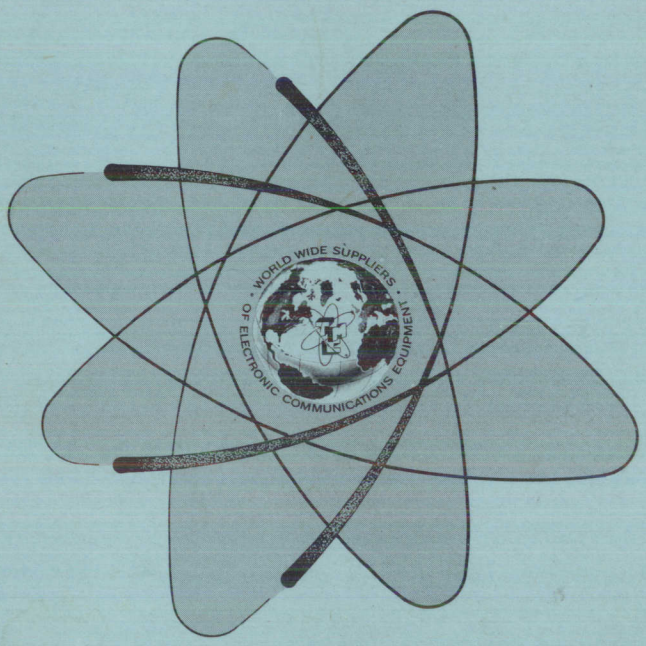
TECHNICAL MANUAL

for

AUTOMATED ANTENNA TUNING SYSTEM

MODEL ATSA-3



THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

Printed in U.S.A.

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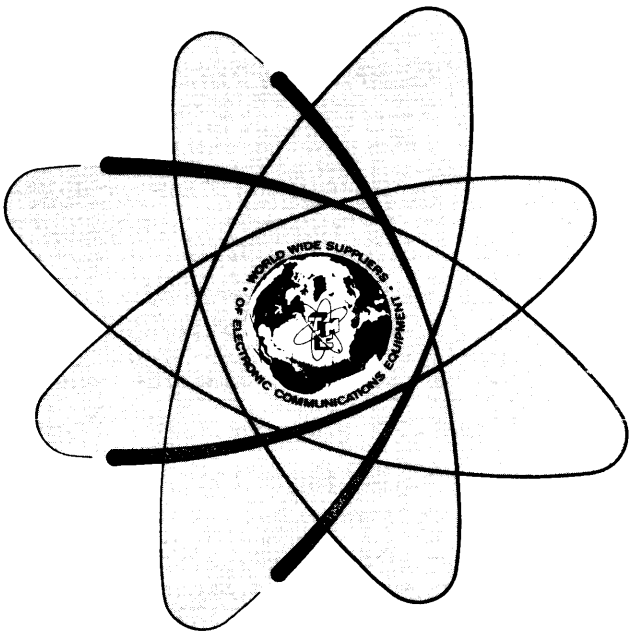

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IN 2102 Issue Date: MARCH 1974

CHANGE NO. 1

INSTRUCTION BOOK CHANGE NOTICE

Date October 1975

Manual affected: Automated Antenna Tuning System, Model ATSA-3 IN 2102

1. Figure 6-3, page 6-7/6-8.

   a. Delete C10 and C18
   b. Add capacitor C21, 25uf, 16V, from base of Q4 to ground.
   c. Change value of resistor R34 to "1.5K".
   d. Change value of resistor R63 to "1K".

2. Figure 6-4, page 6-9/6-10.

   a. Change value of resistor R28 to "2.2K".
   b. Change value of resistor R42 to "4.7K".
   c. Change value of resistor R52 to "3K".

3. Figure 6-5, page 6-11/6-12.

   a. Change value of resistor R8 to "47K".
   b. Change value of resistor R9 to "1.5K".

4. Figure 6-6, page 6-13/6-14.

   a. Change value of resistors R12 and R13 to "10 ohm".

5. Figure 6-7, page 6-15/6-16.

   a. Parts list for AX5180, add C3, "Same as C1".
   b. Pictorial, add capacitor C3, 5pf, 5KV, in parallel with L1 & L2.

6. Figure 6-9, page 6-19/6-20.

   a. Pictorial, delete capacitors C10 and C18.
   b. Pictorial, add capacitor C21, above Q4.
   c. Parts List,
      Change description of C10 and C18 to read "Not Used".
      Add C21, Capacitor, Fixed, Electrolytic, CE105-25-16.
      Change description of R34 to read "Same as R28".

SHOULD ADDITIONAL COPIES OF THIS CHANGE NOTICE BE REQUIRED, PLEASE CONTACT:

THE TECHNICAL MATERIEL CORP., 700 Fenimore Road, Mamaroneck, New York

Attn.: Director of Eng. Services.

CHANGE NO. 1 (continued)

INSTRUCTION BOOK CHANGE NOTICE

Date October 1975

Manual affected: Automated Antenna Tuning System, Model ATSA-3 IN 2102

7. Figure 6-10, page 6-21/6-22.

   a. Change description of R28 to read "Same as R7".
   b. Change description of R42 to read "Resistor, Fixed, Composition, RC07GF472J".
   c. Change description of R44 to read "Same as R42".
   d. Change description of R52 to read "Resistor, Fixed, Composition, RC07GF302J".

8. Figure 6-11, page 6-23/6-24.

   a. Change description of R8 to read "Same as R7".
   b. Change description of R9 to read "Resistor, Fixed, Composition, RC07GF152J".
   c. Change description of R13 to read "Same as R9".

9. Figure 6-17, page 6-33/6-34.

   a. Parts List, R1,
      Change TMC PART NO. to: RV4NAYSA102B

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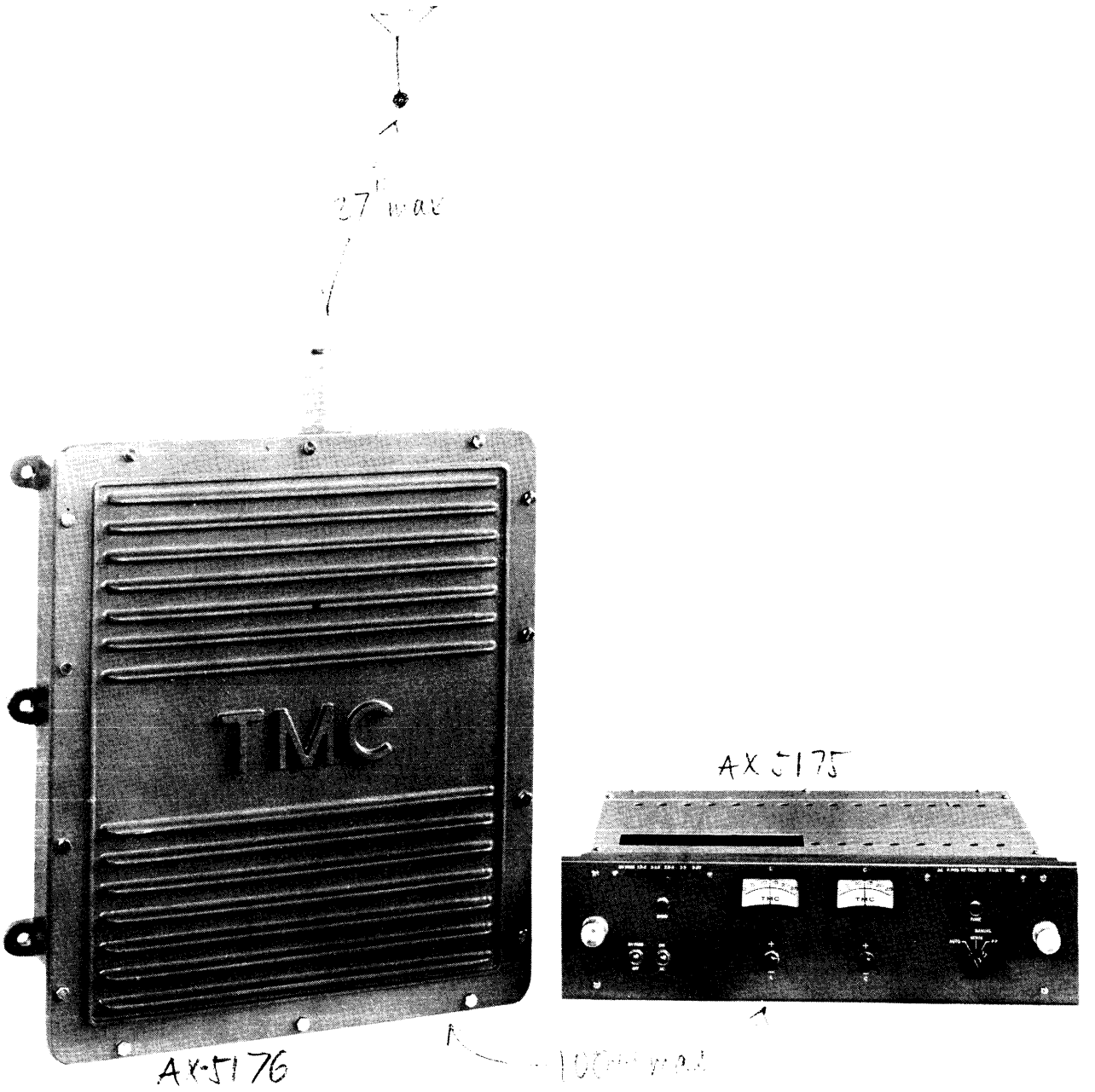


Figure 1-1. Automated Antenna Tuning System Model ATSA-3

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 of excessive moisture accumulation on the AX5175 control unit front panel. 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.

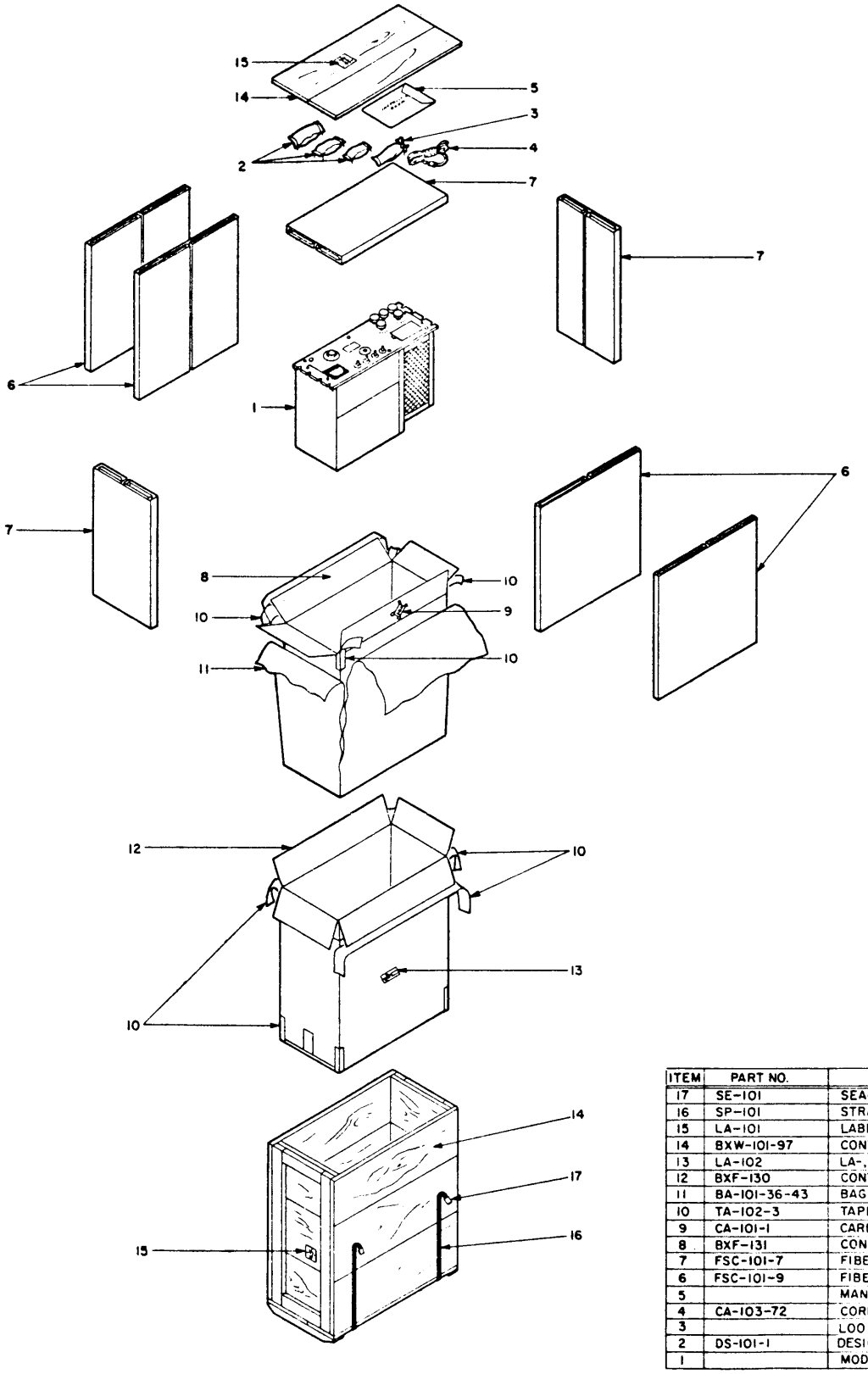
Table 1-1 lists the technical specifications for the ATSA-3 Antenna Tuning System.

TABLE 1-1. TECHNICAL SPECIFICATIONS AX 5176 (ATSA-3)

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 (32° — 122°F) (minus 5°C to 9°F)
Primary power	115/230 volts ±10%, 50/60 hz, single phase, at approximately 80 watts

TABLE 1-1. TECHNICAL SPECIFICATIONS (Continued)

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.



ITEM	PART NO.	DESCRIPTION
17	SE-101	SEALS, STRAPPING
16	SP-101	STRAPPING, STEEL
15	LA-101	LABEL, FRAGILE
14	BXW-101-97	CONTAINER, SHIPPING
13	LA-102	LA-, METHOD II
12	BXF-130	CONTAINER, OUTER
11	BA-101-36-43	BAG, BARRIER
10	TA-102-3	TAPE, PRESSURE SENSITIVE
9	CA-101-1	CARD, HUMIDITY INDICATOR
8	BXF-131	CONTAINER
7	FSC-101-7	FIBERBOARD SHEET, CREASED
6	FSC-101-9	FIBERBOARD SHEET, CREASED
5		MANUALS, INSTRUCTION
4	CA-103-72	CORD, LINE
3		LOOSE ITEMS
2	DS-101-1	DESICCANT, 16 UNIT
1		MODULAR UNIT

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 Materiel 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.

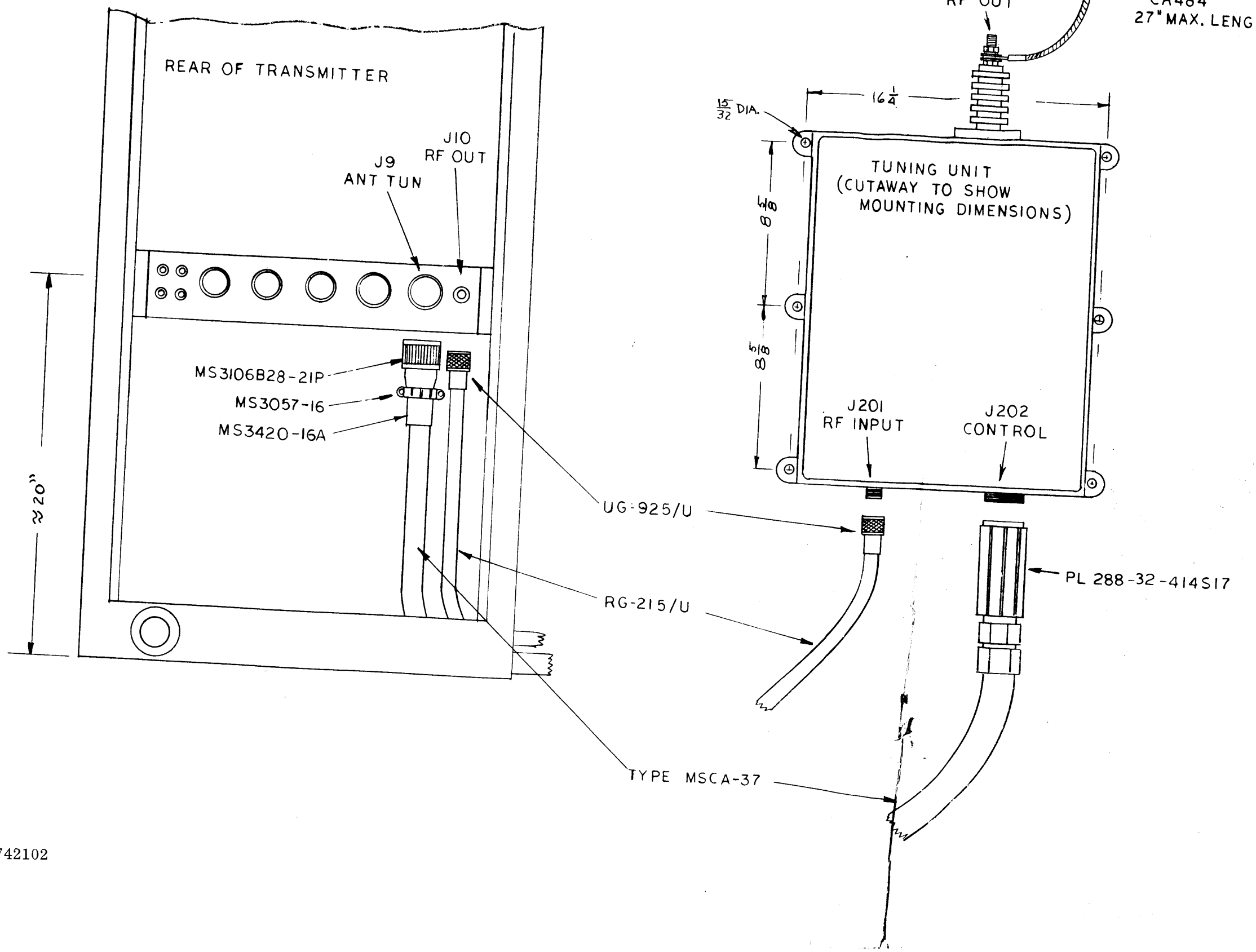
c. When the sides have been removed, rip off the moisture-proof paper. If a knife is used, care should be exercised not to mar equipment.

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.


REAR OF TRANSMITTER
J9
ANT TUN
J10
RF OUT
MS3106B28-21P
MS3057-16
MS3420-16A
≈20"
TO WHIP ANTENNA
E201
RF OUT
CA484
27" MAX. LENGT
16 1/4
15/32 DIA.
8 5/8
5/8
8 5/8
TUNING UNIT
(CUTAWAY TO SHOW
MOUNTING DIMENSIONS)
J201
RF INPUT
J202
CONTROL
UG-925/U
RG-215/U
TYPE MSCA-37
PL 288-32-414S17

Ø03742102

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.

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 watertight 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.

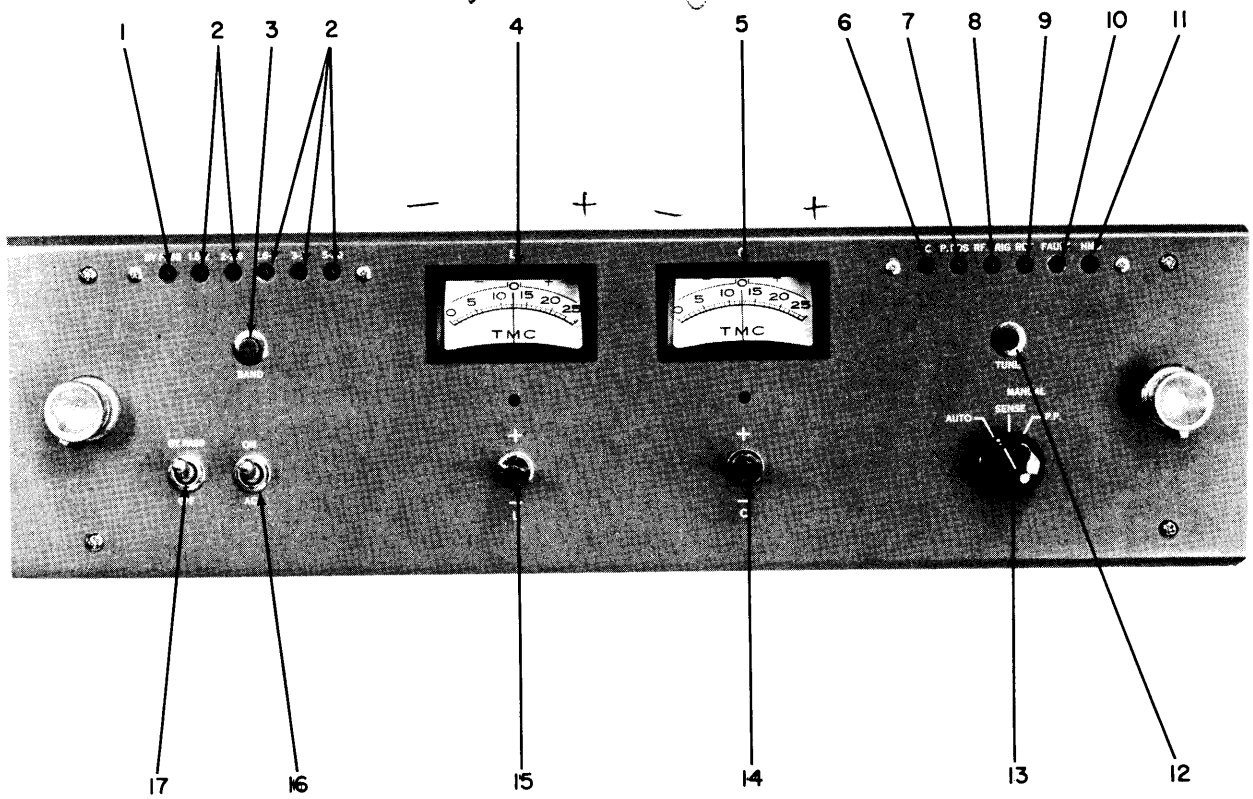


Figure 3-1. AX5175 Control Unit, Controls and Indicators

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; 3-5; or 5-30.
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.) (Inside)
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).

TABLE 3-1. CONTROLS AND INDICATORS (Continued)

Panel Designation	Function
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.
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, adjust 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.

TABLE 3-1. CONTROLS AND INDICATORS (Continued)

Panel Designation	Function
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	In BYPASS position, bypasses the tuning circuitry in the AX5176 tuning unit, thus 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 prepositioned.
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 MANUAL 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
		NOTE 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 pushbutton sequentially until the appropriate band indicator illuminates.	
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.
		NOTE 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.	
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.

TABLE 3-3. MANUAL TUNING (Continued)

Step	Unit	Operation	Normal 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.
9	Associated transmitter	Perform a check of reflected power	Refer to associated transmitter technical manual.

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.

TABLE 3-3. MANUAL TUNING (Continued)

Step	Unit	Operation	Normal Indication
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
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

TABLE 3-4. PREPOSITION TUNING CHART
(Continued)

Frequency (Mhz)	P.P. L	P.P. C
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
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.

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 adjustments 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 CR1 through CR14 on the preposition board. 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 four L preposition potentiometers R1 through R4 and to one of four C preposition potentiometers R5 through R8. The resultant d-c output of the selected potentiometers is routed through normally closed contacts of relay 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 Q5 and Q6 and applied to amplifier Z2. The output of amplifier Z2 is again amplified by Z1 and Q3, buffered by emitter follower Q4, and developed across push-pull amplifier Q1, 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 meters 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 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 CR8 which provides an indication of emitter follower Q4 output. The rectified output of each output servo amplifier is summed by resistors R9 and 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 Z2 on the control board. The positive output of Z2 turns on switch Q5 which turns off switch Q6. With Q6 turned off, the +35 volts switched is allowed to be applied to time delay circuit consisting of resistor R25 and capacitor 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 alloted time delay, capacitor C6 is allowed to charge to within 2/3 of the +35-volt level, which turns on switch Q7. Turning on switch Q7 fires scr Q11, which indicates a fault and a number of events occur. First, the front panel FAULT indicator is lighted. Also, scr Q13 is fired and turns off switch Q14, Q15 which removes the +35-volts switched from the system. With switch Q14, Q15 turned off, switch Q4 is turned off, switch Q3 is turned on, enabling switch Z1. The output of Z1 then fires control triac Q2 which fires a-c triac Q1. Firing 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

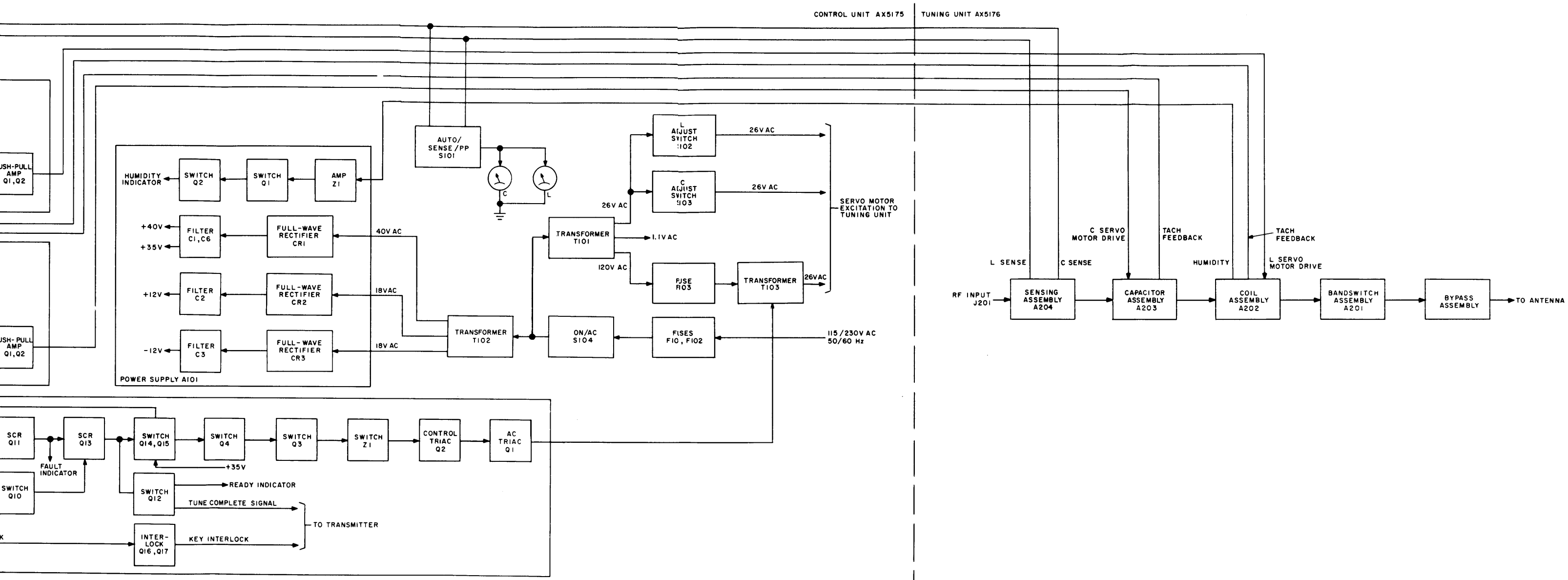


Figure 4-1. Antenna Tuning System ATSA-3, Functional Block Diagram

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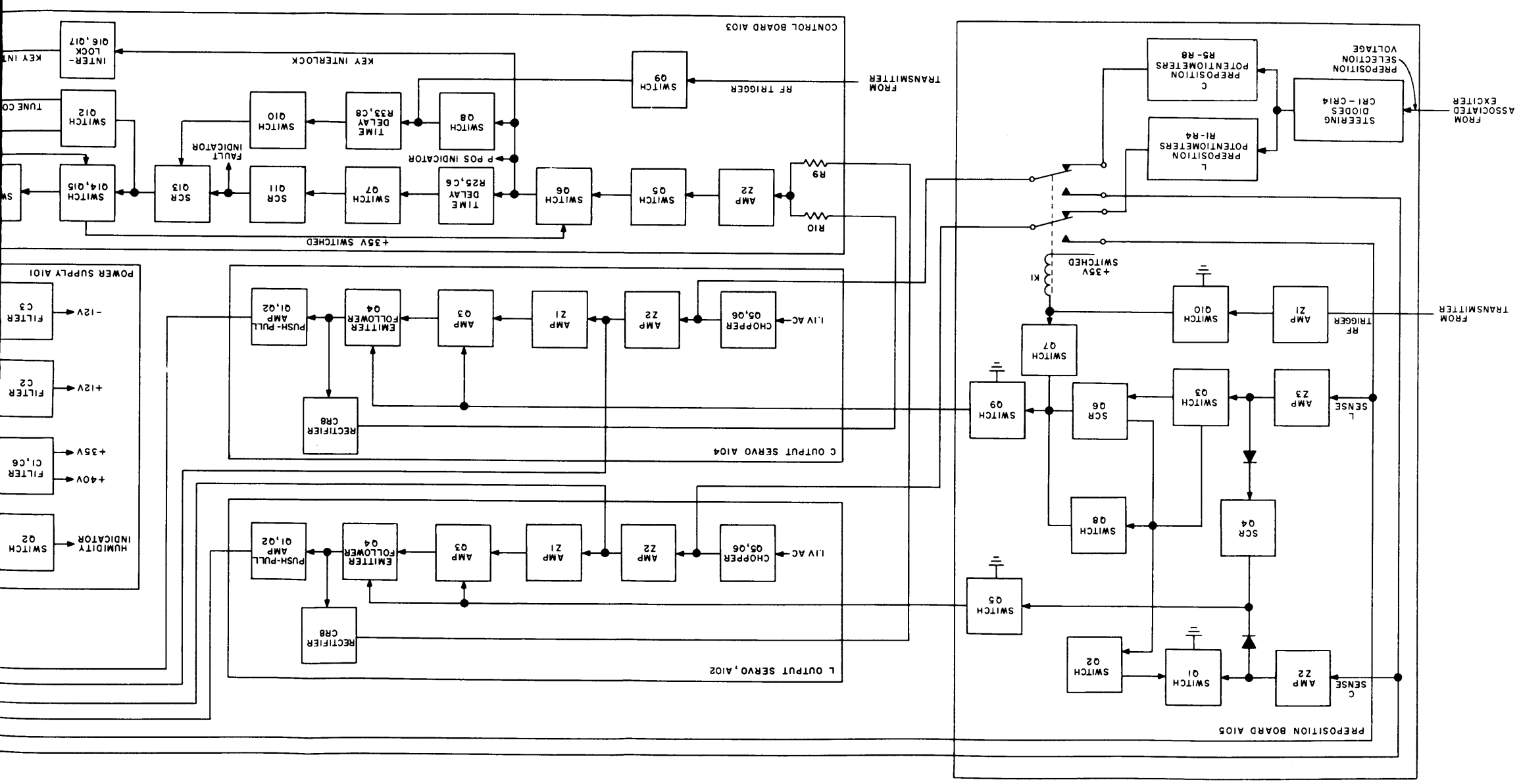

PREPOSITION BOARD A103
C SENSE
AMP Z2
SWITCH Q1
SWITCH Q2
L SENSE
AMP Z3
SWITCH Q3
SCR Q4
SCR Q6
SWITCH Q5
SWITCH Q7
SWITCH Q8
SWITCH Q9
RF TRIGGER
AMP Z1
SWITCH Q10
FROM TRANSMITTER
+35V SWITCHED
K1
STEERING DIODES CR1 - CR14
PREPOSITION SELECTION VOLTAGE
FROM ASSOCIATED EXCITER
L PREPOSITION POTENTIOMETERS R1-R4
C PREPOSITION POTENTIOMETERS R5-R8
L OUTPUT SERVO, A102
CHOPPER Q5,Q6
I.IV AC
AMP Z2
AMP Z1
AMP Q3
EMITTER FOLLOWER Q4
PUSH-PULL AMP Q1,Q2
RECTIFIER CR8
C OUTPUT SERVO A104
CHOPPER Q5,Q6
I.IV AC
AMP Z2
AMP Z1
AMP Q3
EMITTER FOLLOWER Q4
PUSH-PULL AMP Q1,Q2
RECTIFIER CR8
POWER SUPPLY A101
HUMIDITY INDICATOR
SWITCH Q2
FILTER C1,C6
+40V
+35V
FILTER C2
+12V
FILTER C3
-12V
CONTROL BOARD A103
FROM TRANSMITTER
RF TRIGGER
SWITCH Q9
KEY INTERLOCK
INTER-LOCK Q16,Q17
KEY INT
P POS INDICATOR
TIME DELAY R33,C8
SWITCH Q8
SWITCH Q10
FAULT INDICATOR
SCR Q11
SCR Q13
SWITCH Q12
TUNE CO
TIME DELAY R25,C6
SWITCH Q6
SWITCH Q7
SWITCH Q5
AMP Z2
R9
R10
SWITCH Q14,Q15
+35V SWITCHED

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 Q11 and 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 capacitive elements in the tuning unit are prepositioned correctly within the alloted 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 R9 and 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 Z2 on the control board then goes to zero, turning off switch Q5 which turns on switch 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 applied to amplifier Z1 on the preposition board. The resultant output of Z1 turns on switch Q10 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 Z2 and Z3, respectively, on the preposition board.

k. Simultaneously, an r-f trigger from the transmitter is applied to switch Q9 on the control board. The r-f trigger turns off Q9 and starts a time delay circuit consisting of resistor R33 and capacitor 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 tuning 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 sensing circuit amplifier Z3 receives a positive voltage and the C sensing circuit amplifier Z2 receives a negative voltage. With a positive input voltage applied to Z3, the output of Z3 is also positive. The positive output turns on switch Q3. With switch Q3 turned on, scr Q6 cannot be fired. With Q6 disabled, switch Q9 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 Q5 is turned off. There are two methods in which switch Q5 can be turned on. One method is via amplifier Z2; however, with a negative C servo input, the negative output of Z2 is blocked by a diode.

The second manner is via scr Q4 and an associated diode. However, because scr Q6 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 Z3 turned on switch Q3. This fires scr Q6. Simultaneously, switch Q8 is turned on and turns off switch Q9, removing the ground from the C servo, permitting the C servo to tune. With Q6 fired, switch Q2 is turned on, turning off switch Q1. Now, if the C input to amplifier Z2 goes positive, the positive output of Z2 is routed through the diode and turns on switch Q5. With switch Q5 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 Q6. 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, Q6 has fired, removed the ground from the C servo input, and primed scr Q4. Therefore, a second positive output from amplifier Z3 is routed through a diode and fires scr Q4. With Q4 fired, switch Q5 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 Z3 is negative or zero, it immediately fires scr Q6. (The only time Q6 is not fired is on a positive input.) With Q6 fired, switch Q2 is turned on and turns off switch Q1. The output of amplifier Z2 is now a positive voltage which turns on switch Q5 via the diode. With switch Q5 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 Q9 and starts a time delay circuit consisting of resistor R33 and capacitor C8. The time delay circuit provides sufficient time for the circuits to zero out. After the time delay is completed, switch Q10 is turned on and fires scr Q13. Firing Q13 disables the system as previously described, except that the FAULT indicator does not light because scr Q11 is not fired. Switch Q12 operates off of scr Q13. When the tuning sequence is completed, scr Q13 fires and effectively turns off switch Q12. With 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 Q16, 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 +40, +35, +12, and -12 volts d-c. The secondary windings of T101 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 Z1 on the power supply card. When the humidity exceeds a preset level, the humidity signal turns off amplifier Z1. As a result, switch Q1 is turned off and turns on switch Q2. With 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 unit inputs and outputs are routed to connector J103. The transmitter inputs and outputs are routed to connector J104.

a. PREPOSITION. (See figure 6-3.)

(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 CR1 through CR15 in such a manner that one potentiometer R1 through R4 is selected to preposition L and one potentiometer R5 through R8 is selected to preposition C. Potentiometers R1 through R8 provide a voltage for prepositioning the L and C servos via contacts of relay 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 CR7 and is developed across potentiometer R4 and is also routed through diode CR8 and is developed across potentiometer R5. In addition, the positive potential at the cathode of CR7 and CR8 back biases diodes CR4, CR5, CR6, CR11, CR12, CR13, and CR14. Further, the positive output of R4 is routed through CR20 and the positive output of R5 is routed through CR19. The positive potential at the cathode of CR19 and CR20 back biases diodes CR16, CR17, CR18, CR21, CR22, and CR23.

(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 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. The system can perform preposition and remain in the preposition mode. However, 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 circuit in the tuning unit. When an r-f trigger is applied to pin 21, the positive voltage is applied to amplifier Z1. The resultant positive output voltage of Z1 forward biases transistor switch Q10. With switch Q10 forward biased, a ground is applied to one side of relay K1. The other side of relay K1 is connected to +35 volts switched via pin 12, and relay K1 energizes with the application of a ground. With relay K1 energized, the preposition voltages from potentiometers R1 through R8 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 13 and 10, respectively. From pins 10 and 13, they are applied to amplifiers Z3 and Z2, respectively, in addition to being routed to the servos in the tuning unit via energized contacts of relay 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 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 tuning 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 Z3 receives a positive voltage and C sensing circuit amplifier Z2 receives a negative voltage. With a positive input voltage applied to pin 3 of amplifier Z3, the output at pin 6 of Z3 is also positive. The positive output at pin 6 is applied to the base of transistor switch Q3, forward biasing Q3. As a result of forward biasing Q3, a ground is applied at the junction of resistors R44 and R45. This effectively removes the voltage developed across resistor R46 via the +35-volt switched input line at pin 12. The grounding of the junction of resistors R44 and R45 prevents firing scr transistor Q6. With Q6 disabled, the +35 volts switched is applied to the base of Q9 via resistors R52 and R53. The positive voltage at the base of Q9 forward biases Q9 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 Q5 is back biased. There are two methods in which Q5 can be forward biased. One method is via amplifier Z2; however, with a negative C servo input, the negative output of Z2 is

blocked by diode CR25 and prevents enabling Q5. The second manner is via scr Q4 and diode CR30, however, because scr Q6 is disabled by the ground via Q3 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 Q3. This removes the ground from the junction of resistors R44 and R45 and results in the firing of scr Q6. Simultaneously, transistor switch Q8 is forward biased and grounds the input to Q9 which disables Q9 and removes the ground from the C servo, permitting the C servo to tune. With Q6 fired, the +35 volts switched input is routed through Q6 to the base of Q2, enabling Q2. With Q2 enabled, the +35 volt switched input to the base of Q1 is grounded, disabling Q1. Now, if the C input to amplifier Z2 goes positive, the positive output of Z2 is routed through diode CR25 and forward biases transistor switch Q5. With Q5 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 zeroes out and fires scr Q6. 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, Q6 has fired, removed the ground from the C servo input, and primed scr Q4. Therefore, a second positive output from amplifier Z3 is routed through diode CR26 and fires scr Q4. With Q4 fired, a positive voltage is applied to the base of

transistor switch Q5 via diode CR30, enabling Q5. With Q5 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 being 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 Q6. (The only time Q6 is not fired is on a positive input.) With Q6 fired, transistor Q2 is enabled which grounds the input to transistor Q1, disabling Q1. The output of amplifier Z2 is now a positive voltage which is applied to the base of transistor switch Q5 via diode CR25, enabling Q5. With Q5 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 6-4.)

(1) The control board sums the C and L servo outputs and senses the time required to complete prepositioning, and deactivates the servos after final tuning. Resistors R9 and 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 prepositioning, a positive voltage is applied to pin 3 of ready amplifier Z2. As a result, a positive voltage appears at output pin 6 of Z2 which is passed through diode CR13 and forward biases transistor switch Q5. With Q5 enabled, a ground is applied to the base of transistor Q6, back biasing Q6. With 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 input level. The time delay is a nominal 25 seconds, and is adjusted for optimized preposition tuning to provide at least twice the time required. Therefore, should the tuning miss, sufficient time is alloted to recatch it before a fault is indicated.

(3) If the servos do not attain proper prepositioning and the voltage is maintained across capacitor C6 until it charges to approximately 2/3 of the +35-volt level, unijunction transistor Q7 fires and enables scr transistor Q11. When Q11 fires, a fault is indicated and a number of events occur. A voltage is developed across resistor R38 and lights the front panel FAULT indicator. The voltage developed across R38 also fires off scr Q13. As a result of firing Q13, the input to the base of transistor Q15 goes low which turns off transistor Q14. Turning off Q14 disables the +35 switched output voltage in addition to back biasing a-c off transistor Q4. Disabling the +35-volt switched output removes +35 volts from the preposition 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 Q4 off, a-c off transistor 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 Z1. The output of Z1 then fires control varistat Q2 which is an a-c switch. In turn, Q2 turns off Q1. 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 Q11 via diode CR6 and to scr Q13 via diode 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 prepositioned correctly within the alloted time, the L and C feedback voltage is equal to the preset voltage and the voltage at the junction of resistors R9 and R10 goes to zero. As a result, capacitor C6 is not allowed to reach 2/3 of the total charge and the circuit does not fault out. Once the circuits have been prepositioned correctly, they can remain in the preposition 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 transistor Q9. With Q9 disabled, capacitor C8 starts charging through resistor 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, Q10 fires which, in turn, fires Q13. Firing Q13 disables the system as described above, except that the FAULT indicator does not light because Q11 is not fired.

(8) Transistor switch Q12 operates off of scr transistor Q13. When the tuning sequence is completed, scr transistor Q13 fires and effectively removes base voltage from Q12, back biasing Q12. With 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 Q16 and transistor switch 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 Q6 is back biased. As a result, scr transistor Q16 cannot be fired. Holding Q16 off, forward biases transistor switch 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 Q6 is forward biased. As a result, +35 volts switched is routed through resistor R22 and Q6 to the junction of resistors R23 and R24. The positive voltage at the junction of R23 and R24 is routed to pin S to light the front panel P.POS indicator and is also applied to scr transistor Q16. The application of a positive potential to Q16 fires the scr and back biases transistor switch Q17. With 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 6-5.)

(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 emitter follower Q4 is also 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 signal.

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

(1) The power supply consists of three basic full-wave rectifier circuits followed by filter and resistive bleeder circuits. Full-wave rectifier circuit CR1 develops +40 volts which is filtered by capacitor C1. The +40 volts is made available at pin R. The

+40 volts is again filtered by capacitor C6 and dropped to +35 volts by resistors R12 and R13 and the +35 volts is made available at pin T.

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

(3) R22 is a humidity potentiometer adjustment which is connected across +12 volts and ground. The voltage is tapped off R22 and developed across resistor R23. Connected in series with resistor R23 is the humidity potentiometer A202R2 on the antenna tuning unit. As the parallel combination of resistor R23 and the humidity potentiometer A202R2 drain current from potentiometer R22, the resultant voltage drop turns off amplifier Z1. With Z1 off, transistor Q1 is back biased, resulting in the forward biasing of transistor Q2. With transistor Q2 forward biased, the HMD indicator lights indicating excessive humidity.

e. TUNING UNIT. (See figure 6-7.)

(1) The tuning unit receives the r-f input from the transmitter and impedance matches the 1-kilowatt output to a 35-foot vertical whip 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 A204T2, in conjunction with coil A204L1 and capacitor A204C2, form a current sensing circuit. Coil L1 and capacitor C2 develop a fixed voltage for the current through the secondary of transformer T2. It is aligned so that at 50 ohms, the current through the secondary of T2 and the voltage drop across L1 and C2 are such that 0-volt appears at the output of the L sense circuit. If the impedance tends to decrease, the voltage decreases and the current increases, producing a voltage swing in one direction. If 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 A204T1 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 A204R1 and A204R2 is 180-degrees out-of-phase with the voltage drop across transformer T1 due to capacitor A204C1. 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 A203C1, coil A202L1, and coil A201L1 comprise the output tuning network. Capacitor A203C1 and coil A202L1 are controlled by a servo system. Series coil A201L1 is controlled by the BAND switch on the front panel of the control unit. Above 8 mhz, series inductance A201L1 is completely short circuited by S1C. Below 8 mhz, different segments of A201L1 are short circuited.

(5) The tuned combination of capacitor A203C1 and inductance A202L1 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 A201L1 is selected in preposition, whereas capacitor A203C1 and inductance A202L1 are linearly servo tuned. Mechanically ganged to capacitor A203C1 is resistor A203R1 and mechanically ganged to inductance A202L1 is resistor A202R1. These resistors provide feedback information for prepositioning 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 A202R2 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 weekly 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 weekly inspection checklist for the ATSA-3.

TABLE 5-1. WEEKLY INSPECTION ROUTINE

Assembly of Subassembly	Check
Cables	Check cables for cracks, nicks, or fraying.
Main Chassis Assemblies	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.

TABLE 5-1. WEEKLY INSPECTION ROUTINE (Continued)

Assembly or Subassembly	Check
Main Chassis Assemblies (continued)	4. Check printed circuit board jacks for tightness against chassis.
	5. Check ground connections for security.
Front and Rear Panels	1. Check panel for general cleanliness.
	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 weekly 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 ±1%.

(b) Check voltage at pin T; voltage should be +35 vdc ±1%.

(c) Check voltage at pin U; voltage should be +12 vdc ±1%.

(d) Check voltage at pin K; voltage should be -12 vdc ±1%.

(3) Functional Test. Perform the preoperational checkout procedure for the ATSA-3 outlined in paragraph 2-7 on a weekly 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, 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.

CAUTION

Trichloroethylene contains a paint removing solvent; avoid contact with painted surfaces.

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 unit 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-pounds.

5-2. ALIGNMENT.

The following paragraphs 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.

WARNING

Do not remove control card A103 without first turning off a-c power. Set the ON/AC switch to AC. A potential of 120 volts a-c is always present on triac's Q1 and Q2.

a. POWER SUPPLY BOARD A101. Adjust the setting of amplifier Z1 with 0-volt input at pin 3 of amplifier Z1; adjust potentiometer R18 for 0-volt output at pin 6.

b. PREPOSITION BOARD A105.

(1) Adjust the setting of amplifiers Z1, Z2, and Z3 with 0-volt input at pin 3 of each amplifier, adjust potentiometers R60, R38, and R20, respectively, for 0-volt output at pin 6.

(2) Adjust the prepositioning potentiometers R1 through R8 by following the preposition chart in table 3-4, and adjusting the potentiometers for the L and C meter readings indicated in table 3-4 for each frequency. The meter readings are obtained in the MANUAL PP position of the AUTO/SENSE/PP switch, while the adjustment is made in the AUTO position, requiring alternating switch positions as each potentiometer is adjusted. The particular potentiometer to be adjusted at each frequency band is obtained by referring to the preopsition board schematic diagram, figure 6-3.

c. CONTROL BOARD A103.

(1) Adjust the setting of amplifier Z2 with o-volt input at pin 3 of Z2; adjust potentiometer R51 for a 0-volt output at pin 6.

(2) The time delay potentiometer R25 is factory adjusted to provide a nominal 25 seconds before the circuit goes to a fault condition. This is sufficient time for prepositioning to be successfully accomplished, and includes a margin for recapture if prepositioning should miss on the initial try. Prepositioning is designed to be completed within 5 seconds. The setting of the time delay potentiometer should not require adjustment under normal conditions. However, the potentiometer may be adjusted to lengthen or shorten the time delay.

CAUTION

Too long a time delay could result in damage to the servo motors in the tuning unit when a fault condition is sensed. Too short a time delay does not allow sufficient time for preposition recapture in the event of a miss.

d. TUNING UNIT.

(1) The tuning unit contains a sensing circuit in sensing assembly 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.

WARNING

Use an insulated tool to adjust capacitor C2.

(2) Capacitor assembly A203 and coil assembly A202 each contains a preposition potentiometer R1 that is driven by a servo motor. To align the potentiometers, deenergize the equipment. Set the coil assembly inductance to maximum (positive stop). Connect an ohmmeter from the arm of the potentiometer to ground and set the ohmmeter to the 1K ohm scale. Adjust the potentiometer to mechanical zero, and then back off approximately 1/2 turn (to approximately 10 ohms), and lock the potentiometer. The capacitor assembly potentiometer is adjusted in a similar manner by setting the capacitor to maximum capacitance, setting the potentiometer to 0 ohm (mechanical stop) from the arm to ground with the ohmmeter, backing off 1/2 turn, and locking the potentiometer.

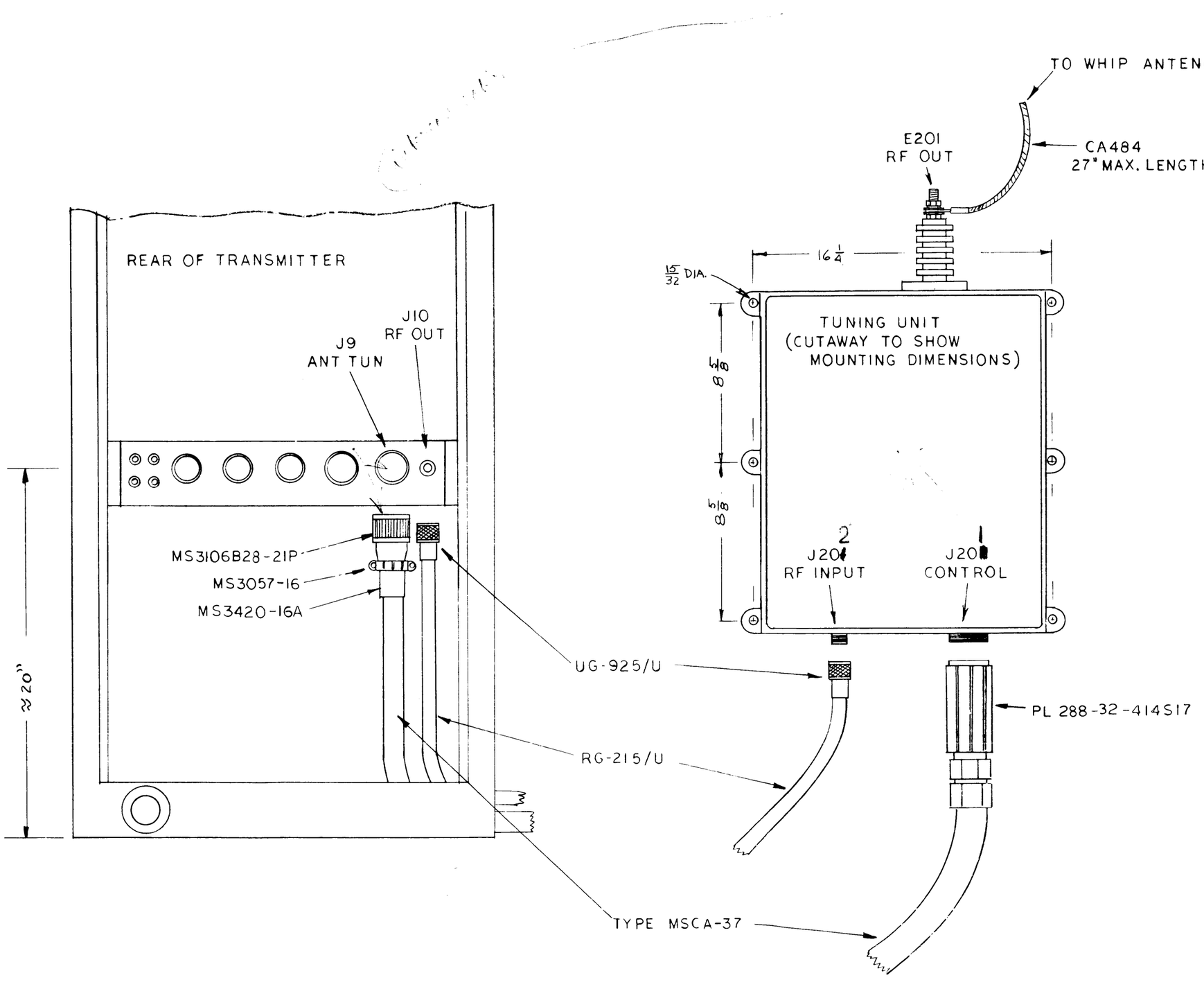
NOTE

Perform complete preposition alignment if potentiometer(s) slip.

(3) Coil assembly A202 contains humidity potentiometer R2 which can be set to any desired level, according to the humidity level it is desired to sense. Adjust the potentiometer until the control unit front panel HMD indicator lights, and then back off the setting until the HMD indicator extinguishes. This sets the humidity indication for any humidity exceeding the preset level.

SECTION 6

DIAGRAMS
AND
PARTS LIST



CONTROL CABLE INTERCONNECTION	
FROM J9 PIN NO.	TO 201 J[redacted] 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
Y	Y
Z	Z
a	a
b	b
c	c
d	d
e	e
f	f
g	g
h	h
j	j
k	k
m	m
n	n
p	p
r	r
s	6

Figure 2-2. Outline Dimensional

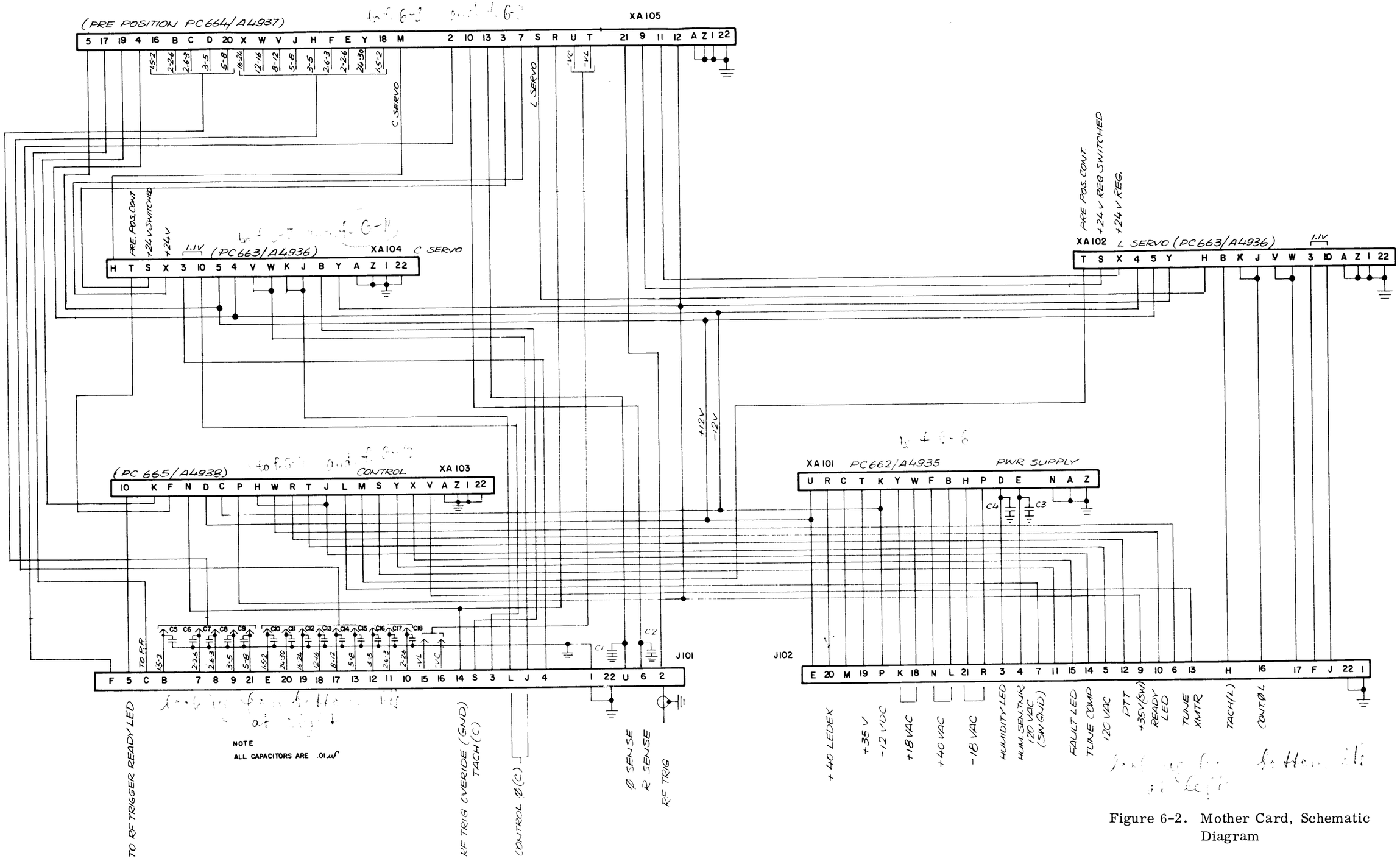


Figure 6-2. Mother Card, Schematic Diagram

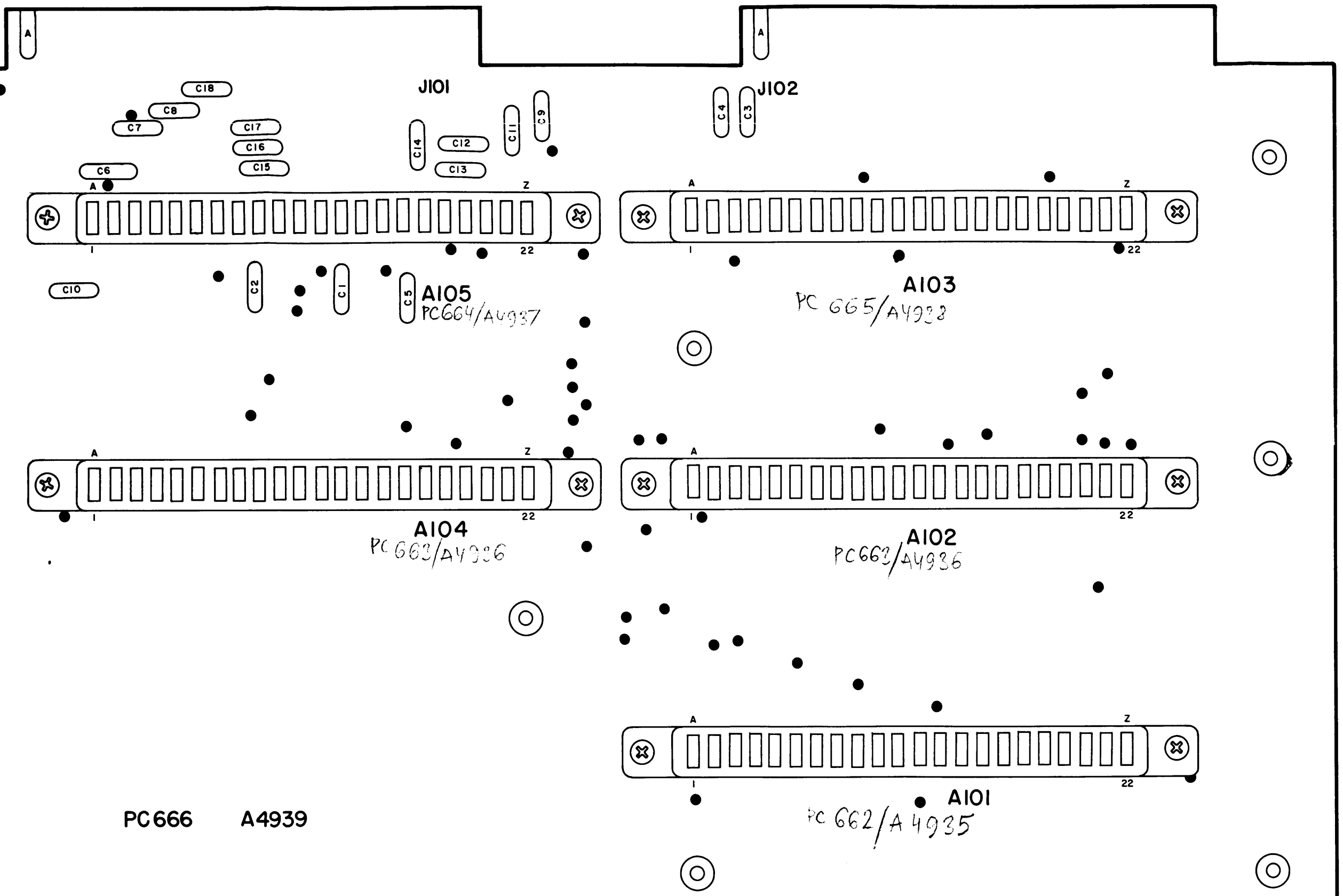
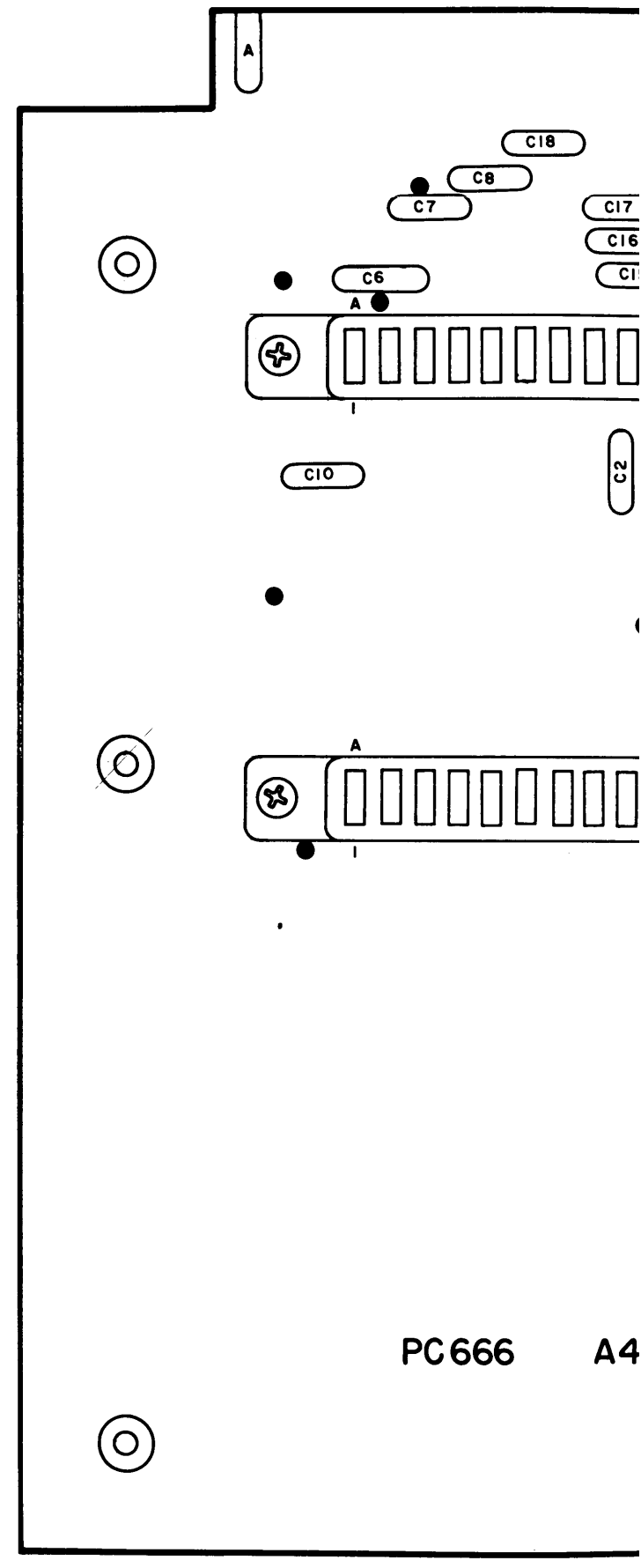


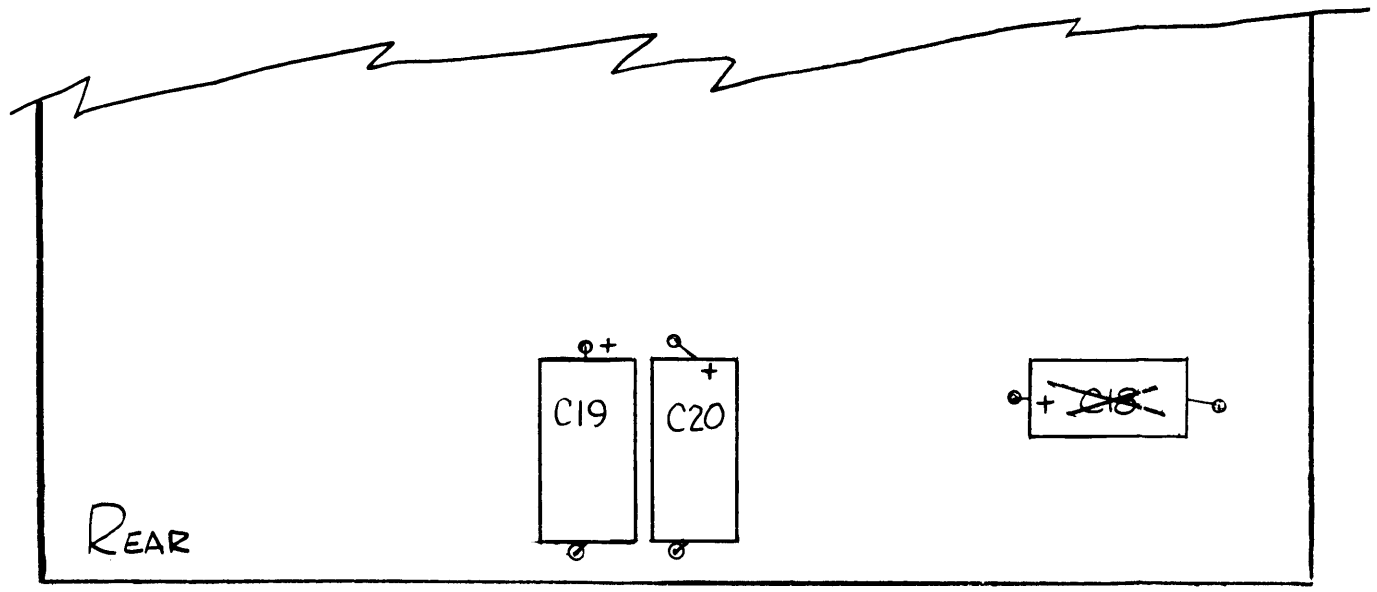
Figure 6-8. Mother Card, Assembly Diagram

Parts List for Mother Board A-4939

SYMBOL	DESCRIPTION	TMC P/N
C1 thru C18	Capacitor, Fixed	CC100-42



1-502	R68	Resistor, Fixed, Composition	RC07GF122J
	R69	Same as R27	
F273J	Z1 thru Z3	Integrated Circuit	NW156
F472J			
F221J			
F562J			
F152J			
F221J			
F102J			
F682J			
F822J			
F102J			
F473J			



C18, C19, C20 TO BE MOUNTED ON REAR OF BOARD

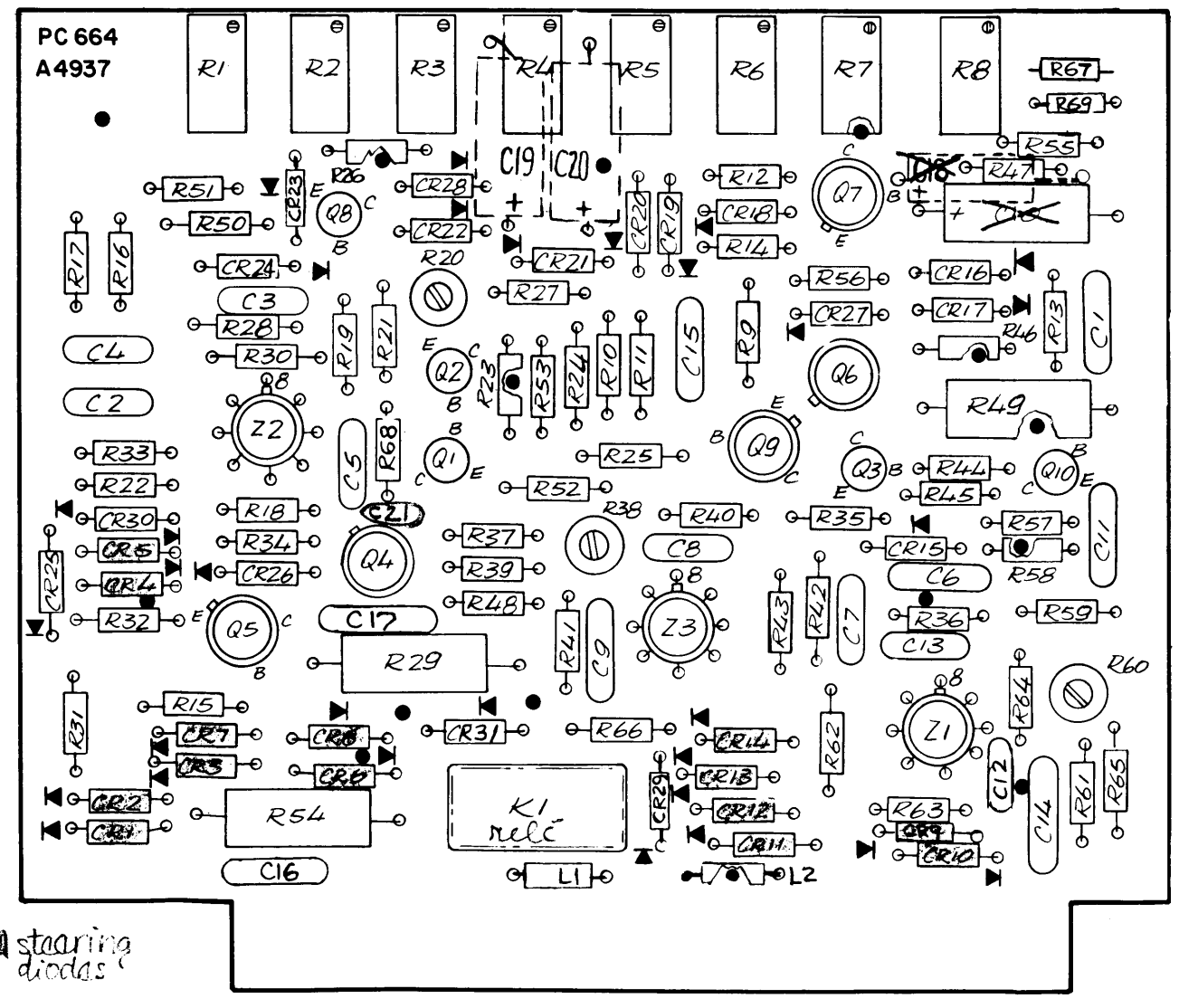


Figure 6-9. Preposition Card, Assembly Diagram

PC 664/A 4937
XA 105

6-25-16-20

Parts List for Preposition A-4937

SYMBOL	DESCRIPTION	TMC P/N
C1	Capacitor, Fixed, Ceramic	CC100-28
C2	Same as C1	
C3	Capacitor, Fixed, Ceramic	CC100-43
C4	Samc as C1	
C5	Capacitor, Fixed, Ceramic	CC100-29
C6	Same as C1	
C7	Same as C5	
C8	Same as C3	
C9	Same as C1	
~~C10~~ not used	~~Capacitor, Fixed, Electrolytic~~	~~CE105-100-16~~
C11	Same as C1	
C12	Same as C5	
C13	Same as C3	
C14 thru C17	Same as C1	
~~C18~~ not used	~~Capacitor, Fixed, Electrolytic~~	~~CE105-25-16~~
C19	Capacitor, Fixed, Electrolytic	CE105-100-25
C20	Same as C19	
CR1 thru CR23	Diode (C21 fixed electrolytic CE 105-25-16)	1N645
CR24 thru CR30	Diode	1N100
CR31	Diode	1N957
K1	Relay	RL143-5
L1	Coil, Fixed, R-f	CL275-121
L2	Same as L1	
Q1	Transistor	2N3646
Q2	Same as Q1	
Q3	Same as Q1	
Q4	Transistor	2N1595
A5	Transistor	2N696
Q6	Same as Q4	
Q7	Same as Q5	
Q8	Same as Q5	
Q10	Same as Q1	
R1 thru R8	Resistor, Variable Composition	RV119-1-502A
R9	Resistor, Fixed, Composition	RC07GF182J
R10	Same as R9	
R11	Resistor, Fixed, Composition	RC07GF103J
R12	Same as R9	
R13	Same as R11	
R14	Same as R9	
R15	Resistor, Fixed, Composition	RC07GF222J
R16	Same as R11	
R17	Same as R11	
R18	Resistor, Fixed, Composition	RC07GF104J
R19	Resistor, Fixed, Composition	RC07GF123J
R20	Resistor, Variable, Composition	RV124-1-502
R21	Resistor, Fixed, Composition	RC07GF273J
R22	Same as R11	
R23	Resistor, Fixed, Composition	RC07GF472J
R24	Resistor, Fixed, Composition	RC07GF221J
R25	Same as R11	
R26	Same as R11	
R27	Resistor, Fixed, Composition	RC07GF562J
R28	Resistor, Fixed, Composition	RC07GF152J
R29	Resistor, Fixed, Composition	RC42GF221J
R30	Same as R24	
R31	Same as R23	
R32 (R34)	Resistor, Fixed, Composition	RC07GF102J
R33 thru R35	Same as R24	
R36	Same as R11	
R37	Same as R19	
R38	Same as R20	
R39 (same as R28)	Same as R21	
R40	Same as R28	
R41	Resistor, Fixed, Composition	RC07GF682J
R42	Same as R11	
R43	Same as R18	
R44	Same as R11	
R45	Same as R32	
R46	Same as R11	
R47	Resistor, Fixed, Composition	RC07GF822J
R48	Same as R27	
R49	Resistor, Fixed, Composition	RC32GF102J
R50 thru R52	Same as R11	
R53	Same as R32	
R54	Same as R29	
R55	Same as R11	
R56	Resistor, Fixed, Composition	RC07GF473J
R57	Same as R24	
R58	Same as R11	
R59	Same as R19	
R60	Same as R20	
R61	Same as R21	
R62	Same as R28	
R63	Same as R15	
R64	Same as R18	
R65	Same as R11	
R66	Same as R11	
R67	Same as R27	
R68	Resistor,	
R69	Same as I	
Z1 thru Z3	Integrated	

9		
8		
8		
Fixed, Composition		RC07GF104J
Fixed, Composition		RC07GF152J
Fixed, Composition		RC07GF123J
Fixed, Composition		RC07GF273J
8		
Fixed, Composition		RC07GF223J
Fixed, Composition		RC07GF183J
8		
Fixed, Composition		RC07GF221J
9		
21		
Fixed, Composition		RC07GF331J
Variable,		RV124-1-254
ion		
Fixed, Composition		RC07GF470J
8		
R7		
8		
7		
9		
Fixed, Composition		RC07GF471J
Fixed, Composition		RC07GF473J
26		
24		
Fixed, Composition		RC42GF102J
Fixed, Composition		RC07GF151J
24		
9		
Fixed, Composition		RC07GF101J
33		
FIXED, COMPOSITION		RC07GF472J
Fixed, Composition		RC32GF222J
Fixed, Composition		~~RC07GF472J~~ same as R42
Fixed, Composition		RC42GF221J
7		
9		
5		
26		
8		
Variable,		RV124-1-502
ion		
FIXED, COMPOSITION		RC07GF302J
R53	Resistor, Fixed, Composition	RC07GF681J
R54	Same as R8	
R55	Same as R9	
TP1 thru TP4	Terminal, Stud	TE127-2
Z1	Integrated Circuit	NW194
Z2	Integrated Circuit	NW156

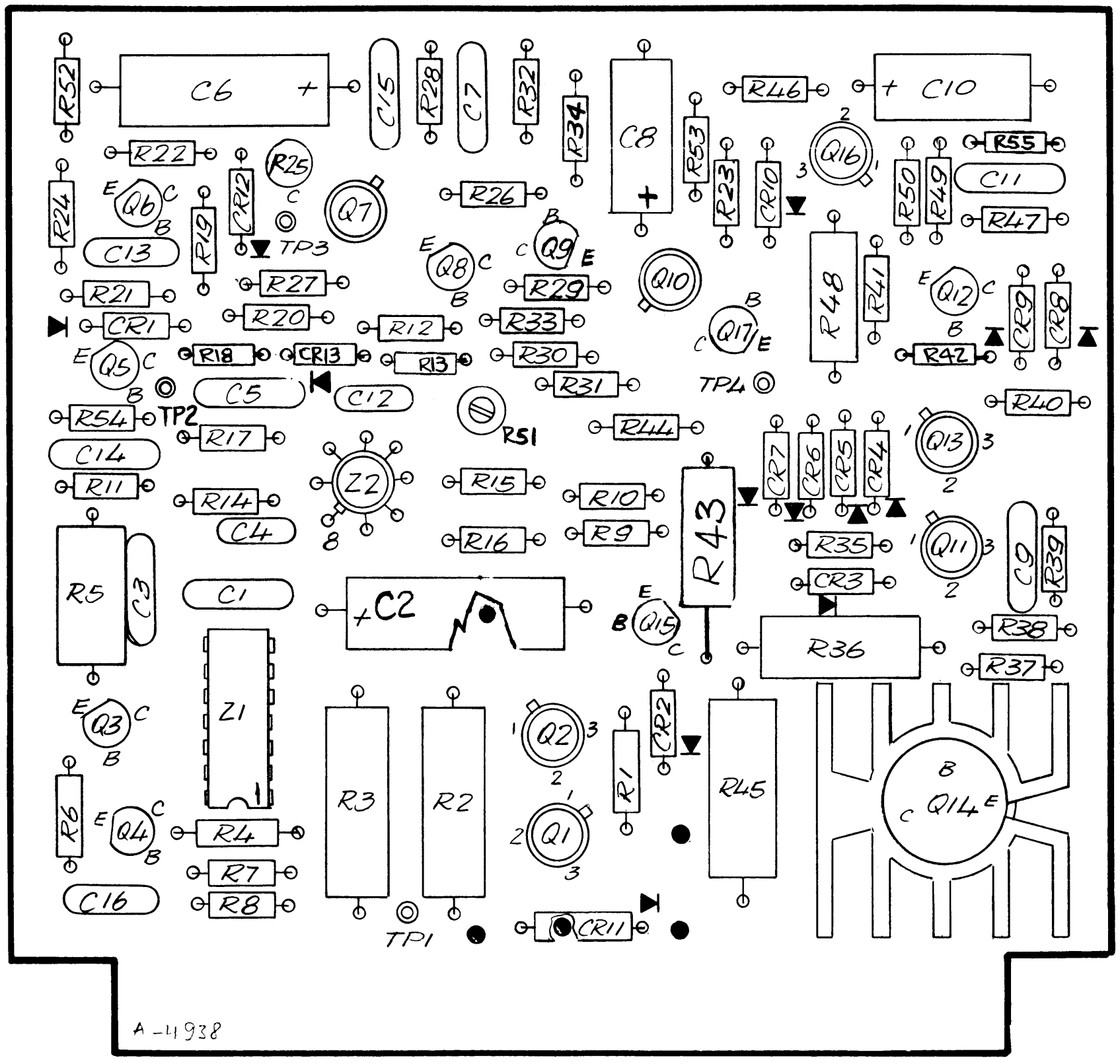


Figure 6-10. Control Card, Assembly Diagram

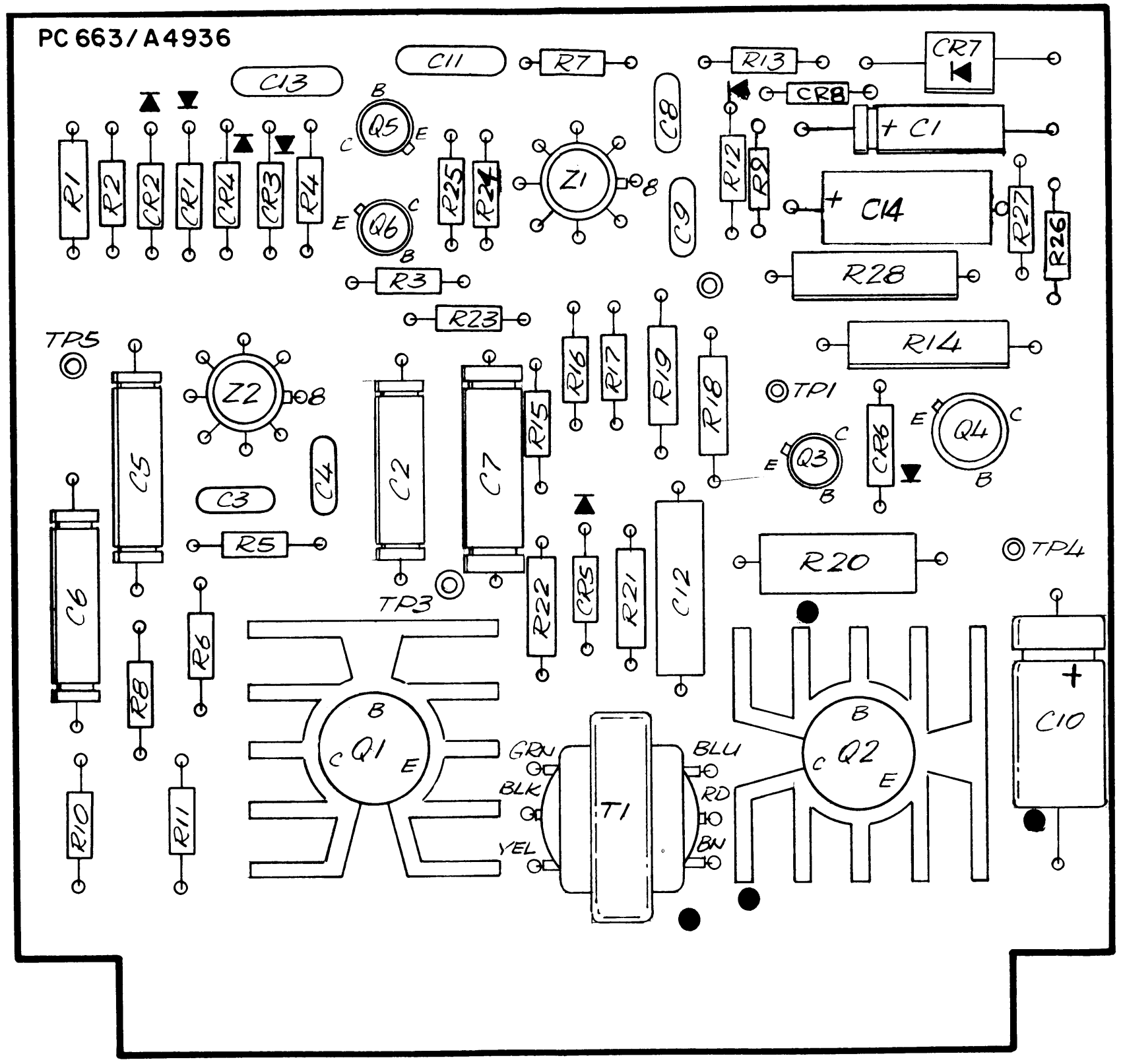
XA 103
PC 665/A4938

Parts List for Control Board A-4938

SYMBOL	DESCRIPTION	TMC P/N
C1	Capacitor, Fixed, Ceramic	CC100-28
C2	Capacitor, Electrolytic	CE105-100-15
C3	Same as C1	
C4	Capacitor, Fixed, Ceramic	CC100-29
C5	Same as C1	
C6	Same as C2	
C7	Same as C1	
C8	Capacitor, Electrolytic	CE105-10-16
C9	Same as C1	
C10	Same as C2	
C11	Same as C1	
C12	Same as C4	
C13 thru C16	Same as C1	
CR1	Diode	1N100
CR2	Same as CR1	
CR3	Diode	1N645
CR4	Same as CR1	
CR5	Same as CR3	
CR6 thru CR10	Same as CR1	
CR11	Diode	1N957
CR12	Same as CR11	
CR13	Diode	1N914
Q1	Transistor, Triac	40526
Q2	Same as Q1	
Q3 thru Q6	Transistor	2N3646
Q7	Transistor	2N1671
Q8	Same as Q3	
Q9	Same as Q3	
Q10	Same as Q7	
Q11	Transistor, SCR	2N1595
Q12	Same as Q3	
Q13	Same as Q11	
Q14	Transistor	2N1485
Q15	Transistor	2N696
Q16	Same as Q11	
Q17	Same as Q3	
R1	Resistor, Fixed, Composition	RC20GF102J
R2	Resistor, Fixed, Composition	RC42GF103J
R3	Same as R2	
R4	Resistor, Fixed, Composition	RC20GF103J
R5	Resistor, Fixed, Composition	RC32GF332J
R6	Resistor, Fixed, Composition	RC07GF393J
R7	Resistor, Fixed, Composition	RC07GF222J
R8	Resistor, Fixed, Composition	RC07GF103J
R9	Resistor, Fixed, Composition	RC07GF102J
R10	Same as R9	
R11	Same as R8	
R12	Same as R8	
R13	Resistor, Fixed, Composition	RC07GF104
R14	Resistor, Fixed, Composition	RC07GF152
R15	Resistor, Fixed, Composition	RC07GF123
R16	Resistor, Fixed, Composition	RC07GF273
R17	Same as R8	
R18	Resistor, Fixed, Composition	RC07GF223
R19	Resistor, Fixed, Composition	RC07GF183
R20	Same as R8	
R21	Resistor, Fixed, Composition	RC07GF221
R22	Same as R9	
R23	Same as R21	
R24	Resistor, Fixed, Composition	RC07GF331
R25	Resistor, Variable, Composition	RV124-1-25
R26	Resistor, Fixed, Composition	RC07GF470
R27	Same as R8	
R28	Same as ~~R7~~ R7	
R29	Same as R8	
R30	Same as R7	
R31	Same as R9	
R32	Resistor, Fixed, Composition	RC07GF471
R33	Resistor, Fixed, Composition	RC07GF473
R34	Same as R26	
R35	Same as R24	
R36	Resistor, Fixed, Composition	RC42GF102
R37	Resistor, Fixed, Composition	RC07GF151
R38	Same as R24	
R39	Same as R9	
R40	Resistor, Fixed, Composition	RC07GF101
R41	Same as R33	
R42	~~Same as R7~~ FIXED, COMPOSITION	RC07GF472
R43	Resistor, Fixed, Composition	RC32GF222
R44	~~Resistor, Fixed, Composition~~	~~RC07GF472~~
R45	Resistor, Fixed, Composition	RC42GF221
R46	Same as R7	
R47	Same as R9	
R48	Same as R5	
R49	Same as R26	
R50	Same as R8	
R51	Resistor, Variable, Composition	RV124-1-50
R52	~~Same as R7~~ FIXED, COMPOSITION	RC07GF

Ø03742102
A4938-Ø

TMC P/N			
CE105-5-25	R18	Resistor, Fixed, Composition	RC20GF431J
CX118E2N60C1	R19	Resistor, Fixed, Composition	RC20GF222J
CC100-6	R20	Resistor, Fixed, Composition	RC32GF222J
CC100-41	R21	Resistor, Fixed, Composition	RC20GF1R0J
	R22	Same as R21	
CX118E1R5N75C1	R23	Same as R3	
CX118E10N15C1	R24	Resistor, Fixed, Composition	RC07GF181J
	R25	Same as R24	
	R26	Same as R3	
	R27	Resistor, Fixed, Composition	RC07GF561J
CC100-7	R28	Resistor, Fixed, Composition	RC32GF560J
CN114R068-5J	TP1 thru TP5	Terminal, Stud	TE127-2
CC100-25	T1	Transformer	TF425
1N914	Z1	Integrated Circuit	NW156
	Z2	Same as Z1	
1N277			
1N4245			
1N957			
1N1780			
2N1485			
2N2222			
2N3499			
RC20GF473J			
RC07GF682J			
RC07GF102J			
RC07GF332J			
RC07GF273J			
RC07GF473J			
~~RC07GF823J~~ same as R7 RC07GF152J			
RC07GF272J			
RC07GF103J			
RC07GF123J			
~~RC07GF152J~~ same as R9			
RC32GF511J			
RC07GF223J			
RC07GF471J			



XA 104

Figure 6-11. Output Servo Card, Assembly Diagram

PC 663/A4936

Parts List for Servo Control A-4936

SYMBOL	DESCRIPTION	TMC P/N
C1	Capacitor, Fixed, Electrolytic	CE105-5-25
C2	Capacitor, Fixed, Electrolytic	CX118E2N60C1
C3	Capacitor, Fixed, Ceramic	CC100-6
C4	Capacitor, Fixed, Ceramic	CC100-41
C5	Same as C2	
C6	Capacitor, Fixed, Electrolytic	CX118E1R5N75C1
C7	Capacitor, Fixed, Electrolytic	CX118E10N15C1
C8	Same as C4	
C9	Same as C3	
C10	Same as C1	
C11	Capacitor, Fixed, Ceramic	CC100-7
C12	Capacitor, Fixed	CN114R068-5J
C13	Capacitor, Fixed, Electrolytic	CC100-25
CR1	Diode	1N914
CR2	Same as CR1	
CR3	Diode	1N277
CR4	Same as CR3	
CR5	Diode	1N4245
CR6	Diode	1N957
CR7	Diode	1N1780
CR8	Same as CR1	
Q1	Transistor	2N1485
Q2	Same as Q1	
Q3	Transistor	2N2222
Q4	Transistor	2N3499
Q5	Same as Q3	
Q6	Same as Q3	
R1	Resistor, Fixed, Composition	RC20GF473J
R2	Resistor, Fixed, Composition	RC07GF682J
R3	Resistor, Fixed, Composition	RC07GF102J
R4	Same as R3	
R5	Resistor, Fixed, Composition	RC07GF332J
R6	Resistor, Fixed, Composition	RC07GF273J
R7	Resistor, Fixed, Composition	RC07GF473J
R8	~~Resistor, Fixed, Composition~~	~~RC07GF823J~~ same as R7
R9	~~Same as R8~~ FIXED, COMPOSITION	RC07GF152J
R10	Resistor, Fixed, Composition	RC07GF272J
R11	Resistor, Fixed, Composition	RC07GF103J
R12	Resistor, Fixed, Composition	RC07GF123J
R13	~~Resistor, Fixed, Composition~~	~~RC07GF152J~~ same as R9
R14	Resistor, Fixed, Composition	RC32GF511J
R15	Same as R5	
R16	Resistor, Fixed, Composition	RC07GF223J
R17	Resistor, Fixed, Composition	RC07GF471J
R18		
R19		
R20		
R21		
R22		
R23		
R24		
R25		
R26		
R27		
R28		
TP1 thr		
T1		
Z1		
Z2		

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Parts List for Indicator A-4945

SYMBOL	DESCRIPTION	TMC P/N
C1 thru C6	Capacitor, Fixed, Ceramic	CC100-43
DS1 thru DS6	Lamp, Incandescent	BI132
R1	Resistor, Fixed, Composition	RC07GF152J
R2	Same as R1	

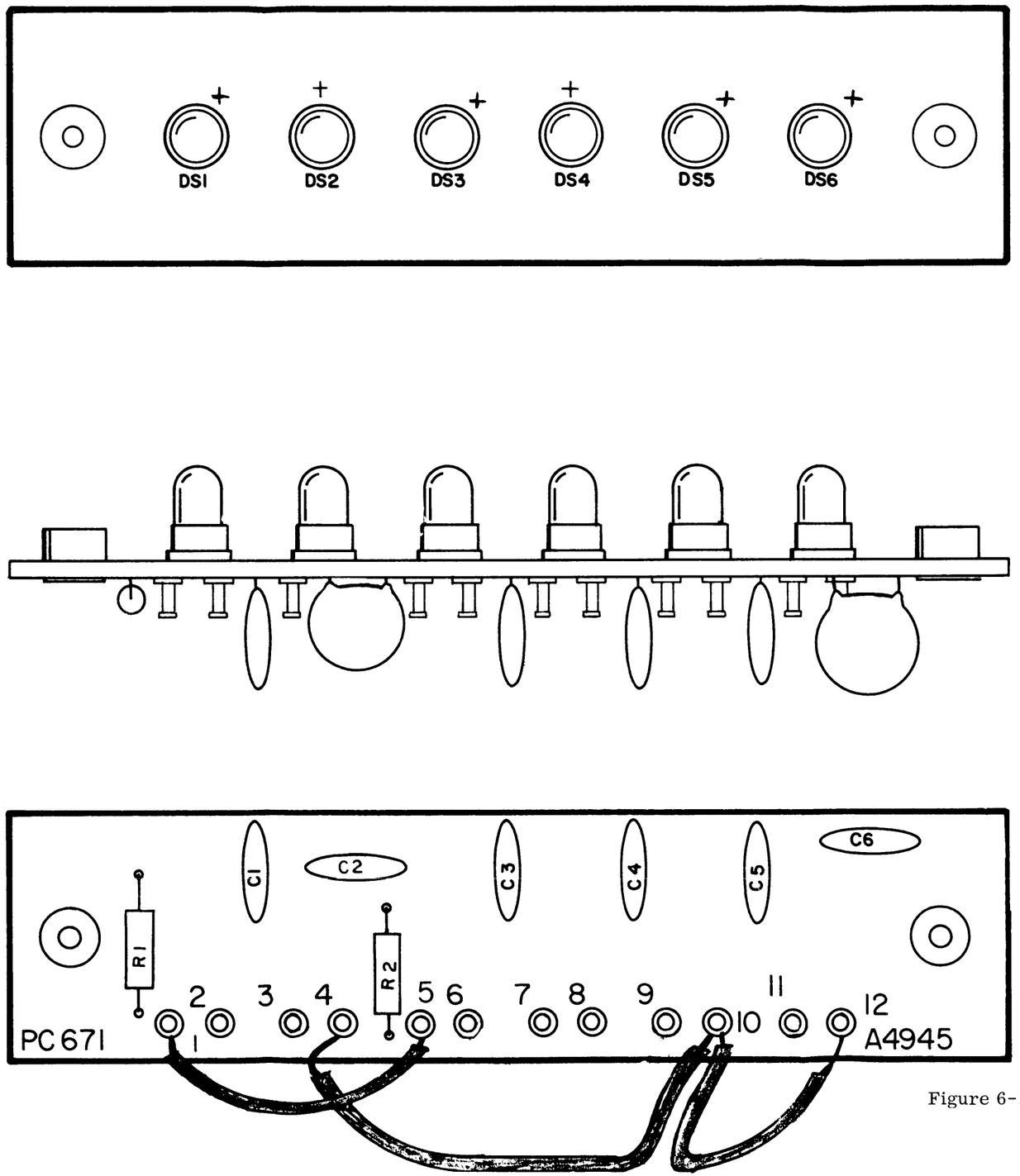

Figure 6-12. Function Indicators, Assembly Diagram

Parts List for Indicators A-4946

SYMBOL	DESCRIPTION	TMC P/N
C1 thru C6	Capacitor, Fixed, Ceramic	CC100-43
DS1 thru DS6	Lamp, Incandescent	BI132
R1	Resistor, Fixed, Composition	RC07GF152J

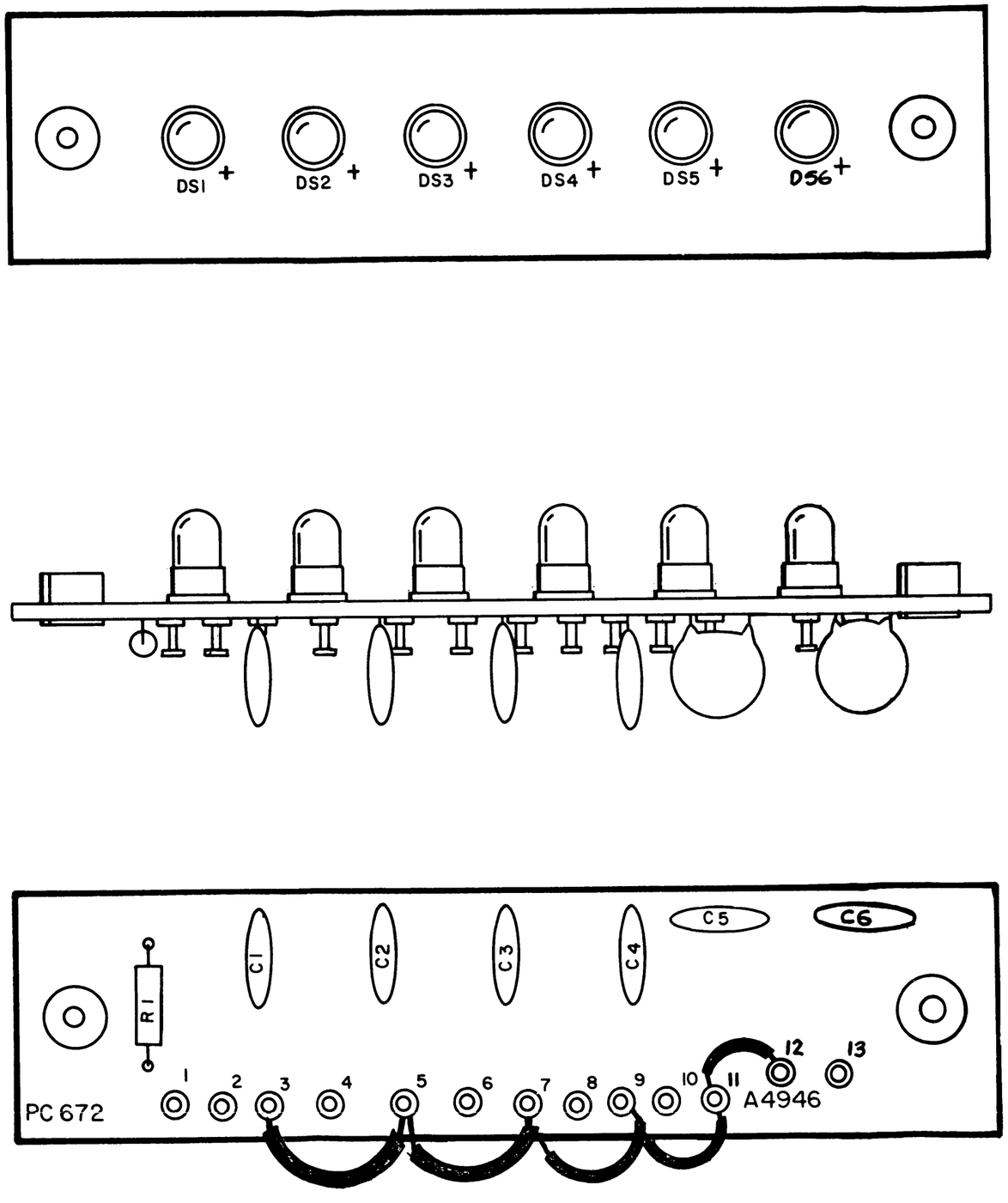

Figure 6-13. Indicator Card, Assembly Diagram

Parts List for C-Sense A-4967

SYMBOL	DESCRIPTION	TMC P/N
C1 thru C5	Capacitor, Fixed, Ceramic	CC100-43
CR1	Diode	1N914
CR2	Same as CR1	
L1	Coil, R-f	CL240-120
R1	Resistor, Fixed, Composition	RC42GF470J
R2	Same as R1	
R3	Resistor, Fixed, Composition	RC42GF221J
R4	Same as R3	
R5 thru R8	Resistor, Fixed, Composition	RC20GF102J
R9	Resistor, Variable, Composition	RV119-1-102A
R10	Resistor, Fixed, Composition	RC20GF103J

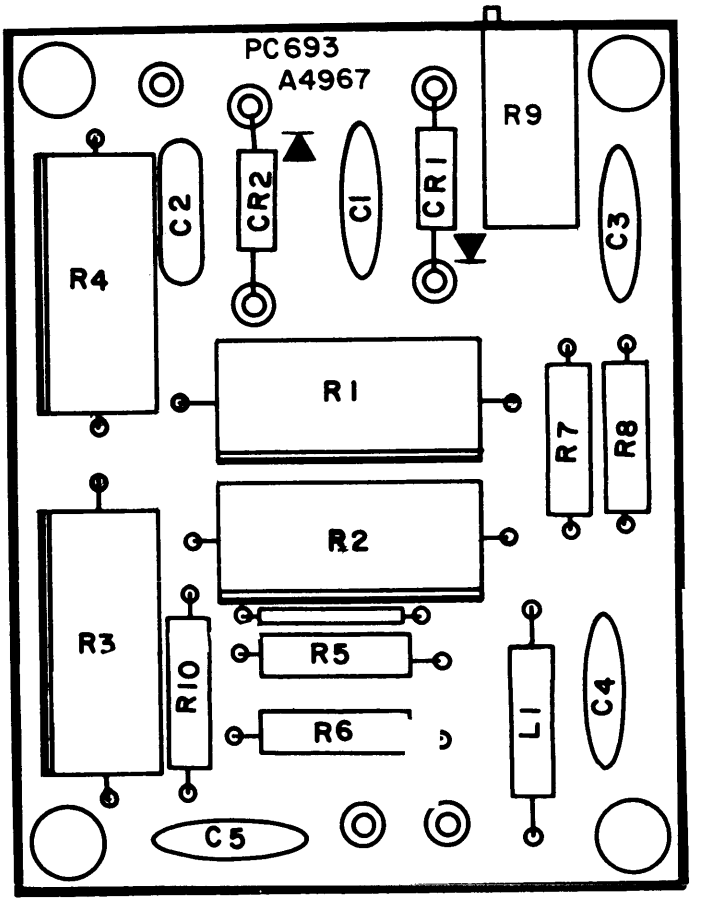

Figure 6-14. C Sensing Circuit, Assembly Diagram

Parts List for L-Sense L-4968

SYMBOL	DESCRIPTION	TMC P/N
C1	Capacitor, Fixed, Mica	CM111F331J5S
C2 thru C5	Capacitor, Fixed, Ceramic	CC100-43
CR1	Diode	1N914
CR2	Same as CR1	
L1	Coil, R-f	CL275-472K
L2	Coil, R-f	CL240-120
R1	Resistor, Fixed, Composition	RC42GF750J
R2	Resistor, Fixed, Composition	RC20GF102J
R3	Same as R2	
R4	Resistor, Fixed, Composition	RC20GF332J
R5	Same as R4	

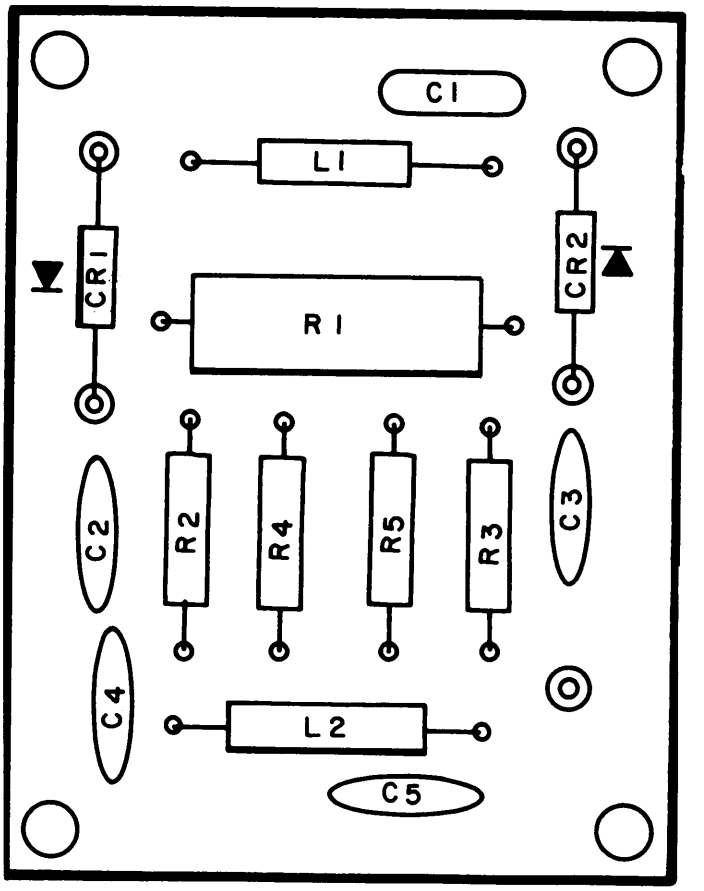

Figure 6-15. L Sensing Circuit, Assembly Diagram

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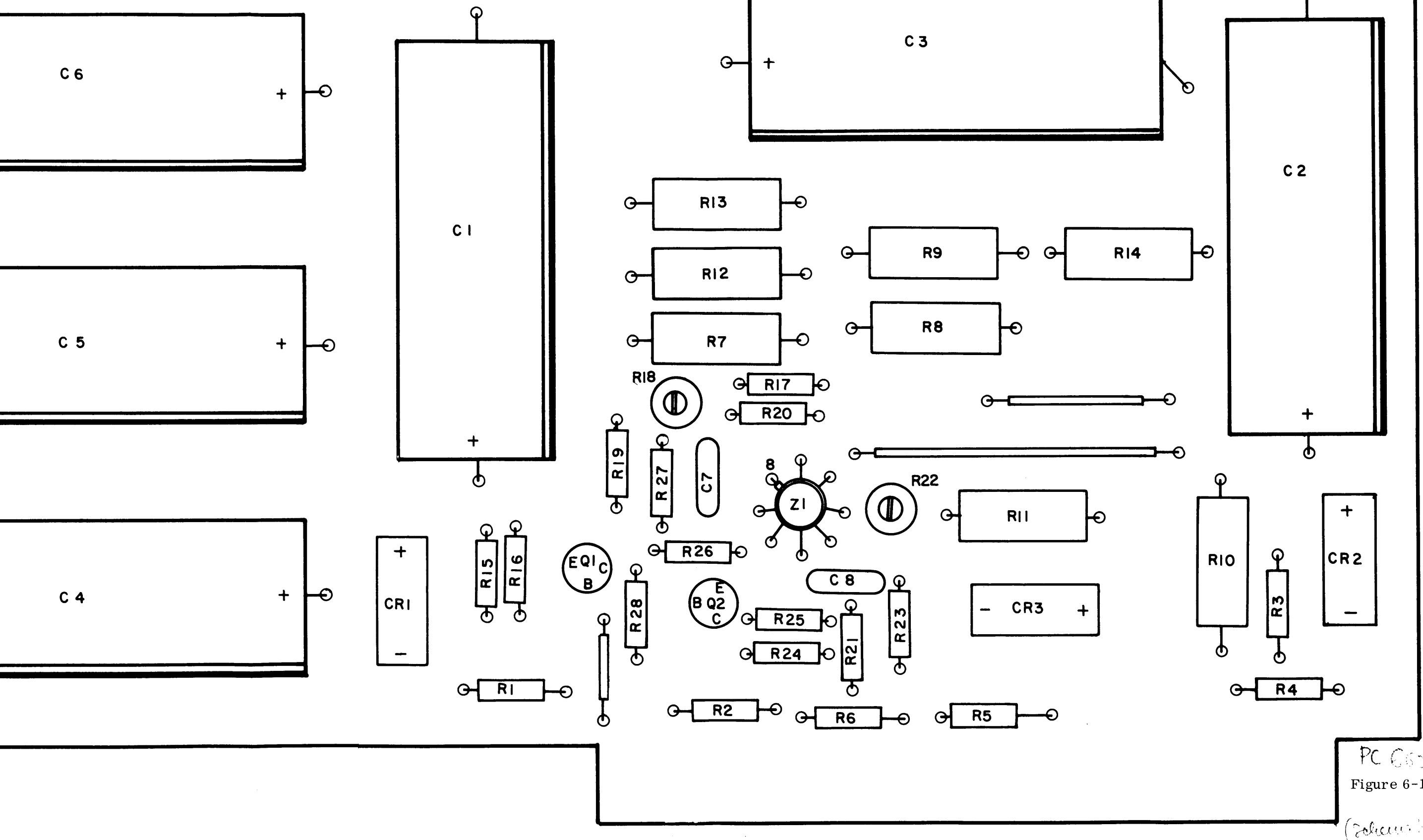


PC662/A4935

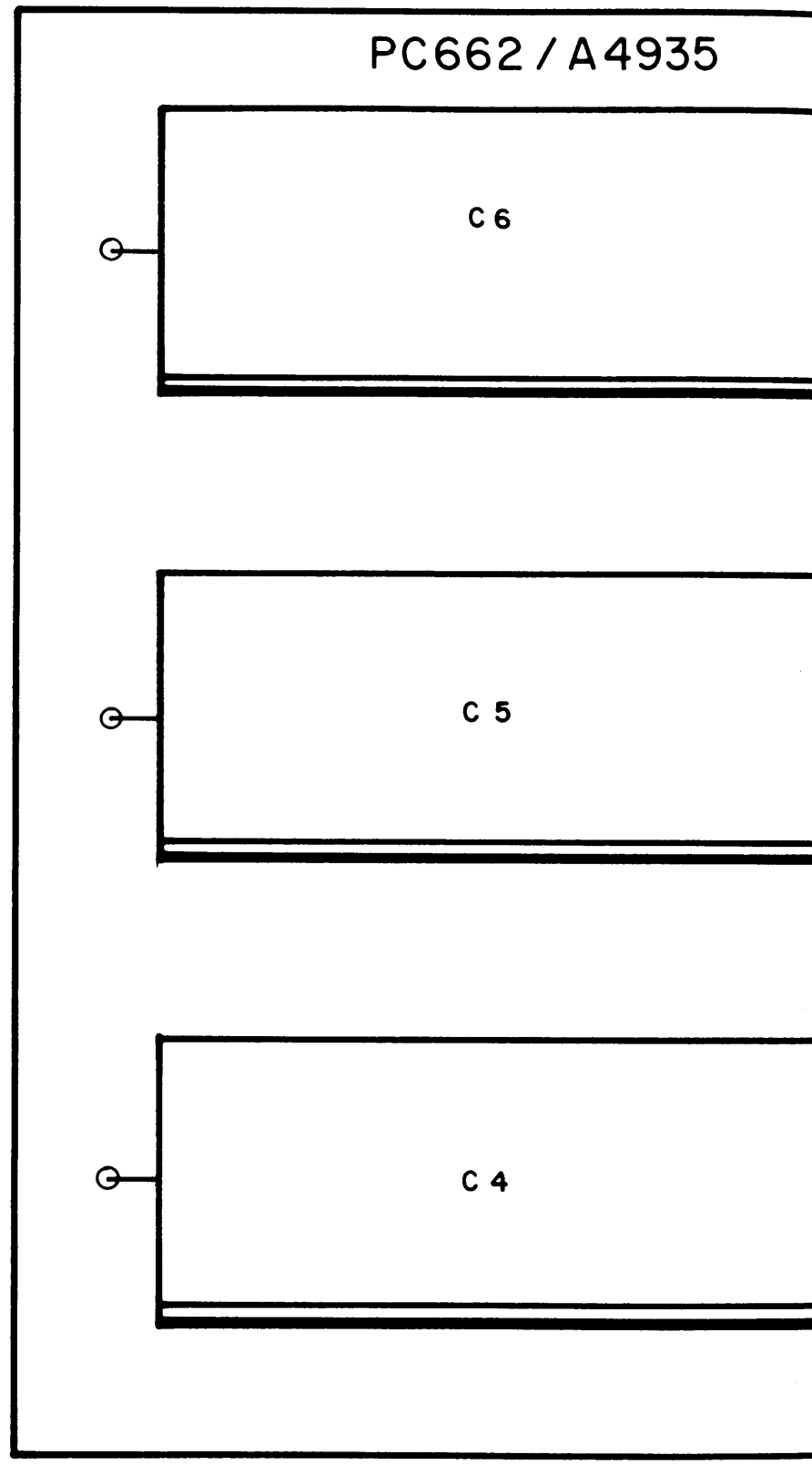
Figure 6-16. Power Supply, Assembly Diagram

(schematic at f. 6-6)

6516-02

Parts List for Power Supply A-4935

SYMBOL	DESCRIPTION	TMC P/N
C1 thru C6	Capacitor, Fixed, Electrolytic	CE116-8VN
C7	Capacitor, Fixed	CC100-29
C8	Same as C7	
CR1	Rectifier, Bridge	DD130-200-3.0
CR2	Rectifier, Bridge	DD130-200-1.5
CR3	Same as CR2	
Q1	Transistor	2N3646
Q2	Same as Q1	
R1 thru R6	Resistor, Fixed, Composition	RC20GF1R0J
R7 thru R9	Resistor, Fixed, Composition	RC42GF100J
R10	Resistor, Fixed, Composition	RC42GF150J
R11	Same as R10	
R12	Resistor, Fixed, Composition	RC42GF220J
R13	Same as R12	
R14	Resistor, Fixed, Composition	RC42GF332J
R15	Resistor, Fixed, Composition	RC07GF102J
R16	Same as R15	
R17	Resistor, Fixed, Composition	RC07GF123J
R18	Resistor, Variable, Composition	RV124-1-502
R19	Resistor, Fixed, Composition	RC07GF273J
R20	Resistor, Fixed, Composition	RC07GF152J
R21	Resistor, Fixed, Composition	RC07GF474J
R22	Resistor, Variable, Composition	RV124-1-103
R23	Same as R21	
R24	Resistor, Fixed, Composition	RC07GF103J
R25	Resistor, Fixed, Composition	RC07GF104J
R26	Resistor, Fixed, Composition	RC07GF222J
R27	Same as R15	
R28	Resistor, Fixed, Composition	RC07GF101J
Z1	Integrated Circuit	NW156



Parts List for Power Supply A-4935

SYMBOL	DESCRIPTION	TMC P/N
B1	Motor, Servo	M0127
C1	Capacitor, Fixed, Ceramic	CC100-44
C2	Same as C1	
J1	Connector, Receptacle	JJ313-1
L1	Coil, R-f	CL133-6R25CW
R1	Resistor, Variable	~~RV117-2-102~~ RV4NAYSA102B
R2	Resistor Board	PC675

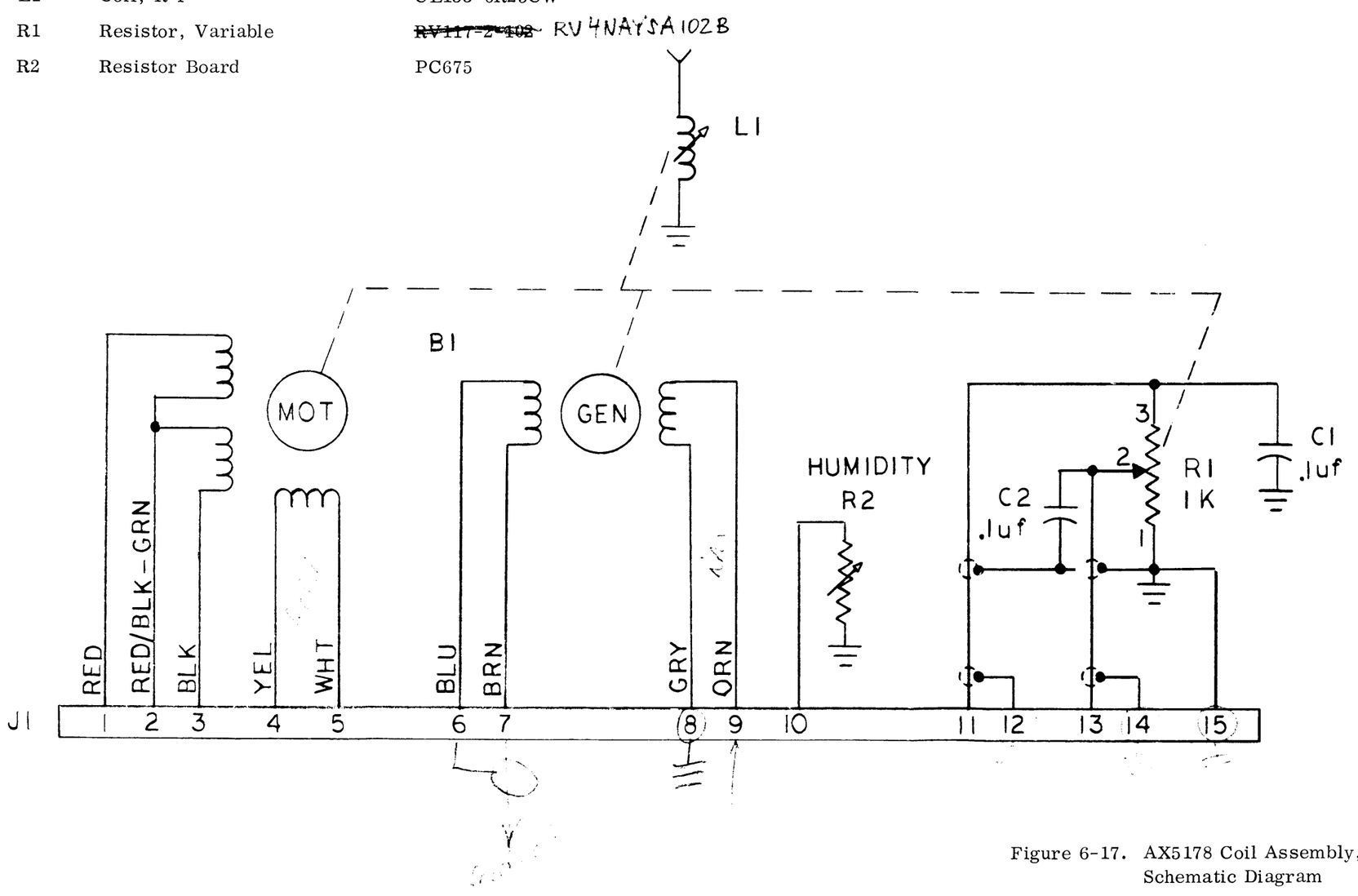
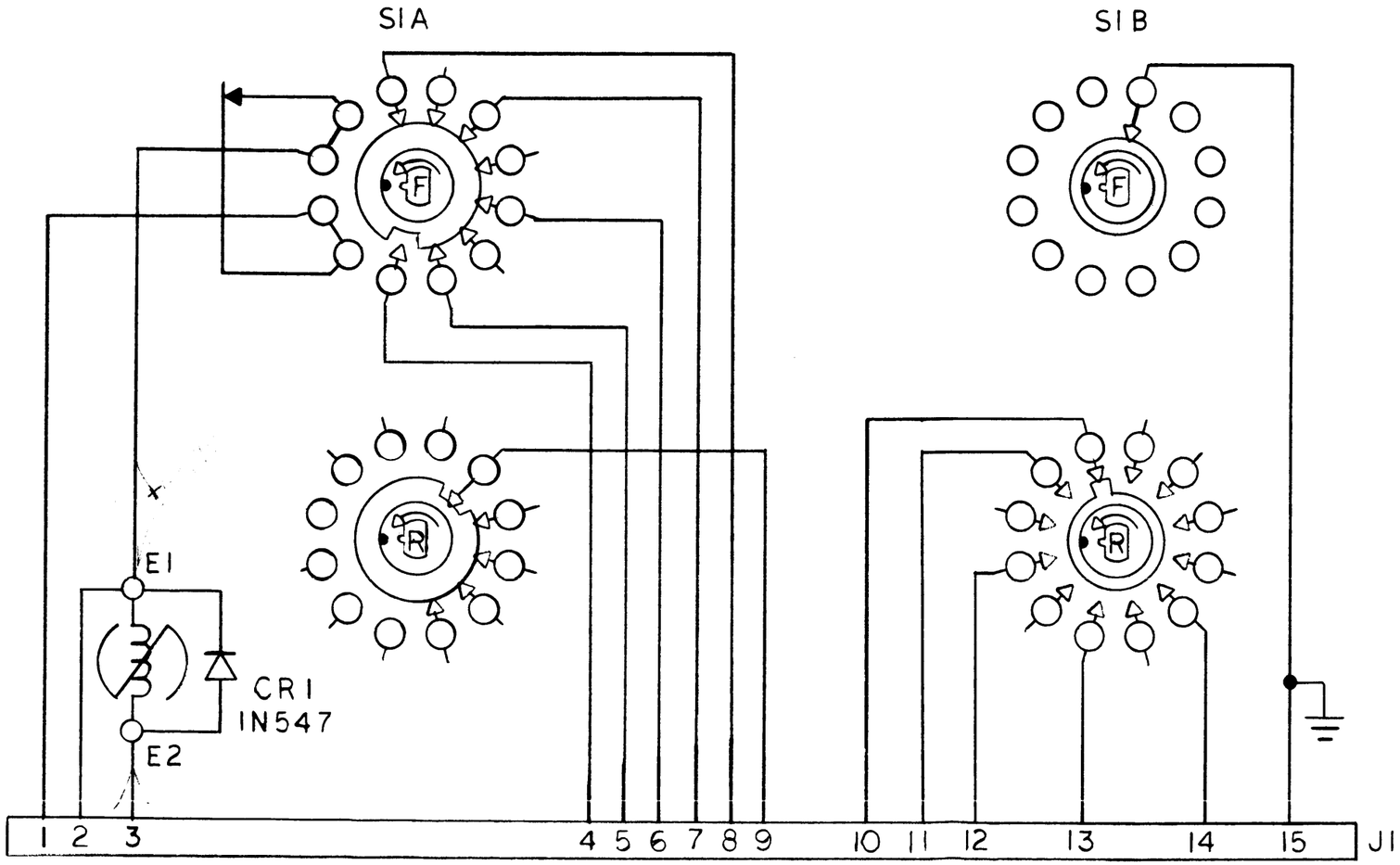


Figure 6-17. AX5178 Coil Assembly, Schematic Diagram

Parts List for Bandswitch Assembly AX5177

SYMBOL	DESCRIPTION	TMC P/N
CR1	Diode	1N547
E1	Terminal, Turret	TE102-2
E2	Same as E1	
J1	Connector, Receptacle	JJ313-1
L1	Coil, R-f	
S1	Switch, Rotary	SW555



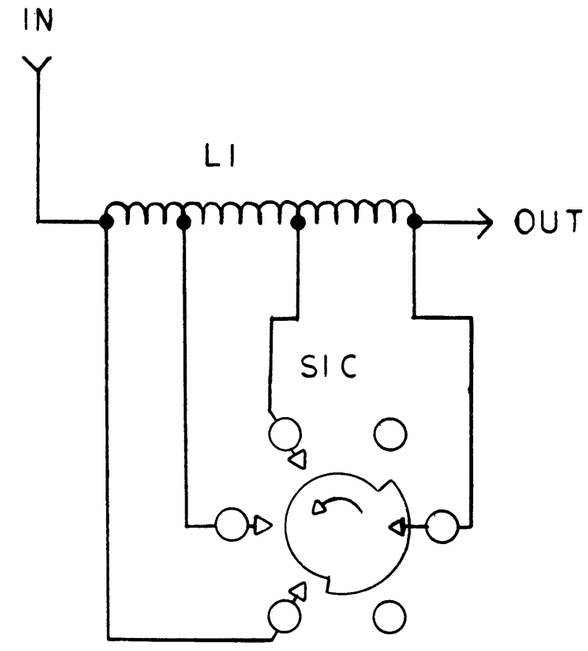


Figure 6-18. AX5177 Bandswitch Assembly, Schematic Diagram

Parts List for Capacitor Assembly AX5179

SYMBOL	DESCRIPTION	TMC P/N
B1	Motor, Servo	M0127
C1	Capacitor, Variable, Vacuum	CB147
C2	Capacitor, Fixed, Ceramic	CC100-44
C3	Same as C2	
J1	Connector, Receptacle	JJ313-1
R1	Resistor, Variable	RV117-2-102

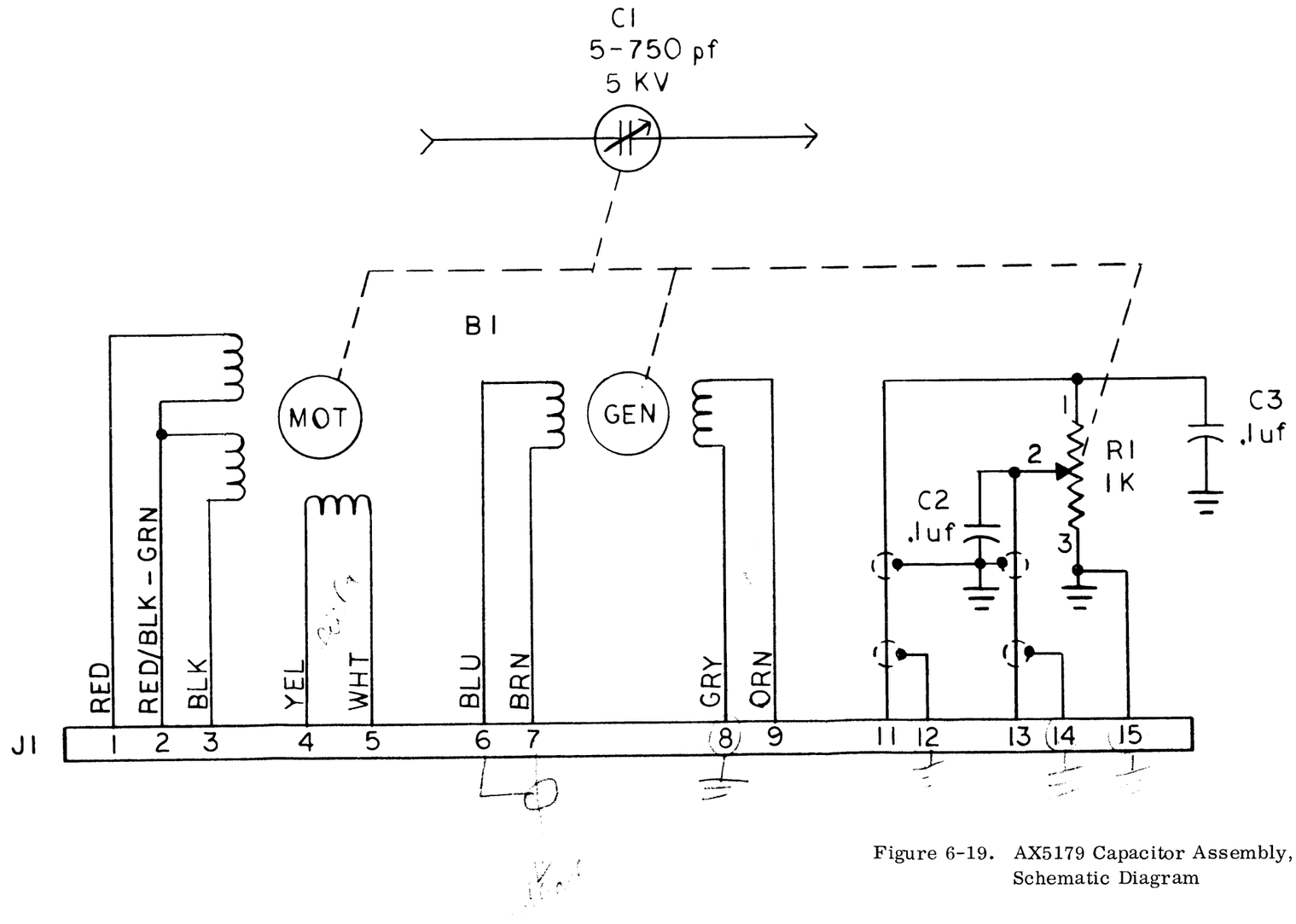


Figure 6-19. AX5179 Capacitor Assembly, Schematic Diagram

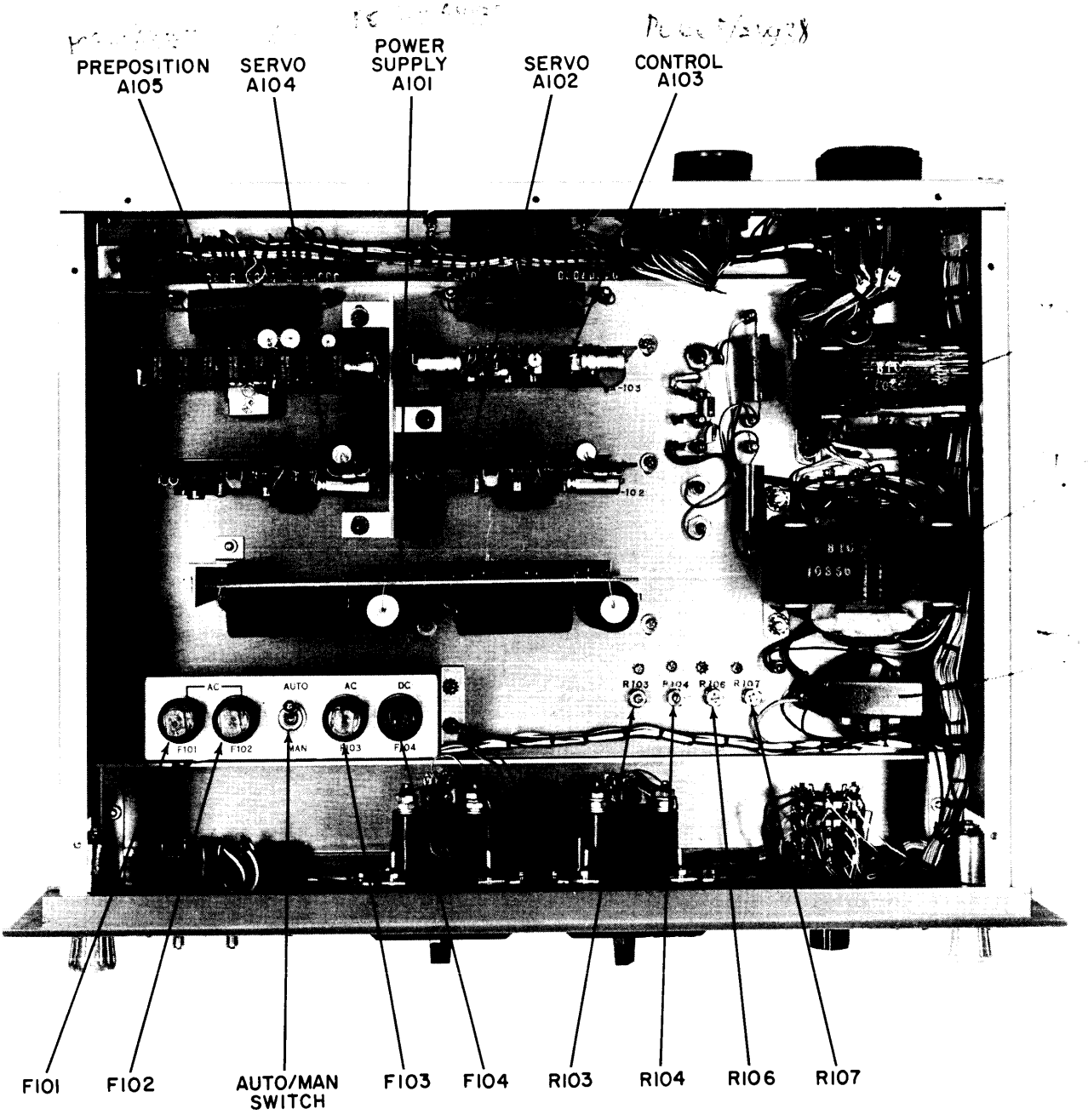


Figure 6-20. AX5175 Control Unit, Top View

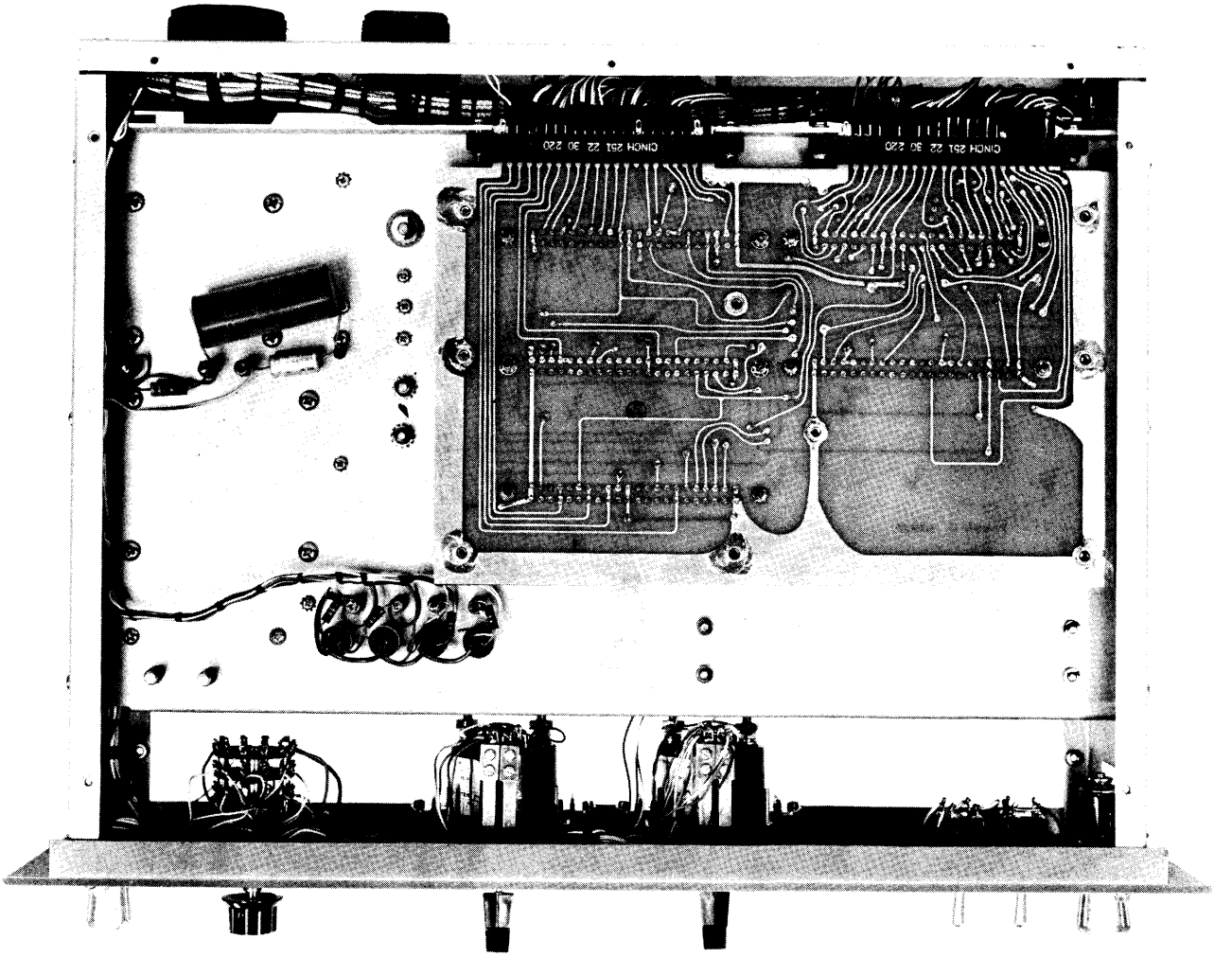


Figure 6-21. AX5175 Control Unit, Bottom View

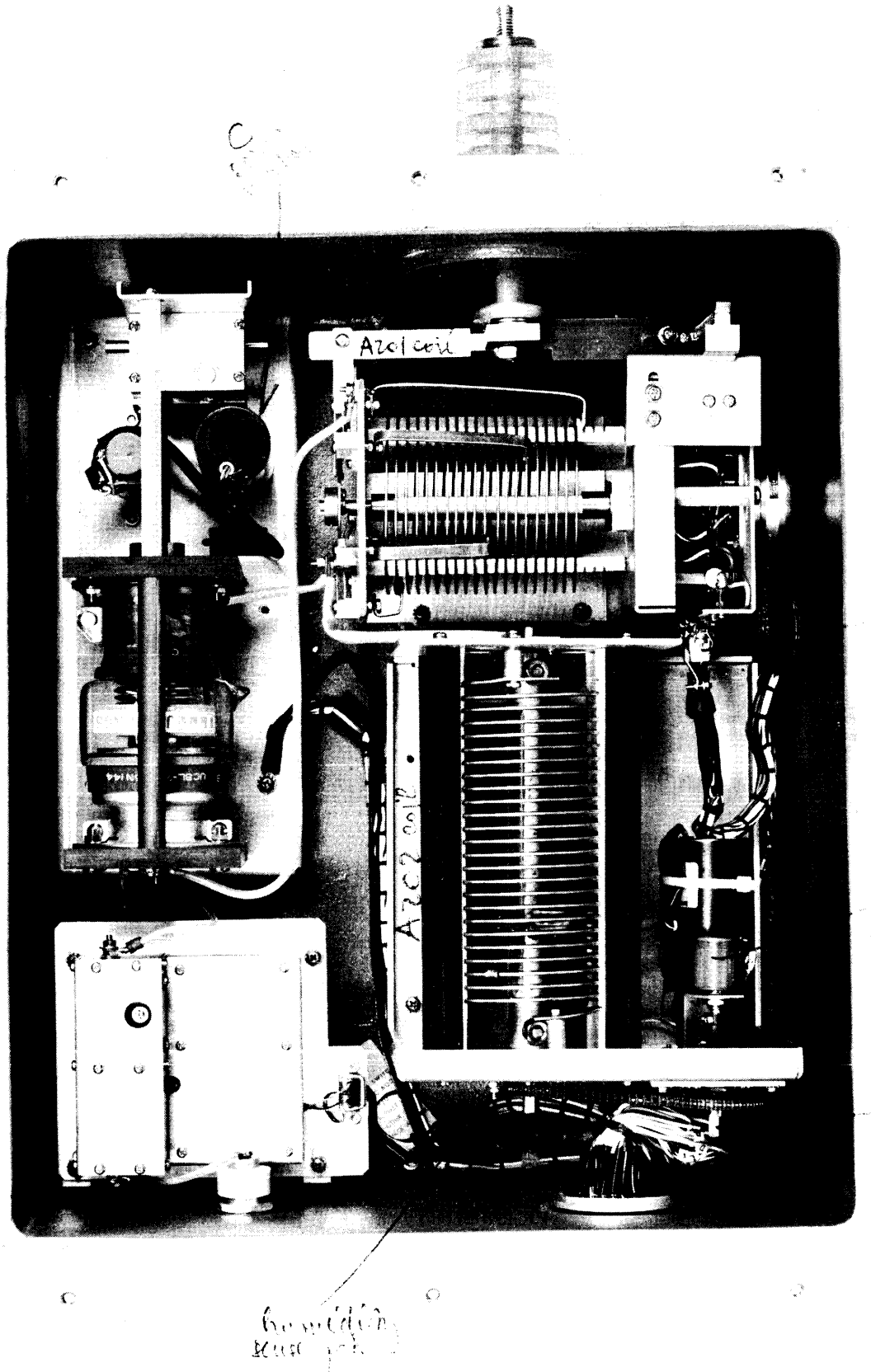


Figure 6-22. AX5176 Tuning Unit, Interior View