



MAINTENANCE COPY
DO NOT DESTROY

MAINTENANCE COPY
DO NOT DESTROY

TECHNICAL MANUAL

FOR
1KW HF ANTENNA TUNING SYSTEM
MODEL ATS-3

RETURN TO MAIN
FILE

RETURN TO MAIN
FILE

RETURN TO MAIN
FILE

PUBLICATION NUMBER
P120-040303-1

ISSUE DATE
01 APR 1978

MAINTENANCE COPY
DO NOT DESTROY

MAINTENANCE COPY
DO NOT DESTROY

RETURN TO MAIN
FILE

THE TECHNICAL MATERIEL CORPORATION

CABLE: TEPEI

700 FENIMORE ROAD, MAMARONECK, NY 10543 U.S.A.
TEL: 914-698-4800

TLX: 137-358

TWX: 710-566-1100

TMC (CANADA) LIMITED

TMC INTERNATIONAL

RR No. 5, Ottawa K1G 3N3 Ontario CANADA

TEL. 613-521-2050

TLX: 053-4146

NOTICE

THE CONTENTS AND INFORMATION CONTAINED IN THIS INSTRUCTION MANUAL IS PROPRIETARY TO THE TECHNICAL MATERIEL CORPORATION TO BE USED AS A GUIDE TO THE OPERATION AND MAINTENANCE OF THE EQUIPMENT FOR WHICH THE MANUAL IS ISSUED AND MAY NOT BE DUPLICATED EITHER IN WHOLE OR IN PART BY ANY MEANS WHATSOEVER WITHOUT THE WRITTEN CONSENT OF THE TECHNICAL MATERIEL CORPORATION.

LEWIS & CLARK
FOR

TECHNICAL MATERIEL CORP.

RECORD OF REVISIONS

NO.	ISSUED	DESCRIPTION	ENTERED	BY
001		STAG 31387		
002				
003				
004				
005				
006				
007				
008				
009				
010				

NOTE: Please file Technical Newsletters at back of manual for permanent record.

TABLE OF CONTENTS

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
<u>SECTION 1 - GENERAL INFORMATION</u>		
1-1	General.....	1-1
1-2	Description.....	1-1
	a. AX5175 Control Unit.....	1-1
	b. AX5176 Tuning Unit.....	1-1
1-3	Reference Data.....	1-2
<u>SECTION 2 - INSTALLATION</u>		
2-1	Equipment Inspection.....	2-1
2-2	Equipment Packaging.....	2-1
2-3	Inspection and Damage.....	2-2
2-4	Uncrating Methods.....	2-2
2-5	Power Requirements.....	2-5
2-6	Installation.....	2-5
2-7	Preoperational Checkout.....	2-5
<u>SECTION 3 - OPERATOR'S SECTION</u>		
3-1	General.....	3-1
3-2	Controls and Indicators.....	3-1
3-3	Preliminary Control Settings.....	3-2
3-4	Operating Procedures.....	3-3
3-5	Operator's Maintenance Procedures.....	3-7
<u>SECTION 4 - PRINCIPLES OF OPERATION</u>		
4-1	General.....	4-1
4-2	Functional Block Diagram Description.....	4-1

TABLE OF CONTENTS (Continued)

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
	<u>SECTION 4 - PRINCIPLES OF OPERATION (Continued)</u>	
4-3	Detail Circuit Description.....	4-7
	a. Preposition.....	4-7
	b. Control Board.....	4-9
	c. Output Servo.....	4-11
	d. Power Supply.....	4-12
	e. Tuning Unit.....	4-12
	<u>SECTION 5 - MAINTENANCE</u>	
5-1	Preventive Maintenance.....	5-1
	a. Inspection and Test.....	5-1
	(1) General Inspection.....	5-1
	(2) Power Supply Checks.....	5-2
	(3) Functional Test.....	5-2
	b. Cleaning Instructions.....	5-2
	c. Tuning Unit Dessicant.....	5-3
5-2	Alignment.....	5-3
	a. Humidity Sense Board A202.....	5-3
	b. Control and Servo Boards.....	5-3
	c. Preposition Board A105.....	5-5
	<u>SECTION 6 - DIAGRAMS AND PARTS LIST.....</u>	<u>6-1</u>

LIST OF TABLES

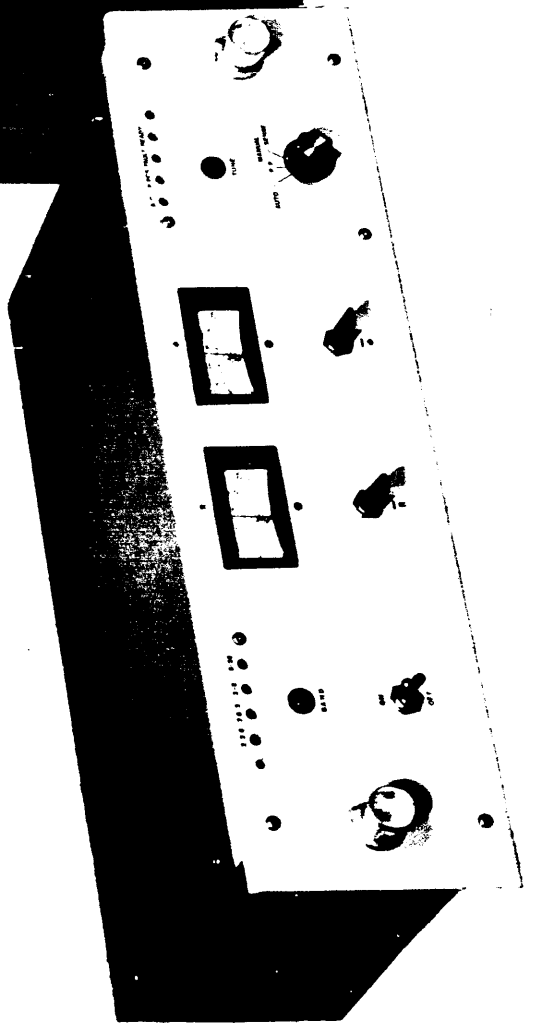
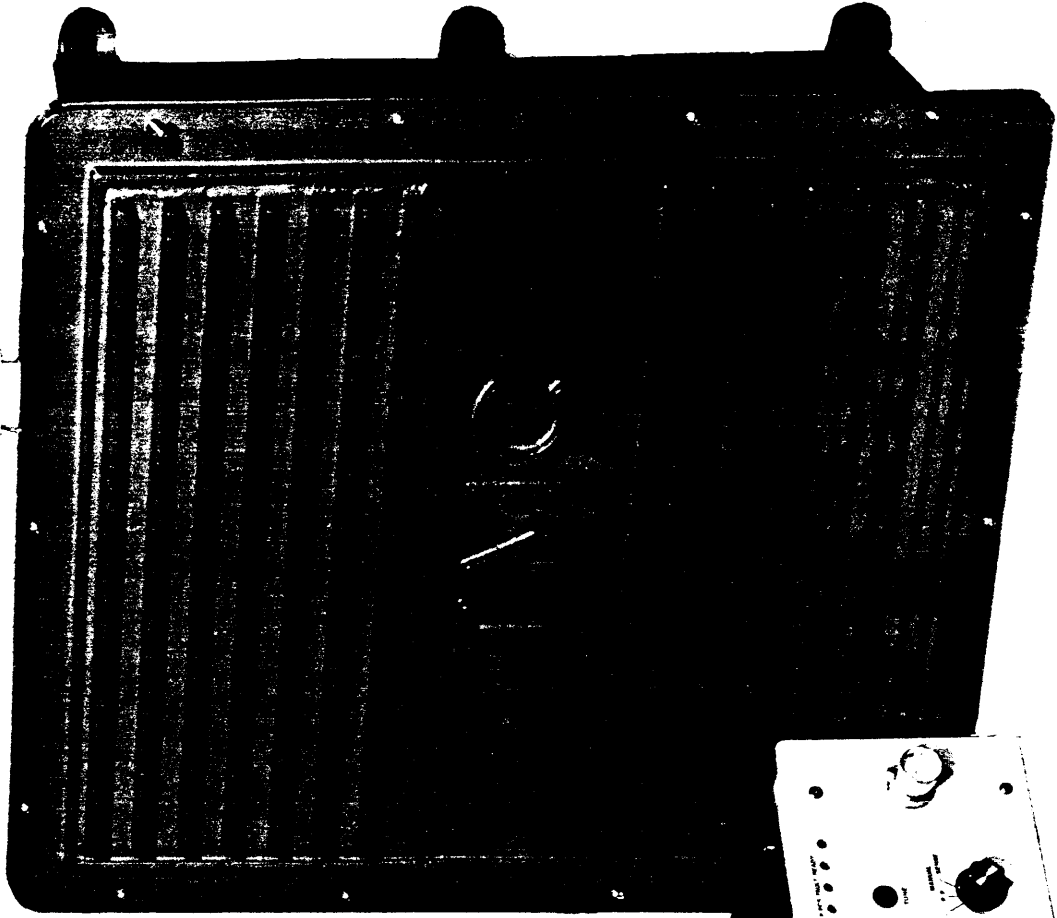
<u>Table</u>	<u>Title</u>	<u>Page</u>
1-1	Technical Specifications.....	1-2
2-1	Loose Items.....	2-1
3-1	Controls and Indicators.....	3-1
3-2	Automatic Tuning.....	3-3
3-3	Manual Tuning.....	3-3
3-4	Preposition Tuning Chart.....	3-5
5-1	Scheduled Inspection Routine.....	5-1
5-2	Preposition Potentiometers.....	5-5
5-3	Preposition Tuning Chart.....	5-6

LIST OF ILLUSTRATIONS

<u>Figure</u>	<u>Title</u>	<u>Page</u>
1-1	Automated Antenna Tuning System Model ATSA-3.....	1-0
2-1	Typical Equipment Packaging.....	2-0
2-2	Outline Dimensional.....	2-3
3-1	AX5175 Control Unit, Controls and Indicators.....	3-0
4-1	Antenna Tuning System ATSA-3, Functional Block Diagram..	4-3
6-1	Antenna Tuning Control Unit AX5175, Schematic Diagram...	6-3
6-2	Antenna Tuning Control Unit AX5175, Assembly Diagram....	6-5
6-3	Mother Card, Schematic Diagram.....	6-7
6-4	Mother Card, Assembly Diagram.....	6-9
6-5	Preposition Card, Schematic Diagram.....	6-11
6-6	Preposition Card, Assembly Diagram.....	6-13

LIST OF ILLUSTRATIONS (Continued)

<u>Figure</u>	<u>Title</u>	<u>Page</u>
6-7	Control Card, Schematic Diagram.....	6-15
6-8	Control Card, Assembly Diagram.....	6-17
6-9	Output Servo Card, Schematic Diagram.....	6-19
6-10	Output Servo Card, Assembly Diagram.....	6-21
6-11	Power Supply Card, Schematic Diagram.....	6-23
6-12	Power Supply Card, Assembly Diagram.....	6-25
6-13	AX5176 Tuning Unit, Schematic Diagram.....	6-27
6-14	Function Indicators, Assembly Diagram.....	6-30
6-15	Indicator Card, Assembly Diagram.....	6-31
6-16	AX5180 Sensing Assembly Schematic/Assembly Diagram.....	6-32
6-17	AX5178 Coil Assembly, Schematic Diagram.....	6-35
6-18	AX5177 Bandswitch Assembly, Schematic Diagram.....	6-36
6-19	AX5179 Capacitor Assembly, Schematic Diagram.....	6-37



SECTION 1

GENERAL INFORMATION

1.1 GENERAL.

The Automated Antenna Tuning System, Model ATSA-3, designed and manufactured by The Technical Materiel Corporation, Mamaroneck, New York, impedance matches the nominal 50-ohm output of a 1-kilowatt transmitter to a 35-foot vertical whip antenna. It will also tune into a long wire antenna of shorter lengths, depending on frequency and antenna configuration. The impedance matching is accomplished either automatically or manually by the insertion of the necessary inductance or capacitance to resonate the antenna to the transmitter operating frequency, within the range of 2 to 30 mhz.

1.2 DESCRIPTION.

The ATSA-3 Antenna Tuning System, shown in figure 1-1, is comprised of two modular units; the AX5175 control unit and the AX5176 tuning unit. The AX5175 control unit is designed for mounting in the associated transmitter equipment cabinet; the AX5176 tuning unit is designed for mounting at the base of the associated whip antenna.

a. AX5175 CONTROL UNIT. The AX5175 control unit provides the power and control signals necessary to operate the AX5176 tuning unit. Tuning is accomplished automatically in less than 5 seconds upon initiating the tune sequence. The tune sequence may be initiated via the AX5175 control unit or by the associated transmitter. Tuning can also be accomplished manually by operation of the front panel controls. The operating controls and indicators on the AX5175 control unit provide complete control for tuning the AX5176 tuning unit from a remote position.

The AX5175 control unit is housed in a chassis designed for installation in a standard 19-inch wide electrical equipment cabinet; the unit is approximately 19 inches wide by 5-1/4 inches high by 14 inches deep and weighs approximately 18 pounds. The unit circuitry is completely solid state, and all components are easily accessible for servicing. All operating controls and indicators are located on the front panel; interconnect cabling to the AX5175 control unit from the associated transmitter and the AX5176 tuning unit is made at the rear of the unit.

b. AX5176 TUNING UNIT. The AX5176 tuning unit impedance matches a 35-foot whip antenna (or other antenna configuration) to a nominal 50-ohm transmission line, at a frequency within the range of 2 to 30 mhz. The AX5176 tuning unit receives its power and control signals from the AX5175 control unit.

The AX5176 tuning unit is housed in a cast aluminum case, which provides complete protection from the elements by weatherproof fittings. A humidity sensor is incorporated and provides an indication on the AX5175 front panel, of excessive moisture accumulation. The unit is designed for mounting (either horizontally or vertically) at the base of the associated whip antenna. Six mounting feet enable the unit to be attached to the mast or a platform at the antenna base. The unit is approximately 18 inches wide by 9-1/2 inches high (mounting feet to top of cover) by 24 inches deep and weighs approximately 60 pounds. Access to the AX5176 tuning unit circuitry is gained by removal of the case cover.

All circuitry is mounted on separate chassis assemblies, which are securely fastened to the case housing. The chassis assemblies and their individual circuit components are easily accessible and removable for servicing.

1.3 REFERENCE DATA.

Table 1-1 lists the technical specifications for the ATSA-3 Antenna Tuning System.

TABLE 1-1. TECHNICAL SPECIFICATIONS

Frequency range	2 to 30 mhz 50-ohm unbalanced.
RF capability	1-kilowatt PEP and average (on all operating modes).
VSWR	1.5:1 maximum.
Tuning time	5 seconds nominal.
Environmental temperature	0 to 50°C.
Primary power	115/230 volts $\pm 10\%$, 50/60 hz, single phase, at approximately 80 watts.
Modes of operation	Automatic, semi-automatic, and manual.
Antenna matching capabilities	Designed to match a standard 35-foot whip antenna; will also tune into a long wire antenna of shorter length, depending on frequency and antenna configuration.

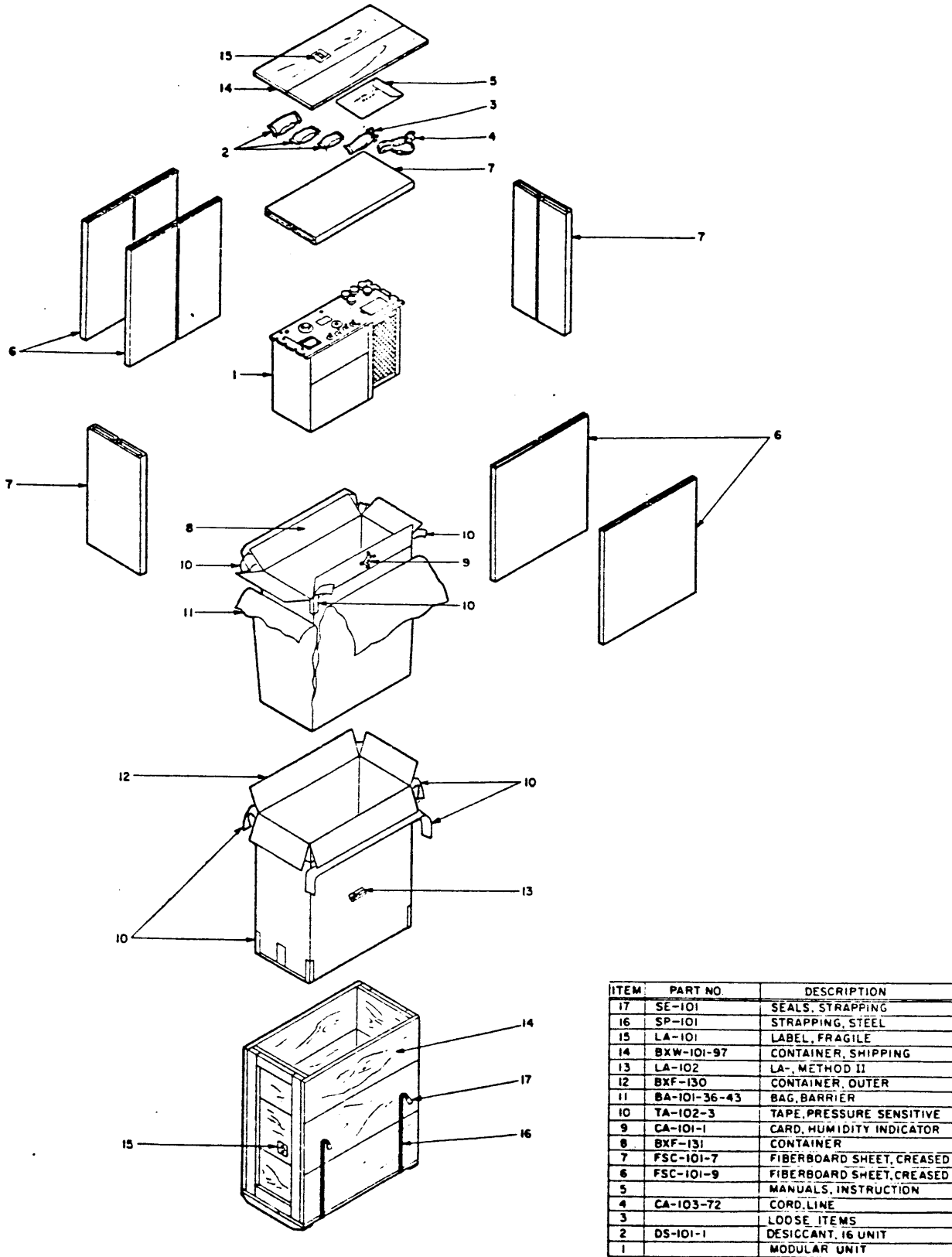


Figure 2-1. Typical Equipment Packaging

SECTION 2
INSTALLATION

2.1 EQUIPMENT INSPECTION.

The ATSA-3 was assembled, calibrated, and tested at the factory before shipment. Inspect all packages for possible damage during transit. Carefully unpack each crate as indicated by the packing list provided with the shipment. Inspect all packing material for parts that may have been shipped as loose items (technical manuals, hardware, etc.).

2.2 EQUIPMENT PACKAGING.

The equipment is shipped in boxes as shown in figure 2-1 (typical equipment packaging). The box number and contents are stenciled on the outside of each box. Whether an equipment is crated or uncrated, various precautions must be observed in handling to prevent personnel injury and/or damage to the equipment.

The ATSA-3 is packed in two crates including loose items crate (table 2-1). Each crate is assigned a number which appears on the crate. Figure 2-1 shows typical packaging. Figure 2-2 illustrates the outline dimensions and contains installation information.

TABLE 2-1. LOOSE ITEMS

Part No.	Description	Qty
CA484	Cable, antenna	1
MS3057-16	Clip, cable	1
MS3106B28-21P	Connector	1
MS3420-16A	Bushing, rubber	1
PL288-32-414S17	Connector, waterproof	1
UG925/U	Connector, rf	2
RG215/U	Cable, coaxial	
MSCA-37	(When customer specified)	

2.3 INSPECTION AND DAMAGE.

Inspect the outside of all crates for possible transit damage. While following the procedural installation instructions, carefully unpack each crate as indicated. Inspect all packing material for parts which may have been shipped as loose items.

With respect to equipment damage for which the carrier is liable, The Technical Corporation will assist in describing methods of repair and furnishing of replacement parts.

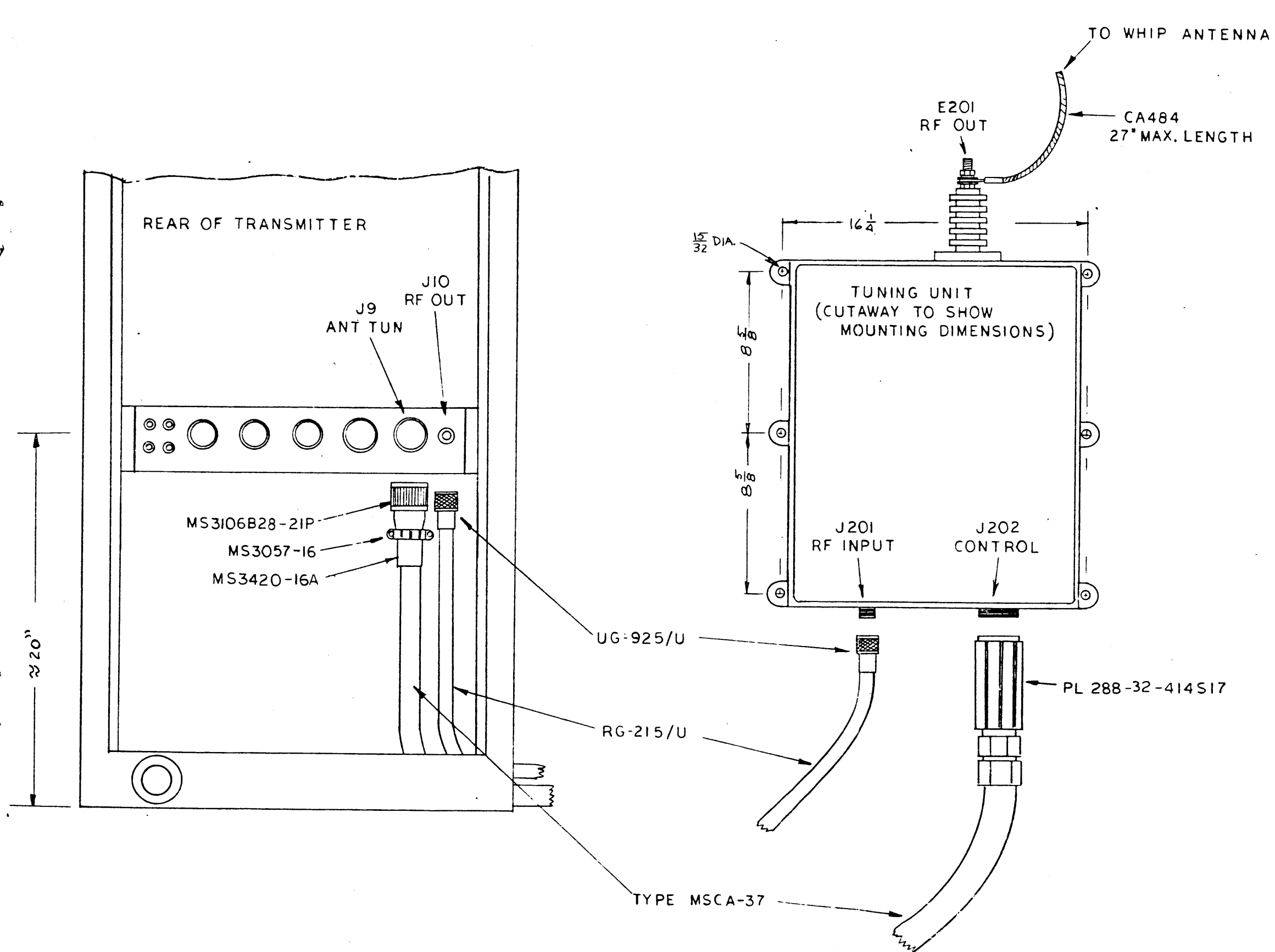
2.4 UNCRATING METHODS.

The following information briefly outlines general uncrating methods. They must be adhered to when unpacking the ATSA-3 to prevent damage. Keeping in mind previously discussed information on material handling, packing data, inspection and damage, proceed as follows:

- a. Remove wire straps or bands from around the crate with a pair of snips.
- b. Unless otherwise specified, remove nails from three sides of the crate with a nail puller. Do not use claw hammer, pinch bar, etc.
- c. When the sides have been removed, rip off the moisture-proof paper. If a knife is used, care should be exercised not to mar equipment.
- d. If equipment is not packed in a cardboard carton remove it from crate.
- e. If after removing moisture-proof paper, a cardboard carton is encountered, carefully open with a case cutter or remove tape.
- f. Where applicable, remove the following:
 1. Creased cardboard blocking pieces.
 2. Barrier bags.
 3. Tape.
 4. Molded cushioning.
 5. Cellulose wadding.
 6. Tissue paper.
- g. Check off items unpacked on the packing list or equipment supplied list.

NOTE

Anticipating the possibility of repacking the ATSA-3 for relocation, it is suggested that all packing crates and materials be saved.



CONTROL CABLE INTERCONNECTION	
FROM J9 PIN NO.	TO J202 PIN NO.
A	A
B	B
C	C
D	D
E	E
F	F
G	G
H	H
J	J
K	K
L	L
M	M
N	N
P	P
R	R
S	S
T	T
U	U
V	V
W	W
X	X
Z	Z
a	a
b	b
c	c
d	d
e	e
f	f
g	g
h	h
j	j
k	k
m	m
p	p
r	r
s	s
	6

Figure 2-2. Outline Dimensional

2.5 POWER REQUIREMENTS.

The ATSA-3 requires a single-phase source of 115/230 vac[±]10%, 50/60 hz. The minimum power requirement is 80 watts.

2.6 INSTALLATION.

NOTE

This paragraph (2-6) contains general installation instructions for both the AX5175 control unit and the AX5176 tuning unit. However, since it is more convenient to check out the AX5176 tuning unit before it is secured in its final installation, it is suggested that the AX5175 control unit be installed in the transmitter equipment rack and that interconnect cables be connected between the equipment rack and the AX5176 tuning unit (positioned but not yet secured in its final installation). Preoperational checkout of bandswitching and prepositioning should then be performed in accordance with paragraph 2-7. Upon successful completion of the preoperational checkout, the AX5176 tuning unit should be secured in its final installation.

The AX5175 control unit is normally installed in the transmitter equipment rack and the AX5176 tuning unit is normally installed remote from the control unit (no more than 100 feet) and at the base of the antenna installation (within 27 inches). The AX5175 control unit is designed for installation in a standard 19-inch equipment rack, making its location basically fixed and predicated on the total transmitter installation. However, some flexibility is permitted with the AX5176 tuning unit installation. It may be installed at any attitude, providing the installation is secured with the six mounting apertures of the case. (The AX5176 tuning unit weighs approximately 60 pounds.) Further, since the tuning unit contains no operating controls or indicators, it may be encased in a water-tight enclosure, providing additional protection against the elements, particularly humidity. The only restrictions imposed on the installation of the AX5176 tuning unit are that it be no more than 100 feet from the AX5175 control unit and that it be no more than 27 inches from the antenna. Refer to figure 2-2 for further installation details.

It is suggested that connectors J201 and J202 on the AX5176 tuning unit be wrapped with waterproof tape as an added precaution. It is not necessary to wrap the RF OUT connector, but electrical tape may be used.

2.7 PREOPERATIONAL CHECKOUT.

Once the AX5175 control unit and the AX5176 tuning unit have been installed and interconnected with the associated transmitting system, a checkout of bandswitching and prepositioning should be performed in accordance with the following procedure.

NOTE

No r-f power is required for these checks, and high voltage should not be applied to the transmitter.

a. Energize the associated transmitter. (Refer to transmitter technical manual for this operation.)

b. Set the AUTO/MANUAL switch (located within AX5175 control drawer) to the AUTO position.

c. On the AX5175, set the AUTO/SENSE/PP switch to the AUTO position, and set the ON/AC switch to the ON position.

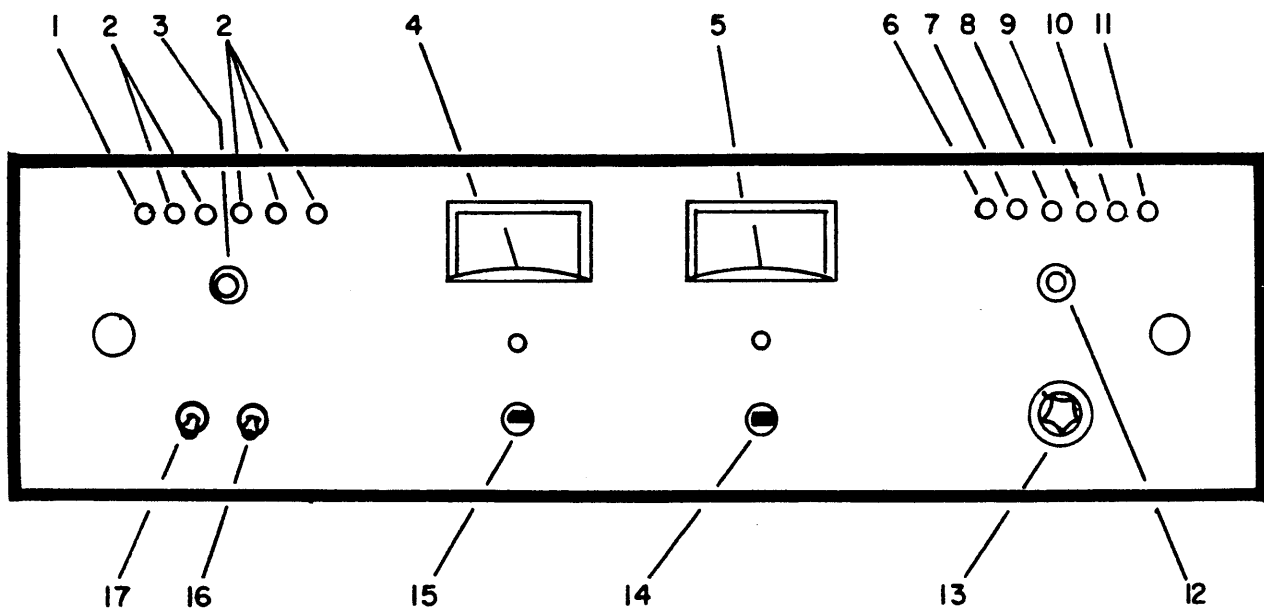
d. On the transmitter exciter unit, set the frequency selector switches to 02.59999 mhz. Proper bandswitching of the AX5176 tuning unit will be indicated by illumination of the appropriate band indicator on the AX5175 control unit.

e. Initiate prepositioning on the associated transmitter. (On TMC HFT-1KJ series transmitters, prepositioning is initiated by depressing the TUNE pushbutton on the AX5130. In some instances, the TUNE pushbutton must be depressed twice.) Prepositioning of the AX5176 will be indicated on the AX5175 control unit by the illumination of the P.POS indicator.

f. Repeat steps D. and E. for the following frequencies: 02.5999, 02.9999, 05.0000, 08.0000, and 16.0000 mhz.

NOTE

The humidity potentiometer in the AX5176 tuning unit is preset. However, the setting may not be proper for the particular installation and will cause the HMD indicator on the AX5175 control unit front panel to light erroneously for the installation. If this should occur, remove the tuning unit cover and back off on the setting of the humidity potentiometer to extinguish the HMD indicator.



AX5175 CONTROLS AND INDICATORS

FIGURE 3-1

SECTION 3
OPERATOR'S SECTION

3.1 GENERAL.

The ATSA-3 impedance matches the nominal 50-ohm output of a 1-kilowatt transmitter to a 35-foot vertical whip antenna. This section details the functions of the AX5175 control unit front panel controls and indicators. The AX5176 tuning unit does not contain any front panel operating controls and indicators. For full operating instructions for the ATSA-3, when combined with a transmitter configuration, refer to the associated transmitter operating instructions.

3.2 CONTROLS AND INDICATORS.

Table 3-1 details the functions of the AX5175 control unit operating controls and indicators. Figure 3-1 locates the controls and indicators.

TABLE 3-1. CONTROLS AND INDICATORS

Panel Designation	Function
1. BYPASS indicator	Lights to indicate BYPASS/OFF switch is set to BYPASS position.
2. Band indicators	When illuminated, indicates the position of the AX5176 tuning unit bandswitch: 1.5-2; 2-2.6; 2.6-3; 3-8 or 8-30.
3. BAND pushbutton	Permits manual control of the band selection circuitry in the AX5176 tuning unit. When pressed, causes the AX5176 bandswitch to step one position; releasing and pressing the BAND pushbutton again causes the bandswitch to step to its next position. (AUTO/MAN switch must be set to MAN position for manual control of bandswitching.)
4. L meter	Provides an indication of the inductance tuning for both prepositioning (using feedback from preposition potentiometers) and for final tuning (using output of sensing circuit).
5. C meter	Provides an indication of the capacitance tuning for both prepositioning (using feedback from preposition potentiometers) and for final r-f tuning (using output of sensing circuit).
6. AC indicator	Lights to indicate application of power to ATSA-3 when ON/AC switch is set to ON.
7. P.POS indicator	Lights to indicate completion of prepositioning.
8. RF TRIG indicator	Lights to indicate application of r-f trigger from associated transmitter.

TABLE 3-1. CONTROLS AND INDICATORS (Continued)

Panel Designation	Function
9. RDY indicator	Lights to indicate completion of final tuning.
10. FAULT indicator	Lights to indicate tuning has not been accomplished within 5 seconds nominal.
11. HMD indicator	Lights to indicate excessive humidity in the AX5176 tuning unit.
12. TUNE pushbutton	When pressed, initiates the tuning sequence; however, in applicable transmitting systems, the TUNE pushbutton on the transmitter control unit should be used to initiate tuning.
13. AUTO/SENSE/PP switch	In AUTO position, tuning is accomplished automatically. In MANUAL SENSE position, connects front panel L and C meter to sense circuits, providing indication for final tuning. In MANUAL PP position, connects front panel L and C meters to the preposition control circuits, and indicates prepositioning.
14. C switch	In down (-) position, adjusts capacitance tuning in negative direction; in up (+) position, adjusts capacitance tuning in positive direction. Used only in manual tuning.
15. L switch	In down (-) position, adjusts inductance tuning in negative direction; in up (+) position, adjusts inductance tuning in positive direction. Used only for manual tuning.
16. ON/AC switch	Controls primary power application to the AX5175 control unit. In ON position, a-c power is applied. In AC position, a-c power is disconnected.
17. BYPASS/OFF switch	Bypass is the tuning circuitry in the AX5176 tuning unit enabling direct connection of the antenna to a receiver.

3.3 PRELIMINARY CONTROL SETTINGS.

Before applying power to the associated transmitter, of which the ATSA-3 is a part, check that the antenna connection is properly made at the output of the AX5176 tuning unit, and check that all controls on the associated transmitter are set to their proper positions. Refer to the associated transmitter technical manual.

Before proceeding with the operating procedures, ensure that the ON/AC switch on the AX5175 control unit front panel is set to AC (off).

3.4 OPERATING PROCEDURES.

The ATSA-3 is designed primarily for automatic tuning operation; however, in the event of failure in automatic control circuitry, it may be operated manually. The procedure for automatic tuning is outlined in table 3-2; the procedure for manual tuning is outlined in table 3-3. Before attempting to operate the ATSA-3, the control settings for the associated transmitter should be completed. Refer to the associated transmitter technical manual.

TABLE 3-2. AUTOMATIC TUNING

Step	Unit	Operation	Normal Indication
1	Associated transmitter	Energize associated transmitter.	Refer to associated transmitter technical manual.
2	ATSA-3	Set AUTO/SENSE/PP switch to AUTO position and set the AUTO/MANUAL switch (located within AX5175 control drawer) to AUTO.	The appropriate Band indicator on the AX5175 will illuminate when bandswitching (for the selected frequency) is complete.
3		Set ON/AC switch to ON.	AC indicator lamp should light as soon as tuning elements are repositioned.
4	Associated transmitter	Apply high voltage, adjust power level, and initiate tuning on associated transmitter.	Refer to associated transmitter technical manual. ATSA-3 will tune automatically. During the tuning sequence, the ATSA-3 front panel P.POS indicator will light, followed by the RF TRIG indicator lighting, followed by the RDY indicator lighting.

TABLE 3-3. MANUAL TUNING

Step	Unit	Operation	Normal Indication
1	Associated transmitter	Energize associated transmitter.	Refer to associated transmitter technical manual.
2	ATSA-3	Set AUTO/SENSE/PP switch to MAN-PP position.	No indications.
3		Set ON/AC switch to ON.	AC indicator lights. The appropriate Band indicator lights for the frequency selected on the associated transmitter.

TABLE 3-3. MANUAL TUNING (Continued)

Step	Unit	Operation	Normal Indication
<u>NOTE</u>			
<p>Bandswitching for the ATSA-3 is accomplished automatically when the unit is interconnected in the transmitter system. The bandswitching however, may be accomplished manually by setting the AUTO/MANUAL switch (located within AX5175 control drawer) to the MANUAL position and by pressing and releasing the BAND push-button sequentially until the appropriate band indicator illuminates.</p>			
4	ATSA-3	Adjust inductance and capacitance to prepositioning reference data for selected band by carefully adjusting L and C switches in required directions.	The L and C meter readings are set to the proper levels as indicated on the prepositioning reference data (table 3-4) for the selected band.
<u>NOTE</u>			
<p>Operation of the associated transmitter on different frequencies over an extended period of time will allow the operating station to compile a tuning chart. Once this has been accomplished, the operator should use the tuning chart for prepositioning the L and C components of the ATSA-3. The data supplied in table 3-3 may be used as a starting reference until a station tuning chart has been compiled.</p>			
5	Associated transmitter	Apply high voltage to associated transmitter.	Refer to associated transmitter technical manual.
6	Associated transmitter	Tune associated transmitter.	Refer to associated transmitter technical manual.
7	ATSA-3	Set AUTO/SENSE/PP switch to MANUAL SENSE position.	No indication.
8		Perform final tuning by very carefully adjusting L and C switches in small increments in required direction until both L and C meters indicate 0 on upper scale. If L meter is initially on positive (+) side of 0, adjust L switch first to zero L meter. If L meter is initially on negative (-) side of 0, adjust C switch first to zero C meter.	L and C meters indicate 0.

TABLE 3-3. MANUAL TUNING (Continued)

Step	Unit	Operation	Normal Indication
------	------	-----------	-------------------

NOTE

The choice of starting with the L or C switch for final tuning will generally be correct by noting on which side of 0 the L meter is indicating. If the L meter initially indicates on the positive side of 0, adjust the L switch first; if the L meter initially indicates on the negative side of 0, adjust the C switch first. However, certain crossover points may be encountered, especially at the low end of the frequency bands and following the indicated rule will actually result in both meters moving away from 0 in the opposite directions. If the meters continue to move away from 0 as the L or C switches are repeatedly tapped, a point can be reached where the tuning is lost, necessitating returning to preposition the elements, by removing high voltage and repeating steps 2 and 4. If this situation is encountered, reverse the rule when final tuning is repeated. Continued operation of the final tuning procedure at particular frequencies will provide awareness of the location of these crossover points and indicate when the rule applies and when the opposite is true.

9	Associated transmitter	Perform a check of reflected power	Refer to associated transmitter technical manual.
10	ATSA-3	Adjust L and C switches for minimum reflected power.	Associated transmitter reflected power meter will indicate minimum reflected power. Refer to associated transmitter technical manual.

TABLE 3-4. PREPOSITION TUNING CHART

Frequency (Mhz)	P.P. L	P.P. C
02.0000	10	12
02.1000	8.75	12
02.2000	7.25	12
02.3000	7	12
02.4000	6	12
02.5999	5	12
02.6000	6.6	12

TABLE 3-3. MANUAL TUNING (Continued)

Step	Unit	Operation	Normal Indication
------	------	-----------	-------------------

TABLE 3-4. PREPOSITION TUNING CHART

Frequency (Mhz)	P.P. L	P.P. C
02.7000	5.75	12
02.8000	4.9	12
02.9999	4.1	12
03.0000	4.9	12
04.9999	4.9	12
05.0000	3	12
06.0000	3	12
07.9999	3	12
08.0000	3	8.5
09.0000	3	8.5
10.0000	3	8.5
11.9999	3	8.5
12.0000	3	9
13.0000	3	9
14.0000	3	9
15.9999	3	9
16.0000	3	8
17.0000	3	8
18.0000	3	8
19.0000	3	8
20.0000	3	8
21.0000	3	8

TABLE 3-4. PREPOSITION TUNING CHART
(Continued)

Frequency (Mhz)	P.P. L	P.P. C
22.0000	3	8
23.0000	3	8
24.0000	3	8
25.0000	3	8
26.0000	3	8
27.0000	3	8
28.0000	3	8
29.0000	3	8
30.0000	3	8

3.5 OPERATOR'S MAINTENANCE PROCEDURES.

Operator's maintenance should be performed during idle periods of shut down. When equipment is operated on a fairly constant basis, cable connections and movable parts should be periodically inspected for mechanical and/or electrical operation.

The operator should inspect the front and rear of the AX5175 control unit and observe that all meters, knobs, indicators and terminal strips are not broken or cracked. Refer to paragraph 3-4 and ascertain that all controls and indicators are operating properly. Should any component show signs of wear, aging, or overheating, perform the necessary replacement and repair procedures.

Operator's maintenance should also include the repair of broken or cracked knobs, fuses, and indicator lamps. Cable connections, where necessary, should be repaired if found to be broken or loose. It is particularly important to check cabling for snagging if equipment is affixed with equipment slides and mounted in an equipment cabinet or transmitter frame.

The AX5176 tuning unit contains a sensing circuit in sensing assembly (AX5180) A204 that may require adjustment. It is not recommended that the adjustment be performed at the antenna base. The assembly must be removed from the tuning unit and adjusted by operating into a 50-ohm dummy load with the transmitter set to 16 mhz and a 200-watt power output. (See figure 6-7.) Connect a d-c vtvm from J1-4 to ground and adjust balance potentiometer R9 for a 0-volt indication. Then connect the d-c vtvm from J1-1 to ground and adjust capacitor C2 for a 0-volt indication.

TABLE 3-5. OPERATOR'S MAINTENANCE PROCEDURES

(Continued)

WARNING

Use an insulated tool to adjust capacitor C2.

SECTION 4

PRINCIPLES OF OPERATION

4.1 GENERAL.

The principles of operation of the ATSA-3 are presented in two parts. The first part provides a functional block description of the equipment to define the signal flow between board assemblies and units and to indicate the general functions within each board assembly and unit. The second part describes the operation of each board assembly and unit at the detail circuit level to better understand circuit operation and to identify circuit controls and adjustment for operation and maintenance.

4.2 FUNCTIONAL BLOCK DIAGRAM DESCRIPTION (See figure 4-1)

a. The ATSA-3 operates in two modes; preposition and final tuning. In the preposition mode, the capacitive and inductive elements in the tuning unit are positioned according to the frequency band selection, to obtain as near a starting point before final tuning. In the final tuning mode, the capacitive and inductive elements undergo final positioning to obtain minimum vswr.

b. Prepositioning is controlled by application of a preposition selection voltage from the associated exciter to steering diodes on the preposition board A105. A positive d-c voltage is placed on the line corresponding to the selected band. The steering diodes route the d-c voltage to one of six L preposition potentiometers A105 R9 through A105 R14 to one of eight C preposition potentiometers A105 R1 through A105 R8. The resultant d-c output of the selected potentiometers is routed through normally closed contacts of relay A105 K1 to a C and L output servo board. The C and L output servo boards are identical; each receives the associated C and L signal.

c. The d-c preposition voltage is mixed with a 1.1-volt a-c chopped signal from A102 Q5 and A102 Q6 and applied to amplifier A102 Z2. The output of amplifier A102 Z2 is again amplified by A102 Z1 and A102 Q3, buffered by emitter follower A102 Q4, and developed across push-pull amplifier A102 Q1, and A102 Q2. The push-pull amplifier develops drive for the servo motor in the tuning unit, and the associated servo motor starts driving towards the preposition point. As the servo motors drive toward the final preposition value, a tach feedback signal derived from a potentiometer driven by the servo motors indicate the servo position, and is applied back to the associated output servo board. The tach feedback signal is summed with the preposition voltage at the input of amplifier A102 Z1. When the tach feedback signal, which indicates the position of the servo, equals the preposition voltage, which indicates the requested preposition point, the output of the output servo board goes to zero and the servos stop driving.

d. Each output servo board contains a rectifier A102 CR8 which provides an indication of the output. The rectified output of each output servo amplifier A102 and A104 is summed by resistors A103 R9 and A103 R10 on the control board. The d-c voltages are a function of servo imbalance, representing the difference between the requested servo position and the actual servo position.

e. As the servos are prepositioning, a positive voltage is applied to amplifier A103 Z2 on the control board. The positive output of A103 Z2 turns on switch A103 Q5 which turns off switch A103 Q6. With A103 Q6 turned off, the +35 volts switched is allowed to be applied to time delay circuit consisting of resistor A103 R25 and capacitor A103 C6. The time delay circuit provides a nominal 25 second delay to allow sufficient time for prepositioning to be completed before a fault is indicated.

f. If the servos do not preposition within the allotted time delay, capacitor A103 C6 is allowed to charge to within 2/3 of the +35-volt level, which turns on switch A103 Q7. Turning on switch A103 Q7 fires scr A103 Q11, which indicates a fault and a number of events occur. First, the front panel FAULT indicator is lighted. Also, scr A103 Q13 is fired and turns off switch A103 Q14. With A103 Q14 and A103 Q15 turned off, switch A103 Q4 is turned off, switch A103 Q3 is turned on, enabling switch A103 Z1. The output of A103 Z1 then fires control triac A103 Q2 which fires a-c triac A1-3 Q1. Firing A103 Q1 opens the 120-volt a-c primary line of transformer T103 and removes the 26-volt a-c excitation for the servo motors in the tuning unit. Therefore, disabling the +35-volt switched voltage removes +35 volts from the preposition board, the two output servo boards, and the tuning unit; disabling the 26-volt a-c excitation voltage stops and prevents damaging the servo motors. As a result, the entire ATSA-3 system is effectively shut down, except for the plus and minus 12 volt supply.

g. After a fault occurs, the circuits must be reset. This is accomplished by pressing the front panel TUNE button which applies a ground to scr's A103 Q11 and A103 Q14, effectively unfiring the scr's returning the circuits to the status that existed before timing out to a fault condition.

h. If the inductive and capacitance elements in the tuning unit are prepositioned correctly within the allotted time, the tach feedback signals from the coil assembly A202 and capacitor assembly A203 in the tuning unit, respectively, are equal to the preset voltage and the voltage at the junction of resistors A103 R9 and A103 R10 on the control board goes to zero. As a result the time delay circuit is not allowed to time out and a fault condition is not sensed. The output of amplifier A103 Z2 on the control board then goes to zero, turning off switch A103 Q5 which turns on switch A103 Q6 and lights the front panel P.POS indicator, indicating the successful completion of the preposition mode. The ATSA-3 can remain in the preposition mode indefinitely, and await an r-f trigger from the transmitter before the final tuning mode is initiated.

i. Following the preposition mode, the ATSA-3 circuitry awaits r-f triggers from the transmitter before entering the final tuning mode. Two r-f triggers are applied from the transmitter; one is applied to the preposition board to switch from the preposition voltages to the sensing voltages from the tuning unit; the other is applied to the control board to initiate a timing cycle.

j. The r-f trigger from the transmitter is amplifier A105 Z1 on the preposition board. The resultant output of A105 Z1 turns on switch A105 Q1 which applies a ground to relay K1, energizing K1. With K1 energized, the preposition voltages from the preposition potentiometers are disconnected and the C sense and L sense outputs of sensing assembly A204 on the tuning unit are routed through the contacts of relay K1 to the respective output servo card. In addition to being routed to the output servo cards, the C sense and L sense signals are also applied to amplifiers A105 Z2 and A105 Z3, respectively, on the preposition board.

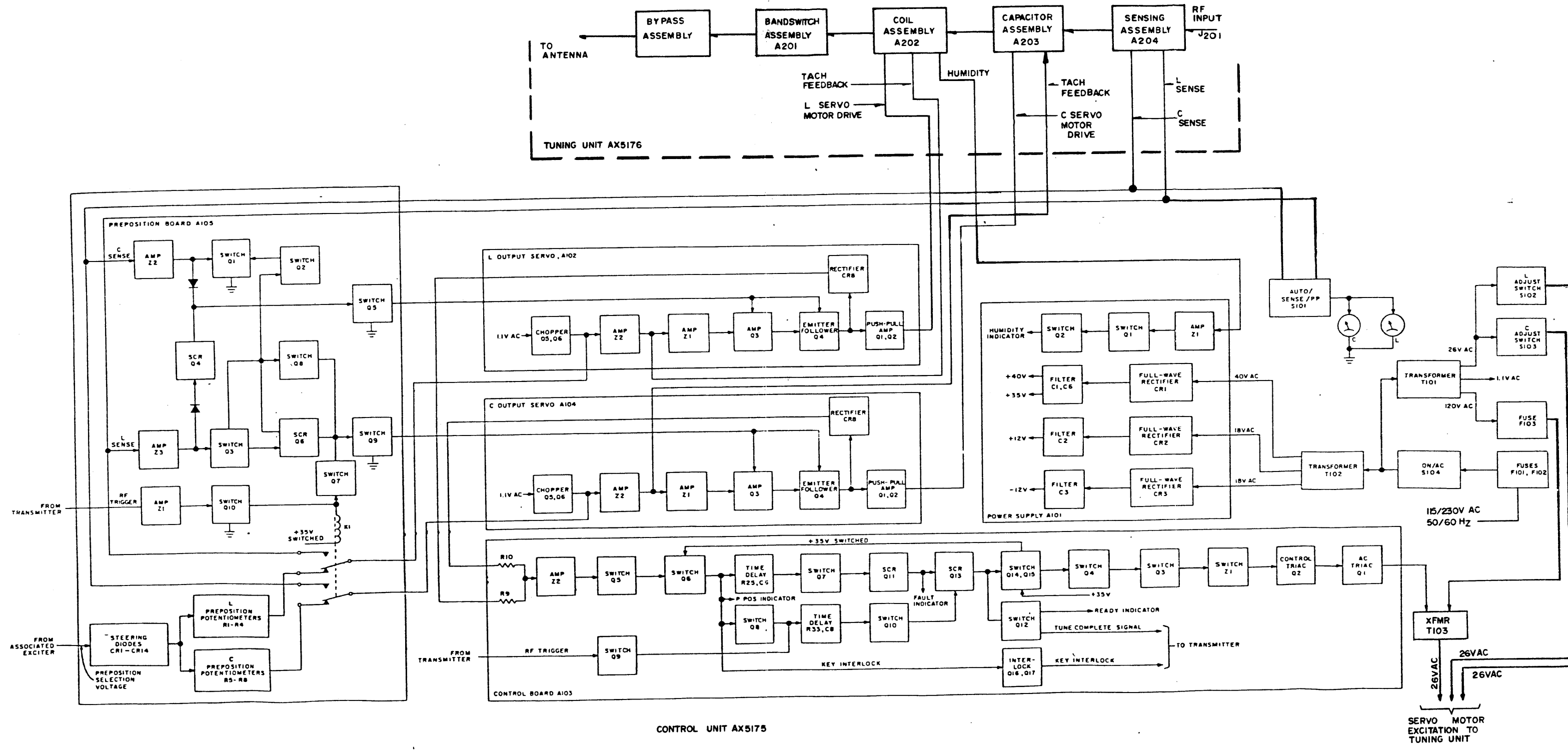


FIG. 4-1 ANTENNA TUNING SYSTEM ATSA-3 FUNCTIONAL BLOCK DIAGRAM

k. Simultaneously, an r-f trigger from the transmitter is applied to switch A103 Q9 on the control board. The r-f trigger turns off A103 Q9 and starts a time delay circuit consisting of resistor A103 R33 and capacitor A103 C8. The time delay is adjusted to allow sufficient time for the ATSA-3 circuitry to complete final tuning before shutting down the system.

l. Thus, when the final tuning mode is entered, a number of events occur simultaneously. First, the fixed preposition voltages are removed, allowing the servos to continue tuning. The voltage to which they will tune is derived from the sensing circuit on the tuning unit which is routed through energized contacts of relay K1 on the preposition board and to the servos in the tuning unit via associated servo amplifiers. Finally, a time delay circuit is activated on the control board which allows sufficient time for the circuits to zero out before shutting down the system.

m. The order of tuning must be controlled and is accomplished by the remaining circuitry on the preposition board. The operation of the tuning circuits on the preposition board can be divided into various possible sequences, according to frequency. First, a (normal) sequence is described in the frequency range of 4 to 30 mhz. Then, the sequences below 4 mhz are described.

NOTE

The reason for not considering below 4 mhz as a normal sequence is because of possible phase reversals that may occur at the low end of the frequency band; a contingency that has been anticipated by the addition of certain circuits on the preposition board.

n. Above 4 mhz, the L sense circuit amplifier A105 Z3 receives a positive voltage and the C sensing circuit amplifier A105 Z2 receives a negative voltage. With a positive input voltage applied to A105 Z3, the output A105 Z3 is also positive. The positive output turns on switch A105 Q6. With switch A105 Q6 turned on scr A105 Q5 cannot be fired. With A105 Q5 disabled switch A105 Q3 is turned on and places a ground on the C servo input line, effectively turning off the C servo.

o. Meanwhile, the L servo is permitted to tune because switch A105 Q8 is turned off. There are two methods in which switch A105 Q8 can be turned on. One method is via amplifier A105 Z2; however, with a negative C servo input, the negative output of A105 Z2 is blocked by a diode. The second manner is via scr A105 Q7 and an associated diode. However, because scr A105 Q5 is disabled as a result of a positive L input, this path is also blocked. Therefore, on initial normal tuning sequence, the C circuit is disabled and remains disabled until the L circuit goes to zero.

p. Thus, the normal sequence is that when C is enabled, it will zero out if it is phased correctly. As C goes to zero, L is correcting the zero and therefore never moves off zero. After both C and L zero out, the circuitry is satisfied and tuning is completed in a normal sequence.

q. If the C servo were to undergo a crossover after going to zero a first time, it would result in erroneous final tuning if allowed to continue. If a phase reversal should occur, it must be sensed and the order of tuning must be reversed. Thus, instead of grounding the C servo and permitting the L servo to tune in the normal sequence described above, the L servo input must be grounded and the C servo permitted to tune. When the L input went to zero, the zero output of amplifier A105 Z3 turned off switch A105 Q6. This fires scr A105 Q5. Simul-

taneously, switch A105 Q4 is turned on and turns off switch A105 Q3, removing the ground from the C servo, permitting the C servo to tune. With A105 Q5 fired, switch A105 Q11 is turned on, turning off switch A105 Q10. Now, if the C input to amplifier A105 Z2 goes positive the positive output of Z2 is routed through the diode and turns on switch A105 Q8. With switch A105 Q8 turned on, the L servo input is grounded. Thus, on a phase reversal, the L servo is disabled and the C servo takes over the tuning function.

r. Below 4 mhz, consider L starting positive as tuning commences. L zeros out and fires scr A105 Q5. Then C starts tuning, As C approaches zero, there may be a crossover. Instead of L correcting itself, it starts going to a positive direction a second time. Remember that after having gone from positive to zero a first time, A105 Q5 has fired, removed the ground from the C servo input, and primed scr A105 Q7. Therefore, a second positive output from amplifier Z3 is routed through a diode and fires scr A105 Q7. With A105 Q7 fired, switch A105 Q8 is turned on and the resultant ground deactivates the L servo. The C servo is now allowed to zero out. Then when C goes to zero, the tuning sequence is satisfied. This is one instance where, instead of going to zero, the L input reverses and goes positive a second time. When this condition is sensed, the L servo is disabled and the C servo is permitted to correct itself.

s. A possibility exists at 2 Mhz that instead of the L input being positive, it is negative and instead of the C input being negative, it is positive (a complete reversal). If the output of amplifier A105 Z3 is negative or zero, it immediately fires scr A105 Q5. (The only time A105 Q5 is not fired is on a positive input.) With A105 Q5 fired, switch A105 Q11 is turned on and turns off switch A105 Q10. The output of amplifier A105 Z2 is not a positive voltage which turns on switch A105 Q8 via the diode. With switch A105 Q8 turned on, a ground is applied to the L servo, turning off the L servo. Now, the C servo is allowed to do the tuning and is permitted to zero out.

t. When an r-f trigger is applied to the control board from the transmitter, it turns off switch A103 Q9 and starts a time delay circuit consisting of resistor A103 R33 and capacitor A103 Q8. The time delay circuit provides sufficient time for the circuits to zero out. After the time delay is completed, switch A103 Q10 is turned on and fires scr A103 Q13. Firing A103 Q13 disables the system as previously described, except that the FAULT indicator does not light because scr A103 Q11 is not fired. Switch A103 Q12 operates off scr A103 Q13. When the tuning sequence is completed, scr A103 Q13 fires and effectively turns off switch A103 Q12. With A103 Q12 turned off, the tune complete signal and the ready signal lines are open. Opening these lines lights the front panel RDY indicator and informs the transmitter that it can now load and drive up.

u. The control board contains a key interlock circuit A103 Q16 and A103 Q17. The key interlock circuit maintains the transmitter in an off condition preventing the generation of r-f until prepositioning is attained. This ensures that r-f is not generated until the preposition area is reached.

v. The ATSA-3 operates from a 115/230 volt input which is applied to switch S104 via fuses F101 and F102. When the ON/AC switch is set to ON, the primary input voltage is routed to transformers T101 and T102. From T102, secondary windings develop 18 and 40 volts a-c which are applied to the power supply board. On the power supply board, the voltages are routed through full-wave rectifier circuits followed by filtering networks to develop 1.1 volts a-c that is used in the chopper circuit on the output servo cards, and 26 volts a-c that is used for servo excitation.

w. The tuning unit contains a humidity sensing potentiometer on coil assembly A202 which supplies a humidity signal to amplifier A101 Z1 on the power supply card. When the humidity exceeds a preset level, the humidity signal turns off amplifier A101 Z1. As a result, switch A101 Q1 is turned off and turns on switch A101 Q2. With A101 Q2 turned on, the front panel HMD indicator lights alerting the operator to the sensing of excessive humidity in the tuning unit.

4.3 DETAIL CIRCUIT DESCRIPTION. (See figures 6-1 and 6-2)

NOTE

Figure 6-1 is the AX5175 overall schematic diagram and figure 6-2 is a schematic diagram of the mother card. The control unit contains five cards A101 through A105 whose inputs and outputs are routed to connectors J101 and J102. The tuning inputs and outputs are routed to connector J103. The transmitter inputs and outputs are routed to connector J104.

a. PREPOSITION. (See figure 6-5)

(1) The preposition inputs correspond to the transmitter bands with the selected band receiving +24 volts dc. The +24-volt d-c input is routed by steering diodes in such a manner that one potentiometer A105 R9 through A105 R14 is selected to preposition L and one potentiometer A105 R1 through A105 R8 is selected to preposition C. Potentiometers A105 R1 through A105 R14 provide a voltage for prepositioning the L and C servos via contacts of relay A105 K1 and pins S and M, respectively. Various combinations of potentiometers are selected according to the band selection.

(2) For example, selecting the 5-8 mhz band places +24 volts dc on pin J. The positive voltage is routed through diode A105 CR12 and is developed across potentiometer A105 R12 and A105 R5. The positive output of A105 R12 is routed through A105 CR13 and the positive output of A105 R5 is routed through A105 CR19. The positive potential at the cathode of A105 CR19 and A105 CR13 back biases diodes A105 CR4, CR10, CR11, CR14, CR20, CR27, CR29, CR31, CR34, CR35, CR36, and CR38.

(3) The L preposition inputs at pins 16 and 17 in the 2-2.9999 mhz range is divided into 10 preposition voltages. The 10 voltages are controlled by a resistive voltage divider on the 100 khz wafer switch on the associated exciter. As the frequency is incrementally increased between 2.0 and 2.9999 mhz, a different valued resistor is inserted in series with the L preposition input to the preposition board. Dividing up the low end of the frequency band provides a fine tuning for the L section to obtain minimum swr.

(4) The resultant preposition output voltage from the selected potentiometers is routed to pins S and M via contacts of relay A105 K1. From pins S and M, the voltages are applied to the output servo cards where they are chopped and develop a corresponding a-c voltage that is applied to the respective servos in the tuning unit. As a result, of receiving the a-c voltages, the servos position themselves to the corresponding selected preposition setting.

(5) After prepositioning is accomplished, the next mode is the final tuning mode. Once an r-f trigger is received, it must tune within approximately 25 seconds, or a fault will be indicated. Following a fault, the system awaits recycling.

(6) Following the preposition mode, the preposition board circuitry awaits a positive r-f trigger input at pin 21. The r-f trigger is derived from the sensing circuits in the tuning unit. When an r-f trigger is applied to pin 21, the positive voltage is applied to amplifier A105 Z1. The resultant positive output voltage of A105 Z1 forward biases transistor switch A105 Q1. With switch A105 Q1 forward biased, a ground is applied to one side of relay A105 K1. The other side of relay A105 K1 is connected to +35 volts switched via pin 12, and relay A105 K1 energized with the application of a ground. With relay A105 K1 energized, the preposition voltages from potentiometers A105 R1 through A105 R14 are removed from the L and C servos. Instead, the L and C sense signals derived from the sensing assembly A204 on the tuning unit are applied to pins 10 and 13, respectively. From pins 10 and 13, they are applied to amplifiers A105 Z3 and A105 Z2, respectively, in addition to being routed to the servos in the tuning unit via energized contacts of relay A105 K1 and pins M and S, respectively.

(7) Thus, when the final tuning mode is entered, a number of signals are removed and/or rerouted. First, the fixed preposition voltages are removed allowing the servos to continue tuning. The voltage to which they will tune is derived from the sensing circuit on the tuning unit which is routed through energized contacts of relay A105 K1 on the preposition board and to the servos in the tuning unit via associated servo amplifiers. Finally, the order of tuning must be controlled and is accomplished by the remaining circuitry on the preposition board and is detailed in the following paragraphs.

(8) The operation of the tuning circuits on the preposition board will be divided into various possible sequences, according to frequency. First, a (normal) sequence is described in the frequency range of 4 to 30 mhz. Then, the sequences below 4 mhz are described.

NOTE

The reason for not considering below 4 mhz as a normal sequence is because of possible phase reversals that may occur at the low end of the frequency band; a contingency that has been anticipated by the addition of certain circuits on the preposition board.

(9) Above 4 mhz, L sensing circuit amplifier A105 Z3 receives a positive voltage and C sensing circuit amplifier A105 Z2 receives a negative voltage. With a positive input voltage applied to pin 3 of amplifier A105 Z3, the output at pin 6 of A105 Z3 is also positive. The positive output at pin 6 is applied to the base of transistor switch A105 Q6, forward biasing A105 Q6. As a result of forward biasing A105 Q6, a ground is applied at the junction of resistors A105 R36 and A105 R39. This effectively removes the voltage developed across resistor A105 R43 via the +35-volt switched input line at pin 12. The grounding of the junction of resistors A105 R36 and A105 R39 prevents firing scr transistor A105 Q5. With A105 Q5 disabled, the +35 volts switched is applied to the base of A105 Q3 via resistors A105 R29 and A105 R21. The positive voltage at the base of A105 Q3 forward biases A105 Q3 and places a ground on the C servo input line, effectively turning off the C servo.

(10) Meanwhile, the L servo is permitted to tune because transistor switch A105 Q8 is back biased. There are two methods in which A105 Q8 can be forward biased. One method is via amplifier A105 Z2; however, with a negative C servo input, the negative output of A105 Z2 is blocked by diode A105 CR33 and prevents enabling A105 Q8. The second manner is via scr A105 Q7 and diode

A105 CR21, however, because scr A105 Q5 is disabled by the ground via A105 Q 6 as a result of a positive L input, this path is also blocked. Therefore, on initial normal tuning sequence, the C circuit is disabled and remains disabled until the L circuit goes to zero.

(11) Thus, the normal sequence is that when C is enabled, it will zero out if it is phased correctly. As C goes to zero, L is correcting the zero and therefore, never moves off zero. After both L and C zero out, the circuitry is satisfied and tuning is completed in a normal sequence.

(12) If the C servo were to undergo a crossover after going to zero a first time, it would result in erroneous final tuning if allowed to continue. If a phase reversal should occur, it must be sensed and the order of tuning must be reversed. Thus, instead of grounding the C servo and permitting the L servo to tune in the normal sequence described above, the L servo input must be grounded and the C servo permitted to tune. When the L input went to zero, the zero output of amplifier Z3 unbiased transistor switch A105 Q6. This removes the ground from the junction of resistors A105 R36 and A105 R39 and results in the firing of scr A105 Q5. Simultaneously, transistor switch A105 Q4 is forward biased and grounds the input to A105 Q3 which disables A105 Q3 and removes the ground from the C servo, permitting the C servo to tune. With A105 Q11 fired, the +35 volts switched input is routed through A105 Q5 to the base of A105 Q11, enabling A105 Q10. Now, if the C input to amplifier Z2 goes positive, the positive output of Z2 is routed through diode A105 CR33 and forward biases transistor switch A105 Q8. With A105 Q8 enabled, the L servo input is grounded. Thus, on a phase reversal, the L servo is disabled and the C servo takes over the tuning function.

(13) Now consider the tuning sequence below 4 mhz. Consider L starting positive as tuning commences. L zeros out and fires scr A105 Q5. Then, C starts tuning. As C approaches zero, there may be a crossover. Instead of L correcting itself, it starts going in a positive direction a second time. Remember that after having gone from positive to zero a first time, A105 Q5 has fired, removed the ground from the C servo input, and primed scr A105 Q7. Therefore, a second positive output from amplifier Z3 is routed through diode A105 CR18 and fires scr A105 Q7. With A105 Q7 fired, a positive voltage is applied to the base of transistor switch A105 Q8 via diode A105 CR21, enabling A105 Q8. With A105 Q8 enabled, the resultant ground deactivates the L servo. The C servo is now allowed to zero out. Then, when C goes to zero, the tuning sequence is satisfied. This is one instance where, instead of going to zero, the L input reverses and goes positive a second time. When this condition is sensed, the L servo is disabled and the C servo is permitted to correct itself.

(14) A possibility exists at 2 mhz that, instead of the L input positive, it is negative and instead of the C input being negative, it is positive (a complete reversal). If the output of amplifier Z3 is negative or zero, it immediately fires scr A105 Q5. (The only time A105 Q5 is not fired is on a positive input.) With A105 Q5 fired, transistor A105 Q11 is enabled which grounds the input to transistor A105 Q10, disabling A105 Q10.

The output of amplifier Z2 is now a positive voltage which is applied to the base of transistor switch A105 Q8 via diode A105 CR33, enabling A105 Q8. With A105 Q8 enabled, a ground is applied to the L servo, turning off the L servo. Now, the C servo is allowed to do the tuning and is permitted to zero out.

b. CONTROL BOARD. (See figure 6-7)

(1) The control board sums the C and L servo outputs and senses the

time required to complete repositioning, and deactivates the servos after final tuning. Resistors A103 R9 and A103 R10 sum the rectified output voltage of the last servo amplifiers on the C and L output servo cards, respectively. The d-c voltages are a function of servo imbalance, representing the difference between the requested servo position and the actual servo position.

(2) During repositioning, a positive voltage is applied to pin 3 of ready amplifier A103 Z2. As a result, a positive voltage appears at output pin 6 of A103 Z2 which is passed through diode A103 CR13 and forward biases transistor switch A103 Q5. With A103 Q5 enabled, a ground is applied to the base of transistor A103 Q6, back biasing A103 Q6. With A103 Q6 turned off, +35-volts switched is applied to a time delay circuit consisting of capacitor C6 and potentiometer R25, and C6 starts charging towards the +35-volt level. The time delay is a nominal 25 seconds, and is adjusted for optimized repositioning tuning to provide at least twice the time required. Therefore, should the tuning miss, sufficient time is allotted to recatch it before a fault is indicated.

(3) If the servos do not attain proper repositioning and the voltage is maintained across capacitor A103 C6 until it charges to approximately 2/3 of the +35-volt level, unijunction transistor A103 Q7 fires and enables scr transistor A103 Q11. When A103 Q11 fires, a fault is indicated and a number of events occur. A voltage is developed across resistor A103 R38 and lights the front panel FAULT indicator. The voltage is developed across A103 R38 and fires off scr A103 Q13. As a result of firing A103 Q13, the input to the base of transistor A103 Q15 goes low which turns off transistor A103 Q14. Turning off A103 Q14 disables the +35 switched output voltage in addition to back biasing a-c off transistor A103 Q4. Disabling the +35-volt switched output removes +35 volts from the reposition board, the two servo amplifier cards, and the tuning unit, effectively shutting down the entire ATSA-3 system (except for the 12-volt supply).

(4) With A103 Q4 off, a-c off transistor A103 Q3 is enabled (because it operates from the +12-volt supply), resulting in the application of a ground into pin 14 of 0-volt switch A103 Z1. The output of A103 Z1 then fires control varistor A103 Q2 which is an a-c switch. In turn, A103 Q2 turns off A103 Q1 is connected to the primary of transformer T103 via pin L and removes the 26 volts ac from the control phases of the servo meters to prevent burning them out. Therefore, when a fault is sensed, everything is off except the plus and minus 12 volts.

(5) After a fault occurs, the circuits must be reset. The resetting function is performed by pressing the front panel TUNE button. Pressing the TUNE button applies a ground at pin V which is applied to scr A103 Q11 via diode A103 CR6 and to scr A103 Q13 via diode A103 CR7. The ground effectively unfires the scr's and returns the circuits to the status before timing out to a fault condition.

(6) If the L and C are repositioned correctly within the allotted time, the L and C feedback voltage is equal to the preset voltage and the voltage at the junction of resistors A103 R9 and A103 R10 goes to zero. As a result, the capacitor A103 C6 is not allowed to reach 2/3 of the total charge and the circuits does not fault out. Once the circuits have been repositioned correctly, they can remain in the reposition mode indefinitely and await an r-f trigger on pin N.

(7) When an r-f trigger is applied to pin N, it back biases tran-

sistor A103 Q9. With A103 Q9 disabled, capacitor A103 Q8 starts charging through resistor A103 R33. Simultaneously, the servo inputs are switched from the preposition voltages to the sensing circuits. The servos again have a voltage applied to the inputs, and start zeroing out. When the servos zero out, the sensing circuits and both front panel L and C meters go to zero. The ready delay provides sufficient time for the circuits to zero out. After the time delay is completed, A103 Q10 fires which, in turn, fires A103 Q13. Firing A103 Q13 disables the system as described above, except that the FAULT indicator does not light because A103 Q11 is not fired.

(8) Transistor switch A103 Q12 operates off scr transistor A103 Q13. When the tuning sequence is completed, scr transistor Q13 fires and effectively removes base voltage from A103 Q12, back biasing A103 Q12. With A103 Q12 back biased, the transmitter antenna tuner complete signal and the ready signal lines are open. Opening these lines lights the front panel RDY indicator and informs the transmitter that it can now load and drive up.

(9) The control board contains a key interlock circuit consisting of scr transistor A103 Q16 and transistor switch A103 Q17. The key interlock circuit maintains the transmitter in an off condition, preventing the generation of rf until prepositioning is attained. This ensures that rf is not generated until the preposition area is reached. During prepositioning, transistor switch A103 Q6 is back biased. As a result, scr transistor A103 Q16 cannot be fired. Holding A103 Q16 off forward biases transistor switch A103 Q17 and applies a ground on the key interlock line. A grounded key interlock line prevents the transmitter from generating an r-f output. After the servos have been properly prepositioned without the occurrence of a fault, transistor switch A103 Q6 is forward biased. As a result, +35 volts switched is routed through resistor A103 R22 and A103 Q6 to the junction of resistors A103 R23 and A103 R24. The positive voltage at the junction of A103 R23 and A103 R24 is routed to pin S to light the front panel P. POS indicator and is also applied to scr transistor A103 Q16. The application of a positive potential to A103 Q16 fires the scr and back biases transistor switch A103 Q17. With A103 Q17 open, the ground is removed from the key interlock line, permitting the transmitter to generate an r-f output.

c. OUTPUT SERVO. (See figure 6-9)

(1) The control unit contains two identical output servo amplifier boards, A102 and A104. Each output servo board receives a preposition signal from the tuning unit via the preposition board and develops an amplified a-c signal that drives the servos in the tuning unit, in addition to developing a corresponding d-c voltage that is applied to the control board indicating the difference between the requested servo position and the actual servo position.

(2) The sense signal is a d-c voltage whose amplitude is proportional to the servo imbalance. The sense signal is applied to choppers Q5 and Q6 via the preposition board. The chopper circuit develops an a-c voltage that is limited by diodes CR1 and CR2 and is amplified by Z2. The resultant output signal of Z2 is again limited by diodes CR3 and CR4 and is summed at the input of amplifier Z1 with the tachometer feedback signal from the servo in the tuning unit. The input to the output servo board is the requested servo position from the sensing circuit in the tuning unit. The tachometer signal is the actual servo position from the servo in the tuning unit. The difference is summed and

amplified by Z1 and applied to amplifier Q3. The signal is amplified by Q3, buffered by emitter follower Q4, and applied to the servo motor via push-pull amplifier Q1 and Q2.

(3) The output signal from amplifier Z2 is also routed to amplifier Q7 where the output is half-wave rectified by diode CR8 and filtered by capacitor C1 to form the prepositioning control signal that is applied to the control board. If a difference exists between the requested servo position and the actual servo position, a positive preposition control voltage is applied to the control board. The control board sums the two voltages from the C and L output servos to monitor the time required for the system to achieve proper prepositioning. If the prepositioning time exceeds nominal 10 seconds, the timing circuit on the control board faults out and effectively shuts down the ATSA-3 system. However, if the prepositioning time is not exceeded and the actual servo position reaches the requested servo position, the preposition control voltage goes to zero, disabling the fault circuit on the control board and completing prepositioning.

(4) During final tuning, the input to the output servo boards changes from the preposition signal to the sense signals.

d. POWER SUPPLY. (See figure 6-11)

(1) The power supply consists of three basic full-wave rectifier circuits followed by filter and resistive bleeder circuits. Full-wave rectifier circuit A101 CR1 develops +40 volts which is filtered by capacitor A101 C1. The +40 volts is made available at pin R. The +40 volts is again filtered by capacitor A101 C6 and dropped to +35 volts by resistors A101 R12 and A101 R13 and the +35 volts is made available at pin T.

(2) Full-wave rectifier A101 CR2 develops +18 volts which is filtered by capacitor A101 C2 and dropped to +12 volts which is made available at pin U. Similarly, full-wave rectifier A101 CR3 develops -18 volts which is filtered by capacitor A101 C3 and dropped to -12 volts which is made available at pin K.

(3) A101 R22 is a humidity potentiometer adjustment which is connected across +12 volts and ground. The voltage is tapped off A101 R22 and developed across resistor A101 R23. Connected in parallel with resistor A101 R23 is the humidity potentiometer A202 R2 on the antenna tuning unit. As the parallel combination of resistor A101 R23 and the humidity potentiometer A202 R2 drain current from potentiometer A101 R22, the resultant voltage drop turns off amplifier A101 Z1. With A101 Z1 off, transistor A101 Q1 is back biased, resulting in the forward biasing of transistor A101 Q2. With transistor A101 Q2 forward-biased, the HMD indicator lights indicating excessive humidity.

e. TUNING UNIT (See figure 6-13)

(1) The tuning unit receives the r-f input from the transmitter and impedance matches the 1-kilowatt output to a 35-foot vertical antenna. The r-f input at connector J201 is applied to sensing assembly A204. The sensing assembly controls the servo loops via a C and L sense circuit. Within the tuning range for the selected transmitted frequency, there is one point where both sensing circuits are satisfied. At that point, the input impedance appears as a 50-ohm resistive network with 0-phase shift.

(2) The sensing assembly contains two balanced detector circuits. Transformer A204 T2, in conjunction with coil A204 L1 and capacitor A204 C2, form a current sensing circuit. Coil A204 L1 and capacitor A204 C2 develop a fixed voltage for the current through the secondary of transformer A204 T2. It is aligned so that at 50 ohms, the current through the secondary of A204 T2 and the voltage drop across A204 L1 and A204 C2 are such that 0-volt appears at the output of the L sense circuit. If the impedance tends to decrease, the voltage increases, the current through the device decreases and produces the opposite swing. There is one point where the voltage and current are equal, and at that point, the impedance is 50 ohms.

(3) With no reflected power in the line, the phase relationship on the secondary of transformer A204 T1 is 180 degrees. With a 180-degree out-of-phase relationship, the two voltages sum to zero with respect to ground. The voltage drop across resistors A1 R1 and A1 R2 is 180-degrees out-of-phase with the voltage drop across transformer T1 due to capacitor A204 C1. The remaining circuitry comprises a balanced detector network which rectifies and filters any unbalance and applies the resultant d-c output voltage to the preposition board and to the front panel meter.

(4) Transformer T201 is a broad band tuned autotransformer that matches 50 ohms to approximately 22.5 ohms. A series-parallel circuit formed by transformer T201, capacitor A203 C1, coil A202 L1, and coil A201 L1 comprise the output tuning network. Capacitor A203 C1 and coil A202 L1 are controlled by a servo system. Series coil A201 L1 is controlled by the BAND switch on the front panel of the control unit. Above 8 mhz, series inductance A201 L1 is completely short circuited by S1C. Below 8 mhz, different segments of A201 L1 are short circuited.

(5) The tuned combination of capacitor A203 C1 and inductance A202 L1 produce an input impedance of 50 ohms terminated into an output impedance produced by a 35-foot whip antenna. When tuning is completed, the vswr in the line is between 0 and a ratio of 1.5 to 1. (If tuned manually, the components are adjusted for minimum vswr.)

(6) Series inductance A201 L1 is selected in preposition, whereas capacitor A203 C1 and inductance A202 L1 are linearly servo tuned. Mechanically ganged to capacitor A203 C1 is resistor A203 R1 and mechanically ganged to inductance A202 L1 is resistor A202 R1. These resistors provide feedback information for preposition and for metering. In the manual tune position, the positions of the inductance and capacitance can be monitored.

(7) The tuning unit contains a humidity indicator A202 R2 whose resistance varies as a function of humidity. The humidity indicator is connected to a humidity circuit on the power supply board and lights the front panel HMD indicator on the control unit when the humidity increases above a preset level. The tuning unit is normally mounted in a location that is exposed to weather conditions. The humidity sensing circuit provides a means of monitoring the humidity inside the tuning unit from a remote location at the control unit.

SECTION 5
MAINTENANCE

5.1 PREVENTIVE MAINTENANCE

The following paragraphs describe procedures to inspect, check, and clean the components of the ATSA-3. In general, preventive maintenance provides a basis for recognizing future probable causes of equipment malfunction in the early stages of deterioration. Many such cases are apparent to the senses of sight, touch, and smell. Therefore, by adhering to a stringent program of preventive maintenance, involving periodic inspection and checks, the most probable causes of equipment malfunction can be avoided, thereby minimizing equipment downtime and the possibility of compromising important schedules.

a. INSPECTION AND TEST. The following paragraphs describe equipment inspection, power supply checks, and functional test to be performed on a scheduled basis.

(1) General Inspection. A most important and least expensive tool in the preventive maintenance program is the sense of sight; a thorough visual inspection of an assembly or component for tell-tale signs of deterioration prior to failure can save hours of test and troubleshooting time after a complete breakdown. Table 5-1 presents a scheduled inspection checklist for the ATSA-3.

TABLE 5-1. SCHEDULED INSPECTION ROUTINE

Assembly of Subassembly	Check
Cables	Check cables for cracks, nicks, or fraying.
Main Chassis Assemblies	<ol style="list-style-type: none">1. Check underside of chassis for dirt and dust.2. Check all inter-connector wiring for nicks, cracks or fraying.3. Check all printed circuit boards for cracks; check components for looseness and evidence of deterioration from possible overheating.4. Check printed circuit board jacks for tightness against chassis.5. Check ground connections for security.
Front and Rear Panels	<ol style="list-style-type: none">1. Check panel for general cleanliness.

TABLE 5-1. SCHEDULED INSPECTION ROUTINE (Continued)

Front and Rear Panels	Check
(continued)	<ol style="list-style-type: none"> 2. Check all control knobs for smooth action from limit-to-limit. Check all switches for positive action. 3. Check meter faces for cracks, scratches, etc. 4. Check all input/output jacks for security.
Tuning Unit	Check that plate is securely affixed for water tightness.

(2) Power Supply Checks. Perform the power supply checks on a scheduled basis as follows:

- (a) Using a vtvm, or equivalent, check d-c voltage at pin R of power supply board; voltage should be +40 vdc $\pm 1\%$.
- (b) Check voltage at pin T; voltage should be +35 vdc $\pm 1\%$.
- (c) Check voltage at pin U; voltage should be +12 vdc $\pm 1\%$.
- (d) Check voltage at pin K; voltage should be -12 vdc $\pm 1\%$.

(3) Functional Test. Perform the preoperational checkout procedure for the ATSA-3 on a scheduled basis, after a check has been made of the power supply.

b. CLEANING INSTRUCTIONS. In general, the ATSA-3 should be cleaned once a month, using a soft camel's hair brush, using forced air pressure of not more than 20 psi, and a suitable cleaning agent such as trichloroethylene or methylchloroform.

WARNING

When using toxic solvents, make certain that adequate ventilation is provided; prolonged or repeated breathing of the vapor shall be avoided. Avoid prolonged or repeated contact with skin. Flammable solvents shall not be used on energized equipment or near other equipment from which a spark may be received.

Remove dirt or grease from wiring and chassis using cleaning solvent; dry with compressed air. Remove dust from printed circuit boards using a soft camel's hair brush. Blow out accumulated dust from inaccessible areas of chassis using forced air.

c. TUNING UNIT DESICCANT. The tuning unit contains desiccant bags. These bags should be replaced on a periodic basis, depending on the moisture content of the environment.

NOTE

When replacing the tuning cover, the rubber O-ring must be seated in the groove. Apply beads of Dow Corning 4 compound dielectric silicone along the outer edge of the O-ring after seating in the groove. Hand-tighten each screw successively and then torque to approximately 70 inch-pound.

5.2 ALIGNMENT.

The following paragraph contain alignment procedures for the ATSA-3 which are required to maintain the equipment in a satisfactory operating condition. The only test equipment required to align the ATSA-3 is a Hewlett-Packard Model 410B, or equivalent. An extender card is provided with the ATSA-3 to provide easy access to the cards.

a. HUMIDITY SENSE - The humidity light (HMD) on the front panel will come on when there is too much moisture in the antenna tuning unit. Placing a finger on the humidity sense board A202 R2 (located on coil assembly in the AX5176) should cause the light to come on. Should the HMD light not function properly perform the following alignment:

1. Place power supply board A101 on extender card in the AX5175 unit.
2. Ground pin E.
3. Measure the voltage at pin 6 of A101 Z1. The voltage should be 0. If not, adjust A101 R18 until 0 reading is achieved.
4. Adjust A101 R22 on the power supply board until HMD light comes on. Once the light comes on readjust A101 R22 until the light goes off. This sets the threshold of the humidity sense. Placing a finger on the sense board should cause the light to come on.

b. CONTROL AND SERVO BOARDS

1. With GPTA-1K series set the MAN/AUTO/REMOTE switch on the TMA-1K to MAN position.
2. Install control card A103 onto a extender card and place into the A103 connector.

3. Remove preposition card.
4. On another extender card install the following resistors:
 - a. 220 ohm between pins 9 and 11
 - b. 220 ohm between pins 3 and 7
 - c. 1K ohm between pins A and U.
 - d. 1K ohm between pin S and 22.
5. Place this extender card into the preposition connector XA105.
6. Place voltmeter on pin 6 of A103 Z2 on the control card A103.
7. Adjust A103 R51 for a reading slightly positive on pin 6 of A103 Z2. (approximately + .15V)
8. Remove voltmeter. Ground pin N of A103. The preposition light should go out. The RF TRIG. light should come on followed by the RDY light.
9. Remove the ground from pin N. The RF TRIG light should go out leaving the RDY light on.
10. Press the tune button. The p. POS light should come on.
11. Set the VOM for RX1 scale. Connect meter from pin E or M to ground on control card A103.
12. The P. POS light should go out after approximately 25 seconds. The FAULT light should come on. The fault time delay is set by A103 R25 should the time delay be incorrect.
13. Turn off AC on AX5175 unit and remove control card A103 and its extender card.
14. Remove servo card A102 and replace with extender card. Place A102 onto extender card. Replace control card A103 back into its connector XA103.
15. Set VOM on RX1 scale. Turn on AC on AX5175 unit.
16. Connect VOM from pin H on servo card A102 to ground. The coil in the antenna tuning unit AX5176 should be moving toward the antenna with the polarity switch on the VOM set to the (+) position. Reversing the polarity switch should reverse the direction of the coil.
17. Turn off AC on AX5175 unit.
18. Repeat steps 15 to 17 for servo card A104 for the capacitor in the tuning unit. A (+) on the meter should move the capacitor toward the antenna.

c. PREPOSITION BOARD

1. Turn off AC on AX5175.
2. Place preposition card onto a extender card and place in XA105 connector.
3. On preposition card check the voltage on TP1 of IC A105 Z1. The voltage should be slightly positive. If not, adjust A105 R33 until approximately +.15V is present on TP1.
4. Perform step 3 for IC's A104 Z2 and A105 Z3. Adjust A105 R75 for TP2 and A105 R51 for TP3.
5. Set exciter to frequencies shown in table 5-3. Adjust the preposition potentiometers R1 through R14 for the L and C meter reading indicated in table 5-3 for each frequency. The meter readings are obtained in the MANUAL PP position of the AUTO/SENSE/PP switch, while alternating switch positions as each potentiometer is adjusted. The particular potentiometer to be adjusted at each frequency band is obtained by referring to table 5-2. Each reading is an approximation and may vary with the antenna system used.

TABLE 5-2. PREPOSITION POTENTIOMETERS

<u>Frequency</u>	<u>Adj. Pot.</u>	<u>Controls</u>
2 - 2.999 MHz	A105 R1	C
2 - 2.999 MHz	A105 R9	L
2.3 - 2.599 MHz	A105 R2	C
2.6 - 2.999 MHz	A105 R10	L
2.6 - 2.999 MHz	A105 R3	C
3 - 4.999 MHz	A105 R11	C
3 - 4.999 MHz	A105 R4	L
5 - 7.999 MHz	A105 R5	C
5 - 11.999 MHz	A105 R12	L
8 - 11.999 MHz	A105 R6	C
12 - 15.999 MHz	A105 R13	L
16 - 29.999 MHz	A105 R14	L
16 - 29.999 MHz	A105 R8	C

TABLE 5-3. PREPOSITION TUNING CHART

Frequency (MHz)	P.P. L	P.P. C
02.0000	10	6.5
02.1000	9	8.5
02.2000	8	9.0
02.3000	7.5	7.5
02.4000	7.0	8.0
02.5999	7.0	8.0
02.6000	6.0	9.0
02.7000	5	9.0
02.8000	4.5	9.0
02.9999	4.0	9.0
03.0000	2.0	12
04.9999	4.9	12
05.0000	3	12
06.0000	3	12
07.9999	3	12
08.0000	3	12
09.0000	3	8.5
10.0000	3	8.5
11.9999	3	8.5
12.0000	3	9
13.0000	3	9
14.0000	3	9
15.9999	3	9
16.0000	3	8

TABLE 5-3. PREPOSITION TUNING CHART
(Continued)

Frequency (Mhz)	P.P. L	P.P. C
17.0000	3	8
18.0000	3	8
19.0000	3	8
20.0000	3	8
21.0000	3	8
22.0000	3	8
23.0000	3	8
24.0000	3	8
25.0000	3	8
26.0000	3	8
27.0000	3	8
28.0000	3	8
29.0000	3	8
30.0000	3	8

SECTION 6
DIAGRAMS
AND
PARTS LIST

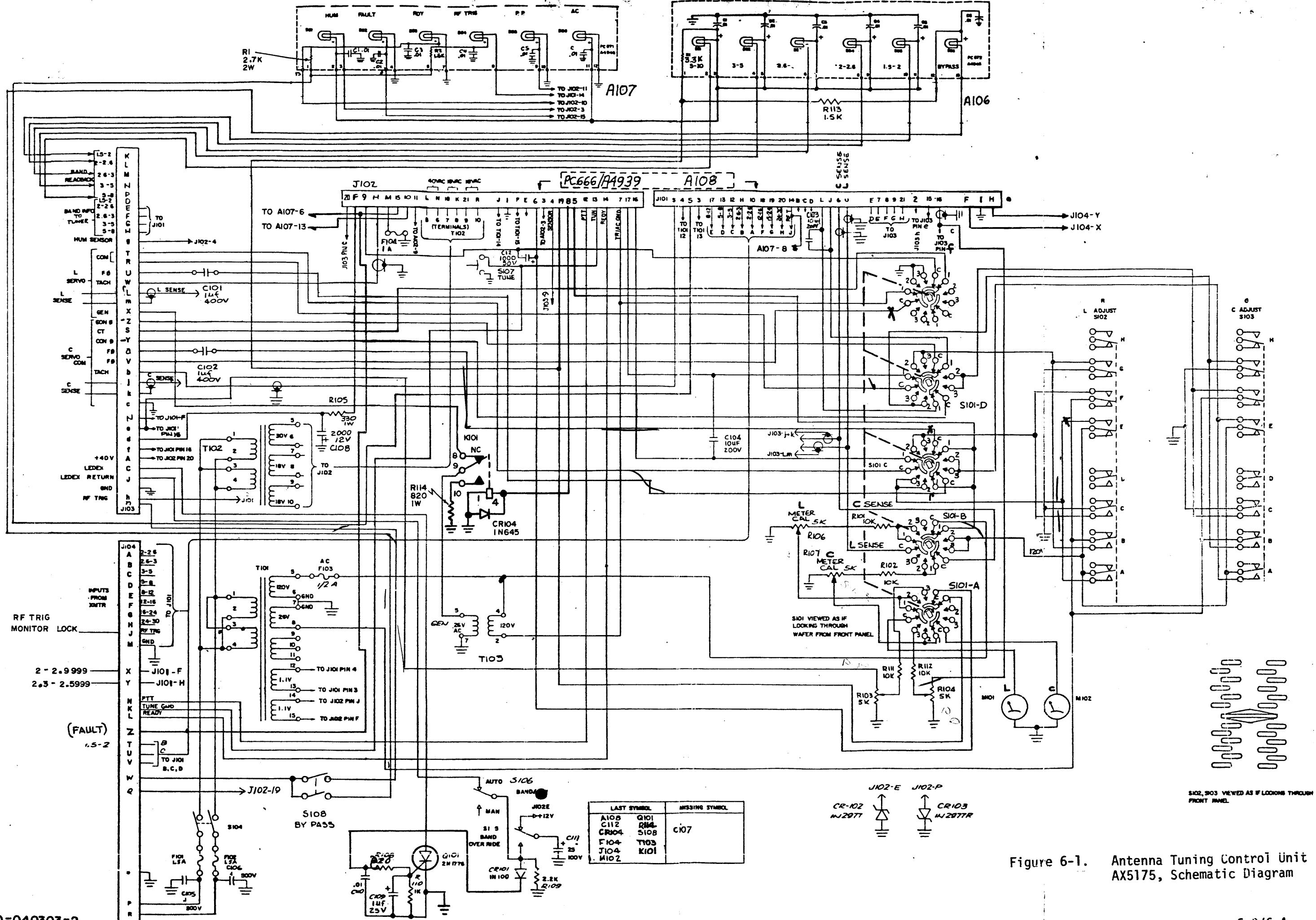
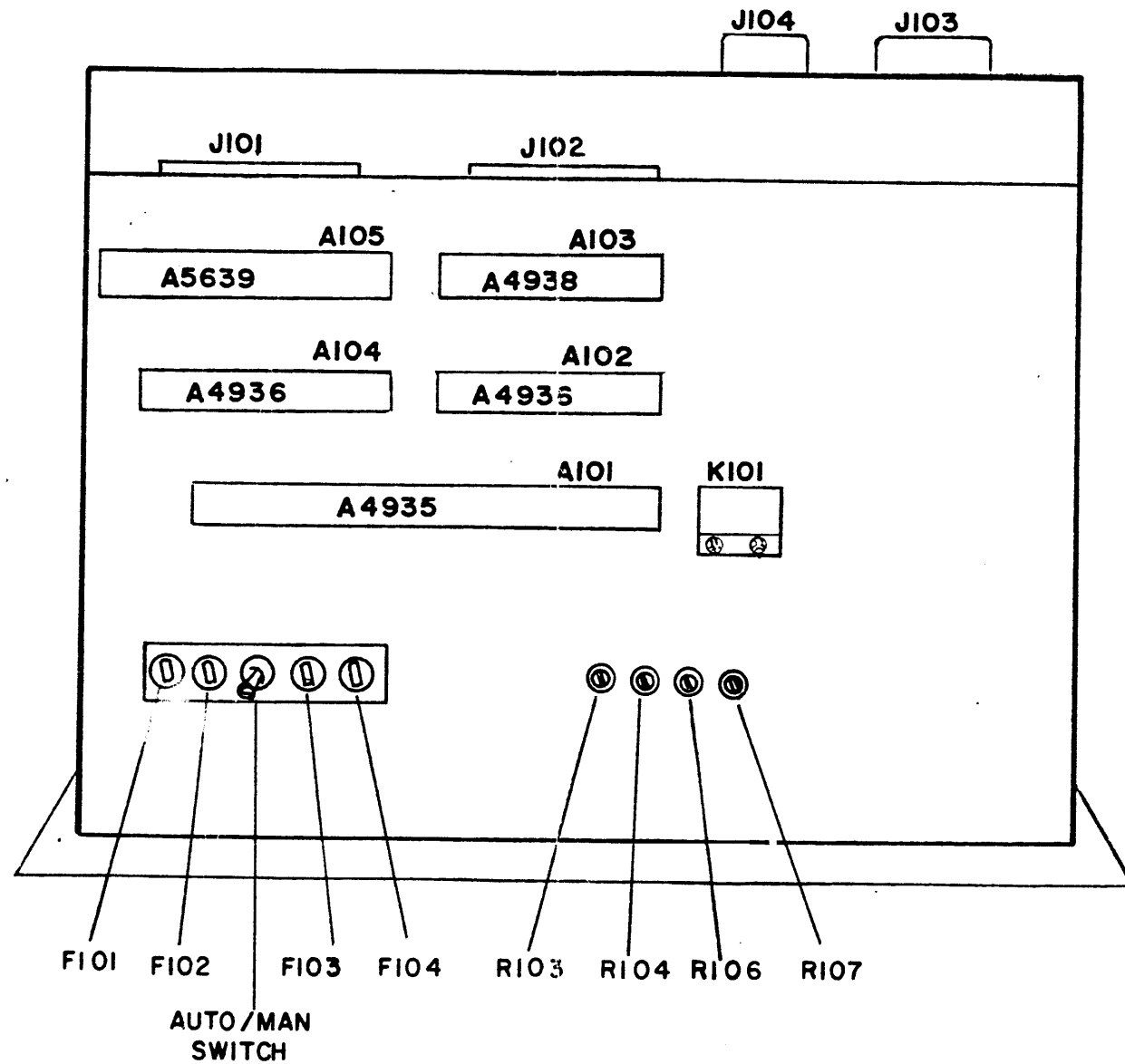


Figure 6-1. Antenna Tuning Control Unit AX5175, Schematic Diagram

Part Number	Description	Used On	Qty	Symbol Number
A4945	IND, BD ASSY	BMA512	1	A107
A4946	IND, BD ASSY	BMA512	1	A106
MR235	METER	BMA512	2	M101,M102
ST22K	SWITCH	BMA512	2	S104,S108
SW296-1	SWITCH, PB	BMA512	1	S106
SW296-2	SWITCH, PB	BMA512	1	S107
SW523-3	SW, LEVER, 3 POS	BMA512	2	S102,S103
SW554	SWITCH, WAFER	BMA512	1	S101

Part Number	Description	Used On	Qty	Symbol Number
A4935	PWR SUPPLY ASSY	AX5175	1	A101
A4936	SERVO CONT ASSY	AX5175	2	A102,A104
A4937	PRE-POSIT BD ASSY	AX5175	1	A105
A4938	CONTROL BD ASSY	AX5175	1	A103
A4939	MOTHER BD ASSY	AX5175	1	A105
CC100-37	CAP, FXD, CER	AX5175	2	C105,C106
CC100-43	CAP, FXD, CER	AX5175	1	C110
CE105-1-25	CAP, FXD, MICA	AX5175	1	C109
CE105-100-25	CAP, FXD, MICA	AX5175	1	C111
CE116-8VN	CAP, FXD, ELECT	AX5175	1	C112
CE116-9VN	CAP, FXD, ELECT	AX5175	1	C108
CN114-1R04J	CAP, MET MYLAR	AX5175	2	C101,C102
CN114-10R02J	CAP, MET MYLAR	AX5175	2	C103,C104
FH104-3	FUSE HOLDER	AX5175	3	XF101,XF102,XF103
FH104-11	FUSE HOLDER	AX5175	1	XF104
FU102-.5	FUSE, CARTRIDGE	AX5175	1	F103
FU102-1.5	FUSE, CARTRIDGE	AX5175	2	F101,F102
FU102-2	FUSE, CARTRIDGE	AX5175	1	F104
JJ319-22DFE	CONN, REC, ELECT	AX5175	2	J101,J102
RC20GF102J	RES, FXD, COMP	AX5175	1	R110
RC20GF103J	RES, FXD, COMP	AX5175	4	R101,R102,R111,R112
RC20GF222J	RES, FXD, COMP	AX5175	2	R108,R109
RC32GF331J	RES, FXD, COMP	AX5175	1	R105
RC32GF821J	RES, FXD, COMP	AX5175	1	R114
RL156-14	RELAY	AX5175	1	K101
RV106UX8B502A	RES, VAR, COMP	AX5175	4	R103,R104,R106,R107
ST103-2-62	SWITCH	AX5175	1	S105
TF429	XFMR	AX5175	1	T101
TF430	XFMR	AX5175	1	T102
TF431	XFMR	AX5175	1	T103
1N100	SCOND, DEV, DIO	AX5175	1	CR101
1N645	SCOND, DEV, DIO	AX5175	1	CR104
1N2977	SCOND, DEV, DIO	AX5175	1	CR102
1N2977R	SCOND, DEV, DIO	AX5175	1	CR103
2N1776	DIODE	AX5175	1	Q101



AX5175 CONTROL UNIT

FIGURE 6-2

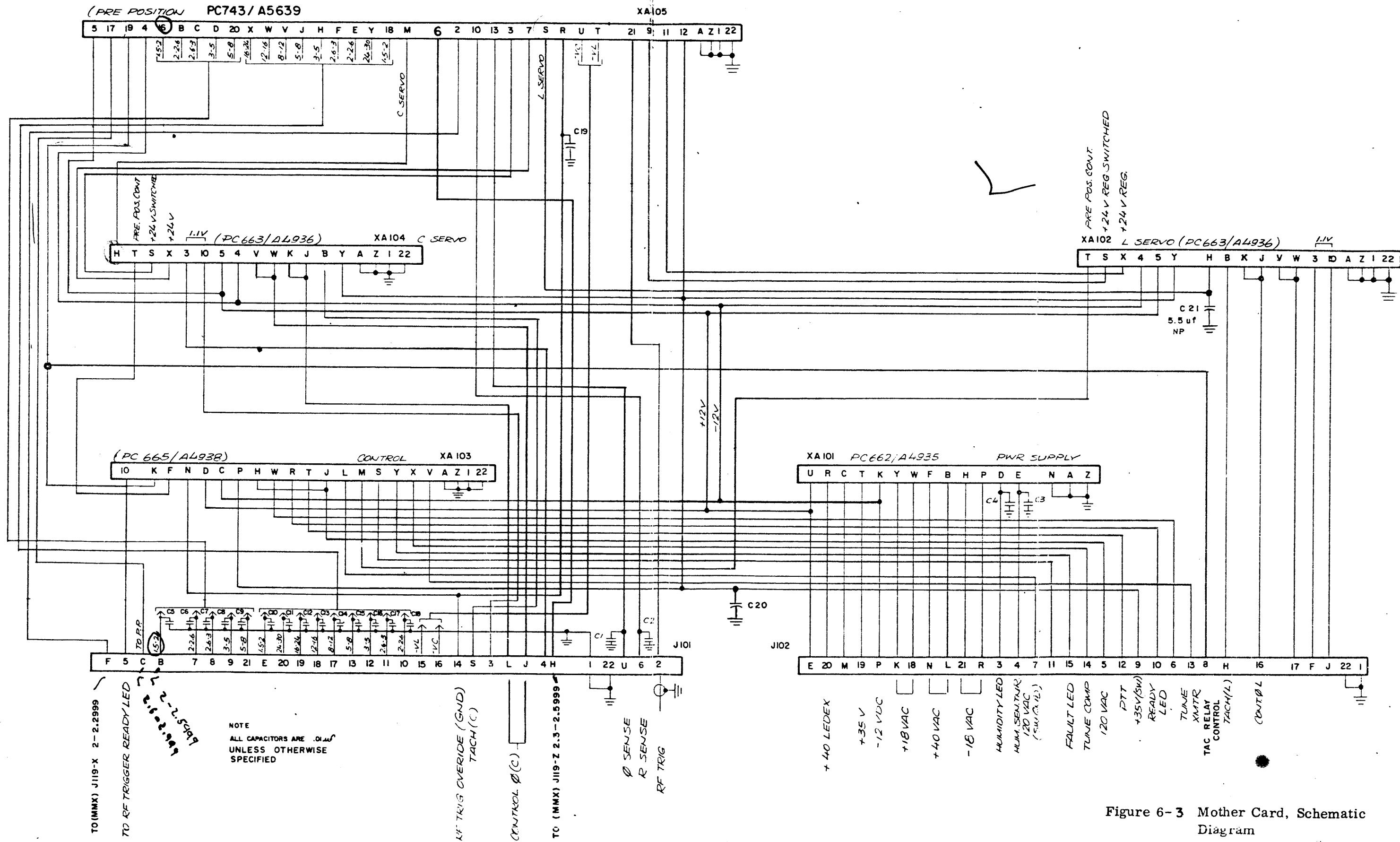
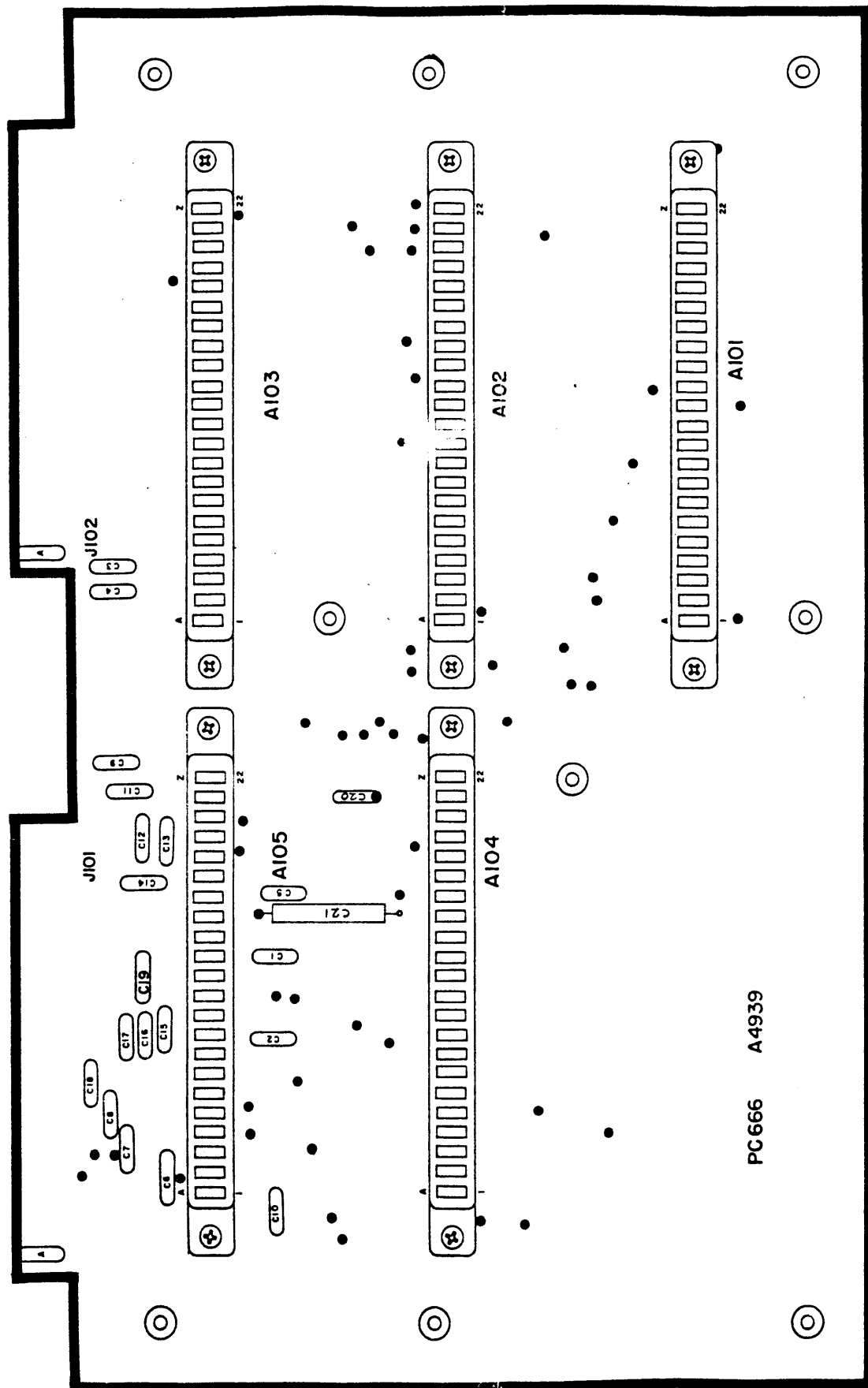


Figure 6-3 Mother Card, Schematic Diagram



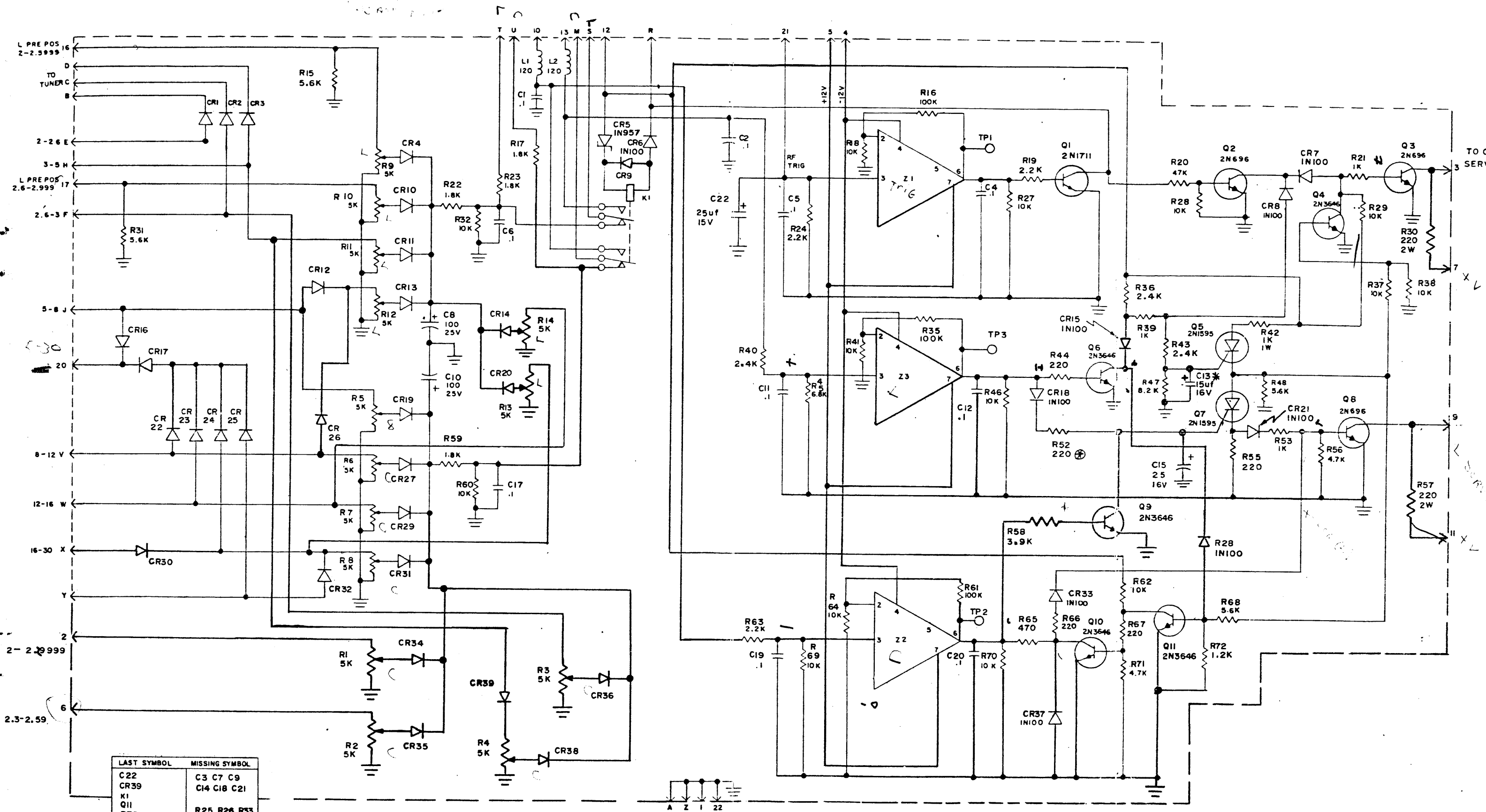
MOTHER CARD
ASSEMBLY DIAGRAM

FIGURE 6-4

6-9/6-10

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC131-39	CAP, FXD, CER	A4939	20	C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20
CX118P5R5N30C1	CAP, FXD, NP	A4939	1	C21
JJ319-22DPD	CONN, RECP	A4939	5	XA101, XA102, XA103, XA104, XA105

NEG VOLT
FROM
CART

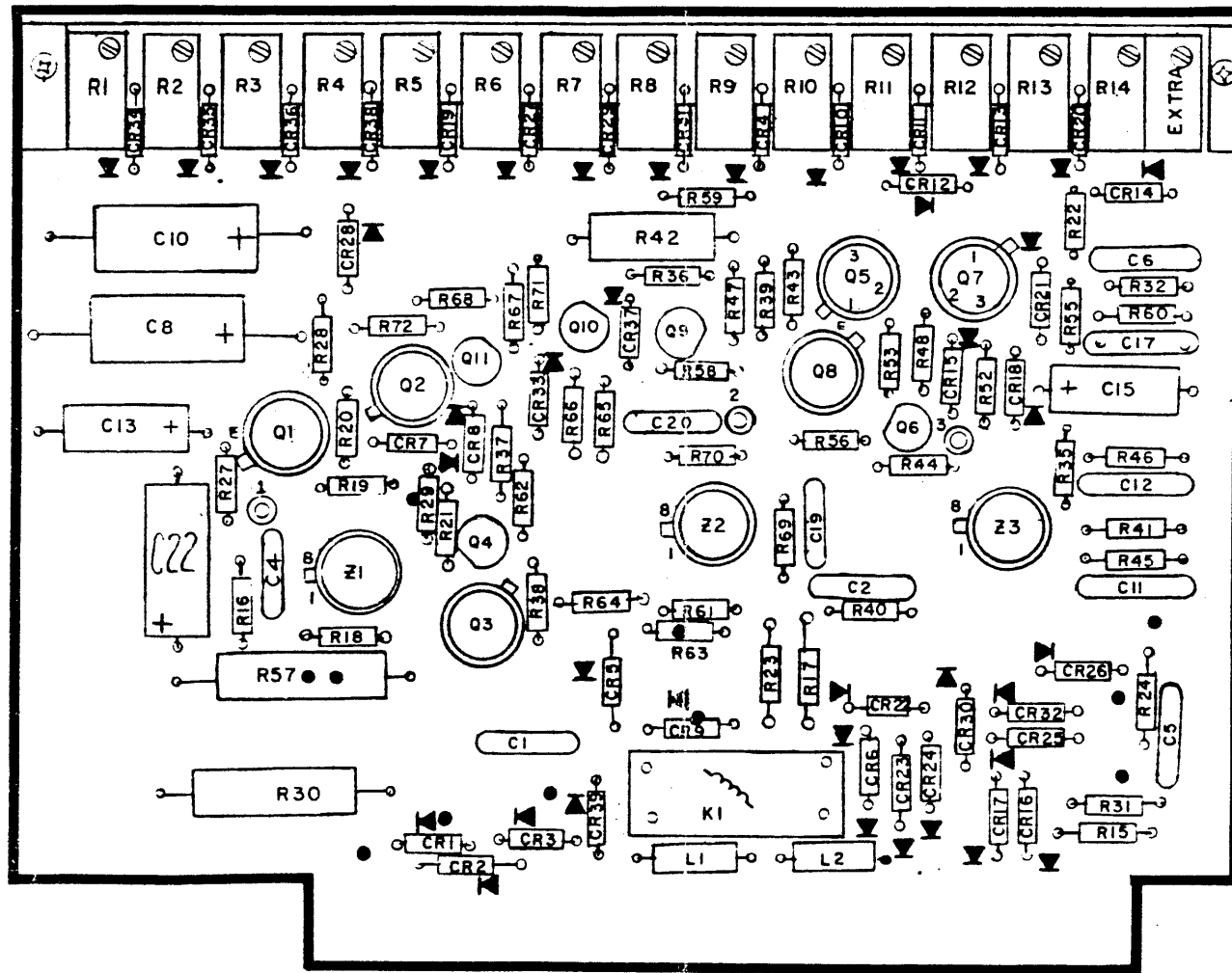


LAST SYMBOL	MISSING SYMBOL
C 22	C 3 C 7 C 9
CR 39	CR 4 CR 8 CR 21
K 1	R 25 R 26 R 33
Q 11	R 34 R 49 R 50
R 72	R 51 R 54
Z 1	
L 2	

UNLESS OTHERWISE SPECIFIED:
ALL DIODES ARE 1N645
ALL CAPACITORS ARE IN μ F
ALL RESISTOR VALUES ARE IN OHMS 1/4 WATT

FACTORY ADJUSTMENTS
* C 15
R 52 FROM 220 TO 1.5K

FIG. 6-5 PREPOSITION CARD SCHEMATIC DIAGRAM

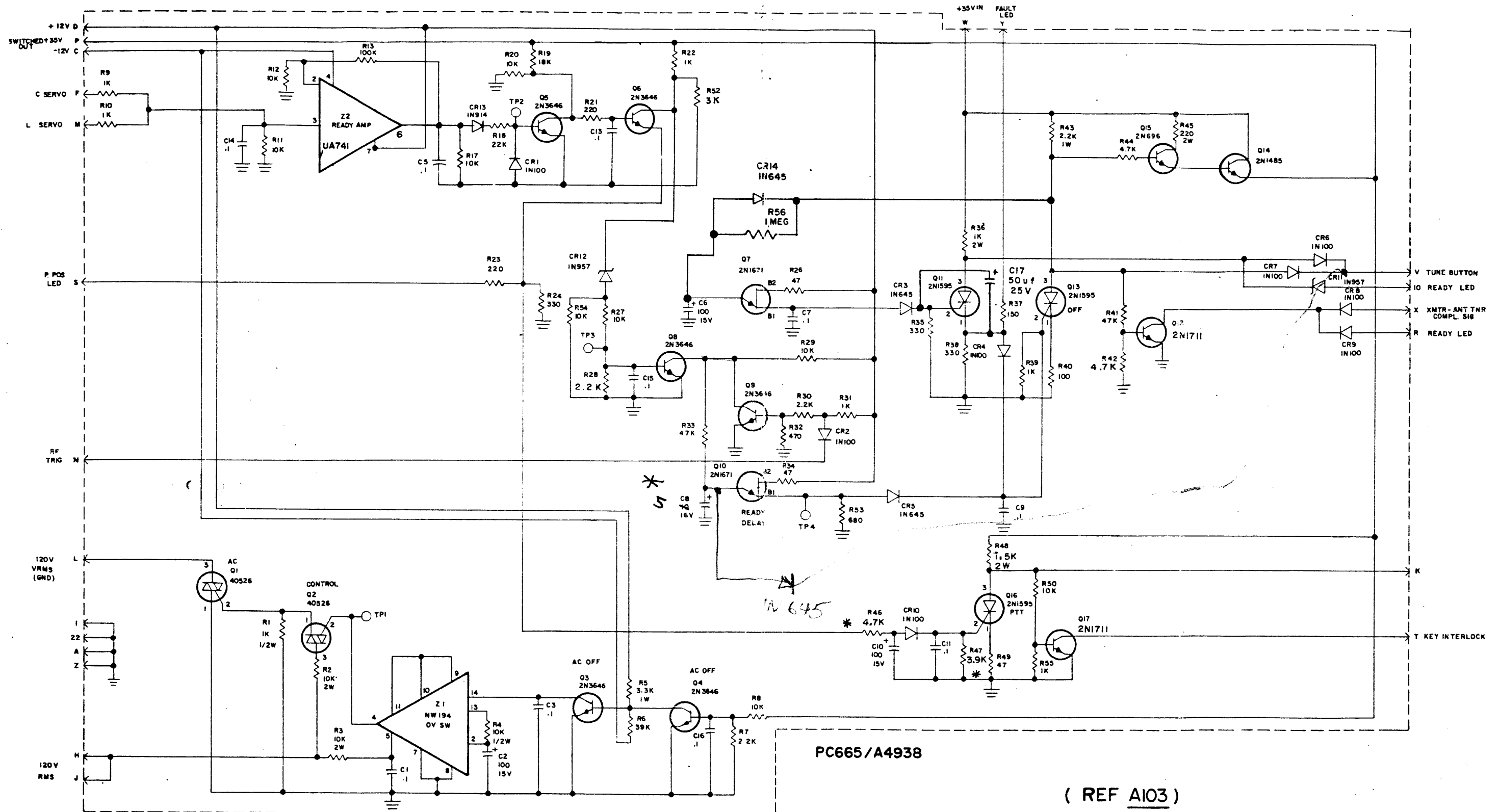


PREPOSITION CARD
ASSEMBLY DIAGRAM

FIGURE 6-6

6-13 / 6-14

Part Number	Description	Used On	Qty	Symbol Number
CC131-39	CAP, FXD, CER	A5639	10	C1, C2, C4, C5, C6, C11, C12, C17, C19, C20
CE105-15-16V	CAP, FXD, ELECT	A5639	1	C13
CE105-25-16V	CAP, FXD, ELECT	A5639	2	C15, C22
CE105-100-25	CAP, FXD, ELECT	A5639	2	C8, C10
CL275-121	COIL, FXD, RF	A5639	2	L1, L2
NW156	MICRO-CKT, DIGITAL	A5639	3	Z1, Z2, Z3
RC07GF102J	RES, FXD, COMP	A5639	3	R21, R39, R53
RC07GF103J	RES, FXD, COMP	A5639	14	R18, R27, R28, R29, R32, R37, R38, R41, R46, R60, R62, R64, R69, R70
RC07GF104J	RES, FXD, COMP	A5639	3	R16, R35, R61
RC07GF122J	RES, FXD, COMP	A5639	1	R72
RC07GF182J	RES, FXD, COMP	A5639	4	R17, R22, R23, R59
RC07GF221J	RES, FXD, COMP	A5639	5	R44, R52, R55, R66, R67
RC07GF222J	RES, FXD, COMP	A5639	3	R19, R24, R63
RC07GF242J	RES, FXD, COMP	A5639	3	R36, R40, R43
RC07GF392J	RES, FXD, COMP	A5639	1	R58
RC07GF471J	RES, FXD, COMP	A5639	1	R65
RC07GF472J	RES, FXD, COMP	A5639	2	R56, R71
RC07GF473J	RES, FXD, COMP	A5639	1	R20
RC07GF562J	RES, FXD, COMP	A5639	4	R15, R31, R48, R68
RC07GF682J	RES, FXD, COMP	A5639	1	R45
RC07GF822J	RES, FXD, COMP	A5639	1	R47
RC32GF102J	RES, FXD, COMP	A5639	1	R42
RC42GF221J	RES, FXD, COMP	A5639	2	R30, R57
RL160-3	RELAY	A5639	1	K1
RV119-1-502A	RES, VAR, COMP	A5639	14	R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14,
TE127-2	TERMINAL, STUD	A5639	3	TP1, TP2, TP3
TS212	SKT, TRANSISTOR	A5639	2	XQ5, XQ7
TS213-1	SKT, SCOND DEV	A5639	3	XZ1, XZ2, XZ3
1N100	SCOND, DEV, DIO	A5639	9	CR6, CR7, CR8, CR15, CR18, CR21, CR28, CR33, CR37
1N645	SCOND, DEV, DIO	A5639	29	CR1, CR2, CR3, CR4, CR9, CR10, CR11, CR12, CR13, CR14, CR16, CR17, CR19, CR20, CR22, CR23, CR24, CR25, CR26, CR27, CR29, CR30, CR31, CR32, CR34, CR35, CR36, CR38, CR39
1N957	SCOND, DEV, DIO	A5639	1	CR5
2N696	TRANSISTOR	A5639	3	Q2, Q3, Q8
2N1595	TRANSISTOR	A5639	2	Q5, Q7
2N1711	TRANSISTOR	A5639	1	Q1
2N3646	TRANSISTOR	A5639	5	Q4, Q6, Q9, Q10, Q11



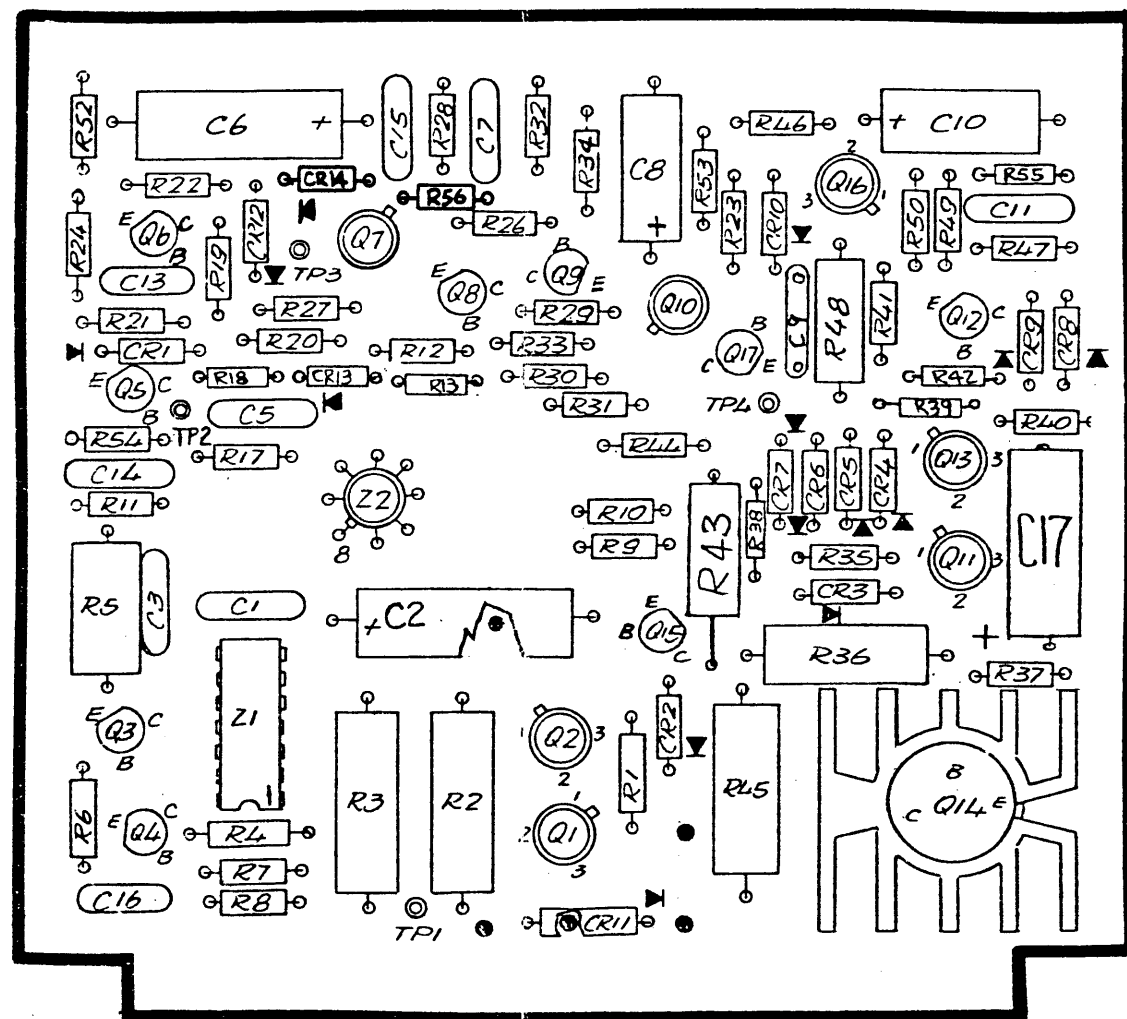
PC665/A4938

(REF A103)

LAST SYMBOL	MISSING SYMBOL
C16	C4, C12
CR14	R14, R15, R16
Q17	R25, R51
R56	
TP4	
Z2	

UNLESS OTHERWISE SPECIFIED:
 ALL CAPS ARE IN μF
 ALL RESISTOR VALUES ARE IN OHM
 1/4 W
 * R46, R47 FACTORY ADJUST

Figure 6-7. Control Card, Schematic Diagram

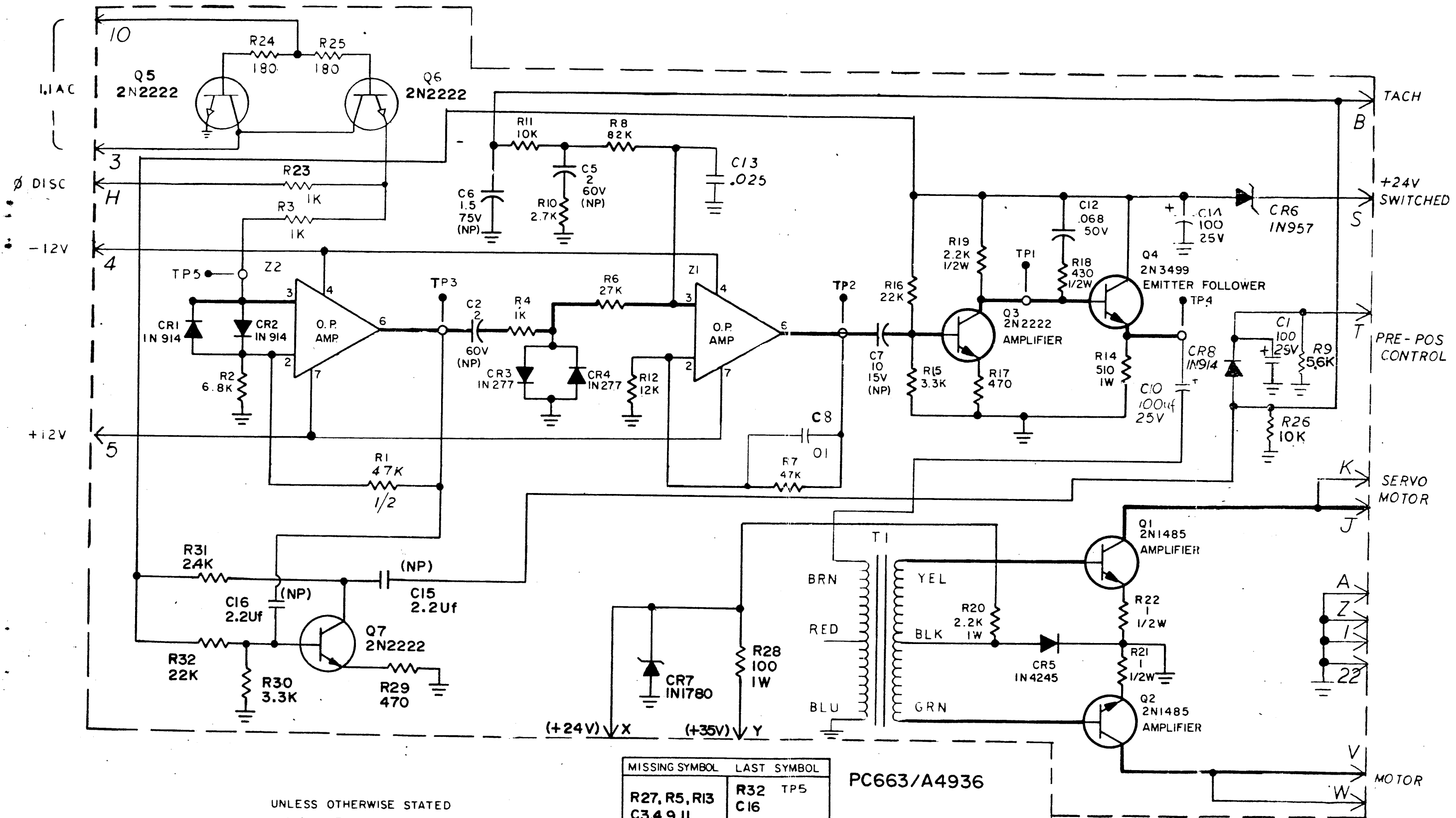


CONTROL CARD
ASSEMBLY DIAGRAM

FIGURE 6-8

6-17 / 6-18

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-28	CAP, FXD, CER	A4938	10	C1, C3, C5, C7, C9, C11, C13, C14, C15, C16
CE105-10-16	CAP, FXD, ELEC	A4938	1	C8
CE105-50-25	CAP, FXD, ELEC	A4938	1	C17
CE105-100-15	CAP, FXD, ELEC	A4938	3	C2, C6, C10
NW194	NW, IC	A4938	1	Z1
RC07GF101J	RES, FXD, COMP	A4938	1	R40
RC07GF102J	RES, FXD, COMP	A4938	5	R9, R10, R22, R31, R39, R55
RC07GF103J	RES, FXD, COMP	A4938	9	R8, R11, R12, R17, R20, R27, R29, R50, R54
RC07GF104J	RES, FXD, COMP	A4938	1	R13
RC07GF105J	RES, FXD, COMP	A4938	1	R56
RC07GF151J	RES, FXD, COMP	A4938	1	R37
RC07GF152J	RES, FXD, COMP	A4938	1	R48
RC07GF183J	RES, FXD, COMP	A4938	1	R19
RC07GF221J	RES, FXD, COMP	A4938	2	R21, R23
RC07GF222J	RES, FXD, COMP	A4938	3	R7, R28, R30
RC07GF223J	RES, FXD, COMP	A4938	1	R18
RC07GF302J	RES, FXD, COMP	A4938	1	R52
RC07GF331J	RES, FXD, COMP	A4938	3	R24, R35, R38
RC07GF392J	RES, FXD, COMP	A4938	1	R47
RC07GF393J	RES, FXD, COMP	A4938	1	R6
RC07GF470J	RES, FXD, COMP	A4938	3	R26, R34, R49
RC07GF471J	RES, FXD, COMP	A4938	1	R32
RC07GF472J	RES, FXD, COMP	A4938	3	R42, R44, R46
RC07GF473J	RES, FXD, COMP	A4938	2	R33, R41
RC07GF681J	RES, FXD, COMP	A4938	1	R53
RC20GF102J	RES, FXD, COMP	A4938	1	R1
RC20GF103J	RES, FXD, COMP	A4938	1	R4
RC32GF222J	RES, FXD, COMP	A4938	2	R28, R43
RC32GF332J	RES, FXD, COMP	A4938	1	R5
RC42GF102J	RES, FXD, COMP	A4938	1	R36
RC42GF103J	RES, FXD, COMP	A4938	2	R2, R3
RC42GF221J	RES, FXD, COMP	A4938	1	R45
TE127-2	TERM, STUD	PC665	4	TP1, TP2, TP3, TP4
UA741	NW, IC	A4938	1	Z2
1N100	SCOND, DEV, DIO	A4938	8	CR1, CR2, CR4, CR6, CR7, CR8, CR9, CR10
1N645	SCOND, DEV, DIO	A4938	3	CR3, CR5, CR14
1N914	SCOND, DEV, DIO	A4938	1	CR13
1N957	SCOND, DEV, DIO	A4938	2	CR11, CR12
2N696	TRANSISTOR	A4938	1	Q15
2N1485	TRANSISTOR	A4938	1	Q14
2N1595	SCOND, DEV, SCR	A4938	3	Q11, Q13, Q16
2N1671	TRANSISTOR	A4938	2	Q7, Q10
2N3646	TRANSISTOR	A4938	8	Q3, Q4, Q5, Q6, Q8, Q9, Q12, Q17
40526	SCOND, DEV, TRIAC	A4938	2	Q1, Q2

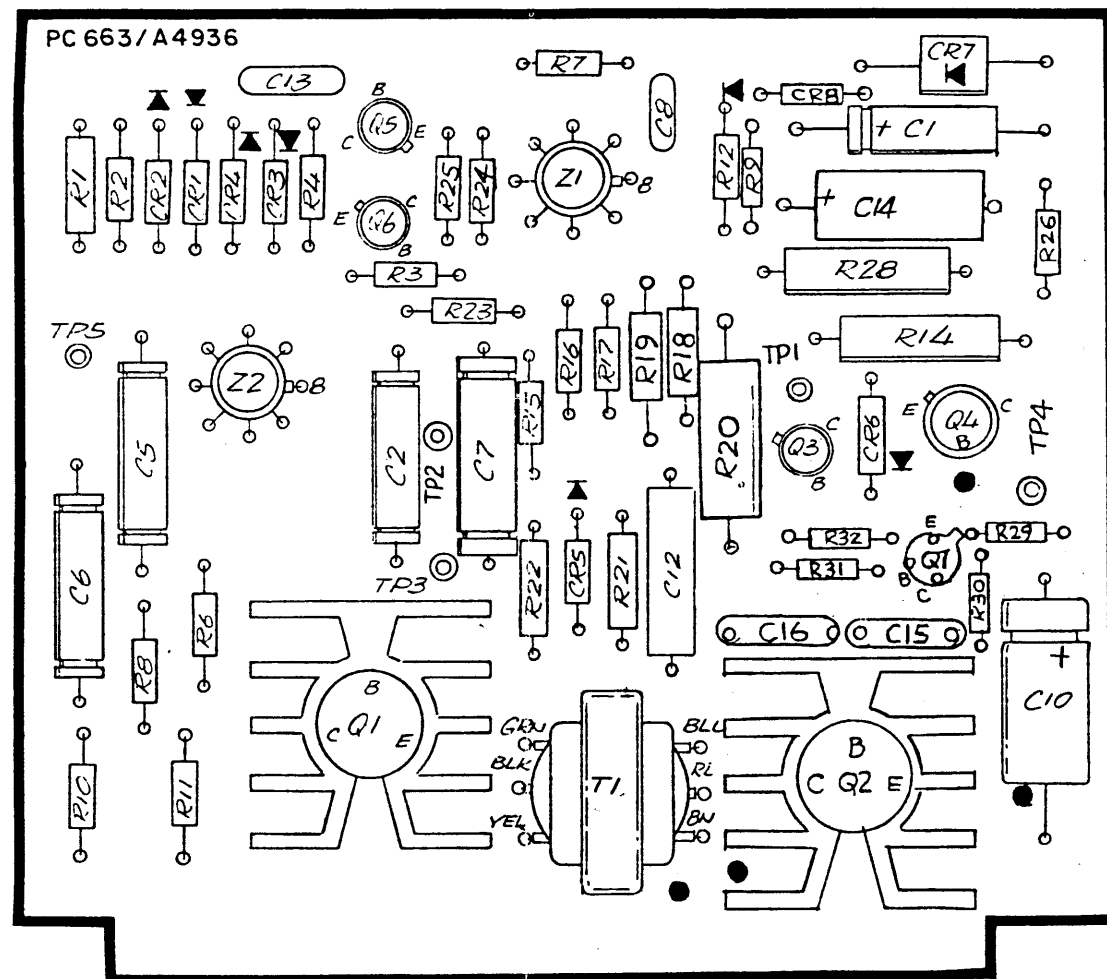


UNLESS OTHERWISE STATED
 1. ALL RESISTORS ARE IN OHMS 1/4 W
 2. ALL CAPACITORS ARE IN MICRO FARADS

MISSING SYMBOL	LAST SYMBOL
R27, R5, R13	R32 TP5
C3, 4, 9, 11	C16
	Q7
	Z 2
	CR8
	T1

PC663/A4936
 (REF A102/A104)

Figure 6-9. Output Servo Card, Schematic Diagram



OUTPUT SERVO CARD
ASSEMBLY DIAGRAM

FIGURE 6-10

6-21 / 6-22

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-25	CAP, FXD, ELECT	A4936	1	C13
CC100-41	CAP, FXD, CER	A4936	1	C8
CC131-48	CAP, FXD, CER	A4936	2	C15, C16
CE105-100-25	CAP, FXD, ELECT	A4936	3	C1, C10, C14
CN114R068-5J	CAP, FXD, MTLZ	A4936	1	C12
CX118E1R5N75C1	CAP, FXD, ELECT	A4936	1	C6
CX118E10N15C1	CAP, FXD, ELECT	A4936	1	C7
CX118E2N60C1	CAP, FXD, ELECT	A4936	2	C2, C5
RC07GF102J	RES, FXD, COMP	A4936	3	R3, R4, R23
RC07GF103J	RES, FXD, COMP	A4936	2	R11, R26
RC07GF123J	RES, FXD, COMP	A4936	1	R12
RC07GF181J	RES, FXD, COMP	A4936	2	R24, R25
RC07GF223J	RES, FXD, COMP	A4936	2	R16, R32
RC07GF242J	RES, FXD, COMP	A4936	1	R31
RC07GF272J	RES, FXD, COMP	A4936	1	R10
RC07GF273J	RES, FXD, COMP	A4936	1	R6
RC07GF332J	RES, FXD, COMP	A4936	2	R15, R30
RC07GF471J	RES, FXD, COMP	A4936	2	R17, R29
RC07GF473J	RES, FXD, COMP	A4936	1	R7
RC07GF562J	RES, FXD, COMP	A4936	1	R9
RC07GF682J	RES, FXD, COMP	A4936	1	R2
RC07GF823J	RES, FXD, COMP	A4936	1	R8
RC20GF1R0J	RES, FXD, COMP	A4936	2	R21, R22
RC20GF222J	RES, FXD, COMP	A4936	1	R19
RC20GF431J	RES, FXD, COMP	A4936	1	R18
RC20GF473J	RES, FXD, COMP	A4936	1	R1
RC32GF101J	RES, FXD, COMP	A4936	1	R28
RC32GF222J	RES, FXD, COMP	A4936	1	R20
RC32GF511J	RES, FXD, COMP	A4936	1	R14
TE127-2	TERM, STUD	PC663	5	TP1, TP2, TP3, TP4, TP5
TF425	XFMR, INTERSTAGE	A4936	1	T1
UA741	NW, OP AMP	A4936	2	Z1, Z2
1N914	SCOND, DEV, DIO	A4936	3	CR1, CR2, CR8
1N957	SCOND, DEV, DIO	A4936	1	CR6
1N277	SCOND, DEV, DIO	A4936	2	CR3, CR4
1N1780	SCOND, DEV, DIO	A4936	1	CR7
1N4245	SCOND, DEV, DIO	A4936	1	CR5
2N1485	TRANSISTOR	A4936	2	Q1, Q2
2N2222	TRANSISTOR	A4936	4	Q3, Q5, Q6, Q7
2N3499	TRANSISTOR	A4936	1	Q4

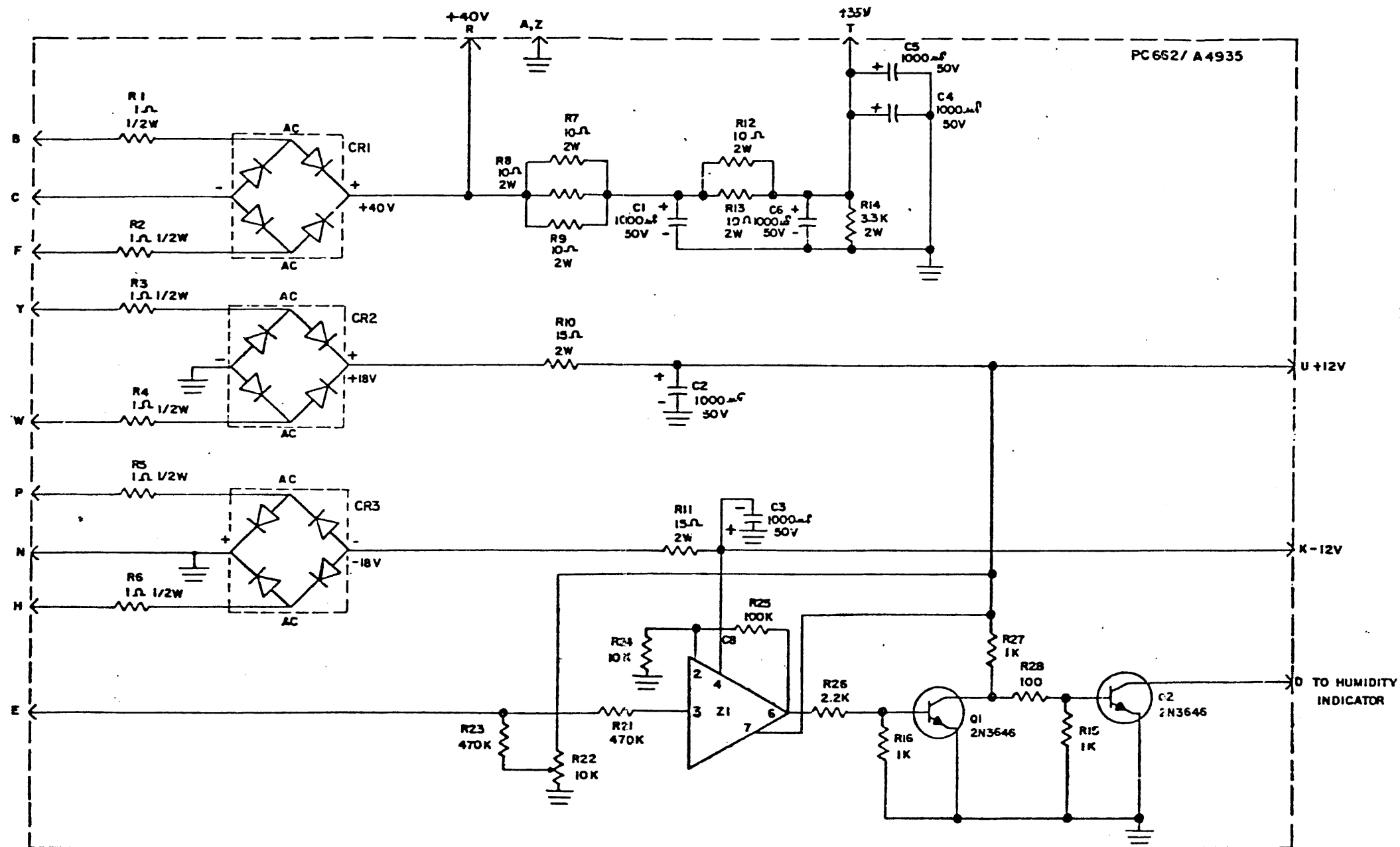
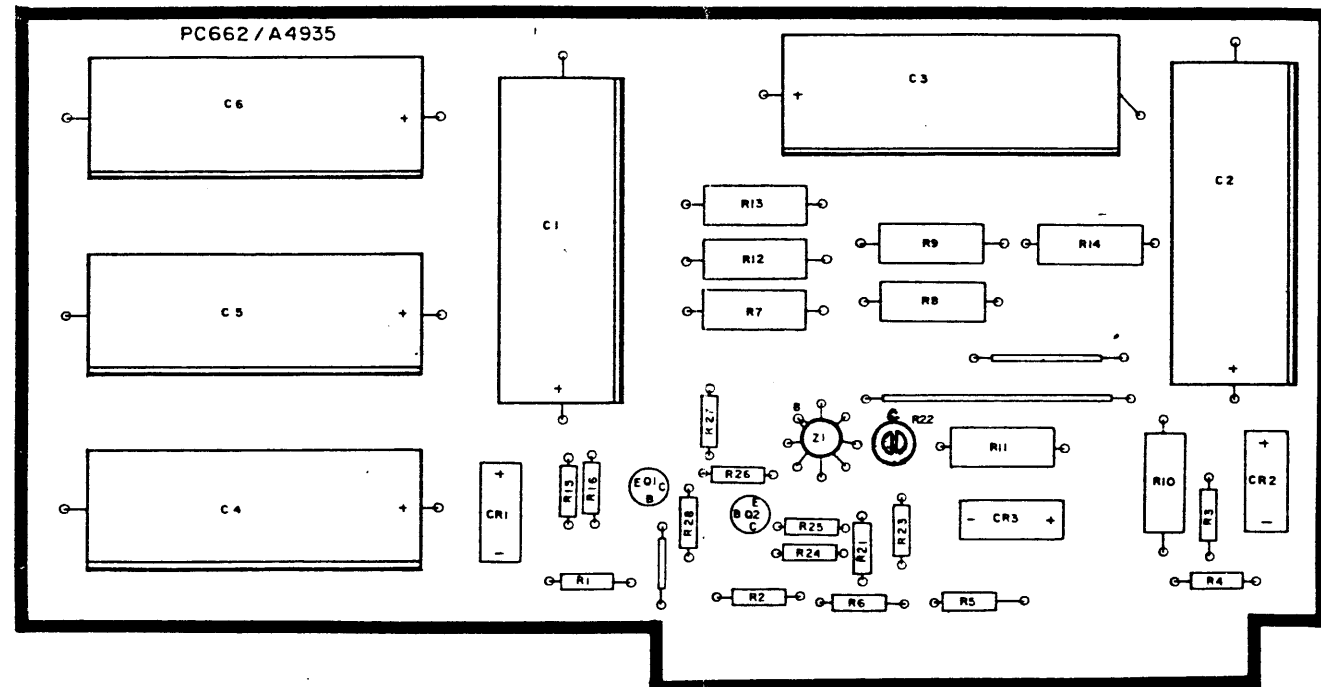


FIG. 6-II. POWER SUPPLY CARD SCHEMATIC DIAGRAM



POWER SUPPLY CARD
ASSEMBLY DIAGRAM

FIGURE 6-12

6-25 / 6-26

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CE116-8VN	CAP, FXD, ELEC	A4935	6	C1, C2, C3, C4, C5, C6
DD130-200-1.5	RECT, BRIDGE	A4935	2	CR2, CR3
DD130-200-3.0	RECT, BRIDGE	A4935	1	CR1
RC07GF101J	RES, FXD, COMP	A4935	1	R28
RC07GF102J	RES, FXD, COMP	A4935	3	R15, R16, R27
RC07GF103J	RES, FXD, COMP	A4935	1	R24
RC07GF104J	RES, FXD, COMP	A4935	1	R25
RC07GF222J	RES, FXD, COMP	A4935	1	R26
RC07GF474J	RES, FXD, COMP	A4935	2	R21, R23
RC20GF1R0J	RES, FXD, COMP	A4935	6	R1, R2, R3, R4, R5, R6
RC42GF100J	RES, FXD, COMP	A4935	5	R7, R8, R9, R12, R13
RC42GF150J	RES, FXD, COMP	A4935	2	R10, R11
RC42GF332J	RES, FXD, COMP	A4935	1	R14
RV124-1-103	RES, VAR, COMP	A4935	1	R22
UA741	NETWORK, IC	A4935	1	Z1
2N3646	TRANSISTOR	A4935	2	Q1, Q2

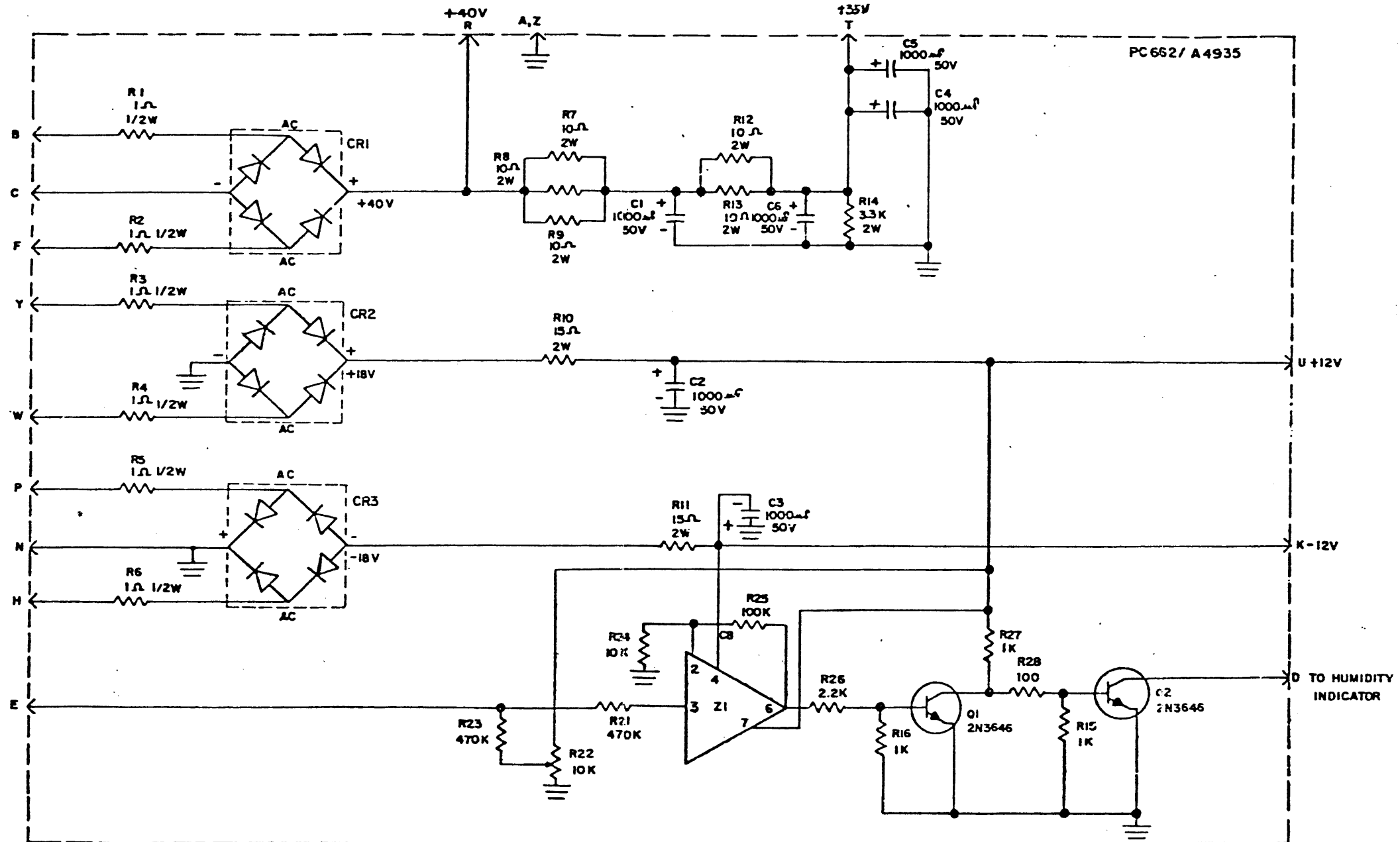
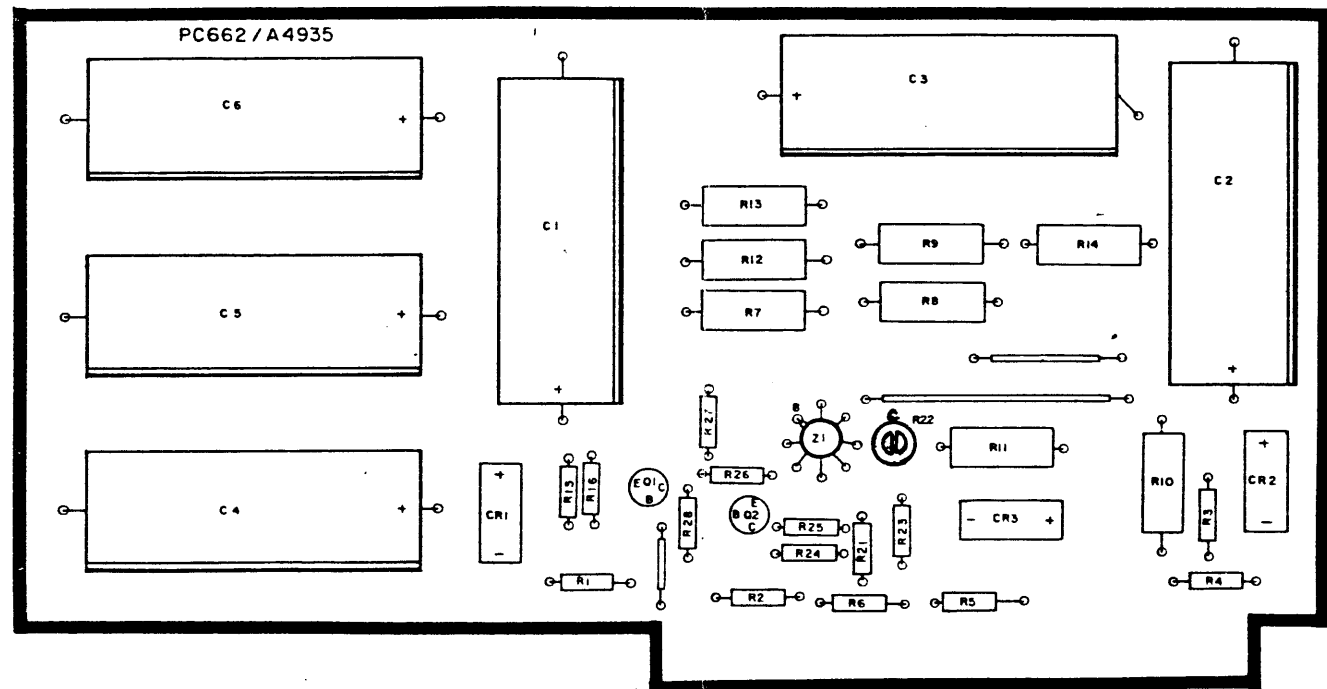


FIG. 6-II. POWER SUPPLY CARD SCHEMATIC DIAGRAM



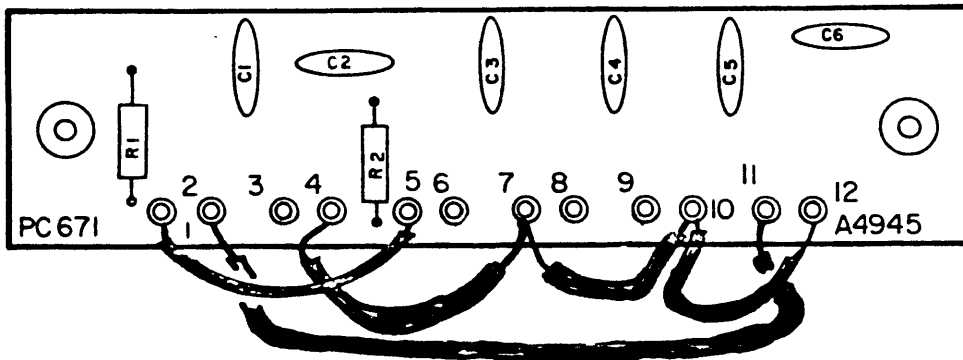
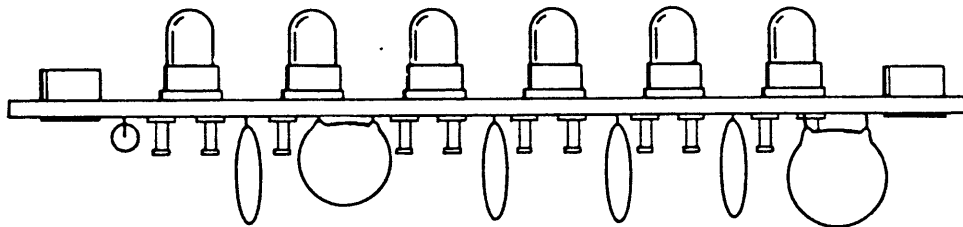
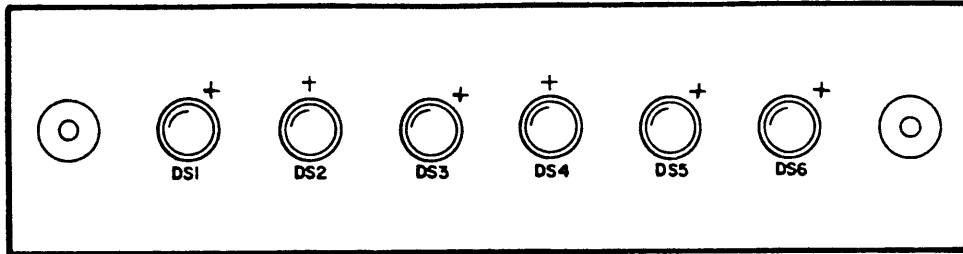
POWER SUPPLY CARD
ASSEMBLY DIAGRAM

FIGURE 6-12

6-25 / 6-26

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CE116-8VN	CAP, FXD, ELEC	A4935	6	C1, C2, C3, C4, C5, C6
DD130-200-1.5	RECT, BRIDGE	A4935	2	CR2, CR3
DD130-200-3.0	RECT, BRIDGE	A4935	1	CR1
RC07GF101J	RES, FXD, COMP	A4935	1	R28
RC07GF102J	RES, FXD, COMP	A4935	3	R15, R16, R27
RC07GF103J	RES, FXD, COMP	A4935	1	R24
RC07GF104J	RES, FXD, COMP	A4935	1	R25
RC07GF222J	RES, FXD, COMP	A4935	1	R26
RC07GF474J	RES, FXD, COMP	A4935	2	R21, R23
RC20GF1R0J	RES, FXD, COMP	A4935	6	R1, R2, R3, R4, R5, R6
RC42GF100J	RES, FXD, COMP	A4935	5	R7, R8, R9, R12, R13
RC42GF150J	RES, FXD, COMP	A4935	2	R10, R11
RC42GF332J	RES, FXD, COMP	A4935	1	R14
RV124-1-103	RES, VAR, COMP	A4935	1	R22
UA741	NETWORK, IC	A4935	1	Z1
2N3646	TRANSISTOR	A4935	2	Q1, Q2

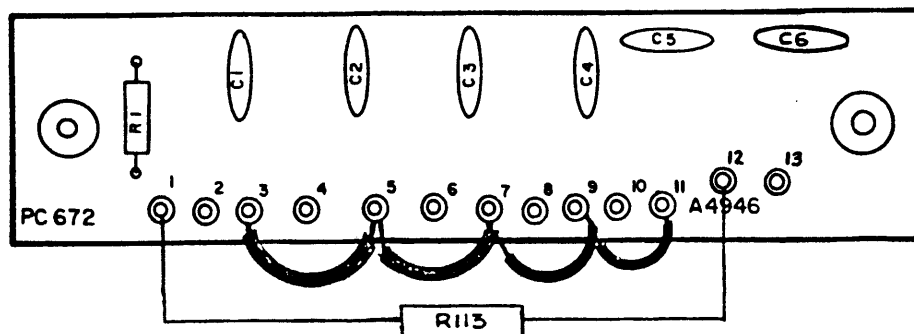
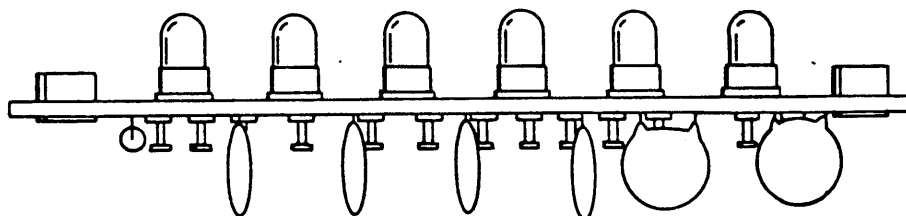
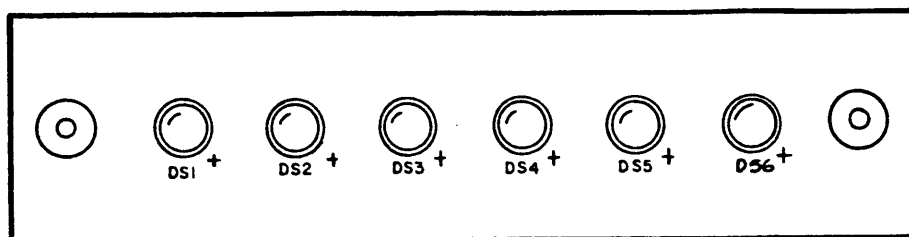
Part Number	Description	Used On	Qty	Symbol Number
BI132	LAMP, INCANDESCENT	A4945	6	DS1, DS2, DS3, DS4, DS5, DS6
CC100-43	CAP, FXD, CER	A4945	6	C1, C2, C3, C4, C5, C6
RC07GF152J	RES, FXD, COMP	A4945	1	R2
RC42GF272J	RES, FXD, COMP	A4945	1	R1



FUNCTION INDICATORS
ASSEMBLY DIAGRAM

FIGURE 6-14

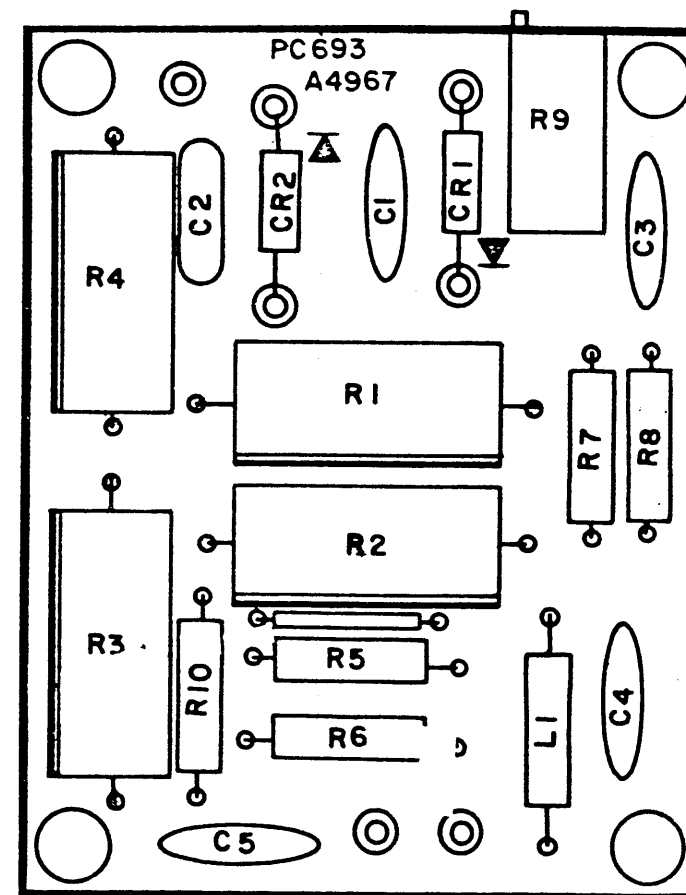
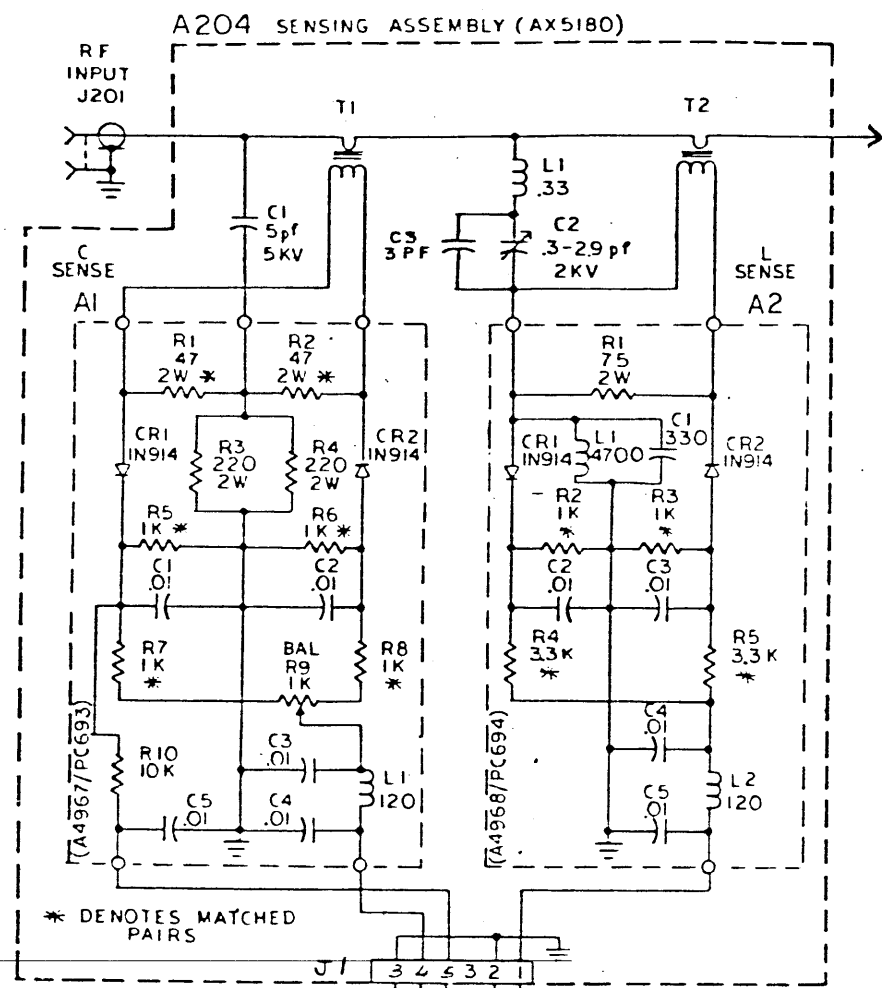
Part Number	Description	Used On	Qty	Symbol Number
BI132	LAMP, INCANDESCENT	A4946	6	DS1, DS2, DS3, DS4, DS5, DS6
CC100-43	CAP, FXD, CER	A4946	6	C1, C2, C3, C4, C5, C6
RC42GF332J	RES, FXD, COMP	A4946	1	R1
RC20GF152J	RES, FXD, COMP	A4946	1	R113



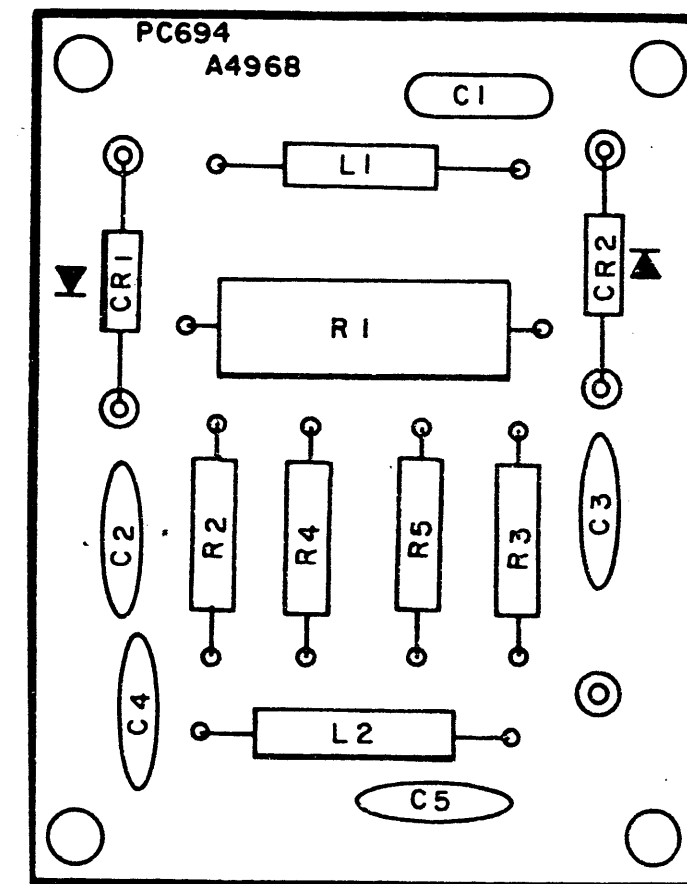
INDICATOR CARD
ASSEMBLY DIAGRAM

FIGURE 6-15

UNLESS OTHERWISE SPECIFIED:
 1. ALL RESISTANCES ARE IN OHMS, 1/2 W.
 2. ALL CAPACITANCES ARE IN MICROFARADS.
 3. ALL INDUCTANCES ARE IN MICROHENRIES.



C Sensing Circuit,
 Assembly Diagram



L Sensing Circuit,
 Assembly Diagram

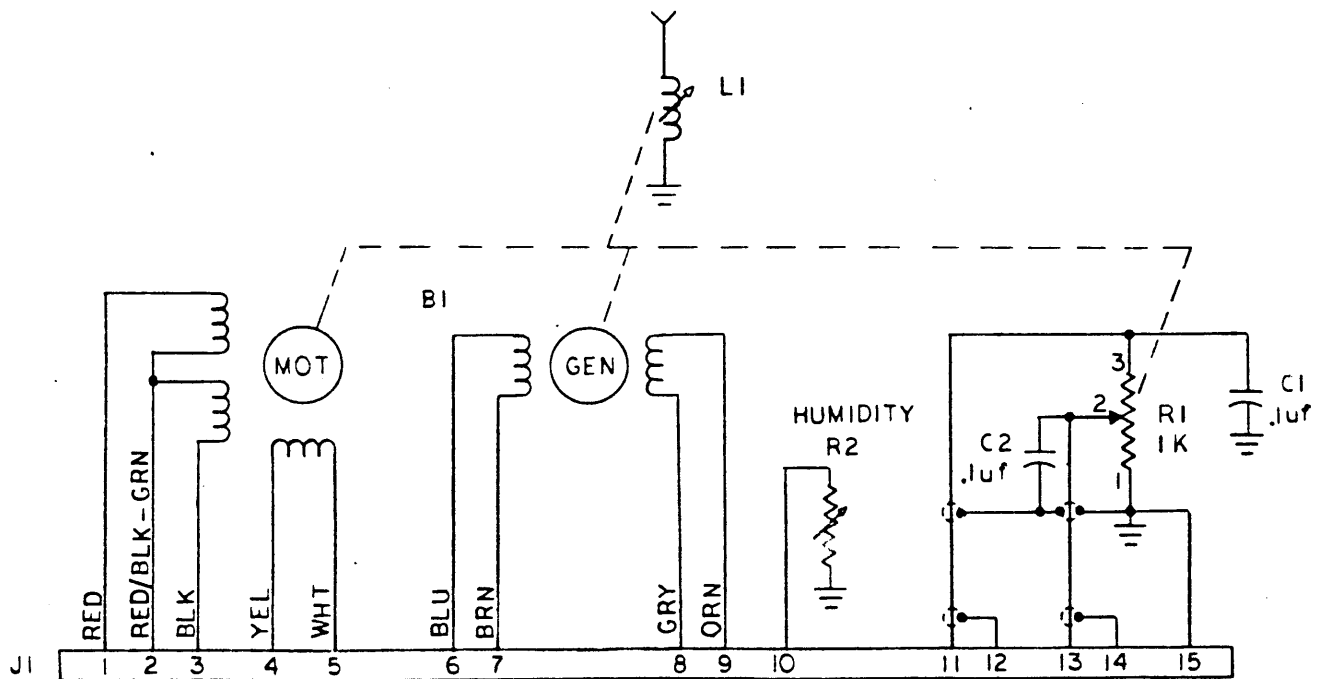
FIG. 6-16 AX5180 SENSING ASSY
 SCHEMATIC / ASSEMBLY DIAG.

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
A1546-5	COIL, RF	AX5180	1	L1
A4967	ASSY, PC BD C SENS	AX5180	1	A1 (1)
A4968	ASSY, PC BD L SENS	AX5180	1	A2 (1)
CC109-1	CAP, FXD, CER	AX5180	1	C3
CC109-4	CAP, FXD, CER	AX5180	1	C1
CV117	CAP, VAR, HV	AX5180	1	C2
JJ913-4	CONN PLUG ELECT	AX5180	1	J1
TZ233	TOROLD, SENSING	AX5180	2	T1, T2

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-43	CAP, FXD, CER	A4968	4	C2, C3, C4, C5
CL240-120	COIL, RF	A4968	1	L2
CL275-472K	COIL, RF	A4968	1	L1
CM111F331J5S	CAP, FXD	A4968	1	C1
RC20GF102J	RES, FXD, C	A4968	2	R2, R3 (121)
RC20GF332J	RES, FXD, C	A4968	2	R4, R5 (121)
RC42GF750J	RES, FXD, C	A4968	1	R1
1N914	SCOND, DEV, DIO	A4968	2	CR1, CR2

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-43	CAP, FXD, CER	A4967	5	C1, C2, C3, C4, C5
CL240-120	COIL, RF	A4967	1	L1
RC20GF102J	RES, FXD, C	A4967	4	R5, R6, R7, R8 (121)
RC20GF103J	RES, FXD, C	A4967	1	R10
RC42GF221J	RES, FXD, C	A4967	2	R3, R4
RC42GF470J	RES, FXD, C	A4967	2	R1, R2 (121)
RV119-1-102A	RES, VAR	A4967	1	R9
1N914	SCOND, DEV, DIO	A4967	2	CR1, CR2

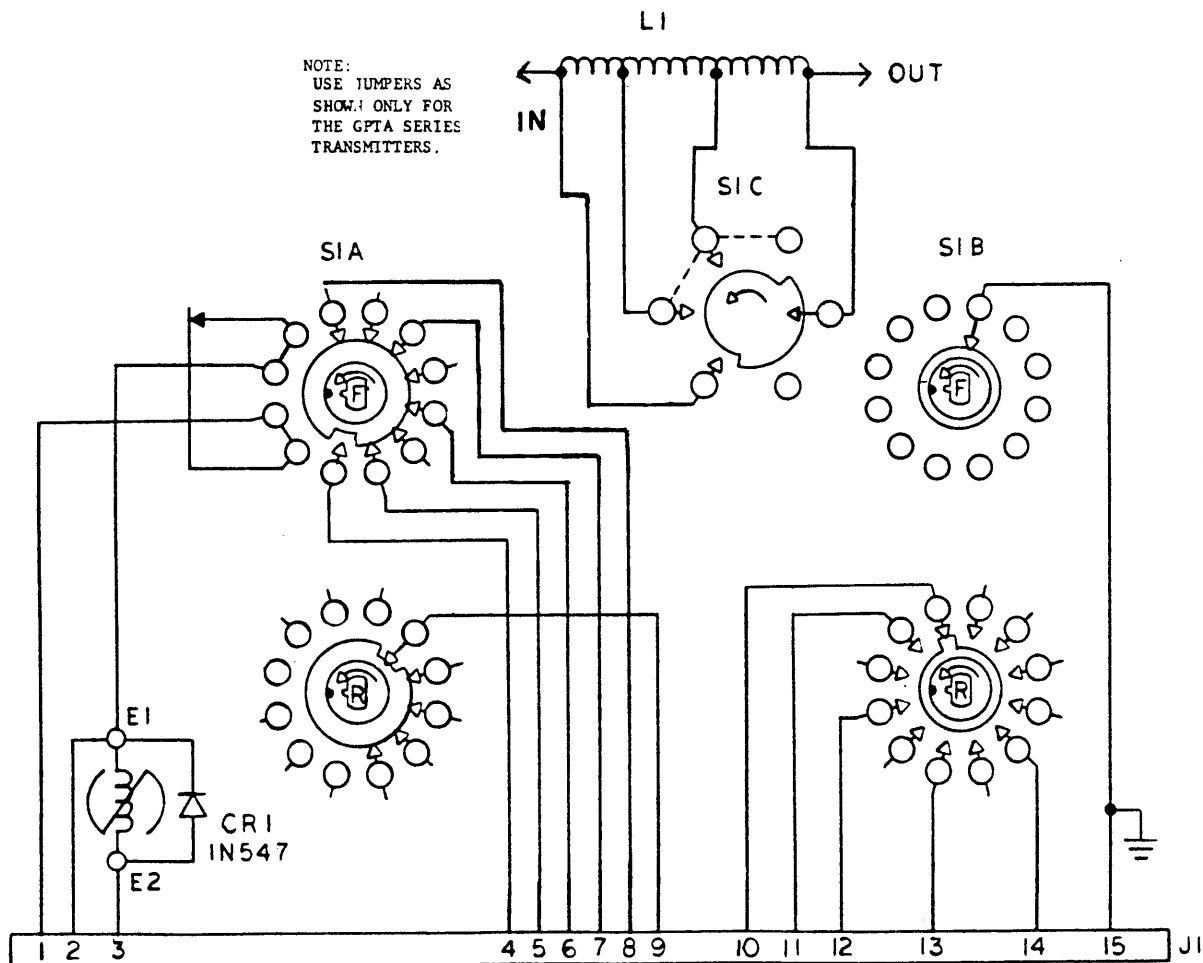
PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CB147	CAP, VAR, VAC	AX5179	1	C1
CC100-44	CAP, FXD, CER	AX5179	2	C2, C3
JJ313-1	CONN, RECEP, ML	CA1742	1	J1
MO126	MOTOR, SERVO	AX5179	1	B1
RV4NAYSA102B	RES, VAR	AX5179	1	R1



AX 5178 COIL ASSEMBLY
SCHEMATIC DIAGRAM

FIGURE 6-17

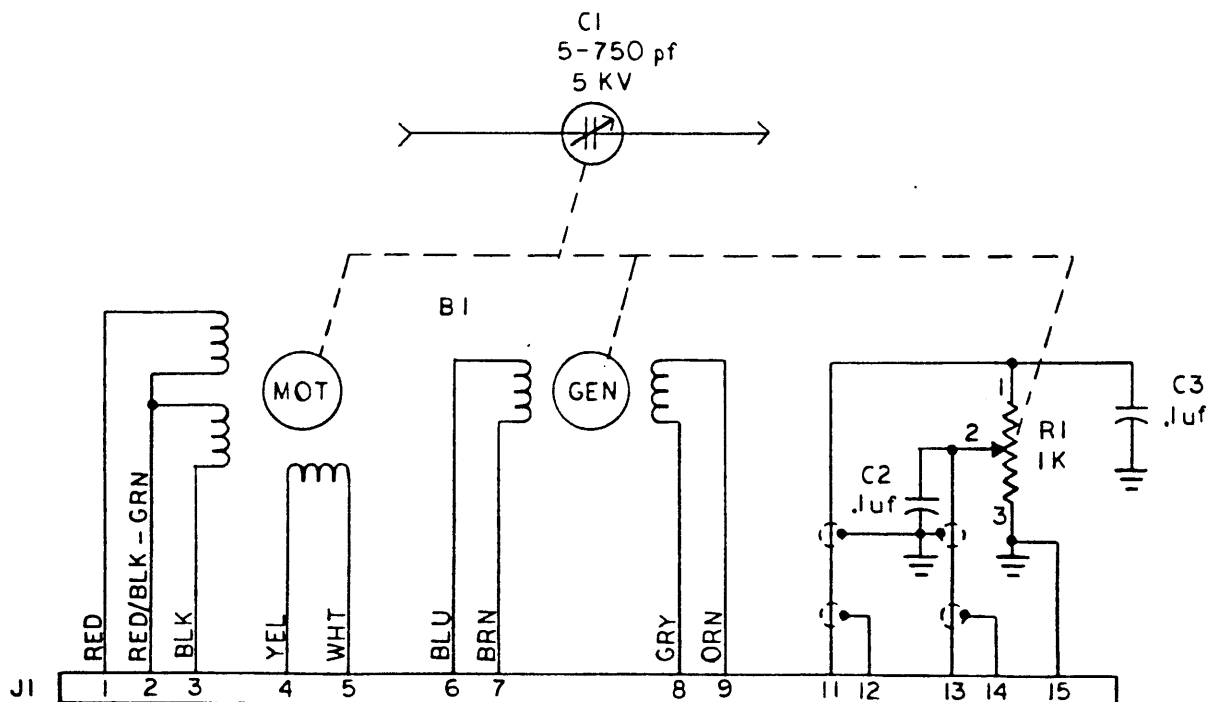
PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CL497	COIL, RF	AX5177	1	L1
JJ313-1	CONN, RECP, ML	AX5177	1	J1
SW555	SW, ROT, SA	AX5177	1	S1
SZ104	SOLENOID	AX5177	1	K1
TE102-2	TERM, TURRET	AX5177	2	E1, E2
1N547	SCOND, DEV, DIO	AX5177	1	CR1



AX5177 BANDSWITCH ASSEMBLY
SCHEMATIC DIAGRAM

FIGURE 6-18

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CB147	CAP, VAR, VAC	AX5179	1	C1
CC100-44	CAP, FXD, CER	AX5179	2	C2, C3
JJ313-1	CONN, RECEP, ML	CA1742	1	J1
MO126	MOTOR, SERVO	AX5179	1	B1
RV4NAYSA102B	RES, VAR	AX5179	1	R1



AX5179 CAPACITOR ASSEMBLY
SCHEMATIC DIAGRAM

FIGURE 6-19



REQUEST FOR SPARE PARTS

REQUESTED BY:

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE/PROV _____

COUNTRY _____ TELEPHONE/TLX/TWX _____

- Fold

SPARE PARTS REQUIRED:

Part Number	Description	Qty	Symbol	Notes/Used On

- Fold

DATE _____

SIGNED BY: _____



BUSINESS REPLY MAIL
FIRST CLASS PERMIT No. 10, MAMARONECK, N. Y.

THE TECHNICAL MATERIEL CORPORATION

P. O. Box 142

Mamaroneck, New York, 10543 U. S. A.



THE TECHNICAL MATERIEL CORP.

700 Fenimore Road
Mamaroneck, N.Y. 10543
U. S. A.