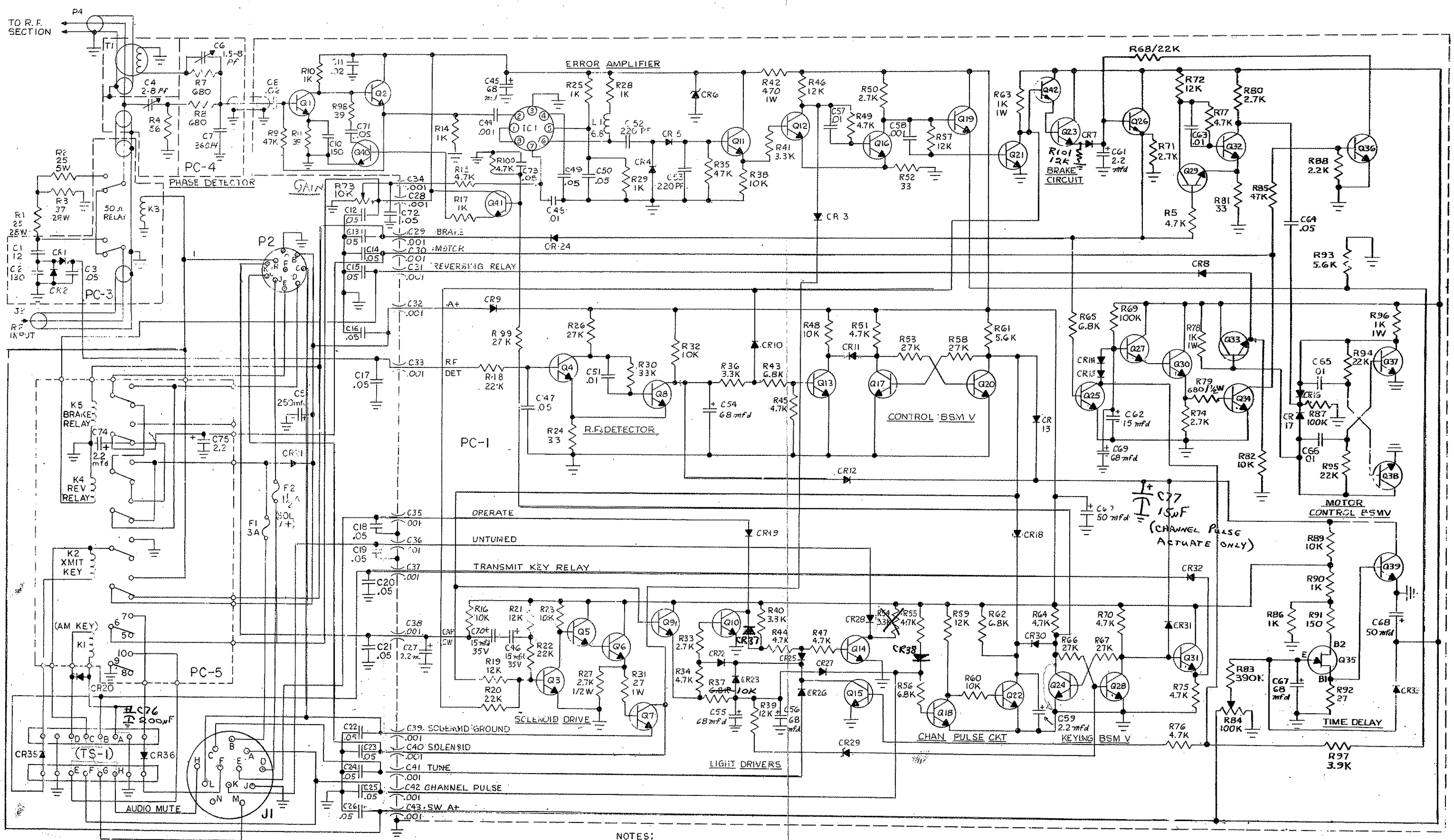
NOTES:
1. ALL RESISTORS IN OHMS ±10% ¼W UNLESS NOTED.
2. ALL CAPACITORS IN uf UNLESS NOTED.

ELECTRONICS DRAWER SCHEMATIC DIAGRAM
FIGURE III-3



NOTES:- ALL CAPACITORS IN pf UNLESS NOTED.
ALL RESISTORS IN OHMS 1/4W CARBON ±10% UNLESS NOTED.
ALL INDUCTORS IN μh UNLESS NOTED.

R.F. SECTION SCHEMATIC DIAGRAM
FIGURE III-2

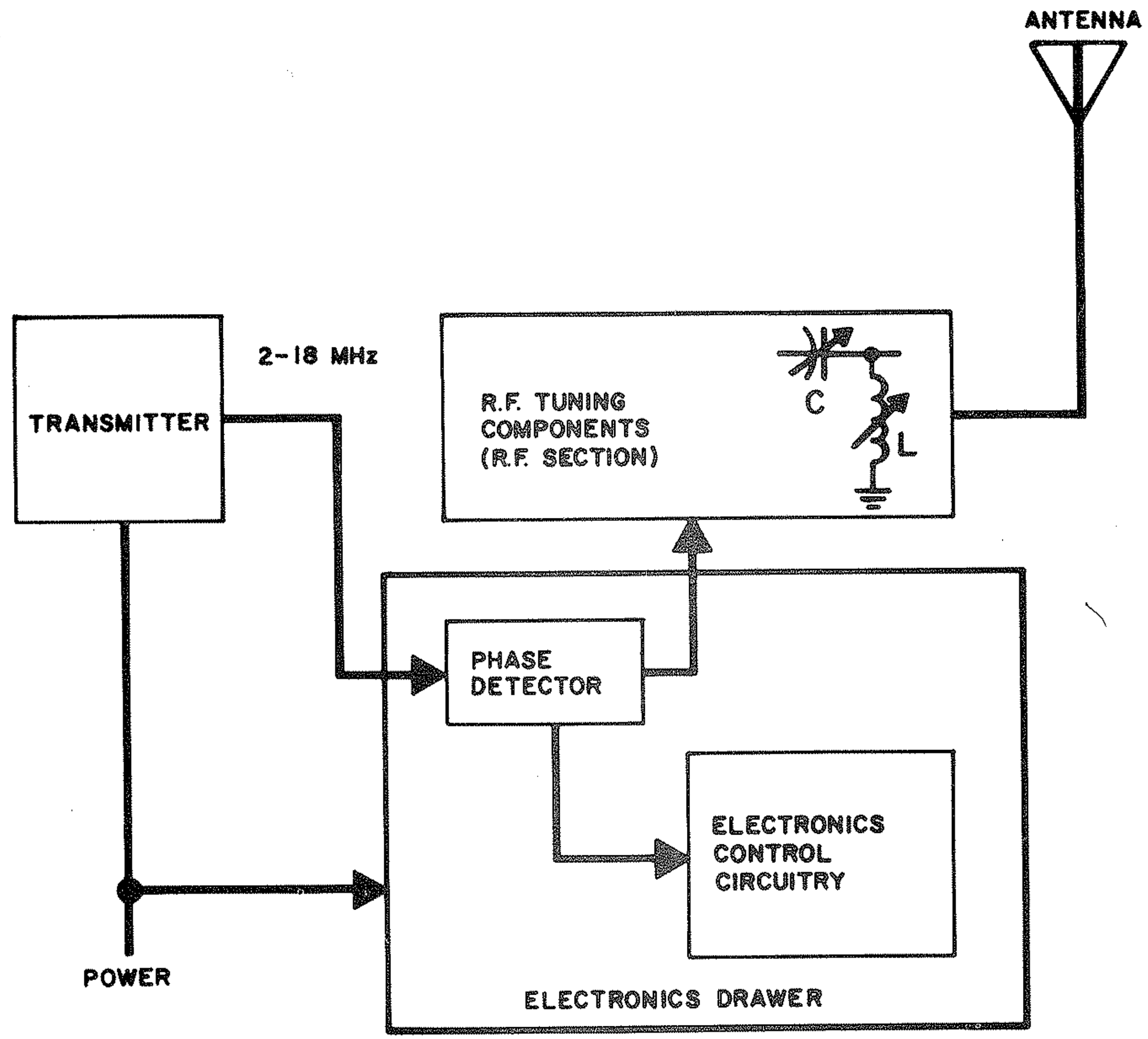


P.T.T. ACTUATE
A CONNECTED TO GND
B CONNECTED TO D
C CONNECTED TO G
E CONNECTED TO H
F NO CONNECTION

CHANNEL PULSE ACTUATE
A CONNECTED TO C
B NO CONNECTION
F CONNECTED TO D
E CONNECTED TO G
H NO CONNECTION

NOTES:
1. ALL RESISTORS IN OHMS ±10% 1/4W UNLESS NOTED.
2. ALL CAPACITORS IN μf UNLESS NOTED.

ELECTRONICS DRAWER SCHEMATIC DIAGRAM
FIGURE III-3



AUTOMATIC ANTENNA TUNER
GENERAL BLOCK DIAGRAM
FIGURE III-1

SECTION 4

THEORY OF OPERATION

A. PHASE DETECTOR

The phase detector is located in the electronics drawer and consists of T1, C4, C6 and associated components in the rf tight enclosure. During the tuning mode, the input power from the transmitter is terminated with a 50 ohm-10DB pad that is switched in series with the phase detector by K3, the 50 ohm relay. This action is required to present a 50 ohm load to the transmitter during the tuning mode. The 50 ohm pad consists of R1, R2 and R3. The input tuning power should be limited to a maximum of 30 watts to prevent overheating the pad resistors. The pad is switched out after the tuning cycle is completed. The output from the 10DB pad (3 watts with 30 watts input) is fed to the phase detector input and to the r.f. tuning section via P4.

The phase detector samples the voltage on the line and the current in the line to determine when the input to the r.f. tuning section is 50 ohms resistive. C4 and R4 sample the voltage and transformer T1 samples the current. Transformer T1 is phased so its output voltage is opposed to the voltage across R4. Capacitors C4 and C6 are adjusted so that, when the output of the phase detector is terminated with 50 ohms, the AC output from the phase detector (Base of Q1) is near zero or nulled. Since the motor drive voltage is derived from the phase detector error voltages, the motor will continue to run as long as there is error voltage from the phase detector. The error voltage will null when the input to the r.f. section is 50 ohms resistive. Adjustment of the phase detector is covered in the maintenance section.

B. ERROR AMPLIFIER

The error amplifier consists of IC1, Q1, Q2, Q11, Q12, Q16, Q21 and associated circuitry. The output from the phase detector (Q1 base) is fed to the input of Q1, via C8. R73, the gain control, adjusts the gain of IC1 and thereby sets the threshold of the null from the phase detector. The gain control is mounted on the front panel of the tuner and may be readily adjusted for minimum reflected power, while still achieving tuning on all frequencies. IC1 is a broadband a.c. amplifier and its output (pin 6) is coupled to a voltage doubler circuit via C52. The d.c. output from the voltage doubler (CR4 and CR5) is fed to the emitter follower, Q11, which provides a low driving impedance to drive the trigger, Q12 and Q16. (CR3, connected to Q12 collector, prevents detection of nulls during the network switching intervals.) The collector output of Q16 is a square wave that is +22V when the error voltage is greater than the threshold and is near zero volts when the phase detector output nulls, indicating a 50 ohm point. Q19 is an emitter follower used to drive Q15,"tuning in progress"lamp driver. Q21 inverts the output of Q16 and presents a positive pulse input to the brake circuit when the 50 ohm point is detected. Also, Q21 output connects to R20, inhibiting an output to the rotary solenoid, to prevent changing networks once a 50 ohm point has been found.

The collector of Q21, through CR10, prevents Q13, from toggling the control BSMV until a 50 ohm tuning point has been reached. (Function of the Control BSMV is discussed in F).

C. BRAKE CIRCUITRY

The brake circuit consists of Q42, Q23 and Q26. This circuit is basically a pulse stretching circuit that accepts the narrow (50 microseconds) phase detector output pulse and lengthens it to 4 to 10 milliseconds. When the tuner is channeling in the fast mode, the variometer is operating at approximately 700 RPM. Since a few degrees of variometer rotation can tune through a 50 ohm point, the resulting nulls can be quite narrow. Q26 of the brake circuit drives the brake relay (K5) via CR24. When K5 is energized, a short is placed across the motor winding, creating a dynamic braking action and causing the motor to stop rotating in a short period of time. The brake pulse also saturates Q25, which shorts the voltage on the base of Q27, via CR14 and CR15. Since the motor drive voltage is derived from Q27, the motor drive voltage is reduced to zero. It should be noted that the charging time constant of the base of Q27 is quite long. R69, C62, C69 time constant causes the base voltage of Q27 to rise very slowly when the brake pulse has ended. This slowly rising motor drive voltage causes the motor to begin turning very slowly and initiates the fine tune mode. The output from the brake circuit, Q26, also drives a trigger, Q29, and Q32, which is used to toggle the motor control BSMV via C64. In other words, after the end of the brake pulse, the direction of motor rotation is reversed.

D. MOTOR DRIVE

The motor drive circuitry consists of Q27, Q30, Q33, Q34, Q37, Q38 and relay K4; Q37 and Q38 are configured as a bi-stable multivibrator (BSMV) and determine the direction of rotation of the motor. Q33 is an emitter follower used to drive K4 via CR8. K4 switches the polarity of the motor between +28 Volts and the collector of Q34. In other words, the state of the motor reversing BSMV determines whether K4 is energized or not. If K4 is energized, the motor turns in one direction. If K4 is not energized, the motor turns in the opposite direction. The speed of the motor is determined by the amount of current allowed to flow through Q34. Q34 is driven by Q27 and Q30 connected as current amplifiers. Therefore, if a ramp (slowly rising) voltage is applied to the base of Q34, the motor will begin turning very slowly. The motor used is a torque motor that has a large speed variation with current drive.

E. R.F. DETECTOR

The r.f. detector consists of a voltage doubler (C1, C2, CR1 and CR2) plus Q4, Q8 and associated circuitry. The purpose of the r.f. detector circuitry is to prevent the tuner from sensing the null output from the phase detector at the beginning of a tuning cycle. When the transmitter is first keyed on at the beginning of the tuning cycle, the r.f. waveform requires a few milliseconds to reach its full value. During this interval the output from the phase detector is near null. The time constant of R32 and C54 assures that the transmitter output will be to full output before Q13 can be driven from the voltage at the junction of R32 and C54. This circuitry prevents false tunes at the initiation of a tuning cycle.

F. CONTROL BSMV

Q17 and Q20 comprise the control BSMV. This BSMV is used to control the solenoid switching circuitry. The solenoid, located in the r.f. tuning section, drives a switch that changes the basic networks used for impedance matching. At the beginning of a tuning cycle, the control BSMV is set (via CR18) by the channel pulse so that Q20 is saturated and Q17 is cut off. The collector of Q20 drives Q3 via R19. When the collector of Q20 is at zero volts (saturated), Q3 is allowed to amplify pulses from the capacitor microswitch and solenoid channeling continues. However, when the control BSMV is reset by a null pulse from the error amplifier (via CR10), Q20 collector rises to a positive voltage and the solenoid is prevented from channeling by R19 saturating Q3. In addition to controlling the solenoid switching, the control BSMV controls the light drivers via Q9.

G. SOLENOID DRIVE

Solenoid drive circuitry generates a high current switching pulse for driving the switching solenoid in the r.f. tuning section. The circuitry, Q3, Q5, Q6, Q7 and associated components, accepts a negative going pulse, generated by the capacitor microswitch, via C70 and C46. The base circuit of Q3 is configured as an AND gate. When the inputs to R19, R20 and R22 are all zero volts, Q3 will cut off and its collector will rise to 20 volts. This action drives Q5 and Q6 into high conduction, saturating Q7 and driving the solenoid one position. The solenoid drive pulse is 10 milliseconds in duration. No solenoid pulse will occur if there is a null from the phase detector, because Q21 collector will not be at ground and Q3 will be inhibited via R20. Similarly, if the control BSMV has been reset, indicating a 50 ohm point has been found, Q20 collector will not be at ground, and Q3 will be inhibited by the input through R19.

H. LIGHT DRIVERS

The three indicating lights are controlled by the light drivers, Q10, Q14, Q15 and associated components. These indicating lights are normally located in the control panel of the associated transmitter or on the auxiliary light panel (Sunair Part No. 99467) and provide the operator with a visual indication of the status of the tuner. Power for the lights is normally supplied from the cockpit dimmer control. The lights are turned on by a ground being supplied in the tuner by Q10 for the operate (tuned) lamp; Q14 for the untuned lamp; and Q15 for the cycling (tune) lamp. When the tuner is first turned on (+28V applied to pin B of J1) Q20 will be saturated because of the unequal collector load resistors of Q17 and Q20. The emitter of Q9 will be at zero volts and therefore Q10 will be cut off and its collector will be approximately 22 volts. The tuned light will not be turned on because diode CR19 will be reverse biased. However, since Q15 is saturated only during the tuning cycle when error voltage is present, Q10 collector (22V) will saturate Q14 and the untuned light will be turned on. It should be noted that the channel pulse (via CR18) and the time delay circuit (via CR13) also cause Q20 to be saturated. Therefore, the untuned light is on during the following intervals: Initial turn on of the unit; after the time delay has run out; and after the associated transmitter has been changed to a new channel.

The cycling light is turned on any time there is an error voltage present at the output of Q19. Q15 is saturated via R76 and R97 and the cycling light is turned on via CR26. The cycling light provides a visual indication that the tuner is tuning during the cycling mode and also provides an indication of an untuned condition after the tuning cycle has been completed. For example, some types of antennas tuned on the ground will detune when the aircraft has become airborne. Any time the transmitter is keyed on and the cycling light is on indicates that the antenna characteristic has changed and the tuner should be re-cycled. This can be accomplished by generating a channel pulse and keying the transmitter, or rechanneling only, depending on the wiring of TS-1.

The tuned light is turned on by Q10 being saturated. Since Q10 drive voltage is supplied by Q20 (via Q9), the tuned light cannot be turned on until the control BSMV has been reset by a 50 ohm null pulse via CR10. If the control BSMV has been reset but the tuner is in the slow tuning mode, Q15 will be saturated by the error voltage and the tuned light will be on only during braking pulses. Therefore, during the final seconds of tuning in the slow tuning mode the cycling and tuned lights will blink on and off until the tuned light remains on continuously and the transmitter is automatically unkeyed by K1 or K2.

I. CHANNEL PULSE CIRCUIT

The channel pulse input is fed to the junction of R55 and R56. The negative going pulse causes Q18 to cut off and Q22 to saturate. When Q22 is saturated the keying BSMV and the control BSMV are both set via CR30 and CR18, respectively. C59 connected to the collector of Q22 prevents noise spikes from randomly setting the two BSMV's.

J. KEYING BSMV

Q24 and Q28 are connected as a BSMV which is used to control the transmit keying relay K2 via Q31 and CR32. When the keying BSMV is set by the channel pulse, the collector of Q28 rises to a positive voltage and K2 has voltage applied to one side of its winding. When the transmitter is keyed, a ground is placed on the other end of K2 winding and relay K2 will become energized. K2 is connected as a latching relay, that is, when the transmitter is keyed and K2 becomes energized, it will remain on until the driving voltage is removed from Q31. Pin M of J1 is connected to the transmitter key line. One pole of K2 is used to switch +28VDC to the tuner (SW A+) and the other pole is used to place a ground on the K2 winding.

At the conclusion of the tuning cycle and the tuned light is on, time constant R37 - C55, C56 charges up toward +20 volts and zener diode CR29 conducts, resetting the keying BSMV. This action concludes the tuning cycle. When the keying BSMV is reset relay K2 is de-energized, the transmitter is unkeyed, and SW A+ is removed from the tuner. The SW A+ controls the AM keying relay K1 (Used to condition the transmitter to carrier operation during the tuning cycle), the 50 ohm relay (Used for switching in the 10 DB pad) and mechanical brake in the r.f. tuning section. The collector of Q24 is also connected to the base of Q41 via R99. Q41 drives Q40 which is an attenuator switch. When Q40 is saturated, R98 and C71 are effectively shorted to ground, reducing the gain of the error amplifier. This action is required to compensate for the difference in power level during tuning (3W) and the power during normal operation (130 watts PEP).

K. TIME DELAY

The time delay circuit consists of R84, Q35, Q39 and associated components. The uni-junction, Q35 is driven from R84, R83 and C67. R84 is adjusted to set the time required for the voltage on the emitter of the uni-junction to rise to firing potential. This time is set to 45 seconds. When the tuning cycle begins, SW A+ begins charging the emitter of Q35. If the tuning has not been completed after 45 seconds, Q35 emitter voltage will have exceeded the firing potential and Q35 will fire. The discharge current from Q35 develops a positive pulse across R92, saturating Q39. When Q39 saturates, its collector drops to zero volts, setting the control BSMV via CR13 and resetting the keying BSMV via CR31. Therefore, after the time delay runs out and Q35 fires, the tuner is turned off and the untuned light will remain on. The action of the time delay firing indicates the tuner has gone through all possible networks and the proper combination of matching networks has not been found.

L. TYPICAL TUNING SEQUENCE

Figure V-4 (maintenance section) illustrates the waveforms to be observed at various points in the tuner during the tuning sequence. It should be noted that the magnitudes of the voltage waveforms are general, either maximum or minimum with no values indicated. Typical values of voltages are shown in the maintenance section.

M. R.F. COMPONENTS SWITCHING

Figure V-1 is a schematic diagram of the r.f. section of the antenna tuner. Figure V-3; R.F. Networks, Simplified, illustrates each circuit individually. Operation of the r.f. section is as follows. When the tuning cycle begins, by channeling or depressing the PTT switch, K1 de-energizes the brake solenoid, BR, and the holding brake is released. Simultaneously, motor M1 is energized and begins to rotate, turning C80 and L2 via the gear box. The variometer, L2, rotates at approximately 700 RPM while the variable capacitor, C80, revolves at 46 RPM. The range of C80 is 21-104pf and L2 changes from 2 to 10 Microhenries.

Switches S2 and S3 are mechanically actuated by cams on the shaft of C80. The cams for S2 and S3 are placed 180° out of phase. The S2 cam is adjusted to close S2 at maximum capacity and S3 cam for minimum capacity. Switch S2 closes each time C80 reaches maximum capacity and a solenoid advance pulse is generated. Switch S3, however, is controlled by wafer S1-A. Switch S1-A is wired to prevent S3 from generating a solenoid advance pulse on networks 2, 4, 6, 8, 10 and 12. Therefore, the solenoid switches at maximum capacity and minimum capacity for networks 14, 16, 18, 20, 22 and 24 and at maximum capacity only for networks 2, 4, 6, 8, 10 and 12. Each time the rotor of S1-A reaches position 2, relay K7 changes state (K7 is a Bi-stable relay) and relay K8 is energized or de-energized, depending upon its previous condition. Relay K8, when energized, removes the short from C75 and places 25 pf in series with C80, changing the network tuning range. This condition is referred to as the "A" Position. Network 12A has 25 pf in series with C80 while network 12 is identical to network 12A except the series 25 pf, C75, is shorted out.

Switches S1-A, S1-B, S1-C, S1-D and S1-E are all driven by a common shaft and are actuaged by the switching solenoid KR2. The ground pulses generated by S2 and S3 produce a negative pulse at the input to Q3 located in the electronics drawer. This pulse is amplified by Q5 and Q6, driving Q7 into saturation. When Q7 saturates, solenoid KR2 advances one position. However, all odd positions (1, 3, 5, etc.) of the wafer S1-A are connected to ground and by action of the interrupter in series with KR2, the solenoid advances another position to an even position. Therefore, the solenoid advances two switch positions for each input pulse from S2 or S3. S1 cannot stop on an odd position.

N. PUSH-TO-TALK OR CHANNEL PULSE KEYING OPERATION

Figure IV-1 illustrates the components connections to TS-1 with no jumpers connected. Figure IV-2 illustrates the jumpers required for PTT operations and Figure IV-4 shows the jumpers required for channel pulse actuations. Figures IV-3 and IV-5 show the simplified operational circuit of each mode.

CHANNEL PULSE/PTT OPERATION

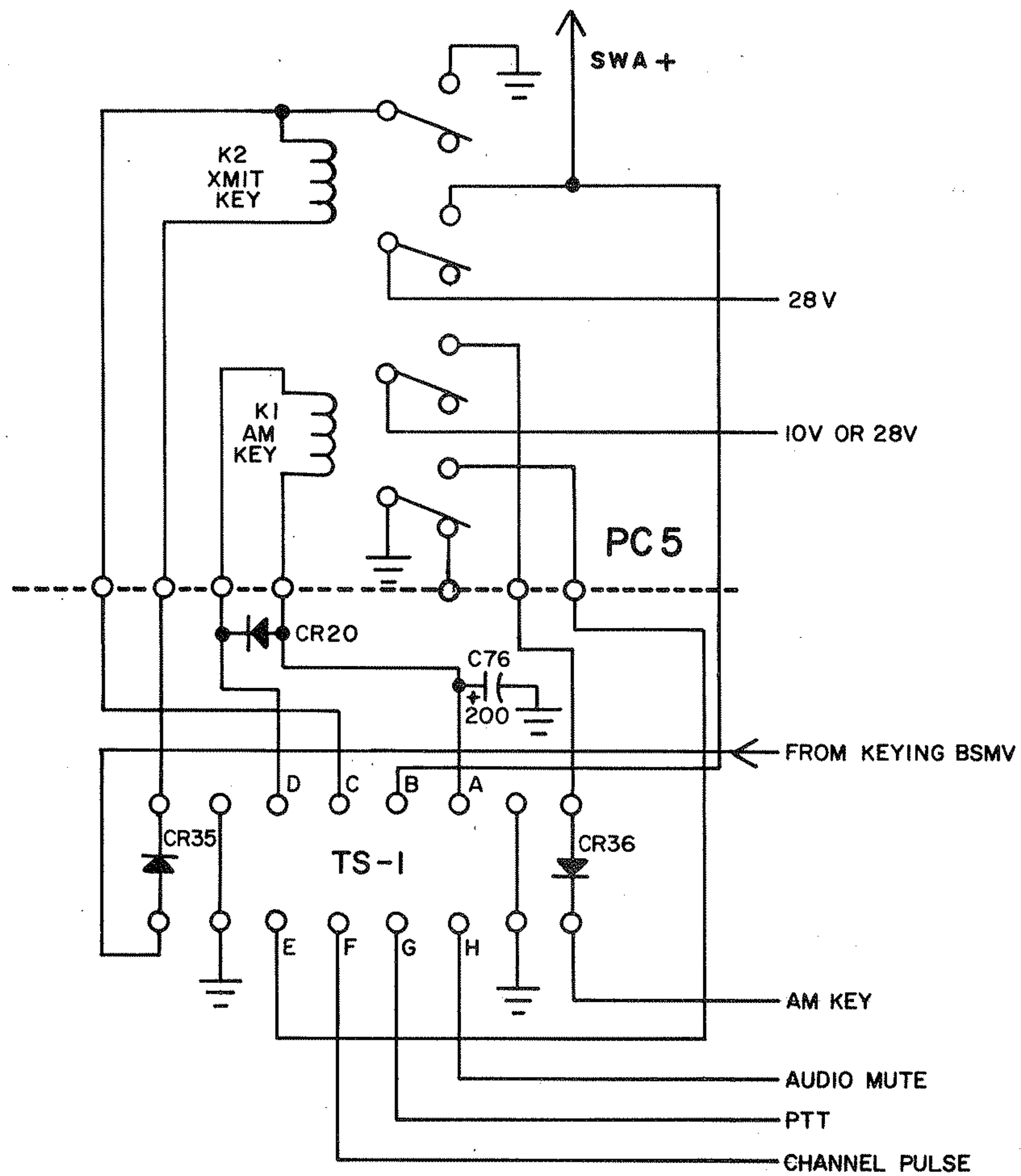


FIGURE IV-1

PTT OPERATION

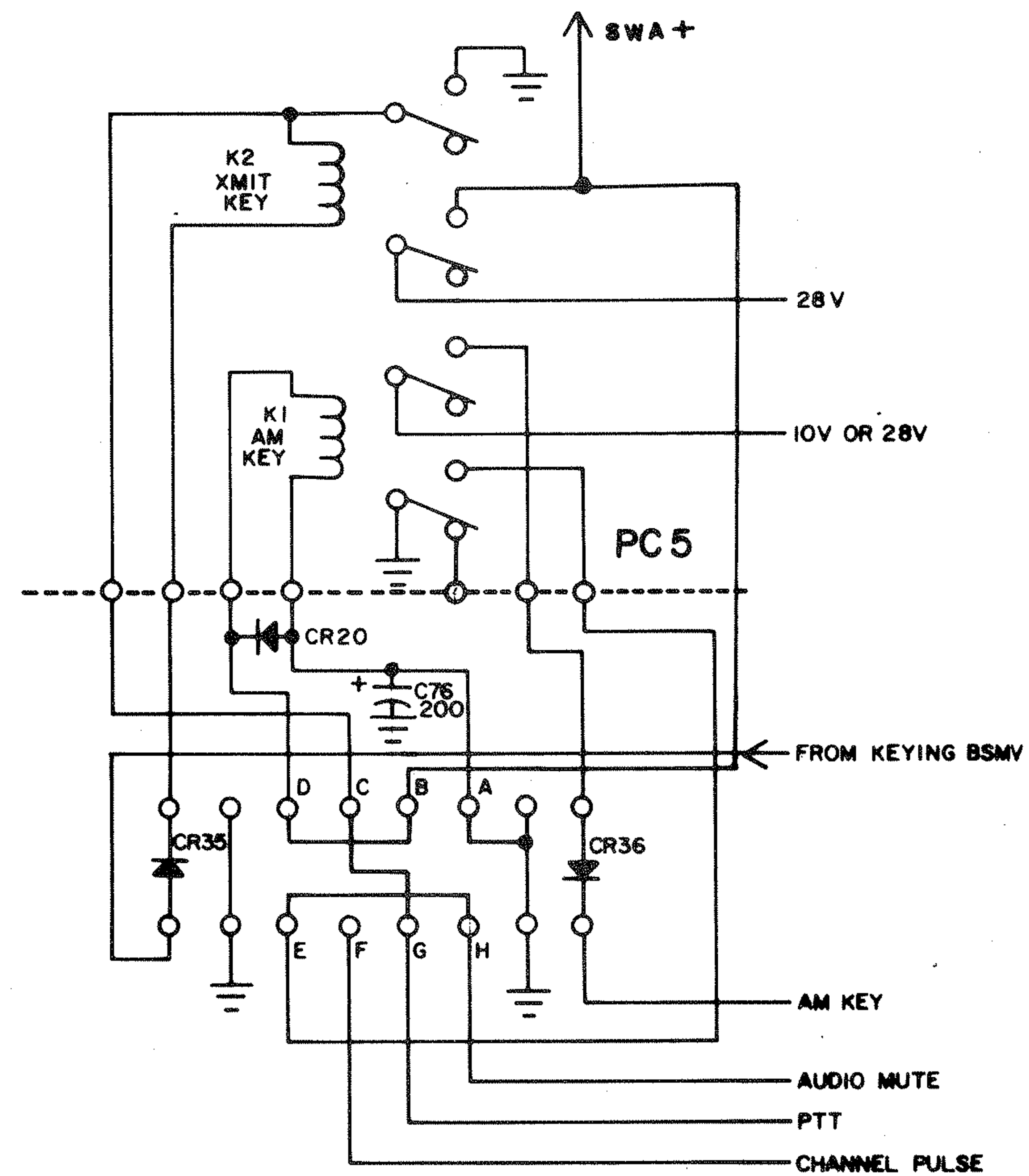


FIGURE IV-2

PTT OPERATION EQUIVALENT CIRCUIT

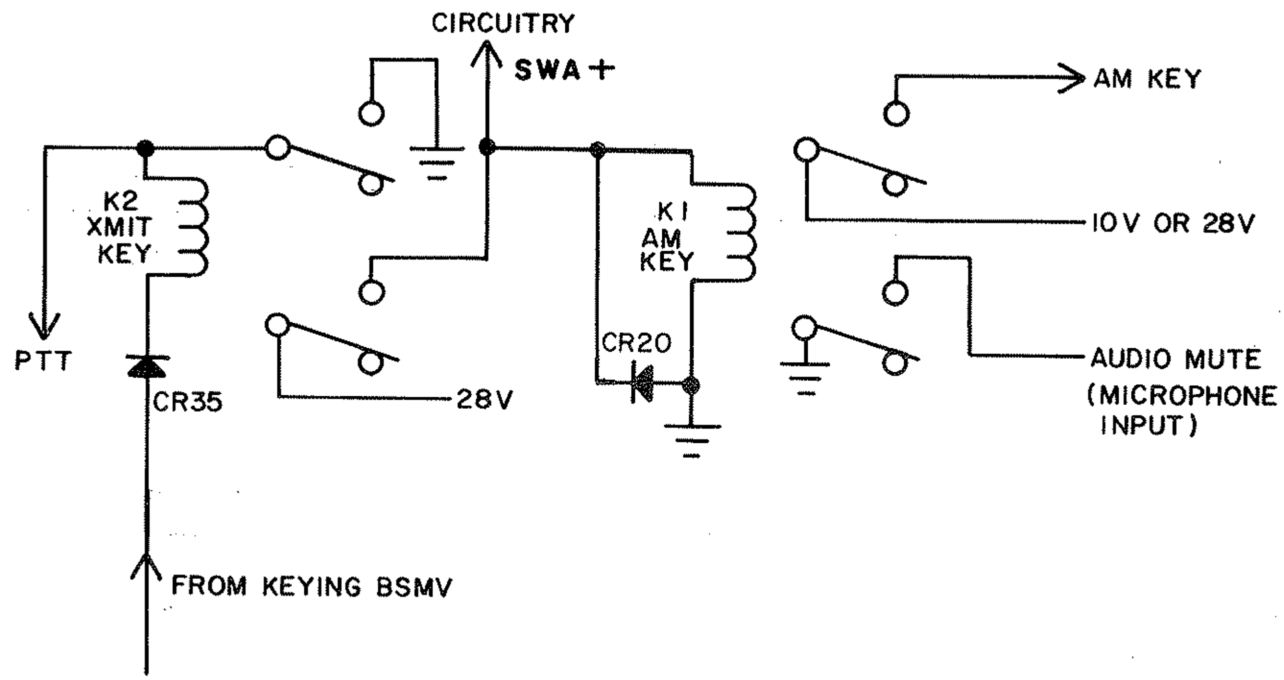


FIGURE IV-3

When the SAC-69( ) is connected for PTT actuate, the equivalent circuit of K_1 and K_2 is as shown above. The channel pulse sets the keying BSMV (Q24 and Q28) and applies a voltage to K_2. K_2 has voltage applied to one side but is not pulled in until the PTT line is depressed. When the microphone push to talk switch is depressed, relay K_2 pulls in and keys the transmitter on. Note that K_2 is connected as a latching relay and will hold in (transmitter keyed on) until the voltage is removed from the keying BSMV. This occurs when the tuning cycle is completed. K_1 pulls in when SW A+ is applied to K_1. K_1 conditions the transmitter for AM operation and also mutes the audio to prevent modulation of the transmitter during the tuning cycle.

CHANNEL PULSE

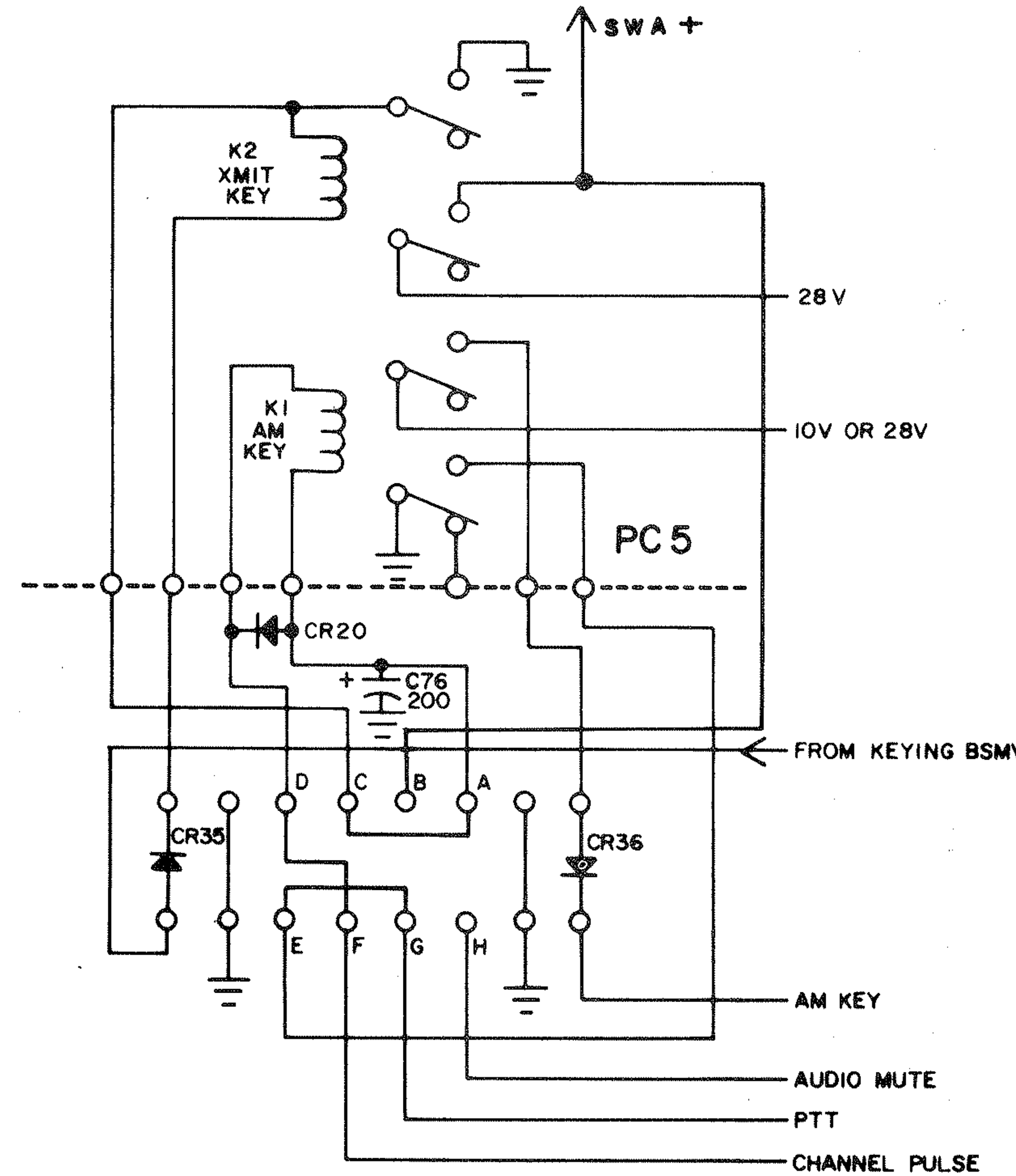


FIGURE IV-4

CHANNEL PULSE OPERATIONAL EQUIVALENT CKT

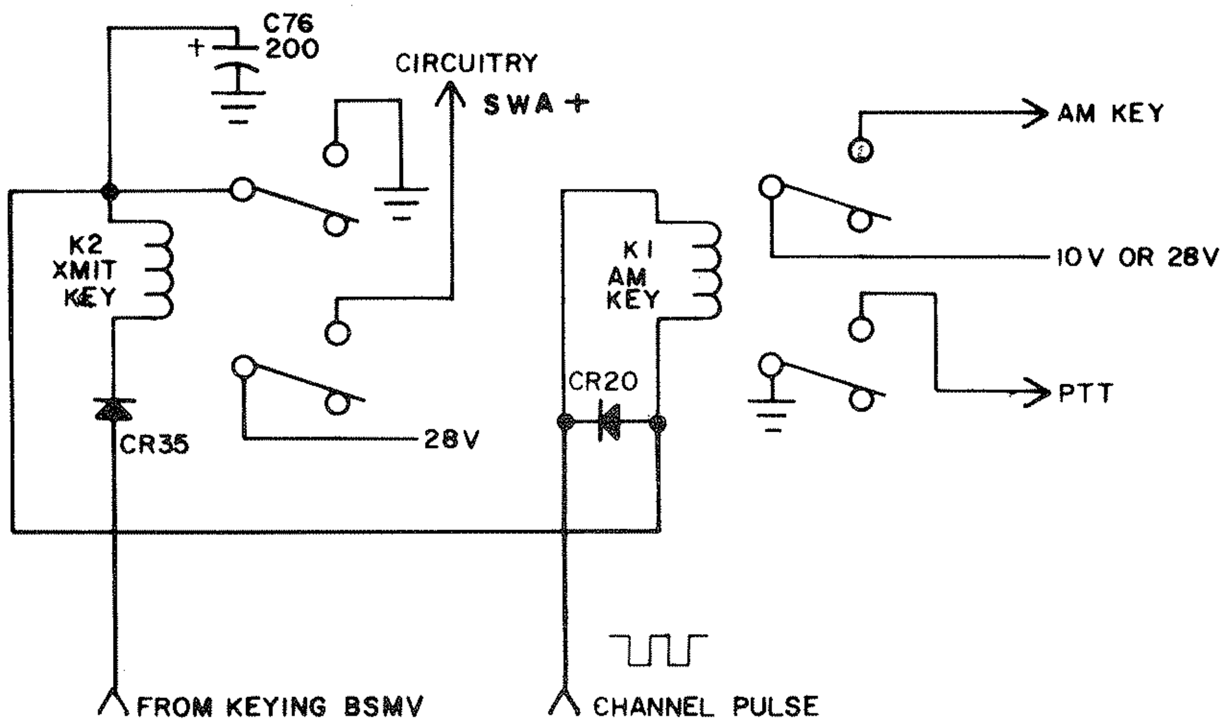


FIGURE IV-5

When the SAC-69( ) is connected for Channel Pulse actuate, the equivalent circuit of K_1 and K_2 is as shown above. When a channel pulse is applied (negative going +28V to ground), the keying BSMV (Q24 and Q28) is set and a positive voltage is applied to K_2 via CR35 and K_2 pulls in immediately because the channel pulse line is at ground and CR20 provides a complete circuit for K_2. K_1 will not pull in until the channeling has been completed and the channel pulse line rises to +28V. Note that K_1 keys the transmitter on for channel pulse operation and K_2 keys the transmitter on for PTT operation. This feature prevents the transmitter from being keyed on until the unit has completed channeling.

SECTION 5
MAINTENANCE AND REPAIR

A. GENERAL INFORMATION

1. When the SAC-69( ) antenna tuner requires maintenance, both fuses should be checked first. Failure of the 3 ampere fuse generally indicates a trouble in the electronics drawer, or Motor M1, located in the R.F. section. Failure of the 1-1/2 amp fuse indicates a fault in the switching solenoid, KR2, BR, or its associated circuitry. The top cover of the R.F. section should be removed and switches, capacitors, relays and mechanical parts checked for signs of overheating or other damage.

   The electronics drawer can be removed by disconnecting the coax connector, P4, and plug P2, using the access holes in the bottom cover and removing the five (5) screws holding the electronics drawer into the bottom of the wrap-around. After the two modules have been separated, the trouble can be isolated using the procedures in C & D below.

B. EQUIPMENT REQUIRED

1. Multimeter 20K ohms/volt Simpson Model 260 or equivalent
2. R.F. Signal Generator H-P Model 606 or equivalent
3. 50 ohm non-reactive dummy load (1 watt carbon resistor can be used)
4. 8-15 ohm 10 watt resistor
5. 28 VDC power supply, 3 Amp capability

C. R.F. SECTION

1. Perform the following ohmmeter test:

FUNCTION	FROM	TO	RESISTANCE READING
Ground	J2A	Chassis Ground	Short
Spare	J2B	J2 All pins	Open
Solenoid Ground	J2C	Chassis Ground	Open
Motor M1	J2D	J2E	18 Ohms
Motor M1	J2E	J2D	18 Ohms

FUNCTION	FROM	TO	RESISTANCE READING
Spare	J2F	J2 All pins	Open
Brake Ground	J2H	J2J	200 Ohms
Solenoid A+	J2J	J2L	8 Ohms
Cap. Switch	J2K	J2 All pins	Open S2 & S3 Not operated
Sol. (To Q7)	J2L	J2J	8 Ohms

2. If all resistances check correct, apply +28 volts to J2 pin J and minus to pin H and observe if brake solenoid BR energizes. The small holding pad should be against the large brake disc when the solenoid is energized. Check to see if the brake disc is free to turn while the brake solenoid is not energized. If the large brake disc is not free to turn in both directions, a malfunction in the gear box is indicated, i.e., the gears are jammed or severely worn. If there is a malfunction in the gear box, refer to paragraph D, Gear Box Maintenance. If the variometer shaft is free to turn, proceed to paragraph 3.

3. Connect pin E to chassis ground. Apply 28 volts between pin D (+) and chassis ground (-). The motor should run and the variometer and variable capacitor should rotate. Note the direction of rotation of the capacitor. Reverse the polarity to the motor by applying 28V (+) to pin E and ground to pin D the direction of rotation of the motor should reverse.

   Connect an ohmmeter between pin K and chassis ground. Ground pin C. Connect the 28V for rotation of the motor in either direction. The ohmmeter should indicate a short to chassis ground each time switch S2 closes for S1 positions 2, 4, 6, 8, 10 and 12. For S1 positions 14, 16, 18, 20, 22 and 24, the ohmmeter will indicate a ground for each 1/2 revolution, i.e., the closing of S2 and S3. The speed of the motor may be checked by counting the number of closures of S2 per minute. The speed of the variable capacitor should be between 45 RPM and 60 RPM.

4. Apply 28VDC between pin J (+) and chassis ground. Connect ground to pin L. The switching solenoid should begin rotating S1. Check for the alignment of the rotor of S1 with the contacts to be sure the coupling from the switching solenoid to the shaft of S1 has not slipped. Connect a voltmeter between the output (pole) of K7 and ground. Channel the switching solenoid by placing a ground on pin L. The voltmeter should read 28 volts for one revolution of S1, drop to zero for the next and alternately switch back and forth between +28V and zero volts for each revolution. S1A places a ground at the junction of R5 and K7 when the rotor comes to position 2. The operation of relay K7 (bi-stable relay) and K8 can also be checked by placing a momentary ground at R5-K7 junction.

5. Closer inspection of other components in the R.F. section can best be accomplished by removing the wrap-around. Remove three (3) screws from each side, one from the rear and five (5) from the front plate. The wrap-around can be slipped off by gently pulling the sides out and away from the R.F. section chassis. Conventional ohmmeter and voltmeter checks can be made on CR34, R6, etc. with the wrap-around removed.

D. GEAR BOX AND VARIOMETER MAINTENANCE

CAUTION

> Do not run the motor with the top cover removed from the gear box as the gear lubricant will be lost.

The gear box is designed to provide long life with a minimum of maintenance. It is thoroughly lubricated at the factory and tested for accuracy and operation. In the unlikely event that a failure occurs in the gear box, it may be inspected by removing the five (5) screws holding the cover to the top of the gear box. Lift the gear box cover for inspection. To remove the motor, proceed as follows. Remove the five (5) screws holding the front plate to the wrap-around. Unsolder the antenna output wire from the front plate and remove the front plate. Remove the screws from the motor and pull the motor from the gear box. The motor has a precision collar that fits into the gear box. The motor can be removed quite easily be gently applying pressure perpendicularly to the axis of the motor shaft to free the collar from the gear box. If there is no visible damage to any of the gears or bearings, check the motor shaft for excess end play. If the motor has excess end play, the motor worm will ride out too far on the worm gear and cause binding. Also, check end play in the variometer shaft. Too much end play can cause binding or excess friction drag. If the gears appear to be dry, lubricate liberally with molykote type L, or equivalent, gear grease. A fine grade oil can be used to lubricate the bearings on the ends of the shaft driving the variometer. Also, apply a drop of oil to the three washers behind the worm gear on the motor shaft and the bearings on the ends of the shaft that drives the micro switch cams.

All gears are pinned to the shafts and replacement is difficult without proper tooling. Therefore, it is recommended that the gear box be returned to Sunair for overhaul should this action be required.

The variometer bearings may become dry and create excess friction after a period of time. (See Figure V-8). The bearings may be lubricated with a plunger type hypodermic needle using Dow Corning 4X silicone grease.

E. ELECTRONICS DRAWER

If the failure is in the electronics drawer, another drawer may be substituted while the malfunctioning unit is bench tested in the radio shop.

CAUTION

WHEN PERFORMING THE FOLLOWING TEST AND MEASUREMENTS, CARE SHOULD BE EXERCISED TO AVOID INADVERTENT SHORTS TO GROUND OR 28 VOLT POINTS. THE USE OF SMALL CLIP LEADS WITH INSULATED HOODS WILL REDUCE THE POSSIBILITY OF SHORTING COLLECTORS TO 28 VOLTS AND DAMAGING TRANSISTORS. ALSO, BE CERTAIN TO CONNECT THE +28V SUPPLY TO PIN B OF J1 SO THAT THE FUSE (F1) WILL PROTECT THE ELECTRONICS DRAWER DURING TESTS.

THE CASES OF ALL TO-5 (44379) AND TO-3 (44381) TRANSISTORS ARE THE COLLECTORS AND CAN BE USED AS TEST POINTS FOR MEASUREMENT OF VOLTAGES. INADVERTENT GROUNDS ON THESE COLLECTORS WILL NOT DAMAGE TRANSISTORS. HOWEVER, SHORTS FROM THE COLLECTORS TO 28V COULD CAUSE DAMAGE. MAKE SURE P2 DOES NOT SHORT TO GROUND.

1. Take off the bottom cover by removing the nine (9) screws. Examine the wiring, relays, and other components for damage. Check for broken or loose wires. Remove the shield cover on the electronics compartment and check for burned parts. If there is not visible evidence of damage, proceed with the following paragraphs.

F. RELAYS

Refer to Figure V-7. The electronics drawer contains five (5) relays. These relays may be checked individually for proper operation. Check the wiring of the jumpers on TS-1 to be sure it is wired for the proper type of actuation. Apply 28 volts D.C. between pin B, J1, (+) and chassis ground (-). The voltage may be applied to the fuse holder for F1. Be sure the fuse is in series with the power supply. Monitor the input current. It should be approximately 170 milliamperes and relay K5 should pull in. Remove one end of each jumper on TS-1. Check operation of individual relays as follows:

1. AM KEY RELAY, K1

Ground terminal A of TS-1. Apply +28 volts to terminal D of TS-1. Relay K1 should actuate. Check opening and closing of both sets of contacts with an ohmmeter. Check from terminal E of TS-1 to ground for one set and pin F of J1 to the ungrounded side of R73 for the other set of contacts. Note diode CR36 and connect the ohmmeter for the proper polarity. Relay K1 is shown in the de-energized position.

2. TRANSMIT KEY RELAY, K2

Remove the ground used to check K1. Ground terminal C of TS-1. Apply +28V to the transmit key line. K2 should pull in. Remove the ground from terminal C. K2 should remain energized because it is connected as a latching relay. Check the other set of contacts of K2 with an ohmmeter from C5 to the switched A+ line and the brake line. (See Figure V-5 for the designations of the wires on feed thru capacitors in the R.F. shield around PC #1).

3. 50 OHM RELAY, K3

Apply +28 VDC between switched A+ and chassis ground. K3 and K5 should pull in. K4 might pull in depending on the state of the motor control BSMV. Check the contact opening and closing of K3 with an ohmmeter between the R.F. input and the input to the phase detector. When K3 is energized the ohmmeter should read a short circuit and when de-energized, it should read 50 ohms.

4. MOTOR REVERSING RELAY, K4

Apply +28 D.C. between the reversing relay line (+) and chassis ground. K4 should pull in. Check contacts of the relay with an ohmmeter to be sure they are fully making and breaking. This is most easily accomplished by checking pins D and E of P2 to pin B of J1 and the motor line coming from the PC #1 feed thru. With relay K4 energized pin E of P2 is connected to A+ and pin D of P2 is connected to the motor line. When K4 is de-energized, the contacts reverse.

5. BRAKE RELAY, K5

Energize K5 by connecting +28 VDC between pin B, J1 (+) and chassis ground. Check proper operation of contacts with an ohmmeter. Check the motor contacts as follows. When K5 is de-energized, there should be continuity between pin E of P2 and the motor drive line. When K5 is energized, there should be a short between pins D and E of P2. <u>IT IS IMPORTANT TO NOTE THAT THE SHORT DISAPPEARS WHEN K5 IS DE-ENERGIZED</u>. When K5 is energized, there should be no continuity between pin E, P2 and the motor line.

G. ELECTRONICS CONTROL BOARD

1. Time delay

Connect all jumpers on TS-1 for proper actuate mode (PTT ACTUATE OR CHANNEL PULSE ACTUATE as shown in Figure IV-5). Adjust the gain control to maximum counter-clockwise position. Apply +28 VDC between pin B, J1 (+) and chassis ground (-). With a clip lead, short the channel pulse line to ground and then ground the PTT line. If TS-1 is configured for channel pulse actuate, relays K1, K2 and K3 will pull in when a short is placed on the PTT line after a ground has been placed on the channel pulse line. Note the time when K2 and K3 pull in. After approximately 45 seconds K1, K2 and K3 should drop out. This is the result of the time delay circuit running out. A voltmeter connected between the collector of Q21 and ground should read approximately 25 volts during the interval when the time delay is running out.

Note the physical setting of the time delay control, R84. Adjust it to maximum CLOCKWISE position. This will disable the time delay and switched A+ will remain on indefinitely to allow voltage measurements to be made. If the power supply is turned off for any reason, another channel pulse or channel pulse - PTT ground combination will have to be made in order to get the K1, K3 and switched A+ back on.

2. ERROR AMPLIFIER

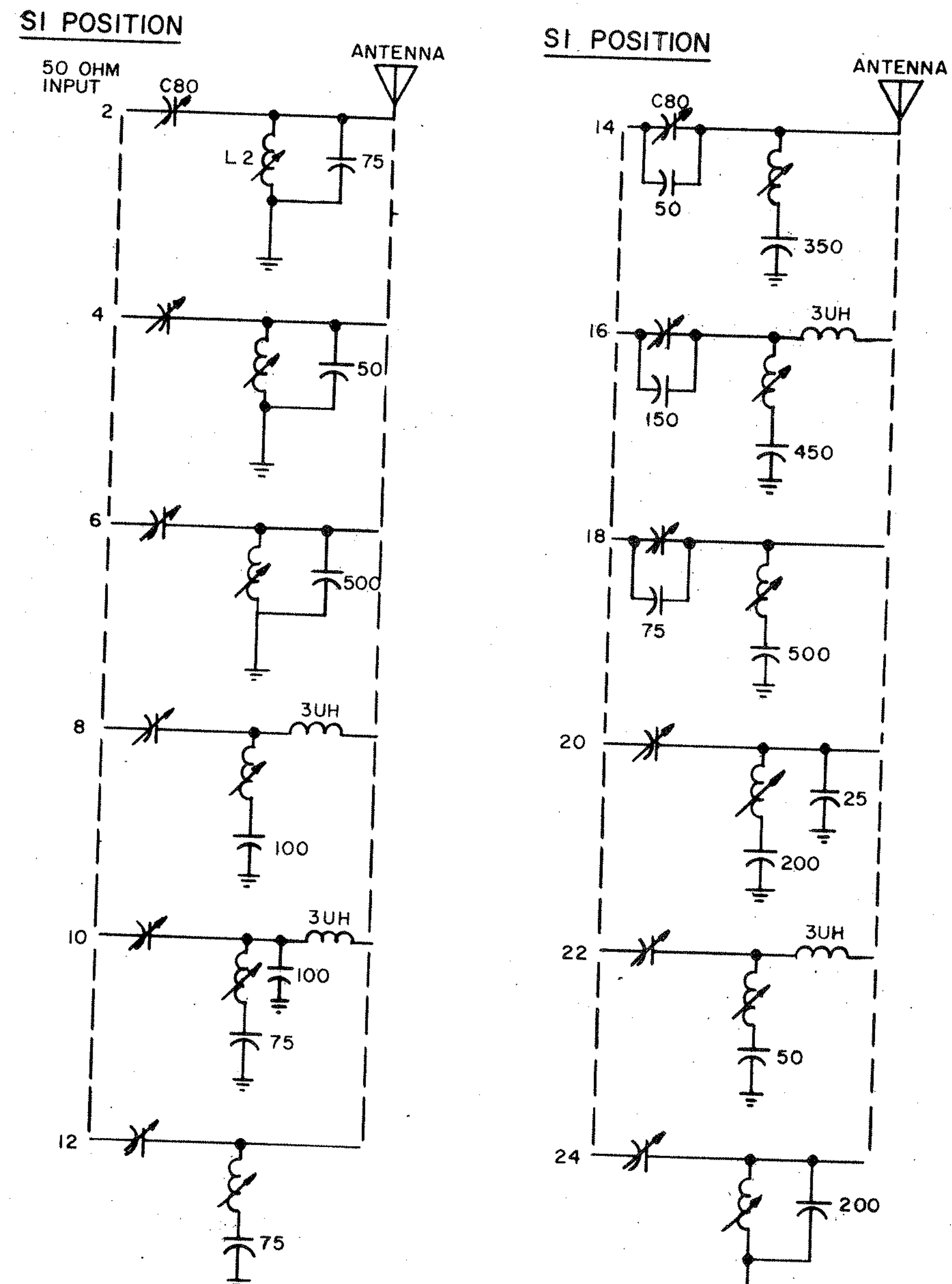
Connect a signal generator to J3, rf input and set the level to 1.5 volts RMS at 18 MHz. Adjust the gain control to maximum CLOCKWISE position. Make sure the phase detector output (P4) is NOT terminated. Monitor the collector of Q21 with a voltmeter. Slowly reduce the level of the signal generator output to below one volt. The voltage on Q21 collector should rise to 25 volts. The level of the signal generator output where switching of Q21 occurs is the threshold level. Slowly increase and decrease the signal generator above and below the threshold level.

3. MOTOR REVERSING

Note the action of relays K4 and K5. When the signal generator is decreased below the threshold and Q21 collector increases to 25V, K5 (brake relay) should be energized and pull up. As the input signal is increased and Q21 collector drops to zero, K5 should drop out (down position) and immediately thereafter, K4 should change state, that is, if it is energized, it will de-energize. In other words, at the end of the brake pulse, the direction of the motor (K4 is the motor reversing relay) rotation will reverse.

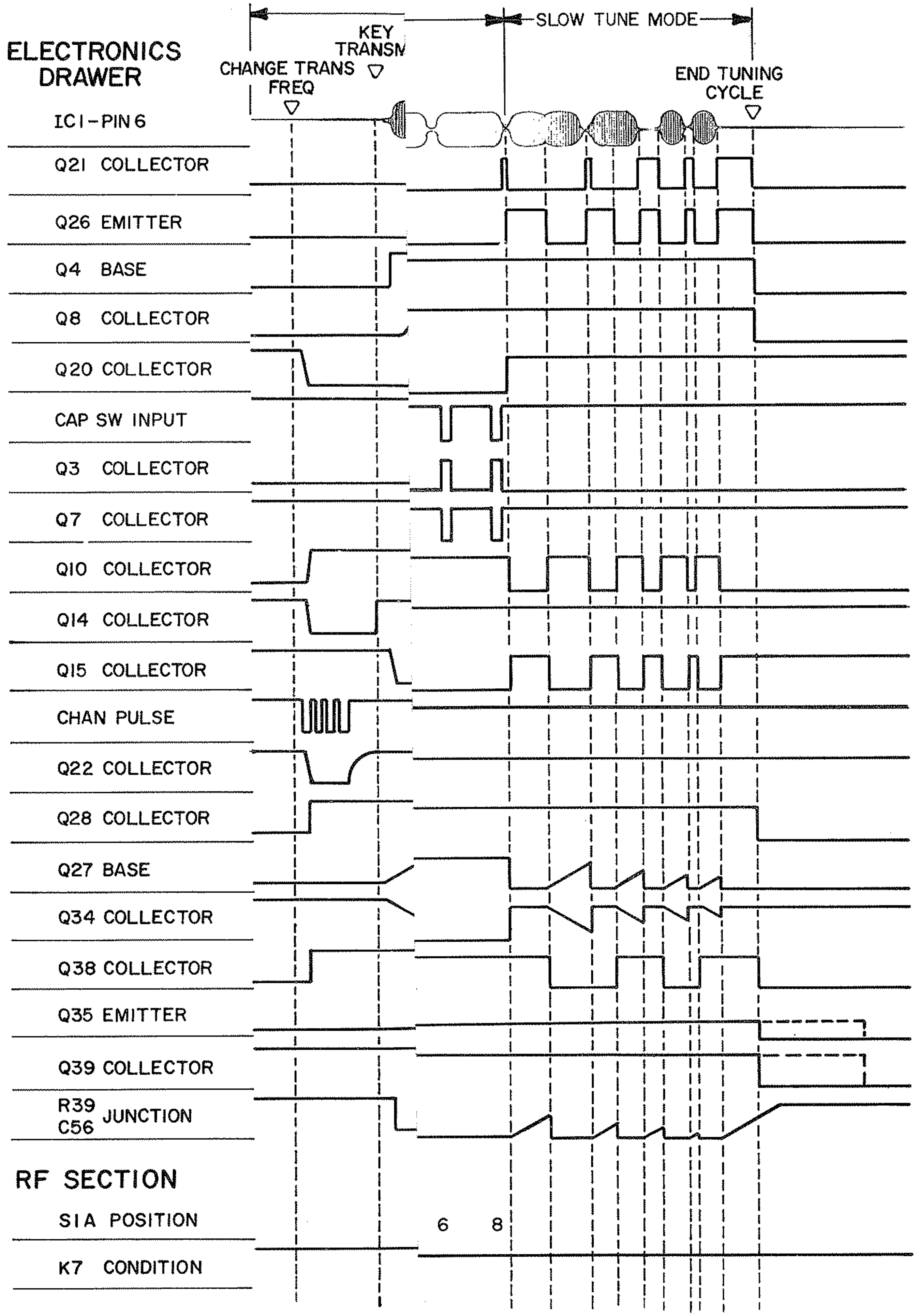
4. KEYING BSMV

Adjust the output of the signal generator to 1.5 VRMS. Connect a clip lead jumper from the r.f. detector line to SW A+. Terminate the output of the phase detector with a 50 ohm nonreactive load. Within a maximum of one second relays K1, K2 and K3 should drop out and K5 should be energized. This test simulates the final tuning, reduction of error voltage from the phase detector and checks the operation of the error amplifier, R.F. detector, control BSMV and the keying BSMV.



NOTE: FOR POSITIONS 2A-24A RELAY K8 IS ENERGIZED AND C75 (25pf) IS SWITCHED IN SERIES WITH C80.

STD SAC-69( ) R.F.NETWORKS SIMPLIFIED
FIGURE V-3

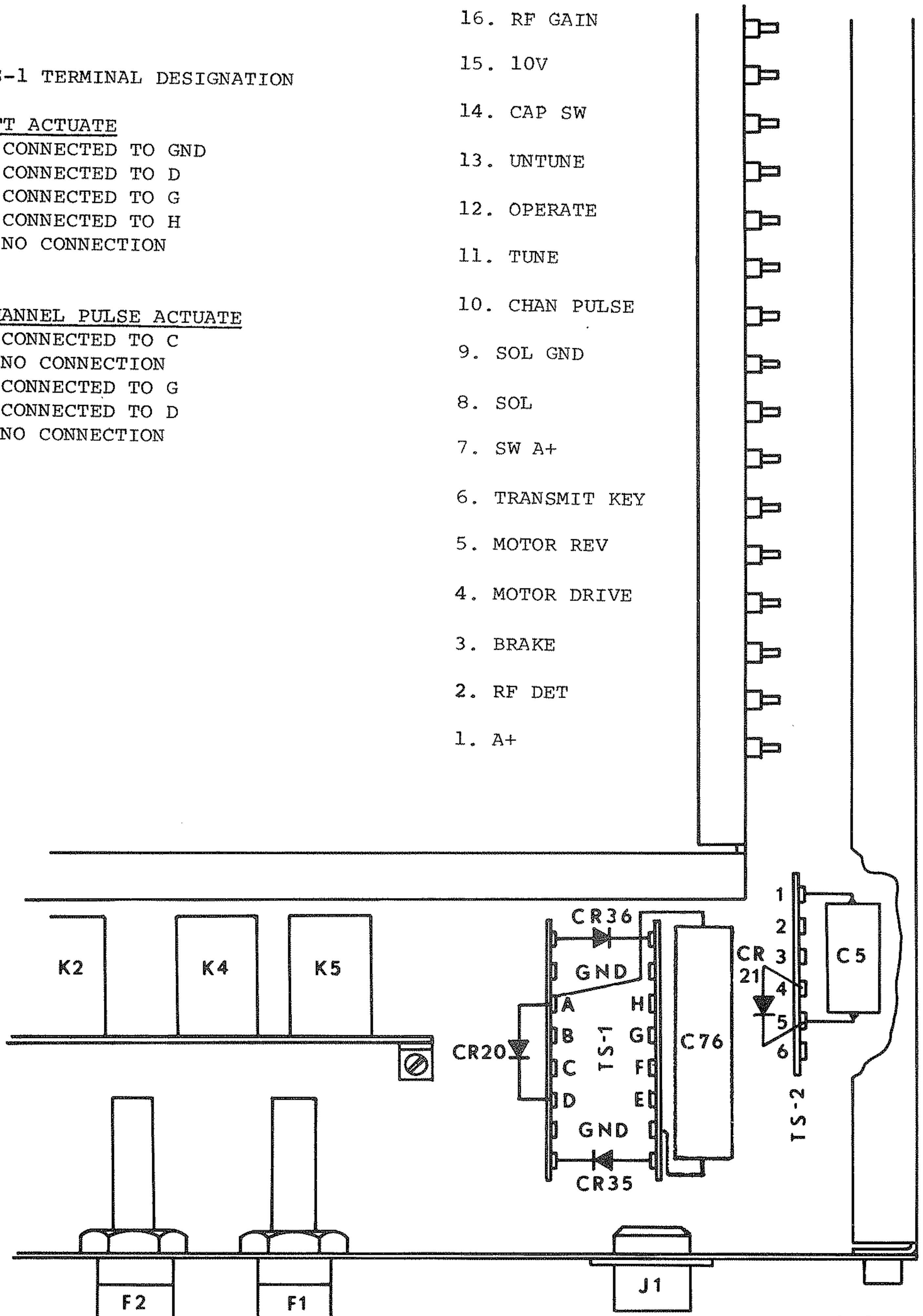


ELECTRONICS DRAWER
CHANGE TRANS FREQ
KEY TRANSM
SLOW TUNE MODE
END TUNING CYCLE
IC1-PIN 6
Q21 COLLECTOR
Q26 EMITTER
Q4 BASE
Q8 COLLECTOR
Q20 COLLECTOR
CAP SW INPUT
Q3 COLLECTOR
Q7 COLLECTOR
Q10 COLLECTOR
Q14 COLLECTOR
Q15 COLLECTOR
CHAN PULSE
Q22 COLLECTOR
Q28 COLLECTOR
Q27 BASE
Q34 COLLECTOR
Q38 COLLECTOR
Q35 EMITTER
Q39 COLLECTOR
R39 C56 JUNCTION
RF SECTION
S1A POSITION
6
8
K7 CONDITION

TS-1 TERMINAL DESIGNATION

PTT ACTUATE
A CONNECTED TO GND
B CONNECTED TO D
C CONNECTED TO G
E CONNECTED TO H
F NO CONNECTION

CHANNEL PULSE ACTUATE
A CONNECTED TO C
B NO CONNECTION
E CONNECTED TO G
F CONNECTED TO D
H NO CONNECTION



5. LIGHT DRIVERS

Remove the 50 ohm load from the phase detector. Remove the jumper from SW A+ to the R.F. detector line. Connect +28 VDC to pin B J1, connect the signal generator to J3, and apply another channel pulse or channel pulse PTT ground combination. With the voltmeter, check the collectors of Q10, Q14 and Q15. With the signal generator level above threshold, Q15 collector should be zero, Q14 collector 18 volts and Q10 collector should be 15 volts. Decrease the signal generator level below threshold. Q15 collector should be 10 volts, Q14 collector zero volts and Q10 collector 18 volts. With the signal generator level below threshold, connect the clip lead jumper between SW A+ and the R.F. detector line. All relays except K5 should drop out and the light drivers should be as follows:

Q15 collector 13 volts, Q14 collector 25 volts and Q10 collector 0 volts. This test checks all circuitry except the three diodes CR19, CR28 and CR26. The light driver circuits can also be tested using three lamps or resistors connected between the OPERATE, TUNE AND UNTUNED lines and A+ or a voltage compatible with the lamps used.

6. SOLENOID DRIVE CIRCUITRY

Disconnect the jumper from SW A+ to the r.f. detector line. Recondition the unit with a channel pulse or channel pulse -PTT combination. Connect a ground jumper between SOLENOID GROUND line and chassis ground. Connect a 8-15 ohm 10 watt resistor between the SOLENOID line and pin B, J1. Monitor the collector of Q7 (Solenoid) with a voltmeter and ground the CAP SW line. There should be a momentary downward deflection of the voltage. C70-C46 differentiates the input and generates a pulse on the collector of Q7. If an oscilloscope is available the duration of the pulse can be measured as 30 to 50 milliseconds. Momentarily grounding the junction of R21 and R22 should cause the collector voltage of Q7 to decrease to zero. CAUTION- do not leave a prolonged ground at this point as the average collector current of Q7 is almost two amperes. If the collector of Q7 drops to zero, the solenoid drive circuitry is working properly. Disconnect all jumpers.

7. GAIN REDUCTION CIRCUIT (Q40, Q41)

Connect +28V to pin B of J1 and (-) to chassis ground.

Condition the unit with a channel pulse or channel pulse -PTT combination. Connect a voltmeter between the emitter of Q11 and ground. Set the signal generator to 18 MHz and leave the output of the phase detector open circuited. Adjust the gain control (R73) to maximum gain (fully clockwise). Adjust the signal generator output level to approximately 0.3v RMS or until the voltmeter reads some convenient reference, such as 0.25 volts. Place a ground on the collector of Q28. Increase the output of the signal generator until the voltmeter reads the same reference. The output of the generator should increase approximately 15 to 20 db.

8. D.C. VOLTAGE MEASUREMENTS

The table of D.C. voltage measurements was taken with the following conditions.

(a) Gain control (R73) set to 1/2 max clockwise
(b) Time delay increased to infinite (R84 max clockwise)
(c) Channel pulse or channel pulse -PTT applied to unit
(d) No r.f. input signal to unit
(e) All measurements made with a Simpson 260 or equal

H. PHASE DETECTOR BALANCE

Apply power (+28 VDC) to pin B, J1. Ground the collector of Q24 with a clip lead to the case of the transistor. DO NOT apply a channel pulse or PTT pulse. Check to be sure K3 is not pulled in. Connect the signal generator to J3 (R.F. input) and set to 3.0 volts RMS and 18 MHz. Monitor the base of Q11 with a voltmeter. Terminate the phase detector output (P4) with a 50 ohm nonreactive load. Adjust the GAIN control (R73) to maximum clockwise position. Using an insulated alignment tool, adjust C4 and C6 for a minimum reading on the meter. This dip should be from zero to .1V. Change the frequency of the signal generator to 2 MHz. Readjust C4 slightly in order to get the same dip at 2 MHz as at 18. Continue adjusting C4 until the measured D.C. voltage on the base of Q11 is essentially flat and the minimum possible from 2 to 18 MHz. Remove the 50 ohm load from the output of the phase detector. The voltage on the base of Q11 should increase to 2.5 volts for all frequencies from 2 to 18 MHz.

I. BRAKE ADJUSTMENT

The brake assembly (97943) is mounted to the base of the gear box by two screws into the solenoid bracket (10817). Slotted holes are provided in the gear box base to allow adjustment of the spacing between the brake pad and the brake disc. The two screws are located beneath the gear box and are accessible through the large clearance hole in the bottom of the R.F. compartment. (The access hole is located beneath the gear box - See Figure V-9)

Check the spacing between the brake pad (10820-rubber) and the brake disc. With the brake solenoid de-energized, the clearance should be .030 inches. Use a thickness garage or other suitable spacer and check the clearance. If the rubber pad becomes badly worn, the brake will not hold properly. If the spacing is too close, the solenoid will not completely pull in and the holding power of the solenoid will not be adequate.

If the brake assembly needs adjustment or replacement, loosen the two screws and place the .030 inch spacer between the pad and the disc and shove the assembly forward until the spacer is held firmly. Make sure the brake pad is parallel to the disc. Tighten the screws. Check operation of the brake by applying 28V to pin J and ground on pin H of J2. The solenoid should pull in and the brake disc should be held firm. Check to be sure the brake pad hits the disc perpendicular because an offset can cause movement of the variometer when the brake is energized.

J. MICRO SWITCHES

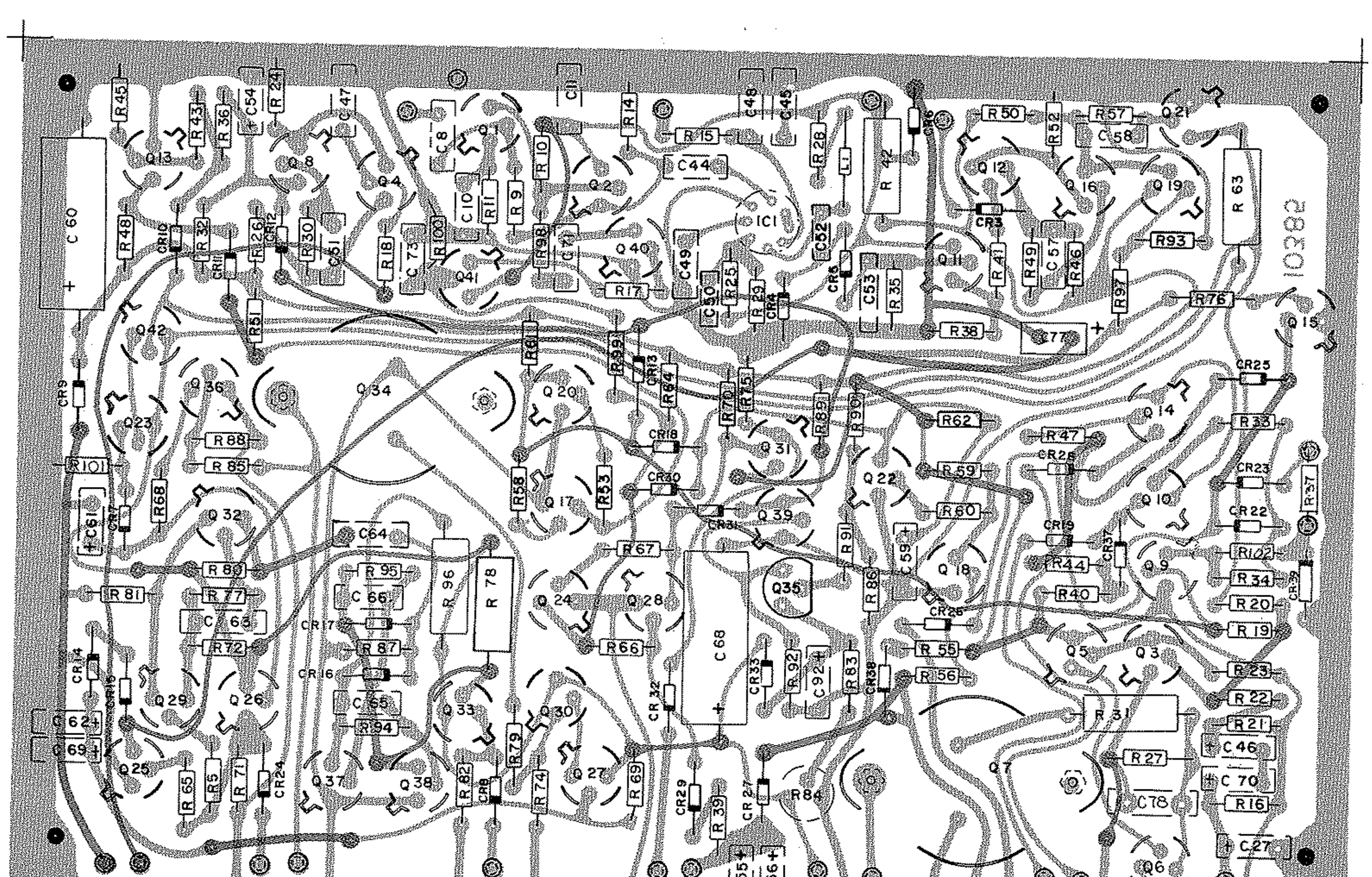
If either of the two microswitches mounted on the gear box must be replaced access to the two mounting screws holding the switches is obtained through the access hole in the end plate of C-80.

D.C. VOLTAGES

TRANSISTOR	EMITTER (V)	BASE (V)	COLLECTOR (V)	TRANSISTOR	EMITTER (V)	BASE (V)	COLLECTOR (V)
Q1	.25	1	4	Q23	24	24.5	26
Q2	3.7	4	10	Q26	23	24	26
Q40	0	0	0	Q29	.25	.8	.25
Q41	0	0	10	Q32	.25	.25	26
IC1	Pin 1 & 8	Pin 2	Pin 3	Q36	0	0	23.5
	0	.9	0	Q4	.1	0	14
	Pin 4	Pin 5	Pin 6	Q8	.1	.85	.25
	.2	5	9.7	Q13	0	.1	26
	Pin 7			Q17	0	.05	22
Q11	0	0	10	Q20	0	.6	.05
Q12	.35	0	7.3	Q25	0	.6	.03
Q16	.35	.9	.4	Q27	.5	1.1	26
Q19	.05	.4	26	Q30	.35	.5	26
Q21	0	.3	25	Q34	0	.35	0
Q42	24.5	25	26	Q33	24V	24.5	26
Q37*	0	.6	.1	Q3	0	.55	.05
Q38*	0	.05	24.5	Q5	0	.05	26
Q39	0	.05	26	Q6	.15	0	26
Q9	.15	.05	26	Q7**	6.8	.15	6.8
Q10	0	.15	20	Q15	0	.05	10
Q14	0	.6	.05	Q18	0	.6	.05
Q22	0	.05	26	Q24	0	.6	.05
Q31	19.4	20	26	Q28	0	.05	20
Q35	Base 1	Base 2	Emitter				
	.05	12	0				

*Q37 and Q38 are configured as a BSMV and could be read with interchanged voltages, depending on how the BSMV comes on when power is applied. By alternately putting a ground on the collector of Q37 and Q38 the voltages will change. Also, relay K4 should change state when the BSMV changes state. **Q7 has no connection on emitter or collector (Sol,Gnd. and Solenoid wires are open). The 6.8 volts observed is feed thru voltage via CR3 from the collector of Q12.

TABLE C
ELECTRONIC DRAWER D.C. VOLTAGES



P.C.-1 COMPONENT LAYOUT

FIGURE V-6

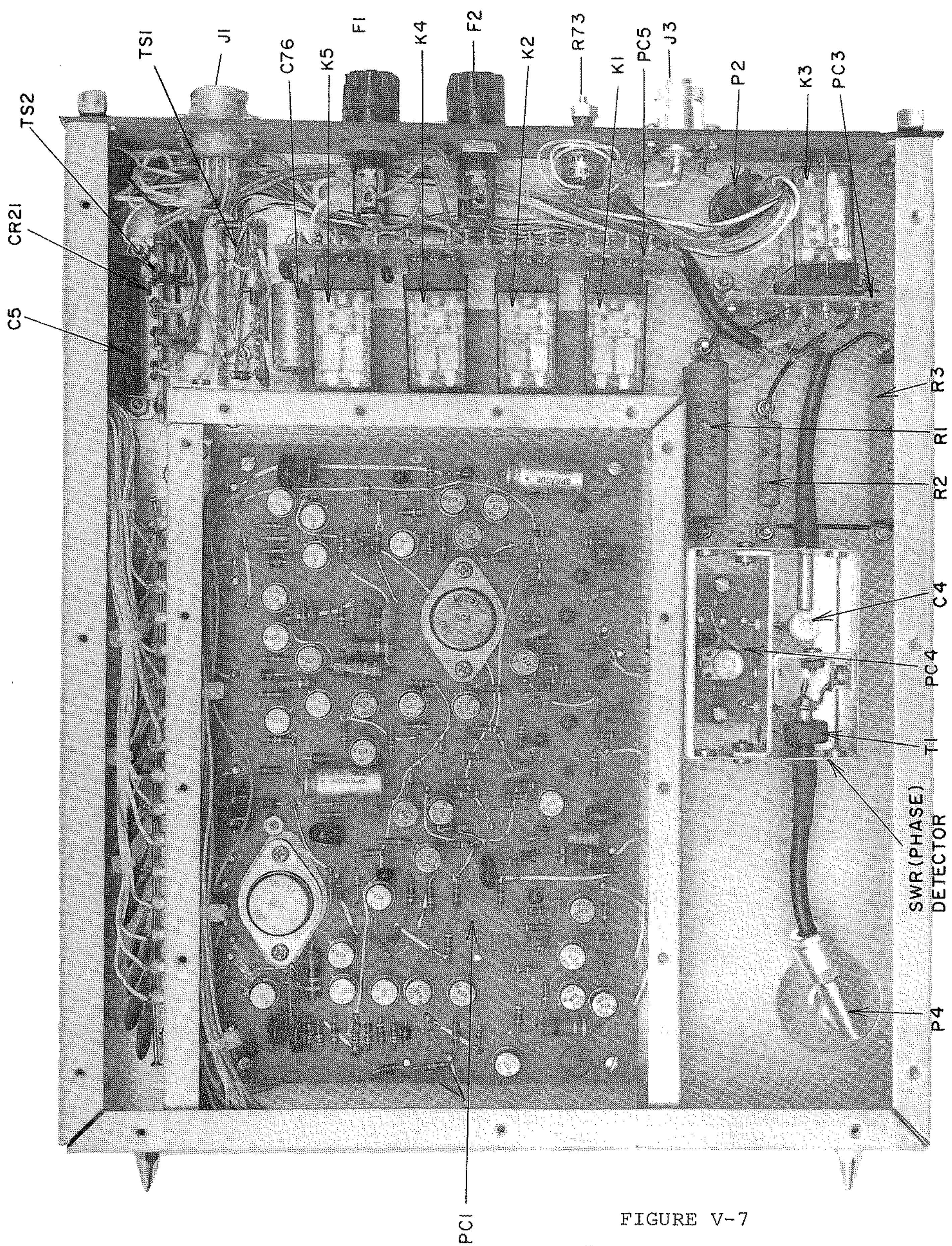


FIGURE V-7

COMPONENT LAYOUT
ELECTRONICS DRAWER

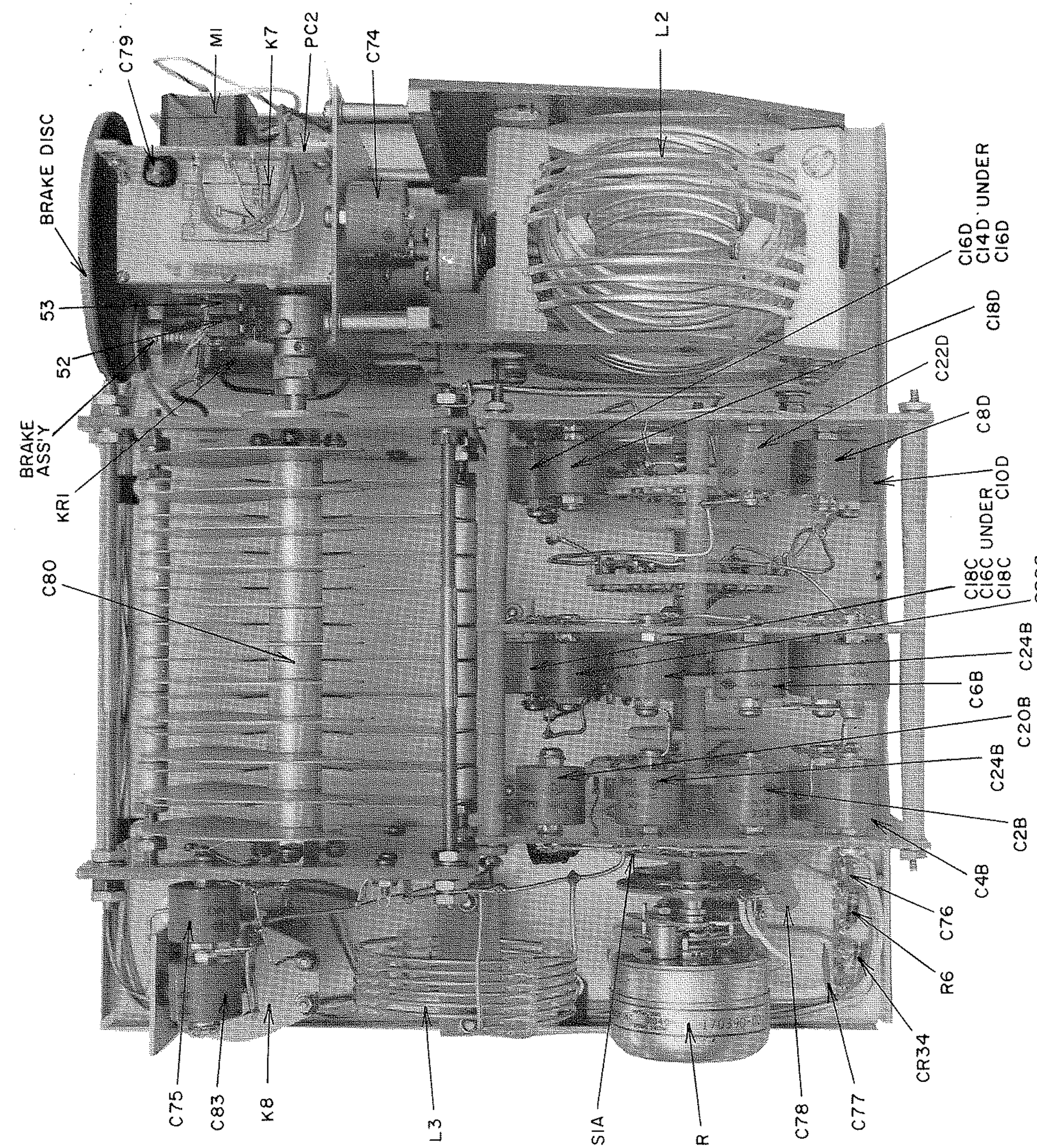


FIGURE V-8
ANTENNA TUNER, TOP VIEW

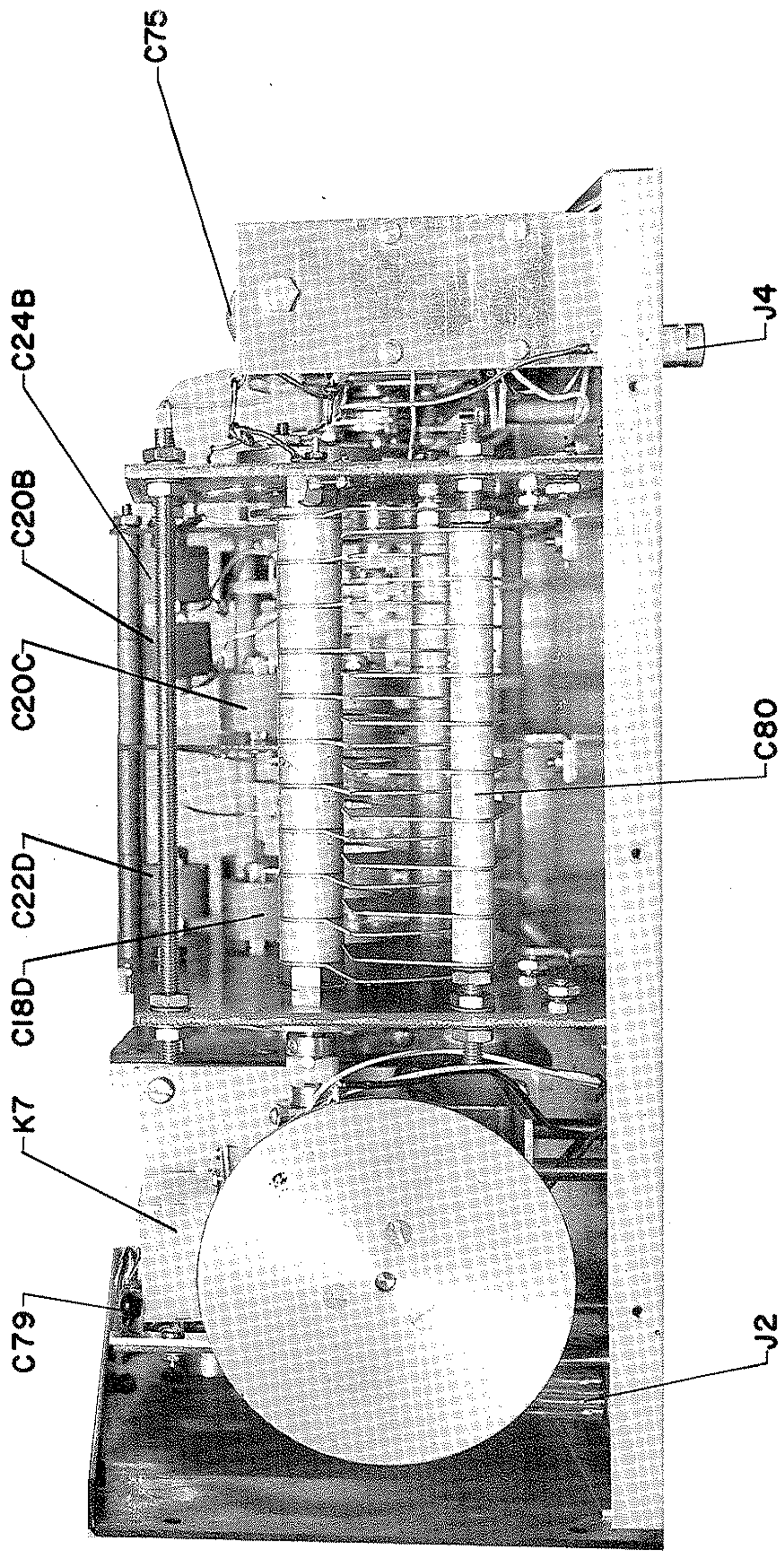


FIGURE V-9
ANTENNA TUNER, RIGHT VIEW

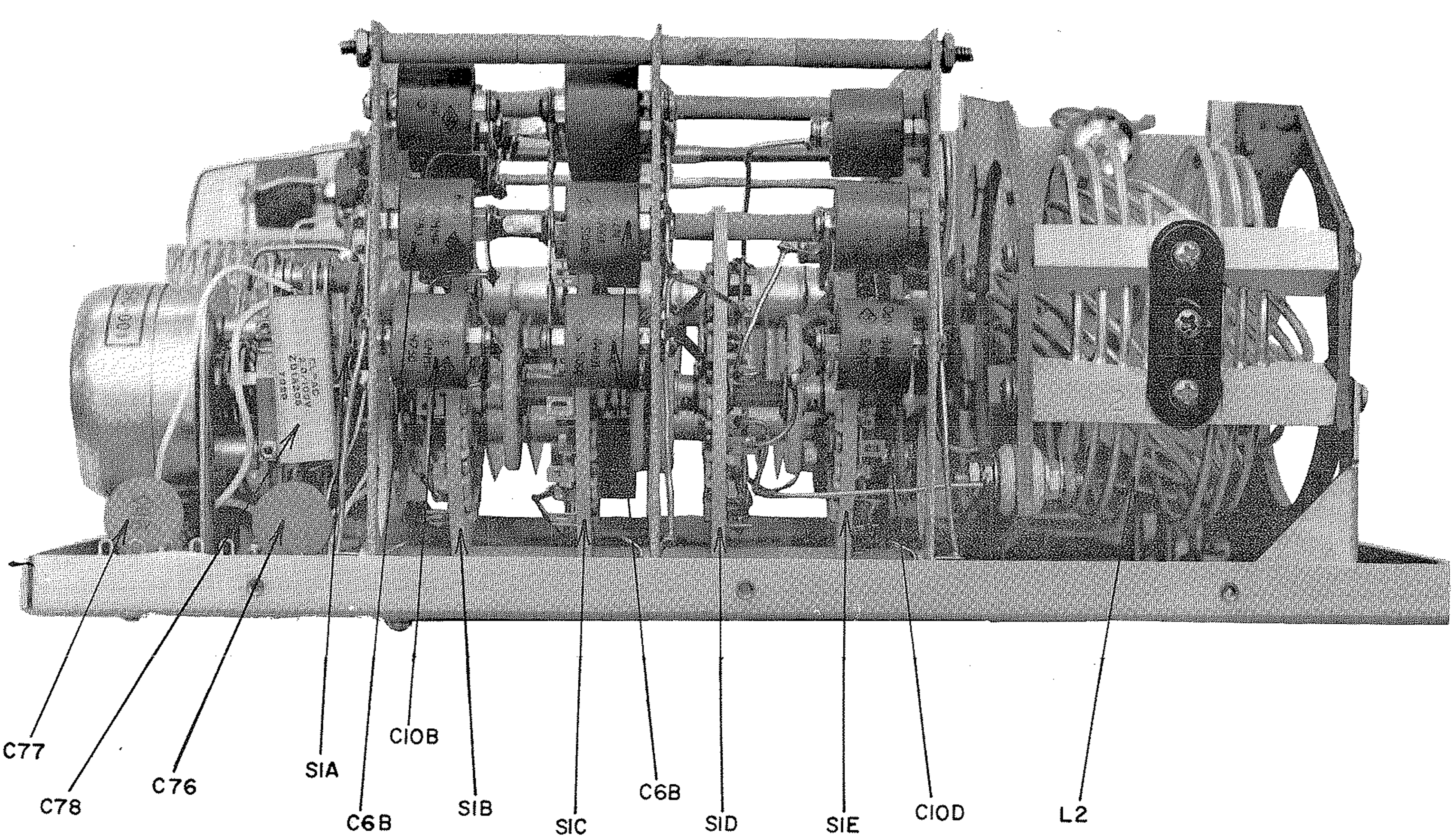


FIGURE V-10
ANTENNA TUNER, LEFT VIEW

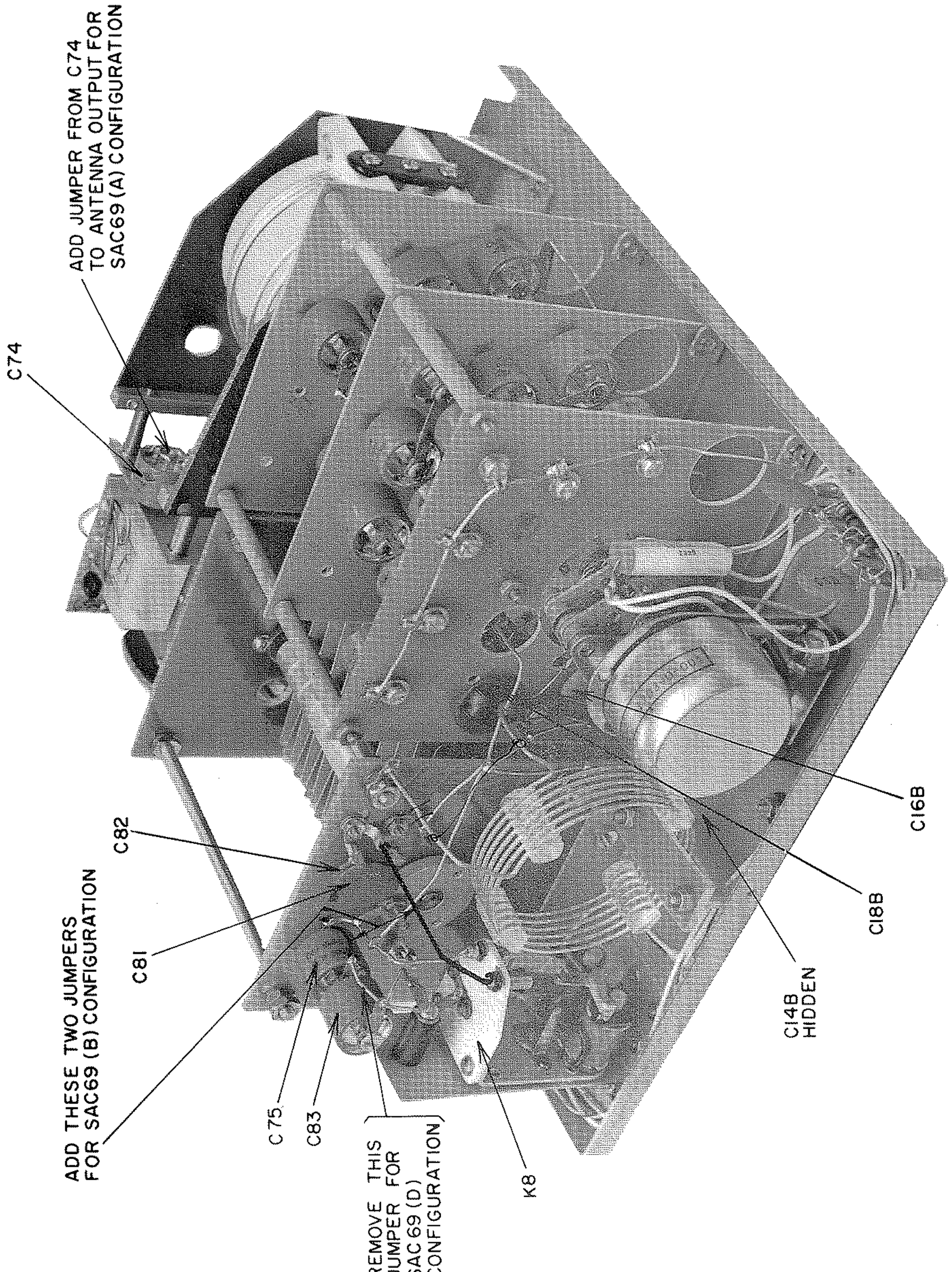


FIGURE V-11

ANTENNA TUNER, SIDE VIEW

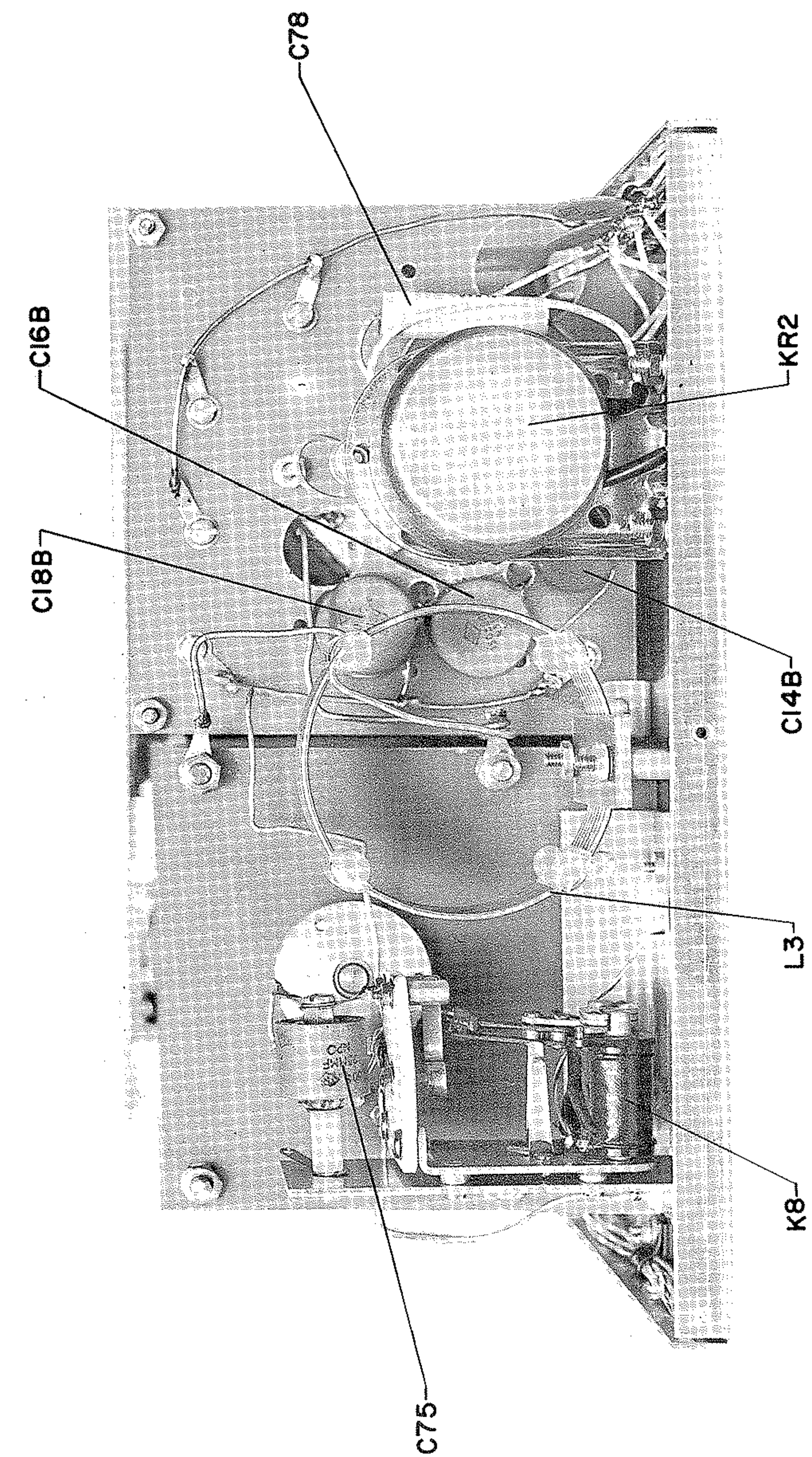
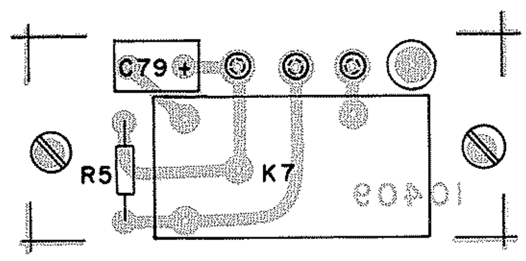
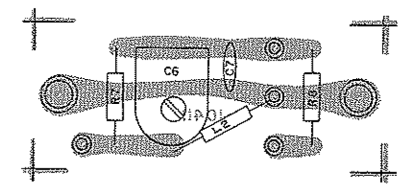


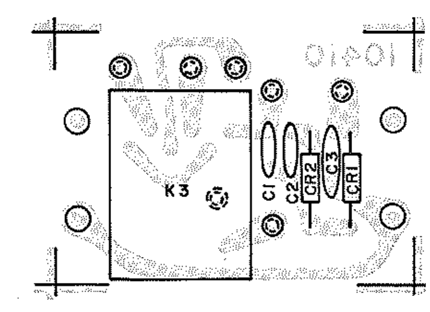
FIGURE V-12
ANTENNA TUNER REAR VIEW



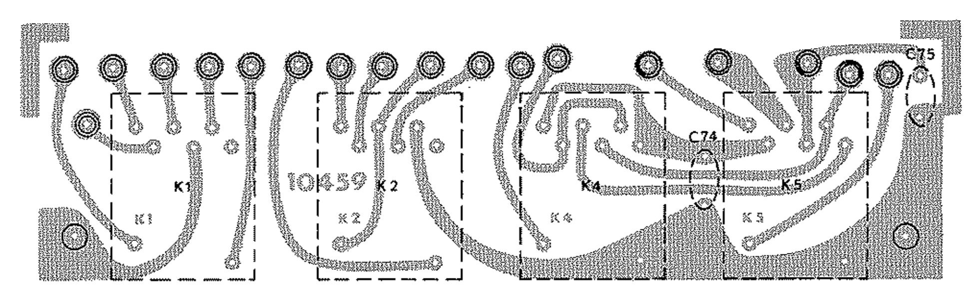
P.C.-2 COMPONENT LAYOUT



P.C.-4 COMPONENT LAYOUT



P.C.-3 COMPONENT LAYOUT



P.C.-5 COMPONENT LAYOUT

FIGURE V-13

SECTION 6

PARTS LIST

ELECTRONICS DRAWER

CKT. SYM.	PART NO.	DESCRIPTION
	99401	Electronics Control Drawer, SAC-69( ) Antenna Tuner
C1	28648	Capacitor, Dipped Mica, 12pf
C2	28703	Capacitor, Dipped Mica, 120pf
C3	27357	Capacitor, Disc Ceramic, .05mfd, 25V
C4	27840	Capacitor, Variable, Ceramic, NPO, 2-8pf
C5	27292	Capacitor, Electrolytic, 250mfd, 50V
C6	26250	Capacitor, Variable, 1.5-8pf, NPO
C7	28727	Capacitor, Dipped Mica, 360pf
C8	27345	Capacitor, Disc Ceramic, .02mfd, 100V
C10	28090	Capacitor, Dipped Mica, 150pf
C11	27345	Capacitor, Disc Ceramic, .02mfd, 100V
C12 Thru C26	24393	Capacitor, Disc Ceramic, .05mfd, 75V
C27	27395	Capacitor, Tantalum, 2.2mfd, 35V
C28 Thru C43	25866	Capacitor, Feed-Thru, .001mfd, 100V
C44	28208	Capacitor, Disc Ceramic, .001mfd, 100V
C45	28038	Capacitor, Tantalum, 68mfd, 15V
C46	27400	Capacitor, Tantalum, 15mfd, 35V
C47	27357	Capacitor, Disc Ceramic, .05mfd, 25V
C48	27321	Capacitor, Disc Ceramic, .01mfd, 100V
C49	27357	Capacitor, Disc Ceramic, .05mfd, 25V
C50	27357	Capacitor, Disc Ceramic, .05mfd, 25V
C51	27321	Capacitor, Disc Ceramic, .01mfd, 100V
C52	28325	Capacitor, Dipped Mica, 220pf
C53	28325	Capacitor, Dipped Mica, 220pf
C54 Thru C56	28038	Capacitor, Tantalum, 68mfd, 15V
C57	27321	Capacitor, Disc Ceramic, .01mfd, 100V
C58	28208	Capacitor, Disc Ceramic, .001mfd, 100V
C59	27395	Capacitor, Tantalum, 2.2mfd, 35V
C60	24707	Capacitor, Electrolytic, 50mfd, 50V
C61	27395	Capacitor, Tantalum, 2.2mfd, 35V
C62	27400	Capacitor, Tantalum, 15mfd, 35V
C63	27321	Capacitor, Disc Ceramic, .01mfd, 100V
C64	27357	Capacitor, Disc Ceramic, .05mfd, 25V
C65	27321	Capacitor, Disc Ceramic, .01mfd, 100V
C66	27321	Capacitor, Disc Ceramic, .01mfd, 100V
C67	28038	Capacitor, Tantalum, 68mfd, 15V
C68	24707	Capacitor, Electrolytic, 50mfd, 50V
C69	28038	Capacitor, Tantalum, 68mfd, 15V
C70	27400	Capacitor, Tantalum, 15mfd, 35V
C71	27357	Capacitor, Disc Ceramic, .05mfd, 25V
C72	24393	Capacitor, Disc Ceramic, .05mfd, 75V
C73	27357	Capacitor, Disc Ceramic, .05mfd, 25V
C74,C75	28168	Capacitor, Tantalum, 3.3mfd, 35V
C76	25816	Capacitor, Electrolytic, 200mfd, 35V
C77	27400	Capacitor, Electrolytic, 15mfd, 35V
C78	24393	Capacitor, Disc Ceramic .05mfd 75V
CR1 Thru CR5	44290	Diode, Silicon, 1N914
CR6	40385	Diode, Zener, 1N5240B
CR7	44290	Diode, Silicon, 1N914
CR8	40165	Diode, Silicon, R10D4

CKT. SYM.	PART NO.	DESCRIPTION
CR9	40165	Diode, Silicon, R10D4
CR10 Thru CR19	44290	Diode, Silicon, 1N914
CR20	40165	Diode, Silicon, R10D4
CR21	40165	Diode, Silicon, R10D4
CR22	40165	Diode, Silicon, R10D4
CR23	44290	Diode, Silicon, R10D4
CR24	40165	Diode, Silicon, R10D4
CR25	44290	Diode, Silicon, 1N914
CR26	44290	Diode, Silicon, 1N914
CR27	40165	Diode, Silicon, R10D4
CR28	44290	Diode, Silicon, 1N914
CR29	40540	Diode, Zener, 8.2V 1N5237
CR30	44290	Diode, Silicon, 1N914
CR31	44290	Diode, Silicon, 1N914
CR32	40165	Diode, Silicon, R10D4
CR33	44290	Diode, Silicon, 1N914
CR35	40165	Diode, Silicon, R10D4
CR36	40165	Diode, Silicon, R10D4
CR37, CR38	44290	Diode, Silicon, 1N914
CR39	40359	Diode, Zener 12V 1N4742
F1	89666	Fuse, Type 3AG, 3A, Slo-Blo
F2	89654	Fuse, Type 3AG, 1.5A Slo-Blo
K1 Thru K5	66573	Relay, 24VDC, 700 Ohms, DPDT, 5A Contacts
L1	64604	Choke, R.F., 6.8 Microhenry
L2	66420	Choke, R.F., .33 Microhenry
Q1	44329	Transistor, 2N3563
Q2	44252	Transistor, 2N3646
Q3	44379	Transistor, 40347
Q4	44252	Transistor, 2N3646
Q5	44379	Transistor, 40347
Q6	44379	Transistor, 40347
Q7	44381	Transistor, 40251
Q8	44252	Transistor, 2N3646
Q9	44379	Transistor, 40347
Q10	44379	Transistor, 40347
Q11	44252	Transistor, 2N3646
Q12	44379	Transistor, 40347
Q13	44252	Transistor, 2N3646
Q14 Thru Q33	44379	Transistor, 40347
Q34	44381	Transistor, 40251
Q35	44654	Transistor, Unijunction, TIS43
Q36 Thru Q39	44379	Transistor, 40347
Q40	44252	Transistor, 2N3646
Q41,42	44379	Transistor, 40347
IC1	44642	Integrated Circuit, CA3028A
R1	19116	Resistor, 25 Ohm ± 10%, 28 Watt, composed of Two 50 Ohm 14 Watt Resistors in Parallel
R2	19128	Resistor, 25 Ohm ±10%, 5 Watt

PARTS LIST

CKT. SYM.	PART NO.	DESCRIPTION
R3	19130	Resistor, 37 Ohm ±10%, 28 Watts, Composed of Two 75 Ohm 14 Watt Resistors in Parallel
R4	17429	Resistor, 560 Ohm ±10%, 1/4W
R5	17077	Resistor, 4.7K ±10%, 1/4W
R7	17663	Resistor, 680 Ohm ±10%, 1/4W
R8	17663	Resistor, 680 Ohm ±10%, 1/4W
R9	17106	Resistor, 47K ±10%, 1/4W
R10	17156	Resistor, 1K ±10%, 1/4W
R11	18289	Resistor, 39 Ohm ±10%, 1/4W
R14	17156	Resistor, 1K ±10%, 1/4W
R15	17077	Resistor, 4.7K ±10%, 1/4W
R16	17041	Resistor, 10K ±10%, 1/4W
R17	17156	Resistor, 1K ±10%, 1/4W
R18	17223	Resistor, 22K ±10%, 1/4W
R19	18318	Resistor, 12K ±10%, 1/4W
R20	17223	Resistor, 22K ±10%, 1/4W
R21	18318	Resistor, 12K ±10%, 1/4W
R22	17223	Resistor, 22K ±10%, 1/4W
R23	17041	Resistor, 10K ±10%, 1/4W
R24	18253	Resistor, 33 Ohm ±10%, 1/4W
R25	17156	Resistor, 1K ±10%, 1/4W
R26	17120	Resistor, 27K ±10%, 1/4W
R27	18667	Resistor, 2.7K ±10%, 1/4W
R28	17156	Resistor, 1K ±10%, 1/4W
R29	17156	Resistor, 1K ±10%, 1/4W
R30	17792	Resistor, 33K ±10%, 1/4W
R31	19142	Resistor, 27 Ohm ±10%, 1W
R32	17041	Resistor, 10K ±10%, 1/4W
R33	18667	Resistor, 2.7K ±10%, 1/4W
R34	17077	Resistor, 4.7K ±10%, 1/4W
R35	17106	Resistor, 47K ±10%, 1/4W
R36	17089	Resistor, 3.3K ±10%, 1/4W
R37	17041	Resistor, 10K ±10%, 1/4W
R38	17041	Resistor, 10K ±10%, 1/4W
R40	17089	Resistor, 3.3K ±10%, 1/4W
R41	17089	Resistor, 3.3K ±10%, 1/4W
R42	16528	Resistor, 470 Ohm ±10%, 1W
R43	17481	Resistor, 6.8K ±10%, 1/4W
R44	17077	Resistor, 4.7K ±10%, 1/4W
R45	17077	Resistor, 4.7K ±10%, 1/4W
R46	18318	Resistor, 12K ±10%, 1/4W
R47	17077	Resistor, 4.7K ±10%, 1/4W
R48	17041	Resistor, 10K ±10%, 1/4W
R49	17077	Resistor, 4.7K ±10%, 1/4W
R50	18667	Resistor, 2.7K ±10%, 1/4W
R51	17077	Resistor, 4.7K ±10%, 1/4W
R52	18253	Resistor, 33 Ohm ±10%, 1/4W
R53	17120	Resistor, 27K ±10%, 1/4W
R55	17077	Resistor, 4.7K ±10%, 1/4W
R56	17481	Resistor, 6.8K ±10%, 1/4W
R57	18318	Resistor, 12K ±10%, 1/4W
R58	17120	Resistor, 27K ±10%, 1/4W
R59	18318	Resistor, 12K ±10%, 1/4W
R60	17041	Resistor, 10K ±10%, 1/4W
R61	18306	Resistor, 5.6K ±10%, 1/4W
R62	17481	Resistor, 6.8K ±10%, 1/4W
R63	16516	Resistor, 1K ±10%, 1W
R64	17077	Resistor, 4.7K ±10%, 1/4W
R65	17481	Resistor, 6.8K ±10%, 1/4W
R66	17120	Resistor, 27K ±10%, 1/4W
R67	17120	Resistor, 27K ±10%, 1/4W
R68	17223	Resistor, 22K ±10%, 1/4W
R69	17039	Resistor, 100K ±10%, 1/4W

CKT. SYM.	PART NO.	DESCRIPTION
R70	17077	Resistor, 4.7K ±10%, 1/4W
R71	18667	Resistor, 2.7K ±10%, 1/4W
R72	18318	Resistor, 12K ±10%, 1/4W
R73	33590	Potentiometer, 10K, 1/2W
R74	18667	Resistor, 2.7K ±10%, 1/4W
R75	17077	Resistor, 4.7K ±10%, 1/4W
R76	17077	Resistor, 4.7K ±10%, 1/4W
R77	17077	Resistor, 4.7K ±10%, 1/4W
R78	16516	Resistor, 1K ±10%, 1W
R79	16750	Resistor, 680 Ohm ±10%, 1/2W
R80	18667	Resistor, 2.7K ±10%, 1/4W
R81	18253	Resistor, 33 Ohm ±10%, 1/4W
R82	17041	Resistor, 10K ±10%, 1/4W
R83	19051	Resistor, 390K ±10%, 1/4W
R84	34352	Potentiometer, 100K 1/2W
R85	17106	Resistor, 47K ±10%, 1/4W
R86	17156	Resistor, 1K ±10%, 1/4W
R87	17039	Resistor, 100K ±10%, 1/4W
R88	17807	Resistor, 2.2K ±10%, 1/4W
R89	17041	Resistor, 10K ±10%, 1/4W
R90	17156	Resistor, 1K ±10%, 1/4W
R91	17273	Resistor, 150 Ohm ±10%, 1/4W
R92	17259	Resistor, 27 Ohm ±10%, 1/4W
R93	18306	Resistor, 5.6K ±10%, 1/4W
R94	17223	Resistor, 22K ±10%, 1/4W
R95	17223	Resistor, 22K ±10%, 1/4W
R96	16516	Resistor, 1K ±10%, 1W
R97	17883	Resistor, 3.9K ±10%, 1/4W
R98	18289	Resistor, 39 Ohm ±10%, 1/4W
R99	17120	Resistor, 27K ±10%, 1/4W
R100	17077	Resistor, 4.7K ±10%, 1/4W
R101	18318	Resistor, 12K Ohm ±10%, 1/4W
R102	17156	Resistor, 1K Ohm ±10%, 1/4W
PC5	10459	Relay Mounting Board
PC1	10385	PC Board, Electronic Control
PC4	10411	Phase Detector, P C Board
PC3	10410	Attenuator Relay Board
J1	74350	Connector, Male Receptacle
J3	74697	UG-58/U RF Receptacle, Type N
	84903	Fuse Holders
P2	75005-2	Connector
	75005-3	Hood
PC1	97788	P C Board 10385 with Components
PC3	97790	P C Board 10410 with Components
PC4	97791	P C Board 10411 with Components
PC5	99458	P C Board 10459 with Components Less Plug In Relays

SECTION 6
PARTS LIST

ELECTRONICS DRAWER

CKT. SYM.	PART NO.	DESCRIPTION
	99401	Electronics Control Drawer, SAC-69( ) Antenna Tuner
C1	28648	Capacitor, Dipped Mica, 12pf
C2	28703	Capacitor, Dipped Mica, 120pf
C3	27357	Capacitor, Disc Ceramic, .05mfd, 25V
C4	27840	Capacitor, Variable, Ceramic, NPO, 2-8pf
C5	27292	Capacitor, Electrolytic, 250mfd, 50V
C6	26250	Capacitor, Variable, 1.5-8pf, NPO
C7	28727	Capacitor, Dipped Mica, 360pf
C8	27345	Capacitor, Disc Ceramic, .02mfd, 100V
C10	28090	Capacitor, Dipped Mica, 150pf
C11	27345	Capacitor, Disc Ceramic, .02mfd, 100V
C12 Thru C26	24393	Capacitor, Disc Ceramic, .05mfd, 75V
C27	27395	Capacitor, Tantalum, 2.2mfd, 35V
C28 Thru C43	25866	Capacitor, Feed-Thru, .001mfd, 100V
C44	28208	Capacitor, Disc Ceramic, .001mfd, 100V
C45	28038	Capacitor, Tantalum, 68mfd, 15V
C46	27400	Capacitor, Tantalum, 15mfd, 35V
C47	27357	Capacitor, Disc Ceramic, .05mfd, 25V
C48	27321	Capacitor, Disc Ceramic, .01mfd, 100V
C49	27357	Capacitor, Disc Ceramic, .05mfd, 25V
C50	27357	Capacitor, Disc Ceramic, .05mfd, 25V
C51	27321	Capacitor, Disc Ceramic, .01mfd, 100V
C52	28325	Capacitor, Dipped Mica, 220pf
C53	28325	Capacitor, Dipped Mica, 220pf
C54 Thru C56	28038	Capacitor, Tantalum, 68mfd, 15V
C57	27321	Capacitor, Disc Ceramic, .01mfd, 100V
C58	28208	Capacitor, Disc Ceramic, .001mfd, 100V
C59	27395	Capacitor, Tantalum, 2.2mfd, 35V
C60	24707	Capacitor, Electrolytic, 50mfd, 50V
C61	27395	Capacitor, Tantalum, 2.2mfd, 35V
C62	27400	Capacitor, Tantalum, 15mfd, 35V
C63	27321	Capacitor, Disc Ceramic, .01mfd, 100V
C64	27357	Capacitor, Disc Ceramic, .05mfd, 25V
C65	27321	Capacitor, Disc Ceramic, .01mfd, 100V
C66	27321	Capacitor, Disc Ceramic, .01mfd, 100V
C67	28038	Capacitor, Tantalum, 68mfd, 15V
C68	24707	Capacitor, Electrolytic, 50mfd, 50V
C69	28038	Capacitor, Tantalum, 68mfd, 15V
C70	27400	Capacitor, Tantalum, 15mfd, 35V
C71	27357	Capacitor, Disc Ceramic, .05mfd, 25V
C72	24393	Capacitor, Disc Ceramic, .05mfd, 75V
C73	27357	Capacitor, Disc Ceramic, .05mfd, 25V
C74,C75	28168	Capacitor, Tantalum, 3.3mfd, 35V
C76	25816	Capacitor, Electrolytic, 200mfd, 35V
C77	27400	Capacitor, Electrolytic, 15mfd, 35V
C78	24393	Capacitor, Disc Ceramic .05mfd 75V
CR1 Thru CR5	44290	Diode, Silicon, 1N914
CR6	40385	Diode, Zener, 1N5240B
CR7	44290	Diode, Silicon, 1N914
CR8	40165	Diode, Silicon, R10D4

CKT. SYM.	PART NO.	DESCRIPTION
CR9	40165	Diode, Silicon, R10D4
CR10 Thru CR19	44290	Diode, Silicon, 1N914
CR20	40165	Diode, Silicon, R10D4
CR21	40165	Diode, Silicon, R10D4
CR22	40165	Diode, Silicon, R10D4
CR23	44290	Diode, Silicon, R10D4
CR24	40165	Diode, Silicon, R10D4
CR25	44290	Diode, Silicon, 1N914
CR26	44290	Diode, Silicon, 1N914
CR27	40165	Diode, Silicon, R10D4
CR28	44290	Diode, Silicon, 1N914
CR29	40540	Diode, Zener, 8.2V 1N5237
CR30	44290	Diode, Silicon, 1N914
CR31	44290	Diode, Silicon, 1N914
CR32	40165	Diode, Silicon, R10D4
CR33	44290	Diode, Silicon, 1N914
CR35	40165	Diode, Silicon, R10D4
CR36	40165	Diode, Silicon, R10D4
CR37, CR38	44290	Diode, Silicon, 1N914
CR39	40539	Diode, Zener 12V 1N4742
F1	89666	Fuse, Type 3AG, 3A, Slo-Blo
F2	89654	Fuse, Type 3AG, 1.5A Slo-Blo
K1 Thru K5	66573	Relay, 24VDC, 700 Ohms, DPDT, 5A Contacts
L1	64604	Choke, R.F., 6.8 Microhenry
L2	66420	Choke, R.F., .33 Microhenry
Q1	44329	Transistor, 2N3563
Q2	44252	Transistor, 2N3646
Q3	44379	Transistor, 40347
Q4	44252	Transistor, 2N3646
Q5	44379	Transistor, 40347
Q6	44379	Transistor, 40347
Q7	44381	Transistor, 40251
Q8	44252	Transistor, 2N3646
Q9	44379	Transistor, 40347
Q10	44379	Transistor, 40347
Q11	44252	Transistor, 2N3646
Q12	44379	Transistor, 40347
Q13	44252	Transistor, 2N3646
Q14 Thru Q33	44379	Transistor, 40347
Q34	44381	Transistor, 40251
Q35	44654	Transistor, Unijunction, TIS43
Q36 Thru Q39	44379	Transistor, 40347
Q40	44252	Transistor, 2N3646
Q41, 42	44379	Transistor, 40347
IC1	44642	Integrated Circuit, CA3028A
R1	19116	Resistor, 25 Ohm ± 10%, 28 Watt, composed of Two 50 Ohm 14 Watt Resistors in Parallel
R2	19128	Resistor, 25 Ohm ±10%, 5 Watt

PARTS LIST

CKT. SYM.	PART NO.	DESCRIPTION
R3	19130	Resistor, 37 Ohm ±10%, 28 Watts, Composed of Two 75 Ohm 14 Watt Resistors in Parallel
R4	17429	Resistor, 560 Ohm ±10%, 1/4W
R5	17077	Resistor, 4.7K ±10%, 1/4W
R7	17663	Resistor, 680 Ohm ±10%, 1/4W
R8	17663	Resistor, 680 Ohm ±10%, 1/4W
R9	17106	Resistor, 47K ±10%, 1/4W
R10	17156	Resistor, 1K ±10%, 1/4W
R11	18289	Resistor, 39 Ohm ±10%, 1/4W
R14	17156	Resistor, 1K ±10%, 1/4W
R15	17077	Resistor, 4.7K ±10%, 1/4W
R16	17041	Resistor, 10K ±10%, 1/4W
R17	17156	Resistor, 1K ±10%, 1/4W
R18	17223	Resistor, 22K ±10%, 1/4W
R19	18318	Resistor, 12K ±10%, 1/4W
R20	17223	Resistor, 22K ±10%, 1/4W
R21	18318	Resistor, 12K ±10%, 1/4W
R22	17223	Resistor, 22K ±10%, 1/4W
R23	17041	Resistor, 10K ±10%, 1/4W
R24	18253	Resistor, 33 Ohm ±10%, 1/4W
R25	17156	Resistor, 1K ±10%, 1/4W
R26	17120	Resistor, 27K ±10%, 1/4W
R27	18667	Resistor, 2.7K ±10%, 1/4W
R28	17156	Resistor, 1K ±10%, 1/4W
R29	17156	Resistor, 1K ±10%, 1/4W
R30	17792	Resistor, 33K ±10%, 1/4W
R31	19142	Resistor, 27 Ohm ±10%, 1W
R32	17041	Resistor, 10K ±10%, 1/4W
R33	18667	Resistor, 2.7K ±10%, 1/4W
R34	17077	Resistor, 4.7K ±10%, 1/4W
R35	17106	Resistor, 47K ±10%, 1/4W
R36	17089	Resistor, 3.3K ±10%, 1/4W
R37	17041	Resistor, 10K ±10%, 1/4W
R38	17041	Resistor, 10K ±10%, 1/4W
R40	17089	Resistor, 3.3K ±10%, 1/4W
R41	17089	Resistor, 3.3K ±10%, 1/4W
R42	16528	Resistor, 470 Ohm ±10%, 1W
R43	17481	Resistor, 6.8K ±10%, 1/4W
R44	17077	Resistor, 4.7K ±10%, 1/4W
R45	17077	Resistor, 4.7K ±10%, 1/4W
R46	18318	Resistor, 12K ±10%, 1/4W
R47	17077	Resistor, 4.7K ±10%, 1/4W
R48	17041	Resistor, 10K ±10%, 1/4W
R49	17077	Resistor, 4.7K ±10%, 1/4W
R50	18667	Resistor, 2.7K ±10%, 1/4W
R51	17077	Resistor, 4.7K ±10%, 1/4W
R52	18253	Resistor, 33 Ohm ±10%, 1/4W
R53	17120	Resistor, 27K ±10%, 1/4W
R55	17077	Resistor, 4.7K ±10%, 1/4W
R56	17481	Resistor, 6.8K ±10%, 1/4W
R57	18318	Resistor, 12K ±10%, 1/4W
R58	17120	Resistor, 27K ±10%, 1/4W
R59	18318	Resistor, 12K ±10%, 1/4W
R60	17041	Resistor, 10K ±10%, 1/4W
R61	18306	Resistor, 5.6K ±10%, 1/4W
R62	17481	Resistor, 6.8K ±10%, 1/4W
R63	16516	Resistor, 1K ±10%, 1W
R64	17077	Resistor, 4.7K ±10%, 1/4W
R65	17481	Resistor, 6.8K ±10%, 1/4W
R66	17120	Resistor, 27K ±10%, 1/4W
R67	17120	Resistor, 27K ±10%, 1/4W
R68	17223	Resistor, 22K ±10%, 1/4W
R69	17039	Resistor, 100K ±10%, 1/4W

CKT. SYM.	PART NO.	DESCRIPTION
R70	17077	Resistor, 4.7K ±10%, 1/4W
R71	18667	Resistor, 2.7K ±10%, 1/4W
R72	18318	Resistor, 12K ±10%, 1/4W
R73	33590	Potentiometer, 10K, 1/2W
R74	18667	Resistor, 2.7K ±10%, 1/4W
R75	17077	Resistor, 4.7K ±10%, 1/4W
R76	17077	Resistor, 4.7K ±10%, 1/4W
R77	17077	Resistor, 4.7K ±10%, 1/4W
R78	16516	Resistor, 1K ±10%, 1W
R79	16750	Resistor, 680 Ohm ±10%, 1/2W
R80	18667	Resistor, 2.7K ±10%, 1/4W
R81	18253	Resistor, 33 Ohm ±10%, 1/4W
R82	17041	Resistor, 10K ±10%, 1/4W
R83	19051	Resistor, 390K ±10%, 1/4W
R84	34352	Potentiometer, 100K 1/2W
R85	17106	Resistor, 47K ±10%, 1/4W
R86	17156	Resistor, 1K ±10%, 1/4W
R87	17039	Resistor, 100K ±10%, 1/4W
R88	17807	Resistor, 2.2K ±10%, 1/4W
R89	17041	Resistor, 10K ±10%, 1/4W
R90	17156	Resistor, 1K ±10%, 1/4W
R91	17273	Resistor, 150 Ohm ±10%, 1/4W
R92	17259	Resistor, 27 Ohm ±10%, 1/4W
R93	18306	Resistor, 5.6K ±10%, 1/4W
R94	17223	Resistor, 22K ±10%, 1/4W
R95	17223	Resistor, 22K ±10%, 1/4W
R96	16516	Resistor, 1K ±10%, 1W
R97	17883	Resistor, 3.9K ±10%, 1/4W
R98	18289	Resistor, 39 Ohm ±10%, 1/4W
R99	17120	Resistor, 27K ±10%, 1/4W
R100	17077	Resistor, 4.7K ±10%, 1/4W
R101	18318	Resistor, 12K Ohm ±10%, 1/4W
R102	17156	Resistor, 1K Ohm ±10%, 1/4W
PC5	10459	Relay Mounting Board
PC1	10385	PC Board, Electronic Control
PC4	10411	Phase Detector, P C Board
PC3	10410	Attenuator Relay Board
J1	74350	Connector, Male Receptacle
J3	74697	UG-58/U RF Receptacle, Type N
	84903	Fuse Holders
P2	75005-2	Connector
	75005-3	Hood
PC1	97788	P C Board 10385 with Components
PC3	97790	P C Board 10410 with Components
PC4	97791	P C Board 10411 with Components
PC5	99458	P C Board 10459 with Components Less Plug In Relays

PARTS LIST   R F SECTION

CKT. SYM.	PART NO.	DESCRIPTION
	99402	R.F. Section, SAC-69 ( ) Antenna Tuner
C2B	29056	Capacitor, Transmitting, 75pf, 7500V, 6A
C4B	29020	Capacitor, Transmitting, 50pf, 7500V, 10A
C6B	29044	Five (5) Capacitors, Transmitting, 100pf, 5000V, 9.8A
C8D	29020	Capacitor, Transmitting, 50pf 5000V, 9.8A
C10D	29032	Capacitor, Transmitting, 25pf, 7500V, 6A
C14B	25933	Capacitor, Disc Ceramic, 50pf, NPO, 3KV
C14D	29044	Capacitor, Transmitting, 100pf, 5000V, 9.8A
C16B	24070	Capacitor, Disc Ceramic, 150pf, 1KV
C16C	29044	Capacitor, Transmitting, 100pf 5000V, 9.8A
C16D	29044	Capacitor, Transmitting, 100pf, 5000V, 9.8A
C18B	25921	Capacitor, Disc Ceramic 75pf, 3KV
C18C	29044	Capacitor, Transmitting, 100pf, 5000V, 9.8A
C18D	29044	Capacitor, Transmitting, 100pf, 5000V, 9.8A
C20B	29032	Capacitor, Transmitting, 25pf, 7500V, 7A
C20C	29020	Capacitor, Transmitting, 50pf, 5000V, 9.8A
C22D	29020	Capacitor, Transmitting, 50pf 7500V, 10A
C24B	29044	Two (2) Capacitors, Transmitting, 100pf, 5000V, 9.8A
C75	29032	Capacitor, Transmitting, 25pf, 7500V, 7A
C76	24393	Capacitor, Disc Ceramic, .05mfd, 75V
C77	24393	Capacitor, Disc Ceramic, .05mfd, 75V
C78	27242	Capacitor, Mylar, 2mfd, 100V
C79	27400	Capacitor, Tantalum, 15mfd, 35V
C80	97774	Capacitor, Variable, 21-104pf
C81	25933	Capacitor, Ceramic Disc 50pf NPO 3KV
C82	25933	Capacitor, Ceramic Disc 50pf NPO 3KV
C83	29032	Capacitor, Transmitting, 25pf 7500V, 6A
CR34	40165	Diode, R10D4
J2	75005-1	Connector, Female
J5	75304	HN High Voltage Connector UG 496/U
J4	74374	Connector, RF, BNC
K7	66561	Bi - Stable Relay
K8	66585	High Voltage Relay
KR2	~~97772~~ 34271	Motor, Solenoid

CKT. SYM.	PART NO.	DESCRIPTION
L2	97775	Variometer, 2-10 Microhenries
M1	71290	Motor, Torque
R5	17041	Resistor, 10K, 1/4W, ±10%
R6	18538	Resistor, 10 Ohm, 1/2W, ±10%
S1-A	~~34584~~	Switch, Wafer, Phenolic
S1-B thru S1-E	34569	Switch, Wafer, Ceramic, 24 Position
S2	34556	Switch, Micro SPDT
S3	34556	Switch, Micro SPDT
	32223	Coupling, Variometer
	34544	Coupling, Capacitor
	10400	Gear Box Assembled
	33253	Shaft, Glass, RF Switch
PC2	10409	P C 2 Board - Antenna Relay Board
PC2	97789	P C Board 10409 with Components
BR	97943	Brake Assembly
	10818	Brake Hub
	66781	Solenoid
	53643	Spring
	10820	Pad, Rubber
	10817	Bracket, Solenoid
	10819	Coupling, Spring
	97945	Installation Instructions

sunair

RECOMMENDED SPARE PARTS LIST

Quantity Required for supporting indicated numbers of units per year				MODEL SAC-69 ( )	Voltage 28V		
1	5	10	25	SunAir P/N	Description	Unit Price	Total Price
	1	1	3	27242	Capacitor		
1	1	3	5	27400	Capacitor		
	1	1	3	29020	Capacitor, Transmitting		
	1	1	3	29032	Capacitor, Transmitting		
1	1	3	5	29044	Capacitor, Transmitting		
	1	1	3	29056	Capacitor, Transmitting		
		1	2	34271	Motor, Solenoid		
		1	2	71290	Motor, Torque		
	1	1	2	97943	Brake Assembly		
	1	1	2	66561	Relay, Bi-stable		
		1	1	34556	Switch, Micro		
1	1	2	5	40165	Diode		
	1	1	2	66585	Relay, High Voltage		
		1	2	34569	Switch, Ceramic		
		1	2	34584	Switch, Phenolic		
	1	1	2	75005-1	Connector, Female		
		1	2	97775	Variometer		
		1	1	75304	Connector, High Voltage		
		1	1	75316	Plug, High Voltage		
	1	2	5	32223	Coupling, Variometer		
	1	1	2	34544	Coupling, Capacitor		
	1	1	5	10402	Capacitor Variable		
		1	2	97774	Capacitor, Variable		
			1	99402	R.F. Section, Complete		

PARTS LIST   R F SECTION

CKT. SYM.	PART NO.	DESCRIPTION
	99402	R.F. Section, SAC-69 ( ) Antenna Tuner
C2B	29056	Capacitor, Transmitting, 75pf, 7500V, 6A
C4B	29020	Capacitor, Transmitting, 50pf, 7500V, 10A
C6B	29044	Five (5) Capacitors, Transmitting, 100pf, 5000V, 9.8A
C8D	29020	Capacitor, Transmitting, 50pf 5000V, 9.8A
C10D	29032	Capacitor, Transmitting, 25pf, 7500V, 6A
C14B	25933	Capacitor, Disc Ceramic, 50pf, NPO, 3KV
C14D	29044	Capacitor, Transmitting, 100pf, 5000V, 9.8A
C16B	24070	Capacitor, Disc Ceramic, 150pf, 1KV
C16C	29044	Capacitor, Transmitting, 100pf 5000V, 9.8A
C16D	29044	Capacitor, Transmitting, 100pf, 5000V, 9.8A
C18B	25921	Capacitor, Disc Ceramic 75pf, 3KV
C18C	29044	Capacitor, Transmitting, 100pf, 5000V, 9.8A
C18D	29044	Capacitor, Transmitting, 100pf, 5000V, 9.8A
C20B	29032	Capacitor, Transmitting, 25pf, 7500V, 7A
C20C	29020	Capacitor, Transmitting, 50pf, 5000V, 9.8A
C22D	29020	Capacitor, Transmitting, 50pf 7500V, 10A
C24B	29044	Two (2) Capacitors, Transmitting, 100pf, 5000V, 9.8A
C75	29032	Capacitor, Transmitting, 25pf, 7500V, 7A
C76	24393	Capacitor, Disc Ceramic, .05mfd, 75V
C77	24393	Capacitor, Disc Ceramic, .05mfd, 75V
C78	27242	Capacitor, Mylar, 2mfd, 100V
C79	27400	Capacitor, Tantalum, 15mfd, 35V
C80	97774	Capacitor, Variable, 21-104pf
C81	25933	Capacitor, Ceramic Disc 50pf NPO 3KV
C82	25933	Capacitor, Ceramic Disc 50pf NPO 3KV
C83	29032	Capacitor, Transmitting, 25pf 7500V, 6A
CR34	40165	Diode, R10D4
J2	75005-1	Connector, Female
J5	75304	HN High Voltage Connector UG 496/U
J4	74374	Connector, RF, BNC
K7	66561	Bi - Stable Relay
K8	66585	High Voltage Relay
KR2	97772	Motor, Solenoid
L2	97775	Variometer, 2-10 Microhenries
M1	71290	Motor, Torque
R5	17041	Resistor, 10K, 1/4W, ±10%
R6	18538	Resistor, 10 Ohm, 1/2W, ±10%
S1-A	32211	Switch, Wafer, Phenolic
S1-B thru S1-E	34584	Switch, Wafer, Ceramic, 24 Position
S2	34556	Switch, Micro SPDT
S3	34556	Switch, Micro SPDT
	32223	Coupling, Variometer
	34544	Coupling, Capacitor
	10400'	Gear Box Assembled
	33253	Shaft, Glass, RF Switch
PC2	10409	P C 2 Board - Antenna Relay Board
PC2	97789	P C Board 10409 with Components
BR	97943	Brake Assembly
	10818	Brake Hub
	66781	Solenoid
	53643	Spring
	10820	Pad, Rubber
	10817	Bracket, Solenoid
	10819	Coupling, Spring
	97945	Installation Instructions

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RECOMMENDED SPARE PARTS LIST

Quantity Required for supporting indicated numbers of units per year				MODEL SAC-69 ( )	Voltage 28V		
1	5	10	25	SunAir P/N	Description	Unit Price	Total Price
	1	1	3	27242	Capacitor		
1	1	3	5	27400	Capacitor		
	1	1	3	29020	Capacitor, Transmitting		
	1	1	3	29032	Capacitor, Transmitting		
1	1	3	5	29044	Capacitor, Transmitting		
	1	1	3	29056	Capacitor, Transmitting		
		1	2	34271	Motor, Solenoid		
		1	2	71290	Motor, Torque		
	1	1	2	97943	Brake Assembly		
	1	1	2	66561	Relay, Bi-stable		
		1	1	34556	Switch, Micro		
1	1	2	5	40165	Diode		
	1	1	2	66585	Relay, High Voltage		
		1	2	34569	Switch, Ceramic		
		1	2	32211	Switch, Phenolic		
	1	1	2	75005-1	Connector, Female		
		1	2	97775	Variometer		
		1	1	75304	Connector, High Voltage		
		1	1	75316	Plug, High Voltage		
	1	2	5	32223	Coupling, Variometer		
	1	1	2	34544	Coupling, Capacitor		
	1	1	5	10402	Capacitor Variable		
		1	2	97774	Capacitor, Variable		
			1	99402	R.F. Section, Complete		

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RECOMMENDED SPARE PARTS LIST

Quantity Required for supporting indicated numbers of units per year				MODEL SAC-69 ( )	Voltage 28V		
1	5	10	25	SunAir P/N	Description	Unit Price	Total Price
1	1	2	5	28038	Capacitor		
		1	2	27395	Capacitor		
		1	2	24707	Capacitor		
		1	1	27840	Capacitor, Variable		
		1	1	26250	Capacitor, Variable		
		1	2	97779	Toroidal Inductor, T1		
	1	2	5	19116	Resistor		
		1	2	19128	Resistor		
	1	2	5	19130	Resistor		
		1	2	33590	Potentiometer		
		1	2	34532	Potentiometer		
2	2	5	5	44290	Diode		
		1	2	40385	Diode, Zener		
	1	2	5	44252	Transistor		
2	3	4	6	44379	Transistor		
	1	2	2	44381	Transistor		
		1	2	44359	Transistor		
		1	2	44642	Transistor, Integrated Circuit		
		1	2	44654	Transistor		
		1	2	74350	Connector		
		1	2	75005-2	Connector		
		1	2	75005-3	Hood		
1	2	3	5	66573	Relay		
		1	2	75299	Connector		

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RECOMMENDED SPARE PARTS LIST

Quantity Required for supporting indicated numbers of units per year				MODEL SAC-69 ( )	Voltage 28V		
1	5	10	25	SunAir P/N	Description	Unit Price	Total Price
		1	2	74702	Connector		
		1	2	74362	Connector		
2	3	5	10	89654	Fuse 1.5A		
2	3	5	10	89666	Fuse 3.0A		
		1	2	99401	Electronics Control Drawer		
		1	2	99467	Indicator Assy.		
1	2	4	7	84034-1	Indicator Lamp Red 4-6V		
1	2	4	7	84034-2	Indicator Lamp Green 4-6V		
1	2	4	7	84034-3	Indicator Lamp Amber 4-6V		
1	2	4	7	84034-4	Indicator Lamp Red 22-28V		
1	2	4	7	84034-5	Indicator Lamp Green 22-28V		
1	2	4	7	84034-6	Indicator Lamp Amber 22-28V		
1	2	4	7	25816	Capacitor, Electrolytic		