TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT

MAINTENANCE MANUAL

RADAR SET AN APN-158A

This copy is a reprint which includes current pages from Changes 1 and 2,

HEADQUARTERS, DEPARTMENT OF THE ARMY

MAY 1972

WARNING

HIGH VOLTAGE

is used in the operation of this equipment

DEATH ON CONTACT

May result if personnel fail to observe safety precautions.

Learn the areas containing high voltage in each piece of equipment.

Be careful not to contact high-voltage connections when installing or operating this equipment.

Before working on the equipment, turn power off and ground points of high potential before touching the equipment.

WARNING

RF BURNS

Radio frequency energy having high-power density can have harmful effects on the human body and can ignite combustible materials. Do not stand directly in front of the antenna reflector. Do not stand closer than 18 feet from the antenna reflector while the radar system is in operation. Keep all combustible materials at least 18 feet from the antenna reflector while the weather radar system is in operation. Refer to AR 40-583 for additional information.

TECHNICAL MANUAL)
)
No. 11-5841-241-34-1)

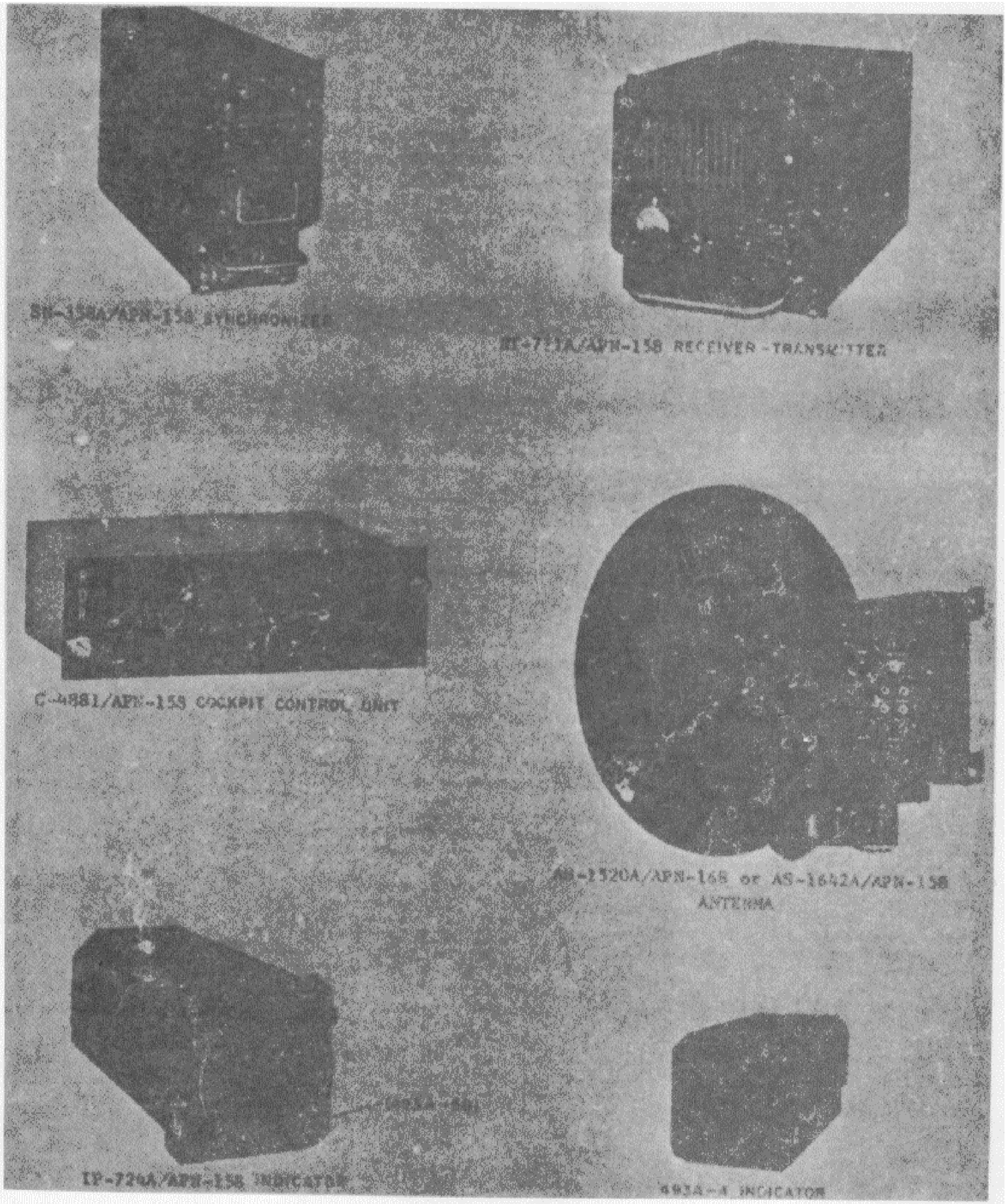
HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., 18 May 1972

RADAR SET AN/APN-158A

LIST OF ILLUSTRATIONS

CHAPTER 1

RADAR SET AN/APN-158A SYSTEM



Radar Set AN/APN-158A
Figure 1-1

Section I. INTRODUCTION

1-1. SCOPE.

This manual provides the overall functioning of Radar Set AN/APN-158A and describes direct support, general support, and depot maintenance of the system. Chapter 1 contains information on the overall system functioning, troubleshooting, testing, aligning, and repair on a system level. Chapters 2 through 7 contain similar information on each of the five individual units of the system. Chapter 8 contains depot overhaul standards for the system.

1-2. INDEXES OF PUBLICATIONS.

A. DA Pam 310-4.

Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

B. DA Pam 310-7.

Refer to the latest issue of DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1-3. REPORTING OF EQUIPMENT MANUAL IMPROVEMENTS.

Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publication) and forwarded direct to Commanding General, U.S. Army Electronic Command, ATTN: DAMSEL-MA-AN, Fort Monmouth, N.J. 07703

NOTE: For applicable forms and records refer to TM 11-5841-241-12.

1-4. LIST OF COMPONENTS. (Refer to figures 1-1 and 1-2.)

The components of Radar Set AN/APN-158A are shown in figure 1-1 and described in figure 1-2. The equipment (except the 495A-4) is referred to by its military nomenclature throughout this manual except in diagrams. A list of commercial-to-military nomenclature conversion is presented below.

1-5. MAINTENANCE CONCEPT.

A. General.

This manual contains maintenance instructions for use at the direct support level, general support level, and depot level. Maintenance capabilities are determined by the test equipments allocated to the different categories of maintenance as listed in the Maintenance Allocation Chart (appendix C of TM 11-5841-241-12). Maintenance personnel should refer to the MAC prior to performing any maintenance. In many instances, some of the maintenance procedures contained in this manual may be performed at the direct support

EQUIPMENT	DESCRIPTION	COLLINS PART NUMBER
RT-711A/APN-158 Receiver-Transmitter	X-band pulse transmitter and receiver.	777-1572-001
SN-358A/APN-158 Synchronizer	Generates synchronous sweep signal with antenna azimuth, provides line of sight stabilization to compensate for roll and pitch of aircraft, and provides video signal.	777-1768-001
493A-4 Indicator	Provides a visual output of the radar information including range and azimuth.	522-6104-005
IP-724A/APN-158	Has longer persistence, brighter display.	777-1770-001
AS-1520A/APN-158 Antenna	Radiates the rf energy pulses, and receives the reflected signals (12-inch reflector).	777-1771-001
AS-1642A/APN-158 Antenna	Same as AS-1520A with 18-inch reflector.	777-1772-001
C4881/APN-158 Cockpit Control Unit	Provides control functions for AN/APN-158A system (components only)	522-5883-004
MT-3069/APN-158 Shockmount	Provides mounting facilities for the 776C-4 Synchronizer.	522-6116-004 (776C-4 Synchronizer)
MT-3068/APN-158 Shockmount	Provides mounting facilities for the RT-711A/APN-158 Receiver-Transmitter.	772-5136-001

Equipment Covered
Figure 1-2

in this manual may be performed at the direct support, general support, or depot level. The nature and extent of maintenance for each category is described in the following paragraphs.

B. Direct Support Maintenance.

Maintenance personnel at this category of maintenance perform maintenance on the components and subassemblies of Radar Set AN/APN-158A and return the repaired item directly to the user. Maintenance at this level consists of troubleshooting, repair of conventional circuits, such as replacement of parts and subassemblies, and alignment and adjustments. Functional tests of system components are performed at this level as required.

C. General Support Maintenance.

Maintenance personnel at this category of maintenance repair components, sub- assemblies, modules, etc. and return the repaired item to the user. This level of maintenance is similar to that described in the preceding paragraph except that maintenance is extended to more complex circuitry and replacement of detail parts within the components and modules of the AN/APN-158A.

D. Depot Level Maintenance.

Maintenance personnel at this level perform complete major overhaul of the equipment. Repair of components containing gear trains, synchros, etc. are performed at this level only by maintenance personnel possessing the necessary specialized skills.

Section II. SYSTEM DESCRIPTION AND OPERATION

1-6. GENERAL.

This section presents purpose, specifications, general description, and general theory of operation of Radar Set AN/APN--158A. Refer to figure 1-1 for an overall view of the Radar Set. All units, except the C4881/APN-158 Cockpit Control Unit, are shown in approximately true relative size. For clarity, the C4881/APN-158 is shown approximately twice relative size.

1-7. PURPOSE OF EQUIPMENT.

Radar Set AN/APN-158A providers a PPI presentation of radar visible weather conditions within 60 degrees to either side of the aircraft heading. Through the use of the ANT tilt control, the system also, provides radar visible presentations of outstanding terrain features such as lakes, streams, shorelines, mountains, and cities along the aircraft heading. The system has a selectable video range presentation of 30, 60, and 150 nautical miles.

Section III. THEORY

1-8. THEORY OF OPERATION.

A. General.

The following paragraphs describe the system theory of operation. The discussion is divided into a simplified block diagram section and a detailed functional block diagram section. For a more detailed discussion, refer to the individual unit overhaul manuals. Refer to paragraph 1-4 for a commercial-to-military nomenclature conversion list. Since the AS-1520A and AS-1642A antennas and IP-724A and 493A-4 Indicators are similar in operation, only the AS-1520A and IP-724A are discussed.

B. Simplified Block Diagram Theory. (Refer to figure 1-3.)

All primary power to Radar Set AN/APN-158A is applied through the RT-711A Receiver-Transmitter. The transmitted pulses are generated in the RT-711A and applied to the AS-1520A Antenna. The reflected signals are received by the AS-1520A and applied to the RT-711A where they are heterodyned, preamplified, and applied to the SN-358A Synchronizer. The SN-358A provides the video signals, control signals, and deflection currents to the IP-724A Indicator.

Synchronization between the AS-1520A reflector motion, in the azimuth plane, and the indicator sweep is accomplished by amplitude modulating the deflection currents that are generated in the SN-358A with azimuth information from the AS-1520A.

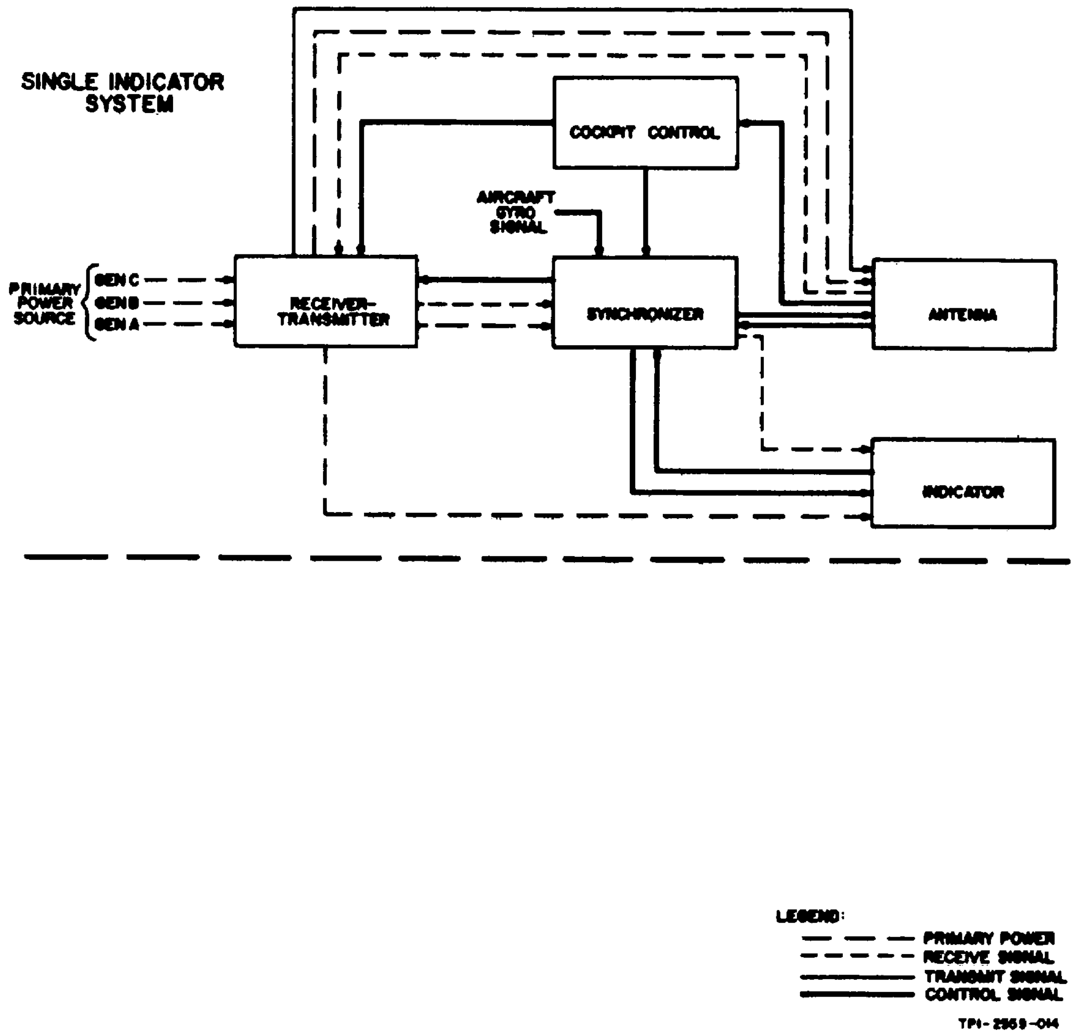
Stabilization of the AS-1520A is accomplished by providing a vertical reference in the form of pitch and roll (analog information) voltages. The analog voltages are provided by the aircraft’s vertical reference gyro.

Radar Set AN/APN-158A is controlled by the C-4881 Cockpit Control Unit. The C-4881 controls the application of primary power to the system. In addition, it permits manual antenna tilt, receiver gain control, and the selection of standby, operate, or contour mode of operation.

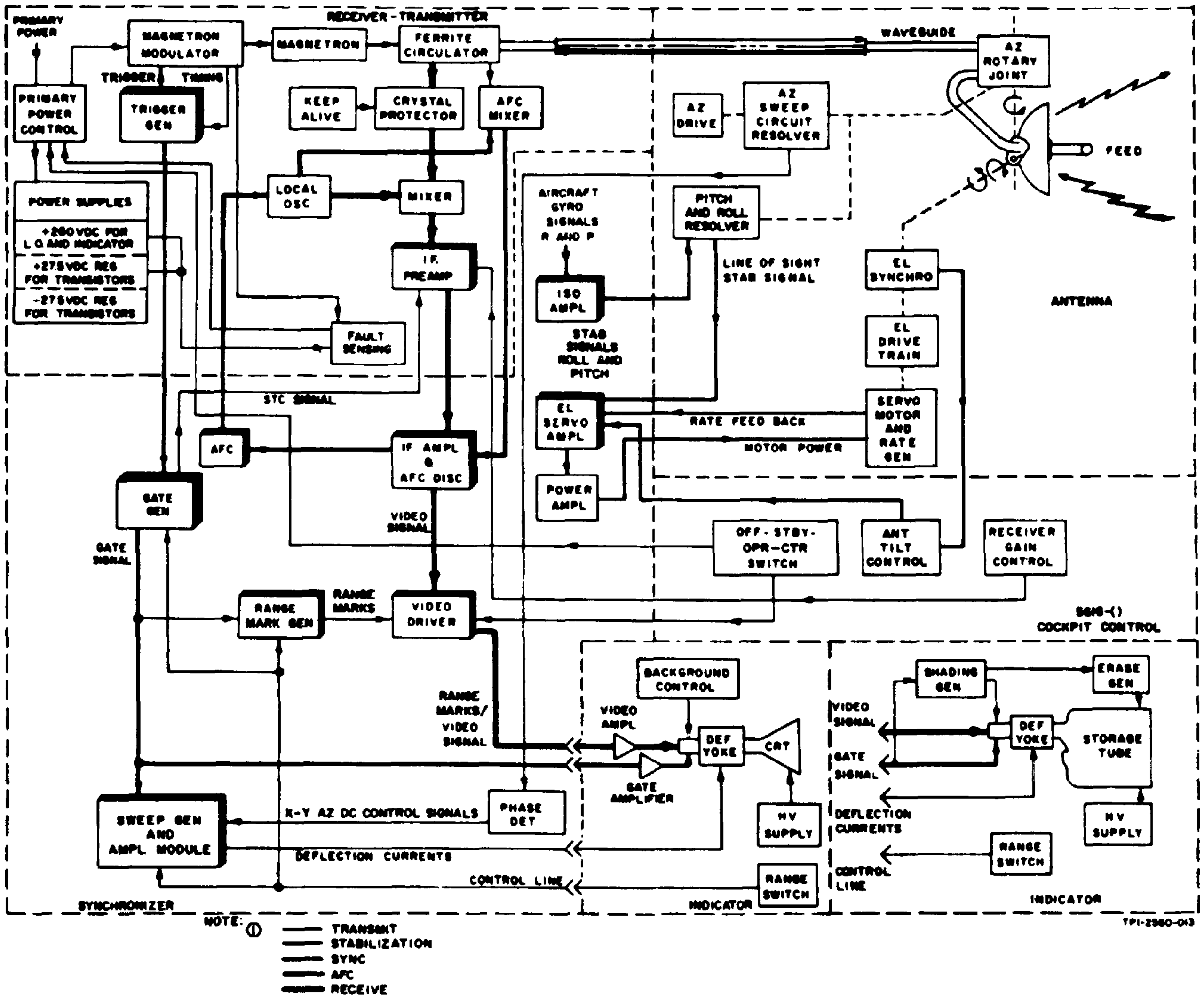
C. Detailed Functional Block Diagram Theory.

(1) General.

Figure 1-4 is a detailed block diagram of Radar Set AN/APM-158A. Primary functions (transmit, receive, synchronization, afc, and stabilization) are shown and identified. Secondary functions are not identified. Both the primary and secondary functions are discussed in detail in the following paragraphs.



Radar Set AN/APN-158, Simplified Block Diagram
Figure 1-3



Radar Set AN/APN-158A, Detailed Block Diagram
Figure 1-4

(2) Transmitter. (Refer to figure 1-5.)

(a) General.

The transmitter section consists of the trigger generator module, magnetron modulator, ferrite circulator (1-way isolator), interconnecting waveguide, and AS-1520A Antenna.

(b) Transmission.

The trigger generator produces the trigger pulse that triggers the magnetron modulator. The magnetron oscillates at 9375 MHz for the duration of each pulse. The ferrite circulator and interconnecting waveguide couple the magnetron output to the AS-1520A.

(c) Receiver Isolation.

The system uses the same AS-1520A and interconnecting waveguide to transmit and receive. To prevent damage to the receiver mixer crystals during transmission, a TR tube is used to provide rf switching for the receiver.

The TR tube is located in the waveguide between the ferrite circulator and signal mixer. During transmission, the phase of the transmitted pulse in such that only a small portion of the transmitted pulse is impressed on the TR tube, which causes the TR tube to ionize. When the TR tube ionizes, the rf is blocked at the receiver output of the ferrite circulator.
This prevents further entry of the transmitted pulse.

The keep-alive supply holds the TR tube near its ionization potential to minimize the amount of rf energy and time required for ionization.

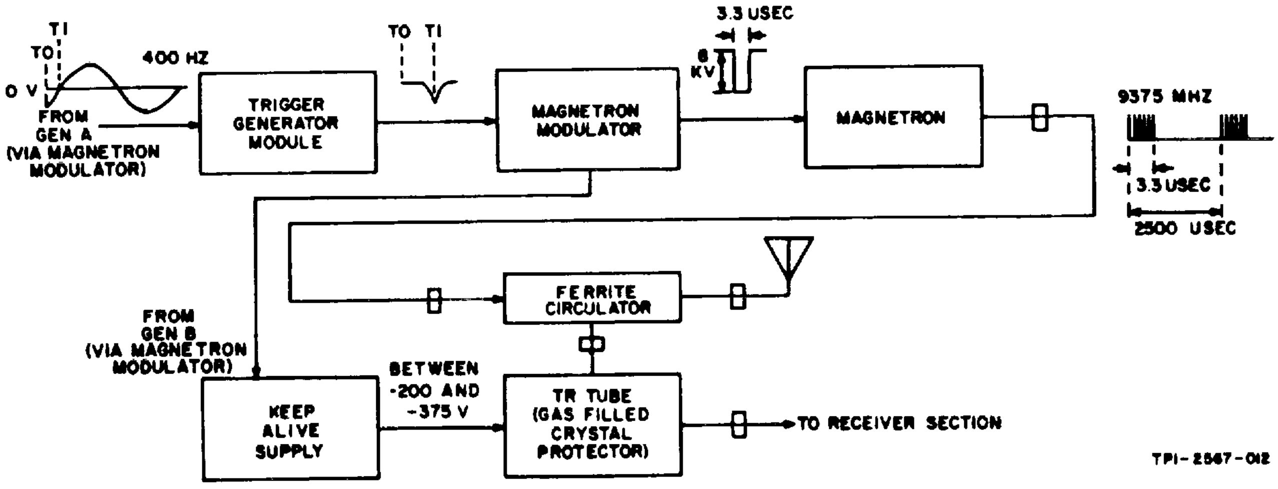
During reception, the waveguide twist assembly and the ferrite circulator direct the received signal into the receiver. In addition, the circulator rotates the energy field of the received signal so that it is not absorbed by the magnetron.

(3) Receiver. (Refer to figure 1-6.)

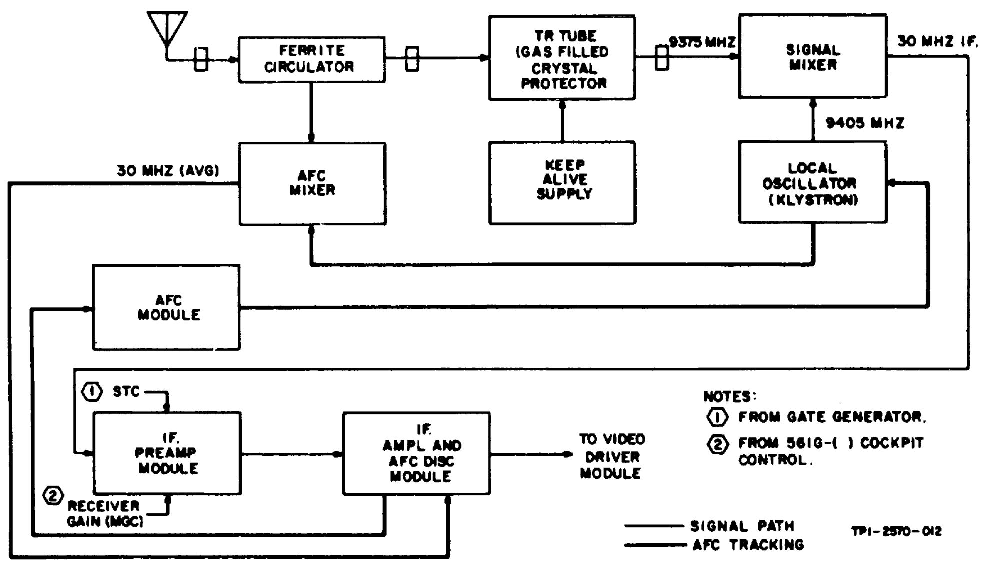
The receiver section consists of the AS-1520A, interconnecting waveguide, ferrite circulator, TR tube and keep-alive supply, signal mixer, local oscillator, if. preamplifier module, if. amplifier and afc discriminator module, and afc circuits.

The ferrite circulator and waveguide twist assembly direct the received signal into the signal mixer. Following the transmitter pulse, the TR tube is deionized, thereby allowing the received signal to enter the signal mixer.

The signal mixer heterodynes the received signal with the output of the local oscillator. This results in a 30-MHz if. that is applied to the if. preamplifier.



Transmitter Section, Functional Block Diagram
Figure 1-5



Receiver Section, Functional Block Diagram
Figure 1-6

There are three factors that determine the gain of the if. preamplifier: age, stc (sensitivity time control), and mgc (manual receiver GAIN control on the C-4881 cockpit control). Agc is internal, automatic, and a function of the received signal strength. Stc, from the gate generator module, controls the gain of the if. preamplifier up to a range of 25 miles. The ate varies the gain at an exponential rate. This is necessary to prevent close range target returns from overdriving the if. preamplifier. Mgc is set by the operator and determines the receiver sensitivity established by the overall gain of the if. preamplifier.

The output of the if. preamplifier is amplified by the if. amplifier. The amplified video output of the if. amplifier varies linearly with the input, then at a selected point, the output varies logarithmically.

(4) Automatic Frequency Control. (Refer to figure 1-6.)

The afc maintains a constant if. by controlling the local oscillator frequency. It consists of the transmitter, the afc mixer, afc discriminator, an attenuator, afc module, and the local oscillator.

The afc mixer heterodynes the output of the local oscillator with the attenuated transmitted rf energy, sampled at the ferrite circulator. The resultant signal, approximately 30 MHz, is applied to the afc discriminator section of the if. amplifier and afc discriminator module. The afc discriminator detects any change in frequency of the 30-MHz signal and converts it to a signal that is applied to the afc module. The discriminator output is a series of pulses whose amplitude is a function of the frequency of the discriminator input. The afc module detects the amplitude of the input pulses, amplifies, and converts the signal to supply a negative de potential to the local oscillator (klystron repeller voltage). The level of the potential supplied by the afc module controls the frequency of oscillation of the klystron to hold the if. at 30 MHz.

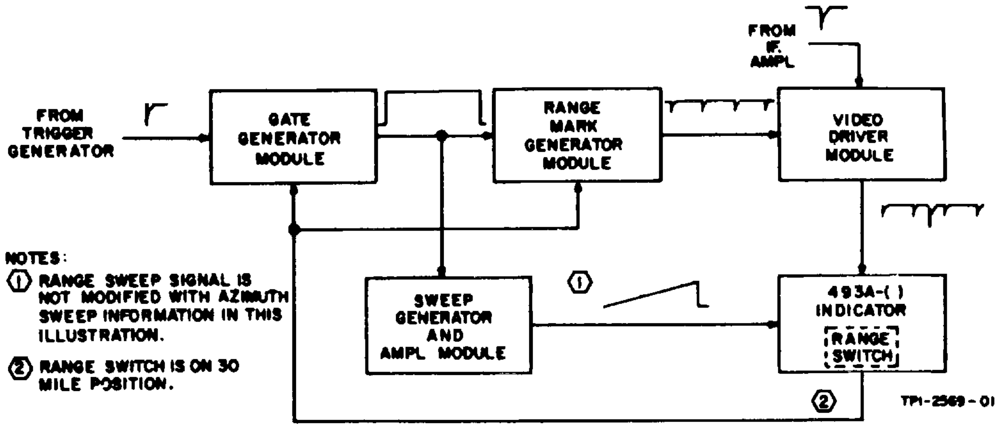
A standardization procedure allows setting each of the various adjustments so that the module and unit are interchangeable.

The afc module also has a sweeping mode of operation in which the klystron frequency is scanned. This mode is used to acquire a lock-on condition immediately after the radar set is turned on.

(5) Display. (Refer to figure 1-7.)

The display system consists of the circuits necessary for presentation of target and range information. The system incorporates the gate generator module, range mark generator module, sweep generator and amplifier module, video driver module, and all circuits in the indicator.

The gate generator, pulsed by the trigger generator, provides output gate pulses at a rate equal to that of the primary power (400 Hz) and a pulse duration equivalent to the desired sweep time for the range selected. The range mark generator supplies 10-, 15-, or 25-mile range marks to the video driver module. The range mark generator is turned on and off by the output from the gate generator. The range marks are added to the target video in the video driver. When the system control switch is in the CTR contour position, received signals above a predetermined level are canceled by the video driver.



Display System, Functional Block Diagram
Figure 1-7

This results in black spots or dark areas in the video presentation that represent severe storm cells. The output of the video driver is applied to the IP-724A Indicator. After amplification (493A-4 only), the video is applied to the cathode-ray tube. The range switch, located on the front panel of the IP-724A, selects the gate time and the frequency of the range marks.

(6) Synchronization/Timing. (Refer to figures 1-7 and 1-8.)

The display circuits measure the time between the transmitted pulse and the received echo. This permits accurate display of range information on the IP-724A. To accomplish this, the triggering of the display circuits is coincident with the transmitted pulse. Figure 1-7 is a block diagram of the display system. Figure 1-8 is the AN/APN-158A system synchronization/ timing chart.

The AN/APN-158A system completes one cycle of operation every 2500 microseconds. During the first 3.3 microseconds, the system is in the transmit mode of operation. This is followed by the received mode. The received mode is followed by a quiescent period in which both the transmitter and receiver are silent. Figure 1-8 shows that the time for one cycle of operation is 645 microseconds greater than the longest range available (150 miles). This prevents received echoes from targets beyond 150 miles from appearing as close range targets on the next cycle of operation. Since 645 microseconds is equal to 52 radar miles*, only received echoes from targets beyond a range of 202 (150 + 52) miles could appear as close range targets. However, the signal level from targets at this range is insignificant.

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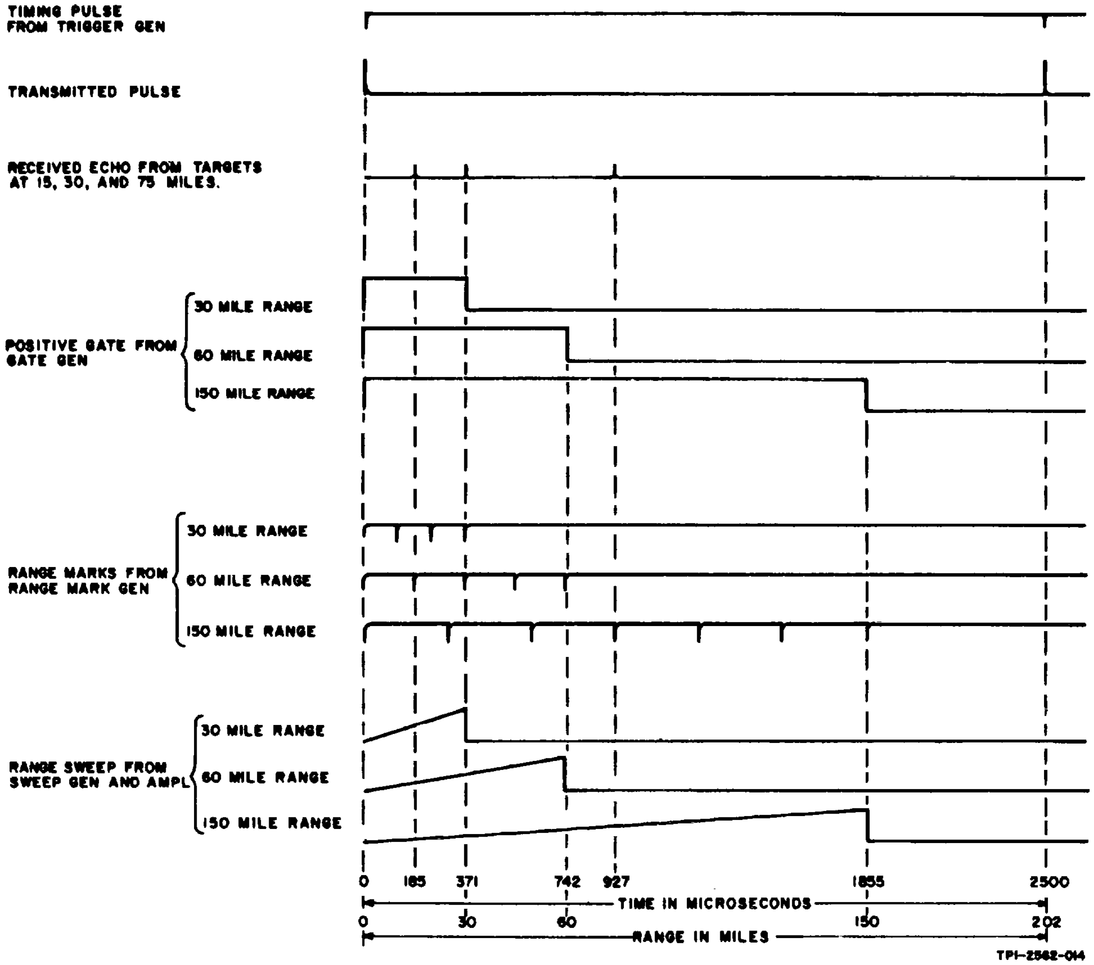
*A radar mile is defined as the time it takes a transmitted pulse to travel 2 miles (1 mile out and 1 mile back).



Radar Set AN/APN-158A, Synchronization/Timing
Figure 1-8

(7) Sweep. (Refer to figure 1-9.)

The sweep system consists of the azimuth sweep resolver, four phase-sensitive detectors, four synchronized sweep generators (sweep generator and amplifier module), and four isolated deflection coils (IP-724A deflection yoke).

The AN/APN-158A system uses an electromagnetically deflected sweep. The deflection currents are generated by the four sweep generators. These cur- rents are modulated by azimuth information from the AS-1520A sweep resolver and applied to the IP-724A deflection yoke to produce a PPI (plan position indicator) sector scan presentation. This presentation is synchronous with the AS-1520A reflector motion. Dc positioning currents, through one vertical yoke winding, position the sweep origin near the bottom center of the lP-724A face.

The two output windings of the azimuth sweep resolver provide azimuth position information. The output signals from the azimuth sweep resolver are processed by the phase detectors to obtain the desired azimuth information. The output of each phase detector amplitude modulates the sweep of each respective sweep generator. The sweep time of each generator is controlled by the gate pulse from the gate generator module.

Each sweep generator drives a deflection coil located around the neck of the IP-724A crt. The composite magnetic field from all four deflection coils deflects the crt electron beam to produce an off-center, sector scan, PPI presentation.

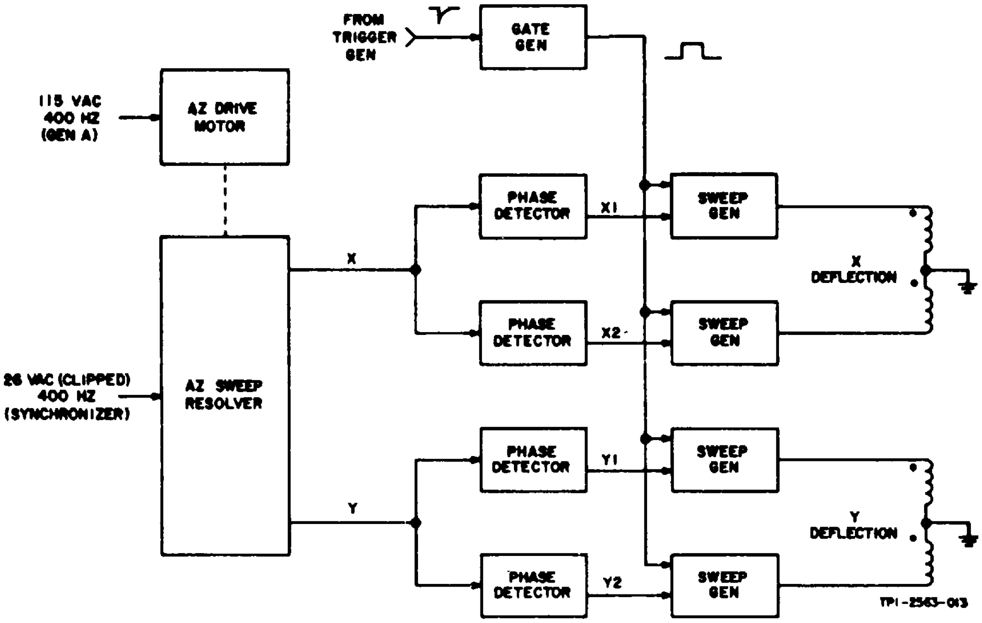
(8) AS-1520A Antenna Stabilization.

(a) General.

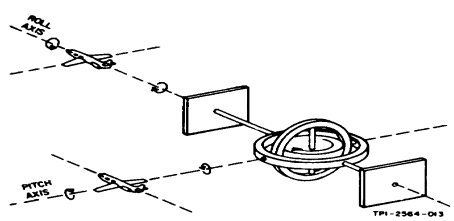
The AS-1520A stabilization system maintains the AS-1520A beam horizontal by compensating for pitch and roll of the aircraft to prevent loss of target presentation on the IP-724A. The AS-1520A positioning circuits form a closed loop servo system. The inputs to the AS-1520A stabilization system are analog voltage signals from the aircraft vertical reference gyro. These signals provide a vertical reference for the AS-1520A. The ANT tilt control on the C-4881 cockpit control modifies the signal to cause the AS-1520A dish to tilt with respect to the vertical reference.

(b) Aircraft Gyro. (Refer to figure 1-10.)

The stabilization system is controlled by the pitch and roll error signals from the aircraft vertical gyro. Since the gyro is free to move within the mounting gimbals in any direction, the aircraft pitches and rolls around the gyro. Pitch and roll synchro transmitters (center-tapped potentiometer in some cases) are attached to the pitch and roll axis. When the aircraft pitches or rolls, an error signal is provided by the corresponding synchro transmitter. The magnitude of the error signal from either the pitch or roll synchro transmitter is determined by the amount and direction of the pitch and roll motion of the aircraft.



Sweep System, Functional Block Diagram
Figure 1-9



Gyro Application, Pictorial Diagram
Figure 1-10

(c) Stabilization System Operation. (Refer to figure FO-1.)

The pitch and roll error signals from the vertical reference gyro are applied to the isolation amplifier module in the SN-358A where the phase of the error signals is properly set and the sensitivity of the gyro is normalized for operation in the system, The phase-corrected, normalized output signals from the isolation amplifier module are applied to the pitch and roll resolver in the AS-1520A.

The output of the pitch and roll resolver is added to the output of the antenna tilt motor rate generator and applied to one input of the elevation servo amplifier in the SN-358A. This signal is a combined elevation error and antenna tilt commend signal. The output of the amplifier is applied to the control winding of the tilt drive motor in the AS-1520A to position the AS-1520A in elevation. A rate generator, part of the tilt drive motor, produces an output voltage that is proportional to the speed of the motor rotation. This signal is returned to the input of the elevation servo amplifier module as degenerative feedback to prevent overshoot or hunting of the AS-1520A.

(d) ANT Tilt Control.

The ANT tilt control enables the operator to position the AS-1520A reflector at a fixed angle above or below horizontal (0-degree elevation). Since the antenna tilt control synchro receives excitation from the elevation synchro in the AS-1520A, the antenna tilt signal is a combined elevation error and antenna tilt command signal. This signal is vectorially added to the output of the pitch and roll resolver, amplified, and applied to the tilt drive motor.

(e) Controls and Adjustments.

Several controls are available in the SN-358A for the proper orientation and adjustment or the stabilization system. PITCH PHASE and ROLL PHASE controls (R5 and R8) adjust the electrical phase of the gyro pitch and roll signals. PITCH AMPLITUDE and ROLL AMPLITUDE controls (R7 and R10) adjust the gain of the pitch and roll channels in the WP-103G system. PITCH TRIM control (R7 in the AS-1520A) is adjusted to compensate for minor inaccuracies in the physical alignment of the antenna relative to the vertical axis of the gyro. RATE control (R4 in the AS-1520A) adjusts the level of damping signal.

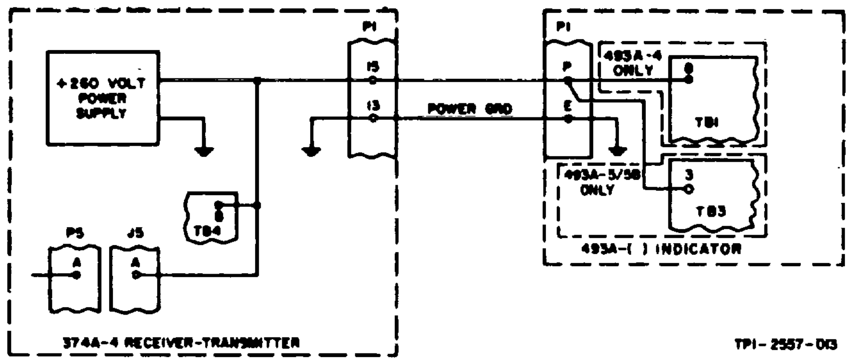
(9) Power Distribution. (Refer to figures 1-11 through 1-14.)

The distribution of do power is illustrated in figures 1-11 through 1-13. All low-voltage do power supplies are located in the RT-711A. The distribution of ac power is shown in figure 1-14.

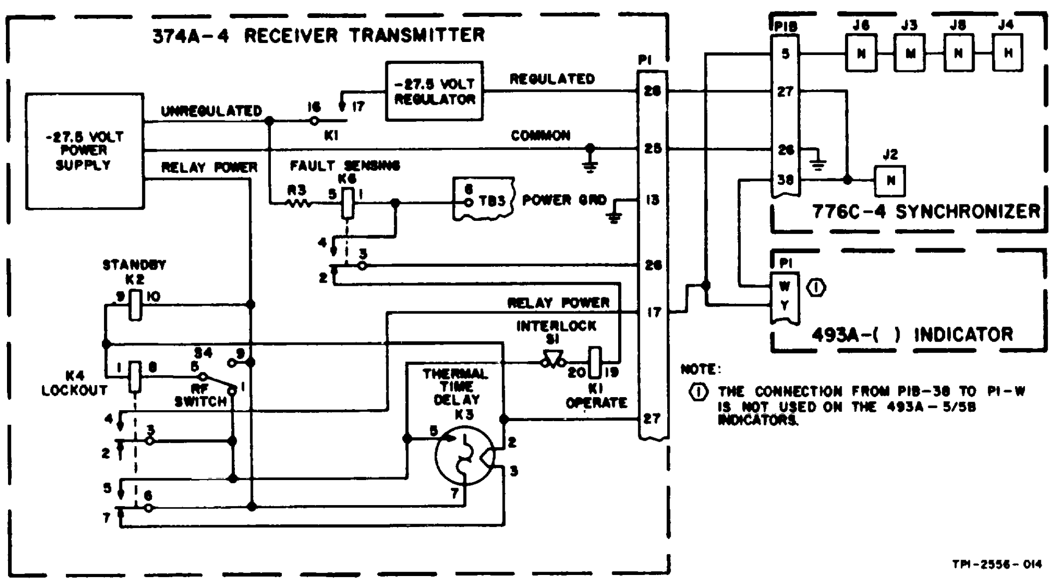
(10) Fault Sensing Circuit. (Refer to figure 1-15.)

(a) General.

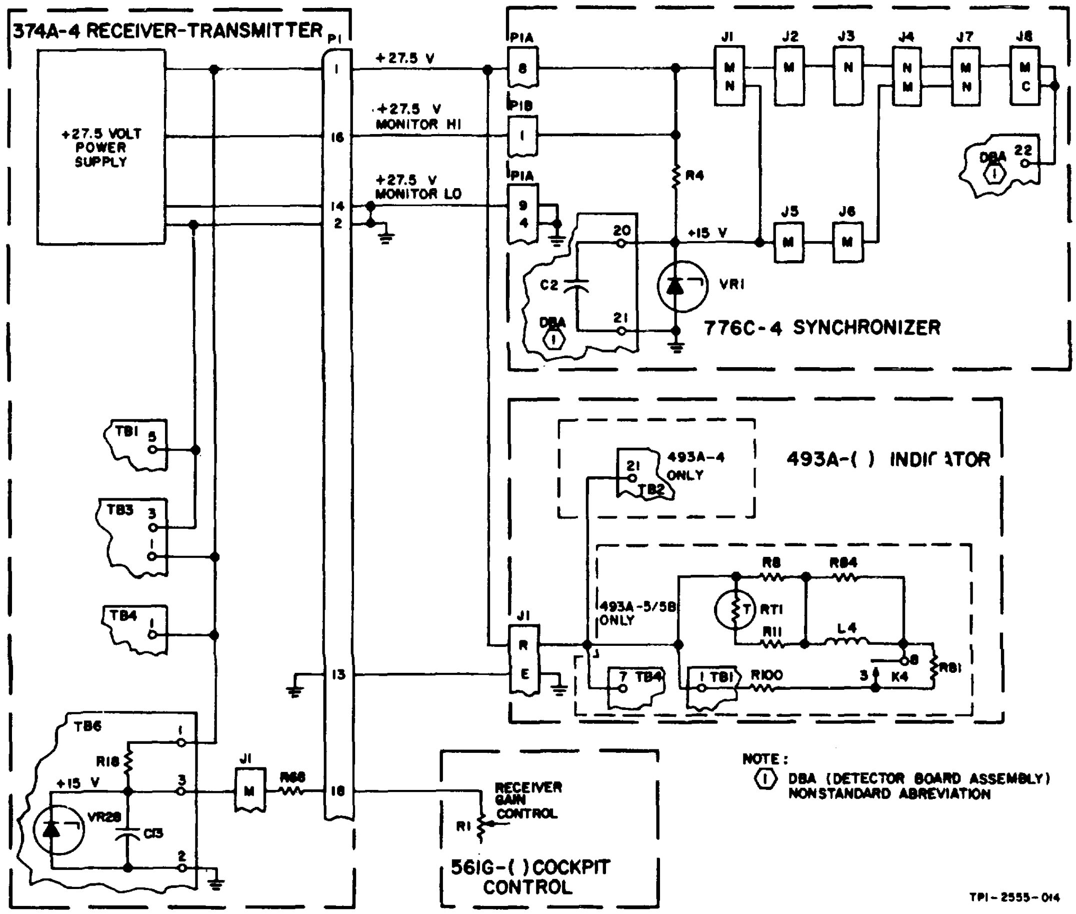
The fault sensing circuit monitors the magnetron modulator for continued excessive piv, and the +260- and +27.5-volt power supplies in the RT-711A



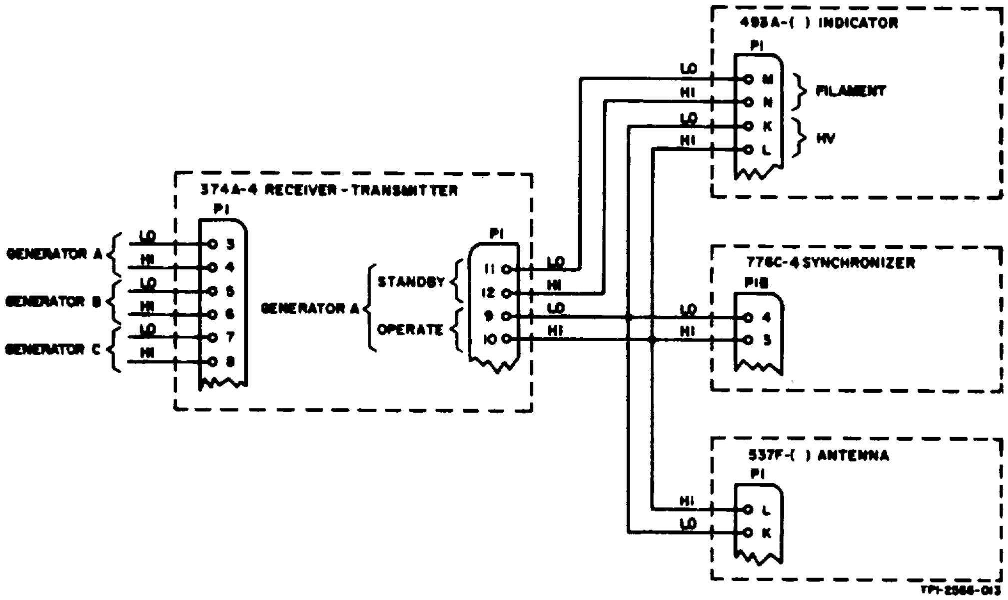
Positive 260-Volt Power Distribution Diagram
Figure 1-11



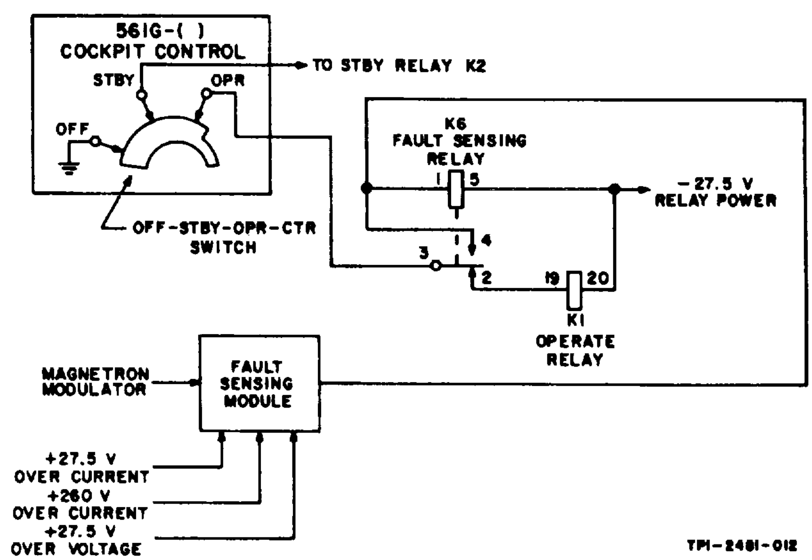
Negative 27. 5-Volt Power Distribution Diagram
Figure 1-12



Positive 27. 5-Volt Power Distribution Diagram
Figure 1-13



AC Power Distribution Diagram
Figure 1-14



Fault Sensing, Simplified Functional Block Diagram
Figure 1-15

The circuit consists of the fault sense board and fault sensing relay K6. If a failure occurs, it deenergizes operate relay K1.

(b) Operation.

As shown in figure 1-15, operate relay K1 is energized by the -27.5-volt relay power source. Ground is supplied to relay K1 through contacts 2 and 3 of relay K6. If a malfunction occurs, the circuits on the fault sense board detect the malfunction and energize fault sensing relay K6. With relay K6 energized, ground is removed from the relay K1 and applied to relay K6. This keeps relay K6 energized until the OFF-STBY-OPR-CTR switch is changed from OPR to STBY.

(11) Operating Controls.

The locations and functions of the operating controls are listed in figure 1-16.

CONTROL	LOCATION	FUNCTION
OFF-STBY-OPR-CTR	C-4881 cockpit control.	System power control switch. Selects standby, operate, or contour mode of operation.
METER switch	RT-711A Receiver-Transmitter.	Selects the function measured by the meter.
BACKGRD	IP-724A Indicator.	Adjusts the contrast between the echo return and screen background.
RECEIVER GAIN	Part of C-4881 cockpit control.	Controls the if. amplification of received signals.
ANT TILT	Part of C-4881 cockpit control	Varies the tilt of the antenna to a maximum of 15 degrees above or 15 degrees below 0-degree elevation.
RANGE switch	IP-724A Indicator.	Selects the range of operation and corresponding range marks.
SCAN-OFF switch	AS-1520A Antenna.	Controls antenna scan motion (on or off).
ON-RF-OFF switch	RT-711A Receiver-Transmitter.	Removes high voltage from modulator in the OFF position.
DIM	IP-724A Indicator.	Permits display intensity control.

Radar Set AN/APN-158A, Operating Controls
Figure 1-16

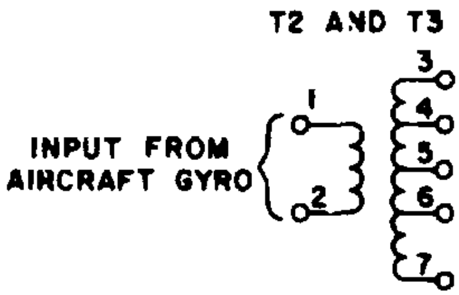
D. Vertical Reference Gyro (Associated Equipment).

Radar Set stabilization circuit receives pitch and roll error information from the aircraft vertical reference gyro.

The SN-358A is factory wired and adjusted for use with a vertical reference gyro that conforms to ARINC Characteristic 529. ARINC Characteristic 529 requires pitch and roll output linearity of 50 millivolts per degree (+10 percent) and that the electrical phase shift of the pitch and roll readouts leads the gyro excitation voltage 10 degrees (±2 degrees).

Transformers T2 and T3, chassis mounted on rear bracket of SN-358A, must be wired in accordance with figure 1-17 when used with vertical reference gyros that do not conform to ARINC Characteristic 529. Pitch and roll phase-shifting net- works require readjustment when used with aircraft gyros that do not conform to ARINC: Characteristic 529. Alignment procedures are given in Chapter 3.

NOTE; Gyro excitation voltage must be from same source as GEN A.



GYRO OUTPUT VOLTAGE	TRANSFORMER SECONDARY TAPS FOR 50 MV/DEG OUTPUT TO ANT STAB SYSTEM
(1) 50 MV/DEG	7 AND 3
100 MV/DEG	7 AND 4
(2) 200 MV/DEG	7 AND 5
400 MV/DEG	7 AND 6

(1) ARINC CHARACTERISTIC 564-1

(2) ARINC CHARACTERISTIC 407   TPI-2568-012

SN-358A Synchronizer Modification,
Depending on Aircraft Gyro
Figure 1-17

Section IV. SYSTEM ADJUSTMENTS AND TEST

1-9. PREINSTALLATION TEST.

NOTE: This section contains information required to test the AN/APN-158A Radar Set. Included are preinstallation and postinstallation test procedures. No internal adjustments should be attempted after the system is installed in the aircraft. Internal adjustments that may be made prior to installation are described in Chapters 2 through 7 of this manual.

A. General.

The preinstallation test/troubleshooting procedures (figure 1-21) are performed to ensure that the AN/APN-158A Radar Set, as shipped from the factory is operating properly prior to installation in the aircraft. Adjustments and controls required at a system level are externally located on the individual units. The pre-installation test/troubleshooting procedures also determine the accuracy of systems that have been in operation for extensive periods.

Figure FO-2 is a system interconnect diagram.

The AN/APM-247 Radar Test Set (Collins nomenclature 978G-1), Collins part number 522-5731-015, is used as a wiring harness. When using the AN/APM-247, the stc is defeated by shorting it out on the SN-358A rear test panel and the position loop is opened by shorting the manual elevation control rotor in the C-4881 cockpit control.

B. Test Equipment Required.

(1) General.

Figure 1-18 lists the test equipment and fixtures required to perform the pre- installation test/troubleshooting procedures. While substitution of equipment other than manufacturer and type listed is not recommended, other equipment may be used if it equals or exceeds the minimum specifications of the equipment listed. Nomenclatures shown in parentheses identify commercial equipment equivalent to the military units described.

(2) Bench Test Power Requirements.

The AN/APN-158A Radar Set primary power requirements are 115 volts ac ±5 percent, 400 Hz ±5 percent, 325 volt-amperes. The primary power is obtained from either a single-phase or 3-phase, 4-wire, wye source. The system divides the primary power into three separate loads. Regardless of which source is used, each of the three loads should be separately fused.

EQUIPMENT	TYPE OR PART NUMBER AND MANUFACTURER	MINIMUM SPECIFICATIONS
Items 1 through 11 are required for preinstallation testing and troubleshooting with the AN/APM-247 Radar Test Set and AN/APM-246 Wiring Harness Tester.		
1. Radar test set Also contains the following: Cable assemblies as follows: CX-10242 CX-11555 CG-1464/U (6 each) Adapters as follows: UG-273/U (3 each) UG-201A/U (2 each)	AN/APM-247 (Collins 978G-1, part number 522-5731-015)	Used to interconnect the AN/APN-158A units for preinstallation testing and troubleshooting.
2. Wiring harness tester Consists of all extension cables and connectors required for mating to cables of 978G-1	AN/APM-246 (Collins 979A-1, part number 522-5729-000)	Used to test the interconnect function of the the 978G-1.
3. Multimeter	AN/USM-210 (Simpson 260)	Sensitivity: 5000 ohms/volt (ac) Voltage: 0 to 50 volts (ac). Accuracy: 3% (ac).
4. Oscilloscope (with CA plug-in unit) (Cont)	AN/USM-81 (Tektronix 535 and Tektronix probe: P6006, 010-128)	Vertical deflection sensitivity: 20 mv/cm to 20 v/cm. Sweep range: 0.1 us./cm to 5 s/cm, calibrated.

Test Equipment Required (Sheet 1 of 3)
Figure 1-18

EQUIPMENT	TYPE OR PART NUMBER AND MANUFACTURER	MINIMUM SPECIFICATIONS
4. Oscilloscope (Cont)		External trigger input level: 0.2 to 10 volts. Input impedance: 1 megohm. Bandwidth: dc to 10 MHz.
5. Deleted		
*6. Echo box	TS-488A/UP (Narda 830)	Frequency accuracy: 9.2 to 9.4 GHz (±2 MHz) Loaded Q: 75,000
7. Dummy load	DA-383/APN-158 (Hewlett-Packard X912A)	Frequency range: 9.2 to 9.4 GHz. Power dissipation: 50 watts average, 50 kw peak. Vswr: 1.1 to 1 max.
8. Gyro simulator	Part of (AN/APM-247)	
9. Vtvm	ME-26A/U (Hewlett-Packard 410B)	Voltage range: 0 to 1000 volts (dc). Input impedance: 100 megohms (dc).
10. Power meter (Cont)	AN/USM-260 (Hewlett-Packard 431C)	Power range 0 to 10 mw. Meter accuracy: -20 to +10 dbm (5-db steps).

Test Equipment Required (Sheet 2 of 3)
Figure 1-18

EQUIPMENT	TYPE OR PART NUMBER AND MANUFACTURER	MINIMUM SPECIFICATIONS
11. Thermistor mount	MX-2144/U (Hewlett-Packard 478A)	Power handling capability: 30 mv, 50 watts peak. Vswr: 1.5 to 1.0 25 MHz to 7 GHz. Frequency range: 9.2 to 9.4 GHz.
*Use RG-214 coaxial cable, maximum of 3 feet, to interconnect echo box receiver-transmitter.		

Test Equipment Required (Sheet 3 of 3)
Figure 1-18

The ac requirements for each of the three leads (generators A, B, and C) are listed in figure 1-19.

(3) Bench Test Setup.

Prior to interconnecting the units of the Radar Set, shown in figure FO-2, the AS-1520A Antenna should be checked as follows:

(a) Secure the AS-1520A to a locally fabricated mount and position on its back.

(b) Position the dish (reflector) to align with center lubber line on the azimuth and elevation markers.

(c) Starting at 0 degree, measure the distance between reflector rim and mount at 90-degree intervals around the circumference of the dish.

NOTE: If the measurements are not the same for all readings, refer to Chapter 6 for alignment procedures.

CAUTION: STRONG MAGNETIC FIELDS EXIST WITHIN A 3-FOOT RADIUS OF THE RECEIVER-TRANSMITTER. MAINTAIN A DISTANCE OF 3 FEET (MINIMUM) BETWEEN THE RECEIVER- TRANSMITTER AND INDICATOR. DAMAGE TO WRIST WATCHES AND OTHER SUCH DEVICES MAY RESULT IF LOCATED WITHIN THIS AREA.

(4) Bench Test Setup Using AN/APM-247.

(a) Place AC POWER switch to OFF.

QUANTITY PER SYSTEM	NAME	TYPE	REQUIRED CHARACTERISTIC	POWER (volt-amperes)
1	Generator A	Primary power source	115 volts ac ±5 percent, 400 Hz ±5 percent	55
1	Generator B	Primary power source	115 volts ac ±10 percent, 400 Hz ±5 percent	160
1	Generator C	Primary power source	115 volts ac ±10 percent, 400 Hz ±5 percent	110

Generators A, B, and C, Primary Power Requirements
Figure 1-19

(b) Connect AN/APM-247 to bench primary power.

(c) Interconnect the units of the AN/APN-158A Radar Set using the appropriate cables on the AN/APM-247.

(d) Position TEST SET FUNCTION SELECTOR (AN/APM-247) to SYSTEM OPERATION.

(e) Place the CONTROL UNIT SELECTOR (AN/APM-247) to the EXT position.

(f) Place GYRO SIMULATOR ON-OFF switch (AN/APM-247) to ON.

(g) Set SYRO SIMULATOR PITCH AND ROLL controls (AN/APM-247) to 0.

(h) Install jumper connector between R-T UNIT and SYNC receptacles (AFC section of front panel) on AN/APM-247.

(i) Install jumper connector between R-T UNIT and SYNC receptacles (IF section of front panel) on AN/APM-247.

(j) Position the AC POWER switch (AN/APM-247) to ON.

(k) Through the use of the INPUT VOLTAGE ADJUST (AN/APM-247), obtain 115 volts ac on the INPUT VOLTAGE meter (AN/APM-247). Readjust as required.

(l) Observe the INPUT FREQUENCY meter and note that the frequency is 400 Hz ±5 percent (AN/APM-247).

NOTE: The AN/APM-247 is not set up for system mode of operation. All control settings and switch positions shall remain in their present position unless otherwise specified.

C. Preinstallation Test/Troubleshooting Procedures.

Before performing the preinstallation test/troubleshooting procedures, position all switches and controls of the Radar Set as shown in figure 1-20 and remove the top dust cover from the RT-711A and SN-358A.

The preinstallation test/troubleshooting procedures outlined in figure 1-21 are a system test. Start with test A and perform all tests in the sequence shown.

CAUTION: BEFORE OPERATING THE SYSTEM, INSTALL DUMMY LOAD AT WAVEGUIDE CONNECTION TO RT-711A.

UNIT	CONTROL	POSITION
Gyro simulator (not part of Radar Set)	ON-OFF switch	OFF
	PITCH control	0
	ROLL control	0
C-4881 cockpit control	OFF-STBY-OPR-CTR switch	OFF
	ANT tilt control	0
	GAIN control	Fully clockwise
RT-711A Receiver-Transmitter	Meter switch	OFF
	RF switch	ON
AS-1520A Antenna	SCAN-OFF switch	SCAN
IP-724A Indicator	BACKGRD control (493A-5/5B)	Fully counter-clockwise
	BACKGROUND control (493A-4)	
	RANGE control	30/10
Indicator (only)	DIM tab	DOWN

Initial Control Settings
Figure 1-20

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
A. RT-711A meter readings. K.A., (steps 2 - 10) WARNING: THIS TEST CONSISTS OF HIGH-VOLTAGE MEASURE-MENTS.	1	Pull out inter lock switch on back of RT-711A.			
	2	Remove left side cover from RT-711A.			
	3	Set OFF-STBY-OPR-CTR switch (C-4881 to STBY.	RT-711A blower motor operates.	RT-711A blower motor fails to operate.	RT-711A
	4	Using vtvm, measure the -dc voltage be-tween high voltage lead on Keep Alive board (TB2-4) and ground.	-625 to -800 volts dc.	Any other reading.	RT-711A
	5	Replace left side cover on RT-711A.			
	6	Remove trigger generator mod-ule from RT-711A.			
	7	Set OFF-STBY-OPR-CTR switch (C-4881) to OPR.			
(Cont)	8	Set meter switch (RT-711A) to AFC.			

Preinstallation Test/Troubleshooting Procedures (Sheet 1 of 16)
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
A. (Cont)	9	Observe meter (RT-711A) and record maximum needle deflection.	Meter needle sweeps at a rate of 5 to 10 times in 10 seconds.	No needle deflection. Meter needle sweeps at a rate other than specified.	RT-711A or SN-358A SN-358A
	10	Set OFF-STBY-OPR-CTR switch to STBY.			
	11	Insert trigger generator module in RT-711A			
	12	Set OFF-STBY-OPR-CTR switch (C-4881) to OPR.			
	13	Observe afc meter reading on RT-711A.	Meter needle locks on within half a division of maximum deflection recorded in step 9. NOTE: Must lock on between 3 and 10.	Any other reading.	Refer to chapters 2 and 3 for afc standardization and alignment procedures for the RT-711A and SN-358A.
(Cont)	14	Set meter switch (RT-711A) to REV and note meter reading.	Meter needle is locked on between 3 and 10.	Any other reading.	RT-711A

Preinstallation Test/Troubleshooting Procedures (Sheet 2 of 16)
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
A. (Cont)	14 (Cont)		NOTE: Record the needle reading.		
	15	Set meter switch (RT-711A) to FWD and note meter reading.	Meter needle is locked on between 3 and 10 and within 1-1/2 major divisions of needle reading recorded in step 14.	Any other reading.	RT-711A
	16	Set meter switch (RT-711A) to MAG and observe meter.	Midscale ±1 major division.	Any other reading.	RT-711A
	17	Set OFF-STBY-OPR-CTR switch (C-4881) to STBY.			
	18	Set meter switch (RT-711A) to GEN A and observe meter.	Midscale ±1 major division.	Any other reading.	Bench primary power or RT-711A.
	19	Set meter switch (RT-711A) to GEN B and observe meter.	Midscale ±1 major division.	Any other reading.	Bench primary power or RT-711A.
(Cont)	20	Set meter switch (RT-711A) to GEN C and observe meter.	Midscale ±1 major division.	Any other reading.	Bench primary power or RT-711A.

Preinstallation Test/Troubleshooting Procedures (Sheet 3 of 16)
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
A. (Cont)	21	Set OFF-STBY-OPR CTR switch to OPR.			
	22	Set meter switch (RT-711A) to -27.5V and observe meter.	Midscale ±1 major division.	Any other reading.	RT-711A
	23	Set meter switch (RT-711A) to +27.5V and observe meter.	Midscale ±1 major division.	Any other reading.	RT-711A
	24	Set meter switch (RT-711A) to +260V and observe meter.	Midscale ±1 major division.	Any other reading.	RT-711A
B. Display system	1	Set OFF-STBY-OPR-CTR switch (C-4881) to STBY and back to OPR. NOTE: Audible change produced by magnetron.	AS-1520A scans 60 degrees to each side with no mechanical interference.	AS-1520A dish remains stationary. Any other indication.	RT-711A or AN-1520A NOTE: If audible change was detected, AS-1520A is at fault. AS-1520A
(Cont)	2	While observing IP-724A, rotate BACKGROUND control until uniform display is visible. Some background noise should be visible.			

Preinstallation Test/Troubleshooting Procedures Sheet 4 of 156
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
B. (Cont)	3	Set SCAN-OFF switch (AS-1520A) to OFF, and using manual sweep adjust, position dish to one side.	Sweep trace not visible on IP-724A (range marks are acceptable).	Sweep trace visible.	AS-1520A
	4	While observing IP-724A, and using manual sweep adjust AS-1520A, rotate dish.	Trace is visible at all angles within 55 degrees each side of dead ahead and is continuous.		
	5	Using manual sweep adjust AS-1520A, position dish dead ahead.			
	6	Using BACKGROUND control IP-724A, reduce background until trace is barely visible.	Trace should be located within one-eighth of an inch of the vertical lubber line and range display panel.	Any other indication.	IP-724A
	7	While observing IP-724A, select 30-, 60-, and 150-mile display respectively with the use of the RANGE switch.	Correct number of range marks, and last range mark (all ranges) is within 3/16 ±1/8 inch of the top of the sweep trace.	Incorrect number of range marks. Last range mark present, but not within 3/16 ±1/8 inch of top of 493A-( ).	SN-358A IP-724A or SN-358A
(Cont)					

Preinstallation Test/Troubleshooting Procedures Sheet 5 of 16)
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
B. (Cont)	8	Set SCAN-OFF switch(AS-1520A) to SCAN.			
	9	Rotate BACK-GROUND control (IP-724A) until background noise is just visible.	Background noise is uniform over entire sector and range marks are concentric, evenly spaced, and circular.	Any other indication.	IP-724A
	10	While observing IP-724A, change ranges.	Previous range marks disappear within 2 to 6 seconds.	Previous range marks disappear too soon or take too long to disappear.	IP-724A
	11	Set RANGE switch to 60-mile range and adjust BACK-GROUND control (IP-724A)for a comfortable noise presentation.			
(Cont)	12	Observe noise presentation on the other ranges.	Background noise is comfortable on all ranges.	Variations in degree of background noise between ranges.	IP-724A NOTE: Intermal adjustment of IP-724A will correct problem.

Preinstallation Test/Troubleshooting Procedures (Sheet 6 of 16)
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
B. (Cont)	13	Place DIM control tab (IP-724A only) in the up position.	Presentation on IP-724A disappears.	No change.	IP-724A
	14	Place DIM control tab in the down position.			
C. Stabilization system	1	Set OFF-STBY-OPR-CTR switch (C-4881) to OPR.			
	2	Rapidly vary ANT tilt control (C-4881).	Dish scans smoothly.	Dish erratic or oscillates.	AS-1520A NOTE: Adjustment of R4 on AS-1520A should correct abnormal indicator.
	3	Adjust BACKGRD (IP-724A) BACKGROUND (493A-4) fully counterclockwise.			
	4	Lift front panel access shutter on SN-358A.			
(Cont)	5	Set SCAN-OFF switch (AS-1520A) to OFF.			

Preinstallation Test/Troubleshooting Procedures (Sheet 7 of 16)
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
C. (Cont)	6	Using manual sweep adjust (AS-1520A), align dish with center lubber line on azimuth marker.			
	7	Observe alignment of dish with respect to elevation marker.	Aligned with center lubber on elevation marker.	Any other position.	AS-1520A NOTE: When using a locally fabricated control unit, it must be aligned in accordance with the 561G-( ) cockpit control overhaul manual.
	8	Adjust ANT tilt control (C-4881) 15 degrees up and 15 degrees down.	Dish pitched 7.5 mechanical degrees up and down respectively. NOTE: Outer lubber lines on elevation marker represent 15 mechanical degrees from center lubber line.		AS-1520A, SN-358A, or C-4881. NOTE: Most expedient procedure may be to check SN-358A first, in accordance with overhaul manual.
(Cont)	9	Set ON-OFF switch on gyro simulator to ON.			

Preinstallation Test/Troubleshooting Procedures (Sheet 8 of 16)
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
C. (Cont)	10	Using multimeter, adjust roll control on gyro simulator for 1 volt rms, right wing down. If using gyro simulator AN/APM-247, adjust ROLL control to 20 RIGHT WING DOWN position.			
	11	Jumper PITCH HI to LO on SN-358A front panel.			
	12	Connect multimeter to ROLL HI and LO on SN-358A front panel.	Meter indicates 5 ±0.5 volts rms.	Any other reading.	ROLL AMP potentiometer on SN-358A front panel. Adjust as necessary.
	13	Set SCAN-OFF switch (AS-1520A) to SCAN.			
(Cont)	14	Connect multimeter to SERVO test jacks (J22 and J23) on SN-358A rear test panel.	Needle sweeps and maximum deflection does not exceed 20 volts rms.	Any other reading.	ROLL PHASE potentiometer on SN-358A front panel. Adjust as necessary.

Preinstallation Test/Troubleshooting Procedures (Sheet 9 of 16)
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
C. (Cont)	15	Connect multimeter to STAB HI and LO on SN-358A front panel.			
	16	Set SCAN-OFF switch (AS-1520A) to OFF.			
	17	Using manual sweep adjust (AS-1520A), position dish for null condition.	Pointer should be aligned with center lubber line on azimuth marker.	Any other indication.	AS-1520A
	18	Position dish 60 degrees to the right (SCAN switch side).	Dish pitched up 8.5 ±1 mechanical degrees.	Any other indication.	AS-158A or SN-358A
	19	Remove jumper from PITCH HI and LO on SN-358A front panel.			
(Cont)					

Preinstallation Test/Troubleshooting Procedures (Sheet 10 of 16)
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
C. (Cont)	20	Using multimeter, adjust PITCH control on gyro simulator for 1 volt rms, nose down, and set ROLL control to 0. If using gyro simulator (AN/APM-247), adjust PITCH control to 20 degrees NOSE DOWN and ROLL control to 0.			
	21	Jumper ROLL HI to LO on SN-358A front panel.			
	22	Connect multimeter to PITCH HI and LO on SN-358A front panel.	Meter indicates 5 ±0.5 volts rms.	Any other indication.	PITCH AMP potentiometer on SN-358A front panel. Adjust as necessary.
	23	Set SCAN-OFF switch (AS-1520A) to SCAN.			
	24	Connect multimeter to SERVO test jacks (J22 and J23) on SN-358A rear test panel.	Needle sweeps and maximum deflection does not exceed 20 volts rms.	Any other reading.	PITCH PHASE potentiometer on SN-358A front panel. Adjust as necessary.
(Cont)					

Preinstallation Test/Troubleshooting Procedures (Sheet 11 of 16)
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
C. (Cont)	25	Set SCAN-OFF switch (AS-1520A) to OFF.			
	26	Using manual sweep adjust (AS-1520A), position dish dead ahead.	Dish is pitched up 10 ±1 mechanical degrees.	Any other indication.	AS-1520A or SN-358A
	27	Set ON-OFF switch (gyro simulator) to OFF.			
	28	Remove jumper from ROLL HI and LO on SN-358A front panel.			
	29	Adjust PITCH control (gyro simulator) to 0.			
D. Transmitter power	1	Using RG-214 coaxial cable (maximum 3 feet) connect one end to TP6 (RT-711A) and the other end to the 20-db fixed attenuator.			
(Cont)	2	Connect 20-db fixed attenuator to thermistor mount.			

Preinstallation Test/Troubleshooting Procedures (Sheet 12 of 16)
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
D. (Cont)	3	Connect thermistor mount to AN/USM-260			
	4	Observe power meter AN/USM-260 record average power. NOTE: Account for all db loss.			
	5	Accurately determine line frequency and record.	400 ±20 Hz (this is the prf).	Any other reading.	Bench primary power off frequency.
	6	Using RG-59/U coaxial cable, connect TP4 (RT-711A) to CHANNEL A input on AN/USM-81.			
	7	Measure and record pulse width.	3.3 ±0.2 us.	Any other reading.	RT-711A
(Cont)	8	Calculate peak as follows: Peak power (kw) $= \frac{\text{avg. power (w)}}{\text{pulse width (us)}} \times \frac{1000}{\text{prf}}$	20 kw minimum.	Below 20 kw.	RT-711A

Preinstallation Test/Troubleshooting Procedures (Sheet 13 of 16)
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
D. (Cont)	9	Set OFF-STBY-OPR-CTR switch to STBY and disconnect TP6 (RT-711A) from AN/USM-260.			
	10	Disconnect TP-4 (RT-711A) from 535.			
E. Ring time NOTE: This test is essentially a test for receiver sensitivity. (Cont)	1	Connect TRIGGER INPUT AN/USM-81 to TP4 (RT-711A).			

Preinstallation Test/Troubleshooting Procedures (sheet 14 of 16)
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
E. (Cont)	2	Connect CHANNEL A AN/USM-81 to VIDEO test jack ON SN-358A rear test panel.			
	3	Set STC DEFEAT switch (test signal junction box) to DEFEAT. If using 978G-1, short the stc at SN-358A rear test panel to ground.			
	4	WARNING: HIGH VOLTAGES ARE PRESENT IN THE IMMEDIATE AREA OF TP6. Using RG-214 coaxial cable, connect echo box to TP6 (RT-711A).			
(Cont)	5	Set OFF-STBY-OPR-CTR switch to OPR and, using tuning control on echo box, obtain maximum deflection on meter.			

Preinstallation Test/Troubleshooting Procedures (Sheet 15 of 16)
Figure 1-21

TEST	STEP	PROCEDURE	NORMAL INDICATION	ABNORMAL INDICATION	
				INDICATION	PROBABLE CAUSE
E. (Cont)		NOTE: Reduce sensitivity control as needed to keep reading on meter scale.			
	6	Observe ring time presentation on 535.	Minimum ring time 25 us.	Below 25 us.	RT-711A or SN-358A
	7	Set STC DEFEAT switch (test signal junction box) to normal. If using 978G-1, remove the stc short at SN-358A rear test panel.	Minimum ring time of 80% to 90% of ring time recorded in step 6.	Less than 80%.	SN-358A
	8	Set OFF-STBY-OPR-CTR switch (C-4881) to OFF and disconnect all test equipment.			

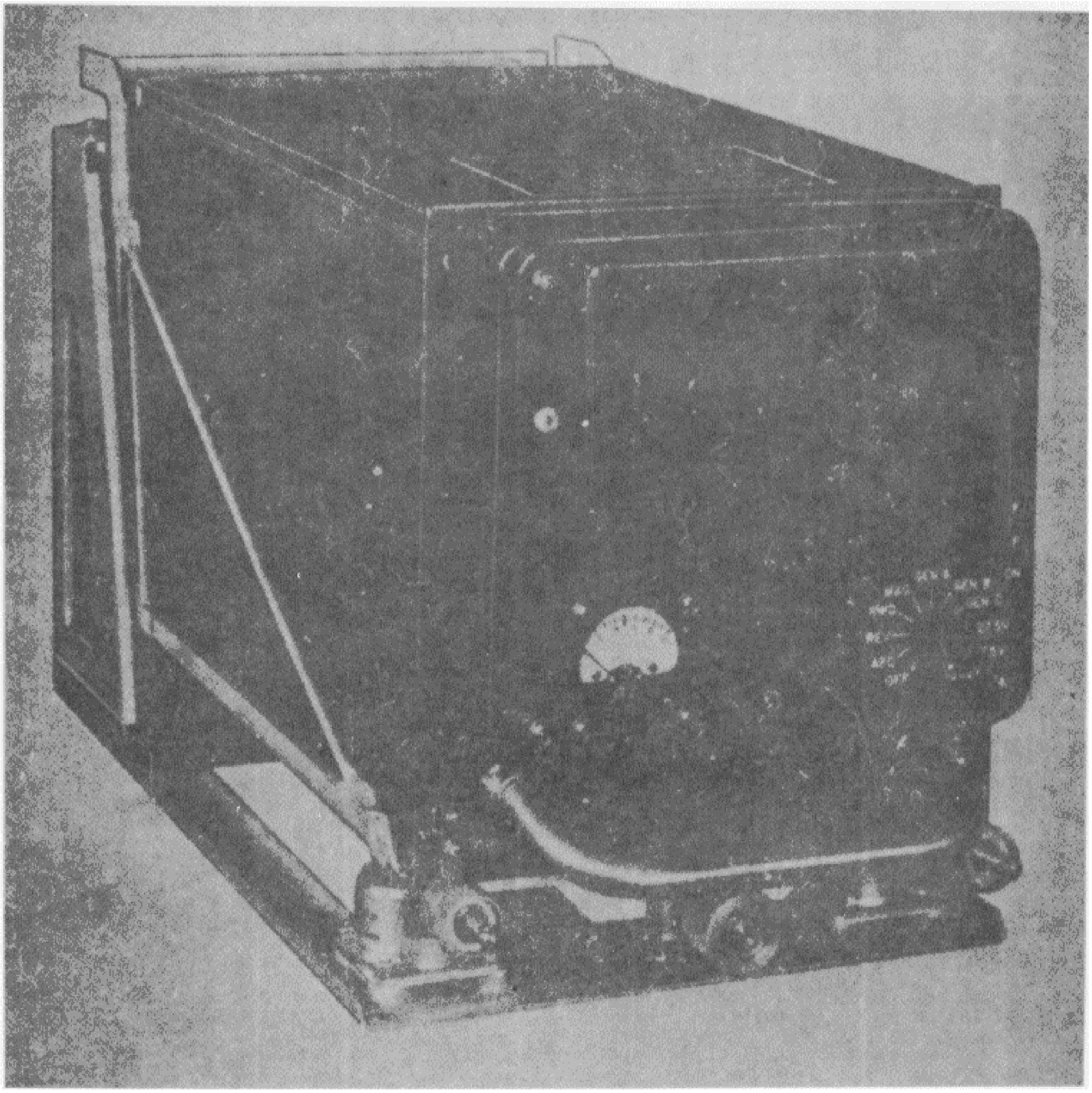
Preinstallation Test/Troubleshooting Procedures (Sheet 16 of 16)
Figure 1-21

Section V. COMPONENTS LOCATION

Components location illustrations are provided in the last section of each chapter, as applicable. These illustrations are provided for components location only. They are-not to be used for requisitioning. To requisition components comprising Radar Set AN/APN-158A, refer to TM 11-5841-241-34P-1.

CHAPTER 2

RECEIVER-TRANSMITTER RT-711A/APN-158
AND
MOUNT, RECEIVER-TRANSMITTER MT-3068/APN-158



RT-711A/APN-158 Receiver-Transmitter and MT-3068/APN-158 Shockmount
Figure 2-1

Section I. DESCRIPTION AND OPERATION

2-1. GENERAL.

Included within this section are the purpose of equipment, the equipment specifications, the equipment description, and theory of operation. Refer to figure 2-1 for an over- all view of the RT-711A/APN-158 Receiver-Transmitter. Figure 2-2 is a table of equipment covered in this chapter.

EQUIPMENT	COLLINS PART NUMBER
RT-711A/APN-158 Receiver-Transmitter	777-1572-001
MT-3068/APN-158 Shockmount	772-5135-001

Equipment Covered
Figure 2-2

2-2. PURPOSE OF EQUIPMENT.

The RT-711A/APN-158 Receiver-Transmitter (referred to as the RT-711A) provides the receiving and transmitting circuits and all primary power for the AN/APN-158A Weather Radar System. The transmitter is a fixed-frequency pulse unit operating in the X-band at 9375 MGz. The rf energy from the transmitter is radiated by the AS-1520A/APN-158 Antenna. The return signal received by the antenna are applied to receiver circuits in the RT-711A/APN-158. The output of the receiver is applied to the SN358A/APN-158 Synchronizer, where the signal is amplified and the video information is detected. The video output is applied to the IP-724A/APN-158 Indicator for presentation.

The MT-3068/APN-158 Shockmount (referred to as the MT-3068) provides mounting facilities for the RT-711A Receiver Transmitter.

2-3. EQUIPMENT SPECIFICATIONS.

The equipment specifications for the RT-711A Receiver-Transmitter and the MT-3068 Shockmount are listed in figure 2-3.

CHARACTERISTIC	SPECIFICATION
RT-711A Receiver-Transmitter	
Weight	29.2 pounds (13.2 kg)
Physical dimensions (3/4 ATR short)	15-1/16 inches (38.26 cm) long, 7-13/16 inches (19.85 cm) high, and 7-5/8 inches (19.35 cm) wide
Cooling	Blower equipped, forced air cooling
Shock conditions	
Performance criteria	Eighteen 10-millisecond shocks at 7.5 g
Safety criteria	Six 10-millisecond shocks at 15 g
Vibration	1.5 g peak acceleration at 10 to 55 Hz when mounted in a solid mount and 5 g peak acceleration at 10 to 500 Hz when mounted in MT-3068 Shockmount
Power requirements	(Sources must be phase synchronous.)
Source A	115 v ±5%, 400 Hz ±5%
Standby	3 watts, 3 volt-amperes
Operating	50 watts, 55 volt-amperes
Source B	115 v ±10%, 400 Hz ±5%
Standby	51 watts, 55 volt-amperes
Operating	200 watts, 225 volt-amperes
Source C	115 v ±10%, 400 Hz ±5%C
Standby	5 watts, 6 volt-amperes
Operating	100 watts, 110 volt-amperes
Load vswr	2:1 maximum
Recovery time	10 microseconds maximum from leading edge of transmitted pulse

Equipment Specifications (Sheet 1 of 3)
Figure 2-3

CHARACTERISTIC	SPECIFICATION
RT-711A Receiver-Transmitter (Cont)	
Local oscillator radiation	0.001 milliwatt maximum
Time delay	4 minutes (nominal)
Protective devices required	
Source A	1-ampere fuse
Source B	2-ampere fuse
Source C	2-ampere fuse
Protective devices provided	Fault sensing circuit (returns unit to standby) Modulator latch-up circuit (momentarily removes high voltage from modulator)
Altitude	Category A, TSO C63
	45, 000 feet
Temperature	Category A
Continuous operation	-55 to +55°C (-67 to +131°F)
30-minute operation	+71°C (+160° F)
Relative humidity	Category A
	95% to 100% at +55°C (+131°F)
Operating frequency	9375 ±40 MHz
Duty cycle	Continuous duty
Transmitter power output	20 kw peak minimum at 115 v input
Pulse width	3.3 microseconds nominal
Pulse repetition rate	400 p/s (nominal) synchronized with primary power frequency
Duty factor	0.0013

Equipment Specifications (Sheet 2 of 3)
Figure 2-3

CHARACTERISTIC	SPECIFICATION
RT-711A Receiver-Transmitter (Cont)	
Minimum discernible signal	-104 dbm (measured beyond the range of stc action)
Noise figure	10 db maximum at +25°C (+77°F)

MT-3068 Shockmount	
Weight	
MT-3068/APN-158	4.3 pounds (1.95 kg)
Physical dimensions	17-3/4 inches (45 cm) long, 9-7/8 inches (25 cm) high, and 8-5/8 inches (22 cm) wide

Equipment Specifications (Sheet 3 of 3)
Figure 2-3

2-4. EQUIPMENT DESCRIPTION.

A. General.

This section presents a mechanical and an electrical description of the RT-711A Receiver-Transmitter.

B. Mechanical Description.

The receiver-transmitter is enclosed in a 3/4-ATR short case and weighs 29.2 pounds. A 4-piece dust cover completely encloses the receiver-transmitter. Forced air cooling is provided by a blower on the front of the unit with exhaust air routed through the base. An equivalent UG-135/U choke flange that mates with the shock- mount waveguide connector is provided at the rear of the receiver-transmitter for the waveguide connection. A DPX-32C2-33S connector (Collins part number 370-2159-00) on the rear panel of the receiver-transmitter provides power and signal interconnections to other units of the AN/APN-158A system.

The MT-3068 Shockmount provides electrical connection of the receiver-transmitter to the system wiring harness and mechanical isolation of the receiver-transmitter. from the aircraft. The shockmount also has a waveguide block (with waveguide connections) that permits pressurization of the waveguide system. An electrical connector, type DPXLF-A32C2-34P (Collins part number 370-2143-00), is mounted on the shockmount to mate with the receiver-transmitter power and signal connector. System wiring harness interconnections to the receiver-transmitter are made to the shockmount connector.

The revision level of the receiver-transmitter is stamped near the unit nameplate. All digits must be used to completely identify the unit revision level. Modules have revision identification stamped on the module itself.

C. Electrical Description.

The receiver-transmitter consists of a trigger generator; modulator circuit; magnetron oscillator; mixer-duplexer; klystron local oscillator; if. preamplifier; +260-v, +27.5-v, -27.5-v, and -700-v power supplies; metering circuit; and fault sensing circuit. The receiver-transmitter provides transmitted pulses, preamplification of received signals, system trigger pulses, and power distribution to all other units of the AN/APN-158A system.

2-5. THEORY OF OPERATION.

A. General.

This section presents a simplified and functional block diagram theory and a detailed theory of operation. The block diagram sections discuss the various circuit functions of the receiver-transmitter. Detailed circuit analysis is discussed in the detailed theory of operation section.

B. Simplified Block Diagram Theory. (Refer to figure 2-4.)

(1) Trigger Generator.

The input to the trigger generator is obtained from the modulator network. The input synchronizes the trigger pulses to the 400-Hz frequency of the aircraft primary power. Output trigger pulses from the trigger generator are applied to the modulator and to the gate generator in the synchronizer.

(2) Modulator Network.

The modulator contains circuits for developing the high-voltage pulse to the magnetron, circuits for sensing and protecting the modulator from internal malfunctions, circuits for sensing magnetron malfunctions, power transformers for the magnetron filament voltage and TR tube keep-alive voltage, and power supplies for the modulator circuits.

A trigger pulse from the trigger generator module causes discharge of the pulse forming network through the pulse transformer. The high-potential pulse created is applied to the magnetron cathode.

(3) Magnetron.

The magnetron produces an rf signal for the duration of the pulse applied from the pulse transformer (in the modulator) to the magnetron cathode. The rf-~ signal is waveguide coupled to the antenna through the mixer-duplexer.

Magnetron current is monitored by the metering circuit.

(4) Mixer-Duplexer.

The mixer-duplexer contains a ferrite circulator, TU tube, and afc and receiver if. mixers. The transmitted energy from the magnetron, in passing through the circulator, has the plane of polarization rotated for proper orientation with the twist section of the waveguide. Rotation of signals through the circulator pre- vents returned signals from entering the magnetron instead of the receiving branch of the mixer-duplexer.

During transmission, the high power causes the TR tube to ionize. The ionized tube attenuates the transmitted rf energy entering the receiving branch of the mixer-duplexer, thus protecting the receiver mixer crystals.

Signals returned from targets enter the mixer-duplexer from the antenna and are directed through the deionized TR tube to the receiving branch of the mixer- duplexer. The returned signals and the klystron output are heterodyned in the receiver if. mixers. The output of the mixers is applied to the if. preamplifier. A portion of the magnetron output signal is mixed with the klystron output in the afc mixer to provide an afc signal to the synchronizer.

The afc and receiver if. mixer currents are monitored by the metering circuit.

(5) Klystron Local Oscillator.

The klystron produces a signal 39 MHz above the magnetron frequency. The klystron output is heterodyned with returned signals in the receiver mixers. The resulting 30-MHz if. is applied to the if, preamplifier. The klystron output is also heterodyned with a portion of the magnetron output in the afc mixer. This signal is applied to the afc circuit in the synchronizer.

The synchronizer afc circuit supplies the klystron repeller voltage. When the if. changes from 30 MHz, the afc changes the repeller voltage which causes the klystron output to return the if. to 30 MHz.

(6) IF. Preamplifier.

The low-level 30-MHz signals from the receiver mixers in the mixer-duplexer are amplified by the if. preamplifier. The amplified signals are applied to the if. amplifier in the synchronizer. A time-varying voltage that reduces the gain of the if. preamplifier for close range targets is received from the stc (sensitivity time control) circuit in the synchronizer. A manual gain control voltage is applied to the if. preamplifier from the radar control unit.

(7) Metering Circuit.

A metering circuit measures outputs fr6m the primary power sources, power supplies in the receiver-transmitter, magnetron current, and mixer-duplexer crystal currents. A front panel switch selects the signal to be measured and applies it to the front panel meter of the receiver-transmitter.

(8) Primary Power.

The aircraft power generator provides 3-phase primary power to the radar system through the receiver-transmitter. The primary power frequency (380 to 420 Hz) determines the output trigger frequency from the trigger generator module.

(9) Power Supplies.

The receiver-transmitter supplies dc voltages to other units of the system. The dc voltages from all supplies except the keep-alive supply and relay power supply are regulated. Fault protection is provided for the +27.5-v and +260-v power supplies.

The +27.5-v, -27.5-v, and +260-v power supply voltages are monitored by the metering circuit.

(10) Fault Sensing.

The fault sensing circuit receives fault signals from the positive power supplies and the modulator. Voltages from the protected circuits are present at the fault sensing circuit at all times during operation. Abnormal operation of the protected circuits causes an output from the fault sensing circuit that removes part of the primary power from the system. When this occurs, the system reverts to the standby mode of operation.

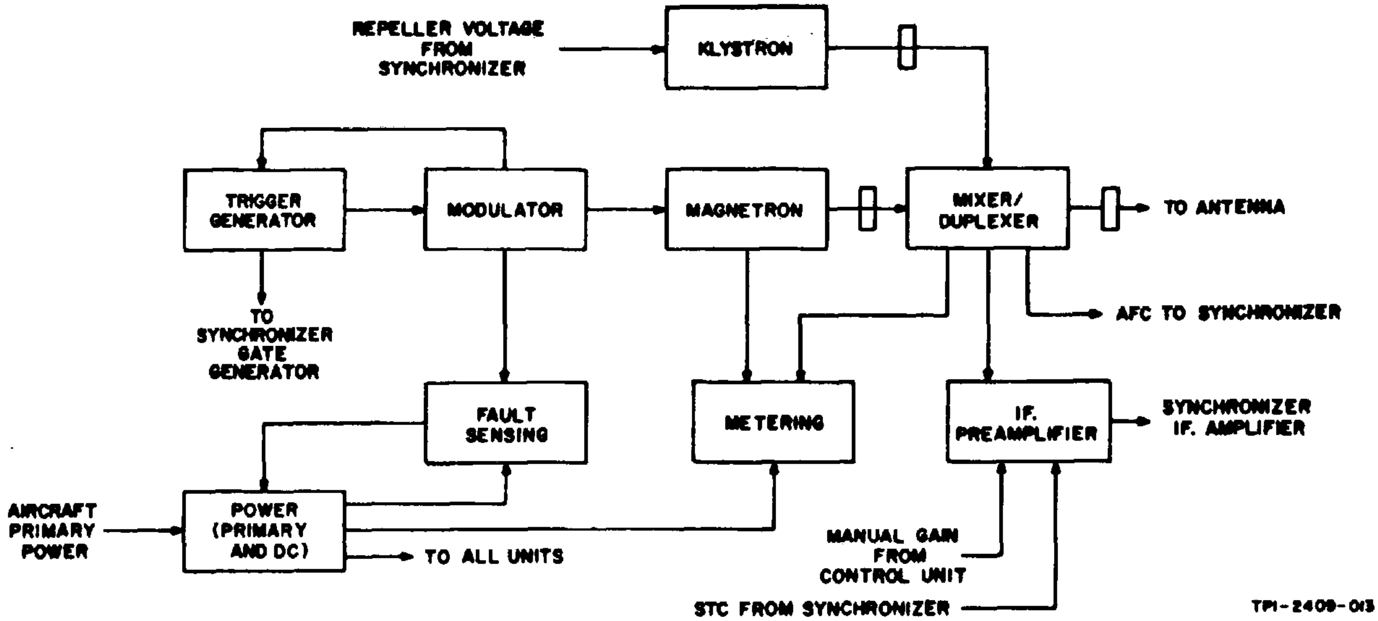
C. Functional Block Diagram Theory. (Refer to figure FO-3.)

(1) Transmitter Section.

The transmitter section develops trigger pulses for system timing and synchronization, and high-energy rf pulses for target illumination. Contained in this section are a trigger generator, modulator, magnetron, keep-alive voltage supply, and mixer-duplexer. Some portions of the mixer-duplexer are common to both the transmitter and receiver since the mixer-duplexer isolates these sections from each other. Functions of the various circuits within the transmitter section are discussed in the following paragraphs.

(a) Trigger Generator.

The trigger generator provides trigger pulses that are synchronized to the aircraft primary power frequency (400 Hz). The synchronizing signal to the trigger generator is obtained from the filament transformer in the modulator network. The positive zero-volt crossing triggers a one-shot



RT-711A Receiver-Transmitter, Simplified Block Diagram
Figure 2-4

multivibrator in the trigger generator. The multivibrator output is differentiated, amplified, and applied to the modulator network to trigger the discharge of the pulse forming network. The differentiated output is also applied to the gate generator in the synchronizer to initiate timing pulses for the rest of the system.

(b) Modulator.

The modulator provides a high-potential pulse in synchronization with the trigger generator output. This high-potential pulse is applied to the magnetron to produce rf output pulses. The high-voltage power supply in the modulator charges the capacitors in the pfn. A trigger, from the trigger generator module, gates the scr into conduction to provide a discharge path for the pulse forming network. This discharge, through the pulse transformer, produces a -8-kv pulse that is applied to the magnetron cathode.

In the event the scr does not stop conducting at the end of the pulse forming network discharge, a latch-up circuit momentarily switches off the high-voltage power supply.

Magnetron misfire or spark gap operation causes a fault signal to be developed in the modulator. This signal is applied to the fault sensing circuit. If the fault signals reach a prescribed percentage time limit, the fault sensing circuit causes the system to revert to the standby mode of operation.

Transformers for the keep-alive supply, magnetron filament voltage, and trigger generator-to-scr isolation are also contained in the modulator.

(c) Magnetron.

The magnetron provides pulses of rf energy for the receiver-transmitter. The magnetron cathode is connected to the pulse transformer (within the modulator network). When the pfn discharges through this transformer, a very high negative potential is applied to the magnetron cathode for the duration of the pulse. This high-potential pulse causes the magnetron to oscillate. The resulting rf signal is waveguide coupled through the mixer-duplexer to the antenna where it is radiated into space. Voltage developed from the magnetron current pulses is applied to the metering circuit to provide monitoring of magnetron current.

(d) Mixer-Duplexer.

The mixer-duplexer contains a ferrite circulator, TR tube, and afc and receiver if. mixers. The transmitted pulse from the magnetron enters the mixer-duplexer and is rotated 45 degrees by the circulator for proper orientation to exit through the twist section of the waveguide. When rf energy directly from the magnetron or a nearby source is present, the TR tube is ionized. The ionized tube prevents the rf energy of levels greater than 200 mw from entering the receiving branch of the mixer-duplexer and damaging the receiver mixer crystals. A portion of the magnetron output is mixed with the klystron output in the afc mixer crystal. The resulting if. is applied to the afc circuit in the synchronizer.

Between transmitted pulses, returned signals enter the circulator. The circulator rotates the signals for proper orientation with the mixer-duplexer receiving branch probe. The probe couples the signals to the receiver mixer crystals where the signals are mixed with the output of the klystron. The resulting 30-MHz signal is applied to the if. preamplifier.

Afc and receiver if. (both forward and reverse) mixer currents are monitored by the front panel meter when the meter function selector switch is in the appropriate position.

(e) Keep-Alive Supply.

The keep-alive supply applies -700 V (-300 V; revision J, serial no 1059, and below; before incorporation of service bulletin no. 1) to the TR tube to partially ionize the gas about the electrodes in the tube. Energy from the magnetron or external sources causes complete ionization of the gas between the electrodes. When completely ionized, the tube prevents high level rf energy from entering the mixer-duplexer receiving branch and damaging the mixer crystals.

(2) Receiver Section.

The receiver section provides preamplification of returned signals and an afc signal for local oscillator frequency control. These functions are accomplished by the if. preamplifier, klystron local oscillator, and mixer crystals in the mixer-duplexer. The klystron and if. preamplifier functions are discussed in the following paragraphs.

(a) Klystron.

The klystron frequency is tuned to 30 MHz above the magnetron frequency. The klystron output is coupled to the balanced receiver if. mixer crystals and the afc mixer crystal. In the if. mixer crystals, returned signals are heterodyned with the klystron output to produce a 30-MHz if. The if. is applied to the if. preamplifier.

The klystron output is also heterodyned with a portion of the magnetron out-put in the afc mixer crystal. The resulting signal is applied to the synchronizer afc circuit. The afc circuit senses any deviation from the 30-MHz if. and produces a corresponding change in the klystron repeller voltage. Because the klystron frequency depends on the value of the repeller voltage, afc action maintains the klystron output at 30 MHz above the magnetron frequency.

(b) If. Preamplifier.

The if. preamplifier is a low-noise cascode amplifier that uses Nuvistor type tubes. It amplifies the low-level 30-MHz if. signal from the receiver mixer crystals. The amplified signal is coupled to the if. amplifier in the synchronizer. Positive 82-v plate voltage for the if. preamplifier is obtained from the junction of the zener voltage regulator diodes in the +260-v supply.

A sensitivity-time control (stc) voltage from the synchronizer automatically reduces the gain of the if. preamplifier during the time in which signals from nearby targets are being received. This permits short-range targets to be presented with the same intensity as targets farther away. Manual gain of the preamplifier is provided by the GAIN control on the radar control unit.

(3) Power and Control Circuits Section.

The power and control circuits section contains -27.5-v, +27.5-v, and +260-v power supplies, a metering circuit to monitor certain voltages and currents, a fault sensing circuit for protection against potentially damaging faults, and relays to control application of primary and dc power to the system. Functions of these circuits are discussed in the following paragraphs.

(a) Metering Circuit.

The metering circuit measures the following:

Afc mixer current	Generator B voltage
Reverse if. mixer current	Generator C voltage
Forward if. mixer current	-27.5-v supply voltage
Magnetron current	+27.5-v supply voltage
Generator A voltage	+260-v supply voltage

Outputs from these circuits are connected to a wafer switch on the front panel of the receiver-transmitter. Rotating the switch to any of the meter positions selects the applicable signal. The signal is applied to the front panel meter through appropriate shunts to provide mid-scale reading for normal operation. (Due to variation in crystal efficiencies, normal crystal current readings may not occur at mid-scale.)

(b) Fault Sensing.

The fault sensing circuit has inputs from the +260-v and +27.5-v power supplies and from the modulator. When abnormal operation of any of these circuits occurs, the fault sensing circuit causes the system to revert to the standby mode of operation. When excessive current is drawn from either of the positive power supplies (or an over voltage condition in the +27.5-v supply occurs), the input signal from the supply to the fault sensing circuit increases. This increase biases the fault sensing circuit output transistor into conduction and causes the fault sensing relay to latch closed. When the fault sensing relay is energized, operate relay K1 is deenergized and generator C power is removed from the power supplies.

When a magnetron misfire or spark gap arc-over occurs, a fault signal from the modulator network is applied to a one-shot multi-vibrator. If the misfire or arc-over rate exceeds approximately 10 percent, the integrated output of the one shot activates the fault sensing output transistor.

The circuit can be reset by returning the system control switch to STBY and then setting it back to OPR.

(c) +260-V Supply.

The +260-v supply provides a regulated voltage for the klystron, the indicator unit, and the if. preamplifier. Aircraft generator C power is applied to the +260-v supply transformer when operate relay K1 is energized. The transformer output is rectified, filtered, and applied to two series-connected zener diodes. The diodes provide regulation to +260 v. A +82-v output is taken from the junction of the diodes and applied to the if. preamplifier for plate voltage. An overcurrent signal voltage is applied to the fault sensing circuit when abnormal current is drawn from the supply.

An output from the +260-v supply is applied to the metering circuit for monitoring the output voltage.

(d) +27.5-V Supply.

The +27.5-v supply provides a regulated voltage for the receiver- transmitter, synchronizer, and indicator. Aircraft generator C power is applied to the +27.5-v supply when operate relay K1 is energized. A full wave bridge rectifier provides a dc voltage for the regulator circuit. When excessive current is drawn from the +27.5-v supply, or an over voltage condition occurs, a voltage in excess of that during normal operation is applied to the fault sensing circuit.

Positive 32 v from the +27.5-v bridge rectifier and a zener-regulated +15 v from the +27.5-v supply output are applied to the trigger generator. The +15-v output also supplies voltage for the manual gain control circuit.

An output voltage from the +27.5-v supply is applied to the metering circuit for monitoring the output voltage.

(e) -27.5-V Supply.

The -27.5-v supply provides a regulated voltage for the fault sensing circuit, the synchronizer unit, and the indicator unit. An unregulated voltage is obtained from the bridge rectifier for control relay power.

Aircraft generator C power is applied to the -27.5-v supply transformer at all times. A full-wave bridge rectifier circuit supplies unfiltered relay power (for the control relays) and a filtered voltage. When standby relay K2 is energized, the filtered voltage is supplied to the -27.5-v series regulator circuit.

An output voltage is applied from the -27.5-v supply to the metering circuit for monitoring the -27.5-v output.

(f) Power Control Circuit.

Aircraft generator A applies 115-v, 400-Hz power through standby relay K2 to all units. Generator B applies 115 v, 400 Hz to internal circuits of the receiver-transmitter when relay K2 is energized. Relay K2 is energized when the system control switch on the cockpit control unit is in any position other than OFF.

Operate relay K1 is energized when the system control switch is in the OPR or CTR positions. Input power from aircraft generator C is applied to the -27.5-v and relay power supply transformer when primary power is applied to the system. When operate relay K1 is energized, generator C power is applied to the positive power supplies.

D. Detailed Theory of Operation.

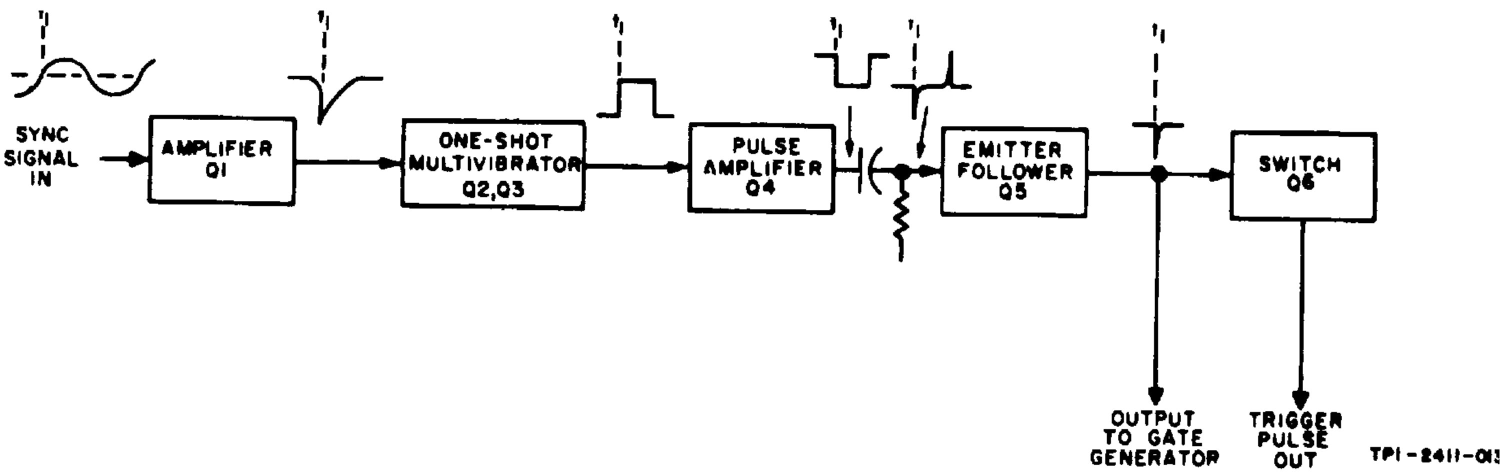
(1) Trigger Generator Module. (Refer to figures 2-5 and FO-6.)

The trigger generator module provides the system timing pulse and trigger pulse for the modulator. The system timing pulse is applied to the synchronizer gate generator module. Simultaneously, the trigger pulse is applied to the modulator network to initiate discharge of the pulse forming network, These outputs are synchronized with the primary power frequency (nominally 400 Hz) and occur 40 degrees after the positive-going 0-volt crossing of the primary input voltage. Refer to figure 2-6 for trigger generator and modulator waveform relationships.

The synchronizing signal for the trigger generator is obtained from the magnetron filament transformer in the modulator network. With relay K2 energized (STBY selected on the cockpit control unit), generator A power is applied to the magnetron filament transformer through K2, magnetron filament temperature compensation network R79 through R81, RT82, and R83, and a combination of resistors R73, R75, and R78 on TB1. A sampling of the magnetron filament voltage is applied from P7-24 through phase shifting network R70 and C55 to pin B of J1.

The voltage at J1-B is coupled through R1 and C1 to the base of inverter amplifier Q1. The output of Q1 is differentiated by C2 and R4. The negative differentiated pulse, coupled through crt, is applied to the base of Q2 (refer to figure 6). This biases Q2 into conduction. Transistor Q2 is one-half of a monostable multi-vibrator. When Q2 conducts, the collector is at approximately the emitter potential of +15 v. This charges C3 and cuts off Q3.

With Q3 cut off, C3 begins discharging. When C3 discharges sufficiently, Q3 begins to conduct again. With Q3 conducting, the multi-vibrator is in the stable state.

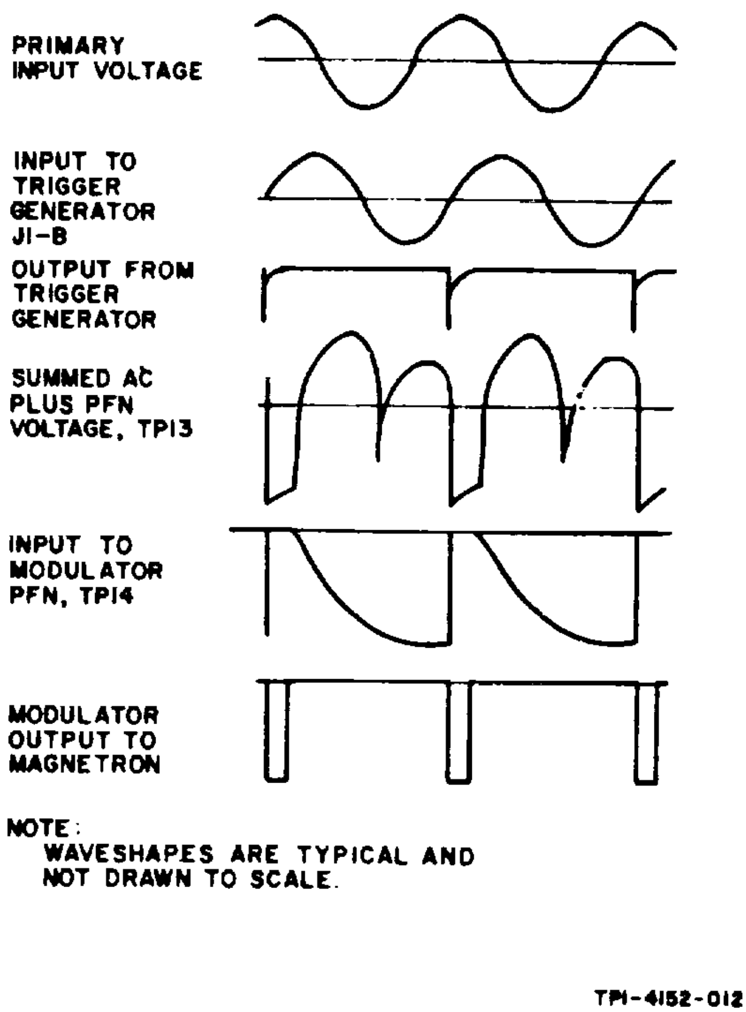


Trigger Generator Module, Block Diagram
Figure 2-5

The positive-going pulse from the collector of Q2 is coupled to the base of amplifier Q4. This pulse biases Q4 into conduction. The resulting negative-going pulse from the collector of Q4 is time-limited by C7 and L1 and applied to the base of emitter follower Q5. Diode CR6 clamps the resonant circuit to the +32-v supply level. The negative pulse from Q5 is applied to the base df switching transistor Q6. Transistor Q6 is normally off, and C15 is charged to approximately +32 v. When Q6 is pulsed into conduction, C15 discharges through the isolation transformer in the gate circuit of the modulator solid-state thyratron (scr Q1). This 9-us. pulse gates the scr into conduction to discharge the pulse forming network, located in the modulator. The output from Q5 is also coupled through J1-E and -F and P1-23 and -24 to the synchronizer gate generator module to initiate timing circuits for the system.

(2) Modulator. (Refer to figures 2-6, 2-7, and FO-6.)

The modulator supplies high-voltage pulses to the magnetron cathode in synchronization with the trigger generator output. A low-voltage power supply, high-voltage power supply, latch-up circuit, magnetron filament transformer, keep-alive voltage transformer, and modulator charging circuit are contained in the modulator. With the exception of those components connected to the anode of Q1, the modulator circuits are floating above ground potential. The floating reference potential is approximately that shown for TP13 in figure 2-6.



Trigger Generator and Modulator Waveforms
Figure 2-6

Positive 29 volts for operation of the latch-up circuit is obtained from the regulated supply Q4, VR17, and associated components. During normal operation, the latch-up circuit develops a gate voltage across R10 and R11 to maintain conduction through Q2 and Q3, a full-wave rectifier circuit. Capacitor C1 and charging reactor L1 form a series resonant load (approximately 200 Hz) for the power supply. Capacitor C1 charges to a high potential through pulse transformer T3, VR14, T4, CR5, and L2.

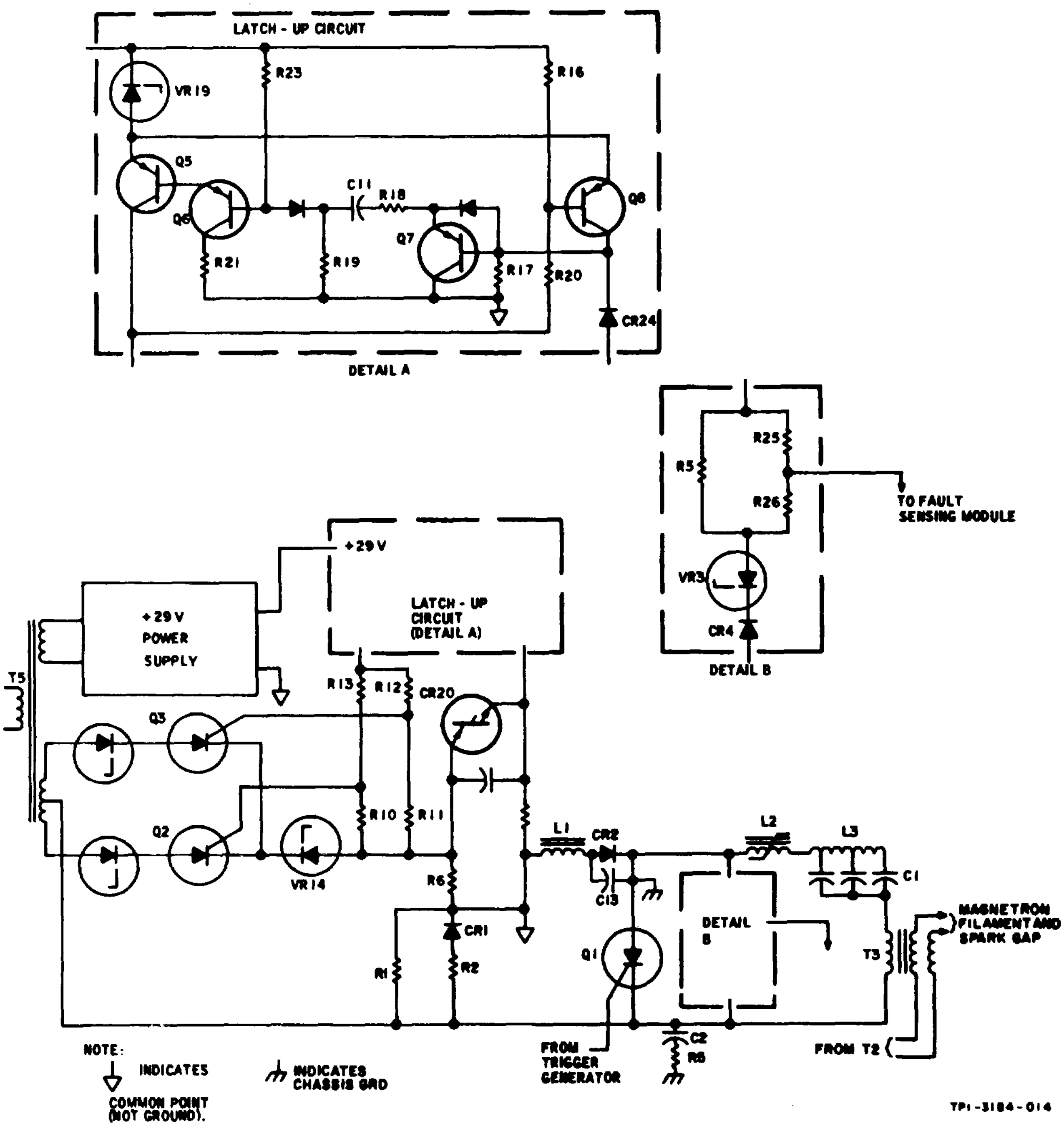
At the time the potential across C1 is maximum, CR2 is back-biased. This effectively disconnects the charging circuit from the pfn, Q1 and associated components. Also, at this time, the trigger generator supplies a trigger to gate scr Q1 into conduction. When conducting, Q1 provides a discharge path for the multiple capacitor C1 and inductor L3 (the pulse forming network) through L2 and pulse transformer T3. The saturable core reactor L2 momentarily delays buildup of the discharge pulse to permit the scr to go into the fully conducting state. Discharge of the pulse forming network through T3 develops a -8-kv, 3.3-us. pulse at the cathode of the magnetron. Transformer T4 supplies a magnetron current pulse signal to TP4 for monitoring purposes.

In the event Q1 does not turn off at the end of the pulse forming network discharge, the excessive voltage developed across R6 causes CR20 to conduct. When this occurs, Q5 is biased off, removing the voltage across R10 and R11. The voltage across VR14 then biases the gates of Q2 and Q3 negative, causing the scr's to stop conducting. This removes the source of high voltage from the charging circuit, allowing Q1 to turn off.

In the latch-up circuit (refer to detail A of figure 2-7), Q5 and Q6 are normally conducting. Resistors in the collector circuit of Q5 provide forward bias for the gates of Q2 and Q3. When CR20 conducts (Q1 fails to turn off), a positive-going voltage is applied, through CR24, to the base of Q7. This positive voltage at the base of Q7 charges C11 more positive. The charging current, through R19, develops an increased voltage at the base of Q6. This voltage reverse biases Q6, causing it to turn off Q5. With Q5 off, the gates of Q2 and Q3 are reverse biased by VR14, disabling the high-voltage supply.

With the high voltage removed from the modulator charging circuit, C11 is discharged in approximately 270 ms and the latch-up circuit returns to normal operation. Rectifiers Q2 and Q3 are then gated on for normal modulator operation. In the event the modulator returns to normal operation near the maximum of an input voltage cycle, voltage surges may immediately trigger the latch-up circuit. The circuit will again cause the modulator to switch off, go through the normal off cycle, then switch back on.

Some of the energy from the pulse forming network is reflected back by the magnetron load. This voltage, of opposite polarity to the discharge voltage, aids in turning off Q1. It is absorbed by R24 and R7. If only a small amount of energy from the pulse forming network is dissipated (due to magnetron misfire or spark gap operation), the remainder is reflected back in opposite polarity. When this occurs, VR3 and CR4 (refer to detail B of figure 2-7) are biased into conduction. Current through R5, R25, and R26 develops a voltage pulse that is applied to the fault sensing module input. With a 10-percent



Modulator, Simplified Schematic Diagram
Figure 2-7

(nominal), or greater, misfire rate, the fault sensing circuit causes the system to revert to the standby mode of operation. Thus, the modulator and magnetron are protected from abnormal operation.

(3) Mixer-Duplexer Module.

The mixer-duplexer module provides electronic switching to permit transmission and reception with a common antenna; a local oscillator signal: a received-signal intermediate frequency (if.) for receiver input; an if. preamplifier load isolation for the magnetron of not less than 15 db; magnetron-receiver isolation of approximately 20 db; and an afc if. for control of local oscillator frequency.

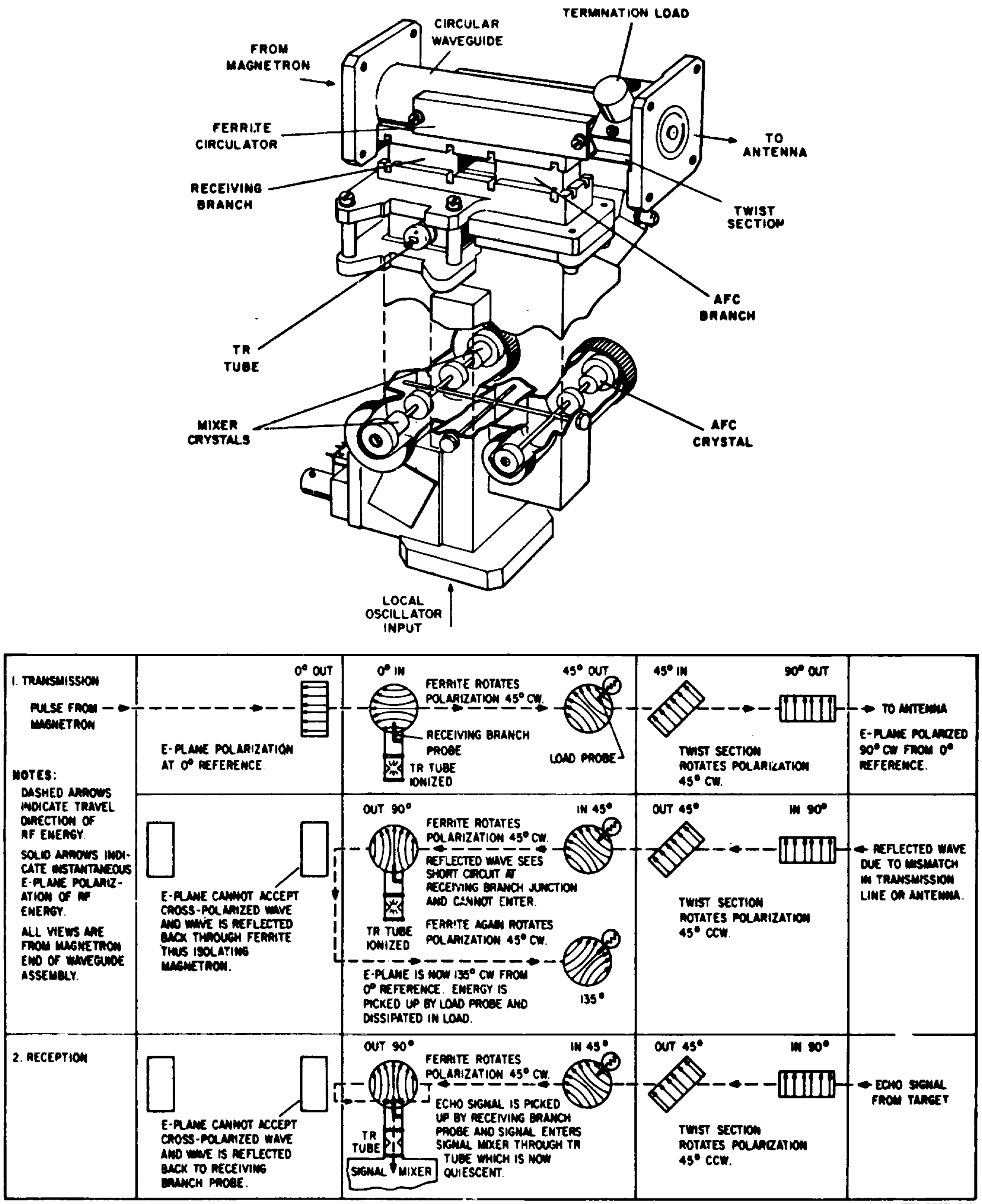
(a) Ferrite Circulator. (Refer to figure 2-8.)

The ferrite circulator is a dielectric-filled section of the circular waveguide with a ferrite rod embedded along the center axis between a receiving branch probe and a matching load probe. The circulator acts as a one-way isolator to minimize the effects of mismatch, and it eliminates the need for ATR tubes. The receiving branch of the duplexer is near the input (magnetron) flange and is probe-coupled to the circular waveguide section. The afc branch is near the output (antenna) flange and is aperture-coupled to the circular waveguide.

The path of a magnetron-generated rf pulse through the waveguide assemblies is shown in figure 2-8. Starting at the magnetron output, the electric field (E-plane) polarization is shown across the narrow dimension (0° reference) of the waveguide. The rf pulse leaves the magnetron and enters the circular waveguide with E-plane polarization still at 0°. When the rf pulse reaches the junction of the receiving branch, a small portion of the pulse energy enters the receiving branch and ionizes TR tube V3. The ionized TR tube is a short circuit across the receiving branch and prevents high-energy rf pulse from entering the signal mixer section. This protects the mixer crystals from the transmitted pulse.

As the rf pulse proceeds past the receiving branch, it meets a ferrite rod embedded along the cylindrical axis of the circular waveguide section. The ferrite rod is magnetized to near saturation along the longitudinal axis by two permanent magnets attached to opposite outside surfaces of the circular waveguide section parallel to the ferrite rod. The combination of ferrite rod, permanent magnets, and circular waveguide rotates the polarization of the electromagnetic waves through 45°. As the transmitted pulse passes the far end of the ferrite rod, a small sample of the rf energy is aperture-coupled to the afc mixer.

The E-plane polarization of the rf energy is now at the proper angle (45° clockwise with respect to 0°) for transmission through the twist section of the waveguide. The twist section rotates the polarization clockwise another 45°. The E-plane polarization at the twist section output flange is in the proper plane (90° clockwise with respect to 0°) for transmission through the external wave guide to the antenna.



Mixer-Duplexer Assembly
Figure 2-8

The frequency stability of a magnetron is closely dependent upon the impedance into which the magnetron is operated. In a typical radar system, an undesirable and possibly time-varying mismatch, due to the scanning motion of the antenna, is connected to the magnetron. Discontinuities of the waveguide, waveguide joints, or the rotary joint can also contribute mismatches. Mismatches reflect rf energy back toward the magnetron and cause frequency pulling and a poor spectrum. The ferrite circulator acts as a one-way isolator to minimize the effects of mismatch, and it also eliminates the need for ATR tubes. Any reflected rf energy, due to mismatches, enters the twist sect on of waveguide, and the E-plane is rotated 45° counterclockwise (as viewed from the magnetron). Because the transmitted rf is rotated 90° clockwise and +he reflected rf is rotated 45° counter-clockwise (with respect to 90° clockwise), the reflected rf into the circulator has a relative position of 45° clockwise. The ferrite circulator rotates the reflected Fr 45° clockwise, and the Fr reaches the receiving branch junction with a relative 900 clockwise position. Reflected Fr occurs during the pulse period and cannot enter the receiving branch, because the TR tube is ionized and reflects a short circuit at the receiving junction. The short circuit across the receiving branch junction is a reflection of the short circuit an, so the TR tube that is spaced one-half wavelength from the junction. Since the rf cannot enter the receiving branch, it continues toward the rectangular waveguide at the magnetron. This waveguide cannot accept the cross-polarized Fr (90° clockwise with respect to the magnetron), and it is reflected back through the ferrite circulator. The circulator rotates the Fr 45° clockwise to 135°, which is the pickup angle of the matching load probe. The reflected Fr is probe-coupled to the matching load and absorbed by the load.

At the end of the magnetron pulse period, the TR tube deionizes. Echo signals entering the twist section of the waveguide from the antenna have the same polarization as the transmitted pulse (90° clockwise). Echo signals experience a polarization rotation of 45° counterclockwise through the twist section and 45° clockwise through the ferrite circulator, ending at the receiving branch junction with a 90° clockwise angle. Since the TR tube is now deionized, the short across the receiving branch junction no longer exists, and the echo signals are probe-coupled into the receiving branch. A small portion of the echo signals that are not intercepted by the receiving branch probe continue toward the magnetron. The echo signals have a 90° clockwise angle with respect to the magnetron, and the magnetron cannot accept these signals. These signals are reflected back toward the receiving branch probe and are coupled into the receiving branch. The spacing between the receiving branch probe and the waveguide at the magnetron is critically set so that the incident and reflected waves reinforce each other at the receiving branch probe. All echo signals coupled into the receiving branch pass through the deionized TR tube and enter the signal mixer section.

(b) TR Tube V3. (Refer to figure 2-8.)

The TR tube is an rf switch placed in the receiving branch of the waveguide approximately one-half wavelength from the circulator junction. The TR tube is essentially a cavity resonator that is broadly fixed-tuned to the transmitter frequency, filled at a low pressure with gas, and constructed with an internal spark gap. A small portion of the gas in the tube, near the gap but not across it, is kept ionized by the application of a negative, keep-alive voltage. The keep-alive voltage is supplied from keep-alive supply module TB2. The keep-alive voltage minimizes the TR tube ionizing time, which increases the crystal protective function of the tube. When the tube is ionized by the magnetron rf pulse, the high-power, rf pulse cannot reach the signal mixer section and damage the mixer crystals. The TR tube is deionized during receive time, and received signals pass through to the signal mixer section.

(c) Mixer Section. (Refer to figure 2-8.)

The mixer section consists of a signal mixer, an afc mixer, and a local oscillator and feed section assembly. The local oscillator output is probe-coupled into a coaxial-to-waveguide, crossbar transition. The local oscillator energy is divided equally and connected by two coaxial lines to two equivalent magic-T hybrid mixers constructed of coaxial line and waveguide. Received signal energy is coupled into the signal mixer section, and a sample of the transmitter pulse is coupled into the afc mixes section. The local oscillator energy and received-signal energy are heterodyned in the signal mixer to produce the received-signal intermediate frequency. Local oscillator energy and a sample of the magnetron rf energy are heterodyned in the afc mixer to produce the afc intermediate frequency.

The signal mixer section contains a forward signal crystal diode (CR42) and a reverse signal crystal diode (CR41) in identical, opposed, coaxial, crystal mounts that are attached to the broad walls of the receiving branch waveguide. The local oscillator frequency, 30 MHz above the magnetron frequency, is probe-coupled into the signal mixer. The signal mixer crystals are spaced one-half wavelength (signal frequency) apart in the waveguide, and the local oscillator output is probe-coupled into the waveguide midway between the two crystals. The local oscillator probe radiates energy equally in opposite directions, and the crystals receive rf energy that is equal in amplitude and is in phase. Because of the 180° (one-half wavelength) spacing of the crystals, the received-signal rf energy applied to the crystals is equal in amplitude but 180° out of phase. The combination of the local oscillator frequency and the received-signal frequency produces two phase relationships, one in phase and the other 180° out of phase. The two crystal outputs (in phase and 180° out of phase) are combined by capacitor C30. Noise generated by the local oscillator is equal in amplitude, but opposite in phase; therefore, the noise signals cancel. The low-noise if. (30 MHz) signal from C30 is supplied to the if. preamplifier. A filter composed of capacitors C31 through C36, rf chokes L5 through L10, and resistors R59 and R60 provide dc crystal cur-rent outputs at pins 1 and 3 of plug P2 to connect the signal to meter circuit module TB4.

The afc mixer section contains a single crystal diode (CR40) in a coaxial crystal mount. To balance the double-ended mixer, a resistive coaxial termination is mounted on the broad wall of the waveguide opposite the crystal mount. A sample of the magnetron output and the local oscillator output is heterodyned in the afc mixer. The difference frequency (30 MHz) is detected by CR40 and coupled through C28 to the afc discriminator circuit in the synchronizer. A 15-MHz trap is formed by L3 and C29. This prevents 15-MHz afc operation caused by frequency doubling in the synchronizer. An attenuator between the klystron and the afc mixer permits adjustment of dc current through crystal diode CR40. A filter composed of rf chokes L3 and L4, capacitors C29 and C58, and resistor R56 provides a dc crystal current output through J4 to meter circuit module TB4.

(d) Local Oscillator V4. (Refer to lA10 on figure FO-6.)

The local oscillator is a reflex klystron that operates 30 MHz above the magnetron frequency. The cathode is grounded and +260 v from TB1 is applied to the accelerating grid and the body of the tube. Negative voltage from the synchronizer afc module is applied to the klystron repeller. If the voltage applied to the repeller becomes more negative, the klystron frequency will increase, and, if the voltage becomes less negative, the frequency will decrease. This “afc loop” maintains the klystron frequency at 30 MHz above the magnetron frequency. Potentiometer R71 permits adjustment of the klystron repeller voltage to accommodate tolerance variations in the klystron mode. The frequency of the klystron tuning cavity is controlled by a tuning screw adjustment.

During standby operation, -27.5 v is applied to the klystron repeller through a network consisting of R76, R77, C59, and CR42. This potential prevents electron bombardment of the repeller while the tube is not operating.

(e) Directional Coupler and Twist Assembly. (Refer to figure 2-8.)

The cross-guide directional coupler is a section of rectangular waveguide secured at right angles to the broad wall of the twist waveguide assembly. Two cross-shaped apertures provide coupling between the cross-guide directional coupler and the twist assembly. Test point TP6 is a probe inserted into one end of the directional coupler. This permits sampling the Fr energy for transmitter measurements and injecting signals for receiver measurements. A termination load assembly is contained in the waveguide opposite TP6. The directional coupler introduces approximately 20-db attenuation between the twist section flange and the directional coupler output jack.

The twist waveguide assembly is connected to the ferrite circulator and rotates the E-plane polarization 45° clockwise during transmission and counterclockwise during reception. The Fr energy coupled to the antenna has a 90° clockwise polarization with respect to the magnetron.

(f) IF. Preamplifier. (Refer to 1A10 on figure FO-6.)

The if. preamplifier is a cascode amplifier circuit consisting of low-noise triodes V5 and V6. The 30-MHz signal from the signal mixer crystals is coupled through a matching network and L17 to the grid of V5. Capacitors C48 and C54 tune the input and output circuits, respectively.

The amplified signal at the plate of V5 is coupled to the cathode of V6, amplified by V6, and coupled through C49, L22, and J6 to P1-Al. From P1-Al it is connected to the if. amplifier in the synchronizer.

The gain of the preamplifier is manually controlled by the GAIN potentio-meter in the cockpit control unit. This potentiometer controls the positive dc voltage applied to the cathode of V5, thus controlling the gain. Positive 15 v from TB6-3 is supplied through R68 (located on the chassis) and the cockpit control unit to P2-7. Potentiometer R102 is an internal gain adjust-ment to provide standardization of amplifier gain.

The stc pulse from the synchronizer gate generator is applied to the grid of V5 in the if. preamplifier. This negative-going pulse, coincident with the magnetron firing, has a sharp leading edge and an exponential decay. The stc pulse decreases the gain of the preamplifier as a function of range so a rainstorm (or other target) will not appear to be getting heavier when actually it is only getting closer.

(4) +260-V Supply and Regulator. (Refer to 1A2 on figure FO-6.)

The +260-v supply and regulator provides +260 v for the klystron and indicator unit, and +82 v for the plate of V6 in the if. preamplifier. Primary power from generator C is applied to transformer T1 when operate relay K1 is energized. One of the secondary windings of T1 is used for the +260-v supply and is connected to the full-wave bridge rectifier consisting of CR9 through CR12. The rectified voltage from the bridge circuit is filtered by C6 and applied through R11 to the voltage regulating zener diodes VR22 and VR23. The regulated voltage across VR22 and VR23 is +260 v. Positive 82 v for V6 (in the if. preamplifier) is obtained from the junction of VR22 and VR23.
Current through the +260-v supply develops a voltage across resistor R10. This voltage is applied to the fault sensing circuit. When excessive current is drawn from the supply, the increased voltage across R10 causes the fault sensing circuit to remove primary power from transformer T1.

(5)+27.5-V Supply and Regulator. (Refer to 1Ab on figure FO-6.)

The +27.5-v supply and regulator provides transistor power for all units of the system. Primary power from generator C is applied to transformer T1 when operate relay K1 is energized. One of the secondary windings of T1 is used for the +27.5-v supply and is connected to a full-wave bridge rectifier consisting of CR13 through CR16. The rectified voltage from the bridge circuit is filtered by C8 and C9 (located on TB1) and L1 (located on the chassis). Transistors Q3 through Q7 form a regulator circuit in which Q7 is a difference detector and Q4 and Q5 are series regulators. The +27.5-v output from the collectors of Q4 and Q5 is supplied to the other units through P1-i and P1-2.

A sample of the supply voltage is returned from the synchronizer to the receiver transmitter through pins 14 and 16 of P1. Monitoring the voltage in the synchronizer provides better regulation at the point of use. In the receiver-transmitter, the monitor lines are connected to a voltage divider consisting of R23, R24, and R25. The wiper arm of potentiometer R24 is connected to the base of difference detector Q7. The setting of R24 determines the output voltage of the power supply.

When the supply output voltage becomes more positive, the voltage at the base of Q7 becomes more positive. Conduction through Q7 is increased since the emitter is held at a constant potential by the action of Q6 and zener diodes VR26 and VR27. As conduction through Q7 increases, the voltage (developed across R22) at the emitter of Q6 becomes more positive. This decreases conduction through Q6 and R22, thus decreasing the voltage (across R22) applied to the emitter of Q7. This action stabilizes the voltage at the emitter of Q7 and also provides temperature compensation.

Also, when conduction through Q7 is increased, the increased current through R20 causes a more negative voltage at-the base of Q3. The negative bias in-creases conduction through Q3 and R19. As the voltage dropped across R19 in-creases, the bases of Q4 and Q5 become more positive. This decreases current through the load, thus reducing the output voltage. Stabistors CR24 and CR25 aid in temperature compensation and ensure that Q4 and Q5 properly divide the load.

Unregulated +32 v from TB1-7 is supplied to the trigger generator module. Regulated +15 v is provided by R18, VR28, and C13 on the -27.5-v regulator module TB6. The +15 v is applied to the trigger generator module and to the if. preamplifier gain control circuit.

The +27.5-v supply output is applied to terminal 1 of fault sensing module TB3. Primary power to the power supply is removed by the fault sensing circuit if an over voltage or overcurrent condition exists.

(6) -27.5-V Supply and Regulator. (Refer to 1A4 on figure FO-6.)

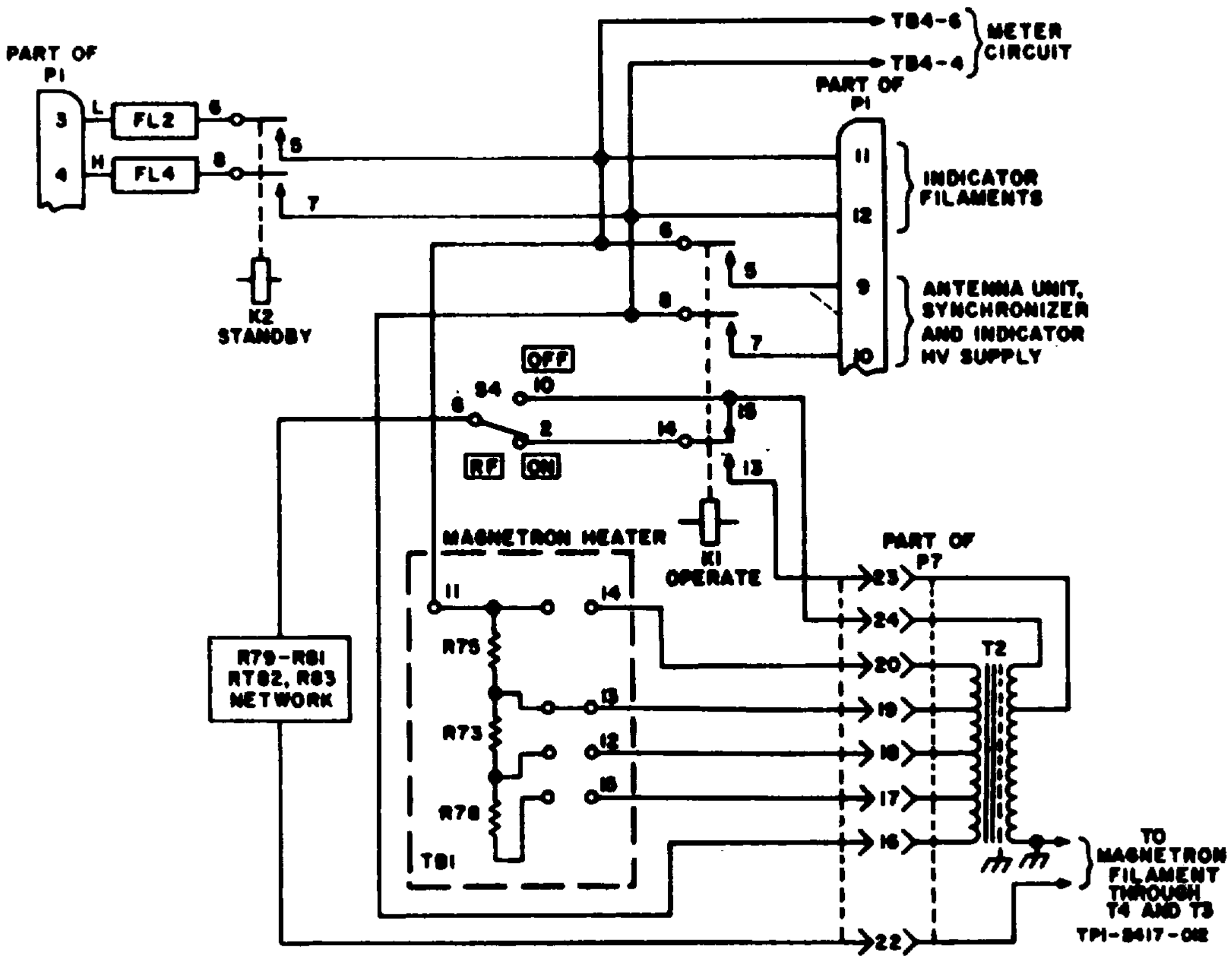
The -27. 5-v supply and regulator provide power for the fault sensing circuit and for the synchronizer and indicator units. Generator C power is applied directly to the primary of transformer T2. The secondary of T2 is connected to a full-wave bridge rectifier consisting of diodes CR18 and CR21. The filter circuit, located on TB6, consists of resistors R16 and R17 and capacitors Cll and C12.

The unfiltered output of the rectifier is used as relay power for the control re-lays. The filtered output is applied, through K1-16, K1-17, and R15, to the collector of Q2. Transistor Q2 is a series regulator with the base voltage held constant by zener diode VR17. If the output voltage increases (becomes more negative), the larger negative voltage at the emitter causes Q2 to conduct less. The smaller current through Q2 reduces the current through the load and de-creases the voltage across the load.

(7) Power Distribution and Control Circuits.

(a) Generator A Power Distribution Circuit. (Refer to figure 2-9.)

Power from generator A of the aircraft primary power supply is applied to the magnetron filament circuit, metering circuit, antenna unit, and



RT-711A Receiver-Transmitter, Generator A Power Distribution Diagram
Figure 2-9

indicator unit. The 115-v, 400-Hz power is applied through P1-4 and P1-3 and filters FL4 and FL2 to contacts 6 and 8 of relay K2. When K2 is energized (STBY selected on cockpit control), the high side of generator A output is connected from K2-7 to meter circuit TB4-4, magnetron filament transformer (through P7-16 on the modulator), contact 8 of relay K2, and the indicator unit through P1-12. The low side of generator A output is connected from K2-5 to meter circuit TB4-6, contact 6 of relay K2, magnetron heater circuit (terminal 11 of TB1), and the indicator unit through P1-11.

When K1 is energized (OPR or CTR selected on cockpit control), generator .A power is applied from K1-5 and -7 to the antenna unit through P1-9 and -10.

When modulator power is applied to the magnetron, the magnetron filament voltage is reduced from 6.3 vac to approximately 3.5 vac to prevent electron bombardment from overheating the cathode. Part of the filament transformer secondary is connected from P7-23 and -24 to K1-13 and -15. When K1 is energized, the 3.5-vac tap (P7-23) is placed in the circuit. When K1 is de-energized, or RF switch S4 is OFF, the 6. 3-vac terminal (P7-24) is in the circuit. The filament circuit is completed through the temperature compensation network P7-22, and modulator terminal 25 to the magnetron. The resistive network R79 through R81, thermistor RT82, and R83 provide temperature compensation for the magnetron filament voltage. Compensation is necessary due to the change in resistance with temperature of the windings of the pulse transformer.

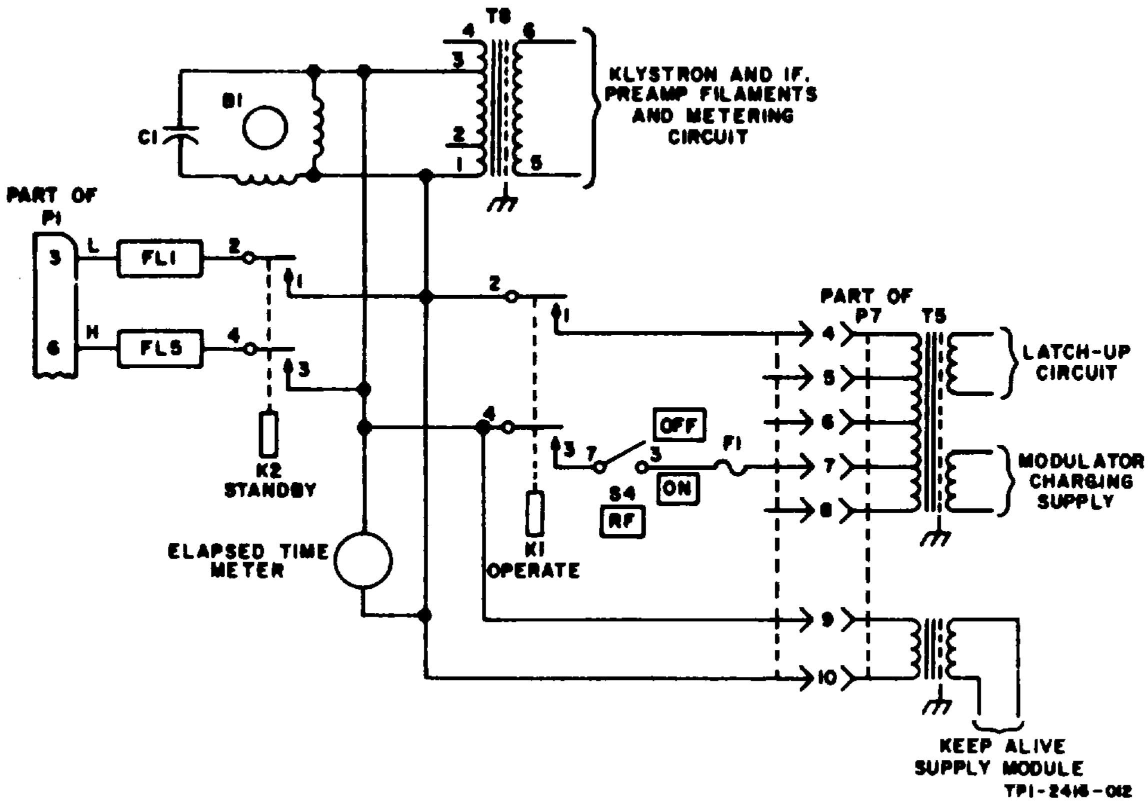
The magnetron voltage adjustment circuit mounted on TB1 (+260-v regulator) consists of resistors, R73, R75, and R78. By connecting these resistors in series and/or parallel and selecting the proper tap (TB1-12, -13, -14, or -15) on the magnetron filament transformer, the filament voltage for the particular magnetron-modulator combination can be adjusted to the correct value. Due to the series resistance in the circuit, 15 vac may be required at the transformer to obtain 6.3 vac at the magnetron filament.

(b) Generator B Power Distribution Circuit. (Refer to figure 2-10.)

Power from generator B of the aircraft primary power supply is applied to the klystron and if. preamplifier tube filaments, blower motor, elapsed time meter, metering circuit (through transformer T8), and power transformers in the modulator. The modulator transformers provide voltage for the keep-alive circuit and circuits within the modulator network. The 115-v, 400-Hz power is applied through P1-3 and P1-6 and through filters FL1 and FL5 to contacts 2 and 4 of relay K2.

When K2 is energized (STBY selected on cockpit control) the high side of generator B power is connected through K2-3 to the elapsed time meter, blower motor, transformer T8, P7-9 of the modulator and contact 4 of relay K1. The low side of generator B is connected through K2-1 to the elapsed time meter, blower motor, transformer T8, P7-10 of the modulator and contact 2 of relay K1. Terminal 6 of transformer T8 is connected to terminal 5 of meter circuit TB4, klystron filament through J5-E, and if. preamplifier tube filaments through J2-9. Terminal 5 of the secondary of T8 is connected to J5-B and J2-6. The keep-alive supply transformer in the modulator obtains power through P7-9 and -10. The output is connected through terminals 28 and 29 of the modulator to the keep-alive supply module. TB2. Operation of the time meter (when K2 is energized) gives elapsed magnetron “filament on” time.

Relay K1 energizes when OPR or CTR is selected on the cockpit control. With K1 energized, power is applied to the modulator from K1-1 to P7-4, and K-13 through S4-7 and S4-3, fuse F1, and a selectable tap to P7-5, -6,



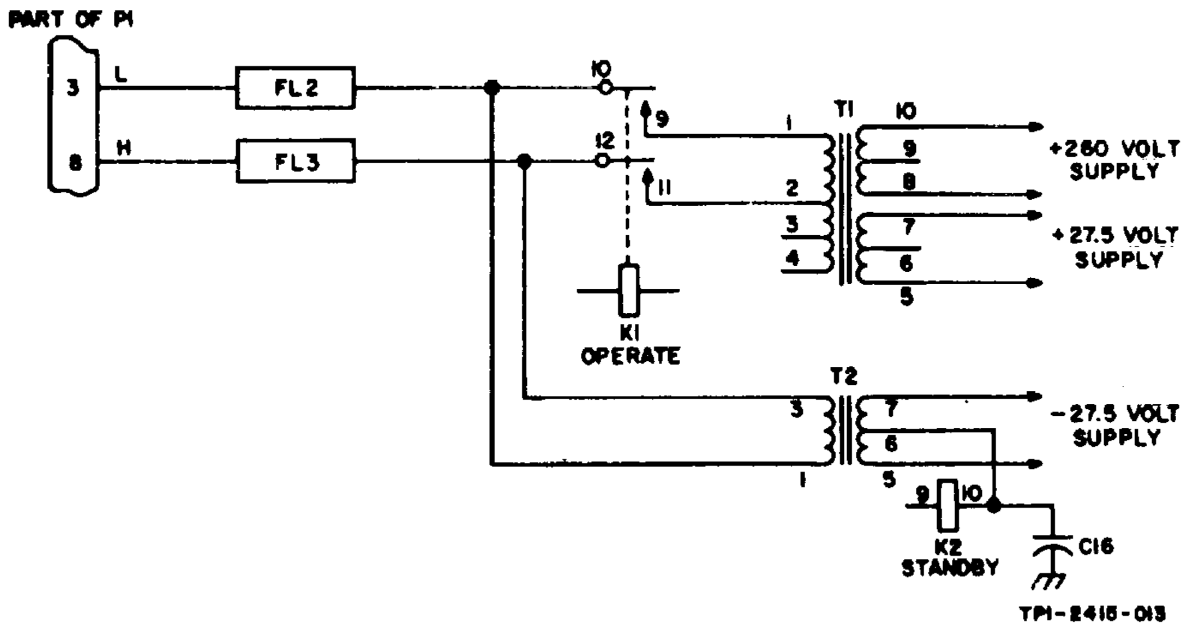
RT-711A Receiver-Transmitter, Generator B Power Distribution Diagram
Figure 2-10

-7, or -8. The taps permit adjustment of the modulator high voltage power supply output to obtain proper output power from the magnetron (20-kw minimum).

(c) Generator C Power Distribution Circuit. (Refer to figure 2-11.)

Power from generator C of the aircraft primary power supply is applied to the +260-v, +27.5-v, and -27.5-v power supplies. The 115-v, 400-Hz power is applied through P1-8 and P1-3 and filters FL3 and FL2 to the primary of transformer T2 and contacts 12 and 10 of relay K1. The secondary of T2 is connected to the -27.5-v bridge rectifier circuit. The secondary center tap of T2 is approximately -27 v with respect to ground because of the bridge rectifier connected across the secondary winding. This negative voltage is used as power for relays K1, K2, the heater of K3, and K4.

When relay K1 is energized (OPR or CTR selected on the cockpit control), power is supplied from K1-9 and K1-11 to the primary of transformer T1. One secondary winding of T1 is connected to the +260-v power supply and the other secondary is connected to the +27.5-v power supply.



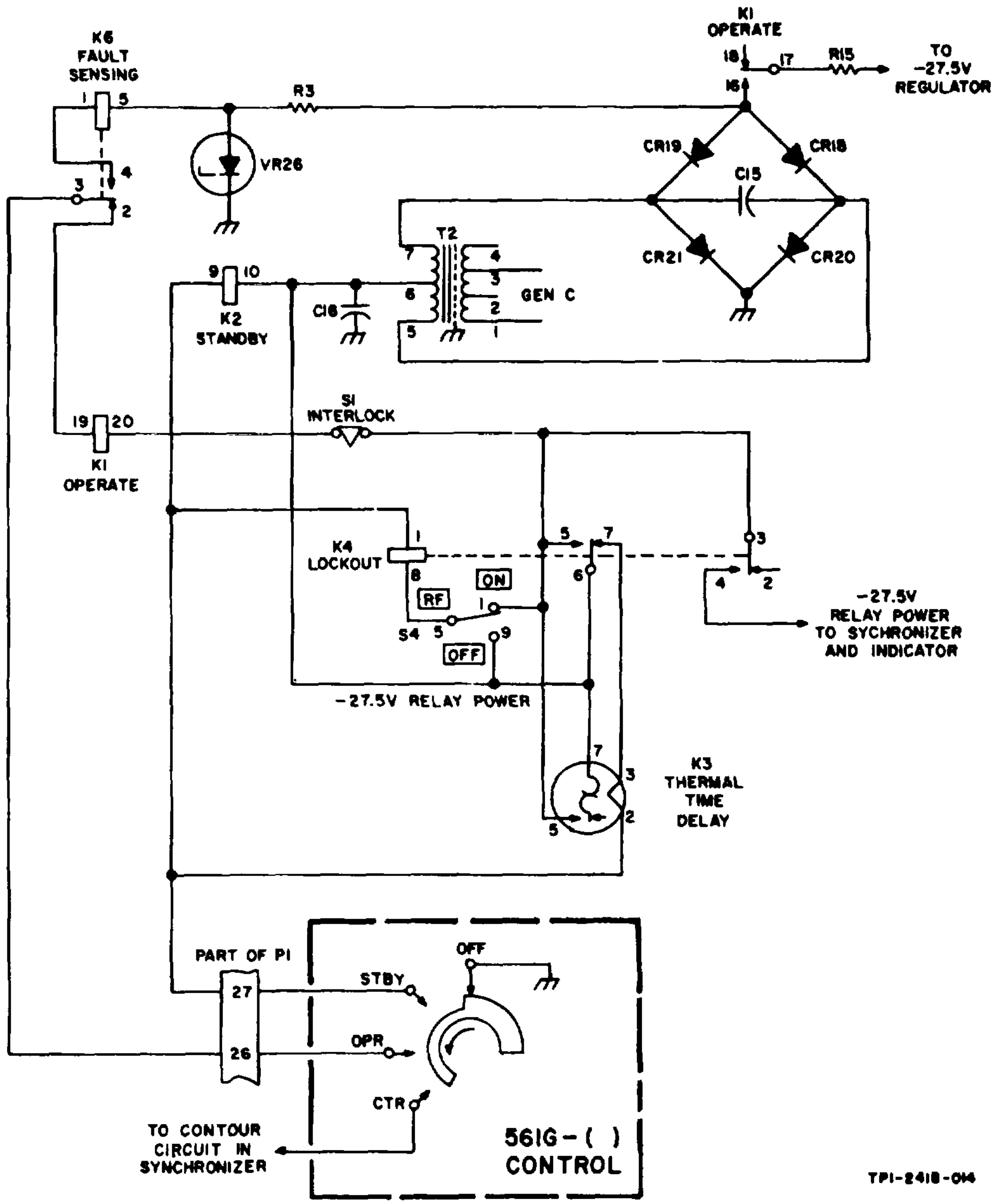
RT-711A Receiver-Transmitter, Generator C Power Distribution Diagram
Figure 2-11

Voltage for monitoring generator C output is applied to terminal 10 of meter circuit TB4 from K4-3.

(d) Power Control Circuit. (Refer to figure 2-12.)

The power control circuit relays control the application of aircraft primary power to all other circuits. A fault sensing circuit interrupts the application of power when a potentially damaging fault occurs.

Generator C power is applied to transformer T2 when aircraft power is applied to the equipment. The bridge rectifier and center tap (terminal 6) of T2 produce the negative voltage used for relay power. The relay power is sup-plied to the coil (terminal 10) of standby relay K2, contact 9 of RF switch S4, and through lockout relays K4-6 and -7 to the heater element (terminal 3) of thermal time delay relay K3. When STBY is selected on the cockpit control, a ground is connected to the coil of standby relay K2 and the heater element (terminal 2) of time delay relay K3. After a delay of approximately four minutes, contacts 5 and 7 of K3 close and lockout relay K4 energizes. When K4 energizes, voltage is removed from the heater element of K3 and relay power is applied through K4-3 and -4 to the synchronizer and indicator, -



Power Control Circuits, Simplified Schematic Diagram
Figure 2-12

and through interlock S1 to the coil of operate relay K1. Interlock switch S1 is actuated by the pressure of the top dust cover or by placing the switch lever in the upper (latched) position.

When OPR is selected on the cockpit control, a ground is applied through fault sensing relay K6-3 and -2 to the coil of operate relay K1, and K1 energizes. Negative voltage from the rectifier is applied through R3 to the coil (terminal 5) of fault sensing relay K6. When a fault is detected by the fault sensing circuit, K6 energizes and operate relay K1 de-energizes.

(8) Fault Sensing Circuit. (Refer to figure 2-13 and 1A7 on figure FO-6.)

(a) General.

The fault sensing circuit provides protection from abnormal operating conditions in the +260 and +27. 5-v power supplies and the modulator charging circuit. When a fault is detected by the fault sensing module, fault sensing relay K6 energizes. With K6 energized, relay power is removed from operate relay K1; thus, the system is reverted to the standby mode of operation. Relay K6 remains energized until the cockpit control switch is re-turned to the STBY position to remove the ground connection from terminal 1 of the relay. At K6, VR26 provides a regulated bias for Q7.

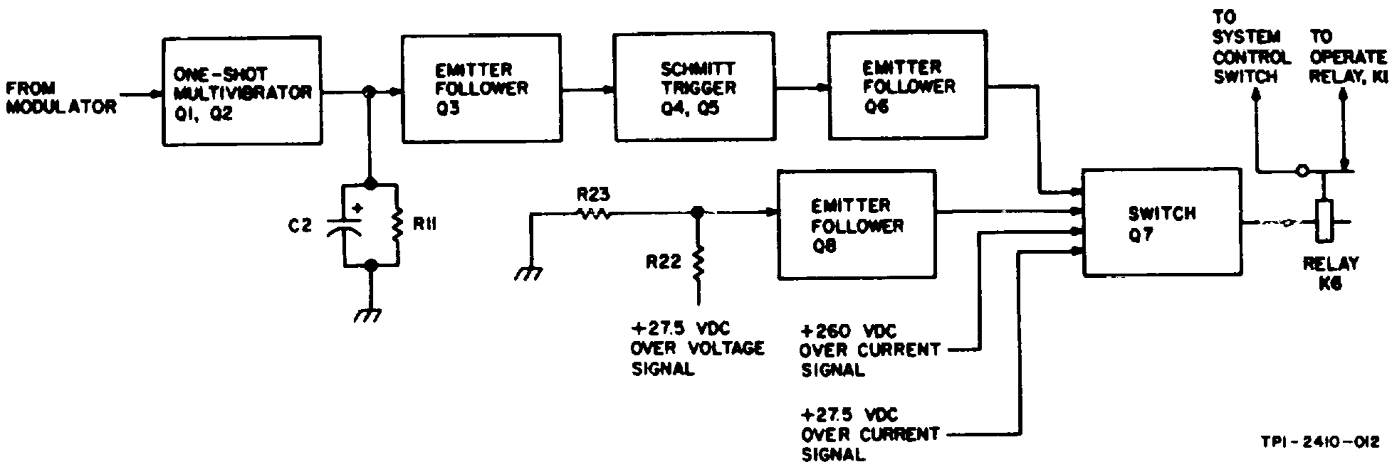
The fault sensing circuit contains two resistors, R2 and R9, that are selected for each unit. Resistor R2 is selected to compensate for the differences in characteristics of individual transistors used as Q7. Resistor R9 is selected to compensate for differences in the dc resistance of individual inductors used as L1.

(b) +260-V Overcurrent Sensing.

Current through the +260-v power supply is sampled by resistor R10. When current through the power supply increases, the voltage applied to the cathode of VR5 increases (more negative). When the current increases beyond the safe level, the negative voltage exceeds the breakdown voltage of the zener and is applied to the base of Q7. This causes Q7 to conduct heavily and energize fault sensing relay K6. When K6 energizes, power is removed from the coil of operate relay K1. This de-energizes K1, removing generator C power from transformer T1, the power transformer for the +260-v supply.

(c) +27.5-V Over voltage Sensing.

The +27. 5-v regulator output (TB5-5) is applied to a voltage divider at terminal 1 of fault sensing module TB3. The voltage divider consists of resistors R22 and R23. The base of transistor Q8 is connected to the junction of these resistors. When the power supply output voltage increases, the bias at the base of Q8 increases, increasing conduction through the transistor and resistor R21. If the +27. 5-v supply output increases beyond the safe level, the increased voltage across R21 exceeds the zener voltage of VR7. This causes zener diode VR7 to conduct, applying a positive voltage to the emitter of Q7. This causes Q7 to conduct heavily, energizing fault sensing relay K6, When K6 is energized, primary power for transformer T1 (the power transformer for the +27.5-v supply) is removed.



Fault Sensing Module, Block Diagram
Figure 2-13

(d) +27.5-V Overcurrent Sensing.

Current through the +27.5-v supply passes through inductor L1. The voltage developed across L1 is applied to R9, R20, R25, and RT1, a resistive net-work providing temperature compensation for the bias of Q7. When the supply current increases, the voltage at the junction of R9 and R20 increases. This voltage is applied to the base of Q7. If the power supply current in-creases beyond the safe level, the increased voltage causes Q7 to conduct heavily and energizes K6. When K6 is energized, power is removed from transformer T1, the power transformer for the +27.5-v supply.

(e) Modulator Overcurrent Sensing.

In the event of magnetron misfire, a fault-signal voltage from the modulator (P7-14) is applied to terminal 11 of the fault sensing module. When the input signals exceed the zener voltage of VR2 and VR3, the one-shot multi-vibrator, Q1 and Q2, is triggered and produces a positive-going square-wave output. The output charges C2, applying a positive potential to the base of Q3. Due to the pulse width of the multi-vibrator output and the time constants of the charge and discharge paths of the capacitor, the charge on C2 will not immediately bias Q3 into conduction. Approximately forty consecutive misfires or a 10-percent misfire rate of the magnetron will cause the charge on C2 to reach the level required to forward bias Q3. The conduction of Q3 produces a trigger for the Schmitt trigger circuit, Q4 and Q5. The Schmitt trigger output biases Q6 into conduction. This causes a voltage at the junction of R19 and R24 greater than the zener voltage of VR4. When VR4 conducts, the increased voltage across R2 causes Q7 to conduct heavily. This energizes fault sensing relay K6, removing primary power from the modulator charging circuit (P7-4).

(9) Metering Circuits. (Refer to figure 2-14 and figure FO-6.)

(a) AFC Mixer Crystal Current Metering.

Current from afc diode, CR40, is applied through rf chokes L3 and L4 to terminal 2 of S5A and $5C. With the meter switch in the AFC position, current flows through terminal 2 of S5A, out terminal 12, through the meter into terminal 12 of S5B, out terminal 2, and through R44 to ground. When the meter switch is not in the AFC position, afc crystal current flows through R41 to terminal 2 of S5C and out terminal 12 to ground. This provides an equivalent resistance path for afc crystal current when the meter switch is not in the AFC position.

(b) Reverse (REV) Mixer Crystal Current Metering.

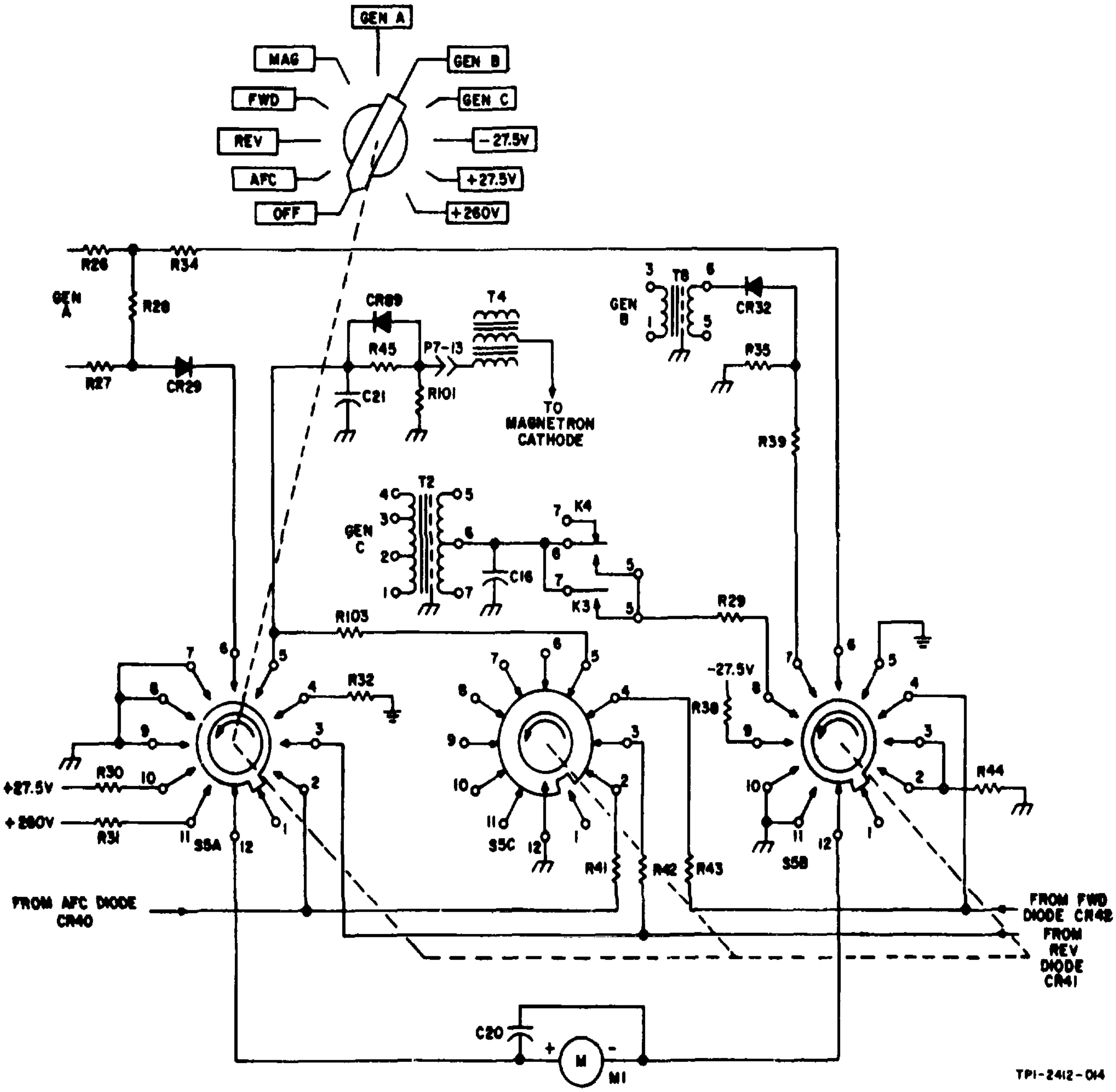
Current from reverse diode, CR41, is applied through rf chokes L5, L7, and L9 to terminal 3 of S5A and S5C. With the meter switch in the REV position, current flows through terminal 3 of S5A, out terminal 12, through the meter into terminal 12 of S5B, out terminal 3 and through R44 to ground. When the meter switch is not in the REV position, reverse crystal current flows through R42 to terminal 3 of S5C and out terminal 12 to ground. This provides an equivalent resistance path for reverse crystal current when the meter switch is not in the REV position.

(c) Forward (FWD) Mixer Crystal Current Metering.

Current from forward diode, CR42, is applied through rf chokes L6, L8, and L10 to terminal 4 of S5B and S5C. With the meter switch in the FWD position, current flows through terminal 4 of S5B, out terminal 12, through the meter into terminal 12 of S5A, out terminal 4, and through R32 to ground. When the meter switch is not in the FWD position, forward crystal current flows through R43 to terminal 4 of S5C and out terminal 12 to ground. This provides an equivalent resistance path for forward crystal current when the meter switch is not in the FWD position.

(d) Magnetron Current Metering.

A voltage pulse, created by firing of the magnetron, is obtained from the modulator (P7-13). This pulsating voltage developed across R101 and clamped by CR89, is filtered by R45 and C21 and applied to terminal 5 of S5A. With the meter switch in the MAG position, current flows through terminal 5 of S5A, out terminal 12, through the meter into terminal 12 of S5B, and out



Metering Circuits, Simplified Schematic Diagram
Figure 2-14

terminal 5 to ground. When the meter switch is not in the MAG position, current flows through R103 to terminal 5 of S5C and out terminal 12 to ground.

(e) Generator A Metering.

Current from generator A flows through R26, R27, and R28 on TB4. The voltage developed across R28 is rectified by CR29 and applied to terminal 6 of S5A. With the meter switch in the GEN A position, current flows from terminal 12 of S5A through the meter to terminal 12 of S5B, out terminal 6 and through R34 back to R28.

(f) Generator B Metering.

Generator B voltage is applied to the primary of transformer T2. Voltage from the secondary winding is rectified by CR32 and applied to R35. The voltage developed across R35 (to ground) is connected through R39 to terminal 7 of S5B. When the meter switch is in the GEN B position, current flows from terminal 12 of S5B through the meter to terminal 12 of S5A, and out terminal 7 to ground.

(g) Generator C Metering.

When time delay relay K3 energizes lockout relay K4, a sample of generator C voltage from the center tap of T2 is applied from K4-3 through R29 to terminal 8 of S5B. With the meter switch in the GEN C position, current flows from terminal 12 of S5B through the meter to terminal 12 of S5A, and out terminal 8 to ground.

(h) -27.5-V Metering.

Negative 27.5 v from the emitter of Q2 is applied through R38 to terminal 9 of S5B. With the meter switch in the -27.5 V position, current flows from terminal 12 of S5B, through the meter to terminal 12 of S5A, and out terminal 9 to ground.

(i) +27.5-V Metering.

Positive 27.5 v from TB5-5 is applied through R30 to terminal 10 of SS5A. With the meter switch in the +27.5 V position, current flows from terminal 12 of S5A, through the meter to terminal 12 of S5B, and out terminal 10 to ground.

(j) +260-V Metering.

Positive 260 v from TB1-8 is applied through R31 to terminal 11 of S5A. With the meter switch in the +260 V position, current flows from terminal 12 of S5A, through the meter to terminal 12 of S5B, and out terminal 11 to ground.

Section II. DISASSEMBLY

2-6. GENERAL.

This section presents instructions for disassembling the RT-711A Receiver-Transmitter and the MT-3068 Shock mount. These instructions are arranged so that disassembly of each major part is an individual operation. When it is necessary to disassemble the unit, locate the part in the table of contents and begin-on the page indicated. The procedures begin with the highest assemblies, proceed to the next lower subassemblies, and end with the major parts. Reference is made to previous disassembly steps that must be performed before a part may be removed or disassembled. In any event, the disassembly procedure should be continued only as far as necessary to replace the fault component. The disassembly of terminal strips on boards and of isolated components can usually be accomplished by inspection, and determination made of the extent of disassembly required. These instructions include special techniques, cautions, warnings, and unique procedures. The numbers used to reference component parts shown in the illustrations in this section do not correspond to the item numbers of the component parts in the illustrated parts list.

2-7. PRECAUTIONS AND GENERAL TECHNIQUES.

Mark, tag, or otherwise identify all disconnected electrical wiring. Note the color coding, placement of leads, and method of applying insulation before unsoldering or removing any electrical components. These procedures supply sufficient information to completely remove the parts listed in the table of contents. In most cases, however, parts may be released and moved aside to gain access to other parts without unsoldering the connecting leads; this applies particularly to the printed circuit boards. Do not unsolder these leads unless absolutely necessary.

CAUTION: TO PREVENT DAMAGE TO A SOLID-STATE DEVICE, USE A HEAT SINK ON THE LEAD BETWEEN THE POINT BEING UNSOLDERED AND THE DEVICE.

WARNING: THE RT-711A RECEIVER-TRANSMITTER USES EXTREMELY HIGH VOLT-ACES. DO NOT ATTEMPT ANY DISASSEMBLY WHILE PRIMARY POWER IS APPLIED TO THE UNIT. ENSURE THAT THE POWER CABLE IS REMOVED TO PREVENT VOLTAGE TRANSIENTS WHICH COULD DAMAGE OR DESTROY SEMICONDUCTORS.

CAUTION: REMOVE WRISTWATCH BEFORE WORKING IN THE VICINITY OF THE MAGNETRON OR MIXER-DUPLEXER MODULE.

CAUTION: HANDLE THE MAGNETRON AND MIXER-DUPLEXER MODULE WITH EX-TREME CARE. NEVER JAR THE UNITS OR STRIKE THEM WITH TOOLS. NEVER PLACE THEM ON A STEEL WORKBENCH OR ON A WORKBENCH THAT MAY HAVE IRON FILINGS OR STRANDS OF STEEL WOOL PRESENT. USE NONMAGNETIC TOOLS, WHICH WILL NOT CAUSE DEGAUSSING. NEVER ALLOW DELICATE INSTRUMENTS TO COME IN THE VICINITY OF THE MAGNETRON OR MIXER-DUPLEXER MODULE.

WARNING: CAPACITORS IN THE RT-711A RECEIVER-TRANSMITTER MAY HOLD A CHARGE FOR LONG PERIODS OF TIME AFTER PRIMARY POWER HAS BEEN REMOVED. OBSERVE SAFETY PRECAUTIONS WHEN WORKING ON THE RECEIVER-TRANSMITTER.

These precautions are repeated in the text of the disassembly procedures where applicable.

2-8. DISASSEMBLY PROCEDURE.

A. Remove Air Filter. (Refer to figure FO-4.)

(1) Remove filter bracket (1) by releasing two turn lock fasteners (2) securing bracket to front housing (5).

(2) Remove retaining screen (3) and air filter (4).

B. Remove Front Housing. (Refer to figure FO-4.)

(1) Remove meter function switch knob (6) by loosening two setscrews (7) securing knob to meter function switch S5 (21).

(2) Remove front housing (5) by loosening four retaining screws (8) securing housing to four mounting posts (9).

C. Remove 427.5-V Regulator Module TB5. (Refer to figure FO-4.)

(1) Remove front housing (5). Refer with paragraphs 2-8. B. (1) and 2-8. B. (2).

(2) Remove four machine screws, lockwashers, and flat washers (11) securing +27. 5-v regulator module TB5 (10) to four standoffs (12).

(3) Pull TB5 (10) forward, away from standoffs (12) to expose rear wiring.

(4) Unsolder and tag the leads from the terminals of TB5.

(5) Remove the module.

D. Remove -27.5-V Regulator Module TB6. (Refer to figure FO-4.)

(1) Remove front housing (5). Refer to paragraphs B(1) and B(2) above.

(2) Remove four machine screws, lockwashers, and flat washers (14) securing-27. 5-v regulator module TB6 (13) and meter circuit module TB4 (16) to four hexposts (17).

(3) Remove four spacers (15).

(4) Pull TB6 (13) forward, away from meter circuit module TB4 (16), to expose rear wiring.

(5) Unsolder and tag the leads from the terminals of TB6.

(6) Remove the module.

E. Remove Meter Circuit Module TB4. (Refer to figure FO-4.)

(1) Remove front housing (5). Refer to paragraphs B(1) and B(2) above.

(2) Release -27.5-v regulator module TB6 (13). Refer to paragraphs D(2) through D(4) above.

(3) Pull meter circuit module TB4 (16) forward, away from hexposts (17) to expose rear wiring.

(4) Unsolder and tag the leads from the terminals of TB4.

(5) Remove the module.

F. Remove Meter M1. (Refer to figure FO-4.)

(1) Remove front housing (5). Refer to paragraphs B(1) and B(2) above.

(2) Remove four machine screws and lockwashers (19) securing meter (18) to four meter posts (20).

(3) Pull meter M1 (18) forward, away from meter posts (20) to expose rear wiring.

(4) Unsolder and tag the meter leads.

(5) Remove the meter.

G. Remove Meter Function Switch S5. (Refer to figure FO-4.)

(1) Remove front housing (5). Refer to paragraphs B(1) and B(2) above.

(2) Remove three machine screws (22) securing switch bracket (23) to three standoffs (24).

(3) Pull wafer switch assembly (21) forward, away from standoffs (24), to expose wiring.

(4) Unsolder and tag the leads from the terminals of S5.

(5) Remove wafer switch assembly.

H Remove RF ON/OFF Switch S4. (Refer to figure FO-4.)

(1) Remove front housing (5). Refer to paragraphs B(1) and B(2) above.

(2) Unsolder and tag the leads from the terminals of switch S4 (25).

(3) Release switch 54 (25) from switch plate (27) by removing retainer nut and lock-washer (26).

(4) Remove switch S4.

I. Remove Tubeaxial Fan B1. (Refer to figure FO-4.)

(1) Remove from housing (5). Refer to paragraphs B(1) and B(2) above.

(2) Release three synchro clamps (28) by loosening screws securing clamps to front mounting plate (30).

(3) Pill fan B31 (27) forward, away from front mounting plate (30), tee expose fan terminal strip (29).

(4) Remove and tag the leads from fan terminal strip (29).

(5) Remove fan B1.

J. Remove and Disassemble Front Plate. (Refer to figure FO-4.)

(1) Remove front housing (5). Refer to paragraphs B(1) and B(2) above.

(2) Release front mounting plate (30) by removing eight machine screws (33) (on plate edges) and two machine screws (34) (bottom screw in each toe fastener) securing mounting plate to chassis assembly (35).

(3) Pull front mounting plate (30) forward, away from chassis assembly (35).

(4) The following components, attached to the rear of front mounting plate (30), are now accessible and may be removed as required.

(a) Components Q2, Q3, Q4, Q5, CR17, CR24, CR25, VR22, and VR23.

(b) Magnetron filament lead and spark gap connectors.

(5) The following components, attached to the front of chassis assembly (35) are now accessible and may be removed as required.

(a) Terminal board TB8.

(b) Components R11, R15, and R19.

(6) Remove meter M1 (18). Refer to paragraphs F(1) through F(5) above.

(7) Remove +27.5-v regulator module TB5 (10). Refer to paragraphs C(1) through C(5) above.

(8) Remove -27.5-v regulator module TB6 (13). Refer to paragraphs D(1) through D(6) above.

(9) Remove meter circuit module TB4 (16). Refer to paragraphs E(1) through E(5) above.

(10) Remove meter functions switch S5 (21). Refer to paragraphs G(1) through G(5) above.

(11) Remove RF ON/OFF switch S4 (25). Refer to paragraphs H(1) through H(4) above.

(12) Remove tubeaxial fan B1 (27). Refer to paragraphs I(1) through I(5) above.

(13) Remove capacitor C1 (31) and mounting bracket (32) as follows:

(a) Unsolder and tag the capacitor lead from terminal stud.

(b) Disconnect and tag the capacitor lead from terminal strip (29) of tube- axial fan B1 (27).

K. Remove Outer Dust Covers. (Refer to figure FO-4.)

(1) Remove top dust cover (36) by releasing five turnlock fasteners (37) securing cover to chassis assembly (35).

(2) Remove side dust covers (38) by removing six machine screws (39) in each cover securing cover to chassis assembly (35).

(3) Turn unit over and remove bottom dust cover (40) by releasing four turnlock fasteners (41) securing cover to chassis assembly (35).

L. Remove Trigger Generator Module. (Refer to figure FO-4.)

(1) Remove top dust cover (36). Refer to paragraph K(1) above.

(2) Remove trigger generator module (42) by lifting out of J1 and removing from printed board mount (43).

M. Remove Magnetron. (Refer to figure FO-4.)

CAUTION: HANDLE THE MAGNETRON WITH EXTREME CARE. NEVER JAR THE UNIT OR STRIKE IT WITH TOOLS. NEVER PLACE IT ON A STEEL WORKBENCH OR ON A WORKBENCH THAT MAY HAVE IRON FILINGS OR STRANDS OF STEEL WOOL PRESENT. USE NON-MAGNETIC TOOLS WHICH WILL NOT CAUSE DEGAUSSING. NEVER ALLOW DELICATE INSTRUMENTS TO COME IN THE VICINITY OF THE MAGNETRON. WIPE GREASE FROM LEADS AFTER REMOVAL.

(1) Remove left dust cover. Refer to paragraph K(2) above.

(2) Remove (do not disconnect) keep-alive module TB2 (1, figure 2-15). Refer to paragraphs O(2) through O(8) below.

(3) Remove front plate (30). Refer to paragraphs J(1) through J(3) above.

(4) Remove magnetron filament leads from modulator (52).

NOTE: Connectors are only finger tight and should not be forced.

(5) Remove four machine screws and flat washers (46) securing mixer-duplexer module (49) to magnetron (44).

NOTE: Two lower machine screws are accessible through holes in chassis below rear waveguide connector.

(6) Remove four magnetron mounting screws and flat washers (46) securing magnetron (44) to chassis assembly (35).

(7) Remove waveguide spacer (47).

(8) Lift magnetron from chassis.

N. Remove Mixer-Duplexer Module. (Refer to figure FO-4.)

CAUTION: HANDLE THE MIXER-DUPLEXER MODULE WITH EXTREME CARE. NEVER JAR THE UNIT OR STRIKE IT WITH TOOLS. NEVER PLACE IT ON A STEEL WORKBENCH OR ON A WORKBENCH THAT MAY HAVE IRON FILINGS OR STRANDS OF STEEL WOOL PRESENT. USE NONMAGNETIC TOOLS WHICH WILL NOT CAUSE DEGAUSSING. NEVER ALLOW DELICATE INSTRUMENTS TO COME IN THE VICINITY OF THE UNIT.

(1) Remove outer dust covers. Refer to paragraphs K(1) through K(3) above.

(2) Remove high-voltage lead (50) from keep-alive tube cap and cable clamp.

(3) Remove trigger generator module (42). Refer to paragraphs L(1) and L(2) above.

(4) Disconnect J2 and P6, accessible from bottom of unit, and J3, J4, and P5, accessible from top of unit.

(5) Remove four machine screws and flat washers (45) securing mixer-duplexer to waveguide spacer (47) and magnetron (44).

NOTE: Two lower machine screws are accessible through holes in chassis below rear waveguide connection.

(6) Remove two machine screws, lock washers, and flat washers (48) securing waveguide connector to rear of chassis assembly (35).

(7) Loosen four magnetron mounting screws (46) to enable magnetron to be tipped up and toward front of unit.

(8) Tip magnetron toward front of chassis and remove spacer (47).

(9) Remove mixer-duplexer module.

NOTE: For convenience, magnetron may be completely removed. Refer to paragraph M above.

O. Remove Keep-Alive Supply Module TB2. (Refer to figure FO-4.)

(1) Remove left (38) and top (36) dust covers. Refer to paragraphs K(1) through K(3) above.

(2) Remove high voltage lead (50, figure FO-4) from keep-alive tube cap.

(3) Remove cable clamp (51, figure FO-4) from waveguide spacer (47, figure FO-4) by removing machine screw and washer.

(4) Remove two machine screws and lock washers (2) securing keep-alive supply module TB2 (1) to front of chassis assembly (35).

(5) Remove machine screw, lock washer, and flat washer (3) and spacer (4) securing TB2 (1) to magnetron mounting bracket.

(6) Remove hexnut, lock washer, solder lug, hexnut, and flat washer (5) from threaded stud.

(7) Pull TB2 (1) forward, away from chassis assembly (35), to expose rear wiring.

(8) Unsolder high-voltage lead from TB2-4.

(9) Unsolder and tag the leads from the terminals of TB2.

(10) Remove the module.

P. Remove Fault Sensing Module TB3. (Refer to figure 2-15.)

(1) Remove bottom dust cover (40, figure FO-4). Refer to paragraph K(3) above.

(2) Unsolder and tag the leads from the terminals of fault sensing module TB3 (6).

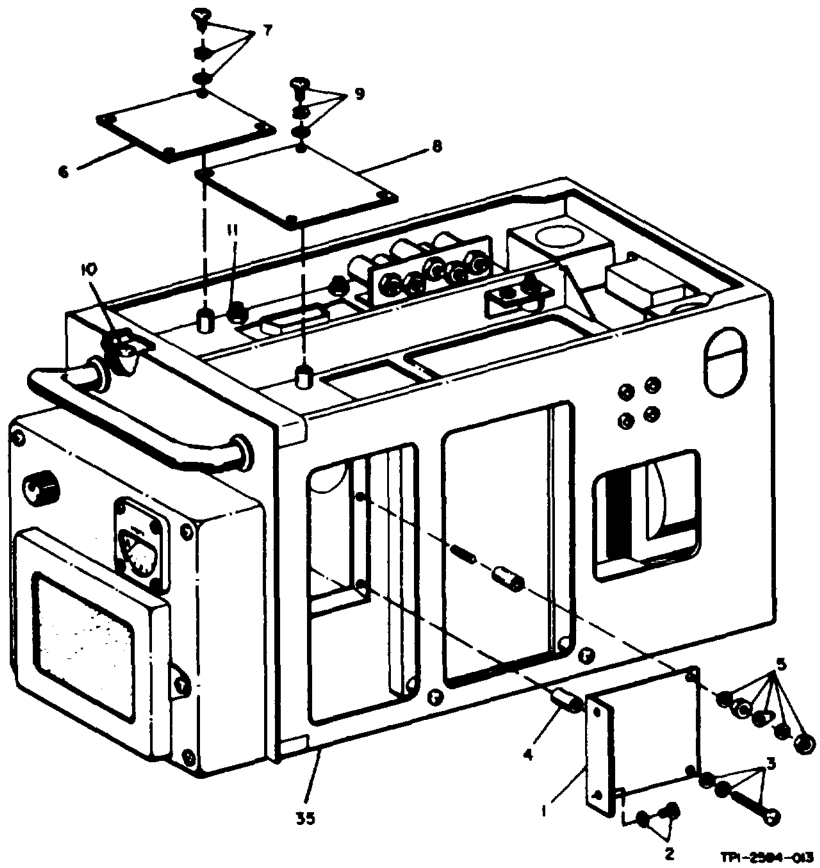
(3) Release TB3 (6) by removing four machine screws, lock washers, and flat washers (7) securing TB3 to chassis assembly (35).

(4) Remove the module.

Q. Remove +260-V Supply Module TB1. (Refer to figure 2-15.)

(1) Remove bottom dust cover (40, figure FO-4). Refer to paragraph K(3) above.

(2) Release +260-v supply module TB1 (8) by removing four machine screws, lock washers, and flat washers (9) securing it to chassis assembly (35).



RT-711A/APN-158 Receiver-Transmitter, Exploded Bottom View
Figure 2-15

(3) Unsolder and tag the leads from the terminals of TB1 (8).

(4) Remove the module.

R. Remove Modulator. (Refer to figure 2-15.)

(1) Remove dust covers. Refer to paragraphs K(1) through K(3) above.

(2) Remove keep-alive module TB2 (1). Refer to paragraphs 0(2) through 0(8) above.

(3) Remove magnetron (44, figure FO-4). Refer to paragraphs M(3) through M(6) above.

(4) Remove spark gap lead from modulator connector.

NOTE: Connector is only finger tight and should not be forced. Wipe excess grease from area around high-voltage connectors.

(5) Remove machine screw (53, figure FO-4) securing top front of modulator (52, figure FO-4) to air plenum chamber.

(6) Remove two machine screws and lock washers (54, figure FO-4) securing modulator (52, figure FO-4) to rear mounting plate.

(7) Place unit upside down and disconnect P7.

(8) Unsolder and tag wires to modulator terminals 28, 29, and 30.

(9) Remove fault sensing module TB3 (6). Refer to paragraphs P(2) and P(3) above.

(10) Under fault sensing module area, remove two machine screws (10) securing modulator (52, figure FO-4) to chassis assembly (35).

(11) Remove hexnuts and washers from four studs (11) securing modulator (52, figure FO-4) to chassis assembly (35).

(12) Remove modulator from chassis.

NOTE: Bracket (55, figure FO-4) held by two screws and lock washers (56, figure FO-4) need not be removed unless modulator is to be replaced.

(13) Temporarily secure fault sensing and keep-alive modules with hardware removed in steps (2) and (9).

S. Disassemble MT-3068 Shockmount. (Refer to figure FO-5.)

(1) Remove extractor assembly (1) by removing two machine screws (2) and two machine screws (3).

NOTE: If necessary to replace thrust bearing (4), remove two machine screws (5) and remove bearing (4) from jaw (6).

(2) Remove front retainers (7) by removing cotter pin (8) and pin (9).

(3) Remove tray (10) as follows:

(a) Remove machine screw (11) and spacer (12) from each of two bottom front isolators (13).

(b) Remove machine screw, lock washer, and flat washer (14) and spacer (15) from each of two top rear isolators (16).

(c) Remove machine screw (19A) from bottom rear isolator (19).

(d) Remove two machine screws, flat washers, and hexnuts (17) securing two ground straps (18) to tray (10).

(e) Pull tray (10) forward for access to connector assembly (10A).

(f) Remove connector-filter capacitor cable assembly (10A) by removing ten machine screws holding standoff insulators and ground lugs (Detail A).

(g) Remove four screws holding shells of connector. Pull connector shells apart.

(h) Holding connector parts together, remove from shockmount by pulling through hole in baseplate (24).

(i) Place shells back on connector and temporarily secure together.

(4) Remove vibration isolators as follows:

(a) Remove tray (10) in accordance with step (3) above.

(b) Remove two bottom front isolators (13) by removing four machine screws, lock washers, and hexnuts (20) securing each isolator to baseplate (24).

(c) Remove two top rear isolators (16) by removing four machine screws and lock washers (21) securing each isolator standoff (22) to baseplate (24).

(d) Remove bottom rear isolator (19) by removing four machine screws, lock washers, and hexnuts (23) securing isolator to baseplate (24).

NOTE: Further disassembly of the MT-3068 Shockmount is not recommended unless part replacement is necessary.

Section III. CLEANING

2-9. GENERAL.

This section presents instructions for cleaning the dismantled and disassembled components, parts, and subassemblies of the RT-711A Receiver-Transmitter and the MT-3068 Shockmount. These instructions are tabulated and arranged to facilitate reference to the text procedure for cleaning the various parts an(d assemblies. All parts requiring particular methods of cleaning are considered separately, and parts which are similar enough to permit identical cleaning procedures are grouped together. Either Turcosol or Stoddard solvent may be used in the following procedures.

WARNING: PERFORM OPERATIONS INVOLVING CLEANING SOLVENT UNDER A VENTILATED HOOD. AVOID BREATHING SOLVENT VAPOR AND FUMES. WEAR A SUITABLE MASK WHEN NECESSARY. AVOID CONTINUOUS CONTACT WITH THE SOLVENT. USE GOGGLES, GLOVES, AND AN APRON TO PREVENT IRRITATION FROM PROLONGED CONTACT. CHANGE CLOTHING THAT HAS BECOME SATURATED) WITH SOLVENT.

References to "air jet" in this section indicate a hand-operated air nozzle supplied with clean, dry, compressed air at a maximum pressure of 28 pounds per square inch.

WARNING: WEAR GOGGLES WHEN USING THE AIR JET TO BLOW DIRT AND DUST FROM EQUIPMENT PARTS. WARN OTHER PERSONS AWAY FROM HAZARDOUS AREA OR WORKING ENCLOSURE.

2-10. CLEANING PROCEDURE.

The following paragraphs present instructions and procedures for cleaning the various parts of the dismantled and disassembled equipment preparatory to per-forming inspection procedures. For convenience, components, parts, and subassemblies ate alphabetically listed and cross-referenced to the appropriate paragraphs containing the cleaning instructions. Refer to figure 2-16.

WARNING: OBSERVE ALL FIRE PRECAUTIONS WHEN USING FLAMMABLE MATERIALS FOR CLEANING PURPOSES. THESE MATERIALS SHOULD ONLY BE USED OUTSIDE OR IN A VENTILATED BOOTH PROVIDE) WITH EXPLOSION-PROOF ELECTRICAL EQUIPMENT AND AN EXHAUST FAN HAVING SPARK-PROOF BLADES.

A. Air Filters.

CAUTION: A MILD SOAP MAY BE USED. DO NOT, HOWEVER, USE DETERGENTS TO CLEAN THE FILTER.

(1) Wash the filter in clean, warm (not hot) water.

(2) Dry the filter with an air jet.

ITEM	REFER TO PARAGRAPH
Air filters	2-10.A
Castings	2-10.B
Connectors	2-10.C
Covered cables	2-10.D
Covers and shields	2-10.E
Electron tubes	2-10.F
Gaskets and washers (paper, fiber, cork, and rubber)	2-10.G
Insulators (ceramic, Mycalex, and plastic)	2-10.H
Jacks	2-10.I
Knobs and panels	2-10.J
Machined metal parts	2-10.K
Mechanical metal parts	2-10.L
Molded plastic parts	2-10.M
Printed circuit boards	2-10.N
Receptacles	2-10.O
Relays	2-10.P
Switches	2-10.Q
Transformers and inductors	2-10.R
Vibration isolators	2-10.S
Waveguide assemblies	2-10.T
Wired chassis	2-10.U

Index of Cleaning Procedures
Figure 2-16

(3) Reinstall the filter when it is thoroughly dry.

B. Castings.

Unfinished, finished, or partly finished castings should be cleaned as follows:

(1) Remove bulk of surface dirt with rags.

(2) Blow dust from surfaces, holes, and recesses using an air jet.

(3) Immerse casting in washing bath of solvent, and scrub until clean, working over all surfaces and into all holes and recesses with a suitable nonmetallic brush. Flat, wood-backed brushes with soft-fiber bristles are recommended for surfaces; round brushes, similar to those used for washing bottles and test tubes, are recommended for holes and recesses.

(4) Raise casting from bath, and permit solvent to drain into bath.

CAUTION: WEAR PROTECTIVE CLOTHING WHEN USING THE AIR JET TO REMOVE EXCESS SOLVENT.

(5) Immerse casting in rinsing bath of clean solvent, rinse, and raise from bath. Position casting to drain dry so that solvent is not trapped in holes or recesses. When practical positioning will not permit complete draining, use an air jet to blow out any trapped solvent.

(6) When thoroughly dry, touch up any minor damage to the finish.

(7) Protect casting from dust and moisture pending inspection.

C. Connectors.

(1) Wipe dust and dirt from bodies, shells, and cable clamps, using a solvent- moistened, lintless cloth. Wipe dry with a clean, dry, lintless cloth.

(2) Remove dust from inserts using a small, soft-bristled brush and an air jet.

CAUTION: DO NOT ALLOW SOLVENT TO RUN INTO SLEEVES OR CONDUIT COVERING ANY WIRES OR CABLES CONNECTED TO CONTACT TERMINALS OF THE INSERT.

(3) Wash dirt and any traces of lubricant from inserts, insulation, and contacts, using solvent applied sparingly with a small, camel-hair brush.

(4) Dry the insert with an air jet.

D. Covered Cables.

(1) Clean outer surfaces by wiping away dirt with a solvent-moistened, lintless cloth.

(2) Wipe dry, using a clean, dry, lintless cloth.

(3) Treat any connector terminations in accordance with paragraph C above. Wipe lug terminations clean with a solvent-moistened, lintless cloth, and dry with a clean, dry, lintless cloth.

E. Covers and Shields.

Clean all unfinished, finished, and partly finished sheet-metal covers, such as dust covers, inspection covers, and housings, in accordance with the procedures given for castings in paragraph B above.

F. Electron Tubes.

CAUTION: USE EXTREME CARE WHEN HANDLING THE MAGNETRON. DO NOT STRIKE OR JAR THE UNIT. DO NOT PLACE IT ON A METAL WORKBENCH OR ON A WORKBENCH THAT MAY HAVE IRON FILINGS OR STEEL WOOL PRESENT. DO NOT'USE STEEL TOOLS ON THE UNIT. DO NOT ALLOW THE MAGNETRON TO COME IN THE VICINITY OF DELICATE INSTRUMENTS. AVOID CONTAMINATING THE CONNECTORS WITH DIRT OR METAL CHIPS.

(1) Remove dust and dirt from surfaces of glass or metal envelopes and sides of tube base with a solvent-moistened, lintless cloth. Apply the cloth lightly to avoid obliterating the tube-type markings.

(2) Dry and polish these surfaces by gently wiping them with a clean, dry, lintless cloth.

G. Gaskets and Washers (Paper, Fiber, Cork, and Rubber).

(1) Remove any grease from surfaces with dry, lintless cloth.

(2) Wipe all surfaces with a solvent-moistened, clean, lintless cloth.

(3) Immediately dry all surfaces using a clean, dry, lintless cloth.

(4) Protect from dust, moisture, and lubricants, pending inspection.

H. Insulators (Ceramic, Mycalex, and Plastic).

Clean ell glazed porcelain insulators, ceramic insulators, Mycalex insulators, and plastic standoff insulators as follows:

(1) Wipe clean with a solvent-moistened, clean, lintless cloth.

(2) Wipe dry and polish, using a clean, 'dry, lintless cloth.

I. Jacks.

(1) Remove dust from exteriors with a camel-hair brush and an air jet.

(2) Blow dust from interior of female contacts with an air jet.

J. Knobs and Panels.

Clean knobs and panels by gently wiping the surfaces With a clean, soft, lintless cloth. When clean, polish with tissue paper.

K. Machined Metal Parts.

Detached shafts, keys, pins, collars, and similar machined parts should be cleaned in a suitable cleaning machine if available. If a cleaning machine is not available, proceed as follows:

NOTE: Do not touch any clean machined or unfinished parts with bare hands. (1) Clean machined metal parts in accordance with paragraphs (1) and (3) through (5) above.

(2) Dry in dust-free, dry area or suitable enclosure. Radiant heat used in a ventilated enclosure is recommended for drying, particularly where atmospheric humidity is high.

(3) After the drying process is completed, apply a light coat of lubricating oil to any bare steel surfaces (MIL-L-6085).

L. Mechanical Metal Parts.

The detached miscellaneous mechanical metal parts include mounting plates, mounting clamps and brackets, nuts, bolts, screws, washers, fasteners, and other hardware. These should be cleaned in a suitable cleaning machine or in accordance with applicable steps of the procedures for castings contained in paragraph B above.

M. Molded Plastic Parts.

Plastic parts include such items as insulating members, terminal boards, and mounting blocks. These should be cleaned in the following manner: (1) Using an air jet, blow loose dust and dirt from surfaces, holes, and crevices.

(2) Wipe with a solvent-moistened, clean, lintless cloth.

(3) Dry and polish with a clean, dry, lintless cloth.

N. Printed Circuit Boards.

(1) Using an air jet and a small, camel-hair brush, blow and brush dust and dirt from surfaces, holes, and crevices.

CAUTION: THE EPOXY MOISTURE SEALANT ON THE PRINTED CIRCUIT BOARDS IS SUSCEPTIBLE TO SOFTENING IF SOLVENT IS APPLIED FOR EXCESSIVE PERIODS OF TIME OR IN EXCESSIVE AMOUNTS. USE CARE IN CLEANING THESE PRINTED CIRCUIT BOARDS WITH A SOLVENT-MOISTENED CLOTH. DRY WITH A CLEAN, LINT- LESS CLOTH IMMEDIATELY AFTER CLEANING.

(2) Wipe clean using a lintless cloth slightly moistened with solvent.

O. Receptacles.

Clean receptacles in accordance with the applicable paragraphs given for connectors in paragraph C above.

P. Relays.

All relays are hermetically sealed and do not require cleaning.

Q. Switches.

Clean phenolic wafer switches as follows:

(1) Remove all dust with an air jet, turning switch rotor back and forth several times.

(2) Wash all contacts and insulation with solvent lightly applied with a small, camel- hair brush.

(3) Dry with an air jet; then repeat wash using clean solvent and rotating switch rotor.

(4) Dry with an air jet; then apply a thin coating of Lubriplate 105 with a camel-hair brush.

R. Transformers and Inductors.

(1) Wipe dust and dirt from transformers and inductors with a clean, lintless cloth slightly moistened with solvent.

(2) Dry with a clean, dry, lintless cloth.

S. Vibration Isolators.

Clean detached vibration isolators as follows:

(1) Blow dust and dirt from surfaces with an air jet.

(2) Immerse In solvent bath and wash until clean.

(3) Raise from bath and let solvent drain into bath.

CAUTION: WEAR PROTECTIVE CLOTHING WHEN USING THE AIR JET TO REMOVE EXCESS SOLVENT.

(4) Use an air jet to remove any trapped solvent.

(5) Protect from dust and moisture pending inspection.

T. Waveguide Assemblies.

CAUTION: DO NOT ALLOW ANY SOLVENT TO GET INTO THE WAVEGUIDE.

(1) Clean the outside surfaces of waveguide assemblies with a clean, lintless cloth slightly moistened with solvent.

(2) Remove any foreign matter adhering to the inside surfaces of waveguide assemblies by wiping them with a clean, dry, soft, lintless cloth.

(3) Protect from dust and moisture pending inspection.

U. Wired Chassis.

The following procedures should be used for chassis containing resistors, capacitors, switches, tube sockets, inductors, transformers. and other wired parts.

CAUTION: AVOID AIR-BLASTING DELICATE PARTS BY TOO CLOSE AN APPROACH WITH THE AIR JET NOZZLE. USE CAUTION WHEN BRUSHING DELICATE PARTS.

(1) Remove dust and dirt from all surfaces, including parts and wiring, using soft- bristled brushes and an air jet.

NOTE: When it is necessary to disturb the position and dress of wiring and cables, ensure that they are properly restored after cleaning is completed.

(2) With minimum disturbance of wiring, clean connectors in accordance with paragraph C above.

(3) Clean insulators in accordance with paragraph H above.

(4) Clean jacks in accordance with paragraph I above.

(5) Clean switches in accordance with paragraph Q above.

(6) Clean transformers and inductors in accordance with paragraph R above.

(7) Complete chassis cleaning by wiping all finished surfaces with a solvent-moistened, lintless cloth.

(8) Dry and polish these surfaces, using a clean, dry, lintless cloth.

(9) Protect from dust and moisture, pending inspection.

Section IV. INSPECTION/CHECK

2-11. GENERAL.

This section presents instructions and procedures to assist in determining, by inspection, the condition of the dismantled, disassembled, and cleaned components, parts, and assemblies of the RT-711A Receiver-Transmitter and the MT-3068 Shockmount. Defects resulting from wear, physical damage, deterioration, or other causes would be discovered by these inspection procedures. Detailed inspection procedures are alphabetically arranged. Refer to the repair section of this manual for replacement or repair of defective components.

2-12. INSPECTION PROCEDURES.

Figure 2-17 lists the mechanical and electrical parts to be inspected and contains cross-references to applicable paragraphs containing inspection routines.

ITEM	REFER TO PARAGRAPH
Air filters	2-12.A
Capacitors	2-12.B
Castings	2-12.C
Chassis	2-12.D
Connectors	2-12. E
Covers and shields	2-12.F
Electron tubes	2-12.G
Gaskets and washers (paper, fiber, cork, and rubber)	2-12.H
High- voltage wiring	2-12.I
Insulators (ceramic, Mycalex, and plastic)	2-12.J
Jacks	2-12.K
Knobs and panels	2-12. L
Machined metal parts	2-12.M

Index of Inspection Procedures (Sheet 1 of 2)
Figure 2-17

ITEM	REFER TO PARAGRAPH
Mechanical metal parts	2-12.N
Molded plastic parts	2-12.0
Printed circuit boards	2-12. P
Receptacles	2-12.Q
Relays	2-12. R
Resistors	2-12.S
Semiconductors	2-12. T
Soldered terminal connections	2-12.U
Switches	2-12. V
Transformers and inductors	2-12.W
Vibration isolators	2-12.X
Waveguide assemblies	2-12.Y
Wiring	2-12.Z

Index of Inspection Procedures (Sheet 2 of 2)
Figure 2-17

A. Air Filters.

Inspect the air filter for physical damage and deformation, such as tears, creases, and imbedded foreign material. Light should be visible through the filter.

B. Capacitors.

Inspect capacitors for the defects listed in figure 2-18.

C. Castings.

Inspect castings for cracks or breaks and marred or damaged machine surfaces, holes, counterbores, or threads. Check for damage to the finish that may require touchup.

DEFECT	METAL TYPE	MOLDED TYPE	CERAMIC TYPE
Leakage (at case seams or around terminal insulation)	X		
Cracked, broken, or charred terminal insulation	X		
Case damage (dents or holes)	X		
Case damage (cracks or breakage)		X	
Loose, broken, or corroded terminal studs, lugs, or leads	X	X	X
Loose, broken, or poorly soldered connections	X	X	X

Fixed Capacitor Inspection
Figure 2-18

D. Chassis.

Inspect chassis for deformation, dents, punctures, badly worn surfaces, and damaged connectors and fastening devices. Examine the chassis for corrosion and damage that may require refinishing.

E. Connectors.

Inspect connector bodies for broken parts, deformed shells or clamps, and other irregularities. Inspect for cracked or broken insulation and for contacts that are broken, deformed, or out of alignment. Check for corroded or damaged plating on contacts and for loose, poorly soldered, broken, or corroded terminal connections.

F. Covers and Shields.

Inspect covers and shields for punctures, deep dents, and badly worn surfaces. Check for damaged fastening devices, corrosion, and other damage that may require refinishing.

G. Electron Tubes.

CAUTION: HANDLE THE MAGNETRON WITH EXTREME CARE. DO NOT STRIKE OR JAR THE UNIT. DO NOT PLACE THE UNIT ON A METAL WORK- BENCH OR ON A WORKBENCH THAT MAY HAVE IRON FILINGS OR STRANDS OF STEEL WOOL PRESENT. DO NOT USE STEEL TOOLS ON IT. DO NOT ALLOW IT TO COME IN THE VICINITY OF DELICATE INSTRUMENTS.

Inspect electron tube envelopes for cracked glass or ceramic or dented metal, separation from the base, and obliterated markings. Inspect for deformed, broken, or misaligned base contacts or damaged leads. Inspect magnetron for cracked, chipped, or broken rf windows or broken rubber flanges on the connectors.

H. Gaskets and Washers (Paper, Fiber, Cork, and Rubber).

Inspect gaskets and washers for deformation and for damage such as tears, creases, rough surfaces, and imbedded foreign matter.

I. High-Voltage Wiring.

Inspect all high-voltage wiring. There should not be any leads of excessive length, and there should be no breaks, cracks, or other damage or evidence of deterioration. Solder joints should have ample solder to cover joints and should be rounded (no sharp edges). All high-voltage leads should be positioned equidistant from all metal objects. Excess grease from the spark gap and magnetron connectors should be removed.

J. Insulators (Ceramic, Mycalex, and Plastic).

Inspect ceramic, Mycalex, and plastic insulators for evidence of damage, such as broken or chipped edges, burned areas, or foreign material.

K. Jacks.

Inspect all jacks for corrosion, rust, loose or broken parts, cracked insulation, and other irregularities.

L. Knobs and Panels.

Inspect knobs and panels for physical damage and deformation, marred surfaces, and impairment of markings.

M. Machined Metal Parts.

Inspect machined metal parts for physical damage to surfaces, corners, and edges. Closely inspect all machined surfaces, holes, bores, counterbores, slots, grooves, shoulders, flanges, tapped holes, and all threaded members, both male and female, for damage of any sort, including roughness of surface, corrosion, or foreign matter. Inspect plated or finished areas for damage requiring replating or refinishing beyond touchup repair.

N. Mechanical Metal Parts.

Inspect unmachined mechanical metal parts, including mounting plates, chassis, mounting clamps, brackets, nuts, bolts, screws, washers, fasteners, and hardware for damage or deformation. Inspect for corrosion and any damage that would require replating or refinishing beyond touchup repair.

O. Molded Plastic Parts.

Inspect molded plastic parts, such as terminal boards, mounting blocks, and insulating members, for signs of corrosion, cracked or charred insulation, and loose or missing mounting hardware. Inspect for other abnormal indications which might be a source of future breakdown.

P. Printed Circuit Boards.

Inspect printed circuit boards for loose, broken, corroded, or poorly soldered terminal connections. Inspect for any evidence of damage, such as burned, broken, cracked, or corroded plating. Check for loose or improperly soldered components and for loose mounting of the circuit boards.

Q. Receptacles.

Inspect receptacles for cracked, broken, or charred insulation. Inspect for damage to all other parts, loose or'bent contacts, damage to contact plating, corrosion, and other abnormal conditions.

R. Relays.

Inspect for bent, loose, and broken terminals. Inspect relay case and mounting for looseness and physical damage or corrosion.

S. Resistors.

Inspect fixed composition resistors for cracked, broken, blistered, or charred bodies and for loose, broken, poorly soldered, or corroded terminal connections. Inspect fixed, wire-wound resistors for signs of heating; cracked, broken, or charred insulation; loose, poorly soldered, broken, or corroded terminal connections; and loose mounting. Inspect variable resistors for corrosion of shafts, cases, or other visible parts; loose mountings; and physical damage.

T. Semiconductors.

Inspect diodes and transistors for cracked, broken, blistered, or damaged bodies and cases. Inspect for loose, broken, poorly soldered or corroded terminal connections.

U. Soldered Terminal Connections.

Inspect soldered terminal connections for cold-soldered or rosin joints. These joints present a porous or dull, rough appearance. Check for strength of bond using a pointed tool. Examine for excess of solder, protrusions from the joint, pieces adhering to adjacent insulation, and particles lodged between joints, conductors, or other parts. Inspect for insufficient solder and unsoldered strands of wire protruding from conductor joints. Check also for insulation that is stripped back too far from joints or badly frayed at the joint. Inspect for corrosion on copper conductor joints.

V. Switches.

Inspect wafer switch insulation for cracks or breaks and for charring. Inspect movable and stationary contacts for deformation, breaks, wear, burns, pits, and corrosion. Inspect terminals for loose, poorly soldered, broken, or corroded connections. Inspect mechanical parts for damage or corrosion and for irregular or rough action.

W. Transformers and Inductors.

Inspect transformers and inductors for signs of excessive heating, physical damage to cases, cracked or broken insulators, and other irregularities. Inspect for corroded, poorly soldered, or loose terminals and loose, broken, or missing mounting hardware.

X. Vibration Isolators.

Inspect the metal parts of vibration isolators for corrosion, damaged surfaces, and deformation. Inspect the elastic members for deep cracks and other physical damage. Inspect elastic members for loss of resiliency by distorting them manually and noting return) to normal position upon release. Sluggish return or failure to return completely to normal position indicates a defective isolator.

Y. Waveguide Assemblies.

Inspect the external surfaces of waveguides and waveguide assemblies for cracks, dents, punctures, or chips. Check for broken, cracked, chipped, or missing mounting hardware. Inspect internal waveguide surfaces for deformation of any kind and the presence of any foreign matter. Check all surfaces for corrosion.

Z. Wiring.

Inspect open and laced wiring of chassis, terminal boards, and parts by checking insulation for physical damage and charring. Inspect wires for breakage and for improper dress in relation to adjacent wiring and chassis.

Section V. REPAIR

2-13. GENERAL.

This section presents instructions and procedures for the replacement or repair of damaged or defective components of the RT-711A Receiver-Transmitter and the MT-3068 Shockmount. Faulty components are usually detected through procedures in the inspection/ check or testing sections of this manual. New parts should be inspected and/or tested before being installed. Most of the replacement or repair instructions apply to disassembled equipment. Refer to the disassembly section for proper instructions.

2-14. REPAIR PROCEDURES.

Figure 2-19 is an alphabetically arranged index of repair procedures. Each component, part, or assembly is cross-referenced to the appropriate paragraph containing the correct repair procedure.

ITEM	REFER TO PARAGRAPH
Air filters	2-14.A
Capacitors	2-14.B
Castings	2-14.C
Connectors	2-14.D
Covers and shields	2-14.E
Electron tubes	2-14. F
Finished surfaces	2-14.G
Frames	2-14.H
Gaskets and washers (paper, fiber, cork, and rubber)	2-14.I
High-voltage wiring	2-14.J
Insulators (ceramic, Mycalex, and plastic)	2-14.K

Index of Repair Procedures (Sheet 1 of 2)
Figure 2-19

ITEM	REFER TO PARAGRAPH
Jacks	2-14. L
Knobs and panels	2-14. M
Machined metal parts	2-14. N
Mechanical metal parts	2-14. O
Modulator	2-14. P
Molded plastic parts	2-14. Q
Printed circuit boards	2-14.R
Receptacles	2-14. S
Relays	2-14. T
Resistors	2-14. U
Semiconductors	2-14. V
Soldered terminal connections	2-14. W
Switches	2-14. X
Transformers and inductors	2-14.Y
Vibration isolators	2-14. Z
Waveguide assemblies	2-14. AA
Wiring	2-14. AB

Index of Repair Procedures (Sheet 2 of 2)
Figure 2-19

A. Air Filters.

Clean in water with detergent. Do not blast with air hose. If defective, replace air filter.

B. Capacitors.

If defective or if performance is questionable, capacitors should be replaced. Clean all connections thoroughly, and apply new solder.

C. **Castings.**

Damaged castings should be replaced unless suitable machine shop facilities are available for their repair.

D. **Connectors.**

Straighten bent pins and damaged shell areas. Replace defective connectors, broken wires, or wires with split insulation. If a connector insert is broken, replace the connector.

E. **Covers and Shields.**

Replace damaged screws, straighten any dents or warped sections, and retouch scratched or worn painted surfaces.

F. **Electron Tubes.**

Replace defective tubes. Clean corroded pins with a clean, lintless cloth or soft- bristled brush.

G. **Finished Surfaces.**

CAUTION: DO NOT TOUCH UP ANY AREA WHERE AN ELECTRICAL CONNECTION IS MADE.

Touch up minor scratches in all painted surfaces with a high-quality, black enamel applied with a small brush. Refinish black wrinkle as required in accordance with MIL-E-5558A and MIL-P-8585A. Refinish black lusterless surfaces as required in accordance with MIL-E-14072 (SIGC). Touch up unpainted aluminum with Alodine 1200, or suitable water-lacquer mixture, applied with a pipe cleaner or small brush.

H. **Frames.**

Straighten all misshapen areas. Remove all corrosion with a suitable cleaner. Retouch silk screening, and refinish where needed.

I. **Gaskets and Washers (Paper, Fiber, Cork, and Rubber).**

Replace all broken, deformed, or defective gaskets and washers.

J. **High-Voltage Wiring.**

Replace all cracked, broken, or otherwise damaged high-voltage wiring. Have tube vendor replace damaged leads if tube still has serviceable life. Ensure that high- voltage wiring is properly placed within the chassis.

K. **Insulators (Ceramic, Mycalex, and Plastic).**

Replace any insulators which show signs of physical damage such as cracks, burns, chips, or any other type of damage or deterioration.

L. Jacks.

Replace cracked, broken, or severely misshapen jacks or jacks with bent or broken center conductors or insulation.

M. Knobs and Panels.

Replace cracked, chipped, broken, or otherwise damaged knobs. Retouch or refinish panels in accordance with paragraph G above.

N. Machined Metal Parts.

If satisfactory machine shop facilities for suitable repair of these surfaces are not available, the defective or damaged part should be replaced.

O. Mechanical Metal Parts.

Straighten bent or misshapen mounts, clamps, and mounting plates. Replace broken, bent or cross-threaded bolts, screws, nuts, washers, and other hardware.

P. Modulator.

Do not attempt repair of modulator. Remove modulator and return to Collins for repair.

Q. Molded Plastic Parts.

Replace cracked, chipped, or broken plastic parts, and replace any defective mounting hardware.

R. Printed Circuit Boards.

Replace any cracked, broken, chipped, or otherwise damaged printed circuit boards. Repair of these boards is not recommended.

S. Receptacles.

Replace all receptacles with cracked, broken, chipped, or charred insulation or loose, bent, or otherwise damaged contacts. Clean in accordance with the appropriate paragraph in the cleaning section of this manual.

T. Relays.

If a relay appears to be defective or is intermittent, replace it. Damaged relays are replaced as individual units. Make a sketch of wire connections to facilitate rewiring. Sealed relays cannot be repaired and must be replaced if found defective. Clean all connections thoroughly, and apply new solder.

U. Resistors.

If defective or if performance is questionable, resistors should be replaced. Clean all connections thoroughly, and apply new solder. Replace variable resistors if the shaft is loose in the case. Clean corroded terminals.

V. Semiconductors.

CAUTION: TO PREVENT DAMAGE, USE A HEAT SINK BETWEEN THE LEAD BEING SOLDERED AND THE SEMICONDUCTOR DEVICE.

If a semiconductor appears defective or is suspected of questionable operation, it should be replaced. Replace semiconductors which show signs of overheating or which have damaged cases.

W. Soldered Terminal Connections.

Resolder cold-soldered or rosin joints. Remove all traces of corrosion.

X. Switches.

Individual wafers or connector terminals may sometimes be replaced in certain types of wafer switches. Defective encapsulated switches must be replaced. Identify leads to facilitate rewiring.

Y. Transformers and Inductors.

Replace all cracked, chipped, broken, or charred transformers and inductors. Replace all transformers and inductors if defective or suspected of questionable performance. Identify leads to facilitate rewiring. Clean connections and apply new solder.

Z. Vibration Isolators.

Ensure that the metal parts of vibration isolators are clean and free from corrosion and physical defects, Isolators whose elastic members show loss of resiliency should be replaced.

AA. Waveguide Assemblies.

Deformed or defective waveguide assemblies or sections should be returned to the manufacturer for rework.

AB. Wiring.

NOTE: When it is necessary to disturb the dress of wires or cables, carefully ensure that the original wire dress is restored.

Replace damaged wiring with wire of the same size and color coding. Ensure that no bare wires are touching the chassis, other bare wires, or metal cases of other parts. If a wire is to be removed from a terminal or component, it should be marked with an identification tag to minimize incorrect connections. Clean all terminals and apply new solder.

Section VI. ASSEMBLY

2-15. GENERAL.

This section presents instructions for assembling the RT-711A Receiver-Transmitter and the MT-3068 Shockmount. These instructions are arranged so that assembly of each major part is an individual operation. When it is necessary to assemble the unit, locate the part in the table of contents and begin on the page indicated. Reference is made to subsequent assembly steps that must be performed to completely restore the unit. The order of assembly begins with the lowest parts, proceeds to the next higher subassemblies, and ends with the completed unit. These instructions include special techniques, cautions, warnings, and unique procedures.

The numbers used to reference component parts shown in the illustrations referenced (in the disassembly section) do not correspond to the item numbers of the component parts in the illustrated parts list.

2-16. PRECAUTIONS AND GENERAL TECHNIQUES.

Before soldering any lead or component, refer to the notes of color coding, placement of leads, and wire insulation made during disassembly. If there is any doubt as to the placement of such leads or components, refer to the appropriate diagrams, and perform continuity tests to ensure proper replacement. Ensure also that proper dress or lacing of wires and cables is restored. Any component requiring removal of potting compound for disassembly must be repotted during/after assembly.

CAUTION: **TO PREVENT DAMAGE TO A SOLID-STATE DEVICE, USE A HEAT SINK ON THE LEAD BETWEEN THE POINT BEING SOLDERED AND THE DEVICE.**

WARNING: **THE RT-711A RECEIVER-TRANSMITTER USES EXTREMELY HIGH VOLTAGES. DO NOT ATTEMPT ANY ASSEMBLY WHILE ANY PRIMARY POWER IS APPLIED TO THE UNIT. ENSURE THAT THE POWER CABLE IS REMOVED TO PREVENT VOLTAGE TRANSIENTS WHICH COULD DAMAGE OR DESTROY SEMICONDUCTORS.**

CAUTION: **REMOVE WRISTWATCH[I BEFORE WORKING IN THE VICINITY OF THE MAGNETRON OR MIXER-DUPLEXER MODULE.**

CAUTION: **HANDLE THE MAGNETRON AND MIXER-DUPLEXER Module WITH EXTREME CARE. NEVER JAR THE UNITS OR STRIKE THE WITH TOOLS. NEVER PLACE THEM ON A STEEL WORKBENCH OR ON A WORKBENCH THAT MAY HAVE IRON FILINGS OR STRANDS OF STEEL WOOL PRESENT. USE NONMAGNETIC TOOLS WHICH WILL NOT CAUSE DEGAUSSING. NEVER ALLOW DELICATE INSTRUMENTS TO COME IN THE VICINITY OF THE MAGNETRON OR MIXER-DUPLEXER MODULE.**

WARNING: CAPACITORS IN THE RT-711A RECEIVER-TRANSMITTER MAY HOLD A CHARGE FOR LONG PERIODS OF TIME AFTER PRIMARY POWER HAS BEEN REMOVED. OBSERVE SAFETY PRECAUTIONS WHEN WORKING ON THE RECEIVER-TRANSMITTER.

These precautions are repeated in the text of the assembly procedures where applicable.

2-17. ASSEMBLY PROCEDURE.

A. Assemble MT-3068 Shockmount. (Refer to figure FO-5.)

(1) Replace vibration isolators as follows:

(a) Replace bottom rear isolator (19) by securing it to baseplate (24) with four hexnuts, lockwashers, and machine screws (23).

(b) Replace two top rear isolators (16) by securing each isolator standoff (22) to baseplate (24) with four machine screws (21).

(c) Replace two bottom front isolators (13) by securing each isolator to baseplate (24) with four hexnuts, lockwashers, and machine screws (20).

(2) Replace tray (10) as follows:

(a) Holding connector parts together, insert through hole in baseplate (24).

(b) Secure connector shells to tray (10) by replacing four screws holding shells together.

(c) Replace connector-filter capacitor cable assembly (10A) by replacing 10 machine screws holding ground lugs and standoff insulators to tray (10).

(d) Secure two ground straps (18) to tray (10) with two hexnuts, flat washers, and machine screws (17).

(e) Secure tray (10) to bottom rear isolator (19) by replacing machine screw (19A).

(f) Secure tray (10) to each of two top rear isolators (16) by replacing spacer (15) and machine screw, lockwasher, and flat washer (14).

(g) Secure tray (10) to each of two bottom front isolators (13) by replacing spacer (12) and machine screw (11).

(3) Replace front retainers (7) by replacing pin (9) and cotter Pin (8).

NOTE: If thrust bearing (4) was removed, replace it in jaw (6) and secure with two machine screws (5y, Lubricate thrust bearing and threaded end of extractor shaft assembly (1) with aircraft and instrument grease (Collins part number 005-0234-00).

(4) Replace extractor assembly (1) by securing it to shockmount tray (10) with two machine screws (2) and two machine screws (3).

NOTE: Apply an ample coating of aircraft and instrument grease (Collins part number 005-0234-00) as per MIL-G-3278 to pin and bearing after assembly.

B. Replace Modulator. (Refer to figure 2-15.)

(1) Secure module or (52, figure FO-4) to chassis assembly (35) by replacing washers and hexnuts on four studs (11).

(2) Secure modulator (52, figure FO-4) to chassis assembly (35) by replacing two machine screws (10) in area under fault sensing module TB3.

(3) Replace fault sensing module TB3 (6). Refer to paragraphs D(1) and D(2) below.

(4) Solder wires to modulator terminals 28, 29, and 30.

(5) Connect P7 and turn unit right side up.

(6) Secure modulator (52, figure FO-4) to rear mounting bracket by replacing two machine screws and lock washers (54, figure FO-4).

(7) Secure modulator front mounting bracket to air plenum chamber by replacing machine screw (53, figure FO-4).

(8) If bracket (55, figure FO-4) was removed, replace by securing to modulator (52, figure FO-4) with two machine screws and lock washers (56, figure FO-4).

(9) Replace magnetron (44, figure FO-4). Refer to paragraphs G(1) through G(3) below.

NOTE: Do not permit grease to get inside connector receptacle or on modulator connector contact. A faulty electrical connection may result.

(10) Place small amount of grease (DC 4, Collins part number 005-0201-00) on spark gap lead at both sides of rubber flange (push connector cap back for access).

CAUTION: CONNECTORS SHOULD NOT BE TIGHTENED MORE THAN FINGER TIGHT. DO NOT USE FORCE.

(11) Connect spark gap connector to modulator terminal 26S.

(12) Replace keep-alive module (1). Refer to paragraphs E(1) through E(4) below.

(13) Replace dust covers. Refer to paragraphs 1(1) through 1(3) below.

C. Replace +260-V Supply Module TB1. (Refer to figure 2-15.)

(1) Solder leads to terminals of +260-v supply module TB1 (8).

(2) Secure TB1 (8) to chassis assembly (35) by replacing four flat washers, look-washers, and machine screws (9).

(3) Replace bottom dust cover (40, figure FO-4). Refer to paragraph I(1) below.

D. Replace Fault Sensing Module TB3. (Refer to figure 2-15.)

(1) Secure fault sensing module TB3 (6) to chassis assembly (35) by replacing four flat washers, lock washers, and machine screws (7).

(2) Solder leads to terminals of TB3 (6).

(3) Replace bottom dust cover (40, figure FO-4). Refer to paragraph I(1) below.

E. Replace Keep-Alive Supply Module TB2. (Refer to figure 2-15.)

(1) Solder leads to terminal of keep-alive supply module TB2(1).

(2) Secure TB2 (1) to magnetron mounting bracket by replacing spacing sleeves, flat washer, lock washers, and machine screw.

(3) Secure TB2 (1) to threaded stud (on magnetron mounting bracket) by replacing spacing sleeve (if removed), flat washer, hexnut, solder lug, lock washer, and hexnut (5).

(4) Secure TB2 (1) to front of chassis assembly (35) by replacing two lock washers and machine screws (2).

(5) Replace left side dust cover (38 figure FO-4). Refer to paragraph I(2) below.

F. Replace Mixer-Duplexer Module. (Refer to figure FO-4.)

CAUTION: HANDLE THE MIXER-DUPLEXER MODULE WITH EXTREME CARE. NEVER JAR THE UNIT OR STRIKE IT WITH TOOLS. NEVER PLACE IT ON A STEEL WORKBENCH OR ON A WORKBENCH THAT MAY HAVE IRON FILINGS OR STRANDS OF STEEL WOOL PRESENT. USE NON-MAGNETIC TOOLS WHICH WILL NOT CAUSE DEGAUSSING. NEVER ALLOW INSTRUMENTS TO COME IN THE VICINITY OF THE MIXER-DUPLEXER MODULE.

(1) Loosen four magnetron mounting screws (46) to enable magnetron to be tipped up.

(2) Tip magnetron (44) toward front of chassis and set mixer-duplexer module (49) in place.

(3) Secure mixer-duplexer to magnetron by replacing spacer (47) and four lock- washers and machine screws (45).

NOTE: Two lower screws are accessible through holes in chassis near rear waveguide connection.

(4) Secure waveguide connector to rear of chassis with two lock washers, flat washers and machine screws (48).

(5) Connect J2, J3, J4, P5, and P6.

(6) Replace trigger generator module (42). Refer to paragraph H(1) below.

(7) Replace high-voltage cap (50) on keep-alive tube.

(8) Replace outer dust covers. Refer to paragraphs I(1) through 2-17 I(3) below.

G. Replace Magnetron. (Refer to figure FO-4.)

CAUTION: HANDLE THE MAGNETRON WITH EXTREME CARE. NEVER JAR THE UNIT OR STRIKE IT WITH TOOLS. NEVER PLACE IT ON A STEEL WORKBENCH OR ON A WORKBENCH THAT MAY HAVE IRON FILINGS OR STRANDS OF STEEL WOOL PRESENT. USE NONMAGNETIC TOOLS WHICH WILL NOT CAUSE DEGAUSSING. NEVER ALIOW DELICATE INSTRUMENTS TO COME IN THE VICINITY OF THE 'MAGNETRON.

(1) Place magnetron (44) in mounting position and secure magnetron and modulator bracket (55) to chassis assembly (35) with four flat washers and mounting screws (46).

(2) Place small amount of grease (DC 4, Collins part number 005-0201-00) on magnetron leads at both sides of rubber flange (push connector cap back for access).

NOTE: Do not permit grease to get inside connector receptacle or on modulator connector contact. A faulty electrical connection may result.

(3) Reconnect magnetron filament leads to modulator (52).

NOTE: Green lead connects to terminal 27 and yellow lead connects to terminal 26.

CAUTION: CONNECTORS MUST NOT BE TIGHTENED MORE THAN FINGER TIGHT. DO NOT USE FORCE.

(4) Secure mixer-duplexer (49) to magnetron (41) by replacing waveguide spacer (47) and four flat washers and machine screws (45).

NOTE: Two lower screws are accessible through holes in chassis below rear waveguide connection.

(5) Replace keep-alive module TB2 (1, figure 2-15). Refer to paragraphs E(1) through E(4) above.

(6) Replace front plate (30). Refer to paragraphs J(11) and 2-17 J(12) below.

(7) Replace left dust cover (38). Refer to paragraph I(2) below.

H. Replace Trigger Generator Module. (Refer to figure FO-4.)

(1) Place trigger generator module (42) in printed board mount (43,) (components turned inward) and press into connector J1.

(2) Replace top dust cover (36). Refer to paragraphs 2-17 I(3) below.

I. Replace Outer Dust Covers. (Refer to figure FO-4.)

(1) Secure side dust covers (38) to chassis assembly (35) by replacing six machine screws (39) in each cover.

(2) Replace bottom dust cover (40) by securing it to chassis assembly (35) with four turnlock fasteners (41).

(3) Replace top dust cover (36) by securing to chassis assembly (35) with five turn-lock fasteners (37).

J. Assemble- and Replace Front Plate. (Refer to, figure FO-4.)

(1) The following components, attached to the front of chassis assembly (35) may be replaced while the front plate (30) is removed.

(a) Components R11, R15, and R19.

(b) Terminal board TB8.

(2) The following components, attached to the rear of the front plate (30) may be replaced while the plate is removed.

(a) Components Q2, Q3, Q4, and Q5.

(b) Components CR17, CR24, CR25, VR22, and VR23.

(3) Replace capacitor (31) and mounting bracket (32) as follows:

(a) Secure bracket (32) to the front plate (30) with four machine screws (33).

(b) Attach capacitor lead to terminal strip (29) of tubeaxial fan B1.

(c) Solder capacitor lead to terminal stud.

(4) Replace tubeaxial fan B1 (27). Refer to paragraphs K(1) and K(2) below.

(5) Replace RF ON/OFF switch S4 (25). Refer to paragraphs L(1) and L(2) below.

(6) Replace meter function switch S5 (21). Refer to paragraphs M(1) and M(2) below.

(7) Replace meter circuit module TB4 (16). Refer to paragraphs N(1) and N(2) below.

(8) Replace -27.5-v regulator module TB6 (13). Refer to paragraphs 0(1) through 0(3) below.

(9) Replace +27.5-v regulator module TB5 (10). Refer to paragraphs P(1) and P(2) below.

(10) Replace meter M1 (18). Refer to paragraphs Q(1) and Q(2) below.

(11) Place front plate (30) in mounting position and secure it to chassis assembly (35) with eight machine screws (33) (on plate edges) and two machine screws (34) (bottom screw in each toe fastener).

(12) Replace front housing (5) in accordance with paragraphs R(1) and R(2) below.

K. Replace Tubeaxial Fan B1. (Refer to figure FO-4.)

(1) Replace fan leads by securing them to fan terminal strip (29).

(2) Replace tubeaxial fan B1 (27) by securing it to front mounting plate (30) with three synchro clamps (28).

NOTE: Be certain machine screws securing synchro clamps to front plate are tight.

(3) Replace front housing (5). Refer to paragraphs R(1) and R(2) below.

L. Replace RF ON/OFF Switch S4. (Refer to figure FO-4.)

(1) Mount switch S4 (25) by securing it to switch plate (27) with lockwasher and retainer nut (26).

(2) Solder leads to switch terminals.

(3) Replace front housing (5). Refer to paragraphs R(1) and R(2) below.

M. Replace Meter Function Switch S5. (Refer to figure FO-4.)

(1) Place switch (21) in mounting position and solder leads to switch terminals.

(2) Secure wafer switch (21) and switch bracket (23) to three standoffs (24) with three machine screws (22).

(3) Replace front housing (5). Refer to paragraphs R(1) and R(2) below.

N. Replace Meter Circuit Module TB4. (Refer to figure FO-4.)

(1) Solder leads to terminals of meter circuit module TB4 (16).

(2) Secure to four hexposts (17). Refer to paragraphs 0(2) and 0(3) below.

(3) Replace front housing (5). Refer to paragraphs 2-17 R(1) and 2-17 R(2) below.

O. Replace -27.5-V Regulator Module TB6. (Refer to figure FO-4.)

(1) Solder leads to terminals of -27.5-v regulator module TB6 (13).

(2) Replace four spacers (15).

(3) Secure TB6 (13) and meter circuit module TB4 (16) to four hexposts (17) by replacing four flat washers, lockwashers, and machine screws (14).

(4) Replace front housing (5). Refer to paragraphs R(1) and R(2) below.

P. Replace +27.5-V Regulator Module. (Refer to figure FO-4.)

(1) Solder leads to terminals of +27.5-v regulator module TB5 (10).

(2) Secure TB5 (10) to four standoffs (12) with four flat washers, lockwashers, and machine screws (11).

(3) Replace front housing (5). Refer to paragraphs R(1) and R(2) below.

Q. Replace Meter. (Refer to figure FO-4.)

(1) Solder leads to meter terminals.

(2) Secure meter Ml (18) to meter posts (20) with four lockwashers and machine screws (19).

(3) Replace front housing (5). Refer to paragraphs R(1) and R(2) below.

R. Assemble and Replace Front Housing. (Refer to figure FO-4.)

(1) Replace front housing (5) by securing four turnlock fasteners (8) to four mounting posts (9).

(2) Replace meter function switch knob (6), securing it to meter function switch S5 (21) by tightening two setscrews (7).

S. Replace Air Filter and Brackets. (Refer to figure FO-4.)

(1) Place air filter (4) and retaining screen (3) in bracket (1).

(2) Secure filter bracket (1) to front housing (5) with two turnlock fasteners (2).

Section VII. TESTING

2-18. GENERAL.

This section presents the procedures for bench testing the RT-711A Receiver- Transmitter. Procedures are first given for a functional check of the equipment (figure 2-20). Results obtained will enable the technician to determine if repair or alignment is necessary. When a malfunction is indicated, refer to the detailed test procedures for more complete testing instructions.

Performance test procedures are given for testing with the AN/APM-247 Radar Test Set, and the MK-774/APN-158 Maintenance Kit. All procedures are in tabular format.

Procedures for testing the AN/APM-247 Radar Test Set and the MK-774/APN-158 Maintenance Kit include a column listing suggested troubleshooting areas relative to the test being performed.

2-19. EQUIPMENT REQUIRED.

Refer to figure 2-25 for equipment required for testing the receiver-transmitter.
Interconnecting cables for use with the maintenance kit and radar test set are included with the respective equipment.

2-20. PRELIMINARY PROCEDURES.

Preliminary procedures for equipment setup prior to testing are given in each test procedures section.

2-21. TEST PROCEDURES.

A. Functional Test.

Interconnect the receiver-transmitter with a C-4881/APN-158 Cockpit Control Unit and SN/358A/APN-158 Synchronizer. (Interconnection with other units of the system is not required for this test.) Connect a dummy load to the waveguide connection, set the RF switch to ON, and place the meter switch in the MAG position.

Verify that the primary power input to the test harness is 115 v, 400 ±20 Hz, and proceed with the test given in figure 2-20.

STEP	TEST	INSTRUCTIONS	RESULTS
(1)	Power supplies and time delay	Note time, then immediately set system control switch to OPR.	Fan operates immediately. Meter indicates zero.
		Set meter switch to GEN A. Set meter switch to GEN B.	Meter indicates 5 ±1. Meter indicates 5 ±1.
		Set meter switch to MAG and note time when meter begins indicating magnetron current.	Elapsed time is 4 ±1 min. Meter indicates 5 ±1.
		Set meter switch to -27.5V.	Meter indicates 5 ±1.
		Set meter switch to +27.5V.	Meter indicates 5 ±1.
		Set meter switch to +260V.	Meter indicates 5 ±1.
		Set system control switch to STBY. Remove top and left side covers and pull interlock switch S1 into locked position.	
		Measure voltage from high-voltage cable on keep-alive supply module (TB2) to ground.	-625 v to -800 v
(2)	Transmitter	Connect oscilloscope to TP4.	
		Set system control switch to OPR and observe magnetron current pulse.	Pulse is 3.3 -0.3 +0.5µs wide and 40 ±5 v amplitude. (Refer to TP4 waveshape in figure 2-22)
		Connect frequency meter input to TP6, frequency meter output to 20-db attenuator and attenuator output to thermistor mount. Connect thermistor mount to power meter before applying ac power to power meter.	
(Cont)		After RT has stabilized (approx 15 min of operation), rotate frequency meter control until a 1-db, or greater, dip occurs in power meter reading. Frequency indicated is magnetron frequency.	9375 +20, -25 MHz at +25 °C.

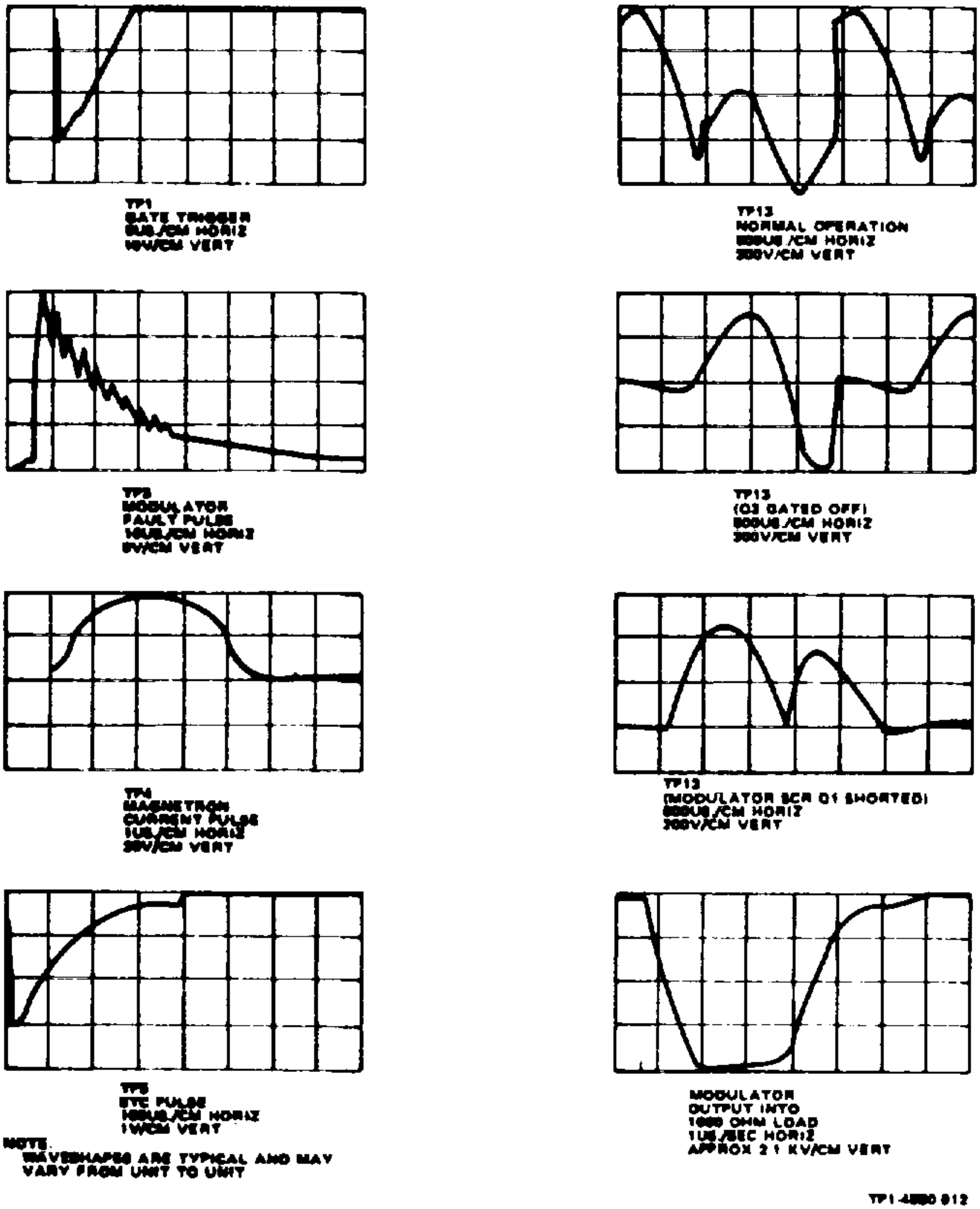
RT-711A Receiver-Transmitter Functional Test (Sheet 1 of 3)
Figure 2-20

STEP	TEST	INSTRUCTIONS	RESULTS
(2) (Cont)		Rotate frequency meter control to approx 100 MHz away from magnetron frequency.	
		Determine average transmitter power output by adding attenuation of directional coupler (approx 20 db; exact value stamped on coupler), frequency meter insertion loss, cable loss, 20-db attenuator, and power meter reading.	Total attenuation should be not less than 44. 25 dbm (26.5-w avg power) for 3.3-us. pulse width and 2500-us. pulse spacing.
		From value of pulse width and average power, calculate peak power as follows:	
		peak power (kw)= avg power (watts) x 1000 pulse width (us.) x prf **NOTE: Prf = primary power frequency (400 Hz -5+%).**	20 kw minimum.
(3)	Receiver	Attach echo box to TP6 and oscilloscope to synchronizer VIDEO test point (J16). Connect jumper wire between synchronizer STC (J17) and GROUND (J35).	
		Adjust echo box for maximum ring time and note value.	
		While observing ring time, connect 100-kilohm resistor between synchronizer AFC test point (J21) and ground.	Ring time momentarily decreases then returns to previous value as afc loop "locks" again.
(Cont)		Connect calibrated 20-db attenuator to TP6 and shf signal generator rf output to attenuator using not more than 3 ft of RG-214, or equivalent, coaxial	

RT-711A Receiver-Transmitter Functional Test (Sheet 2 of 3)
Figure 2-20

STEP	TEST	INSTRUCTIONS	RESULTS
(3) (Cont)		cable. Connect signal generator sync input to TP4. Adjust signal generator for pulsed signal output 5 us. wide with pulse delay of 200 us. and value of frequency obtained for magnetron frequency above.	
		Observe video signal at VIDEO test point while increasing attenuation of input signal. As signal level approaches system noise level, vary pulse delay to distinguish pulse from noise.	
		Just before pulse becomes indiscernible from system noise, note total attenuation of signal (sum of signal generator attenuation, 20-db fixed attenuator, and directional coupler attenuation stamped on coupler). Value of total attenuation is minimum discernible signal (MDS).	MDS should be within -103 to -110 dbm.
(4)	Fault sensing	Set RF switch to OFF and meter switch to -27.5V. Connect pulse generator output to TP3 (left side of chassis). Adjust pulse generator for 10-us. wide, 30-p/s, 10-v amplitude pulses. (Adjust amplitude while connected to TP3.)	
		Increase pulse rate approx 1 p/s until fault sensing circuit reverts system to standby mode of operation (meter indicates 0).	Pulse rate is 50 ±5 p/s.

RT-711A Receiver-Transmitter Functional Test (Sheet 3 of 3)
Figure 2-20



RT-711A Receiver-Transmitter Test Point Waveshapes
Figure 2-21

B. Performance Testing With the AN/APM-247 Radar Test Set.

This section presents the procedures for testing the receiver-transmitter using the AN/APM-247 (978G-1) Radar Test Set. These procedures are presented in tabular form in figure 2-23.

When a malfunction is indicated, some possible causes are referenced at the appropriate test in the POSSIBLE TROUBLE AREAS column. After a malfunction is corrected, the unit should be tested again to verify that repairs have not affected normal operation.

For a detailed description and maintenance instructions for the radar test set, refer to the applicable service manual.

(1) Use of Test Procedures.

Procedures to be observed in using the test procedures follow.

(a) Switches not on the test set subpanels in use are not referenced and may be in any position.

(b) The correct position of all test set switches applicable to the tests are listed at the top of the 978G-1 INSTRUCTIONS column on each page. Necessary changes of switch positions are noted at the appropriate test step. All other switches are to remain in their last referenced position.

(c) The RESULTS column lists the indications of a properly functioning unit.

(d) The POSSIBLE TROUBLE AREAS column lists troubleshooting areas for a malfunction indicated by the appropriate test.

(e) The following list of abbreviations and definitions are used in figure 2-23.

ABBREVIATION	**DEFINITION**
Fall time	Measured from 90% to 20% of amplitude of the waveform trailing edge
Pulse width	Measured at 50% amplitude
Rise time	Measured from 10% to 90% of amplitude of waveform leading edge
RT	RT-711A Receiver-Transmitter
620A	Hewlett-Packard 620A SHF Signal Generator
978G-1	AN/APM-247 (978G-1) Radar Test Set

(2) Test setup.

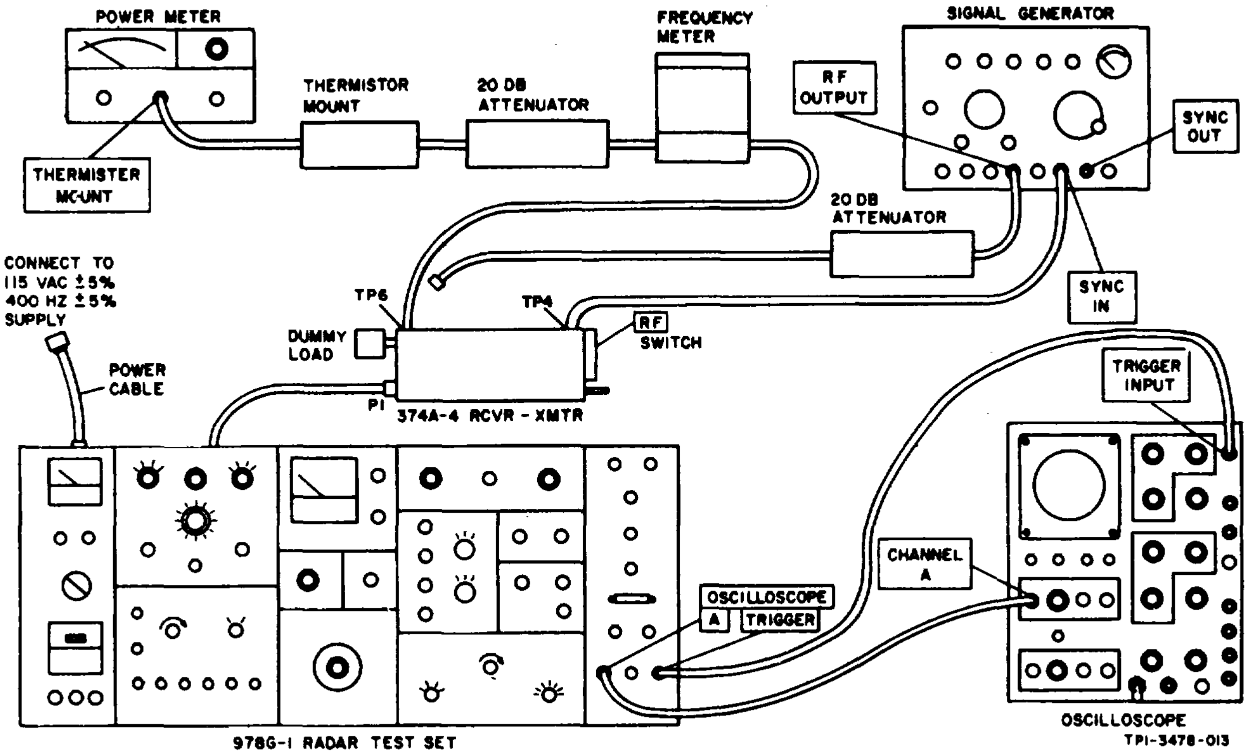
Connect the 978G-1, RT, and other test equipment as shown in figure 2-22. Changes required in the hookup will be given at the appropriate step in the procedures.

CAUTION: DO NOT OPERATE THE 978G-1 RADAR TEST SET FROM PRIMARY POWER THAT IS NOT 400 HZ ±5 PERCENT. DAMAGE TO THE EQUIPMENT MAY RESULT.

Connect the dummy load to the RT waveguide connection and set the RF switch to OFF. Set the 978G-1 AC POWER switch to ON and adjust the INPUT VOLTAGE ADJUST control for 115 ±1 v as indicated on the INPUT POWER meter. Note that the frequency is 400 ±20 Hz as indicated on the INPUT FREQUENCY meter.

(3) Performance Test.

This test measures the performance of the RT-711A Receiver-Transmitter.



Equipment Setup for Testing With AN/APM-247 Radar Test Set
Figure 2-22

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULTS	POSSIBLE TROUBLE AREAS
1.	Control circuits	TEST SET FUNCTION SELECTOR -- RECEIVER-TRANSMITTER TESTS; SYSTEM CONTROL -- STANDBY; METER MULTIPLIER -- X10.		STANDBY RELAY lamp lights. RT blower operates.	Relay K2. Blower m[illegible]r.
			Set RT meter switch to GEN A GEN B GEN C	RT meter indicates 5 ±1 5 ±1 5 ±1	Relay K2. Meter circuit module TB4.
		SYSTEM CONTROL -- OPERATE.		OPERATE RELAY lamp goes out.	Interlock switch S1.
			Pull interlock switch (top rear of RT) all the way up.	OPERATE RELAY lamp lights.	Interlock switch S1.
		SYSTEM CONTROL -- STANDBY.		OPERATE RELAY lamp goes out.	
2.	Operating voltages	TEST FUNCTION (RECEIVER-TRANSMITTER TESTS subpanel) -- RELAY POWER (-50V).		TEST METER reading in green area.	
		METER MULTIPLIER -- X1.		TEST METER indicates -27.0 ±3.0 v.	Transformer T2.
		SYSTEM CONTROL -- OPERATE.		OPERATE RELAY lamp lights.	
		TEST SET FUNCTION SELECTOR -- RECEIVER-TRANSMITTER TESTS; METER MULTIPLIER -- X10; TEST FUNCTION (RECEIVER-TRANSMITTER TESTS subpanel) -- -27V (-50V); SYSTEM CONTROL -- OPERATE.		TEST METER reading in green area.	
		METER MULTIPLIER -- X1.		TEST METER indicates between -25.0 and -28.5 v.	-27.5-v regulator. -27.5-v supply circuit.
			Using oscilloscope, measure peak-to-peak ripple.	Not more than 0.06 v.	
			Set RT meter switch to -27.5V.	RT meter indicates 5 ±1.	Meter circuit module TB4.
		METER MULTIPLIER -- X10; TEST FUNCTION (RECEIVER-TRANSMITTER TESTS subpanel) -- +27.5V (+50V).		TEST METER reading in green area.	
		METER MULTIPLIER -- X1.		TEST METER indicates between +27.4 and +27.6 v. Adjust voltage with TB5-R24 if necessary. (Measure TB5-5 with vtvm.)	+27.5-v regulator. +27.5-v supply circuit.

RT-711A Receiver-Transmitter, Performance Testing
With AN/APM-247 Radar Test Set (Sheet 1 of 8)
Figure 2-23

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULTS	POSSIBLE TROUBLE AREAS
2. (Cont)		FAULT SENSING +27.5V NORMAL LOAD -- NORMAL LOAD.		TEST METER indicates between +27.3 and +27.6 v.	+27.5-v regulator.
			Compute difference between voltage readings in previous two steps.	Not more than 0.1 v.	
		SYSTEM CONTROL -- OPERATE; TEST FUNCTION (RECEIVER-TRANSMITTER TESTS subpanel) -- +27.5V (+50V); METER MULTIPLIER -- X1; FAULT SENSING +27.5V NORMAL LOAD -- NORMAL LOAD; TEST SET FUNCTION SELECTOR -- RECEIVER-TRANSMITTER TESTS.	Measure peak-to-peak ripple on oscilloscope.	Not more than 0.03 v.	
			Set RT meter switch to +27.5V.	RT meter indicates 5 ±1.	Meter circuit module TB4.
		METER MULTIPLIER -- X10; TEST FUNCTION (RECEIVER-TRANSMITTER TESTS subpanel) -- +250V (+500V).		TEST METER reading in green area.	
		METER MULTIPLIER -- X1.		TEST METER indicates between +250 and +270 v.	+260-v supply circuit diodes CR22 and CR23.
		FAULT SENSING +250V SAFE LOAD -- SAFE LOAD.		TEST METER indicates between +245 and +266 v.	Diodes CR22 and CR23.
			Compute difference between voltage readings in previous two steps.	Not more than 5.0 v.	
		SYSTEM CONTROL -- OPERATE; TEST FUNCTION (RECEIVER-TRANSMITTER TESTS subpanel) -- +250V (+500V); METER MULTIPLIER -- X1; FAULT SENSING +250V SAFE LOAD -- SAFE LOAD; TEST SET FUNCTION SELECTOR -- RECEIVER-TRANSMITTER TESTS.	Measure peak-to-peak ripple on oscilloscope.	Not more than 0.85 v.	Diodes CR22 and CR23.
			Set RT meter switch to +260V.	RT meter indicates 5 ±1.	Meter circuit module TB4.
3.	Fault sensing	FAULT SENSING switches -- down position.	Connect test lead between FAULT SENSING TEST VOLTAGE jack and TB3-10 on RT.	OPERATE RELAY lamp goes out.	Fault sense module TB3. NOTE: Measure voltage at TB3-10 with FAULT SENSING TEST VOLTAGE jack connected. Voltage must be -1.8 to -1.85 v. If voltage is not within range, use dc supply adjusted to -1.8 v to perform test.

RT-711A Receiver-Transmitter, Performance Testing With AN/APM-247 Radar Test Set (Sheet 2 of 8)
Figure 2-23

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULTS	POSSIBLE TROUBLE AREA
3. (Cont)		SYSTEM CONTROL -- OPERATE; TEST FUNCTION (RECEIVER-TRANSMITTER TESTS subpanel) -- +250V (+500V); METER MULTIPLIER -- X1; TEST SET FUNCTION SELECTOR -- RECEIVER-TRANSMITTER TESTS.			If necessary, select highest value for R2 on TB3 that will cause the lamp to go out.
			Remove test lead from TB3-10 and FAULT SENSING TEST VOLTAGE jack.		
		SYSTEM CONTROL -- STANDBY then to OPERATE	OPERATE RELAY lamp lights.		
		FAULT SENSING +27.5V SAFE LOAD -- SAFE LOAD.		OPERATE RELAY lamp stays on.	
		FAULT SENSING +27.5V OVERLOAD -- OVERLOAD.		OPERATE RELAY lamp goes out.	Fault sense module TB3.
		SYSTEM CONTROL -- STANDBY then to OPERATE.		OPERATE RELAY lamp lights.	
		FAULT SENSING +27.5 OVERVOLTAGE -- OVERVOLTAGE.		OPERATE RELAY lamp goes out.	Fault sense module TB3.
		SYSTEM CONTROL -- STANDBY then to OPERATE.		OPERATE RELAY lamp lights.	
		FAULT SENSING +250V SAFE LOAD -- SAFE LOAD.		OPERATE RELAY lamp stays on.	
		SYSTEM CONTROL -- OPERATE; TEST FUNCTION (RECEIVER-TRANSMITTER TESTS subpanel) -- +250V (+500V); METER MULTIPLIER -- X1; TEST SET FUNCTION SELECTOR -- RECEIVER-TRANSMITTER TESTS; FAULT SENSING +250V OVERLOAD -- OVERLOAD.		OPERATE RELAY lamp goes out.	Fault sense module TB3.
		SYSTEM CONTROL -- STANDBY then to OPERATE.		OPERATE RELAY lamp lights.	
4.	Gate trigger pulse	TEST FUNCTION (RECEIVER-TRANSMITTER TESTS subpanel) -- TRIGGER.	Measure amplitude and pulse width of gate pulse displayed on oscilloscope.	Amplitude -- not less than -29.5 v. Pulse width -- 6 to 9 us.	Trigger generator module 1A11.
5.	KA-TR check		Connect test lead (CX-10092) between KA-TR TEST LEAD jack and high-voltage lead on TB2.		

RT-711A Receiver-Transmitter, Performance Testing
With AN/APM-247 Radar Test Set (Sheet 3 of 8)
Figure 2-23

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULTS	POSSIBLE TROUBLE AREA
5. (Cont)		TEST FUNCTION (RECEIVER-TRANSMITTER TESTS sub-panel) -- KA-TR (-1000V); METER MULTIPLIER -- X10; AC POWER -- ON.		TEST METER reads in green area.	
		METER MULTIPLIER -- X1.		TEST METER indicates -625 to -800 v.	Keep-alive supply. TR tube V3.
6.	Filament voltage	SET FUNCTION SELECTOR -- TEST ANTENNA/INDICATOR/ CONTROL UNIT TESTS; ANTENNA TEST (ANTENNA TESTS subpanel) -- TRIM ADJ (10 VAC); METER MULTIPLIER -- X10; SYSTEM CONTROL -- OFF; AC POWER -- OFF.	NOTE: It is not necessary to perform this test unless the magnetron or magnetron heater circuit has been repaired. Remove keep-alive supply module TB2 (refer to disassembly section). Disconnect magnetron filament leads from modulator. Using extender cables and tees (AMP type 830126-4 and type 837692-1) reconnect magnetron filament leads to modulator. Connect ac voltmeter to tees.		
			Remove trigger generator module from RT. Set RF switch to ON.		
		AC POWER -- ON; SYSTEM CONTROL -- STANDBY.		INPUT VOLTAGE meter indicates 115VAC.	
		METER MULTIPLIER -- X1; SYSTEM CONTROL -- STANDBY; TEST SET FUNCTION SELECTOR -- ANTENNA/INDICATOR/ CONTROL UNIT TESTS; ANTENNA TEST (ANTENNA TESTS subpanel) -- TRIM ADJ (10VAC).	NOTE: If voltage adjustment is necessary for correct results, move jumper wire on TB1. Adjust jumper wire for best compromise between 6.3 v when SYSTEM CONTROL SWITCH is in STANDBY position and 3.5 v when SYSTEM CONTROL switch is in OPERATE position. WARNING: TERMINALS ON TB1 HAVE 115 V ON THEM WHEN SYSTEM CONTROL IS IN STANDBY POSITION.	Ac voltmeter indicates 6.3 ±0.2 v.	Module TB1.

R711A RECEIVER-TRANSMITTER, PERFORMANCE TESTING WITH AN/APM-247 RADAR TEST SET (SHEET 4 OF 8)
FIGURE 2-23

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULTS	POSSIBLE TROUBLE AREAS
6. (Cont)		SYSTEM CONTROL -- OFF; TEST SET FUNCTION SELECTOR -- RECEIVER-TRANSMITTER TESTS.	Remove extender cables and tees from test setup. Replace trigger generator module in RT. Reconnect magnetron and replace TB2.		
7.	Thermal time delay	Refer to PROCEDURES column.	Note time, then set SYSTEM CONTROL switch to OPERATE. Note time until OPERATE RELAY lamp lights.	After 4.0 ±1 minutes OPERATE RELAY lamp lights.	Relay K3 out of tolerance.
8.	Transmitter output power and frequency	SYSTEM CONTROL -- STANDBY; TEST SET FUNCTION SELECTOR -- RECEIVER-TRANSMITTER TESTS; METER MULTIPLIER -- X1.	Using RG-214, or equivalent coaxial cable, make the following connections: frequency meter input to TP6, frequency meter output to 20-db attenuator, and 20-db attenuator to thermistor mount. Connect thermistor mount to power meter with signal cable supplied with equipment. Disconnect coaxial cable from 978G-1 OSCILLOSCOPE A jack and connect to TP4 on RT. Set RF switch to ON.		
		SYSTEM CONTROL -- OPERATE.	Measure amplitude and pulse width of pulse displayed on oscilloscope. (Be certain that 4-minute time delay relay has energized.	Amplitude -- between +35 and +45 v. Width (at 50% amplitude) -- between 3.1 and 3.8 us.	Magnetron. Modulator circuit. R101. R45.
			Set RT meter switch to MAG.	RT meter indicates 5 ±1.	Meter circuit module TB4. R45 and/or R101.
			Rotate frequency meter control through its range until a dip is indicated on the power meter.	9375 ±40 MHz.	Magnetron.
			Compute the average power output of the RT by adding the following: a. RT directional coupler loss (approximately 20 db, exact amount stamped on coupler) b. 20-db attenuator c. Frequency meter insertion loss d. Power meter reading	Not less than +43.5 dbm. NOTE: When the power is marginal, an increased width of the pulse will cause a decrease in power that may result in an average output below +43.5 dbm.	Magnetron. Modulator circuit.

RT-711A Receiver-Transmitter, Performance Testing
With AN/APM-247 Radar Test Set (Sheet 5 of 8)
Figure 2-23

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULTS	POSSIBLE TROUBLE AREAS
8. (Cont)		SYSTEM CONTROL -- OPERATE; TEST SET FUNCTION SELECTOR -- RECEIVER-TRANSMITTER TESTS; METER MULTIPLIER -- X1.	Calculate the peak power as follows: Peak power (kw) = $\frac{\text{avg pwr (watts)} \times 1000}{\text{pulse width (us.)} \times \text{prf}}$	Not less than 20 kw for 115-v input to the RT. If power output is not 20 kw, select tap on modulator T5 (J1-5, -6, -7, or -8) that will produce 20-kw output. Do not exceed pulse amplitude of 45 v at TP4.	Magnetron. Modulator circuit.
		Vary INPUT VOLTAGE ADJUST from 105 to 125 v as indicated on INPUT METER.	Observe pulse displayed on oscilloscope.	Pulse should be steady and show no signs of arcing or moding. Arcing is indicated by large increases in pulse current. Moding is indicated by smaller changes in pulse current from pulse to pulse or during a single pulse.	Magnetron
9.	Afc	SYSTEM CONTROL -- STANDBY; TEST FUNCTION (RECEIVER-TRANSMITTER TESTS subpanel) -- AFC MIXER (~500V); AFC subpanel jumper -- AFC MIXER TEST.	Remove trigger generator module. Insert special purpose module extender into trigger generator chassis connector. Insert trigger generator module into module extender card.		
		SYSTEM CONTROL -- OPERATE.	Set RT meter switch to AFC position.		
		Adjust KLYSTRON REPELLER VOLTAGE ADJUST for 185 v on TEST METER.	Rotate klystron mechanical tuning control until maximum RT meter indication is obtained. CAUTION: TYPE BLK-022 KLYSTRON DOES NOT HAVE MECHANICAL STOPS. DO NOT ATTEMPT CLOCKWISE ADJUSTMENT BEYOND POINT OF INCREASED RESISTANCE.		Klystron. Afc metering circuit.
			Connect oscilloscope to 978G-1 OSCILLOSCOPE A connector. Observe oscilloscope (2 us/cm sweep), and slowly rotate klystron mechanical tuning control. A negative pulse should be observed for two different positions of the tuning control. Adjust to obtain max amplitude of most counterclockwise pulse.	NOTE: The clockwise pulse is at 30 MHz less than magnetron frequency. The counterclockwise pulse is at 30 MHz greater than magnetron frequency.	Klystron.

RT-711A Receiver-Transmitter, Performance Testing With AN/APM-247 Radar Test Set (Sheet 6 of 8)
Figure 2-23

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULTS	POSSIBLE TROUBLE AREA
9. (Cont)		SYSTEM CONTROL -- OPERATE; TEST SET FUNCTION SELECTOR -- RECEIVER-TRANSMITTER TESTS; TEST FUNCTION (RECEIVER-TRANSMITTER TESTS sub-panel) -- AFC MIXER (-500); METER MULTIPLIER -- X1.	Adjust R71 for peak amplitude of pulse displayed on oscilloscope.		R71. Klystron. Synchronizer afc output.
			If necessary, adjust attenuator (accessible through hole in extender card) to obtain 10 ±0.5 v pulse amplitude.	NOTE: Correct pulse amplitude corresponds to klystron output of -13 dbm.	If peak amplitude of pulse occurs at less than 10 ±0.5 v, the 978G-1 discriminator may not be calibrated. Refer to applicable instruction manual for calibration procedures.
			Alternately readjust mechanical tuning control, R71, and attenuator to obtain maximum peak pulse (10 ±0.5 v) and maximum AFC indication on RT meter at same time.	If maximum indications do not occur simultaneously, carefully perform the adjustments again. Correct afc adjustment is necessary for proper system operation.	
10.	Crystal current checks		Set RT meter switch to FWD.	RT meter indicates between 3 and 10.	Mixer crystals CR40, CR41, and CR42. Local oscillator attenuator AT1. Metering circuit.
			Set RT meter switch to REV.	RT meter indicates within one major division of FWD reading.	
			Set RT meter switch to AFC.	RT meter indicates between 3 and 10.	
11.	Receiver sensitivity and gain.	SYSTEM CONTROL -- OPERATE; TEST SET FUNCTION SELECTOR -- RECEIVER-TRANSMITTER TESTS; METER MULTIPLIER -- X10. INTERNAL CONTROL UNIT GAIN -- MAX CW; AFC subpanel jumper -- SYNC.	Connect 620A RF OUTPUT to 20-db attenuator and attenuator to TP6. NOTE: Attenuator must be calibrated. Cable from attenuator to TP6 must be RG-214 or equivalent (0.5 db/ft) and not longer than 3 ft. Connect 620A SYNC IN to TP4 and SYNC OUT to oscilloscope trigger input. Adjust 620A to obtain output of 3-to 5-us.-wide pulses with approx 200-us. delay and rf frequency equal to magnetron frequency (9375 ±40 MHz).		
		SYSTEM CONTROL -- STANDBY.	Connect SN-358A/APN-158 Synchronizer to 978G-1. Connect synchronizer STC and GROUND test points together. Connect oscilloscope channel A to synchronizer VIDEO test point J16.		

RT-711A Receiver-Transmitter, Performance Testing
With AN/APM-247 Radar Test Set (Sheet 7 of 8)
Figure 2-23

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURES	RESULTS	POSSIBLE TROUBLE AREAS
11. (Cont)		SYSTEM CONTROL -- OPERATE.	Observe waveform on oscilloscope and decrease signal amplitude (increase attenuation) until just before pulse disappears in system noise. This point is minimum discernible signal level. Record level as system MDS.	MDS between -103 and -110 dbm	Afc circuit. Receiver mixer crystals CR41, CR42. If. preamplifier. Synchronizer video amplifier module.
		SYSTEM CONTROL -- OPERATE; TEST SET FUNCTION SELECTOR -- RECEIVER TRANSMITTER TESTS; METER MULTIPLIER -- X10; INTERNAL CONTROL UNIT GAIN -- max cw.	Remove connection between synchronizer STC and GROUND test points. Adjust 620A PULSE DELAY for 200 us. Adjust OUTPUT ATTEN control to obtain 6-v amplitude pulse as observed on oscilloscope. Note attenuation level.		
		INTERNAL CONTROL UNIT GAIN -- max ccw.	Adjust 620A OUTPUT ATTEN control to obtain 6-v amplitude pulse as observed on oscilloscope. Note attenuation level.	Difference in attenuation levels between this and preceding step is not less than 15 db.	If. preamplifier.

RT-711A Receiver-Transmitter, Performance Testing
With AN/APM-247 Radar Test Set (Sheet 8 of 8)
Figure 2-23

C. Performance Testing With the MK-774/APN-158 Maintenance Kit.

This section presents the procedures for testing the receiver-transmitter trigger generator module using the MK-774/APN-158 (979A-2) Maintenance Kit. These procedures are presented in tabular form in figure 2-24.

When a malfunction is indicated, possible causes are referenced at the appropriate test in the TROUBLESHOOTING AREA OR ADJUSTMENT column. After a malfunction is corrected, the module should be completely tested to verify that repairs have not affected other portions of the circuit.

For a detailed description and maintenance instructions for the maintenance kit, refer to the applicable service manual.

(1) Use of Test Procedures.

Procedures to be observed in using the test procedures follow.

(a) Radar maintenance kit switches not specifically referenced in figure 2-24 are not used during the module test and may be in any position.

(b) The correct position of all test set switches applicable to the maintenance kit are listed at the top of the MODULE TEST SET INSTRUCTIONS column on each page. Necessary changes of switch positions are noted at the appropriate test. All other switches are to remain in their last referenced position.

(c) The TEST POINT/RESULTS column lists the indications of a properly functioning module as displayed on the oscilloscope and maintenance set TEST METER.

(d) The TROUBLESHOOTING AREA OR ADJUSTMENT column lists troubleshooting areas for a malfunctioning module.

(e) The following list of abbreviations and definitions are used in the test procedures.

ABBREVIATION	DEFINITION
ch	Channel
fall time	Measured from 90% to 10% of the amplitude of the waveform trailing edge
pulse width	Measured at 50% amplitude points
rise time	Measured from 10% to 90% of the amplitude of the waveform leading edge
sens	Sensitivity
us.	Microsecond

(2) Test Setup.

Using a UG-273/U adapter and a CG-1464/U cable assembly, connect the module test set output marked OSCILLOSCOPE CHANNEL A to the channel A input of the oscilloscope vertical amplifier. Repeat the procedure for the B channel connections. Using another CG-1464/U cable assembly and UG-273/U adapter, connect the module test set TRIGGER output to the oscilloscope external trigger input. Connect both equipments to primary power.

CAUTION: DO NOT OPERATE THE MK-774/APN-158(979A-2) RADAR MAINTENANCE KIT FROM PRIMARY POWER THAT IS NOT 105 TO 125 V, 380 TO 420 HZ. DAMAGE TO THE EQUIPMENT WILL RESULT.

(3) Oscilloscope Calibration.

Turn on the oscilloscope and adjust the controls to obtain a trace. Not all controls will require changes of settings during the test procedure. The following list indicates initial settings for those controls which will require changes during testing. Necessary changes of control settings are noted at the appropriate test in the TEST FIXTURES INSTRUCTIONS column. Controls not noted in this column are to remain in their last noted position.

OSCILLOSCOPE CONTROL	SETTING
Vertical amplifier (type C-A plug-in unit)	
Vertical sens (oh A and B)	1 VOLT/CM
POLARITY (ch A and B)	NORMAL
MODE (sweep)	ALTERNATE
TIME BASE	A
TRIGGERING MODE	EXT
TRIGGERING SLOPE	- (negative)
HORIZONTAL DISPLAY	A
Sweep speed	0.5 MILLISEC/CM
MAGNIFIER	OFF

NOTE: Control names in capital letters in this list are as silk-screened on the Tektronix 535 oscilloscope and type C-A plug-in unit. If a different oscilloscope is used, set the corresponding control to similar settings as required throughout the test procedures.

The maintenance kit has an accurate 4-v do calibration voltage present at the CHANNEL A and CHANNEL B output terminals when the TEST FUNCTION SELECTOR is in the CAL position.

The following steps outline the calibration procedure for the oscilloscope using the 4-v calibration voltage supplied by the maintenance kit.

(a) Connect the module test set and the oscilloscope as in paragraph (2) above. Apply power to both equipments.

(b) Set the TEST FUNCTION SELECTOR switch on the maintenance kit to OFF. (This grounds the oscilloscope inputs.)

(c) Adjust the do balance of both oscilloscope channels. (Refer to the operating instructions for the oscilloscope.)

(d) Adjust the channel A trace on the oscilloscope to coincide with the bottom line on the graticule.

(e) Set the TEST FUNCTION SELECTOR switch on the maintenance kit to CAL. Adjust the vertical gain of the oscilloscope so the trace falls 4 centimeters (fourth horizontal line) above the bottom line. The 1 v/cm deflection in this step provides accurate calibration for all ranges of channel A vertical sensitivity.

(f) Repeat steps (d) and (e) for channel B of the oscilloscope.

(4) Radar Maintenance Kit Voltage Check.

Make the following switch settings to ensure that the voltages supplied by the module test set are correct.

METER FUNCTION SWITCH POSITION	TEST METER READING
115VAC	109 to 121 v
+27. SV	27.5 ±1.1 v
-27V	27 ±2.5 v
+15V	15 ±2 v
TEST (X10)	Green area

NOTE: For any malfunction in the MK-774/APN-158 (979A-2) Radar Maintenance Kit, refer to the applicable service manual for maintenance and overhaul instructions.

(5) Performance Test.

This test measures the characteristics of both the gate trigger pulse and the modulator SCR trigger pulse outputs of the trigger generator module.

CAUTION: EITHER THE POWER SWITCH OR THE TEST FUNCTION SELECTOR SWITCH MUST BE IN THE OFF POSITION BEFORE INSERTING ANY MODULE INTO THE MK-774/APN-158 (979A-2) RADAR MAINTENANCE KIT.

Insert the trigger generator module into the TRIGGER GENERATOR receptacle on the module test set. Proceed through the test in the order of the steps outlined in figure 2-24.

STEP	TEST	TEST FIXTURES INSTRUCTIONS	MODULE TEST SET INSTRUCTIONS	TEST POINT/RESULTS	TROUBLESHOOTING AREA OR ADJUSTMENT
1.	Power supply loading		POWER -- ON; METER FUNCTION -- +15V		
			TEST FUNCTION SELECTOR -- switch between TRIGGER GEN and any other position	TEST METER -- +15V ±one-half of one minor scale division	Possible shorted wiring or defective component
			METER FUNCTION -- +27.5V		
			TEST FUNCTION SELECTOR -- switch between TRIGGER GEN and any other position	TEST METER -- +27.5V ± one-half of one minor scale division	Possible shorted wiring or defective component
2.	Gate trigger pulse	Oscilloscope -- Display ch B Vert sens 5 VOLTS/CM Sweep 0.5 MILLI-SEC/CM		Pulse waveform -- Amplitude 29.5 v (min) Baseline +32 v	Amplitude and baseline -- Q4, Q5, Q6, and associated components
		Oscilloscope -- Sweep 1μ SEC/CM Sync INT, neg		Negative-going pulse Rise time -- 1.5 us.(max).	C4 and C5
		Oscilloscope -- Sweep 20μ SEC/CM		Pulse width (at baseline) 6 to 9 us.	C15
3.	Modulator trigger pulse	Oscilloscope -- Display ALTERNATE Sweep 0.5 MILLI-SEC/CM Sync EXT, neg Vert sens (ch A and B) 10 VOLTS/CM	POWER -- ON; METER FUNCTION--+27.5V; TEST FUNCTION SELECTOR -- TRIGGER GEN	Modulator trigger (ch A) -- Negative-going pulse coincident with start of gate trigger pulse (ch B)	Q6 and C15
		Oscilloscope Display ch A Sync INT, neg Vert sens (ch A) 5 VOLTS/CM		Negative-going pulse peak amplitude (from baseline) -- 15 v min	Q2, Q3, and Q4
		Oscilloscope -- Sweep 1μ SEC/CM		Pulse rise time -- 1.4 us. max	C4 and C5
				Pulse fall time -- 4 us. max Pulse width (at baseline) 9 us. max, 6 us. min	Q6 and C15

RT-711A Receiver-transmitter, Performance Testing With MK-774/APN-158 Radar Maintenance Kit
Figure 2-24

Section VIII. STORAGE INSTRUCTIONS

2-22. GENERAL.

Included within this section are storage instructions for RT-711A Receiver-Transmitter and MT-3068 Shockmount. Ensure that all subassemblies and modules are secured to the chassis of the receiver-transmitter and the dust covers are installed. Clean all silicone compound from the waveguide connector block of the MT-3068 Shockmount. If the receiver-transmitter or shockmount is to be stored for an extended period, place the unit in its original shipping carton.

Section IX. SPECIAL TOOLS, FIXTURES, AND TEST EQUIPMENT

2-23. GENERAL.

This section presents a list of special tools, fixtures, and test equipment required for test and/or overhaul of the RT-711A Receiver-Transmitter.

2-24. TEST EQUIPMENT REQUIRED.

Figure 2-25 lists the equipment and test fixtures required to test and/or overhaul the receiver-transmitter. Recommended equipment is listed in the MANUFACTURER AND TYPE OR PART NUMBER column. Other equipment may be used if it equals or exceeds the minimum specifications of the equipment listed. Nomenclatures shown in parenthesis identify commercial equipment equivalent to the military units described.

EQUIPMENT	MANUFACTURER AND TYPE OR PART NUMBER	MINIMUM SPECIFICATIONS
Items 1 through 8 are required for testing with the 978G-1 (AN/APM-247) Radar Test Set and the 979A-2 (MK-774/APN-158) Maintenance Kit.		
1. Radar Test Set Also contains: Cable assemblies as follows: 1 CX-10242/APM-247 1 CX-11555/APM-247 6 CG-1464/U (6 ea) Adapters as follows: 3 UG-273/U (3 ea) 2 UG-201A/U (2 ea)	AN/APM-247 (Collins 978G-1, part number 522-5731-015)	
2. Maintenance Kit Also contains: 1 dummy load 1 demagnetizer 1 antenna fixture 2 module extenders, MX-6424 1 module extender, MX-6425 1 module extender, MX-6426	MK-774/APN-158 (Collins 979A-2, part number 522-5730-014)	

Test Equipment Required (Sheet 1 of 3)
Figure 2-25

EQUIPMENT	MANUFACTURER AND TYPE OR PART NUMBER	MINIMUM SPECIFICATIONS
Cable assemblies as follows: 7 CG-1464/U 1 CG-3109/U 1 CX-9813 1 CX-10088 1 CX-10089 1 CX-10090 1 CX-10091 Adapters as follows: 3 UG-273/U 2 UG-201A/U 1 MX-6637 1 MX-6638 2 test leads 1 test probe, 1000:1 1 tuning tool 1 scale, 6 in.		
3. Oscilloscope	AN/USM-81 (Tektronix 535 with CA plug-in unit)	Vertical deflection sensitivity: 20 mv/cm to 20 v/cm. Sweep range: 0.1 us./cm to 5 s/cm, calibrated. External trigger input level: 0.2 v to 10 v. Input impedance: 1 megohm. Bandwidth: dc to 10 MHz.
4. Frequency meter	Federal Stock Number 6625-930-9687 (Hewlett-Packard 537A)	Frequency range: 9.0 to 9.5 GHz. Accuracy: 0.10%.
5. 20-db attenuator	Narda 757-20	Attenuation: 20 ±0.1 db, calibrated. Frequency range: 9.0 to 9.5 GHz. Power input: 250 w, peak; 0.5 w average (maximum).
6. Power meter (requires thermistor mount)	AN/USM-260 (Hewlett-Packard 431C)	Power range: 0 to +10 dbm. Accuracy: 3% of full scale.
7. Thermistor mount (for use with power meter)	MX-2144/U (Hewlett-Packard 478A)	Frequency range: 9.0 to 9.5 GHz. Maximum swr: 1.5:1.

Test Equipment Required (Sheet 2 of 3)
Figure 2-25

EQUIPMENT	MANUFACTURER AND TYPE OR PART NUMBER	MINIMUM SPECIFICATIONS
8. Shf signal generator	Federal Stock Number 6625-553-1465 (Hewlett-Packard 620A)	Output power: 0 to -127 dbm. Output accuracy: 3%. Sync output: positive, variable to 300 us. in advance of rf pulse. Ext sync input: pos pulse, 5 to 20 v peak, 350 to 450 p/s. Ext pulse modulation input: pos, 5 to 30 v, 1 to 10 us. wide pulse.
8A. Extender cable (2)	AMP, Inc. 830126-4	
8B. Extender cable tee (2)	AMP, Inc. 837692-1	

Test Equipment Required Sheet 3 of 3)
Figure 2-25

Section X. COMPONENTS LOCATION

Refer to figures 2-26 through 2-38 for location of components comprising Receiver-Transmitter RT-711A/APN-158.

NOTE

These figures are for component location only. They are not to be used for provisioning component parts.

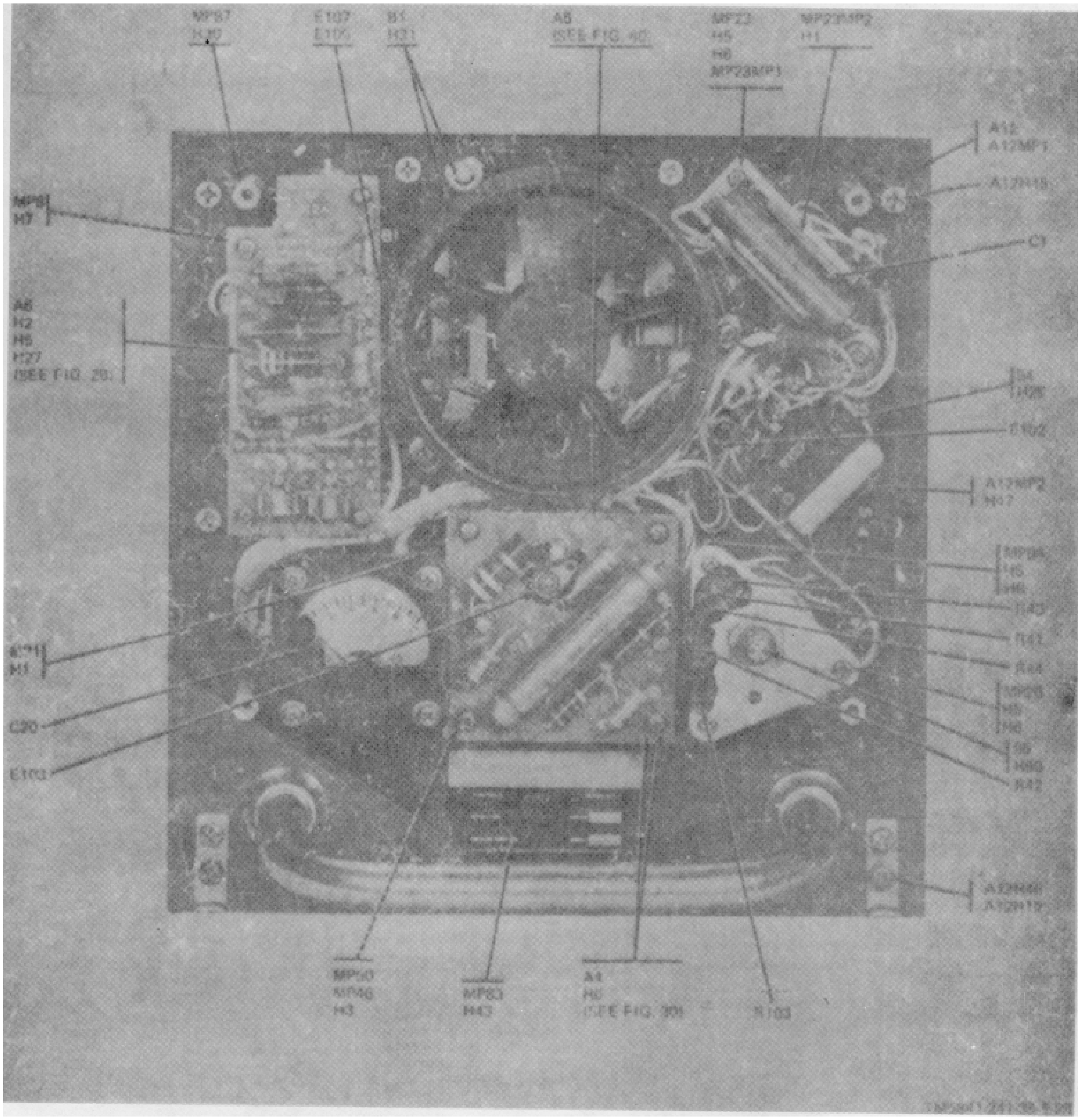


Figure 2-26. RT-711A/APN-158Receiver-Transmitter, Components Location (sheet 1 of 10).

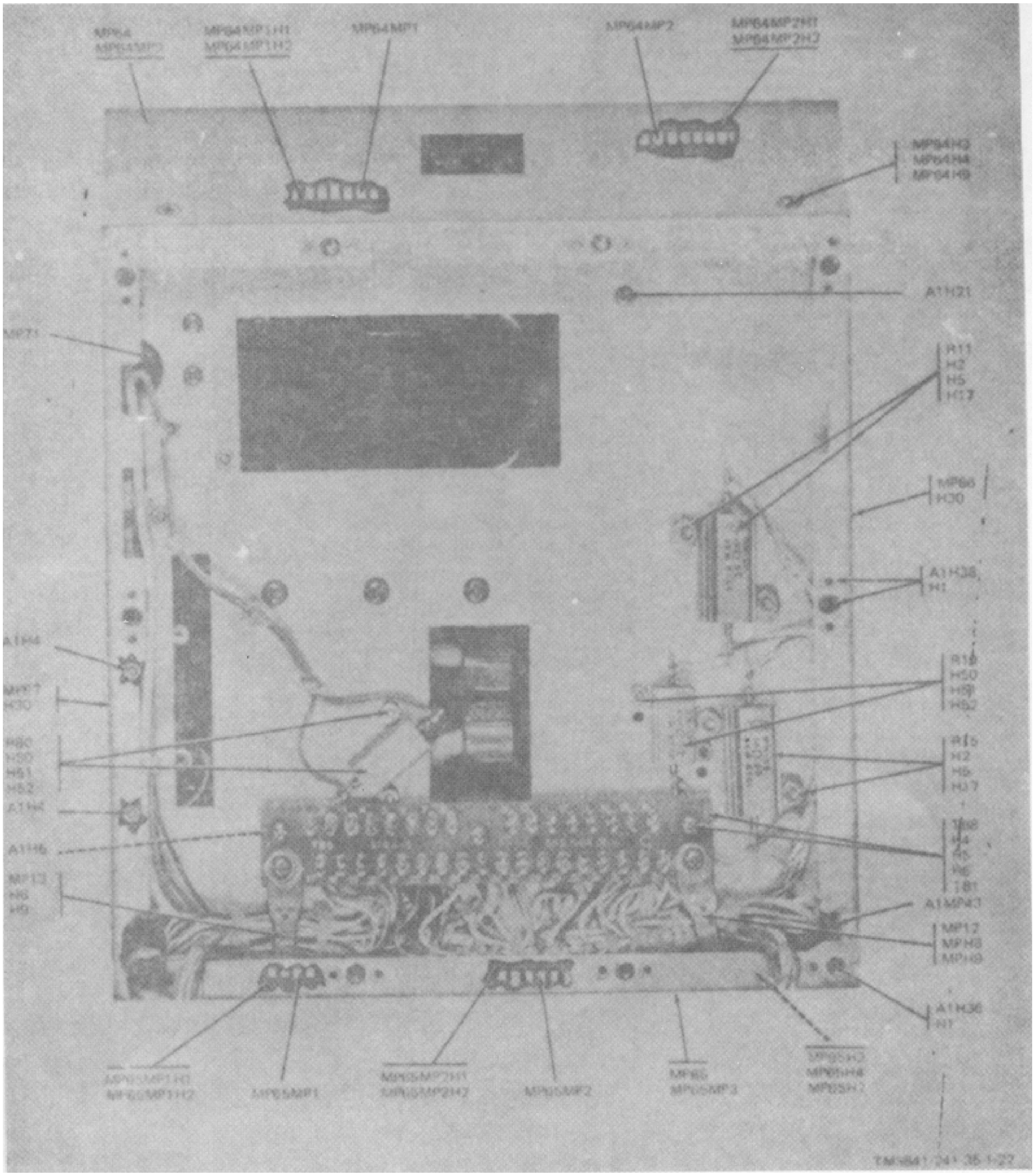


Figure 2-26. RT-711A/APN-158 Receiver- Transmitter, Components Location (sheet2 of 10).

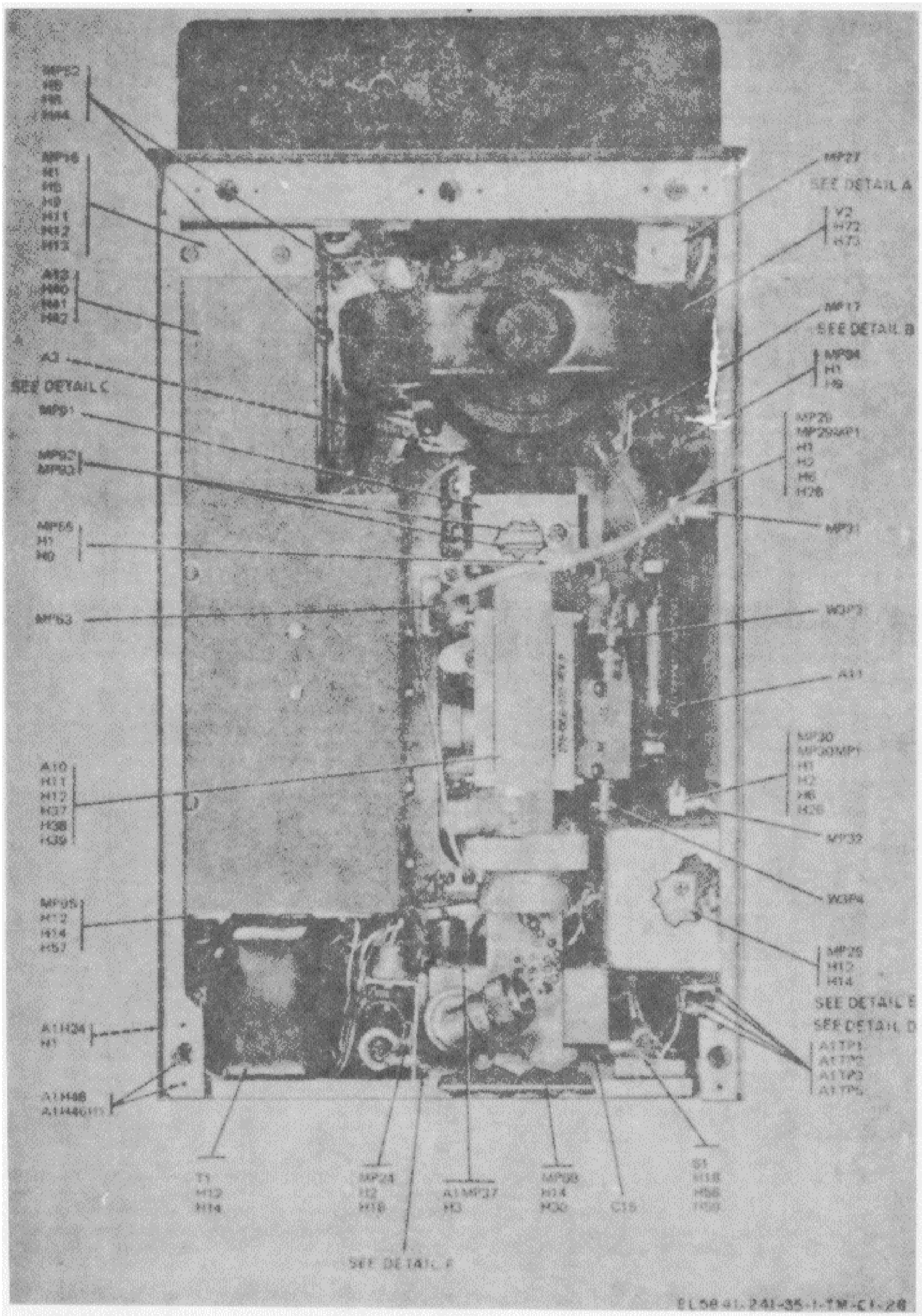


Figure 2-26. RT-711A/APN-158 Receiver-Transmitter, Components Location (sheet 3 of 10)

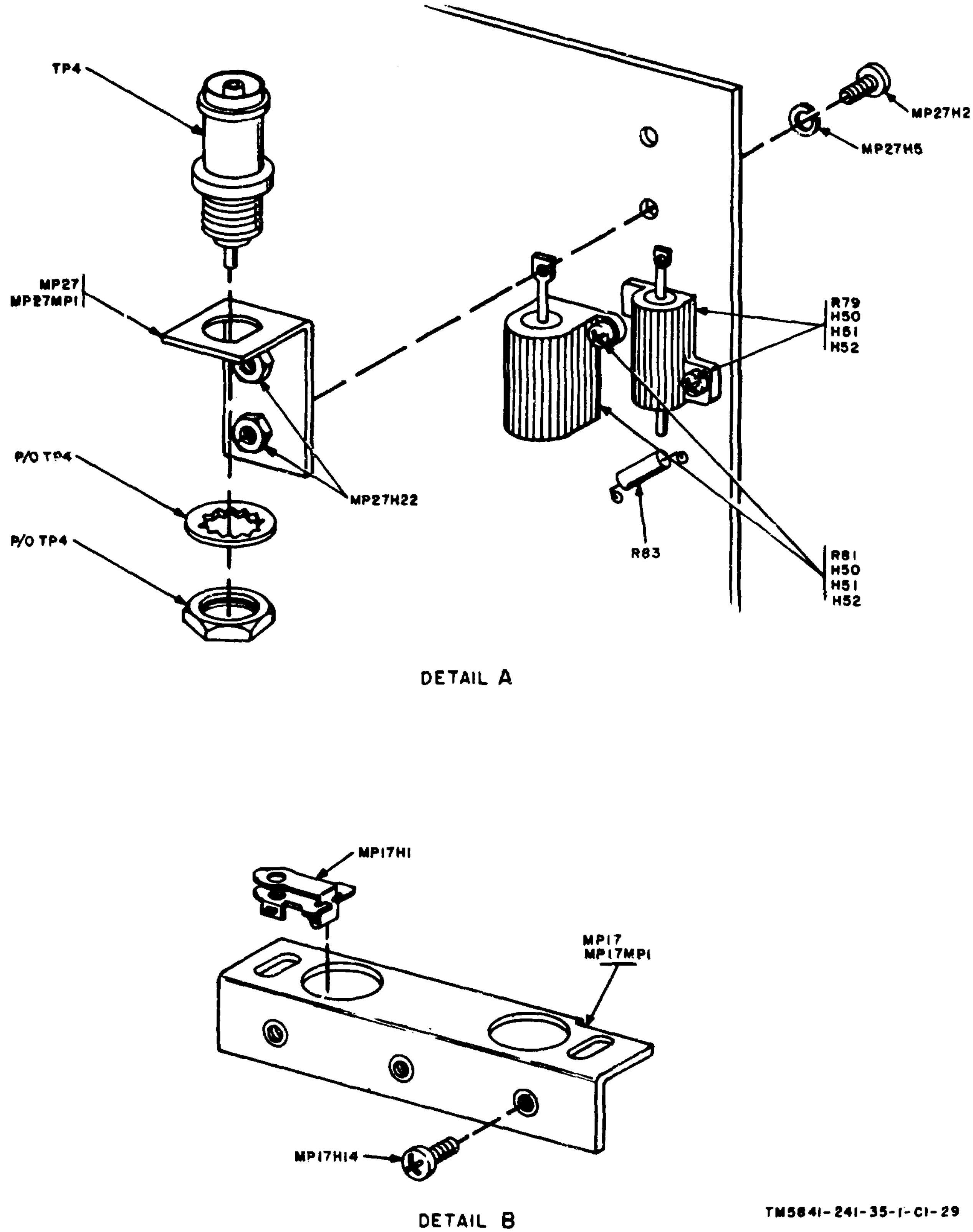
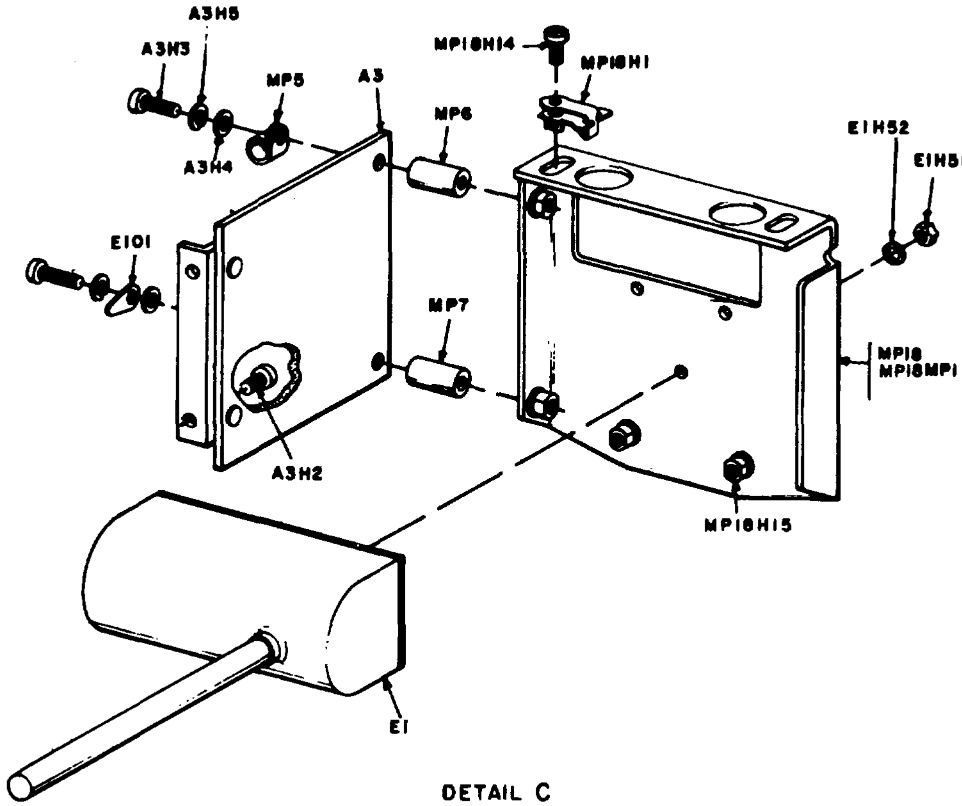


Figure 2-26. RT- 711A /APN-158 Receiver-Transmitter, Components Location (sheet 4 of 10).



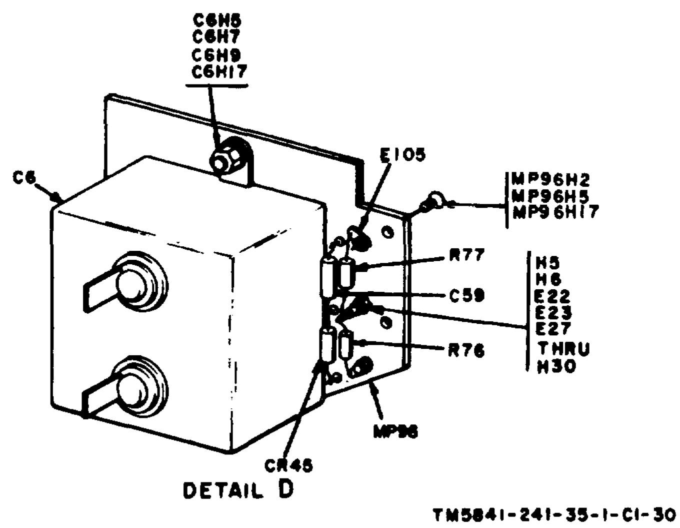


Figure 2-26. RT-711A/APN-158 Receiver-Transmitter, Components Location (sheet 5 of 10)

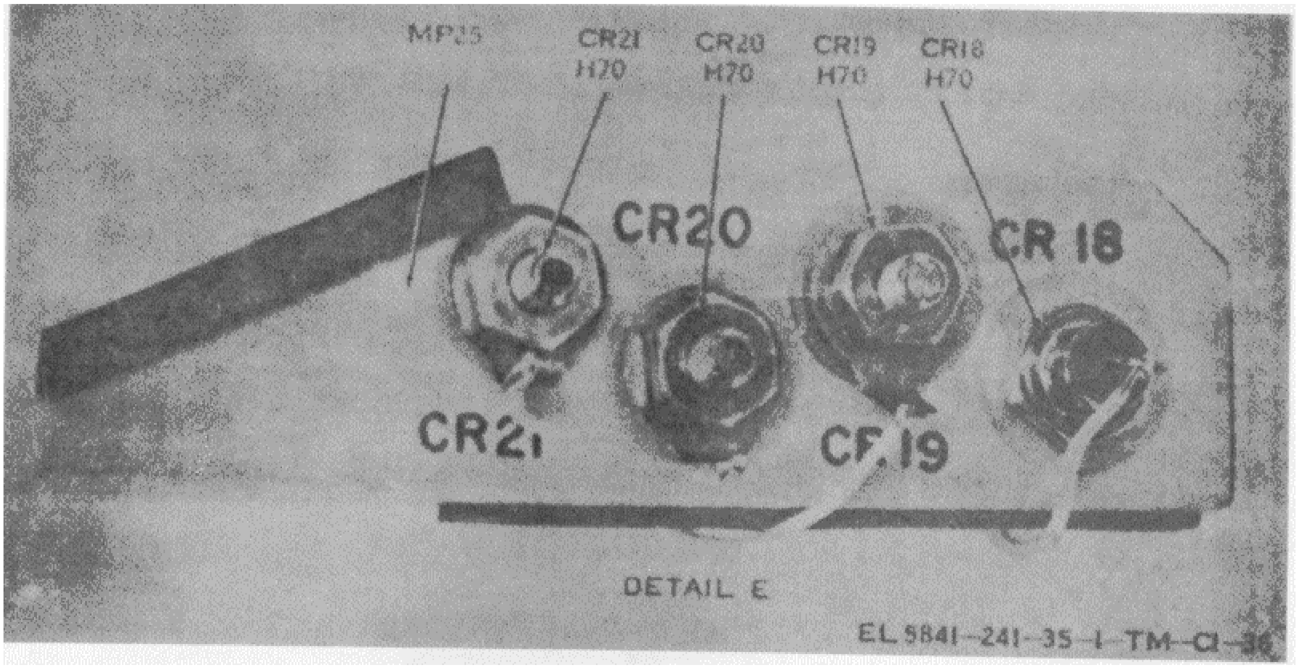


Figure 2-26. R T- 711A/APN-158 Receiver-Transmitter, Components Location (sheet 6 of 10).

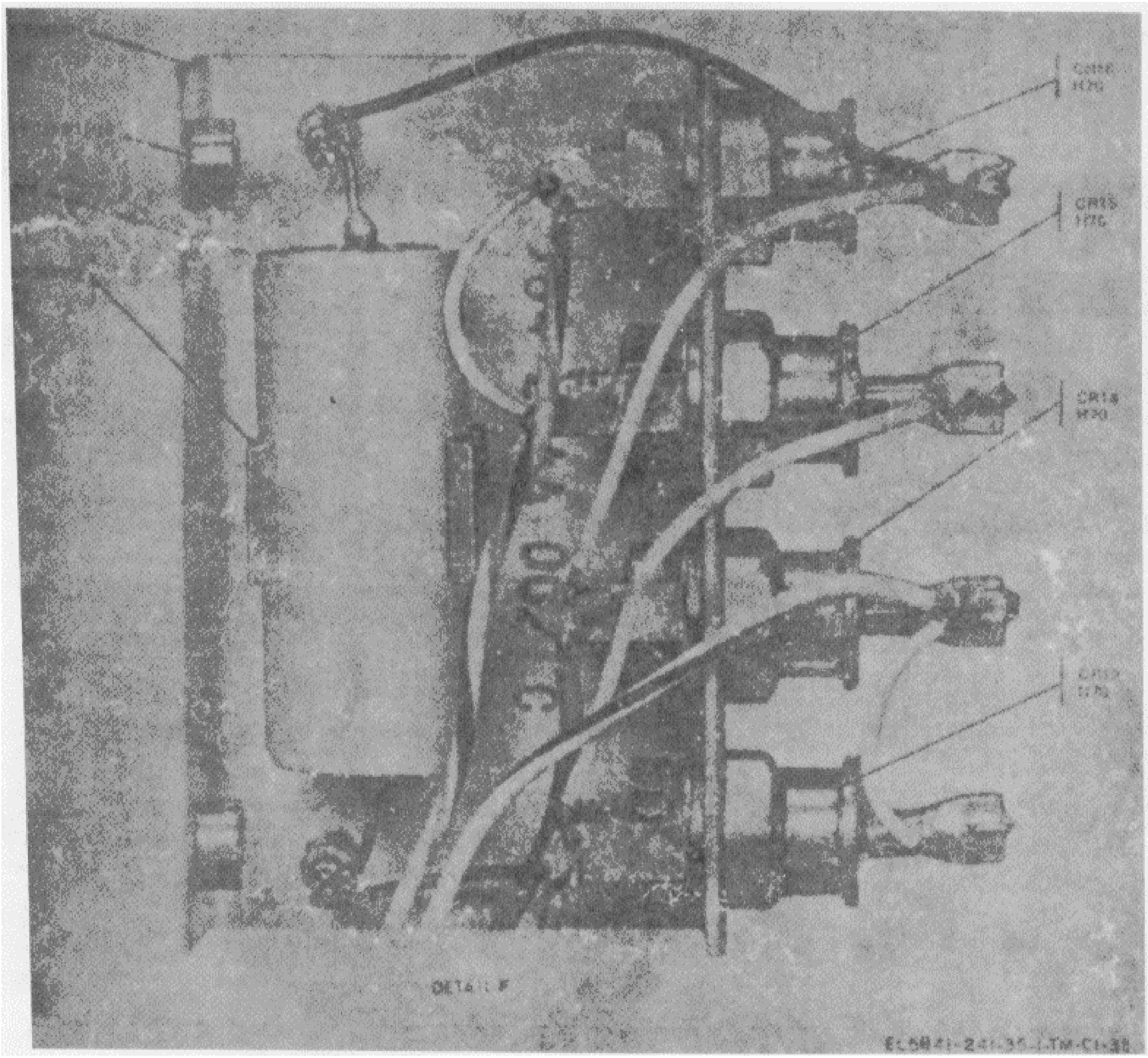


Figure 2-26. RT- 711A /APN-158 Receiver-Transmitter, Components Location (sheet 7 of 10).

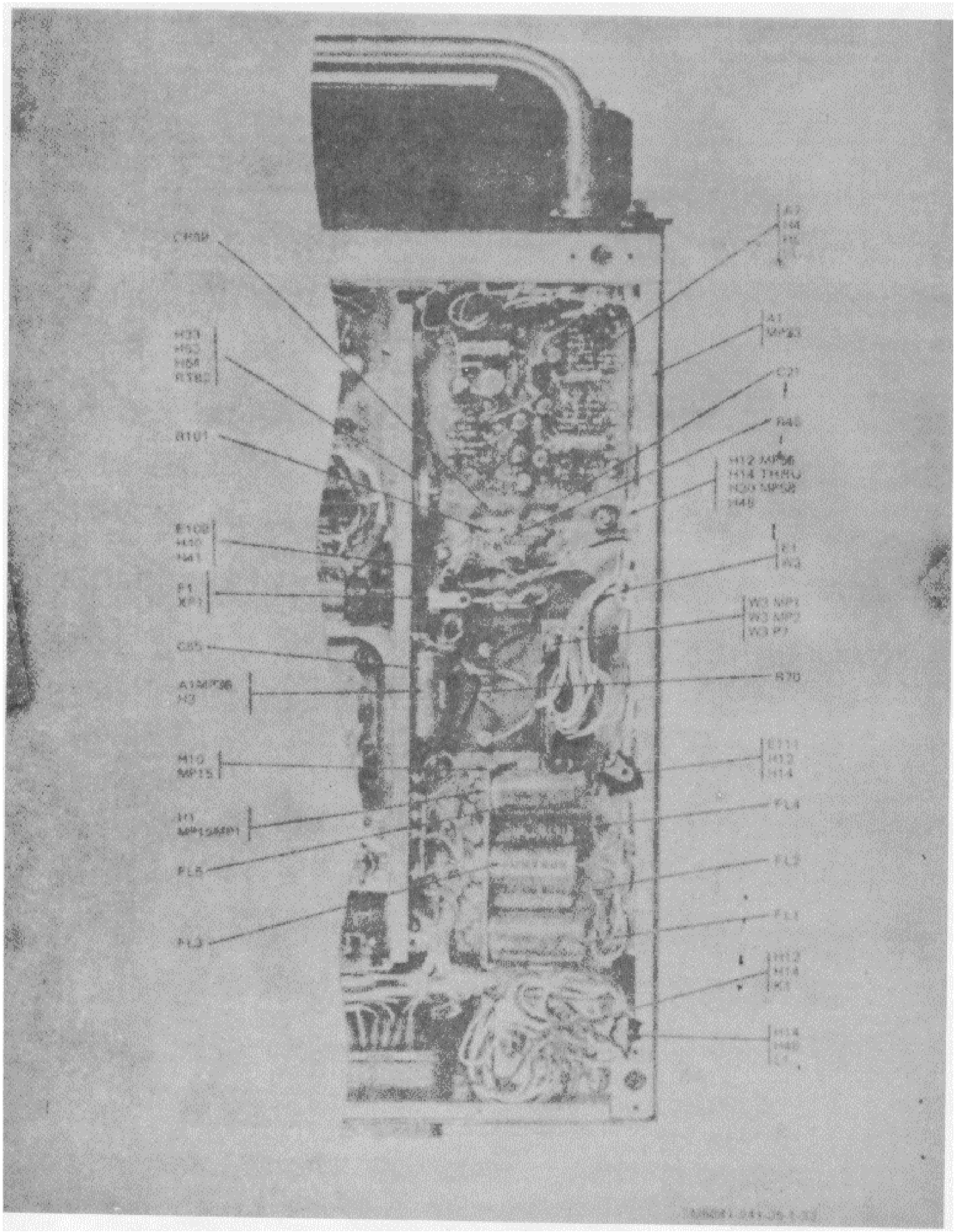


Figure 2-26. RT-711A/APN-158 Receiver-Transmitter, Components Location (sheet 8 of 10).

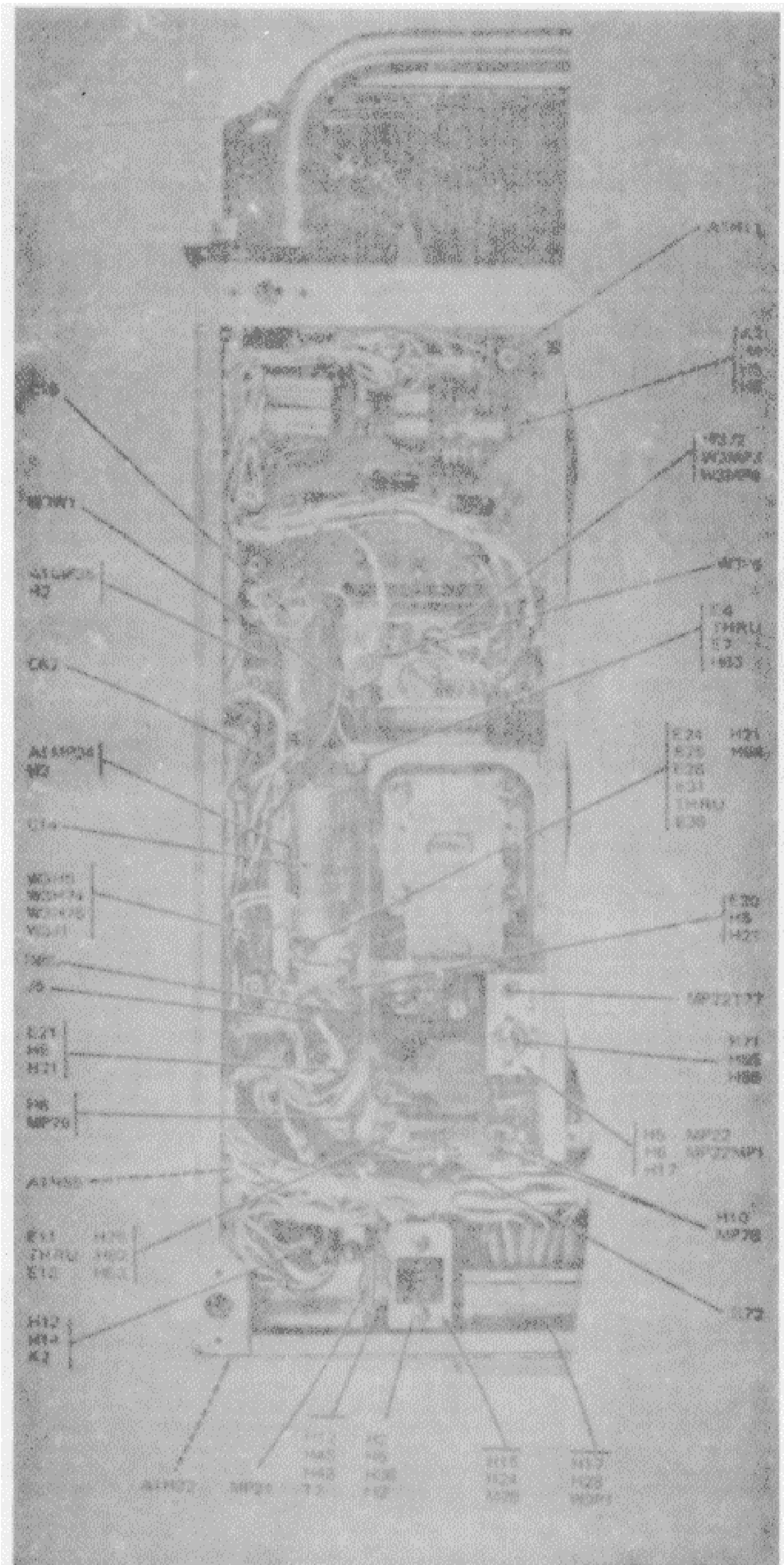


Figure 2-26. RT- 711A/APN-158 Receiver-Transmitter, Components Location (sheet 9 of 10).

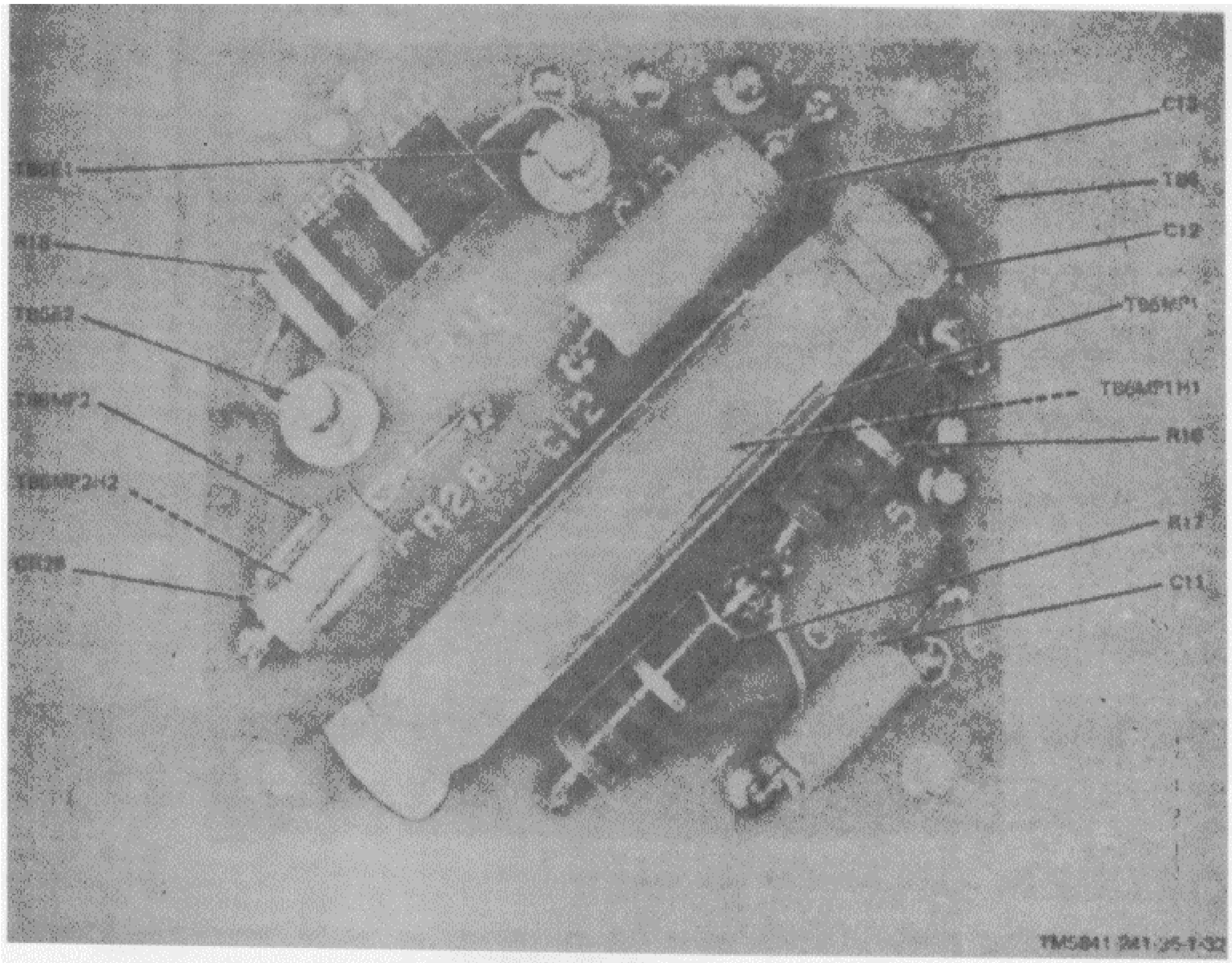


Figure 2-26. R T- 711A /APN-158 Receiver-Transmitter, Components Location (sheet 10 of 10 }

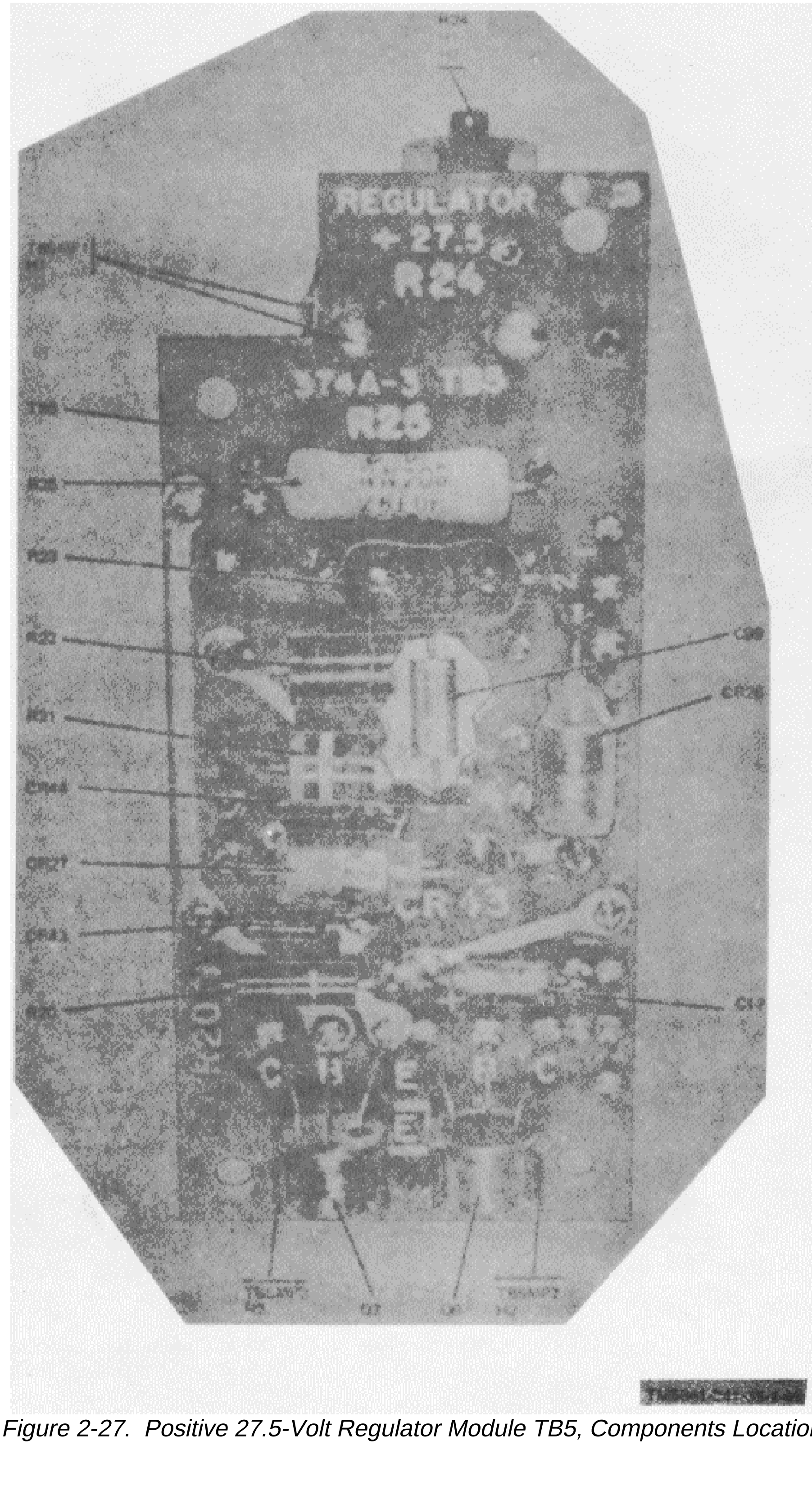


Figure 2-27. Positive 27.5-Volt Regulator Module TB5, Components Location.

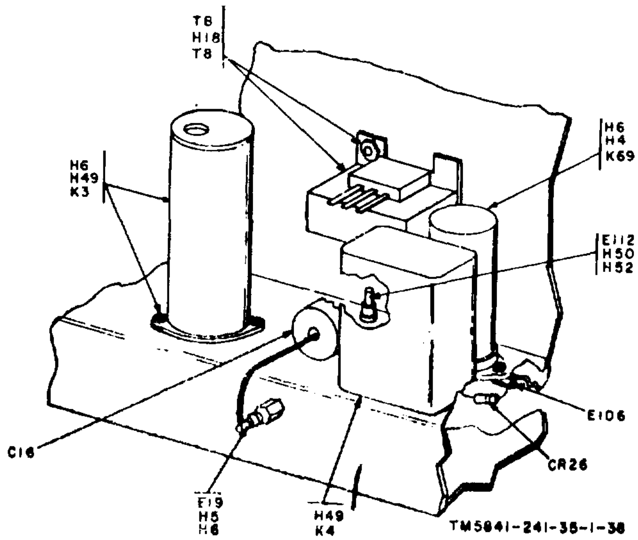


Figure 2-28. Negative 27.5- Volt Regulator Module TB6, Components Location.

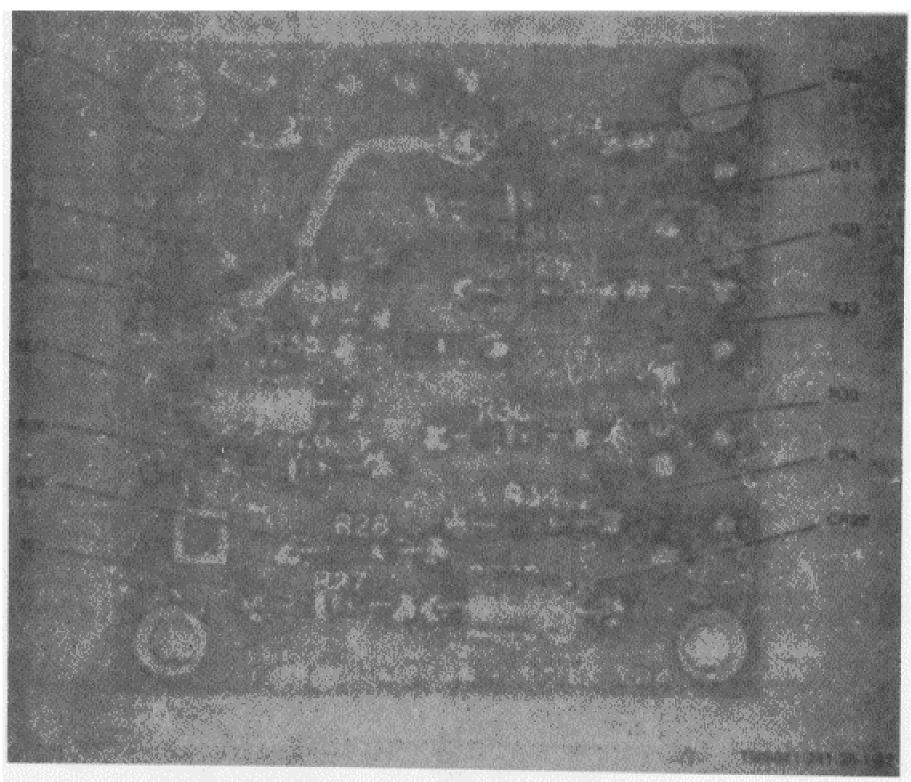


Figure 2-29. Meter Circuit Module TB4, Components Location.

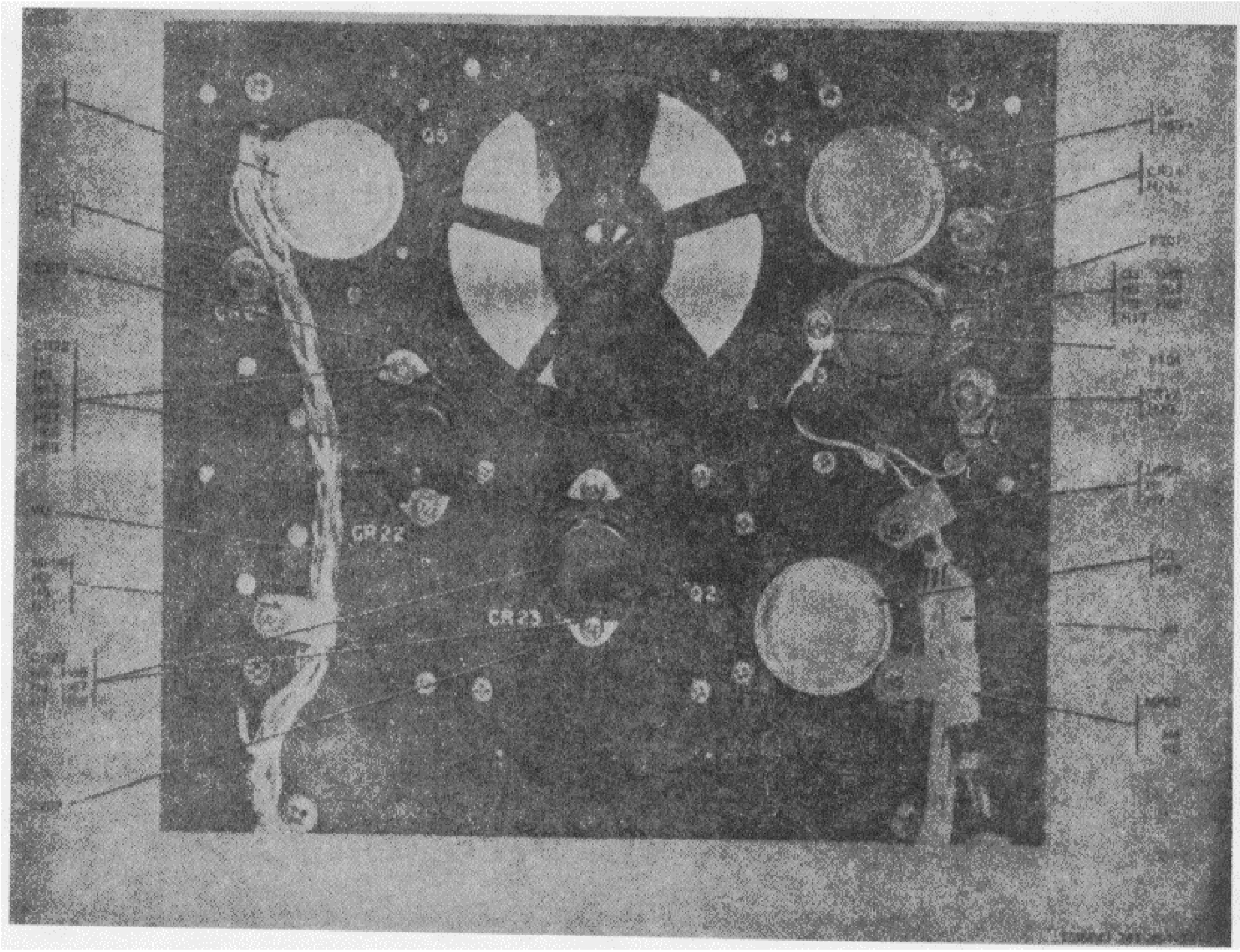


Figure 2-30. RT- 711A Receiver- Transmitter Front Panel Assembly, Component's Location

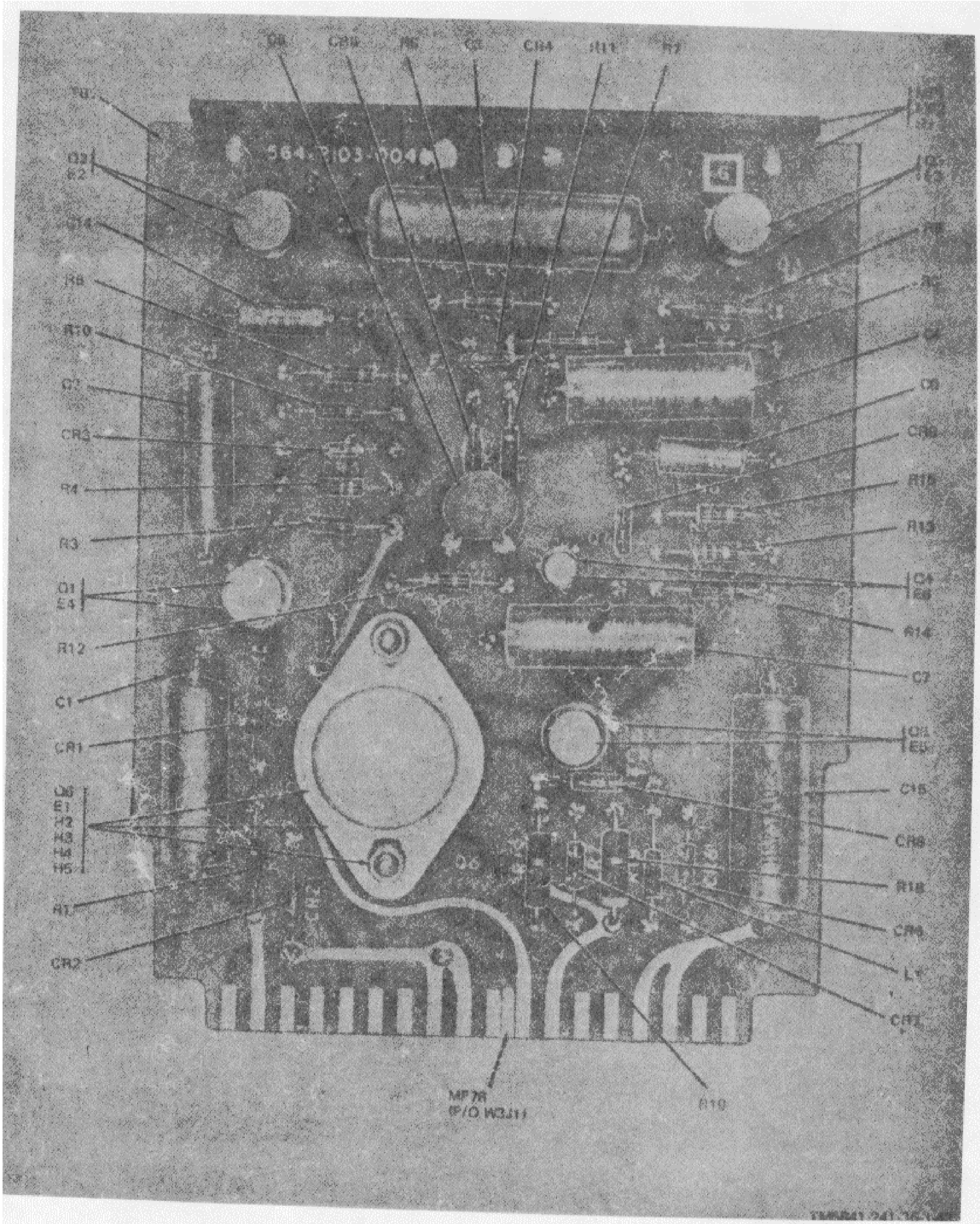


Figure 2-31. Trigger Generator Module, Components Location.

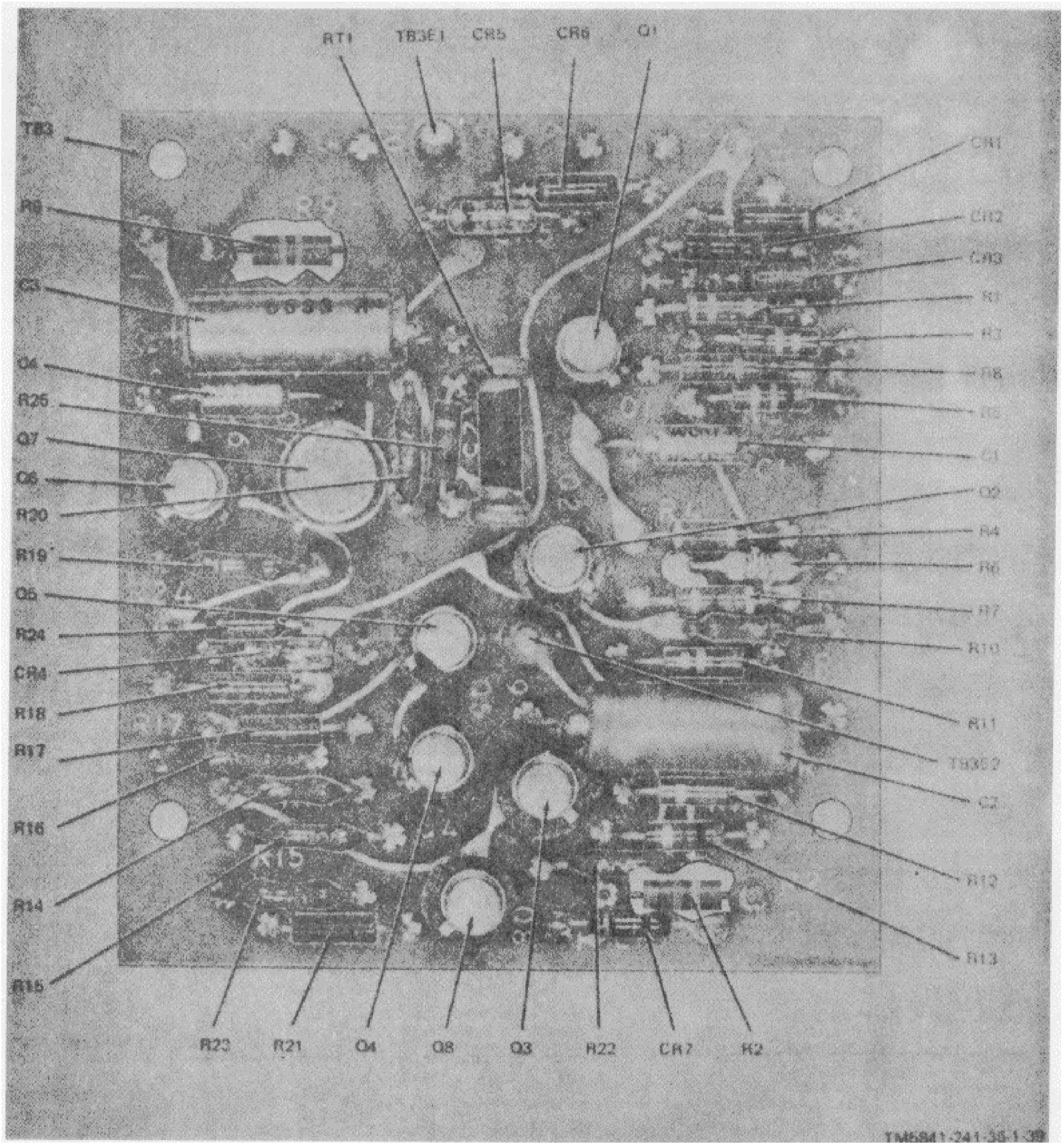


Figure 2-32. Fault-Sensing Module TB3, Components Location.

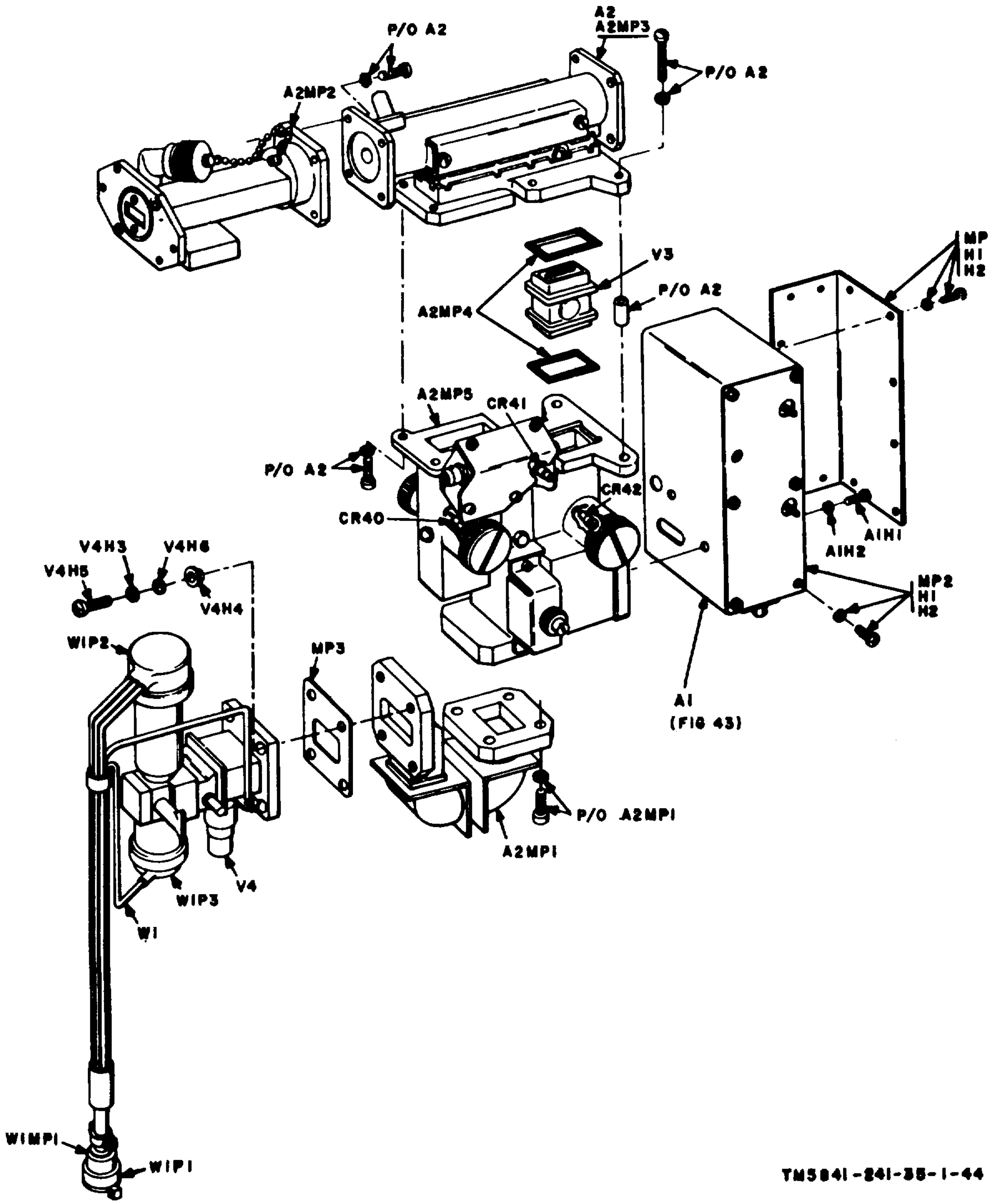


Figure 2-33. Mixer-Duplexer Module, Exploded View.

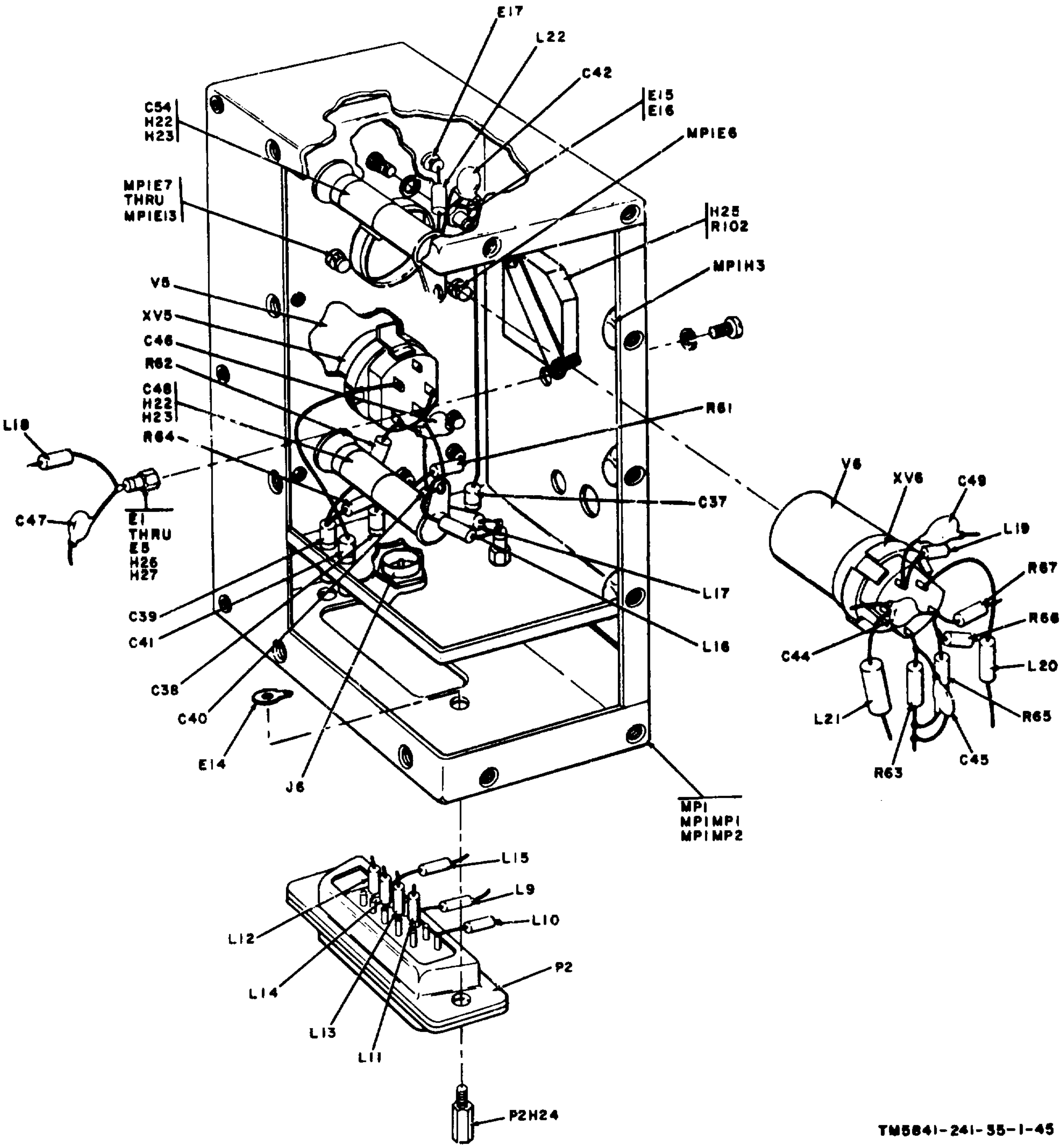


Figure 2-34. IF Preamplifier, Components Location.

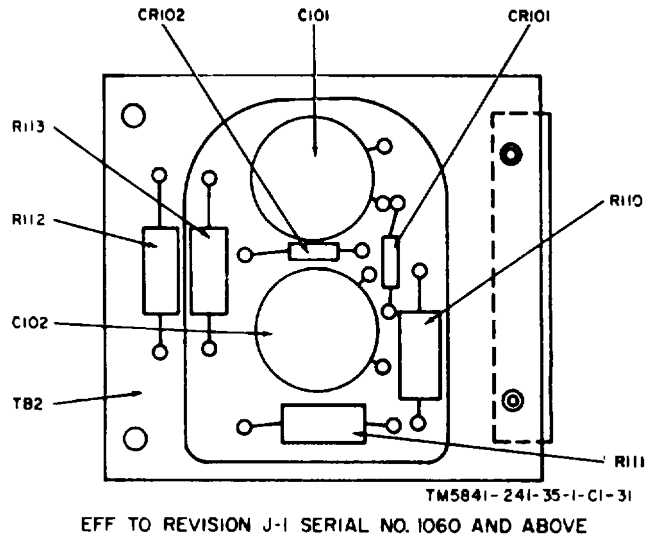


Figure 2-35. Keep-Alive Supply Module TB2, Components Location (sheet 1 of 2).

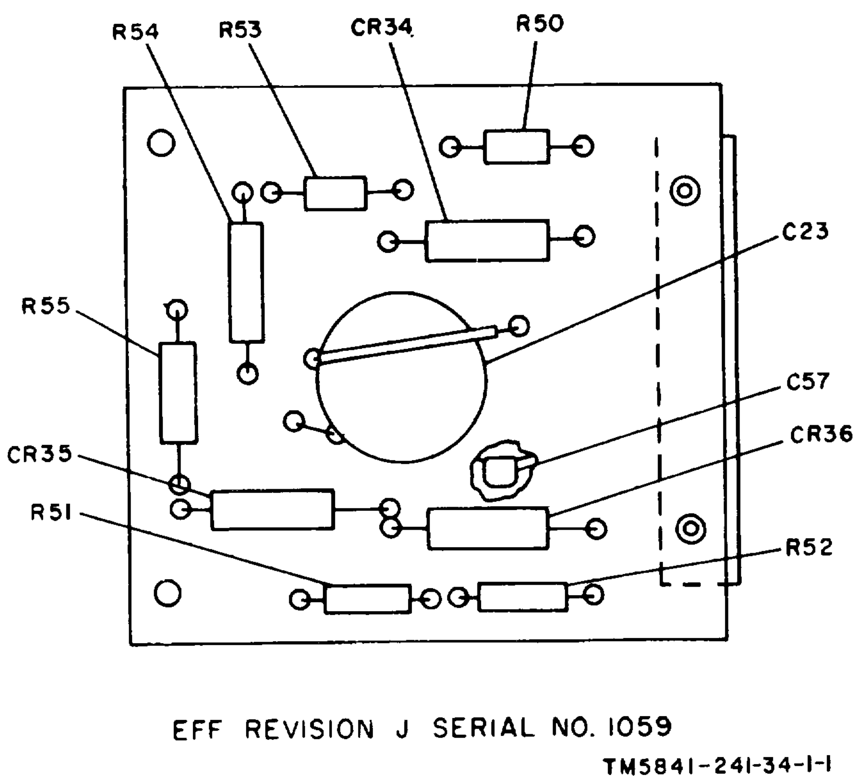


Figure 2-35. Keep-Alive Supply Module TB2, Components Location(sheet 2 of 2).

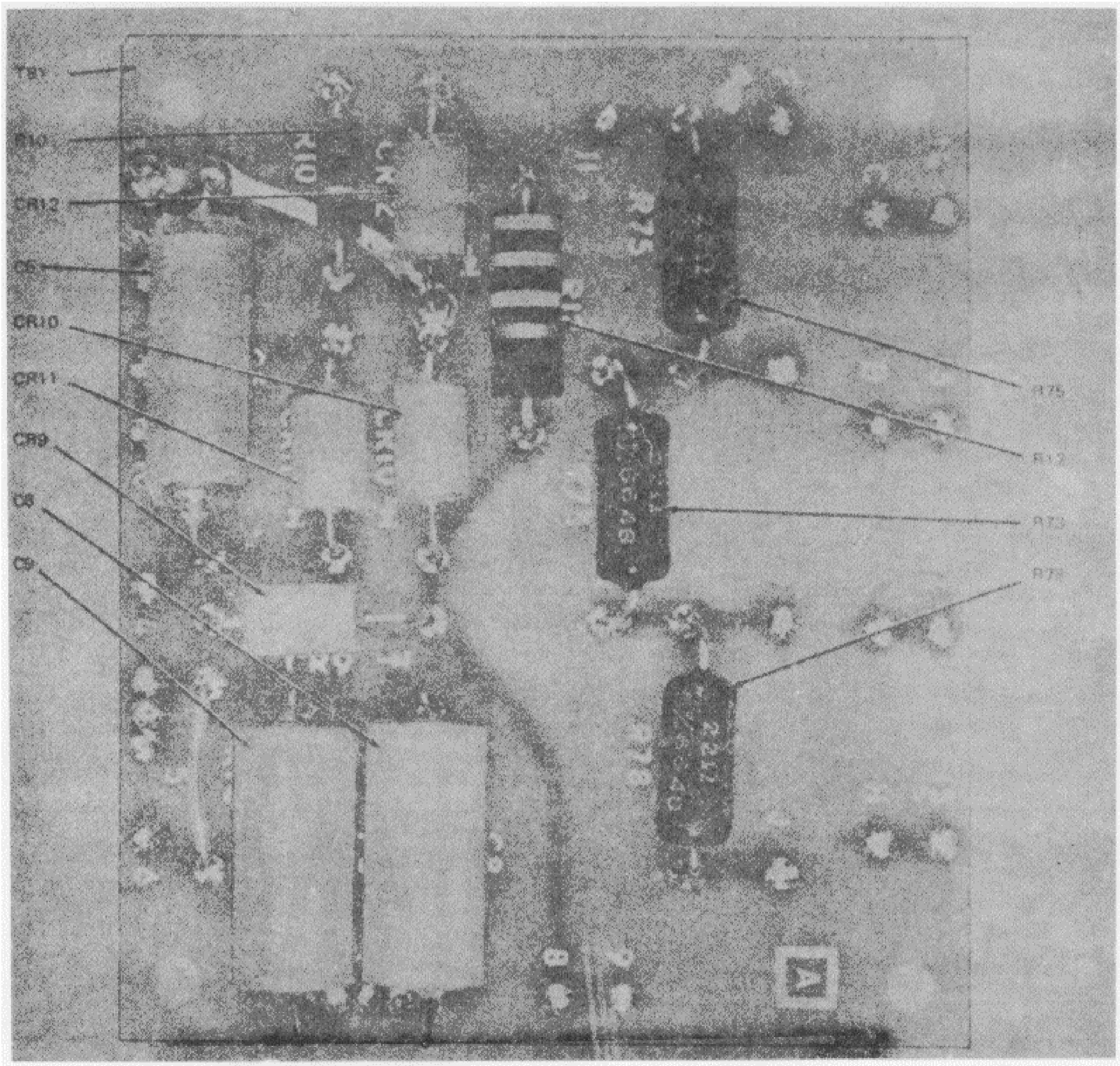


Figure 2-36. Positive 260- Volt Supply Module TB1, Components Location.

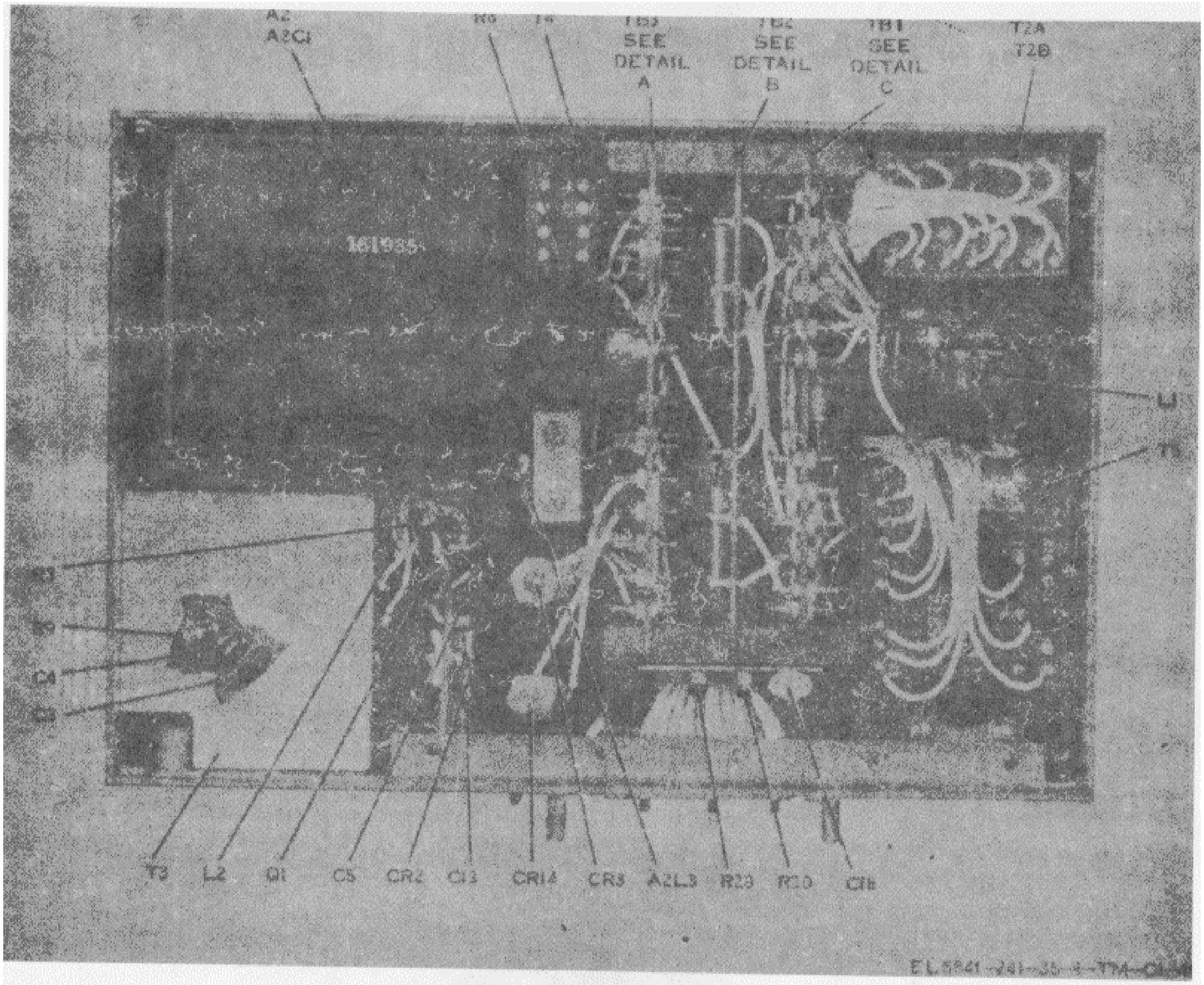


Figure 2-37. Modulator, Components Location(sheet 1 of 4).

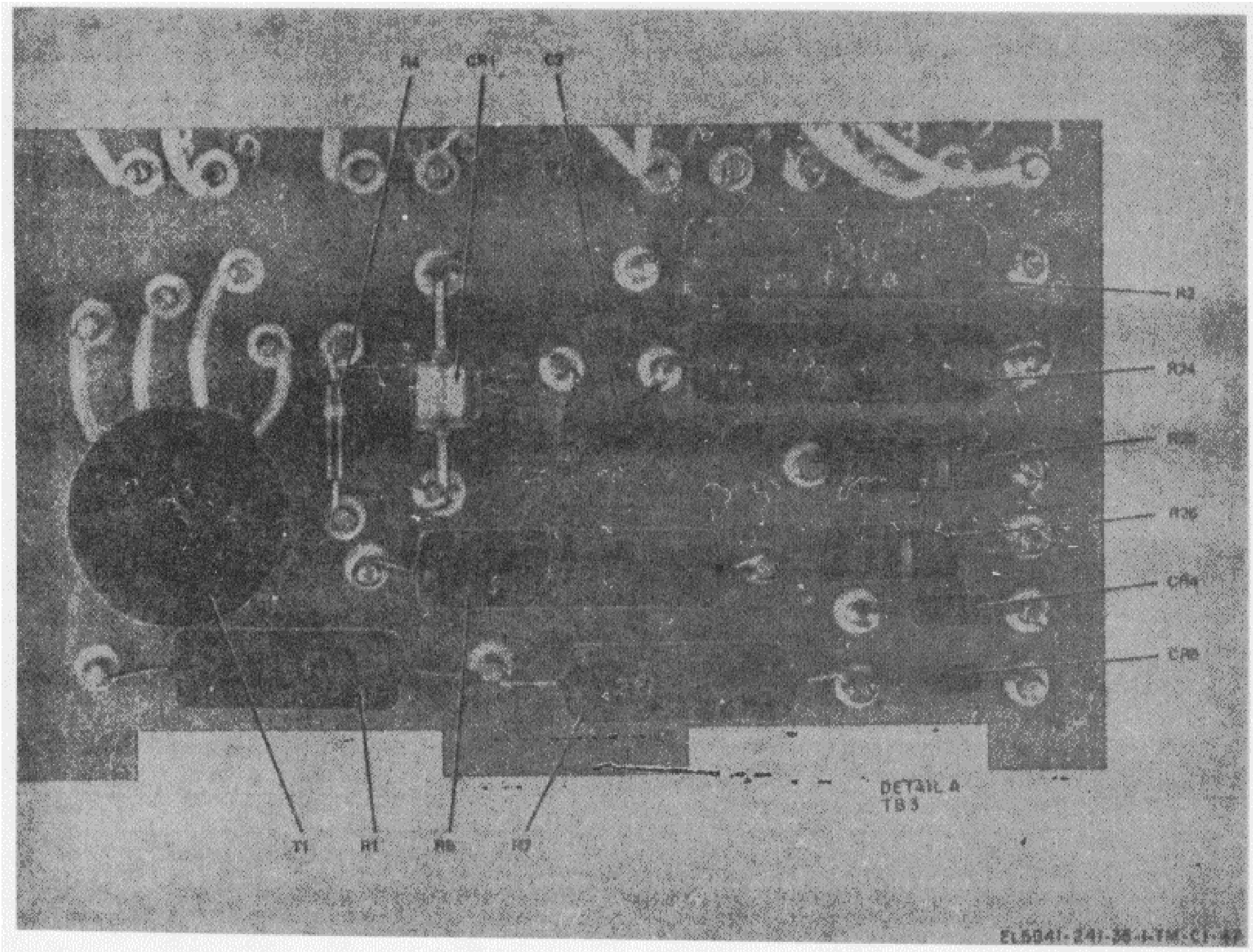


Figure 2-37. Modulator, Components Location(sheet 2 of 4).

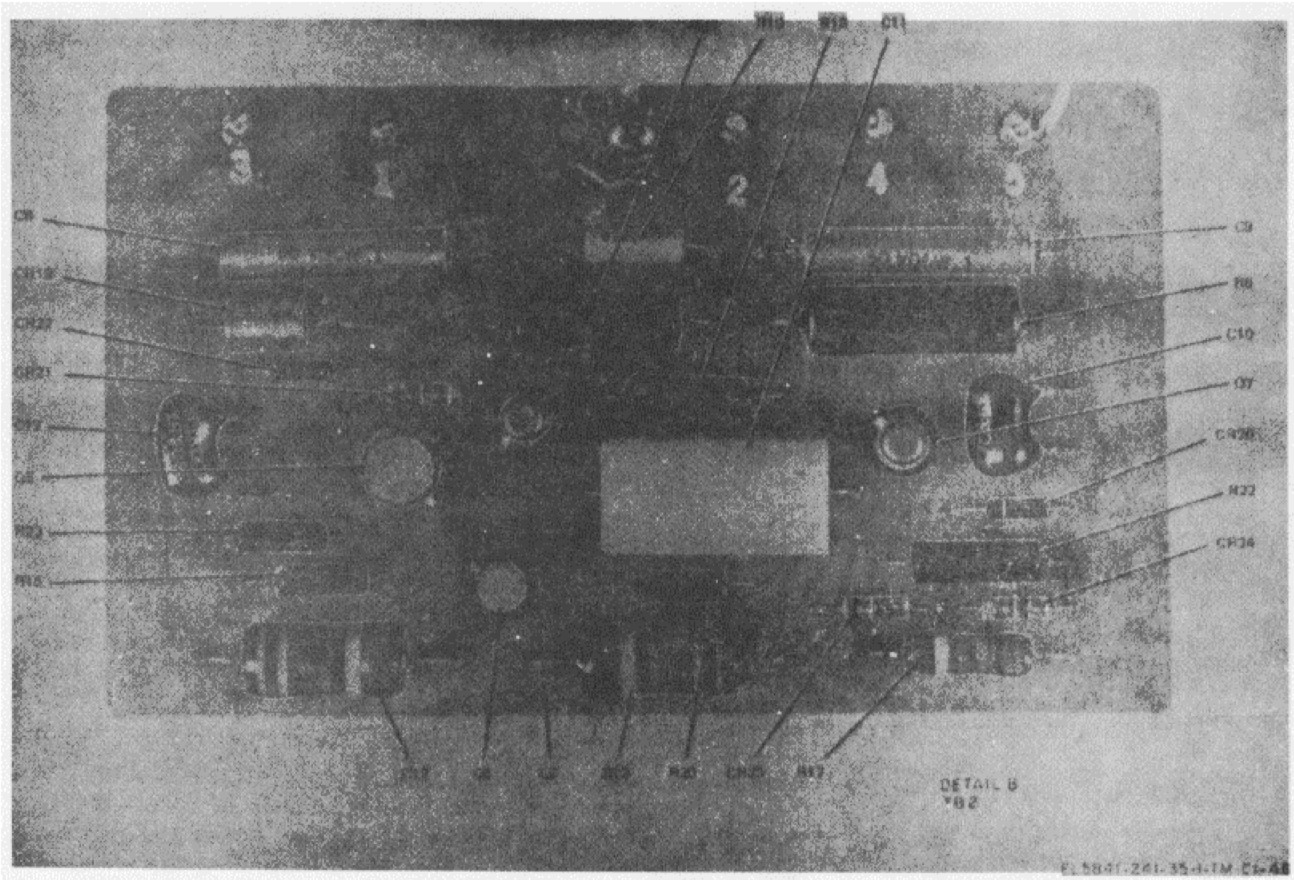


Figure 2-37. Modulator, Components Location(sheet 3 of 4).

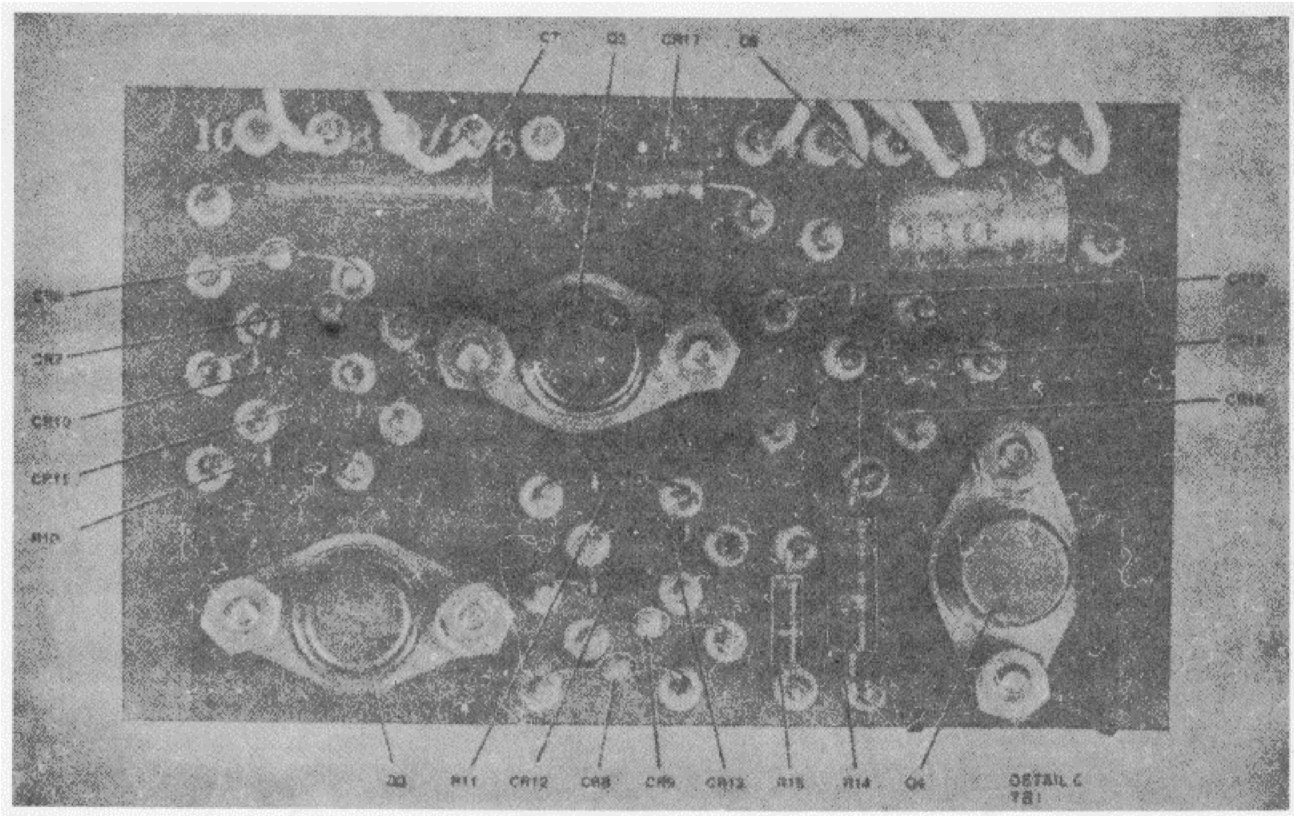


Figure 2-37. Modulator, Components Location (sheet 4 of 4).

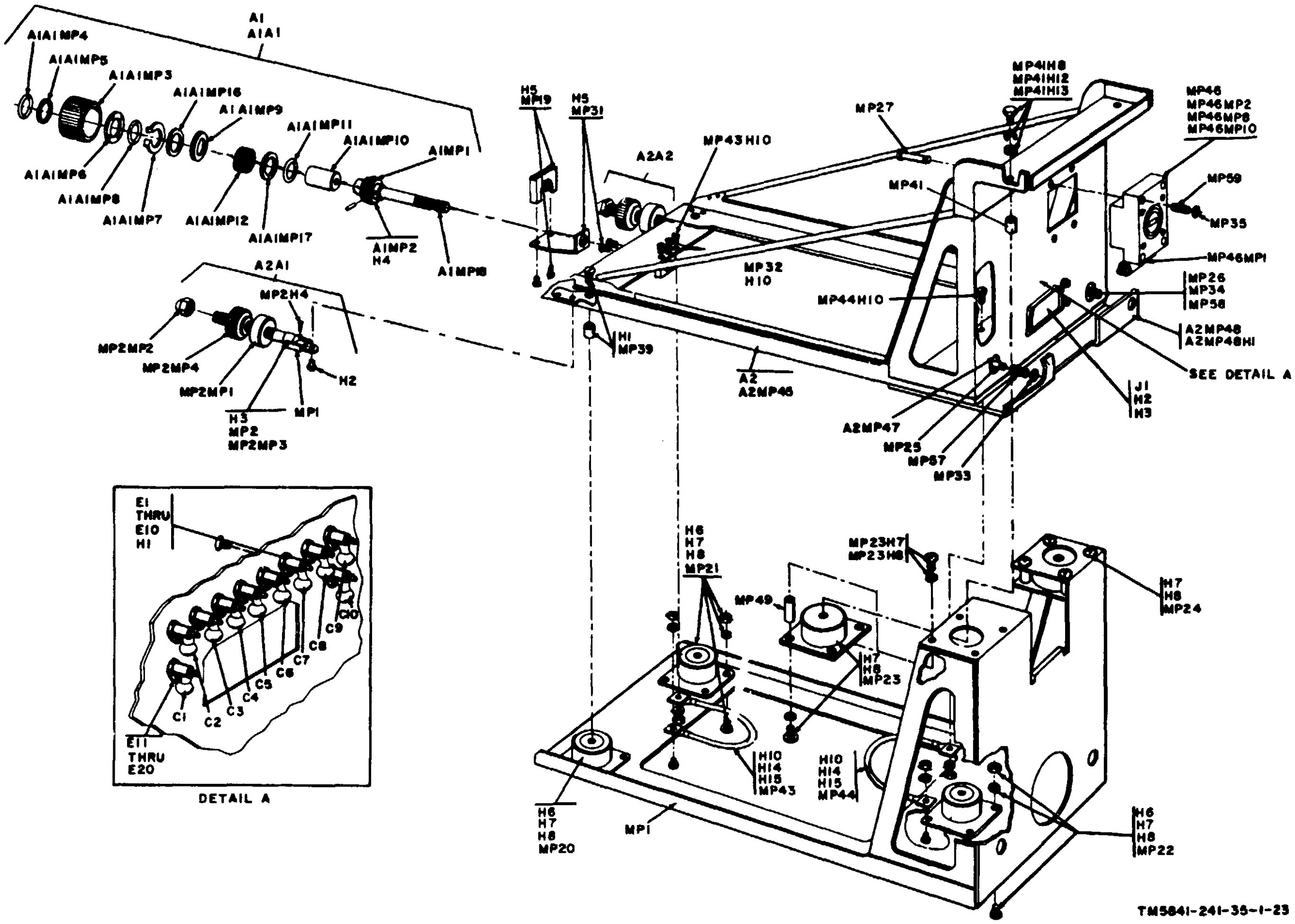
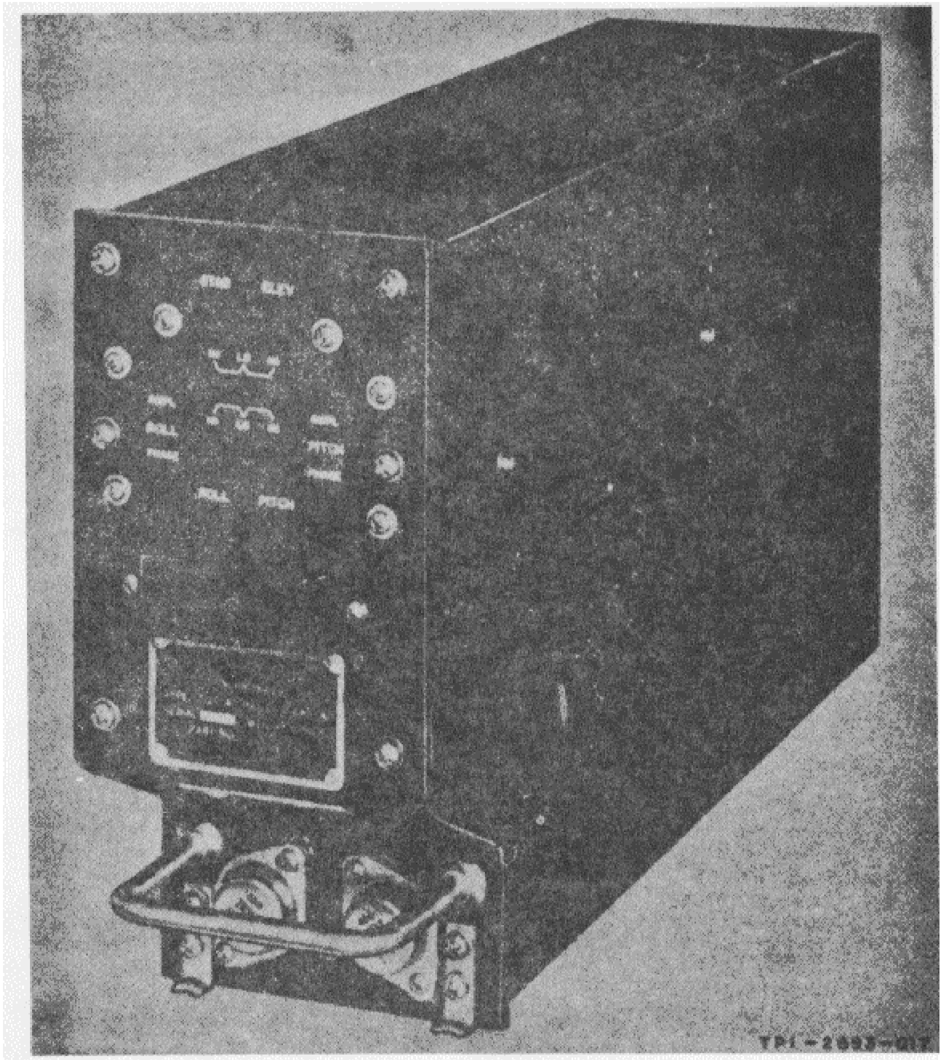


Figure 2-38. MT-306A/APN-t658 Shockmount. Components Location.

CHAPTER 3

SYNCHRONIZER, ELECTRICAL SN-358A/APN-158 (776C-4) AND

MOUNT, SYNCHRONIZER MT-3069/APN-158 (349B-4)



SN-358A/APN-158 Synchronizer
Figure 3-1

Section I. DESCRIPTION AND OPERATION

3-1. GENERAL.

This section presents the purpose of the equipment, equipment specifications, equipment description, and theory of operation of the equipment. Refer to figure 3-1 for an overall view of the equipment. Figure 3-2 is a table of equipment covered in this manual.

EQUIPMENT	DESCRIPTION	COLLINS PART NUMBER
SN-358A/APN-158	Synchronizer	777-1768-001
MT-3069/APN-158	Shockmount	522-6116-004

Equipment Covered
Figure 3-2

3-2. PURPOSE OF EQUIPMENT.

The SN-358A Synchronizer is part of the AN/APN-158A Radar Set. The synchronizer provides synchronization with the antenna azimuth and antenna stabilization circuits to prevent disruption of the target display by roll and pitch of the aircraft. It also generates range mark signals and provides if. signal amplification, video detection, video amplification with signal cancellation for contour presentation, and afc detection and amplification for control of the klystron. The unit supplies a sensitivity time control (stc) pulse to compensate for video amplitude variation with range of close targets. The MT-3069 Shockmount provides mounting facilities for the synchronizer unit.

3-3. EQUIPMENT SPECIFICATIONS.

The equipment specifications for the SN-358A Synchronizer and MT-3069 Shockmount are listed in figure 3-3.

3-4. EQUIPMENT DESCRIPTION.

A. Mechanical Description.

The SN-358A Synchronizer is housed in a 3/8-ATR short case (14-11/16 inches long, 7-3/4 inches high, and 3-11/16 inches wide) and is mounted in the MT-3069 Shockmount. A-1-piece dust cover encloses the synchronizer. Ventilating holes in the dust cover provide for convection cooling.

CHARACTERISTIC	SPECIFICATION
SN-358A Synchronizer	
Weight	10.0 :0.1 pounds (4.54 kg).
Physical dimensions (3/8-ATR short case)	14-11/16 inches (37.5 cm) long, 7-3/4 inches (19.7 cm) high, 3-11/16 inches (9.36 cm) wide.
Power requirements (supplied by RT-711A/APN-158 Receiver-Transmitter)	109 to 121 v, 380 to 420 Hz at 4 watts, +27.5 v at 46 watts, -27.5 v at 13 watts. **NOTE: The 109- to 121-v source must be the same source that excites the gyro.**
Cooling	Convection.
Shock conditions	
Performance criteria	Eighteen 10-millisecond shocks at 7.5 g.
Safety criteria	Six 10-millisecond shocks at 15 g.
Vibration	0.030 total excursion at 10 to 55 Hz and 5.0 g peak acceleration at 55 to 500 Hz when mounted in the MT-3069 Shockmount and 1.5 g peak when mounted solid.
Mounting	MT-3069 Shockmount, Collins part number 522-6116-004.
Duty cycle	Continuous, remote control, airborne operation.
Temperature	
Continuous operation	-55 to +55 °C (-67 to +131 °F).
30-minute operation	-55 to +71 °C (-67 to +160 °F).
Relative humidity	100% at +50 °C (+122 °F).
Altitude	Category A.

Equipment Specifications (Sheet 1 of 2)
Figure 3-3

CHARACTERISTIC	SPECIFICATION
MT-3069 Shockmount	
Weight	1.7 pounds (0.77 kg).
Physical dimensions	17-3/16 inches (44.1 cm) long, 9-1/8 inches (23 cm) high, 4-39/64 inches (11.6 cm) wide.

Equipment Specifications (Sheet 2 of 2)
Figure 3-3

The chassis frame is of box construction and provides mounting facilities for the eight plug-in modules in addition to the other electrical circuits that are chassis mounted. Two transistors are mounted on the outside of the front panel. These transistors are used in conjunction with the elevator servo amplifier to drive the antenna tilt motor. A group of control potentiometers and test points are located on a bracket mounted on the rear of the front panel. Access is provided through holes in the front panel. A sliding hatch covers the access holes when the equipment is in operation. An additional group of test points is located on the upper rear section of the chassis frame. The larger transformers and circuit elements are located on the lower right side of the chassis frame.

B. <u>Electrical Description</u>.

All electrical connections are made to the SN/358A Synchronizer through a connector, type DPX2-B16C3P40P-34A-1073, Collins part number 370-2161-00, located on the rear of the unit. The unit contains eight plug-in type modules and chassis circuits.

Each of the plug-in modules is described in the following paragraphs.

(1) IF. Amplifier Module 3A6.

The if. amplifier module is approximately twice as large as the smaller modules (physically) and contains two sections: an if. section and an afc discriminator section. The if. section consists of six amplifier stages with transformer coupling and two video stages. The afc discriminator section consists of an input limiter-amplifier stage, a frequency discriminator circuit, and a feedback amplifier output stage. The discriminator output is supplied to the afc module. The video output is supplied to the video driver module. The bias voltage in both the if. and afc sections is +15 volts dc.

(2) Video Driver Module 3A11.

The video driver module consists of several amplifiers, a trigger circuit, a canceling circuit, a mixer-adder circuit, and a gain control circuit. The output to the indicator unit is applied through an emitter-follower. The bias voltages are +27 and +15 volts dc. The trigger circuit and the canceling circuit are used in conjunction with the contour (CTR) mode of operation. One amplifier is used to compensate the display for the effects of stc action.

(3) Automatic Frequency Control (AFC) Module 3A10.

The afc module consists of a level detector, an integrator/sweep generator, and a dc-to-dc converter. The level detector consists of a pair of diodes which sample the discriminator pulse output and establish the- operating level of the module. The integrator/sweep generator consists of a feedback amplifier followed by a cascaded amplifier circuit. The dc-to-dc converter is a push-pull, square-wave oscillator transformer coupled to a voltage doubling output circuit.

The bias voltage used is +15 volts de. The input signal is generated in the afc discriminator section of the if. amplifier module. The output signal is used to control the operation of the klystron in the RT-711A/APN-158 Receiver/Transmitter unit.

(4) Isolation Amplifier Module 3A4.

The isolation amplifier module consists of two identical amplifier channels with stable gain and phase characteristics. The bias voltage used by both channels is +27.5 volts de. The input signals are generated in the aircraft gyro and transformer coupled through a phase-shift network to the isolation amplifier module. The output signals are used in the antenna stabilization network.

(5) Elevation Servo-Amplifier Module 3A3.

The elevation servo-amplifier module consists of a phase-shift/filter network, three amplifier stages, a limiting network, and an output stage. The output stage is a double transistor driver stage. The bias voltages used are +15 and +27.5 volts.

The three input signals to the above modules are stabilization, manual elevation, and rate signals. These signals are combined in the first amplifier stage.

The output signal provided by the elevation servo-amplifier module drives a push- pull amplifier circuit mounted on the SN-358A Synchronizer front panel. The output of this amplifier circuit is applied to the antenna tilt motor, with a portion of this signal returned to pins V and U of the elevation servo amplifier to stabilize the servo system.

(6) Gate Generator Module 3A2.

The gate generator module consists of a bistable multivibrator circuit, a differentiating circuit, four amplifier stages, a Schmitt trigger circuit, and two relays. The Schmitt trigger and one amplifier reset the multivibrator circuit which is set by the trigger input signal. The relay circuits, controlled by the IP-724A/APN-158 or 493A-4 Indicator RANGE switch, control the operation of another amplifier that provides the input to the Schmitt trigger circuit. The two remaining amplifiers provide the two output signals from the gate generator module. The sensitivity time control (stc) output, used in the if. preamplifier, provides a constant video amplitude output with range of closing target and provides a dynamic correction to the peak noise level to the video amplifier. The gate output signal is used in the IP-724A/APN-158 or 493A-4 Indicator and in the sweep generator and amplifier module. The bias voltage used is +27.5 volts.

(7) Sweep Generator and Amplifier Module 3A7.

The sweep generator and amplifier module is' approximately twice as large as the smaller plug-in modules and uses two connectors. A separate heat sink power amplifier chassis has a pendant connector that plugs into the module.

The sweep generator and amplifier module consists of one gate signal input amplifier followed by four similar sweep current generating channels. Each channel consists of one sweep cutoff transistor circuit and a relay selected charging network followed by three cascaded sweep amplifiers and a power amplifier.

The two relays that control the charging network are controlled by the RANGE switch on the IP-724A/APN-158 or 493A-4 Indicator. Two +27.5-volt sources, one through each connector, are used in the sweep generator and amplifier module.

A +15-volt source is used to base bias the gate input amplifier and the first sweep amplifier in each channel.

(8) Range Mark Generator Module 3A9.

The range mark generator module consists of two relays, a gate input amplifier, a Colpitts oscillator with tuned circuit, an emitter-follower circuit, a pair of cascaded amplifiers, and a blocking oscillator with transformer output.

The two relays control the switching in the tuned circuit. Bias voltage for the transistor circuits is +15 volts. The two relays are controlled by the RANGE switch on the IP-724A/APN-158 or 493A-4 Indicator. The output of the range mark generator module is applied to the video driver module.

(9) Chassis Mounted Circuits 3A1.

The chassis mounted circuits consist of circuit elements that are too large for convenient module mounting or require some form of heat dissipating mounting. This includes transformers, large power transistors, diodes, resistors, inductors, and capacitors.

Transistors Q1 and Q2 are mounted on the outside of equipment front panel. These transistors are part of the elevation amplifier and antenna tilt motor drive circuit. Bias voltage for this push-pull amplifier circuit is +27.5 volts. Thermistor RT1, mounted at the rear of the front panel, compensates for variations in temperature.

Test jacks J10 through J15 and variable resistors R5, R7, R8, and R10 are located to the rear of the front panel. Access to these components is provided through holes in the front panel. The variable resistors are used in conjunction with the antenna stabilization system. Two capacitors and two transformers are mounted on the rear of the chassis frame. The capacitors, C11 and C12, are filters for the +27.5-volt supply. The transformers, T2 and T3, are part of the isolation amplifier circuit.

Zener diode VR1 is part of the +15-volt supply and is located to the rear of the front panel.

Inductors L1 and L2 and capacitors C20, C21, and C22 form a filter network for the ac supply voltage to the phase detector networks.

The detector board assembly, 3A1A1, is mounted to and located in the lower right side of the chassis frame. This board contains four transistor circuits that generate the sweep excitation signals. The wired servo-phase board, 3A12, is mounted adjacent to the detector board assembly and contains five resistors and two capacitors. These elements are used with the antenna sweep resolver and antenna tilt drive motor circuits.

3-5. THEORY OF OPERATION.

A. General.

This section presents block diagram theory and a detailed circuit analysis of the SN-358A Synchronizer. The block diagram theory provides a general understanding of the basic operational characteristics and functional capabilities of the unit. The detailed circuit analysis provides a detailed description of each module and its associated circuitry. The use of the terms R/T, antenna, and indicator apply respectively to RT-711A/APN-158 Receiver/Transmitter, the AS-1520A/APN-158 or AS-1642A/APN-158 Antenna, and the IP-724A/APN-158 or 493A-4 Indicator.

B. Overall Block Diagram Theory. (Refer to figure 3-4.)

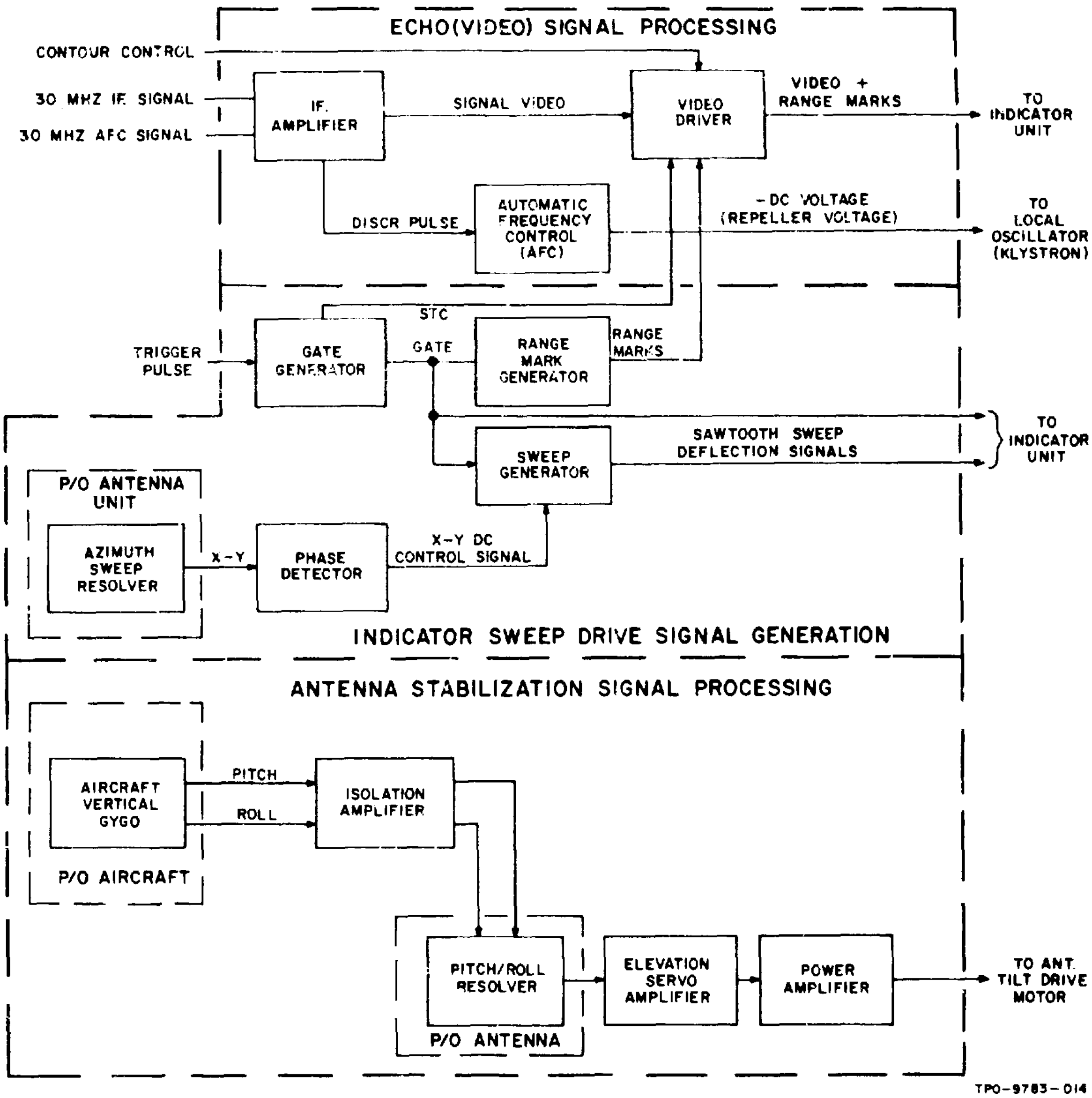
The overall block diagram theory is divided into three separate and distinct functions: echo (video) signal processing, indicator drive signal processing, and antenna stabilization signal processing.

(1) Echo (Video) Signal Processing.

The echo (video) signal processing section consists of an if. amplifier module, an afc module, and a video driver.

Two input signals from the R/T unit, 30-MHz if., and 30-MHz afc are applied into the unit to if. amplifier module 3A6. The if. amplifier section of the module amplifies and detects the 30-MHz signal and sends a processed video signal to the video driver module 3A11. The video driver module provides additional video gain and contour indication, adds correction for stc, mixes in range marks, and applies the video/range mark signal to the indicator for presentation of target.

The input 30-MHz afc signal from the R/T unit is applied to the discriminator section of the if. amplifier module for limiting, discrimination, and amplification. The discriminated pulse is then applied to the afc module for voltage conversion. The afc module converts the input pulse amplitude through a dc-to-dc converter



SN-358A Synchronizer, Overall Block Diagram
Figure 3-4

to a high negative voltage that is used in the R/T unit for frequency control of the klystron.

(2) Indicator Drive Signal Generation.

The indicator drive signal generation section consists of a gate generator module, a sweep generator module, and a range mark generator module. Other circuits associated with the section are contained in the R/T, antenna, and indicator units.

The gate generator module generates a gate that is used as a switching command by the sweep generator module and the range mark generator module. The gate is positive and is triggered by an input from the R/T unit for system synchronization.

The sweep generator receives the positive gate and generates four sawtooth waveforms that are used to drive the deflection coils in the indicator unit for sweep deflection. A phase detector in the chassis provides inputs which are a function of the angular position of the scanning antenna unit to determine the amplitude of the sawtooth waveform s.

The range mark generator module also receives the positive gate input from the gate generator and generates range marks of selectable range as determined by the RANGE switch setting on the indicator unit.

(3) Antenna Stabilization Signal Processing.

The antenna stabilization signal processing section consists of an isolation amplifier module, an elevation servo-amplifier module, and a pitch motor driver amplifier with associated circuits in the antenna unit. The aircraft vertical gyros supply the inputs to this section.

The isolation amplifier receives inputs from the pitch and roll vertical gyros. The inputs are applied into the synchronizer unit through isolation transformers. These signals are phase corrected and adjusted for current gain, amplified, and sent to the pitch/roll resolver in the antenna unit.

The pitch and roll resolver in the antenna unit computes the amount of stabilization required to properly position the elevation of the antenna as a function of the azimuth position of the antenna. The computed elevation stabilization signal is summed with the manual tilt signal of the control unit and applied to the elevation servo-amplifier module.

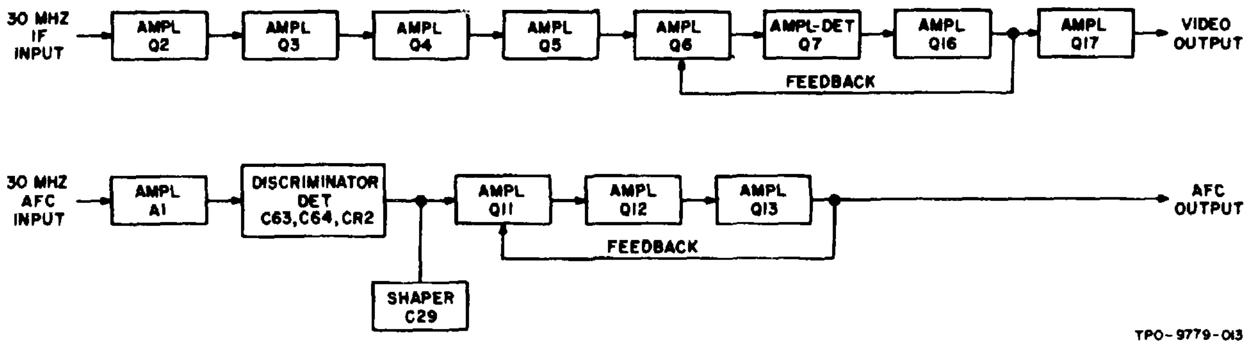
The elevation servo-amplifier module amplifies the stabilization signal and applies a level to drive the pitch motor driver power amplifier. The power amplifier provides power to drive the antenna tilt motor.

C. Detailed Block Diagram Theory.

(1) IF. Amplifier Module 3A6 (Refer to figure 3-5.)

The input signals to this module are received from the R/T unit. The 30-MHz if. signal from the if. preamplifier (R/T) is amplified and detected by the amplifier consisting of Q2 through Q7. Q16 amplifies and provides a feedback signal to the input of Q6 when the video amplitude exceeds a preset level. Q17 is the output amplifier. The output is applied to the video driver module.

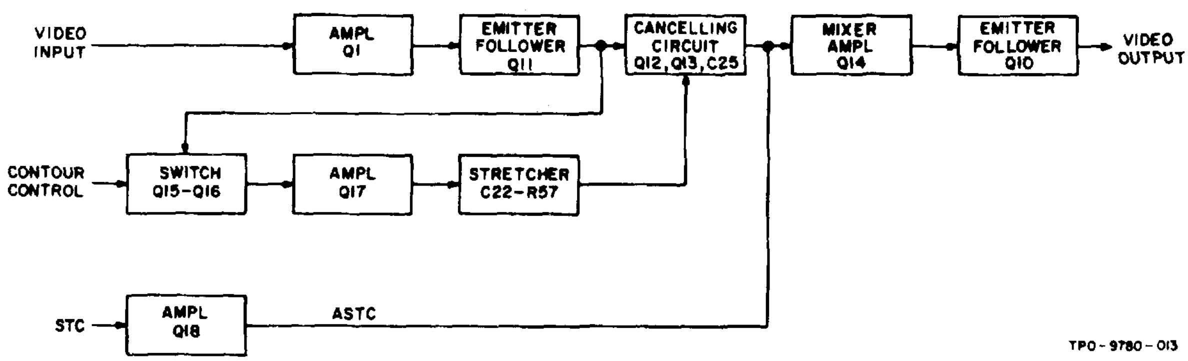
The afc signal input from the afc mixer (R/T) is limited and amplified by A1 and applied to the discriminator circuit. The output of the discriminator is applied to amplifier Q11. Feedback is provided by Q13 to the emitter of Q11. The output of Q13 is applied to the afc module.



IF. Amplifier Module, Block Diagram
Figure 3-5

(2) Video Driver Module 3A11. (Refer to figure 3-6.)

The input to the video driver consists of video from the if. amplifier, range. marks from the range mark generator, contour (CTR) if selected, and an stc signal. The video input is amplified by Q1 and coupled through Q11 to the canceling circuit consisting of Q12, Q13, and C25. With ground applied in the contour (CTR) mode of operation, the video signals above a predetermined value are canceled rather than amplified. The excess level video signals switch Q15 and Q16, which causes Q13 to cancel the signal. The output from the canceling circuit is applied to mixer-amplifier Q14 where range marks are mixed with the video. The video plus range marks output is applied across emitter-follower Q10. The video out signal is applied to the indicator unit.

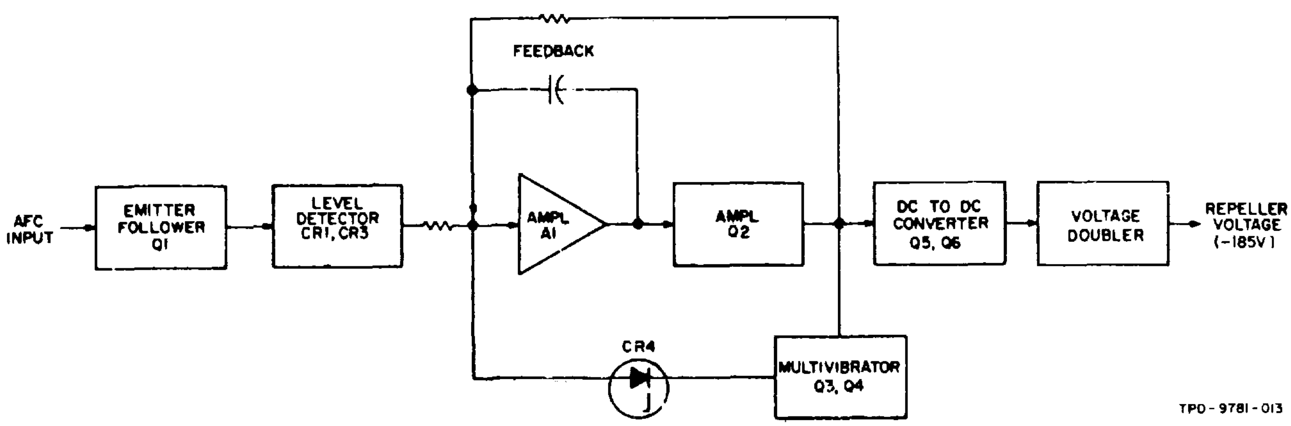


Video Driver Module, Block Diagram
Figure 3-6

An anti-stc (astc) input is provided to compensate for the effects of stc on the video output. The input is applied to Q18, amplified, and coupled to the base of Q14 where it is combined with the range marks and video.

(3) Automatic Frequency Control Module 3A10. (Refer to figure 3-7.) The input to this module is a negative waveform from the discriminator section of the if. amplifier module. The signal is applied across amplifier Q1 and level detector diodes CR1 and CR3. The detected signal is then applied to integrator-amplifier Al and capacitor C16. The amplified signal is then applied through the Darlington amplifier to the dc-to-dc converter circuit. The dc-to-dc converter provides a push-pull action with a transformer for a voltage doubling action of the signal.

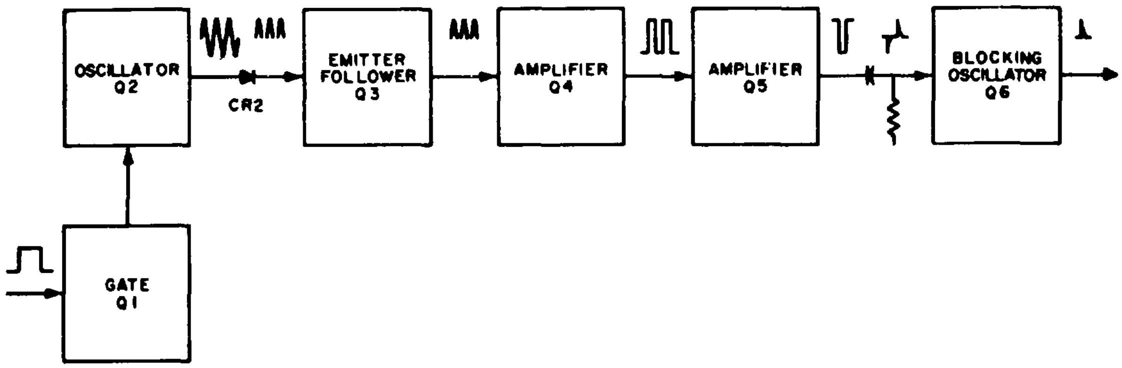
With no input to the module, output of Q2 will rise and causes the multivibrator Q3-Q4 to trip. The multivibrator generates a step signal across the integrator amplifier Al and drops the bias level of A1. This action will reset Q3-Q4, and the action will start over again until an input signal is received at the Input. With an input signal, the level detector supplies a signal to the integrator and the multivibrator is not tripped and no sweeping action occurs. This condition is called the "locked mode."



AFC Module, Block Diagram
Figure 3-7

(4) Range Mark Generator Module 3A9. (Refer to figure 3-8.)

The input to this module is a positive gate from the gate generator module. The input cuts off gate transistor Q1 which permits Q2 to oscillate. The output of oscillator Q2 is clipped by CR2, and the positive pulses are applied to emitter-follower Q3. The output of Q3 is amplified by Q4 and amplified and inverted by Q5. The negative square-wave output of Q5 is differentiated, and the negative spike triggers blocking oscillator Q6. The range mark output of Q6 is applied to the video driver module.



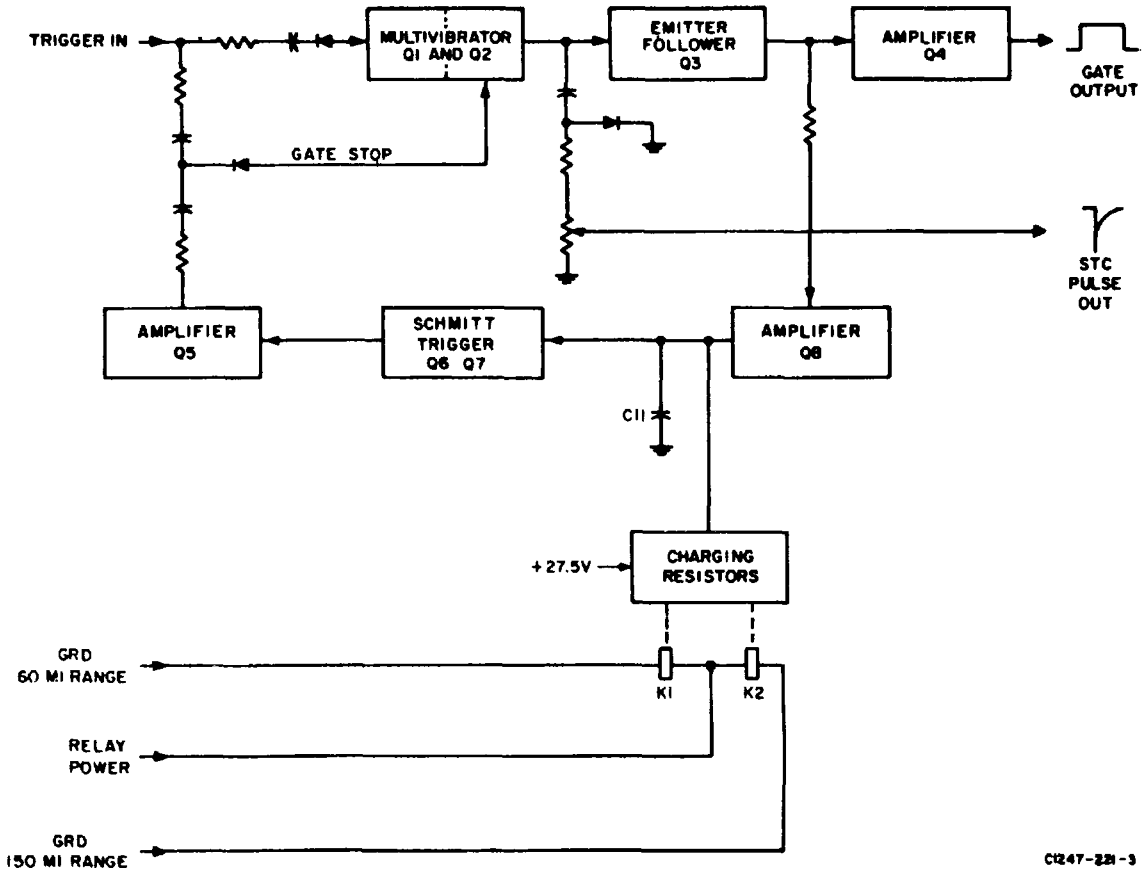
Range Mark Generator Module, Block Diagram
Figure 3-8

(5) Gate Generator Module 3A2. (Refer to figure 3-9.)

The trigger input to the gate generator is obtained from the R/T unit. This negative trigger changes the state of multivibrator Q1 and Q2. The output of the multivibrator is coupled to Q3 and to a differentiating circuit. A sensitivity time control (stc) pulse is supplied to the if. preamplifier and the video driver module from the differentiating circuit. Emitter-follower Q3 provides a negative gate to Q4 and Q8. Q8 is driven into cutoff by the negative gate, and the capacitor begins to charge toward the +27.5-volt line through the charging resistors. The positive charging of the capacitor changes the state of the Schmitt trigger, Q6 and Q7. The pulse from the Schmitt trigger is inverted and amplified by Q5. The output of Q5 changes the condition of multivibrator Q1 and Q2 which determines the length of the gate output. This is applied to the if. preamplifier, range mark generator, sweep deflection circuits, and the indicator.

(6) Isolation Amplifier Module, (Refer to 3A4 on figure FO-7.)

The input to the isolation amplifier consists of pitch and roll reference signals from the aircraft gyro. Since the amplifier contains two identical channels, the roll channel will be described as an example. The roll signal is applied to transformer T2 mounted on the synchronizer chassis. The output of T2 is applied through a chassis mounted phase-shift gain adjustment network to emitter-follower

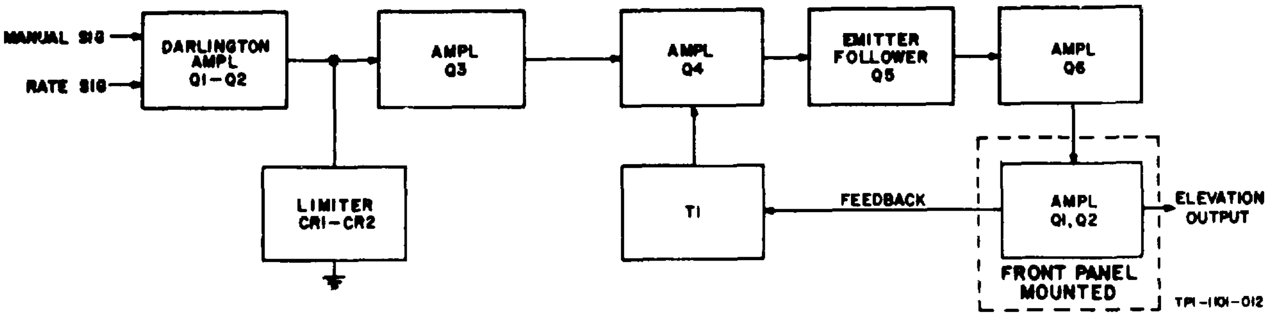


Gate Generator Module, Block Diagram
Figure 3-9

Q1. This signal is coupled through Q1 to amplifier Q2. Q2 amplifies the signal and applies it through emitter-followers Q3 and Q4 from where it is applied out to the pitch/roll resolver in the antenna. A feedback signal to control the gain of the module is applied out to Q4 from the phase-shift gain adjustment network.

(7) Elevation Servo-Amplifier Module 3A3. (Refer to figure 3-10.)

The inputs to the elevation servo amplifier are manual elevation and rate signals. The manual elevation signal from the cockpit control is connected with the



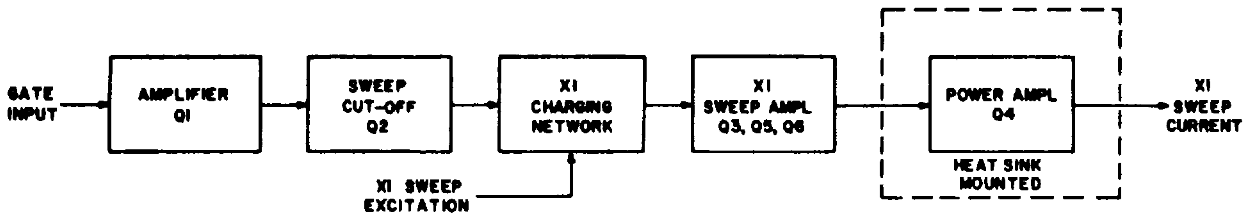
Elevation Servo-Amplifier Module, Block Diagram
Figure 3-10

stabilization signal from the antenna pitch/roll resolver. This composite signal is combined with the rate signal from the antenna rate generator and applied to Darlington amplifier Q1 and Q2. A phase-shift network and harmonic filter are provided at the input. The amplified signal is then applied across a limiting circuit to amplifier Q3. The limiting circuit provided a set amplitude level for the module, Q3 amplifies the signal and applies it to amplifier Q4. The signal to Q4 is amplified and applied across isolation emitter-follower Q5 to amplifier Q6. Q6 amplifies the signal and applies It to the front panel mounted power amplifiers. The output of the front panel mounted amplifiers is applied as negative feedback through T1 to Q4.

(8) Sweep Generator and Amplifier Module 3A7. (Refer to figure 3-11.) The inputs to the sweep generator consist of a positive gate from the gate generator module and sweep excitation from the phase detectors. The operation of the four sweep generating circuits is identical, so the X1 sweep generator is described. The gate signal drives Q1 into conduction and Q2 into cutoff. With clamp Q2 at cutoff, the charging network begins to charge to the instantaneous value of the sweep excitation. As the network charges, the voltage is modulated by the output of the phase detector, and a negative sawtooth is applied to the sweep amplifier circuit. The output of the sweep amplifier is applied to power amplifier Q4 mounted on the heat sink. Feedback from X1 sweep current through R15 causes the sweep current to follow the voltage range. The output of Q4, X1 sweep current, is applied to the deflection yoke in the indicator unit. In this manner, the deflection follows the azimuth position of the antenna.

D. Detailed Theory of Operation.

(1) IF. Amplifier Module. (Refer to 3A6 on figure FO-7.) The if. amplifier has two configurations and consists of two sections: the if. amplifier section (paragraph (a)) and the afc discriminator section (paragraph (b).)



Sweep Generator and Amplifier Module, Block Diagram
Figure 3-11

(a) IF. Amplifier Section.

The if. amplifier consists of a 5-stage tuned amplifier, Q2 through Q6, detector Q7, and video amplifiers Q16 and Q17 with their associated circuits. The relatively small output from the if preamplifier is amplified to provide a relatively large detected video output to the video driver module. The low level video output of the if. amplifier is approximately proportional to the if. signal input. The detected video signals are amplified and applied to Q16 and Q17.

The input to the 5-stage tuned amplifier is applied across an impedance matching network, L34 and R105. The network provides necessary matching from the 75-ohm transmission line to the input impedance of Q2. Each of the if. amplifiers is identical in operation. Each provides 14 db of amplification and is tuned to the center frequency, 30 MHz, in the associated transformer. Q4 has in the base circuit a selected resistor, R90, to set the overall amplification of the series of amplifiers. Resistors R2 through R115 provide stabilization by providing a fixed current through the amplifiers. Radio frequency decoupling between emitters of successive stages is provided by capacitors C2 through C5 and inductors L2, L3, and L4. Decoupling of the base bias between stages is accomplished by inductors L11 through L14, capacitor C53, and the bypass capacitors which are enclosed in the cases of transformers T2 through T6. Resistors R65 through R69 stabilize the gain and control the bandwidth of each stage.

The gain of the overall amplifier is stabilized through the effect of thermal resistors RT79 and RT93. The actions of these elements are to decrease the current in all stages at low temperatures and thus offset the rising gain of each stage. Conversely, the gain is increased at elevated temperatures by an increase in the current in all stages.

The detected video signal current at the emitter of Q7 is supplied from resistor R71. This signal is then applied to common-base amplifier Q16 and emitter follower Q17. The amplified video output from Q16 is developed across resistor R86 and across resistor R99 to the emitter of Q6. The output level of Q17 is clamped by diode CR12.

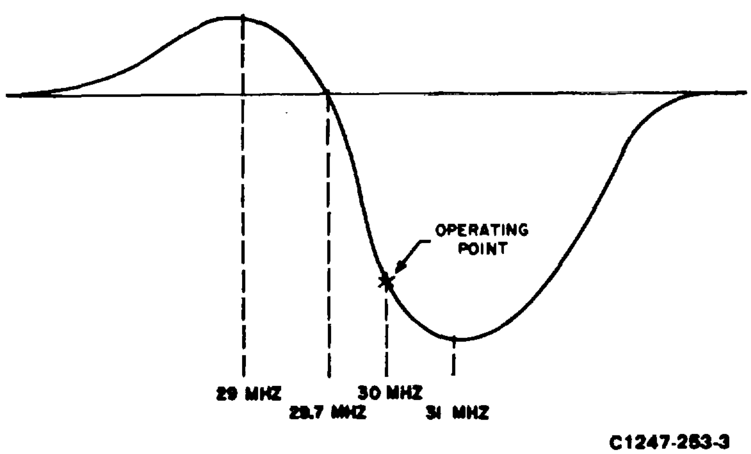
Resistors R95 and R96 provide bias level for CR13 so that only signals greater than 0.6 volt are applied as feedback. Thus the output of the if. amplifier is linear to a set fixed point and is logarithmic above that point. A particular output level is set on the logarithmic curve for operation of the contour circuitry in the video driver module.

(b) AFC Discriminator Section. (Refer to figure 3-12.)

The afc discriminator section consists of limiter-amplifier A1; transistors Q11, Q12, and Q13; and the associated circuit elements. The pulsed 30MHz afc input from the R/T unit is applied to the input of amplifier A1. The amplifier signal from A1 is applied across a circuit that is double tuned by variable capacitors C63 and C64.

When the lower skirt of the double-tuned passband extends from about 29.0 to 31.5 MHz and operation is for 30 MHz, a slope detector discriminator is formed.

The input to Al is applied through a matching network consisting of L18 and C59, and L9 and C69 to match the 72-ohm transmission cable. Resistor R106 is selected to set the gain of A1. The output of Al is then applied across the discriminator circuit consisting of capacitors C62 through C65, L35, and L36 and coupled through C51 to detector diode CR2. The signal is then applied across RT97, a thermal resistor for temperature compensation, to the base of amplifier Q11. Q11 and Q12 amplify the signal and apply it through emitter-follower Q13 to the output as a frequency discriminated signal to the afc module. Feedback is accomplished for dc characteristics through resistor R104 from the emitter of Q13 to emitter of Q11. Capacitor C29 provides for pulse shaping of the input afc signal to amplifier Q11. R106 and R109 are selected for the proper gain of the afc discriminator section.



Frequency Discriminator Response Curve
Figure 3-12

(2) Video Driver Module. (Refer to 3All on figure FO-7.) The negative video output signal from the if. amplifier module is applied through amplifier Q1, across the dc reference network (VR17, CR10, R42, and R75), to emitter-follower Q11. From Q11 the signal is applied to the video canceling circuit. The canceling circuit consists of amplifier Q13, emitter-follower Q12, and capacitor C25. This circuit is operational in the contour (CTR) mode of operation.

For normal operation, the amplified video signal is applied past Q13 and across control potentiometer R12 to the base of amplifier Q14. At Q14, the video is combined with range marks that are applied to the emitter through potentiometer R27 and capacitor C26. The combined video and range mark signal is applied through emitter-follower Q10 and amplifier Q9 to the output at pin S. Diode CR9 clamps the positive pulses at ground. The output at pin S is purely negative in polarity.

In the contour (CTR) mode of operation, a ground is applied to the negative supply of Q15-Q16 circuit through pin P. The ground causes Q15 to stop conducting and allows Q16, half of the Schmitt trigger circuit, to start conducting. When a contour level signal exists, its level will exceed the bias on Q16 that is set by resistor R23, causing Q15, thence Q17, to conduct and Q16 will stop conducting. As typical targets have various random levels, Q17 will be pulsed on and off. To reduce smear of contoured and noncontoured signals by the indicator, the signal is applied across a pulse stretching network, C22 and R57. The stretched pulse is then applied to Q13, which causes Q13 to conduct and cause the video above a predetermined value to be canceled. With Q13 on, a path is provided through emitter-follower Q12 to discharge capacitor C25. Q12 is biased on by a filtered video signal that is applied from the emitter of Q11 through CRII, CR12, and R60 to the base of Q12. C25 charges to the level of the filtered signal to provide the bias level for Q12. As long as the video is of sufficient level and contour (CTR) is selected, this circuit will cancel the video and provide the black "holes" in the presentation.

A sensitivity time control (stc) signal is applied to amplifier Q18 through pin E. The signal is amplified, inverted, and applied to the base of amplifier Q14 as an antisensitivity time control (astc) signal. The astc signal increases the gain of the video amplifier during the time the stc pulse decreases the gain of the if. preamplifier. This provides a constant video signal voltage level output to the indicator even though the if. preamplifier gain is reduced. Thus, strong echo signals from short-range targets are prevented from being displayed with abnormal intensity.

(3) Automatic Frequency Control (AFC) Module. (Refer to 3A10 on figure FO-7.) The afc module provides a controlled negative voltage which serves as both frequency control and repeller supply voltage for the klystron local oscillator. The signal that controls the negative output voltage is obtained from the afc discriminator circuit in the if. amplifier module. Circuit functions contained in the afc module include a peak detector, dc integrator, sweep generator, and a dc-to-dc converter. The modes of operation of this module are referred to as "afc sweeping, " which is the initial operating mode, and "afc locked, " which is the normal operating mode.

The dc-to-dc converter functions in the same manner for both modes of operation. The converter, Q5, Q6, and T1, may be visualized as a transformer-coupled, push-pull, square-wave oscillator with a voltage doubling rectifier in the transformer output circuit. Transistors Q5 and Q6 and the two center-tap windings of T1 make up the oscillator circuit. Because each transistor saturates during its conduction cycle, the output voltage of the converter is directly proportional to the input voltage of the emitters of Q5 and Q6.

In the sweeping mode of operation, initially consider no input signal at pin B and no charge existing on capacitor C6. Under these conditions, Q1, A1, Q2, Q3, and Q4 are disabled. With dc power applied to the module, +6.0 volts dc is applied from zener diode VR8 to pins 1 and 3 of differential amplifier A1. Also, the dc potential applied through CR1 to A1-2 is made more negative than the voltage at A1-3 by voltage divider R4 and R5. This unbalance is amplified by A1. The dc difference starts charging capacitor C6. Thus, the output of A1 is linearly rising. The output of A1 is applied across Darlington amplifier Q2, which provides a unity gain factor. The output of Q2 is coupled to the emitters of dc-to-dc converter transistors Q5 and Q6. Simultaneously, the signal is applied to the base of transistor Q3, which is a part of a multivibrator circuit. At a preset level, Q3 will conduct and trip Q4. The output of Q4 is applied back to pin 2 of A1 to reset the circuit and drive the integrator negatively to base level of 6. 0 volts. Capacitor C6 is discharged through R10 to ground. With the reset, the output of Q2 decreases and Q3 will turn off. Until a signal is applied in at pin B, this cycling action will continue. C6 charges and discharges and Q3 and Q4 will reset the level. The output of Q2 applied to the converter circuit is converted into high-level dc that varies from -145 to -225 volts dc. This voltage is applied to the klystron repeller circuit and causes the klystron output frequency to sweep through approximately 100 MHz of spectrum immediately above the magnetron frequency. When the frequency difference between the klystron and magnetron approaches 30 MHz, an afc signal is developed in the discriminator section of the if. amplifier module. The negative control signal developed by the discriminator circuit is applied to pin B of the afc module.

In the locked mode of operation, the afc signal from the if, amplifier module is a negative pulse of 3.25-v amplitude. This signal is applied to emitter-follower Q1 and coupled through C2 to A1-2. The negative peak is clamped to the level set by R7. If the amplitude of the control pulse increases, the clamping action further decreases conduction of Q1, decreasing the output voltage of the module. The baseline potential is such that the integrated voltage at A1-2 is essentially equal to that at A1-3. With a 3.25-v input, the dc difference between A1-2 and -3 will be negligible; however, this small difference is amplified by A1 and applied through Q2 to the dc-to-dc converter circuit. The signal is converted to the nominal -185 volts of the klystron repeller for the 30-MHz output. Since the signal at the output of Q2 is not large enough in amplitude to trip Q3, the sweeping action does not occur. Resistor R10 across the integrator holds the differential conversion gain of the afc amplifier to (-)60.

When in the afc locked condition, if the klystron frequency drifts more than 30 MHz above the magnetron, the control pulse amplitude from the discriminator increases. This decreases the output voltage of the afc module and the reduced repeller voltage decreases the klystron output frequency. Conversely, if the klystron drifts lower in frequency, the control pulse amplitude decreases, the afc module output voltage increases, and the klystron output frequency increases to return the if. to 30 MHz.

(4) Range Mark Generator Module. (Refer to 3A9 on figure FO-7.)

The range mark generator module supplies the 10-, 15-, and 25-mile range markers to the video driver module. The generator is turned on and off by the positive gate pulse from the gate generator module. Normally conducting gate transistor Q1 is driven to cutoff by the positive gate pulse. When Q1 is conducting, the current through L1 prevents oscillations in the tuned circuit consisting of L1 and C1 through C6. When Q1 is cut off, the Colpitts oscillator containing the tuned circuit and transistor Q2 oscillates at the frequency of the tuned circuit. Oscillator frequencies of 8. 07, 5.36, and 3.18 kHz are available by using the proper combinations of capacitors C1 through C6 in the tuned circuit. All capacitors are in the circuit when the 30-mile range is selected. The oscillator operates at a frequency of 8.07 kHz and provides the 10-mile range markers. Relay K1 is energized when the 60-mile range is selected, shorting out capacitors C3 and C4. The oscillator then operates at a frequency of 5.36 kHz and provides the 15-mile range markers. Relay K2 is energized when the 150-mile range is selected, shorting out capacitors C2, C3, C4, and C5. The oscillator then operates at a frequency of 3.1 kHz and provides the 25-mile range markers.

The output at the emitter of oscillator Q2 is clipped by diode CR2 so that only the positive half-cycles are applied to the base of emitter-follower Q3. The positive half-cycles at the output of emitter-follower Q3 are applied to the emitter of Q4. Amplifier Q4 is overdriven so that positive-going square waves are applied to the base of amplifier Q5. The square waves are inverted and amplified by Q5 and differentiated by C10 and R18. The resulting negative spike is used to trigger blocking oscillator Q6. Transistor Q6 is biased to be normally cut off so that the positive spike resulting from differentiation has no effect on the blocking oscillator. Diode CR5 shunts the output winding of transformer T1 to remove the positive backswing of the blocking oscillator. The output of the module is a series of negative spikes at the frequency of oscillator Q2.

(5) Gate Generator Module. (Refer to 3A2 on figure FO-7.)

The input to the gate generator module consists of a negative trigger input from the R/T. The output consists of a positive gate pulse which is used as an intensity gate by the indicator and as a switching pulse by the sweep generator and amplifier module and the range mark generator module. The duration of each gate pulse is controlled by the RANGE switch on the indicator. A sensitivity time control pulse is supplied to the if. preamplifier to reduce gain to normalize the target returns with respect to range.

The negative trigger input is coupled simultaneously to the bases of transistors Q1 and Q2, which form a bistable multivibrator circuit. The trigger pulse is coupled to the base of Q1 through R4, C2, and CR1 and to the base of Q2 through R5, C3, and CR2. Assuming that Q1 is conducting and Q2 is cut off before the arrival of the trigger, the trigger cuts off Q1. While Q1 is conducting, the collector voltage is low and the collector voltage of Q2 is high. When Q1 is cut off by the negative trigger, the collector voltage rises rapidly toward +27.5 volts. This positive voltage is coupled to the base of Q2 through C1 and R2, causing the collector voltage of Q2 to drop to a low positive potential. This negative-going voltage is applied to the base of emitter-follower Q3. From Q3, negative voltage is coupled through VR4, R15, and C12 to the base of amplifier Q4. The inverted waveform at the collector of Q4 is a positive voltage which is the start of the positive gate output. Zener diode VR4 provides dc coupling to the base of Q4 and Q8.

The negative voltage which is applied to the base of emitter-follower Q3 is also applied to the differentiating network consisting of C6, R13, and R35. The differentiating network forms the negative stc pulse, the amplitude of which can be adjusted by potentiometer R35. Diode CR3 protects Q3 from reverse voltage, and CR5 shunts positive voltage pulses to ground.

The negative gate at the junction of VR4 and C12 is coupled through R37 to the base of amplifier Q8. Before the arrival of the negative gate, Q8 was conducting and C11 was charged to the small positive potential present at the junction of R26 and R34. The negative gate arrives, Q8 cuts off, and C11 begins charging toward the +27.5-volt potential through the series resistance network selected by relays K1 and K2, which are controlled by the position of the RANGE switch on the indicator. Prior to the arrival of the negative gate, Q7 is cut off and Q6 is conducting. Transistors Q6 and Q7 and associated components form a Schmitt trigger circuit. The time required for C11 to charge to a positive voltage sufficient to bring Q7 into conduction is determined by the resistors selected by relays K1 and K2. When C11 has charged sufficiently, the base of Q7 is positive enough to cause conduction of Q7. This causes Q7 collector voltage to drop rapidly, and this change is coupled to the base of Q6 which cuts off Q6. A positive voltage pulse is produced at the collector of Q6 and coupled to the base of amplifier Q5. The negative pulse at the collector of Q5 is coupled through R18 and C7 to the bases of Q1 and Q2. Q1 was cut off by the initial trigger, and Q2 is now conducting. The negative trigger from Q5 cuts off Q2 to change the state of the multivibrator. The trailing edge of the positive gate output is formed by changing the state of the multivibrator. When the multivibrator changes state, Q8 returns to the normally conducting state and discharges C11. This returns Q7, Q6, and Q5 to the conditions that existed before arrival of the trigger input.

(6) Isolation Amplifier Module. (Refer to 3A5 on figure FO-7.)

This isolation amplifier contains two identical channels, one for pitch and one for roll. Each channel has a controlled gain and phase shift. The roll and pitch signals from the aircraft gyro are applied to transformers T2 and T3, respectively, in the synchronizer unit. The secondaries of T2 and T3 are connected to phase-shift networks where the resulting phase from the individual gyro outputs is shifted to correspond to the phase of the elevation servo-amplifier network. The amount of shift in phase of the roll is controlled by potentiometer R5. The amount of shift in phase of the pitch is controlled by potentiometer R8. Potentiometers R7 and R10 adjust the actual gyro (bootstrap) voltage per degree analog to the 20-mv/per degree analog of the elevation servo-amplifier network. The outputs of the phase-shift networks are applied to the amplifier channels in the isolation amplifier module. Since the amplifier channels are identical, only the roll channel is described as an example.

The output of the roll phase-shift network is applied into the isolation amplifier at pins C and B. The signal is applied to emitter-follower Q1, across amplifier Q2, and through emitter-followers Q3 and Q4. This output is applied to the roll windings of the roll-pitch resolver in the antenna unit and to the feedback control potentiometer R10.

(7) Elevation Servo-Amplifier Module. (Refer to 3A3 on figure FO-7.)

The elevation servo-amplifier output drives the antenna tilt drive motor in response to varying combined roll and pitch signals from the pitch-roll resolver in the antenna and in response to the manual tilt signal from the cockpit control. The stabilization signal from the antenna pitch-roll resolver is connected, through pins B and C, in series with the manual elevation signal (pins D and E). The resulting signal is applied through R1 to the junction of R1 and R3 where it is combined with the rate signal (pin F) from the antenna rate generator to produce an elevation correction signal. This signal is applied through R3 to the base of amplifier Q1. The combination of resistors R1 through R4 and capacitors C1 and C2 provide the 90-degree phase shift required for proper phasing of the antenna tilt motor. The 90-degree phase-shift network also provides harmonic filtering. The output signal at the collector of the Darlington amplifier, Q1 and Q2, is applied across a limiter network, CR1, CR2, and C5, which provides a limiting gain control for the amplifier. The input is applied to the base of amplifier Q3 where it is amplified and applied to the base of amplifier Q4. Q4 amplifies the signal and applies it across emitter-follower Q5 to amplifier Q6. The signal is further amplified and applied out through pin P to synchronizer transformer T1. The signal is coupled across T1 to the bases of power amplifiers Q1 and Q2, which are mounted on the synchronizer front panel. The center tap on transformer T1 is connected through resistors R1 and R3 and thermistor RT1 to the emitters of Q1 and Q2. The thermistor compensates for amplifier variations due to heat. The output at the collectors of Q1 and Q2 is applied to the antenna tilt motor and, through J1-U and -V, to the base of amplifier Q4. This feedback is coupled through an isolation transformer, T1, across resistors R15, R16, and R14 as stabilization feedback.

(8) Phase Detectors. (Refer to 3A1A1, detector board assembly, on figure FO-7.)

The phase detectors add the X and Y outputs of the antenna sweep resolver to a regulated ac reference voltage. The composite signals are rectified, filtered, and applied to the sweep generator and amplifier module to provide antenna azimuth position information for the sweep generating circuits. The primary of transformer T4 receives filtered 400-Hz, 115-volt excitation from the generator A power line. The secondary of T4, resistor R11, and diodes CR3 through CR6 form a switching diode bridge that maintains one direction current flow through zener diode VR2. The peak-to-peak amplitude of the ac waveform is limited by VR2.

The regulated ac reference voltage is applied to the primary of transformer T5. The X and Y outputs from the antenna sweep resolver are applied to the secondary of T5. The X and Y signals are coupled from terminals 4 and 5 through voltage dividers consisting of R23, R39, R22, and R38 and through capacitors C18 and C19. Resistors R12 and R16 develop a bias voltage for emitter-followers Q3 through Q6. Potentiometer R13 and Ri4 adjust the level of the X and Y signals to establish the start position of the sweep. The waveforms that result from combining the ac reference voltage and the X and Y signals are rectified by emitter-followers Q3 through Q6 and filtered by the resistor-capacitor combinations in the emitter circuits. The low-impedance outputs of Q3 through Q6, a dc voltage plus a portion of a sine wave, are applied to the sweep generator and amplifier module. These four outputs are applied to the sweep generator and amplifier where they establish the amplitude of the four sweep voltages and are then combined in the indicator to determine the azimuth and range position of the sweep.

The regulated ac reference voltage at the secondary of T5 is also used for excitation of the antenna sweep resolver. The excitation voltage is coupled from terminal 15 of T5 and the wiper arm of R15. Potentiometer R15 adjusts the level of excitation voltage applied to the antenna sweep resolver.

The 115-volt, 400-Hz generator A power line is connected to the primary of transformer T4 through a combination of capacitors and inductors. Capacitors C20, C21, and C22 and inductors L1 and L2 form a filter combination to improve the sweep phase detector circuit tolerance to ripple modulation on the 11-volt, 400-Hz generator A power line.

(9) Sweep Generator and Amplifier Module. (Refer to 3A7 of figure FO-7 and to figure 3-13.)

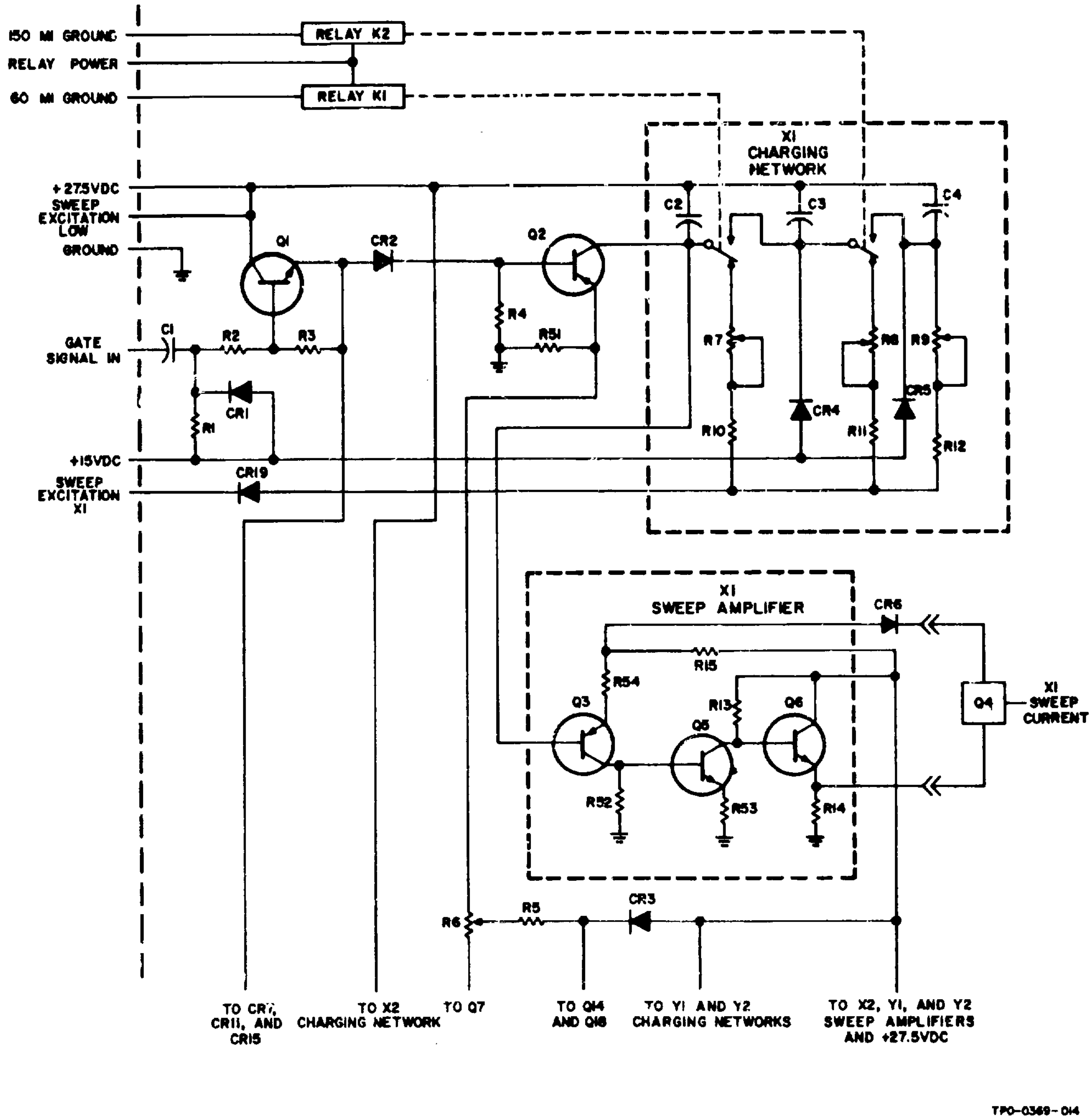
The sweep generator and amplifier module provides X and Y sweep currents to the deflection yoke in the indicator. The four sweep generators each develop a linear sawtooth waveform which varies in amplitude in relationship to the antenna position information provided by the phase detectors. Since the sweep generators are identical in operation, the generator providing sweep current to the X1 winding of the deflection yoke is described as representative.

The simplified schematic, shown in figure 13, shows the details of the X1 sweep generator/amplifier only. In the 30-mile position, relays K1 and K2 are de-energized. The charging network consists of R7 through R12 and C2, C3, and C4. In the 60-mile position, K1 is energized, which places C2, C3, R8, and R11 in the charging circuit. In the 150-mile position, K1 and K2 are both energized, which places R9, R12, C2, C3, and C4 in the charging circuit. Similar changes occur in all four sweep generators. Variable resistors R7, R8, and R9 permit adjustment of the instantaneous slopes of the sweep waveforms for the individual ranges. In the following discussion, C2, C3, and C4 will be referred to as capacitance C.

Prior to the arrival of the positive gate from the gate generator module, Q2 was conducting and Q1 was cut off. The conduction of Q2 shorts capacitance C, preventing it from charging. The positive gate at the base of emitter-follower Q1 causes Q1 to conduct. The positive gate at the emitter of Q1 is coupled through CR2 to the base of Q2 and drives Q2 into cutoff. Balance potentiometer R6 maintains proper position of the indicator presentation by compensating for differences in the bias of the X1 and X2 generators. With Q2 cut off, capacitance C begins to charge through the resistance selected by K1 and K2 to the instantaneous value of sweep excitation.

This excitation voltage contains antenna position information and is provided by the X1 phase detector. As capacitance C charges, a negative-going waveform is applied to the base of amplifier Q3. Transistor Q3 now conducts, and the negative waveform is amplified by Q3 and Q5.

The sawtooth waveform is amplified by emitter-follower Q6 and applied to the base of Q4. The sawtooth at the collector of Q4 is applied to the X1 deflection coil in the indicator. The current through Q4 and the deflection coil produce a sawtooth voltage waveform at the junction of CR6 and R15. This voltage is applied to the emitter of Q3 to provide constant charging of C and to provide inverse feedback to produce a sweep current that follows the sweep voltage at the base of Q3.



Sweep Generator and Amplifier Module, Simplified Schematic Diagram
Figure 3-13

Section II. DISASSEMBLY

3-6. GENERAL.

This section presents instructions for disassembling the SN-358A Synchronizer and the MT-3069 Shockmount. These instructions are arranged so that disassembly of each major part is an individual operation. These procedures begin with the highest assemblies, proceed to the next lower subassemblies, and end with the major parts. Reference is made to previous disassembly steps that must be performed before a part may be removed or disassembled. In any event, the disassembly procedure should be continued only as far as necessary to replace the faulty component. The disassembly of terminal strips on boards and of isolated components can usually be accomplished by inspection and determination of the extent of disassembly required. These instructions include special techniques, cautions, warnings, and unique procedures.

3-7. PRECAUTIONS AND GENERAL TECHNIQUES.

Mark, tag, or otherwise identify all disconnected electrical wiring. Note the color coding, placement of leads, and method of applying insulation before unsoldering or removing any electrical components. These procedures supply information to remove the parts listed in the illustrated parts list. In most cases, however, parts may be released and moved aside to gain access to other parts without unsoldering the connecting leads; this applies particularly to printed circuit boards. Do not unsolder these leads unless absolutely necessary.

CAUTION: TO PREVENT DAMAGE TO A SOLID-STATE DEVICE, USE A HEAT SINK ON THE LEAD BETWEEN THE POINT BEING UNSOLDERED AND THE DEVICE.

WARNING: THE SYNCHRONIZER USES EXTREMELY HIGH VOLTAGES. DO NOT ATTEMPT ANY DISASSEMBLY WHILE PRIMARY POWER IS APPLIED TO THE UNIT. ENSURE THAT THE POWER CABLE IS REMOVED TO PREVENT VOLTAGE TRANSIENTS WHICH COULD DAMAGE OR DESTROY SEMICONDUCTORS.

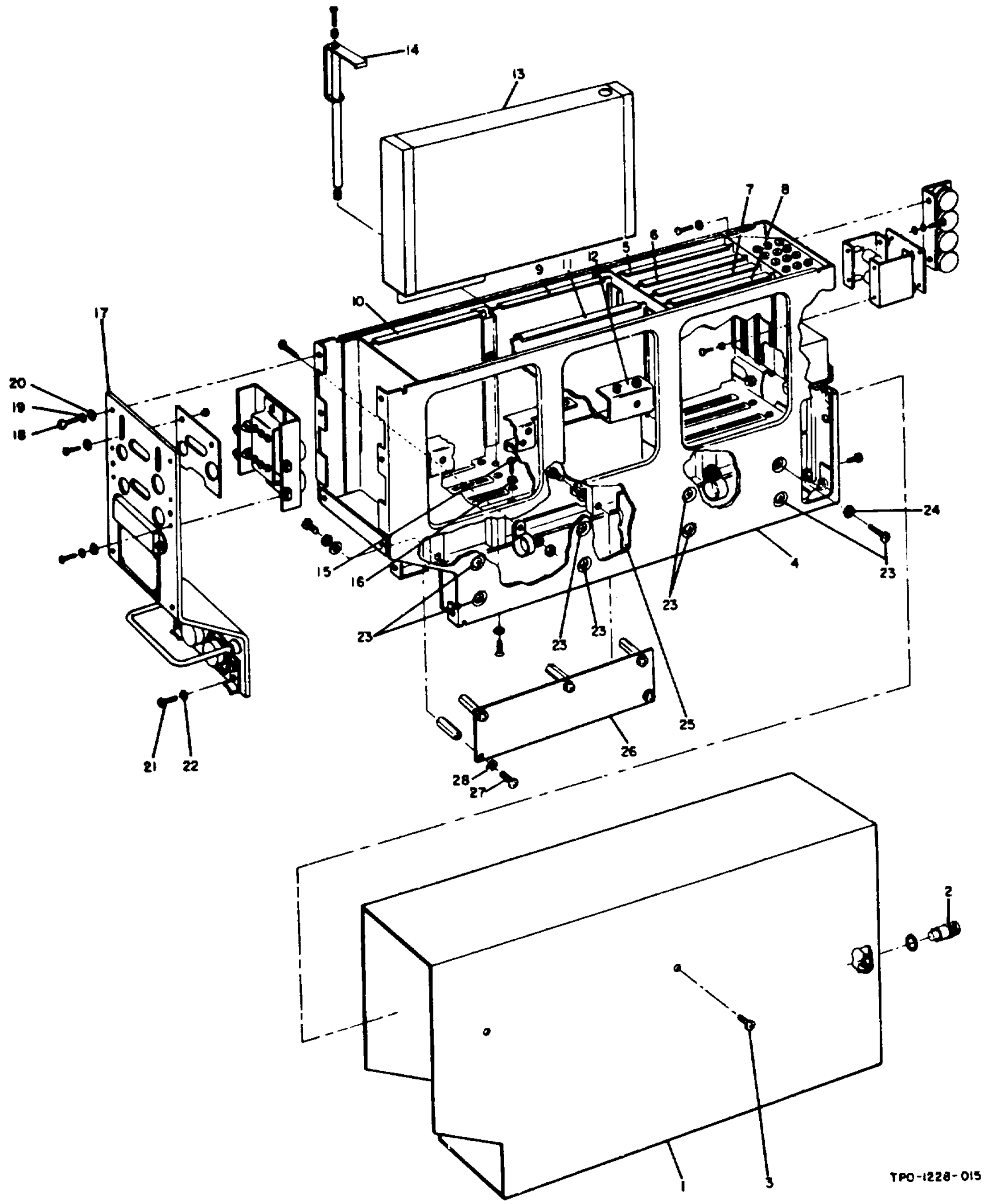
These precautions are repeated in the text of the disassembly procedures where applicable.

3-8. DISASSEMBLY PROCEDURE.

A. <u>Remove Outer Dust Cover.</u> (Refer to figure 3-14.)

(1) Release dust cover (1) by releasing two twist lock fasteners (2) on the rear of the dust cover and by removing two machine screws (3) and two flat washers on the right side of the cover.

(2) Slide dust cover (1) off the chassis assembly (4).



SN-358A Synchronizer, Exploded View
Figure 3-14

B. Remove Plug-in Modules. (Refer to figure 3-14.)

(1) Remove outer dust cover (1) in accordance with paragraph A above.

(2) Remove modules (5 through 11) by grasping the top of the module and, while pulling upward, gently rock them from side to side.

NOTE: Disconnect J1 on wired heat sink (12) before attempting to remove sweep generator and amplifier module (11).

(3) Remove if amplifier module (13) by rotating holddown bracket (14) and lifting the module out of chassis assembly (4).

C. Remove Wired Heat Sink. (Refer to figure 3-14.)

(1) Remove outer dust cover (1) in accordance with paragraph A above.

(2) Remove sweep generator and amplifier module (11) in accordance with paragraph 3. B. (2).

(3) Remove wired heat sink (12) by removing five machine screws (15) and five lockwashers (16) securing it to chassis assembly (4).

D. Remove Front Panel. (Refer to figure 3-14.)

(1) Remove front panel (17) by removing six machine screws (18), six lockwashers (19), six flat washers (20), two machine screws (21), and two lockwashers (22).

(2) Components located on the rear of front plate (17) are now accessible and may be removed as required.

E. Remove Transformer Plate. (Refer to figure 3-14.)

(1) Remove outer dust cover (1) in accordance with paragraph A above.

(2) Remove machine screws (23) and lockwashers (24) securing transformer plate (25) to chassis assembly (4).

(3) Gently pull the transformer plate (25) away from chassis assembly (4).

(4) The components mounted on the transformer plate are not accessible and may be removed as required.

F. Remove Detector Board Assembly. (Refer to figure 3-14.)

(1) Remove outer dust cover (1) in accordance with paragraph A above.

(2) Remove five machine screws (27) and five lockwashers (28) securing detector board assembly TB1 (26) to chassis assembly (4).

(3) Pull the board away from chassis assembly and unsolder and tag the leads from the board terminals.

(4) Remove the board.

G. Disassemble MT-3069 Shockmount. (Refer to figure 3-15.)

(1) Remove front retainers (1) by removing cotter pin (2) and pin (3).

(2) Remove shockmount tray (4) from baseplate (5) as follows: (a) Remove two machine screws (6) and two flat washers (7).

(b) Remove two machine screws (8), two flat washers (9), and lockwashers (10).

(c) Remove machine screw (11).

(d) Remove two grounding straps (12) by removing four machine screws (13), four flat washers (14), and four hexnuts (15) securing them to baseplate (5).

(e) Remove shockmount tray (4).

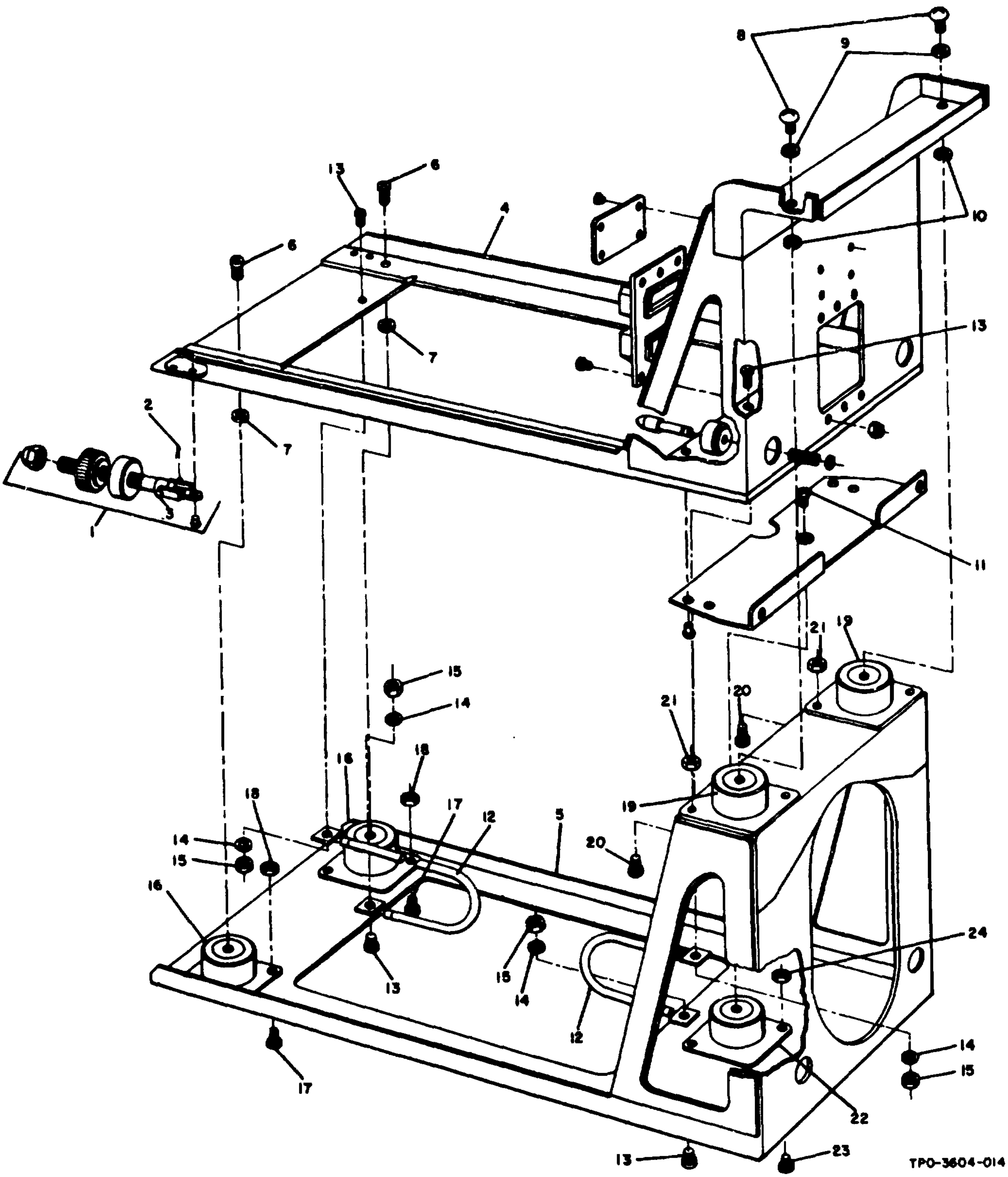
(3) Remove the vibration isolators as follows:

(a) Remove two vibration isolators (16) by removing four machine screws (17) and four hexnuts (18) securing them to baseplate (5).

(b) Remove two vibration isolators (19) by removing four machine screws (20) and four hexnuts (21) securing them to baseplate (5).

(c) Remove vibration isolator (22) by removing two machine screws (23) and two hexnuts (24) securing it to baseplate (5).

NOTE: Further disassembly of the MT-3069 Shockmount is not recommended unless part replacement is necessary.



MT-3069 Shockmount, Exploded View
Figure 3-15

Section III. CLEANING

3-9. GENERAL.

This section presents instructions for cleaning the dismantled and disassembled components, parts, and subassemblies of the SN-358A Synchronizer and the MT-3069 Shockmount. These instructions are tabulated and arranged to facilitate reference to the test procedure for cleaning the various parts and assemblies. All parts requiring special methods of cleaning are considered separately, and parts which are similar enough to permit identical cleaning procedures are grouped together. Either Turcosol or Stoddard solvent may be used in the following procedures.

WARNING: PERFORM OPERATIONS INVOLVING CLEANING SOLVENT UNDER A VENTILATED HOOD. AVOID BREATHING SOLVENT VAPOR AND FUMES. WEAR A SUITABLE MASK WHEN NECESSARY. AVOID CONTINUOUS CONTACT WITH THE SOLVENT. USE GOGGLES, GLOVES, AND AN APRON TO PREVENT IRRITATION FROM PROLONGED CONTACT. CHANGE CLOTHING THAT HAS BECOME SATURATED WITH SOLVENT.

Reference to "air jet" in this section indicates a hand-operated air nozzle supplied with clean, dry, compressed air at a maximum pressure of 28 pounds per square inch.

WARNING: WEAR GOGGLES WHEN USING THE AIR JET TO BLOW DUST AND DIRT FROM EQUIPMENT PARTS. WARN OTHER PERSONS AWAY FROM HAZARDOUS AREA OR WORKING ENCLOSURE.

3-10. CLEANING PROCEDURES.

The following paragraphs present instructions and procedures for cleaning the various parts of the dismantled and disassembled equipment preparatory to performing inspection procedures. For convenience, components, parts, and subassemblies are alphabetically listed and cross-referenced to the appropriate paragraphs containing the cleaning instructions. Refer to figure 3-16.

WARNING: OBSERVE ALL FIRE PRECAUTIONS WHEN USING FLAMMABLE MATERIALS FOR CLEANING PURPOSES. THESE MATERIALS SHOULD ONLY BE USED OUTSIDE OR IN A VENTILATED BOOTH PROVIDED WITH EXPLOSION-PROOF ELECTRICAL EQUIPMENT AND AN EXHAUST FAN HAVING SPARK-PROOF BLADES.

A. Connectors.

(1) Wipe dust and dirt from bodies, shells, and cable clamps using a solvent moistened, lintless cloth. Wipe dry with a clean, dry, lintless cloth.

(2) Remove dust from inserts, using a small, soft-bristled brush and an air jet.

ITEM	REFER TO PARAGRAPH
Connectors	3-10.A
Covered cables	3-10.B
Covers and shields	3-10.C
Insulators: Ceramic, Mycalex, and plastic	3-10.D
Jacks	3-10.E
Machined metal parts	3-10.F
Mechanical metal parts	3-10.G
Panels	3-10.H
Printed circuit boards	3-10.I
Vibration isolators	3-10.J
Wired chassis	3-10.K

Index of Cleaning Procedures
Figure 3-16

(3) Wash dirt and any traces of lubricant from inserts, insulation, and contacts using solvent applied sparingly with a small, camel-hair brush.

<u>CAUTION</u>: DO NOT ALLOW SOLVENT TO RUN INTO SLEEVES OR CONDUIT COVERING ANY WIRES OR CABLES CONNECTED TO CONTACT TERMINALS OF THE INSERT.

(4) Dry the insert with an air jet.

B. <u>Covered Cables.</u>

(1) Clean outer surfaces by wiping away dirt with a solvent-moistened, lintless cloth.

(2) Wipe dry using a clean, dry, lintless cloth.

(3) Treat any connector terminations in accordance with paragraph A above. Wipe lug terminations clean with a solvent-moistened, lintless cloth, and dry with a clean, dry, lintless cloth.

C. Covers and Shields.

Clean all unfinished, finished, and partly finished sheet-metal covers, such as dust covers, inspection covers, and housings, as follows: (1) Remove the bulk of surface dirt with rags.

(2) Blow dust from surfaces, holes, and recesses using an air jet.

(3) Immerse the cover or shield in a washing bath of solvent, and scrub until clean, working over all surfaces and into all holes and recesses with a suitable nonmetallic brush. Flat, wood-backed brushes with soft fiber bristles are recommended for surfaces; round brushes, similar to those used for washing bottles and test tubes, are recommended for holes and recesses.

(4) Raise casting from bath and permit solvent to drain into bath.

(5) Immerse the cover or shield in rinsing bath of clean solvent, rinse, and raise from bath. Position the cover or shield to drain dry so that solvent is not trapped in holes or recesses. When practical positioning will not permit complete draining, use an air jet to blow out any trapped solvent.

CAUTION: WEAR PROTECTIVE CLOTHING WHEN USING THE AIR JET TO REMOVE EXCESS SOLVENT.

(6) When thoroughly dry, touch up any minor damage to the finish.

(7) Protect the cover or shield from dust and moisture, pending inspection.

D. Insulators: Ceramic, Mycalex, and Plastic.

Clean all glazed porcelain insulators, ceramic insulators, Mycalex insulators, and plastic standoff insulators as follows:

(1) Wipe clean with a solvent-moistened, clean, lintless cloth.

(2) Wipe dry and polish using a clean, dry, lintless cloth.

E. Jacks.

(1) Remove dust and dirt from exteriors with a camel-hair brush and an air jet.

(2) Blow dust and dirt from interior of female contacts with an air jet.

F. Machined Metal Parts.

Detached shafts, keys, pins, collars, and similar machined parts should be cleaned in a suitable cleaning machine if available. If a cleaning machine is not available, proceed as follows:

(1) Clean machined metal parts in accordance with paragraphs C(1) and C(3) through C(5) above.

NOTE: Do not touch any clean machined or unfinished parts with bare hands.

(2) Dry in a dust-free, dry area or suitable enclosure. Radiant heat used in a ventilated enclosure is recommended for drying, particularly where atmospheric humidity is high.

(3) After the drying process is completed, apply a light coat of lubricating oil (MIL-L-6085) to any bare steel surfaces.

G. Mechanical Metal Parts.

The detached miscellaneous mechanical metal parts include mounting plates, mounting clamps and brackets, nuts, bolts, screws, washers, fasteners, and other hardware. These should be cleaned in a suitable cleaning machine or in accordance with applicable steps of the procedures for covers and shields contained in paragraph C above.

H. Panels.

Clean panels by gently wiping the surfaces with a clean, soft, lintless cloth. When clean, polish with tissue paper.

I. Printed Circuit Boards .

(1) Using an air jet and a small, camel-hair brush, blow and brush dust and dirt from surfaces, holes, and crevices.

(2) Wipe clean using a lintless cloth slightly moistened with solvent.

CAUTION: THE EPOXY MOISTURE SEALANT ON THE PRINTED CIRCUIT BOARDS IS SUSCEPTIBLE TO SOFTENING IF SOLVENT IS APPLIED FOR EXCESSIVE PERIODS OF TIME OR IN EXCESSIVE AMOUNTS. USE CARE IN CLEANING THESE PRINTED CIRCUIT BOARDS WITH A SOLVENT MOISTENED CLOTH. DRY WITH A CLEAN, LINTLESS CLOTH IMMEDIATELY AFTER CLEANING.

J. Vibration Isolators.

Clean detached vibration isolators as follows:

(1) Blow dust and dirt from surfaces with an air jet.

(2) Immerse in solvent bath and wash until clean.

(3) Raise from bath and let solvent drain into bath.

(4) Use an air jet to remove any trapped solvent.

K. Wired Chassis.

The following procedures should be used for chassis containing resistors, capacitors, switches, tube sockets, inductors, transformers, and other wired parts.

(1) Remove dust and dirt from all surfaces, including parts and wiring, using soft-bristled brush and an air jet.

CAUTION: AVOID AIR-BLASIO DEIUCATE PARTS BY TOO CLOSE AN APPROACH WITS THE AIR JET NOZZLE. UBE CAUTION WHEN BRUSIING DELICATE PARTS.

(2) With a minimum disturbance of wiring, clean connectors in accordance with paragraph A above.

(3) Clean insulators in accordance with paragraph D above.

(4) Clean jacks in accordance with paragraph E above.

(5) Complete chassis cleaning by wiping all finished surfaces with a solvent-moistened, lintless cloth

(6) Dry end polish them Using a clean, dry, lintless cloth.

(7) Protect from dust and moisture pending inspection.

Section IV. INSPECTION/CHECK

3-11. GENERAL.

This section presents instructions and procedures to assist in determining, by inspection, the condition of the dismantled, disassembled, and cleaned components, parts, and assemblies of the SN-358A Synchronizer and the MT-3069 Shockmount. Defects resulting from wear, physical damage, deterioration, or other causes would be discovered by these inspection procedures. Detailed inspection procedures are alphabetically arranged with the exception of rf coils, paragraph K below. Refer to section V of this manual for replacement or repair of defective components.

3-12. INSPECTION PROCEDURES.

Figure 3-17 lists the mechanical and electrical parts to be inspected and contains cross references to applicable paragraphs containing inspection procedures.

ITEM	REFER TO PARAGRAPH
Capacitors	3-12.A
Chassis	3-12.B
Connectors	3-12.C
Covers and shields	3-12.D
Insulators: Ceramic, Mycalex, and plastic	3-12.E
Jacks	3-12.F
Machined metal parts	3-12.G
Mechanical metal parts	3-12.H
Panels	3-12.I
Printed circuit boards	3-12.J
Rf coils	3-12.K

Index of Inspection Procedures (Sheet 1 of 2)
Figure 3-17

ITEM	REFER TO PARAGRAPH
Receptacles	3-12.L
Relays	3-12.M
Resistors	3-12.N
Semiconductors	3-12.O
Soldered terminal connections	3-12.P
Transformers and inductors	3-12.Q
Vibration isolators	3-12.R
Wiring	3-12.S

Index of Inspection Procedures (Sheet 2 of 2)
Figure 3-17

A. Capacitors.

Inspect capacitors for the defects listed in figure 3-18.

DEFECT	METAL TYPE	MOLDED TYPE	CERAMIC TYPE
Leakage (at case seams or around terminal insulation)	X		
Cracked, broken, or charred terminal insulation	X		
Case damage (dents or holes)	X		
Case damage (cracks or breakage)		X	
Loose, broken, or corroded terminal studs,	X	X	X
Loose, broken, or poorly soldered connections	X	X	X

Fixed Capacitor Inspection
Figure 3-18

B. Chassis.

Inspect chassis for deformation, dents, punctures, badly worn surfaces, damaged connectors and fastening devices. Examine the chassis for corrosion and damage that may require refinishing.

C. Connectors.

Inspect connector bodies for broken parts, deformed shells or clamps, and other irregularities. Inspect for cracked or broken insulation and for contacts that are broken, deformed, or out of alignment. Check for corroded or damaged plating on contacts and for loose, poorly soldered, broken, or corroded terminal connections.

D. Covers and Shields.

Inspect covers and shields for punctures, deep dents, and badly worn surfaces. Check for damaged fastening devices, corrosion, and other damage that may require refinishing.

E. Insulators: Ceramic, Mycalex, and Plastic.

Inspect ceramic, Mycalex, and plastic insulators for evidence of damage, such as broken or chipped edges, burned areas, or foreign material. Check for loose, corroded, or poorly soldered connections.

F. Jacks.

Inspect all jacks for corrosion, loose or broken parts, cracked insulation, and other irregularities.

G. Machined Metal Parts.

Inspect machined metal parts for physical damage to surfaces, corners, and edges. Closely inspect all machined surfaces, holes, bores, counterbores, slots, grooves, ,shoulders, flanges, tapped holes, and all threaded members, both male and female, for damage of any sort including roughness of surface, corrosion, or foreign matter. Inspect plated or finished areas for damage requiring replating or refinishing beyond touchup repair.

H. Mechanical Metal Parts.

Inspect unmachined mechanical metal parts, including mounting plates, chassis, mounting clamps, brackets, nuts, bolts, screws, washers, fasteners, and other hard- ware for damage or deformation. Inspect for corrosion and any damage that would require replating or refinishing beyond touchup repair.

I. Panels.

Inspect all panels for physical damage and deformation, marred surfaces, and impairment of markings.

J. Printed Circuit Boards.

Inspect printed circuit boards for loose, broken, corroded, or poorly soldered terminal connections. Inspect for any evidence of damage, such as burned, broken, cracked, or corroded plating. Check for loose or improperly soldered components and for loose mounting of the circuit boards.

K. RF Coils.

Inspect rf coils for broken leads, loose mountings, and loose, poorly soldered, or broken terminal connections. Also, check for crushed, scratched, cut, bruised, or charred windings, corrosion on windings, leads, terminals, and connections, and for physical damage to forms.

L. Receptacles.

Inspect receptacles for cracked, broken, or charred insulation. Inspect for damage to all other parts, loose or bent contacts, damage to contact plating, corrosion, and other abnormal conditions.

M. Relays.

Inspect encapsulated relay cases, mountings, and terminal connections for looseness, physical damage, corrosion, and improperly soldered connections.

N. Resistors.

Inspect fixed composition resistors for cracked, broken, blistered, or charred bodies and for loose, broken, poorly soldered, or corroded terminal connections.

Inspect fixed wire-wound resistors for signs of heating, cracked, broken, or charred insulation, loose, poorly soldered, broken, or corroded terminal connections, and loose mounting.

Inspect variable resistors for corrosion of shafts, cases, or other visible parts, loose mountings, and physical damage. Where possible, rotate the shaft to determine whether action is too rough, too loose, or too tight.

O. Semiconductors.

Inspect diodes and transistors for cracked, broken, blistered, or damaged bodies and cases. Inspect for loose, broken, poorly soldered or corroded terminal connections.

P. Soldered Terminal Connections.

Inspect soldered terminal connections for cold-soldered or rosin joints. These joints present a porous or dull, rough appearance. Check for strength of bond using a pointed tool. Examine for excess of solder, protrusions from the joint, pieces adhering to adjacent insulation, and particles lodged between joints, conductors, or other parts. Inspect for insufficient solder and unsoldered strands of wire protruding from conductor joints. Also check for insulation that is stripped back too far from joints or badly frayed at the joint. Inspect for corrosion on copper conductor joints.

Q. Transformers and Inductors.

Inspect transformers and inductors for signs of excessive heating, physical damage to cases, cracked or broken insulators, and other irregularities. Inspect for corroded, poorly soldered, or loose terminals and for loose, broken, or missing mounting hardware.

R. Vibration Isolators.

Inspect the metal parts of vibration isolators for corrosion, damaged surfaces, and deformation. Inspect the elastic members for deep cracks and other physical damage. Inspect elastic members for loss of resiliency by manually distorting and noting return to normal position upon release. Sluggish return or failure to return completely to normal position indicates a defective isolator.

S. Wiring.

Inspect open and laced wiring of chassis, terminal boards, and parts by checking insulation for physical damage and charring. Inspect wires for break-age and for improper dress in relation to adjacent wiring and chassis.

Section V. REPAIR

3-13. GENERAL.

This section presents instructions and procedures for the replacement or repair of damaged or defective components of the SN-358A Synchronizer and the MT-3069 Shockmount. Faulty components are usually detected through procedures in the inspection/check or testing sections of this manual. New parts should be inspected and/or tested before being installed. Most of the replacements or repair instructions apply to disassembled equipment. Refer to the disassembly section for proper instructions.

3-14. REPAIR PROCEDURES.

Figure 3-19 lists an alphabetically arranged index (REFER TO PARAGRAPH column) of repair procedures. Each component, part, or assembly is cross referenced to the appropriate paragraph containing the correct repair procedure.

ITEM	REFER TO PARAGRAPH
Capacitors	3-14.A
Connectors	3-14.B
Covers and shields	3-14.C
Finished surfaces	3-14.D
Frames	3-14.E
Insulators: Ceramic, Mycalex, and plastic	3-14.F
Jacks	3-14.G
Machined metal parts	3-14.H
Mechanical metal parts	3-14.I
Panels	3-14.J
Printed circuit boards	3-14.K
Rf coils	3-14.L

Index of Repair Procedures (Sheet 1 of 2)
Figure 3-19

ITEM	REFER TO PARAGRAPH
Relays	3-14.M
Resistors	3-14.N
Semiconductors	3-14.O
Soldered terminal connections	3-14.P
Transformers and inductors	3-14.Q
Vibration isolators	3-14.R
Wiring	3-14.S

Index of Repair Procedures Sheet 2 of 2)
Figure 3-19

A. Capacitors.

If defective or if performance is questionable, capacitors should be replaced. Clean all connections thoroughly and apply new solder.

B. Connectors.

Straighten bent pins and damaged shell areas. Replace defective connectors, broken wires, or wires with split insulation. If a connector insert is broken, replace the connector.

C. Covers and Shields.

Replace damaged screws, straighten any dents or warped sections, and retouch scratched or worn painted surfaces.

D. Finished Surfaces.

Touch up minor scratches in all painted surfaces with a high-quality, black enamel applied with a small brush. Refinish black wrinkle as required, in accordance with MIL-E-5558A and MIL-P-8585A. Refinish black lusterless surfaces, as required, in accordance with MIL-E-14072 (SIGC). Touch up unpainted aluminum with Alodine 1200, or suitable water-lacquer mixture, applied with a pipe cleaner or small brush.

E. Frames.

Straighten all misshapen areas. Remove all corrosion with a suitable cleaner. Retouch silk screening, and refinish where needed.

F. Insulators.

Replace any insulators which show signs of physical damage, such as cracks, burns, chips, or any other type of damage or deterioration.

G. Jacks.

Replace cracked, broken, or severely misshapen jacks or jacks with bent or broken center conductors or insulation.

H. Machined Metal Parts.

If satisfactory machine shop facilities for suitable repair of these surfaces are not available, the defective or damaged part should be replaced.

I. Mechanical Metal Parts.

Straighten bent or misshapen mounts, clamps, and mounting plates. Replace broken, bent or cross-threaded bolts, screws, nuts, washers, and other hardware.

J. Panels.

Replace cracked, chipped, broken, or otherwise damaged panels. Retouch or refinish in accordance with paragraph D above.

K. Printed Circuit Boards.

Replace any cracked, broken, chipped, or otherwise damaged printed circuit boards. Repair of these boards is not recommended.

L. RF Coils.

Replace cracked, chipped, broken or burned rf coils or coils with damaged tuning slugs.

M. Relays.

If a relay appears to be defective or intermittent, the relay should be replaced. Damaged relays are replaced as individual units. Make a sketch of wire connections to facilitate rewiring. Sealed relays cannot be repaired if found defective. Clean all connections and apply new solder.

N. Resistors.

If defective or if performance is questionable, resistors should be replaced. Clean all connections thoroughly and apply new solder. Add a drop or two of contact cleaner (carbon tetrachloride) to the windings or variable resistors with rough or intermittent operation. Replace variable resistors if the shaft is loose in the case. Clean corroded terminals.

O. Semiconductors.

If a semiconductor appears defective or is suspected of questionable operation, it should be replaced. Replace any semiconductor which shows signs of overheating or which has damaged cases.

CAUTION: TO PREVENT DAMAGE, USE A HEAT SINK BETWEEN THE LEAD BEING SOLDERED AND THE SEMICONDUCTOR DEVICE.

P. Soldered Terminal Connections.

Resolder cold-soldered or rosin joints. Remove all traces of corrosion.

Q. Transformers and Inductors.

Replace all cracked, chipped, or charred transformers and inductors. Replace all transformers and inductors if defective or suspected of questionable performance. Identify leads to facilitate rewiring. Clean all connections thoroughly and apply new solder.

R. Vibration Isolators.

Ensure that the metal parts of vibration isolators are clean and free from corrosion and physical defects. Isolators whose elastic members show loss of resiliency should be replaced.

S. Wiring.

Replace damaged wiring with wire of the same size and color coding. Ensure that no bare wires are touching the chassis, other bare wires, or metal cases of other parts. If a wire is to be removed from a terminal or component, it should be marked with an identification tag to minimize incorrect connections. Clean all terminals and apply new solder.

NOTE: When necessary to disturb the dress of wires or cables, carefully ensure that the original wire dress is restored.

Section VI. ASSEMBLY

3-15. GENERAL.

This section presents instructions for assembling the SN-358A Synchronizer and the MT-3069 Shockmount. These instructions are arranged so that assembly of each major part is an individual operation. Reference is made to subsequent assembly steps that must be performed to completely restore the unit. The order of assembly begins with the lowest parts, proceeds to the next higher subassemblies, and ends with the completed unlit. These instructions include special techniques, cautions, warnings, and unique procedures.

3-16. PRECAUTIONS AND GENERAL TECHNIQUES.

Before soldering any lead or component, refer to the notes of color coding, placement of leads, and wire insulation made during disassembly. If there is any doubt as to the placement of such leads of components, refer to the appropriate diagrams and perform continuity tests to ensure proper replacement. Ensure, also, that proper dress or lacing of wires and cables is restored.

CAUTION: TO PREVENT DAMAGE TO A SOLID-STATE DEVICE, USE A HEAT SINK ON THE LEAD BETWEEN THE POINT BEING SOLDERED AND THE DEVICE.

WARNING: THE SYNCHRONIZER USES EXTREMELY HIGH VOLTAGES. DO NOT ATTEMPT ANY ASSEMBLY WHILE PRIMARY POWER IS APPLIED TO THE UNIT. ENSURE THAT THE POWER CABLE IS REMOVED TO PREVENT VOLTAGE TRANSIENTS WHICH COULD DAMAGE OR DESTROY SEMICONDUCTORS.

These precautions are repeated in the text of the assembly procedures, where applicable.

3-17. ASSEMBLY PROCEDURE.

A. Assemble MT-3069 Shockmount. (Refer to figure 3-15.)

(1) Replace the vibration isolators as follows:

(a) Replace vibration isolator (22) by securing it to baseplate (5) with two machine screws (23) and two hexnuts (24).

(b) Replace two vibration isolators (19) by securing them to baseplate (5) with four machine screws (20) and four hexnuts (21).

(c) Replace two vibration isolators (16) by securing them to baseplate (5) with four machine screws (17) and four hexnuts (18).

(2) Secure shockmount tray (4) to baseplate (5) as follows:

(a) Place shockmount tray (4) in mounting position.

(b) Replace two grounding straps (12) by securing them to baseplate (5) with four machine screws (13), four flat washers (14), and four hexnuts (15).

NOTE: Liquid-stake isolator screws (6, 11) using grade C sealant (Collins part number 005-0548-00).

(c) Replace machine screw (11).

(d) Replace two machine screws (6) and two flat washers (7).

(e) Replace two machine screws (8), two flat washers (9), and two lock washers (10).

(3) Replace front retainers (1) by replacing pin (3) and cotter pin (2).

NOTE: Apply an ample coating of aircraft and instrument grease (Collins part number 005-0234-00), as per MIL-G-3278, to pin and bearing after assembly.

B. Replace Synchronizer Detector Board Assembly. (Refer to figure 3-14.)

(1) Place the detector board assembly in mounting position and solder the leads to the board terminals.

(2) Secure detector board assembly TB1 (26) to chassis assembly (4) with five machine screws (27), and five lock washers (28).

(3) Replace outer dust cover (1) in accordance with paragraph G below.

C. Replace Synchronizer Transformer Plate. (Refer to figure 3-14.)

NOTE: Components mounted on the transformer plate should be replaced before proceeding with this procedure.

(1) Place the transformer plate in mounting position.

(2) Secure transformer plate (25) to chassis assembly (4) with machine screws (23) and lock washers (24).

(3) Replace outer dust cover (1) in accordance with paragraph G below.

D. Replace Front Panel. (Refer to figure 3-14.)

NOTE: Components mounted on the rear of the front panel should be replaced before proceeding with this procedure. Replace front panel (17) by securing it to chassis assembly (4) with six machine screws (18), six lock washers (19), six flat washers (20), two machine screws (21), and two lock washers (22).

E. Replace Wired Heat Sink. (Refer to figure 3-14.)

(1) Replace wired heat sink (12) by securing it to chassis assembly (4) with five machine screws (15) and five lock washers (16).

(2) Replace sweep generator and amplifier module (11) in accordance with paragraph F below.

(3) Replace outer dust cover (1) in accordance with paragraph G below.

F. Replace Plug-in Modules. (Refer to figure 3-14.)

(1) Replace if. amplifier module (13) and secure it in position by rotating hold-down bracket (14).

(2) Replace modules (5 through 11).

NOTE: Connect J1 on wired heat sink (12) after replacing sweep generator and amplifier module (11).

(3) Replace outer dust cover (1) in accordance with paragraph G below.

G. Replace Outer Dust Cover. (Refer to figure 3-14.)

(1) Slide dust cover (1) over chassis assembly (4).

(2) Secure two twist lock fasteners (2) on the rear of the dust cover, and replace two machine screws (3) and two flat washers on the right side of the cover.

Section VII. TESTING

3-18. GENERAL.

This section presents information and procedures to test and align the SN-358A Synchronizer.

3-19. TEST EQUIPMENT REQUIRED.

Refer to figure 3-26 for equipment required to test the SN-358A Synchronizer.

3-20. TEST PROCEDURES.

A. Use of Test Procedures.

(1) Overall Test Procedures.

The overall unit test procedures present a procedure testing the unit with a AN/APM-247 (978G-1) Radar Test Set. The procedures using the test set are contained in figure 3-22 in tabular form. The STEP/TEST column denotes the step number and test nomenclature of each complete test, the PROCEDURE column gives direction or commands to be performed on the equipment or associated test equipment, the 978G-1 INSTRUCTIONS column gives instructions necessary to operate the 978G-1 Radar Test Set, and the RESULTS/NOTES column gives the indication expected for the test being performed. The AN/APM-247 is referred to by its commercial nomenclature (978G-1) throughout the test procedure.

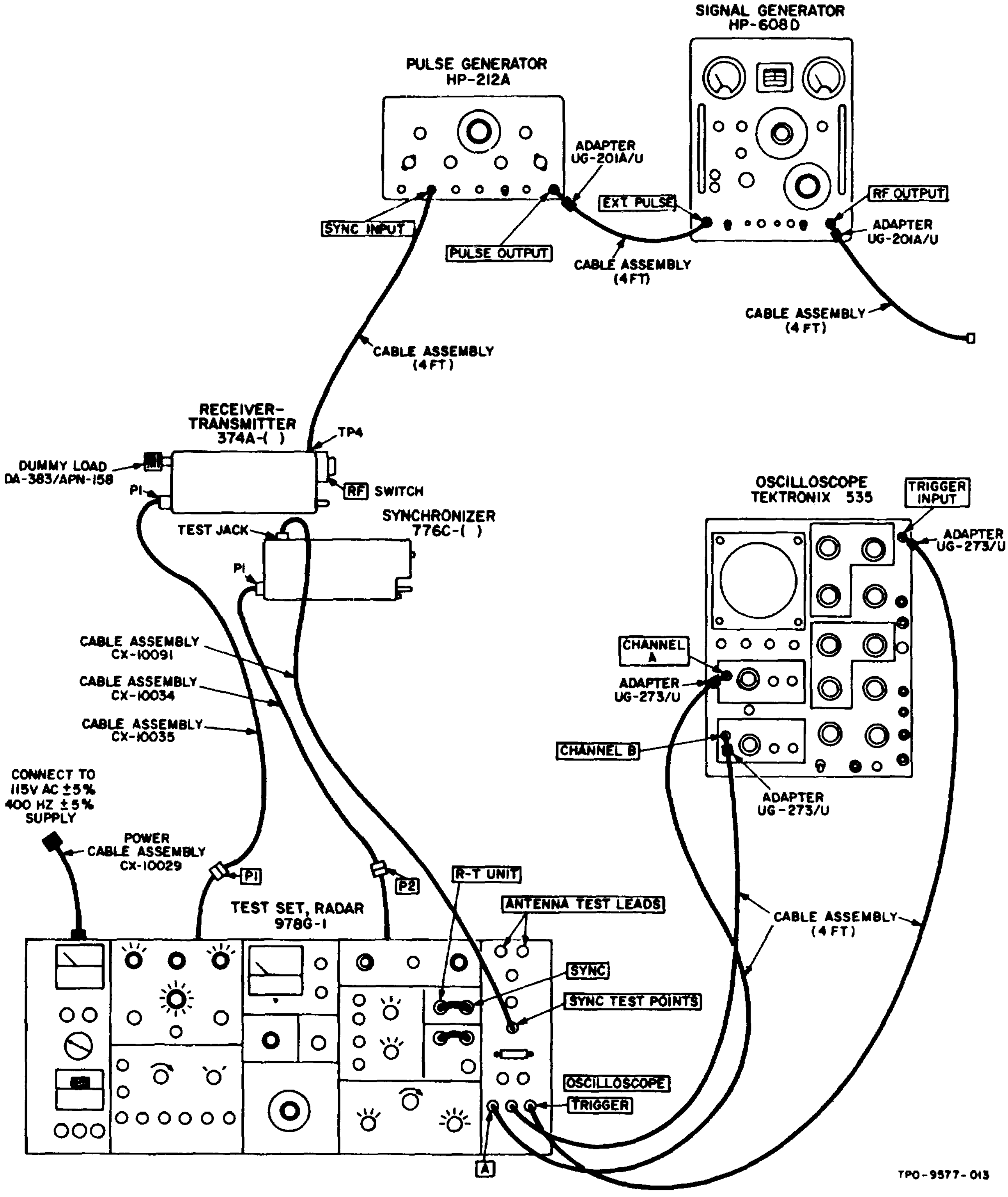
(2) Individual Module Test Procedures. The individual module test procedures test the modules with the MK-774/ APN-158 Radar Maintenance Kit. The procedure using the test set is contained in figure 3-24 in tabular form. The STEP/TEST column denotes the step number and test nomenclature for each complete test, the PROCEDURE column gives direction or commands to be performed on the equipment or associated test equipment, the 979A-2 SETTING column gives instructions necessary to operate the 979A-2, the RESULTS/NOTES column gives the indication expected for the test being performed, and the ALIGNMENT/ TROUBLESHOOTING column gives the alignment instructions and/or possible cause of a malfunction. The MK-774/APN-158 is referred to by its commercial nomenclature (979A-2) throughout the test procedure.

(3) Overall System Test Setup Procedures Using the AN/APM-247 (978G-1) Test Set.

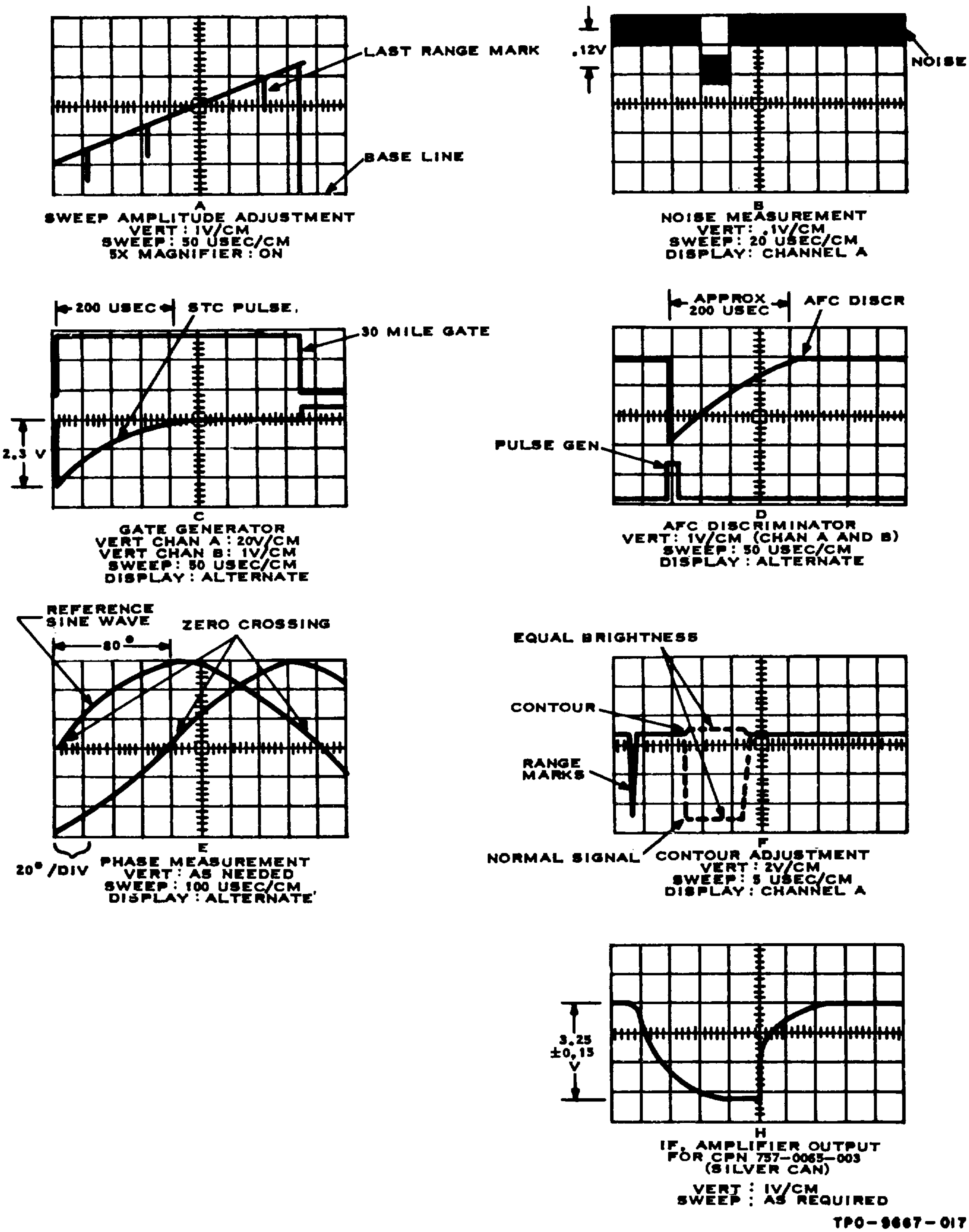
(a) Connect the SN-358A Synchronizer into the system harness with the associated equipment per figure 3-20.

(b) Initially set the AN/APM-247 (978G-1) Test Set control as follows:

1. Set the AC POWER switch to OFF.
2. Set the METER MULTIPLIER switch to X10.
3. Set the SYSTEM CONTROL switch to OFF.
4. Set the INPUT VOLTAGE ADJUST control to counterclockwise stop.
5. Set the TEST FUNCTION switch on the RECEIVER/TRANSMITTER TEST subpanel to OFF.
6. Set the TEST FUNCTION switch on the SYNCHRONIZER TEST subpanel to OFF.
7. Set the ANTENNA TESTS switch to OFF.
8. Set the GYRO SIMULATOR switch to OFF.
9. Connect the test set to a 115-volt, 400-Hz power source.
10. Perform the procedures as outlined in figure 3-22.



Synchronizer Bench Test Setup Using the AN/APM-247 Radar Test Set
Figure 3-20



Waveforms for Testing
Figure 3-21

STEP/TEST	PROCEDURE	978G-1 INSTRUCTIONS	RESULTS/NOTES
1. Preliminary setup	a. Set all switches to OFF or fully counter-clockwise.		
	b. Connect and/or verify equipment (per figure 3-20).		
	c. Apply power to the 978G-1 Radar Test Set.	c. AC POWER switch to ON.	c. AC POWER lamp lights.
	d. Note input frequency on978G-1 FREQUENCY METER.		d. Frequency is 400 ±20 Hz.
	e. Set up the 978G-1.	e. TEST FUNCTION SELECTOR switch to SYNCHRONIZER TESTS, SYSTEM CONTROL to OPERATE, and TEST FUNCTION switch on the SYNCHRONIZER TESTS subpanel to GATE.	
	f. Set the mode selector on the oscilloscope to A ONLY. will appear on channel A.		f. Check oscilloscope setup and ensure that a signal
2. Gate pulse	a. Measure the peak-to-peak amplitude and rise time of the pulse displayed on the oscilloscope (figure 3-21).		a. Amplitude: Not less than20 v. Rise time: Not more than 2.5 us. (10 and 90% points).

SN-358A Synchronizer Test Procedures Using the AN/APM-247 Radar Test Set
(Sheet 1 of 14)
Figure 3-22

STEP/TEST	PROCEDURE	978G-1 INSTRUCTIONS	RESULTS/NOTES
2. (Cont.)	b. Set the 978G-1.	b. TEST RANGE SELECTOR switch to 30, 60, and 150 in sequence. (R31 on gate generator module may be adjusted to meet specifications.)	b. Gate length. POSITION / PULSE WIDTH 30 — 430 ±30 us. 60 — 860 ±50 us. 150 — 2100 +90 us.
3. Range marks	a. Set the 978G-1.	a. TEST FUNCTION switch on the SYNCHRONIZER TESTS subpanel to RANGE and the TEST RANGE SELECTOR switch to 30, 60, and 150 in sequence. (Measure the amplitude and width of channel A. pulse on oscilloscope.)	a. Amplitude: Negative, not less than 5 v. Width: Not more than4 us. **<u>NOTE</u>- Pulse is displayed on**
(Cont.)	b. Set the 978G-1.	b. TEST RANGE SELECTOR switch to 30, 60, and 150 in sequence.	b. Mark Spacing.

SN/358A Synchronizer Test Procedures Using the AN/APM-247 Radar Test Set
Figure 3-22

STEP/TEST	PROCEDURE	978G1 INSTRUCTIONS	RESULTS/NOTES
3. (Cont.)		Measure the time between the start of the sweep and the third, fourth, and sixth range mark.	RANGE / MARK / TIME (us.) 30 Third 370 ±25 60 Fourth 740 ±40 150 Sixth 1855 ±75
4. Phase detector	**NOTE: Remove gate generator module from synchronizer chassis.**		
	a. Set the 978G-1.	a. TEST FUNCTION switch on the SYNCHRONIZER TESTS subpanel to PHASE DETECTOR, PHASE DETECTOR switch to Y BAL (NULL), and TEST RANGE SELECTOR to 30.	
(Cont.)		b. Note TEST METER.	b. Meter indicates in the green range (scale X10).

SN-358A Synchronizer Test Procedures Using the AN/APM-247 Radar Test Set
(Sheet 3 of 14)
Figure 3-22

STEP/TEST	PROCEDURE	978G-1 INSTRUCTIONS	RESULTS/NOTES
4. (Cont.)		c. METER MULTIPLIER switch to X1 and note TEST METER. (Y-POSITION potentiometer R14 on lower left side of synchronizer may be adjusted.)	c. Meter indicates center scale null of less than one-half of one minor scale division.
	d. Set the 978-1.	d. PHASE DETECTOR switch to Y-LENGTH (50) and note TEST METER. (Adjust EXC LEVEL potentiometer R15 on lower left side of synchronizer).	d. Meter indicates 22.5±1.0 v.
	e. Set the 978G-1.	e. PHASE DETECTOR switch to X BAL (NULL) and note TEST METER. (Adjust X- POSITION potentiometer R13 on lower left side of synchronizer.)	e. Meter indicates center scale null of less than one-half of one minor scale division.
	f. Set the 978G-1.	f. PHASE DETECTOR switch to X-LENGTH (50) and note TEST METER.	f. Meter Indicates 22.5±1. 0 v.
5. Sweep balance (Cont.)	a. Set the 978G-1.	a. TEST FUNCTION switch on SYNCHRONIZER TESTS subpanel to SWEEP BAL(NULL), SWEEP BAL(NULL) switch to X, and note TEST METER. (Adjust X-balance potentiometer R6 on the sweep generator and amplifier module.)	a. Meter Indicates center scale null of less than one-half of one minor division.

SN-358A Synchronizer Test Procedures Using the AN/APM-247 Radar Test Set
(Sheet 4 of 14)
Figure 3-22

STEP/TEST	PROCEDURE	978G-1 INSTRUCTIONS	RESULTS/NOTES
5. (Cont.)	b. Set the 978G-1.	b. SWEEP BAL (NULL) switch to Y and note TEST METER. (Adjust Y-balance potentiometer R28 on the sweep generator and amplifier module.)	b. Meter indicates center scale null of less than one-half of one minor division.
	c. Set the 978G-1.	c. SYSTEM CONTROL to STANDBY.	
	d. Reinstall gate generator module.		
	e. Set the 978G-1.	e. SYSTEM CONTROL to OPERATE.	
6. Sweep calibration	a. Set the 978G-1.	a. TEST FUNCTION switch on the SYNCHRONIZER TESTS subpanel to SWEEP CAL, SWEEP CAL switch to SCOPE CAL (5V), and note the TEST METER.	a. Meter indicates 4.0$\pm$0.2 v.
		NOTE: **Check the calibration of the oscilloscope.**	Oscilloscope indicates a dc level of 4.0 *0.2 v on channel A and B.
	b. Set the 978G-1.	b. SWEEP CAL to UP and TEST RANGE SELECTOR switch to 30.	

SN/358A Synchronizer Test Procedures Using the AN/APM-247 Radar Test Set
(Sheet 5 of 14)
Figure 3-22

STEP/TEST	PROCEDURE	978G-1 INSTRUCTIONS	RESULTS/NOTES
6. (Cont.)	c. Adjust channel A and channel B vertical controls of the oscilloscope until the baselines of the two waveforms coincide. Observe the difference in voltages at last range mark that is displayed on oscilloscope.		c. Oscilloscope indicates4.0 $\pm$0.2 v. __NOTE__: **Adjust R42 on and amplifier module. (Use module extender. Set SYSTEM CONTROL to STANDBY to insert extender.)**
	d. Set the 978G-1.	d. TEST RANGE SELECTOR switch to 60 and repeat step c between the fourth range marks.	d. Oscilloscope indicates4.0 $\pm$0.1 v. __NOTE__: **Adjust R43 for the sweep generator and amplifier module.**
	e. Set the 978G 1.	e. TEST RANGE SELECTOR switch to 150 and repeat step c between the sixth range mark.	e. Oscilloscope indicates4.0 $\pm$0.1 v. __NOTE__: **Adjust R44 on the sweep generator and amplifier module.**
	f. Set the 978G-1.	f. SWEEP CAL to DOWN. TEST RANGE SELECTOR to 30, 60, and 150.	f. Oscilloscope indicates4.0$\pm$0.1v for each range.
			__NOTE__**:** **Adjust Y1-R29, R30, R31 on sweep generator and amplifier module.**

SN-358A Synchronizer Test Procedures Using the AN/APM-247 Radar Test Set
(Sheet 6 of 14)
Figure 3-22

STEP/TEST	PROCEDURE	978G-1 INSTRUCTIONS	RESULTS/NOTES
6. (Cont.)	g. Set the 978G-1.	g. SWEEP CAL to RIGHT. TEST RANGE SELECTOR to 30, 60, and 150.	g. Oscilloscope indicates4.0 ±0.1 v for each Range. **<u>NOTE</u>**: **Adjust X1-R7, R8, R9 on sweep generator and amplifier module.**
	h. Set the 978G-1.	h. SWEEP CAL to LEFT. TEST RANGE SELECTOR to 30, 60, and 150.	h. Oscilloscope Indicates4.0 ±0. 1 v for each Range. **<u>NOTE</u>**: **Adjust X2-R17, R18, R19 on sweep generator and amplifier module.**
7. Automatic Frequency control (afc)	a. Set RF switch on R/T to ON. b. Set the meter switch on the receiver/transmitter to AFC.		
	c. Set the 978G-1.	c. TEST FUNCTION switch on SYNCHRONIZER TESTS subpanel to AFC OUT(-500V).	
(Cont.)	d. Disconnect the coax jumper from the AFC SYNC jack on the 978G-1.		

SN-358A Synchronizer Test Procedures Using the AN/APM-247 Radar Test Set
(Sheet 7 of 14)
Figure 3-22

STEP/TEST	PROCEDURE	978G-1 INSTRUCTIONS	RESULTS/NOTES
7. (Cont.)	e. Connect cable assembly from RF OUTPUT jack of the HP-608D to the AFC SYNC jack on the 978G-1. f. Remove cable from 978G-1 OSCILLOSCOPE TRIGGER. Using a "T" connector, connect oscilloscope TRIGGER INPUT to HP-608D EXT PULSE (PULSE OUTPUT from HP-212A). g. Set the output of the pulse generator for a positive5-us., 20-v pulse. h. Set the HP-608D for a pulsed 5-us., 30. 00-MHz signal at a level of-13 dBm. **NOTE: The db level is very critical and should be adjusted with the utmost care.**		
(Cont.)	**NOTE: Temporarily connect RF output to channel A of oscilloscope, and observe RF in both CW and PULSE positions. The two peak-to-peak levels must be identical.**		

SN-358A Synchronizer Test Procedures Using the AN/APM-247 Radar Test Set
(Sheet 8 of 14)
Figure 3-22

STEP/TEST	PROCEDURE	978G-1 INSTRUCTIONS	RESULTS/NOTES
7. (Cont.)	i. Using extender (MX-6424), extend the afc module.		
	j. Connect cable assembly with a X10 probe to the oscilloscope channel A.		
	k. Set oscilloscope MODE switch to A ONLY.		
	l. Connect channel A standard test probe to pin B of the afc module and observe the oscilloscope.		l. Observe 3.25 ±0.25-v negative pulse.
	m. Connect X10 probe (channel A) to AFC test point on rear of synchronizer(dc coupled oscilloscope).		
	n. Set HP-608D attenuation to -25 dbm.		n. Display sweeps from-150±10 to-215 ±10 v.
	o. Set the HP-608D attenuation to -13 dbm. (Check SET LEVEL on HP-608D.)		
	p. Adjust the HP-608D frequency for an indication of -185 v on the 978G-1 TEST METER.		p. HP-608D reads 30.00 MHz ±0.2MHz.
(Cont.)	<u>**NOTE**</u>: **If necessary, adjust R7 on afc module for -185 V with 30.00 ±0.2 MHz input.**		

SN-358A Synchronizer Test Procedures Using the AN/APM-247 Radar Test Set
(Sheet 9 of 14)
Figure 3-22

STEP/TEST	PROCEDURE	978-1 INSTRUCTIONS	RESULTS/NOTES
7. (Cont.)	q. Increase frequency to obtain -150 vdc.		q. HP-608D reads less than 31.0 MHz.
	r. Decrease frequency to cause sweeping indication, then raise to just stop sweeping.		r. TEST METER reads 215 $\underline{+}$10 v. HP-608D reads not less than 29 MHz.
	s. Disconnect cable of step e and reconnect receiver/ transmitter to AFC SYNC jack.		
8. STC pulse	a. Set the 978G-1.	a. TEST FUNCTION switch on the SYNCHRONIZER TESTS subpanel to STC.	
	b. Connect oscilloscope trigger input to 978G-1 OSCILLOSCOPE TRIGGER and oscilloscope CHANNEL A input to OSCILLOSCOPE A on 978G-1.		
	c. Measure the amplitude and pulse width of the signal on the oscilloscope. (Adjust R35 on the gate generator module.)		c. Display has peak-to-peak amplitude of 2.5±0.2 v with a rise time(10 and 90% points) not greater than 15 us. and a fall time (10 and 80% points) of 160 50 us.
9. Receiver gain. (Cont.)	a. Set the 978G-1	a. TEST FUNCTION switch on SYNCHRONIZER TESTS subpanel to VIDEO.	

SN/358A Synchronizer Test Procedures Using the AN/APM-247 Radar Test Set
(Sheet 10 of 14)
Figure 3-22

STEP/TEST	PROCEDURE	978G-1 INSTRUCTIONS	RESULTS/NOTES
9. (Cont.)	b. Connect cable from TP4 on the R/T to the SYNC INPUT jack on the pulse generator. Connect cable from 978G-1 OSCILLOSCOPE TRIGGER to oscilloscope TRIGGER INPUT.		
	c. Connect a cable from the PULSE OUTPUT jack on the pulse generator to the EXT PULSE jack on the HP-608D.		
	d. Disconnect the jumper from the IF SYNC jack on the 978G-1 IF subpanel.		
	e. Connect a cable from the RF OUTPUT jack on the HP-608D to the IF SYNC jack on the 978G-1 IF subpanel.		
	f. Set the MODE SELECTOR switch on the HP-608D to CW and adjust for 30-MHz output signal.		
(Cont.)	g. Set the output level of the HP-608D by setting the panel meter to SET LEVEL with the OUTPUT LEVEL control. (This calibrates the attenuator in the HP-608D for direct dial indication readings.)		

SN-358A Synchronizer Test Procedures Using the AN/APM-247 Radar Test Set
(Sheet 11 of 14)
Figure 3-22

STEP/TEST	PROCEDURE	978G-1 INSTRUCTIONS	RESULTS/NOTES
9. (Cont.)	h. Set the pulse generator for a 10 µs wide, 20-V amplitude output pulse.		
	i. Set the MODE SELECTOR on the HP-608D to PULSE.		
	j. Observe the video display on the oscilloscope.		j. Display is negative going marks visible along the with noise and range baseline.
	k. Increase (negative) the output level of the HP-608D until the video pulse reaches maximum. (Adjust R12 in the video driver module.)		k. Oscilloscope displays a6-volt peak signal.
	l. Set the 978G-1.	1. TEST RANGE SELECTOR switch on the SYNCHRONIZER TESTS subpanel to60.	
	m. Observe range mark amplitude on oscilloscope. (Adjust R27 in the video driver module.)		m. Display is 4.5 to 5.5 v.
10. Contour	a. Set the 978G-1.	a. SYSTEM CONTROL switch to CONTOUR.	
	b. Adjust the attenuator on the HP-608D for a contoured display on the		b. Attenuator dial reading is -75 ±2 dbm. **NOTE: Adjust R23 on module to set contour.**

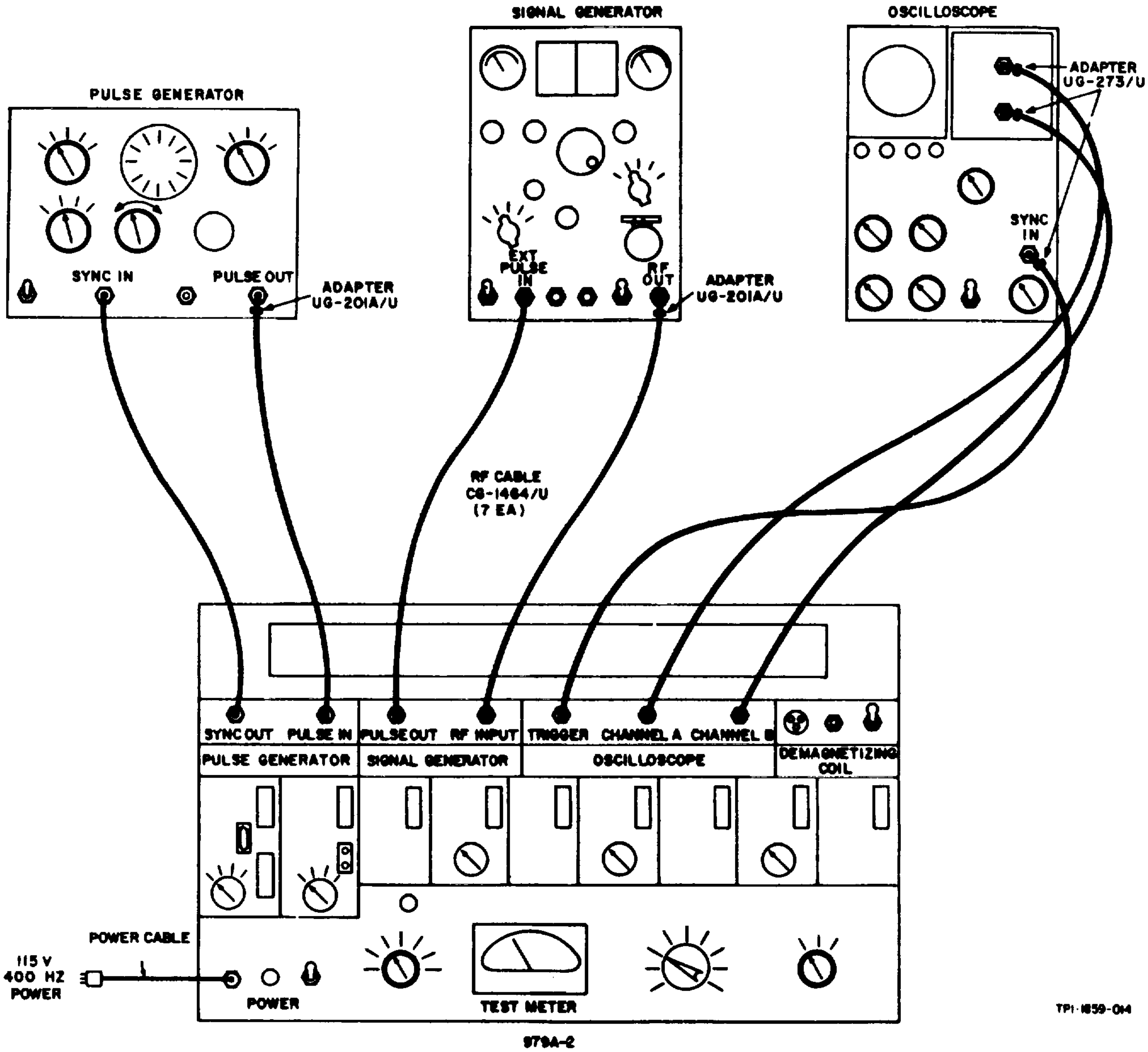
SN-358A Synchronizer Test Procedures Using the AN/APM-247 Radar Test Set
(Sheet 12 of 14)
Figure 3-22

STEP/TEST	PROCEDURE	978G-1 INSTRUCTIONS	RESULTS/NOTES
11. Isolation-amplifier gain	a. Set the 978G-1.	a. TEST FUNCTION switch on SYNCHRONIZER TESTS subpanel to ISO AMP GAIN, GYRO SIMULATOR switch to ON, ISO AMP (10VAC) switch to PITCH.	
	b. Set the 978G-1	b. PITCH control knob to 20 NOSE UP and note TEST METER indication. (Adjust PITCH AMPL potentiometer R10 on front of chassis	b. Meter Indicate 5. 0 v.
	c. Set the 978G-1.	c. ISO AMP switch to ROLL. ROLL control to 20 LEFT WING DOWN and note TEST METER indication. (Adjust ROLL AMP potentiometer R7 on front of chassis.)	c. Meter Indicates 5. 0 v
12. Isolation-amplifier phase	a. Set the 978G-1.	a. TEST FUNCTION switch on the SYNCHRONIZER TESTS subpanel to ISO AMP PHASE and ISO AMP switch to PITCH.	
	b. Set the MODE switch on the oscilloscope to ALTERNATE.		
(Cont.)	c. Adjust the waveforms on the oscilloscope to equal amplitude		

SN-358A Synchronizer Test Procedures Using the AN/APM-247 Radar Test Set
(Sheet 13 of 14)
Figure 3-22

STEP/TEST	PROCEDURE	978G-1 INSTRUCTIONS	RESULTS/NOTES
12. (Cont.)	d. Set the 978G-1.	d. PITCH control to 10.	d. Display on oscilloscope(channel A and B) coincides at the zero crossing points. **<u>NOTE:</u> Adjust PITCH PHASE potentiometer R8 on front of unit if necessary.**
	e. Set the 978G-1.	e. ISO AMP switch to ROLL, ROLL control to 10, and observe oscilloscope.	e. Same as step d. **<u>NOTE:</u> Adjust ROLL PHASE potentiometer R5 on front of the unit if necessary.**
13 Servo amplifier	a. Set the 978G-1.	a. TEST FUNCTION switch on SYNCHRONIZER TESTS subpanel to SERVO (50VAC), SERVO (50VAC) switch to STAB, and observe TEST METER.	a. Meter indicates 10v or greater.
	b. Set the 978G-1.	b. SERVO (SOVAC) switch to RATE and note indication on TEST METER.	b. Meter indicates 10 v or greater.

SN-358A Synchronizer Test Procedures Using the AN/APM-247 Radar Test Set
(Sheet 14 of 14)
Figure 3-22



SN-358A Bench Test Setup Using the MK-774/APN-158 Radar Maintenance Kit
Figure 3-23

(4) Module Test Procedures Using the MK-774/APN-158 (979A-2) Radar Maintenance Kit.

Perform the following starting procedures before attempting any testing of modules in this section.

(a) Remove the top cover from the MK-774/APN-158 (979A-2) Radar Maintenance Kit.

(b) Set the switches as follows:

1. POWER to OFF.

2. DEMAGNETIZING COIL to OFF.

3. METER FUNCTION to OFF.

4. TEST FUNCTION SELECTOR to OFF.

5. All other switches may be in any position.

(c) Connect the power cable to the POWER connector on the front panel of the maintenance kit and the other end to a 115-volt, 400-Hz power source.

(d) Connect the standard test equipment to maintenance kit as shown in figure 3-23.

(e) Perform the following steps to ensure that the maintenance kit is operating properly:

1. Set the POWER switch to ON.

22 2. Set the METER FUNCTION switch to 115V AC, and check that the input voltage is between 109 and 121 volts ac.

3. Set the METER FUNCTION switch to +27.5V, and check that the TEST METER indicates 27.5 ±1.1 volts de on the 50-volt range.

4. Set the METER FUNCTION switch to -27V, and check that the TEST METER indicates -27.0 ±2.5 volts dc on the -50-volt range.

5. Set the METER FUNCTION switch to +15V, and check that the TEST METER indicates 15 ±2 volts dc on the +50-volt range.

6. Return the METER FUNCTION and POWER switches to the OFF

CAUTION: **MAKE CERTAIN THAT EITHER THE POWER SWITCH OR THE TEST FUNCTION SELECTOR SWITCH IS IN THE OFF POSITION BEFORE PLUGGING** MODULE INTO TEST SET.

(f) Plug in the module to be tested into the appropriate connector on the front of the test set; connectors are marked with module names. Remove module after testing is completed.

(g) Set the POWER switch to ON and proceed with tests in figure 7-24.

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
1. Sweep generator and amplifier	NOTE: Perform starting procedures in paragraph 3-20A(7) prior to starting of testing. NOTE: Check power connections and setup.			
a. Power supply loading	(1) Set the 979A-2.	(1) METER FUNCTION to +27.5V. TEST FUNCTION SELECTOR to SWEEP GENERATOR		
		(2) Rotate SWEEP GENERATOR TEST SELECTOR and the TEST RANGE SELECTOR through all possible combinations, observing the TEST METER for +27.5-v indications.	(2) Meter indicates less than one-half of one minor scale division deviation for all positions.	(2) Possible shorted wiring or defective components in power supply.
		(3) METER FUNCTION to +15V; repeat step (2).	(3) Refer to step (2).	(3) Refer to step (2).
b. X amplifier balance	(1) Set the 979A-2.	(1) SWEEP GENERATOR TEST SELECTOR TO X BAL.		
		(2) METER FUNCTION to TEST (X1); note TEST METER.	(2) Meter indicates a NULL ±1 minor scale division.	(2) Adjust X BAL potentiometer R6 on the sweep generator module.

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 1 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
1. (Cont)				
c. Y amplifier balance	(1) Set the 979A-2.	(1) SWEEP GENERATOR TEST SELECTOR to Y BAL.		
		(2) METER FUNCTION to TEST (X1); note TEST METER.	(2) Meter indicates a NULL ±1 minor scale division.	(2) Adjust Y balance potentiometer R28 on the sweep generator module.
d. General operation	(1) Set the 979A-2.	(1) METER FUNCTION to OFF, SWEEP GENERATOR TEST SELECTOR to X1, and TEST RANGE SELECTOR to 150.		
	(2) Set the oscilloscope as follows: (a) MODE to ALTERNATE. (b) Sweep speed to 500 us./cm. (c) Sensitivity (A) to 2 v/cm. (d) Sensitivity (B) to 10 v/cm.			

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 2 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
1. (Cont)	(3) Observe channel A and channel B waveforms.		(3) Display on channel B is 2100 ±90 us. long and has an amplitude of not less than +20 v; channel A is 2100 ±90 us. long (740 ±74 us. short range) and has an amplitude of 4.5 ±0.5 v.	(3) With sweep generator unplugged and the gate on, the input channel B signal is shorted and/or X1 sweep amplifier or range relay circuits are defective. If oscillations appear on the signals, select a new value for C18 in the range of 0 to 4700 pf.
	(4) Set the 979A-2.	(4) TEST RANGE SELECTOR to 60 and 30, individually.	(4) Display is same amplitude as in step (3) with 860 ±50 us. (370 ±37 us. short range) pulse width for 60 and 430 ±30 us. (124 ±12 us. short range) for 30.	(4) Same as step (3).
	(5) Set the 979A-2 and repeat steps (3) and (4).	(5) SWEEP GENERATOR TEST SELECTOR to X2.	(5) Refer to steps (3) and (4).	(5) Same as step (3) with X2 amplifier; select C19.
	(6) Set the 979A-2 and repeat steps (3) and (4).	(6) SWEEP GENERATOR TEST SELECTOR to Y1.	(6) Refer to steps (3) and (4).	(6) Same as step (3) with Y1 amplifier; select C20.
	(7) Set the 979A-2 and repeat steps (3) and (4).	(7) SWEEP GENERATOR TEST SELECTOR to Y2.	(7) Refer to steps (3) and (4).	(7) Same as step (3) with Y2 amplifier; select C21.

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 3 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
1. (Cont)				
e. 150-mile range sweep amplitude checks (preliminary)	(1) Recalibrate the oscilloscope. (2) Set the oscilloscope as follows: (a) MODE to channel A ONLY. (b) Sweep speed to 500 us./cm. (c) Sensitivity (A) to 1 v/cm. (d) Sweep magnifier to 5X.			
	(3) Set the 979A-2.	(3) TEST RANGE SELECTOR to 150.		
f. X1 amplifier	(1) Set the 979A-2.	(1) SWEEP GENERATOR TEST SELECTOR to X1.		
	(2) Observe display on channel A of oscilloscope.		(2) Display is a sawtooth waveform with superimposed range marks.	
(Cont)	(3) Adjust the horizontal control on the oscilloscope so that both the baseline and the last range mark			

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 4 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
1. (Cont)	on the sawtooth waveform are displayed (figure 3-21). (4) Adjust the vertical control on the oscilloscope so that the baseline of the waveform exactly coincides with the bottom horizontal graticule line on the face of the oscilloscope. (5) Verify amplitude of oscilloscope display.		(5) Display amplitude is 4.0 ±0.1 v at the intersection of the last range mark.	(5) Adjust X1-150 potentiometer R9 on the sweep generator.
g. X2 amplifier	(1) Set the 979A-2.	(1) SWEEP GENERATOR TEST SELECTOR to X2.	(1) Repeat steps f.(2) through f.(5).	(1) Adjust X2-150 potentiometer R-19 on the sweep generator.
h. Y1 amplifier	(1) Set the 979A-2.	(1) SWEEP GENERATOR TEST SELECTOR to Y1.	(1) Repeat steps f.(2) through f.(5).	(1) Adjust Y1-150 potentiometer R31 on the sweep generator.
i. Y2 amplifier (Cont)	(1) Set the 979A-2.	(1) SWEEP GENERATOR TEST SELECTOR to Y2.	(1) Repeat steps f.(2) through f.(5).	(1) Adjust Y2-150 potentiometer R44 on the sweep generator.

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 5 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
1. (Cont)				
j. 60-mile range sweep amplitude checks	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 60.		
	(2) Set the oscilloscope sweep speed to 100 us./cm.			
k. X1 amplifier	(1) Repeat steps f. (2) through f. (5).			(1) Adjust X1-60 potentiometer R8 on the sweep generator.
l. X2 amplifier	(1) Repeat steps f. (2) through f. (5) and g. (1).			(1) Adjust X2-60 potentiometer R18 on the sweep generator.
m. Y1 amplifier	(1) Repeat steps f. (2) through f. (5) and h. (1).			(1) Adjust Y1-60 potentiometer R30 on the sweep generator.
n. Y2 amplifier	(1) Repeat steps f. (2) through f. (5) and i. (1).			(1) Adjust Y2-60 potentiometer R43 on the sweep generator.
o. 30-mile range sweep amplitude	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 30.		
(Cont)	(2) Set oscilloscope sweep speed to 50 us./cm.			

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 6 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
1. (Cont)				
p. X1 amplifier	(1) Repeat step k. (1).			(1) Adjust X1-30 potentiometer R7 on the sweep generator.
q. X2 amplifier	(1) Repeat step l. (1).			(1) Adjust X2-30 potentiometer R17 on the sweep generator.
r. Y1 amplifier	(1) Repeat step m. (1).			(1) Adjust Y1-30 potentiometer R29 on the sweep generator.
s. Y2 amplifier	(1) Repeat step n. (1).			(1) Adjust Y2-30 potentiometer R42 on the sweep generator.
2. If. amplifier	NOTE: Perform starting procedures in paragraph 3-20A(7).			
a. Setup	(1) Set up the 979A-2.	(1) METER FUNCTION to +15V, TEST FUNCTION SELECTOR to IF AMPL, and IF AMPLIFIER TEST SELECTOR to DET 4&5.		
(Cont)				

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 7 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
2. (Cont)	(2) Set the oscilloscope as follows: (a) Sweep speed to 5 us./cm. (b) MODE to channel B ONLY. (c) Vertical sensitivity (B) to 0.5 v/cm. (3) Observe oscilloscope and set the pulse generator as follows: (a) Pulse polarity to positive. (b) Pulse amplitude to 1 v peak. (c) Pulse width to 5 us. (d) Sync to external negative. (e) Display to 25 us. from sync pulse. (4) Set the signal generator as follows: (a) Frequency to 30 MHz.			
(Cont)				

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 8 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
2. (Cont)	(b) Modulation to external pulse. (c) Amplitude to -65 dbm.			
b. Power supply loading	(1) Set the 979A-2.	(1) IF AMPLIFIER OUTPUT SELECTOR to each position; note TEST METER for each indication and position.	(1) Meter indicates 15 v for each position with a deviation of less than one-half of one minor scale division.	(1) Defective wiring or or components.
c. Detectors 4 and 5 center frequency check.	(1) Set the 979A-2.	(1) IF AMPLIFIER TEST SELECTOR to DET 4&5.		
	(2) Set the signal generator to 30 MHz at -90 dbm.			
	(3) Set the oscilloscope as follows: a. MODE to ALTERNATE b. Sweep speed to 10 us./cm. c. Sensitivity (A) to 0.1 v/cm d. Sensitivity (B) to 1 v/cm			
(Cont)				

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 9 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
2. (Cont)	(4) Vary signal generator frequency about 30 MHz and check for peak output.		(4) Peak output appears at 30.0 ±0.1 MHz.	(4) Set the signal generator to 30 MHz, and use a tuning tool to adjust transformers T6 and T5 (in order) for maximum pulse amplitude on channel A of the oscilloscope.
d. Detectors 4 and 5 noise check.	(1) Set the oscilloscope as follows: (a) Sweep speed to 20 us./cm. (b) Vertical sensitivity (A) to 0.1 v/cm.			
	(2) Set the signal generator to 30 MHz at -90 dbm and observe signal displayed on channel A of the oscilloscope.		(2) Average display level of baseline noise is 0.02 to 0.10 v and has no apparent oscillation.	(2) Select a value for R90 in the range of 180 to 390 ohms to obtain the proper noise level. Then repeat step 3.A.(6)(c) of the alignment procedure.
e. If. amplifier sensitivity (Cont)	(1) Set the signal generator output frequency to 30 MHz, and adjust the output level to 1.5 volts on channel A of the oscilloscope (figure 3-22)..		NOTE: This pattern represents a signal-plus-noise ratio of 2:1.	

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 10 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
2. (Cont)	(2) Note output level.		(2) Level is -75 ±2 dbm.	(2) Perform alignment procedure in step 3-20A(6)(c). If sensitivity remains low, check the individual gain of the transistors.
	(3) Set output level to -90 dbm.		(3) Oscilloscope indicates 0.1 volt or greater.	
f. If. amplifier bandwidth	(1) Set the signal generator output level for -90 dbm and record oscilloscope indication on channel A.			
	(2) Set signal generator dbm level to -87 dbm.			
	(3) Vary the signal generator frequency above and below 30 MHz and record the two frequencies that reduce the waveform level to that of step (1).		(3) Compute difference in two frequencies; difference is 1.2 ±0.4 MHz.	NOTE: No bandwidth adjustment is possible. The center frequency adjustment should be made.
	NOTE: Maintain rf set level.			NOTE: When signal generator frequency has been changed, recalibration of set level may be required.
(Cont)				

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 11 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
2. (Cont)				
g. Afc discriminator center frequency test	(1) Set the 979A-2.	(1) IF. AMPLIFIER SELECTOR switch to AFC DISC.		
	(2) Set the oscilloscope as follows: (a) Sweep speed to 5 us./cm (b) Vertical sensitivity (A) to 1 v/cm. (c) Vertical sensitivity (B) to 1 v/cm. (d) MODE to ALTERNATE.			
	(3) Observe pulse generator output on channel B and adjust for delay of 25 us.			
	(4) Set the signal generator frequency to 30.00 MHz at -13 dbm.			
	(5) Observe and measure display on channel A.		(5) Display is a negative pulse with a peak amplitude of 3.25 ±0.25 v and is coincident with the pulse generator output on channel B.	
(Cont)				

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 12 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
2. (Cont)				
h. Afc discriminator bandwidth and slope checks	(1) Reduce input dbm level to -15 dbm and set the frequency to 31.5 MHz.		(1) Oscilloscope indicates 6.5 volts or greater.	
	(2) Set input frequency to 30.00 MHz and reduce dbm input level to -25 dbm.			
	(3) Slowly raise dbm input level until waveform on oscilloscope starts to saturate (limit).		(3) Dbm level is -19 ±3.	
3. Gate generator	NOTE: Perform starting procedures in paragraph 3-20A(7).			
a. Setup	(1) Set the 979A-2.	(1) METER FUNCTION to +27.5V, TEST FUNCTION SELECTOR to GATE GEN, and TEST RANGE SELECTOR to 30.		
	(2) Set the oscilloscope as follows:			
(Cont)	(a) Sweep speed at 500 us./cm.			

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 13 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
3. (Cont)				
	(b) MODE to channel A ONLY.			
	(c) Vertical sensitivity (A) to 5 v/cm (dc).			
b. Power supply loading	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR through positions; note TEST METER.	(1) Meter indicates normal +27.5 v with a deviation of less than one-half of one minor scale division.	(1) Shorted wiring or defective components.
c. 30-mile gate	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 30.		
	(2) Check display on channel A of oscilloscope.		(2) Display is two positive pulses that have an amplitude of 20 v peak (minimum).	(2) Set the 979A-2 TEST FUNCTION SELECTOR to SWEEP GEN and check for gate signal. If pulses are present, the gate generator module is defective. Return switch to GATE GEN.
	(3) Set the oscilloscope sweep to 50 us./cm and check pulse width of display.		(3) Pulse width is 430 ±15 us. (124 ±10 short range) at 50% points.	(3) Adjust R31.
	(4) Set the oscilloscope sweep speed to 1 us./cm and check rise time of display.		(4) Rise time (10 and 90% points) is less than 2.5 us.	(4) Check C1, C5, and C12 in the gate generator.

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 14 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
3. (Cont)				
d. 60-mile gate	(1) Set the 979A-2	(1) TEST RANGE SELECTOR to 60; note that dc level of display does not shift noticeably.		(1) Check dc coupling between Q2 and Q4 on the gate generator.
	(2) Set the oscilloscope sweep speed to 100 us. and check pulse width of display.		(2) Pulse width is 860 ±30 us. (370 ±15 us. short range) at 50% points.	(2) Adjust R31 in the gate generator. If adjustment is made, recheck the 30-mile gate.
	(3) Set the oscilloscope sweep speed to 1 us./cm and check rise time of display.		(3) Rise time (10 and 90% points) is less than 2.5 us.	(3) Check C1, C5, and C12 on the gate generator.
e. 150-mile gate	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 150; note that dc level of display does not shift noticeably.		(1) Check dc coupling between A2 and Q4 on the gate generator.
	(2) Set the oscilloscope to 500 us./cm and check the pulse width of the display.		(2) Pulse width is 2100 ±50 us (740 ±30 short range) at 50% points.	(2) Adjust R31. Then check the 30- and 60-mile gates.
(Cont)	(3) Set the oscilloscope sweep speed to 1 us/cm and check the rise time of the display.		(3) Rise time (10 and 90% points) is less than 2.5 us.	(3) Check C1, C5, and C12 on the gate generator.

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 15 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
3. (Cont)				
f. Sensitivity time control	(1) Set the oscilloscope as follows: (a) MODE to ALTERNATE. (b) Sensitivity (A) to 10 v/cm. (c) Sensitivity (B) to 1 v/cm. (d) Sweep speed to 50 us/cm.			
	(2) Set the 979A-2.	(2) TEST RANGE SELECTOR to 30.	(2) Display on channel B is negative-going step that is coincident with the leading edge of the gate pulse on channel A (figure 703). Amplitude is 4.0 ±0.2 v.	(2) Adjust R35 on the gate generator.
	(3) Check recovery time of display.		(3) Recovery time (20 and 90% points) is 160 ±50 us.	(3) Check C6, R13, R35, CR3, and CR5 on the gate generator.
	(4) Set the 979A-2.	(4) TEST RANGE SELECTOR to all positions; observe display on channel B of oscilloscope.	(4) No variation appears in the waveform for each position for the first 200 us.	
(Cont)	(5) Set the 979A-2.	(5) TEST RANGE SELECTOR to 30.		

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 16 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
3. (Cont)	(6) Set the oscilloscope sweep speed to 5 us./cm and check rise time of the display on channel B.		(6) Rise time is less than 15 us.	(6) Recheck rise time of steps c, d, and e.
4. Elevation servo amplifier	NOTE: Perform starting procedures in paragraph 3-20A(7).			
a. Setup	(1) Set the 979A-2.	(1) METER FUNCTION to +15V and TEST FUNCTION SELECTOR to SERVO AMPL and POWER switch to ON.		
	(2) Set the oscilloscope as follows:			
	(a) Sweep speed to 500 us./cm.			
	(b) MODE to ALTERNATE.			
	(c) Vertical sensitivity (A) to 2 v/cm (ac).			
(Cont)	(d) Vertical sensitivity (B) to 0.1 v/cm (ac).			

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 17 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
4. (Cont)				
b. Power supply loading	(1) Set the 979A-2.	(1) SERVO AMPLIFIER TEST SELECTOR to all positions; note TEST METER.	(1) Meter indicates +15 v for each position with a deviation less than one-half of one minor scale division.	NOTE: For steps (1) and (2), shorted wiring and/or defective components may cause a malfunction.
	(2) Set the 979A-2.	(2) METER FUNCTION to +27.5V and TEST RANGE SELECTOR to all positions; observe TEST METER.	(2) Meter indicates +27.5 v for each position with a deviation less than one-half of one minor scale division.	
c. Stabilization input	(1) Set the 979A-2.	(1) SERVO AMPLIFIER TEST SELECTOR to SET INPUT and METER FUNCTION to TEST (X1); adjust the SERVO AMPLIFIER INPUT control for 0.1 v on the TEST METER.		
	(2) Set the 979A-2.	(2) METER FUNCTION to TEST (X10) and SERVO AMPLIFIER TEST SELECTOR to STAB; observe TEST METER.	(2) Meter indicates in the green range.	(2) Check R2, R3, R4, Q2, Q4, and Q5.
(Cont)	(3) Set the 979A-2.	(3) METER FUNCTION to TEST (X1); note TEST METER.	(3) Meter indicates 10 to 16 v.	

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 18 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
4. (Cont)	(4) Measure phase lag of channel A display with respect to channel B.		(4) Lag is 90 +20, -0 degrees.	(4) Check C6, C7, R13, and R14.
d. Rate inputs	(1) Set the 979A-2.	(1) SERVO AMPLIFIER TEST SELECTOR to SET INPUT and METER FUNCTION to TEST (X1); adjust the SERVO AMPLIFIER INPUT for 0.1 v on TEST METER.		
	(2) Set the 979A-2.	(2) METER FUNCTION to TEST (X10) and the SERVO AMPLIFIER TEST SELECTOR to RATE; note TEST METER.	(2) Meter indicates in green range.	(2) Check R2, R3, R4, Q2, Q4, and Q5.
	(3) Set the 979A-2.	(3) METER FUNCTION to TEST (X1); note TEST METER.	(3) Meter indicates 10 to 16 v.	
5. Video driver amplifier	NOTE: Perform starting procedures in paragraph 3-20A(7).			
a. Setup	(1) Set the 979A-2.	(1) METER FUNCTION to +27.5V, TEST FUNCTION SELECTOR to VIDEO AMPL, VIDEO AMPLIFIER TEST SELECTOR to DET 2&3, and TEST RANGE SELECTOR to 30.		
(Cont)				

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 19 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
5. (Cont)	(2) Set the oscilloscope as follows: (a) MODE to ALTERNATE. (b) Vertical sensitivity (A) to 2 v/cm (dc). (c) Vertical sensitivity (B) to 1 v/cm (dc). (d) Sweep speed to 5 us./cm. (3) Set the pulse generator as follows: (a) Pulse polarity to negative. (b) Pulse amplitude to 2 v. (c) Sync to external negative. (d) Pulse width to 10 us. (e) Delay to 10 us.			
b. Power supply loading (Cont)	(1) Set the 979A-2.	(1) METER FUNCTION to +27.5V and VIDEO AMPLIFIER TEST SELECTOR to all positions; note TEST METER.	(1) Meter indicates +27.5 v for each position with a deviation of less than one-half of one minor scale division.	(1) For steps (1) and (2), defective wiring and components are most probable causes of malfunctions.

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 20 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
5. (Cont)	(2) Set the 979A-2.	(2) METER FUNCTION to +15V and VIDEO AMPLIFIER TEST SELECTOR to all positions; note TEST METER.	(2) Same as step (1) with a +15-v indication.	(2) Refer to step (1).
c. Range mark amplitude	(1) Set the oscilloscope sweep speed to 50 us./cm.			
	(2) Observe display on channel A of oscilloscope.		(2) Display (10-mile [redacted] markers) is 4.0 ±0.25 v with four range marks in view.	(2) Adjust R27 for proper amplitude.
	(3) Increase the oscilloscope sweep speed to 1 us./cm and note range mark pulse width.		(3) Range marks are 2 ±0.5 us. wide at the 50% points.	(3) Check Q8 and associated components.
d. Gain check	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 30.		
	(2) Set the oscilloscope as follows: (a) MODE to ALTERNATE. (b) Sensitivity (A) to 1 v/cm (dc). (c) Sensitivity (B) to 1 v/cm (dc). (d) Sweep speed to 5 us./cm.			
(Cont)				

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 21 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROU⁻ .ESHOOTING
5. (Cont)	(3) Set the pulse generator for a 1-v pulse on channel B of the oscilloscope.			
	(4) Observe display on channel A of oscilloscope.		(4) Display is 4.0 ±0.5 v.	(4) Adjust R12. If an adjustment is made, recheck the range mark amplitude.
e. Limiting	(1) Set the oscilloscope vertical sensitivity (A) to 5 v/cm.			
	(2) Increase the pulse generator output level until the display on channel A is at maximum (no limiting). Note amplitude.		(2) Amplitude of display is 7.5-volt peak or greater.	
f. Rise time and overshoot	(1) Set the pulse generator delay time for the minimum delay that prevents coincidence of the first range mark on channel A of oscilloscope.			
	(2) Set the oscilloscope sweep speed to 1 us./cm and set X5 magnifier to on. Observe waveform.		(2) Rise time of the display is 0.5 us. maximum at 10 and 90% points. NOTE: Disregard any overshoot.	(2) Check C1, C2, C3, C4, and C6.
(Cont)				

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 22 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
5. (Cont)				
g. Countour level	(1) Set the 979A-2.	(1) VIDEO AMPLIFIER TEST SELECTOR to CONTOUR.		
	(2) Set the oscilloscope as follows: (a) MODE to ALTERNATE. (b) Sensitivity (B) to 1 v/cm. (c) Sweep speed to 5 us./cm.			
	(3) Set the pulse generator for a 1.5-v, 10-us. output on channel B.			
	(4) Observe display on channel A.		(4) Display is contoured.	(4) Adjust R23 for correct contoured display.
6. Range mark generator (Cont)	NOTE: Perform starting procedures in paragraph 3-20A(7).			

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 23 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
6. (Cont)				
a. Setup	(1) Set the 979A-2.	(1) METER FUNCTION to +27.5V, TEST FUNCTION SELECTOR to RANGE MARK GEN, and TEST RANGE SELECTOR to 30.		
	(2) Set the oscilloscope as follows: (a) MODE to ALTERNATE. (b) Sensitivity (A) to 2 v/cm. (c) Sensitivity (B) to 10 v/cm. (d) Sweep speed to 50 μs/cm.			
b. Power supply loading	(1) Set the 979A-2.	(1) METER FUNCTION to +15V and TEST RANGE SELECTOR to all positions; note TEST METER.	(1) Meter indicates +15 v for each position with a deviation of less than one-half of one minor scale division.	(1) For steps (1) and (2), defective wiring and components are most probable causes of malfunctions.
	(2) Set the 979A-2.	(2) METER FUNCTION to +27.5V; repeat step (1).	(2) Repeat step (1) for +15 v.	
c. 10-mile range marks	(1) Observe display on channel A of oscilloscope.		(1) Display on channel A is four range marks that are within the gate presentation of channel B.	(1) Check the range relays, C1 through C6, and Q1 and associated circuitry.
(Cont)				

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 24 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
6. (Cont)				
d. 15-mile range marks.	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 60.		
	(2) Set the oscillo-scope sweep speed to 100 us./cm.			
	(3) Observe channel A display.		(3) Display on channel A is five (four short range) range marks that are within the gate presentation on channel B (including the one coincident with the start of the gate). Not more than one mark should be outside of the gate.	(3) Check the range relays, C1 through C6, and Q1 and associated circuitry.
e. 25-mile range marks	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 150.		
	(2) Set the oscillo-scope sweep speed to 500 us./cm and observe display on channel A.		(2) Display on channel A is seven (five short range) range marks within the gate on channel B (including the one coincident with the start of the gate). Not more than one mark should be outside the gate.	(2) See step d. (3).
f. Range mark amplitude	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 30.		
(Cont)				

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 25 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
6. (Cont)	(2) Set the oscillo-scope sweep speed to 50 us./cm and observe display on channel A.		(2) Amplitude of channel A display is 5 v minimum.	(2) Check generator output circuit.
g. Range mark delay (10 miles)	(1) Set the oscilloscope sweep speed to 1 us./cm and observe display on channel A.		(1) Leading edge of first range mark occurs less than 3 us. after start of trace.	(1) Check Q1 and associated circuitry.
h. Range mark delay (15 miles)	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 60.		
	(2) Observe channel A display.		(2) Leading edge of the first range mark occurs less than 4 us. after the start of the trace.	(2) Check Q1 and associated circuitry.
i. Range mark delay (25 miles)	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 150.		
	(2) Observe channel A display.		(2) Leading edge of the first range mark occurs less than 10 us. after the start of the trace. NOTE: A small amount of jitter is normal for the 25-mile range.	(2) Check Q1 and associated circuitry.
j. Range mark pulse width	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 30.		
(Cont)				

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 26 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
6. (Cont)				
	(2) Set the oscilloscope sweep speed to 0.5 us./cm and measure first range mark pulse width on channel A.		(2) Pulse width is 3 us. maximum.	(2) Check Q6 and associated circuitry.
k. 10-mile range mark spacing	(1) Set the oscilloscope sweep speed to 50 us./cm and measure time between first and fourth range marks on channel A.		(1) Distance between range marks (1 and 4) is 371 ±5 us. or 185 ±3 us. for short range.	(1) Check range relays and C1 through C6.
l. 15-mile range mark spacing	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 60.		
	(2) Set the oscilloscope sweep speed to 100 us/cm and measure time between first and fifth range marks on channel A.		(2) Distance between range marks (1 and 5) is 742 ±10 us. or 370 ±5 us. for short range.	(2) Check range relays and C1, C2, C5, and C6.
m. 25-mile range mark spacing.	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 150.		
	(2) Set the oscilloscope sweep speed to 200 us./cm and measure the time between first and seventh range marks on channel A.		(2) Distance between range marks (1 and 7) is 1854 ±25 us. or 1110 ±20 us. for short range.	(2) Check range relays and C1 and C6.
(Cont)				

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 27 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
6. (Cont)				
n. 10-mile mark-to-mark spacing	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 30.		
	(2) Set oscilloscope sweep speed to 50 us./cm.			
	(3) Set the oscilloscope 5X multiplier to on, and adjust the horizontal speed and position controls so that the first and second range marks are aligned with the second and eight graticule lines respectively.			
	(4) Using the horizontal position control, align the second range mark with the second graticule line and observe the third range mark.		(4) Third range mark falls within ±1 minor scale division (±0.2 cm) of the eighth graticule scale.	(4) Check range relays and C1 through C6.
	(5) Repeat step (4) for fourth range mark.			
o. 15-mile mark-to-mark spacing.	(1) Set the 979A-2.	(1) TEST RANGE SELECTOR to 60.		
(Cont)	(2) Set the oscilloscope sweep speed to 100 us./cm.			

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 28 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULT/NOTES	ALIGNMENT/ TROUBLESHOOTING
6. (Cont)	(3) With the 5X magnifier on, repeat step n for the 15-mile spacing.			
p. 25-mile mark-to-mark spacing	(1) Set the oscilloscope sweep speed to 200 us./cm and repeat step n for the 25-mile spacing. NOTE: The 25-mile spacing is checked for the fourth, fifth, sixth, and seventh range marks.	(1) TEST RANGE SELECTOR to 150.		
7. Isolation amplifier	NOTE: Perform starting procedures in paragraph 3-20A(7).			
a. Setup	(1) Set the 979A-2.	(1) METER FUNCTION to +27.5V, TEST FUNCTION SELECTOR to ISOLATION AMPL, and ISOLATION AMPLIFIER INPUT fully counterclockwise.		
(Cont)				

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 29 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLSEHOOTING
7. (Cont)	(2) Set the oscilloscope as follows: (a) MODE to ALTERNATE. (b) Sensitivity (A) to 5 v/cm. (c) Sensitivity (B) to 5 v/cm. (d) Sweep speed to 500 us./cm.			
b. Power supply loading	(1) Set the 979A-2.	(1) ISOLATION AMPLIFIER TEST SELECTOR to all positions; note TEST METER. (2) METER FUNCTION to -27V; repeat step (1).	(1) Meter indicates +27.5 v for each position with a deviation of less than one-half of one minor scale division.	(1) Defective wiring or components.
c. Pitch channel gain. (Cont)	(1) Set the 979A-2.	(1) ISOLATION AMPLIFIER TEST SELECTOR to SET INPUT, METER FUNCTION to TEST (X1), and ISOLATION AMPLIFIER INPUT adjusted for 2 v on TEST METER.	NOTE; A signal appears on channel B of the oscilloscope which is similar to the input signal. This signal is used only for phase measurements.	

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 30 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
7. (Cont)		(2) ISOLATION AMPLIFIER TEST SELECTOR to PITCH; note TEST METER.	(2) Meter indicates 4 to 6 v.	(2) Check Q4 and associated circuitry.
	(3) Observe channel A display		(3) Display shows no sign of oscillation or clipping. NOTE: Normally there may be some high-frequency components superimposed on the waveform caused by power source irregularities.	(3) Check dc bias on Q3 and Q4. Check C6, C2, C8, and C11.
d. Pitch channel phase shift	(1) Check phase difference of channel A and channel B on the oscilloscope.		(1) Channel A lags channel B by 0 to 10 degrees.	
e. Roll channel gain.	(1) Set the 979A-2.	(1) ISOLATION AMPLIFIER TEST SELECTOR to SET INPUT, METER FUNCTION to TEST (X1), and ISOLATION AMPLIFIER INPUT adjusted for 2 v on TEST METER.	See note of step c. (1).	
(Cont)				

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 31 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
7. (Cont)		(2) ISOLATION AMPLIFIER TEST SELECTOR to ROLL; note TEST METER.	(2) Meter indicates 4 to 6 v.	(2) Check Q2 and associated circuitry.
	(2) Repeat step c.(3) and step d.			
8. Automatic frequency control	NOTE: Perform starting procedures in paragraph 3-20A(7).			
a. Setup	(1) Set the 979A-2.	(1) METER FUNCTION to +27.5V and TEST FUNCTION SELECTOR to AFC.		
	(2) Set the oscilloscope as follows:			
	(a) MODE to channel A ONLY.			
	(b) Sensitivity (A) to 0.5 v/cm (dc).			
	(c) Sweep speed to 500 us./cm.			
b. Power supply loading	(1) Set the 979A-2.	(1) Set the TEST FUNCTION SELECTOR to any other position other than AFC and then back to AFC; note TEST METER.	(1) Meter indicates a deviation of less than one-half of one minor scale division.	(1) Defective wiring or components.
(Cont)				

Module test procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 32 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
8. (Cont)				
c. Search condition	NOTE: Any voltage indicated on channel A of the oscilloscope is multiplied by 100 for a true value.			
	(1) Set the 979A-2.	(1) TEST FUNCTION SELECTOR to OFF.		
	(2) With the vertical control on the oscilloscope, set up a dc reference on the top horizontal graticule line.			
	(3) Set the 979A-2.	(3) TEST FUNCTION SELECTOR to AFC; check trace.	(3) Trace moves up and down in a search condition. Trace varies from -150 ±10 to -215 ±10 vdc (reading X100).	(3) Check Q1, Q2, Q3, and associated circuitry.
d. Search rate	(1) Set the oscilloscope sweep speed to 0.5 s /cm.			
	(2) Check sawtooth sweep period.		(2) Period should be 2 ±1 seconds.	
e. Locked-in condition	(1) Set the oscilloscope as follows:			
(Cont)	(a) MODE to ALTERNATE.			

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 33 of 34)
Figure 3-24

STEP/TEST	PROCEDURE	979A-2 SETTING	RESULTS/NOTES	ALIGNMENT/ TROUBLESHOOTING
8. (Cont)	(b) Sensitivity (A) to 0.5 v/cm (dc). (c) Sensitivity (B) to 1 v/cm (dc). (d) Sweep speed to 10 us./cm. (2) Set the pulse generator as follows: (a) Polarity to negative. (b) Width to 5 us. (c) Delay to 0.			
	(3) Slowly increase the pulse generator output and observe display on oscilloscope.		(3) Sweep rate on channel A will slow down.	(3) Check Q1, Q2, Q3, and associated circuits.
	(4) Continue to increase output of generator until sweep stops at -185 v on TEST METER.		(4) Amplitude of pulse on channel B is 3.25 ±0.25 v peak.	(4) Adjust pulse generator for 3.25 -v pulse, then, adjust R7 for -185 v on TEST METER.

Module Test Procedures Using MK-774/APN-158 Radar Maintenance Kit (Sheet 34 of 34)
Figure 3-24

Section VIII. TROUBLESHOOTING

3-21. GENERAL.

Figure 3-25 list troubles and probable causes with the applicable test reference step to the test procedures in figure 3-22. The TEST REFERENCE column of the table gives the test step of the test procedures that has i trouble. The TROUBLE column gives a possible trouble for the individual step referenced, and the PROBABLE CAUSE column gives the most probable failure for the unit or module that would give the trouble that is listed for the step.

3-22. TEST EQUIPMENT.

The test equipment required for troubleshooting is listed in figure 3-26.

3-23. TROUBLESHOOTING PROCEDURES.

Figure 3-25 is the troubleshooting table to be used in troubleshooting the SN-358A Synchronizer. Figure FO-7 is the related schematic diagram for the equipment.

TEST REFERENCE	TROUBLE	PROBABLE CAUSE
3-20. A. (3)(b)1. c	Power lamp does not light.	1. Lamp defective. 2. Power not connected. 3. Defective test set.
2. a	Gate pulse out of tolerance.	Gate generator module.
2. b	Pulse widths not within specified tolerances.	Gate generator module.
3. a and b	Range marks out of tolerance.	1. Gate generator module. 2. Range mark generator module.
4. b and c	Green range and/or null out of tolerance.	1. R14 on synchronizer chassis misadjusted. 2. Q5 and/or Q6 on detector board 3A1A1.
4. d	Voltage out of tolerance.	T5 or R15 on detector board 3A1A1.
4. e	Null out of tolerance.	1. R13 on synchronizer chassis misadjusted. 2. Q3 and/or Q4 on detector board 3A1A1.
5. a and b	Null out of tolerance.	1. Potentiometer misadjusted. 2. Sweep generator and amplifier module.
6. a through h	Values out of tolerance.	1. Potentiometer not adjusted. 2. Sweep generator and amplifier module.
7. k	Levels out of tolerance.	If. amplifier module.

SN-358A Synchronizer Troubleshooting Chart
for Figure 3-22 (Sheet 1 of 2)
Figure 3-25

TEST REFERENCE	TROUBLE	PROBABLE CAUSE
3-20. A. (3)(b)7. m, o, p, and q	Voltage out of tolerance.	1. If. amplifier module. 2. Afc module. 3. Adjustment.
8.b	Pulse out of tolerance.	Gate generator module.
9.j	No signal or incorrect signal displayed.	1. If. amplifier module. 2. Video driver module.
9.k	Output not 6 volts.	Video driver module.
10.b	Contour not within tolerances.	Video driver module.
11	Values out of tolerance.	Isolation amplifier module.
12	Phase not as specified.	Isolation amplifier module.
13	Values out of tolerance.	Elevation servo-amplifier module.

SN-358A Synchronizer Troubleshooting Chart
for Figure 3-22 (Sheet 2 of 2)
Figure 3-25

Section IX. STORAGE INSTRUCTIONS

3-24. GENERAL.

Before storing, clean dirt, grease, and moisture from the SN-358A Synchronizer. Ensure that all modules are secured to the chassis and that the dust cover is installed. Store the unit in a clean, dry area where the possibility of impact damage is minimized. If the unit is to be stored for an extended period of time, place it in the original shipping carton.

Section X. SPECIAL TOOLS AND TEST EQUIPMENT

3-25. GENERAL.

This section presents a list of special tools and test equipment required for test and/or overhaul of the SN-358A Synchronizer.

3-26. TEST EQUIPMENT REQUIRED.

Figure 3-26 lists the equipment required to test and/or overhaul the synchronizer. While substitution of equipment other than manufacturer and type listed is not recommended, other equipment may be used if it equals or exceeds the minimum specifications of the equipment listed. Nomenclatures shown in parentheses identify commercial equipment equivalent to the military units described.

EQUIPMENT	MANUFACTURER AND TYPE OR PART NUMBER	MINIMUM SPECIFICATIONS
Items 1 through 6 are required for testing with the AN/APM-247 Radar Test Set and MK-774/APN-158 Maintenance Kit.		
1. Maintenance kit also contains: Dummy load Demagnetizer Antenna fixture Module extender, MX-6424 (2 ea) Module extender, MX-6425 Module extender, MX-6426 Cable assemblies as follows: CG-1464/U (7 ea) CG-3109/U CX-9813 CX-10088 CX-10089 CX-10090 CX-10091 Adapters as follows: MX-6637 MX-6638	MK-774/APN-158 (Collins 979A-2, part number 522-5730-014)	

Test Equipment Required (Sheet 1 of 3)
Figure 3-26

EQUIPMENT	MANUFACTURER AND TYPE OR PART NUMBER	MINIMUM SPECIFICATIONS
1. (Cont) UG-273/U (3 ea) UG-201A/U (2 ea) Test lead (2 ea) Test probe, 1000:1 Tuning tool Scale, 6 in.		
2. Radar test set also contains: Cable assemblies as follows: CX-10242 CX-11555 CG-1464/U (6 ea) Adapters as follows: UG-273/U (3 ea) UG-201A/U (2 ea)	AN/APM-247 (Collins 978G-1, part number 522-5731-015)	
3. Oscilloscope	AN/USM-81 (Tektronix 535 with CA plug-in unit)	Vertical deflection sensitivity: 20 mv/cm to 20 v/cm. Sweep range: 0.1 us./cm to 5 s/cm, calibrated. External trigger input level: 0.2 to 10 v. Input impedance: 1 megohm. Bandwidth: dc to 10 MHz.
4. 374A-4 Receiver-Transmitter	RT-711A/APN-158 (Collins, 772-5135-001)	

Test Equipment Required (Sheet 2 of 3)
Figure 3-26

EQUIPMENT	MANUFACTURER AND TYPE OR PART NUMBER	MINIMUM SPECIFICATIONS
5. Vhf signal generator	AN/USM-44 (Hewlett-Packard 608D)	Frequency range, accuracy: 20 to 40 MHz ±5% full range. Output level: 0.1 uv to 0.5 v ±1 db into 50-ohm resistive load. External pulse modulation: +5 v peak required, 350 to 450 Hz. Internal crystal calibrator.
6. Pulse generator	SG-69B/PPM-1 (Hewlett-Packard 212A)	Pulse length: 2 to 10 us. at 50-v peak. Attenuator range: to 50 db in 10-db steps with variable amplitude on 10-db range. Pulse repetition rate: 350 to 450 p/s (internal sync), 350 to 450 p/s (external sync). Synchronization voltage: ±5 v minimum (input), +28 v or -15 v into 2000-ohm load (output). Internal impedance: 50 ohms or less.

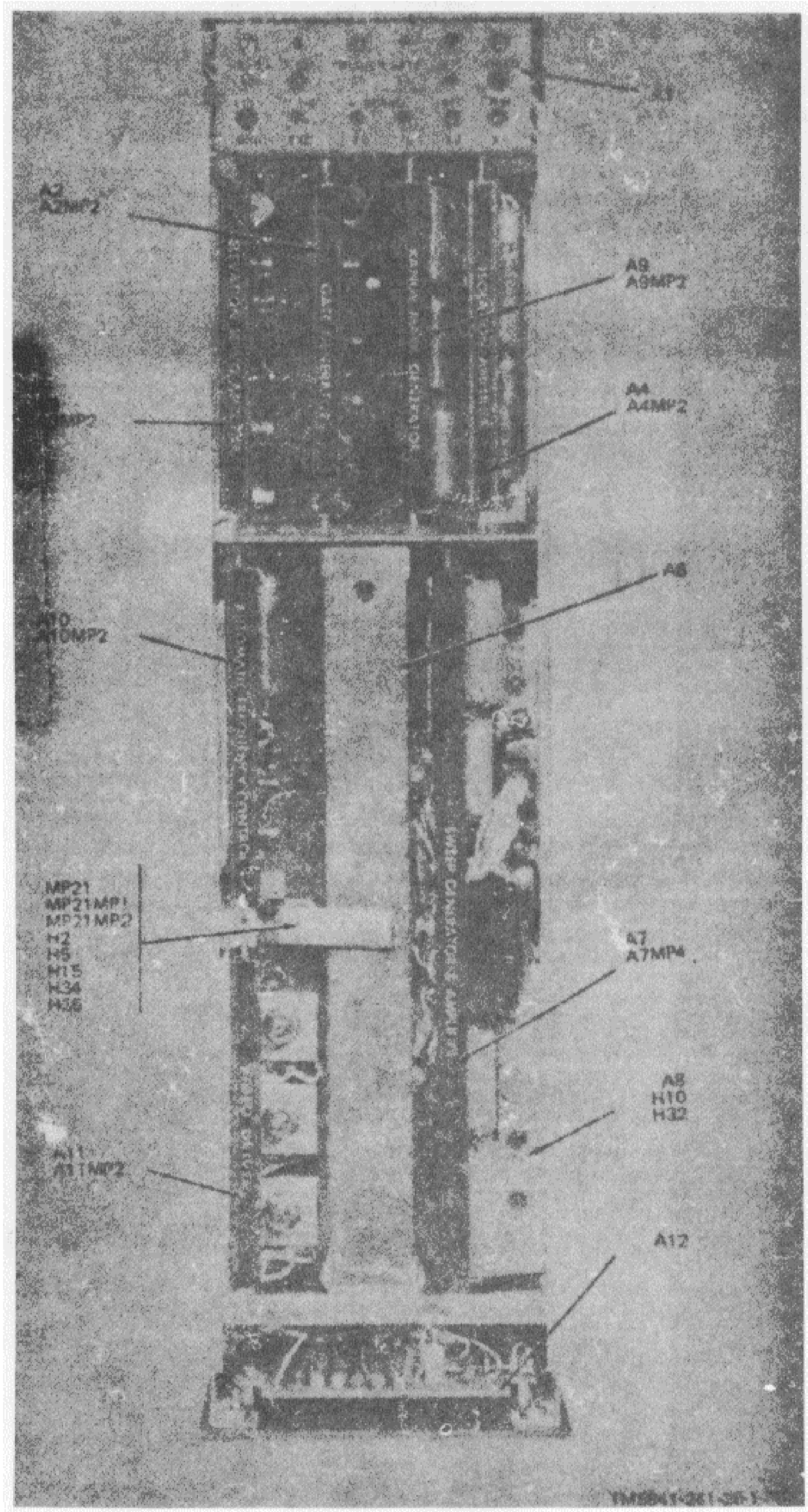
Test Equipment Required (Sheet 3 of 3)
Figure 3-26

Section XI. COMPONENTS LOCATION

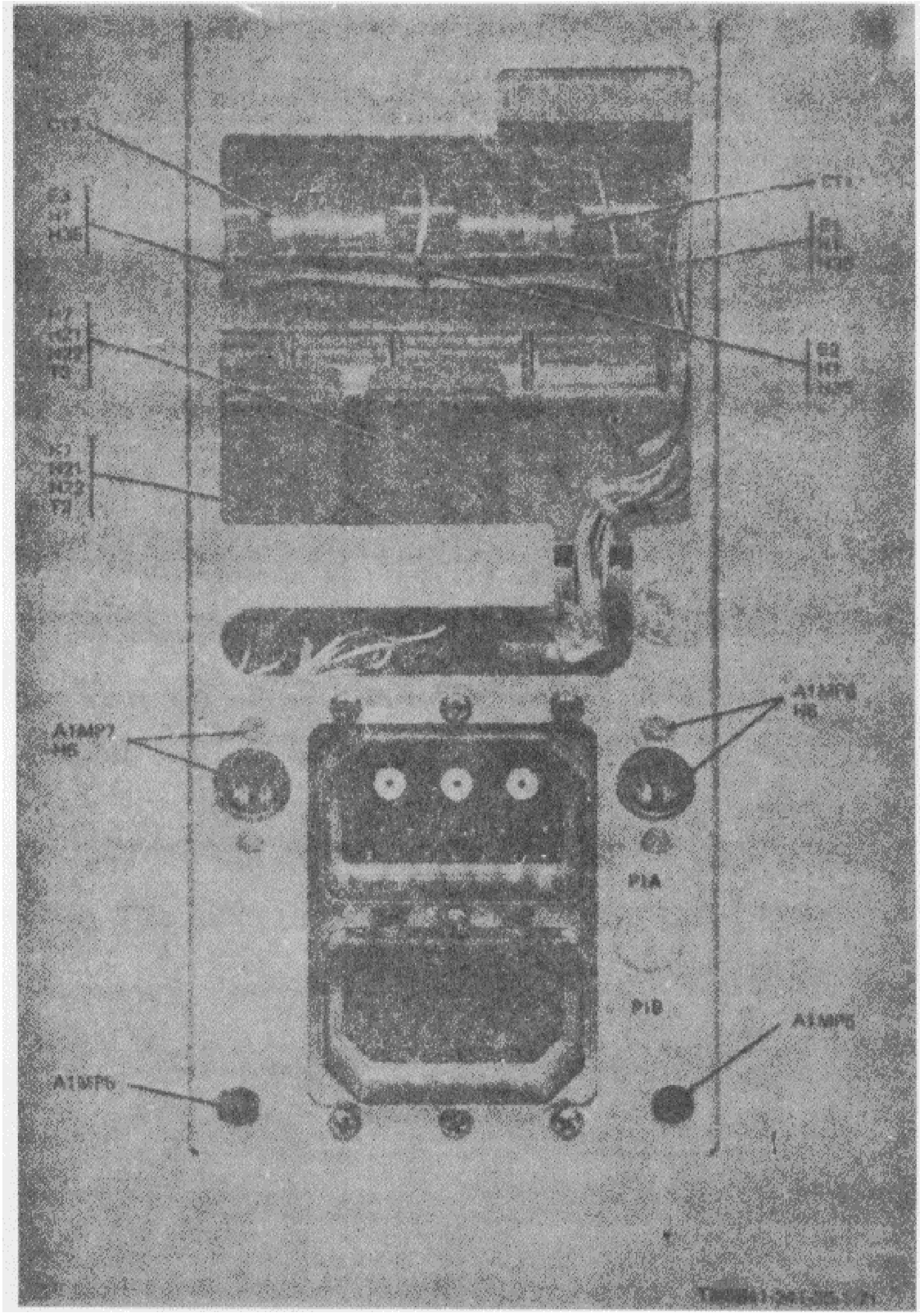
Refer to figure 3-27 through 3-40 for location of components comprising Synchronizer SN-358A/APN-168 (776C-4).

NOTE

These figures are for component location only. They are not to be used for provisioning component parts.

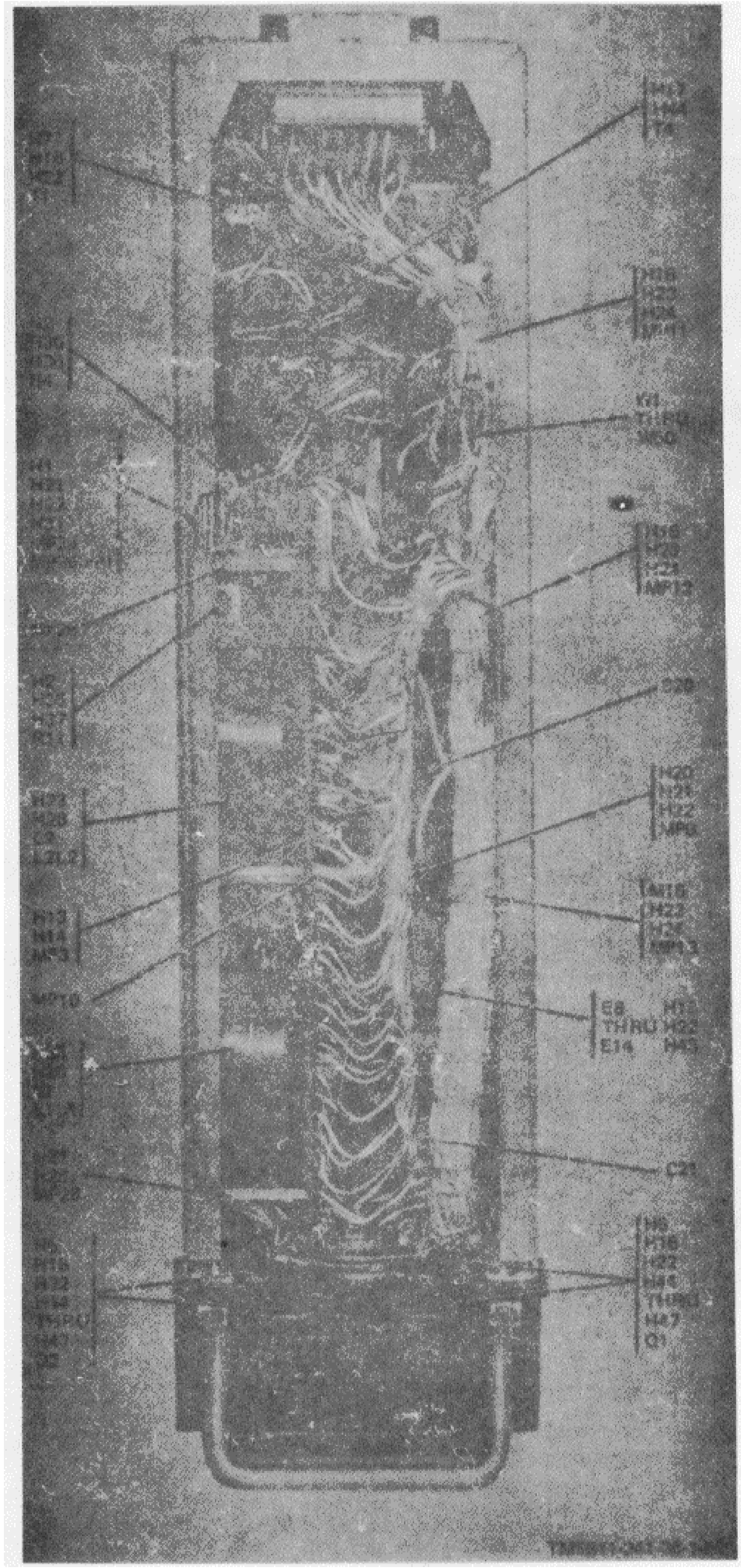


SN-358A/APN-158 Synchronizer, Components Location (sheet 1 of 3).
Figure 3-27

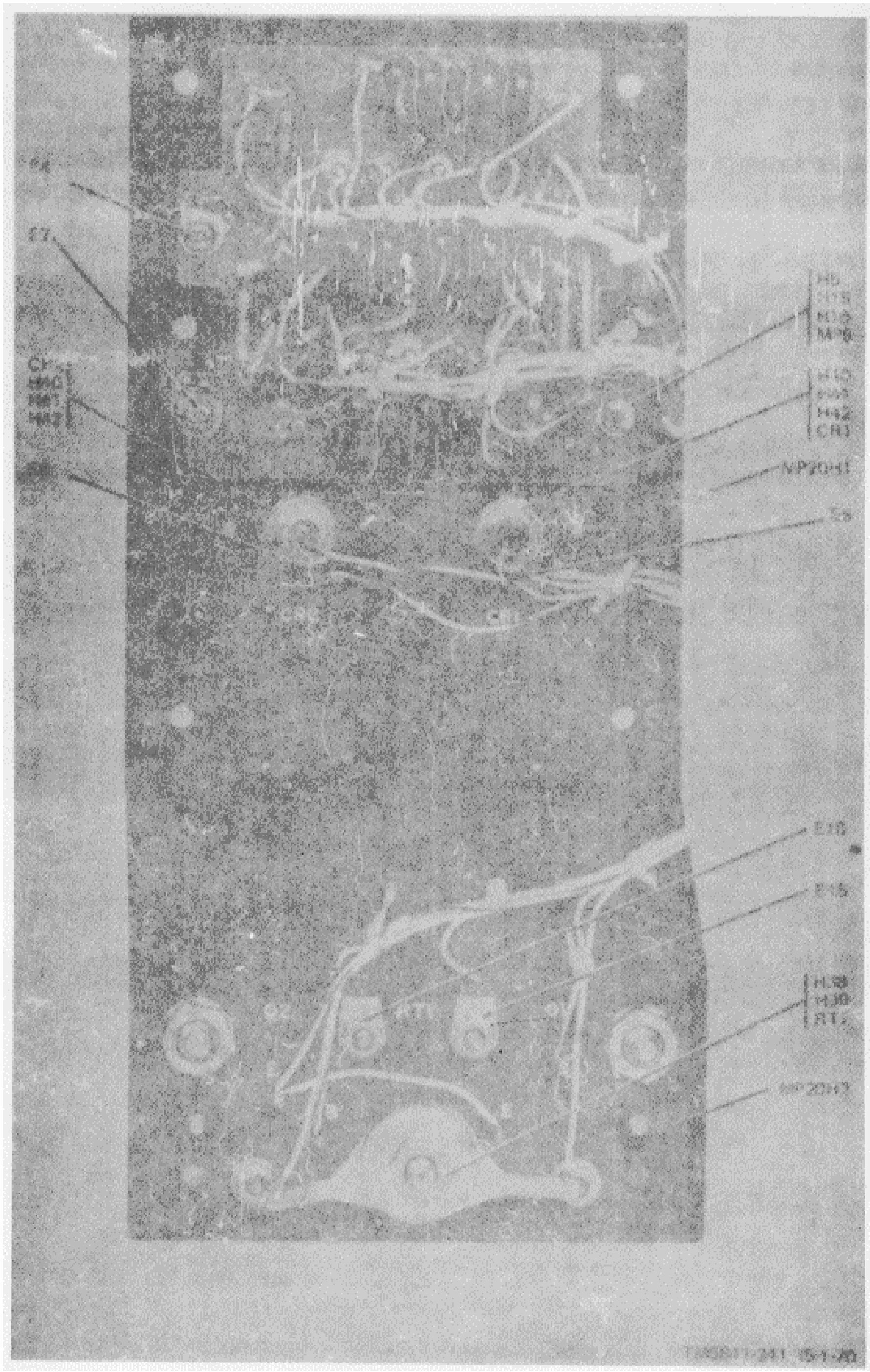


SN-358A /APN-168 Synchronizer, Components Location (sheet 2 of 3).

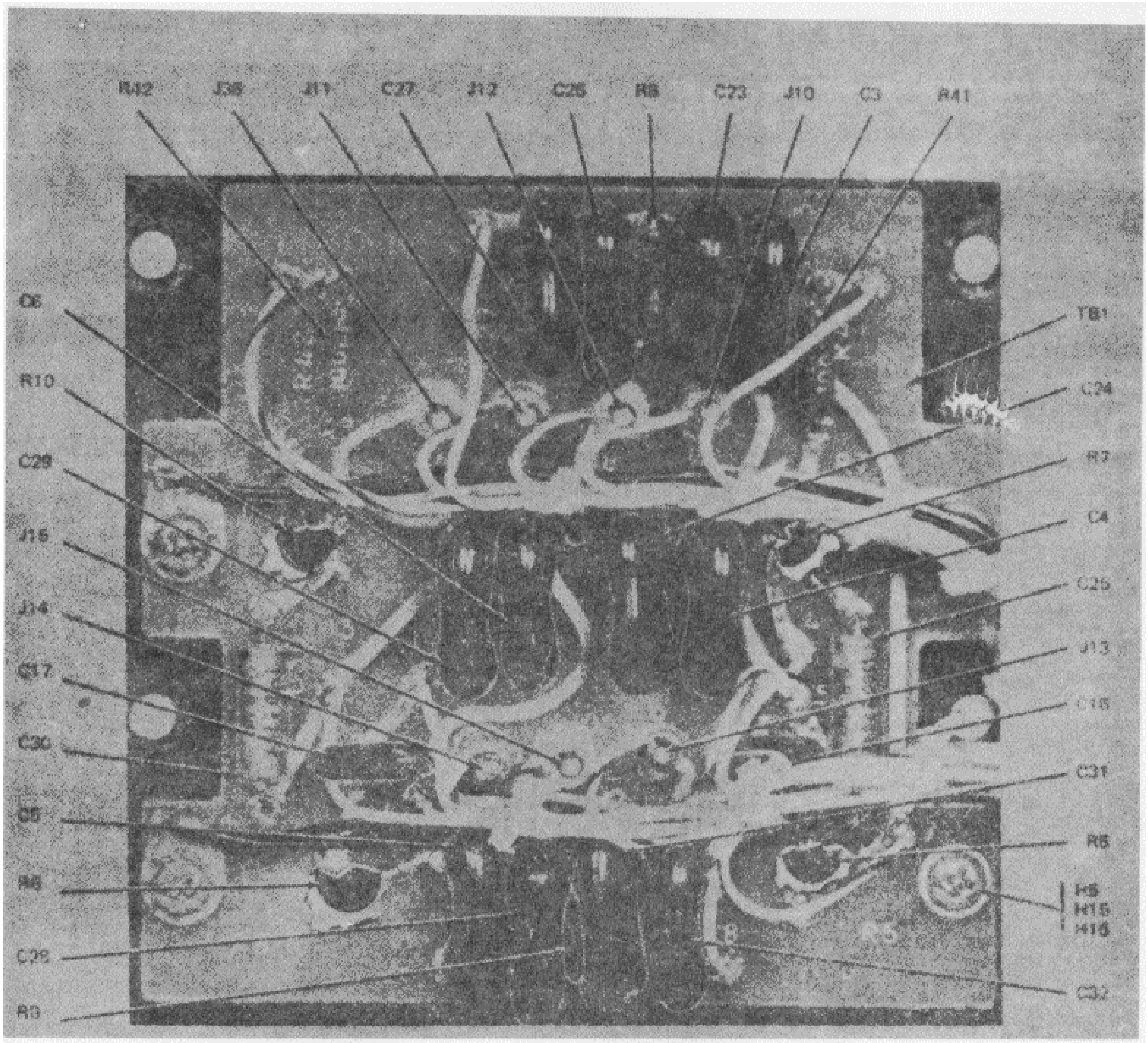
Figure 3-27



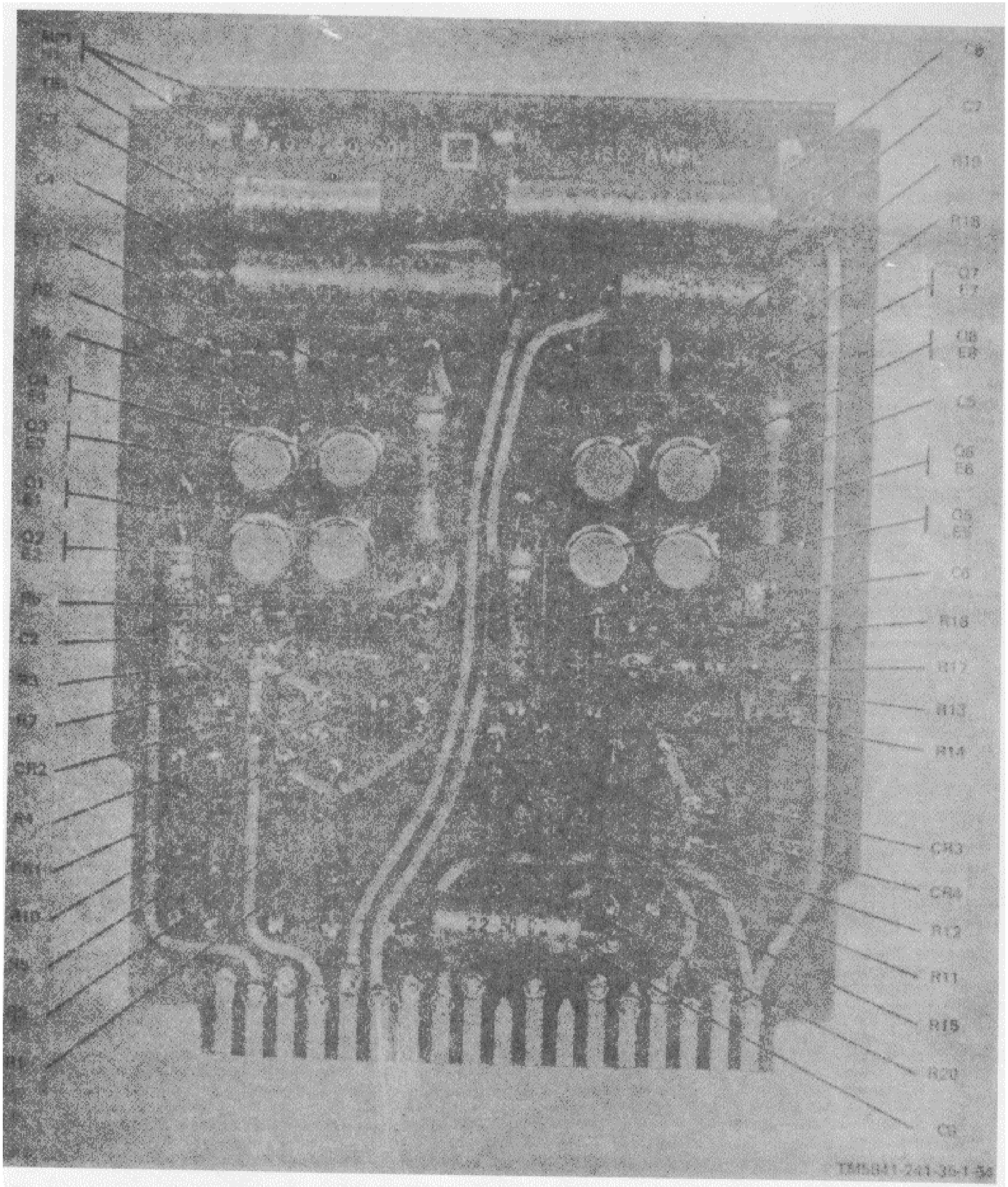
SN-S8A-7APN-168 Synchronizer, Components location (sheet 3 of 3).
Figure 3-7



SN-358A Synchronizer Front Panel Assembly, Components Location
Figure 3-28

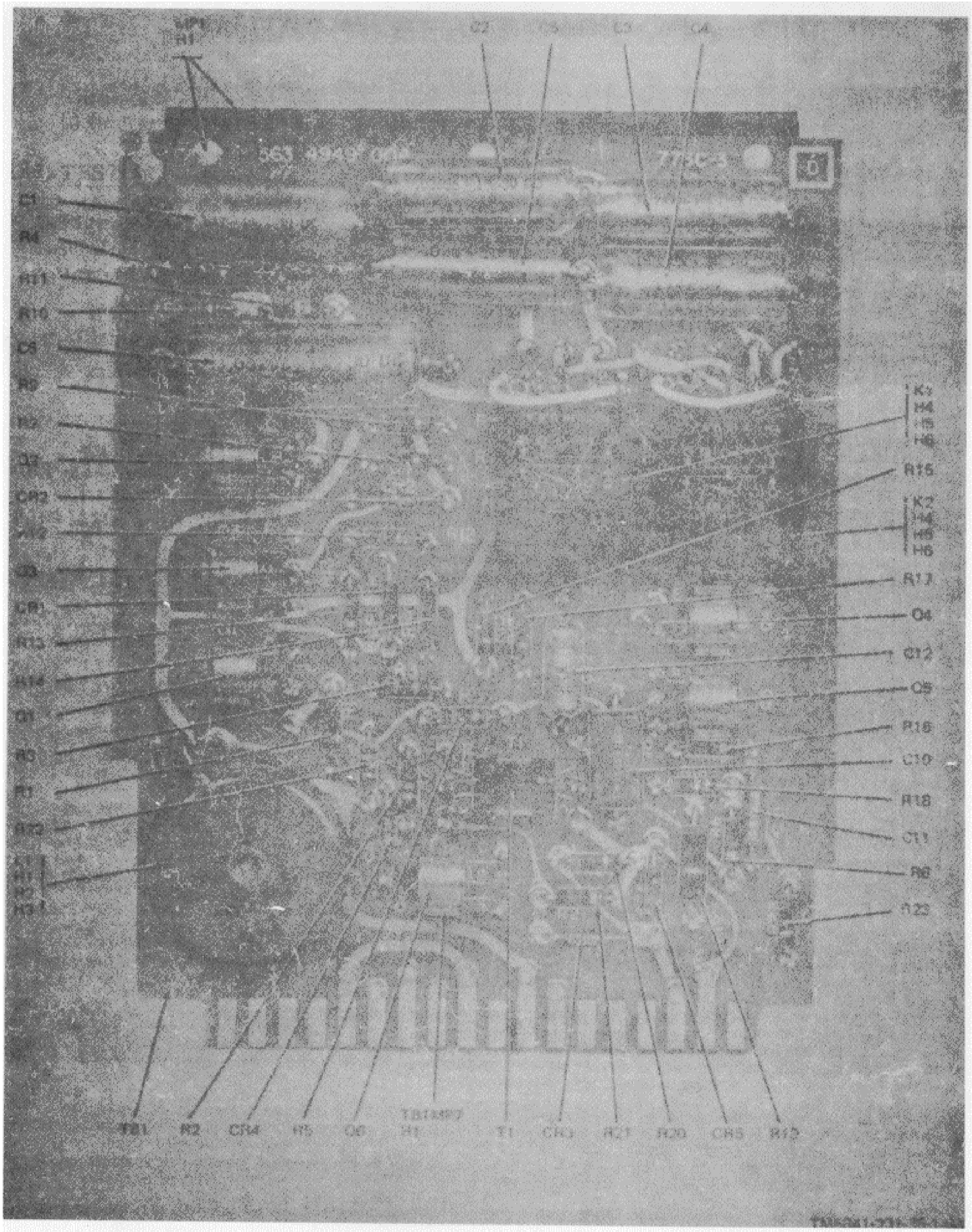


Roll and Pitch Adjust Board, Components Location.
Figure 3-29



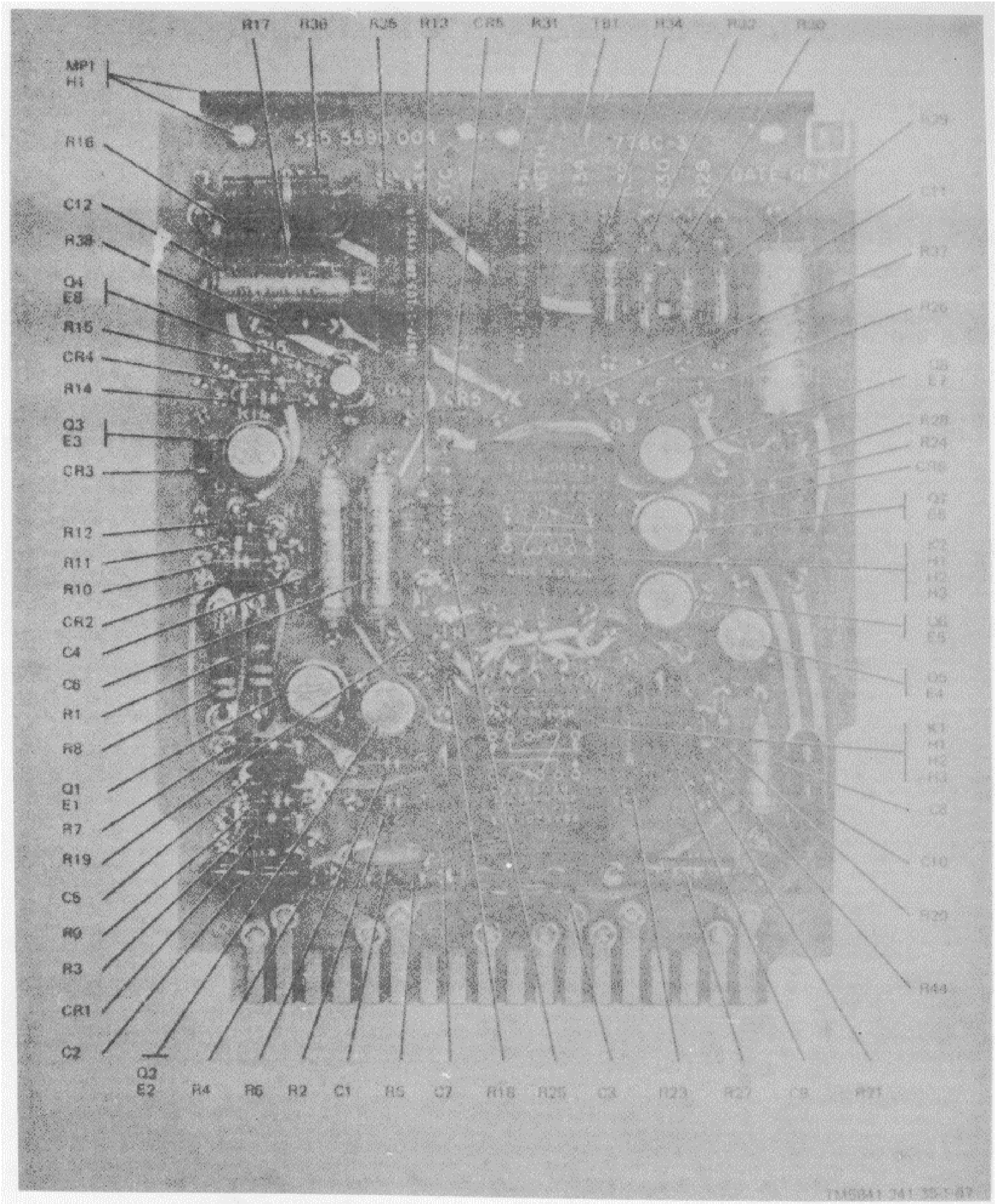
Isolation Amplifier, Components Location.

Figure 3-30

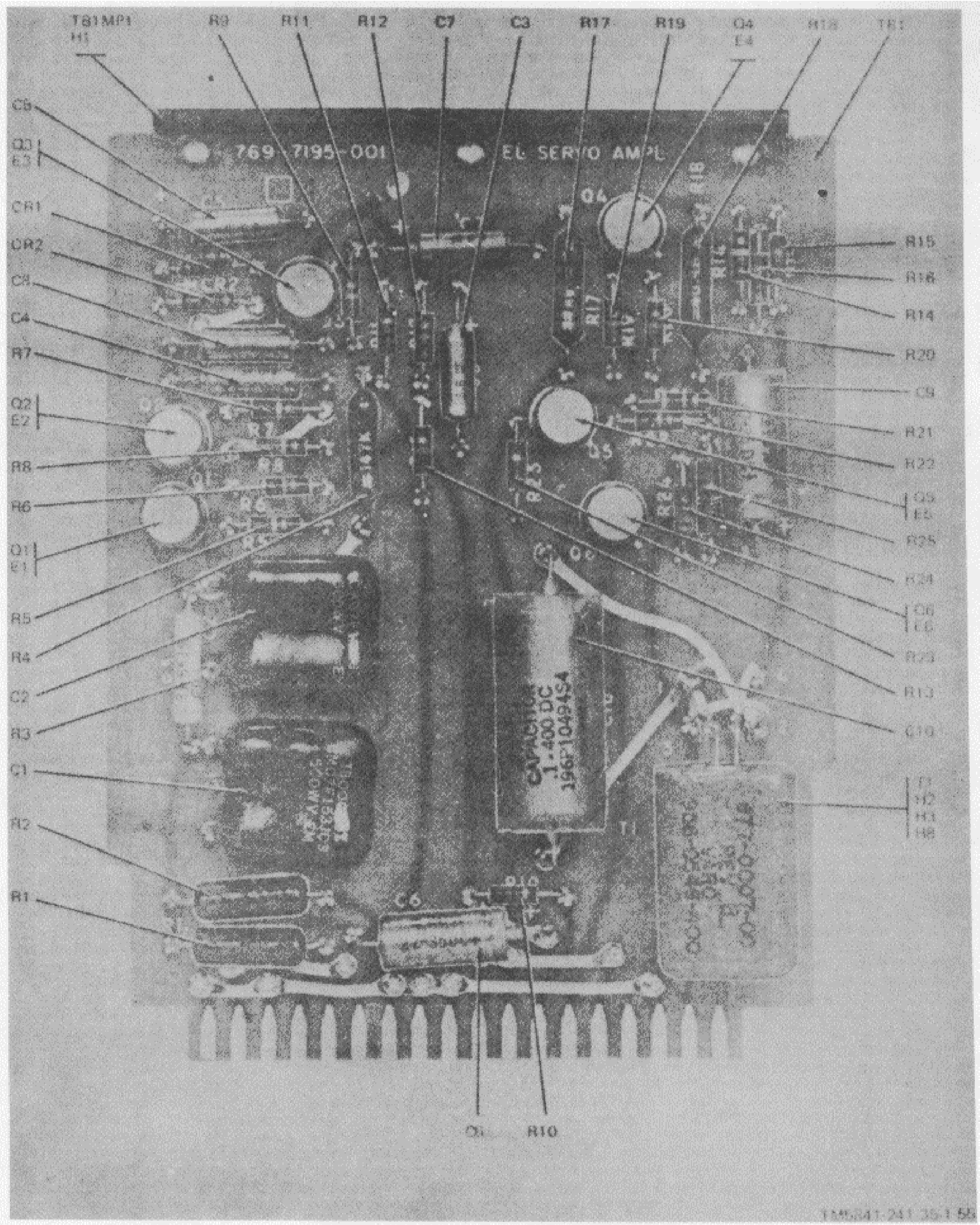


Range Mark Generator, Components Location.

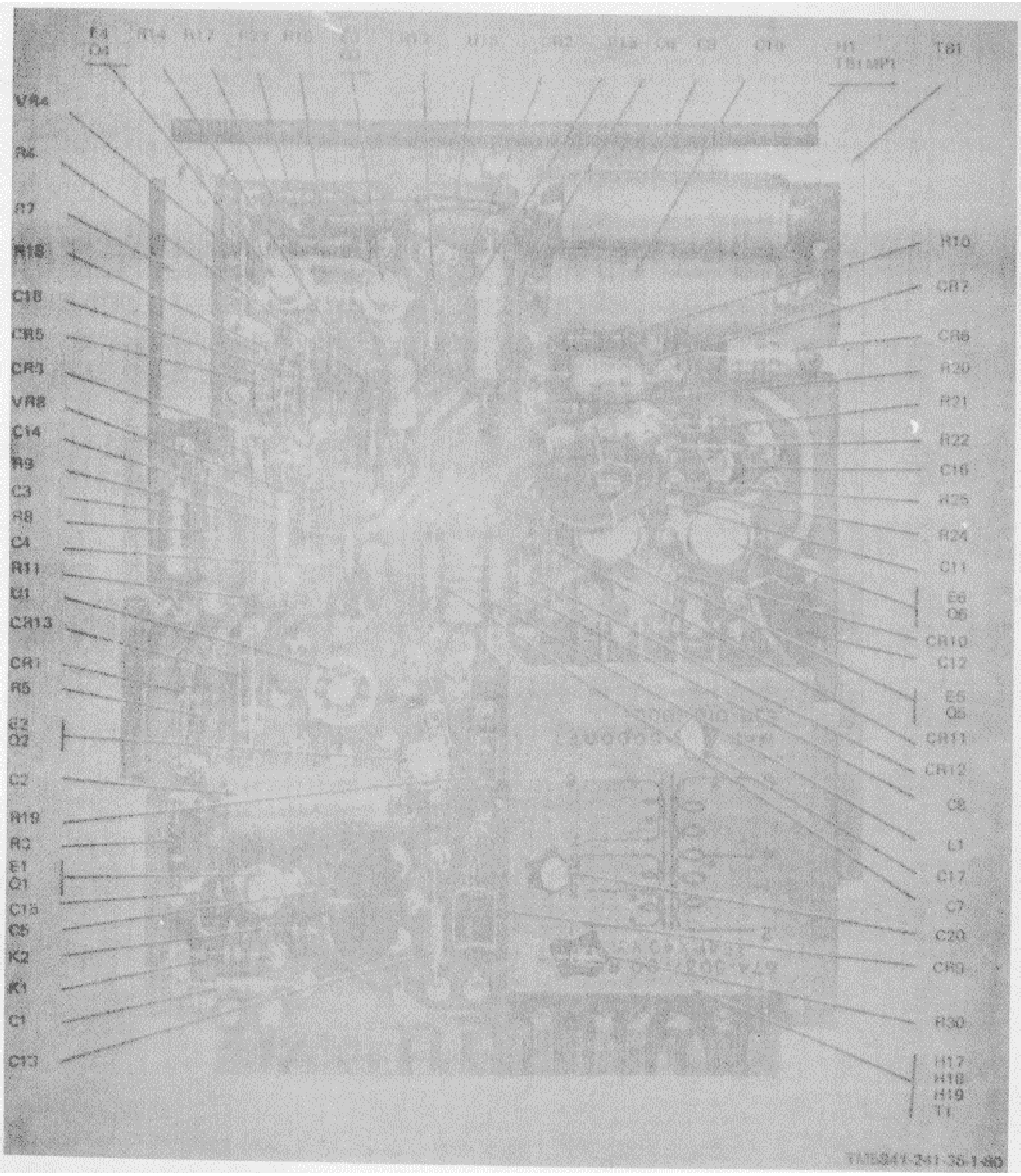
Figure 3-31



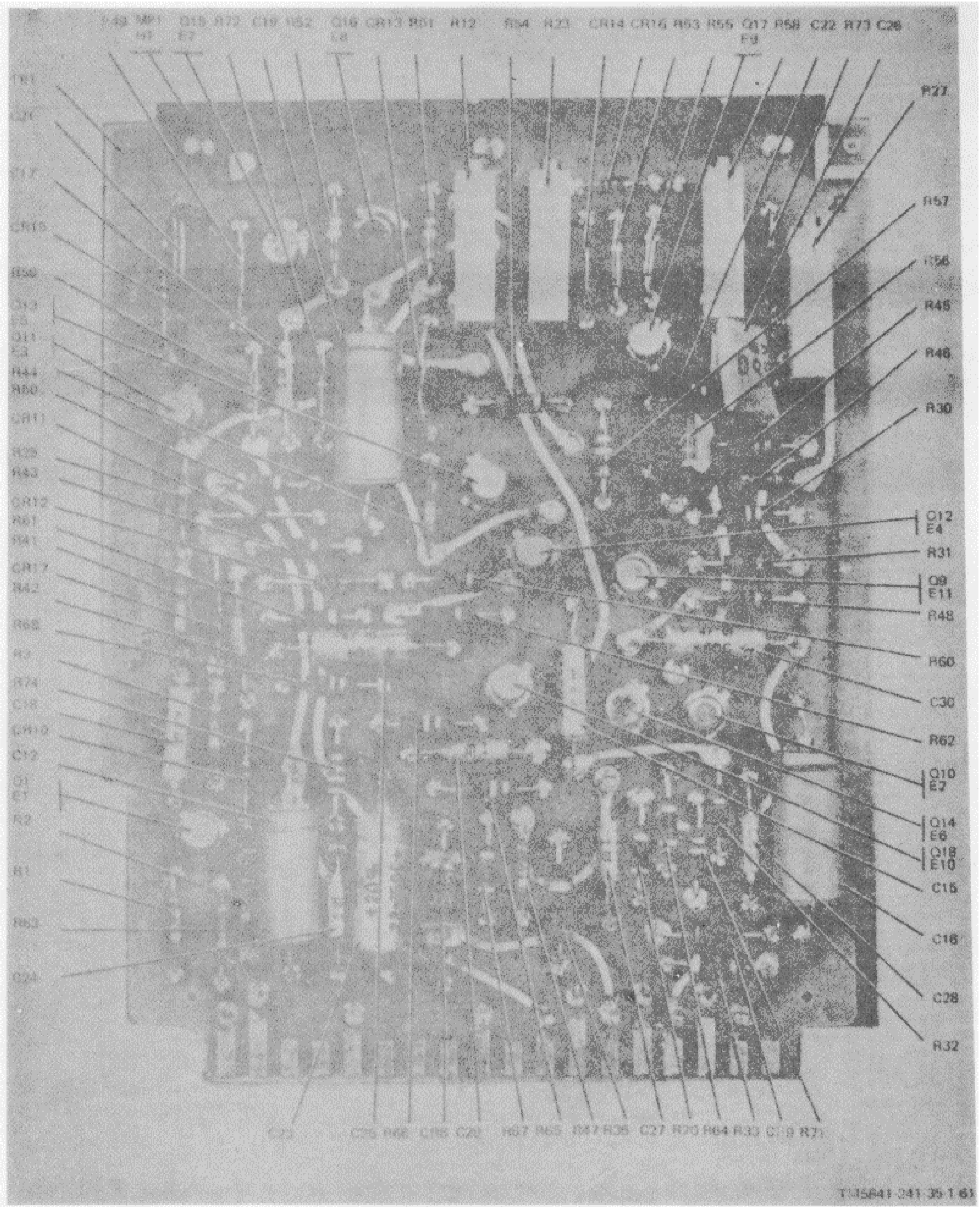
Gate Generator. Components Location.
Figure 3-32



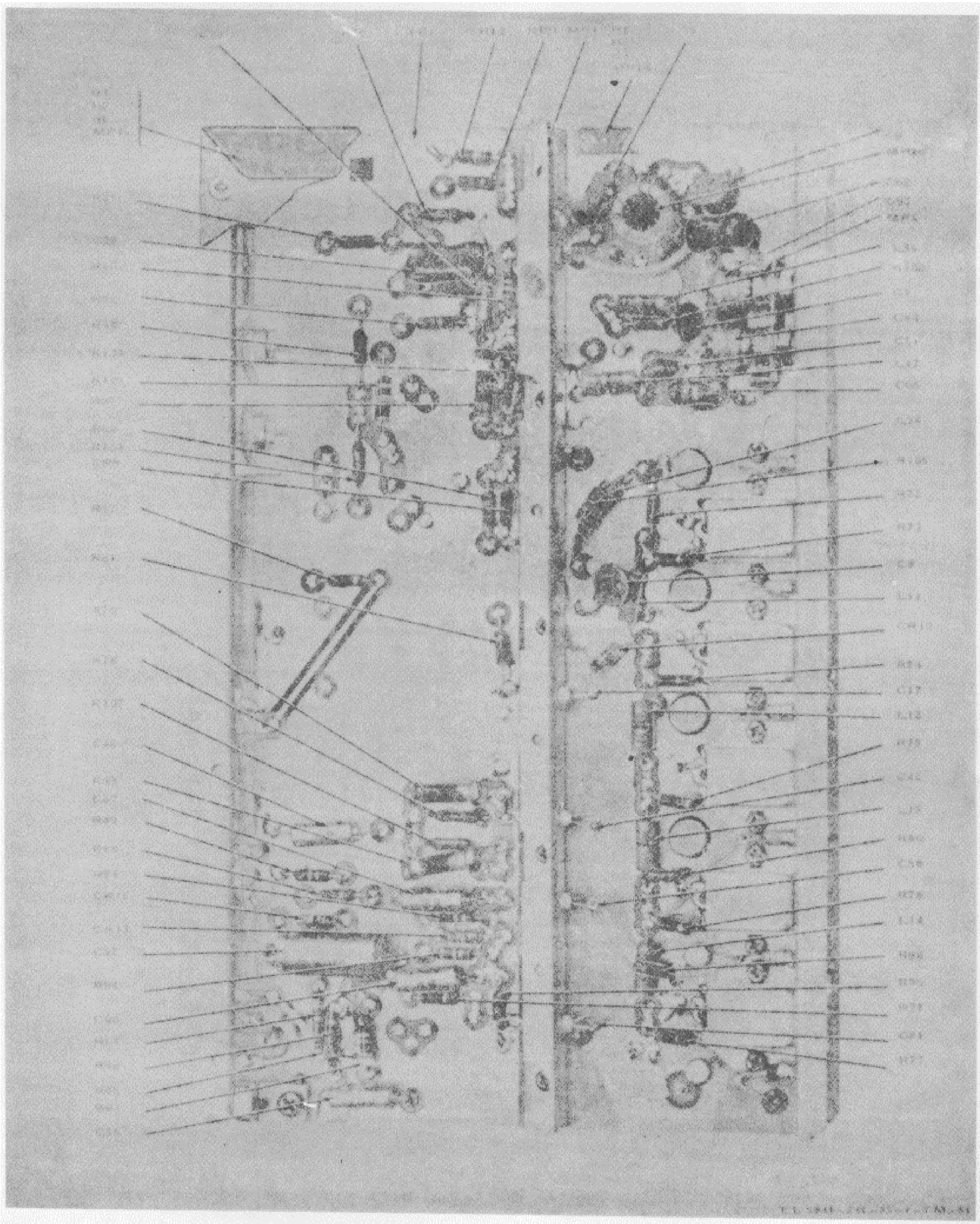
Elevation Servo Amplifier, Components Location.
Figure 3-33



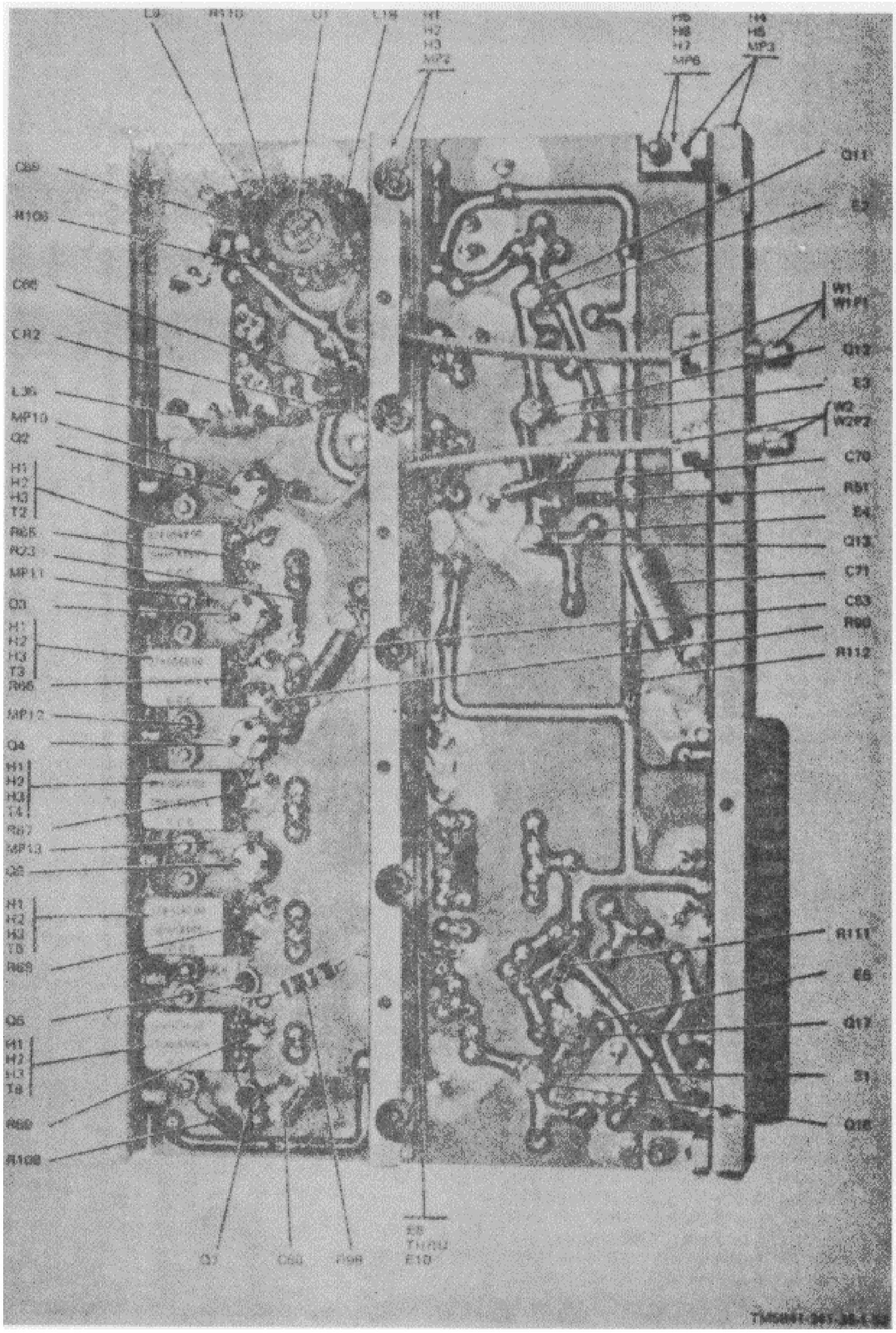
Automatic Frequency Control (AFC), Components Location
Figure 3-34



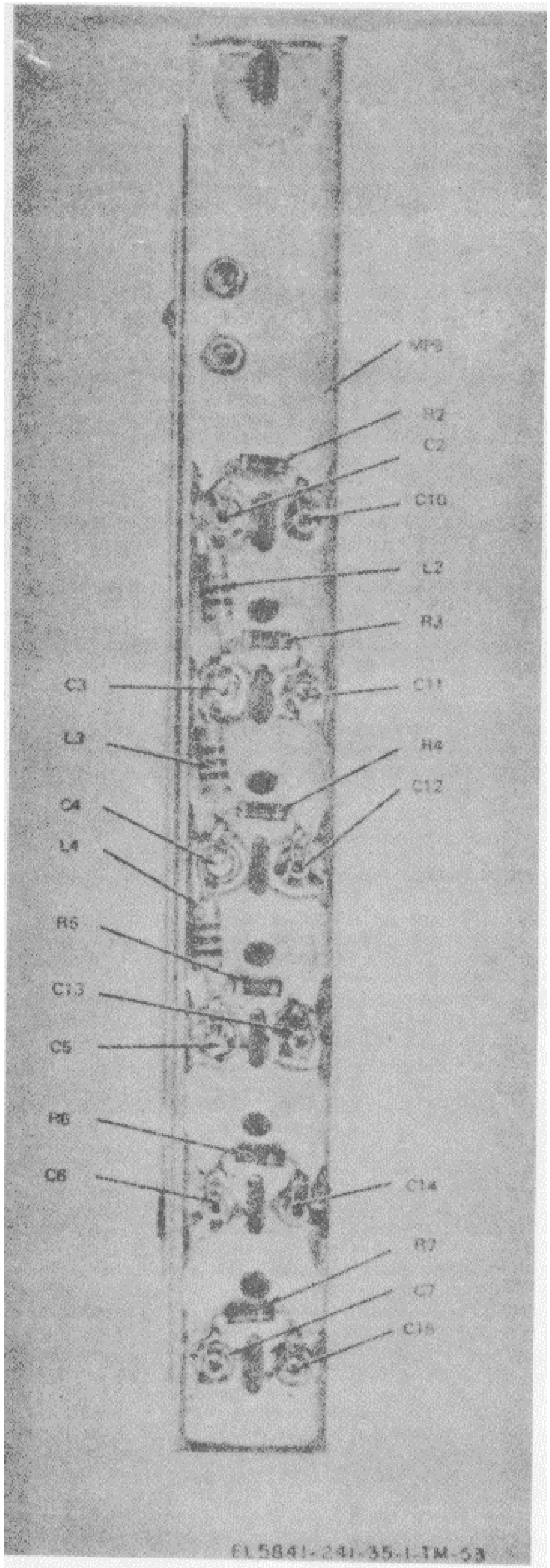
Video Driver Board, Components Location.
Figure 3-35



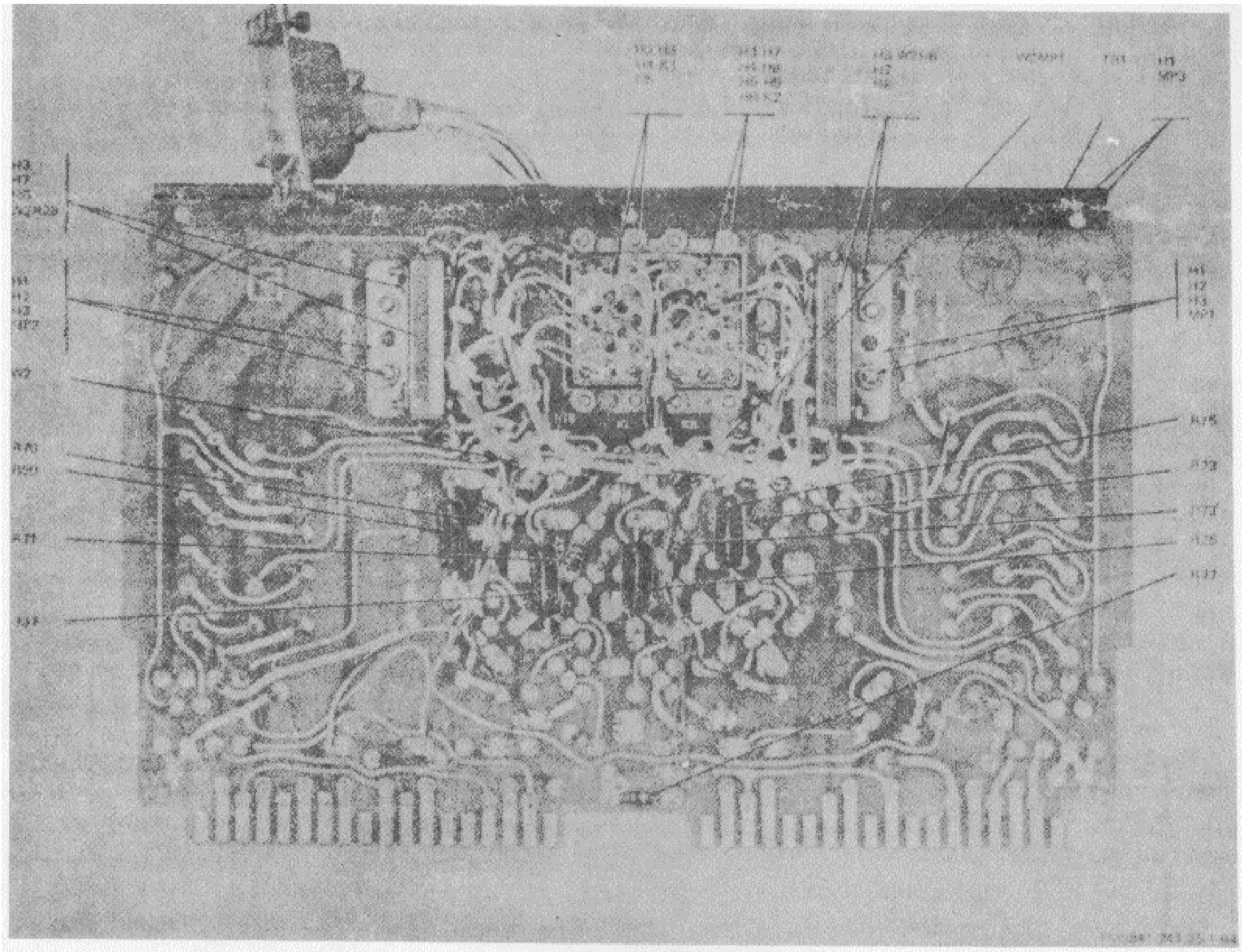
IF Amplifier, Components Location (sheet 1 of 3).
Figure 3-36



IF Amplifier, Components Location (Sheet 2 of 3).
Figure 3-36

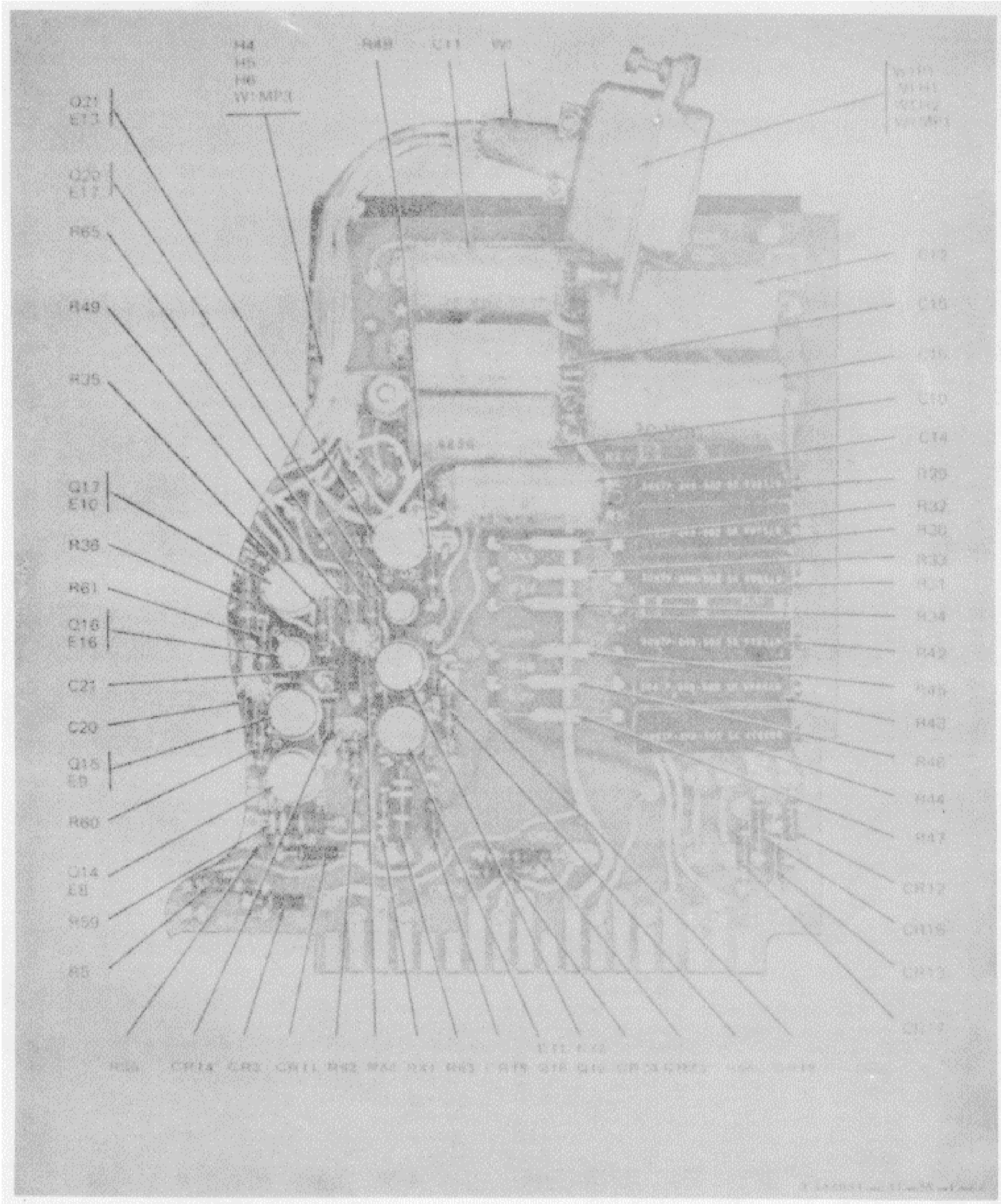


IF Amplifier, Components Location (sheet 3 of 3).
Figure 3-36



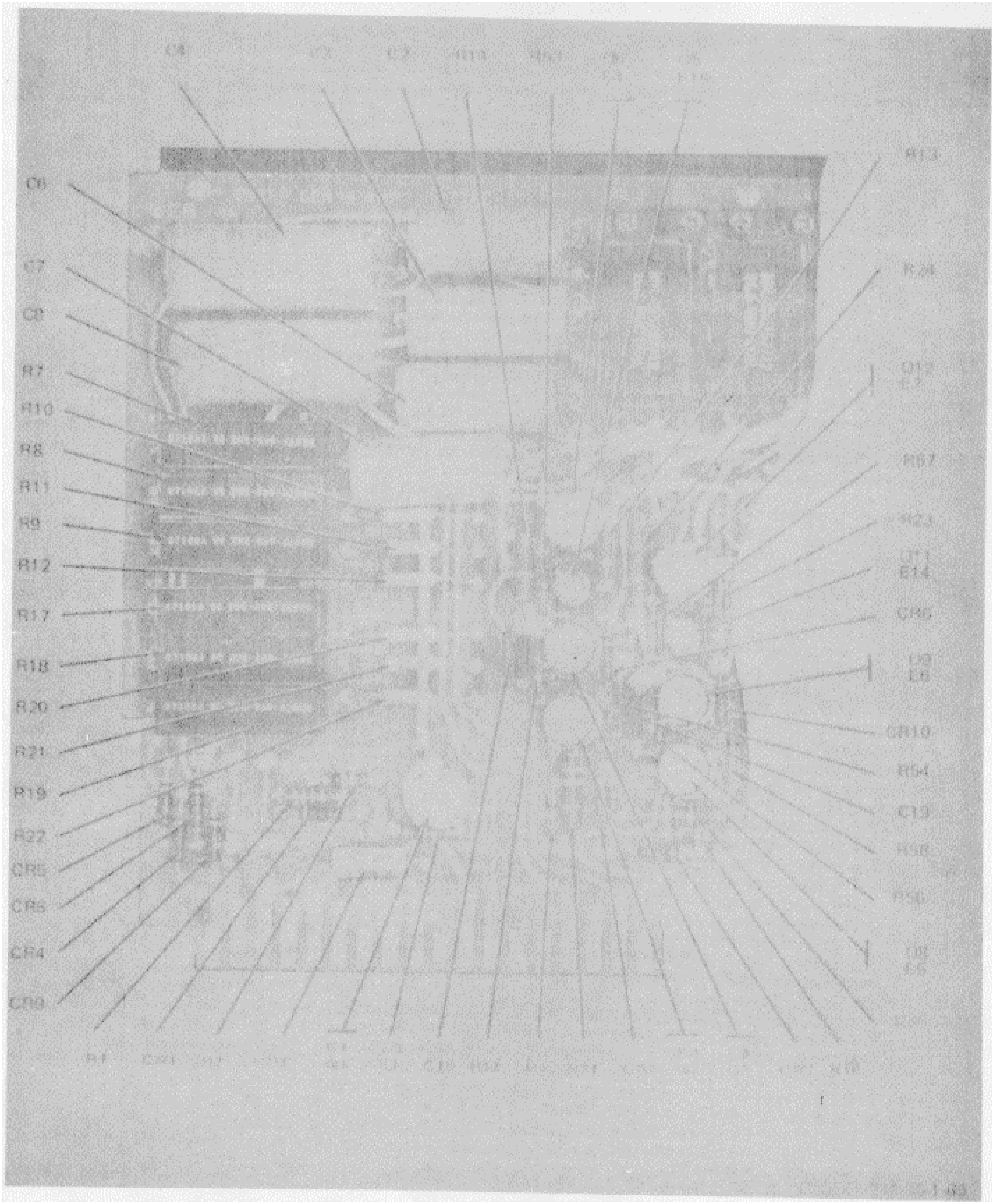
Sweep Generator and Amplifier, Components Location (sheet 1 of 3).

Figure 3-37

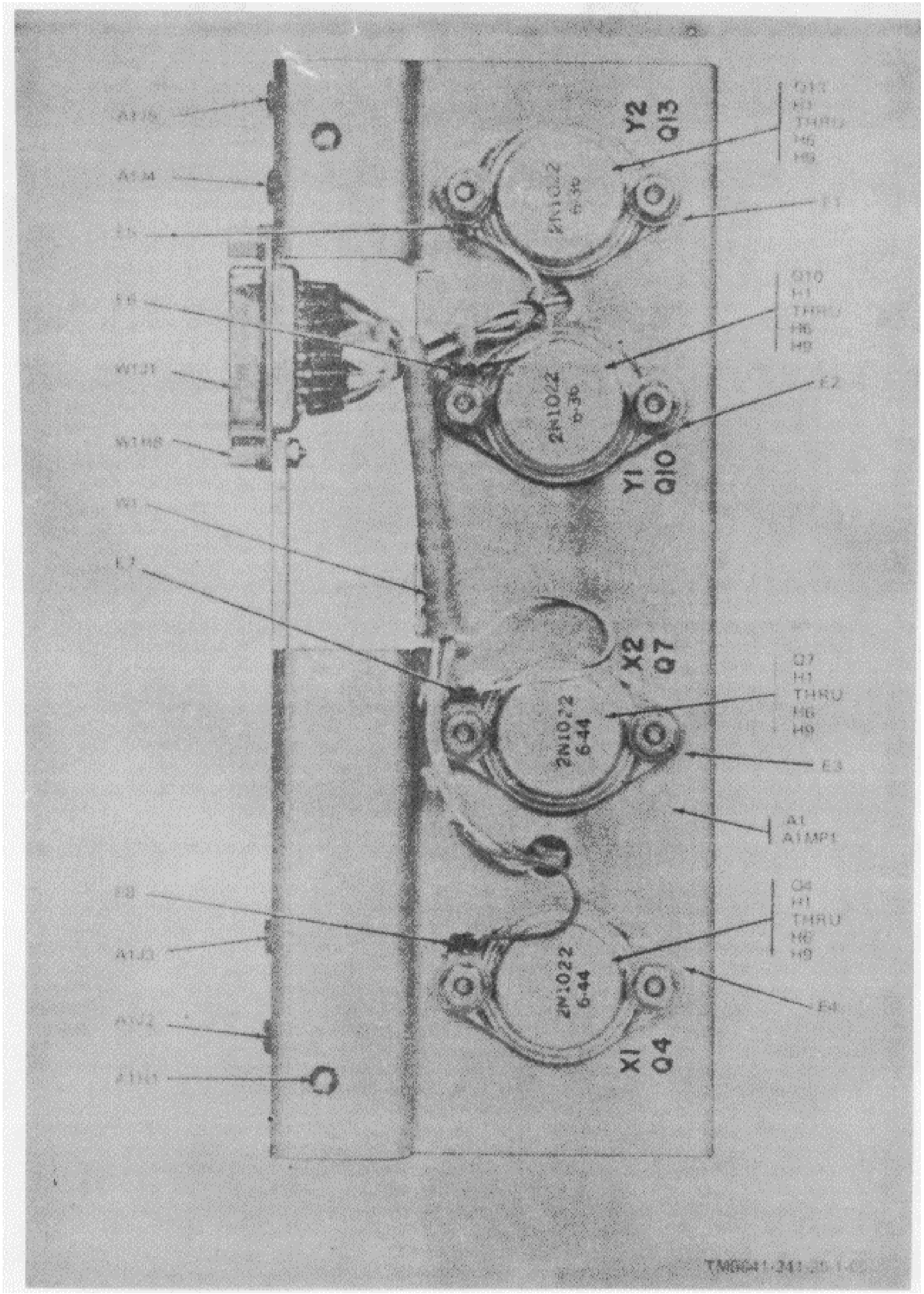


Sweep Generator and Amplifier, Components Location (*sheet 2 of 3*)

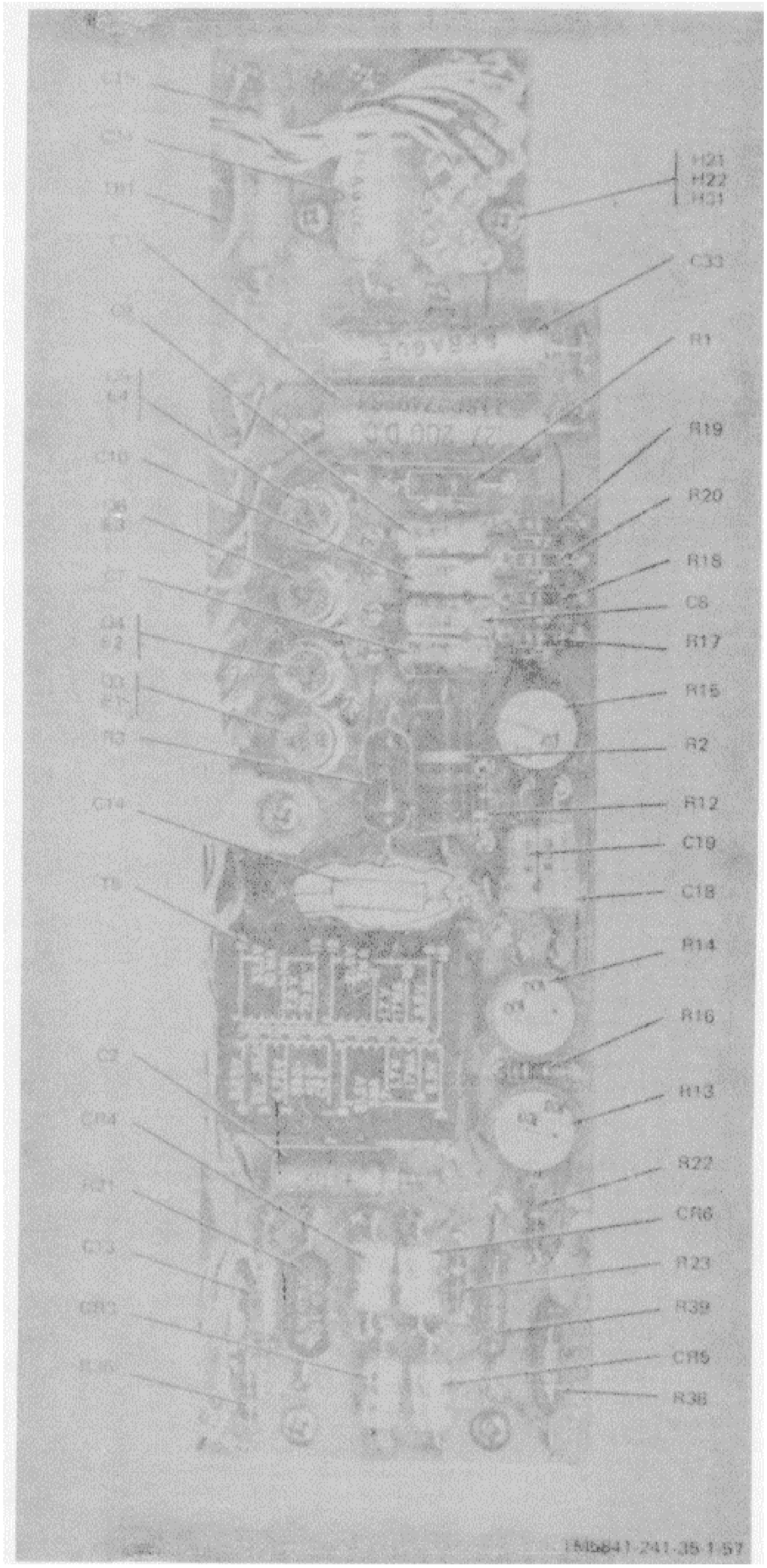
Figure 3-37



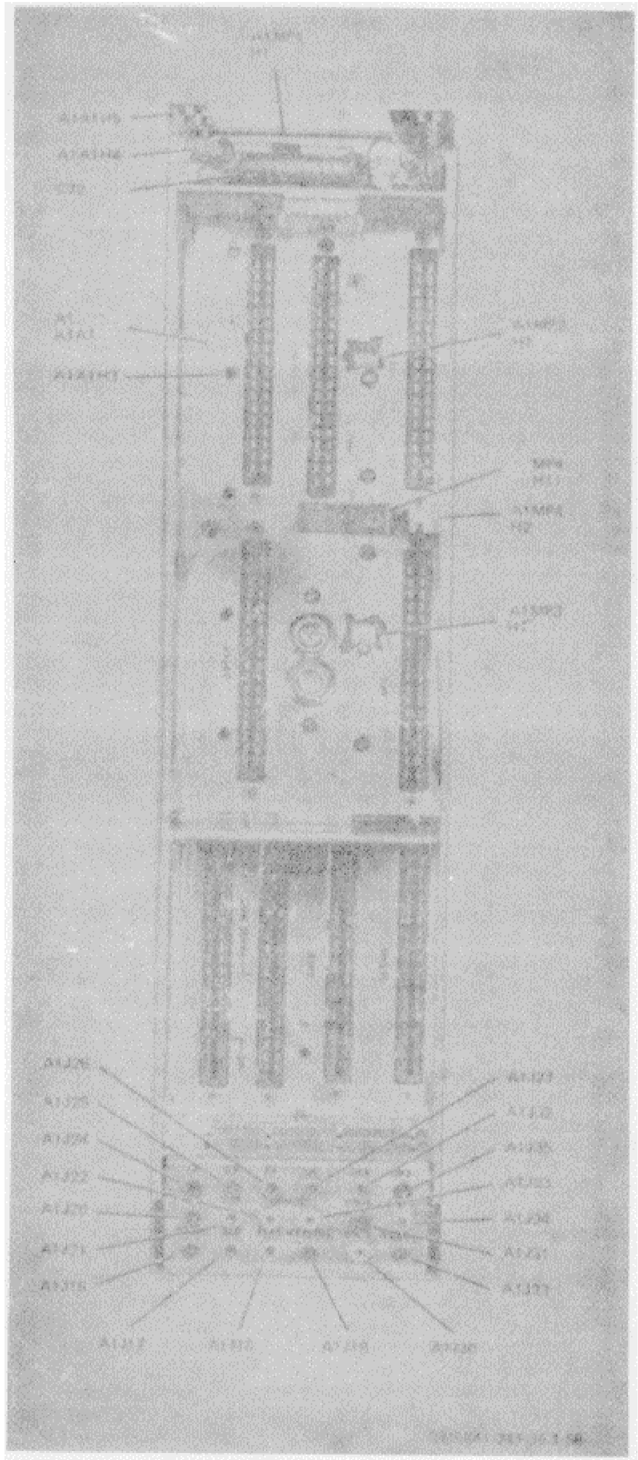
Sweep Generator and Amplifier, Components Location (sheet 3 of 3).
Figure 3-37



Heat Sink, Components Location.
Figure 3-38



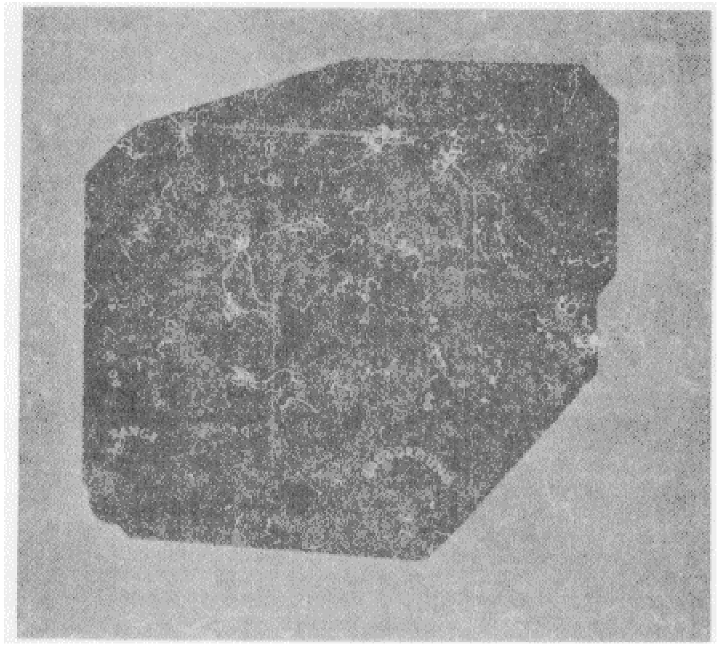
Wired Board Assembly, Components Location.
Figure 3-39



SN-358A Synchronizer Chassis Assembly. Components Location.
Figure 3-40

CHAPTER 4

INDICATOR, WEATHER RADAR 493A-4



493A-4 Indicator, Overall View
Figure 4-1

Section I. DESCRIPTION AND OPERATION

4-1. GENERAL.

This section presents the purpose of the equipment, equipment specifications, equipment description, and theory of operation. Refer to figure 4-1 for an overall view of the 493A-4 Indicator. Figure 4-2 is a table of equipment covered in this manual.

EQUIPMENT	COLLINS PART NUMBER
493A-4 Indicator	522-6104-005

Table of Equipment Covered
Figure 4-2

4-2. PURPOSE OF EQUIPMENT.

The 493A-4 Indicator provides a visual presentation of the weather information detected by the transmit and receive units of the AN/APN-158A Radar Set. The 493A-4 Indicator may be used with the AN/APN-158A Radar Set. A daylight viewing hood, Collins part number 015-1369-000, is available.

4-3. EQUIPMENT SPECIFICATIONS.

The 493A-4 Indicator specifications are listed in figure 4-3.

CHARACTERISTIC	SPECIFICATION
Power requirements (supplied by AN/APN-158A Radar Set)	+250 vdc, 20 ma, +27.5 vdc, regulated, 235 ma, -27.5 vdc, relay power, 50 ma -27.5 vdc, regulated, approximately 0 ma, 115 vac, 400 cps, 200 ma.
Duty cycle	Continuous airborne operation.

Table of Equipment Specifications (Sheet 1 of 2)
Figure 4-3

CHARACTERISTIC	SPECIFICATION
Physical dimensions	
Height	4 - 19/64 inches (10.91 cm).
Width	4 - 19/64 inches (10.91 cm).
Length	10 - 1/4 inches (26.04 cm).
Weight	5.1 pounds (2.31 kg).
Ambient temperature	
Continuous operation	-40 to +55 °C (-40 to +131 °F).
30-minute operation	-55 to +71 °C (-67 to +160 °F).
Relative humidity	100% at +50 °C (+122 °F).
Shock conditions	
Performance criteria	Eighteen 10-millisecond shocks at 7.5 g.
Safety criteria	Six 10-millisecond shocks at 15 g.
Vibration	0.030 total excursion at 10 to 55 cps and 1.5 g peak acceleration at 55 to 500 cps.

Table of Equipment Specifications (Sheet 2 of 2)
Figure 4-3

4-4. EQUIPMENT DESCRIPTION.

A. General.

This section presents a mechanical and electrical description and a description of the external operating controls and internal adjustments of the 493A-4 Indicator.

B. Mechanical Description.

The 493A-4 Indicator is housed in a black, two-piece dust cover. The unit weighs 5.1 pounds, is 4-19/64 inches high, 4-19/64 inches wide, and 10-1/4 inches long. Convection cooling is provided through holes in the dust cover.

The main chassis frame consists of two L-shaped sections that join at the upper right and lower-left edges. A front mounting plate is secured to the joined main chassis sections. A yoke brace, located near the center of the unit, secures the deflection yoke, RANGE switch, and BACKGROUND potentiometer. An encapsulated power supply is located in the upper-rear area of the chassis immediately above the deflection yoke. The front of the crt is secured by a rubber lined clamp. The clamp is secured to the main chassis frame at the bottom and to two brackets at the top. All electrical connections to the 493A-4 Indicator are made through a 32-pin connector, type PT02A-18-32P, Collins part number 371-2005-00, located on the vertical portion of the L-shaped rear plate. The filament transformer and a large inductor, associated with the sweep centering circuit, are secured to the horizontal portion of the rear plate. The only transistor, together with its associated circuit, is secured to a bracket located on the bottom of the chassis frame below the deflection yoke. The two remaining terminal boards are located on either side of the chassis frame near the center of the unit.

C. Electrical Description.

The major electrical components of the 493A-4 Indicator are: Cathode-ray tube with deflection yoke assembly, power supply, video amplifier TB1, positioning circuit TB2, and chassis circuits.

(1) Cathode-Ray Tube with Deflection Yoke Assembly.

The cathode-ray tube is a special 4-inch tube with a long persistence phosphor. The tube face is phosphorescent blue and florescent green or yellow depending upon the type of tube used. A yellow filter over the face of the tube filters out the undesirable blue light from the phosphor. The deflection yoke is a fixed arrangement of four coils that provides electromagnetic deflection of the electron beam within the crt, resulting in the sweeping beam of light that is synchronized with the antenna azimuth motion. The sweep origin is depressed 1.5 inches below the center of the viewing screen by fixed dc bias through one deflection coil. Positioning control potentiometers permit adjustment of the sweep trace 1/2 inch, both horizontally and vertically. (2) Power Supply.

(2) Power Supply.

High and low voltages for biasing the crt are provided by one encapsulated power supply. The high voltage output (approximately 8 kv) is used for final beam acceleration. The low voltage output (approximately 550 v) is used for first accelerator grid biasing.

(3) Video Amplifier TB1.

The video amplifier circuit consists of two type-7586 tubes with associated circuits. The plate supply for both tubes is +250 vdc supplied from the receiver-transmitter.

One of the tube circuits is a gate that controls the crt beam current and control grid voltage. The other tube circuit, the video amplifier, is essentially a grounded cathode amplifier.

(4) Positioning Circuit TB2.

The sweep positioning circuits consist of a symmetrical arrangement of zener diodes, diodes, resistors and coils. A special transistor regulator circuit, separately located, is used with the sweep centering circuits to maintain a constant current flow through the Yi deflection coil. This deflection coil holds the sweep trace near the bottom of the indicator face. Relay K1, located on the sweep positioning circuit, controls the bias voltage (+27.5 or -27.5 vdc) applied to the transistor circuit. Relay K1, in turn, is controlled by the RANGE switch.

(5) Chassis Circuits.

The front panel is illuminated by six miniature lamps. Provisions are made for remotely controlling panel illumination. The RANGE switch, in addition to controlling relay K1 operation, controls the bias on switch tube Vl by varying the cathode resistance and switches range information to the SN-358A/APN-158 Synchronizer. Transformer T1 provides filament voltage for V1, V2, and the crt, V3. The encapsulated power supply provides +550 vdc and +8 kv to the crt. In the standby (STBY) mode of operation, 115 vac, 400 cps is applied to filament transformer T1 to permit system warmup. In the operate (OPR) position, both T1 and the power supply are energized.

D. Operating Controls and Internal Adjustments.

(1) Operating Controls.

The operating controls are located on the front panel. These include the following:

RANGE .... A three-position switch that enables the operator to select one of three operating ranges: 30, 60, or 150 nautical miles.

BACKGROUND .... A potentiometer that provides intensity adjustment of the indicator presentation.

(2) Internal Adjustments.

Four internal adjustments are provided in the 493A-4 Indicator as follows:

Deflection sensitivity, potentiometer R33: Provides deflection sensitivity control by varying the input to the power supply.

VIDEO GAIN, potentiometer R13: Provides video amplifier gain control by varying the amplitude of the video signal at the grid of the video amplifier.

HORIZONTAL centering, potentiometer R16: Provides horizontal position adjustment of sweep trace up to 1/2 inch.

VERTICAL centering, potentiometer R28: Provides vertical position adjustment of sweep trace up to 1/2 inch.

4-5. THEORY OF OPERATION.

A. General.

This section contains a block diagram section and a detailed theory of operation section. The block diagram section, based on figure 4-4, is a discussion of the various functions occurring in the 493A-4 Indicator. Also contained in this section is a brief description of the input signals to the 493A-4 Indicator. B. Block Diagram Theory. (Refer to figure 4-4.)

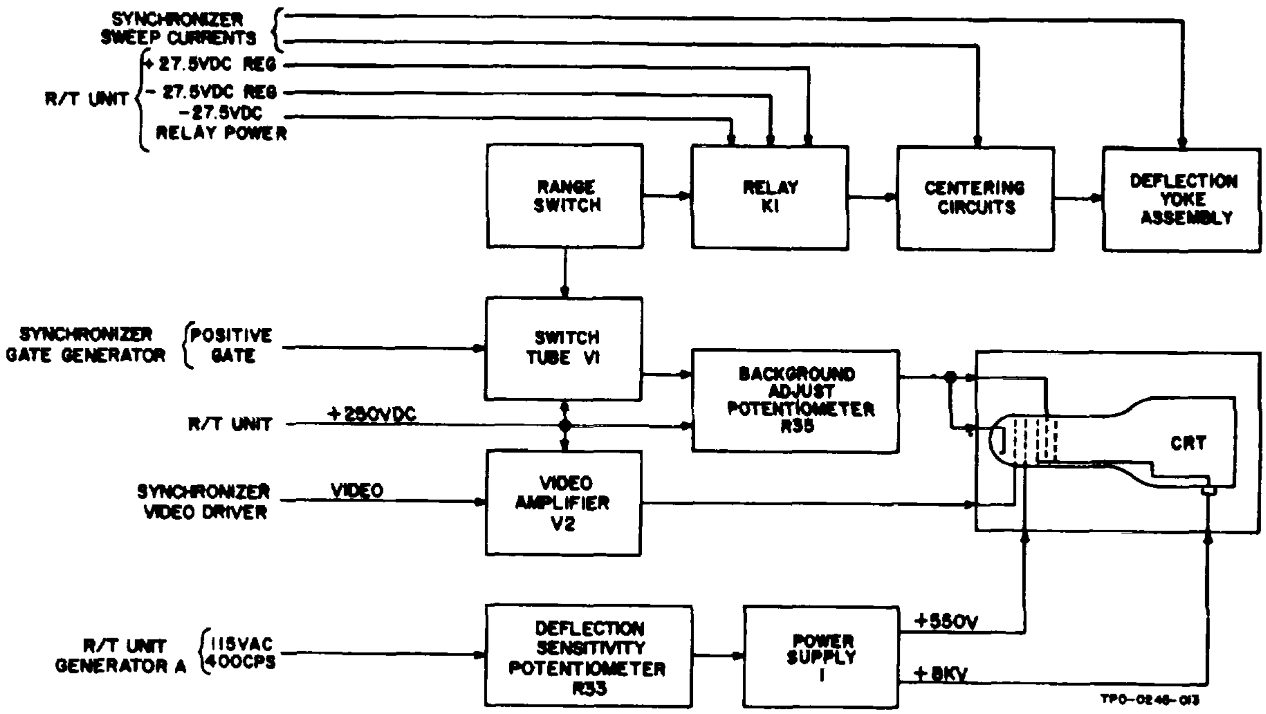
(1) Power Supply.

The power supply provides the high and low voltages for the crt. The high voltage output (approximately 8 kv) is used for final beam acceleration. The low voltage output (approximately 550 v) is used for first accelerator grid biasing. Limited control of the power supply output is provided by the deflection sensitivity potentiometer in series with the primary power input. One resistor can be bypassed to extend the range of control.

(2) Video Amplifier TB1 and BACKGROUND Adjust.

The video amplifier consists of two type-7586 tubes and associated circuits. One of the tube circuits is a gate that controls the operation of the crt beam current and control grid voltage. The positive gate signal is the triggering signal for the switching tube. The other tube circuit, the video amplifier, is essentially a gated, grounded cathode amplifier. The video amplifier amplifies the video signal and applies it to the first grid of the crt.

The plate voltage to both tubes on the video amplifier circuit is +250 vdc, and is supplied to the switching tube through R35. A portion of the voltage developed across R35 is taken from the wiper and applied to the crt cathode and fourth grid, which provides intensity adjustment of the indicator presentation.



493A-4 Indicator, Block Diagram
Figure 4-4

The RANGE switch controls the operation of switch tube V1 by changing the cathode resistance. The varying operation of V1 maintains a uniform indicator presentation for the range selected.

(3) Positioning Circuit TB2 and Transistor Circuit.

The sweep positioning circuits consist of a symmetrical, parallel arrangement of zener diodes, diodes, resistors, and coils. A special transistor circuit, separately located, is used with the sweep centering circuits to maintain a constant dc current flow through the Y1 deflection coil. This particular deflection coil holds the sweep trace near the bottom of the indicator face. Relay K1, controlled by the RANGE switch, controls the bias voltage (-27.5 vdc through a voltage divider network) to the transistor circuit. A +27.5-vdc source (also controlled by relay K1) is provided to bias the sweep current stabilization and sweep centering network.

A separate -27.5-vdc source is provided for energizing relay K1.

(4) Deflection Yoke Assembly.

The deflection yoke is a fixed arrangement of four coils that provides electromagnetic deflection of the electron beam within the crt, resulting in the sweeping beam of light that is synchronized with the antenna azimuth motion. The constant dc current level, maintained by the transistor circuit through the Y1 deflection coil, depresses the sweep trace 1.5 inches below the center of the viewing screen.

(5) Input Signal Description.

(a) Sweep Currents.

The sweep currents are linear sawtooth waveforms applied to each of the four deflection coils. These waveforms begin coincident with the transmitter pulse and have a duration dependent upon the particular range selected. The X sweep currents are a function of the sine of the antenna azimuth position, and the Y sweep currents are a function of the cosine of the antenna azimuth position.

(b) Positive Gate Signal.

The gate signal is a positive going gate signal, the beginning of which is coincident with the beginning of the sweep signal.

(c) Video Signal.

The video signal is a negative going signal imposed on a dc level. The video signals applied to the 493A-4 Indicator are video signals combined with range mark information that is spaced according to the range selected.

C. <u>Detailed Theory-of Operation.</u>

(1) Power Supply. (Refer to figure FO-8.)

The input to the power supply is 115 vac, 400 cps. The high and low voltage outputs are applied to the cathode-ray tube (crt). The high voltage output (approximately 8 kv), is used for final beam acceleration. The low voltage output (approximately 550 v) is used for first grid acceleration. Resistors R29 and R30 are bleeder resistors for the power supply. Deflection sensitivity is adjusted by potentiometer R33. Resistor R36, in series with R33, may be bypassed to provide adequate range for control of deflection sensitivity.

(2) Video Amplifier TB1 and BACKGROUND Adjust Circuit. (Refer to figure FO-8.)

Video signals from the synchronizer video driver module are coupled through C2, C3, and C4 to the grid of grounded cathode amplifier V2. The gain of V2 is adjusted by VIDEO GAIN potentiometer R13. The amplified video signal from the plate of V2 is applied to the control grid of the crt.

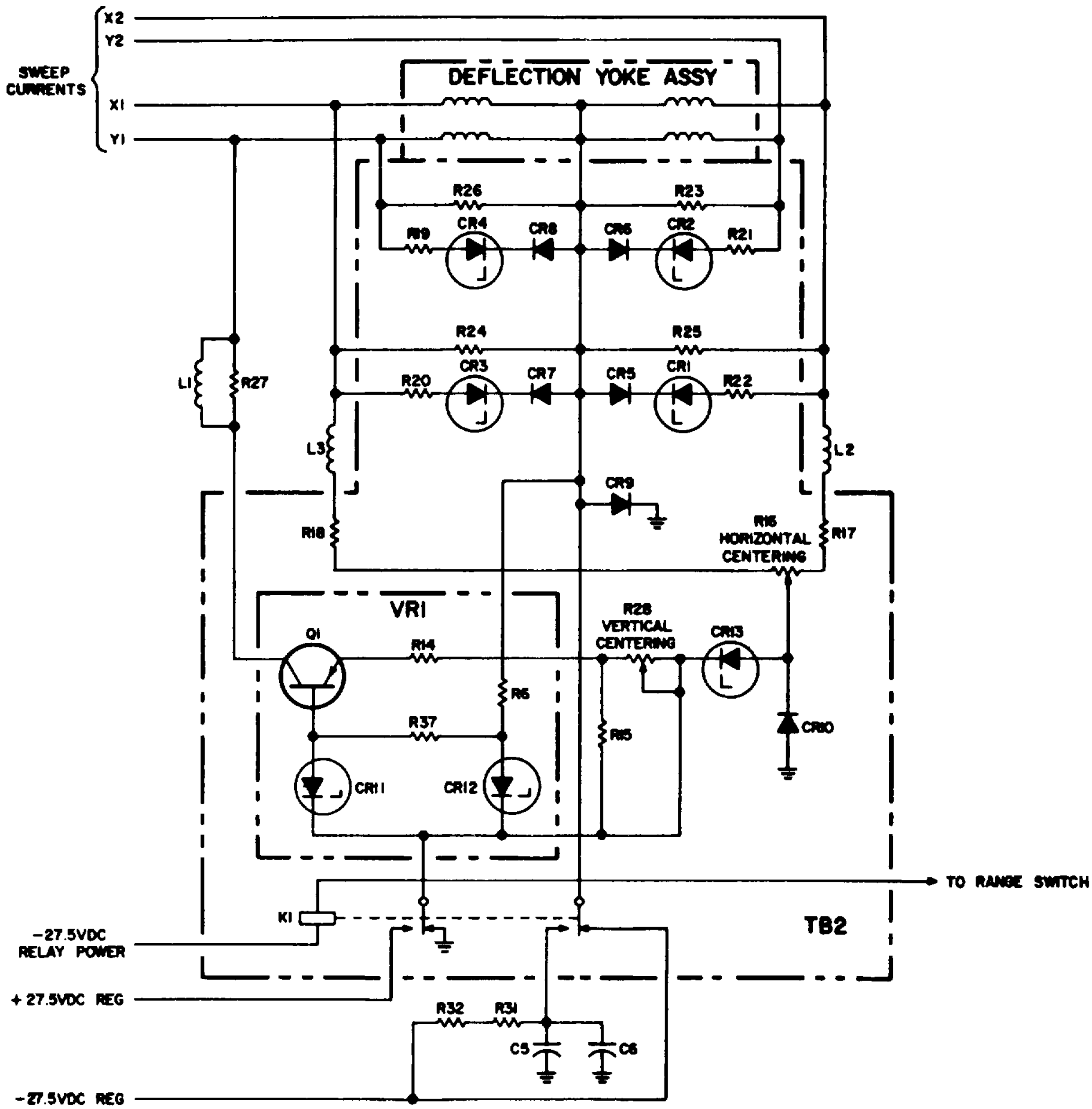
The positive gate signal from the synchronizer gate generator module is a gate that controls the crt beam current and control grid voltage. This gate pulse is applied through R2 to the grid of V1, and causes V1 to conduct heavily. A large negative gate pulse at the plate of V1 is applied to the crt as a sweep intensity gate. BACKGROUND potentiometer R35 varies the sweep intensity. When either the 60- or 150-mile range is selected by the RANGE switch, the sweep beam covers the same physical distance on the indicator in a longer period of time.

This would provide greater excitation of the viewing screen phosphor and produce a brighter trace. To prevent this, more resistance is switched into the cathode of V1 on the 60- and 150-mile ranges. The increase in resistance reduces the conduction of Vi and reduces the amplitude of the negative intensity gate. This, gate is applied to the cathode of the crt to produce uniform sweep intensity for the 30-, 60-, and 150-mile ranges.

(3) Positioning Circuit TB2 and Transistor Circuit. (Refer to figure 4-5.)

The sweep positioning circuit permits adjustment of the horizontal and vertical position of the sweep, and depresses the sweep trace 1.5 inches below the center of the crt. Potentiometer R28 provides adjustment for vertical centering of the sweep, and R16 provides adjustment for horizontal centering of the sweep. A constant current, regulated by Q1 and zener diodes CR11 and CR12, is applied to the Y1 deflection yoke winding for sweep off-centering. Each of the four yoke windings are shunted by a diode, a resistor, and a zener diode. These parts provide a damping action for the yoke winding, and protection for transistors in the synchronizer sweep generator and amplifier module. Inductors L1, L2, and L3 isolate the dc sweep positioning circuits from the sweep deflection signals.

When the RANGE switch is in either the 30- or 60-mile position, the low sides of the deflection coils are connected to -27.5 v through pins 4 and 6 of relay K1. In the 150-mile position, K1 is energized and the deflection coil voltage is reduced approximately 10 v by resistors R31 and R32. The voltage on the dc positioning circuits is also reduced by the drop across zener diode CR13.



493A-4 Indicator Sweep Circuits, Simplified Schematic Diagram
Figure 4-5

Section II. DISASSEMBLY

4-6. GENERAL.

This section presents instructions for disassembling the 493A-4 Indicator. These instructions are arranged so that disassembly of each major part is an individual operation. When it is necessary to disassemble the unit, locate the part in the table of contents and begin on the page indicated. Reference is made to previous disassembly steps that must be performed before a part may be removed or disassembled. In any event, the disassembly procedure should be continued only as far as necessary to replace the faulty component. These instructions include special techniques, cautions, warnings, and unique procedures.

4-7. PRECAUTIONS AND GENERAL TECHNIQUES.

Mark, tag, or otherwise identify all disconnected electrical wiring. Note the color coding, placement of leads, and method of applying insulation before unsoldering or removing any electrical components. These procedures supply sufficient information to completely remove the parts listed in the table of contents. In many cases, however, parts may be released and moved aside to gain access to other parts without unsoldering the connecting leads; this applies particularly to the printed circuit boards. Do not unsolder these leads unless absolutely necessary.

CAUTION: TO PREVENT DAMAGE TO A SOLID-STATE DEVICE, USE A HEAT SINK ON THE LEAD BETWEEN THE POINT BEING UNSOLDERED AND THE DEVICE.

CAUTION: THE 493A-4 INDICATOR USES EXTREMELY HIGH VOLTAGES. DO NOT ATTEMPT ANY DISASSEMBLY WHILE PRIMARY POWER IS APPLIED TO THE UNIT.

WARNING: CAPACITORS IN THE 493A-4 INDICATOR MAY HOLD A CHARGE FOR LONG PERIODS OF TIME AFTER PRIMARY POWER HAS BEEN REMOVED. OBSERVE SAFETY PRECAUTIONS WHEN WORKING ON THE INDICATOR.

WARNING: BREAKAGE OF THE HIGH-VACUUM CATHODE-RAY TUBE MAY RESULT IN INJURY FROM FLYING GLASS. DO NOT STRIKE OR SCRATCH THE TUBE AT ANY TIME. DO NOT APPLY MORE THAN MODERATE PRESSURE WHEN INSERTING OR REMOVING THE TUBE. USE PROTECTIVE DEVICES, SUCH AS GOGGLES, FACE MASKS, AND RUBBER GLOVES.

These precautions are repeated in the text of the disassembly procedures where applicable.

4-8. DISASSEMBLY PROCEDURE.

A. Remove Outer Dust Covers. (Refer to figure 4-6.)

(1) Remove eight machine screws (15) securing two-piece dust cover (14) to the indicator frame.

(2) Remove two-piece dust cover (14).

B. Remove Front Panel and Front Plate. (Refer to figure 4-6.)

(1) Remove RANGE control knob (1) by loosening two setscrews (2) securing it to RANGE control shaft (116).

(2) Remove BACKGROUND control knob (3) by loosening two setscrews (4) securing it to BACKGROUND control shaft (122).

(3) Remove face panel (10) and filter (11) by removing four hooded screws (6, 7).

(4) Remove printed light board (8) by unsoldering and tagging the two panel illumination leads.

(5) Remove front mounting plate (12) by removing eight machine screws (13) securing it to left and right frames (218, 226).

C. Remove Rear Cover Plate. (Refer to figure 4-6.)

(1) Separate rear cover plate (19) from the indicator by removing six machine screws (20) securing it to left and right frames (218, 226).

(2) Unsolder and tag the blue and gray leads from inductor, L3 (24).

(3) Unsolder and tag the blue and white leads from inductor L2 (21).

(4) Unsolder and tag the purple and orange leads from resistors R31 and R32 (27, 31).

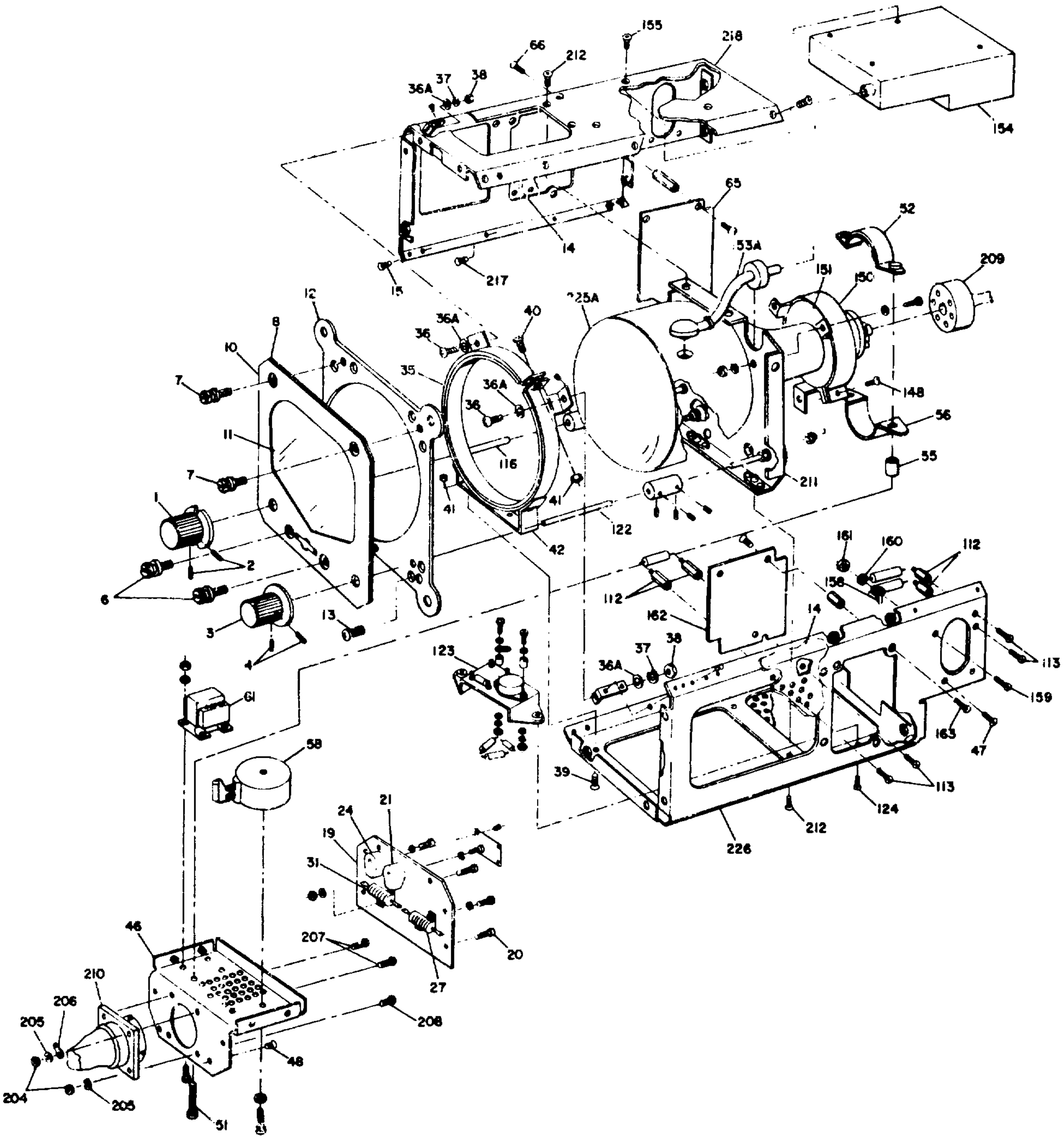
(5) Remove rear cover plate (19).

D. Remove Staked Rear Plate. (Refer to figure 4-6.)

(1) Separate staked rear plate (46) from the indicator by removing six machine screws (47, 48) securing it to left and right frames (218, 226).

(2) Remove electrical connector (210) by removing two machine screws (207), two machine screws (208), four lockwashers (205), four ground terminal lugs (206), and four hexnuts (204) securing it to staked rear plate (46).

(3) Unsolder and tag the yellow and brown leads from inductor L1 (58).



493A-4 Indicator, Exploded View
Figure 4-6

(4) Unsolder and tag the leads from terminals 1, 3, 5, and 6 of transformer T1 (61).

(5) Remove staked rear plate (46).

E. Remove Left Frame. (Refer to figure 4-6.)

(1) Remove two-piece dust cover (14) in accordance with paragraph A above.

(2) Remove front panel (10) and front plate (12) in accordance with paragraph B above.

(3) Separate rear cover plate (19) from left and right frames (218, 226) in accordance with paragraph C (1) above.

(4) Separate staked rear plate (46) from left and right frames (218, 226) in accordance with paragraph D(1) above.

(5) Release tube clamp (35) from left frame (218) by removing machine screw (36), two flat washers (36A), lockwasher (37), and hexnut (38).

(6) Remove nine machine screws (217) securing left and right frames (218, 226) together.

(7) Remove four machine screws (212) securing left frame (218) to rolled brace (211).

(8) Remove four machine screws (155) securing power supply PS1 (154) to left frame (218).

(9) Remove three machine screws (66) securing video amplifier TB1 (65) to left frame (218).

(10) Remove left frame (218).

F. Remove Right Frame. (Refer to figure 4-6.)

(1) Remove two-piece dust cover (14) in accordance with paragraph A above.

(2) Remove front panel (10) and front plate (12) in accordance with paragraph B above.

(3) Separate rear cover plate (19) from left and right frames (218, 226) in accordance with paragraph C (1) above.

(4) Separate staked rear plate (46) from left and right frames (218, 226) in accordance with paragraph D(1) above.

(5) Remove nine machine screws (217) securing left and right frames (218, 226) together.

(6) Release tube clamp (35) from right frame (226) by removing two machine screws (39) and two self-locking hexnuts (41) securing welded clamp (42) to right frame (226), and by removing machine screw (36), two flat washers (36A), lock-washer (37), and hexnut (38) securing tube clamp (35) to right frame (226)

(7) Remove four machine screws (212) securing right frame (226) to rolled brace (211).

(8) Remove two machine screws (124) securing off-centering regulator (123) to right frame (226).

(9) Remove three machine screws (163) securing positioning circuit TB2 (162) to right frame (226).

(10) Pull right frame (226) away from the indicator unit.

(11) Remove four machine screws (113) securing four standoff terminals (112) to right frame (226).

(12) Remove solder lug (158) by removing machine screw (159), lockwasher (160), and hexnut (161).

(13) Remove right frame (226).

G. Remove Power Supply-PS1. (Refer to figure 4-6.)

(1) Remove two-piece dust cover (14) in accordance with paragraph A above.

(2) Remove front panel (10) and front plate (12) in accordance with paragraph B above.

(3) Separate rear cover plate (19) from left and right frames (218, 226) in accordance with paragraph C (1) above.

(4) Separate staked rear plate (46) from left and right frames (218, 226) in accordance with paragraph D(1) above.

(5) Remove left frame (218) in accordance with paragraphs E(5) through E(10) above.

(6) Remove high-voltage lead (153A) from cathode-ray tube (225A).

(7) Unsolder and tag the leads from terminals 1 through 4 of power supply PS1 (154).

(8) Remove power supply, PS1 (154).

H. Remove Video Amplifier TB1. (Refer to figure 4-6.)

(1) Remove two-piece dust cover (14) in accordance with paragraph A above.

(2) Remove front panel (10) and front plate (12) in accordance with paragraph B above.

(3) Separate rear cover plate (19) from left and right frames (218, 226) in accordance with paragraph C (1) above.

(4) Separate staked rear plate (46) from left and right frames (218, 226) in accordance with paragraph D(1) above.

(5) Remove left frame (218) in accordance with paragraphs E(5) through E(10) above.

(6) Unsolder and tag the leads from terminals 1 through 10, 12, and 15, and pins 10 and 12 (filaments) of V1 tube socket of video amplifier TB1 (65).

(7) Remove video amplifier TB1 (65).

J. Remove Positioning Circuit TB2. (Refer to figure 4-6.)

(1) Remove two-piece dust cover (14) in accordance with paragraph A above.

(2) Remove front panel (10) and front plate (12) from the left and right frames (218, 226) in accordance with paragraph B above.

(3) Separate rear cover plate (19) from left and right frames (218, 226) in accordance with paragraph C (1) above.

(4) Separate staked rear plate (46) from left and right frames (218, 226) in accordance with paragraph D(1) above.

(5) Remove right frame (226) in accordance with paragraphs F(5) through F(13) above.

(6) Unsolder and tag the leads from terminals 1 through 25 and pin 7 of relay K1 of positioning circuit TB2 (162).

(7) Remove positioning circuit TB2 (162).

K. Remove Cathode-Ray Tube. (Refer to figure 4-6.)

(1) Remove two-piece dust cover (14) in accordance with paragraph A above.

(2) Remove front panel (10) and front plate (12) in accordance with paragraph B above.

(3) Separate rear cover plate (19) from left and right frames (218, 226) in accordance with paragraph C (1) above.

(4) Separate staked rear plate (46) from left and right frames (218, 226) in accordance with paragraph D(1) above.

(5) Remove left frame (218) in accordance with paragraphs E(5) through E(10) above.

(6) Remove right frame (226) in accordance with paragraphs F(6) through F(13) above.

WARNING: THE FRONT SECTION OF THE CATHODE-RAY TUBE IS UNSUPPORTED WHEN RIGHT FRAME (226) IS REMOVED. A MEANS OF SUPPORT MUST BE PROVIDED TO PREVENT THE APPLICATION OF UNDUE STRESS ON THE NECK OF THE TUBE.

(7) Remove power supply PS1 (154) in accordance with paragraphs G(6) through G(8) above.

(8) Remove cathode-ray tube socket (209).

<u>**NOTE**</u>**: If used in the unit, remove bonded clamps (52 and 56) by removing two machine screws (51) and two spacers (55) securing them to staked rear plate (46).**

(9) Remove cathode-ray tube (225A).

<u>**WARNING**</u>**: EXTREME CARE SHOULD BE EXERCISED WHEN REMOVING THE CATHODE-RAY TUBE. NO STRAIN OR STRESS SHOULD BE EXERTED ON THE NECK OF THE TUBE. BREAKAGE OF THE TUBE MAY RESULT IN INJURY FROM FLYING GLASS. DO NOT APPLY MORE THAN MODERATE PRESSURE WHEN INSERTING OR REMOVING THE TUBE. USE PROTECTIVE DEVICES, SUCH AS GOGGLES, FACE MASKS, AND RUBBER GLOVES.**

(10) Remove tube clamp (35) by loosening machine screw (40) and hexnut (41).

L. <u>Remove Sweep Deflection Yoke Assembly Y1</u>. (Refer to figure 4-6.)

(1) Remove two-piece dust cover (14) in accordance with paragraph A above.

(2) Remove front panel (10) and front plate (12) in accordance with paragraph B above.

(3) Separate rear cover plate (19) from left and right frames (218, 226) in accordance with paragraph C(1) above.

(4) Separate staked rear plate (46) from left and right frames (218, 226) in accordance with paragraph D(1) above.

(5) Remove left frame (218) in accordance with paragraphs E(5) through E(10) above.

(6) Remove right frame (226) in accordance with paragraphs F(6) through F(13) above.

<u>**WARNING**</u>**: THE FRONT SECTION OF THE CATHODE-RAY TUBE IS UNSUPPORTED WHEN RIGHT FRAME (226) IS REMOVED. A MEANS OF SUPPORT MUST BE PROVIDED TO PREVENT THE APPLICATION OF UNDUE STRESS ON THE NECK OF THE TUBE.**

(7) Remove power supply PS1 (154) in accordance with paragraphs G(6) through G(8) above.

(8) Remove the cathode-ray tube in accordance with paragraphs K(8) and K(9) above.

<u>WARNING</u>: EXTREME CARE SHOULD BE EXERCISED WHEN REMOVING THE CATHODE-RAY TUBE. NO STRAIN OR STRESS SHOULD BE EXERTED ON THE NECK OF THE TUBE. BREAKAGE OF THE TUBE MAY RESULT IN INJURY FROM FLYING GLASS. DO NOT STRIKE OR SCRATCH THE TUBE AT ANY TIME. DO NOT APPLY MORE THAN MODERATE PRESSURE WHEN INSERTING OR REMOVING THE TUBE. USE PROTECTIVE DEVICES, SUCH AS GOGGLES, FACE MASKS, AND RUBBER GLOVES.

(9) Unsolder and tag the leads from terminals 5, 4, 14, 15, 16, 17, 11, and 9 of positioning circuit TB2 (162).

(10) Release sweep deflection yoke assembly Y1 (151) by loosening machine screw (148) of yoke band (150).

(11) Remove sweep deflection yoke assembly Y1 (151).

M. <u>Remove Off-Centering Regulator</u>. (Refer to figure 4-6.)

(1) Remove two-piece dust cover (14) in accordance with paragraph A above.

(2) Remove front panel (10) and front plate (12) in accordance with paragraph B above.

(3) Separate rear cover plate (19) from left and right frames (218, 226) in accordance with paragraph C(1) above.

(4) Separate staked rear plate (46) from left and right frames (218, 226) in accordance with paragraph D(1) above.

(5) Remove right frame (226) in accordance with paragraphs F(5) through F(13) above.

(6) Unsolder and tag the leads from off-centering regulator (123).

(7) Remove off-centering regulator (123).

Section III. CLEANING

4-9. GENERAL.

This section presents instructions for cleaning the dismantled and disassembled components, parts, and subassemblies of the 493A-4 Indicator. These instructions are tabulated and arranged to facilitate reference to the test procedure for cleaning the various parts and assemblies. All parts requiring particular methods of cleaning are considered separately, and parts which are similar enough to permit identical cleaning procedures are grouped together. Either Turcosol or Stoddard solvent may be used in the following procedures.

WARNING: PERFORM OPERATIONS INVOLVING CLEANING SOLVENT UNDER A VENTILATED HOOD. AVOID BREATHING SOLVENT VAPOR AND FUMES. WEAR A SUITABLE MASK WHEN NECESSARY. AVOID CONTINUOUS CONTACT WITH THE SOLVENT. USE GOGGLES, GLOVES, AND AN APRON TO PREVENT IRRITATION FROM PROLONGED CONTACT. CHANGE CLOTHING THAT HAS BECOME SATURATED WITH SOLVENT.

References to air jet in this section indicate a hand-operated air nozzle supplied with clean, dry, compressed air at a maximum pressure of 28 pounds per square inch.

WARNING: WEAR GOGGLES WHEN USING THE AIR JET TO BLOW DUST AND DIRT FROM EQUIPMENT PARTS. WARN OTHER PERSONS AWAY FROM HAZARDOUS AREA OR WORKING ENCLOSURE.

4-10. CLEANING PROCEDURE.

The following paragraphs present instructions and procedures for cleaning the various parts of the dismantled and disassembled equipment preparatory to performing inspection procedures. For convenience, components, parts, and subassemblies are alphabetically listed and cross-referenced to the appropriate paragraphs containing the cleaning instructions. Refer to figure 4-7.

WARNING: OBSERVE ALL FIRE PRECAUTIONS WHEN USING FLAMMABLE MATERIALS FOR CLEANING PURPOSES. THESE MATERIALS SHOULD ONLY BE USED OUTSIDE OR IN A VENTILATED BOOTH PROVIDED WITH EXPLOSION-PROOF ELECTRICAL EQUIPMENT AND AN EXHAUST FAN HAVING SPARKPROOF BLADES.

A. Connectors.

(1) Wipe dust and dirt from bodies, shells, and cables clamps using a solvent-moistened, lintless cloth. Wipe dry with a clean, dry, lintless cloth.

(2) Remove dust from inserts using a small soft-bristled brush and an air jet.

ITEM	REFER TO PARAGRAPH
Connectors	4-10.A
Covered cables	4-10.B
Covers and shields	4-10.C
Electron tubes	4-10.D
Knobs and panels	4-10.E
Machined metal parts	4-10.F
Mechanical metal parts	4-10.G
Printed circuit boards	4-10.H
Tube sockets	4-10.J
Wired chassis	4-10.K

Index of Cleaning Procedures
Figure 4-7

(3) Wash dirt and any traces of lubricant from inserts, insulation, and contacts using solvent applied sparingly with a small, camel hair brush.

CAUTION: DO NOT ALLOW SOLVENT TO RUN INTO SLEEVES OR CONDUIT COVERING ANY WIRES OR CABLES CONNECTED TO CONTACT TERMINALS OF THE INSERT.

(4) Dry the insert with an air jet.

B. Covered Cables.

(1) Clean outer surfaces by wiping away dirt with a solvent-moistened, lintless cloth.

(2) Wipe dry using a clean, dry, lintless cloth.

(3) Treat any connector terminations in accordance with paragraph 4-10.A. Wipe lug terminations clean with a solvent-moistened, lintless cloth, and dry with a clean, dry, lintless cloth.

C. Covers and Shields.

Clean all unfinished, finished, and partly finished sheet-metal covers; such as dust covers, inspection covers, and housings as follows:

(1) Remove bulk of any surface grease with rags.

(2) Blow dust from surfaces, holes, and recesses with an air jet.

(3) Immerse in a washing bath of solvent and scrub until clean, working over all surfaces and into all holes and recesses with suitable nonmetalic brushes. Flat, wood-backed brushes with soft, fiber bristles are recommended for surfaces. Round brushes similar to those used for washing bottles and test tubes are recommended for holes and recesses.

(4) Raise from bath and permit solvent to drain into bath.

(5) Immerse in rinsing bath of clean solvent, rinse, and raise from bath. Position to drain dry so that solvent is not trapped in holes or recesses. Where practical positioning will not permit complete drainage, use an air jet to remove any trapped solvent.

CAUTION: USE PROTECTIVE DEVICES WHEN USING THE AIR JET TO REMOVE EXCESS SOLVENT.

(6) When thoroughly dry, touchup minor damage to the finish in accordance with paragraph 4-14. E of the repair section. Extensive damage to the finish may require complete refinishing.

(7) Protect from dust and moisture pending inspection.

D. Electron Tubes.

(1) Remove dust and dirt from surface of glass or metal envelope and side of tube base with solvent-moistened, lintless cloth. Apply the cloth lightly to avoid obliterating the tube type markings.

(2) Dry and polish these surfaces by gently wiping them with a clean, dry, lintless cloth.

(3) Clean bottom of base and all tube contacts with a soft-bristled brush.

NOTE: Abrasives or metal tools should not be used to remove corrosion deposits occasionally present on tube contacts.

CAUTION: USE EXTREME CARE WHEN CLEANING THE CATHODE-RAY TUBE. DO NOT STRIKE OR SCRATCH THE TUBE AT ANY TIME. DO NOT ALLOW IT TO COME IN THE VICINITY OF MAGNETIC MATERIALS. BREAKAGE OF THE TUBE MAY RESULT IN INJURY FROM FLYING GLASS. WEAR PROTECTIVE CLOTHING WHEN HANDLING THE TUBE.

E. Knobs and Panels.

Clean knobs and panels by gently wiping the surfaces with a clean, soft, lintless cloth. When clean, polish with tissue paper.

F. Machined Metal Parts.

Detached shafts, keys, pins, collars, and similar machined parts should be cleaned in a suitable cleaning machine if available. If a cleaning machine is not available, proceed as follows:

(1) Clean machined metal parts in accordance with paragraphs C(1) and C(3) through C(5) above.

NOTE: Do not touch any clean machined or unfinished parts with bare hands.

(2) Dry in dust-free, dry area or suitable enclosure. Radiant heat used in a ventilated enclosure is recommended for drying, particularly where atmospheric humidity is high.

(3) After the drying process is completed, apply a light coat of lubricating oil to any bare steel surfaces.

G. Mechanical Metal Parts.

The detached miscellaneous mechanical metal parts include mounting plates, mounting clamps and brackets, nuts, bolts, screws, washers, fasteners, and other hardware. These should be cleaned in a suitable cleaning machine or in accordance with applicable steps of the procedures for covers and shields contained in paragraph C above.

H. Printed Circuit Boards.

(1) Using an air jet and a small, camel hair brush, blow and brush dust and dirt from surfaces, holes, and crevices.

(2) Wipe clean using a lintless cloth slightly moistened with solvent.

CAUTION: THE EPOXY MOISTURE SEALANT ON THE PRINTED CIRCUIT BOARDS IS SUSCEPTIBLE TO SOFTENING IF SOLVENT IS APPLIED FOR EXCESSIVE PERIODS OF TIME OR IN EXCESSIVE AMOUNTS. USE CARE IN CLEANING THESE PRINTED CIRCUIT BOARDS WITH A SOLVENT MOISTENED CLOTH. DRY WITH A CLEAN, LINTLESS CLOTH IMMEDIATELY AFTER CLEANING.

J. Tube Sockets.

Mica-filled Bakelite sockets are cleaned as follows:

(1) Remove any rosin adhering to silver-plated contacts, using orange sticks depressed to wedge ends.

CAUTION: **DO NOT USE METAL TOOLS TO REMOVE FOREIGN MATTER FROM THESE CONTACTS. DAMAGE TO CONTACT PLATING INVITES CORROSION WHICH MAY ULTIMATELY RESULT IN EQUIPMENT FAILURE.**

(2) Wash contacts with solvent lightly applied with a small, soft-bristled brush.

(3) Using solvent-moistened, lintless cloth, remove any foreign matter adhering to the socket body or wafer.

(4) Dry all parts with an air jet.

CAUTION: **USE PROTECTIVE DEVICES WHEN USING THE AIR JET TO REMOVE EXCESS SOLVENT.**

K. Wired Chassis.

The following procedures should be used for chassis containing resistors, capacitors, switches, tube sockets, inductors, transformers, and other wired parts.

(1) Remove dust and dirt from all surfaces, including parts and wiring, using soft-bristled brushes and an air jet.

CAUTION: **AVOID AIR-BLASTING DELICATE PARTS BY TOO CLOSE AN APPROACH WITH THE AIR JET NOZZLE. USE CAUTION WHEN BRUSHING DELICATE PARTS.**

NOTE: **When necessary to disturb the position and dress of wiring and cables, ensure that they are properly restored after cleaning is completed.**

(2) Clean tube sockets in accordance with paragraph J above.

(3) With minimum disturbance of wiring, clean connectors in accordance with paragraph A above.

(4) Complete chassis cleaning by wiping all finished surfaces with a solvent-moistened, lintless cloth.

(5) Dry and polish these surfaces, using a clean, dry, lintless cloth.

(6) Protect the chassis from dust, moisture, and damage pending inspection.

Section IV. INSPECTION/CHECK

4-11. GENERAL.

This section presents instructions and procedures to assist in determining, by inspection, the condition of the dismantled, disassembled, and cleaned components, parts, and assemblies of the 493A-4 Indicator. Defects resulting from wear, physical damage, deterioration, or other causes would be discovered by these inspection procedures. Detailed inspection procedures are alphabetically arranged. Refer to the repair section of this manual for replacement or repair of defective components.

4-12. INSPECTION PROCEDURE.

Figure 4-8 lists the mechanical and electrical parts to be inspected and contains cross-references to applicable paragraph continuing inspection routines.

ITEM	REFER TO PARAGRAPH
Capacitors	4-12A
Chassis	4-12B
Connectors	4-12C
Covers and shields	4-12D
Electron tubes	4-12E
Insulators: Ceramic, Mycalex	4-12F
Knobs and panels	4-12G
Machined metal parts	4-12H
Mechanical metal parts	4-12I
Printed circuit boards	4-12K
Receptacles	4-12L
Relays	4-12M
Resistors	4-12N
Semiconductors	4-12P

Index of Inspection Procedures Sheet 1 of 2)
Figure 4-8

ITEM	REFER TO PARAGRAPH
Soldered terminal connections	4-12Q
Switches	4-12R
Transformers, power supplies, and inductors	4-12S
Tube sockets	4-12T
Wiring	4-12U

Index of Inspection Procedures (Sheet 2 of 2)
Figure 4-8

A. Capacitors.

Inspect capacitors for the defects listed in figure 4-9.

DEFECT	METAL TYPE	MOLDED TYPE	CERAMIC TYPE
Leakage (at case seams or around terminal insulation)	X		
Cracked, broken, or charred terminal insulation	X		
Case damage (dents or holes)	X		
Case damage (cracks or breakage)		X	
Loose, broken, or corroded terminal studs, lugs, or leads	X	X	X
Loose, broken, or poorly soldered connections	X	X	X

Table of Fixed Capacitor Inspection
Figure 4-9

B. Chassis.

Inspect chassis for deformation, dents, punctures, badly worn surfaces, damaged connectors and fastening devices. Examine the chassis for corrosion and damage that may require refinishing.

C. Connectors.

Inspect connector bodies for broken parts, deformed shells or clamps, and other irregularities. Inspect for cracked or broken insulation and for contacts that are broken, deformed, or out of alignment. Check for corroded or damaged plating on contacts and for loose, poorly soldered, broken, or corroded terminal connections.

D. Covers and Shields.

Inspect covers and shields for punctures, deep dents, and badly worn surfaces. Check for damaged fastening devices, corrosion, and other damage that may require refinishing.

E. Electron Tubes.

Inspect electron tube envelopes for cracked glass, or dented metal, separation from base, and obliterated markings. Check the base for a cracked, chipped, or broken body. Inspect for deformed, broken, or misaligned base contacts. Check for corrosion or other damage to contact plating. Inspect cathode-ray tube phosphor for burns.

CAUTION: USE EXTREME CARE WHEN INSPECTING THE CATHODE-RAY TUBE. DO NOT STRIKE OR SCRATCH THE TUBE AT ANY TIME. DO NOT ALLOW MAGNETIC MATERIALS TO COME IN THE VICINITY OF THE TUBE. BREAKAGE OF THE TUBE MAY RESULT IN INJURY FROM FLYING GLASS. WEAR PROTECTIVE CLOTHING WHEN HANDLING THE TUBE.

F. Insulators: Ceramic and Mycalex.

Inspect ceramic and Mycalex insulators for cracks, burns, chips, or other physical damage. Check for corrosion and loose, broken, or poorly soldered terminal connections.

G. Knobs and Panels.

Inspect knobs and panels for physic l damage and deformation, marred surfaces, and impairment of markings.

H. Machined Metal Parts.

Inspect machined metal parts for physical damage to surfaces, corners, and edges. Inspect closely all machined surfaces, holes, bores, counterbores, slots, grooves, shoulders, flanges, tapped holes, and all threaded members, both male and female, for damage of any sort including roughness of surface, corrosion, or foreign matter. Inspect plated or finished areas for damage requiring replating or refinishing beyond touchup repair.

J. Mechanical Metal Parts.

Inspect unmachined mechanical metal parts, including mounting plates, chassis, mounting clamps, brackets, nuts, bolts, screws, washers, fasteners, and hardware for damage or deformation. Inspect for corrosion and any damage that would require replating or refinishing beyond practical touchup.

K. Printed Circuit Boards.

Inspect printed circuit boards for loose, broken, corroded, or poorly soldered terminal connections. Inspect for any evidence of damage, such as burned, broken, cracked, or corroded plating. Check for loose mounting of printed circuit boards.

L. Receptacles.

Inspect receptacles for cracked, broken, or charred insulation. Inspect for damage to all other parts, loose or bent contacts, damage to contact plating, corrosion, and other abnormal conditions.

M. Relays.

Inspect encapsulated relays for bent, cracked, and punctured cases. Check for corroded, poorly soldered, or loose terminals and for loose, broken, or missing mounting hardware.

N. Resistors.

Inspect fixed, composition resistors for cracked, broken, blistered, or charred bodies and for loose, broken, poorly soldered, or corroded terminal connections. Inspect fixed, wirewound resistors for signs of heating, cracked, broken, or charred insulation, loose, poorly soldered, broken, or corroded terminal connections, and loose mounting.

Inspect variable resistors for corrosion of shafts, cases, or other visible part damage, loose mountings, and any other physical damage. Where possible, rotate the shaft to determine whether the action is too rough, too loose, or too tight.

P. Semiconductors.

Inspect diodes and transistors for cracked, broken, blistered, or damaged bodies and cases. Inspect for loose, broken, poorly soldered, or corroded terminal connections.

Q. Soldered Terminal Connections.

Inspect soldered terminal connections for cold-soldered or rosin joints. These joints present a porous or dull, rough appearance. Check for strength of bond using a pointed tool. Examine for excess of solder, protrusions from the joint, pieces adhering to adjacent insulation, and particles lodged between joints, conductors, or other parts. Inspect for insufficient solder and unsoldered strands of wire protruding from conductor joints. Check, also, for insulation that is stripped back too far from joints or badly frayed at the joint. Inspect for corrosion on copper conductor joints.

R. Switches.

Inspect encapsulated switches for cracked, bent, or punctured cases. Check for loose, broken, or poorly soldered terminal connections. Check, also, to ensure that switch operation is smooth and free from unnecessary binding.

S. Transformers, Power Supplies, and Inductors.

Inspect transformers, power supplies, and inductors for signs of excessive heating, physical damage to cases, cracked or broken insulators, and other irregularities. Inspect for corroded, poorly soldered, or loose terminals and loose, broken, or missing mounting hardware.

T. Tube Sockets.

Inspect tube sockets for loose, broken, missing, or improperly seated mounting rings. Check for cracked, broken, or charred insulation. Inspect for broken, corroded, or deformed contacts and loose, poorly soldered, broken, or corroded terminal connections.

U. Wiring.

Inspect open and laced wiring of chassis, terminal boards, and parts by checking insulation for physical damage and charring. Inspect wires for breakage and for improper dress in relation to adjacent wiring and chassis.

Section V. REPAIR

4-13. GENERAL.

This section presents instructions and procedures for the replacement or repair of damaged or defective components of the 493A-4 Indicator. Faulty components are usually detected through procedures in the inspection/check or testing sections of this manual. New parts should be inspected and/or tested before being installed. Most of the replacement or repair instructions apply to disassembled equipment. Refer to the disassembly section for proper instructions.

4-14. REPAIR PROCEDURES.

Figure 4-10 lists an alphabetically arranged index of repair procedure s. Each component, part, or assembly is cross-referenced to the appropriate paragraph containing the correct repair procedure.

ITEM	REFER TO PARAGRAPH
Capacitors	4-14A
Connectors	4-14B
Covers and shields	4-14C
Electron tubes	4-14D
Finished surfaces	4-14E
Frames	4-14F
Insulators: Ceramic, Myclex	4-14G
Knobs and panels	4-14H
Machined metal parts	4-14J
Mechanical metal parts	4-14K
Printed circuit boards	4-14L
Receptacles	4-14M
Relays	4-14N
Resistors	4-14P

Index of Repair Procedures (Sheet 1 of 2)
Figure 4-10

ITEM	REFER TO PARAGRAPH
Semiconductors	4-14Q
Soldered terminal connections	4-14R
Switches	4-14S
Transformers, power supplies, and inductors	4-14T
Tube sockets	4-14U
Wiring	4-14V

Index of Repair Procedures (Sheet 2 of 2)
Figure 4-10

A. <u>Capacitors</u>.

If defective or if performance is questionable, capacitors should be replaced. Clean all connections thoroughly and apply new solder.

B. <u>Connectors</u>.

Straighten bent pins and damaged shell areas. Replace defective connectors, broken wires, or wires with split insulation. If a connector insert is broken, replace the connector.

C. <u>Covers and Shields</u>.

Replace damaged screws, straighten any dents or warped sections, and retouch scratched or worn painted surfaces.

D. <u>Electron Tubes</u>.

Replace defective electron tubes. Clean corroded pins with a clean, lintless cloth or soft-bristled brush.

E. <u>Finished Surfaces</u>.

Touch up minor scratches in all painted surfaces with a high-quality, black enamel applied with a small brush. Refinish black wrinkle as required, in accordance with MIL-E-5558A and MIL-P-6889G. Refinish black, lusterless surfaces as required, in accordance with MIL-E-14072 (SIGC). Touch up unpainted aluminum with Alodine 1200, or suitable water-lacquer mixture, applied with a pipe cleaner or small brush.

<u>CAUTION</u>: DO NOT TOUCH UP ANY AREA WHERE AN ELECTRICAL CONNECTION IS MADE.

F. Frames.

Straighten all misshapen areas. Remove all corrosion with a suitable cleaner. Retouch silk screening and refinish where needed.

G. Insulators: Ceramic and Mycalex.

Replace any insulators which show physical damage such as cracks, burns, or chips.

H. Knobs and Panels.

Replace cracked, chipped, broken, or otherwise damaged knobs. Retouch or refinish panels in accordance with paragraph E above.

J. Machined Metal Parts.

If satisfactory machine shop facilities for suitable repair of these surfaces are not available, the defective or damaged part should be replaced.

K. Mechanical Metal Parts.

Straighten bent or misshapened mounts, clamps, and mounting plates. Replace broken, bent, or cross-threaded bolts, screws, nuts, washers, and other hardware.

L. Printed Circuit Boards.

Replace any cracked, broken, chipped, or otherwise damaged printed circuit boards. Repair of these boards is not recommended.

M. Receptacles.

Replace all receptacles with cracked, broken, or charred insulation or loose, bent, or otherwise damaged contacts. Clean in accordance with the appropriate paragraph in the cleaning section of this manual.

N. Relays.

Defective encapsulated relays should be replaced. Repair is not recommended.

P. Resistors.

If defective or if performance is questionable, resistors should be replaced. Clean all connections thoroughly and apply new solder. Add a drop or two of contact cleaner (carbon tetrachloride) to the windings of variable resistors with rough or intermittent operation. Replace variable resistors if the shaft is loose in the case. Clean corroded terminals.

Q. Semiconductors.

If a semiconductor appears defective or is suspected of questionable operation, it should be replaced.

CAUTION: TO PREVENT DAMAGE, USE A HEAT SINK BETWEEN THE LEAD BEING SOLDERED AND THE SEMICONDUCTOR DEVICE.

R. Soldered Terminal Connections.

Resolder cold-soldered or rosin joints. Remove all traces of corrosion.

S. Switches.

Replace defective encapsulated switches. Repair is not recommended.

T. Transformers, Power Supplies, and Inductors.

If defective or if performance is questionable, transformers, power supplies, and inductors should be replaced. Make a sketch of wire connections to simplify rewiring. Do not attempt repair of sealed transformers, power supplies, or inductors. Clean all connections thoroughly and apply new solder.

U. Tube Sockets.

Replace cracked, chipped, or broken tube sockets, or tube sockets with broken or severely damaged terminals. Remove all traces of corrosion.

V. Wiring

Replace damaged wiring with wire of the same size and color coding. Ensure that no bare wires are touching chassis, other bare wires, or metal cases of other parts. If a wire is to be removed from a terminal or component, it should be marked with an identification tag to minimize incorrect connections.

NOTE: When necessary to disturb the dress of wires or cables, carefully ensure that the original wire dress is restored.

Section VI. ASSEMBLY

4-15. GENERAL.

This section presents instructions for assembling the 493A-4 Indicator. These instructions are arranged so that assembly of each major part is an individual operation. When it is necessary to assemble the unit, locate the part in the table of contents and begin on the page indicated. Reference is made to subsequent assembly steps that must be performed to completely restore the unit. The order of assembly begins with the individual parts, proceeds to the next higher subassemblies, and ends with the completed unit. These instructions include special techniques, cautions, warnings, and unique procedures. Refer to the fits and clearances section of this manual for assembly tolerances.

4-16. PRECAUTIONS AND GENERAL TECHNIQUES.

Before soldering any lead or component, refer to the notes of color coding, placement of leads, and wire insulation made during disassembly. If there is any doubt as to the placement of such leads or components, refer to the appropriate diagrams and perform continuity tests to ensure proper replacement. Ensure, also, that proper dress or lacing of wires and cables is restored.

CAUTION: TO PREVENT DAMAGE TO A SOLID-STATE DEVICE, USE A HEAT SINK ON THE LEAD BETWEEN THE POINT BEING SOLDERED AND THE DEVICE.

CAUTION: THE 493A-4 INDICATOR USES EXTREMELY HIGH VOLTAGES. DO NOT ATTEMPT ANY ASSEMBLY WHILE PRIMARY POWER IS APPLIED TO THE UNIT.

WARNING: CAPACITORS IN THE 493A-4 INDICATOR MAY HOLD A CHARGE FOR LONG PERIODS OF TIME AFTER PRIMARY POWER HAS BEEN REMOVED. OBSERVE SAFETY PRECAUTIONS WHEN WORKING ON THE INDICATOR.

WARNING: BREAKAGE OF THE HIGH-VACUUM CATHODE-RAY TUBE MAY RESULT IN INJURY FROM FLYING GLASS. DO NOT STRIKE OR SCRATCH THE TUBE AT ANY TIME. DO NOT APPLY MORE THAN MODERATE PRESSURE WHEN INSERTING OR REMOVING THE TUBE. USE PROTECTIVE DEVICES, SUCH AS GOGGLES, FACE MASKS, AND RUBBER GLOVES.

These precautions are repeated in the text of the assembly procedures where applicable.

4-17. ASSEMBLY PROCEDURE.

A. Replace Off-Centering Regulator. (Refer to figure 4-6.)

(1) Place off-centering regulator (123) in mounting position and solder the connecting leads.

(2) Replace right frame (226) in accordance with paragraphs G(1) through G(8) below.

(3) Secure staked rear plate (46) to left and right frames (218, 226) in accordance with paragraph J(5) below.

(4) Secure rear cover plate (19) to left and right frames (218, 226) in accordance with paragraph K(5) below.

(5) Replace front panel (10) and front plate (12) in accordance with paragraph L below.

(6) Replace two-piece dust cover (14) in accordance with paragraph M below.

B. Replace Sweep Deflection Yoke Assembly Y1. (Refer to figure 4-6.)

(1) Place sweep deflection yoke assembly Y1 (151) in mounting position with the yellow and the black and white leads at the bottom.

(2) Tighten machine screw (148) in yoke band (150).

(3) Solder the leads to terminals 5, 4, 14, 15, 17, 16, 11, and 9 of positioning circuit TB2 (162).

(4) Replace cathode-ray tube (225A) in accordance with paragraphs C(1) through C(3) below.

WARNING: EXTREME CARE SHOULD BE EXERCISED WHEN INSERTING THE CATHODE-RAY TUBE. NO STRAIN OR STRESS SHOULD BE EXERTED ON THE NECK OF THE TUBE. BREAKAGE OF THE TUBE MAY RESULT IN INJURY FROM FLYING GLASS. DO NOT STRIKE OR SCRATCH THE TUBE AT ANY TIME. DO NOT APPLY MORE THAN MODERATE PRESSURE WHEN INSERTING OR REMOVING THE TUBE. USE PROTECTIVE DEVICES, SUCH AS GOGGLES, FACE MASKS, AND RUBBER GLOVES.

WARNING: THE FRONT SECTION OF THE CATHODE-RAY TUBE IS UNSUPPORTED WHEN RIGHT FRAME (226) AND LEFT FRAME (218) ARE REMOVED. A MEANS OF SUPPORT MUST BE PROVIDED TO PREVENT THE APPLICATION OF UNDUE STRESS ON THE NECK OF THE TUBE.

(5) Replace power supply PS1 (154), in accordance with paragraphs F(1) and F(2) below.

(6) Replace right frame (226) in accordance with paragraphs G(1) through G(7) below.

(7) Replace left frame (218) in accordance with paragraphs H(1) through H(6) below.

(8) Secure staked rear plate (46) to left and right frames (218, 226) in accordance with paragraphs J(5) below.

(9) Secure rear cover plate (19) to left and right frames (218, 226) in accordance with paragraph K(5) below.

(10) Replace front panel (i0) and front plate (12) in accordance with paragraph L below.

(11) Replace two-piece dust cover (14) in accordance with paragraph M below.

C. Replace Cathode-Ray Tube. (Refer to figure 4-6.)

(1) Secure tube clamp (35) to cathode-ray tube (225A) by tightening machine screw (40) and hexnut (41).

(2) Insert cathode-ray tube (225A) through sweep deflection yoke Y1 (151).

WARNING: EXTREME CARE SHOULD BE EXERCISED WHEN INSPECTING THE CATHODE-RAY TUBE. NO STRAIN OR STRESS SHOULD BE EXERTED ON THE NECK OF THE TUBE. BREAKAGE OF THE TUBE MAY RESULT IN INJURY FROM FLYING GLASS. DO NOT STRIKE OR SCRATCH THE TUBE AT ANY TIME. DO NOT APPLY MORE THAN MODERATE PRESSURE WHEN INSERTING OR REMOVING THE TUBE. USE PROTECTIVE DEVICES, SUCH AS GOGGLES, FACE MASKS, AND RUBBER GLOVES.

WARNING: THE FRONT SECTION OF THE CATHODE-RAY TUBE IS UNSUPPORTED WHEN RIGHT FRAME (226) AND LEFT FRAME (218) ARE REMOVED. A MEANS OF SUPPORT MUST BE PROVIDED TO PREVENT THE APPLICATION OF UNDUE STRESS ON THE NECK OF THE TUBE.

(3) Replace cathode-ray tube socket (209).

NOTE: If used in the unit, replace bonded clamps (52, 56) by securing them to staked rear plate (46) with two machine screws (51) and two spacers (55).

(4) Replace power supply PS1 (154) in accordance with paragraphs F(1) and F(2) below.

(5) Replace right frame (226) in accordance with paragraphs G(1) through G(7) below.

(6) Replace left frame (218) in accordance with paragraphs H(1) through H(6) below.

(7) Secure staked rear plate (46) of left and right frames (218, 226) in accordance with paragraph J(5) below.

(8) Secure rear cover plate (19) to left and right frames (218, 226) in accordance with paragraph K(5) below.

(9) Replace front panel (10) and front plate (12) in accordance with paragraph L below.

(10) Replace two-piece dust cover (14) in accordance with paragraph M below.

D. Replace Positioning Circuit TB2. (Refer to figure 4-6.)

(1) Place positioning circuit TB2 (162) in mounting position near the indicator.

(2) Solder the leads to terminals 1 through 25 and pin 7 of relay K1 of positioning circuit board TB2 (162).

(3) Replace right frame (226) in accordance with paragraphs G(1) through G(8) below.

(4) Secure staked rear plate (46) to left and right frames (218, 226) in accordance with paragraph J(5) below.

(5) Secure rear cover plate (19) to left and right frames (218, 226) in accordance with paragraph K(5) below.

(6) Replace front panel (10) and front plate (12) in accordance with paragraph L below.

(7) Replace two-piece dust cover (14) in accordance with paragraph M below.

E. Replace Video Amplifier TB1. (Refer to figure 4-6.)

(1) Place video amplifier TB1 (65) in mounting position near the indicator.

(2) Solder the leads to terminals 1 through 10, 12, and 15, and pins 10 and 12 (filaments) of V1 tube socket of video amplifier TB1 (65).

(3) Replace left frame (218) in accordance with paragraphs H(1) through H(6) below.

(4) Secure staked rear plate (46) to left and right frames (218, 226) in accordance with paragraph J(5) below.

(5) Secure rear cover plate (19) to left and right frames (218, 226) in accordance with paragraph K(5) below.

(6) Replace front panel (10) and front plate (12) in accordance with paragraph L below.

(7) Replace two-piece dust cover (14) in accordance with paragraph M.

F. Replace Power Supply PS1. (Refer to figure 4-6.)

(1) Place power supply PS1 (154) in mounting position and solder the leads to terminals 1 through 4.

(2) Secure high-voltage lead (153A) to cathode-ray tube (225A).

(3) Replace left frame (218) in accordance with paragraphs H(1) through H(6) below.

(4) Secure staked rear plate (46) to left and right frames (218, 226) in accordance with paragraph J(5) below.

(5) Secure rear cover plate (19) to left and right frames (218, 226) in accordance with paragraph K(5) below.

(6) Replace front panel (10) and front plate (12) in accordance with paragraph L below.

(7) Replace two-piece dust cover (14) in accordance with paragraph M below.

G. Replace Right Frame. (Refer to figure 4-6.)

(1) Place right frame (226) in mounting position.

(2) Replace solder lug (158) by securing it to right frame (226) with machine screw (159), lockwasher (160), and hexnut (161).

(3) Secure four standoff terminals (112) to right frame (226) with four machine screws (113).

(4) Secure positioning circuit TB2 (162) to right frame (226) with three machine screws (163).

(5) Secure off-centering regulator (123) to right frame (226) with two machine screws (124).

(6) Secure right frame (226) to rolled brace (211) with four machine screws (212).

(7) Secure tube clamp (35) to right frame (226) with two machine screws (39) and two self-locking hexnuts (41) and with machine screw (36), flat washers (36A), lockwasher (37), and hexnut (38).

(8) Secure left and right frame (218, 226) together with nine machine screws (217).

(9) Secure staked rear plate (46) to left and right frames (218, 226) in accordance with paragraph J(5) below.

(10) Secure rear cover plate (19) to left and right frames (218, 226) in accordance with paragraph K(5) below.

(11) Replace front panel (10) and front plate (12) in accordance with paragraph L below.

(12) Replace two-piece dust cover (14) in accordance with paragraph M below.

H. Replace Left Frame. (Refer to figure 4-6.)

(1) Place left frame (218) in mounting position.

(2) Secure video amplifier TB1 (65) to left frame (218) with three machine screws (66).

(3) Secure power supply PSI (154) to left frame (218) with four machine screws (155).

(4) Secure left frame (218) to rolled brace (211) with four machine screws (212).

(5) Secure left and right frames (218, 226) together with nine machine screws (217

(6) Secure tube clamp (35) to left frame (218) with machine screw (36), two flat washers (36A), lockwasher (37), and hexnut (38).

(7) Secure staked rear plate (46) to left and right frames (218, 226) in accordance with paragraph J(5) below.

(8) Secure rear cover plate (19) to left and right frames (218, 226) in accordance with paragraph K(5) below.

(9) Replace front panel (10) and front plate (12) in accordance with paragraph L below.

(10) Replace two-piece dust cover (14) in accordance with paragraph M below.

J. Replace Staked Rear Plate. (Refer to figure 4-6.)

(1) Place staked rear plate (46) in position near the rear of the unit.

(2) Solder the leads to terminals 1, 3, 5, and 6 of transformer T1 (61).

(3) Solder the yellow and brown leads to inductor L1 (58).

(4) Secure electrical connector (210) to staked rear plate (46) with two machine screws (207), two machine screws (208), and four lockwashers (205), four ground terminal lugs (206), and four hexnuts (204).

(5) Secure staked rear plate (46) to left and right frames (218, 226) with six machine screws (47, 48).

K. Replace Rear Cover Plate. (Refer to figure 4-6.)

(1) Place rear cover plate (19) in position near the rear of the unit.

(2) Solder the purple and orange leads to resistors R31 and R32 (27, 31).

(3) Solder the blue and white leads to inductor L2 (21).

(4) Solder the blue and gray leads to inductor L3 (24).

(5) Secure rear cover plate (19) to left and right frames (218, 226) with six machine screws (20).

L. Replace Front Panel and Front Plate. (Refer to figure 4-6.)

(1) Secure front mounting plate (12) to left and right frames (218, 226) with eight machine screws (13).

(2) Place printed light board (8) in mounting position and solder the two panel illumination leads to their terminals. Replace the insulating sleeves.

(3) Secure front panel (10) and filter (11) to front mounting plate (12) with four hooded screws (6, 7).

(4) Secure BACKGROUND control knob (3) to BACKGROUND control shaft (122) by tightening two setscrews (4). Check for freedom of movement.

(5) Secure RANGE control knob (1) to RANGE control shaft (116) by tightening two setscrews (2). Check for freedom of movement.

M. Replace Outer Dust Covers. (Refer to figure 4-6.)

(1) Place two-piece dust cover (14) in mounting position around the indicator frame.

(2) Secure two-piece dust cover (14) to the indicator frame with eight machine screws (15).

4-18. FITS AND CLEARANCES.

After assembly, the yoke and the cathode-ray tube must not touch. If they are allowed to touch, breakage of the tube may result from impact. There are no other fit and clearance values applicable to the 493A-4 Indicator.

Section VII. TESTING

4-19. GENERAL.

Included within this section are procedures for bench testing the 493A-4 Indicator. The tests should be performed after any repair to determine that the malfunction has been corrected, and that no other malfunctions exist.

When a malfunction is indicated, portions of the test relative to the malfunction should be performed and, if the 493A-4 fails a test, refer to the troubleshooting section where test steps are referenced, and possible causes of malfunctions are listed.

4-20. TEST EQUIPMENT REQUIRED.

Refer to figure 4-12 for equipment required for testing the 493A-4.

4-21. UNIT TESTS.

A. Deflection Circuits.

(1) Stop the antenna scan and position the antenna dish in the dead-ahead (0°) position, or set the SWEEP POSITION control on the simulator to the UP position.

(2) Adjust the BACKGROUND control on the 493A-4 for a visible sweep trace. The sweep line should be parallel to the vertical scribe line on the filter. If it is not, loosen the yoke clamp and rotate the yoke to obtain a vertical sweep trace. Tighten the yoke clamp, and ensure that the sweep line is vertical.

(3) Adjust the HORIZONTAL centering control (R16 and TB2) to position the sweep line directly behind the vertical scribe line.

(4) Adjust the VERTICAL centering control (R28 and TB2) to position the start of the sweep at the vertex of the face plate.

(5) Position the RANGE switch to the 30-mile range, and check to ensure that the third range mark is 1/8 inch ±1/8 inch below the top of the opening in the face plate.

NOTE: The line voltage must be maintained at exactly 115 v for this step.

Repeat this test for the fourth range mark on the 60-mile RANGE, and the sixth range mark on the 150-mile RANGE. If the range marks do not fall within these limits, adjust the deflection sensitivity control, R33. If the range marks are still not within limits, jumper R36 and readjust R33. Jumpering R36 provides additional deflection sensitivity control. If jumpering of R36 and adjustment of R33 does not provide adequate deflection sensitivity, insert washer (234) and retainer (235) (illustrated parts catalog) on the neck of the cathode-ray tube directly behind the deflection yoke and repeat this step.

(6) Adjust the VERTICAL centering control so the sweep line is 1/8 inch below the vertex of the face plate; this should place the last range mark 1/4 $\pm$1/8 inch below the opening in the face plate.

(7) Position the SWEEP POSITION control on the simulator (or the antenna dish if an antenna is used) to 45° left and 45° right. Check and ensure that the sweep line on the indicator is 40 to 50° for both positions.

B. Video and Gating Circuits.

(1) Using an oscilloscope, observe the waveform at terminal 4 on TB1. The lower limit of the waveform should vary from 10 to 30 v, and the upper limit should vary from 80 to 120 v.

(2) Using the antenna and actual target returns (or an echo box if an antenna is not available), adjust the VIDEO GAIN control (R13 on TB1) for the best video presentation on the indicator. Adjust the BACKGROUND control to produce a slight glow over the face of the tube. Rotate the BACKGROUND control and check that there is at least one quarter turn available on either side of the setting that produces a slight glow.

(3) Rotate the RANGE switch to each of the three ranges and observe that the back-ground glow does not change significantly between ranges.

Section VIII. TROUBLESHOOTING

4-22. GENERAL.

Included within this section is a troubleshooting chart, and schematic diagram for the 493A-4 Indicator.

Figure 4-11 lists troubles, probable causes, and a referenced procedure in the testing section of this manual. If the 493A-4 fails any portion of the unit tests, refer to figure 4-11 to determine the trouble and probable cause. As an aid to troubleshooting, portions of the test procedure relative to the trouble should be performed to isolate the trouble to a functional circuit or component.

After a trouble has been located and corrected, the 493A-4 should be completely tested to verify that the repairs have not affected other portions of the circuit. Refer to the testing , section of this manual.

4-23. TEST EQUIPMENT.

The test equipment required for troubleshooting is listed in figure 4-12.

4-24. TROUBLESHOOTING PROCEDURES.

Figure 4-11 is the troubleshooting chart to be used in troubleshooting the 493A-4 Indicator.

TEST REFERENCE	TROUBLE	POSSIBLE CAUSES
4-21.A.(2)	Sweep trace does not appear when BACKGROUND is turned up.	1. BACKGROUND control (R35) 2. High-voltage power supply 3. Cathode-ray tube (V3)
4-21.A.(3)(4)	Unable to adjust R28 and R16 (centering to locate the spot at the vertex.	1. Positioning circuit (TB2)
4-21.A.(5)	Table to adjust R33 and R36 to obtain proper deflection.	1. High-voltage power supply 2. Deflection sensitivity control 5R33) 3. Deflection yoke (Y1)

493A-4 Indicator Troubleshooting Chart (Sheet 1 of 2)
Figure 4-11

TEST REFERENCE	TROUBLE	POSSIBLE CAUSES
4-21.A.(5)	RANGE switch does not function properly.	1. RANGE switch (S1)
4-21.A.(7)	Sweep lines do not agree with the corresponding mark on the indicator face.	1. Deflection yoke (Y1)
4-21.B.(1)	Gate waveform does not meet the test limits.	1. Video amplifier (TB1)
4-21.B.(3)	BACKGROUND control does not meet the test limits.	1. BACKGROUND Control (35) 2. Video amplifier (TB1)

493A-4 Indicator Troubleshooting Chart (Sheet 2 of 2)
Figure 4-11

Section IX. STORAGE INSTRUCTIONS

Before storing, clean dirt, grease, and moisture from the 493A-4 Indicator. Store the unit in a clean, dry area where the possibility of impact damage is minimized. If the equipment is to be stored for an extended period, place the indicator in the original shipping carton.

Section X. SPECIAL TOOLS, FIXTURES AND TEST EQUIPMENT

4-25. GENERAL.

This section presents a list of the special tools, fixtures, and test equipment required to test and/or overhaul the 493A-4 Indicator.

4-26. TEST EQUIPMENT REQUIRED.

Figure 4-12 lists the equipment required to test and/or overhaul the 493A-4 Indicator. While substitution of other equipment is not recommended, other equipment may be used if it equals or exceeds the specifications of the equipment listed.

EQUIPMENT	MANUFACTURER AND PART NUMBER
SN-358A/APN-158 Synchronizer	Collins 522-6114-006
RT-711A/APN-158 Receiver-Transmitter	Collins 522-6113-006
AS-1520A/APN-158 Antenna	Collins 522-6117-005
or AS-1624A/APN-158 Antenna	Collins 522-6118-005
Oscilloscope (Tektronix 535)	AN/USM-81
Nonmetallic ruler	

Table of Test Equipment Required
Figure 4-12

Section XI. COMPONENTS LOCATION

Refer to figures 4-13 through 4-15 for location of components comprising Weather Radar Indicator 493A-4.

NOTE

These figures are for component location only. They are not to be used for provisioning component parts.

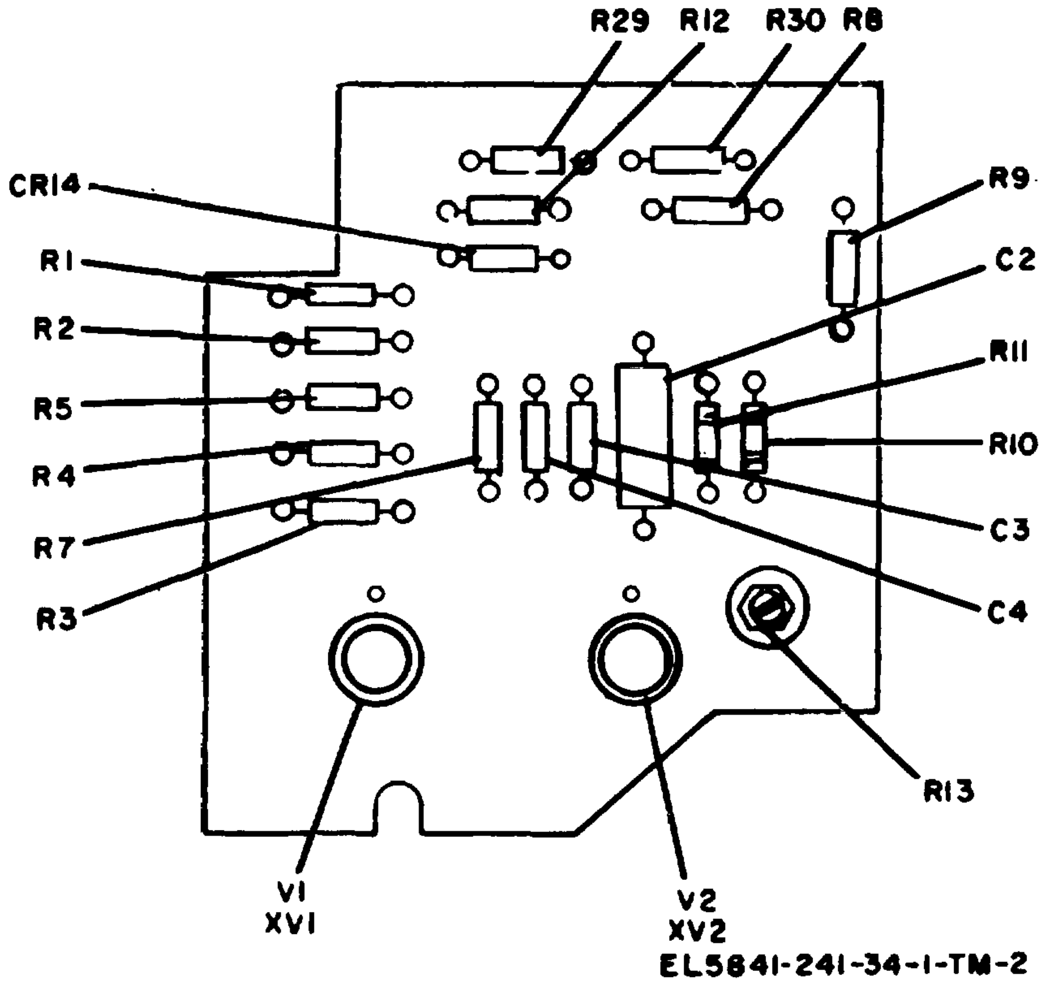
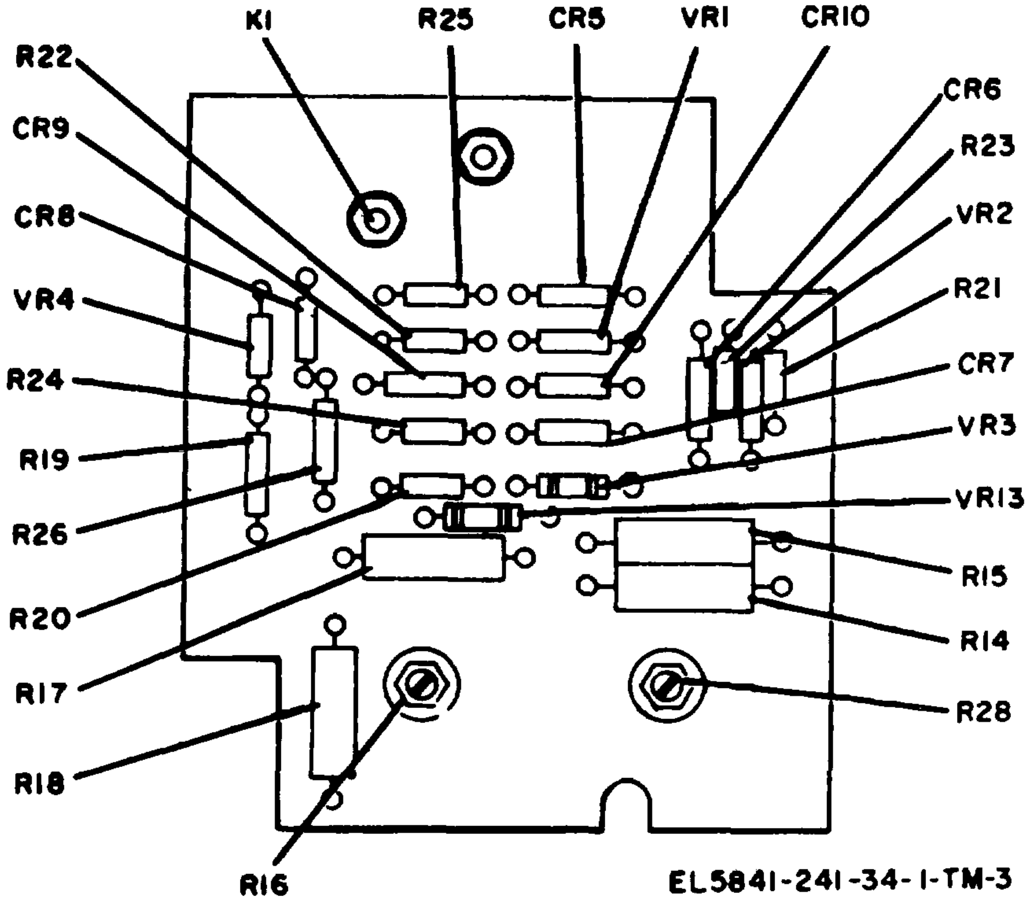
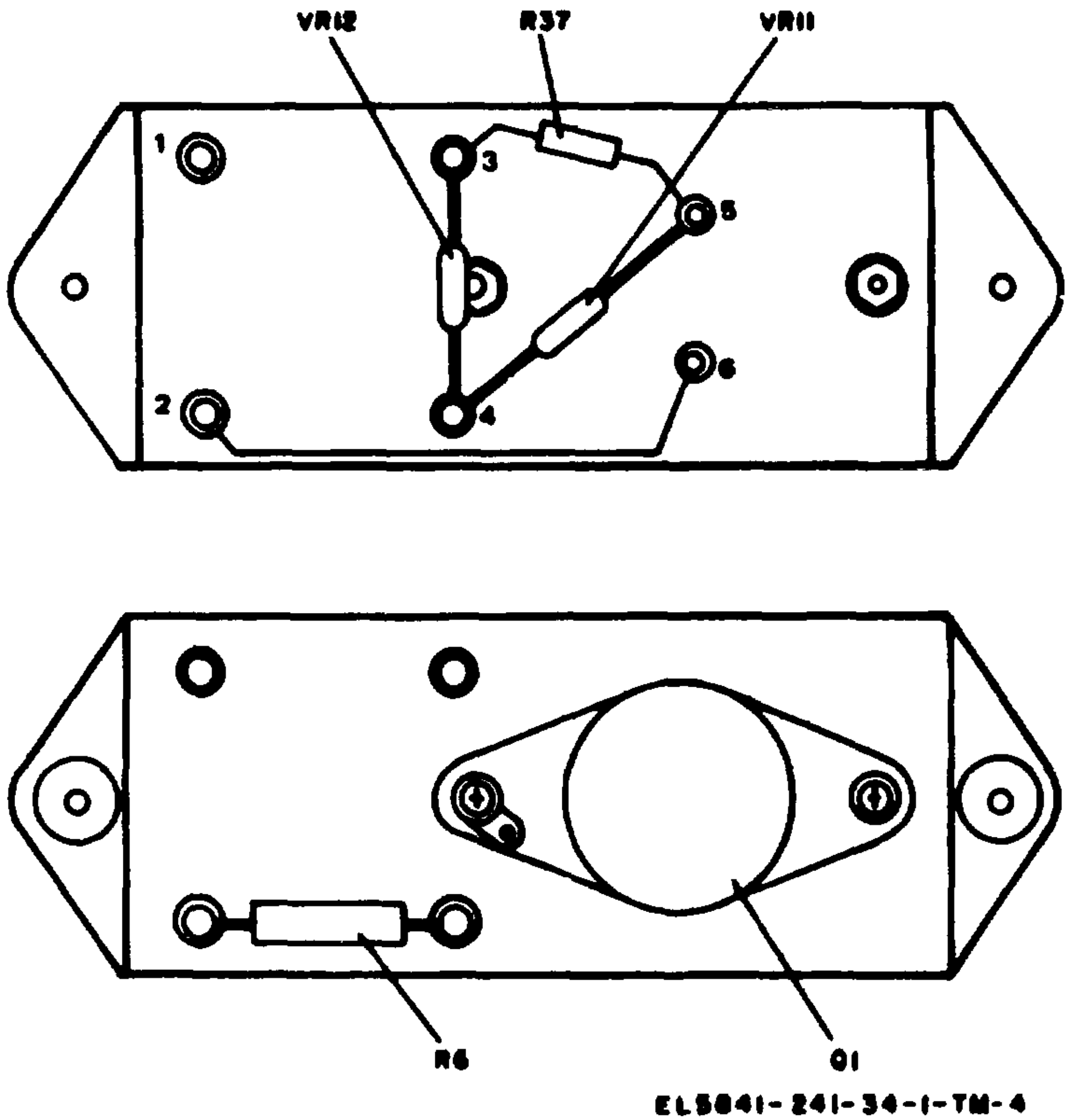


Figure 4-13. Video amplifier TB1. Components Location.



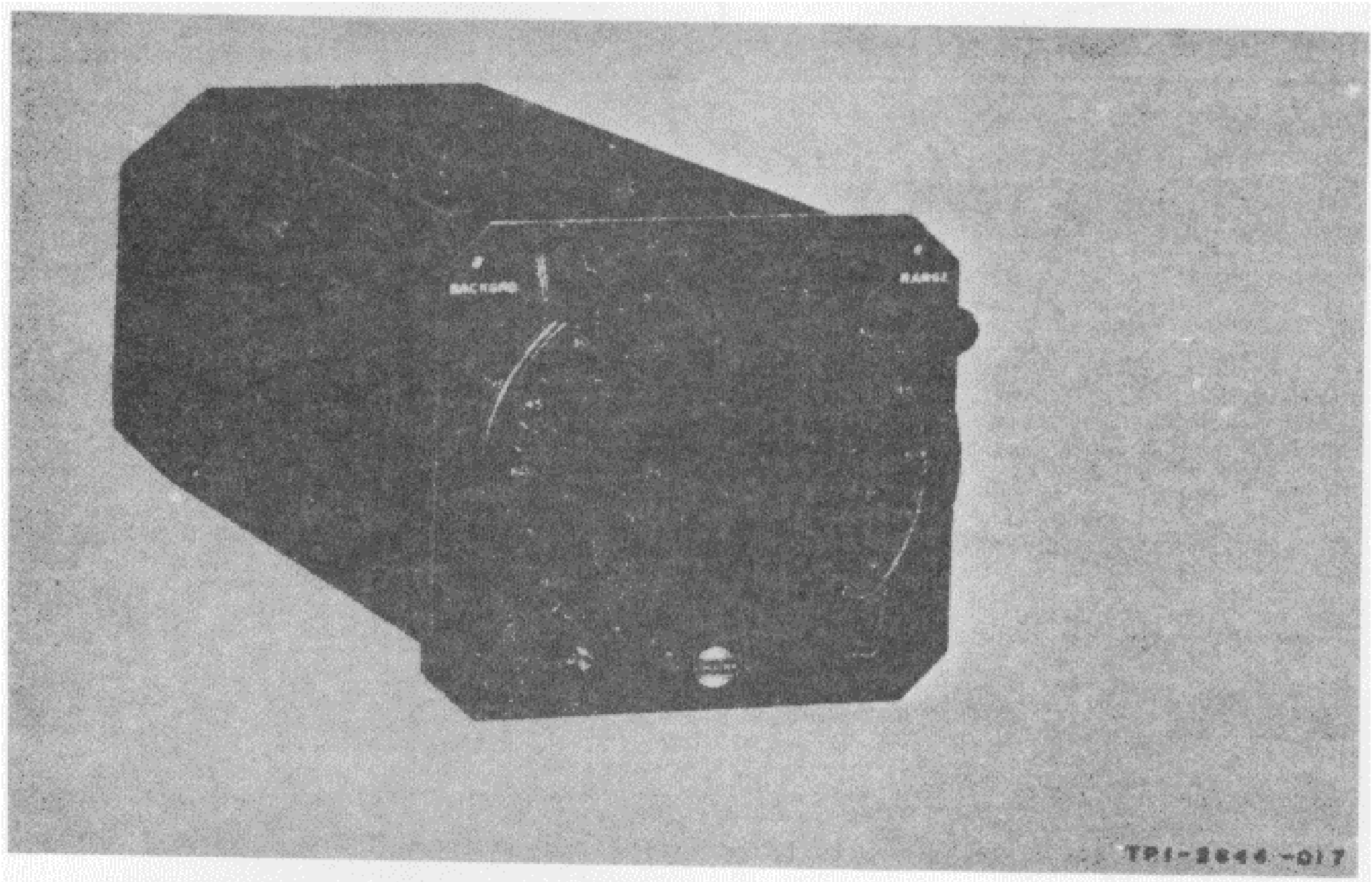
Positioning Circuit TB2, Components Location.
Figure 4-14



Off-Centering Regulator, Components Location
Figure 4-15

CHAPTER 5

IP-724A/APN-158 AZIMUTH-RANGE INDICATOR



IPN-724A/APN-158 Azimuth-Range Indicator
Figure 5-1

Section I. DESCRIPTION AND OPERATION

5-1. GENERAL.

This section includes the purpose of the equipment, equipment specifications, equipment description, and theory of operation.

Refer to figure 5-1 for an overall view of the IP-724A/APN-158 Indicator. Figure 5-2 lists the equipment covered.

EQUIPMENT	COLLINS PART NUMBER
IP-724A/APN-158 Azimuth-Range Indicator	777-1770-001

Equipment Covered
Figure 5-2

5-2. PURPOSE OF THE EQUIPMENT.

The IP-724A Indicator provides a visual representation of terrain and weather information.

5-3. EQUIPMENT SPECIFICATIONS.

The IP-724A specifications are listed in figure 5-3.

CHARACTERISTIC	SPECIFICATION
Power requirements (supplied by RT-711A/APN-158 Receiver-Transmitter)	+260 volts at 15 ma. +27.5 volts regulated at 235 ma. -27.5-volt relay power at 100 ma. -27.5 volts regulated at approximately 0 ma. 115 volts ac, 400 Hz at 220 ma.
Duty cycle	Continuous.
Weight	14.9 ±0.1 pounds (6.86 kg).
Physical dimensions	6-1/4 inches (15.9 cm) high, 6-1/4 inches (15.9 cm) wide, and 14-23/64 inches (36.47 cm) long.
Temperature	
Continuous operation	-40 to +55°C (-40 to +131°F).
30-minute operation	+71°C (+160°F).
Relative humidity	95 to 100 percent at +55°C (+131°F).
Shock conditions	
Performance criteria	Eighteen 10-millisecond shocks at 7.5 g.
Safety criteria	Six 10-millisecond shocks at 15 g.
Vibration	0.030-inch total excursion at 10 to 55 Hz, and 3.0-g peak acceleration at 55 to 500 Hz.
Cooling	Convection.
Altitude	35,000-foot pressure equivalent altitude.

Equipment Specifications
Figure 5-3

5-4. EQUIPMENT DESCRIPTION.

A. General.

This section presents a mechanical, electrical, and external operating controls description of the IP-724A Indicator.

B. Mechanical Description.

The indicator is housed in a black, 2-piece metal dust cover. Convection cooling is provided through holes in this cover.

The main chassis consists of four sections as shown in figure FO-11. Proceeding from front to rear, the sections are as follows:

The first section of the IP-724A Indictor includes the following: the front cover, operating control knobs, DIM tab, polarizing filters, range indicator lights, and the viewing screen.

The second section is a channel frame assembly containing the front section of the cathode-ray tube. An integral magnetic shield with mounting studs simplifies tube mounting. A silicone rubber filler between the tube and shield provides shock and vibration isolation for the crt.

Two encapsulated power supplies are adjacent (i.e., one on each side) to the deflection yoke. Two terminal boards are mounted vertically to the rear of the power supplies. As viewed from the front, TB1 is on the right side and TB3 is on the left side of the yoke. High-voltage circuit TB2 is mounted horizontally on the top of this section. A transparent shield covers TB2 and provides protection to personnel from high voltage. Shading circuit TB4 is located on the bottom rear of this section and is secured to the transformer plate. The transformer plate is located to the rear of the power supplies at the bottom rear of the section.

The fourth section forms the rear cover of the IP-724A Indicator. Two larger Zener diodes and heat sinks are housed in this section.

C. Electrical Description.

The major electrical components of the IP-724A Indicator are as follows: power supplies, sweep positioning, video, and erase circuit TB1, high voltage circuit TB2, low-voltage bias circuit TB3, shading circuit TB4, storage cathode-ray tube and deflection yoke, and the chassis circuits.

(1) Power Supplies.

The two encapsulated power supplies provide high and low voltages for biasing the cathode-ray tube. The low-voltage power supply provides +200 volts, -500 volts, and 2 kilovolts. The high-voltage power supply provides 9.5 kilovolts to the viewing screen.

(2) Sweep Positioning, Video, and Erase Circuit TB1.

The sweep positioning circuit consists of a symmetrical arrangement of resistors and inductors that provide horizontal (HOR POS) and vertical (VER POS) sweep positioning currents to the deflection coils.

The VIDEO potentiometer makes it possible to control the peak signal strength applied to the storage crt.

The erase pulse shaping network is contained on this board and provides an erase pulse to the storage mesh of the storage crt which removes the stored signal presentation.

(3) High-Voltage Circuit TB2.

The high-voltage circuit consists of two voltage dividers and coupling components for the erase pulse.

(4) Low-Voltage Bias Circuit TB3.

The low-voltage bias circuit contains components to control the background level, focus voltage, positive gate, shading waveform, and blanking function. The shading circuit driver amplifier (V2) is located on TB3. The ground blanking function from the antenna is applied to TB3.

(5) Shading Circuit TB4.

TB4 contains a transistor gate amplifier and a multivibrator circuit that generates the shading waveform, dunking pulse, and erase pulse. The driver amplifier for the shading waveform, however, is located on TB3.

(6) Storage Tube and Deflection Yoke Terminal Board.

The storage cathode-ray tube is a special direct-view storage tube that provides a very bright display with controlled persistence. The crt is capable of storing halftone images for variable durations up to 60 seconds with a brightness level suitable for viewing in direct sunlight. This is accomplished by the use of two electron guns.

A specially mixed phosphor is adhered to the face of the crt for improved halftone definitions.

A 4-coil, fixed deflection yoke provides electromagnetic deflection of the electron beam within the crt. This results in the sweeping trace that is synchronized with the AS-1520A/APN-158 or AS-1624A/APN-158 Antenna azimuth scanning motion.

(7) Chassis Circuits.

Three range position lights are located on TB5 behind the polarized filter assembly. The light indicates the position of the range switch.

Two 115-volt, 400-Hz power sources air used in the IP-724A. One source is a; lied to the two power supplies a previously described, and the other is applied to transformer T1. T1 provides filament voltage for the crt and for shading circuit driver amplifier V2. When STBY (standby) is selected on the cockpit control unit, power is applied to T1. When OPR (operate) is selected, power is applied to T1 and to the two power supplies.

The two zener diodes, mounted on the outside of the rear cover, are part of an ac regulator circuit.

D. External Operating Controls.

DIM, RANGE, and BACKGRD are the external controls for the indicators.

The BACKGRD (background) control adjusts the intensity of background noise.

The RANGE switch controls the range indicator lamps and range relays in the radar system. The range relays select the proper gate and sweep duration, range marks, shading waveform, and storage tube bias for the range selected.

The DIM control permits dimming the display for night viewing by the use of a variable density polarizing filter.

5-5. Theory of Operation. (Refer to figure 5-4.)

A. Storage Cathode-Ray Tube Simplified Theory.

The storage cathode-ray tube (figure 5-4) produces a visual display with controllable persistence. The tube has a phosphor viewing screen, backing electrode and collector (fine wire mesh), control elements, and two electron guns.

One of the electron guns is called the writing gun and the other is called the flood-ing gun. The writing gun emits a pencil-like electron beam which is intensity modulated by the terrain and weather information. This information (targets and range marks) is fed to the cathode of the write gun, and is controlled by the blanking, shading, focus, and background controls. The electron beam strikes the backing electrode and scans its surface. After the desired information has been stored on the storage mesh, the entire surface is flooded with electrons from the flood gun. The value of positive charge deposited at each particular point on the backing electrode controls the amount of flood beam current that can pass through it. This controls the current to the viewing screen and the phosphor radiates accordingly.

The storing of an image is made possible by the backing electrode and the collector which acts as a capacitor. The backing electrode is coated with a thin dielectric material on the gun side. The collector, which acts as the other half of the “capacitor”, serves as a gathering plate for the electrons emitted from the gun. The dielectric material, therefore, retains the information.

After the stored information has been observed, it can rapidly or gradually be erased from the storage surface by controlling the voltage to the backing electrode.

B. Block Diagram Theory. (Refer to figure FO-10.)

(1) Power Supplies.

(a) Power Supply’ PS1.

Generator A power (115 volts as, 400 Hz) from the receiver-transmitter is supplied to the ac regulator circuit. The regulator output, 112 volts ac (vtvm measurement) is supplied to power supply PS2 and auto transformer T2. The output of T2 (82 volts ac) is supplied to PSI. PS1 has three outputs: +200 volts, -500 volts, and +2 kilovolts, all of which are used for operation of the storage cathode-ray tube (crt). The +2 kilovolts is added to high-voltage circuit TB2. The +200 volts, which is referenced to the +2-kilovolt output, is applied to TB2. The -500-volt output is applied to low-voltage bias circuit TB3.

(b) Power Supply PS2.

The regulated 112 volts ac from the ac regulator is applied to PS2. The out-put of PS2 is a pulsating dc voltage with a maximum value of +9.5 kilovolts.

This +9.5-kilovolt output is applied to the viewing screen of the crt.

A positive dunking pulse from shading circuit TB4 is applied to PS2, reducing the output to 3 kilovolts. This prevents illumination of the crt during the erase pulse.

(2) Sweep Positioning, Video, and Erase Circuit TB1.

Video and X- and Y-sweep currents from the synchronizer are applied to TB1. The X- and Y-sweep currents are also applied to the crt deflection yoke. A fixed dc bias current is applied through vertical deflection coil Y1 to hold the sweep origin near the bottom of the crt. HOR POS (horizontal position) and VERT POS (vertical position) potentiometers permit adjustment of the sweep trace position.

The amplitude of the video information may be adjusted by the VIDEO (video amplitude) potentiometer R5. The adjusted video signal is then applied to the cathode of the crt write gun. The video signal must be large enough to exceed the threshold potential of the crt, yet small enough to preclude blooming on the crt. The blooming effect can be seen as a growing halation. This effect is undesirable and is controlled by R5.

The erase pulse from shading circuit TB4 is applied to the erase circuit on TB1. The amplitude and width of the erase pulse can be adjusted by ERASE AMPL and ERASE WIDTH potentiometers. The resulting erase pulse is applied to high-voltage circuit TB2.

Regulated +27.5 volts applied to TB1 is used in the sweep positioning, video, and erase circuits.

(3) High-Voltage Circuit TB2.

Inputs to this circuit consist of +200 volts, +2 kilovolts, and the erase pulse. The +200-volt input from power supply PS1 is referenced to the +2-kilovolt input from P81 by a voltage divider on TB2. The +2 kilovolts establishes the deflection sensitivity of the crt. The +200 volts supplies bias voltages for crt flood gun cathode, grids 1 through 4, collector, and the storage mesh. The erase pulse from TB1 is applied through TB2 to the crt storage mesh (backing electrode) to gradually erase the stored video information.

(4) Low-Voltage Bias Circuit TB3.

Inputs to this circuit consist of -500 volts, +260 volts, a positive gate, a shading waveform, and blanking signal.

The -500 volts from PS1 is used for the focusing control of the crt and for biasing write gun grid 1.

The +260 volts is used by the shading amplifier and for biasing write gun grid 2.

The shading waveform from TB4 is applied through relay circuits K1 and K2 to TB3. The RANGE switch selects the proper circuit on TB4 to provide the correct shading waveform to TB3. The shading waveform from TB3 is clamped to the background level and applied to grid 2 of the write gun.

The positive gate from the synchronizer is applied to TB3. The resulting blanking pulse at write gun grid 1 causes the crt to write.

The ground blanking pulse from the AS-1520A/APN-158 or AS-1624A/APN-158 Antenna applies a circuit ground to TB3. This circuit ground is applied at each scan limit (60 degrees either side of dead ahead) to reduce the positive gate to the write gun and prevent a bright sweep line at each scan limit.

(5) Shading Circuit TB4.

The inputs to this circuit are a positive gate from the synchronizer and +27.5 volts from the receiver-transmitter.

The positive gate input is used to generate the erase pulse, the shading waveform, and the dunking pulse.

The erase pulse from TB4 is shaped by TB1 and applied through TB2 to the crt. This pulse is used to erase the stored video information from the crt storage mesh.

The shading waveform is applied through relay circuits K1 and K2 to TB3. This waveform modifies the writing beam current to compensate for sweep line convergence near the center of the display.

The dunking pulse, applied to PS2 from TB4, lowers the viewing screen potential during the erase pulse. This prevents illumination of the viewing screen as the stored video information is being erased.

(6) Storage Cathode-Ray Tube (CRT) and Deflection Yoke.

The storage crt provides a visual presentation of terrain and weather information detected by the AN/APN-158 Radar Set.

Inputs to the crt are received from TB1, TB2, TB3, and PS2. Sweep positioning information for the deflection yoke is received from TB1.

The deflection yoke receives X- and Y-sweep positioning information from TB1. This information produces a sweeping trace synchronous with the antenna aximuth position.

Power supply PS2 supplies +9.5 kilovolts for the viewing screen bf the crt. This voltage is reduced by a dunking pulse during erase time.

High-voltage circuit TB2 supplies biasing voltages for the flood gun cathode, grids 1 through 4, the collector, and the storage mesh.

Low-voltage bias circuit TB3 supplies a shading waveform, a blanking pulse, and a focusing voltage. It also controls the background level.

(7) Chassis Circuits.

The chassis mounted circuits consist of transformers T1 (not shown) and T2; an ac regulator; a -15-volt supply (not shown); and relays K1, K2, and K4 and associated components.

Transformer T1 provides filament voltage for the crt and shading driver amplifier V2 and illumination voltage for range indicator lamps DS1 through DS3. Transformer T2 supplies PS1, PS2, and the -15-volt supply.

Relays K1, K2, and K4 are controlled by the RANGE switch. These relays switch the proper shading waveform, background level, and write gun bias voltages to a uniform video presentation on each range. Relay K4 is energized in the 150-mile range and corrects the vertical position of the sweep trace.

C. Detailed Theory of Operation.

(1) Storage Cathode-Ray Tube (CRT) and Deflection Yoke.

The crt is a direct-view storage type that produces an image of sufficient brightness for viewing in direct sunlight. The tube contains a writing gun and a flooding gun. Biasing voltages for flood gun elements are supplied by two voltage-divider networks on high-voltage circuit TB2. Accelerating voltage for the viewing screen is supplied by power supply PS2. Biasing voltages for write gun elements are supplied by low-voltage bias circuit TB3.

The writing gun uses electrostatic focus and electromagnetic deflection and has two control grids. Focusing voltage for write gun grid 3 is supplied from the FOCUS control on TB3. Electromagnetic deflection is obtained from a 4-coil fixed deflection yoke which surrounds the tube neck containing the write gun. Write gun grid 1 is gated on by the positive gate from the synchronizer. At each scan limit (60 degrees either side of dead ahead), grid 1 is blanked to prevent a bright sweep line at each scan limit. Write gun grid 2 receives a shading wave- form from TB3. This permits correction of the writing beam current to provide a uniform PPI display for each range. The sweep lines in a PPI display converge near the origin, causing an increase in brightness. This increase in brightness is more apparent in storage tubes than in conventional cathode-ray tubes and must be corrected to obtain a usable display. The positive shading waveform from

TB3-5 is applied to write gun grid 2 and decreases the brightness of the sweep near the origin.

Negative video information from the synchronizer is applied through TB1 to the write gun cathode to modulate the writing beam current. The intensity of the writing beam is determined by the video level at the cathode, the positive gate at grid 1, and the shading waveform and background level on grid 2. The combined effect of the video level, positive gate, background level, and positive shading waveform provides a uniform video display on all ranges. The horizontal and vertical position of the sweep is determined by the X- and Y-sweep currents through the deflection yoke.

During the time that the charge on the storage mesh is being neutralized, flood gun electrons can pass through the mesh to illuminate the viewing screen. To prevent this, the viewing screen potential is reduced during the erase pulse by a dunking pulse applied to high-voltage power supply PS2. The positive dunking pulse from TB4-5 is applied to PS2-7 and reduces the +9.5-kilovolt output of PS2 to less than 3 kilovolts during the erase pulse.

The deflection yoke is a fixed arrangement of four coils that provide an off-centered sweep trace synchronous with antenna azimuth scan motion. The deflection yoke surrounds the write gun tube neck and provides electromagnetic sweep deflection. The X-sweep currents represent the sine of the antenna azimuth position and the range. The Y-sweep currents represent the cosine of the antenna azimuth position and the range. The X- and Y-sweep currents from the synchronizer sweep generator and amplifier module are applied to J1. From J1, the sweep currents are applied to sweep centering and damping components on TB1, TB4, and the chassis. The sweep origin is depressed 1-1/2 inches below the center of the viewing screen by a fixed dc bias current through the Y1 deflection coil. The resultant sweep currents from TB1 are applied to the four coils in the deflection yoke.

(2) Power Supplies. (Refer to figure FO-12.)

(a) Power Supply PS1.

When OPR (operate) is selected on the C-4881/APN-158 Cockpit Control, generator A power (115 volts ac, 400 Hz) from the RT-711A/APN-158 Receiver-Transmitter is applied to pins L and K of J1. The high side from J1-Lis applied through J3-A to series-dropping resistors R80, R87, R82, and R86. These resistors are connected to one side of an ac regulator circuit consisting of diodes CR12 through CR15 and zener diodes VR19 and VR20.

The low side of generator A from J1-K is supplied to the opposite side of the regulator circuit. The 112-volt ac regulated output is applied to terminals 1 and 3 of transformer T2 and to terminals 1 and 2 of power supply PS2.

T2 is connected as an auto transformer, with 82 volts ac from terminals 1 and 2 supplied to power supply PS1.

The -500-volt output from terminal 6 is applied to terminal 6 of low-voltage bias circuit TB3.

The +200-volt output of PS1 is applied to terminals 3 and 6 of power supply PS2. The high side (terminal 9) is also applied to terminal 4 of high-voltage circuit TB2. The low side (terminal 8) is applied to filament transformer T1 and terminal 2 of TB2. This +200-volt output is referenced to the +2-kilovolt output through a voltage divider on TB2.

The +2-kilovolt output is applied to terminal 3 of high-voltage circuit TB2. A voltage divider network consisting of R22 through R35 references the f200-volt output of PS1 to +2 kilovolts and provides a deflection control for the CRT.

(b) Power Supply PS2.
Regulated 112 volts ac from the ac regulator circuit (VR19, VR20, and CR12 through CR15) is applied to Terminals 1 and 2 of power supply PS2. PS2 had a pulsating dc output with a peak value of +9.5 kilovolts. This voltage is the potential for accelerating the electron beam and is applied to the crt viewing screen.

A dunking pulse, applied to PS2, lowers the viewing screen potential during erase time. The positive dunking pulse from terminal 5 on shading circuit TB4 is applied to terminal 7 of PS2. This pulse is coupled through a capacitor to the grid of V3. The +9.5-kilovolt output of PS2 is applied to the crt viewing screen through a 1.2-megohm resistor. The plate of V3 is connected to the viewing screen side of this resistor. while,, ‘he positive dunking pulse is applied to the grid of V3, the tube conducts and lowers the output voltage to a level about 1 kilovolt above the deflection control voltage. This prevents illumination of the viewing screen during the erase pulse.

(3) High-Voltage Circuit TB2. (Refer to figures FO-10 and FO-12.)

High-voltage circuit TB2 consists of two voltage divider networks. The reference voltage divider is connected to TB3 and to ground and has 2 kilovolts across it. The crt voltage divider is connected across 200 volts through TB2-2 to TB2-4.

The reference voltage divider provides five possible connection points (A, B, C, D, E) for correct deflection sensitivity. The connection point is determined by the parameters of an individual crt. This connection is set at the factory and maintains the proper sweep length. A connection at point E gives the longest sweep length, while a connection at point A gives the shortest sweep length. When the connection is made, high voltage is delivered to TB2-2. Point A delivers 2 kilo-volts to TB2-2, B delivers 1900 volts, etc.

For the purpose of this discussion, assume the voltage is taken from point A of the voltage divider. Under these conditions, the voltage at TB2-2 is 2 kilovolts with respect to ground. The 2 kilovolts also references the 200-volt supply from PS1. Note that the high voltage is connected in series with the 200-volt supply. TB2-4 now has a 2200-volt potential with respect to ground or a 200-volt potential with respect to TB2-2. Zener diode VR5 holds the cathode of the crt at 2030 volts or 30 volts above the high-voltage reference.

The flood gun grid (FGG) voltage is the lowest voltage in the crt flood gun. The cathode, backing electrode, etc (see block diagram) are at a higher potential in order to attract the electrons emitted from the cathode. Therefore, in testing the unit, many of the crt element potentials are referenced to the cathode. These values are printed on the tube and are used for the initial setting of the tube. The storage mesh (backing electrode) voltage is supplied from the junction of R38 and R79. The collector voltage is supplied from the junction of R43 and R42. The grid 4 (A-3) voltage is adjustable and is supplied from the wiper of FGG-4 control R41. The grid 3 (A-2) voltage is adjustable and is supplied from the wiper of FGG-3 control R39. The grid 2 (A-1) voltage is supplied from the junction of R41 and R42. Grid 1 voltage is adjustable and is supplied from the wiper of FGG control R36. Adjustments are made so that a cloud of electrons equally floods all areas of the backing electrode.

(4) Sweep Positioning, Video, and Erase Circuit TB1. (Refer to figures 5-5 and FO-12.)

Sweep currents from the synchronizer are applied to pins V, U, f, and g of J1. The X-axis sweep currents vary as the sine of the angle formed by the aircraft's line of flight and the orientation of the antenna (in the horizontal plane). The Y-axis sweep currents vary as the cosine of this angle and with range. The X-axis sweep currents from J1-U and J1-V are applied to the X1 and X2 deflection coils and to a parallel combination of resistors and inductors. Resistors R6, R9, R10, and R12 and inductors L2 and L3 provide damping for the X1 and X2 deflection coils. HOR POS (horizontal position) control R7 permits ±1/4-inch horizontal adjustment of the sweep origin.

The Y-axis sweep currents from J1-f and J1-g are applied to the Y1 and Y2 deflection coils and to a parallel combination of resistors and inductors. A fixed dc bias current through vertical deflection coil Y1 depresses the sweep origin 1-1/2 inches below the center of the viewing screen. The fixed bias current flows through Y1; resistors R13, R100, and R81; and the parallel network consisting of LA, R84, R8, R11, and RT1 to the +27.5-volt supply. Thermistor RT1 has a negative temperature coefficient to compensate for the positive temperature coefficient of other components in the Y1 deflection coil bias circuit.

Resistors R14, R77, and R78 and inductor L5 (mounted on TB4) provide damping for Y1 and Y2 deflection coils.

When the RANGE switch is in the 150-mile position, relay K4 is energized and R81 is energized and R81 is bypassed. In the 150-mile range, the vertical position of the sweep trace tends to rise because of the increased voltage drop across vertical deflection coil Y1. The increased voltage drop is due to the longer duration of the sweep waveform on the 150-mile range. When R81 is bypassed, more do bias current flows through Y1 and maintains the sweep trace at the same vertical position as on the 30- and 60-mile range. VERT POS (vertical position) control R13 permits ±1/4-inch vertical adjustment of the sweep trace.

Video information, in the form of range marks and return signals, is applied to TB1 through pin A of J1. Resistor R93 is a load resistor. Diode CR18 assures that the video information will never be positive.

Capacitor C20, and resistors R5 and R95 bias and permit transistor Q5 to be set at a positive potential. When the negative video voltage exceeds the zener voltage of VR22 as well as the positive potential at Q5, the video signal becomes limited.

Resistor R5 is adjusted to minimize the “blooming” effect on the crt. Blooming can be seen as excessive brightness and an enlarging spot size or the viewing screen. This effect is the result of an excessively large negative voltage on the cathode of the crt. Resistor R5 (VIDEO) is set to permit moderate level noise signals to pass to the crt and to provide the illumination threshold for the crt without causing the application of blooming with large signals. Also, the setting of R5 allows proper visual contrast on the crt screen.

The negative-going erase pulse from TB4-4 is applied to terminal 8 of TB1. This pulse is differentiated by C16, R1, and R2. The resulting negative spike is applied to the base of normally cutoff Q4. The leading edge of the negative spike is shunted through forward-biased diode CR16. The positive-going, trailing edge of the spike turns Q4 on. With Q4 on, the emitter voltage rises rapidly toward the +27.5-volt collector potential. This positive voltage spike is applied to the storage mesh to erase the stored video information. The width and amplitude of the erase may be adjusted by ERASE WIDTH control (R1) and ERASE AMPL control (R3) to provide the proper rate of erasing. Zener diode VR17 limits the amplitude of the positive spike to approximately 33 volts under transient conditions.

(5) Low-Voltage Bias Circuit TB3.

This circuit controls the background level, writing blanking and gate shading wave-form, and focus voltage. The blanking pulse from the antenna is applied through this circuit.

Negative 500 volts from PS1-6 is applied to TB3-6. This negative voltage is used for focusing and for write gun grid 1 biasing. The focus voltage-divider network consists of R53, R54, R55, and zener diode VR9. The negative focus voltage applied to the write gun grid 4 may be adjusted by FOCUS control R55. The negative supply voltage for write gun grid 1 is obtained from zener diode VR9. A voltage divider network consisting of thermistor RT2 and resistors R56 and R97 establishes the bias level.

When a positive gate voltage is applied at TB3-2, Q6 conducts and its emitter approaches the positive zener voltage level of VR27. However, when the antenna is at either of the two scan limits (60 degrees either side of dead ahead), a switch in the antenna is closed and applies a circuit ground through pin j of J1 to the cathode of CR26. If a positive gate from pin C of J1 is applied when the cathode of CR26 is grounded, transistor Q6 will not turn on. The voltage drop across R97 will bias the writing gun such that the writing beam will be extinguished. The blanking action occurs at each scan limit and prevents occurrence of a bright sweep line on the viewing screen.

When the cockpit control is switched from OPR (operate) to STBY (standby), Q6 also turns off. This stops current flow to the writing grid and prevents a damaging bright spot on the screen as the high voltage supplies slowly discharge.

The negative shading waveform from TB4-1, TB4-2, or TB4-3 is applied through contacts of K1 and K2 to TB3-11. The amplitude of this waveform may be adjusted by SHADING control R48. The waveform is coupled through C11 to the grid of shading driver amplifier V2. Diode CR8 prevents the grid of V2 from going positive. V2 is normally conducting heavily, and the plate voltage is low. The negative shading waveform at the grid cuts off V2. The positive shading waveform from the plate of V2 is coupled through C12 to write gun grid 3. The positive shading waveform is clamped to the background level by CR7.

When the RANGE switch is in the 30-mile position, the background voltage divider network consists of R44, R66, and R47. In the 60-mile position, the background voltage-divider network consists of R58, R66, and R47. In the 150-mile position, the background voltage divider network consists of R45, R66, and R47. Variable resistors R45 and P.58 are adjusted to eliminate the necessity of re-adjusting BACKGRD control when the 60- or 150-mile range is selected.

(6) Shading Circuit TB4.

The positive gate from the synchronizer gate generator module is applied to J1-C. This gate is used to generate the dunking pulse, erase pulse, and shading waveform. The gate is coupled through C14 on TB3 to write gun grid 1 to gate the write gun on during sweep time. The gate is also coupled to the erase multi-vibrator circuit, Q2 and Q3, and through CR1 to shading waveform generator Q1. Q1 is normally on, and the positive gate applied to the base cuts off Q1. The negative going gate from the collector of Q1 is applied to three similar integrating networks. There is a separate integrating network for each of the range positions. The operation of the integrating networks is identical, and the network for the 30-mile range will be described as representative.

The 30-mile integrating network consists of R73, R74, R75, CR2, and C15. Prior to the arrival of the positive gate, Q1 is saturated and C15 is charged to the positive voltage level at the collector of Q1. The positive gate cuts off Q1, permitting C15 to discharge. The discharging of C15, through R73 and R48, produces a negative-going waveform. This negative-going shading waveform from TB4-1 is applied through the contacts of K1 and K2 to the shading amplifier on TB3. At the end of the positive sate from the synchronizer, Q1 again saturates and C15 is charged through forward-biased diode CR2. This cycle is repeated each time a gate pulse is received.

The 60-mile integrating network consists of R69, R70, R71, C6, and CR4. Relay K1 is energized when the RANGE switch is in the 60-mile position.

The 150-mile integrating network consists of R65, R67, R68, C5, and CR3. Relay K2 is energized when the RANGE switch is in the 150-mile position.

The monostable multi-vibrator circuit, Q2 and Q3, controls the high-voltage dunking pulse and the erase pulse for the crt storage mesh. Prior to the arrival of the positive gate, Q3 is conducting and Q 2 is cut off. Q2 is cut off by the positive voltage on the base due to the positive charge on C2. Capacitor C2 is charged toward +27.5 volts through R17. The positive gate is coupled through C1 and applied to the base of Q2. The negative-going, trailing edge of the positive gate turns Q2 on, and C2 begins to discharge. As Q2 is turned on, a positive-going dunking pulse is generated at the collector. This pulse is coupled through C4 to the base of Q3 and cuts off Q3. As Q3 is cut off, C2 begins charging toward +27.5 volts. When C2 is-charged sufficiently, Q2 is cut off and the multi-vibrator is returned to the stable state.

The positive going dunking pulse from the collector of Q2 is applied through R18 to terminal 7 of PS2. This causes the viewing screen potential to be lowered during the erase cycle. As Q3 is cut off, a negative-going pulse is generated at the collector. This pulse is applied to erase pulse generator Q4 on TB1.

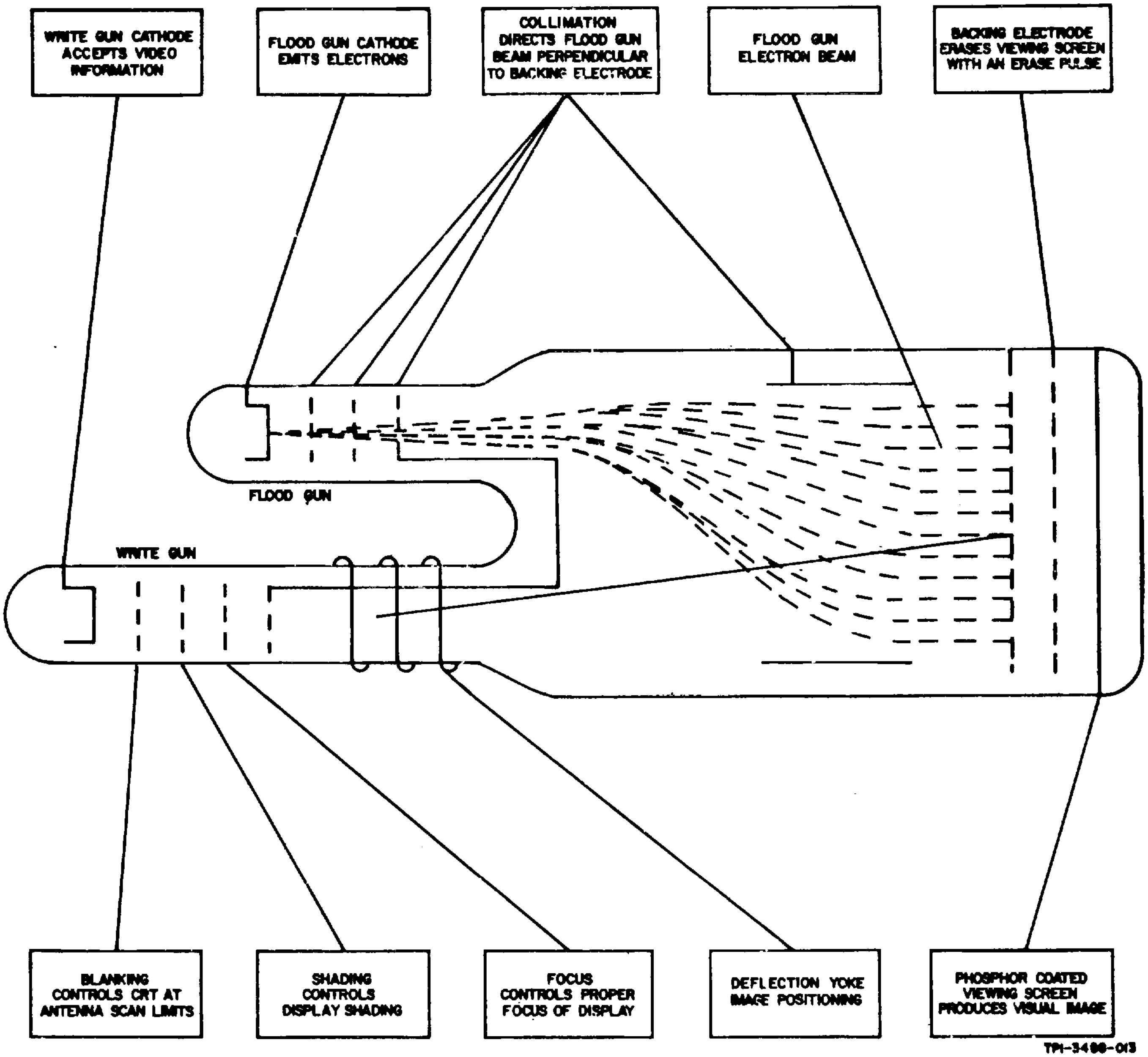
Diodes CR12 through CR15 are part of the ac regulator circuit. The remainder of the ac regulator components, zener diodes CR19 and VR20 and resistors R80, R82, R83, R85, R86, and R87, are mounted on the chassis. Inductor 15 provides isolation for the bias circuits.

(7) Chassis Circuits.

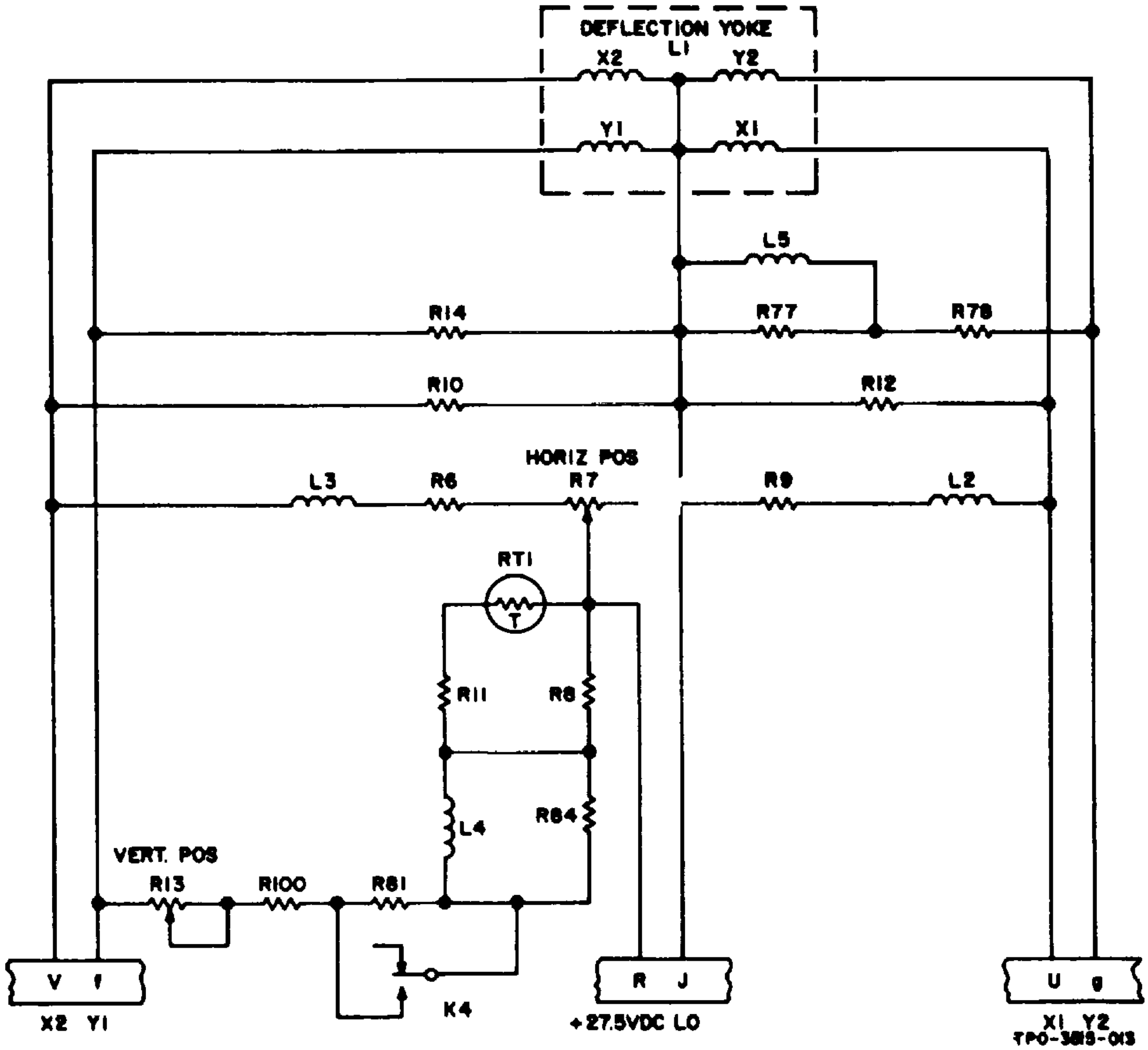
The chassis circuits consist of range lights board TB5; transformers T1 and T2; relays K1, K2, and K4; the ac regulator; and the -15-volt power supply. Transformer T2, the -15-volt power supply, and the ac regulator circuit are described in paragraph 5-5.C.(2)(a).

Range lights board TB5 contains indicator lamps DS1, DS2, and DS3 that provide a visual indication of the RANGE switch position. Illumination voltage for the lamps is supplied from T1-7 through R72 to common terminal 4 on TBS. Generator A power (115 volts ac, 400 Hz) from J1-N and J1-M is supplied to the primary of T1. Transformer T1 provides filament voltage for V1 and V2 and illumination voltage for the range indicator lamps on TBS. The secondary winding of T1 that supplies filament voltage for VIA (flood gun) is referenced to the +2000-volt output of PS1. This is necessary to prevent a large voltage difference between the filament and cathode of V1A. The other secondary winding of T1 provides filament voltage for V1B and V2 and illumination voltage for the range indicator lamps.

Relays K1 and K2, controlled by the RANGE switch, select the correct shading waveform, range indicator lamp, and background voltage-divider network. The shading waveform integrating networks are located on TB4, and the back-ground voltage dividers are located on TB3. Relay K1 is energized in the 60-mile range, and relay K2 is energized in the 150-mile range.



Storage Cathode-Ray Tube, Simplified Diagram
Figure 5-4



IP-724A Indicator, Sweep Deflection Circuit,
Simplified Schematic Diagram
Figure 5-5

Section II. DISASSEMBLY

5-6. GENERAL.

This section presents instructions for disassembly of the IP-724A Indicator. These instructions are arranged so that disassembly of each major part is an individual procedure. When it is necessary to disassemble the unit, locate the part in the table of contents, and begin on the page indicated. Reference is made to previous disassembly steps that must be performed before a part may be removed or disassembled. The disassembly procedure should be continued only as far as necessary to replace the faulty component. These instructions include special techniques, cautions, warnings, and unique procedures.

5-7. PRECAUTIONS AND GENERAL TECHNIQUES.

Mark, tag, or otherwise identify all disconnected electrical wiring. Note the color coding, placement of leads, and method of applying insulation before unsoldering or removing any electrical components. These procedures supply sufficient information to completely remove the parts listed in the table of contents. In many cases, however, parts may be released and moved aside to gain access to other parts without unsoldering the connecting leads; particularly, this applies to the printed circuit boards. Do not unsolder these leads unless absolutely necessary.

CAUTION: TO PREVENT DAMAGE TO A SOLID-STATE DEVICE, USE A HEAT SINK BETWEEN THE POINT BEING UNSOLDERED AND THE DEVICE.

WARNING: THE IP-724A INDICATOR USES EXTREMELY HIGH VOLTAGES. DO NOT ATTEMPT ANY DISASSEMBLY WHILE PRIMARY POWER IS APPLIED TO THE UNIT.

CAPACITORS IN THE IP-724A INDICATOR MAY HOLD A CHARGE FOR LONG PERIODS OF TIME AFTER PRIMARY POWER HAS BEEN REMOVED. OBSERVE SAFETY PRECAUTIONS WHEN WORKING ON THE INDICATOR.

BREAKAGE OF THE HIGH-VACUUM, CATHODE-RAY TUBE MAY RESULT IN INJURY FROM FLYING GLASS. DO NOT STRIKE OR SCRATCH THE TUBE AT ANY TIME. DO NOT APPLY MORE THAN MODERATE PRESSURE WHEN INSERTING OR REMOVING THE TUBE. USE PROTECTIVE DEVICES, SUCH AS GOGGLES, FACE MASKS, AND RUBBER GLOVES.

These precautions are repeated in the text of the disassembly procedures when they are applicable.

5-8. DISASSEMBLY PROCEDURE.

A. Remove Filter Assembly and Front Plate. (Refer to figure FO-11.)

(1) Remove BACKGRD and RANGE knobs (1) by loosening setscrews (2) located in the knobs.

(2) Remove front plate (3) by removing eight machine screws (4) securing it to front brace (5).

(3) Pull front plate (3) forward, separating it from front brace (5).

NOTE: Front plate (3) is held to the cathode-ray tube assembly by four wires that are soldered to range lights board TBS. To remove range lights board TB5, proceed to paragraph C below.

B. Remove and Disassemble Polarizing Filter. (Refer to figure 5-6.)

(1) Remove filter assembly and front plate (6, 3, figure FO-11) in accordance with paragraph A above.

(2) Tip filter assembly and front plate (2, 8, figure 5-6) forward, and release range lights board TB5 (10) and panel light indicator (9) by removing two machine screws (12) securing them to front mounting (8).

NOTE: Range lights board TB5 (10) is held to the cathode-ray tube assembly by four wires. Do not unsolder these wires to disassemble the polarizing filters.

(3) Remove grid (11) by removing three machine screws (13) securing it to the rear of front mounting plate (8).

(4) Remove lens frame (2) by removing four machine screws (1) securing it to the front of front mounting plate (8).

(5) The following filter components are now free and may be removed. Note the order of removal:

(a) Ring (3).

(b) Linear polarizer (4).

(c) Circular polarizer (7).

NOTE: Handle the filters by their edges. Do not touch the glass with bare fingers.

(6) Remove DIM tab (6) by removing two machine screws (5) securing it to circular polarizer (7).

C. Remove Range Lights Board TB5. (Refer to figures FO-11 and 5-6.)

(1) Remove filter assembly and front plate (6, 3, figure FO-13) in accordance with paragraph A above.

(2) Release and remove range lights board TB5 (10, figure 5-6) from front mounting plate (3, figure FO-11) in accordance with paragraph B(2) above.

(3) Unsolder and tag the leads from terminals 1 through 4 of range lights board TB5.

D. Remove Outer Dust Covers. (Refer to figure FO-11.)

(1) Remove 2-piece dust cover (7) by removing six machine screws (8) securing it to the indicator frame.

(2) Lift off dust covers (7).

E. Remove Rear Cover Plate. (Refer to figure 5-7.)

(1) Remove 2-piece dust cover (7, figure FO-11) in accordance with paragraph D above.

(2) Remove rear cover plate (1) by removing eight machine screws (2) securing it to rear chassis assembly (9, figure FO-11).

(3) Pull rear cover plate (1) away from rear chassis assembly (9, figure FO-11).

(4) Remove cable clamp (3, figure 5-7) from rear cover plate (1) by removing machine screw (4), flat washer (5), and hexnut (6).

(5) Unsolder and tag the yellow lead from standoff terminal (7).

(6) Unsolder and tag the three red leads from standoff terminal (8).

(7) Unsolder and tag the orange and brown leads from VR19 and the yellow and brown leads from VR20.

CAUTION: USE A HEAT SINK BETWEEN THE LEAD BEING UNSOLDERED AND THE SEMICONDUCTOR DEVICE.

(8) Remove electrical connector (9) by removing four machine screws (10, 11), two lockwashers (12), two standoff terminals (7, 13), and two hexnuts (14) securing it to rear cover plate (1).

(9) Unsolder and tag the leads from relay K4 (15), and CR21 through CR24.

(10) Rear cover plate (1) is now free from rear chassis assembly (9, figure FO-11), and the components attached to it may be removed as required.

F. Remove High-Voltage Circuit TB2. (Refer to figure 5-7.)

(1) Remove 2-piece dust cover (7, figure FO-11) in accordance with paragraph D above.

(2) Separate rear cover plate (1) from rear chassis assembly (9, figure FO-11) in accordance with paragraphs E(2) and E(3) above.

(3) Remove plastic high-voltage cover (16) by removing four machine screws (17) securing it and high-voltage circuit TB2 (18) to bracket (19).

(4) Remove four spacing sleeves (20) separating plastic high-voltage cover (18) and high-voltage circuit TB2 (18).

(5) Lift high-voltage circuit TB2 (18) up to gain access to the bottom of the board.

(6) Unsolder and tag the red, white, and blue high-voltage leads from terminals 6, 7, and 9 of high-voltage circuit TB2 (18).

(7) Unsolder and tag the remaining leads from terminals 1 through 5, 8, and 10 through 12 of high-voltage circuit TB2 (18).

(8) Remove cable clamp by removing machine screw, flat washer, lockwasher, and hexnut securing it to high-voltage circuit TB2 (18).

(9) High-voltage circuit TB2 is now free and may be removed.

G. Separate the Cathode-Ray Tube Assembly from the Rear Chassis Assembly. (Refer to figures FO-11 and 5-7.)

(1) Remove 2-piece dust cover (7, figure FO-11) in accordance with paragraph D above.

(2) Separate rear cover plate (1, figure 5-7) from rear chassis assembly (9, figure FO-11) in accordance with paragraphs E(2) and E(3) above.

(3) Remove plastic high-voltage cover (16, figure 5-7), release high-voltage circuit TB2 (18), and unsolder and tag the leads from terminals 6, 7, and 9 of high-voltage circuit TB2 in accordance with paragraphs F(3) through F(6) above.

NOTE: **Refer to figure 5-7 for the performance of paragraphs (4) and (5) below.**

(4) Disconnect electrical connector (21) from the cathode-ray tube writing gun.

(5) Disconnect the viewing-screen, light-voltage lead from terminal 4 of power supply PS2 (22).

NOTE: **Refer to figure FO-11 for the performance of paragraphs (6) through (14).**

(6) Turn RANGE control knob (1) or RANGE control shaft (10) until setscrews (11) of coupler (12) are accessible.

(7) remove RANGE switch control shaft (10) from RANGE switch control (13) by loosening two setscrews (11) in coupler (12).

(8) Turn BACKGRD control knob (1) or BACKGRD control shaft (14) until setscrews (15) of coupler (16) are accessible.

(9) Remove BACKGRD control shaft (14) from BACKGRD control (17) by loosening two setscrews (15) of coupler (16).

(10) Remove RANGE switch bracket (17) by removing two machine screws (18) securing it to front brace (19).

(11) Remove BACKGRD control bracket (20) by removing two machine screws (21) securing it to front brace (19).

(12) Release entire front brace (19) from rear chassis assembly (9) by removing eight machine screws (22).

(13) Disconnect connectors (23, 24).

(14) Gently separate rear chassis assembly (9) from front brace (19) until flood-gun tube socket (23, figure 5-7) is accessible.

(15) Remove flood-gun tube socket (23, figure 5-7), and completely separate the two chassis.

<u>WARNING</u>: EXTREME CARE SHOULD BE EXERCISED WHEN REMOVING THE FRONT TUBE SECTION FROM THE REAR CHASSIS ASSEMBLY. NO STRAIN OR STRESS SHOULD BE EXERTED ON THE NECK OF THE CATHODE-RAY TUBE. USE PROTECTIVE DEVICES, SUCH AS GOGGLES, FACE MASKS, AND RUBBER GLOVES.

H. <u>Remove Cathode-Ray Tube</u>. (Refer to figure FO-11.)

(1) Remove 2-piece dust cover (7) in accordance with paragraph D above.

(2) Separate rear cover plate (1, figure 5-7) from rear chassis assembly (9) in accordance with paragraph E(2) and E(3) above.

(3) Remove plastic high-voltage cover (16, figure 5-7), release high-voltage circuit TB2 (18, figure 5-7), and unsolder and tag the leads from terminals 6, 7, and 9 of high-voltage circuit TB2 in accordance with paragraphs F(3) through F(6) above.

(4) Separate the cathode-ray tube assembly from the rear chassis assembly (9) in accordance with paragraphs G(4) through G(15) above.

(5) Remove eight tube fasteners (25) securing cathode-ray tube (26) to front brace (3).

(6) Remove cathode-ray tube (26) from front brace (19).

<u>WARNING</u>: BREAKAGE OF THE HIGH-VACUUM, CATHODE-RAY TUBE MAY RESULT IN INJURY FROM FLYING GLASS. DO NOT STRIKE OR SCRATCH THE TUBE AT ANY TIME. DO NOT APPLY MORE THAN MODERATE PRESSURE WHEN INSERTING OR REMOVING THE TUBE. USE PROTECTIVE DEVICES, SUCH AS GOGGLES, FACE MASKS, AND RUBBER GLOVES.

I. Remove Sweep Deflection Yoke L1. (Refer to figure 5-7.)

(1) Remove 2-piece dust cover (7, figure FO-11) in accordance with paragraph D above.

(2) Separate rear cover plate (1) from rear chassis assembly (9, figure FO-11) in accordance with paragraphs E(2) and E(3) above.

(3) Remove plastic high-voltage cover (16), release high-voltage circuit TB2 (18), and unsolder and tag the leads from terminals 6, 7, and 9 of high-voltage circuit TB2 in accordance with paragraphs F(3) through F(6) above.

(4) Separate the cathode-ray tube assembly from rear chassis assembly (9, figure FO-10) in accordance with paragraphs G(4) through G(15) above.

(5) Remove yoke adjuster (24) by loosening machine screw (25).

(6) Loosen yoke clamp (26) by loosening yoke clamp screw (27).

(7) Loosen one foot of yoke clamp (26) by loosening machine screw (28).

(8) Withdraw yoke (29) from yoke clamp (26).

(9) Unsolder and tag the yoke leads from terminals 2 through 4, 9, and 10 of sweep positioning, video, and erase circuit TB1 (30).

J. Remove and Disassembly Rear Cover Semiconductor Device Set. (Refer to figure 5-8.)

(1) Remove 2-piece dust cover (7, figure FO-11) in accordance with paragraph D above.

(2) Separate rear cover plate (1, figure 5-7) from rear chassis assembly (9, figure FO-12) in accordance with paragraphs E(2) and E(3) above.

(3) Unsolder and tag the orange and brown leads from VR19 and the yellow and brown leads from VR20.

CAUTION: USE A HEAT SINK BETWEEN THE LEAD BEING UNSOLDERED AND THE SEMICONDUCTOR DEVICE.

NOTE: The two semiconductors placed on rear cover plate (1, figure 5-7) are identical. Disassembly procedures describe only one of these sets. Refer to figure 5-8 for the performance of steps (4) through (7).

(4) Remove cover (1) by removing two machine screws (2), two flat washers (3), and two lockwashers (4) securing it to heat sink (5).

(5) Remove heat sink (5) by removing two machine screws (6), two spacers (7), two flat washers (8), and two hexnuts (9) securing it to rear cover plate (1, figure 5-7).

(6) Remove two machine screws (10), two hexnuts (11), two lockwashers (12), four flat washers (13), two insulating sleeves (14), two insulating washers (15), and terminal lug (16).

(7) Remove semiconductor (17) and mica insulator (18).

K. Remove Sweep Positioning, Video, and Erase Circuit TB1. (Refer to figure 5-7.)

(1) Remove 2-piece dust cover (7, figure FO-11) in accordance with paragraph D above.

(2) Separate rear cover plate (1) from rear chassis assembly (9, figure FO-11) in accordance with paragraphs E(2) and E(3) above.

(3) Remove four machine screws (31) and four flat washers (32) securing sweep positioning and circuit TB1 (30) to bracket (19) and transformer plate (33).

(4) Pull sweep positioning, video, and erase circuit TB1 (30) forward, away from bracket (19) and transformer plate (33).

(5) Unsolder and tag the leads from terminals 1 through 11 of sweep positioning, video, and erase circuit TB1 (30).

(6) Remove two cable clamps by removing two machine screws, two flat washers, two lockwashers, and two hexnuts securing clamps to sweep positioning, video, and erase circuit TB1 (30).

(7) Sweep positioning, video, and erase circuit TB1 (30) is now free and may be removed.

L. Remove Low-Voltage Bias Circuit TB3. (Refer to figure 5-7.)

(1) Remove 2-piece dust cover (7, figure FO-11) in accordance with paragraph D above.

(2) Separate rear cover plate (1) from rear chassis assembly (9, figure FO-11) in accordance with paragraphs E(2) and E(3) above.

(3) Remove four machine screws (34) and four flat washers (35) securing low voltage bias circuit TB3 (36) to bracket (19) and transformer plate (33).

(4) Pull low-voltage bias circuit TB3 (36) forward, away from bracket (19) and transformer plate (33), to expose rear wiring.

(5) Unsolder and tag the leads from terminals 1 through 11, 13, and 14 of low voltage bias circuit TB3 (36).

(6) Unsolder and tag leads from the center tap of R55 and pins 10 and 12 (filaments of V2 tube :socket) of low-voltage bias circuit TB3 (33).

(7) Remove cable clamp by removing machine screw, flat washer, lockwasher, and hexnut securing it to low-voltage bias circuit TB3 (33).

M. Remove Shading Circuit TB4. (Refer to figure 5-7.)

(1) Remove 2-piece dust cover (7, figure FO-11) in accordance with paragraph D above.

(2) Separate rear cover plate (1) from rear chassis assembly (9, figure FO-11) in accordance with paragraphs E(2) and E(3) above.

(3) Unsolder and tag the leads from terminals 1 through 14 of shading circuit TB4 (42) and terminals 1 and 2 of power supply PS2 (22).

(4) Release shading circuit TB4 (42) from transformer plate (33) by removing four machine screws (37), four flat washers (38), and four lockwashers.

(5) Remove cable clamp by removing machine screw, flat washer, lockwasher, and hexnut securing it to shading circuit TB4 (42).

(6) Loosen two machine screws (39) securing transformer plate (33) to chassis channel frame (40).

(7) Separate rear chassis channel braces (40, 41) and slide shading circuit TB4 (42) out the rear of the unit.

N. Remove Transformer Plate. (Refer to figure 5-7.)

(1) Remove 2-piece dust cover (7, figure FO-11) in accordance with paragraph D above.

(2) Separate rear cover plate (1) from rear chassis assembly (9, figure FO-11) in accordance with paragraphs E(2) and E(3) above.

(3) Release high-voltage circuit TB4 (42) and plastic high-voltage cover (16) in accordance with paragraphs F(3) and F(4) above.

(4) Release sweep positioning, video, and erase circuit TB1 (30) in accordance with paragraphs F(3) through F(5) above.

(5) Release low-voltage bias circuit TB3 (36) in accordance with paragraphs L(3) through L(7) above.

(6) Release shading circuit TB4 (42) in accordance with paragraph M above.

(7) Remove four machine screws (43) and lockwashers (44) securing transformer plate (33) to chassis frame (40).

(8) Pull transformer plate (33) toward the rear of the unit and expose all wiring.

(9) Unsolder and tag the leads from terminals 1, 4, and 6 through 9 of transformer T1 (45).

(10) Unsolder and tag the lead from solder lug (46).

(11) Unsolder and tag the leads from terminals i through 4 of transformer T2 (47).

(12) Remove solder lug (48) by removing machine screw (49), flat washer (50), lockwasher (51), and hexnut (52).

(13) Unsolder and tag the leads from terminals 1, 3, 4, 7, and 8 of relay K2 (53).

(14) Unsolder and tag the leads from terminals 1 through 3, 6, and 7 of relay K1 (54).

(15) Remove cable clamp (55) by removing machine screw (56), flat washer (57), and hexnut (58).

(16) Transformer plate (33) is now free and may be removed from the unit.

O. Remove Power Supply PS1. (Refer to figure 5-7.)

(1) Remove 2-piece dust cover (7, figure FO-11) in accordance with paragraph D above.

(2) Separate rear cover plate (1) from rear chassis assembly (9, figure FO-11) in accordance with paragraphs E(2) and E(3) above.

(3) Release high-voltage circuit TB2 (18) and plastic high-voltage cover (16) in accordance with paragraphs F(3) through F(6) above.

(4) Separate the cathode-ray tube assembly from rear chassis assembly (9, figure FO-11) in accordance with paragraphs G(4) through G(15) above.

(5) Release sweep positioning, video, and erase circuit TB1 through (30) in accordance with paragraphs K(3) and K(4) above.

(6) Release low-voltage bias circuit TB3 (36) in accordance with paragraphs L(3) and L(4) above.

(7) Release transformer plate (33) in accordance with paragraphs N(7) and N(8) above.

(8) Unsolder and tag the leads from terminals 1, 2, and 6 through 9 of power supply PS1 (59).

(9) Remove bracket (19) by removing two machine screws (60) securing it to chassis brace (61).

(10) Remove four hexnuts (62), four lockwashers (63), and four flat washers (64) securing power supply PS1 (59) to front brace (65).

(11) Power supply PS1 (59) is now free and may be removed from the unit.

P. Remove Power Supply PS2. (Refer to figure 5-7.)

(1) Remove 2-piece dust cover (7, figure FO-11) in accordance with paragraph D above.

(2) Separate rear cover plate (1, figure 5-7) from rear chassis assembly (9, figure FO-10) in accordance with paragraphs E(2) and E(3) above.

(3) Release high-voltage circuit TB2 (18) and plastic high-voltage cover (16) in accordance with paragraphs F(3) through F(6) above.

(4) Separate the cathode-ray tube assembly from rear chassis assembly (9, figure FO-10) in accordance with paragraphs G(4) through G(15) above.

(5) Release sweep positions, video, and erase circuit TB1 (30) in accordance with paragraphs K(3) and K(4) above.

(6) Release low-voltage bias circuit TB3 (36) in accordance with paragraphs L(3) and L(4) above.

(7) Release transformer plate (33) in accordance with paragraphs N(7) and N(8) above.

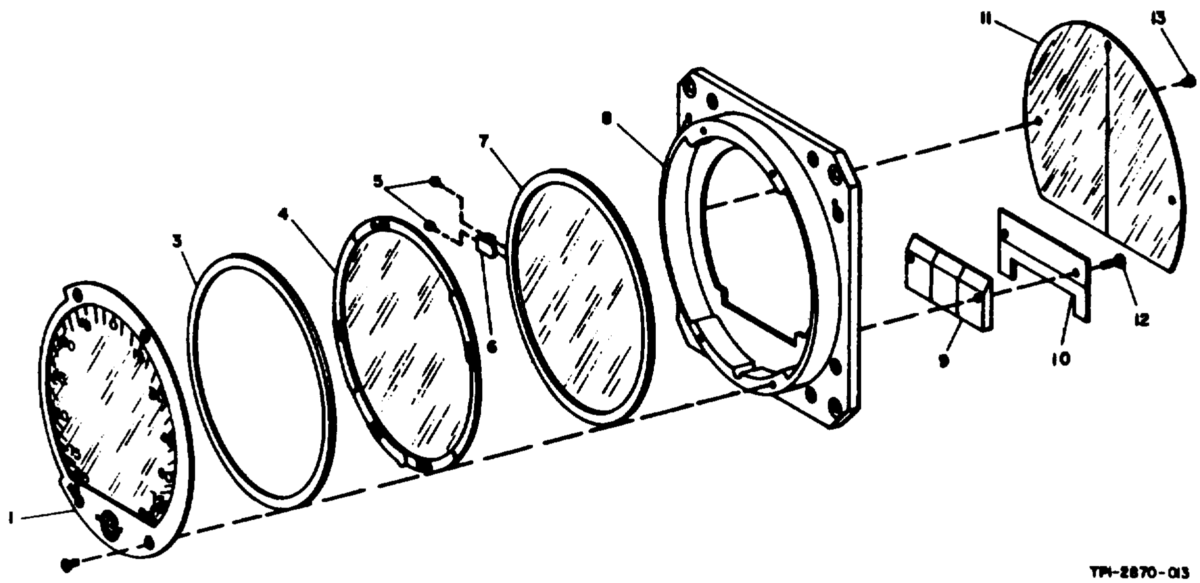
(8) Unsolder and tag the leads from terminals 1 through 3, 6, and 7 of power supply PS2 (22).

(9) Remove the viewing-screen lead from terminal 4 of power supply PS2 (22).

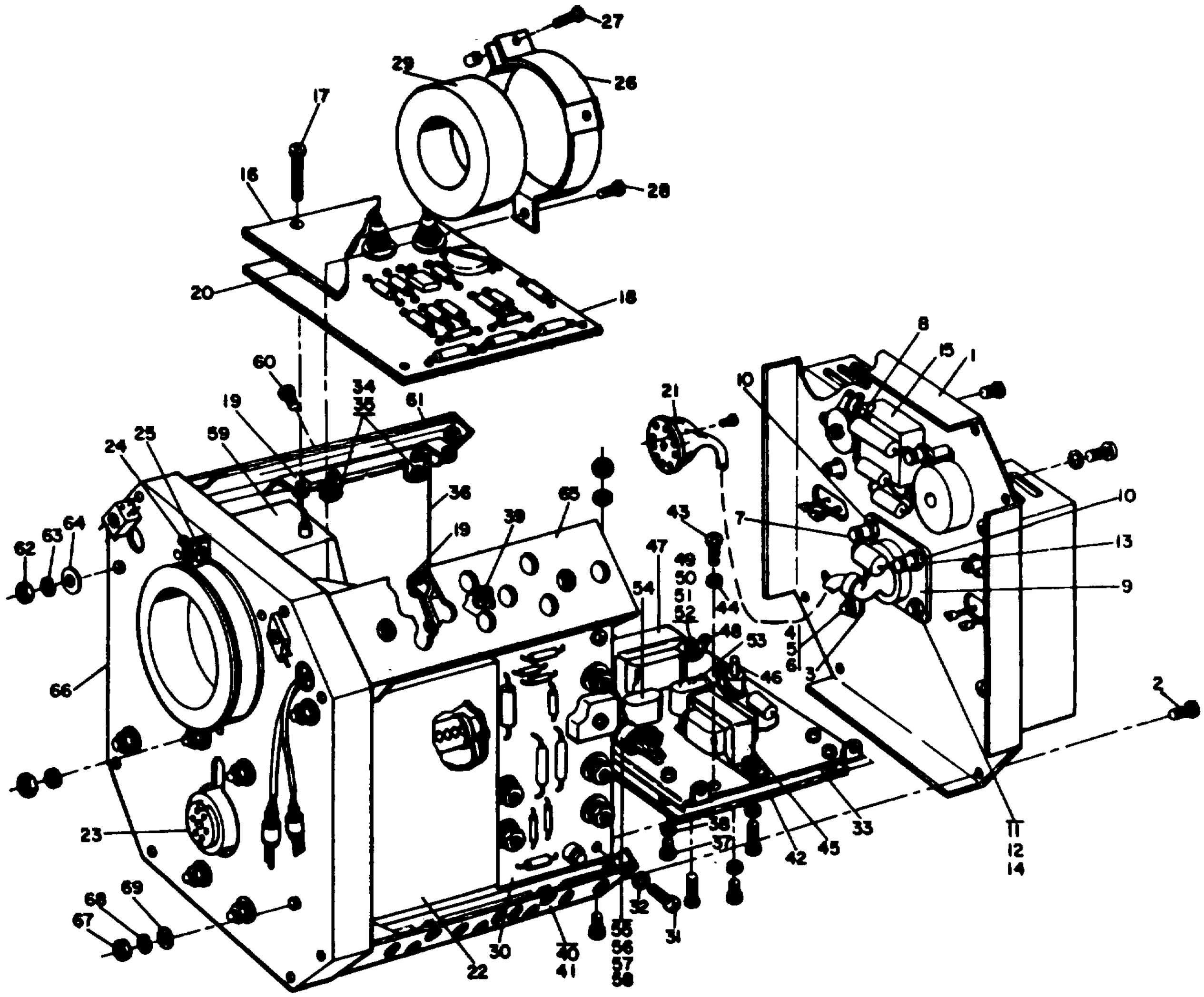
(10) Remove bracket (19) by removing two machine screws (39) securing it to chassis brace (65).

(11) Remove four hexnuts (67), four lockwashers (68), and four flat washers (69) securing power supply PS2 (22) to front brace (66).

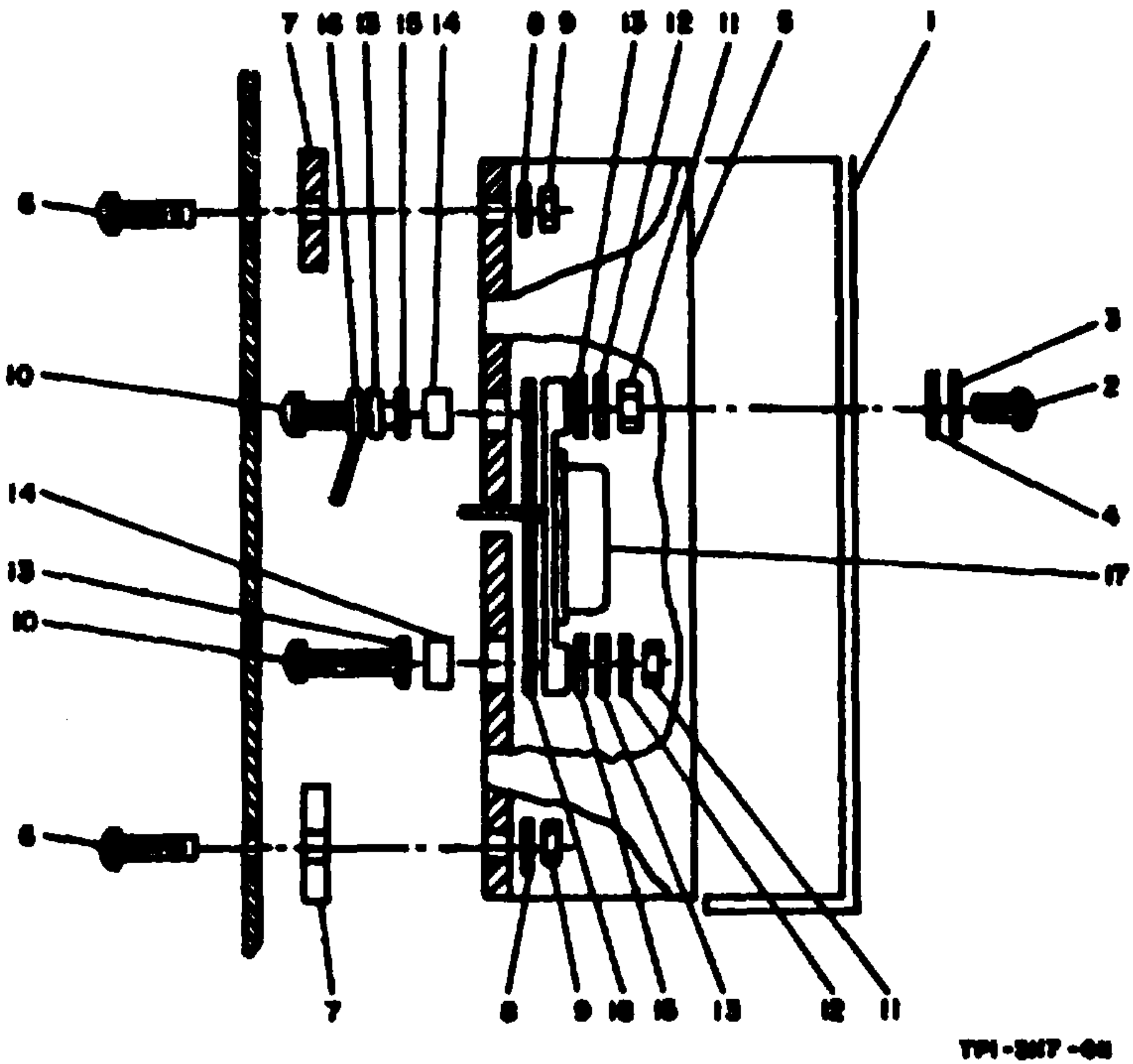
(12) Power supply PS2 (22) is now free and may be removed from the unit.



IP-724A Indicator, Filter Assembly, Exploded View
Figure 5-6



IP-724A Indicator, Chassis Assembly, Exploded View
Figure 5-7



IP-724A Indicator, Semiconductor Assembly, Exploded View
Figure 5-8

Section III. CLEANING

5-9. GENERAL.

This section presents instructions for cleaning the dismantled and disassembled components, parts, and subassemblies of the IP-724A Indicator. These instructions are tabulated and arranged to facilitate reference to the test procedure for cleaning the various parts and assemblies. All parts requiring particular methods of cleaning are considered separately, and parts which are similar enough to permit identical cleaning procedures are grouped together. Either Turcosol or Stoddard solvent may be used in the following procedures.

WARNING: PERFORM OPERATIONS INVOLVING CLEANING SOLVENT UNDER A VENTILATED HOOD. AVOID BREATHING SOLVENT VAPOR AND FUMES. WEAR A SUITABLE MASK WHEN NECESSARY. AVOID CONTINUOUS CONTACT WITH THE SOLVENT. USE GOGGLES, GLOVES, AND AN APRON TO PREVENT IRRITATION FROM PROLONGED CONTACT. CHANGE CLOTHING THAT HAS BECOME SATURATED WITH SOLVENT.

References to air jet in this section indicate a hand-operated air nozzle supplied with clean, dry, compressed air at a maximum pressure of 28 pounds per square inch.

WARNING: WEAR GOGGLES WHEN USING THE AIR JET TO BLOW DUST AND DIRT FROM EQUIPMENT PARTS. WARN OTHER PERSONS AWAY FROM HAZARDOUS AREA OR WORKING ENCLOSURE.

5-10. CLEANING PROCEDURE.

The following paragraphs present instructions and procedures for cleaning the various parts of the dismantled and disassembled equipment preparatory to performing inspection procedures. For convenience, components, parts, and subassemblies are alphabetically listed and cross-referenced to the appropriate paragraphs containing the cleaning instructions. Refer to figure 5-9.

WARNING: OBSERVE ALL FIRE PRECAUTIONS WHEN USING FLAMMABLE MATERIALS FOR CLEANING PURPOSES. THESE MATERIALS SHOULD ONLY BE USED OUTSIDE OR IN A VENTILATED BOOTH PROVIDED WITH EXPLOSION-PROOF ELECTRICAL EQUIPMENT AND AN EXHAUST FAN HAVING SPARK-PROOF BLADES.

A. Connectors.

(1) Clean dust and dirt from bodies, shells, and cable clamps, using a solvent moistened lintless cloth. Wipe dry with a clean, dry, lintless cloth.

(2) Remove dust from inserts, using a small, soft-bristled brush and an air jet.

(3) Wash dirt and any traces of lubricant from inserts, insulation, and contacts, using solvent applied sparingly with a small, camel-hair brush.

<u>CAUTION:</u> DO NOT ALLOW SOLVENT TO RUN INTO SLEEVES OR CONDUIT COVERING ANY WIRES OR CABLES CONNECTED TO CONTACT TERMINALS OF THE INSERT.

(4) Dry the insert with an air jet.

B. <u>Covered Cables</u>.

(1) Clean outer surfaces by wiping away dirt with a solvent-moistened, lintless cloth.

(2) Wipe dry, using a clean, dry, lintless cloth.

(3) Treat any connector terminations in accordance with paragraph A above. Wipe lug terminations clean with a moistened, lintless cloth; dry with a clean, dry, lintless cloth.

ITEM	REFER TO PARAGRAPH
Connectors	5-10A
Covered cables	5-10B
Covers and shields	5-10C
Electron tubes	5-10D
Knobs and panels	5-10E
Machined metal parts	5-10F
Mechanical metal parts	5-10G
Polarizing filters	5-10H
Printed circuit boards	5-101
Tube sockets	5-10J
Wired chassis	5-10K

Index of Cleaning Procedures
Figure 5-9

C. <u>Covers and Shields.</u>

Clean all unfinished, finished, and partly finished sheet-metal covers, such as dust covers, inspection covers, and housings, as follows:

(1) Remove bulk of any surface grease with clean rags.

(2) Blow dust from surfaces, holes, and recesses with an air jet.

(3) Submerge in Freon TF ultrasonic bath.

(4) Raise from bath, and permit Freon to drain into bath.

CAUTION: USE PROTECTIVE DEVICES WHEN USING THE AIR JET TO REMOVE EXCESS SOLVENT.

(5) When thoroughly dry, touch up minor damage to the finish in accordance with paragraph 4-14F of the repair section. Extensive damage to the finish may require complete refinishing.

(6) Protect from dust and moisture pending inspection.

D. Electron Tubes.

WARNING: USE EXTREME CARE WHEN CLEANING THE CATHODE-RAY TUBE. DO NOT STRIKE OR SCRATCH THE TUBE AT ANY TIME. DO NOT ALLOW IT TO COME WITHIN 4 FEET OF MAGNETIC MATERIALS. BREAKAGE OF THE TUBE MAY RESULT IN INJURY FROM FLYING GLASS. WEAR PROTECTIVE CLOTHING WHEN HANDLING THE TUBE.

(1) Remove dust and dirt from surface of glass or metal envelope and side of the tube base with moistened, lintless cloth. Apply the cloth lightly to avoid obliterating the tube type markings.

(2) Dry and polish these surfaces by gently wiping them with a clean, dry, lintless cloth.

(3) Clean bottom of base and all tube contacts with a soft-bristled brush.

NOTE: Abrasives or metal tools should not be used to remove corrosion deposits occasionally present on tube contacts.

CAUTION: USE EXTREME CARE WHEN CLEANING THE CATHODE-RAY TUBE. DO NOT STRIKE OR SCRATCH THE TUBE AT ANY TIME. DO NOT ALLOW IT TO COME WITHIN 4 FEET OF MAGNETIC MATERIALS. BREAKAGE OF THE TUBE MAY RESULT IN INJURY FROM FLYING GLASS. WEAR PROTECTIVE CLOTHING WHEN HANDLING THE TUBE.

E. Knobs and Panels.

Clean knobs and panels by gently wiping the surfaces with a clean, soft, lintless cloth. When clean, polish with tissue paper.

F. Machined Metal Parts.

Detached shafts, keys, pins, collars, and similar machined parts should be cleaned in a suitable cleaning machine, if available. If a cleaning machine is not available, proceed as follows:

(1) Clean machined metal parts in accordance with paragraphs C(1) and C(3) through, C(5) above.

NOTE: Do not touch any clean machined or unfinished parts with bare hands.

(2) Dry in dust-free, dry area or suitable enclosure. Radiant heat used in a ventilated enclosure is recommended for drying, particularly where atmospheric humidity is high.

(3) After the drying process is completed, apply a light coat of lubricating oil to any bare steel surfaces.

G. Mechanical Metal Parts.

The detached miscellaneous mechanical metal parts include mounting plates, mounting clamps and brackets, nuts, bolts, screws, washers, fasteners, and other hardware. These should be cleaned in a suitable cleaning machine or in accordance with applicable steps of the procedures for covers and shields contained in paragraph C above.

H. Polarizing Filters.

Clean the polarizing filters by submerging in a soft liquid detergent solution and dry with a soft, lintless cloth. Do not touch clean filters with bare hands.

I. Printed Circuit Boards.

(1) Using an air jet and a small, camel-hair brush, blow and brush dust and dirt from surfaces, holes, and crevices.

(2) Wipe clean using a slightly moistened, lintless cloth.

CAUTION: THE EPOXY MOISTURE SEALANT ON THE PRINTED CIRCUIT BOARDS IS SUSCEPTIBLE TO SOFTENING IF SOLVENT IS APPLIED FOR EXCESSIVE PERIODS OF TIME OR IN EXCESSIVE AMOUNTS. USE CARE IN CLEANING THESE PRINTED CIRCUIT BOARDS WITH A SOLVENT-MOISTENED CLOTH. DRY WITH A CLEAN, LINTLESS CLOTH IMMEDIATELY AFTER CLEANING.

J. Tube Sockets.

Mica-filled Bakelite sockets are cleaned as follows:

(1) Remove any rosin adhering to silver-plated contacts, using orange sticks depressed to wedge ends.

<u>CAUTION</u>: DO NOT USE METAL TOOLS TO REMOVE FOREIGN MATTER FROM THESE CONTACTS. DAMAGE TO CONTACT PLATING INVITES CORROSION WHICH MAY ULTIMATELY RESULT IN EQUIPMENT FAILURE.

(2) Wash contacts with Freon TF lightly applied with a small, soft-bristled brush.

(3) Using moistened, lintless cloth, remove any foreign matter adhering to the socket body or wafer.

(4) Dry all parts with an air jet.

<u>CAUTION</u>: USE PROTECTIVE DEVICES WHEN USING THE AIR JET TO REMOVE EXCESS SOLVENT.

K. <u>Wired Chassis</u>.

The following procedures should be used for chassis continuing resistors, capacitors, switches, tub sockets, inductors, transformers, and other wired parts.

(1) Remove dust and dirt from all surfaces, including parts and wiring, using soft-bristled brushes and an air jet.

<u>CAUTION</u>: AVOID AIR-BLASTING DELICATE PARTS BY TOO CLOSE AN APPROACH WITH THE AIR-JET NOZZLE. USE CAUTION WHEN BRUSHING DELICATE PARTS.

<u>NOTE</u>: When necessary to disturb the position and dress of wiring and cables, ensure that they are properly restored after cleaning is completed.

(2) Clean tube sockets in accordance with paragraph J above.

(3) With minimum disturbance of wiring, clean connectors in accordance with paragraph A above.

(4) Complete chassis cleaning by wiping all finished surfaces with a moistened, lintless cloth.

(5) Dry and polish these surfaces, using a clean, dry, lintless cloth.

(6) Protect the chassis from dust, moisture, and damage pending inspection.

Section IV. INSPECTION/CHECK

5-11. GENERAL.

This section presents instructions and procedures to assist in determining, by inspection, the condition of the dismantled, disassembled, and cleaned components, parts, and assemblies of the IP-724A Indicator. Defects resulting from wear, physical damage, deterioration, or other causes would be discovered by these inspection procedures. Detailed inspection procedures are alphabetically arranged. Refer to the repair section of this manual for replacement or repair of defective components.

5-12. INSPECTION PROCEDURE.

Figure 5-10 lists the mechanical and electrical parts to be inspected and contains cross- references to applicable paragraphs containing inspection routines.

ITEM	REFER TO PARAGRAPH
Capacitors	5-12A
Chassis	5-12B
Connectors	5-12C
Covers and shields	5-12D
Electron tubes	5-12E
Filter assemblies	5-12F
Insulators: ceramic and Mycalex	5-12G
Knobs and panels	5-12H
Machined metal parts	5-12I
Mechanical metal parts	5-12J
Printed circuit boards	5-12K
Receptacles	5-12L
Relays	5-12M
Resistors	5-12N
Semiconductors	5-12O
Soldered terminal connections	5-12P

Index of Inspection Procedures (Sheet 1 of 2)
Figure 5-10

ITEM	REFER TO PARAGRAPH
Switches	5-12Q
Transformers, power supplies, and inductors	5-12R
Tube sockets	5-12S
Wiring	5-12T

Index of Inspection Procedures (Sheet 2 of 2)
Figure 5-10

A. Capacitors.

Inspect capacitors for the defects listed in figure 5-11.

DEFECT	METAL TYPE	MOLDED TYPE	CERAMIC TYPE
Leakage (at case seams or around terminal insulation)	X		
Cracked, broken, or charred terminal insulation	X		
Case damage (dents or holes)	X		
Case damage (cracks or breakage)		X	
Loose, broken, or corroded terminal studs, lugs, or leads	X	X	X
Loose, broken, or poorly soldered connections	X	X	X

Fixed Capacitor Inspection
Figure 5-11

B. Chassis.

Inspect chassis for deformation, dents, punctures, badly worn surfaces, damaged connectors, and fastening devices. Examine the chassis for corrosion and damage that may require refinishing.

C. Connectors.

Inspect connector bodies for broken parts, deformed shells or clamps, and other irregularities. Inspect for cracked or broken insulation and for contacts that are broken, deformed, or out of alignment. Check for corroded or damaged plating on contacts and for loose, poorly soldered, broken, or corroded terminal connections.

D. Covers and Shields.

Inspect covers and shields for punctures, deep dents, and badly worn surfaces. Check for damaged fastening devices, corrosion, and other damage that may require refinishing.

E. Electron Tubes.

Inspect electron tube envelopes for cracked glass or dented metal, separation from base, and obliterated markings. Check the base for a cracked, chipped, or broken body. Inspect for deformed, broken, or misaligned base contacts. Check for corrosion or other damage to contact plating. Inspect cathode-ray tube phosphor for burns.

WARNING: USE EXTREME CARE WHEN INSPECTING THE CATHODE-RAY TUBE. DO NOT STRIKE OR SCRATCH THE TUBE AT ANY TIME. DO NOT ALLOW MAGNETIC MATERIALS TO COME WITHIN FOUR FEET OF THE TUBE. BREAKAGE OF THE TUBE MAY RESULT IN INJURY FROM FLYING GLASS. WEAR PROTECTIVE CLOTHING WHEN HANDLING THE TUBE.

F. Filter Assemblies.

Inspect filter assemblies for severe scratches, warps, discoloration, breaks, cracks, chips, and worn Teflon. When the unit is assembled, check the filter assemblies for smooth operation of the DIM control.

G. Insulators: Ceramic and Mycalex.

Inspect ceramic and Mycalex insulators for cracks, burns, chips, or other physical damage. Check for corrosion and loose, broken, or poorly soldered terminal connections.

H. Knobs and Panels.

Inspect knobs and panels for physical damage and deformation, marred surfaces, and impairment of markings.

I. Machined Metal Parts.

Inspect machined metal parts for physical damage to surfaces, corners, and edges. Inspect closely all machined surfaces, holes, bores, counterbores, slots, grooves, shoulders, flanges, tapped holes, and all threaded members, both male and female, for damage of any sort including roughness of surface, corrosion, or foreign replating or refinishing beyond touchup repair.

J. Mechanical Metal Parts.

Inspect unmachined mechanical metal parts, including mounting plates, chassis, mounting clamps, brackets, nuts, bolts, screws, washers, fasteners, and hardware for damage or deformation. Inspect for corrosion and any damage that would require replating or refinishing beyond practical touchup.

K. Printed Circuit Boards.

Inspect printed circuit boards for loose, broken, corroded, or poorly soldered terminal connections. Inspect for any evidence of damage, such as burned, broken, cracked, or corroded plating. Check for loose mounting of printed circuit boards.

L.. Receptacles.

Inspect receptacles for cracked, broken, or charred insulation. Inspect for damage to all other parts, loose or bent contacts, damage to contact plating, corrosion, and other abnormal conditions.

M. Relays.

Inspect encapsulated relays for bent, cracked, and punctured cases. Check for corroded, poorly soldered, or loose terminals, and for loose, broken, or missing mounting hardware.

N. Resistors.

Inspect fixed, composition resistors for cracked, broken, blistered, or charred bodies and for loose, broken, poorly soldered, or corroded terminal connections. Inspect fixed, wire-wound resistors for signs of heating, cracked, broken, or charred insulation, loose, poorly soldered, broken, or corroded terminal connections, and for loose mounting. Inspect variable resistors for corrosion of shafts, cases, or other visible part damage, loose mountings, and any other physical damage. Where possible, rotate the shaft to determine whether the action is too rough, too loose, or too tight.

O. Semiconductors.

Inspect diodes and transistors for cracked, broken, blistered, or damaged bodies and cases. Inspect for loose, broken, poorly soldered, or corroded terminal connections.

P. Soldered Terminal Connections.

Inspect soldered terminal connections for cold-soldered or rosin joints. These joints present a porous or dull, rough appearance. Check for strength of bond using a pointed tool. Examine for excess of solder, protrusions from the joint, pieces adhering to adjacent insulation, and particles lodged between joints, conductors, or other parts. Inspect for insufficient solder and unsoldered strands of wire protruding from conductor joints. Check, also, for insulation that is stripped back too far from joints or badly frayed at the joint. Inspect for corrosion on copper conductor joints.

Q. Switches.

Inspect encapsulated switches for cracked, bent, or punctured cases. Check for loose, broken, or poorly soldered terminal connections. Check, also, to ensure that switch operation is smooth and free from unnecessary binding.

R. Transformers, Power Supplies, and Inductors.

Inspect transformers, power supplies, and inductors for signs of excessive heating, physical damage to cases, cracked or broken insulators, and other irregularities. Inspect for corroded, poorly soldered, or loose terminals and loose, broken, or missing mounting hardware.

S. Tube Sockets.

Inspect tube sockets for loose, broken, missing, or improperly seated mounting rings. Check for cracked, broken, or charred insulation. Inspect for broken, corroded, or deformed contacts and loose, poorly soldered, broken, or corroded terminal connections.

T. Wiring.

Inspect open and laced wiring of chassis, terminal boards, and parts by checking insulation for physical damage and charring. Inspect wires for breakage and for improper dress in relation to adjacent wiring and chassis.

Section V. REPAIR

5-13. GENERAL.

This section presents instructions and procedures for the replacement or repair of damaged or defective components of the IP-724A Indicator. Faulty components are usually detected through procedures in the inspection/check or testing sections of this manual. New parts should be inspected and/or tested before being installed. Most of the replacement or repair instructions apply to disassembled equipment. Refer to the disassembly section for proper instructions.

5-14. REPAIR PROCEDURES.

Figure 5-12 lists an alphabetically arranged index of repair procedures. Each component part, or assembly is cross-referenced to the appropriate paragraph containing the correct repair procedure.

ITEM	REFER TO PARAGRAPH
Capacitors	5-14A
Connectors	5-14B
Covers and shields	5-14C
Electron tubes	5-14D
Filter assemblies	5-14E
Finished surfaces	5-14F
Frames	5-14G
Insulators: ceramic and Mycalex	5-14H
Knobs and panels	5-14I
Machined metal parts	5-14J
Mechanical metal parts	5-14K
Printed circuit boards	5-14L
Receptacles	5-14M
Relays	5-14N
Resistors	5-14O
Semiconductors	5-14P

Index of Repair Procedures (Sheet 1 of 2)
Figure 5-12

ITEM	REFER TO PARAGRAPH
Soldered terminal connections	5-14Q
Switches	5-14R
Transformers, power supplies and inductors	5-14S
Tube sockets	5-14T
Wiring	5-14U

Index of Repair Procedures (Sheet 2 of 2)
Figure 5-12

A. Capacitors.

If defective or if performance is questionable, capacitors should be replaced. Clean all connections thoroughly, remove old solder, and apply new solder.

B. Connectors.

Straighten bent pins and damaged shell areas. Replace defective connectors, broken wires, or wires with split insulation. If a connector insert is broken, replace the connector.

C. Covers and Shields.

Replace damaged screws, straighten any dents or warped sections, and retouch scratched or worn painted surfaces.

D. Electron Tubes.

Replace defective tubes. Clean corroded pins with a clean, lintless cloth or soft-bristled brush.

E. Filter Assemblies.

Replace cracked, broken, chipped, or severely scratched filters and filter assembly rings.

F. Finished Surfaces.

Touch up minor scratches in all painted surfaces with a high-quality, flat black epoxy paint.

CAUTION: DO NOT TOUCH UP ANY AREA WHERE AN ELECTRICAL CONNECTION IS MADE.

G. Frames.

Straighten all misshapen areas. Remove all corrosion with a suitable cleaner. Retouch silk screening, and refinish where needed.

H. Insulators: Ceramic and Mycalex.

Replace any insulators which show physical damage such as cracks, burns, or chips.

I. Knobs and Panels.

Replace cracked, chipped, broken, or otherwise damaged knobs. Retouch or refinish panels in accordance with paragraph F above.

J. Machined Metal Parts.

If satisfactory machine shop facilities for suitable repair of these surfaces are not available, the defective or damaged part should be replaced.

K. Mechanical Metal Parts.

Straighten bent or misshapen mounts, clamps, and mounting plates. Replace broken, bent, or cross-threaded bolts, screws, nuts, washers, and other hardware.

L. Printed Circuit Boards.

Replace any cracked, broken, chipped, or otherwise damaged printed circuit boards. Repair of these boards is not recommended.

M. Receptacles.

Replace all receptacles with cracked, broken, or charred insulation or loose, bent, or otherwise damaged contacts. Clean in accordance with the appropriate paragraph in the cleaning section of this manual.

N. Relays.

Defective encapsulated relays should be replaced. Repair is not recommended.

O. Resistors.

If defective or if performance is questionable, resistors should be replaced. Clean all connections thoroughly and apply new solder. Replace variable resistors if the shaft is loose in the case. Clean corroded terminals.

P. Semiconductors.

If a semiconductor appears defective or is suspected of questionable operation, -it should be replaced.

CAUTION: **TO PREVENT DAMAGE, USE A HEAT SINK BETWEEN THE LEAD BEING SOLDERED AND THE SEMICONDUCTOR DEVICE.**

Q. Soldered Terminal Connections.

Resolder cold-soldered or rosin joints. Remove all traces of corrosion.

R. Switches.

Replace defective encapsulated switches. Repair is not recommended.

S. Transformers, Power Supplies, and Inductors.

If defective or if performance is questionable, transformers, power supplies, and inductors should be replaced. Make a sketch of wire connections to simplify rewiring. Do not attempt repair of sealed transformers, power supplies, or inductors. Clean all connections thoroughly and apply new solder.

T. Tube Sockets.

Replace cracked, chipped, or broken tube sockets, or tube sockets with broken or severely damaged terminals. Remove all traces of corrosion.

U. Wiring.

Replace damaged wiring with wire of the same size and color coding. Ensure that no bare wires are touching chassis, other bare wires, or metal cases of other parts. If a wire is to be removed from a terminal or component, it should be marked with an identification tag to minimize incorrect connections.

NOTE: When necessary to disturb the lacing of wires or cables, carefully ensure that the original wire lacing is restored.

Section VI. ASSEMBLY

5-15. GENERAL.

This section presents instructions for assembling the IP-724A Indicator. These instructions are arranged so that assembly of each major part is an individual operation. When it is necessary to assemble the unit, locate the part in the table of contents and begin on the page indicated. Reference is made to subsequent assembly steps that must be performed to restore the indicator to a completely assembled unit. The order of assembly begins with the lowest parts, proceeds to the next higher subassemblies, and ends with the completed unit. These instructions include lubrication data, special techniques, cautions, warnings, and unique procedures. Refer to the fits and clearances paragraph (5-19) of this section for assembly tolerances.

5-16. LUBRICATION DATA.

Lubrication of the IP-724A Indicator is not needed.

5-17. PRECAUTIONS AND GENERAL TECHNIQUES.

Before soldering any lead or component, refer to the notes of color coding, placement of leads, and wire insulation made during disassembly. If there is any doubt as to the placement of such leads or components, refer to the appropriate diagrams and perform continuity tests to ensure proper replacement. Ensure, also, that proper dress or lacing of wires and cables is restored.

CAUTION: TO PREVENT DAMAGE TO A SOLID-STATE DEVICE, USE A HEAT SINK ON THE LEAD BETWEEN THE POINT BEING SOLDERED AND THE DEVICE.

WARNING: THE IP-724A INDICATOR USES EXTREMELY HIGH VOLTAGES. DO NOT ATTEMPT ANY ASSEMBLY WHILE PRIMARY POWER IS APPLIED TO THE UNIT.

CAPACITORS IN THE IP-724A INDICATOR MAY HOLD A CHARGE FOR LONG PERIODS OF TIME AFTER PRIMARY POWER HAS BEEN REMOVED. OBSERVE SAFETY PRECAUTIONS WHEN WORKING ON THE INDICATOR.

BREAKAGE OF THE HIGH-VACUUM, CATHODE-RAY TUBE MAY RESULT IN INJURY FROM FLYING GLASS. DO NOT STRIKE OR SCRATCH THE TUBE AT ANY TIME. DO NOT APPLY MORE THAN MODERATE PRESSURE WHEN INSERTING OR REMOVING THE TUBE. USE PROTECTIVE DEVICES, SUCH AS GOGGLES, FACE MASKS, AND RUBBER GLOVES.

These precautions are repeated in the test of the assembly procedures where applicable.

5-18. ASSEMBLY PROCEDURES.

A. Replace Power Supply PS2. (Refer to figure 5-7.)

(1) Secure power supply PS2 (22) to front brace (66) with four flat washers (69), four lockwashers (68), and four hexnuts (67).

(2) Solder the leads to terminals 1 through 3, 6, and 7 of power supply PS2 (22).

(3) Install the viewing-screen lead of the cathode-ray tube to terminal 4 of power supply PS2 (22).

(4) Secure bracket (19) to brace (65) with two machine screws (39).

(5) Secure transformer plate (33) in accordance with paragraph C(8) below.

(6) Secure low-voltage bias circuit TB3 (36) in accordance with paragraph C(3) below.

(7) Secure sweep positioning and erase circuit TB1 (30) in accordance with paragraph F(3) below.

(8) Attach the cathode-ray tube assembly to rear chassis assembly (9, figure FO-10) in accordance with paragraphs J(1) through J(20) below.

(9) Secure plastic high-voltage cover (16) and high-voltage circuit TB2 (18) in accordance with paragraphs K(4) through K(6) below.

(10) Secure rear cover plate (1) to rear chassis assembly (9, figure FO-10) in accordance with paragraph L(7) below.

(11) Replace 2-piece dust cover (7, figure FO-11) in accordance with paragraph M below.

B. Replace Power Supply PS1. (Refer to figure 5-7.)

(1) Secure power supply PS1 (59) to front brace (65) with four flat washers (64), four lockwashers (63), and four hexnuts (62).

(2) Solder the leads to terminals 1, 2, and 6 through 9 of power supply PS1 (59).

(3) Secure bracket (19) to brace (61) with two machine screws (60).

(4) Secure transformer plate (33) in accordance with paragraph C(8) below.

(5) Secure low-voltage bias circuit TB3 (36) in accordance with paragraph E(3) below.

(6) Secure sweep positioning and erase circuit TB1 (30) in accordance with paragraph F(3) below.

(7) Attach the cathode-ray tube assembly to rear chassis assembly (9, figure FO-10) in accordance with paragraphs J(1) through J(20) below.

(8) Secure plastic high-voltage cover (16) and high-voltage circuit TB2 (18) in accordance with paragraphs K(4) through K(6) below.

(9) Secure rear cover plate (1) to rear chassis assembly (9, figure FO-10) in accordance with paragraph L(7) below.

(10) Replace 2-piece dust cover (7, figure FO-11) in accordance with paragraph M below.

C. Replace Transformer Plate. (Refer to figure 5-7.)

(1) Place transformer plate (33) in mounting position.

(2) Solder the leads to terminals 1 through 3, 6, and 7 of relay K1 (54).

(3) Secure cable clamp (55) to transformer plate (33) with machine screw (56), flat washer (57), and hexnut (58).

(4) Solder the leads to terminals 1, 3, 4, 7, and 8 of relay K2 (53).

(5) Replace solder lug (48) by securing it to transformer plate (33) with machine screw (49), flat washer (50), lockwasher (51), and hexnut (52).

(6) Solder the leads to terminals 1 through 4 of transformer T2 (47).

(7) Solder the lead to solder lug (46).

(8) Solder the leads to terminals 1, 4, and 6 through 9 of transformer T1 (45).

(9) Secure transformer plate (33) to chassis frame (40) with four machine screws (43) and four lockwashers (49).

NOTE: Ensure that proper dress or lacing is restored.

(10) Secure shading circuit TB4 (42) in accordance with paragraph D(3) below.

(11) Secure low-voltage bias circuit TB3 (36) in accordance with paragraph E(3) below.

(12) Secure sweep positioning and erase circuit TB1 (30) in accordance with paragraph F(3) below.

(13) Secure plastic high-voltage cover (16) and high-voltage circuit TB2 (18) in accordance with paragraphs K(4) through K(6) below.

(14) Secure rear cover plate (1) to rear chassis assembly (9, figure FO-11) in accordance with paragraph L(7) below.

(15) Replace 2-piece dust cover, (7, figure FO-11) in accordance with paragraph M below.

D. Replace Shading Circuit TB4. (Refer to figure 5-7.)

(1) Solder the leads to terminals 1 through 14 of shading circuit TB4 (42) and terminals 1 and 2 of power supply PS2 (22).

(2) Install cable clamp with machine screw, flat washer, lockwasher, and hexnut.

(3) Secure shading circuit TB4 (42) to transformer plate (33) with four machine screws (37), four flat washers (38), and four lockwashers.

(4) Secure rear channel brace (40) to transformer plate (33) by tightening two machine screws (39).

(5) Secure rear cover plate (1) to rear chassis assembly (9, figure FO-11) in accordance with paragraph L(7) below.

(6) Replace 2-piece dust cover (7, figure FO-11) in accordance with paragraph M below.

E. Replace Low-Voltage Bias Circuit TB3. (Refer to figure 5-7.)

(1) Solder the leads to terminals 1 through 11, 13, and 14 of low-voltage bias circuit TB3 (36).

(2) Solder the leads to the center tap of R55 and pins 10 and 12 (filaments) of V2 tube socket of low-voltage bias circuit TB3 (36).

(3) Install cable clamp with machine screw, two flat washers, lockwasher, and hexnut.

(4) Secure low-voltage bias circuit TB3 (36) to bracket (19) and transformer plate (33) with four machine screws (34) and four flat washers (35).

(5) Secure rear cover plate (1) to rear chassis assembly (9, figure FO-11) in accordance with paragraph L(7) below.

(6) Replace 2-piece dust cover (9, figure FO-11) in accordance with paragraph M below.

F. Replace Sweep Positioning and Erase Circuit TB1. (Refer to figure 5-7.)

(1) Solder the leads to terminals 1 through 11 of sweep positioning and erase circuit TB1 (30).

(2) Replace two cable clamps by securing them to sweep positioning and erase circuit TB1 (30), with two machine screws, four flat washers, two lockwashers, and two hexnuts.

(3) Secure sweep positioning and erase circuit TB1 (30) to bracket (19) and transformer plate (33) with four machine screws (31) and four flat washers (32).

(4) Secure rear cover plate (1) to rear chassis assembly (9, figure FO-11) in accordance with paragraph L(7) below.

(5) Replace 2-piece dust cover (7, figure FO-11) in accordance with paragraph M below.

G. Assemble and Replace Rear Cover Semiconductor Device Set. (Refer to figure 5-8.)

NOTE: The two semiconductor device sets on rear cover plate (1, figure 5-7) are identical. Assembly procedures describe one of these sets. Refer to figure 5-8 for the performance of paragraphs (1) through (4).

(1) Secure semiconductor (17) and mica insulator (18) to heat sink (5) with two machine screws (6), terminal lug (16), four flat washers (8), two insulating sleeves (14), two insulating washers (15), two lockwashers (12), and two hexnuts (11).

(2) Secure heat sink (5) to rear cover plate (1, figure 5-7) with two machine screws (6), two spacers (7), two flat washers (8), and two hexnuts (9).

(3) Secure heat sink cover (1) to heat sink (5) with two flat washers (3), two lockwashers (4), and two machine screws (2).

(4) Solder the orange and brown leads to VR19 and the yellow and brown leads to VR20.

CAUTION: USE A HEAT SINK BETWEEN THE LEAD BEING SOLDERED AND THE SEMICONDUCTOR DEVICE.

(5) Secure rear cover plate (1, figure 5-7) to rear chassis assembly (9, figure FO-11) in accordance with paragraph L(7) below.

(6) Replace 2-piece dust cover (95, figure FO-10) in accordance with paragraph M below.

H. Replace Sweep Deflection Yoke L1. (Refer to figure 5-7.)

(1) Solder yoke (29) leads to terminals 2 through 4, 9, and 10 of sweep positioning, video, and erase circuit TB1 (30).

(2) Insert yoke (29) into yoke clamp (26).

NOTE: Orient yoke (29) so that the alignment mark is approximately vertical.

(3) Tighten yoke clamp screw (27) just enough to hold yoke (29) in place.

(4) Place yoke adjuster (24) over yoke (29).

NOTE: Orient yoke adjuster (24) so that holding screw (25) is above the yoke.

(5) Tighten holding screw (25) of yoke adjuster (24).

(6) Secure the cathode-ray tube assembly to rear chassis assembly (9, figure FO-11) in accordance with paragraphs J(1) through J(20) below.

(7) Replace plastic high-voltage cover (16) and high voltage circuit TB2 (18) in accordance with paragraphs K(4) through K(6) below.

(8) Secure rear cover plate (1) to rear chassis assembly (9, figure FO-11) in accordance with paragraph L(7) below.

(9) Replace 2-piece dust cover (7, figure FO-11) in accordance with paragraph M below.

I. Replace Cathode-Ray Tube. (Refer to figure FO-11.)

WARNING: BREAKAGE OF THE HIGH-VACUUM, CATHODE-RAY TUBE MAY RESULT IN INJURY FROM FLYING GLASS. DO NOT STRIKE OR SCRATCH THE TUBE AT ANY TIME. DO NOT APPLY MORE THAN MODERATE PRESSURE WHEN INSERTING OR REMOVING THE TUBE USE PROTECTIVE DEVICES, SUCH AS GOGGLES, FACE MASKS, AND RUBBER GLOVES

(1) Insert the cathode-ray tube into the center of front brace (19).

(2) Secure cathode-ray tube (26) to front brace (19) with eight tube fasteners (25).

NOTE: Visually align the cathode-ray tube in the center of the brace while tightening the fasteners.

(3) Secure the cathode-ray tube assembly to rear chassis assembly (9) in accordance with paragraphs J(1) through J(20) below.

(4) Replace plastic high-voltage cover (16, figure 5-7) and high-voltage circuit TB2 (18, figure 5-7) in accordance with paragraphs (4) through (6) below.

(5) Secure rear cover plate (1, figure 5-7) to rear chassis assembly (9) in accordance with paragraph L(7) below.

(6) Replace 2-piece dust cover (7) in accordance with paragraph M below.

J. Attach Cathode-Ray Tube Assembly to Rear (chassis Assembly. (Refer to figure FO-11 and 5-7.)

(1) Place the rear of the cathode-ray tube assembly to within a few inches of the front of rear chassis assembly (9, figure FO-11).

(2) Insert the three high-voltage leads (red, white, and blue) from the cathode-ray tube through the clearance hole of rear chassis assembly (9, figure FO-10).

(3) Insert the viewing-screen lead of the cathode-ray tube through the key slot of flood gun tube socket (23, figure 5-7) on the front of rear chassis assembly (9, figure FO-11).

NOTE: Refer to figure 5-7 for the performance of paragraphs (4) and (5) below.

(4) Connect flood gun tube socket (23).

(5) Insert the neck of the cathode-ray tube writing gun into sweep deflection yoke L1 (29).

WARNING: EXTREME CARE SHOULD BE EXERCISED WHEN INSERTING THE FRONT TUBE SECTION INTO THE REAR CHASSIS ASSEMBLY. NO STRAIN OR STRESS SHOULD BE EXERTED ON THE NECKS OF THE CATHODE-RAY TUBE. USE PROTECTIVE DEVICES, SUCH AS GOGGLES, FACE MASKS, AND RU13BER GLOVES

NOTE: Refer to figure FO-11 for the performance of paragraphs (6) through (13).

(6) Secure RANGE switch bracket (13) to front brace (19) with two machine screws (18).

(7) Secure RANGE switch control shaft (10) to RANGE control (13) by tightening two setscrews (11) in coupler (12).

(8) Secure BACKGRD control bracket (20) to front brace (19) with two machine screws (21).

(9) Secure BACKGRD control shaft (14) to BACKGRD control (17) by tightening two setscrews (15) in coupler (16).

(10) Loosen cathode-ray tube fasteners (25) and align the channels of the front and rear assemblies.

NOTE: Use a straight edge or flat surface to align the channels of both assemblies.

(11) Engage the front and rear assemblies.

(12) Connect electrical connectors (23, 24).

(13) Secure front brace (19) to rear chassis assembly (9) with eight machine screws (22).

NOTE: Refer to figure 5-7 for the performance of paragraphs (14) through (17) below.

(14) Connect writing gun tube socket (21).

(15) Connect the viewing-screen, high-voltage lead to terminal 4 of power supply PS2 (22).

(16) Solder the three high-voltage leads (red, white, and blue) to terminals 6, 7, and 9 of high-voltage circuit TB2 (18).

(17) Loosen screws (28) in the feet of yoke clamp (26).

(18) Tighten cathode-ray tube fasteners (25, figure FO-11).

(19) Position yoke (29) around the glass neck of cathode-ray tube (26, figure FO-11) so that the yoke is approximately one-sixteenth of an inch from the rear of the cathode-ray tube and is equidistant from the sides of the glass neck and not touching it

(20) Tighten screws (28, figure 5-7) in the feet of yoke clamp (26, figure 5-7) and clamp screw (27, figure 5-7).

(21) Replace plastic high-voltage cover (16, figure 5-7) and high-voltage circuit TB2 (18, figure 5-7) in accordance with paragraphs K(4) through K(6) below.

(22) Secure rear cover plate (1, figure 5-7) to rear chassis assembly (9, figure FO-11) in accordance with paragraph L(7) below.

(23) Replace 2-piece dust cover (7, figure FO-11) in accordance with paragraph M below.

K. Replace High-Voltage Circuit TB2. (Refer to figure 5-7.)

(1) Solder the red, white, and blue high-voltage leads to terminals 6, 7, and 9 of high-voltage circuit TB2 (18).

(2) Solder the remaining leads to terminals 1 through 5, 8, and 10 through 12 of high-voltage circuit TB2 (18).

(3) Replace cable clamp by securing it to high-voltage circuit board TB2 (18), with machine screw, flat washer, lockwasher, and hexnut.

(4) Place high-voltage circuit TB2 (18) in mounting position.

(5) Insert four spacing sleeves (20) separating plastic high-voltage cover (16) and high-voltage circuit TB2 (18).

(6) Secure plastic high-voltage cover (16) and high-voltage circuit TB2 (18) to brackets (19) with four machine screws (17).

(7) Secure rear cover plate (1) to rear chassis assembly (9, figure FO-11) in accordance with paragraph L(7) below.

(8) Replace 2-piece dust cover (7, figure FO-11) in accordance with paragraph M below.

L. Replace Rear Cover Plate. (Refer to figure 5-7.)

(1) Solder the leads to relay K4 (15), and CR21 through CR25.

(2) Replace electrical connector (9) by securing it to rear cover plate (1) with four machine screws (10, 11), two lockwashers (12), two standoff terminals (7, 13), and two hexnuts (14).

(3) Solder the orange and brown leads to VR19 and the yellow and brown leads to VR20.

CAUTION: USE A HEAT SINK BETWEEN THE LEAD BEING SOLDERED AND THE SEMI-CONDUCTOR DEVICE.

(4) Solder the three red leads to standoff terminal (8).

(5) Solder the yellow lead to standoff terminal (7).

(6) Secure cable clamp (3) to rear cover plate (1) with machine screw (4), flat washer (5), and hexnut(6).

NOTE: Restore proper dress or lacing to wires and cables.

(7) Secure rear cover plate (1) to rear chassis assembly (9, figure FO-11) with eight machine screws (2).

(8) Replace 2-piece dust cover (7, figure FO-11) in accordance with paragraph M below.

M. Replace Outer Dust Covers. (Refer to figure FO-11.)

(1) Place 2-piece dust cover (7) in position around the indicator as shown in figure FO-10.

(2) Secure 2-piece dust cover (7) to indicator frame with six machine screws (8).

N. Replace Range Lights Board TB5. (Refer to figures 5-,. 5-7, and 5-8.)

(1) Solder the leads to terminals 1 through 4 of range lights board TB5.

NOTE: Restore insulating sleeves to these leads.

(2) Secure range lights board TB5 (10, figure 5-6) to front mounting plate (3, figure FO-11) in accordance with paragraphs 0(5) and 0(6) below and proceed to paragraph N(3) below.

(3) Replace filter assembly and front plate (6, 3, figure FO-11) in accordance with paragraph P below.

O. Assemble and Replace Polarizing Filter Assembly.

NOTE: Handle the filters by their edges. Do not touch the glass with bare fingers. Ensure that the filters are clean (refer to the cleaning section for instructions). No lubrication is required.

(1) Attach DIM tab (6) to circular polarizer (7) with two screws (5).

(2) Install the filter components as follows:

(a) Install circular polarizer (7).

(b) Install linear polarizer (4).

(c) Install ring.

(3) Attach lens frame (2) to front mounting plate (8) with four machine screws (1).

(4) Secure grid (11) to the back of front mounting plate (8) with three machine screws (13).

(5) Install panel light indicator (9) in front mounting plate (8).

(6) Secure range lights board TB5 (10) and panel light indicator (9) to front plate (8) with two machine screws (12).

(7) Replace filter assembly and front plate (6, 3, figure FO-11) in accordance with paragraph P below.

P. Replace Filter Assembly and Front Plate. (Refer to figure FO-11.)

NOTE: If range lights board TB5 has been removed, begin with paragraph N above.

(1) Secure front plate (3) to front brace (5) with eight machine screws (4).

(2) Mount BACKGRD and RANGE knobs (1) on their shafts and tighten setscrews (2).

(3) Check BACKGRD and RANGE knobs (1) for freedom of movement.

5-19. FITS AND CLEARANCES.

The tolerances that apply to the cathode-ray tube of the IP-724A Indicator are compensated for by the adjustment of the yoke clamp. The yoke clamp facilitates the positioning of the yoke around the neck of the tube. The cathode-ray tube must be free to move within the yoke

The indicator mounting screws for the alternate installation mounting must not exceed one-half of an inch in length

The screws that secure the dust cover to the indicator must not exceed one-fourth of an inch in length.

Section VII. TESTING

5-20. GENERAL.

This section presents procedures for bench testing the IP-724A Indicator. Procedures are given for testing with the AN/APN-247 Radar Test Set, and for using the MK774/ APN-158 Maintenance Kit

When a malfunction is indicated, portions of the test relative to the malfunction should be performed. If the indicator fails a test, refer to the troubleshooting section where test steps are referenced and some possible causes for malfunctions are listed. Instructions for use of the AN/APM-247 Radar Test Set are given in paragraph 5-23 These instructions are in a tabular format with suggested troubleshooting areas listed adjacent to the applicable test. Instructions for demagnetizing the indicator with the MK-774/APN-158 Radar Maintenance Kit degaussing coil are given in paragraph 5-24.

5-21. EQUIPMENT REQUIRED.

Refer to figure 5-14 for equipment required for testing the indicator.

5-22. PRELIMINARY PROCEDURES.

Preliminary procedures for equipment setup prior to testing are given in each test procedure.

5-23. TEST PROCEDURES USING THE AN/APM-247 (978G-1) RADAR TEST SET.

This paragraph presents procedures for testing the indicator using the AN/APM-247 (978G-1) Radar Test Set. These procedures are presented in tabular form in figure 5-13. The test set is referred to by its commercial nomenclature (978G-1) throughout the test procedures.

When a malfunction is indicated, some possible causes are referenced at the appropriate test in the POSSIBLE TROUBLE AREA column. After a malfunction is corrected, the unit should be tested again to verify that repairs have not affected normal operation.

For a detailed description and maintenance instructions for the radar test set, refer to the applicable service manual.

A. Use of Test Procedures.

Procedures to be observed in using the test procedures follow.

(1) Switches on the test set subpanels not in use are not referenced and may be in any position.

(2) The correct positions of all test set switches applicable to the tests are listed at the top of the AN/APM-247 (978G-1) INSTRUCTIONS column on each page. Necessary changes of switch positions are noted at the appropriate test step All other switches are to remain in their last referenced position.

(3) The RESULT column lists the Indications of a properly functioning unit.

(4) The POS8IBLE TROUBLE AREA column lists troubleshooting areas for a malfunction indicated by the appropriate test.

(5) The following definitions are used in figure 5-13.

Fall time	Measured from 90 to 20 percent of amplitude of waveform leading edge
Pulse width	Measured between 50 percent points of amplitude of leading and trailing edges
Rise time	Measured from 10 to 90 percent of amplitude of waveform leading edge.

B. Test Setup.

Verify that the jumper cable on the radar test set IF subpanel is connected from R-T UNIT to SYNC. Using cables supplied with the radar test set, make the following connections:

(1) Radar test set P1 to receiver-transmitter P1

(2) Radar test set P2 to synchronizer P1

(3) Radar test set P3 to antenna J1

(4) Radar test set P4 to indicator J1

Using appropriate coaxial cables and connectors, make the following connections:

(1) Radar test set OSCILILOSCOPE TRIGGER output to oscilloscope TRIGGER INPUT connector

(2) Receiver-transmitter TP6 to echo box

(3) Receiver-transmitter TP4 to pulse generator SYNC INPUT

(4) Pulse generator output cable left disconnected until appropriate test setup

Attach dummy load to receiver-transmitter waveguide connection and set receiver transmitter RF switch to OFF. Apply primary power to equipment.

CAUTION: DO NOT OPERATE THE 978G-1 RADAR TEST SET FROM PRIMARY POWER THAT IS NOT 115 VOLTS +5 PERCENT, 400 Hz +5 PERCENT. DAMAGE TO THE EQUIPMENT WILL RESULT.

Set the radar test set AC POWER switch to ON and adjust the INPUT VOLTAGE ADJUST control for 115 ±1 volts as indicated on the INPUT POWER meter. Note that the frequency is 400 ±5 Hz as indicated on the INPUT FREQUENCY meter.

C. Performance Test. (Refer to figure 5-13.)

This test measures the performance of the IP-724A Indicator. Differences in procedures for different revision levels of the indicator are noted at the applicable test step.

5-24. TEST PROCEDURES USING THE MK-774/APN-158 (979A-2) RADAR MAINTENANCE KIT.

This section presents the procedures for demagnetizing the cathode-ray tube using the MK-774/APN-158 Maintenance Kit. When demagnetization is complete, reconnect the cathode-ray tube into the system to assure complete demagnetization.

To demagnetize the storage tube, perform the following steps.

CAUTION: THE MAXIMUM DUTY CYCLE OF THE DEMAGNETIZING COIL IS 2 MINUTES ON AND 10 MINUTES OFF. EXCEEDING THESE LIMITS WILL CAUSE OVERHEATING OF THE COIL.

NOTE: Transients produced during steps A through C may cause magnetization of the storage tube. Place indicator at least 3 feet from demagnetizing coil before power is applied.

A. Connect power to the MK-774/APN-158 (979A-2).

B. Set the DEMAGNETIZING COIL switch to OFF and connect the coil to the DEMAGNETIZING COIL connector.

C. Set the POWER and DEMAGNETIZING COIL switches to ON.

D. Insert the indicator (rear end first) into the demagnetizing coil until the mounting flange contacts the demagnetizing coil.

E. Using a slow, steady movement, remove the indicator from the demagnetizing coil to a distance of at least 3 feet.

F. Set the DEMAGNETIZING COIL switch to OFF.

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULT	POSSIBLE TROUBLE AREA
1.	Power supplies	TEST SET FUNCTION SELECTOR--ANTENNA/ INDICATOR/CONTROL UNIT TESTS: SYSTEM CONTROL--OFF INDICATOR TESTS switch--down position.	Remove dust covers and loosen rear cover plate from indicator.		
		SYSTEM CONTROL--OPERATE.	Pull out interlock switch lever on RT unit to second detent.	OPERATE lamp lights. NOTE: 4 minute time relay must energize first.	Defective time delay relay (K3) in Receiver-Transmitter.
			Set SCAN/OFF switch on antenna to SCAN. Adjust BACKGRD control on front panel of indicator to desired level.		
1a.	PS1		Measure voltage between TB3-6 and ground.	-600 ±60 volts.	Diodes VR19 and VR20. Power supply PS1. Low-voltage circuit TB3.
		SYSTEM CONTROL--STANDBY	Remove plastic cover over TB2.		
		SYSTEM CONTROL--OPERATE	WARNING: 2000 VOLTS IS PRESENT ON BOTH LEADS OF THE VTVM WHEN MEASURING VOLTAGE IN STEP BELOW.		
			Measure voltage between TB2-4(+) and TB2-2(-).	+200 ±20 volts.	Diodes VR19 and VR20. Power supplies PS1 and PS2. Flood gun bias circuit TB2.
		TEST SET FUNCTION SELECTOR--ANTENNA/ INDICATOR/CONTROL UNIT TESTS; SYSTEM CONTROL--OPERATE; INDICATOR TESTS switch --down position.	Measure voltage at TB2-3 using 1000:1 test prod (MX-6639) and oscilloscope.	+2000 ±200 volts.	Diodes VR19 and VR20. Power supplies PS1 and PS2. High-voltage circuit TB2.

IP-724A Indicator, Test Procedures Using the AN/APM-247 Radar Test Set (Sheet 1 d 10) Figure 5-13

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULT	POSSIBLE TROUBLE AREA
1b.	PS2	SYSTEM CONTROL--OFF.	Connect MX-6637 Test Adapter between plate cap of V3 and high-voltage cap on PS2.		
		SYSTEM CONTROL--STANDBY for 60 s, then OPERATE.	Measure voltage at test adapter using 1000:1 probe and oscilloscope.	+7000 ±1500 volts.	Diodes VR19 and VR20. Power supply PS2. Transformer T2.
		SYSTEM CONTROL--OFF.	Remove test adapter and replace high-voltage cap on plate of V3.		
		SYSTEM CONTROL--STANDBY for 60 s, then OPERATE.	Measure amplitude, width, and rise time of pulse at PS2-7 using standard probe and oscilloscope.	Amplitude--not less than 20 volts peak. Width--120 to 200 us. Rise time--NMT 60 us.	Gate and trigger pulse circuit TB4. Power supply PS2.
		SYSTEM CONTROL--STANDBY.	Replace plastic cover over TB2 and replace rear cover plate.		
1c. (Cont)	Flood gun bias	TEST SET FUNCTION SELECTOR--ANTENNA/INDICATOR/CONTROL UNIT TESTS; SYSTEM CONTROL --OPERATE; INDICATOR TESTS switch--down position.	WARNING: THE FOLLOWING VOLTAGE MEASUREMENTS ARE REFERENCED TO +2000 VOLTS. EXTREME CAUTION SHOULD BE EXERCISED TO ENSURE AGAINST PERSONNEL INJURY AND TO ASSURE THAT METER OR TEST LEADS DO NOT COME INTO CONTACT WITH GROUND. ALL VOLTAGE MEASUREMENTS SHOULD BE MADE THROUGH ACCESS HOLES IN PROTECTIVE COVER OVER TB2. SHAFT OF POTENTIOMETERS R36, R39, AND R41 ARE ALSO +2000 VOLTS ABOVE GROUND. AN INSULATED SCREWDRIVER MUST BE USED TO MAKE ADJUSTMENTS.		

IP-724A Indicator, Test Procedures Using the AN/APM-247 Radar Test Set (Sheet 2 of 10) Figure 5-13

[redacted]

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULT	POSSIBLE TROUBLE AREA
1c. (Cont)			Measure voltage between TB2-10 and TB2-11. (FG CATH and FG GRID 1).	Voltage approximately that written on top of indicator tube. Adjust R36 on TB2 as necessary.	Power supply PS2. Flood gun bias circuit TB2.
			Measure voltage between TB2-10 and TB2-8 (FG CATH and FG GRID 3). Adjust R39 on TB2 as necessary.	Voltage approximately that written on top of indicator tube.	Power supply PS2. Flood gun bias circuit TB2.
			Measure voltage between TB2-10 and TB2-7 (FG CATH and FG GRID 4). Adjust R41 on TB2 as necessary.	Voltage approximately that written on top of indicator tube.	Power supply PS2. Flood gun bias circuit TB2.
1d.		TEST SET FUNCTION SELECTOR--ANTENNA/INDICATOR/CONTROL UNIT TESTS; SYSTEM CONTROL --OPERATE; INDICATOR TESTS switch--down position	Measure voltage at TB3-5 with RANGE switch on indicator set to: 30 60 150	 +75 to +200 volts. +68 to +190 volts. +68 to +190 volts.	Low-voltage circuit TB3. Power supply PS1.
2.	Erase pulse		Connect 10:1 oscilloscope probe to junction of R40 and C8 on TB2 (ERASE PULSE test point on some units) and observe waveform.	Amplitude--adjustable by R3 on TB1 +10 to +15 volts peak. Pulse width-adjustable by R1; 10 to 50 us.	Erase pulse generator circuit TB1. Storage mesh coupling circuit TB2.
3.	Gating and writing gun grid bias		Connect 10:1 oscilloscope probe to TB3-4 (beside WGG1 control) and observe waveform.	Amplitude--+10±2 volts, clamped at -70 to -58 volts NOTE: Periodic change in amplitude is due to operation of blanking switch in antenna.	Writing gun grid circuit TB3. Gate input circuit TB4.
4.	Shading pulse		Connect 10:1 oscilloscope probe to TB3-5, set indicator RANGE switch to 150 and observe waveform.	Amplitude--not less than ±40 volts peak.	Shading circuit TB4. Relays K1 and K2 and RANGE switch S1.

IP-724A Indicator, Test Procedures Using the AN/APM-247 Radar Test Set (Sheet 3 of 10) Figure 5-13

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULT	POSSIBLE TROUBLE AREA
5.	Video pulse	TEST SET FUNCTION SELECTOR--SYNCHRONIZER	Remove video driver module from synchronizer. Connect cable (CG-1464/U) from pulse generator PULSE OUTPUT to oscilloscope channel A input. Set RF switch on RT to ON and antenna SCAN switch to SCAN.		
		TEST SET FUNCTION SELECTOR--SYNCHRONIZER; SYSTEM CONTROL--OPERATE; INDICATOR TESTS switch--down position	Observe pulse generator output and adjust for negative 6-volt peak amplitude, 10-us wide pulse delayed 80 to 100 us.		
			Disconnect pulse generator from oscilloscope and connect to synchronizer VIDEO test point J16.		
			Connect oscilloscope probe to junction of CR18 and R93 on TB1. Observe waveform. Typical waveform shown on schematic (figure FO-12). Observe indicator display for blooming of pulse generator signal.	Amplitude--4 volts peak, minimum. NOTE: If blooming occurs on indicator display, adjust VIDEO potentiometer (R5) on TB1 to eliminate blooming.	Video amplitude circuit TB1.
		TEST SET FUNCTION SELECTOR--ANTENNA/INDICATOR/CONTROL UNIT TESTS; SYSTEM CONTROL--STANDBY.	Replace video driver module in synchronizer. Set RF switch on RT to OFF.		
6. (Cont)	Sweep deflection	SYSTEM CONTROL--OPERATE	Set SCAN/OFF switch on antenna to OFF. Set BACKGRD control on indicator front panel for visible sweep trace. Position antenna dish straight ahead.		

IP-724A Indicator, Test Procedures Using the AN/APM-247 Radar Test Set (Sheet 4 of 10) Figure 5-13

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULT	POSSIBLE TROUBLE AREA
6. (Cont)		TEST SET FUNCTION SELECTOR--ANTENNA/ INDICATOR/CONTROL UNIT TESTS; SYSTEM CONTROL-- OPERATE; INDICATOR TESTS switch--ZERO AZIMUTH	Observe alignment of sweep trace.	Sweep trace should be parallel to vertical scribe line running from top of indicator (0°) to bottom center of indicator faceplate. NOTE: If necessary, loosen yoke clamp and rotate yoke to proper position.	For absence of sweep, check the following: Sweep current circuit TB1. Deflection yoke L1. Storage tube filaments.
			Observe position of sweep trace.	Sweep trace should be directly under vertical scribe line from top (0°) to bottom center of indicator faceplate. NOTE: If necessary, adjust HOR POS (R7) on TB1.	
			Observe beginning of sweep trace.	Sweep trace should begin at vertex of indicator faceplate. NOTE: If necessary, adjust VERT POS (R13) on TB1.	Sweep position circuits TB1.
			Set RANGE switch on indicator to 30. Note position of third range mark on sweep trace.	Range mark should be 1/4 ±1/8 inch below top of sweep trace. (Refer to following note.)	Sweep position circuits TB1. High-voltage circuit TB2.
(Cont)		TEST SET FUNCTION SELECTOR--ANTENNA/ INDICATOR/CONTROL UNIT TESTS; SYSTEM CONTROL--OPERATE; INDICATOR TESTS switch--ZERO AZIMUTH		NOTE: If necessary, loosen yoke clamp and move yoke forward to obtain proper position. If yoke adjustment will not obtain proper position, adjust tap on resistors R22 through R25 on TB2. HOR POS and VERT POS controls may require readjustment.	

IP-724A Indicator, Test Procedures Using the AN/APM-247 Radar Test Set (Sheet 5 of 10) Figure 5-13

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULT	POSSIBLE TROUBLE AREA
6. (Cont)			Set RANGE switch on indicator to 60. Note position of fifth range mark on sweep trace.	Same as above except observe fifth range mark.	
			Set RANGE switch on indicator to 150. Note position of fifth range mark on sweep trace.	Same as above except observe fifth range mark.	
			Using manual sweep adjust, manually rotate antenna dish 45° to left and 45° to right while observing sweep trace on indicator.	Sweep trace corresponds to setting of antenna dish ±5°.	Antenna resolver B4. (Refer to chapter 6.)
			Position antenna to one of the extremes of azimuth to close blanking switch.	Closing of blanking switch blanks out sweep trace on indicator.	R60 and writing gun grid circuit on TB3. Blanking switch.
7.	Collimation	SYSTEM CONTROL--STANDBY; INDICATOR TESTS switch--down position	Set antenna SCAN/OFF switch to SCAN.		
		TEST SET FUNCTION SELECTOR--ANTENNA/INDICATOR/CONTROL UNIT TESTS; SYSTEM CONTROL--OPERATE; INDICATOR TESTS switch--down position	Observe indicator display.	During filament warmup, faint green glow is present on face and covers full viewing area.	Indicator tube not properly collimated. Perform following collimating adjustments in PROCEDURE column.
			STOP erasure by rotating ERASE AMP (TB1-R3) fully counterclockwise. Write screen to full brightness by rotating BACKGRD control fully clockwise. NOTE: Flood gun beam may not cover entire screen.		
(Cont)			Stop writing by rotating BACKGRD control counterclockwise.		

IP-724A Indicator, Test Procedures Using the AN/APM-247 Radar Test Set (Sheet 6 of 10) Figure 5-13

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULT	POSSIBLE TROUBLE AREA
7. (Cont)		TEST SET FUNCTION SELECTOR--ANTENNA/INDICATOR/CONTROL UNIT TESTS; SYSTEM CONTROL--OPERATE; INDICATOR TESTS switch--down position	Adjust FG GRID 1 (R36) for maximum screen coverage.		
			Adjust FG GRID 4 (R41) for maximum screen coverage.		
			Adjust FG GRID 3 (R39) for maximum screen coverage and uniformity of illuminated area.		
			Readjust FG GRID 4 and FG GRID 3 for maximum screen coverage and uniformity of illuminated area.		
			Rotate ERASE AMP (TB1-R3) clockwise. Parts of display erase more rapidly than others. Stop erasure before entire display is erased.		
			Readjust FG GRID 4 and FG GRID 3 for display uniformity without decreasing diameter of display.		
			Write screen to full brightness by rotating BACKGRD control clockwise, and repeat two preceding steps until most uniform display and maximum diameter are obtained.		
		TEST SET FUNCTION SELECTOR--ANTENNA/INDICATOR/CONTROL UNIT TESTS; SYSTEM CONTROL --OPERATE; INDICATOR TESTS switch--down position	NOTE: If difficulty is encountered in collimation tests and bright spots appear on screen that do not erase as they should, the indicator should be demagnetized. Refer to test procedures for 979A-2 and 978G-1 test sets or standard equipment for demagnetizing instructions.		

IP-724A Indicator, Test Procedures Using the AN/APM-247 Radar Test Set (Sheet 7 of 10) Figure 5-13

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULT	POSSIBLE TROUBLE AREA
8.	Erasure		Set indicator RANGE switch to 60.		
			Rotate ERASE WIDTH (R1) clockwise. Rotate ERASE AMP (R3) counterclockwise.		
			Write screen to full brightness by rotating BACKGRD control clockwise.		
			Return BACKGRD control to full ccw position.		
			Rotate ERASE AMP (TB1-R3) slowly clockwise until display is just barely erased.		
		TEST SET FUNCTION SELECTOR--ANTENNA/INDICATOR/CONTROL UNIT TESTS; SYSTEM CONTROL --OPERATE; INDICATOR TESTS switch--down position	Adjust BACKGRD control for suitable video display. (If external antenna is not connected, use signal from echo box and short stc signal from synchronizer J17 to ground. Set RF switch on RT to ON.)		
(Cont)			Adjust ERASE WIDTH (R1) to obtain desired persistence. NOTE: Too long a persistence time results in blooming and lack of good contrast.		

IP-724A Indicator, Test Procedures Using the AN/APM-247 Radar Test Set (Sheet 8 of 10) Figure 5-13

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULT	POSSIBLE TROUBLE AREA
8. (Cont)			Check that there is no green glow present on the screen. (This can be determined best in the absence of writing. Set antenna SCAN/OFF switch to OFF.)		
			Tighten locknut on potentiometers R1 and R3 if applicable.		
9.	Writing gun	TEST SET FUNCTION SELECTOR--ANTENNA/INDICATOR/CONTROL UNIT TESTS; SYSTEM CONTROL --OPERATE; INDICATOR TESTS switch--down position	Set BACKGRD control to midrange position. Set RANGE switch to 30. Set antenna SCAN switch to SCAN.	Note that video display has slight background noise and that writing gun does not store. If necessary, adjust WGG 1 (R56).	
			Tighten locknut on potentiometer R56 if applicable.		
			Adjust FOCUS (R55) for best range mark definition.		
			Tighten locknut on potentiometer R55 if applicable.		
10.	BACKGRD control		Adjust BACKGRD control for barely discernible noise presentation.		
			Set RANGE switch to 60. Observe indicator presentation.	Presentation should be same as in preceding step. If necessary, adjust R58.	
			Set RANGE switch to 150. Observe indicator presentation.	Presentation should be the same as for 30-mile range. If necessary, adjust R45.	

IP-724A Indicator, Test Procedures Using the AN/APM-247 Radar Test Set (Sheet 9 of 10) Figure 5-13

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULT	POSSIBLE TROUBLE AREA
11.	Shading	TEST SET FUNCTION SELECTOR--ANTENNA/INDICATOR/CONTROL UNIT TESTS; SYSTEM CONTROL--OPERATE; INDICATOR TESTS switch--down position	Adjust BACKGRD for normal target presentation. Observe that presentation is uniform from center to outside edge of display. If necessary, perform following four steps.		
			Set SHADING (R48) counterclockwise.		
			Adjust BACKGRD control for normal presentation at center of sweep. Slowly adjust SHADING (R48) clockwise while adjusting BACKGRD control counterclockwise to maintain normal presentation from center to outer edge of display.		
			Set RANGE switch to 60 and note that presentation brightness does not change.		
			Set RANGE switch to 30 and note that presentation brightness does not change.		

IP-724A Indicator, Test Procedures Using the AN/APM-247 Radar Test Set (Sheet 10 of 10) Figure 5-13

Section VIII. STORAGE INSTRUCTIONS

Before storage, clean dirt, grease, and moisture from the IP-724A Indicator. Store the IP-724A in a clean, dry area where the possibility of impact damage is minimized. If the indicator is to be stored for an extended period, place the unit in the original shipping carton.

Section IX. SPECIAL TOOLS AND EQUIPMENT

5-25. GENERAL.

This section presents a list of special tools and equipment required for testing and/or overhauling the IP-724A Indicator.

5-26. TEST EQUIPMENT REQUIRED.

Figure 5-14 lists the equipment required to test and/or overhaul the indicator. While substitution of equipment other than manufacturer and type listed is not recommended, other equipment may be used if it equals or exceeds the minimum specifications of the equipment listed. Nomenclatures shown in parentheses identify commercial equipment equivalent to the military units described.

EQUIPMENT	TYPE OR PART NUMBER AND MANUFACTURER	MINIMUM SPECIFICATIONS
Items 1 through 5 are required with the AN/APM-247 Radar Test Set and the MK-774/APN-158 Maintenance Kit.		
1. Maintenance kit Contains the following: Dummy load Demagnetizer Antenna fixture Module extender, MX-6424 (two each) Module extender, MX-6425 Module extender MX-6426	MK-774/APN-158 (Collins 979A-2, part number 522-5730-014)	

Test Equipment Required (Sheet 1 of 3)
Figure 5-14

EQUIPMENT	TYPE OR PART NUMBER AND MANUFACTURER	MINIMUM SPECIFICATIONS
Cable assemblies as follows: CG-1464/U (seven each) CG-3109/U CX-9813 CX-10088 CX-10089 CX-10090 CX-10091 Adapters as follows: MX-6637 MX-6638 UG-273/U (three each) UG-201A/U (two each) Test lead (two each) Test probe 1000:1 Tuning tool Scale, 6 in.		
2. Radar test set Contains the following: Cable assemblies as follows: CX-10242 CX-11555 CG-1464/U (six each) Adapters as follows: UG-273/U (three each) UG-201A/U (two each)	AN/APM-247 (Collins 978G-1, part number 522-5731-015)	

Test Equipment Required (Sheet 2 of 3)
Figure 5-14

EQUIPMENT	TYPE OR PART NUMBER AND MANUFACTURER	MINIMUM SPECIFICATIONS
3. Vtvm	ME-26A/U (Hewlett-Packard 410B)	AC range: 1 to 300 volts. Dc range: 1 to 1000 volts. Dc input impedance: 100 megohms.
4. Pulse generator	SG-96B/PPM-1 (Hewlett-Packard 212A)	Pulse length: 5 us. at 6 volts. Pulse repetition rate: 5000 pulses/second. Internal impedance: 50 ohms or less. Synchronization voltage: ±5 volts.
5. Oscilloscope	AN/USM-81) (Tektronix 535 with C-A plug-in unit)	Vertical sensitivity: 20 mv/cm to 20 v/cm. Sweep range: .1 us./cm to 5 s/cm, calibrated. Input impedance: 1 megohm.

Test Equipment Required (Sheet 3 of 3)
Figure 5-14

Section X. COMPONENTS LOCATION

Refer to figures 5-15 through 5-19 for location of components comprising Azimuth-Range Indicator IP-724A/APN-158.

NOTE

These figures are for component location only. They are not to be used for provisioning component parts.

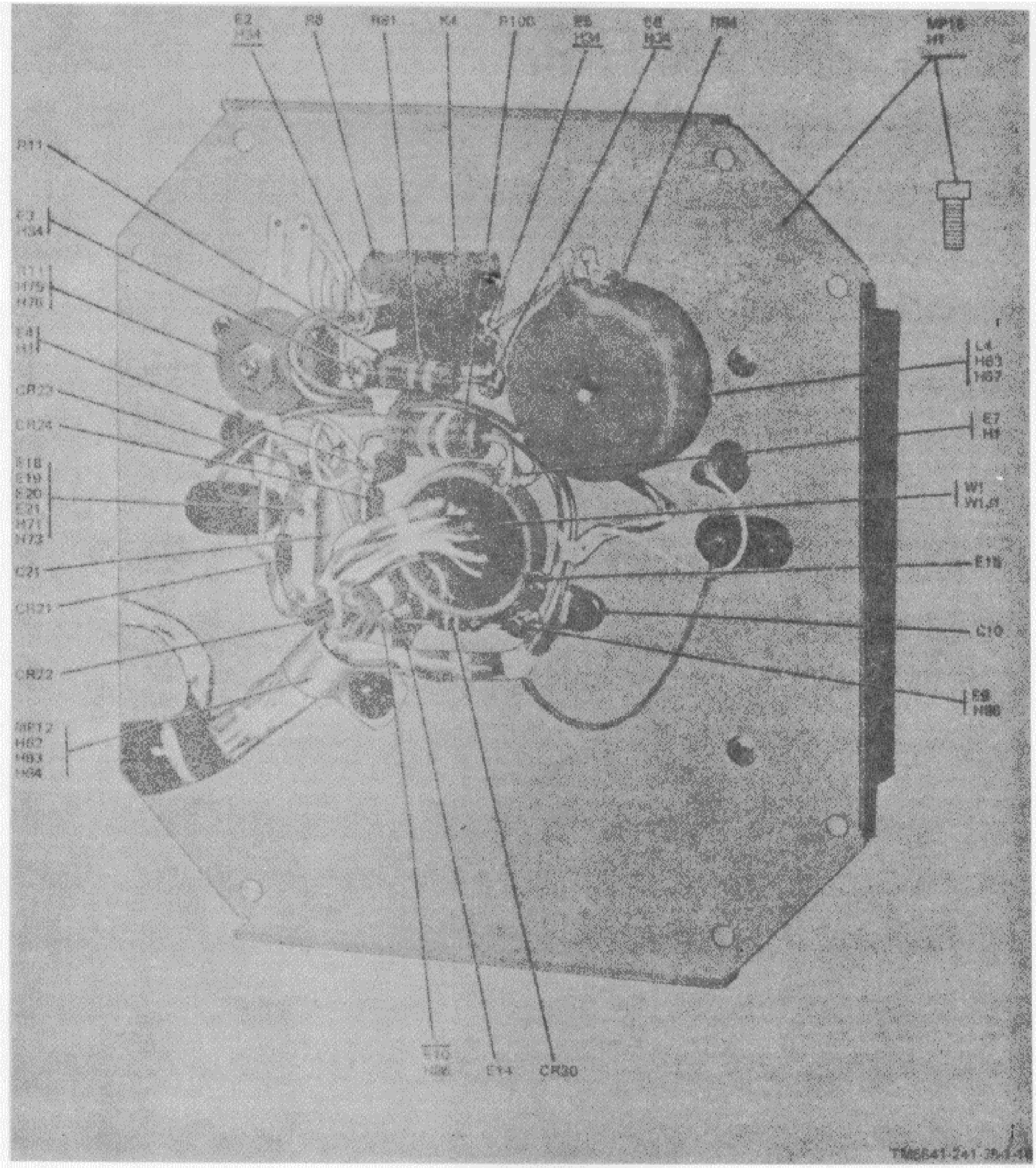


Figure 5-15. ID- 724A Indicator Chassis Assembly. Components Location (sheet 1 of 2).

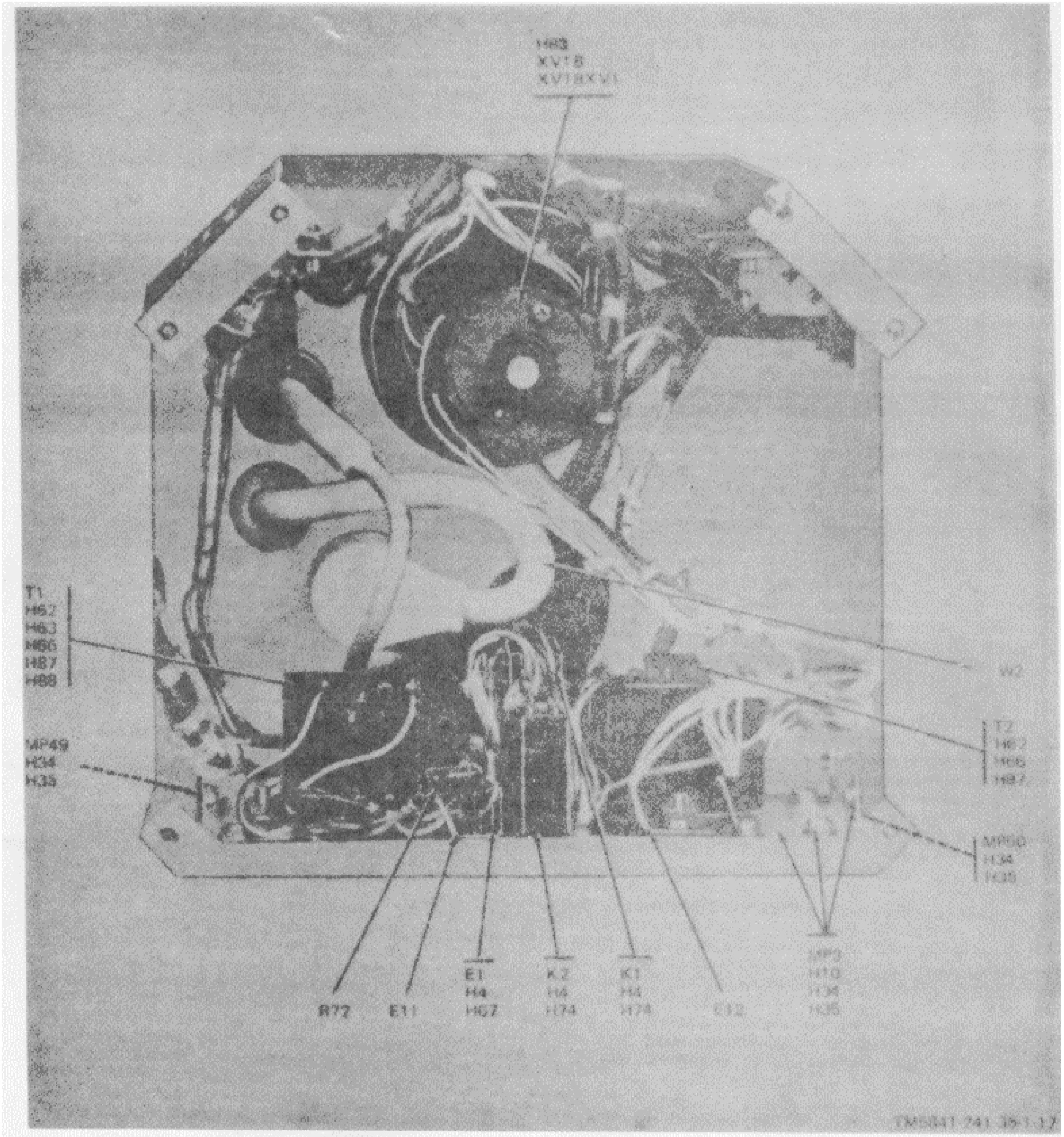


Figure 5-15. ID-724A Indicator Chassis Assembly, Components Location (sheet 2 of 2).

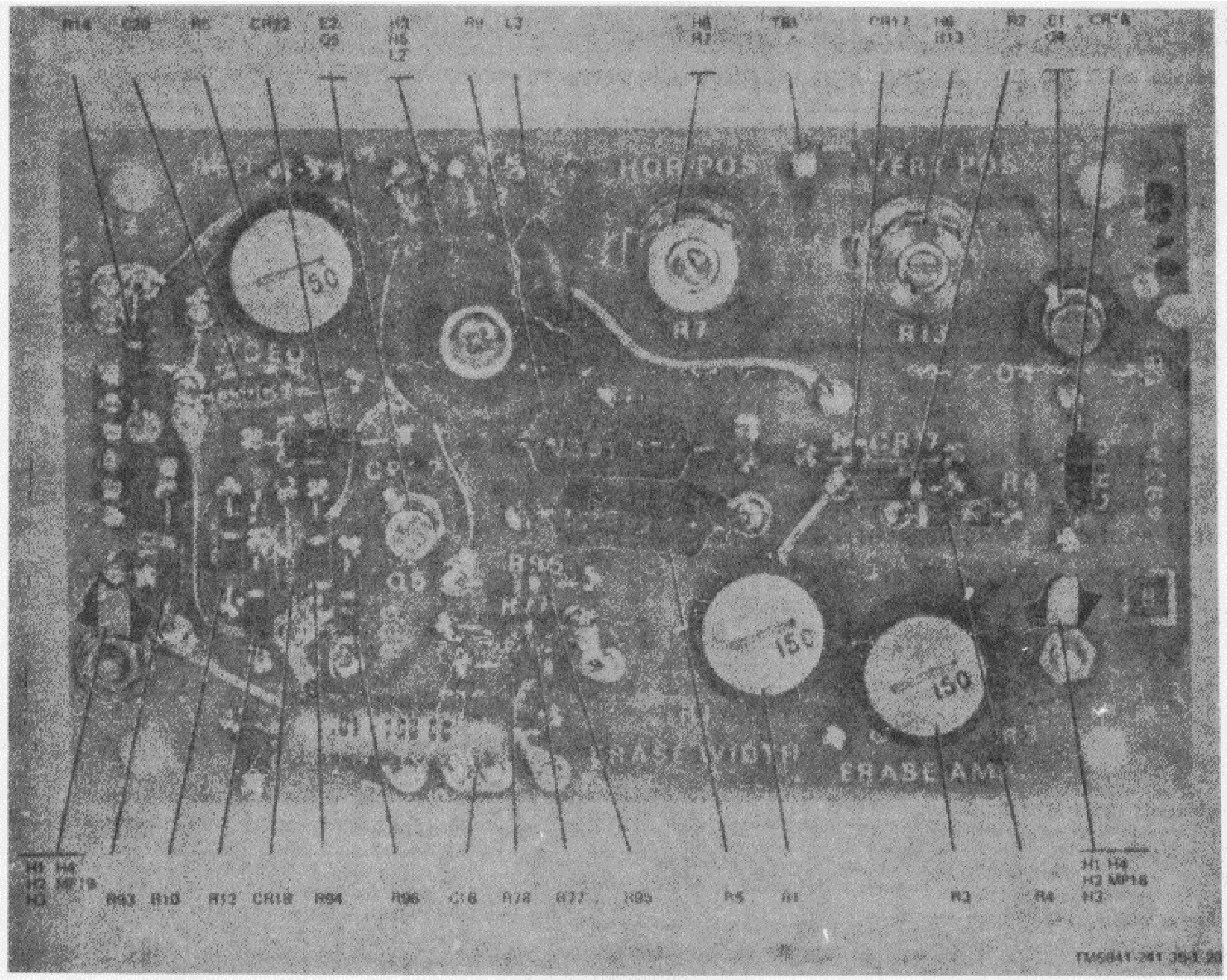


Figure 5-16. Terminal Board Assembly TB1, Components Location.

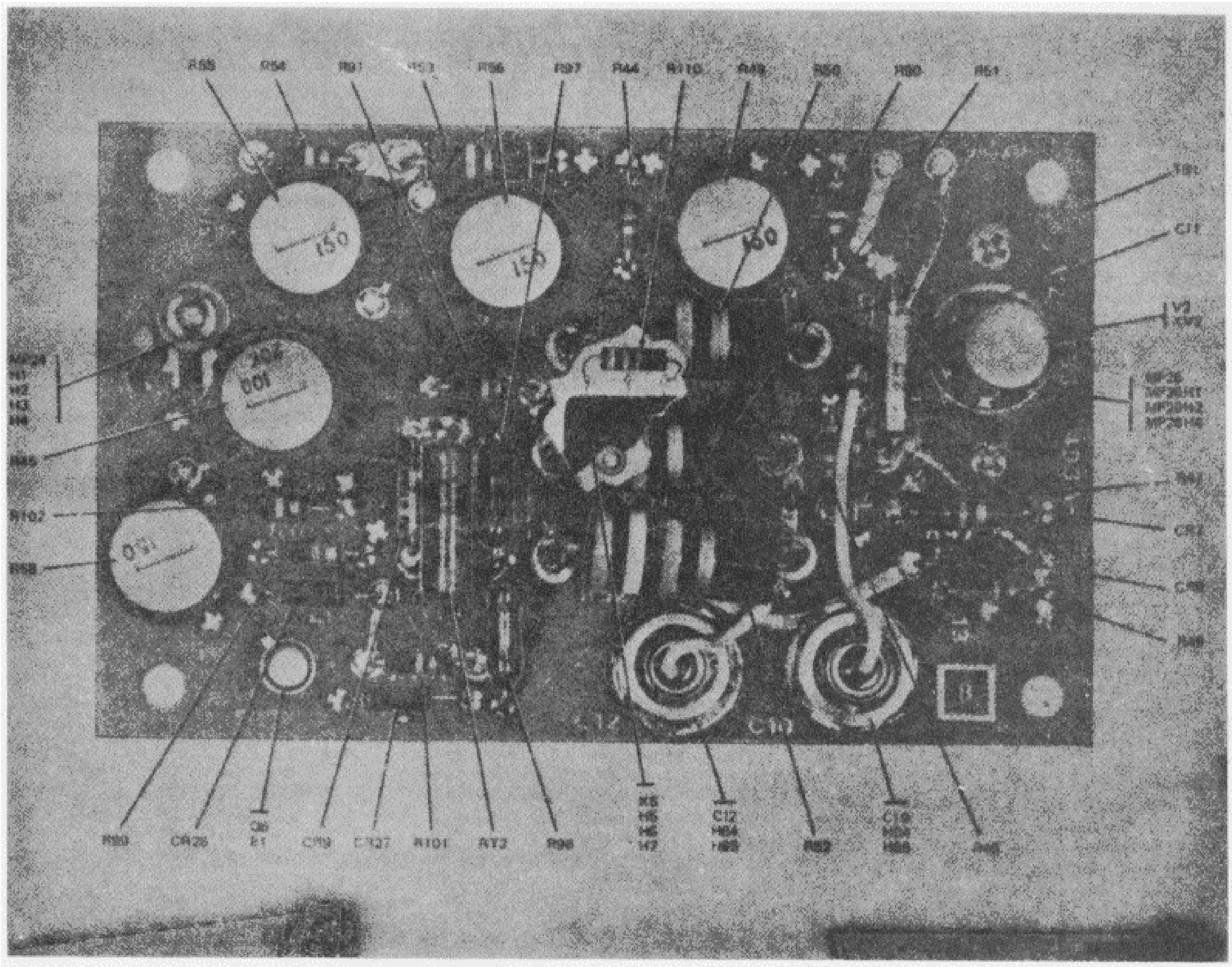


Figure 5-17. Terminal Board Assembly TB3, Component Location.

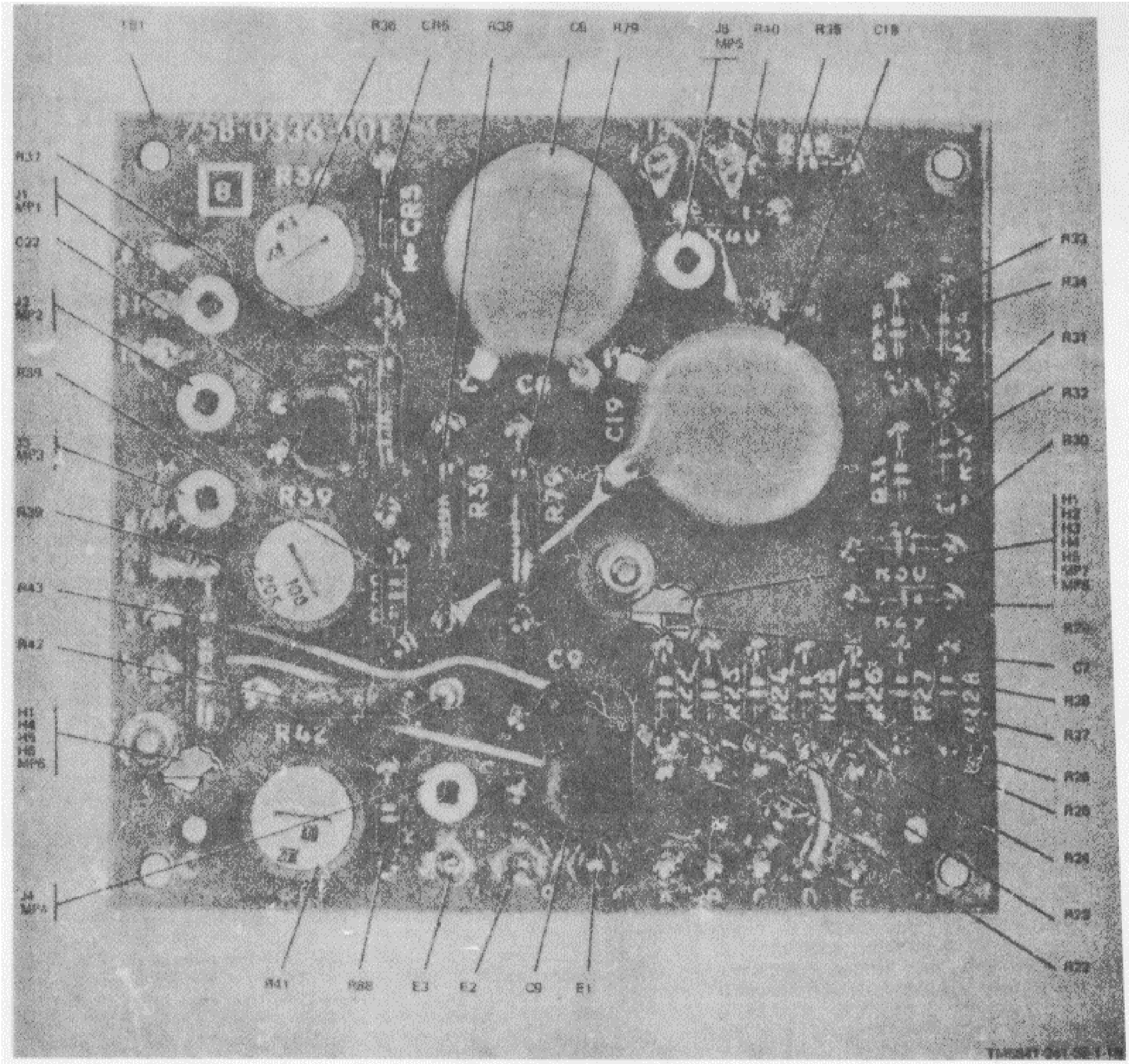


Figure 5-18. High Voltage Circuit Subassembly TB2, Components Location.

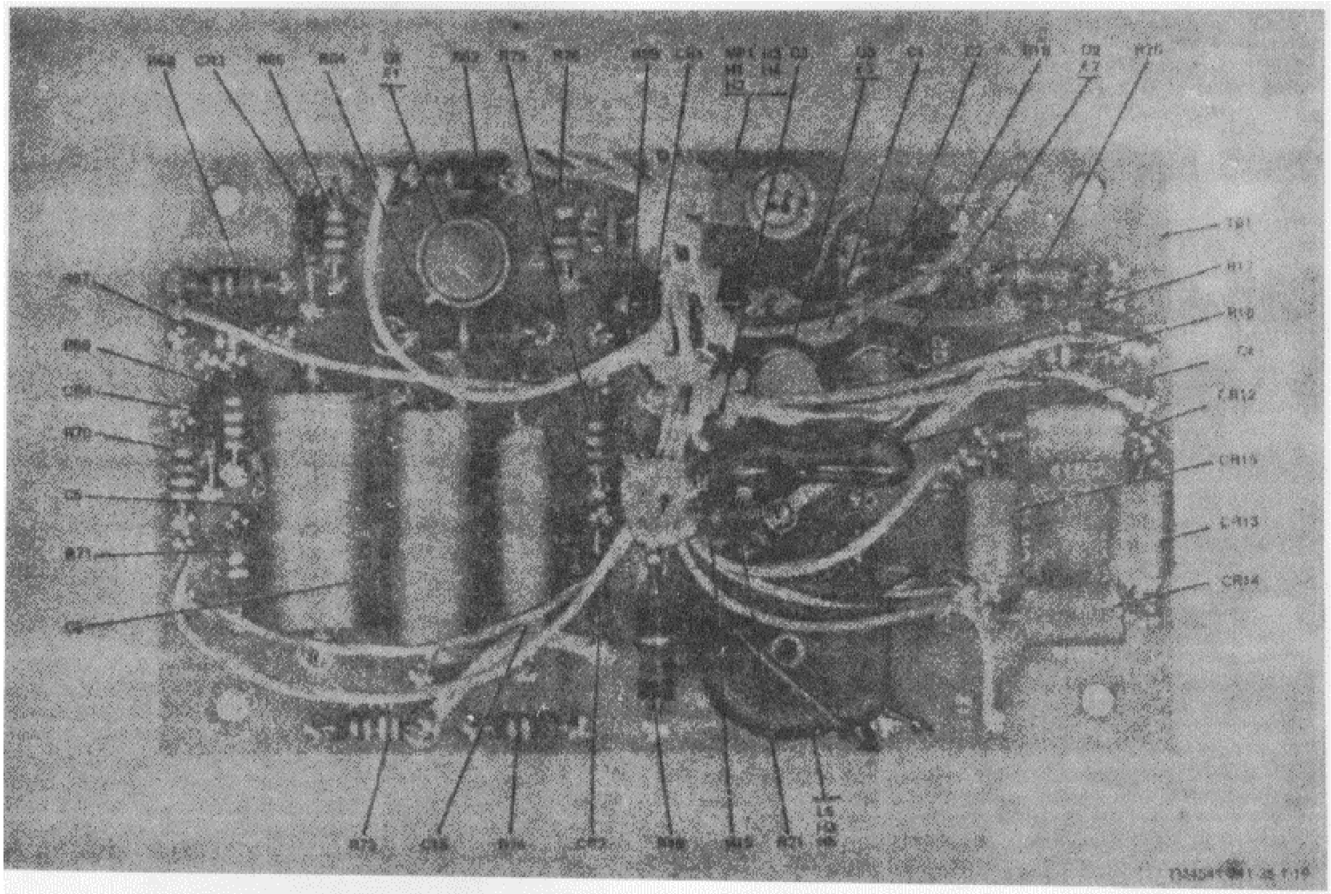
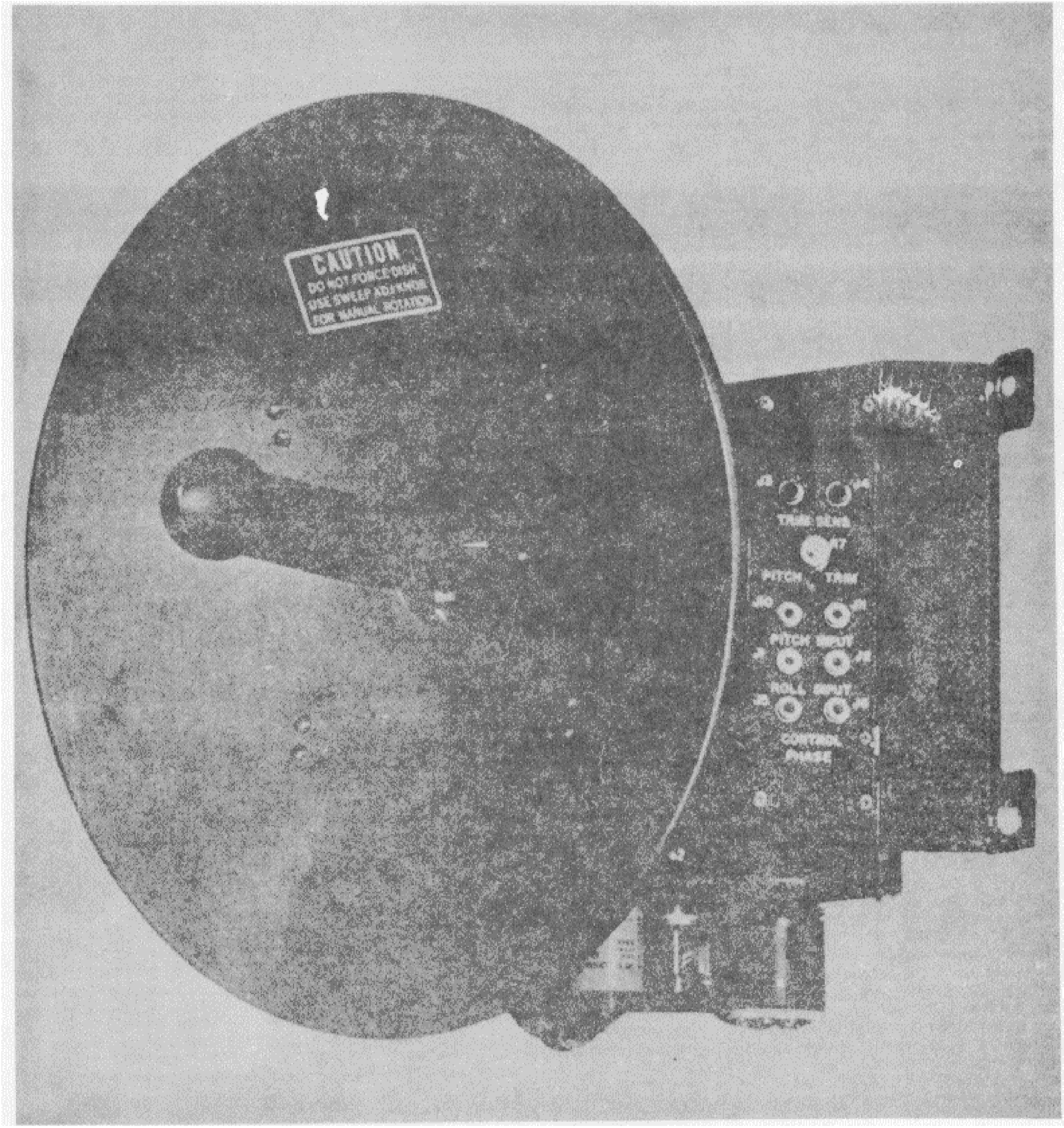


Figure 5-19. Terminal Board Assembly TB4, Components Location.

CHAPTER 6

ANTENNAS AS-1520A/APN-158

AND AS-1642A/APN-158



AS-1520A, (AS-1642A)/APN-158 Antenna
Figure 6-1

Section I. DESCRIPTION AND OPERATION

6-1. GENERAL.

This section presents the purpose of the equipment, equipment specifications, equipment description, and theory of operation. Refer to figure 6-1 for an overall view of the AS-1520A/APN-158 Antenna. Figure 6-2 is a table of equipment covered in this manual.

EQUIPMENT	COLLINS PART NUMBER
AS-1520A/APN-158 Antenna	777-1771-001
AS-1642A/APN-158 Antenna	77-1772-001

Equipment Covered
Figure 6-2

6-2. PURPOSE OF EQUIPMENT.

The AS-1520A/APN-158 and AS-1642A/ APN-158 Antennas radiate rf energy pulses from the receiver-transmitter and receive signals reflected from targets. The AS-1520A and AS-1642A Antennas are compatible with each of the units listed in figure 6-3.

EQUIPMENT	TYPE	COLLINS PART NUMBER
Receiver-transmitter	RT-711A/APN-158	777-1572-001
Synchronizer	SN-358A/APN-158	777-1768-001
Indicator	IP-724A/APN-158 493A-4	522-6104-005 777-1770-001
Cockpit control unit	C-4881/APN-158	522-5883-004

Associated Equipment
Figure 6-3

Throughout this manual whenever the terms receiver-transmitter, synchronizer, indicator, accessory unit, cockpit control unit, or cockpit control kit are used, reference is made to the units specified in figure 6-3.

6-3. EQUIPMENT SPECIFICATIONS.

The equipment specifications for the AS-1520A and AS-1624A Antennas are listed in Figure 6-4.

CHARACTERISTIC	SPECIFICATION
AS-1520A Antenna	
Weight	6.6 pounds (2.99 kg).
Physical dimensions	12 inches (30.48 cm) long.
(Approximate overall space)	12 inches (30.48 cm) long. 14-1/2 inches (36.83 cm) wide.
Shock conditions	
Performance criteria	Eighteen 10-millisecond shocks at 7.5 g.
Safety criteria	Six 10-millisecond shocks at 15 g.
Vibration	0.030 in. total excursion at 10 to15 Hz and 1.5 g peak acceleration at 55 to 500 Hz.
Power requirements (supplied by the receiver-transmitter)	
Standby	None.
Operate	115 $\pm$6 volts, 400 $\pm$20 Hz, 20 watts, 24 va.
Rf power rating	35 kw peak power, maximum.
Pressurization	None required.
Azimuth scan rate	A function of the applied voltage and frequency; for the specified range of voltage and frequency, the scan rate is 28 to 32 scan cycles per minute (240°/cycle).

Equipment Specifications (Sheet 1 of 3)
Figure 6-4

CHARACTERISTIC	SPECIFICATION
AS-1520A Antenna (Cont)	
Radiation pattern	
3-db response points	
E plane (horizontal)	7.3 degrees maximum.
H plane (vertical)	7.3 degrees maximum.
Side lobes	At least 17 db down from main lobe.
Polarization	Linear, E plane is horizontal.
Antenna gain	26.5 db.
Input vswr MHz.	1.50 : 1 maximum, 9345 to 9405
Power loss	Less-than 1/2 db at 9375 MHz.
Stabilization	
Accuracy	±2.5 degrees with respect to servo-system error signal from horizontal plane (±20 degrees maximum combined pitch and roll condition).
Rate	20 degrees per second maximum.
Beam tilt elevation	±15 degrees.
Reflector tilt elevation	±7.5 degrees.
Radome (aircraft)	Supplied by airframe manufacturer.
Ambient temperature range	
Continuous operation	-55 to +71° C (-67 to +160° F),
30-minute operation	-55 to +80° C (-67 to +176° F).
Ambient humidity range	95 percent at +55°C (+131° F).

Equipment Specification (Sheet 2 of 3)
Figure 6-4

CHARACTERISTIC	SPECIFICATION
AS-1624A Antenna	
Weight	7.8 pounds (3.54 kg).
Physical dimensions (Approximate overall space)	18 inches (45.72 cm) long. 18 inches (45.72 cm) long. 22 inches (55.88 cm) wide.
Radiation pattern	
3-db response points	
E plane (horizontal)	4.9 degrees maximum.
H plane (vertical)	4.9 degrees maximum.
Side lobes	At least 17 db down from main lobe.
Antenna gain	30.0 db.
All other specifications listed for the 538F-7A Antenna are applicable for the 537F-8A Antenna.	

Equipment Specification (sheet 3 of 3)
Figure 6-4

6-4. EQUIPMENT DESCRIPTION.

A. General.

This section presents a mechanical and electrical description of the AS-1520A and AS-1624A Antenna.

B. Mechanical Description.

The AS-1520A and AS-1624A Anterams differ only in the diameter of the reflector and the length of the waveguide feeds. The AS-1520A Antenna has a 12-inch reflector and the AS-1624A Antenna has an 18-inch reflector. The AS-1624A Antenna includes a mount to space the antenna from the bulkhead to allow full scan by the larger reflector.

C. Electrical Description.

The AS-1520A and AS-162AA Antennas are used with the AN/APN-158A Radar Set. The antenna radiates rf energy pulses originating in the receiver-transmitter and receives the signals reflected from targets. The radiation pattern is a linearly polarized pencil beam, specifically suited for detection and observation of weather by radar. The antenna has a scan capability of 60 degrees either side of dead ahead (O degree) and a scan rate of approximately 60 scans per minute.

A stabilization system maintains a constant elevation position of the antenna by compensating for pitch and roll of the aircraft. An elevation command signal, derived from the roll and pitch outputs of the aircraft gyro, is compared with the elevation signal. The elevation signal is developed by the tilt synchro transmitter in the antenna and by the control transformer in the cockpit control. Any difference between the two signals is amplified and applied to the antenna tilt motor which controls the elevation angle of the reflector. The manual tilt control on the cockpit control unit permits a variation in the antenna beam tilt from 15 degrees above to 15 degrees below horizontal.

6-5. THEORY OF OPERATION.

A. Basic Theory of Operation.

The AS-1520A and the AS-1624A Antennas radiate rf energy pulses from the receiver-transmitter and receive reflected signals from targets. The antennas consist of a waveguide assembly for transmitting and receiving rf energy; an azimuth drive motor for horizontal scanning; a sweep resolver to provide azimuth position for the indicator sweep circuits; a tilt motor generator to change the antenna elevation; and a pitch and roll resolver and tilt synchro to compensate for aircraft pitch and roll, and manual elevation control. The AS-1520A and the AS-1624A Antennas function identically and any further reference to "antenna" applies to either unit as applicable to the particular system configuration.

B. Detailed Theory of Operation. (Refer to figure FO-14.)

Azimuth motor B5 drives the antenna in the azimuth plane, 60 degrees either side of dead ahead, through reduction gears and a scanning mechanism at a rate of approximately 30 scan cycles per minute. The drive motor is powered by 115-volt, 400-Hz generator A primary power that is applied to the antenna through J1-L and -K. Power is applied to the motor from the terminals of SCAN-OFF switch S1. Capacitor C4 shifts the phase of the control voltage by the required 90 degrees for the control phase winding of the motor. Resistor R8, across the control phase winding, reduces circuit Q and permits the control phase to operate from the 115-volt source.

Sweep resolver B4 is geared to the azimuth motor of the antenna and follows the antenna scan to produce antenna azimuth information for the sweep circuits in the synchronizer. A 400-Hz sweep excitation signal from the synchronizer is applied through J1-X and -E to the rotor windings of the sweep resolver. Capacitors C3 and C5 form a tuned circuit with the rotor windings. The value of C5 is selected to obtain accurate tuning. The two stator windings are physically spaced 90 degrees apart. The voltages induced are coupled through amplitude adjusting resistor R6 and R9 and form the X and Y sweep signals that are applied to the sweep circuits in the synchronizer.

Pitch-roll resolver B3 produces a pitch and roll error voltage necessary to establish a constant antenna angle with respect to the horizon. The two stator and the two rotor windings are physically spaced 90 degrees apart. The resolver acts like a variable transformer with two primary windings. Each rotor winding is capable of maximum coupling with one of the stators for each 90 degrees of rotation. Pitch and roll data from the isolation amplifier module in the synchronizer is applied through pins J1-U and -e (pitch) and J1-V and -C (roll) to the stator windings. The voltage induced in the rotor windings is the vector sum of the roll and pitch error voltages and represents antenna angle correction. PITCH TRIM potentiometer R7, in series with the pitch winding input, provides a trim signal to level the antenna when the antenna mounting surface is not exactly vertical. The voltage for R7 is provided by, transformer T2. Inductor L1, in series with the primary of T2, shifts the phase of the trim voltage to compensate for the phase lag in the resolver winding.

Tilt motor-generator B2 is geared to the tilt axis of the antenna, through reduction gears, to drive the antenna reflector to any desired tilt angle between 7.5 degrees above and 7.5 degrees below the horizontal axis. The rf antenna waveguide remains fixed in the azimuth plane while the reflector tilts, so the effective beam tilt is ±15 degrees from the horizontal. Control voltage from the elevation servo-amplifier module in the synchronizer is applied through J1-F, -G, and -H to the control phase winding. The control voltage determines the speed and direction of the tilt drive. Capacitor C1, across the control phase, tunes the winding for a unity power factor. Capacitor C2 and resistor R2, in series with the rate generator winding, shift the rate generator output phase to zero reference phase. The output voltage is applied across RATE potentiometer R4 through J1-h and -j to the elevation servo-amplifier module in the synchronizer.

The rotor of tilt synchro transmitter B1 is geared to the tilt axis of the antenna with a gear ratio of 2:1. The rotor acts as the primary winding of a transformer and is energized with a 17-volt, 400-Hz reference voltage from T1. The 17-volt level is established by potentiometer R1. The primary of T1 is connected to the autopilot phase (generator A) through J1-L and -K. The voltage induced in each of the three stator secondary windings varies with the tilt angle of the antenna and provides the reference voltage for the three stator windings of the manual elevation control synchro in the cockpit control unit.

SCAN-OFF switch S1 permits the azimuth scan to be disabled during maintenance checks on the antenna by removing power from azimuth motor B5. The MANUAL SWEEP ADJ control permits positioning of the antenna when SCAN-OFF switch is OFF.

Limit switch S2 provides blanking of the indicator for approximately 1 to 1.5 degrees at either end of the azimuth scan. This blanking signal is used by the IP-724A/APN-158 Indicator to prevent the appearance of a bright line at azimuth scan limits.

The rf antenna waveguide section consists of an input section, a rotary coupler, a coaxial line section, and a twist and taper section. Rf energy is radiated out the end of the twist and taper section to a dipole and parasitic reflector where it is reflected back to the parabolic dish.

Section II. DISASSEMBLY

6-6. General.

This section presents instructions for disassembling the AS-1520A and AS-1624A Antennas. Instructions are arranged so that disassembly of each major part is an individual operation. When it is necessary to disassemble the units, locate the part in the table of contents and begin on the page indicated. Reference is made to previous disassembly steps that must be performed before a part may be removed or disassembled. The disassembly procedure should be continued only as far as necessary to replace the faulty component. The instructions include special techniques, cautions, warnings, and unique procedures.

6-7. Precautions and General Techniques.

Mark, tag, or otherwise identify all disconnected electrical wiring. Note the color coding, placement of leads, and method of applying insulation before unsoldering or removing any electrical components. These procedures supply sufficient information to completely remove the parts listed in the table of contents. In many cases, however, parts may be released and moved aside to gain access to other parts without unsoldering the connecting leads.

CAUTION

DO NOT ATTEMPT ANY DISASSEMBLY WHILE PRIMARY POWER IS APPLIED TO THE UNIT.

6-8. Disassembly Procedure.

a. Remove Antenna Dish. (Refer to fig. 6-16 in performing (1) and (2) below.)

(1) First remove grounding strap from antenna dish (13).

(2) Remove two dowel pins (15) in each end of linkage beam (172) by loosening setscrews (14) in associated spacer clamps (171).

NOTE

Refer to figure 6-17 in performing (3) through (6) below.

(3) Remove two dowel pins (26) located in gimbal (36) by removing setscrews (25).

(4) Remove elevation indicator (5) from the mounting support of the antenna dish by removing two machine screws (6) and two lock- washers (7).

(5) Remove the antenna dish (29) from the gimbal assembly (36).

(6) Nylon bushings (28) in the mounting support may be removed if necessary.

b. Remove and Disassemble Azimuth Gear Train Assembly. (Refer to fig. 6-16 in performing (1) through (9) below, unless otherwise indicated.)

(1) Referring to figure 6-18, remove synchro resolvers (18, 19) from outer cover plate (55) by loosening machine screw (20) and then rotating four half-moon synchro clamps (22), one-half turn for each clamp. Remove the resolvers from the gear train assembly.

(2) Remove nylon cable clamp (68) from cover plate (55, fig. 6-18) by removing hexnut (69) and flat washer (70) from machine screw (91).

(3) Remove nylon cable clamp (65) by removing machine screw (66) and two flat washers (67) securing it to hexpost (27, fig. 6-18).

(4) Disconnect and tag the wires attached to solder lugs (74) from microswitch (1, fig. 6-18) by loosening two machine screws on the side of the switch.

(5) Disconnect and tag three wires from induction motor (25, fig. 6-18) by removing the appropriate solder lugs and machine screws from the rear of the motor.

(6) Remove two panhead machine screws (88) from the top of gear train assembly (86).

(7) Remove two hexnuts (89) and two flat washers (90) from machine screws (91, 92).

(8) Loosen two setscrews (87) in the collar of gimbal (36, fig. 6-17).

(9) Remove azimuth gear train assembly (86) from frame (193) by carefully pulling the assembly over two machine screws (91, 92).

NOTE

The gear train assembly may now be placed on the bench for remaining disassembly procedures. Refer to figure 6- 18 in performing (10) through (20) below.

(10) Remove microswitch (1) from outer cover plate (55) by removing machine screw (2), flat washer (6), split lockwasher (4), nuts (3,7), stud (8), and solder lug (5) on the side of the switch.

(11) Remove sweep adjustment knob (9) and cam (10) from the shaft of gear F (50) by loosening setscrew (11) in the knob and setscrew (11) in the cam.

(12) Remove four flathead machine screws (56) from outer cover plate (55).

(13) Lift outer cover plate (55) from gearbox casting (73) over the shaft of gear F (50).

(14) Remove induction motor (25) from cover plate (55) by removing four machine screws (26) on the opposite side of the cover plate.

NOTE

If necessary, three ball bearings (12, 60) may be removed from the outer cover plate by applying moderate pressure to the outer race.

(15) Remove gear A (61) and then gear C (65) from the gearbox casting (73) by gently pulling them free of the ball bearings (60).

(16) Remove resolver gear (58) by loosening setscrews (59) and then pulling the gear off the shaft of crank (42).

(17) Remove inner cover plate (29) by removing four machine screws (30).

NOTE

If necessary, three ball bearings (34, 46, 69) may be removed from inner cover plate (29) by applying moderate pressure to the race.

(18) Lift linkage (33) from cranks (38, 44) and gear F (50).

(19) Pull crank no. 1 (38) and crank no. 2 (44) free of two ball bearings (41, 54) in the gearbox casting.

(20) Pull gear F (50) free of ball bearing (53) in the gearbox casting.

NOTE

If necessary, four ball bearings (41, 53, 54, 69) in the gearbox casting (73) may be removed by applying moderate pressure to the outer race.

c. Remove and Disassemble Gimbal and Waveguide Assembly. (Refer to figure 6-17 in performing (1) through (11) below unless otherwise indicated.)

(1) Remove antenna dish (29) in accordance with paragraph a above.

(2) Release the azimuth gear train assembly in accordance with paragraphs b (2) and b (6) through b (8) above.

(3) Pull the azimuth gear train assembly away from frame (193, figure 6-16 until it is free of gimbal collar.

CAUTION

Ensure that no components are allowed to fall when removing four screws in (4) below.

(4) Remove four capscrews and four flat washers securing rotary joint waveguide (1) and azimuth indicator frame (4) to frame (193, figure 6-16).

(5) Remove the gimbal and waveguide assembly from the frame.

(6) Loosen eight machine screws (11) supporting four nylon feed clamps (8) in gimbal (36).

(7) Remove four socket-head capscrews (2) and four split lockwashers (3) mounting gimbal i (36) to the coaxial line section of rotary joint waveguide (1).

(8) Remove antenna feed waveguide. (12) from the gimbal assembly.

(9) Remove five socket-head screws (2) and five split lockwashers (3) securing antenna feed waveguide (12) to the coaxial line section of the waveguide.

(10) Gently pull the two outer sections of rotary joint waveguide (1) and azimuth indicator (4) free of the joint on the coaxial line section of the waveguide. Do not disassemble bearing end of waveguide assembly.

CAUTION

Protect the grease on the joint from contamination while the joint is disassembled.

NOTE

Do not disassemble the rotary joint unless absolutely necessary. If disassembly is required, do not disturb position of spacing setscrews (fig. FO-1 13). If removal or adjustment of the spacing setscrews is required, refer to the assembly section for assembly procedures. Refer to the testing section to determine proper spacing of the set-screws. Spacing is critical for proper operation of the rotary joint.

(11) If replacement is necessary, four rubber shockmounts (18) may be disassembled from the gimbal by removing four hexnuts (19), four split lockwashers (20), and eight flat washers (22).

d. Remove and Disassemble Elevation Gear Train Assembly. (Refer to figure 6-16.)

(1) Remove right frame (37) from frame (193) by removing four machine screws (38) and four dished washers (39) at the ends of the panel.

NOTE

Removal of components from this panel is not required.

(2) Remove motor generator (153) from front gear-housing plate (192) by loosening the three,,

or five, machine screws and rotating three, or five, synchro clamps (154) one-half turn.

(3) Remove tension spring (162) from the supports on spring wheel (163) and on rear gearhousing cover (188).

(4) Remove synchro transmitter (155) from front gear-housing plate (192) by loosening three machine screws (161) and rotating two synchro clamps one-half turn.

(5) Remove toggle switch (64) from frame (193).

(6) Remove three machine screws (151) and three dished washers (152) from the end of front gear-housing plate (192).

(7) Remove machine screw (161), synchro clamp (160), flat washer (159), and lockwasher (158) from mounting hole at lower right corner of front gear-housing plate (192).

(8) Release linkage beam in accordance with paragraph *a*(2) above.

(9) Carefully remove the elevation gear train assembly.

(10) Remove rear gear-housing cover (188) from front gear-housing plate (192) by sliding bearing (191) in the cover over pin (184) in elevation segment (183).

(11) Loosen the setscrew (185) and slide elevation segment (183) off pin (184).

(12) Remove spring wheel (163) and elevation synchro gear (164) on the shaft of synchro transmitter (155) by loosening screws (165) in the side of the wheel and the gear.

NOTE

If necessary, the two bearings (190, 191) in the two gear-housing plates may be removed by applying moderate pressure to the bearings.

Section III. CLEANING

6-9. GENERAL.

This section presents instructions for cleaning the dismantled and disassembled, components, parts, and subassemblies of the AS-1520A and AS-1624A Antennas.

WARNING: PERFORM OPERATIONS INVOLVING CLEANING SOLVENT UNDER A VENTILATED HOOD PROVIDED WITH EXPLOSION-PROOF ELECTRICAL EQUIPMENT AND AN EXHAUST FAN HAVING SPARKPROOF BLADES. AVOID BREATHING SOLVENT VAPOR AND FUMES. WEAR A SUITABLE MASK WHEN NECESSARY. AVOID CONTINUOUS CONTACT WITH THE SOLVENT. USE GOGGLES, GLOVES, AND AN APRON TO PREVENT IRRITATION FROM PROLONGED CONTACT. CHANGE CLOTHING THAT HAS BECOME SATURATED WITH SOLVENT.

References to "air jet" in this section indicate a hand-operated air nozzle supplied with clean, dry, compressed air at a maximum pressure of 28 pounds per square inch.

WARNING: WEAR GOGGLES WHEN USING THE AIR JET TO BLOW DIRT AND DUST FROM EQUIPMENT PARTS. WARN OTHER PERSONS AWAY FROM HAZARDOUS AREA OR WORKING ENCLOSURE.

6-10. CLEANING PROCEDURE.

The following paragraphs present instructions and procedures for cleaning the various parts of the dismantled and disassembled equipment preparatory to performing inspection procedures. For convenience, components, parts, and subassemblies are alphabetically listed and cross referenced to the appropriate paragraphs containing the cleaning instructions. Refer to figure 6-5.

A. Bearings.

(1) Clean dust and dirt from ball bearing assemblies with an air jet.

CAUTION: DO NOT CLEAN BALL BEARING ASSEMBLIES WITH SOLVENT.

(2) Clean sleeve bearings with solvent and dry with a clean, dry, lintless cloth.

B. Connectors.

(1) Wipe dust and dirt from bodies, shells, and cable clamps using a solvent-moistened, lintless cloth. Wipe dry with a clean, dry, lintless cloth.

(2) Remove dust from inserts using a small soft-bristled brush and an air jet.

(3) Wash dirt and any traces of lubricant from inserts, insulation, and contacts using solvent applied sparingly with a small, camel-hair brush.

ITEM	REFER TO PARAGRAPH
Bearings	6-10A
Connectors	6-10B
Covered cables	6-10C
Covers and shields	6-10D
Insulators: ceramic, Mycalex, and plastic	6-10E
Jacks	6-10F
Knobs and panels	6-10G
Machined metal parts	6-10H
Mechanical metal parts	6-10I
Nylon, epoxy, and plastic parts	6-10J
Switches	6-10K
Transformers and inductors	6-10L
Waveguide assemblies	6-10M
Wired chassis	6-10N

Index of Cleaning Procedures
Figure 6-5

CAUTION: DO NOT ALLOW SOLVENT TO RUN INTO SLEEVES OR CONDUIT COVERING ANY WIRES OR CABLES CONNECTED TO CONTACT TERMINALS OF THE INSERT.

(4) Dry the insert with an air jet.

C. Covered Cables.

(1) Clean outer surfaces by wiping away dirt with a solvent-moistened, lintless cloth.

(2) Wipe dry using a clean, dry, lintless cloth.

(3) Treat any connector termination in accordance with paragraph B above. Wipe lug terminations clean with a solvent-moistened, lintless cloth and dry with a clean, dry, lintless cloth.

D. Covers and Shields.

Clean all unfinished, finished, and partly finished sheet-metal covers, such as dust covers, inspection covers, and housings as follows: (1) Remove the bulk of surface dirt with rags.

(2) Blow dust from surfaces, holes, and recesses using an air jet.

(3) Immerse cover or shield in a washing bath of solvent and scrub until clean, working over all surfaces and into all holes and recesses with a suitable nonmetallic brush. Flat, wood-backed brushes with soft fiber bristles are recommended for surfaces; round brushes, similar to those used for washing bottles and test tubes, are recommended for holes and recesses.

(4) Raise the cover or shield from the bath and permit solvent to drain into the bath.

(5) Immerse the cover or shield in rinsing bath of clean solvent, rinse, and raise from bath. Position the cover or shield to drain dry so that solvent is not trapped in holes or recesses. When practical positioning will not permit complete draining, use an air jet to blow out any trapped solvent.

CAUTION: WEAR PROTECTIVE CLOTHING WHEN USING THE AIR JET TO REMOVE EXCESS SOLVENT.

(6) When thoroughly dry, touch up any minor damage to the finish.

(7) Protect from dust and moisture pending inspection.

E. Insulators: Ceramic, Mycalex, and Plastic.

Clean all glazed porcelain insulators, ceramic insulators, Mycalex insulators, and plastic standoff insulators as follows:

(1) Wipe clean with a solvent-moistened, clean, lintless cloth.

(2) Wipe dry and polish using a clean, dry, lintless cloth.

F. Jacks.

(1) Remove dust from exteriors with a camel-air brush and an air jet.

(2) Blow dust from interior of female contacts with an air jet.

G. Knobs and Panels.

Clean knobs and panels by gently wiping the surfaces with a clean, soft, lintless cloth. When clean, polish with tissue paper.

H. Machined Metal Parts.

Detached shafts, keys, pins, collars, gears, metal bushings, and similar machined parts (except rf fittings) should be cleaned in a suitable cleaning machine if available. If a cleaning machine is not available, proceed as follows:

(1) Clean machined metal parts in accordance with paragraphs D(I) and E(3) through D(5) above.

NOTE: Do not touch any cleaned machined or unfinished parts with bare hands.

(2) Dry in a dust-free, dry area, or suitable enclosure. Radiant heat used in a ventilated enclosure is recommended for drying, particularly where atmospheric humidity is high.

(3) After the drying process is completed, apply a light coat of lubricating oil (MIL-L-6085) to any bare steel surfaces with the exception of gears and other moving parts which should be greased in accordance with the applicable paragraphs contained in the assembly section of this manual.

I. Mechanical Metal Parts.

The detached mounting plates, mounting clamps and brackets, nuts, bolts, screws, washers, fasteners, and other hardware should be cleaned in a suitable cleaning machine or in accordance with paragraph D above.

J. Nylon, Epoxy, and Plastic Parts.

The following procedure does not apply to rf fittings.

(1) Prepare a cleaning solution of two ounces of detergent powder in one gallon of water.

(2) Scrub all parts with a suitable, soft-bristled brush.

(3) Rinse the parts thoroughly in clean water.

(4) Dry parts with a clean, dry, lintless cloth.

K. Switches.

Clean encapsulated switches as follows:

(1) Wipe dust, dirt, and any traces of lubricant from external surfaces with a clean, solvent-moistened, lintless cloth.

(2) Dry with a clean, dry, lintless cloth.

L. Transformers and Inductors.

(1) Wipe dust and dirt from transformers and inductors with a clean, lintless cloth, slightly moistened with solvent.

(2) Dry with a clean, dry, lintless cloth.

M. Waveguide Assemblies.

(1) Clean the exterior surfaces of waveguide assemblies with a clean, dry, lintless cloth or a soft-bristled brush.

(2) Clean the interior surfaces of waveguide assemblies with a clean, dry, lintless cloth or an air jet.

CAUTION: DO NOT USE SOLVENT FOR CLEANING. DO NOT ALLOW FOREIGN SUBSTANCES TO CONTAMINATE THE LUBRICATED SURFACE OF THE TEFLON INSULATOR IN THE ROTARY JOINT.

N. Wired Chassis.

The following procedures should be used for chassis containing resistors, capacitors, switches, inductors, transformers, and other wired parts: (1) Remove dust and dirt from all surfaces, including parts and wiring, using a soft-bristled brush and an air jet.

CAUTION: AVOID A DIRECT CONCENTRATION OF AIR ON DELICATE PARTS. USE CAUTION WHEN BRUSHING DELICATE PARTS.

NOTE: When necessary to disturb the position and dress of wiring and cables, ensure that they are properly restored after cleaning is completed.

(2) With a minimum disturbance of wiring, clean connectors in accordance with paragraph B above.

(3) Clean insulators in accordance with paragraph E above.

(4) Clean jacks in accordance with paragraph F above.

(5) Clean switches in accordance with paragraph K above.

(6) Clean transformers and inductors in accordance with paragraph L above.

(7) Complete chassis cleaning by wiping all finished surfaces with a solvent-moistened, lintless cloth.

(8) Dry and polish these surfaces using a clean, dry, lintless cloth.

(9) Protect from dust and moisture pending inspection.

Section IV. INSPECTION/CHECK

6-11. GENERAL.

This section presents instructions and procedures to assist in determining, by inspection, the condition of the dismantled, disassembled, and cleaned components, parts, and assemblies, of the AS-1520A and AS-1624A Antennas. Detailed inspection procedures are alphabetically arranged. Refer to the repair section of this manual for replacement or repair of defective components.

6-12. INSPECTION PROCEDURES.

Figure 6-6 lists the mechanical and electrical parts to be inspected and contains cross-references to applicable paragraphs containing inspection routines.

ITEM	REFER TO PARAGRAPH
Bearings	6-12A
Capacitors	6-12B
Chassis	6-12C
Connectors	6-12D
Covers and shields	6-12E
Gears	6-12F
Insulators; ceramic, Mycalex, and plastic	6-12G
Jacks	6-12H
Knobs and panels	6-12I
Machined metal parts	6-12J
Mechanical metal parts	6-12K
Nylon, epoxy, and plastic parts	6-12L
Resistors	6-12M
Switches	6-12N

Index of Inspection Procedures (Sheet 1 of 2)
Figure 6-6

ITEM	REFER TO PARAGRAPH
Synchros and motors	6-12O
Transformers and Inductors	6-12P
Waveguide assemblies	6-12Q
Wiring	6-12R

Index of Inspection Procedures (Sheet 2 of 2)
Figure 6-6

A. Bearings.
Inspect bearings for breaks, cracks, dents, scoring, and signs of overheating or excessive wear. Inspect bearing mounts or mounting shafts for similar physical damage or defects.

B. Capacitors.
Inspect capacitors for the defects listed in figure 6-7.

DEFECT	METAL TYPE	MOLDED TYPE	CERAMIC TYPE
Leakage (at case seams or around terminal insulation)	X		
Cracked, broken, or charred terminal insulation	X		
Case damage (dents or holes)	X		
Case damage (cracks or breakage)		X	
Loose, broken, or corroded terminal studs, lugs, or leads	X	X	X
Loose, broken, or poorly soldered connections	X	X	X

Fixed Capacitor Inspection
Figure 6-7

C. Chassis.
Inspect chassis for deformation, dents, punctures, badly worn surfaces, damaged connectors and fastening devices. Examine the chassis for corrosion and damage that may require refinishing.

D. Connectors.
Inspect connector bodies for broken parts, deformed shells or clamps, and other irregularities. Inspect for cracked or broken insulation and for contacts that are broken, deformed, or out of alignment. Check for corroded or damaged plating on contacts and for loose, poorly soldered, broken, or corroded terminal connections.

E. Covers and Shields.
Inspect covers and shields for punctures, deep dents, and badly worn surfaces.
Check for damaged fastening devices, corrosion, and other damage that may require refinishing.

F. Gears.
Inspect all gears for broken, chipped, or badly worn teeth. The presence of a sharp burr on one side of a gear at the edges of the teeth is an indication of excessive wear.
Inspect gear bodies for cracks and deformation. Inspect the bore of gears for excessive wear.

G. Insulators: Ceramic, Mycalex, and Plastic.
Inspect ceramic, Mycalex, and plastic insulators for evidence of damage, such as broken or chipped edges, burned areas, or foreign matter.

H. Jacks.
Inspect all jacks for corrosion, loose or broken parts, cracked insulation, or other irregularities.

I. Knobs and Panels.
Inspect knobs and panels for physical damage and deformation, marred surfaces, and impairment of markings.

J. Machined Metal Parts.
Inspect machined metal parts for physical damage to surfaces, corners, and edges.
Inspect closely all machined surfaces, holes, bores, counterbores, slots, grooves, shoulders, flanges, tapped holes, shafts, and all threaded members, both male and female, for damage of any sort including roughness of surface, corrosion, or foreign matter. Inspect plated or finished areas for damage requiring replating or refinishing beyond touchup repair.

K. Mechanical Metal Parts.

Inspect unmachined mechanical metal parts Including mounting plates, chassis, mounting clamps, brackets, nuts, bolts, screws, washers, fasteners, and other hardware for damage or deformation. Inspect for corrosion and any damage that would require replating or refinishing beyond touchup repair.

L. Nylon, Epoxy, and Plastic Parts.

Inspect nylon, epoxy, and plastic parts, for chips, cracks, burns, breaks, or signs of excessive wear.

M. Resistors.

Inspect fixed composition resistors for cracked, broken, blistered, or charred bodies and for loose, broken, poorly soldered, or corroded terminal connections.

Inspect fixed wirewound resistors for signs of heating, cracked, broken, or charred insulation, loose, poorly soldered, broken, or corroded terminal connections, and loose mounting.

Inspect variable resistors for corrosion of shafts, cases, or other visible parts, loose mountings, and physical damage. Where possible, rotate the shaft to determine whether action is too rough, too loose, or too tight.

N. Switches.

Inspect encapsulated switches for chipped, cracked, broken, or burned bodies. Check for loose, broken, poorly soldered, or corroded terminal connections.

O. Synchros and Motors.

Inspect synchro and motor cases for chips, cracks, burns, or other physical damage.
Check for bent, scored, cracked, or otherwise physically damaged shafts. Check for loose, broken, or corroded terminal connections.

P. Transformers and Inductors.

Inspect transformers and inductors for signs of excessive heating, physical damage to cases, cracked or broken insulation, and other irregularities. Inspect for corroded, poorly soldered, loose, bent, or broken terminal connections and for loose, broken, or missing mounting hardware.

Q. Waveguide Assemblies.

Inspect the external surfaces of waveguide assemblies and waveguides for cracks, dents, punctures or chips. Check for broken, cracked, chipped, or missing mounting hardware. Inspect internal surfaces for deformation of any kind and the presence of foreign matter. Check all surfaces for corrosion.

R. Wiring.

Inspect open and laced wiring of chassis, terminal boards, and parts by checking the insulation for physical damage and charring. Inspect wires for breakage and for improper dress in relation and chassis.

Section V. REPAIR

6-13. GENERAL.

This section presents instructions and procedures for the replacement or repair ox damaged or defective components of the AS-1520A and AS-1624A Antennas. Faulty components are usually detected through procedures in the inspection/check or testing sections of this manual. New parts should be inspected and/or tested before being installed. Most of the replacement or repair instructions apply to disassembled equipment. Refer to the disassembly section for proper instructions.

6-14. REPAIR PROCEDURES.

Figure 6-8 lists an alphabetically arranged index of repair procedures. Each component, part, or assembly is cross referenced to the appropriate paragraph containing the correct repair procedure.

ITEM	REFER TO PARAGRAPH
Antenna dish	6-14A
Bearings	6-14B
Capacitors	6-14C
Connectors	6-14D
Covers and shields	6-14E
Finished surfaces	6-14F
Frames	6-14G
Gears	6-14H
Insulators: ceramic, Mycalex, and plastic	6-14I
Jacks	6-14J
Knobs and panels	6-14K

Index of Repair Procedures (Sheet 1 of 2)
Figure 6-8

ITEM	REFER TO PARAGRAPH
Machined metal parts	6-14L
Mechanical metal parts	6-14M
Nylon, epoxy, and plastic parts	6-14N
Resistors	6-14O
Soldered terminal connections	6-14P
Switches	6-14Q
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Transformers and inductors	6-145
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Index of Repair Procedures Sheet 2 of 2)
Figure 6-8

A. Antenna Dish.

Minor dents and deformations of the parabolic dish can generally be repaired by gently bending the dish with the hands. If the antenna is severely damaged, it should be replaced or returned to the manufacturer for rework.

B. Bearings.

Defective ball bearings should be replaced. No repair is recommended for these components.

C. Capacitors.

If defective or if performance is questionable, capacitors should be replaced. Clean all connections and apply new solder.

D. Connectors.

Straighten bent pins and damaged shell area. Replace defective connectors, broken wires, or wires with split insulation. If a connector insert is broken, replace the connector.

E. Covers and Shields.

Replace damaged screws, straighten any dents or warped sections and retouch scratched or worn painted surfaces.

F. Finished Surfaces.

Touch up minor scratches in all painted surfaces with a high-quality, black enamel applied with a small brush. Refinish black wrinkle as required in accordance with MIL-E-5558A and MIL-P-8585A. Refinish black, lusterless surfaces as required in accordance with MIL-E-14072 (SIGC). Touch up unpainted aluminum with Alodine 1200 or suitable water-lacquer mixture, applied with a pipe cleaner or small brush.

CAUTION: THE RADOME MUST NOT BE PAINTED. THE USE OF METALLIC BASE PAINT WILL SERIOUSLY DEGRADE ANTENNA PERFORMANCE.

DO NOT TOUCH UP ANY AREA WHERE AN ELECTRICAL CONNECTION IS MADE.

G. Frames.

Straighten all misshapen areas. Remove all corrosion with a suitable cleaner. Retouch silk screening and refinish where needed.

H. Gears.

Replace gears that show signs of excessive wear, cracking, or other forms of deformation.

I. Insulators: Ceramic, Mycalex, and Plastic.

Replace any insulators which show signs of physical damage such as cracks, burns, chips, or any other type of damage or deterioration.

J. Jacks.

Replace cracked, broken, or severely misshapen jacks or jacks with bent or broken center conductors or insulation.

K. Knobs and Panels.

Replace cracked, chipped, broken, or otherwise damaged knobs. Retouch or refinish panels in accordance with paragraph F above.

L. Machined Metal Parts.

If satisfactory machine shop facilities for suitable repair of these surfaces are not available, the defective or damaged part should be replaced.

M. Mechanical Metal Parts.

Straighten bent or misshapen mounts, clamps, and mounting plates. Replace broken, bent, or cross-threaded bolts, screws, nuts, washers, and other hardware.

N. Nylon, Epoxy, and Plastic Parts.

Replace cracked, broken, chipped, burned, worn, or otherwise damaged nylon, epoxy, and plastic parts.

O. Resistors.

If defective, or if performance is questionable, resistors should be replaced. Clean all connections thoroughly and apply new solder. Replace variable resistors if the shaft is loose in the case or if they show rough or intermittent action.

P. Soldered Terminal Connections.

Resolder cold-soldered or rosin joints. Remove all traces of corrosion.

Q. Switches.

Replace defective encapsulated switches. Repair of these parts is not recommended.

R. Synchros and Motors.

Replace defective or severely damaged synchros and motors.

S. Transformers and Inductors.

Replace all cracked, chipped, broken, or charred transformers and inductors. Replace all transformers and inductors if defective or suspected of questionable performance. Identify leads to facilitate rewiring. Clean all connections thoroughly and apply new solder.

T. Waveguide Assemblies.

Deformed and damaged waveguides and waveguide assemblies should be returned to the manufacturer for rework.

U. Waveguide Feed Assembly Radome.

If the radome on the antenna waveguide feed assembly is damaged, it should be replaced. When replacing it, mix and apply the adhesive as follows, to assure a strong, flexible bond:

(1) Mix three parts Catalyst 15 with two parts Stycast 2741.

(2) Apply enough of the adhesive to the waveguide to assure a good bond (a small fillet should be formed at each joint).

(3) Install the radome over the adhesive and allow 8 hours for the cement to stiffen to a nonrunning state. If fast hardening is required, place in an oven at 70° C (158 °F) for 30 minutes.

V. Wiring.

Replace damaged wiring with wire of the same size and color coding. Ensure that no bare wires are touching the chassis, other bare wires, or metal oases of other parts. If a wire is to be removed from a terminal or component, it should be marked with an identification tag to minimize incorrect connections. Clean all terminal and apply new solder.

NOTE: When necessary to disturb the dream of wire and cables, carefully ensure that the original wire dress is restored.

Section VI. ASSEMBLY

6-15. General.

This section presents instructions for assembling the AS-1520A and AS-1624A Antennas. Instructions are arranged so that assembly of each major part is an individual operation. When it is necessary to assemble the unit, locate the part in the table of contents and begin on the page indicated. Instructions include lubrication data, mechanical alignment procedures. special techniques, cautions, warnings, and unique procedures.

6-16. Lubrication Data.

Figure 6-9 lists the items that can be lubricated prior to assembly and specifies the type of lubricant to be used. The lubricant listed for each item must be used: substitute lubricants are not recommended.

Lubricant Collins Part Number	*Military Specification*	*Applied To*
005-0779-00 (preferred) or	MIL-G-15793 and MIL-G-3278A	All gear teeth and internal moving parts in azimuth gear train assembly.
005-0810-00	MIL-G-3278A	
005-0201-00	MIL-I-8660	Teflon insulator and coaxial line inside rotary coupler.

Figure 6-9. Lubricants.

a. Contamination and Compatibility. Major contamination problems which arise between :conventional lubricants and silicone lubricants or hydraulic fluids are a result of some additives used in conventional lubricants (oxidation inhibitors, corrosion inhibitors, etc.). Many of these additives are not soluble in silicone lubricants and will be precipitated as gummy or crystalline sludges when the fluids are mixed. When inadequate cleaning procedures lead to this type of contamination, high torques, sticking mechanisms, lubrication failure, and ultimate equipment failure may result. The importance of maintaining the correct lubricant in bearings or other areas cannot be overemphasized. Since failure can result from improper use of lubricants, it is imperative that the required lubricants be used in the proper areas and in the correct amounts.

6-17. Precautions and General Techniques.

Before soldering or replacing any lead or component, refer to the notes of color coding, placement of leads, and wire insulation made during disassembly. If there is any doubt as to the placement of such leads or components, refer to the appropriate diagram and perform continuity tests to ensure proper placement. Ensure, also, that proper dress or lacing of wires and cables is restored.

CAUTION

Do not attempt any assembly while primary power is applied to the unit.

6-18. Assembly Procedure.

a. Assemble and Replace Elevation Gear Train Assembly. (Refer to figure 6-16 in performing (1) through (15) below unless otherwise indicated.)

NOTE

Before assembly, all gears and bearings should be cleaned with a good grade commercial solvent. Refer to the cleaning section of this manual.

(1) Replace two bearings (190, 191) in gearhousing plates (192, 188).

(2) Replace elevation synchro gear (164) and spring wheel (163) on the shaft of synchro transmitter (155) and tighten the setscrews (165) in the components.

(3) If linkage beam (172), elevation swivel (180), and associated hardware have been disassembled, reassemble these components.

(4) If pin (176) has been removed from elevation segment (181), replace the pin but do not tighten the setscrew.

(5) Mount synchro transmitter (155) on the front gear-housing plate (192), rotating two halfmoon synchro clamps (160) by tightening two machine screws (161).

(6) Slide elevation segment (181) onto pin (176).

(7) Slide pin (184) into bearing (191) in the front gear-housing plate (192).

CAUTION

When meshing the elevation segment with the synchro gear, the angular location of spring wheel (163) must conform to the position shown in figure 6-10.

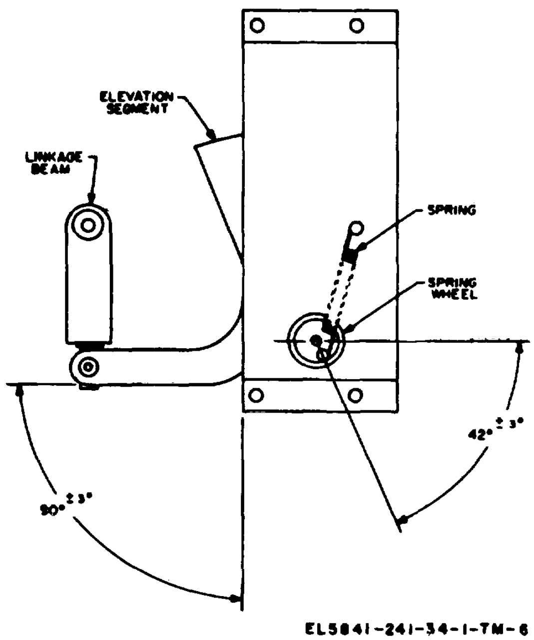


Figure 6-10. Angular position of spring wheel.

(8) Replace rear gear-housing plate (188) on the gear train assembly by sliding bearing in the rear cover over the end of pin (187).

(9) Replace spring (162) by attaching to spring wheel (163) and rear housing plate (188).

(10) Place elevation gear train in mounting position on frame (193).

(11) Secure the elevation gear train assembly to frame (193) by installing and tightening' three machine screws (151) and three split lockwashers (152) in the mounting holes on the left and upper right ends of the assembly.

NOTE

An offset or thin-shafted screwdriver may be required to tighten machine screw (151) at the lower left corner of the assembly.

(12) Lock synchro transmitter (155) by rotating synchro clamps (160) one-half turn and tightening machine screws (161).

(13) Replace toggle switch (64) on frame J 193).

(14) Mount motor generator (153) on front gear-housing plate (192), rotating the three, or.
five, halfmoon synchro clamps one-half turn and tighten three, or five, machine screws (154).

(15) Replace right frame panel (37) on frame [193) by inserting and tightening four machine screws (38) and four split lockwashers at the end)f the panel.

b. Assemble and Replace Gimbal and Waveguide Assembly. (Refer to fig. 6-17 in performing (1) through (13) below unless otherwise indicated.)

(1) Replace four rubber shockmounts (18) on the four corners of gimbal (36) and secure with eight flat washers (22), four split lockwashers (20), and four hexnuts (19).

(2) Clean the external rotary joint sections of waveguide (1) but do not lubricate.

CAUTION

Do not use solvent for cleaning. The ball bearing of the joint is a prelubricated, sealed unit.

CAUTION

Do not allow foreign substances to contaminate the lubricated surface of the teflon insulator in the rotary joint.

NOTE

Proper spacing of the rotary coupler must be accomplished during assembly. Antennas containing rotary coupler with Collins part number 355-0261-010 have three 6-40 x Y4 inch setscrews for spacing adjustment. Refer to figure FO-13. These setscrews are used to provide proper spacing before tightening the four holddown screws. Spacing in couplers not containing these setscrews must be adjusted with the four holddown screws. Spacing of the rotary coupler must be adjusted to produce a smooth motion in the azimuth plane and a vswr of 1.5:1, or less. Holddown screws that are too tight will produce erratic antenna scanning. Screws that are too loose will cause excessive vswr as well as result in a poor mechanical connection. Refer to the testing procedures for instructions on proper setting of the spacing setscrews. In addition, during assembly, ensure that air bubbles or air traps do not occur in the insulation lubricant about the coaxial line of the rotary coupler. Arc-over at high

altitudes may result from air spaces around the coaxial line.

(3) Slip azimuth indicator (4) and retaining ring over coaxial line section (1).

(4) Align the four mounting holes in the end of gimbal (36) with the four holes in the coaxial line section of rotary joint waveguide (1).

(5) Secure the two components with foul socket-head capscrews (2) and four split lockwashers (3).

(6) Insert antenna feed waveguide (12) through the slot in gimbal (36).

(7) Align the five mounting holes in the antenna feed waveguide with the five holes in the coaxial line section of waveguide. Secure the two components with five socket-head capscrews (2) and five split lockwashers (3).

(8) Tighten eight machine screws (11) supporting four nylon, feed clamps (8) in gimbal (36).

(9) Place the outer section of the rotary joint waveguide on the ball bearing joint on the coaxial line section of the waveguide.

(10) Replace and tighten four capscrews and four flat washers securing the gimbal and waveguide assembly to frame (193, figure 6-16).

(11) Slide azimuth gear train assembly (86, figure 6-16) toward frame (193, figure 6-16) until rank no 1 shaft (42, figure 6-18) fits into gimbal collar

(12) Secure azimuth gear train assembly (86, figure 6-16) to frame (193, figure 6-16) in accordance with paragraphs c (20) through c (22) and c (27) below.

(13) Replace antenna dish (29) in accordance with paragraph d below.

c. Assemble and Replace Azimuth Gear Train Assembly. (Refer to figure 6-18.)

NOTE

Before assembly. all internal components should be cleaned with a good commercial solvent (refer to the cleaning section of this manual). A coating of aircraft grease, MIL-G-3278A, should be applied to all gear teeth and other internal moving parts (refer to figure 6-9).

(1) Replace four ball bearings (41, 53, 54, 69) in the proper sockets in gearbox casting (73).

(2) Replace three ball bearings (12, 60) in the proper sockets in outer cover plate (55).

(3) Push shaft (52) of gear F (50) through ball bearing (53) in gearbox casting (73) from the side shown in figure 6-18.

(4) Push crank no. 1 (44) into ball bearing (54) at the top of gearbox casting (73).

NOTE

Crank no. 1 is the crank with the two flat surfaces on the drive shaft for the gimbal collar.

(5) Push crank no. 2 (38) into ball bearing (41) at the lower left corner of gearbox casting (73).

(6) Replace two linkage bushings (34) on linkage (33).

(7) Replace linkage (33) over three shafts on crank no. 1 (44), crank no. 2 (38). and gear F (50).

NOTE

Ensure that linkage (33) is not installed backward.

(8) Replace bushing (32) in the slot of linkage (33) over the shaft (49) of gear F (50).

(9) Replace bearing (68) in inner cover plate (29) and replace the cover plate on gearbox casting (73).

(10) Secure inner cover plate (29) with four flathead machine screws (30).

(11) Install resolver gear (23) on protruding shaft (42) of crank no. 1 (44) through the opposite side of the gearbox casting (73). Tighten setscrew (24) in the gear against the shaft.

(12) Replace gear C (68) by gently pushing shaft (67) of the gear through ball bearing (69) in inner plate (29).

(13) Replace gear A (61) by pushing gearshaft (63) through ball bearing (69) in gearbox casting (73).

(14) Install induction motor (25) on outer cover plate (55) with four machine screws (26) from the opposite side of the cover plate.

(15) Replace outer cover plate (55) on gearbox casting (73) over the shaft of gear F (50).
Secure the plate with four flathead machine screws (56f.

NOTE

Ensure that the gears are meshed before applying force to the cover.

(16) Replace cam (10) and then sweep adjustment knob (9) on the shaft of gear F (50).
Tighten setscrews (11) in each component.

(17) Install microswitch (1) broadside on outer cover plate (55, with machine screw (2), split lockwasher (4), flat washer (6), stud (8), nuts ’72, 7, and 3), and solder lug (5).

NOTE

Refer to figure 6-16 in performing (18) through (29) below unless otherwise indicated.

(18) Ensure that hexnuts (93) on machine screws (91, 92) are secure.

(19) Carefully slide gear train assembly (86) over machine screws(91,92) toward frame (193). Rotate the drive shaft of crank no. 1 (44, fig. 6-18) to the proper point so that shaft (42, fig. 6-18) will

fit properly into the collar of gimbal (36, fig. 617).

(20) Replace and secure two split lockwashers (90) and two plain hexnuts (89) onto two machine screws (91, 92) at the bottom of cover plate (55, fig. 6-18).

(21) Replace and secure two panhead machine screws (88) securing gear train assembly (86) to frame (193).

NOTE

In performing (22) below, the gimbal must be properly centered before tightening the setscrews.

(22) Tighten two setscrews (87) in the collar of the gimbal (36, fig. 6-17) against the flat surfaces of the drive shaft of crank no. 1 (44, fig. 6-18).

(23) Connect three wires to induction motor 125, fig. 6-18) as follows:

a. The red and white wire to terminal 1.

b. The green and white wire to terminal 2.

c. The blue and white wire to terminal 3.

(24) Connect two wires to microswitch (1, fig. 6-18) as follows:

a. The red, black, and white wire to the common (upper) terminal.

b. The orange, black, and white wire to the normally open (lower) terminal.

(25) Fasten solder lugs (74) to the terminals on the left side of microswitch (1, fig. 6-18) with two machine screws and two washers.

(26) Fasten nylon cable clamp (65) to the top of hexpost (21, fig. 6-18) with machine screw (66) and two flat washers (67).

(27) Fasten nylon cable clamp (68) to machine screw (91) with hexnut (69) and two flat washers (70).

(28) Install two synchro resolvers (18 and 19, fig. 6-18) in the left and right mounting holes.

NOTE

Deleted

CAUTION

Referring to figure 6-18, insure that the gears on synchro resolvers (18, 19) are properly meshed with resolver gear (58) before the resolvers are fastened.

(29) Still referring to figure 6-18, fasten each resolver (18, 19) to cover plate (55) by rotating four synchro clamps (22) and by tightening machine screws (15).

d. Replace Antenna Dish.

NOTE

Before assembly, bushings should be cleaned with a good commercial solvent (refer to the cleaning section). A thin P coating of aircraft grease, MIL-G-3278A, should be applied to the four nylon bearings (28, fig. 6-17) and the four dowel pins (26, fig. 6-17; 15, fig. 6-16) for the antenna dish mounting supports (refer to fig. 6-9).

NOTE

Refer to figure 6-17 in performing (1) through (5) below.

(1) Install elevation indicator (5) on mounting support (30) of the dish with two machine screws (6) and two lockwashers (7).

(2) Position antenna dish (29) onto gimbal (36).

(3) Insert two dish supports (33) and two flat washers (27) for two dowel pins (26) between the mounting supports of the gimbal.

(4) Insert each of two dowel pins (26) through the metal bushing of the gimbal support and nylon bearing (28) for dish supports (33).

NOTE

Position the pins so that the outer ends protrude about 1/16 inch beyond the metal bushing.

(5) Tighten setscrew (25) in each dish support.

NOTE

Refer to figure 6-16 in performing (6) through (9) below unless otherwise indicated.

(6) Insert two mounting supports on linkage beam (172) for two dowel pins (15) between two mounting supports (33, fig. 6-17) of the dish.

NOTE

In performing (7) below, position the pins so that the outer ends protrude 1/16 inch beyond the nylon bearings.

(7) Insert each of two dowel pins (15) through nylon bearings (28, fig. 6-17) of the dish support and metal bushing (171) of linkage beam (172).

(8) Tighten setscrews (14) in bushing (171).

(9) Replace grounding strap (7) on antenna dish.

6-19. Fits and Clearances

The AS-1520A and AS-1642A Antenna drive systems tend to correct for errors which may exist in the mechanical drive assembly. Stringent clearance requirements are not applicable. If the antenna drive system operates smoothly, the fit of the parts is acceptable. During disassembly, components should be inspected as outlined in the inspection/check section. Parts showing obvious signs of wear, deformation, or deterioration should be replaced or repaired.

Section VII. TESTING

6-20. GENERAL.

This section presents the method for bench testing the AS-1520A and AS-1642A Antennas. Complete tests should be performed after any repair to ensure that the malfunction has been corrected and that no other malfunctions exist.

The antenna test uses the AN/APM-247 (978G-1) Radar Test Set. The test set contains a built-in wiring harness and gyro simulator. Test procedures for testing with the test set are presented in tabular format in figure 6-13. The test set is referred to by its commercial nomenclature (978G-1) throughout the test procedure.

NOTE: The gyro pitch and roll inputs on the synchronizer used for antenna testing must be set for 50 mv/degree sensitivity. Input sensitivity is adjusted by changing taps on transformers T2 and T3 in the synchronizer. Refer to the initial installation procedures in Chapter 1 of this manual for synchronizer wiring modification.

6-21. TEST EQUIPMENT REQUIRED.

Refer to figure 6-14 for equipment required for testing the antenna.

6-22. TEST PROCEDURES USING THE AN/APM-247 (978G-1) RADAR TEST SET.

A. Test Setup.

Equipment must be set up as shown in figure 6-11. Power required is 115 volts, 400 Hz.

NOTE: A receiver-transmitter and synchronizer known to be operating properly must be used with these tests. Cover must be removed from synchronizer.

B. Preliminary Settings.

Before starting tests, perform the following steps:

(1) Set the 978G-1 controls as follows (figure 6-12):

(a) AC POWER switch to OFF.

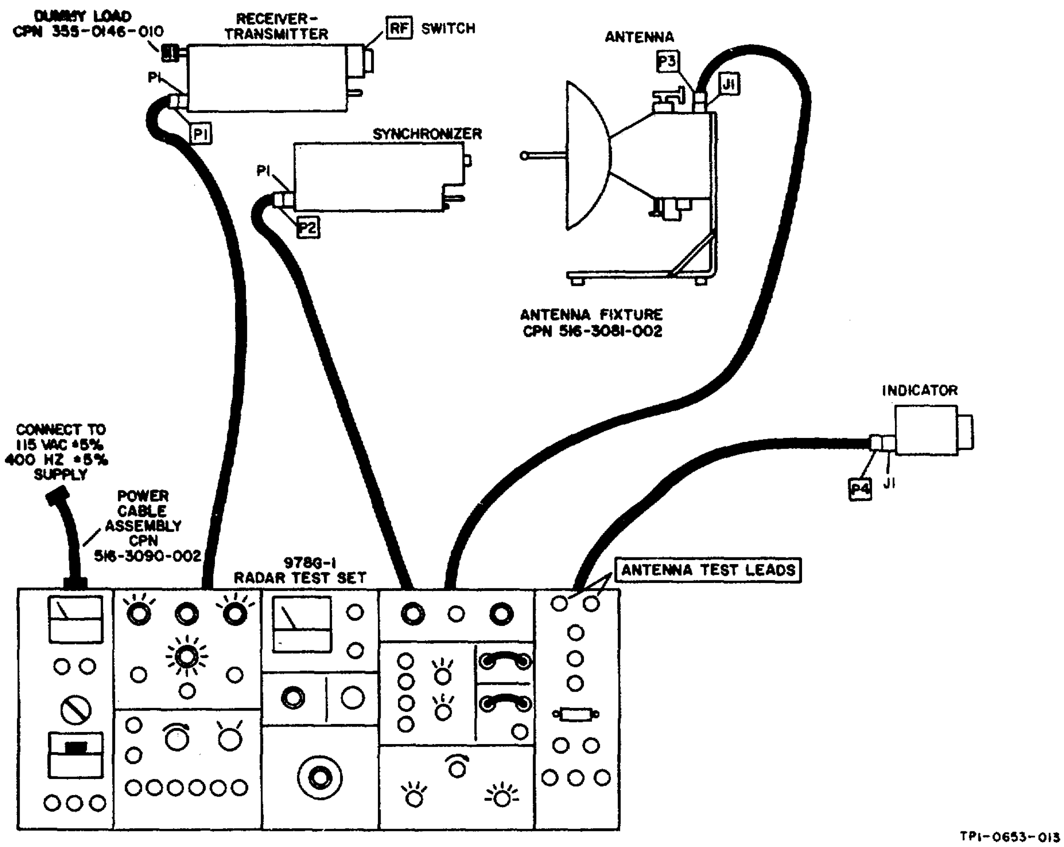
(b) METER MULTIPLIER switch to X10.

(c) INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OFF.

(d) INPUT VOLTAGE ADJUST control fully counterclockwise.

(e) RECEIVER TRANSMITTER TESTS-TEST FUNCTION switch to OFF.

(f) SYNCHRONIZER TESTS-TEST FUNCTION switch to OFF.



Antenna Test Setup
Figure 6-11

(g) ANTENNA TESTS switch to OFF,

(h) GYRO SIMULATOR switch to OFF.

(i) CONTROL UNIT TESTS-CONTROL UNIT SELECTOR switch to INT.

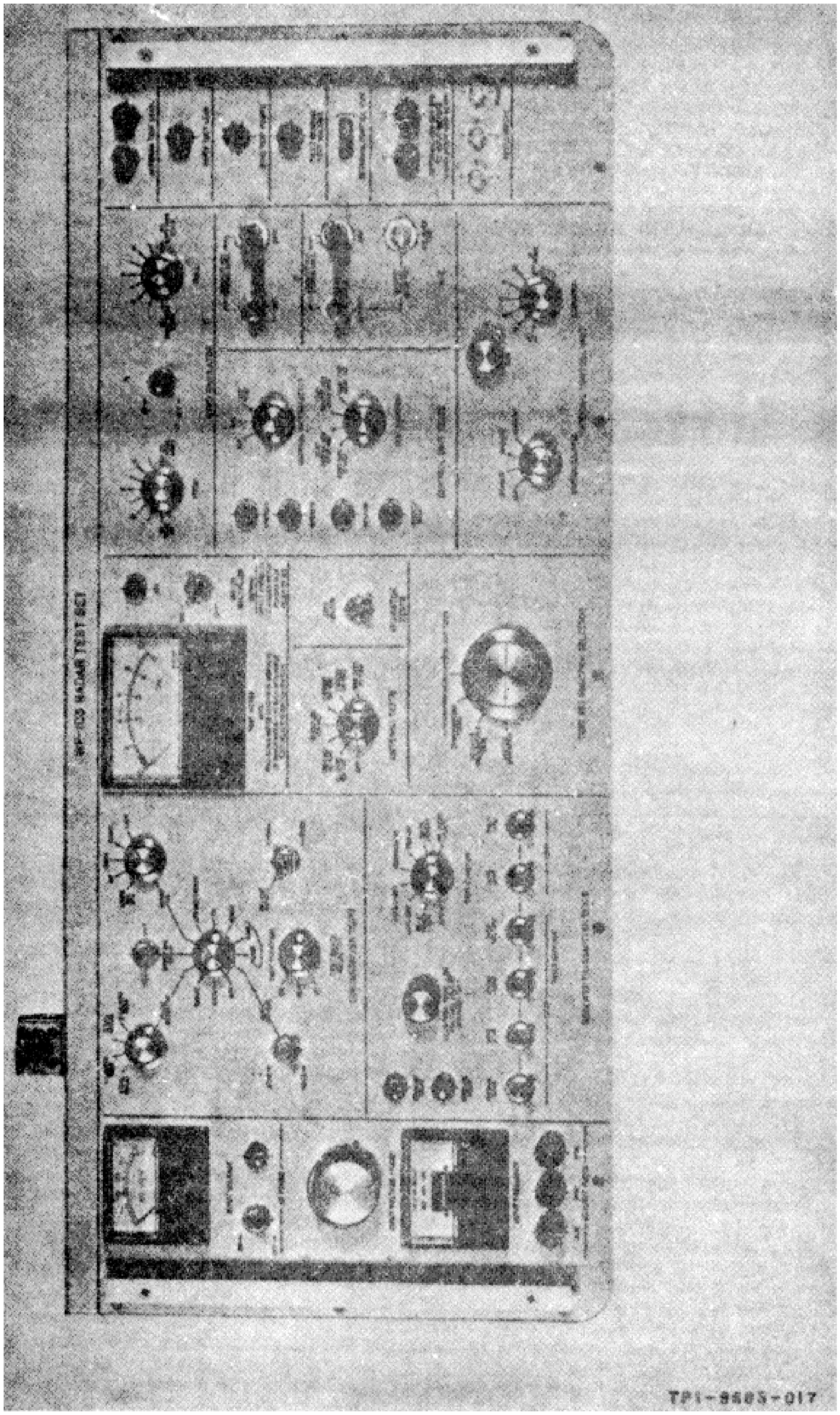
(2) Connect power cable assembly to 978G-1 test set and to 115-volt 400-Hz source.

(3) Set the RF switch on the receiver-transmitter to OFF, and connect dummy load to waveguide output connector.

(4) Set AC POWER switch on 978G-1 test set to ON. The AC POWER lamp should light.

(5) Set the INPUT VOLTAGE ADJUST control for 115 $\pm$1.0 volts as indicated on the INPUT VOLTAGE meter.

(6) The INPUT FREQUENCY meter should indicate from 395 to 405 Hz.



AN/APM-247 (978G-1) Radar Test Set
Figure 6-12

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
C. (1)	Antenna rotation	(1) Set TEST SET FUNCTION SELECTOR switch to ANTENNA/ INDICATOR/CONTROL UNIT TESTS; CONTROL UNIT SELECTOR switch to INT; SYSTEM CONTROL switch to OPERATE; and ANTENNA TESTS switch to OFF.		
(2)		(2) Set antenna SCAN/OFF switch to SCAN.		(2) Antenna scans at the rate of 30 ±3 scan cycles per minute.
(3)			(3) Observe that rotation of manual scan adjust knob is counter-clockwise when viewed from below.	
(4)			(4) Observe that azimuth motion of antenna is not less than 58 degrees nor more than 61 degrees either side of dead-ahead position.	
(Cont)				

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 1 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
C. (Cont)				
(5)		(5) Set antenna SCAN/OFF switch to OFF and SYSTEM CONTROL switch to STANDBY.	(5) Lay antenna on base. Manually position dish so azimuth and elevation pointers correspond to their respective zero scribe marks. Verify alignment of pointers by measuring from rim of dish to flat surface at base of antenna. If dish is not parallel to flat surface, place it parallel and reposition pointers to zero scribe marks.	
D.(1)	Elevation synchro	(1) Set TEST SET FUNCTION SELECTOR switch to ANTENNA/ INDICATOR/ CONTROL UNIT TESTS; CONTROL UNIT SELECTOR switch to INT; SYSTEM CONTROL switch to OPERATE; and ANTENNA TESTS to EL SYNC.		
(Cont)				

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 2 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
D. (Cont)				
(2)			(2) Connect test leads from ANTENNA TEST LEADS jacks to TRIM SENS jacks (J3 and J4) on antenna.	
(3)			(3) Set primary input voltage as indicated on INPUT VOLTAGE meter to 115 ±0.5 volts ac using INPUT VOLTAGE ADJUST control on test set.	
(4)		(4) Set METER MULTIPLIER switch to X1.	(4) The TEST METER should indicate 17 ±0.5 volts. If necessary, adjust R1 on antenna. WARNING: EXERCISE CARE IN MAKING THE ABOVE ADJUSTMENT. 115 VOLTS IS PRESENT ON TERMINALS OF RESISTOR R1. AN INSULATED SCREWDRIVER SHOULD BE USED TO PREVENT ACCIDENTAL SHORTING. NOTE: To remove 115 volts ac from R1 during mechanical adjustment, set SYSTEM CONTROL switch to STANDBY. Return switch to OPERATE to apply power and make voltage measurements.	
(5)			(5) Disconnect test leads from ANTENNA TEST LEAD jacks and TRIM SENS jacks (J3 and J4).	
(6) (Cont)		(6) Ensure that GYRO SIMULATOR switch is in OFF position.		

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 3 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
D. (Cont)				
(7)		(7) Set TEST SET FUNCTION SELECTOR switch to ANTENNA/INDICATOR/CONTROL UNIT TESTS; CONTROL UNIT SELECTOR switch to INT; SYSTEM CONTROL switch to OPERATE; ANTENNA TESTS switch to EL SYNC; and GYRO SIMULATOR switch to OFF.	(7) Set INTERNAL CONTROL UNIT-ELEVATION control to zero. If necessary, loosen locking screws and position tilt synchro (B1) on antenna for proper alignment of marks. Retighten locking screws being careful not to disturb setting.	(7) Observe that the elevation indicator at side and to the rear of antenna dish is in alignment with center scribe mark on gimbal.
(8)			(8) Set INTERNAL CONTROL UNIT-ELEVATION control to 10 degrees UP and return to 0.	(8) Observe that antenna dish moves up and returns.
E. (1)	Pitch and roll resolver alignment	(1) Set ANTENNA TESTS switch to TRIM ADJ.		
(2)		(2) Set GYRO SIMULATOR switch to ON.		
(3) (Cont)		(3) Set GYRO SIMULATOR-ROLL control to zero.		

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 4 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
E. (Cont)				
(4)		(4) Set GYRO SIMULATOR-PITCH control to 20 degrees NOSE DOWN.		(4) Antenna should move up to compensate for PITCH control position.
(5)			(5) Position antenna 60 degrees left as viewed from front. Set GYRO SIMULATOR-ROLL control to 20 degrees RIGHT WING DOWN. If necessary, rotate pitch-roll resolver B3 on antenna 180 degrees and repeat steps (4) and (5).	(5) Antenna should move up to compensate for ROLL control position.
(6)		(6) Set GYRO SIMULATOR switch to OFF.		
(7)		(7) Set TEST SET FUNCTION SELECTOR switch to ANTENNA/INDICATOR/ CONTROL UNIT TESTS; CONTROL UNIT SELECTOR switch to INT; SYSTEM CONTROL switch to OPERATE; ANTENNA TESTS switch to TRIM ADJ; AND GYRO SIMULATOR switch to OFF.	(7) Connect test leads from ANTENNA TEST LEADS jacks to J10 and J11 on antenna.	
(Cont)				

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 5 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
E. (Cont)				
(8)			(8) Position antenna in a dead-ahead position, and adjust PITCH TRIM potentiometer R7 on antenna for minimum voltage as indicated on TEST METER.	
(9)		(9) Set GYRO SIMULATOR switch to ON.		
(10)			(10) Connect multimeter between J8 and J9 on antenna, and adjust GYRO SIMULATOR-PITCH control for 0 volts ac reading on multimeter.	
(11)			(11) Set GYRO SIMULATOR-ROLL control maximum clockwise. If necessary, rotate resolver B3 on antenna until null occurs at the dead-ahead position of antenna. Lock resolver in this position.	(11) Observe that as antenna is moved in azimuth, a null occurs in the dead-ahead position as indicated on the multimeter.
(12) (Cont)			(12) Disconnect test leads from antenna.	

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 6 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
F.(1)	Elevation position accuracy.	(1) Set TEST SET FUNCTION SELECTOR switch to ANTENNA/INDICATOR/CONTROL UNIT TESTS; CONTROL UNIT SELECTOR switch to INT; SYSTEM CONTROL switch to OPERATE and ANTENNA TESTS switch to TRIM ADJ.		
(2)		(2) Set GYRO SIMULATOR switch to ON.		
(3)		(3) Set GYRO SIMULATOR-PITCH control to 20 degrees NOSE UP.	(3) Measure ac voltage between PITCH HI (J14) and LO(J15) on synchronizer, using a multimeter. Adjust GYRO SIMULATOR-PITCH control for a reading of 5.0 ±0.25 volts ac.	
(4)			(4) Remove meter leads and connect jumper wire between ROLL HI (J13) and LO (J15) on front of synchronizer.	
(5)		(5) Set GYRO SIMULATOR-ROLL control to 0.		
(6)			(6) Position antenna dead ahead.	
(7)			(7) Place combination square against antenna dish. Be careful not to displace dish with pressure of square.	(7) Level bubble on combination square should indicate 10 ±2 degrees down in elevation axis with respect to 0-degree pitch position of dish.
(Cont)				

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 7 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
F. (Cont)				
(8)		(8) Set GYRO SIMULATOR-PITCH control to 0.		
(9)		(9) Set TEST SET FUNCTION SELECTOR switch to ANTENNA/INDICATOR/CONTROL UNIT TESTS; CONTROL UNIT SELECTOR switch to INT; SYSTEM CONTROL switch to OPERATE; ANTENNA TESTS switch to TRIM ADJ; GYRO SIMULATOR switch to ON; and GYRO SIMULATOR-PITCH control to 0.	(9) Remove jumper connected in step (4) and connect it between PITCH HI (J14) and GROUND (J35) on synchronizer.	
(10)		(10) Set GYRO SIMULATOR-ROLL control to 20 degrees RIGHT WING DOWN.	(10) Adjust GYRO SIMULATOR-ROLL so that 5.0 ±0.25 volts ac is measured between ROLL HI (J13) and LO (J15) on synchronizer.	
(11)			(11) Position antenna dish to 60 degrees right as viewed from front.	(11) Level bubble on combination square should indicate 0.87 of the reading obtained in step (7) ±0.5 degrees shown in elevation axis.
(Cont)				

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 8 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
F.(12)			(12) Remove jumper wire connected in step (9).	
(13)		(13) NOTE: If antenna is to be used in aircraft without perpendicular antenna mounting, perform this step with the antenna mounted on the aircraft.	(13) Set gyro simulator pitch and roll controls to 0. Position antenna dish straight ahead. Adjust PITCH TRIM potentiometer R7 for desired elevation angle of antenna mounted on aircraft on which antenna is used.	
G.(1)	Rate adjustment	(1) Set TEST SET FUNCTION SELECTOR switch to ANTENNA/INDICATOR/CONTROL UNIT TESTS; CONTROL UNIT SELECTOR switch to INT; SYSTEM CONTROL switch to OPERATE; ANTENNA TESTS switch to TRIM ADJ; and GYRO SIMULATOR switch to OFF.	(1) Rapidly move antenna dish up and down using INTERNAL CONTROL UNIT-ELEVATION control.	Observe that antenna dish does not overshoot or oscillate.
(2)			(2) If antenna dish overshoots or oscillates, adjust RATE potentiometer R4 on antenna for proper operation of dish.	
H.(1)	Sweep excitation	(1) Set ANTENNA TESTS switch to SWEEP EXC.		(1) TEST METER should indicate 35 ±5 volts. Record voltage.
I.(1) (Cont)	Sweep resolver alignment	(1) Set ANTENNA TESTS switch to Y SWEEP.	(1) Sweep antenna dish about dead ahead position, using MANUAL SWEEP ADJUST control.	

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 9 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
I.(2)			(2) Monitor ac voltage between X SIG and GROUND (synchronizer test points) for null of 50 mv or less with antenna in dead ahead position.	
(3)			(3) If necessary, loosen screws holding resolver B4 and rotate for null (50 mv or less) with antenna in dead ahead position.	
(4)			(4) Set antenna SCAN switch to SCAN and observe IP-724A/APN-158 display. If display sweep is opposite to normal display, loosen clamps around B4 and rotate B4 180°. Repeat steps (1), (2), and (3).	
J.(1)	X sensitivity adjustment	(1) Set TEST SET FUNCTION SELECTOR switch to ANTENNA/INDICATOR/CONTROL UNIT TESTS; CONTROL UNIT SELECTOR switch to INT; SYSTEM CONTROL switch to OPERATE; ANTENNA TESTS switch to X SWEEP; and GYRO SIMULATOR switch to OFF.	(1) Loosen bracket on sweep resolver B4 on antenna and position it to make contact with case of pitch-roll resolver B3. Secure bracket in place.	
(2) (Cont)			(2) Loosen three screws that secure resolver B4 in place. (Mark original position of B4.) Rotate B4 until other end of bracket makes contact with case of resolver B3. Resolver B4 has now been rotated 90 degrees from its original position.	

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 10 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
J.(3)			(3) Position antenna dish straight ahead. Monitor ac voltage between X SIG and GROUND with vtvm. Voltage should be 0.303 times the voltage recorded in step H. If not, adjust X OUT potentiometer R6 on antenna to obtain this value.	
K.(1)	Y sensitivity adjustment	(1) Set ANTENNA TESTS switch to Y SWEEP.		
(2)			(2) Rotate resolver B4 on antenna back to its original position and secure in place. Check for null as in step I.(2).	
(3)		(3) Set TEST SET FUNCTION SELECTOR switch to ANTENNA/INDICATOR/CONTROL UNIT TESTS; CONTROL UNIT SELECTOR switch to INT; SYSTEM CONTROL switch to OPERATE; ANTENNA TESTS switch to Y SWEEP; and GYRO SIMULATOR switch to OFF.	(3) Position antenna dish straight ahead. Monitor ac voltage between Y SIG and GROUND with vtvm. Voltage should be same as in step J.(3). If necessary, adjust Y OUT potentiometer R9 on antenna for proper indication on vtvm.	
L.(1)	Resolver tune	(1) Set ANTENNA TESTS switch to RES TUNE.		(1) The TEST METER should indicate not more than 3.0 volts.
M.(1) (Cont)	Manual elevation	(1) Set GYRO SIMULATOR switch to OFF.		

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 11 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
M.(2)		(2) Set INTERNAL CONTROL UNIT-ELEVATION control to 0 degree.	(2) With combination square, ensure that antenna dish is level as measured in step F.(7).	
(3)		(3) Set INTERNAL CONTROL UNIT-ELEVATION control to 15 degrees UP.		(3) The combination square should indicate 7-1/2 ±1 degrees of elevation with respect to reading obtained in step (2).
(4)		(4) Set INTERNAL CONTROL UNIT-ELEVATION control to 15 degrees DOWN.		(4) The combination square should indicate 7-1/2 ±1 degrees of elevation with respect to reading obtained in step (2).
N.(1)	Limits	(1) Set INTERNAL CONTROL UNIT-ELEVATION control to 15 degrees DOWN.		
(2) (Cont)		(2) Set GYRO SIMULATOR switch to ON. Set GYRO SIMULATOR-PITCH control to 15 degrees NOSE UP. Set TEST SET FUNCTION SELECTOR switch to ANTENNA/INDICATOR/		(2) Observe combination square to see that antenna dish elevation movement is not less than 12 degrees from that recorded in

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 12 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
N.(2) (Cont)		CONTROL UNIT TESTS; CONTROL UNIT SELECTOR switch to INT; SYSTEM CONTROL switch to OPERATE; ANTENNA TESTS switch to RES TUNE; GYRO SIMULATOR switch to ON; and GYRO SIMULATOR-PITCH control to 15 degrees NOSE UP.		step M.(2). If necessary, adjust rubber stops on antenna.
(3)		(3) Set INTERNAL CONTROL UNIT-ELEVATION control to 15 degrees UP.		
(4)		(4) Set GYRO SIMULATOR-PITCH control to 15 degrees NOSE DOWN.		(4) Observe combination square to see that antenna dish elevation movement is not less than 12 degrees from that recorded in step M.(2).
(5) (Cont)			(5) Rapidly move INTERNAL CONTROL UNIT-ELEVATION control between 15 degrees UP and 15 degrees DOWN.	(5) Observe that antenna dish or tilt linkage does not strike gimbal.

NOTE:

It is not necessary to perform the remaining steps of the test procedure unless the rotary coupler has been disassembled.

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 13 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
O.(1)	Blanking switch adjustment	(1) Set SYSTEM CONTROL switch to STANDBY.	(1) Set multimeter for use as an ohmmeter and connect leads to terminals of blanking switch.	
				(2) Check that switch closes when antenna is at azimuth angle greater than 60 degrees right and also greater than 60 degrees left. Reposition cam if necessary.
P.(1)	Rotary coupler adjustment	(1) Connect equipment as shown in figure 6-15. NOTE: Do not connect antenna to slotted section at this time.		
(2)		(2) Set the test equipment controls as follows: 978G-1; TEST SET FUNCTION SELECTOR switch to SYSTEM OPERATION, SYSTEM CONTROL switch to STANDBY, AC POWER switch to ON, and allow the equipment to warm up for a minimum of 10 minutes.		
(Cont)				

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 14 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
P. (2) (Cont)		AN/USM-37A; INPUT SELECTOR switch to XTAL 200 Ω, RANGE switch to 30, METER SCALE switch to NORMAL and GAIN control to maximum cw. X382A (FSN 6625-602-2089); Variable attenuator to 20 dB. FR 126( )/U; Frequency meter to 9500 MHz. 620A (FSN 6625-553-1465); MOD SELECTOR switch to OFF, ZERO SET control to obtain zero position on POWER SET meter, MOD SELECTOR switch to CW, POWER SET control to position pointer on POWER SET meter on 0 dB (red line), OUTPUT ATTEN control to 0 dB, SIGNAL FREQUENCY control to 9375 MHz, MOD SELECTOR switch to ⊓⊔ (square wave), and SYNC SELECTOR switch to X10. Vary the PULSE RATE control until the		

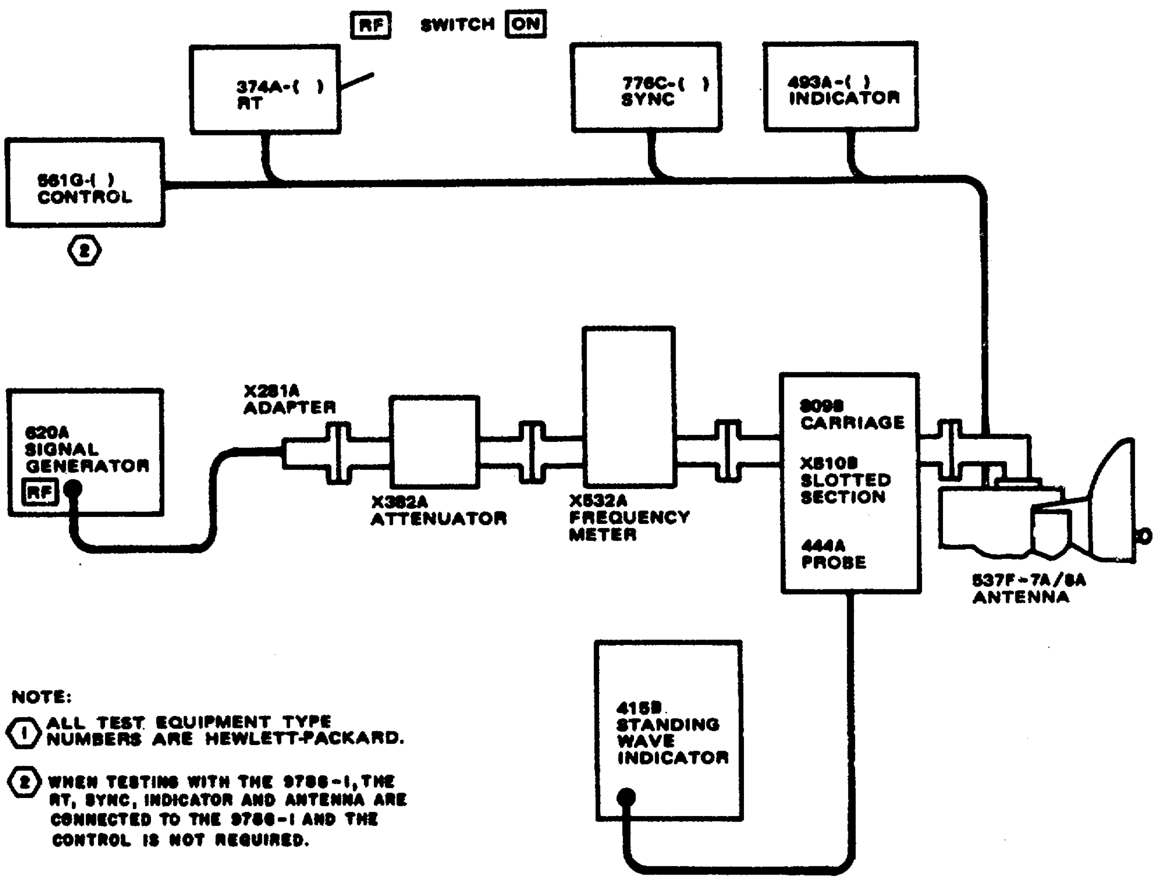
Test Procedures Using AN/APM-247 Radar Test Set (Sheet 15 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
P. (2) (Cont)		AN/USM-37A meter peaks at a maximum (the AN/USM-37A filter network requires a frequency of 1000 Hz ±2%).		
(3)		(3) Adjust the FR-126( )/U until a dip occurs in the 415B meter indication.		(3) The dip should occur at 9375 ±5 MHz. If so, proceed to step (5). If the dip did not occur, proceed to step (4).
(4)		(4) Set the FR-126( )/U to 9375 MHz and vary the 620A SIGNAL FREQUENCY control.		(4) A dip should occur in the AN/USM-37A meter indication.
(5)			(5) Rotate the FR-126( )/U frequency control knob to at least one-fourth turn from the resonance setting.	
(6)		(6) Connect the antenna to the UG-1106/USM-37 Slotted Section.	(6) Carefully align the waveguide sections to prevent standing waves due to the waveguide joint.	
(7)			(7) Move the probe carriage along the UG-1106/USM-37.	(7) A peak indication should occur on the AN/USM-37A meter.
(8)		(8) Set the AN/USM-37A GAIN control to nearby maximum.	(8) Vary the input signal level with the FR-126( )/U until an indication of 1 is obtained on the SWR scale of the AN/USM-37A meter.	
(Cont)				

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 16 of 17)
Figure 6-13

STEP	TEST	INSTRUCTIONS	PROCEDURES/ADJUSTMENTS	RESULTS/ COMMENTS
P. (Cont)				
(9)			(9) Move the probe carriage along the UG-1106/USM-37 until a minimum indication is obtained on the AN/USM-37A meter.	(9) The swr must be less than 1.5. If the swr is greater than 1.5, proceed to step (10).
(10)			(10) Refer to figure FO-13. Loosen the holddown screws and tighten the spacing setscrews, or loosen the spacing setscrews and tighten the holddown screws as required to obtain a swr of 1.5 or less (ideally, 1.0). Repeat the test procedures beginning with step P. (1).	

Test Procedures Using AN/APM-247 Radar Test Set (Sheet 17 of 17)
Figure 6-13



NOTE:

1 ALL TEST EQUIPMENT TYPE NUMBERS ARE HEWLETT-PACKARD.

2 WHEN TESTING WITH THE 978G-1, THE RT, SYNC, INDICATOR AND ANTENNA ARE CONNECTED TO THE 978G-1 AND THE CONTROL IS NOT REQUIRED.

HP TYPE	MILITARY NOMENCLATURE
415B	AN/USM-37A
809B	MX-1545/USM-37
X810B	UG-1106/USM-37
444A	MX-1546/USM-37
X532A	FR-126( )/U
X382A	FSN 6625-602-2089
X281A	FSN 5985-553-6082
620A	FSN 6625-553-1466

TPI-9512-019

Test Setup for AS-1520A (AS-1642A)/APN-158 Antenna Rotary Coupler Adjustments
Figure 6-14

Section VIII. STORAGE INSTRUCTIONS

This section presents instructions for storage of the AS-1520A and AS-1624A Antennas. Before storage, clean dirt, grease, and moisture from the antenna and cover the open end of the waveguide. If the antenna is to be stored for an extended period of time, place the unit in the original shipping carton and store the unit in a clean, dry area where the possibility of impact damage is minimized.

Section IX. SPECIAL TOOLS AND TEST EQUIPMENT

6-23. GENERAL.

This section presents a list of special tools and test equipment required to test and/or overhaul the AS-1520A and AS-1624A Antennas.

6-24. TEST EQUIPMENT REQUIRED.

Figure 6-14 lists the equipment and test fixtures required to test and/or overhaul the AS-1520A and AS-1624A Antennas. While substitution of other equipment is not recommended, other equipment may be used if it equals or exceeds the specifications of the equipment listed. Nomenclatures shown in parentheses identify commercial equipment equivalent to the military units described. Tests may be performed with either equipment.

EQUIPMENT	MANUFACTURER AND TYPE OR PART NUMBER	MINIMUM SPECIFICATIONS
Items 1 through 18 are required for testing with the AN/APM-247 Radar Test Set.		
1. Radar Test Set, also contains the following: Cable assemblies as follows: CX-10242/APM-247 CX-11555/APM-247 CG-1464/U (6 ea) Adapters as follows: UG-273/U (3 ea) UG-201A/U (2 ea)	AN/APM-247 (Collins, 978G-1 Part number 522-5731-015)	
2. Antenna mounting fixture	MX-6640/APN-158 (Collins part number 516-3081-002 contained in MK-774/APN-158 Maintenance Kit)	

Test Equipment Required (Sheet 1 of 4)
Figure 6-15

EQUIPMENT	MANUFACTURER AND TYPE OR PART NUMBER	MINIMUM SPECIFICATIONS
3. Test lead (2 ea)	CX-10092/APN-158 (Collins part number 516-3088-001 contained in MK-774/APN-158 Maintenance Kit)	
4. Dummy load	DA-383/APN-158 (Collins part number 355-0146-010 contained in MK-774/APN-158 Maintenance Kit)	
5. Combination square	MX-6613/APN-158 (Collins part number 516-3075-001 contained in MK-774/APN-15 8 Radar Test Set)	
6. Synchronizer	SN-358A/APN-158 (Collins 776C-4, part number 777-1768-001)	
7. Receiver-transmitter	RT-711A/APN-158 (Collins 374A-4, part number 777-1572-001)	
8. Vacuum-tube voltmeter	ME-26A/U (Hewlett-Packard 410B)	Ac range: 1 to 100 V Accuracy: ±3% Ac input impedance: 10 megohms
9. Indicator	JP-724A/APN-158 (Collins 493A-5, part number 777-1770-001)	
10. Multimeter (vom)	AN/USM-210 (Simpson 260)	Sensitivity: 5000 ohms/Vac Voltage range: 0 to 1000 Vac Resistance range: 0 to 1000 ohms Accuracy: 3%

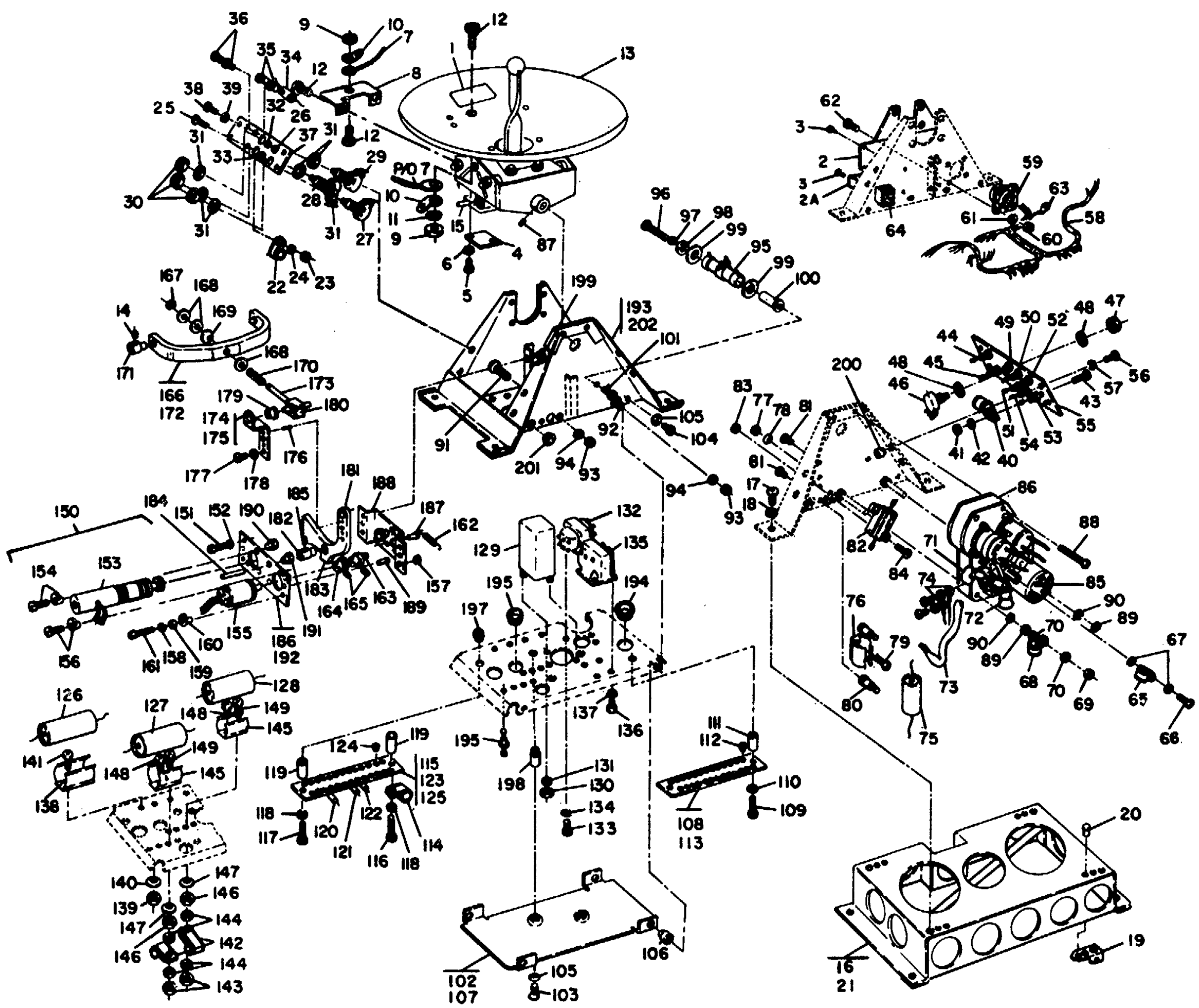
Test Equipment Required (Sheet 2 of 4)
Figure 6-15

EQUIPMENT		MANUFACTURER AND TYPE OR PART NUMBER	MINIMUM SPECIFICATIONS
11.	Standing wave ratio indicator	AN/USM-37A (Hewlett-Packard 415B)	Bandwidth: 30 Hz (nominal) Sensitivity: 0.1 µV at 200 ohms.
12.	Carriage	MX-1545/USM-37 (Hewlett-Packard 809B)	Vernier reading to 0. 1 mm
13.	Untuned probe	MX-1546/USM-37 (Hewlett-Packard 444A)	Fits carriages with 3/4-inch mounting hole Frequency range: 2. 6 to 18 GHz
14.	Slotted sections	UG-1106/USM-37 (Hewlett-Packard X810B)	Frequency range: 8.2 to 12.4 GHz Slot discontinuity resulting in swr < 1.01
15.	Frequency meter	FR-126 ( )/U (Hewlett-Packard X532A)	Frequency range: 8.2 to 12.4 GHz Accuracy: 0.08%
16.	Variable attenuator	Federal stock number 6625-602-2089 (Hewlett-Packard X382A)	Frequency range: 8.2 to 12.4 GHz Average power capacity: 10 watts Accuracy: $\pm$2%
17.	Adapter	Federal stock number 5985-553-6082 (Hewlett-Packard X281A)	Frequency range: 8.2 to 12.4 GHz Swr: 1.25
18.	Shf signal generator	Federal stock number 6625-553-1465 (Hewlett-Packard 620A)	Frequency range: 9.0 to 9.5 GHz Output power level: 0 to -127 dBm Output accuracy: 3%

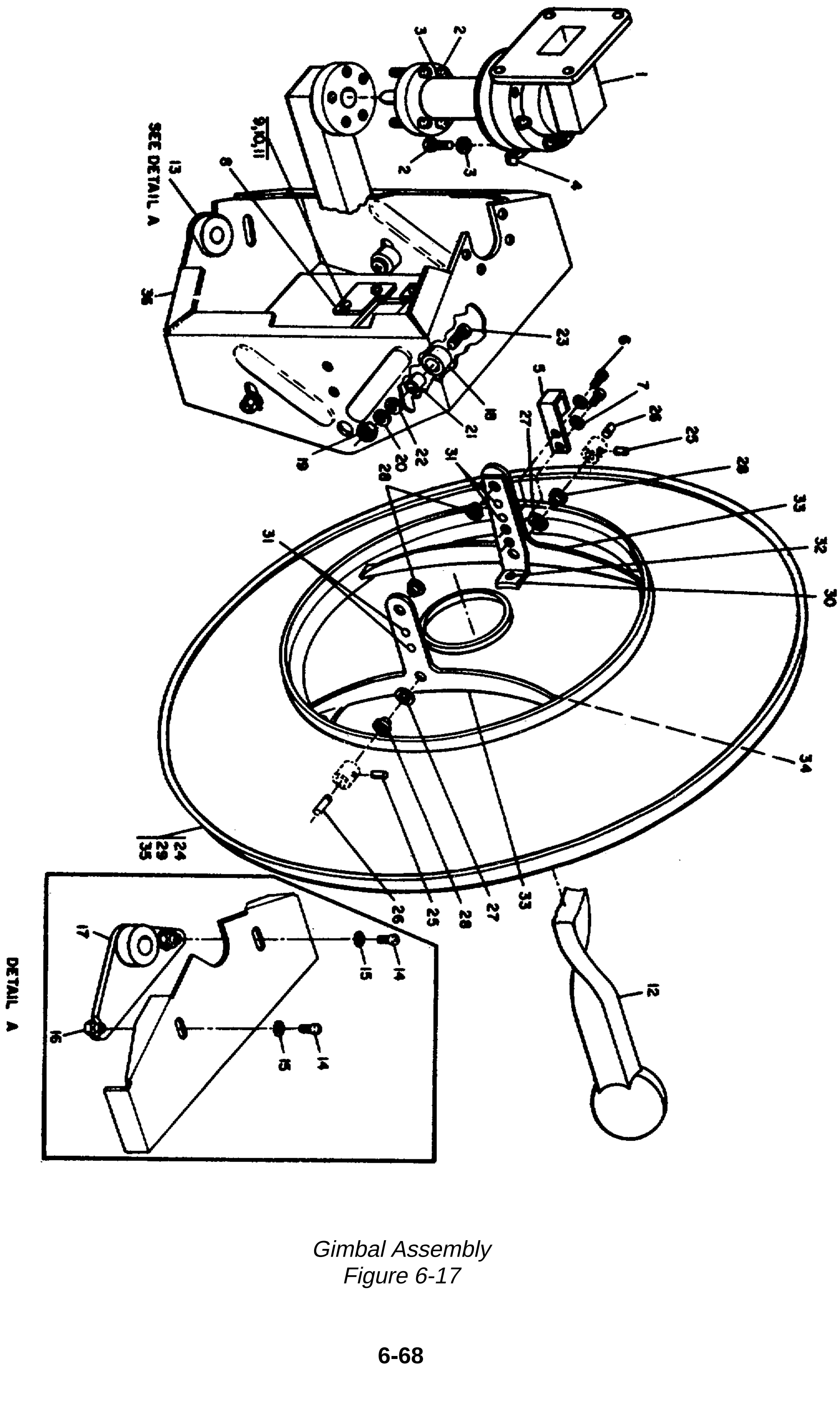
Test Equipment Required (Sheet 3 of 4)
Figure 6-15

EQUIPMENT	MANUFACTURER AND TYPE OR PART NUMBER	MINIMUM SPECIFICATIONS
18. (Cont)		Sync output signal: Positive, simultaneous with or variable from 3 to 300 µs in advance of rf pulse External sync input: Positive pulse, 5- to 20-V peak, 350 to 450 p/s External pulse modulation input: Positive, 5 to 30 V, 1- to 10-µs pulse width

Test Equipment Required (Sheet 4 of 4)
Figure 6-15



AS-1520A/APN-158 and AS-1642A/APN-158 Antenna
Figure 6-16



Gimbal Assembly
Figure 6-17

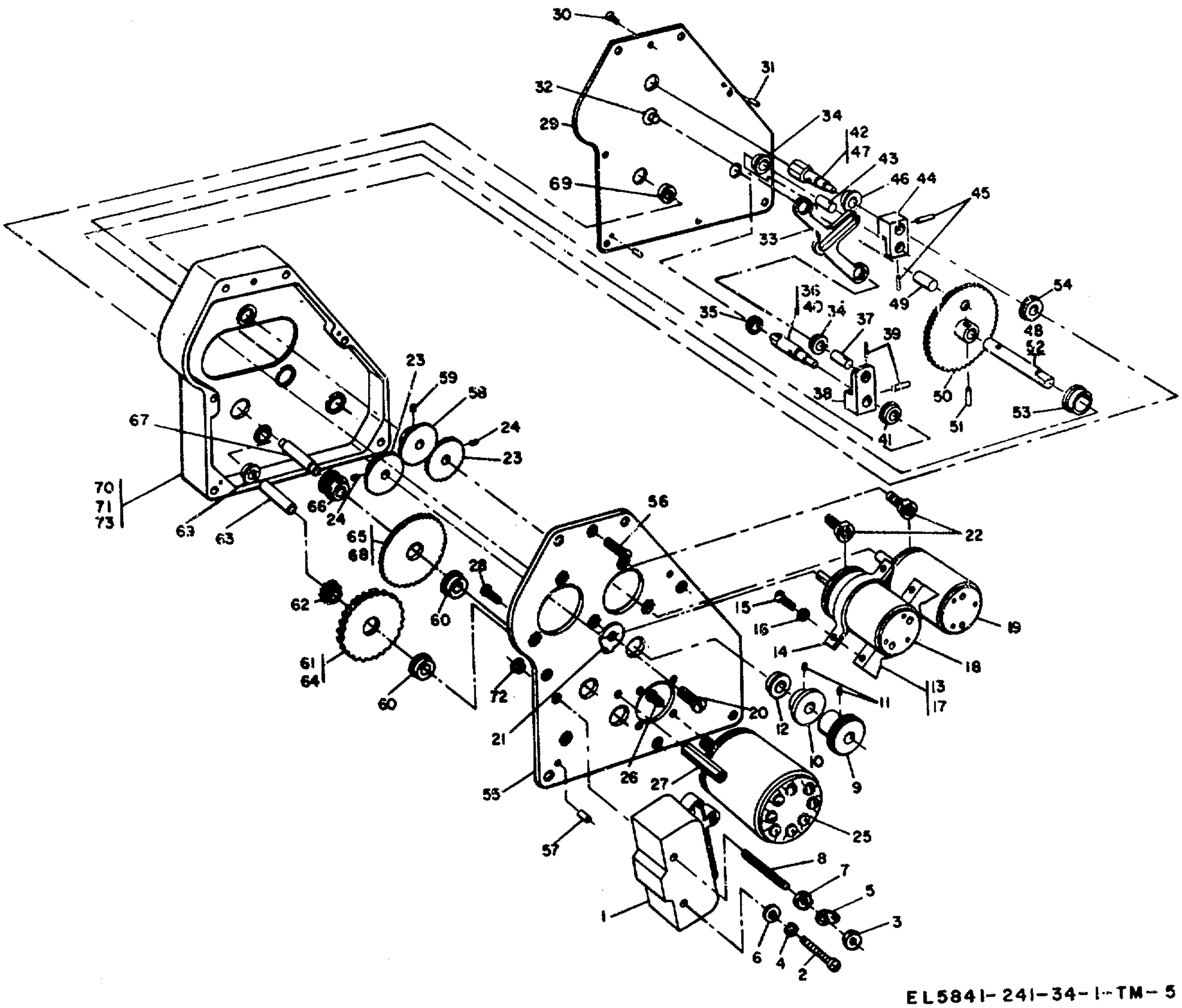


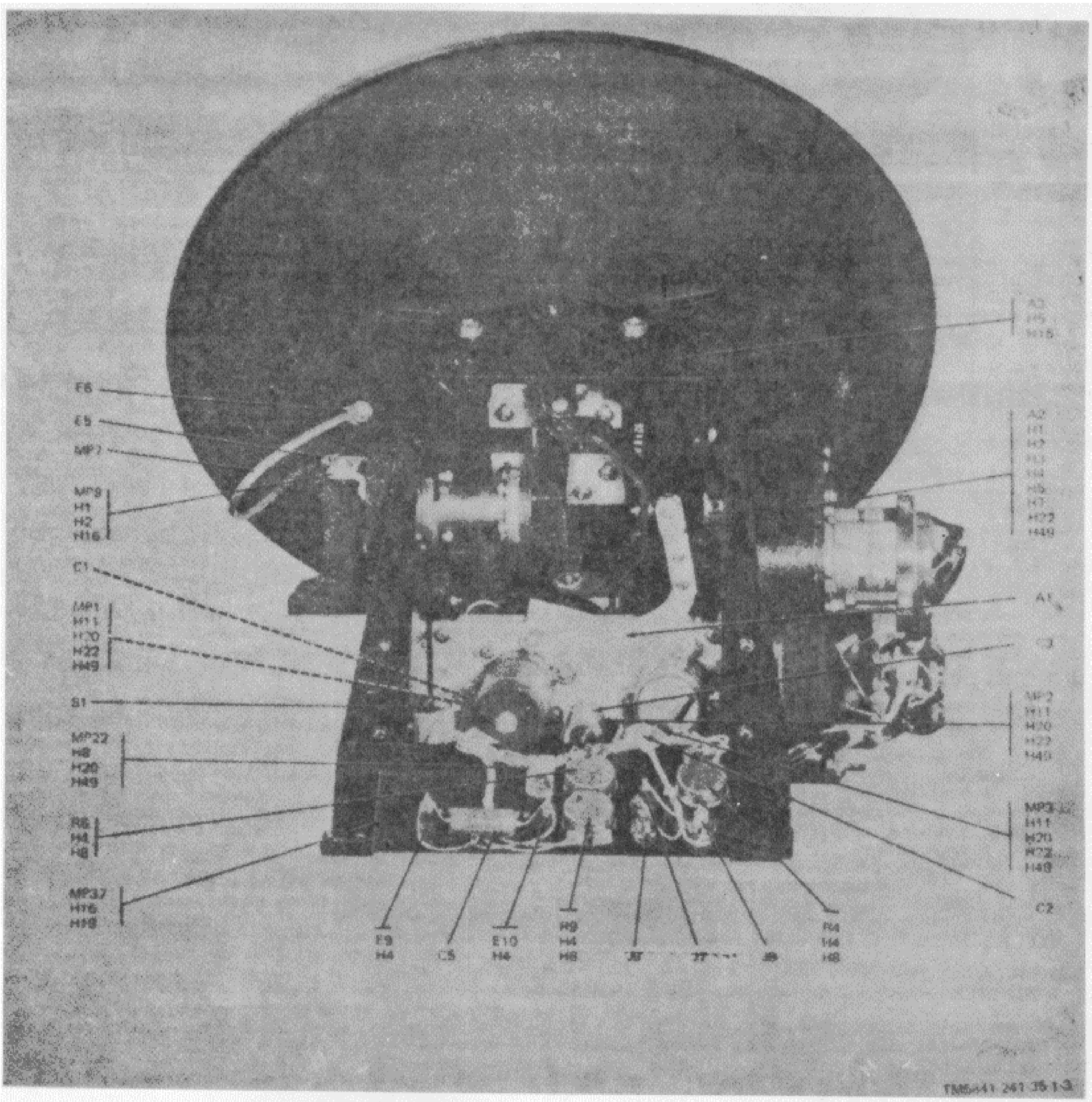
Figure 6-18. Geartrain Assembly AS-1520A/AS-1642A/APN-158, exploded view.

Section X. COMPONENTS LOCATION

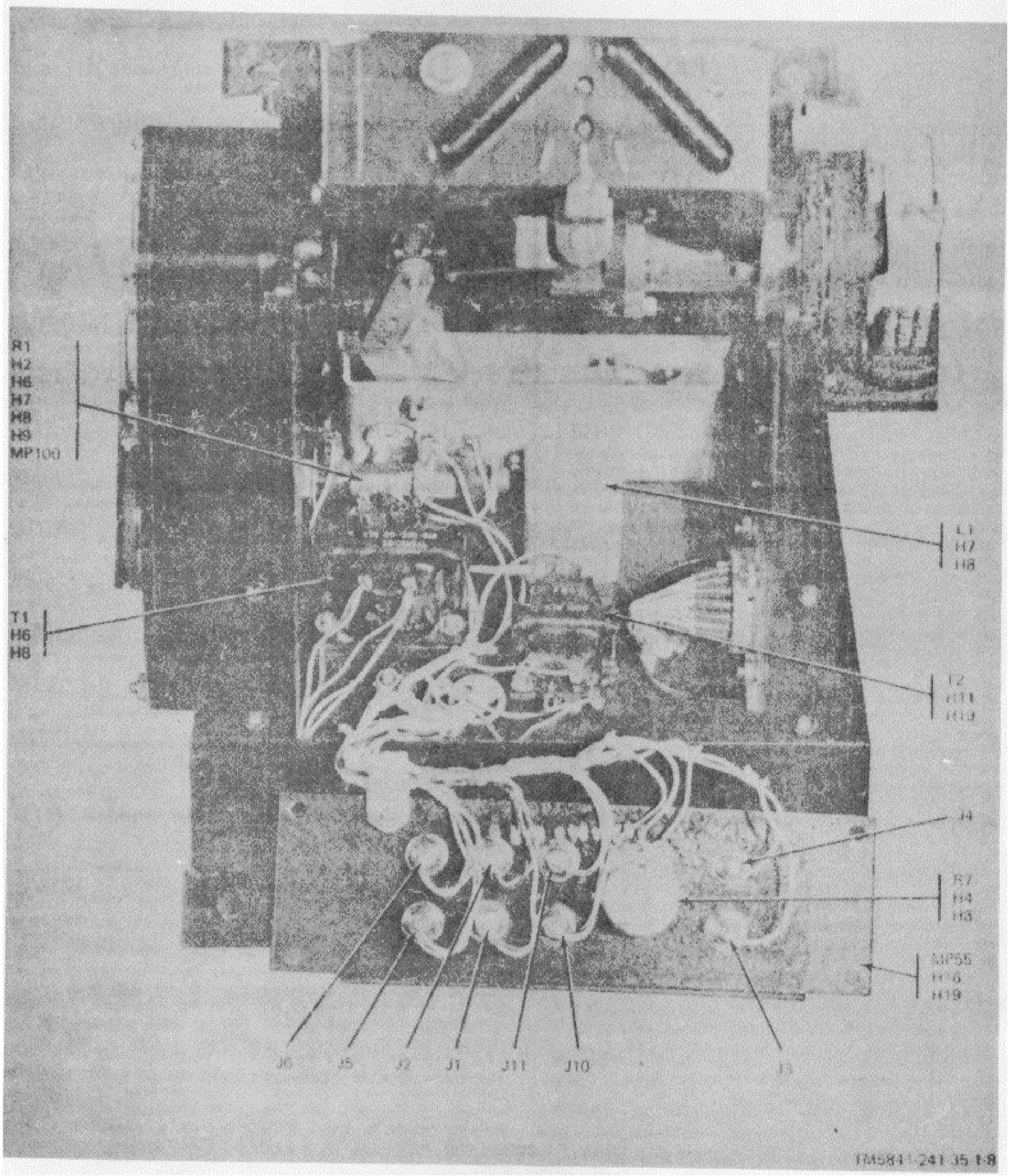
Refer to figure 6-19 for location of components comprising Antennas AS-1520A/APN-158 (AS-1642A)/APN-158.

NOTE

The AS-1520A and AS-1642A Antennas differ only in the diameter of the reflector and the length of the waveguide feeds. The two antennas are identical as far as the location of components is concerned.

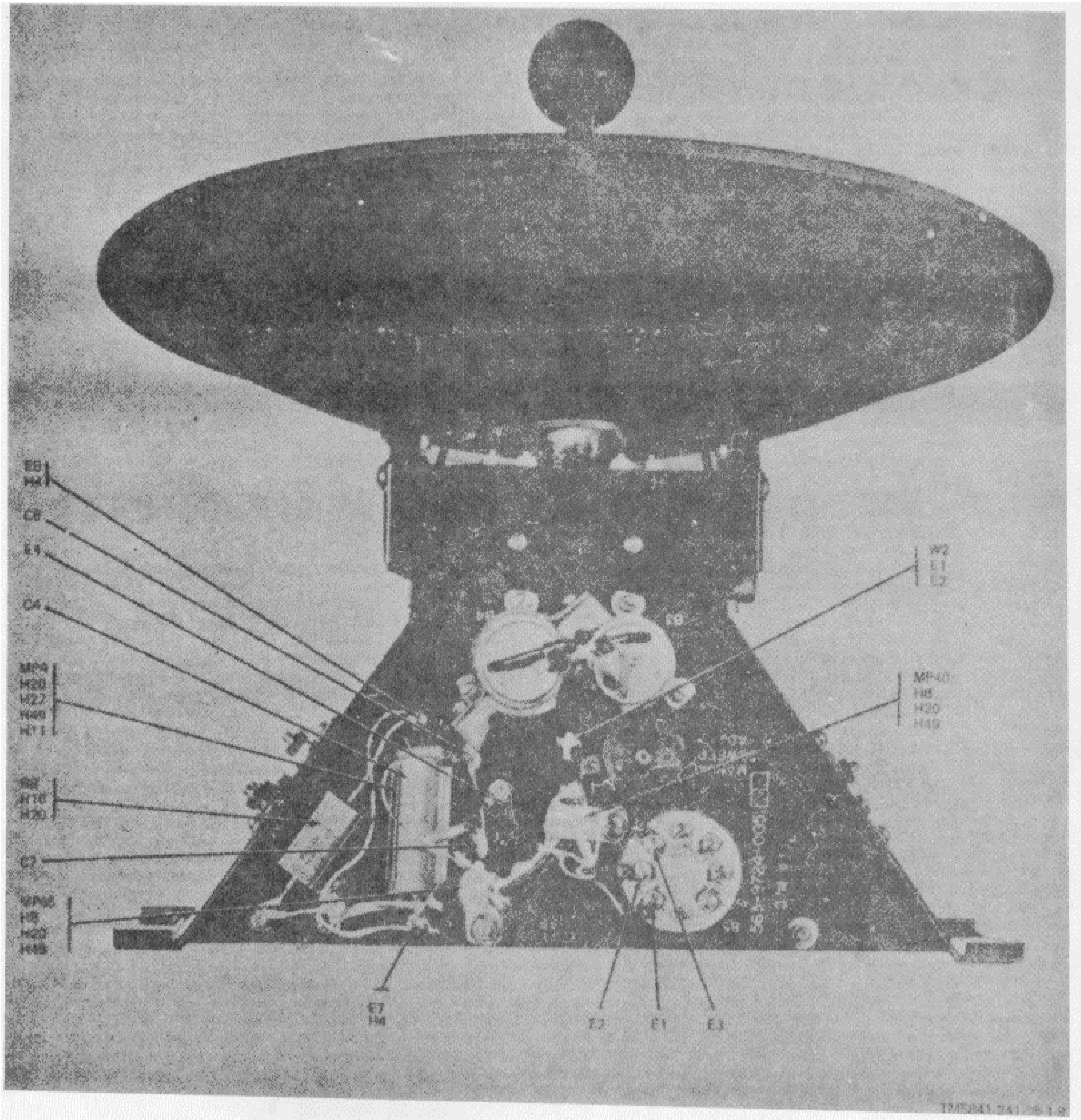


AS-1520A (AS-1642A) /APN-158 Antenna, Components Location(sheet 1 of 3).
Figure 6-19



AS-1520A (AS-1642A) /APN-158 Antenna, Components Location (sheet 2 of 3)

Figure 6-19



AS-1520A (AS-1642A) /APN-158 Antenna, Components Location (sheet 3 of 3).

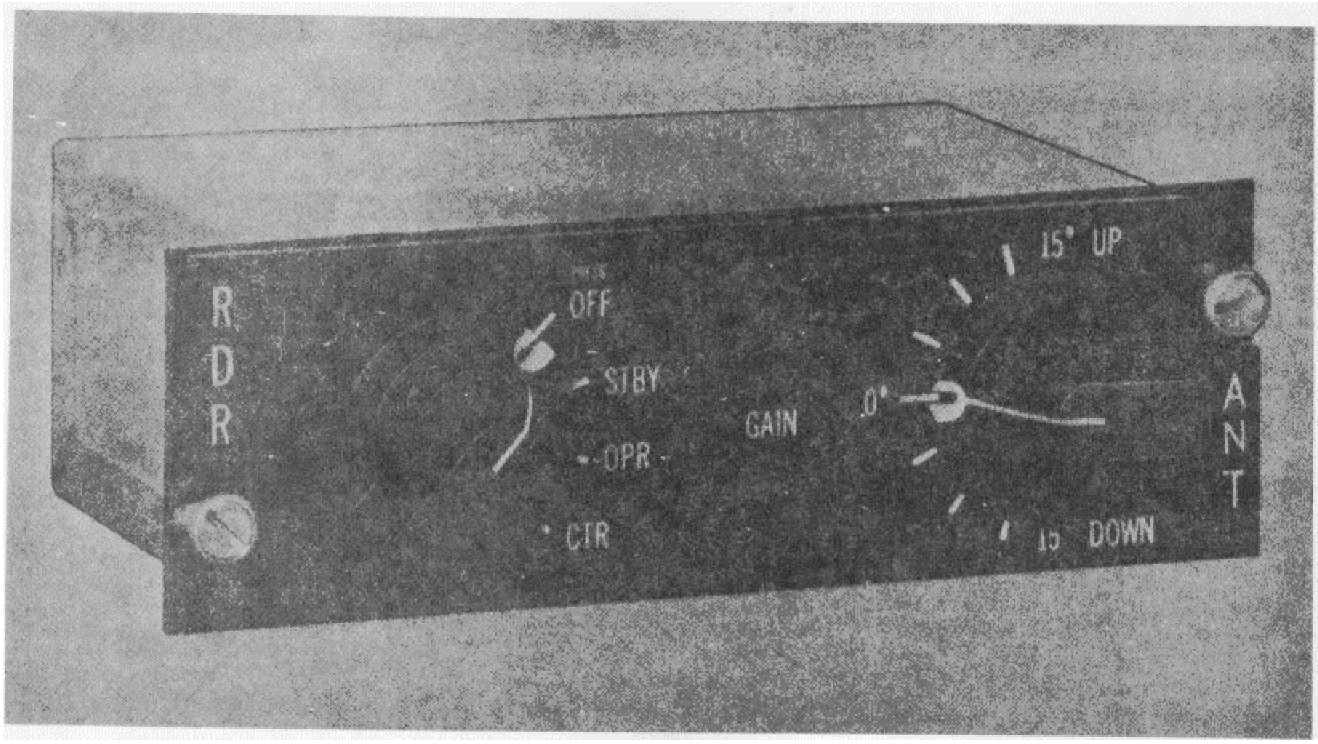
Figure 6-19

CHAPTER 7

CONTROL RADAR SET

C-4881/APN-158

(561G-4)



C-4881/APN-158 Cockpit Control Unit, Overall View
Figure 7-1

Section I. DESCRIPTION AND OPERATION

7-1. GENERAL.

This section presents the purpose of the equipment, equipment specifications, equipment description, and theory of operation. Figure 7-1 is an overall view of the C-4881/APN-158 Cockpit Control Unit. Figure 7-2 is a table of equipment covered in this manual.

EQUIPMENT	COLLINS PART NUMBER
C-4881/APN-158 Cockpit Control Unit	522-5883-004

Equipment Covered
Figure 7-2

7-2. PURPOSE OF EQUIPMENT.

The C-4881 Cockpit Control Unit provides remote control facilities for the AN/APN-158A Radar Set.

7-3. EQUIPMENT SPECIFICATIONS.

The C-4881 Cockpit Control Unit specifications are listed in figure 7-3.

CHARACTERISTIC	SPECIFICATION
Power requirements	Supplied by the AN/APN-158 Radar Set RT-711A Receiver-Transmitter
Duty cycle	Continuous
Ambient temperature range	-62°C (-79.6°F) to +71°C (+159°F)
Ambient humidity range	95 percent relative humidity at +55°C (+131°F)
Shock conditions	
Performance criteria	Eighteen 10 millisecond shocks at 7.5 g
Safety criteria	Six 10-millisecond shocks at 15 g

Equipment Specifications (Sheet 1 of 2)
Figure 7-3

CHARACTERISTIC	SPECIFICATION
Vibration	0.030 in total excursion at 10 to 55 Hz and 1.5 g peak acceleration at 55 to 500 Hz
Weight	
(561G-3)	0. 5 lb
(561G-4)	1.0 lb

Equipment Specifications (Sheet 2 of 2)
Figure 7-3

7-4. <u>EQUIPMENT DESCRIPTION</u>.

A. <u>General</u>.

This section presents a mechanical and electrical description and a description of the external operating controls for the C-4881 Cockpit Control Unit.

B. <u>Mechanical Description</u>.

The C-4881 Cockpit Control Unit consists of three controls and a panel illumination lamp mounted on an engraved aluminum panel and housed in a one-piece dust cover. The unit provides three separate controls for remotely controlling the AN/APN-158A Weather Radar System. The C-4881 provides a switch for OFF, STBY (standby), OPR (operate), and CTR (contour) modes of operation; a potentiometer for GAIN control; and a synchro for antenna elevation control. The unit is designed for overhead panel or pedestal mounting.

C. <u>Electrical Description</u>.

The electrical description is presented in paragraph B above.

D. <u>Operating Controls</u>.

The operating controls are described in paragraph B above.

7-5. <u>THEORY OF OPERATION</u>.

A. <u>General</u>.

This section presents a detailed theory of operation for the C-4881 Cockpit Control Unit.

B. Detailed Theory of Operation. (Refer to figure 7-4.)

(1) General.

The C-4881 provides remote control facilities for the AN/APN-158A Weather Radar System.

(2) C-4881 Cockpit Control Unit.

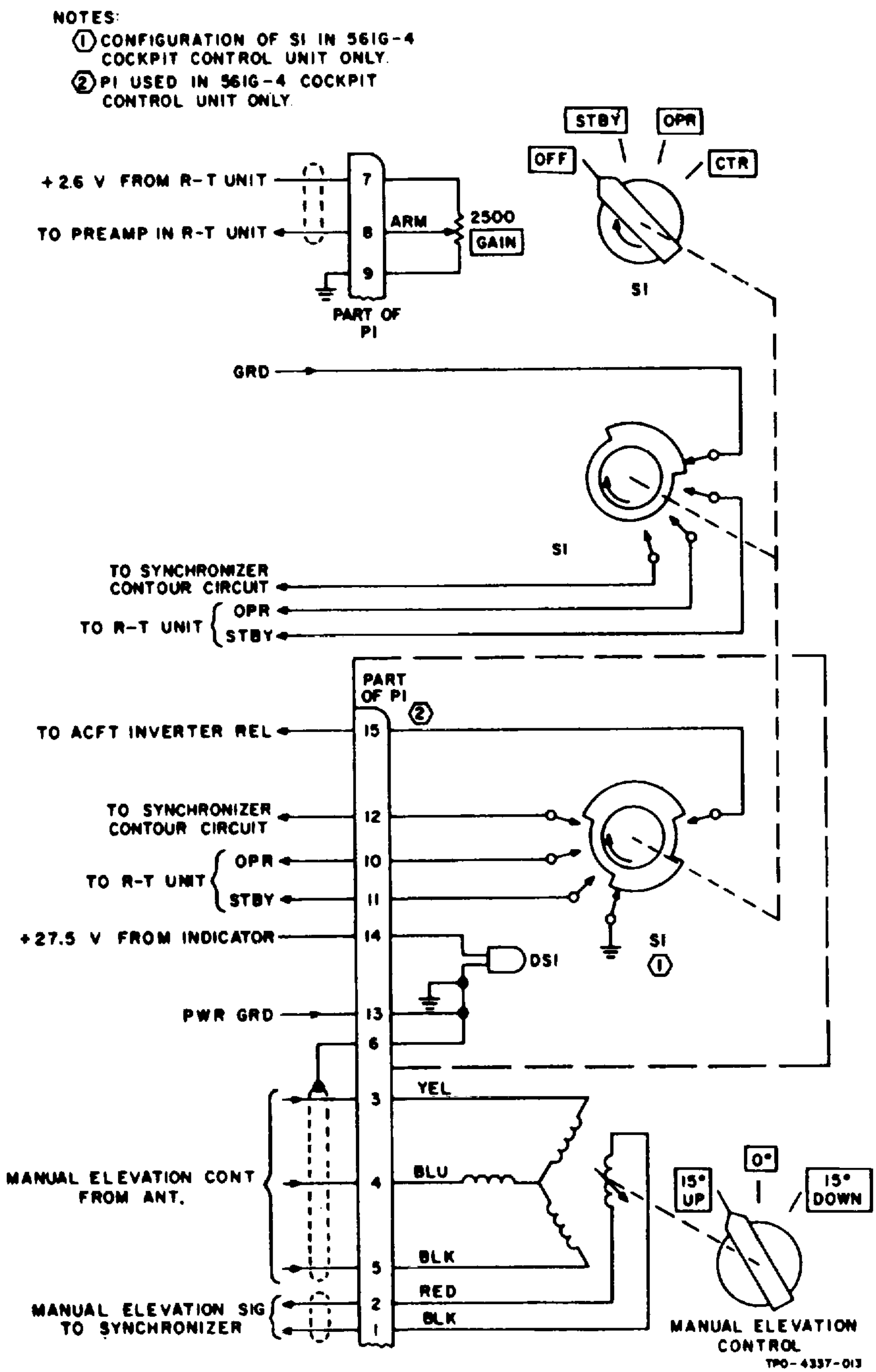
The C-4881 Cockpit Control Unit enables the operator to control the gain of the receiver if. preamplifier, the application of primary power, and the elevation of the antenna.

Switch S1 controls the application of primary power in the system. Ground is applied to the switch at all times. In the OFF position, the switch does not make contact with any of the remaining contacts, and there is no output. When the switch is in the STBY (standby) position, ground is applied through the switch to the standby relay in the receiver-transmitter unit. When the switch is in the OPR (operate) position, ground is applied through the switch to both the standby and operate relays in the receiver-transmitter unit. When the switch is in the CTR (contour) position, ground is applied through the switch to both the standby and operate relays in the receiver-transmitter unit and to the video driver module in the synchronizer.

The GAIN potentiometer controls the gain of the if. preamplifier. Positive 15 volts from the receiver-transmitter unit is applied to the high side of the 2500- ohm GAIN potentiometer. The low side of the potentiometer is connected to ground. Varying the GAIN control varies the wiper arm voltage that is coupled to the receiver-transmitter unit to control the gain of the if. preamplifier.

The manual elevation control allows the operator to position the antenna from 15 degrees above to 15 degrees below the horizontal attitude. A 400-Hz control voltage from the tilt synchro transmitter in the antenna is applied to the 3 stator windings of the manual elevation control. The control voltage corresponds to the actual physical tilt of the antenna. When the rotor of the manual elevation control synchro corresponds to the physical position of the antenna, no voltage is induced into the rotor winding. When the rotor does not correspond to the physical position of the antenna, an error signal is induced into the rotor. The error signal is applied to the elevation servo-amplifier module in the synchronizer as a correction signal, and the antenna position will change until the error signal is reduced to zero.

Positive 27.5 volts is supplied from the indicator to illuminate DS1.



C-4881/APN-158 Cockpit Control Unit, Schematic Diagram
Figure 7-4

Section II. MAINTENANCE

7-6. DISASSEMBLY.

Disassembly of the C-4881 Cockpit Control Unit is obvious, and no detailed explanation is necessary. Follow the necessary precautions given in the disassembly sections of the other chapters.

7-7. CLEANING.

Clean the C-4881 Cockpit Control Unit in accordance with the applicable procedures given in the cleaning sections of the RT-711A/APN-158 Receiver-Transmitter and the AS-1520A/APN-158 and AS-1624A/APN-158 Antenna chapters.

7-8. INSPECTION/CHECK.

Inspect the C-4881 Cockpit Control Unit in accordance with the applicable procedures given in the Inspection/check sections of the RT-711A/APN-158 Receiver-Transmitter and the AS-1520A/APN-158 and AS-1624A/APN-158 Antenna chapters.

7-9. REPAIR.

Repair the C-4881 Cockpit Control Unit in accordance with the applicable procedures given in the repair sections of the RT-711A/APN-158 Receiver-Transmitter and the AS-1520A/APN-158 and AS-1624A/APN-158 Antenna chapters.

7-10. ASSEMBLY.

Assembly of the C-4881 Cockpit Control Unit is obvious, and no detailed explanation is necessary. Follow the necessary precautions given in the assembly sections of the other chapters.

Section III. TESTING

7-11. GENERAL.

Procedures for testing the C-4881 Cockpit Control Unit with the AN/APM-247 (978G-1) Radar Test Set are given below.

A. Testing with the AN/APM-247 (978G-1) Radar Test Set.

This section presents the procedures for testing the cockpit control unit using the AN/APM-247 (978G-1) Radar Test Set. These procedures are presented in tabular form in figure 7-5. The test set is referred to by its commercial nomenclature (978G-1) throughout the test procedure.

When a malfunction is indicated, some possible causes are referenced at the appropriate test in the POSSIBLE TROUBLE AREA column. After a malfunction is corrected, the unit should be tested again to verify that repairs have not affected normal operation.

For a detailed description and maintenance instructions for the radar test set, refer to the applicable service manual.

(1) Use of Test Procedures.

Procedures to be observed in using the test procedures follow.

(a) Switches not on the test set subpanel in use are not referenced and may be in any position.

(b) The correct position of all test set switches applicable to the tests are listed at the top of the 978G-1 INSTRUCTIONS column on each page. Necessary changes of switch positions are noted at the appropriate test step. All other switches are to remain in their last referenced position.

(c) The RESULT column lists the indications of a properly functioning unit.

(d) The POSSIBLE TROUBLE AREA column lists troubleshooting areas for a malfunction indicated by the appropriate test.

(2) Test Setup.

Using the cable supplied, connect J1 on the C-4881 Cockpit Control Unit to the EXTERNAL CONTROL UNIT connector on the AN/APM-247 Radar Test Set. Connect the radar test set to primary power.

CAUTION: DO NOT OPERATE THE 978G-1 RADAR TEST SET FROM PRIMARY POWER THAT IS NOT 115 VOLTS ±5 PERCENT, 400 HZ ±5 PERCENT. DAMAGE TO THE EQUIPMENT WILL RESULT.

Set the 978G-1 AC POWER switch to ON, and adjust the INPUT VOLTAGE ADJUST control for 115 ±1 volts as indicated on the INPUT POWER meter. Note that the frequency is 400 ±5 Hz as indicated on the INPUT FREQUENCY meter. Proceed to the tests outlined in figure 7-5.

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULT	POSSIBLE TROUBLE AREA
1.	Function switch	TEST SET FUNCTION SELECTOR -- ANTENNA/INDICATOR/ CONTROL UNIT TESTS; CONTROL UNIT TEST subpanel, CONTROL UNIT SELECTOR -- EXT TEST	System control switch (on control unit) -- STBY.	STANDBY lamp lights. NOTE: If system control switch has detent at OFF position, INVERTER RELAY lamp lights in STBY, OPR, and CTR positions.	Switch S1.
			System control switch -- OPR.	OPERATE lamp lights.	Switch S1.
			System control switch -- CTR.	CONTOUR lamp lights.	Switch S1.
2.	Receiver gain	CONTROL UNIT TEST subpanel, TEST FUNCTION -- RCVR GAIN	Position GAIN control (on control unit) to counterclockwise stop.	TEST METER indicates 2.6 ±0.2 v.	Potentiometer R1 +15 v from receiver-transmitter.
			Position GAIN control to clockwise stop.	TEST METER indicates not more than 2.0 v.	Potentiometer R1.

C-4881 Cockpit Control Unit Test Procedures
*Using the AN/APM-247 Radar Test Set (Sheet **1** of 2)*
Figure 7-5

STEP	TEST	978G-1 INSTRUCTIONS	PROCEDURE	RESULT	POSSIBLE TROUBLE AREA
3.	Elevation control	CONTROL UNIT TEST subpanel, TEST FUNCT-ION -- ELEV COARSE ADJ 8V	Set ELEVATION control (on control unit) to 0.	TEST METER indicates 8.0 ±0.5 v.	Misalignment of synchro. If necessary, loosen screws hold-ing elevation synchro and rotate synchro for correct indica-tion.
		CONTROL UNIT TEST subpanel, TEST FUNCT-IONS -- ELEV COARSE ADJ 5V		TEST METER indicates 5.0 ±0.5 v.	Misalignment of synchro. If necessary, rotate synchro 180 degrees and repeat 8- and 5v adjust test.
		CONTROL UNIT TEST subpanel, TEST FUNCT-ION -- ELEV FINE ADJ (1 VAC)		TEST METER indicates less than 50 mv.	Misalignment of synchro. If necessary, rotate synchro for null indication of less than 50 mv.
			Secure synchro in place.	Ensure that null reading remains at voltage ob-tained in step above.	

C-4881 Cockpit Control Unit Test Procedures
Using the AN/AP, M-247 Radar Test' Set (Sheet 2 of 2)
Figure 7-5

Section IV. STORAGE INSTRUCTIONS

Before storing, clean dirt, grease, and moisture from the C-4881 Cockpit Control Unit. Store the units in a clean, dry area where the possibility of impact damage is minimized. If the equipment is to be stored for an extended period, place the units in the original shipping cartons.

CHAPTER 8

DEPOT OVERHAUL STANDARDS

8-1. Applicability of Depot Overhaul Standards.

The tests outlined in this chapter are designed to measure the performance capability of repaired equipment. Equipment that is to be returned to stock should meet the standards given in these tests.

8-2. Applicable References.

A. Repair Standards. Applicable procedures of the depots performing these tests, and the general standards for repaired electronic equipment given in TB BIG 355-1, TB BIG 355-2, and TB BIG 355-3 form a part of the requirements for testing this equipment.

B. Technical Publication. TM 11-6625-664-12, is also applicable to this equipment.

8-3. Test Facilities Required

Use the following equipment (or suitable equivalent to determine compliance with the requirements of this specific standard.

Test equipment	Stock No.	Quantity Req	Technical manual
Test Set, Radar AN/APM-246 and AN/APM-247 --------------------------	---------------	1	TM 11-6625-664-12
Pulse Generator AN/PPM-1 ----------------	---------------	1	TM 11-2678
Multimeter AN/USM-223 --------------------	6625-553-0142	1	
Signal Generator AN/U8M-44--------------	6625-539-9685	1	TM 11-6625-508-10
Oscilloscope AN/USM-281 -----------------	6625-053-3112	1	
Echo Box TS-488A/UP (outside antenna preferred) -------------------------	6625-519-7594	1	TM 11-6625-220-10
Maintenance Kit, Electronic Equipment MK-774/APN-158 -----------	5841-868-8232	1	TM 11-5841-259-12
Dummy load, Electrical DA-383/APN-158 ---------------------	6625-923-1090	1	
Adapter UG-201A/U --------------------	5935-258-7429	2	
Adapter UG-273/U ----------------------	5935-149-3534	3	
Cable Assembly, Radio frequency CG-1464/U (4 ft) ----------------------	5995-931-1047	7	

Test equipment	Stock No.	Quantity Req	Technical manual
Cable Assembly, Special Purpose CX-10091/APN-158 -----------------------	5995-926-0842	1	
Lead, Test CX-10092/APN-158 -----------	6625-930-7952	2	
Prod, Test MX-6639/APN-158 -------------	6625-923-1089	1	
Adapter, Test MX-6637/APN-158---------	6625-926-7679	1	
Antenna Fixture MX-6640/ APN-158 ------------------------------------	6625-923-1029	1	
Extender Module MX-6424/ APN-158 ------------------------------------			
Receiver-Transmitter RT-711A/APN-158-------------------------	5841-082-3538	1	
Synchronizer, Electrical SN-358A/ APN-158 ------------------------------------	5841-082-3545	1	
Antenna AS-1642A/APN-158 or AS-1520A/APN-158 -----------------------	5841-082-3803	1	
Indicator, Azimuth-Range IP-724A/APN-158 or 493A-4 ------------	5841-082-3544	1	
Control, Radar Set C-4881/ APN-158 ------------------------------------	5841-082-3540	1	

8-4. General Test Requirements, Radar Set AN/APN-158A.

Most of the tests for Radar Set AN/APN-158A will be performed under the conditions listed below and as illustrated in figures 8-1 through 8-7. Testing will be simplified if connections and panel control settings are made initially and modifications made as required for the individual tests. Set the AN/APN-247 controls as follows:

A. AC POWER switch to OFF.

B. METER MULTIPLIER switch to X10.

C. INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OFF.

D. INPUT VOLTAGE ADJUST control fully counterclockwise.

E. RECEIVER TRANSMITTER TESTS-TEST FUNCTION switch to OFF.

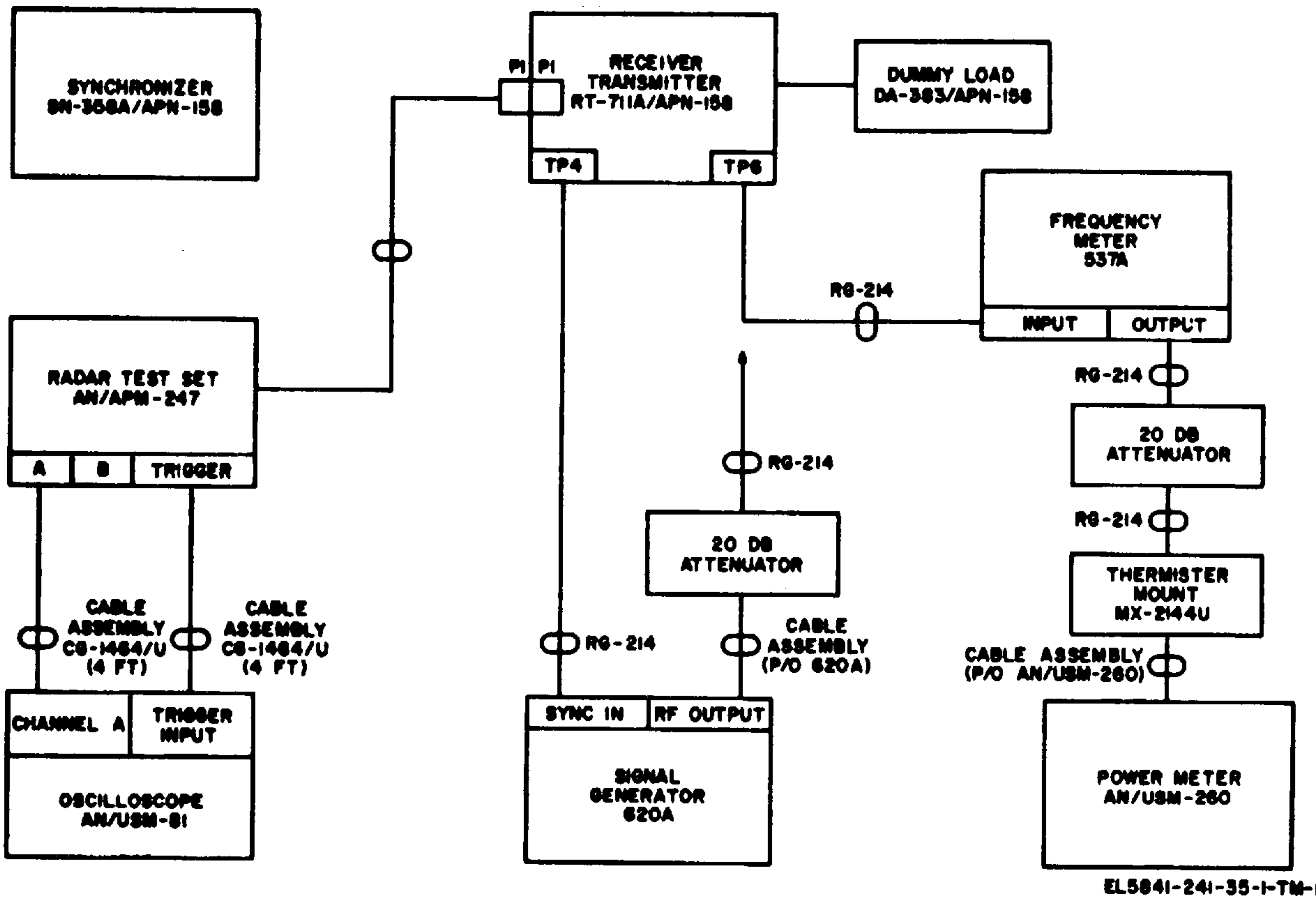
F. SYNCHRONIZER TESTS-TEST FUNCTION switch to OFF.

G. ANTENNA TESTS switch to OFF.

H. GYRO SIMULATOR switch to OFF.

I. CONTROL UNIT TESTS-CONTROL UNIT SELECTOR switch to INT.

J. Connect Electrical Power Cable Assembly CX-10029/APM-247 to 115 volts, 400 Hertz (Hz).



Testing Receiver-Transmitter RT-711A/APN-158, block diagram.
Figure 8-1

8-5. Receiver-Transmitter RT-711A/APN-158 Tests.

Interconnect the equipment as shown in figure 8-1. Perform the procedures given below to check out the circuits in the RT-711A/APN-158. All control settings are for the AN/APM-247, unless indicated otherwise.

A. Input Voltage and Frequency Check.

(1) Set the RT-711A/APN-158 RF switch to OFF.

(2) Set the AC POWER switch to ON; the AC POWER lamp should light.

(3) Set the INPUT VOLTAGE ADJUST control for 115 ±1.0 volts as indicated on the INPUT VOLTAGE meter.

(4) The INPUT FREQUENCY meter shall indicate 400 ±5 Hz.

B. Control Circuit Checks.

CAUTION

Be sure that dummy load, electrical DA-383/APN-158 is connected to the waveguide output of the RT-711A/APN-158.

(1) Set the TEST SET FUNCTION SELECTOR switch to RECEIVER TRANSMITTER TESTS.

(2) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY. The STANDBY RELAY lamp shall light and the RT-711A/APN-158 blower shall operate.

(3) Set the RT-711A/APN-158 meter switch to GEN A, GEN B, and GEN C, in sequence; the meter shall indicate 5.0 ±1.0.

(4) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OPERATE; after 4 minutes the OPERATE RELAY lamp shall light.

(5) Remove top cover from the RT-711A/APN-158. The OPERATE RELAY lamp shall extinguish.

(6) Pull interlock switch S1, located at the top rear of the RT-711A/APN-158, all the way up; the OPERATE RELAY lamp shall light.

(7) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL to OFF.

C. Operating Voltage Checks.

(1) Set Oscilloscope AN/USM-81 (oscilloscope) for operation on channel A using negative trigger.

(2) Set the RECEIVER TRANSMITTER TESTS-TEST FUNCTION switch to RELAY POWER.

(3) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY: the TEST METER shall indicate within the green area.

(4) Set the METER MULTIPLIER switch to X1. The TEST METER shall indicate -27.0 ±3. 0 volts.

(5) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OPERATE.

(6) Set the METER MULTIPLIER switch to X10.

(7) Set the RECEIVER TRANSMITTER TESTS-TEST FUNCTION switch to -27V. The TEST METER shall indicate within the green area.

(8) Set the METER MULTIPLIER switch to X1. The TEST METER shall indicate between -25.0 and -28.5 volts.

(9) The peak-to-peak ripple shall be not more than 0. 06 volt peak-to-peak as measured on the oscilloscope.

(10) Set the RT-711A/APN-158 meter switch to -27.5V. The RT-711A/APN-158 meter shall read 5.0 ±1.0.

(11) Set the METER MULTIPLIER switch to X10.

(12) Set the RECEIVER TRANSMITTER TESTS-TEST FUNCTION switch to +27. 5V. The TEST METER shall indicate within the green area.

(13) Set the METER MULTIPLIER switch to XI. The TEST METER shall indicate between +27.4 and +27.6 volts. If necessary, remove the front cover of the RT-711A/APN-158 and adjust TB5-R24 for a proper indication.

(14) Hold the FAULT SENSING +27.5V NORMAL LOAD switch to NORMAL LOAD. The TEST METER shall read between +27.3 and +27.6 volts.

(15) The indications obtained in (13) and (14) above shall be within 0.1 volt of each other.

(16) While holding the FAULT SENSING +27.5V NORMAL LOAD switch to NORMAL LOAD, measure the peak-to-peak ripple displayed on the oscilloscope. It shall be not more than 0.03 volt peak-to-peak. Release the FAULT SENSING +27.5V switch.

(17) Set the RT-711A/APN-158 meter switch to +27.5V. The meter shall Indicate within 5.0 ±1.0.

(18) Set the METER MULTIPLIER switch to X10.

(19) Set the RECEIVER TRANSMITTER TESTS-TEST FUNCTION switch to +250V. The TEST METER shall indicate within the green area.

(20) Set the METER MULTIPLIER switch to X1. The TEST METER shall indicate between +250 and +270 volts.

(21) Hold the FAULT SENSING +250V SAFE LOAD switch to SAFE LOAD. The TEST METER shall indicate between +245 and +266 volts.

(22) The indications obtained in (20) and (21) above shall be within 5.0 volts of each other.

(23) While holding the FAULT SENSING +250V SAFE LOAD switch to SAFE LOAD, measure the peak-to-peak ripple displayed on the oscilloscope; it shall be not more than 0.85 volt peak-to-peak. Release the FAULT SENSING +250V SAFE LOAD SWITCH.

(24) Set the RT-711A/APN-158 meter switch to +260V. The meter shall indicate 5.0 ±1.0.

(25) Set the METER MULTIPLIER switch to X10.

D. Fault Sensing Circuits.

(1) Connect Lead, Test CX-10092/APN-158 between the FAULT SENSING TEST VOLTAGE jack and fault sensing terminal board TB3 terminal 10 in the RT-711A/APN-158. THE OPERATE RELAY lamp shall extinguish.

NOTE

Measure the voltage at TB3-10 with FAULT SENSING TEST VOLTAGE jack connected. Voltage must be -1.8 to -1.85 volts. If voltage is not within range, use dc supply adjusted to -1.8V to perform test.

NOTE

If the OPERATE RELAY lamp does not extinguish select the highest value for R2 on TB3 in the RT-711A/APN-158 that will cause the lamp to extinguish.

(2) Remove the Lead, Test CX-10092/APN-158 from TB3-10 and the FAULT SENSING TEST VOLTAGE Jack.

(3) Set the INTERNAL CONTROL UNIT--SYSTEM CONTROL switch to STANDBY, and then to OPERATE. The OPERATE RELAY lamp shall light.

(4) Momentarily set the FAULT SENSING +27.5V SAFE LOAD switch to SAFE LOAD. The OPERATE RELAY lamp shall remain lighted.

(5) Momentarily set the FAULT SENSING +27.5V OVER LOAD switch to OVER LOAD. The OPERATE RELAY lamp shall extinguish.

(6) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY, and then to OPERATE. The OPERATE RELAY lamp shall light.

(7) Momentarily set the FAULT SENSING +27.5V OVER VOLTAGE switch to OVER VOLTAGE. The OPERATE RELAY lamp shall extinguish.

(8) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY, and then to OPERATE. The OPERATE RELAY lamp shall light.

(9) Momentarily set the FAULT SENSING +250V SAFE LOAD switch to SAFE LOAD. The OPERATE RELAY lamp shall remain lighted.

(10) Momentarily set the FAULT SENSING +250V OVER LOAD switch to OVER LOAD. The OPERATE RELAY lamp shall extinguish.

(11) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY, and then to OPERATE. The OPERATE RELAY lamp shall light.

E. <u>Gate Trigger Pulses</u>.

(1) Set the RECEIVER TRANSMITTER TESTS-TEST FUNCTION switch to TRIGGER.

(2) Measure the amplitude of the trigger pulse displayed on the oscilloscope. The amplitude shall not be less than -29.5 volts.

F. <u>KA-TR Voltage Checks</u>.

(1) Set the AC POWER switch to OFF.

(2) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OFF.

(3) Connect Lead, Test CX-10092/APN-158 from the KA-TR TEST LEAD Jack to the high voltage lead on TB2.

(4) Set the RECEIVER TRANSMITTER TESTS-TEST FUNCTION switch to KA-TR.

(5) Set the METER MULTIPLIER switch to X10.

(6) Set the AC POWER switch to ON.

(7) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY. The TEST METER shall indicate within the green area.

(8) Set the METER MULTIPLIER to X1. The TEST METER shall indicate -625 to -800 volts. Set the AC POWER switch and the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OFF.

(9) Disconnect the CX-10092/APN-158 from the high voltage lead.

NOTE

It is not necessary to perform the procedures given in G below unless the magnetron or associated circuitry has been repaired; perform only G(6), (7), and (11) below to check time relay.

G. <u>Filament Voltage Check and Thermal Time Delay</u>.

(1) Set the TEST SET FUNCTION SELECTOR switch to ANTENNA/INDICATOR CONTROL UNIT TESTS.

(2) Set the ANTENNA TESTS switch to TRIM ADJ.

(3) Remove keep-alive supply module TB2 (refer to disassembly section). Disconnect magnetron filament leads from modulator. Using extender cables and tees (AMP type 8301264 and type 837692-1) reconnect magnetron filament leads to modulator. Connect AN/USM-223 voltmeter to tees.

(4) Set the METER MULTIPLIER switch to X10.

(5) Remove the trigger generator module from the RT-711A/APN-158.

(6) Set the RT-711 A/APN-158 RF switch to ON.

(7) Set the AC POWER switch to ON.

WARNING

TB1 terminals have 115 volts (ac) present when the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch is set to STANDBY.

(8) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY.

(9) Set METER MULTIPLIER switch to X1. The AN/USM-223 shall indicate 6.3 $\pm$0.2 volts. If necessary, move the jumper on TB10 in the bottom of the RT-711A/APN-158.

(10) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OFF.

(11) Remove the test leads and reconnect magnetron filament leads.

(12) Note the time; then set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OPERATE. The elapsed time until the OPERATE RELAY lamp lights shall be 4.0 $\pm$1 minutes.

(13) Set the TEST SET FUNCTION SELECTOR switch to RECEIVER TRANSMITTER TESTS.

(14) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY.

(15) Replace TB2 (if removed) and the trigger generator module in the RT-711A/APN-158.

H. <u>Transmitter Output Power and Frequency.</u>

(1) Using RG-214, or equivalent coaxial cable, make the following connections: frequency meter (FSN 6625-930-9687, Hewlett-Packard 537A) input to TP6, frequency meter output to 20-db attenuator (Narda 757-20) and 20-db attenuator to thermistor mount (MX-2144/U, Hewlett-Packard 478A). Connect thermistor mount to power meter (AN/USM-260, Hewlett-Packard 431C) with signal cable supplied with equipment.

(2) Disconnect the CG-1464U from the OSCILLOSCOPE A jack and connect it to TP4 on RT-711A/APN-158.

(3) Set the RT-711A/APN-158 RF switch to ON.

(4) Set the INTERNAL CONTROL UNIT-8YSTEM CONTROL switch to OPERATE.

NOTE

The elapsed time must be 4 i1 minutes since (4) above to allow sufficient time for the time delay relay to engage.

(5) Measure the amplitude and pulse width of the pulse displayed on the oscilloscope. The amplitude shall be from +35 to +45 volts, and the pulse width from 3.1 to 3.8 microseconds at the 50% amplitude points.

(6) Set the RT-711A/APN-158 meter switch to MAG. The meter shall indicate from 4 to 6.

(7) Rotate the frequency meter control through its range until a dip is indicated on the power meter. The frequency meter shall indicate 9, 375 ±40 megahertz.

(8) Compute the average power output of the RT-711A/APN-158 by adding the following: RT-711A/APN158 directional coupler loss (approximately 20 db, exact amount stamped on coupler), 20 db attenuator loss, frequency meter insertion loss, and power meter reading. The total shall be not less than +43.5 dbm (referred to 1 milliwatt in 600 ohms).

NOTE

+43 dbm = approximately 20 watts average power.

(9) Calculate the peak power as follows:

$$\text{Peak power (kilowatts)} = \frac{\text{average power (watts)} \times 1000}{\text{pulse width (microseconds)} \times \text{prf}}$$

The peak power shall be not less than 20 kilowatts.

NOTE

If power output is not 20 kilowatts select the tap on modulator T5 (J1-5. -6, -7, or -8) that will produce a 20 kw output. Do not exceed a pulse amplitude of 45 volts at TP4.

(10) Vary the INPUT VOLTAGE ADJUST from 105 to 125 volts as indicated on INPUT METER while observing the pulse displayed on the oscilloscope. The pulse shall be steady and show no signs of arcing or moding. Arcing is indicated by large increases in pulse current. Moding is indicated by smaller changes in pulse current from pulse to pulse or during a single pulse.

I. Afc Mixer Output.

(1) Set the RECEIVER TRANSMITTER TESTS-TEST FUNCTION switch to AFC MIXER. Disconnect the CG-1464/U from TP4 on the RT-711A/APN-158 and connect it to OSCILLOSCOPE A.

(2) Disconnect the coaxial jumper from the AFC SYNC jack and connect it to the MIXER TEST jack.

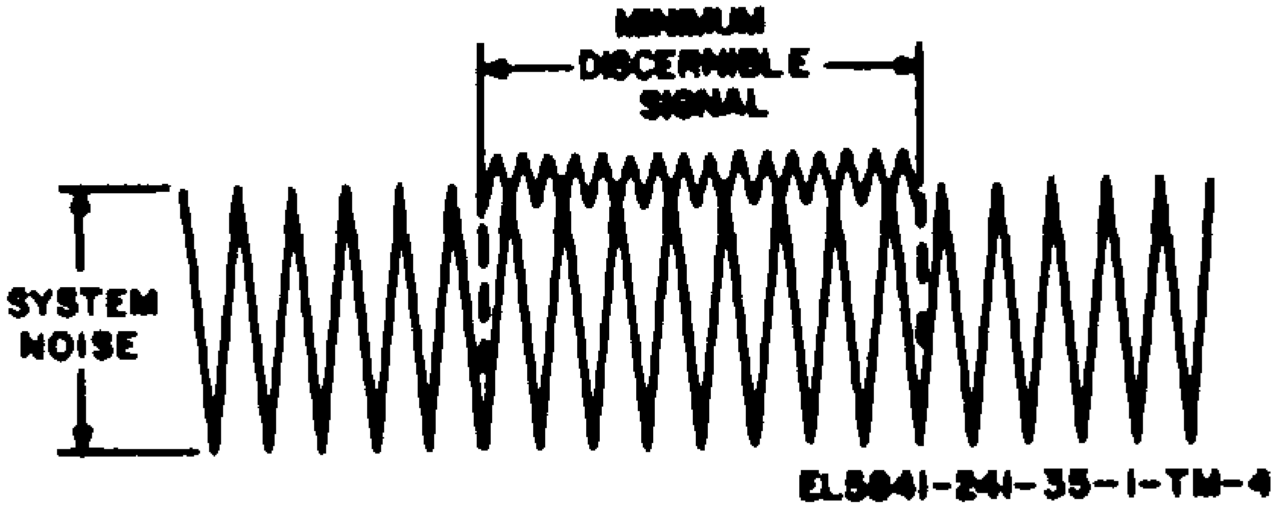
(3) Adjust the KLYSTRON REPELLER VOLTAGE ADJUST control for an indication of -185 ±2 volts on the TEST METER;

(4) Set the RT-711A/APN-158 meter switch to AFC.

(5) Turn the RT-711A/APN-158 klystron mechanical tuning control to clockwise stop.

(6) Mechanically tune the klystron, slowly counterclockwise for maximum amplitude pulse as observed on the oscilloscope.

(7) Again, mechanically tune the klystron, slowly, counterclockwise for a second maximum ampliture negative pulse as observed on the oscilloscope. The pulse amplitude should be 10 ±0.5 volts. If necessary, extend the RT-711A/APN-158 trigger generator module with Extender Module MX-6424/APN-158. Insert a screwdriver through the hole in the MX-6424/APN-158 and adjust the attenuator for the proper amplitude signal.



Minimum Discernible Signal Display.
Figure 8-2

J. Crystal current Check.

(1) Set the RT-711A/APN-158 meter switch to FWD. The RT-711A/APN-158 meter should indicate between 3 and 10.

(2) Set the RT-711A/APN-158 meter switch to REV. The RT-711A/APN-158 meter should indicate within ±1 major division of the reading obtained in (1) above.

(3) Set the RT-711A/APN-158 meter switch to AFC. The RT-711A/APN-158 meter should indicate between 3 and 10.

(4) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY.

(5) Disconnect the coaxial jumper from the AFC MIXER TEST Jack and reconnect it to AFC SYNC jack.

K. Receiver Sensitivity and Gain.

(1) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OPERATE.

(2) Set the METER MULTIPLIER to X10.

(3) Set the INTERNAL CONTROL UNIT GAIN to maximum cw position.

(4) Disconnect the RG-214 cable from TP6 on the RT-711A/APN-158 to the frequency meter (537A) at TP6.

(5) Connect the signal generator (Hewlett-Packard 620A) RF OUTOUT to a 20 db attenuator (Narda 757-20) and the attenuator to TP6 on the RT-711A/APN-158.

(6) Connect the signal generator SYNC IN to TP4 on the RT-711A/APN-158 with RG-214 cable.

(7) Disconnect the CG-1464/U cable assembly from the AN/USM-81 TRIGGER INPUT.

(8) Connect the AN/USM-81 TRIGGER INPUT to SYNC OUT on the signal generator.

(9) Adjust the signal generator to obtain an output of 3- to 5-microseconds-wide pulses with approximately 200-microseoonds delay and rf frequency equal to magnetron frequency (9,375 ±40 MHz).

(10) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY.

(11) Connect SN-358A/APN-158 synchronizer, P1 to AN/APM-247 P2.

(12) Connect SN-358A/APN-158 STC and GROUND test points together.

(13) Connect oscilloscope channel A to SN-358A/APN-158 VIDEO test point J16.

(14) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OPERATE.

(15) While observing the signal on the oscilloscope, decrease the signal amplitude from the signal generator until just before the pulse disappears in system noise. This point is the minimum discernible signal (MDS) level (refer to figure 8-2).

(16) Compute the gain by adding the following: RT-711A/APN-158 directional coupler loss (approximately 20 db, exact amount stamped on coupler), 20 db attenuator loss, frequency meter insertion loss and power meter reading. The system MDS shall be from -103 to -110 dbm (read on signal generator).

(17) Remove the connection between the SN-358A/APN-158 STC and GROUND test points.

(18) Adjust the signal generator PULSE DELAY for 200 microseconds.

(19) Adjust the signal generator OUTPUT ATTEN control to obtain a 6-volt amplitude pulse on the oscilloscope. Record the attenuation level.

(20) Set the INTERNAL CONTROL UNIT GAIN to maximum ccw position.

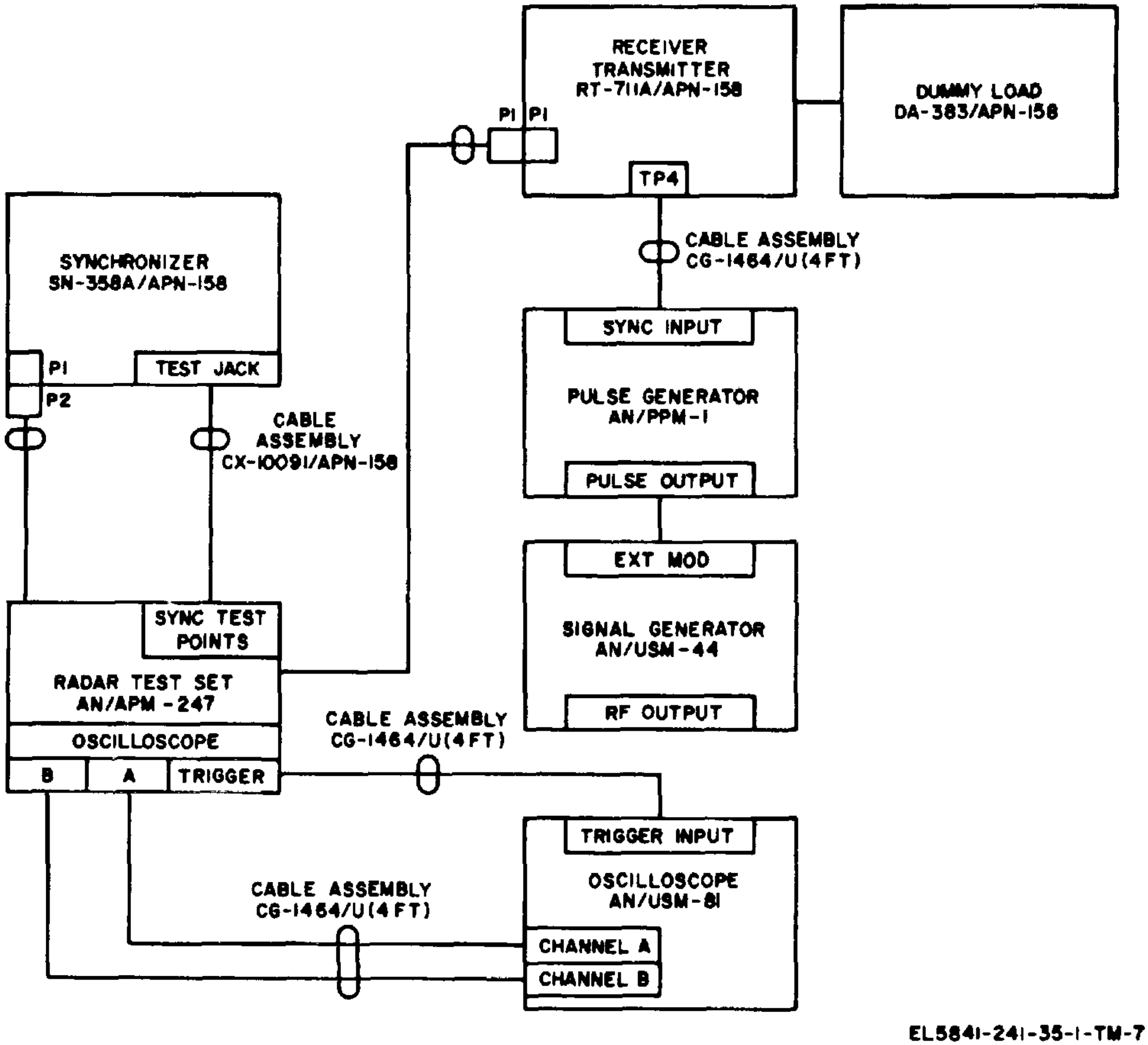
(21) Readjust the signal generator OUTPUT ATTEN control to obtain a 6-volt amplitude pulse on the oscilloscope. Record the attenuation level.

(22) The difference in the attenuation levels recorded in steps (19 and (20) above shall be 15 db or greater.

(23) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY.

8-6. Synchronizer, Electrical SN-358A/APN-158 Tests.

Interconnect the equipment as shown in figure 8-3. Perform the preliminary procedures given in paragraph 8-4 and 8-5A. All control settings are for the AN/APM-247, unless indicated otherwise.



Testing Synchronizer, Electrical SN-385A/APN-158,
block diagram
Figure 8-3

NOTE
A known good RT-711A/APN-158 must be connected during these tests.

A. Gate Pulse.

(1) Set the RT-711A/APN-158 RF switch to OFF.

(2) Set the TEST SET FUNCTION SELECTOR switch to SYNCHRONIZER TESTS.

(3) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OPERATE.

(4) Set the SYNCHRONIZER TESTS-TEST FUNCTION switch to GATE.

(5) Measure the peak-to-peak amplitude and risetime of the pulse displayed on the oscilloscope. The amplitude should be not less than 20 volts with a maximum risetime of 2.5 microseconds from the 10- to 90-percent points.

(6) Set the SYNCHRONIZER TESTS-TEST RANGE SELECTOR switch to 30, 60, and 150 in sequence. The width of the pulse displayed on the oscilloscope shall be 430 +30 microseconds, 860 *50 microseconds, and 2, 100 *90 microseconds in that order. If the pulse widths are not within tolerance, adjust R31 on the SN-358A/APN-158 gate generator module.

NOTE
The pulse widths are measured at the 50% amplitude points.

B. Rangemarks.

(1) Set the SYNCHRONIZER TESTS-TEST FUNCTION switch to RANGE.

(2) Set the SYNCHRONIZER TESTS-TEST RANGE SELECTOR switch to 30, 60, and 150 in sequence. Measure the amplitude and width of the pulse displayed on the oscilloscope at each switch position. The pulse shall be negative-going and not less than 3.75 volts in amplitude with a maximum pulse width of 4 microseconds

NOTE

The pulse widths are measured at the 50% amplitude points.

(3) Set the SYNCHRONIZER TESTS-TEST RANGE SELECTOR switch to 30. The time from the start of the sweep to the third rangemark, as measured on the oscilloscope, shall be 370 ±25 microseconds.

(4) Set the SYNCHRONIZER TESTS-TEST RANGE SELECTOR switch to 60. The time from the start of the sweep to the fourth rangemark, as measured on the oscillosoope, shall be 740 ±40 microseconds.

(5) Set the SYNCHRONIZER TESTS-TEST RANGE SELECTOR switobh to 150. The time from the start of sweep to the sixth rangemark, as measured on the oscilloscope, shall be 1,855 ±75 microseconds.

C. Phase Detector.

NOTE

If resistor adjustment is necessary, the gate generator module must be extended. Use module extender MX-6424. Set SYSTEM CONTROL to STANDBY when installing or removing the extender.

(1) Set the SYNCHRONIZER TESTS-TEST FUNCTION switch to PHASE DETECTOR.

(2) Set the PHASE DETECTOR switch to Y BAL.

(3) Set the SYNCHRONIZER TESTS-TEST RANGE SELECTOR switch to 30. The TEST METER shall indicate in the green area.

(4) Set the METER MULTIPLIER switch to X1. The TEST METER shall indicate a null ± one-half of one minor division. If necessary, adjust Y-position potentiometer R14 on the SN-358A/APN-158.

(5) Set the PHASE DETECTOR switch to Y LENGTH. The TEST METER shall indicate 22.5 ±1.0 volts. If necessary, adjust EXC LEVEL potentiometer R15 on the SN-358A/APN-158

(6) Set the PHASE DETECTOR switch to X BAL. The TEST METER shall indicate a null ± one-half of one minor division. If necessary, adjust SN-358A/APN-158 X-POSITION potentiometer R13.

(7) Set the PHASE DETECTOR switch to X-LENGTH. The TEST METER switch shall indicate 22. 5 ±1.0 volts.

NOTE

In tests D and E below, the sweep generator module must be extended if resistor adjustment is necessary. Use module extender, MX-6426. Set SYSTEM CONTROL to STANDBY when installing or removing the extender.

D. Sweep Balance.

(1) Set the SYNCHRONIZER TESTS-TEST FUNCTION switch to SWEEP BAL.

(2) Set the SWEEP BAL switch to X. The TEST METER shall indicate a null ± one-half of one minor division. If necessary, adjust X-balance potentiometer R6 on the SN-358A/APN-158 sweep generator and amplifier module.

(3) Set the SWEEP BAL switch to Y. The TEST METER shall indicate a null ± one-half of one minor division. If necessary, adjust Y balance potentiometer R28 on the SN-358A/APN-158 sweep generator and amplifier module.

E. Sweep Calibration.

(1) Set the SYNCHRONIZER TESTS-TEST FUNCTION switch to SWEEP CAL.

(2) Set the SWEEP CAL switch to SCOPE CAL. The TEST METER shall indicate 4. 0 ±0.2 volts.

NOTE

Check the calibration of channels A and B on the oscilloscope. The dc level displayed on both channels shall be 4.0 ±0. 2 volts.

(3) Set the SWEEP CAL switch to UP.

(4) Set the oscilloscope MODE switch to ALTERNATE.

(5) Set the SYNCHRONIZER TESTS-TEST RANGE SELECTOR switch to 30.

(6) Adjust the oscilloscope channels A and B vertical controls until the baselines of the two waveforms coincide (refer to figure 8-4). The voltage difference between the third rangemarks, as measured on the oscilloscope, shall be 4.0 ±0.2 volts. If necessary, adjust R42 on sweep generator and amplifier module,

(7) Set the SYNCHRONIZER TESTS-TEST RANGE SELECTOR switch to 60.

(8) Repeat (6) above, except measure the voltage difference between the fourth rangemarks; difference shall be 4.0 ±0.1 volts (fig. 8-3). If necessary adjust R43 on sweep generator and amplifier module.

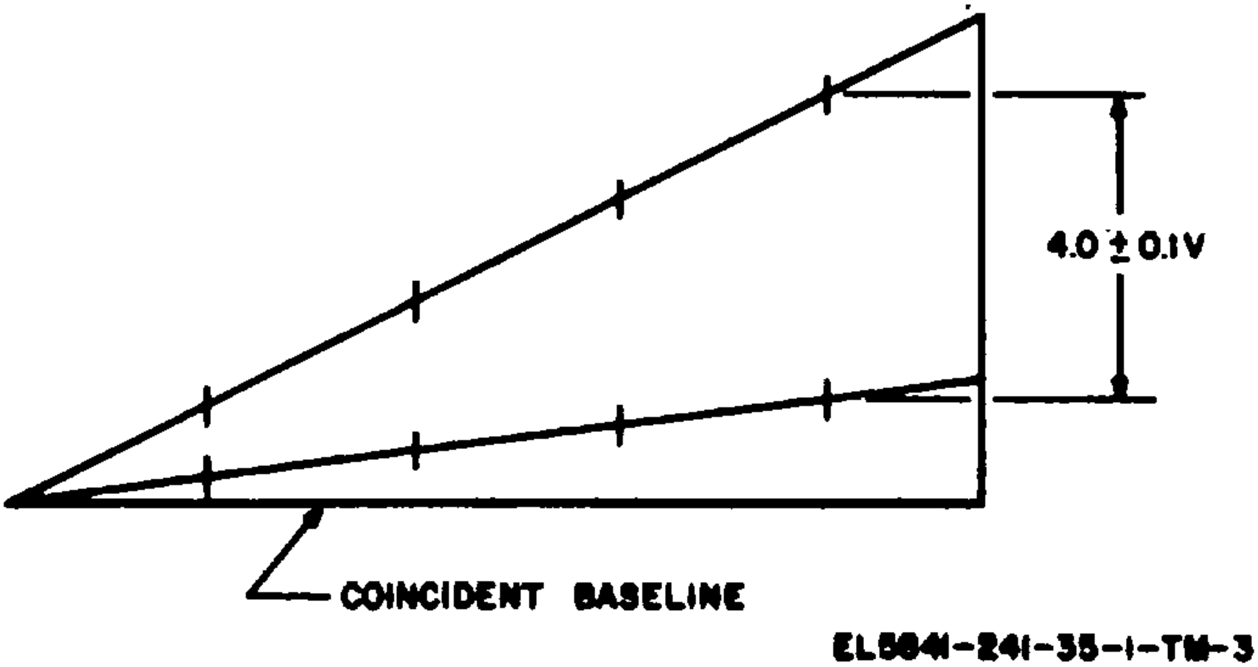
(9) Set the SYNCHRONIZER TESTS-TEST RANGE SELECTOR switch to 150.

(10) Repeat (6) above, except measure the voltage difference between the sixth rangemarks; difference shall be 4.0 ±0.1 volts. If necessary, adjust R44 on the sweep generator and amplifier module.

(11) Set the SWEEP CAL switch to DOWN. Repeat the procedures in (5) through (10) above; the results shall be the same. If necessary adjust Y1-R29, R30, R31 on the sweep generator and amplifier module.

(12) Set the SWEEP CAL switch to RIGHT. Repeat the procedures in (5) through (10) above; the results shall be the same. If necessary adjust X1-R7, R8, R9 on sweep generator and amplifier module.

(13) Set the SWEEP CAL switch to LEFT. Repeat the procedures in (5) through (10) above; the results shall be the same. If necessary, adjust X2-R17, R18, R19 on sweep generator and amplifier module.



Waveform for channels A and B calibration.
Figure 8-4

F. Automatic Frequency Control (Afc).

(1) Set the RT-711A/APN-158 RF to ON. Allow for a 4-minute warmup period.

(2) Set the RT-711A/APN-158 meter switch to AFC.

(3) Set the SYNCHRONIZER TESTS-TEST FUNCTION switch to AFC OUT.

(4) Disconnect the coaxial jumper from the AFC SYNC jack. Connect the CG-1464/U from the RF OUTPUT jack of the AN/USM-44 to the AFC SYNC Jack.

(5) Set the output of Pulse Generator AN/PPM-1 for a positive, 5-microsecond, 20-volt pulse.

(6) Set the output of the AN/USM-44 for a 400-Hz, pulsed 5-microsecond, 30-megahertz at a level of -13 dbm.

(7) With the MX-6424/APN-158, extend the afc module located in the SN-358A/APN-158.

(8) Connect a standard probe from channel A of the oscilloscope to pin B of the afc module. The waveform displayed on the oscilloscope is a negative pulse with a peak-to-peak amplitude of 3 ±0.25 volts.

(9) Disconnect Cable Assembly, Special Purpose CX-10091/APN-158 from the SN-358A/ APN-158, and connect a 10:1 probe from channel A of the oscilloscope to the AFC test point at the rear of the SN-358A/APN-158.

(10) Reduce the output signal level of the AN/USM-44 to -25 dbm. The oscilloscope should indicate a sweeping direct current (dc) voltage from -150 ±10 to -215 ±10 volts.

(11) Reconnect Cable Assembly, Special Purpose CX-10091/APN-158 to the SN-358A/ APN-158, and OSCILLOSCOPE A to pin B of the afc module.

(12) Increase the signal level of the AN/USM-44 to -13 dbm.

(13) Adjust the frequency of the AN/USM-44 until the TEST METER indicates -185 ±2 volts. AN/USM-44 meter shall indicate 30.00 ±0.2 megahertz. If necessary, adjust R7 on the afc module for -185 volts with 30.00 ±0. 2 megahertz input.

(14) Increase frequency of the AN/USM-44 until the TEST METER indicates -150 volts. AN/USM-44 meter shall indicate less than 31.0 megahertz.

(15) Decrease frequency of the AN/USM-44 to cause a sweeping indication on the oscilloscope, then increase frequency to just stop sweeping. The TEST METER shall indicate 215 ±10 volts and the AN/USM-44 meter shall indicate not less than 29.0 megahertz.

(16) Disconnect the CG-1464/U from the AFC SYNC jack, and reconnect the RT-711A/APN-158 coaxial cable to the AFC SYNC jack.

G. Stc Pulse.

(1) Set the SYNCHRONIZER TESTS-TEST FUNCTION switch to STC.

(2) Measure the amplitude and pulse width of the signal displayed on the oscilloscope. The peak-to-peak amplitude shall be 2.5 ±0.2 volts, with a rise time (10 and 90% points) not greater than 15 microseconds and a fall time (10 and 80% points) of 160 ±50 micro- seconds. If necessary, adjust R35 on the SN-358A/APN-158 gate generator module for proper amplitude of signal.

H. Video Gain.

(1) Set the SYNCHRONIZER TESTS-TEST FUNCTION switch to VIDEO.

(2) Connect a CG-1464/U from TP4 on the RT-711A/APN-158 to the SYNC INPUT jack on the AN/PPM-1.

(3) Connect a CG-1464/U from the PULSE OUTPUT jack on the AN/PPM-1 to the EXT MOD jack on the AN/USM-44.

(4) Disconnect the coaxial jumper from the IF SYNC jack.

(5) Connect a CG-1464/U (4 ft.) cable from the RF OUTPUT jack on the AN/USM-44 to the IF SYNC jack.

(6) Set the AN/USM-44 POWER switch to ON.

(7) Set the AN/USM-44 MODE SELECTOR to CW.

(8) Adjust the AN/USM-44 for a 30-megahertz output signal.

(9) Set the output level to SET LEVEL on the meter of the AN/USM-44 with the OUTPUT LEVEL control. This action calibrates the AN/USM-44 attenuator and the output can now be read directly from the dial in dbm.

(10) Set the AN/PPM-1 POWER switch to ON.

(11) Set the AN/PPM-1 for a 10-microsecond wide, 20 volt amplitude output pulse.

(12) Set the AN/USM-44 MODE SELECTOR switch to PULSE.

(13) Observe the output on the oscilloscope. The video pulse shall be negative-going with noise and rangemarks visible on the baseline.

(14) Increase the output of the AN/USM-44 until the video pulse reaches a maximum indication. The oscilloscope shall indicate a 6-volt peak signal. If necessary, adjust VIDEO GAIN control R12 on the SN-358A/APN-158 video module for the proper amplitude signal.

(15) Set the TEST RANGE SELECTOR switch to 60. The rangemarks amplitude shall be 4. 5 to 5. 5 volts. If necessary, adjust R27 on the SN-358A/APN-158 video driver module for the proper amplitude rangemarks.

I. Contour Check.

(1) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to CONTOUR.

(2) Set the AN/USM-44 attenuator for an output of -75 ±2. On the RT-711A/APN-158 meter, note that afc is in the locked condition.

(3) Observe that the video pulse that appears on the oscilloscope contours on half the input pulse (equal intensity at the top of pulse and the baseline). If necessary, adjust potentiometer R23 on the SN-358A/APN-158 video driver module.

J. Isolation Amplifier Gain and Phase Checks.

(1) Set the SYNCHRONIZER TESTS-TEST FUNCTION switch to ISO AMP GAIN.

(2) Set the GYRO SIMULATOR switch to ON.

(3) Set the SYNCHRONIZER TESTS-ISO AMP switch to PITCH.

(4) Set the GYRO SIMULATOR-PITCH control to 20 NOSE UP. The TEST METER shall indicate 4 to 6 volts (nominal). If necessary, adjust PITCH AMPL control R10 on the front of the SN-358A/APN-158 for 5 volts.

(5) Set the GYRO SIMULATOR-ROLL control to 20 LEFT WING DOWN. The TEST METER shall indicate 5.0 volts (nominal). If necessary, adjust ROLL AMPL R7 on the front of the SN-358A/APN-158 for a proper indication.

(6) Set the SYNCHRONIZER TESTS-TEST FUNCTION switch to ISO AMP PHASE.

(7) Set the SYNCHRONIZER TESTS-ISO AMP switch to PITCH.

(8) Set the Oscilloscope MODE switch to ALTERNATE. Set the PITCH control to 10. The waveforms (as observed on channels A and B of the oscilloscope) shall coincide at the zero crossing points. If necessary, adjust PITCH PHASE control R8 on the front panel of the SN-358A/APN-158 for zero phase shift.

(9) Set the SYNCHRONIZER TEST-ISO AMP switch to ROLL.

(10) Adjust the GYRO SIMULATOR-ROLL control to 10. The waveforms shall coincide at zero crossing points. If necessary, adjust ROLL PHASE control R5 on the front panel of the SN-358A/APN-158 for zero phase shift.

K. Elevation Servo.

(1) Set the SYNCHRONIZER TESTS-TEST FUNCTION switch to SERVO.

(2) Set the SERVO switch to STAB. The TEST METER shall indicate not less than 10 volts.

(3) Set the SERVO switch to RATE. The TEST METER shall indicate not less than 10 volts.

8-7. Antenna AS-1642A/APN-158 or AS-1520A/APN-158 Tests.

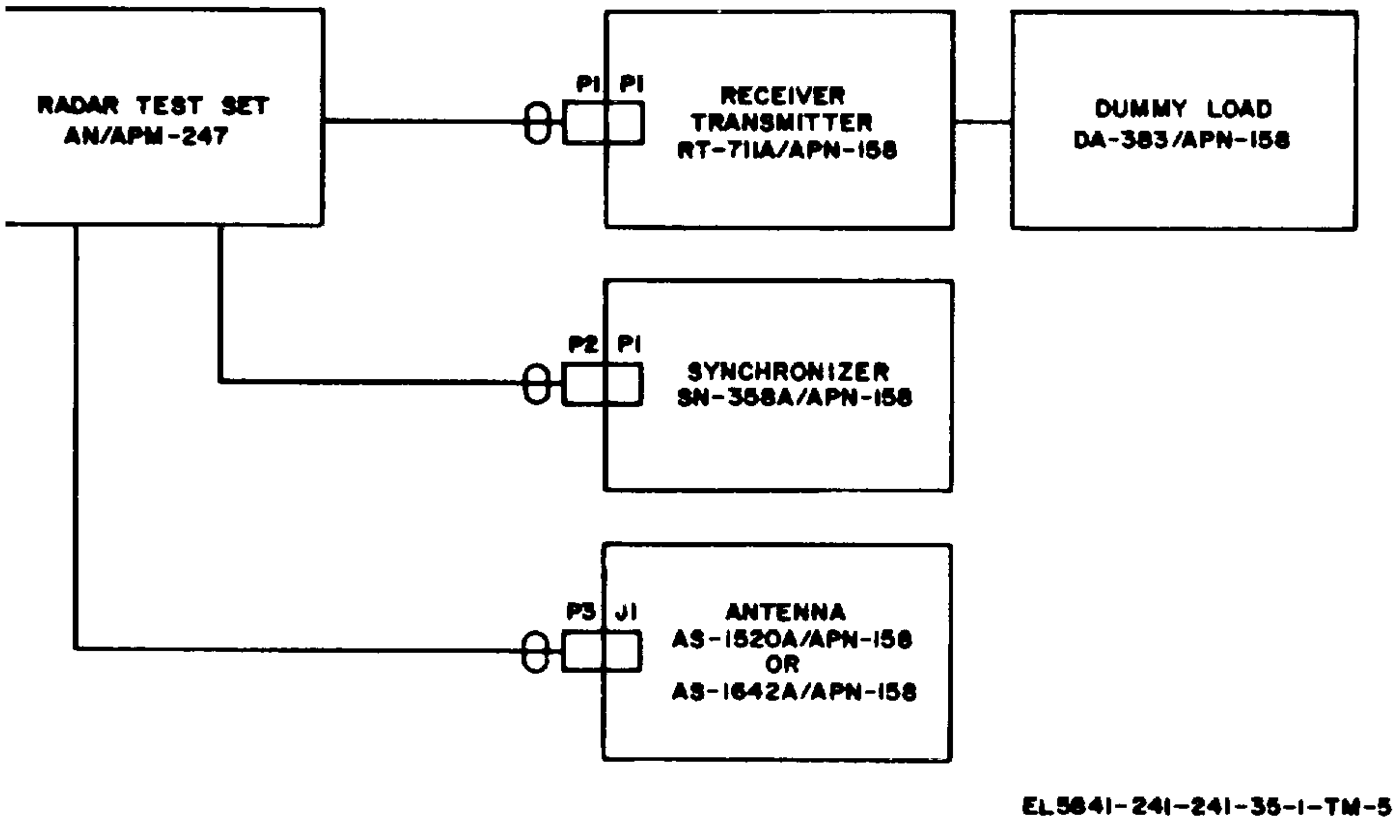
Interconnect the equipment as shown in figure 8-5. Perform the preliminary procedures given in paragraphs 8-4 and 8-5A. All control settings are for the AN/APM-247, unless indicated otherwise.

NOTE

A known good RT-711A/APN-158 and SN-358A/APN-158 must be used with these tests.

A. Antenna Rotation.

(1) Set the RT-711A/APN-158 RF switch to OFF.



Testing Antenna AS-1642A(AS-1520A)/APN-158, block diagram
Figure 8-5

(2) Set the TEST SET FUNCTION SELECTOR switch to ANTENNA/INDICATOR/ CONTROL UNIT TESTS.

(3) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OPERATE.

(4) Set the AS-1642A(AS-1520A)/APN-158 SCAN switch to ON. The antenna shall scan at a rate of 30 ±3 cycles per minute.

(5) Observe that the rotational movement of .the manual scan adjust knob is counter-clockwise when viewed from below.

(6) The azimuth movement of the antenna shall be not less than 58° nor more than 61° either side of dead ahead.

(7) Set the AS-1642A(AS-1520A)/APN-158 SCAN switch to OFF and INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY. Manually position the antenna dish until it is parallel to the antenna housing mount ±1/4° using Combination Square MX-6613/APM-246. Observe the alignment of the antenna pointer mark and the zero scribe mark on the gimbal. If necessary, reposition the pointer.

B. Elevation Synchro.

(1) Set INTERNAL CONTROL UNIT-SYSTEM CONTROL to OPERATE.

(2) Set the ANTENNA TESTS switch to EL SYNC.

(3) Connect Leads, Test CX-10092/APN-158 from the ANTENNA TEST LEADS jacks to the AS-1642A(AS-1520A)/APN-158 TRIM SENS jacks (J3 and J4).

(4) Set METER MULTIPLIER switch to X1.

WARNING

Be careful in making the following adjustment; 115 volts is present on the resistor. An insulated screwdriver should be used to prevent accidental shorting out of the 115 volts.

NOTE

To remove 115 volts ac from R1 during mechanical adjustment set the INTERNAL CONTROL UNIT-SYSTEM CONTROL to STANDBY. Return switch to OPERATE to apply power and make voltage measurements.

(5) The TEST METER shall indicate 17 ±0.2 volts. If necessary, adjust AS-1642A (AS-1520A)/APN-158 potentiometer R1.

(6) Disconnect the test leads from ANTENNA TEST LEAD jacks and TRIM SENS jacks (J3 and J4).

(7) Check to see that the GYRO SIMULATOR is set to OFF.

(8) Set the INTERNAL CONTROL UNIT-ELEVATION control to 0. Observe that the pointer at the rear of the antenna dish is in alignment with the scribe mark on the gimbal. If necessary, loosen the locking screws and position the AS-1642A(AS-1520A)/APN-158 tilt synchro (B1) for proper alignment of the marks.

(9) Set the INTERNAL CONTROL UNIT-ELEVATION control to 10° UP and return to 0°. Observe that the antenna dish moves up and returns.

C. <u>Pitch and Roll Resolver Alignment.</u>

(1) Set the ANTENNA TESTS switch to TRIM ADJ.

(2) Set the GYRO SIMULATOR switch to ON.

(3) Set the GYRO SIMULATOR-ROLL control to 0.

(4) Set the GYRO SIMULATOR-PITCH control to 20 NOSE DOWN. The antenna shall move up to compensate for the PITCH control position.

(5) Position the antenna 60° left, as viewed from the front. Set the GYRO SIMULATOR-ROLL control to 20 RIGHT WING DOWN. The antenna shall move up to compensate for the ROLL control position. If necessary, rotate pitch-roll resolver B3 on the AS-1642A (AS-1520A)/APN-158 180° and repeat the procedures given in (4) and (5) above.

(6) Set the GYRO SIMULATOR switch to OFF.

(7) Connect Leads, Test CX-10092/APN-158 from the ANTENNA TEST LEADS jacks to jacks J10 and J11 on the AS-1642A(AS-1520A)/APN--158.

(8) Position the antenna in a dead ahead position and adjust PITCH TRIM potentiometer R7 on the antenna for a minimum voltage as indicated on the TEST METER.

(9) Set the GYRO SIMULATOR switch to ON.

(10) Connect AN/USM-210 between J8 and J9 or the AS-1520A (AS-1642A)/APN-158.

(11) Adjust the GYRO SIMULATOR-PITCH control for a zero volts ac indication on the AN/USM-210.

(12) Set the GYRO SIMULATOR-ROLL control fully clockwise. Observe that, as the antenna is moved in azimuth, a null occurs in the dead ahead position as indicated on the AN/USM-210 and by the alignment marks. If necessary, rotate pitch-roll resolver B3 on the AS-1642A(AS-1520A)/APN-158 until a null does occur at the dead ahead position of the antenna. Lock pitch-roll resolver B3 in this position.

(13) Disconnect the test leads from the ANTENNA TEST LEADS jacks and from jacks J10 and J11 on the AS-1642A(AS-1520A)/APN-158.

(14) Disconnect the AN/USM-210 from J8 and J9 on the AS-1520A(AS-1642A)/APN-158.

D. Pitch and Roll Resolver Output.

(1) Set the GYRO SIMULATOR switch to ON.

(2) Set the GYRO SIMULATOR-PITCH to 20 NOSE UP.

(3) Measure ac voltage between PITCH Hl(J14) and LO(J15) on SN-358A/APN-158 with AN/USM-210.

(4) Adjust GYRO SIMULATOR-PITCH control for a reading of 5.0 $\pm$0. 25 volts ac.

(5) Remove AN/USM-210 and connect a jumper wire between ROLL HI(J13) and LO(J15) on SN-358A/APN-158.

(6) Set the GYRO SIMULATOR-ROLL control to 0.

(7) Position the antenna dead ahead.

(8) Place Combination Square MX-66-13/APM-246 against the AS-1642/APN-158 antenna dish.

(9) The level bubble on the MX-6613/APM-246 shall indicate 10° $\underline{+}$2° in the elevation axis.

(10) Set the GYRO SIMULATOR-PITCH control to 0.

(11) Remove jumper connected in step (6) above, and connect it between PITCH HI (J14) and GROUND (J35) on SN-358A/APN-158.

(12) Set the GYRO SIMULATOR-ROLL control to 20 RIGHT WING DOWN.

(13) Measure ac voltage between ROLL HI(J13) and LO(J15) on SN-358A/APN-158 with AN/USM-210.

(14) Adjust GYRO SIMULATOR-ROLL control for reading of 5.0 $\underline{+}$0.5 volts ac.

(15) Position the AS-1642A(AS-1520A)/APN-158 antenna dish to 60° right as viewed from the front. The level bubble on the MX-6613/APM-246 shall indicate 0.87 of the reading obtained in (9) above in the elevation axis $\underline{+}$0.5°

NOTE

If the antenna is to be mounted on a nonperpendicular bulkhead, PITCH TRIM potentiometer R7 may be adjusted to compensate for the elevation offset angle.

E. Sweep Excitation. Set the ANTENNA TESTS switch to SWEEP EXC. The TEST METER shall indicate 35 $\underline{+}$5 volts.

F. Sweep Resolver Alignment.

(1) Set the ANTENNA TESTS switch to X SWEEP.

(2) Sweep the AS-1520A(AS-1642A)/APN-158 dish about the dead ahead position, using the MANUAL SWEEP ADJUST control.

(3) Measure the ac voltage between the SN-358A/APN-158 X SIG and GROUND TEST points with the AN/USM-210, for a null of 50 millivolts with the AS-1520A(AS-1642A)/ APN-158 in dead ahead position. Record the voltage.

(4) If necessary, loosen screws holding resolver B4 and rotate B4 for a null (50 millivolts or less) with the AS-1520A(AS-1642A)/APN-158 in dead ahead position.

(5) Connect an IP-724A/APN-158 Indicator, known to be in good condition, to P4 of the AN/APM-247.

(6) Set the AS-1520A(AS-1642A)/APN-158 SCAN switch to SCAN and observe the IP-724A/APN-158 display. If the display sweep is opposite to normal, loosen the clamps around B4 and rotate B4 180°. Repeat steps (1) through (4) above.

G. X-Sensitivity Adjustment.

(1) Loosen the bracket on AS-1520A(AS-1642A)/APN-158 sweep resolver B4 and position it to make contact with the case of pitch-roll resolver B3. Secure the bracket in place.

(2) Loosen the three screws that secure resolver B4 in place. (Mark the original position of B4.) Rotate B4 until the other end of the bracket makes contact with the case of resolver B3. Resolver B4 has now been rotated 90° from its original position.

(3) Position the AS-1520A(AS-1642A)/APN-158 straight ahead. Measure the ac voltage between the SN-358A/APN-158 X SIG and GROUND test points with the AN/USM-210. The voltage shall be 0.303 times the voltage obtained in step F above. If not, adjust X OUT potentiometer R6 on the AS-1520A(AS-1642A)/APN-158 to obtain the proper voltage.

H. Y-Sensitivity Adjustment.

(1) Set the ANTENNA TESTS switch to Y SWEEP.

(2) Rotate AS-1520A(AS-1642A)/APN-158 resolver B4 back to its original position and secure it in place.

(3) Position the AS-1520A(AS-1642A)/APN-158 antenna dish straight ahead. The AN/USM-21(shall indicate the same as in G(3) above. If necessary, adjust AS-1520A(AS-1642A)/APN-158 Y-out potentiometer R9 for the proper indication on the AN/USM-210.

I. Resolver Tune.

(1) Set the ANTENNA TESTS switch to RES TUNE.

(2) The TEST METER shall indicate not more than 3.0 volts.

J. Rate Adjustment.

(1) Rapidly move the AS-1642A(AS-1520A)/APN-158 antenna dish up and down with the INTERNAL CONTROL UNIT-ELEVATION control. Observe that the antenna dish does not overshoot or oscillate.

(2) If the antenna dish overshoots or oscillates, adjust AS-1642A(AS1642A/APN-158 rate control potentiometer R4 for proper operation of the dish.

K. Manual Elevation.

(1) Set GYRO SIMULATOR switch to OFF.

(2) Set the INTERNAL CONTROL UNIT-ELEVATION control to 0°. With the MX-6613/APM-246, observe that the antenna dish is level with respect to 0° pitch position of the dish.

(3) Set the INTERNAL CONTROL UNIT-ELEVATION control to 15° UP. The MX-6613/APM-246 shall indicate 7 1/2 ±1° of elevation with respect to the reading obtained in (2) above.

(4) Set the INTERNAL CONTROL UNIT-ELEVATION control to 150 DOWN. The MX-6613/APM-246 shall indicate 7 1/2 ±1° of elevation with respect to the reading obtained in (2) above.

L. Limit Switch.

(1) Set the INTERNAL CONTROL UNIT-ELEVATION control to 15° DOWN and set GYRO SIMULATOR switch to ON.

(2) Set the GYRO SIMULATOR-PITCH control to 15° NOSE UP. Observe the MX-6613/APM-246 to see that the antenna-dish elevation movement is not less than 12° from that recorded in K(2) above. If necessary, adjust the rubber stops on the antenna.

(3) Set the INTERNAL CONTROL UNIT-ELEVATION control to 15° UP.

(4) Set the GYRO SIMULATOR-PITCH control to 15° NOSE DOWN. Observe the MX-6613/APM-246 to see that the antenna dish elevation movement is not less than 12° from that recorded in K(2) above.

(5) Rapidly move the GYRO SIMULATOR-ELEVATION control between 15° UP and 15° DOWN. Observe that the antenna dish or tilt linkage do not strike the gimbal.

8-8. Indicator, Azimuth-Range IP-724A/APN-158 Tests.

Interconnect the equipment as shown in figure 8-6. Perform the preliminary procedures given in paragraphs 8-4 and 8-5A. All control settings are for the AN/APM-247, unless otherwise indicated.

NOTE

A known good RT-711A/APN-158, SN-358A/APN-158, and AS-1642A or AS-1520A/APN-158 must be connected during these tests.

A. Power Supplies.

WARNING

Be extremely careful when working on PS-1 and PS-2. Assume that very high voltages are present on all terminals in steps (6) through(17) below.

(1) Set the RT-711A/APN-158 RF switch to ON.

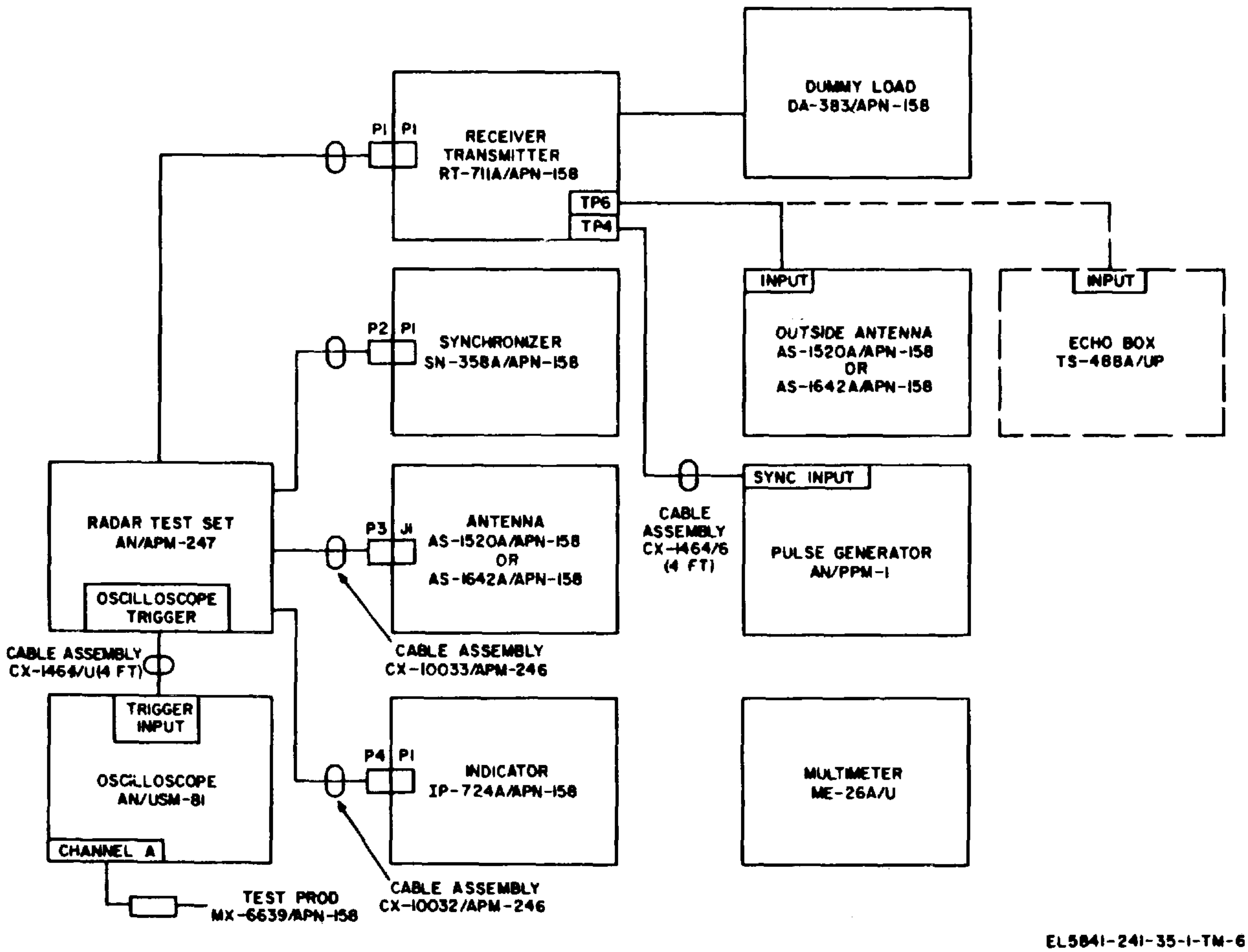
(2) Set the TEST SET FUNCTION SELECTOR switch to ANTENNA/INDICATOR/CONTROL UNIT TESTS.

(3) Remove the covers and rear plate from Indicator, Azimuth-Range IP-724A/APN-158.

(4) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OPERATE. There is a 4-minute time delay before the OPERATE lamp lights.

(5) Set the AS-1642A(AS-1520A)/APN-158 SCAN/OFF switch to SCAN. If necessary, adjust the BACK-GRD control on the IP-724A/APN-158 front panel to the desired level.

(6) With Multimeter ME-26A/U measure the voltage between TB3 terminal 6 and ground in the IP-724A/APN-158. The voltage shall be -500 ±50 volts dc.



Testing Indicator, Azimuth-Range IP-724A/APN-158, block diagram .
Figure 8-6

(7) Remove the plastic cover over TB2 in the IP-724A/APN-158.

(8) With the ME-26A/U measure the voltage between TB2 terminal 4(±) and TB2 terminal 2(-) in the IP-724A/APN-158. The voltage shall be ±200 ±30 volts dc. (Referenced to 2000 volts.)

(9) With Prod, Test MX-6639/APN-158 (1000:1 probe) and the oscilloscope, measure the voltage at terminal 3 of TB2 in the IP-724A/APN-158. The voltage shall be +2,000 ±300 volts dc.

(10) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OFF.

(11) Connect Adapter, Test MX-6637/APN-158 between the V3 plate cap and the high voltage cap on PS-2 in the IP-724A/APN-158.

(12) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY for 4 minutes, then to OPERATE.

(13) Measure the voltage at Adapter, Test MX-6636/APN-152 with Prod, Test MX-6639/ APN-158 (1000:1 probe) and the oscilloscope. The voltage shall be 7,000 ±1,500 volts dc average and 9.5 kv peak.

(14) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OFF.

(15) Remove Adapter, Test MX-6637/APN-158 and replace the high voltage cap on the V3 plate in the IP-724A/APN-158.

(16) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY for 60 seconds, then to OPERATE.

(17) With a standard probe and the oscilloscope, measure the amplitude, width, and rise- time of the pulse at terminal 7 of PS-2 in the IP-724A/APN-158. The pulse amplitude shall be not less than 20 volts peaks the pulse width shall be 120 to 200 microseconds, and the risetime shall be NMT 60 microseconds.

(18) Set INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY.

(19) Replace the plastic cover over TB2 in the IP-724A/APN-158.

WARNING

The following voltage measurements are relatively low dc voltages, but are referenced to +2,000 volts. Be extremely careful to insure against personnel injury and be certain that the meter or test leads do not come in contact with ground. AU high voltages should be measured through the access holes in the protective cover over TB2. The shafts of potentiometers R36, R39, and R41 are also +2,000 volts above ground. An insulated screwdriver must be used to make these adjustments.

B. Flood Gun Bias

(1) With the ME-26A/U measure the voltage between terminals 10 and 4 of TB2 in the IP-724A/APN-158. The voltage should be approximately the value written on the top of the indicator tube, or best possible visual presentation possible.

(2) With the ME-26A/U measure the voltage between terminals 10 and 8 of TB2 in the IP-724A/APN-158. The voltage should be approximately the value written on the top of the indicator tube.

(3) With the ME-26A/U measure the voltage between terminals 10 and 7 of TB2 in the IP-724A/APN-158. The voltage should be approximately the value written on the top of the indicator tube.

C. Writing Gun Bias.

With the ME-26A/U measure the voltage at terminal 5 of TB3 in the IP-724A/APN-158 with the IP-724A/APN-158 RANGE switch set to the following positions:

(1) 30: +75 to +200 volts dc.

(2) 60: +68 to +190 volts dc.

(3) 150: 68 to +190 volts dc.

D. Erase Pulse.

(1) Connect the standard probe (10:1) on the oscilloscope to the junction of R40 and C8 on TB2 in the IP-724A/APN-158 (test point ERASE PULSE on some units).

(2) Measure the amplitude and width of the pulse displayed on the oscilloscope. The amplitude should be adjustable by TB1-R3 from +10 to +15 volts peak with a width of 10 to 50 microseconds at the 50-percent points, adjustable by TB1-R1.

E. Gate Pulse.

(1) Connect the standard probe (10:1) on the oscilloscope to terminal 4 of TB3 in the IP-1724A/APN-158 (the terminal point next to the .WGG-1 control).

(2) Measure the amplitude and negative level to which the gate pulse is clamped, with the oscilloscope.

NOTE
The periodic change in amplitude is caused by the operation of the blanking switch.

(3) The amplitude shall be 10 ±2 volts, clamped at -20 to -58 volts.

F. Shading Pulse.

(1) Connect the standard probe (10:1) on the oscilloscope to terminal 5 of TB3 in the IP-724A/APN-158.

(2) Set the IP-724A/APN-158 RANGE switch to 150.

(3) Measure the amplitude of the pulse displayed on the oscilloscope; amplitude shall be not less than 40 volts peak.

G. Video Pulse.

(1) Remove the video driver module from Synchronizer, Electrical SN-358A/APN-158.

(2) Connect the CG-1464/U from the PULSE OUTPUT jack on Pulse Generator AN/PPM-1 to OSCILLOSCOPE A.

(3) Set the TEST SET FUNCTION SELECTOR switch to SYNCHRONIZER.

(4) Set the output of the AN/PPM-1 for a -6 volt peak amplitude, 10-microsecond wide pulse delayed 80 to 100 microseconds.

(5) Disconnect AP/PPM-1 from oscilloscope and connect to SN-358A/APN-158 VIDEO test point J16.

(6) Connect the standard probe (10:1) on the oscilloscope to the junction of CR18 and R93 on TB1 in the IP-724A/APN-158.

(7) Measure the amplitude and width of the pulse displayed on the oscilloscope. The pulse amplitude shall be 4 volts peak minimum. If necessary, adjust video amplitude potentiometer R5 on TB1 in the IP-7214/APN-18 for proper amplitude.

(8) Disconnect the CG-1464/U from the OSCILLOSCOPE A jack and replace the video driver module in the SN-358A/APN-158.

(9) Set the TEST SET FUNCTION SELECTOR switch to ANTENNA/INDICATOR/CONTROL UNIT TESTS.

(10) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to STANDBY.

H. Sweep Deflection.

(1) Set the AS-1642A(AS-1520A)/APN-158 SCAN/OFF switch to OFF.

(2) Set the IP-724A(AS-1520A)/APN-158 BACKGRD control maximum counterclockwise.

(3) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OPERATE.

(4) Position the AS-1642A(AS-1520A)/APN-158 antenna dish straight ahead.

(5) Adjust the IP-724A/APN-158 BACKGRD control for a visible sweep trace.

(6) Set the INDICATOR TESTS switch to ZERO AZIMUTH. The sweep/trace shall be parallel to the vertical scribe line on the top of the IP-724A/APN-158 to bottom center of face plate. If necessary, loosen the yoke clamp on the IP-724A/APN-158 and rotate the yoke to the proper position.

(7) The sweep trace shall be directly underneath the vertical scribe line on the IP-724A/APN-158. If necessary, adjust horizontal position potentiometer R7 on TB1 in the IP-724A/APN-158 until the sweep trace is positioned directly underneath the vertical scribe line.

(8) The sweep trace shall start at the vertex of the IP-724A/APN-158 faceplate. If necessary, adjust vertical position potentiometer R13 on TB1 in the IP-724A/APN-158 to position the start of the sweep trace at the vertex of the faceplate.

(9) Set the IP-724A/APN-158 RANGE switch to 30. The third rangemark on the sweep trace shall be 1/4 inch (±1/8 inch) below the top opening of the IP-724A/APN-158 faceplate. If necessary, loosen the clamp on the yoke and move the yoke forward to shorten the sweep and backward to lengthen the sweep. This action may change the deflection center and R7 and R13 may have to be readjusted. If adjustment of the yoke is not sufficient to position the third rangemark as desired, move the tap on resistors R22-R25 on TB2 in the IP-724A/APN-158 until the third rangemark is properly positioned.

(10) Set the IP-724A/APN-158 RANGE switch to 60. Repeat the procedures given in (9) above, except observe the fifth rangemark on the sweep trace.

(11) Set the IP-724A/APN-158 RANGE switch to 150. Repeat the procedures given in (9) above, except observe the fifth rangemark on the sweep trace.

(12) Manually rotate the AS-1642A(AS-1520A)/APN-158 antenna dish 45° to the left and the 45° to the right. The position of the sweep trace at each setting of the antenna dish shall be 45° ±5°.

NOTE

A visual performance check and further adjustments of the IP-724A/APN-158 are outlined in paragraph 8-10. The applicable test must be performed to insure proper operation of the IP-724A/APN-158.

(13) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OFF.

8-9. Control, Radar Set C-4881/APN-158 Tests.

Interconnect the equipment as shown in figure 8-7. Perform the preliminary procedures given in paragraphs 8-4 and 8-5A. All control settings are for the AN/APM-247, unless indicated otherwise.

A. Function Switch.

(1) Set the TEST SET FUNCTION SELECTOR switch to ANTENNA/INDICATOR/CONTROL UNIT TESTS.

(2) Set the CONTROL UNIT TEST-CONTROL UNIT SELECTOR switch to EXT TEST.

(3) Set the C-4881/APN-158 SYSTEM CONTROL switch to STANDBY. The STANDBY lamp shall light.

NOTE

If the SYSTEM CONTROL switch has a detent position before turning to OFF, the INVERTER RELAY lamp shall light in STANDBY, OPERATE, and CONTOUR positions.

(4) Set the C-4881/APN-158 SYSTEM CONTROL switch to OPERATE. The OPERATE lamp shall light.

(5) Set the C-4881/APN-158 SYSTEM CONTROL switch to CONTOUR. The CONTOUR lamp shall light.

B. Receiver Gain.

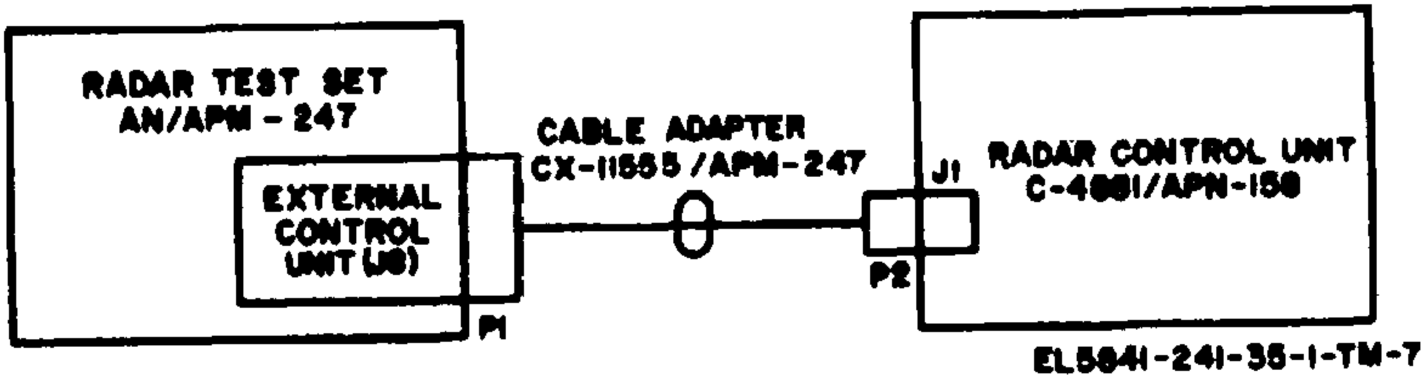
(1) Set the CONTROL UNIT TEST-TEST FUNCTION switch to RCVR GAIN.

(2) Connect a jumper wire between terminals 13 and 20 of P1 of AN/AP-247e

(3) Set the C-4881/APN-158 GAIN control to counterclockwise stop The TEST METER shall indicate 1.7 $\pm$2 volts

(4) Set the C-4881/APN-158 GAIN control to clockwise stop. The TEST METER shall indicate not more than 0.2 volt (in the lower third of the green section of the meter scale).

(5) Remove Jumper wire from P1 of the AN/APM-247.



Testing Control, Radar Set C-4881/APN-158, block diagram .

Figure 8-7

C. Elevation Control.

(1) Set the CONTROL UNIT TEST-TEST FUNCTION switch to ELEV COARSE ADJ 8V.

(2) Set the C-4881/APN-158 ELEVATION control to 0. The TEST METER shall indicate 8.0 ±0.5 volts. If necessary, loosen the screws that hold the elevation synchro in the C-4881/APN-158 and rotate the elevation synchro for the correct indication.

(3) Set the CONTROL UNIT TEST-TEST FUNCTION switch to ELEV COARSE ADJ 5V. The TEST METER shall indicate 5.0 ±0.5 volts. If necessary, rotate the C-4881/APN-158 elevation synchro to 1800 and repeat the procedures given in (1) and (2) above.

(4) Set the CONTROL UNIT TEST-TEST FUNCTION switch to ELEV FINE ADJ. The TEST METER shall indicate less than 50 millivolts. If necessary, rotate the C-4881/APN-158 elevation synchro for a null indication of less than 50 millivolts.

(5) Secure the elevation synchro in place. Be sure that a null reading is still indicated on the TEST METER (same as (4) above).

8-10. System Performance Tests

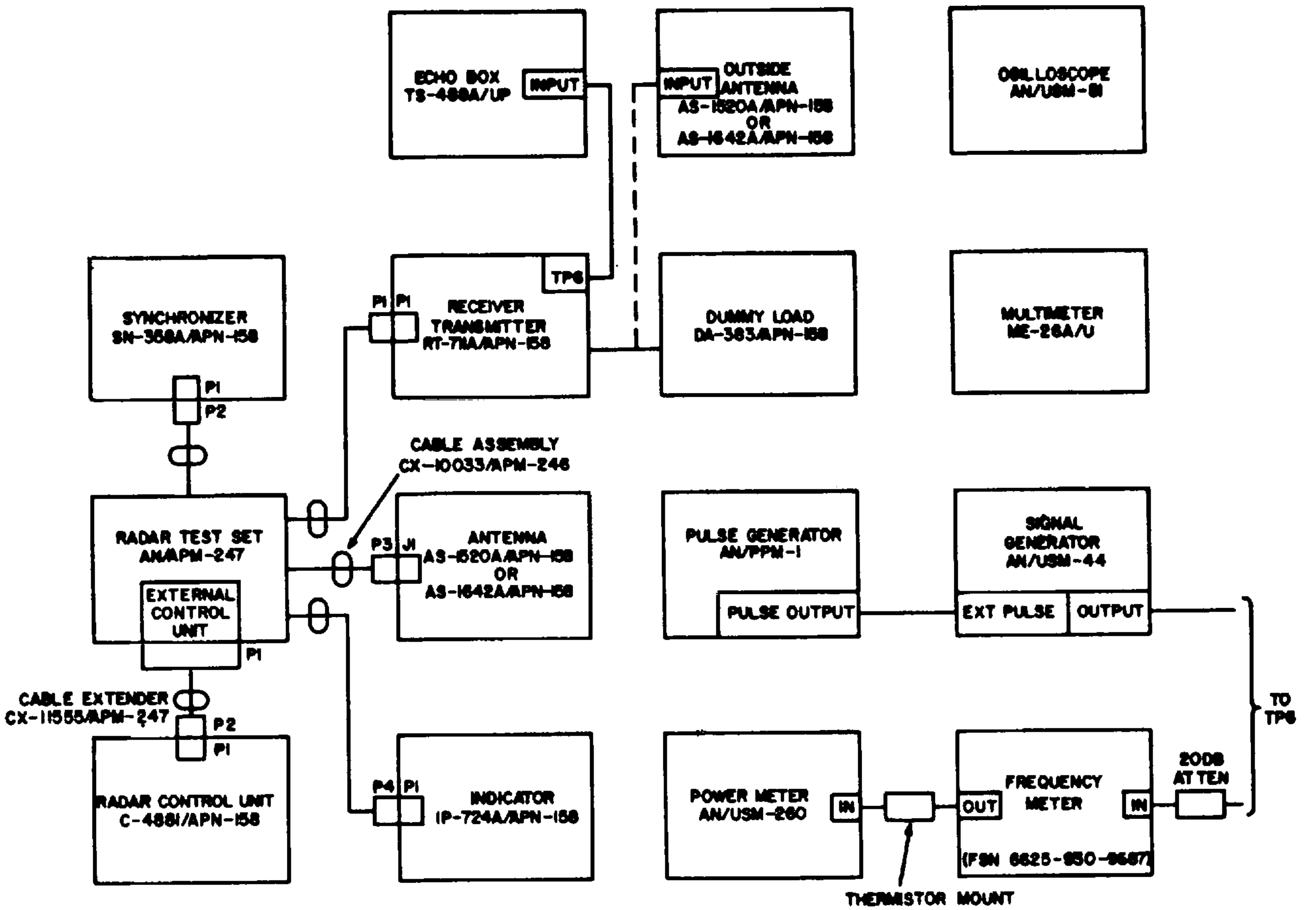
Interconnect the equipment as shown in figure 8-8. All control settings are for the AN/APM-247, unless indicated otherwise. Perform the starting procedures below.

NOTE

When the AN/APM-247 is operated in the SYSTEM OPERATION mode, the only function of the AN/APM-247 is to interconnect the complete radar system. All panel controls, except the INPUT VOLTAGE ADJUST, INPUT VOLTAGE meter, INPUT FREQUENCY meter, and GYRO SIMULATOR, are disabled.

A. Preliminary Control Settings.

(1) Set the INTERNAL CONTROL UNIT-SYSTEM CONTROL switch to OFF.



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System performance test of AN/APN-158A, block diagram .
Figure 8-8

(2) Set the AC POWER switch to OFF.

(3) Set the TEST SET FUNCTION SELECTOR switch to SYSTEM OPERATION.

(4) Set the RT-711A/APN-158 RF switch to ON.

(5) Set the AS-1642A(AS-1520A)/APN-158 SCAN/OFF switch to SCAN.

(6) Set the CONTROL UNIT TEST-CONTROL UNIT SELECTOR switch to EXT.

(7) Set the INPUT VOLTAGE ADJUST control fully counterclockwise.

(8) Set the AC POWER switch to ON. Adjust the voltage on the INPUT VOLTAGE meter for 115 volts ac. Observe that the INPUT FREQUENCY meter indicates approximately 400 Hz.

B. Collimation.

(1) Set the C-4881/APN-158 control switch to OPR. Allow for a 4-minute time delay.

(2) Set the C-4881/APN-158 control switch to STBY and allow filaments in the IP-724A/APN-158 to cool.

(3) Set the C-4881/APN-158 control switch to OPR; note that, for a short period of time (warmup of filaments) a faint green glow is present on the IP-724A/APN-158 screen and covers the full viewing face of the tube. If the preceding requirements are not met, the following adjustments will be necessary.

(4) Set the erasure by rotating IP-724A/APN-158 ERASE AMP control R3 counterclockwise.

(5) Write the screen to full brightness by rotating the IP-724A/APN-158 BACKGRD control clockwise.

NOTE
The flood gun beam may not cover the entire screen at this time.

(6) Stop writing by rotating the IP-724A/APN-158 BACKGRD control counterclockwise.

(7) Adjust IP-724A/APN-158 F.G. GRID 1 control R36 for maximum screen coverage.

(8) Adjust IP-724A/APN-158 F.G. GRID 4 control R41 for maximum screen coverage.

(9) Adjust IP-724A/APN-158 F.G. GRID 3 control R39 for maximum screen coverage and maximum uniformity or illuminated area.

(10) Readjust IP-724A/APN-158 F.G. GRID 4 control R41 and F.G. GRID 3 control R39 for maximum screen coverage and maximum uniformity of illuminated area.

(11) Rotate IP-724A/APN-158 ERASE AMP control R3 clockwise. Certain portions of the display may erase more rapidly than others. Stop the erasure before the entire display is erased.

(12) Slightly readjust F.G. GRID 4 control R41 and F.G. GRID 3 control R39 for display uniformity without decreasing the diameter of the display.

(13) Write screen to full brightness by rotating the IP-724A/APN-158 BACKGRD control clockwise and repeat the procedures given in (11) and (12) above several times until the most uniform display and maximum diameter are obtained.

NOTE

If difficulty is encountered in the collimation test, and bright spots appear on the screen that do not erase as they should, refer to TM 11-5841-259-12 for procedures to demagnetize the IP-724A/APN-158.

C. Erasure.

(1) Set the IP-724A/APN-158 RANGE switch to the 60-mile range position.

(2) Set IP-724A/APN-158 ERASE WIDTH control R1 fully clockwise.

(3) Set IP-724A/APN-158 ERASE AMP control R3 fully counterclockwise.

(4) Write screen to full brightness by momentarily rotating the IP-724A/APN-158 BACKGRD control clockwise.

(5) Slowly rotate IP-724A/APN-158 ERASE AMP control R3 clockwise until the display is just barely erased.

(6) Adjust IP-724A/APN-158 BACKGRD control for a suitable video display.

(7) Adjust IP-724A/APN-158 ERASE WIDTH control R1 to obtain desired persistence.

NOTE

Too long a persistence time will result in blooming and lack of good contrast.

(8) Check to see that there is not a green glow present on the screen. This can be determined best in the absence of writing.

(9) Tighten the locknuts on IP-724A/APN-158 controls R1 and R3.

D. Writing Gun.

(1) Set the IP-724A/APN-158 BACKGRD control to its midrange position.

(2) Set the IP-724A/APN-158 RANGE switch to the 30-mile range position.

(3) Observe that the video display has slight background noise and the writing gun sweep line does not store. If necessary, adjust IP-724A/APN-158 WGG 1 control R56.

(4) Adjust FOCUS control R55 for the best rangemark definition.

E. BACKGRD Control.

(1) Set the IP-724A/APN-158 RANGE switch to the 30-mile range position. Adjust the IP-724A/APN-158 BACKGRD control for a barely discernable noise presentation.

(2) Set the RANGE switch to the 60-mile range position. Observe the presentation on the screen; it should be the same as (1) above. If necessary, adjust R58 on the IP-724A/APN-158.

(3) Set the RANGE switch to the 150-mile range position. Observe the presentation on the screen; it should be the same as (1) above. If necessary, adjust R45 on the IP-724A/APN-158.

F. Shading.

(1) Set the IP-724A/APN-158 RANGE switch to the 150-mile range position.

(2) Adjust the IP-724A/APN-158 BACKGRD control for a normal target presentation. Observe that the target presentation is uniform from the center to the outside edge of the display. If necessary, perform the procedures given in (3) through (6) below

(3) Set IP-724A/APN-158 SHADING control R48 fully counterclockwise.

(4) Adjust IP-724A/APN-158 BACKGRD control for a normal target presentation at the center of the sweep. Slowly adjust SHADING control R48 clockwise while adjusting the BACKGRD control counterclockwise, as necessary, to achieve a normal target presentation from the center to the outer edge of the display.

(5) Set the IP-724A/APN-158 RANGE switch to the 60-mile range position and observe that the presentation brightness does not change.

(6) Set the RANGE switch to the 30-mile range position and observe that the presentation brightness does not change.

G. Blanking.

(1) Set the AS-1642A(AS-1520A)/APN-158 SCAN/OFF switch to OFF.

(2) Position the antenna to one of the extremes of its azimuth movement to close the blanking switch.

(3) With a normal display on the IP-724A/APN-158, check to see that closing the blanking switch blanks out the outer edge of the display on the IP-724A/APN-158.

(4) Set the SCAN/OFF switch to ON.

NOTE

The tests below are designed to evaluate the performance of the radar system. If adjustments are necessary, refer to the unit tests given for the individual units.

H. Sweep. Set the IP-724A/APN-158 RANGE switch to each of its range positions and observe that the intensity of the rangemarks is approximately the same on all ranges.

I. BACKGRD Control. Set the IP-724A/APN-158 BACKGRD control for a barely visible trace on the screen. Check the BACKGRD control for at least a one-quarter turn in either direction from this setting.

J. Indicator Trace. When viewing the antenna from the front, observe that as the antenna moves to the left, the indicator sweeps from left to right.

K. Video Level Adjust.

(1) Connect an outside antenna for this test if available; if not, use the TS-488A/UP echo box.

(2) Vary the C-4881/APN-158 GAIN control from maximum cw to maximum ccw. Observe

NOTE

If the TS-488A/UP is used, short the STC test jack in the SN-358A/APN-158 to ground and remove short after the check is performed.

(2) Vary the C-4881/APN-158 GAIN control from maximum cw to maximum cw. Observe that maximum video signal is displayed in cw position, and no video signal is displayed in cow position.

(3) Adjust the video signal level for the best target presentation using the C-4881/APN-158 GAIN control.

L. Rangemarks. Set the IP-724A/APN-158 RANGE switch to each range position, and in each position observe the last rangemark; it shall be 1/4 inch (±1/8 inch) from the top of the facemask.

M. Sweep Start. Set the AS-1642A(AS-1520A)/APN-158 SCAN/OFF switch to OFF. Observe that the start of the sweep is within 1/8 inch of the cross vertically, and within 3/32 inch of the lubber line horizontally. Set the AS-162A(AS-1520A)/APN-158 SCAN/OFF switch to ON.

N. Pitch and Roll Phasing. Set the GYRO SIMULATOR switch to ON. Observe that as the GYRO SIMULATOR-PITCH control is moved to the NOSE UP position, the antenna will move down, and that as the GYRO SIMULATOR-PITCH control is moved to the NOSE DOWN position, the antenna will move up. Set the GYRO SIMULATOR switch to OFF.

O. Gate Length. Observe that there is no sweep foldover and there is not more than 1/4-inch lack band at the top of the normal viewing area.

P. Transmitter Output Power and Frequency.

NOTE

This test is requires if a system check only is being run

(1) Set the C-4881/APN-158 control switch to STBY. Observe the INPUT VOLTAGE meter; it shall read 115 volts ac.

(2) Remove the TS-488A/UP from TP6 on the RT-711A/APN-158.

(3) connect the oscilloscope to TP4 on the RT-711A/APN-158.

(4) Connect the frequency meter (FSN 6625-930-9687) input to TP6 on the RT-711A/APN-158. Connect the frequency meter output to a 20 db attenuator (Narda 757-20) and the attenuator to a thermistor mount (MX 2144/U). Connect thermistor mount to power meter (AN/USM-260) with signal cable supplied.

(5) Set the RT-711A/APN-158 RF switch to ON.

(6) Set the C-4881/APN-158 control switch to OPR.

NOTE

Allow an elapsed time of 4 ±1 minutes before proceeding to allow sufficient time for the time delay relay to engage.

(7) Measure the amplitude and pulse width of the pulse displayed on the AN/USM-81. The amplitude shall be from +35 to +45 volts, and the pulse width from 3.1 to 3.8 microseconds at the 50% amplitude points.

(8) Set the RT-711A/APN-158 meter switch to MAG. The meter shall indicate from 4 to 6.

(9) Rotate the frequency meter control through its range until a dip is indicated on the AN/USM-260. The AN/USM-260 shall indicate 9,375 ±40 megahertz.

(10) Compute the average power output of the RT-711A/APN-158 by adding the following: RT-711A/APN directional coupler loss (approximately 20 db, exact amount stamped on coupler), 20 db attenuator loss, frequency meter insertion loss, and power meter reading. The total shall be not less than +43.5 dbm (referred to 1 milliwatt in 600 ohms).

NOTE

+43. dbm = approximately 20 watts average power.

(11) Calculate the peak power as follows:

$$\text{Peak power (kilowatts)} = \frac{\text{average power (watts) x 1000}}{\text{pulse width (microseconds) x prf}}$$

The peak power shall be not less than 20 kilowatts.

Q. Receiver Sensitivity and Gain.

(1) Set the C-4881/APN-158 control switch to OPR.

(2) Set the METER MULTIPLIER to X10.

(3) Set the C-4881/APN-158 GAIN to maximum cw position.

(4) Disconnect the RG-214 cable from TP6 on the RT-711A/APN-158. to the frequency meter (537A) at TP6.

(5) Connect the signal generator (Hewlett-Packard 620A) RF OUTPUT to a 20 db attenuator (Narda 757-20) and the attenuator to TP6 on the RT-711A/APN-158.

(6) Connect the pulse generator SYNC IN to TP4 on the RT-711A/APN-15 -with RG-214 cable.

(7) Disconnect the CG-1464/U cable assembly from the AN/USM-81 TRIGGER INPUT.

(8) Connect the AN/USM-81 TRIGGER INPUT to SYNC OUT on the signal generator.

(9) Adjust the signal generator to obtain an output of 3- to 5-microseconds-wide pulses with approximately 200-microseconds delay and rf frequency equal to magnetron frequency (9,375 40 MHz).

(10) Set the C-4881/APN-158 control switch to STBY.

(11) Connect SN-358A/APN-158 STC and GROUND test points together.

(12) Connect oscilloscope channel A to SN-358A/APN-158 VIDEO test point J16.

(13) Set the C-4881/APN-158 control switch to OPR.

(14) While observing the signal on the oscilloscope, decrease the signal amplitude from the signal generator until just before the pulse disappears in system noise. This point is the minimum discernible signal (MDS) level (refer to figure 8-2).

(15) Compute the gain by adding the following: RT-711A/APN-158 directional coupler loss (approximately 20 db, exact amount stamped on coupler), 20 db attenuator loss, frequency meter insertion loss and power meter reading. The system MDS shall be from -103 to -110 dbm,

(16) Remove the connection between the SN-358A/APN-158 STC and GROUND test points.

(17) Adjust the signal generator PULSE DELAY for 200 microseconds.

(18) Adjust the signal generator OUTPUT ATTEN control to obtain a 6-volt amplitude pulse on the oscilloscope. Record the attenuation level.

(19) Set the INTERNAL CONTROL UNIT GAIN to maximum ccw position.

(20) Readjust the signal generator OUTPUT ATTEN control to obtain a 6-volt amplitude pulse on the oscilloscope. Record the attenuation level.

(21) The difference in the attenuation levels recorded in steps (19) and (20) above shall be 15 db or greater.

R. Contour.

(1) Disconnect the signal generator (620A) from the RT-711A/APN-158.

(2) Connect the AN/PPM-1 SYNC INPUT to TP4 on the RT-711A/APN-158.

(3) Connect the AN/PPM-1 PULSE OUTPUT to the EXT PULSE jack on the AN/USM-44.

(4) Disconnect the 20 db attenuator from TP6 on the RT-711A/APN-158.

(5) Connect the AN/USM-44 RF OUTPUT to TP6 on the RT-711A/APN-158.

(6) Set the C-4881/APN-158 control switch to CTR.

(7) Adjust the AN/PPM-1 for a 10-microsecond wide output pulse.

(8) Adjust the AN/USM-44 frequency control for a maximum output amplitude of the pulse displayed on the oscilloscope (ensure that the afc is in the locked condition).

(9) Adjust the AN/USM-44 output level control until the signal level of the pulse displayed on the oscilloscope is contoured (the top of the pulse and baseline are of equal intensity.)

S. RF Pulse. Observe that the pulse width at TP4 on the RT-711A/APN-158 is 3.1 to 3.8 microseconds wide at the 50-percent amplitude points, as measured with the oscilloscope.

T. Manual Elevation Control. Rotate the C-4881/APN-158 ANT control UP; the antenna dish shall move up. Rotate the ELEVATION control DOWN; the antenna dish shall move down.

U. Video Signal. Measure the saturated video level at the SN-358A/APN-158 VIDEO jack; it shall not measure less than 6 volts nor more than 7 volts.

V. Panel Meter Indications. Check the RT-711A/APN-158 front panel meter; all meter positions shall indicate 5.0 ±1.0 except as follows:

(1) AFC shall indicate 3-10.

(2) FWD shall indicate 3-10.

(3) REV shall indicate ±1.0 of the indication obtained in (2) above.

W. Set the AN/APM-247 AC POWER switch to OFF and disconnect equipment.

APPENDIX A

REFERENCES

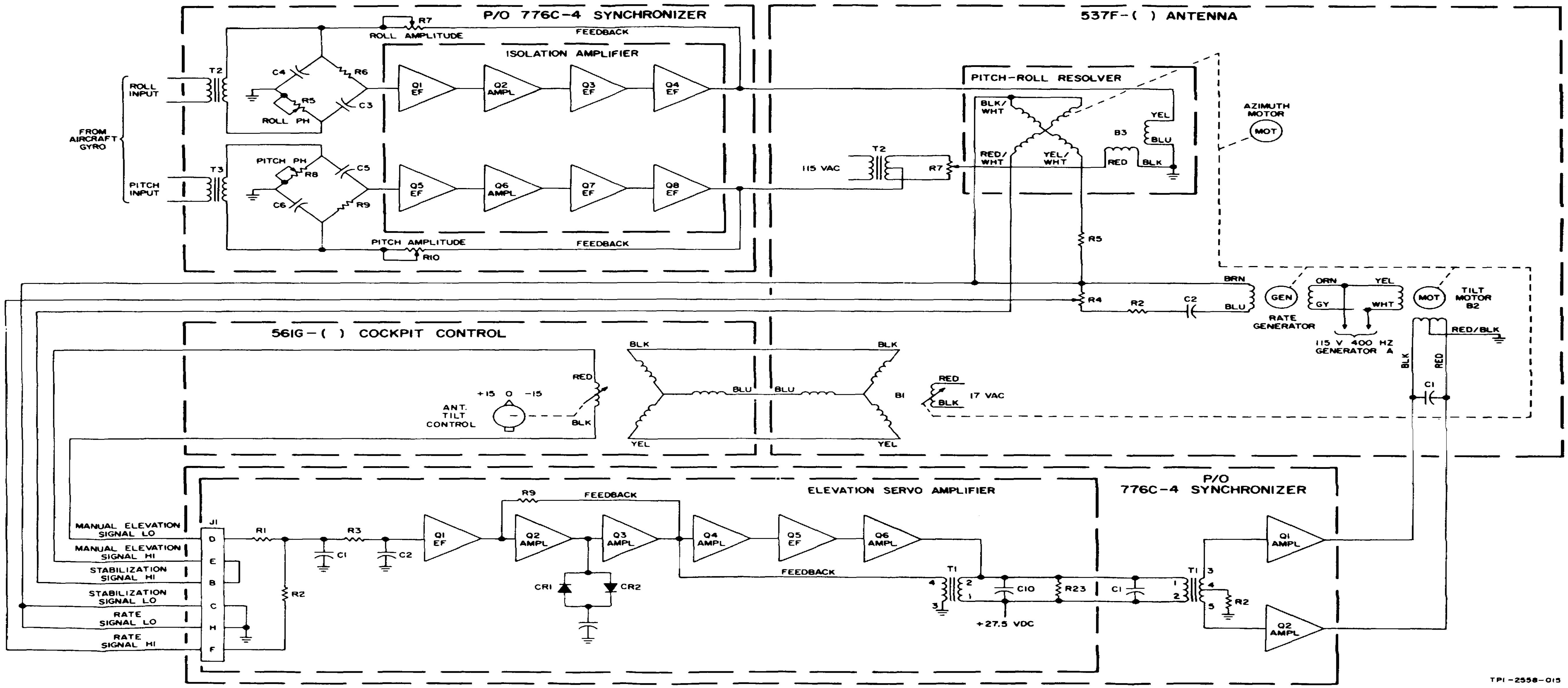
The following is a list of references available to the repairmen of Radar Set AN/APN-158A.

DA Pam 310-4	Military Publication: Index of Technical Manuals, Technical .Bulletins, Supply Manuals (types 7, 8, and 9, Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	Military Publication: Index of Modification Work Orders.
SB 11-573	Painting and Preservation Supplies Available for Field Use for Electronics Command Equipment.
SB 38-100	Preservation, Packaging, and Packing Materials, Supplies, and Equipment Used By the Army.
TB SIG 355-1	Depot Inspection Standards for Repaired Signal Equipment.
TB SIG 355-2	Depot Inspection Standards for Refinished Repaired Signal Equipment.
TB SIG 355-3	Depot Inspection Standards for Moisture and Fungus Resistance Treatment.
TB 746-10	Field Instructions for Painting and Preserving Electronics Command Equipment.
TM 9-6625-2362-12	Operator’s Manual: Oscilloscope AN/USM-281.
TM 11-2678	Operator, Organizational, field and depot Maintenance Manual: Pulse Generator AN/PPM-1 and AN/PPM- 1A.
TM 11-5841-259-12	Organizational Maintenance Manual: Maintenance Kit, Electronics Equipment MK-774/APN-158
TM 11-6625-200-15	Operator, Organizational, DS, GS, and Depot Maintenance Manual Multimeters ME-26A/U, ME-26B/U, ME-26C/U, and ME-26D/U.
TM 11-6625-508-10	Operator’s Manual: Signal Generators AN/USM-44 and AN/USM-44A.
TM 11-6625-519-10	Operation: Echo Box TS-488A/UP.
TM 11-6625-664-12	Organizational Maintenance Manual: Test Set, Radar AN/APM-246 and Test Set, Radar AN/APM-247.

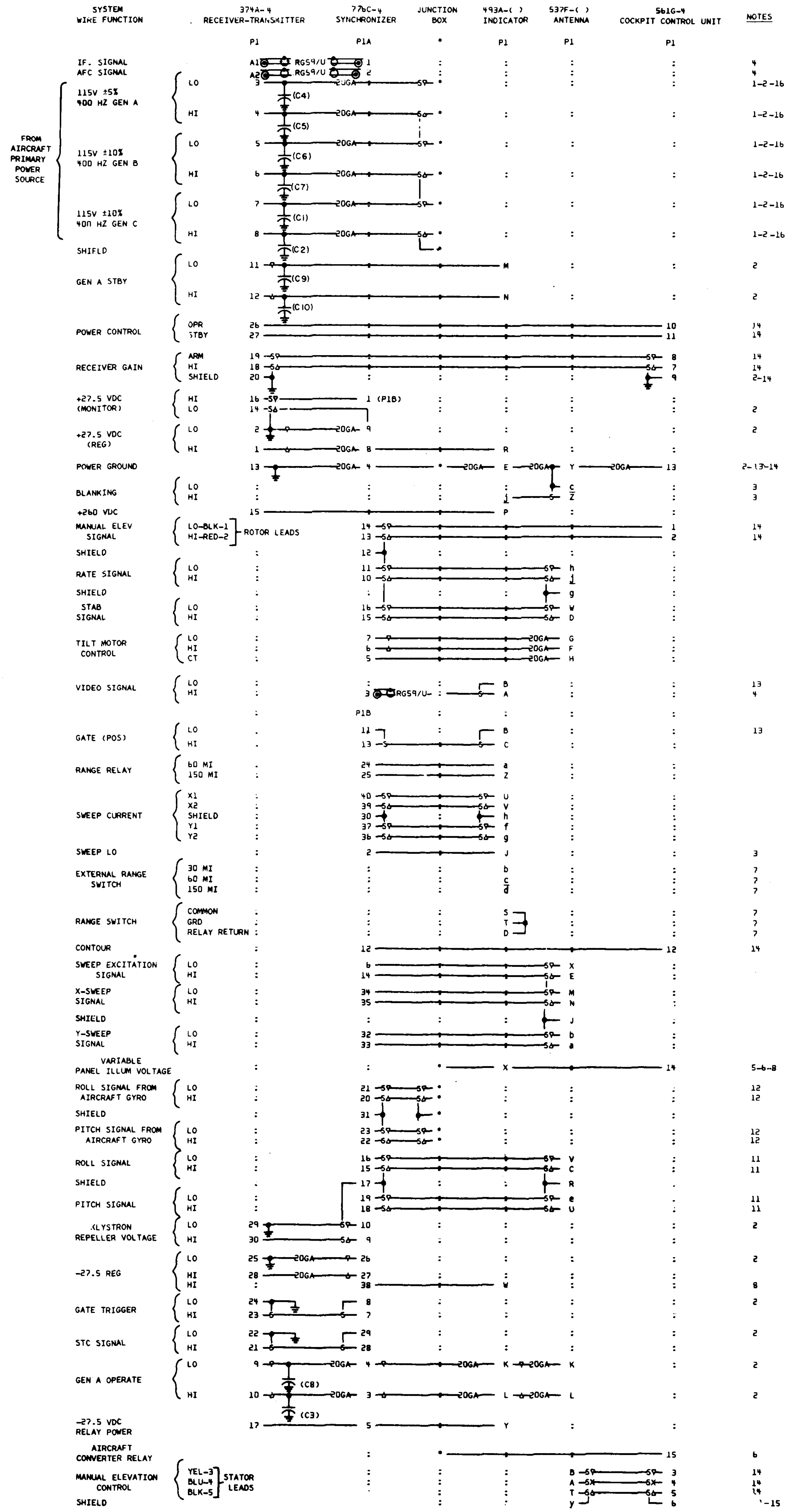
APPENDIX A (coat)

REFERENCES

TM 38-750	The Army Maintenance Management System (TAMMS).
TM 740-0-1	Administrative Store of Equipment.



Stabilization System, Simplified Schematic Diagram
Figure FO-1



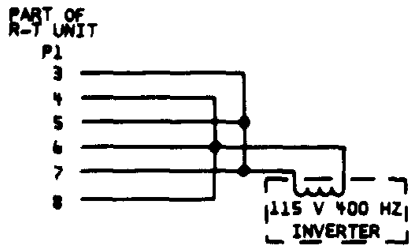
TPI-1717-024

AN/APN-158A Weather Radar System, Interconnect Diagram (Sheet 1 of 2)
Figure FO-2

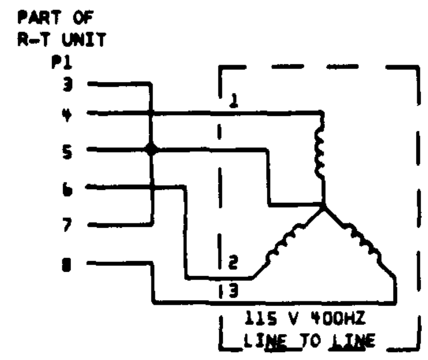
(Sheet 1 of 2)

NOTES.

1 FROM AIRCRAFT PRIMARY POWER SOURCE.



PRIMARY POWER INTERCONNECT TO WP-103 G WEATHER RADAR SYSTEM FROM AIRCRAFT USING A SINGLE PHASE PRIMARY POWER SOURCE



PRIMARY POWER INTERCONNECT TO WP-103 G WEATHER RADAR SYSTEM FROM AIRCRAFT USING A THREE-PHASE FOUR-WIRE WYE PRIMARY POWER SOURCE.

2. CAPACITORS AND GROUNDS (SHOWN ON INTERCONNECT) ARE LOCATED ON 349A-1 SHOCKMOUNT, COLLINS PART NUMBER 772-5135-001.

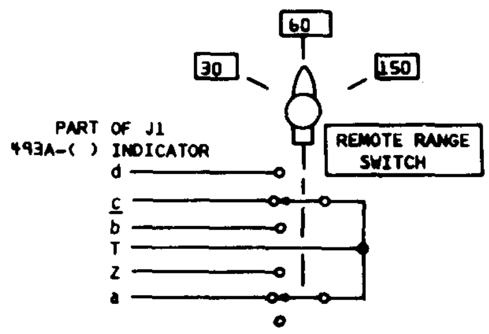
3. 493A- 5/5B INDICATORS ONLY.

4. CONNECTORS FOR RF CABLE (TYPE RG 59/U) ARE TYPE RF 6621-78, COLLINS PART NUMBER 357-9887-00.

5. IF VARIABLE PANEL ILLUMINATION VOLTAGE IS NOT AVAILABLE, PANEL CAN BE ILLUMINATED BY CONNECTING A JUMPER BETWEEN PINS X AND Y OF J1 ON THE 493A-4 INDICATOR.

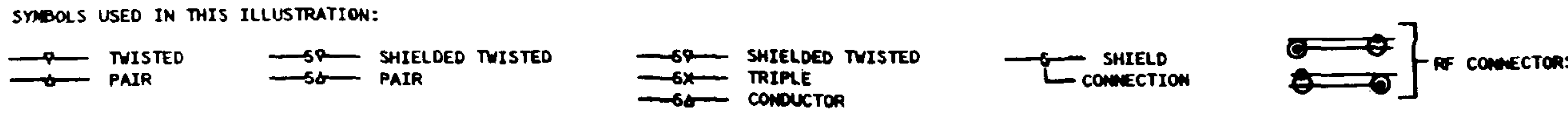
6. 561G-4 ONLY.

7. WHEN MOUNTING REQUIREMENTS OF THE 493A-( ) INDICATOR NECESSITATE THE USE OF A REMOTE RANGE SWITCH, REMOVE JUMPERS FROM PINS S, T, AND D OF J1 AND CONNECT REMOTE RANGE SWITCH AS SHOWN BELOW.



8. 493A-4 ONLY

9. SYMBOLS USED IN THIS ILLUSTRATION:



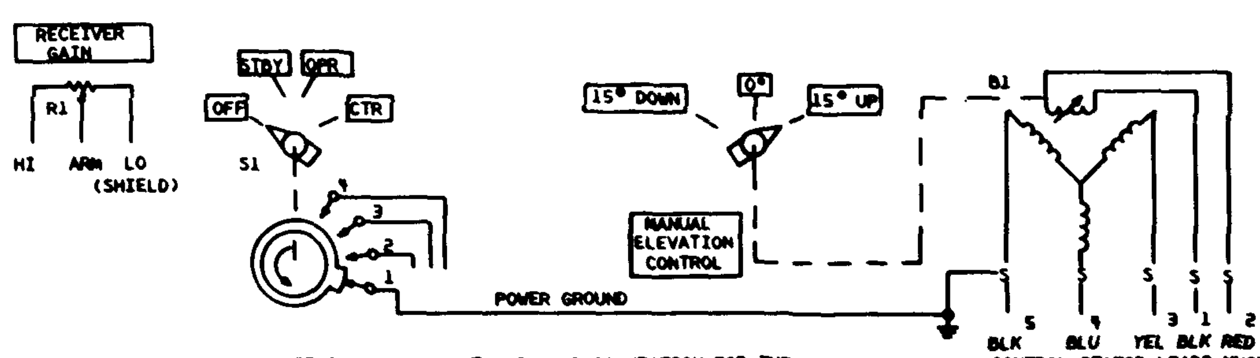
10. UNLESS OTHERWISE INDICATED, ALL WIRING IS NO 22 GAUGE.

11. WHEN NO GYRO IS PRESENT, CONNECT JUMPERS BETWEEN ANTENNA PINS C AND V, U AND e.

12. PITCH AND ROLL GYRO SIGNALS MUST BE PHASE-SYNCHRONOUS WITH SOURCE GEN A.

13. PIN Y ON ANTENNA AND PIN B ON INDICATOR ARE REFERENCED TWICE ON INTERCONNECT.

14. 561G-3 INTERCONNECT TO OTHER UNITS. PIN DESIGNATION ON COMPONENTS ARE FOR REFERENCE DESIGNATION ONLY AND DO NOT APPEAR ON INDIVIDUAL COMPONENTS. WIRE COLORS REFER TO SERVO CONNECTIONS-ROTOR LEADS MAY HAVE A SPIRAL TRACER. THE 561G-3 CONTROL KIT AND THE 561G-4 CONTROL UNIT ARE INTERCHANGEABLE. 561G-3 CONTAINS THE SAME COMPONENTS AS THE 561G-4 EXCEPT DS1 AND S1 WITH INVERTER RELAY GROUND TERMINAL.



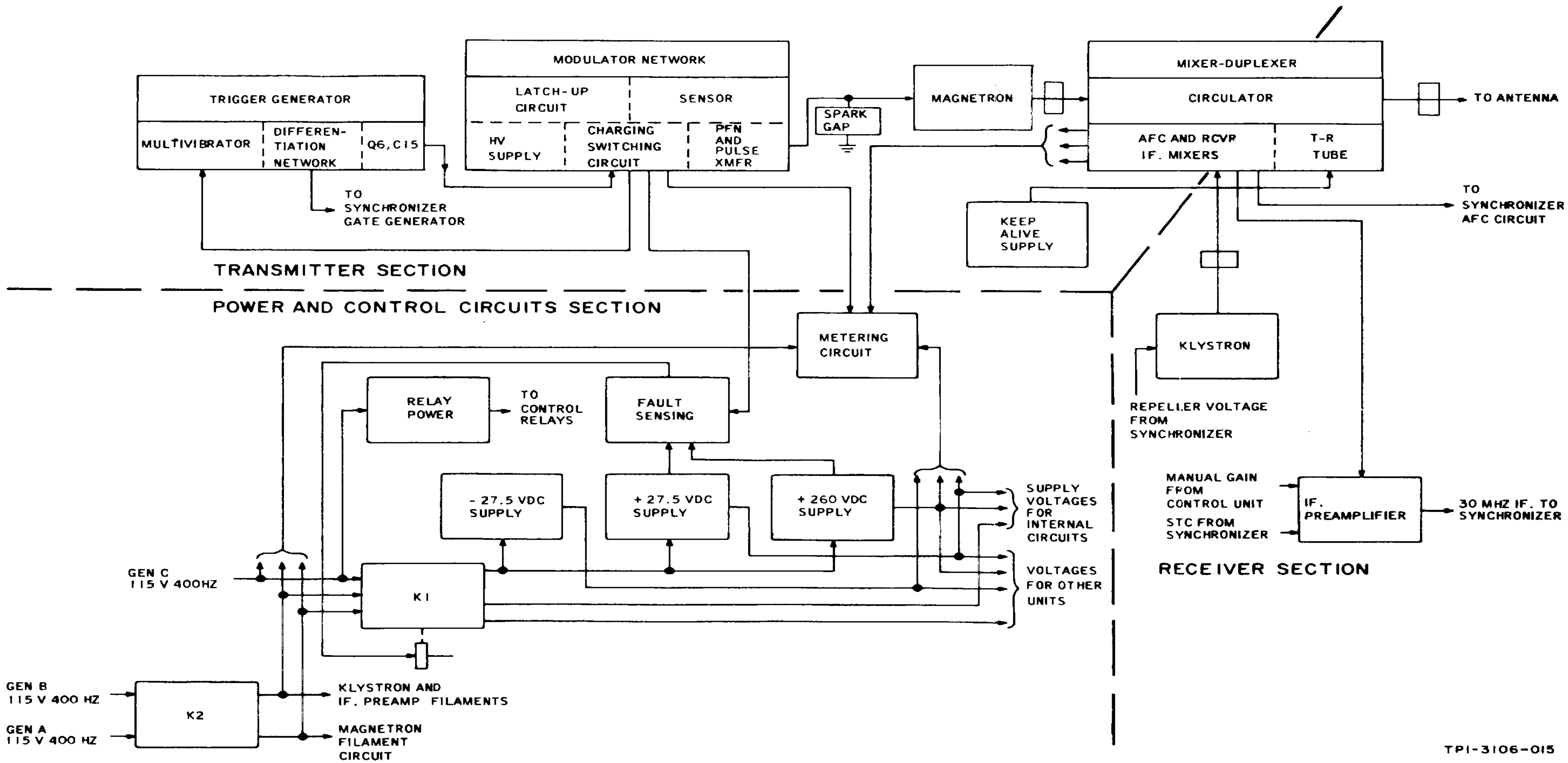
15. WHEN USING THE 561G-3 COCKPIT CONTROL KIT, THE SHIELD CONNECTION FOR THE ANTENNA TILT CONTROL STATOR LEADS MUST BE AT THE ANTENNA END ONLY.
16. GEN A, B AND C MUST BE PHASE-SYNCHRONOUS.
17. MATING CONNECTOR INFORMATION:

UNITS	UNIT CONNECTOR TYPE	UNIT CONNECTOR COLLINS PART NUMBER	MATING CONNECTOR DESIGNATION	MATING CONNECTOR TYPE	MATING CONNECTOR COLLINS PART NUMBER
374A-4	DPXLF-A32C2-34P	370-2143-000	P1	DPX-32C2-33S	370-2154-000
776C-4	DPX2-B16C3P40P-34A-1073	370-2161-000	P1A & P1B	DPX2-M16C3S40S-33A-1073	370-2203-000
493A-( )	PT02A-18-32P	371-2005-000	P1	PT06A-32S(SR)	371-2476-000
537F-( )	PT02A-18-32P	371-2005-000	P1	PT06A-18-32S(SR)	371-2476-000
561G-4	DA-15P-C33	371-0169-000	P1	DA-15S-C7	371-0280-000

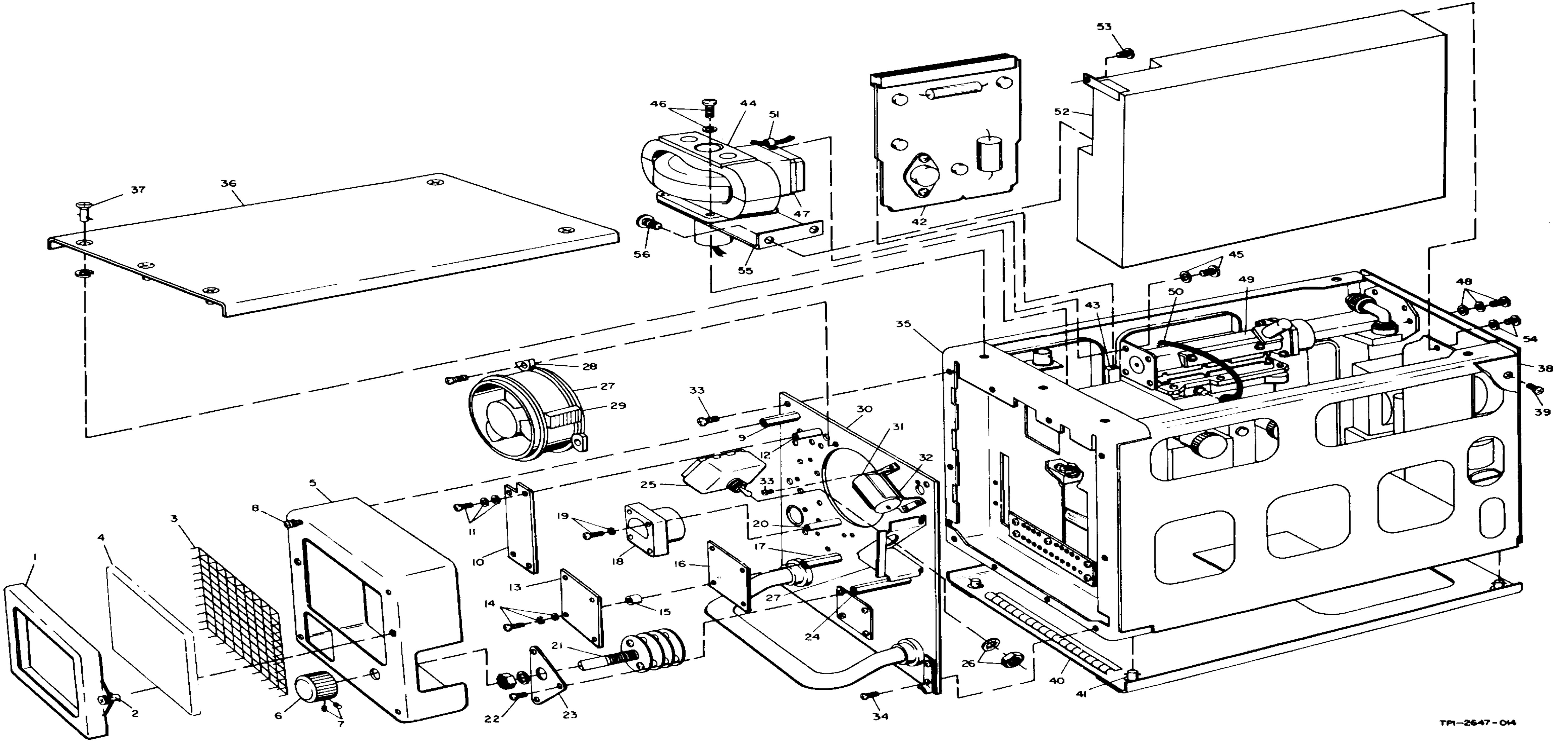
TPI-1717-024

AN/APN-158A Weather Radar System, Interconnect Diagram (Sheet 2 of 2)
Figure FO-2

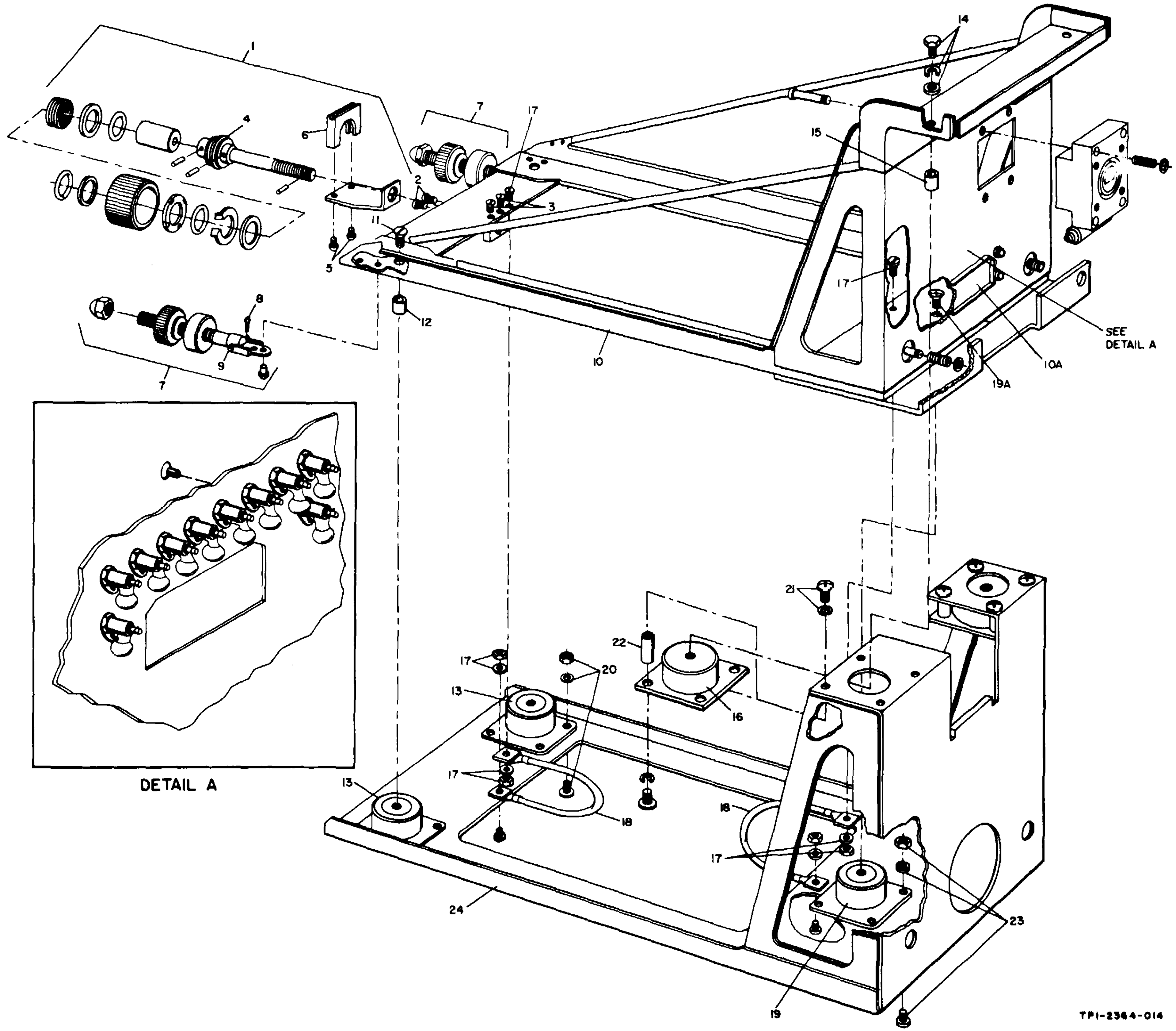
(Sheet 2 of 2)



RT-711A/APN-158 Receiver-Transmitter, Functional Block Diagram
Figure FO-3



RT-711A/APN-158 Receiver-Transmitter, Exploded View
Figure FO-4



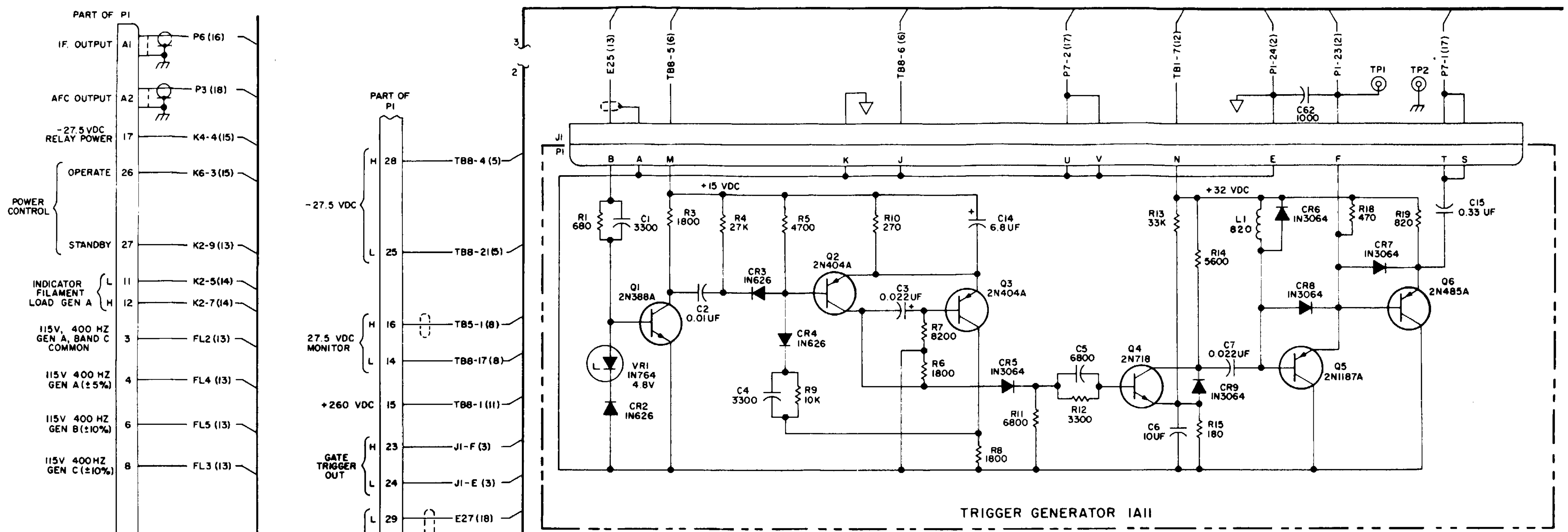
MT-3068/APN-158 Shockmount, Exploded View
Figure FO-5

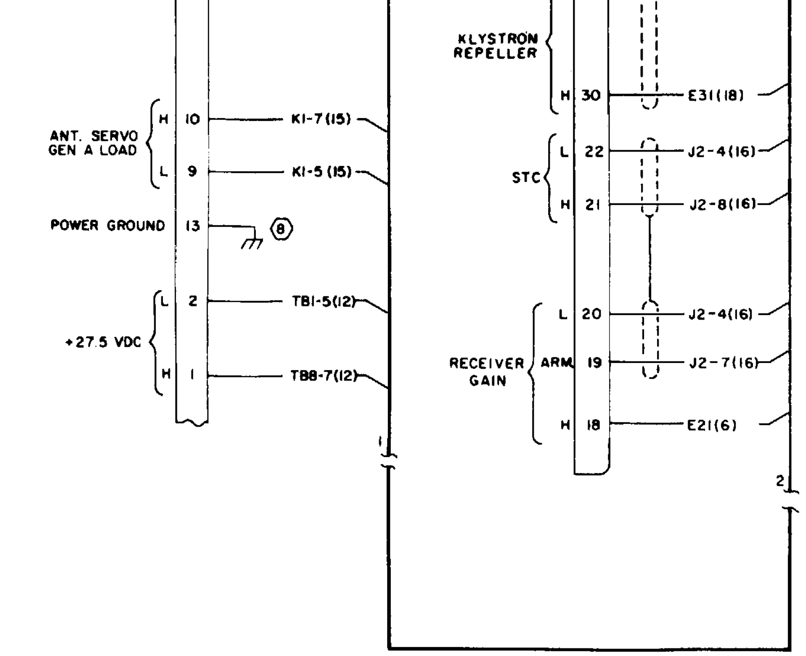
SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A1	Improved keep-alive supply module TB2, CPN 789-4074-000 installed. Was CPN 564-2652-003.	1	Units of revision J-1, ser no 1060, and above.
A2	Eliminate hf oscillations from +27.5-vdc regulator. Removed C18; Q3 was 2N1542A, changed to 2N553; Q6 was 2N956, changed to 2N1711; Q7 was 2N947, changed to 2N2405.	2	Units of revision J-1, ser no 1060, and above.
A3	Changed component value to provide 20-db system gain. R68 was 3300 ohms, changed to 2700 ohms.	3	Units of revision P, ser no 1073, and above.
A4	Corrected schematic errors.		
A5	Corrected schematic error.		

RT-711A/APN-158 Receiver-transmitter, Schematic Diagram (sheet A)
Figure FO-6

(Sheet A)

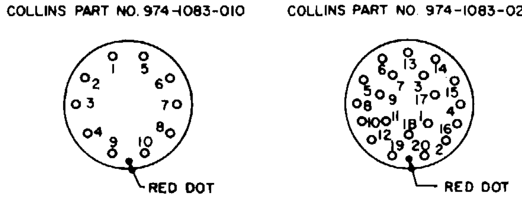




NOTES:

1. NUMBERS IN PARENTHESIS BEHIND CALL OUTS CORRESPOND TO LARGE NUMBERS WHICH DIVIDE THE CHANNEL INTO SEGMENTS.
2. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS AND INDUCTANCE VALUES ARE IN MICROHENRYS.
3. TERMINAL NUMBERS ON S4 ARE ASSIGNED FOR REFERENCE PURPOSES ONLY AND DO NOT APPEAR ON COMPONENT.
4. VR22 AND VR23 SELECTED TO PROVIDE 260 VOLTS ±2 PERCENT.
5. CONNECTION BETWEEN D, E, F, OR J AND A, B, C, OR H ON TB1 IS MADE TO ADJUST MAGNETRON HEATER VOLTAGE TO 6.3 VOLTS IN STANDBY (SHOWN WITH JUMPER BETWEEN B AND E).
6. R2 IS SELECTED IN TEST FROM 215, 261, 287, 316, 348, 422, 464, 510, 562, 619, 681, 750, 825, 909, 1000, 1200 AND 1500 OHMS, ±1 FERCENT.
7. TB8 IS A ONE TO ONE JUNCTION BOARD. THE JUNCTION POINTS ARE FOR REFERENCE PURPOSES.
8. SYMBOL FOR DIRECT CHASSIS GROUND.
   SYMBOL FOR GROUND THROUGH TB9.
9. TAP SELECTED DURING TEST.
10. R9 IS SELECTED IN TEST FROM 180, 220, 240, 270, 330, 360, 390, 470, 510, 560, 610, 680, 820, 910 1000, 1200, AND 1500 OHMS, ±5 PERCENT.
11. R101 IS SELECTED IN TEST FROM 42.2, 44.2, 46.4, 48.7, 51.1, 53.6, 56.2, 59.0; R45 FROM 61.9, 64.9, 68.1, 71.5, 75.0, 78.7 OHMS ± 1 PERCENT.
12. R59, R60 AND R56 ARE SELECTED TO MATCH THE MIXER-DUPLEXER ASSEMBLY. R104, R105 AND R106 ARE SELECTED BY VENDOR TO PAD THE AFC OUTPUT.
13. TERMINAL NUMBERS ARE ASSIGNED FOR REFERENCE PURPOSES ONLY AND DO NOT APPEAR ON COMPONENT.

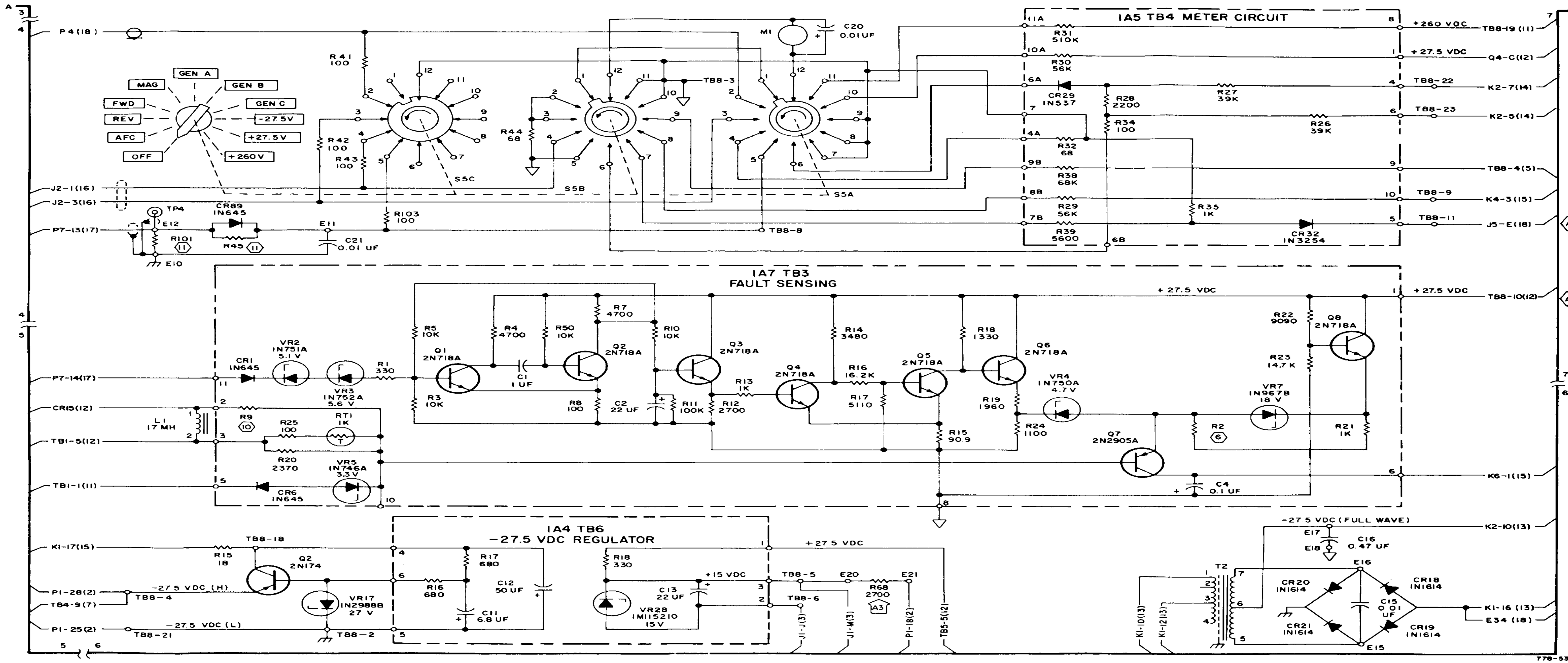
RELAY K2 COLLINS PART NO. 974-1083-010 — RELAY K1 COLLINS PART NO. 974-1083-020



778-5394

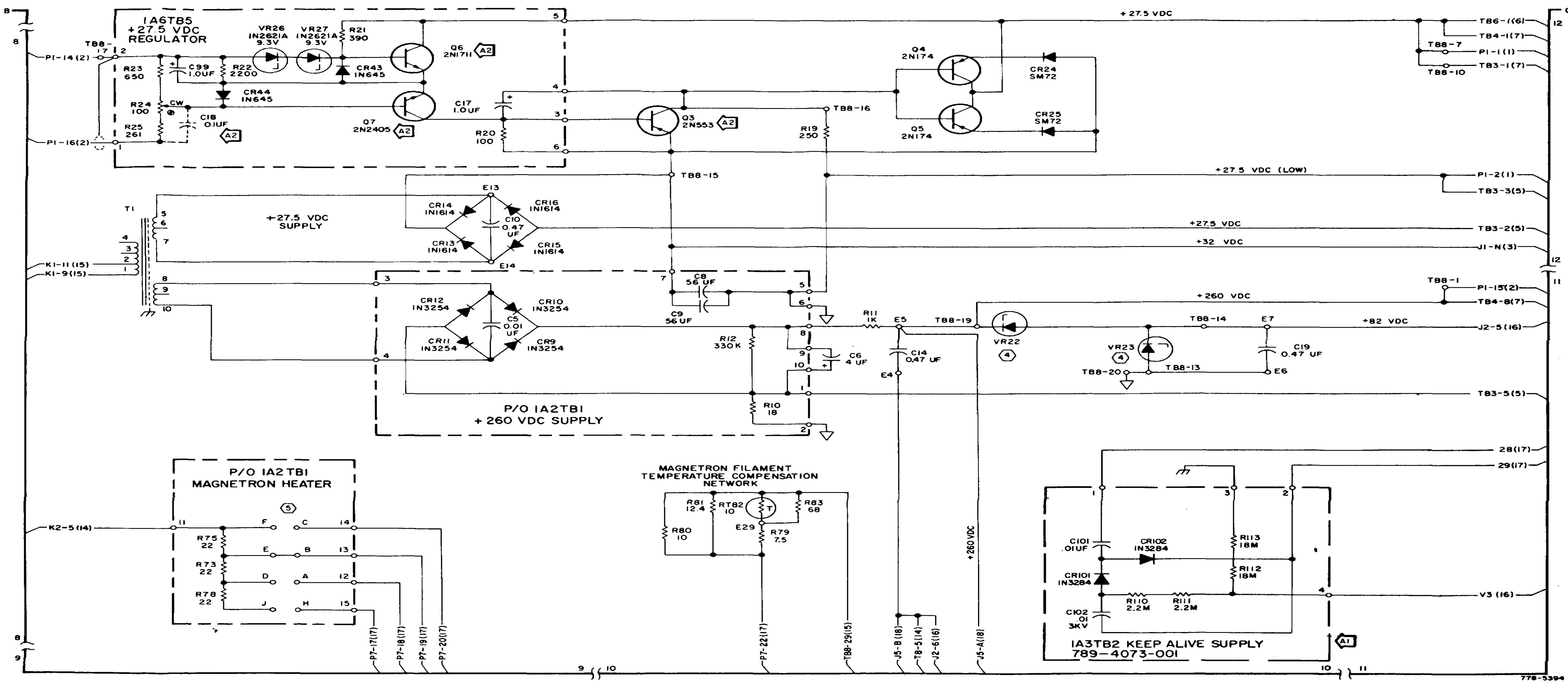
RT-711A/APN-158 Receiver-Transmitter, Schematic Diagram (Sheet 1 of 7)
Figure FO-6

(Sheet 1 of 7)



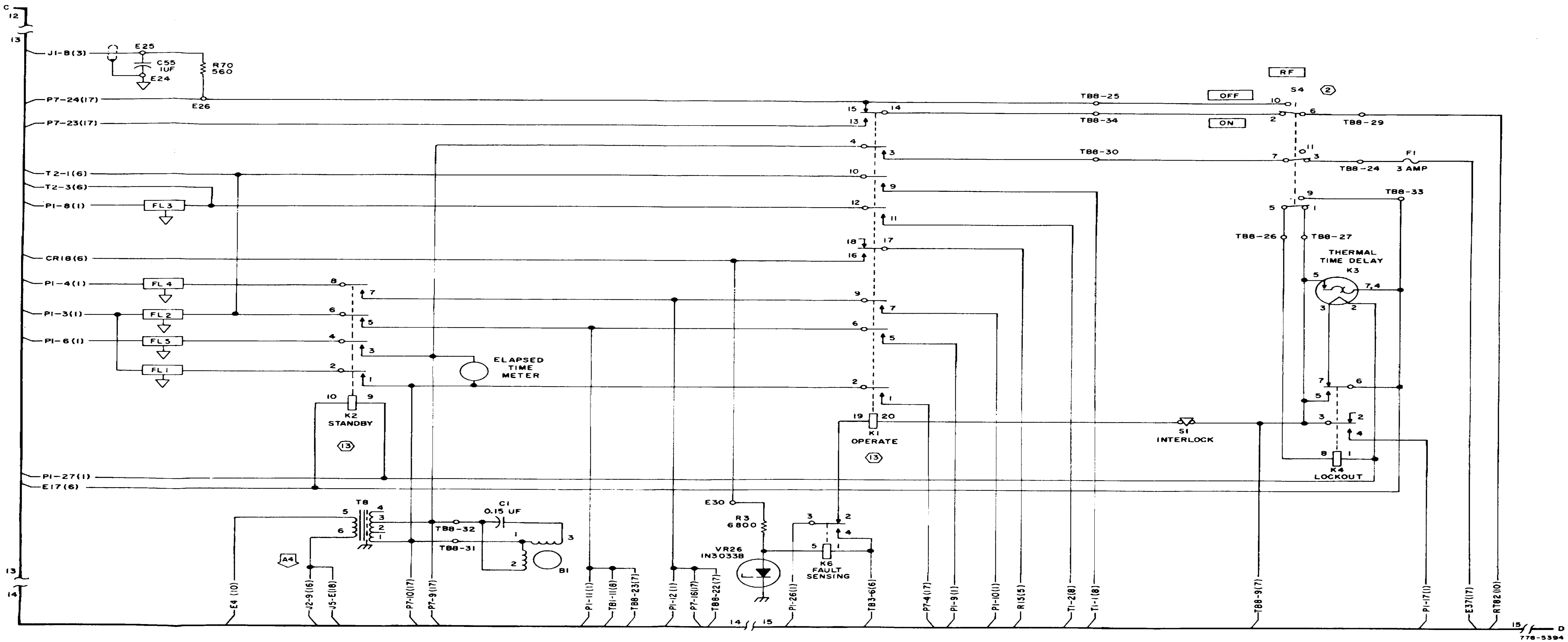
RT-711A/APN-158 Receiver-Transmitter, Schematic diagram (Sheet 2 of 7)

(Sheet 2 of 7)



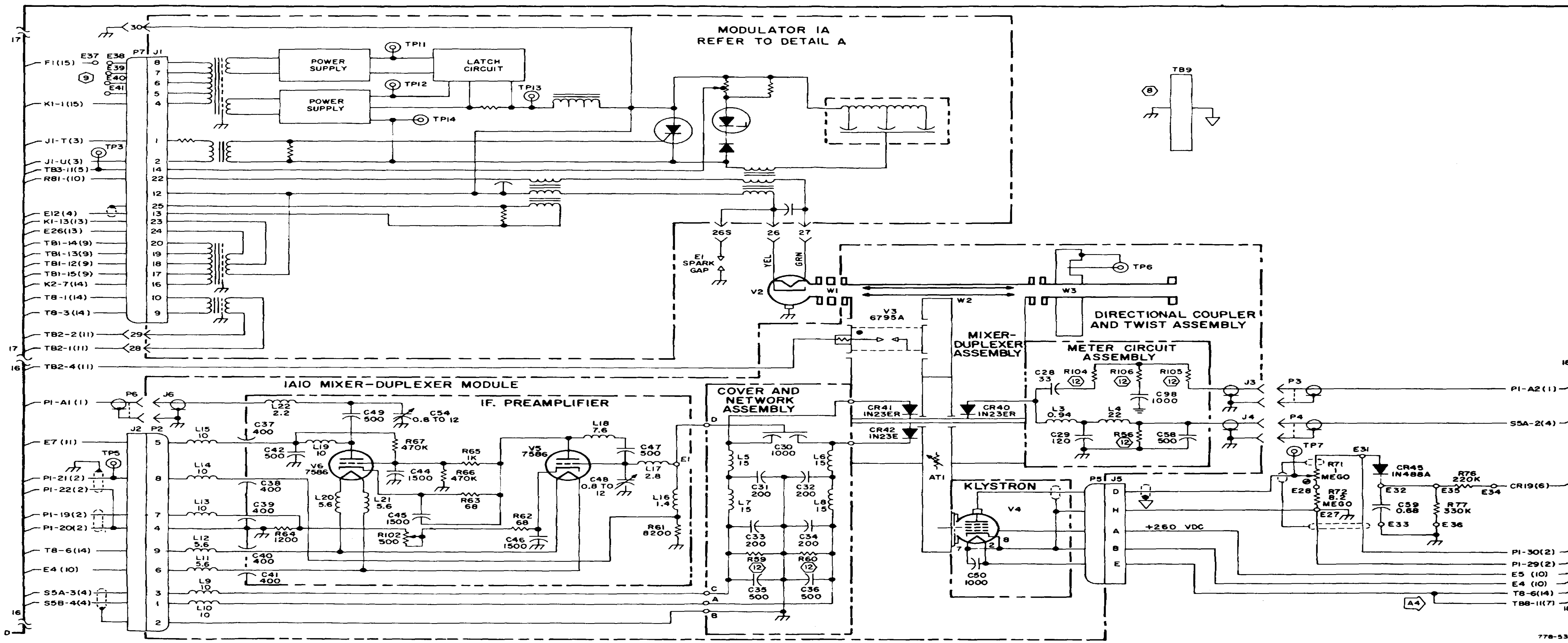
RT-711A/APN-158 Receiver-Transmitter, Schematic diagram (Sheet 3 of 7)
Figure FO-6

(Sheet 3 of 7)



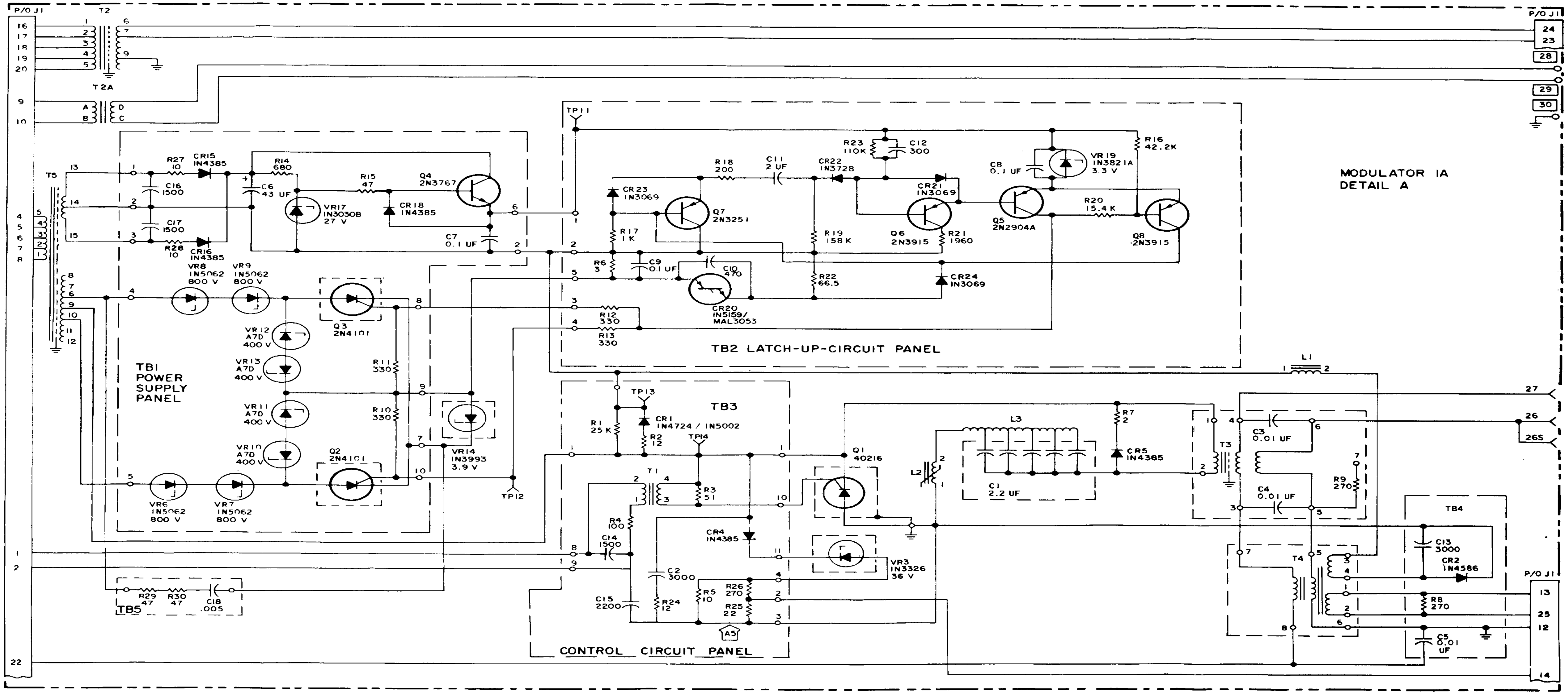
RT-711A/APN-158 Receiver-Transmitter, Schematic Diagram (Sheet 4 of 7)
Figure FO-6

(Sheet 4 of 7)



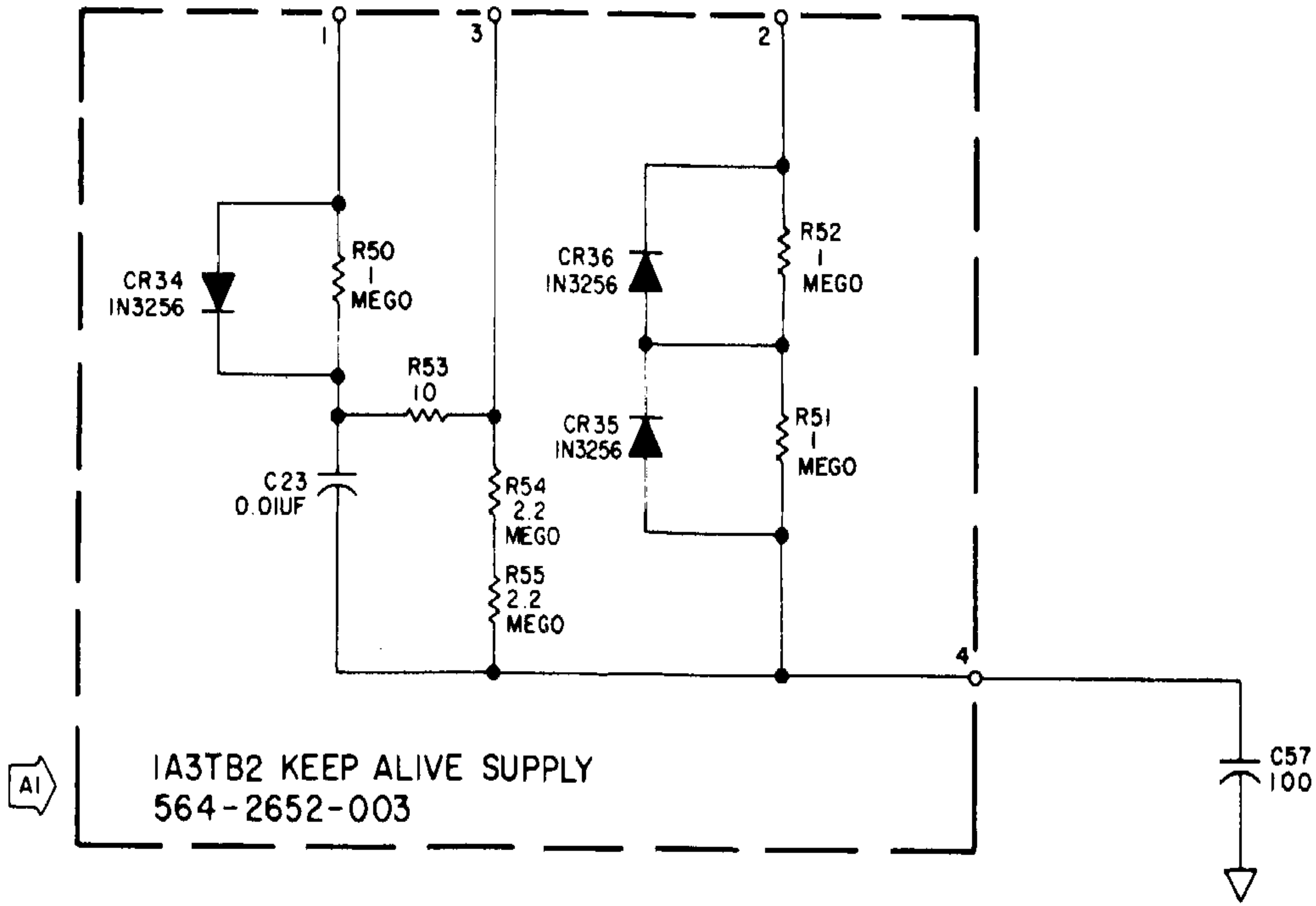
RT-711A/APN-158 Receiver-Transmitter, Schematic Diagram (Sheet 5 of 7)
Figure FO-6

(Sheet 5 of 7)



RT-711A/APN-158 Receiver-Transmitter, Schematic Diagram (Sheet 6 of 7)
Figure FO-6

(Sheet 6 of 7)



RT-711A/APN-158 Receiver-Transmitter, Schematic Diagram (Sheet 7 of 7)
Figure FO-6

(Sheet 7 of 7)

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A1	R23 (1500) was 430. Changed to maintain correct current through zener VR8.		Rev E
A2	Q2, Q3, Q8, Q9, Q14, Q15, Q18, and Q19 (2N2905A) were 2N1131. Q1, Q6, Q12, Q17, and Q21 (2N1711) were 2N388A. C18, C19, C20, and C21 (0.1 μF) were 4700 pF. Added R70, R71, R72, and R73 (220). Changes to eliminate oscillations in a low temperature environment.	1	Rev V/T
A3	R27 and R5 (22.6) were 12. R14, R24, R36, and R49 (3300) were 2200. Same reason as for revision A2.	1	Rev V/T
A4	R53 (1000) was 5600. Change to maintain correct current through zener VR14.		Rev H
A5	Added note 11 and reference to note 11.		All
A6	Added R30 (47). R12 (1470) was 1000. VR4 (PS17146, 6 V) was 1N755A, 7.5 V. Changes to improve reliability of afc circuit at cold temperatures.		Rev N
A7	C6 (22 μF) was 15 μF. R17 (681) was 825. Changes to make afc sweep longer.		Rev M
A8	Added note 12 and reference to note 12.		All
A9	Added note 13 and reference to note 13.		All
A10	Added C20, 0.02 μF. Change to improve reliability at cold temperatures.		Rev J

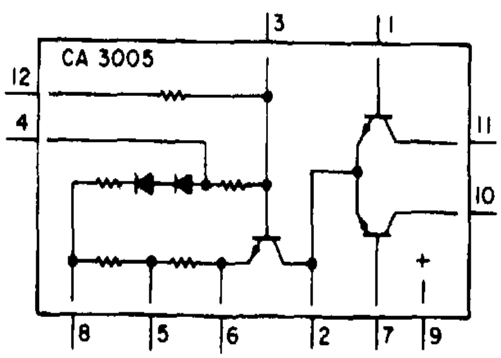
SN-358A/APN-158 Synchronizer, Schematic Diagram (Sheet A)
Figure FO-7

(Sheet A)

NOTES:

1. UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN PICOFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRYS.
2. TYPE RG59/U, RF-6621-78 COLLINS PART NUMBER 357-9887-00.
3. NUMBERICAL BREAK POINTS IN WIRING CONTINUITY MAY BE USED FOR MODULE AND PIN LOCATION ON SCHEMATIC DIAGRAM.
4. NONSTANDARD ABBREVIATION: DBA-DETECTOR BOARD ASSEMBLY.
5. [ ] INDICATES PANEL MARKINGS.
6. 3A6R86 SELECTED FROM 2000 TO 3900 OHMS.
7. 3A6R90 SELECTED FROM 100 TO 1000 OHMS.
8. 3A6R99 SELECTED FROM 1800 TO 3300 OHMS.
9. 3A6R106 SELECTED FROM 17.8K TO 23.7K.
10. 3A6R109 SELECTED FROM 1300 TO 2740 OHMS.

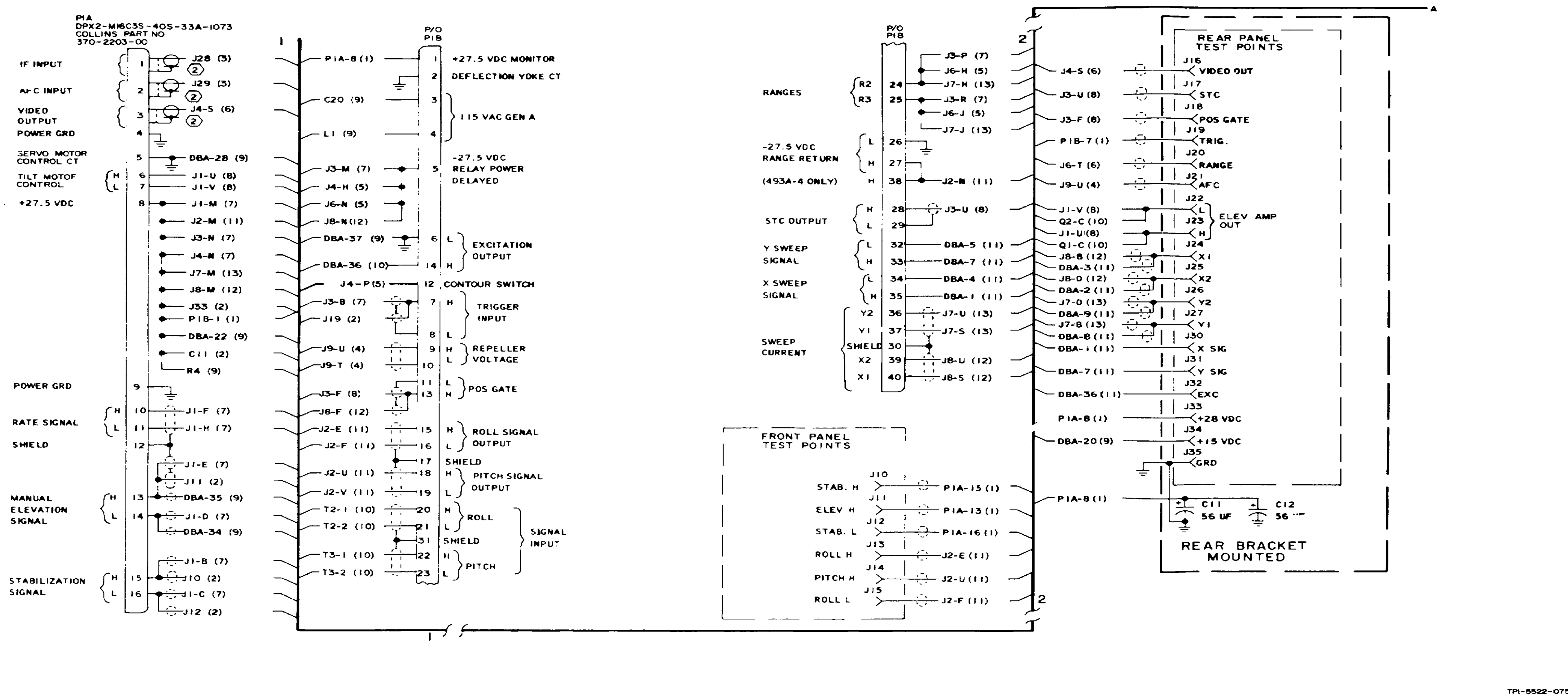
A5 11.



A8 12. 3A10R20 SELECTED FROM 82K TO 270K.

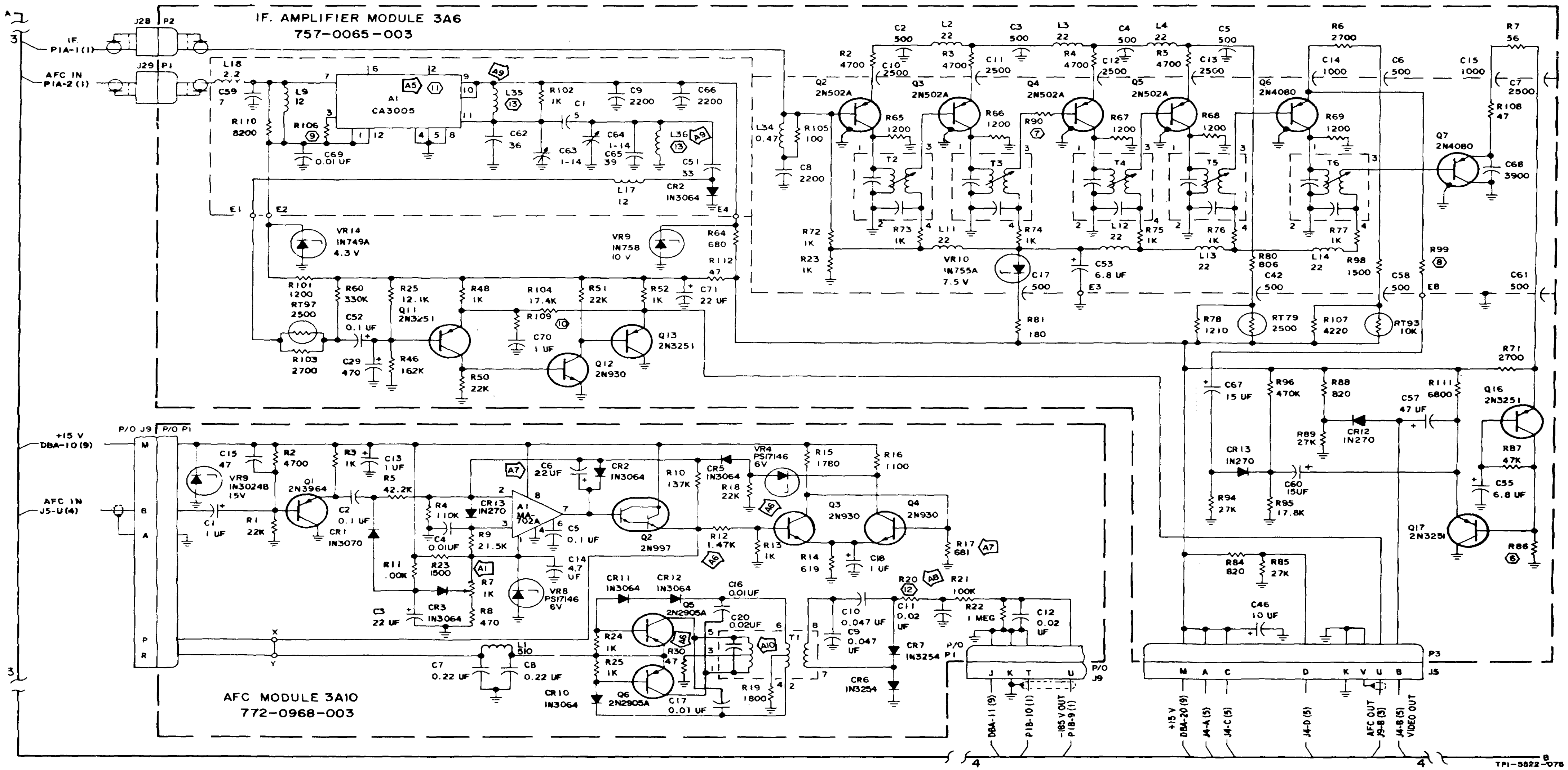
A9 13. 3A6L35 AND 3A6L36 SELECTED IN TEST FROM THE FOLLOWING VALUES; 0.47UH, 0.56UH, 0.68UH.

SN-358A/APN-158 Synchronizer, Schematic Diagram (Sheet 1 of 7)
Figure FO-7
(Sheet 1 of 7)



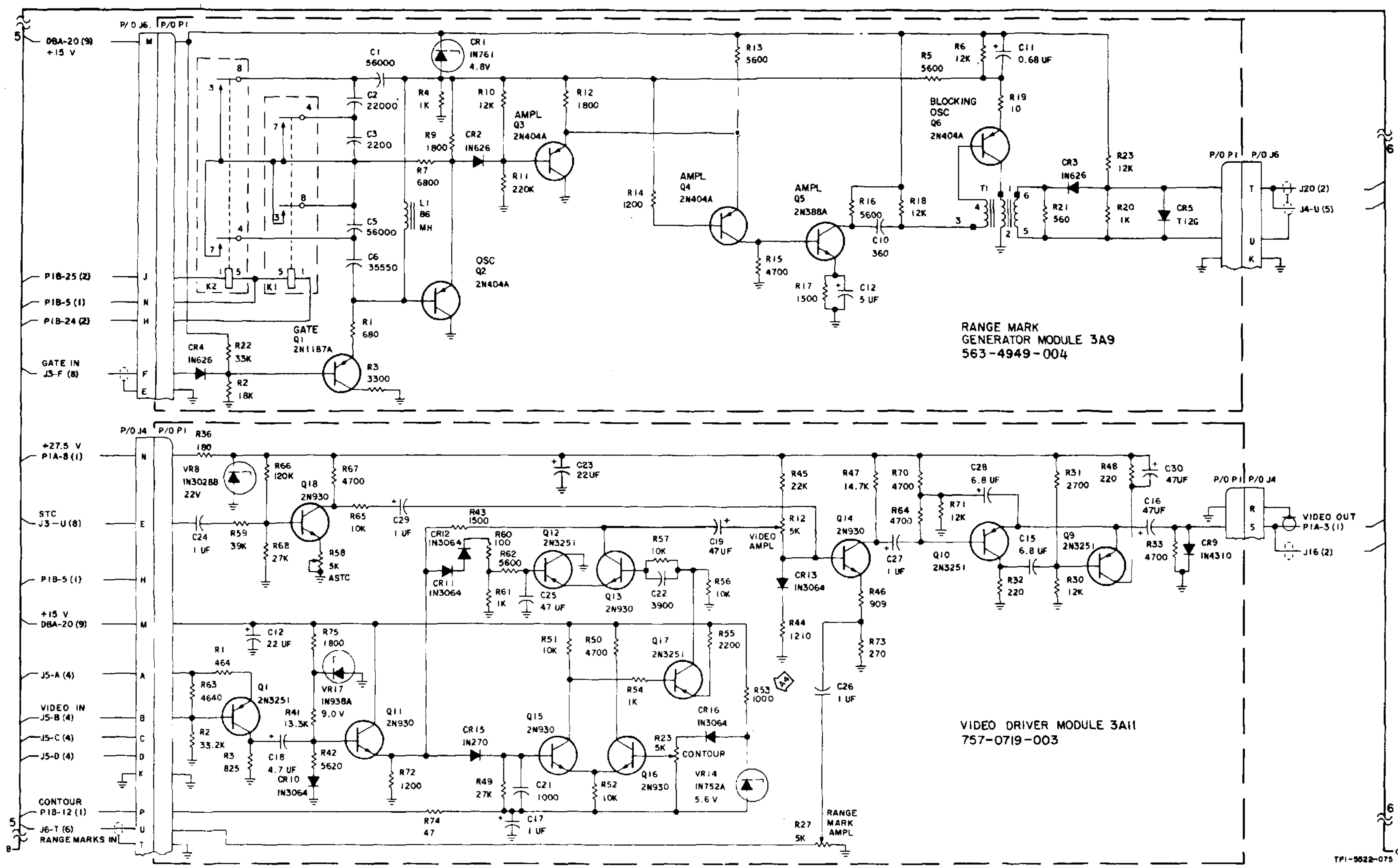
SN-358A/APN-158 Synchronizer,. Schematic Diagram (Sheet 2 of 7)
Figure FO-7

(Sheet 2 of 7)



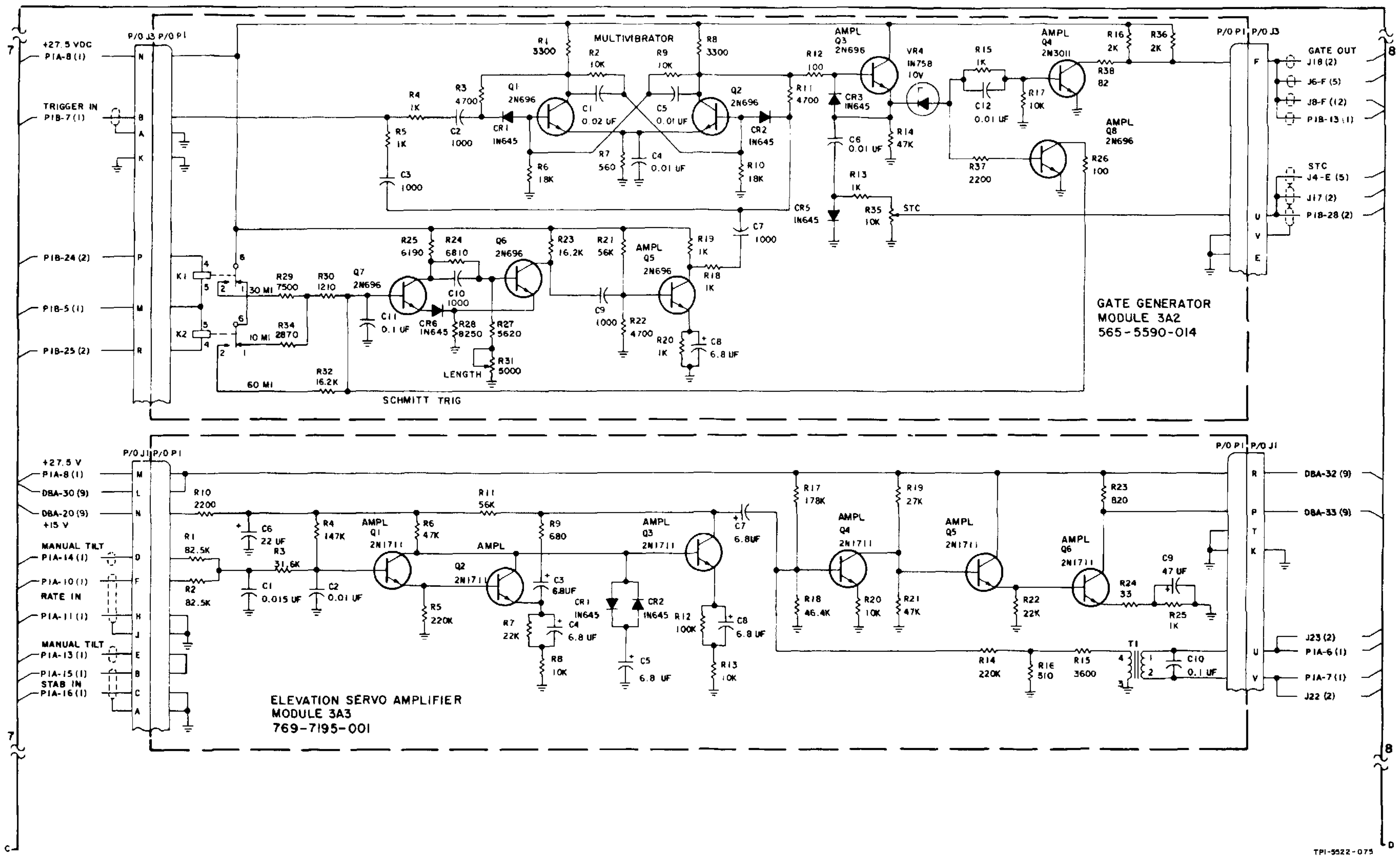
SN-358A/APN-158 Synchronizer, Schematic Diagram (Sheet 3 of 7)
Figure FO-7

(Sheet 3 of 7)



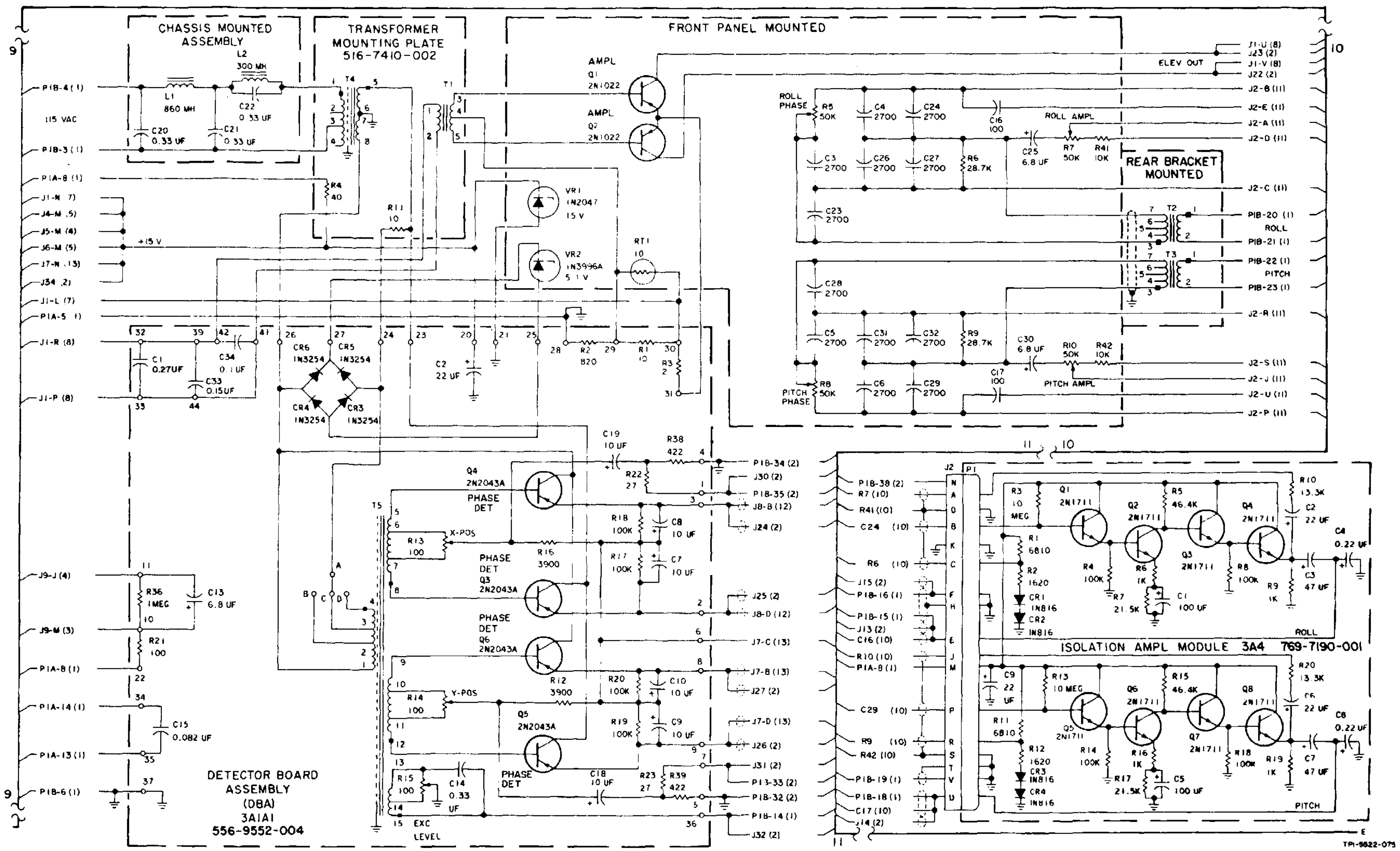
SN-358A/APN-158 Synchronizer, Schematic diagram (Sheet 4 of 7)
Figure FO-7

(Sheet 4 of 7)



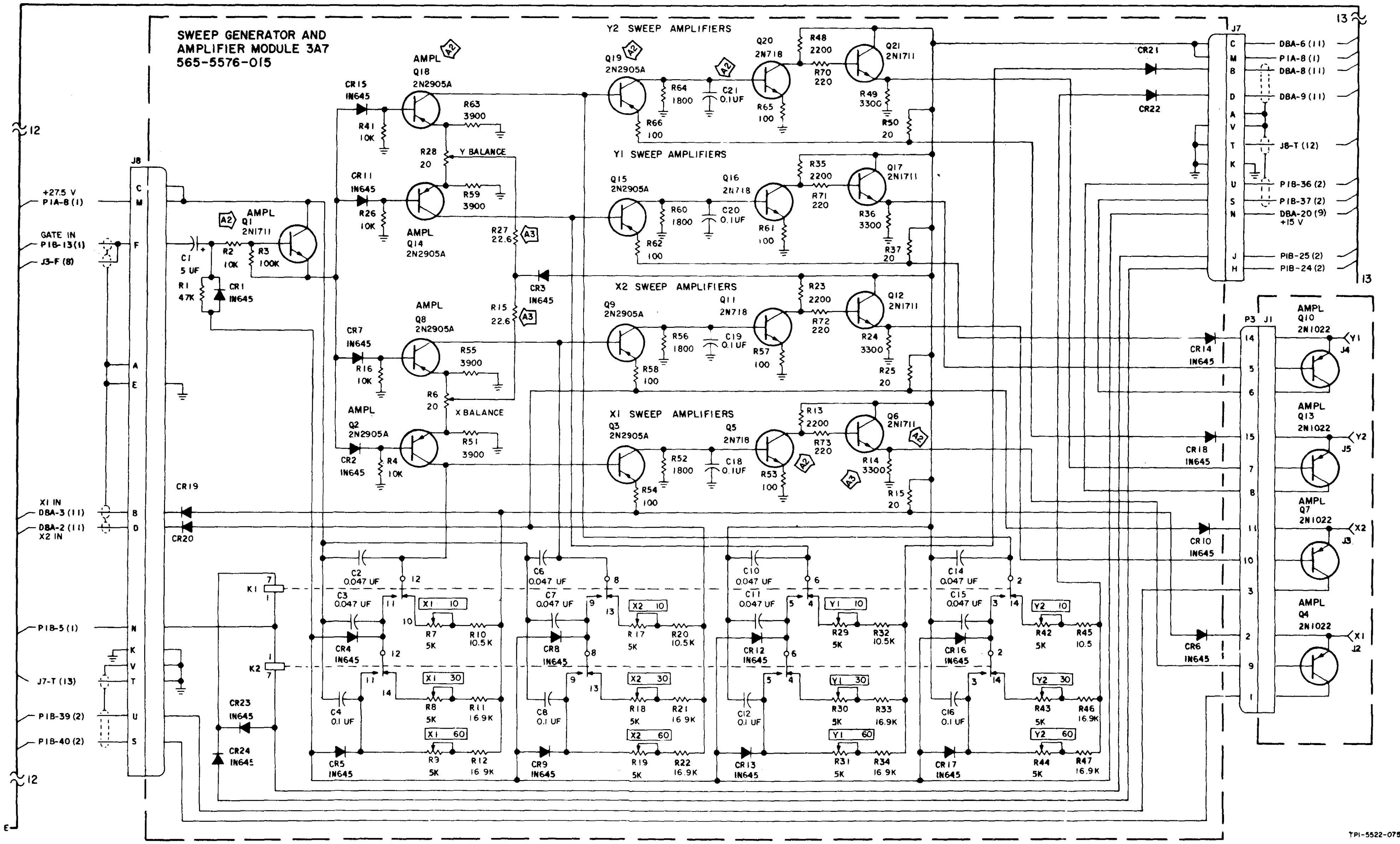
SN-358A/APN-158 Synchronizer, Schematic diagram (Sheet 5 0f 7)
Figure FO-7

(Sheet 5 of 7)

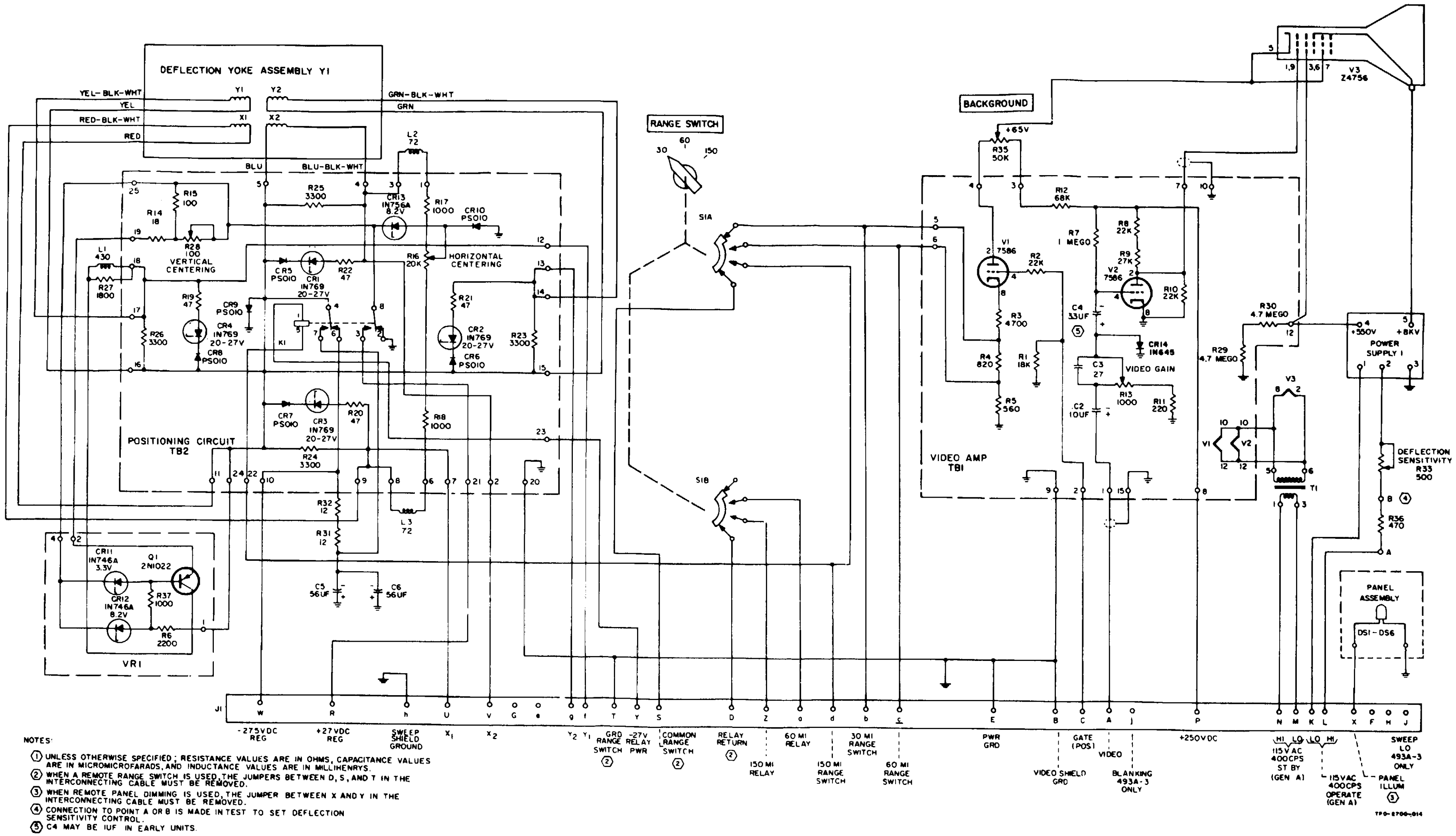


SN-358A/APN-158 Synchronizer, Schematic diagram (Sheet 6 of 7)
Figure FO-7

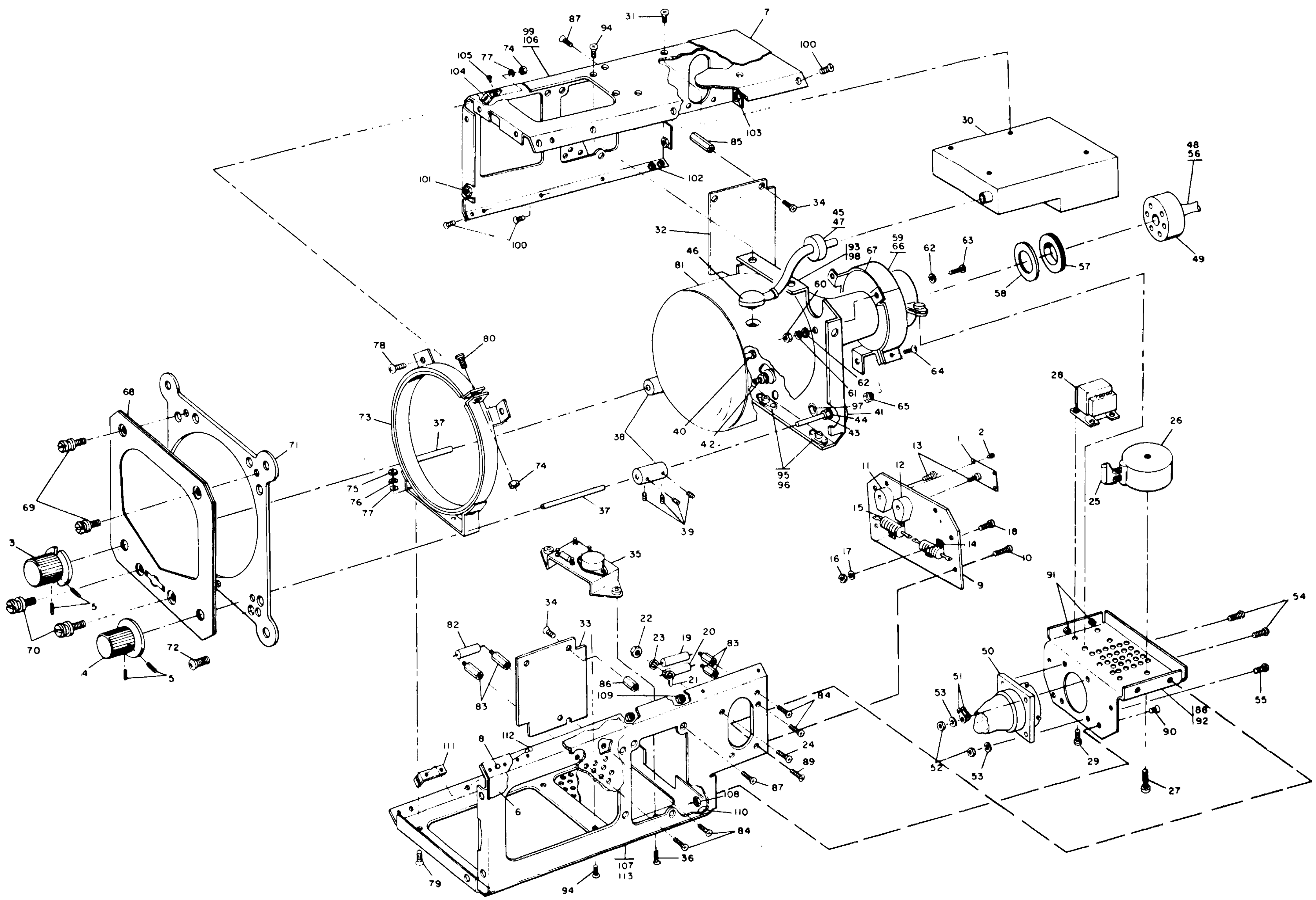
(Sheet 6 of 7)



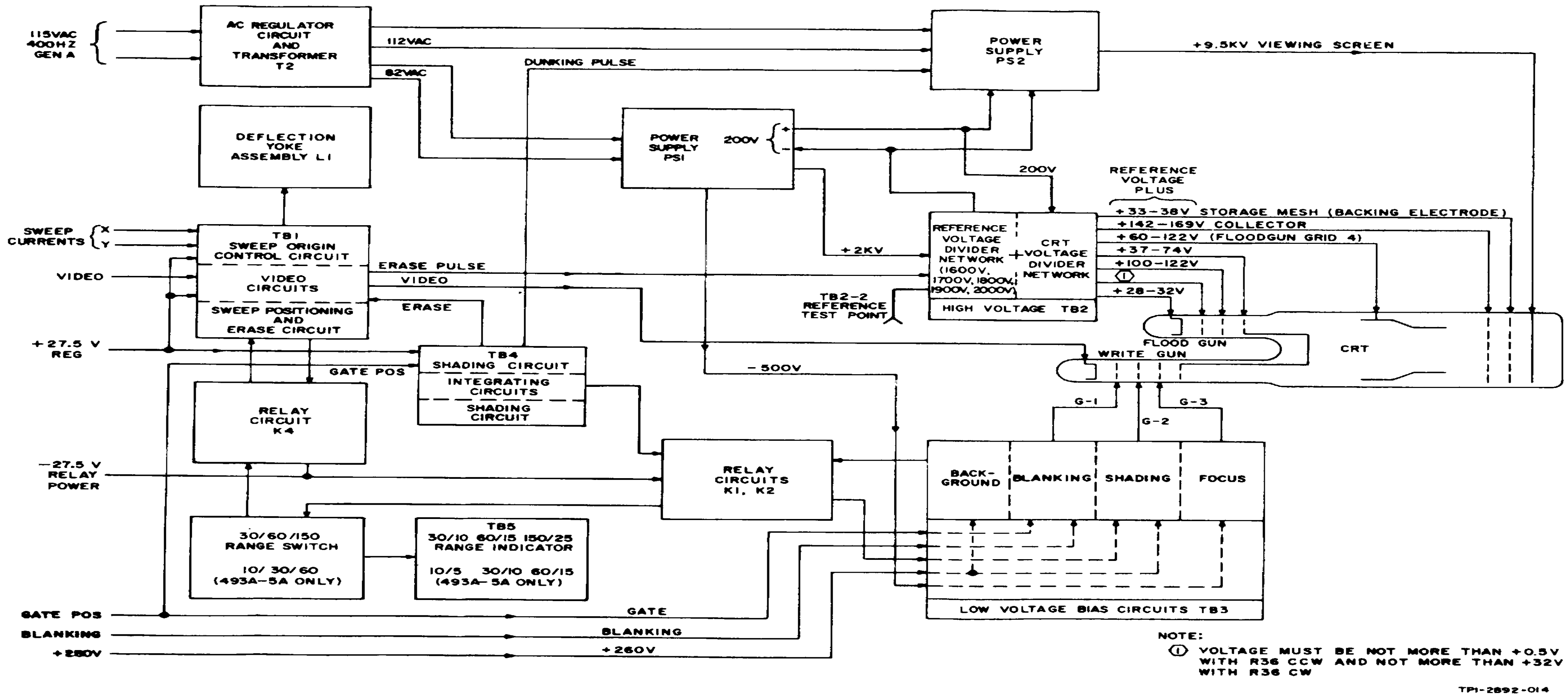
SN-358A/APN-158 Synchronizer, Schematic diagram (Sheet 7 of 7)
Figure FO-7



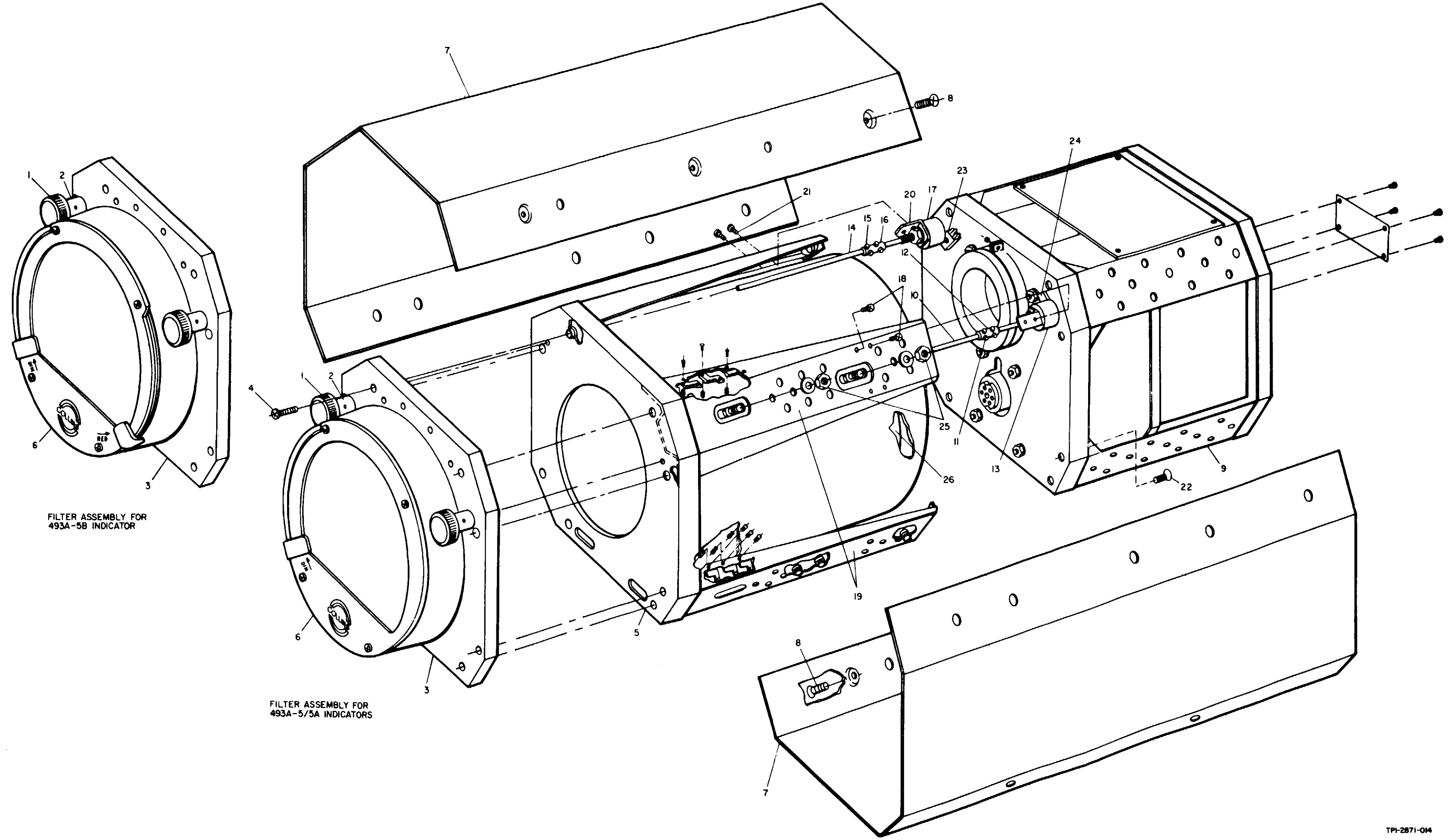
493A-4 Indicator, Schematic diagram
Figure FO-8



493A-4 Indicator
Figure FO-9



IP-724A/APN-158 Indicator, Block Diagram
Figure FO-10

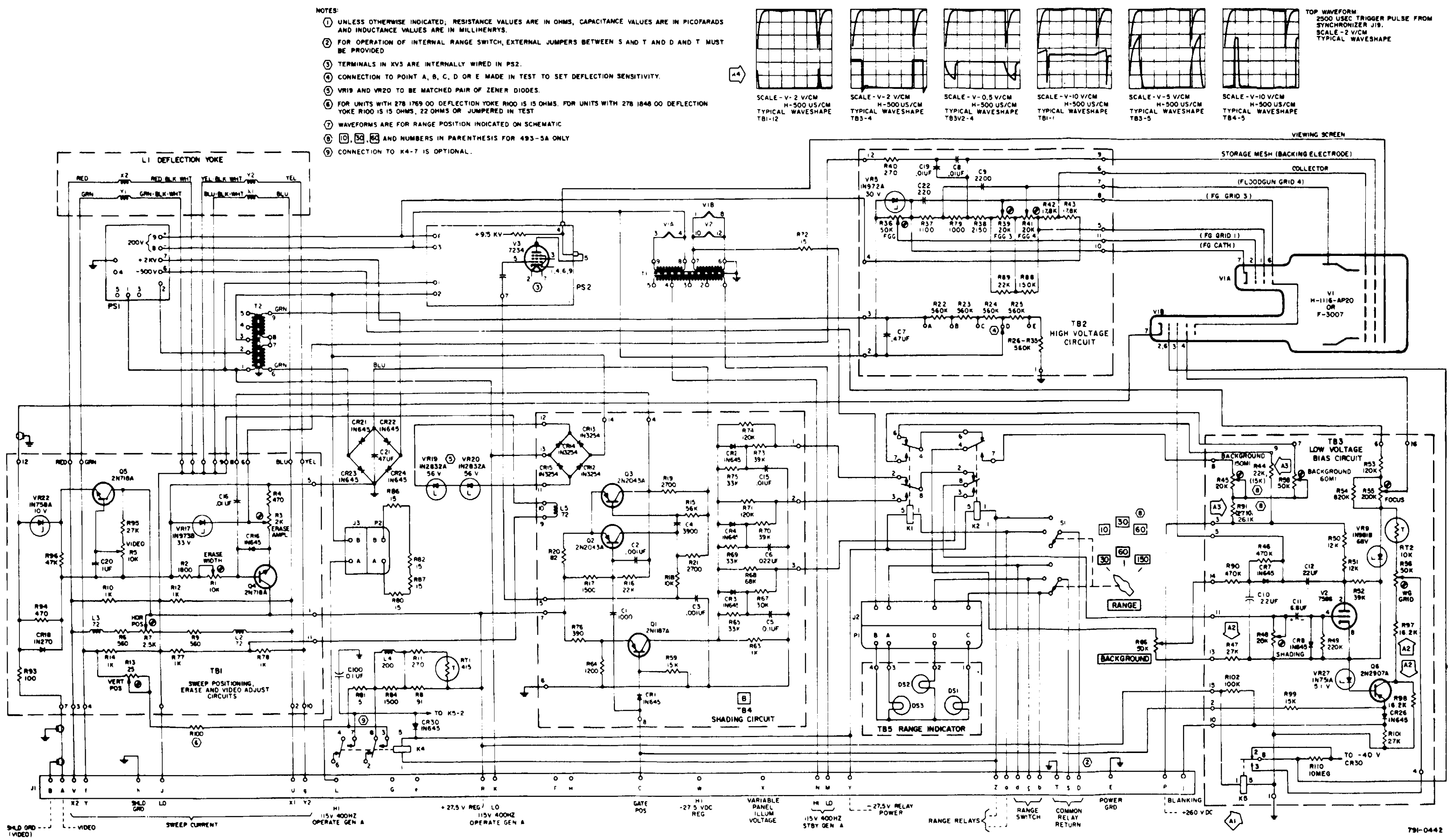


IP-724A/APN-158 Indicator, Block Diagram
Figure FO-11

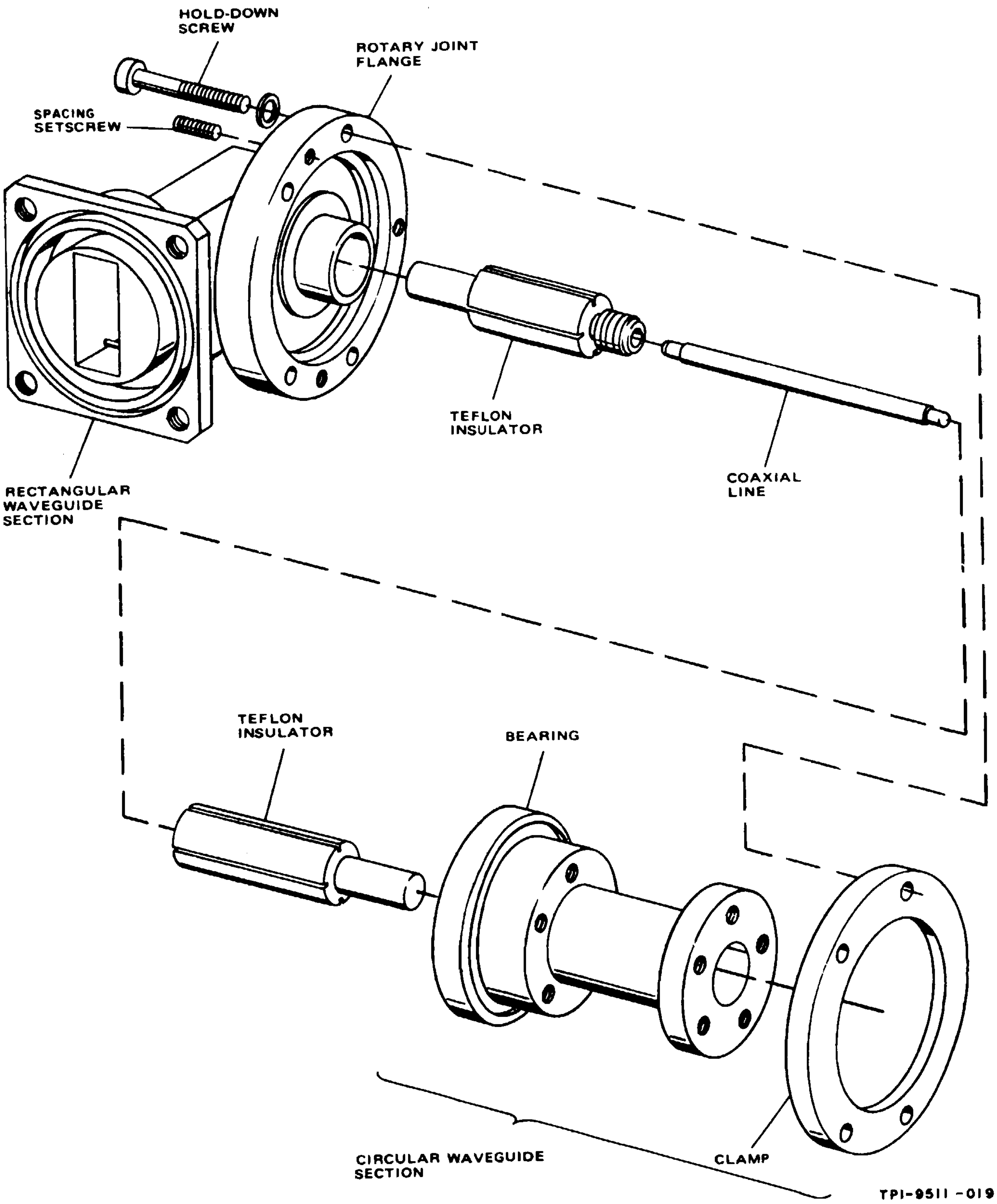
SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A1	Added K5 and R110 (10 MΩ) to eliminate charged area on storage mesh.	1 (493A-5)	Rev E
A2	R47 (27 kΩ) was 56 kΩ.	2 (493A-5)	Serial number 1060
	R97 (16.2 kΩ was 26 kΩ.	2 (493A-5A	Serial number 1133
	R98 (16.2 kΩ was 46.4 kΩ.		
	Modification to increase write gun bias voltage range.		
A3	R91 (26.1 kΩ) was 27 kΩ.		Eff for 493A-5 and 493A-5B only, rev F
A4	Corrected waveform.		All

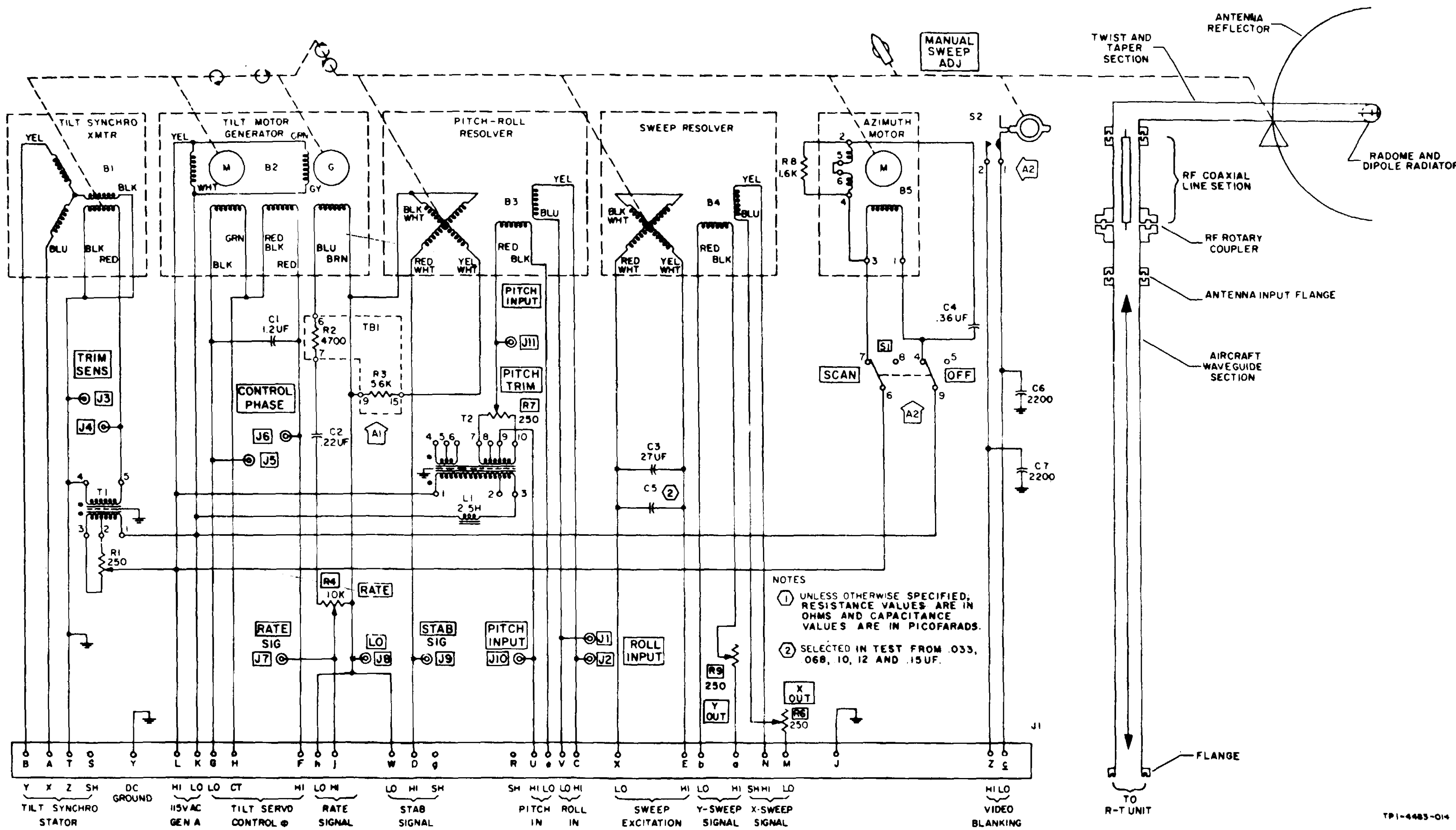
IP-724A/APN-158 Indicator, Block Diagram
Figure FO-12



IP-724A/APN-158 Indicator, Block Diagram
Figure FO-12



IP-724A/APN-158 Indicator, Block Diagram
Figure FO-13



IP-724A/APN-158 Indicator, Block Diagram
Figure FO-14

SCHEMATIC CHANGES

REVISION IDENTIFICATION	DESCRIPTION OR REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
A1	Indicated components mounted on terminal board (TB1).		All
A2	Added terminal numbers of S1 and S2.		All

AS-1520A/APN-158 and AS-1624A/APN-158 Antennas, Schematic Diagram (Sheet A)
Figure FO-14

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:

VERNE L. BOWERS,
Major General, United States Army,
The Adjutant General.

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PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

THE METRIC SYSTEM AND EQUIVALENTS

'NEAR MEASURE

. Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

'EIGHTS

Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 lb.
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

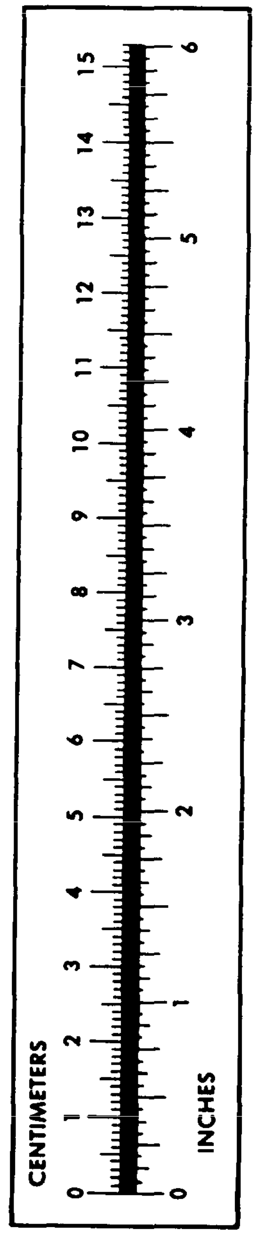
TEMPERATURE

5/9(°F - 32) = °C
212° Fahrenheit is evuivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5C° + 32 =°F

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
ıts	Liters	0.473
arts	Liters	0.946
allons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
'ers	Gallons	0.264
.ms	Ounces	0.035
.ograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pounds-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
'ometers per Liter	Miles per Gallon	2.354
›meters per Hour	Miles per Hour	0.621



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