TM 11-6660-206-35

TECHNICAL MANUAL

DIRECT SUPPORT, GENERAL SUPPORT AND DEPOT MAINTENANCE MANUAL WITH DEPOT OVERHAUL STANDARDS

RAWIN SET AN/GMD-IA (NSN 6660-00-224-6137)
RAWIN SET AN/GMD-IB (NSN 6660-00-599-8257)
RAWIN SET AN/GMD-IC (NSN 6660-01-077-7797)
RAWIN SET AN/GMD-ID (NSN 6660-01-072-9995)

This copy is a reprint which Includes current pages from Changes 1 and 3.

HEADQUARTERS, DEPARTMENT OF THE ARMY

22 DECEMBER 1971

Change No. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, *1 June 1983*

Direct Support, General Support, and Depot Maintenance Manual With Depot Overhaul Standards

RAWIN SET AN/GMD-1A (NSN 6660-00-224-6137)
RAWIN SET AN/GMD-1B (NSN 6660-00-599-8257)
RAWIN SET AN/GMD-lC (NSN 6660-01-077-7797)
RAWIN SET AN/GMD-1D (NSN 6660-01-072-9995)

TM 11-6660-206-35, 22 December 1971, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin. Where an entire chapter, section or illustration is added or revised, the vertical bar is placed opposite the identification number and title.

Remove pages	*Insert pages*
v and vi	v and vi
l-1/(1-2 blank)	1-1/(1-2 blank)
A-1 and A-2,	A-1 and A-2
FO-13	FO-13
	FO-20.1
	FO-23.1
	FO-23.2
	FO-23.3
	FO-23.4
	FO-25.1
	FO-25.2
	FO-25.3
	FO-25.4
	FO-26.1
FO-27	FO-27

2. File this change sheet in front of the publication.

By Order of the Secretary of the Army:

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CHANGE No. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 15 *July 1981*

Direct Support, General Support, and Depot Maintenance Manual with Depot Overhaul Standards for RAWIN SET AN/GMD-lA (NSN 6660-00-224-6137) RAWIN SET AN/GMD-1B (NSN 6660-00-599-8257) RAWIN SET AN/GMD-lC (NSN 6660-01-077-7797) RAWIN SET AN/GMD-lD (NSN 6660-01-072-9995)

TM 11-6660-206-35, 22 December 1971, is changed as follows:

1. Title of the manual is changed as shows above.
2. New or changed material is indicated by a vertical bar in the margin.
3. Remove old pages and insert new pages as indicated below:

Remove	*Insert*
i and ii	i and ii
1-1	1-1/(1-2 blank)
7.11 and 7-12	7-11and 7-12
7.17 through 7-26	7-17 through 7-26
A-l and A-2	A-1 through A-2

4. File this change sheet in front of the manual for reference purposes.

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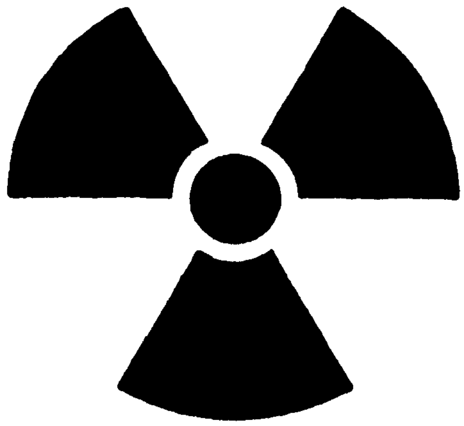
USASIGS (5)
USAADS (2)
USAFAS (2)
USAARMS (2)
USAIS (2)
USAES (2)
USAICS (3)
MAAG (1)
USARMIS (1)
USAERDAA (1)
USAERDAW (1)
Ft Carson (5)
Ft Gillem (10)
Ft Gordon (10)
Ft Richardson (CERCOM Oft) (2)
USA Dep (1)
Sig Sec USA Dept (1)
Unit org under fol TOE:
29-207 (2)
29610 (2)

NG: State AG (0); Units — None
USAR: None
For explanation of abbreviations used, see AR 310-50.

WARNING

RADIATION HAZARD



This equipment contains one type 6627/0B2 electron tube which contains either Ra 226, 0.095-0.055 microcuries or Ni 63 0.01-0.05 microcuries. Danger results from broken tubes. Unbroken tubes are safe but should never be carried in a pocket. Radiation danger levels are:

Ni 63	1.0 microcurie
Ra 226	0.1 microcurie

However, much smaller quantities entering the body through cute or ingestion can be dangerous in later years.

TECHNICAL MANUAL
NO. 11-6660-206-35

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *22 December 1971*

DIRECT SUPPORT GENERAL SUPPORT AND DEPOT MAINTENANCE MANUAL WITH DEPOT OVERHAUL STANDARDS FOR

RAWIN SET AN/GMD-IA (NSN 6660-00-224-61 37)
RAWIN SET AN/GMD-IB (NSN 6660-00-599-8257)
RAWIN SET AN/GMD-IC (NSN 6660-01-077 -7797)
RAWIN SET AN/GMD-ID (NSN 6660-01-072-9995)

*This manual supersedes TM 11-6660-206-35/TO 31M1-2GMD1-112, 7 February 1962.

LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER 1
INTRODUCTION

1-1. Scope

a. This manual covers direct support, general support, and depot maintenance procedures for Rawin Sets AN/GMD-lA, AN/GMD-lB, AN/GMD-lC, and AN/GMD-lD. It includes a description of the function of the rawin set and instructions for troubleshooting, testing, aligning, repairing the equipment, and replacing or repairing specified maintenance parts,

b. The complete technical manuals for the rawin set include TM 11-6660-206-12, TM 11-6660-206-35, TM 11-6660-206-20P, and TM 11-6660-206-34P.

c. The complete technical manuals for the Meteorological Data Processing Groups OL-192/GMD-l and OL-192A/GMD-l are TM 11-6660-263-10, TM 11-6660-263-24-1, TM 11-6660-263-24-2, TM 11-6660-263-24-3, TM 11-6660-263-24-4, TM 11-6660-263-20P, and TM 11-6660-263-34P,

NOTE

Applicable forms and records are covered in TM 11-6660-206-12.

1-2. Consolidated Index of Army Publications and Blank Forms

Refer to the latest issue of DA Pam 310-1 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

1-3. Reporting Errors and Recommending Improvements

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: DRSEL-ME-MP, Fort Monmouth, NJ 07703, A reply will be furnished direct to you.

1-4. Reporting Equipment improvement Recommendations (EIR)

If your Rawin Set AN/GMD-l needs improvement, let us know. Send us an EIR, You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don 't like the design. Put it on an SF 368 (Quality Deficiency Report).

Mail it to Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: DRSEL-ME-MP, Fort Monmouth, NJ 07703. We'll send you a reply.

1-5. Differences in Models

Differences in models are covered in TM 11-6660-206-12.

CHAPTER 2

FUNCTION OF EQUIPMENT

Section I. RF SYSTEM

2-1. General

a. The rf system consists of a reflector, an eccentric cup rotated by a drive motor and hollow drive shaft, a dipole antenna, and a transmission line. All components except the reflector are part of the antenna scanner assembly. The basic functions of the rf system are to receive the energy radiated by a radiosonde and to sinusoidally modulate this energy by conical scanning. The amount of modulation superimposed on the received energy depends on the position of the radiosonde with respect to the axis of the reflector. This sinusoidal modulation of the received rf energy is introduced by the rawin set to permit automatic tracking of the radiosonde. It should not be confused with the meteorological pulse modulation originating in the radiosonde. The output of the rf system is connected to the mixer assembly, a part of the receiving system, through a short length of transmission line.

b. The relationship of the rf system with respect to the other functional systems of the rawin set is described in TM 11–6660–206–12.

2-2. Functional Diagram Discussion

a. Reflector. The reflector receives the rf energy from the radiosonde and concentrates it on the eccentric cup, located just beyond the focal point of the reflector.

b. ***Eccentric Cup.*** The eccentric cup is a small off-center reflector which collects the rf energy from the reflector ***(a*** above) and directs it toward the dipole. Rotation of the eccentric cup causes the received signal carrier to vary in phase and amplitude. The amount of variations depends on the position of the radiosonde.

c. Antenna Scanner Assembly Drive Motor and Hello w Drive Shaft. The antenna scanner assembly drive motor, B101, and hollow drive shaft are used to rotate the eccentric cup.

d. Dipole Antenna. The antenna is a half-wave dipole. The rf energy reflected by the eccentric cup induces an rf signal in the dipole antenna. This signal is applied to the transmission line.

e. ***Transmission Line.*** The rigid coaxial transmission line conveys the rf signal from the dipole antenna to the mixer assembly, a part of the receiving system.

2-3. Reflector

The reflector is made of spun aluminum, is parabolic in shape,. has a diameter of 7 feet, and is perforated to decrease wind resistance. The reflector is manufactured in three sections which are bolted together when installed. Together with the other components of the rf system, the reflector is mounted on a support which can be rotated 360° in azimuth and 95° in elevation. The reflector intercepts the plane waves radiated by the radiosonde and reflects them toward the eccentric cup. Because the characteristics of microwaves are similar to those of light waves, the reflector may be used as a directional device at these frequencies.

2-4. Antenna Scanner Assembly Drive Motor

Antenna scanner assembly drive motor B101 is the power source (mechanical) of the conical scanning action and rotates at 1,725 revolutions per minute (r/rein). It is coupled to the hollow drive shaft by a gilmer-type, V-drive belt that causes the drive shaft and eccentric cup to rotate at 2,040 r/rein. Since the eccentric cup is mechanically connected to the hollow drive shaft, they both rotate when power is applied to the drive motor. The rotating joint at the end of the hollow drive shaft acts as a quarter-wave choke to prevent antenna currents from flowing on the outside of the hollow drive shaft. Next to the sprocket on the hollow drive shaft is a gear that meshes with a similar gear on the shaft of the reference generator; this gear ratio is 1 to 1. The reference voltage generator develops an alternating voltage that is used for phase reference in the antenna positioning system. Operation of the drive motor is controlled by the motor standby circuit (para 2–23*f*) and is switched on and off with S602 on the antenna control and S805 on the control-recorder.

2-5. Eccentric Cup

a. Description. The eccentric cup is an off-center, hemispherical reflector that rotates about the axis of the rawin set reflector. It is driven by the antenna scanner assembly drive motor and hollow drive shaft, and is located in front of the dipole antenna. As the cup rotates on its axis, its focus describes a circle about the dipole antenna and causes the antenna lobe to rotate about the axis of the reflector. This rotation of the antenna lobe produces the effects of conical scanning. This effect is illustrated in figure 2–1.

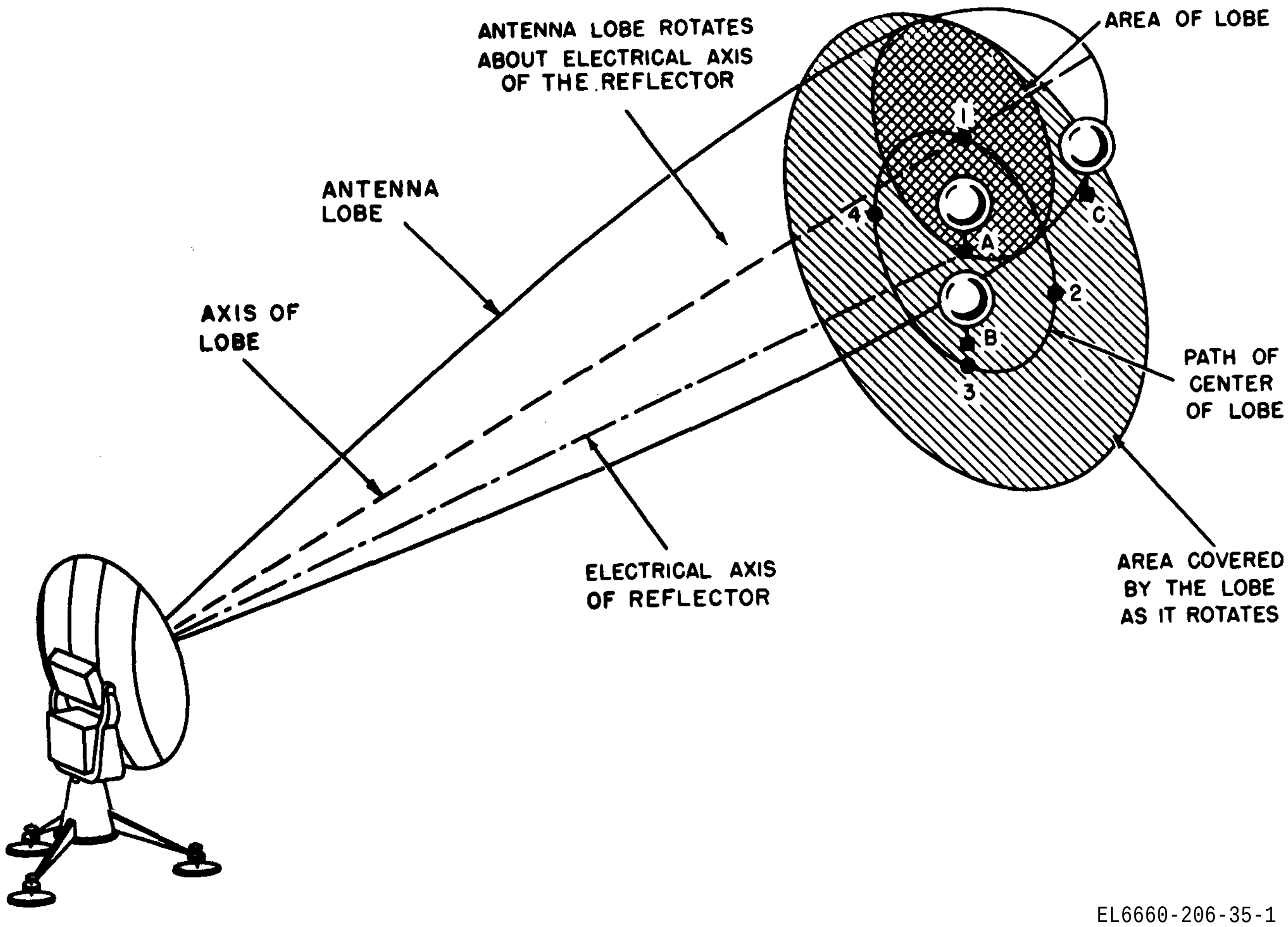


Figure 2–1. Effect of conical scanning.

b. Scanning.

(1) The eccentric cup is rotated at 2,040 r/rein by the drive motor (para 2-4) and thus causes the antenna lobe to revolve about the axis of the reflector at the rate of 2,040 r/rein. The angle between the most vertical direction of the lobe axis and its direction at any particular time is called the lobe angle. When the transmitter is directly in line with the electrical axis of the reflector, it will be intersected by the same point on the antenna lobe throughout the rotation of the antenna lobe. Therefore, the power received at the dipole and the voltage induced will be constant. However, if the transmitter is away from the axis, it will be intersected by different points of the antenna lobe and the dipole voltage will vary sinusoidally at one cycle per revolution (2,040 r/min = 34 Hz).

(2) Figure 2–1 shows the effect of conical scanning when the radiosonde is in three different positions in relation to the electrical axis of the reflector. When the radiosonde is in position A, it is in the direct line of the electrical axis, and the same amount of energy is induced in the dipole antenna for all positions of the rotating antenna lobe. When the radiosonde moves to position B, equal amounts of energy are induced in the dipole antenna. for lobe positions 2 and 4, but more energy is induced in the dipole antenna for lobe position 3 than lobe position 1. This results in an error voltage being superimposed on the received signal. This condition causes the antenna positioning system to move the reflector downward. When the radiosonde moves to position C, more energy is induced in the dipole antenna for lobe position 2 than for lobe position 4, and more energy is induced for lobe position 1 than lobe position 3. This condition results in an error voltage which causes the antenna positioning system to move the reflector upward and to the right.

(3) Therefore, when the radiosonde is on the electrical axis of the reflector, the received signal remains constant as the antenna lobe rotates. When the radiosonde departs from the electrical axis of the reflector, the received rf signal will have a 34 Hz sinusoidal modulation envelope superimposed on it. The magnitude of the departure of the radiosonde from the electrical axis of the reflector determines the magnitude of the sine signal, and the direction of the departure of the radiosonde from the electrical axis of the reflector determines the phase of the sine signal.

c. Thirty-Four Hz Modulation. Modulation of the rf signal resulting from rotation of the eccentric cup is shown in figure 2–2. When the radiosonde is at point X (A, fig. 2–2), it is in line with the electrical axis of the reflector. The same amount of power, in this case 80 percent of the maximum receivable power, reaches the dipole for all positions of the antenna lobe ***(b*** above). Therefore, the induced voltage in the dipole antenna is unmodulated as shown by the straight line in B, figure 2–2. When the radiosonde moves off the electrical axis of the reflector at point Y (A, fig. 2–2), 100 percent of the maximum receivable power reaches the dipole antenna when the antenna lobe is in the upper position, and only 30 percent reaches when the antenna lobe is in the lower position. Because the antenna lobe is rotating at a fixed rate, the power that reaches the antenna at intermediate points between these extremes varies sinusoidally as shown by the sine wave in B, figure 2–2.

2-6. Dipole Antenna

The dipole antenna (fig. 2–3) consists of two rods, each a quarter-wave long at the radiosonde frequency of 1,680 MHz. The dipole antenna is connected near one end of the rigid transmission line and is oriented vertically, between the reflector and the eccentric cup. The rf energy reflected from the reflector to the eccentric cup is concentrated at the’ dipole antenna and induces energy therein. This energy is conducted by the transmission line from the dipole antenna to the mixer assembly in the receiving system. One-half of the dipole antenna is connected to the outer conductor of the transmission line; the other half is connected to the inner conductor. A shorted quarter-wave stub is formed by the continuation of the transmission line beyond the dipole antenna mounting. This provides additional mechanical support for the dipole antenna. Because this stub is located at the voltage node, it does not affect the operation of the dipole antenna. A threaded coupling connects the dipole antenna assembly to the main body of the transmission line.

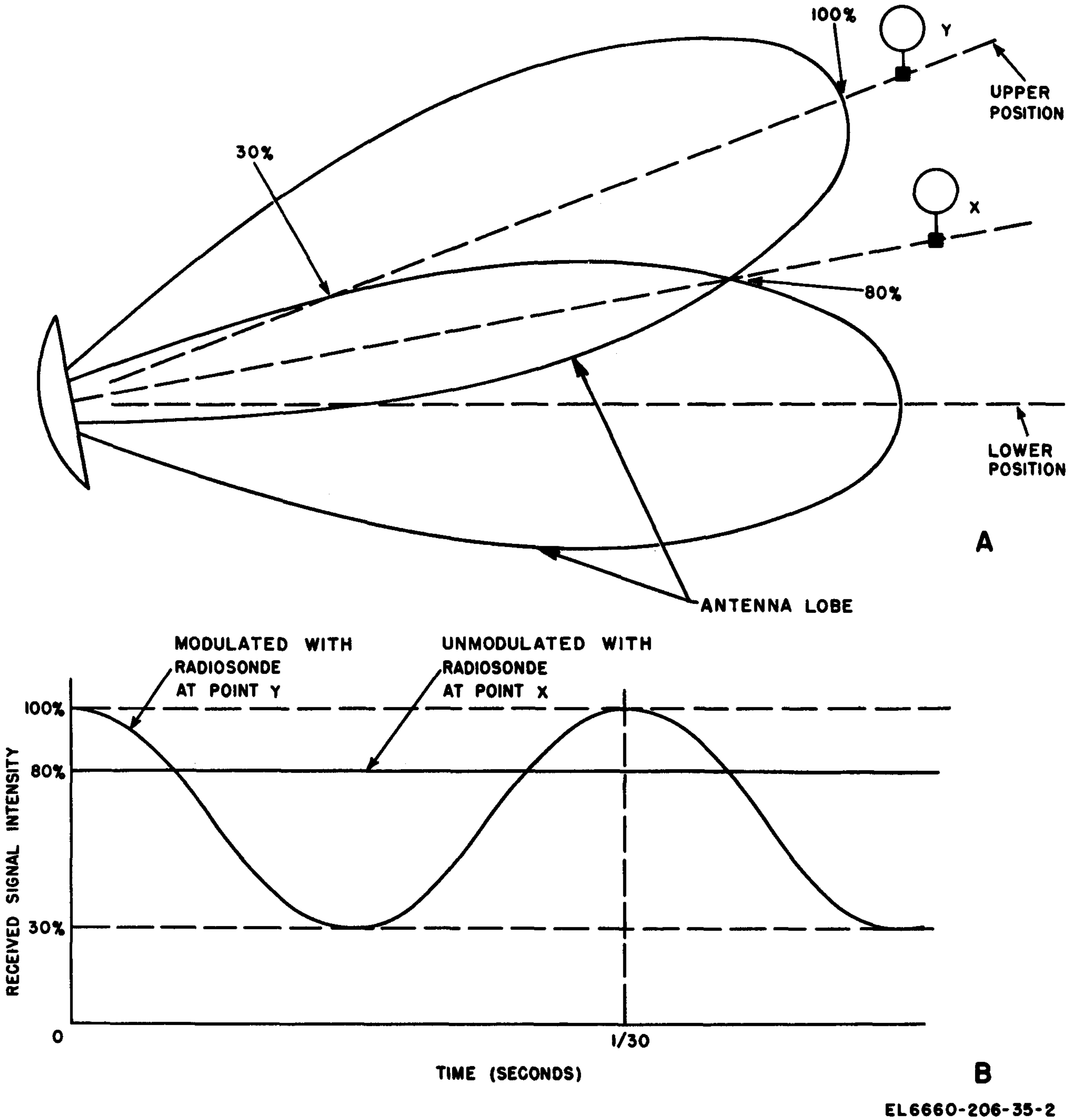


Figure 2-2. Development of sine modulation.

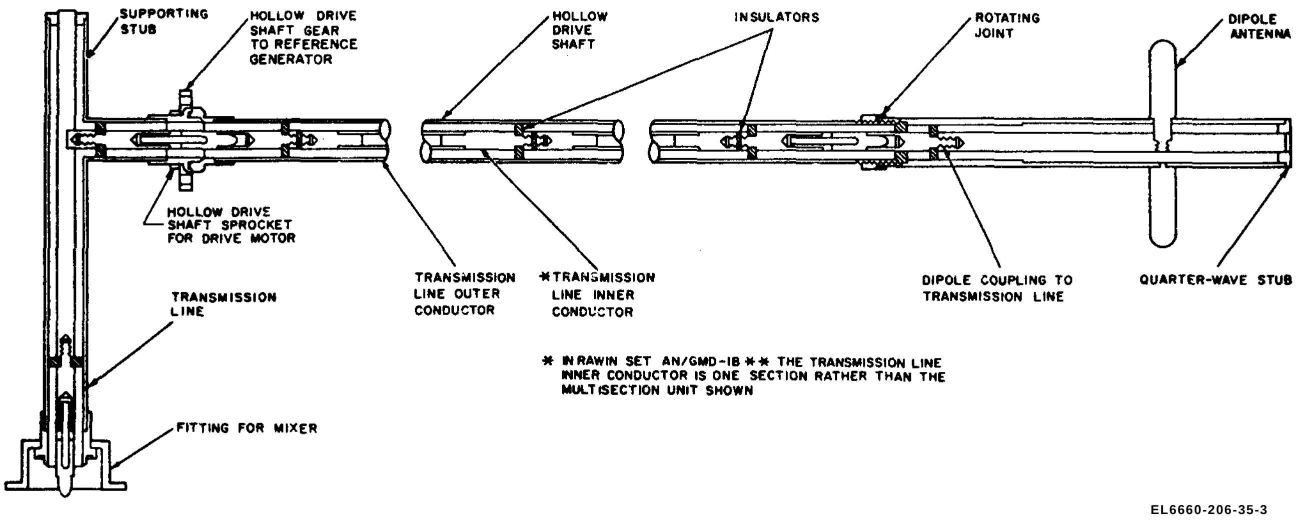


Figure 2–3. Dipole antenna and Transmission line, cross-sectional view.

2-7. Transmission Line

The transmission line (fig. 2–3) is a metal rod mounted in a metal tube by means of insulating washers. This assembly forms a rigid coaxial line and conveys rf energy from the dipole antenna to the mixer assembly of the receiving system. A coaxial transmission line is used to reduce power loss caused by radiation and induction by confining the electromagnetic field of the rf energy to the space between the inner and outer conductors. A rigid transmission line is used to further reduce power loss. By reducing these power losses, the transmission line delivers optimum power to the mixer assembly.

Section II. RECEIVING SYSTEM THEORY

2-8. General

a. The receiving system (fig. 2–4) consists of a mixer assembly, a local oscillator, if. amplifier, modulation amplifier and cathode follower circuit, service meter circuit, afc and oscillator tuning circuit, and power supply. In the mixer assembly, the modulated rf signal from the rf system (para 2–1) is heterodyned with the output of the local oscillator to produce an if. signal. This if. signal is amplified and detected in the if. amplifier. The detected signal is then passed to the antenna positioning system and the meteorological data transmission system by the modulation amplifier and cathode follower circuit. An afc and oscillator tuning circuit is included in the receiving system to maintain a constant if. frequency by its control of the local oscillator. The service meter circuit is used for checking various currents and voltages present in the rawin set. The power supply provides necessary operating voltages for the receiving system, and all other systems of the rawin set except the rf system.

b. The relationship of the receiving system with respect to the other functional systems of the rawin set is described in TM 11–6660–206–12.

2-9. Block Diagram Discussion

a. General. A block diagram discussion of the receiving system is covered in ***b*** through ***h*** following. Differences between Rawin Set AN/GMD-lA and Rawin Set AN/GMD-lB are discussed and references are made to figure 2-5 for Rawin Set AN/GMD-lA and figure 2-6 for Rawin Set AN/GMD–lB.

NOTE

The rf signal from the radiosonde transmitter may be either am. or frequency

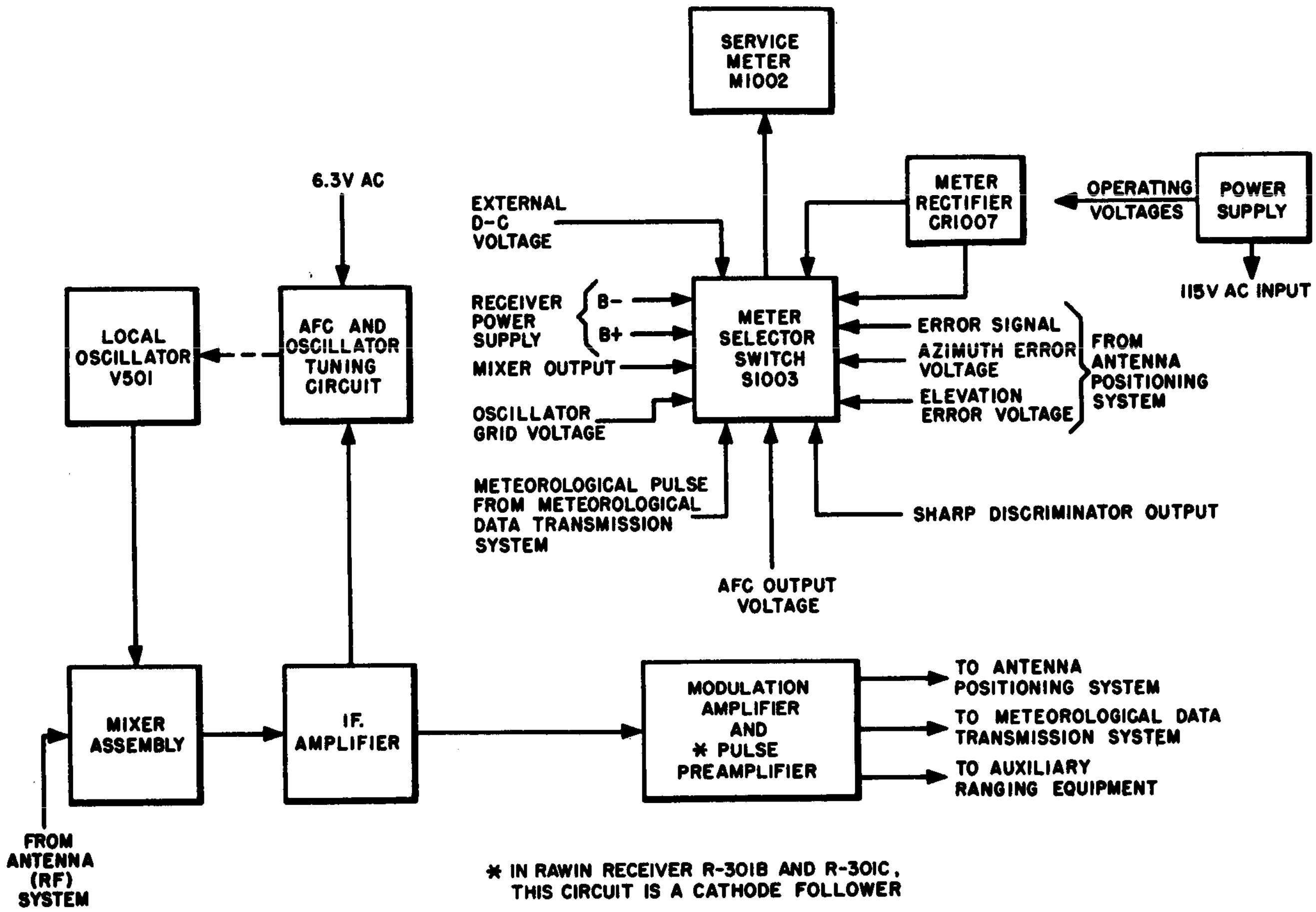


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Figure 2-4. Receiving system, block diagram.

modulation (fro), depending on the model of radiosonde in use. For purpose of discussion in this manual, the received signal is considered as coming from an am. radiosonde. This signal consists of rf pukes being transmitted at a varying rate. It is assumed also that the received rf signal has been modulated in the rf system of the rawin set by a sinusoidal error signal, caused by the radiosonde being off the electrical axis of the rawin set reflector.

*b. **Mixer Assembly.*** The transmission line of the rf system (para 2-1) carries the modulated (34-Hz sine wave and meteorological data) rf signal from the dipole to the mixer assembly (fig. 2-5). The output of local oscillator V501 (30 MHz lower than the received rf signal) is also connected to the mixer assembly. The rf and local oscillator signals are mixed in a nonlinear circuit element (crystal), where they produce a number of other frequencies. The desired difference frequency (30 MHz), which contains both the 34-Hz sine wave and the meteorological data modulation, is then selected and passed to the if. amplifier.

c. Local Oscillator. Local oscillator V501 produces an rf signal 30 MHz below the incoming signal for use in the mixer assembly. It can be tuned manually or controlled automatically by using the afc and oscillator tuning circuit (g below).

d. If. Amplifier. The output of the mixer assembly is applied to cascaded if. amplifiers V401 throuigh V405 (fig. 2-5). These first five if. amplifiers have a relatively broad band pass (2.5 MHz). Their output is rectified by am. detector

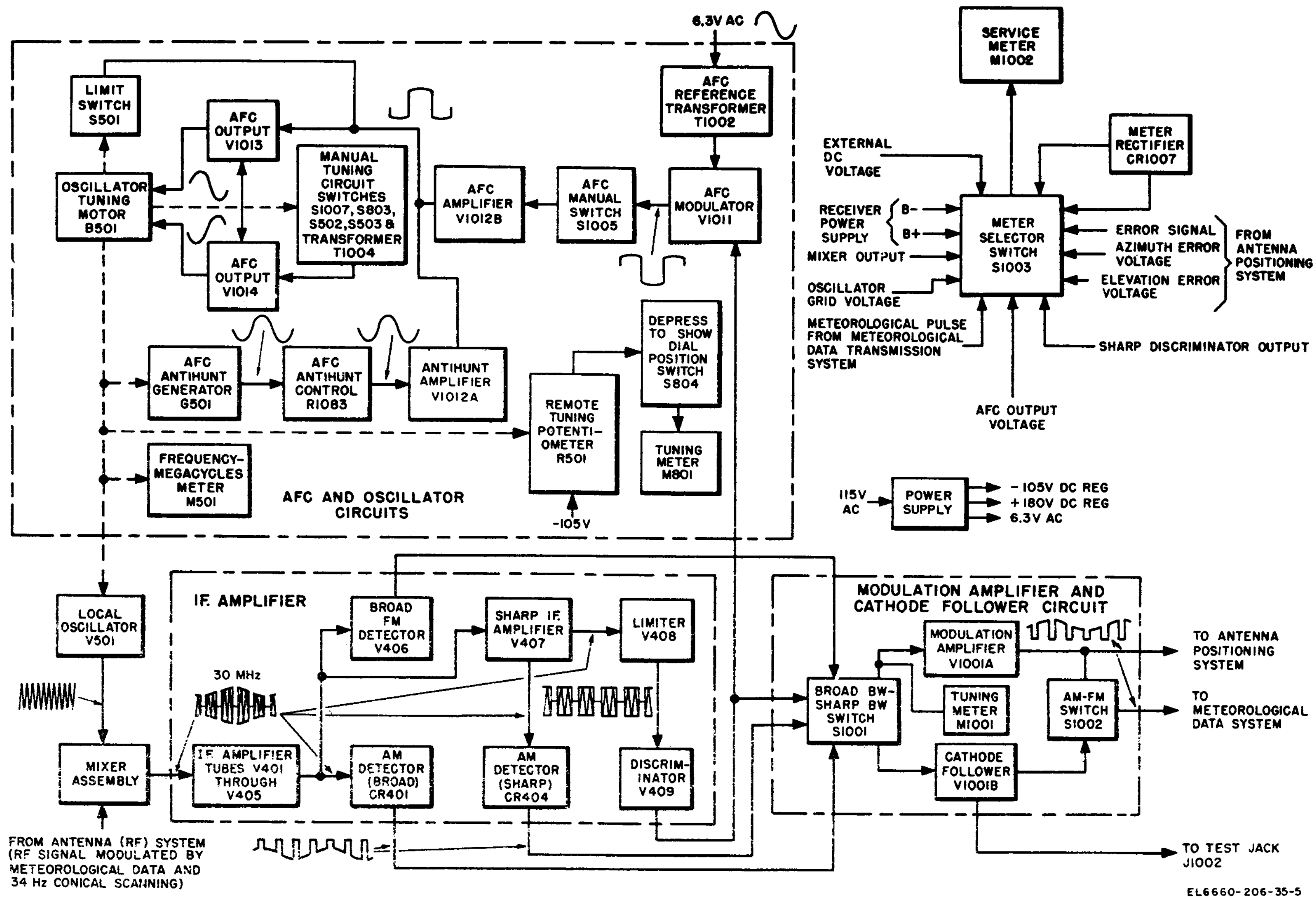


Figure 2–5. Receiving system, AN/GMD–1A, complete block diagram.

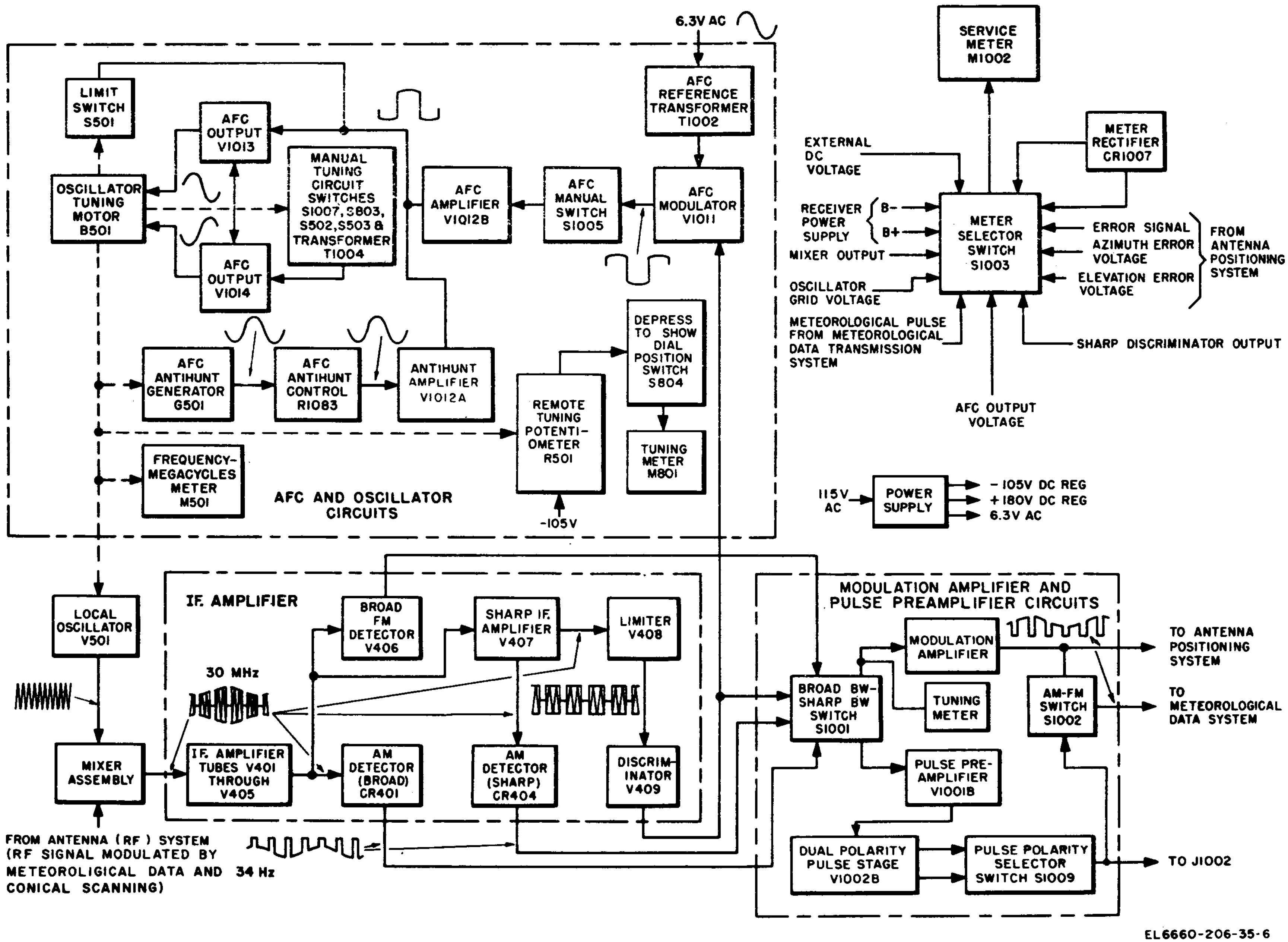


Figure 2–6. Receiving system, AN/GMD–1B, complete block diagram.

(broad) CR401, and applied to modulation amplifier V1001A when switch S1001 is in the BROAD position. The output of the if. amplifiers is also connected to broad fm detector V406 and to if. amplifier (sharp) V407. The output of the broad fm detector is applied to cathode follower V1001B (on AN/GMD-lA) when S1001 is in the BROAD position. On the AN/GMD-lB (fig. 2-6), V1001B is a pulse preamplifier. Sharp if, amplifier V407 (either model) is a sixth stage of if. amplification. This stage provides a signal of greater amplitude and narrower bandwidth (0.8 MHz) than the output of if. amplifiers V401 through V405. The output of sharp if. amplifier V407 is rectified by am. detector (sharp) CR404 and is applied to modulation amplifier V1001A when switch S1001 is in the SHARP position. The unrectified output of sharp if. amplifier V407 is applied to limiter V408. Limiter V408 removes amplitude modulation from the signal and applies a signal of constant amplitude to discriminator V409. Discriminator V409 develops a dc potential which varies in polarity with the departure of the if. signal from 30 MHz. The output of discriminator V409 is connected to the afc and oscillator circuit for control of the local oscillator, and it is also connected to cathode follower (pulse preamplifier) in the AN/GMD-lB) V1001B when switch S1001 is in the SHARP position.

e. Modulation Amplifier and Cathode Follower. This circuit in Rawin Set AN/GMD-lA is described in (1) below. Changes that were made in Rawin Set AN/GMD-lB are described in (2) below.

(1) The various detected outputs (meteorological pulses modulated by the 34 Hz error voltage) of the if. amplifier are applied through bandwidth selector switch S1001 (fig. 2-5) to modulation amplifier V1OO1A and cathode follower V1001B. TUNING METER M1001 is also connected to the output of S1001 to indicate relative signal strength to aid in the tuning of the rawin set. When AM-FM switch S1002 is in the AM position, the output of modulation amplifier V1001A is applied to both the antenna positioning and meteorological data systems. When AM-FM switch S1002 is in the FM position, the output of cathode follower V1001B is connected to the meteorological data system. Cathode follower V1001B also provides a low impedance wide-band video output for test purposes. Test instruments can be connected to J1002 without disturbing the performance of the circuits.

(2) In Rawin Set AN/GMD-lB, provision has been made for ranging equipment to be added later. Modulation amplifier V1001A (fig. 2-6) continues to operate as described in (1) above, but cathode follower V1001 B has been converted to an amplifier stage (pulse preamplifier V1001B). The inverted signal from pulse preamplifier V1001B is applied to dual polarity pulse stage V1002B, which delivers simultaneous positive and negative pulses to pulse polarity selector switch S1009. This switch permits manual selection of the polarity desired, and the selected pulse is delivered to switch S1002.

f. Service Meter Circuit. The service meter circuit consists of SERVICE METER M1002, METER SELECTOR switch S1003, meter rectifier CR1007, and associated circuit components. This circuit provides a convenient means of checking significant currents and voltages in the rawin set. Circuits and conditions measured are called out in figure 2–5.

g. Afc and Oscillator.

(1) The afc and oscillator circuits maintain the frequency of local oscillator V501 at 30 MHz below the received rf signal. Deviations above or below the 30 MHz if. are detected by discriminator V409 and presented to the afc and oscillator tuning circuit as positive or negative dc voltages. Afc modulator V1011, with the use of afc reference transformer T1002, converts this dc error voltage to an ac voltage, the magnitude and phase of which are a function of the magnitude and polarity of the dc signal. The signal is amplified by afc amplifier V1012B and applied to a push-pull driver amplifier circuit (afc output stages V1013 and V1014).

(2) The signal output of this circuit energizes the two-phase local oscillator tuning motor B501 and drives the oscillator tuning plunger associated with local oscillator V501. Limit switch S501 is used to disable the afc circuit when the tuning of local oscillator V501 is at either end of safe limits. AFC-MANUAL switch S1005 (fig. 2-5) selects afc or manual tuning of local oscillator V501. In the manual position of S1005, tuning of local oscillator V501 is accomplished by S1007, S803, S502, S503,

and transformer T1004. Remote tuning potentiometer R501 rotates with oscillator tuning motor B501 and makes an indication of local oscillator frequency available at the control-recorder. This indication may be seen on TUNING METER M801 on the control-recorder by operating DEPRESS TO SHOW DIAL POSITION switch S804.

(3) When an error in the 30 MHz if. exists, oscillator tuning motor B501 rotates the tuning mechanism of local oscillator V501 in the necessary direction until the error is corrected. To minimize hunting (continuous overshooting near the correct frequency), afc antihunt generator G501 is coupled to B501 so that the phase of the voltage generated is opposite to that obtained from afc modulator V1011 through afc amplifier V1012B. The magnitude of the generator voltage is proportional to its speed of rotation. Afc antihunt control R1083 and antihunt amplifier V1012A provide amplification and a means of adjustable control for the antihunt voltage from afc antihunt generator G501. When the proper antihunt voltage is mixed with the error voltage at the output of afc amplifier V1012B, hunting is minimized. FREQUENCY MEGACYCLE meter M501 is coupled to oscillator tuning motor B501 to indicate the frequency of the local oscillator.

h. Power Supply. The power supply has an input of 115 volts ac and outputs of regulated -105 volts dc, 6.3 volts ac, and regulated +180 volts dc for use in all systems of the rawin set except the rf system.

2-10. Mixer Assembly and Local Oscillator

a. Mixer Assembly.

(1) *General.* The cross-sectional view of the mixer assembly (fig, 2–7) shows a tubular metal assembly equipped with two arms and three connectors. The connector at the mounting extension end is attached to the transmission line and the signal from the rf system is fed to this point. The oscillator arm contains a 50-ohm disk resistor and a nonreplaceable capacitor, The oscillator arm is used for the injection of energy from the local oscillator. Crystal mixer CR101 is mounted in the mixer assembly at the base of the if. arm The 30 MHz if. is fed from the if. arm through a connector and cable to the input stage of the if. amplifier.

(2) *Detection.* Ordinary heterodyne detection occurs in mixer CR101 when the 1,680 MHz modulated rf signal from the rf system is combined with the 1,650 MHz signal from the local oscillator. From the resulting original, sum, and difference frequencies, the 30 MHz difference is selected by the if. amplifier. The equivalent electrical circuit of the mixer assembly is shown in figure 2–8. The rf and local oscillator” signals are applied in parallel across the electrodes of mixer CR101.

(3) Rf input. The rf input power from the dipole antenna is fed to mixer CR101 by means of the transmission line. When it is terminated in the dipole antenna at one end and mixer CR101 at the other end, this line has a flat response at the frequencies of the equipment and maximum transfer of energy is obtained.

(4) Oscillator injection. The output of the local oscillator is fed to the mixer by means of the oscillator injection stub (fig. 2–7). The coupling is very loose; therefore, the local oscillator presents a high impedance (coupling impedance in fig. 2–8) in parallel with the antenna circuit. As a result, the local oscillator does not load down the rf signal source enough to cause an appreciable loss of signal. The low impedance of the crystal is matched to the higher impedance of first if. amplifier V401 by the input circuit (in if. amplifier). The equivalent capacitor C_H represents the equivalent capacitance of the crystal holder and the if. arm (fig. 2–7) that leads to the if. cable. Resistor R101 provides a 50-ohm termination for the local oscillator input for impedance matching.

(5) Crystal types. A type 1N21B silicone crystal was originally used in Rawin Set AN/GMD–lA. An improved type 1N21C crystal was used in Rawin Set AN/GMD–lB*. Rawin Set AN/GMD-lB** presently uses a type 1N21WE crystal. The crystal is mounted in a ceramic tube and is similar in appearance to a tubular resistor. This crystal holder contains the crystal and is mounted in the mixer assembly.

(6) Mixer output. The mixer crystal enables modulation of the local oscillator by the rf

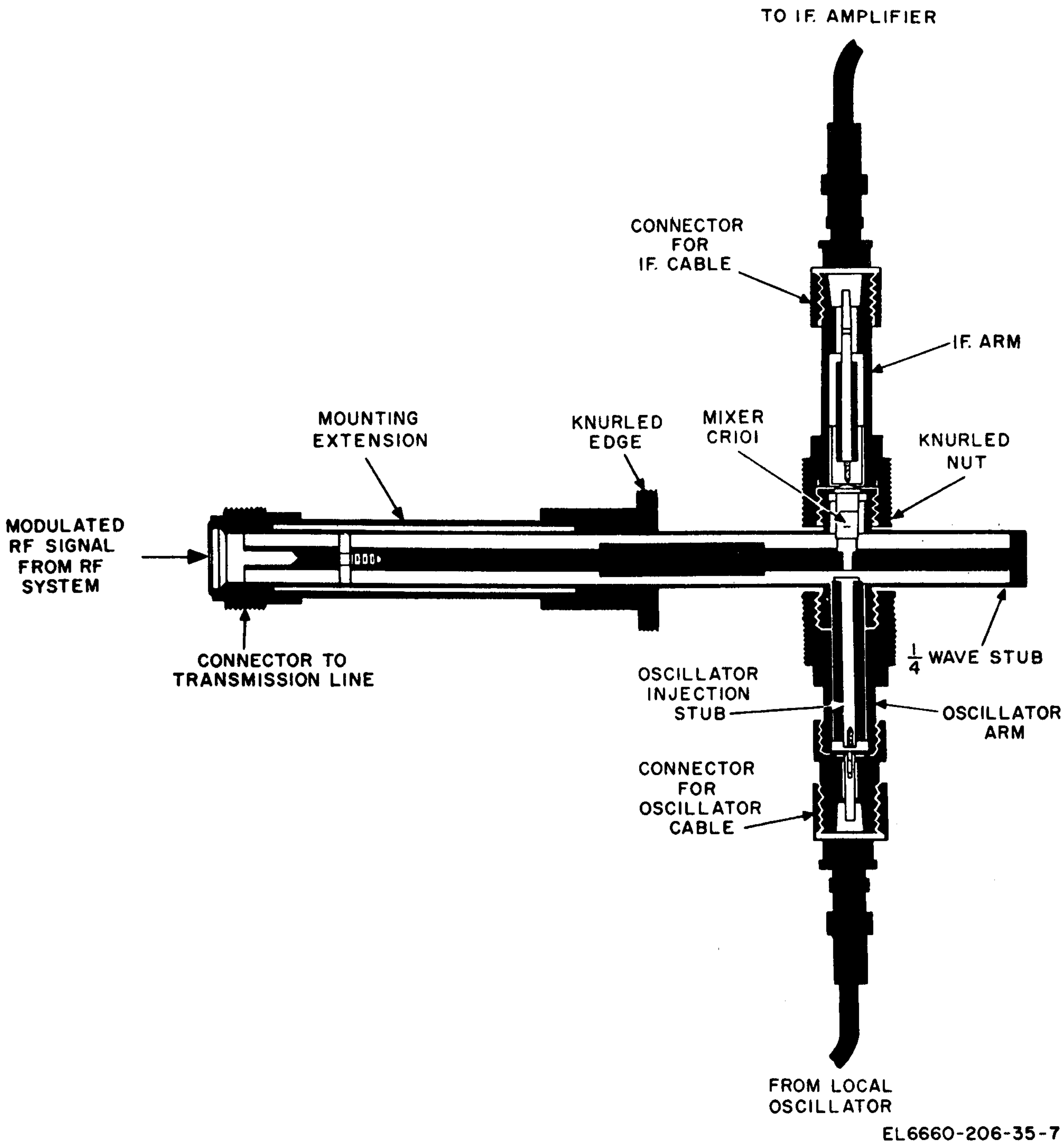


Figure 2-7. Mixer assembly, cross-sectional view.

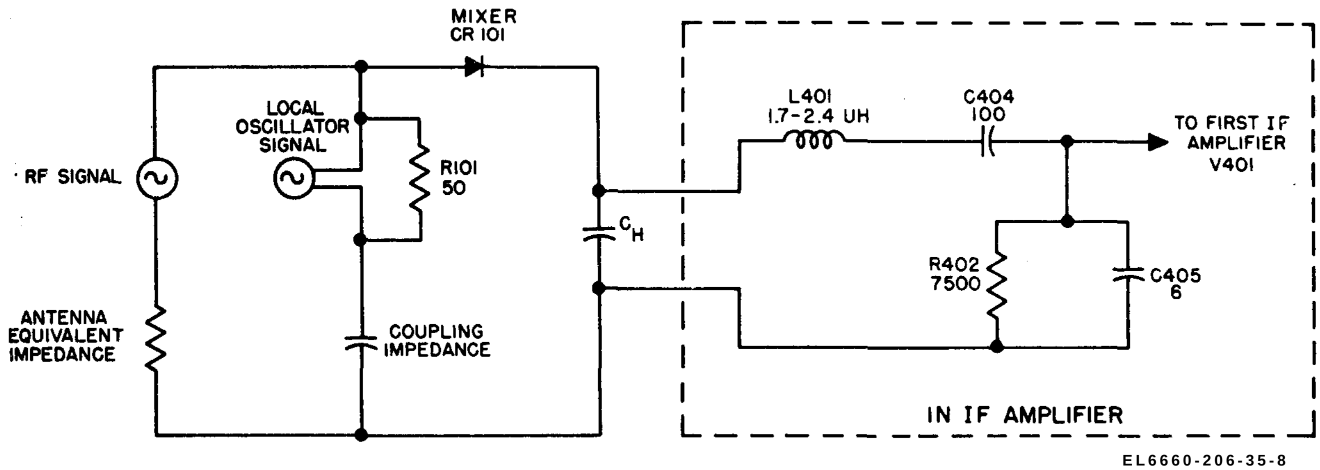


Figure 2–8. Mixer assembly, equivalent circuit.

signals. The resultant 30 MHz if. signal is applied through a coaxial cable (if. cable) to the if. amplifier.

b. Local Oscillator.

(1) Ultra-high frequency (UHF) local oscillator V501 uses an indirectly heated triode tube. The physical construction of V501 and its electrical equivalent are shown in figure 2-9. The tube has a metal cylinder at each end, and is joined together by two glass cylinders. The metal disk at the center of the tube supports the grid. The upper metal cylinder is the anode, or plate; the lower cylinder is the cathode. The grid is a cylindrical mesh, supported from one end by the grid support disk. The cathode is a short length of oxide-coated tubing connected to and supported by the metal cylinder on the lower end of the tube. The two wires projecting through the lower end of the tube are the connections to the filament. The tube is mounted in the local oscillator assembly (fig. 2-10). The center conductor of the cathode coaxial cavity is the cathode support cylinder (fig. 2-9) of the oscillator tube. Similarly, the center conductor of the plate coaxial cavity (fig. 2-10) is the plate cylinder (fig. 2-9) of the oscillator tube. These cavities have both capacitance and inductance and function as the plate-and cathode-tuned circuits. A tuning plunger inside the plate coaxial cavity, which may be controlled manually or automatically (fig. 2-10), determines the frequency at which oscillation occurs. A tuning plunger inside the cathode coaxial cavity is adjusted for maximum power output. The output of the oscillator is applied to the mixer (J502) by a pickup loop in the plate line and is adjusted by the output coupling adjustment.

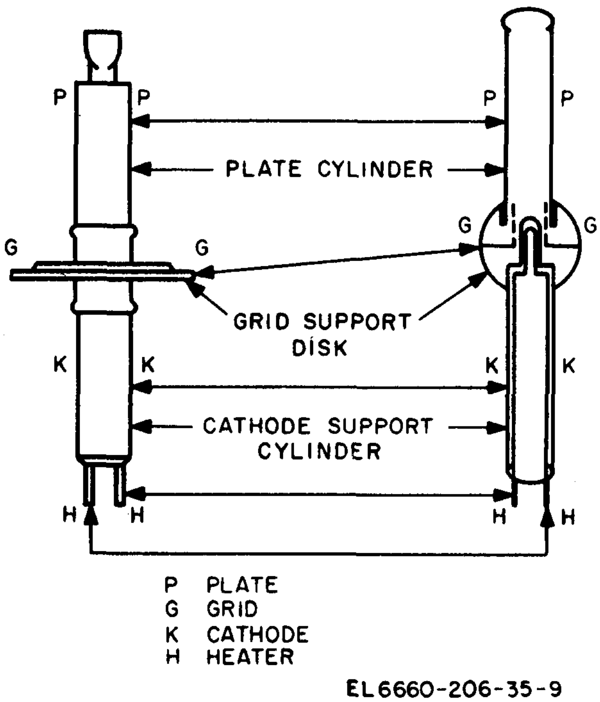


Figure 2–9. Physical construction of oscillator tube and electrical equivalent.

(2) The equivalent circuit of the local oscillator (fig. 2-11) shows a tuned-plate, tuned-cathode type oscillator. The tuned-plate circuit, formed by the plate cavity is represented by inductor L_P and capacitor C_{Pg}. It is tuned by C504 which, physically is the motor-driven tuning

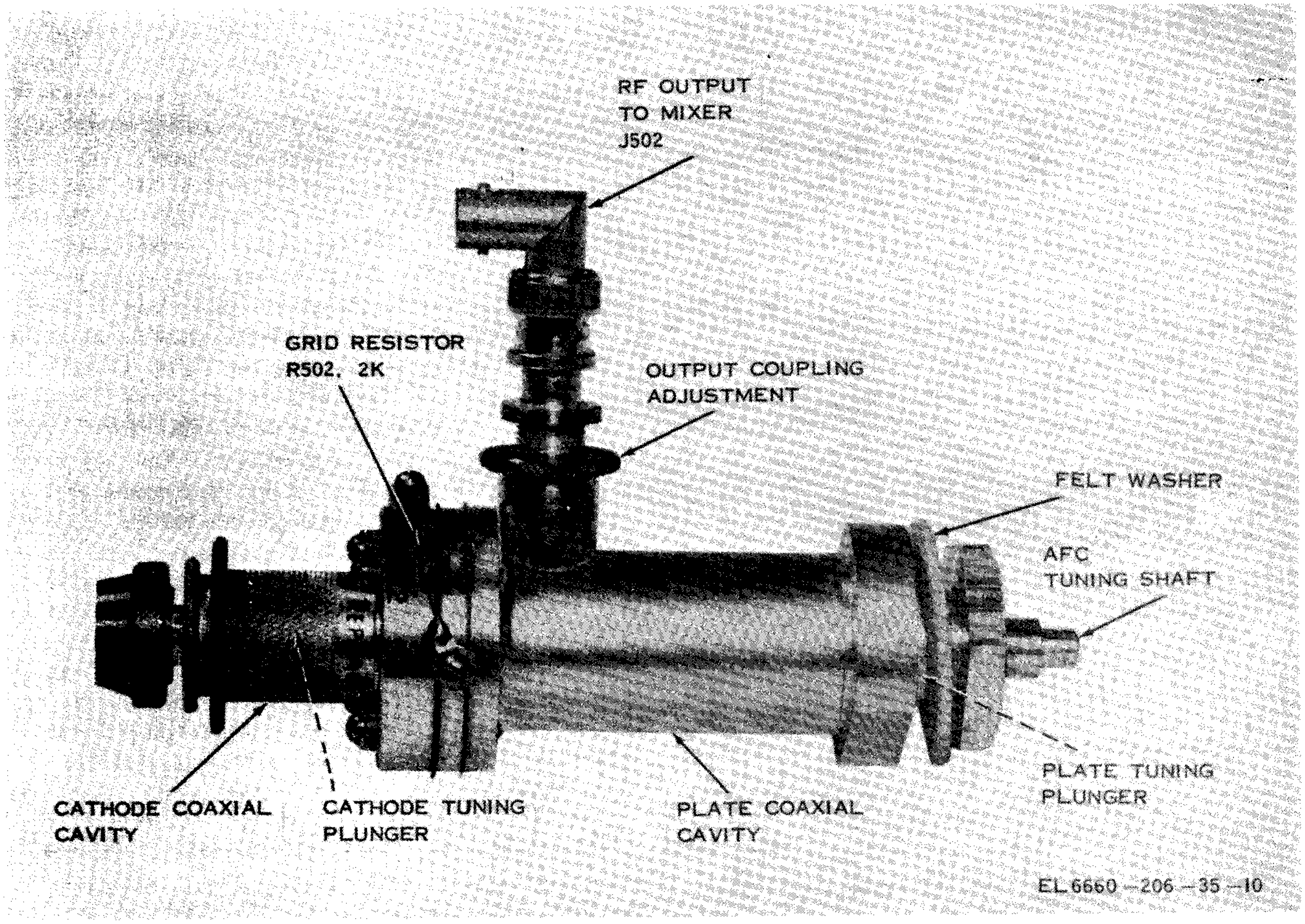


Figure 2–10. Local oscillator assembly.

plunger. This motor may be controlled automatically by the afc circuit or manually by S1007 on the receiver panel or S803 on the control-recorder. The frequency is set at 1,650 MHz, 30 MHz below the received signal. The oscillator is adjustable from 1,625 to 1,675 MHz. Energy from the plate-grid circuit is fed back to the grid-cathode circuit through C502, which is built into the cavity and is not replaceable. The tuned-cathode circuit formed by the cathode 'avity is represented by inductor L_k and capacitor $_{gk}$. The local oscillator is self-biased by R502 which is effectively rf bypassed by a built-in, nonreplaceable capacitor, C503. The oscillator output is fed to J502 and the mixer assembly by means of an adjustable pickup loop (L.) in the plate line.

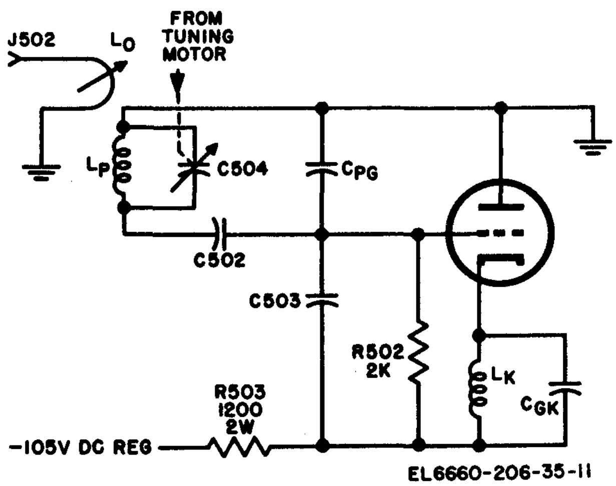


Figure 2–11. Local oscillator, equivalent circuit,

2-11. If. Amplifier Circuits

a. If. Amplifiers. The if. amplifiers include first if, amplifier V401, second if. amplifier V402, third if. amplifier V403, fourth if. amplifier V404, and fifth if. amplifier V405. Because they are similar, only first if. amplifier V401 is described in detail in (1) through (5) below.

(1) The 30 MHz if. signal from the mixer assembly enters the if. amplifier through jack J401 (fig. 2–12). The dc portion (crystal current) of this signal is fed through a filter network inductors L402, L403, resistor R401, and capacitors C401, C402, and C403) to METER SELECTOR switch S1003 in the service meter circuit. When this switch is in the INJECTION position, SERVICE METER M1002 indicates the current level of the local oscillator and the rf signal.

(2) The 30 MHz if. signal from the mixer assembly is applied to the grid of first if. amplifier V401 through an if. cable, inductor L401, and capacitor C404. The inductance of L401, and the capacitance of C404 and C40b, combined with the capacitance of the cable and input capacitance of V401, form a tuned circuit for the 30 MHz input signal. This circuit matches the input impedance of the if. amplifier to the output impedante of the coaxial cable from the mixer assembly, for maximum transfer of the if. signal. Physically, C404 is a part of the series-resonant circuit, and is used to block the dc potential. The series-resonant circuit formed by C431 and L418 functions as a 15 MHz wave trap to prevent signals of this frequency from entering the if. amplifier. This is necessary because the if. amplifier is normally operating at 30 MHz, which is also the second harmonic of 15 MHz. Resistor R402 is the grid resistor for V401.

(3) Tube V401 has a high amplification factor and low input capacitance. The plate voltage of this tube is lower than the screen grid voltage by an amount equal to the voltage drop across plate load tesistor R404. Resistor R403 is the cathode bias resistor, and C406 is the cathode bypass capacitor. Resistor R405 and capacitor C407 decouple the plate circuit of V401 from the other if. amplifier stages. Rf choke L404 and capacitor C409 (figure FO-1) decouple the filament of V401 from the other if. amplifier stages.

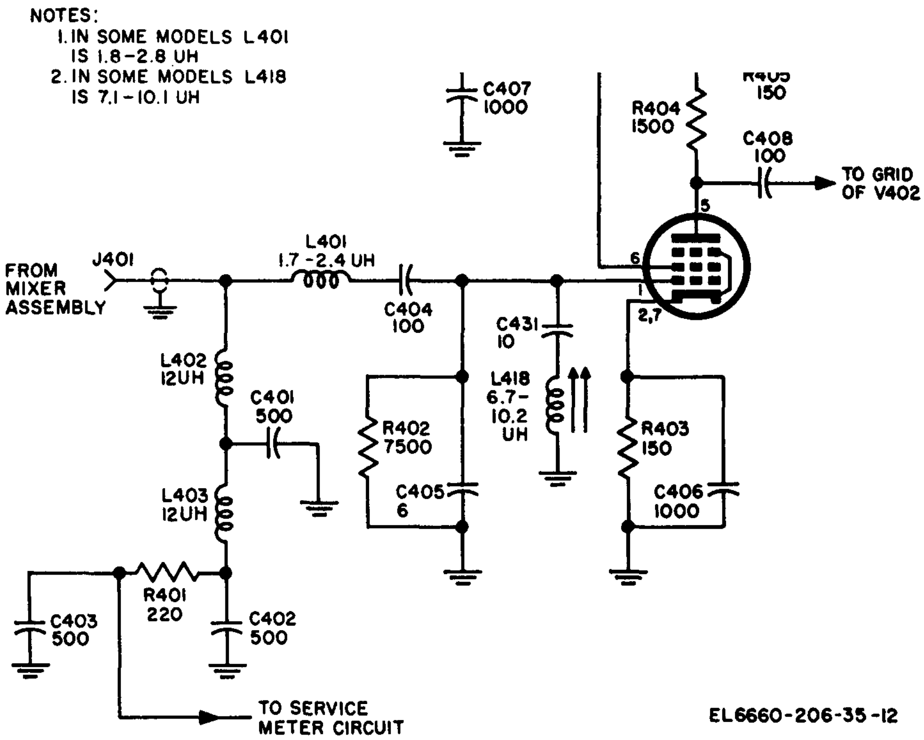


Figure 2-12. First if. amplifier, simplified schematic diagram.

The output if. signal at the plate of V401 is coupled to second if. amplifier V402 through coupling capacitor C408. Because plate load resistors of low value are used, the bandwidth of each if. amplifier stage is relatively broad and the stage gain is sacrificed. The overall bandwidth of this portion of the if. amplifier is approximately 1.5 MHz.

(4) The inductance and the distributed capacitance of L405, and the input capacitance of V402 form a circuit tuned to 30 MHz in the grid circuit of V402. Tuning is accomplished by means of a slug in coil L405. Capacitor C410 and resistor R407 form a decoupling network between the grid of V402 and the automatic volume control (avc) circuit (*b* below).

(5) The signal at the plate of V404 is coupled through capacitor C424 to the grid of fifth if. amplifier V405 (fig. 2–13). The circuit and functions of this stage are similar to the preceding if. amplifier stages, except that no avc voltage is applied to the grid. The output of V405 is coupled through coupling capacitor C428 to am. detector CR401, broad fm detector V406, and sharp if. amplifier V407.

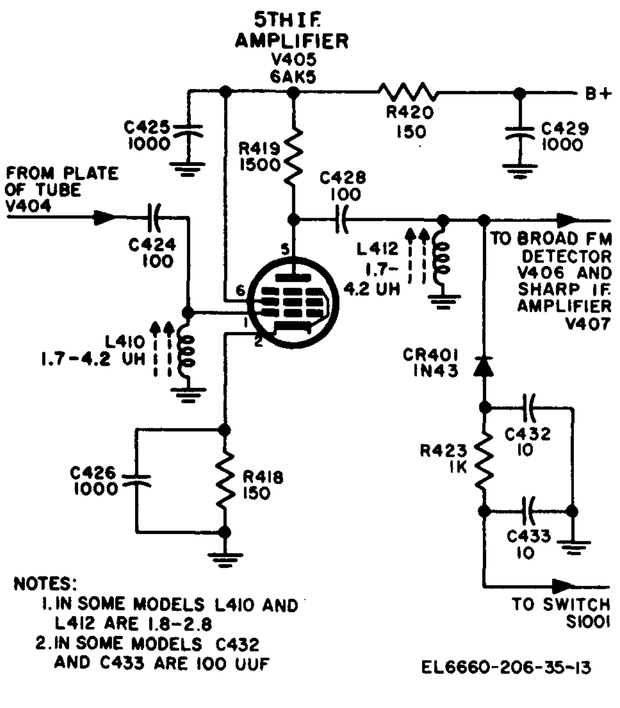


Figure 2-13. Fifth if. amplifier, simplified schematic diagram.

b. Broad Am. Detector and Avc Circuit.

(1) With the use of Radiosonde AN/AMT–4(*) in the rawinsonde system, an amplitude-modulated signal is applied to broad am. detector CR401 (fig. 2–14) from the fifth if. amplifier. This if. signal also contains the 34 Hz error voltage caused by conical scanning in the rf system. The detected output of broad am. detector CR401 is normally coupled to modulation amplifier V1001A to be used in the meteorological data and antenna positioning systems. Its output is also used to provide avc voltage for three of the if. amplifiers and a voltage proportional to signal strength for tuning meters M1001 and M801 .

(2) The basic diode detector circuit consists of: the signal source, L412; the diode rectifier, CR401; the filter network, C432, R423, and C433; and the diode load, R1008, R1009, and R1010. BROAD-SHARP switch S1001 is normally kept in the BROAD position in the rawinsonde system now in use. Negative meteorological pulses varying in amplitude with the 34 Hz error voltage are coupled from the diode load through coupling capacitor C1003 to modulation amplifier V1001A (para 2-12b).

(3) The varying detected signal developed across the diode load is filtered by R1003, C1002, R1002, and C1001. The resulting average dc voltage is applied as avc voltage to the grids of the second, third, and fourth if. amplifiers through their decoupling networks. If the received signal becomes greater, more negative avc voltage is fed back to decrease the gain of the if. amplifier. When the received signal is weak, less negative avc voltage is fed back to increase the gain of the if. amplifier.

(4) To assist in tuning the rawin set to the correct incoming frequency, TUNING METER M1001 on the receiver indicates the voltage across R1009, part of the diode load. This voltage varies directly with the input signal Strength. For remote tuning from the control-recorder, TUNING METER M801 indicates the voltage across R1010, also part of the diode load. Switch S804 is closed whenever it is desired to place M801 into this circuit.

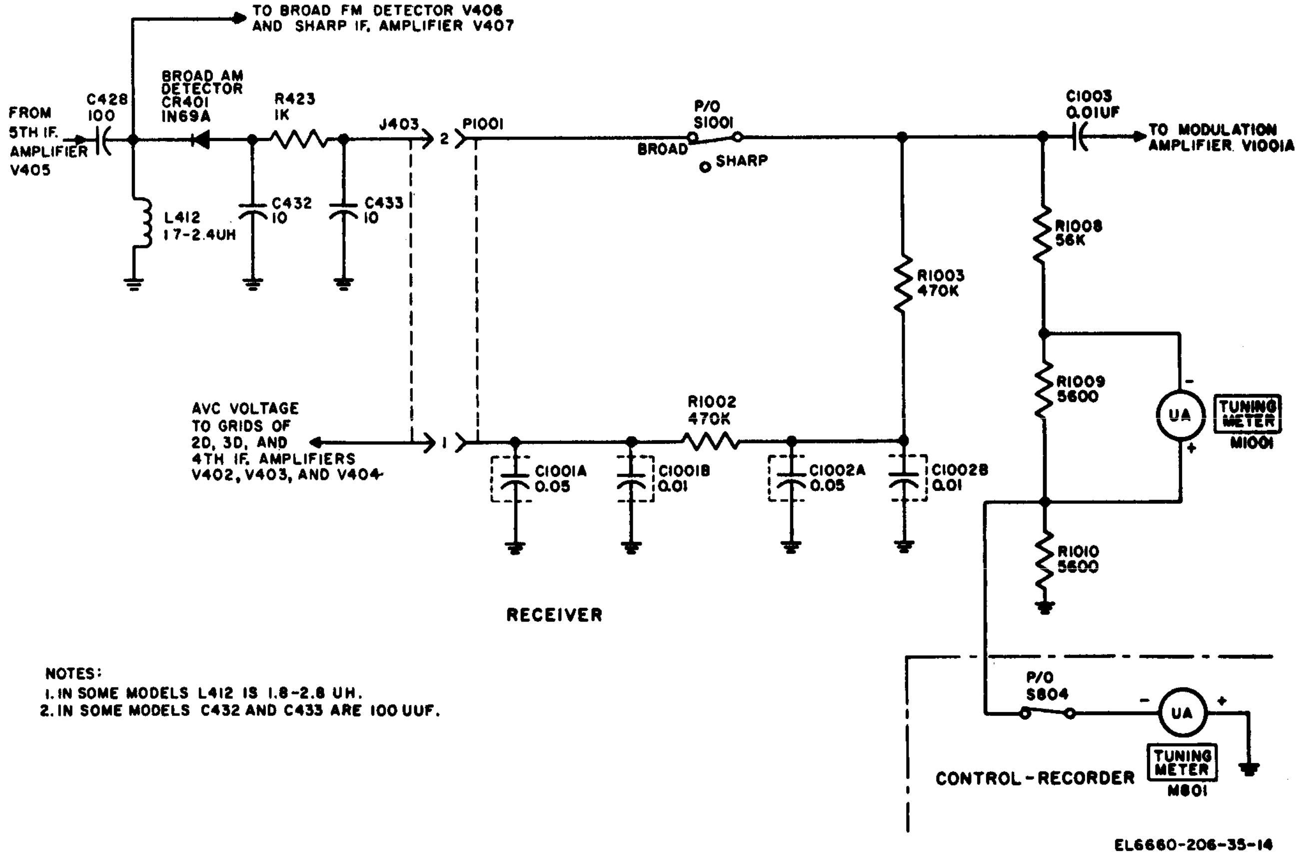


Figure 2–14. Broad am. detector and associated circuits, simplified schematic diagram.

c. Broad Fin Detector.

(1) *General*

(a) Broad fm detector V406 (A, fig. 2–15) consists of a type 6BN6 gated-beam tube, and associated components. This stage converts frequency variations into voltage variations. When a frequency-modulated radiosonde is used, the meteorological information (periodic deviations of the carrier from the center frequency (pulse modulation)) may be detected by broad fm detector V406.

(b) Variations m the amplitude of the input signal to the broad fm detector are prevented from appearing as output signals because of the limiting action of the tube.

(c) The tube is constructed (C, fig. 2-15) so that the electron stream leaving the cathode passes through focusing and accelerator electrodes to the first control grid. If this grid is either zero or positive, the electrons continue through a second focusing electrode, a screen grid, and then through a narrow slit which acts, in effect, as a cathode for a second control (quadrature) grid. If the second control grid is zero or positive, the electron stream continues to the plate.

(d) Both control grids have a step-shaped control characteristic; the plate current rises abruptly from zero to a sharply defined maximum as the grid voltage changes from negative to positive. The step-shaped control characteristic of the first control grid is used for limiting purposes. The two control grids may be regarded

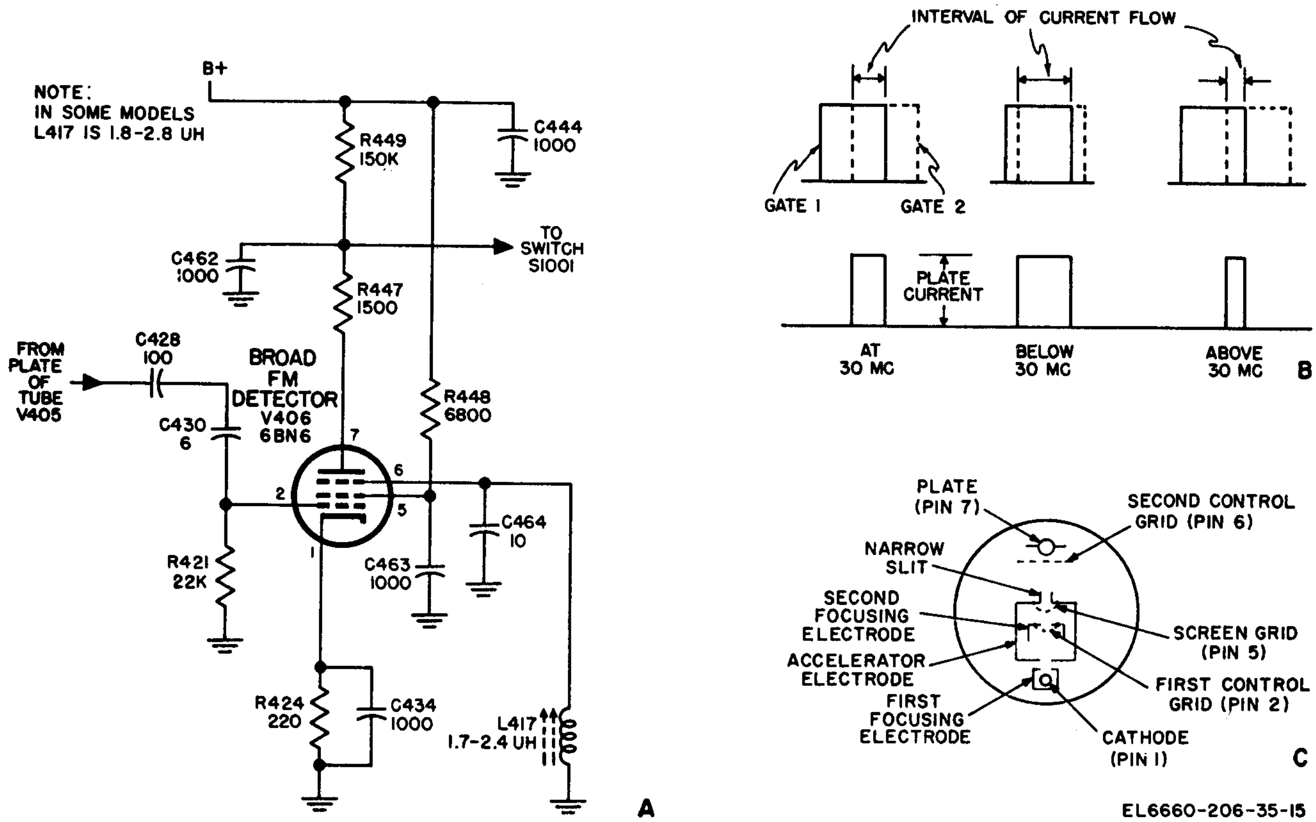


Figure 2-15. Broad fm detector, simplified schematic diagram.

as gates, both of which must be open simultaneously for plate current to flow. The first grid is controlled by the applied signal; the second by a 30 MHz tuned circuit. The time (phase) relationship between the signals on the grids determines the period of plate current flow, and when the applied signal is 30 MHz, and average plate current is maintained. Any departure of the applied signal from the center frequency of 30 MHz causes an increase or decrease in the period of time in which plate current can flow and results in a change of average plate current. The changes in average plate current are detected and the resultant output voltages are a function of the modulating frequency of the carrier. The modulating frequencies are the pulses at varying repetition rates which contain the meteorological information.

(2) *Limiting action of V406.*

(a) The output signal of fifth if. amplifier V405 is applied to the first control grid (pin 2) of V406 through coupling capacitors C428 and ***C430.*** The first control grid is biased to the midpoint of its control characteristic by cathode resistor R424. Capacitor C434 bypasses the cathode at 30 MHz. Resistor R421 returns the first control grid to ground.

(b) Electrons leaving the cathode of V406 are focused in a beam and directed to the first control grid by the accelerator electrode (pin 5). If the first control grid is negative, the progress of the electrons is slowed and a space charge or cloud of electrons forms in front of the grid. This space charge tends to prevent more electrons from reaching the grid. As the voltage applied to the first grid changes from negative to positive, the plate current rises sharply from zero to maximum and no further increase in the applied positive voltage can cause additional plate current to flow. Therefore, the first control grid limits the amplitude of the output signals by cutting off the plate current on negative signals and rising quickly to maximum on small positive signals. The application of signal voltage acts as a switch that turns the tube plate current on and off with each cycle. The plate current then consists of positive-going pulses which are flat topped.

(3) Discriminator action.

(a) The electron stream which passes the first control grid and screen grid is directed by a portion of the accelerator electrode (narrow slit) to the second control grid (pin 6) called the quadrature grid. The quadrature grid is connected to ground through a 30-MHz tuned circuit (C464 and L417). The beam that approaches the quadrature grid forms a space charge in front of the grid which varies periodically and in step with the plate current pulses. The resulting electrostatic induction between the space charge and the quadrature grid produces a small charging current in the quadrature circuit. The charging current excites the tuned circuit which is tuned to 30 MHz, and a voltage is produced between grid and ground. The voltage across the tuned circuit follows the voltage at the first control grid. However, the voltage across the tuned circuit is shifted in phase because of the interelectrode capacitance of the tube and resistive, capacitive, and inductive appearance of the tuned circuit.

(b) At 30 MHz, the quadrature grid voltage lags the first control grid voltage by 90°, above 30 MHz the quadrature grid voltage lags the first control grid voltage by more than 90°, and below 30 MHz the quadrature voltage lags the first control grid voltage by less than 90°. The voltage fed back to the quadrature grid (through plate-to-grid interelectrode capacitance) is in the proper phase to reinforce the 30-MHz oscillations. The quadrature grid voltage operates the second control grid on the steep portion of its control characteristic in the same way as the first control grid is operated. The two grids can be considered as two gates which open and close at intervals, with the second gate opening after the first gate. The electron beam passes through the tube to the plate only during those intervals when both gates are open.

(c) The fm signal varies above and below the center frequency. When the applied signal is 30 MHz, the signal induced in the quadrature grid lags the applied signal by 90°, and plate current flows for an interval which may be considered the reference for the unmodulated carrier. When the frequency departs from 30 MHz, the phase relation between the voltages on the two grids shifts and the interval of plate current flow changes. Conduction occurs for a longer interval when the frequency drops below 30 MHz, and for a shorter interval when the frequency rises above 30 MHz. B, figure 2-15, illustrates the conditions of current flow when the applied signal is 30 MHz, and when the applied signal is below or above 30 MHz. The average plate “current vanes as the carrier frequency changes, and the detected modulating voltage appears across R449. The output of this stage is an average voltage equal to the integrated value of the constant amplitude but with varying pulse widths in the plate circuit. Capacitors C444 and C462, together with R447, decouple the plate circuit. Resistor R448 drops the voltage applied to the screen grid (pin 5) and C463 is the bypass capacitor for this grid. The output at the plate of V406 is applied to switch S1001 for application to the cathode follower circuit (para 2-12c.)

d. Sharp If. Amplifier.

(1) The signal at the plate of fifth if. amplifier V405 is coupled through coupling capacitors C428 and C441 to the grid of sharp if. amplifier V407 (fig. 2-16). This tube and its associated circuit components provides a sixth stage of if. amplification. The bandwidth of this stage is 0.8 MHz in contrast to the 2.5 MHz bandwidth of the first five if. amplifier stages. A better signal-to-noise ratio is obtained when SHARP transmission is used. Tube V407 is a sharp-cutoff pentode amplifier. Resistor R430 is the grid resistor, R431 is the cathode-bias resistor, and C445 is the cathode’ bypass capacitor. Resistor R432 is the screen-dropping resistor and C442 is the screen bypass capacitor. Resistor R434 and capacitor C444 decouple the plate circuit of V407 from the other’ stages of the if. amplifier. The signal at the plate of V407 is impressed across a 30 MHz tuned circuit that consists of the primary of T401 and C466. Damping resistor R445 is across this combination, and C451 is a decoupling capacitor for the plate supply. The signal developed across the tuned-plate circuit is inductively coupled to the secondary of T401. Capacitor C468 provides additional coupling between the primary and secondary of this transformer. Resistor R446 is the damping resistor across the secondary. The 30 MHz output signal of this stage is coupled to the grid of limiter V408 through capacitor C450. This capacitor, the input capacitance of V408, and the secondary of T401 form a 30 MHz series-tuned circuit for the input of V408.

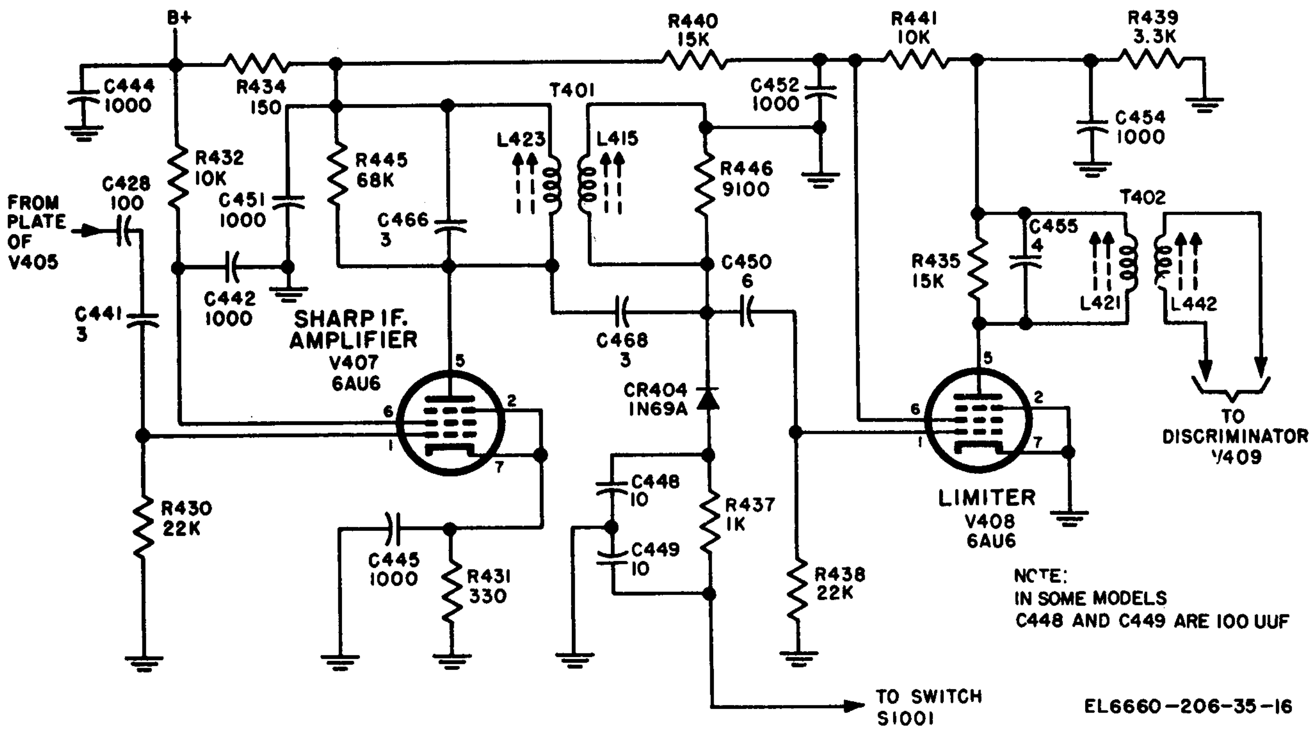


Figure 2—16. Sharp if. amplifier, detector, and limiter, simplified schematic diagram.

(2) The signal at the plate of V407 is coupled through C468 to one side of CR404. This diode detects the 30 Hz error voltage and the pulse modulation of the output of the sharp if. amplifier. The if. component of the detected signal is filtered by R437, C448, and C449, and the resulting signal is applied to switch S1001 for application to the modulation amplifier circuit (para 2-12b.)

e. Limiter V408.

(1) Discriminator V409 (*f* below) will respond to either amplitude or frequency variations, but the signal present at the output of the discriminator must be proportional only to frequency variations. Limiter V408 (fig. 2–16) in the if. amplifier removes the amplitude modulation from the signal and passes a signal of constant amplitude to discriminator V409.

(2) The limiter tube, a type 6AU6 sharp-cutoff pentode, is operated with low plate voltage so that it saturates easily, and a grid-leak bias with a long time constant compared to the incoming 30 MHz signal. A voltage divider that consists of R434, R440, R441, and R439 provides the screen and plate voltages. With the lower plate voltage, plate saturation occurs when a positive signal is applied to the grid of V408 and the desired clipping action is produced. Since both the cathode and grid are grounded (the grid being grounded through grid-leak resistor R438), no initial bias exists in the circuit. As the first positive alternation of the signal is applied from grid to cathode, grid current flows. This flow of current during the positive peaks of the signal loads the preceding stage and the tuned input circuit which consists of C450, the input capacitance of V408, and the secondary winding of T401. Because of this loading, there is a voltage drop during the positive peaks. The clipped positive signal on the grid of V408 is amplified and appears in the plate circuit as a clipped wave. While the grid is drawing current, C450 is charging so that the side connected to the, grid becomes negative. The amount of this charge depends on the signal strength. At the first negative alternation, the grid no longer draws current. Capacitor C450 discharges and develops a bias voltage through R438. The bias voltage developed, plus the negative signal voltage, drives the tube to cutoff, and the output wave is

clipped in the plate circuit because no plate current flows at cutoff.

(3) The time constant of C450 and R438 is long compared to the period of the incoming 30 MHz signal, and only a small amount of the charge across C450 leaks off during negative alternations. After several complete cycles of the input signal, a state of balance is reached, the amount of charge, and discharge of the grid capacitor is equal for each input cycle, and a constant operating bias is maintained. Thereafter, all positive signals are clipped in the grid circuit because of grid current flow, and all negative signals are clipped in the plate circuit by plate current cutoff. As long as the input signal is of sufficient magnitude to drive the sharp-cutoff tube to cutoff, the output of the limiter is a signal of constant amplitude. In addition to the voltage divider action of R439 and R441, R435 slightly lowers the Q of the tuned (30 MHz) output circuit which consists of C455 and the primary of T402. This is necessary to maintain the same Q throughout the if. amplifier. Decoupling for the screen and plate circuits of the limiter is provided by capacitators C451, C452, and C454.

f. Discriminator V409.

(1) The afc circuit in the receiver maintains the frequency difference between the received rf signal and the local oscillator at the 30 MHz intermediate frequency. Discriminator V409 (A, fig. 2-17) produces a signal, the polarity and magnitude of which are a function of the direction and amount in which the intermediate frequency differs from 30 MHz. If an fm radiosonde transmitter is used, this circuit also serves as the detector for the sharp bandwidth signal. In this case, in addition to being applied to the afc circuit, the discriminator output is fed to cathode follower V1OO1B (para 2-12c).

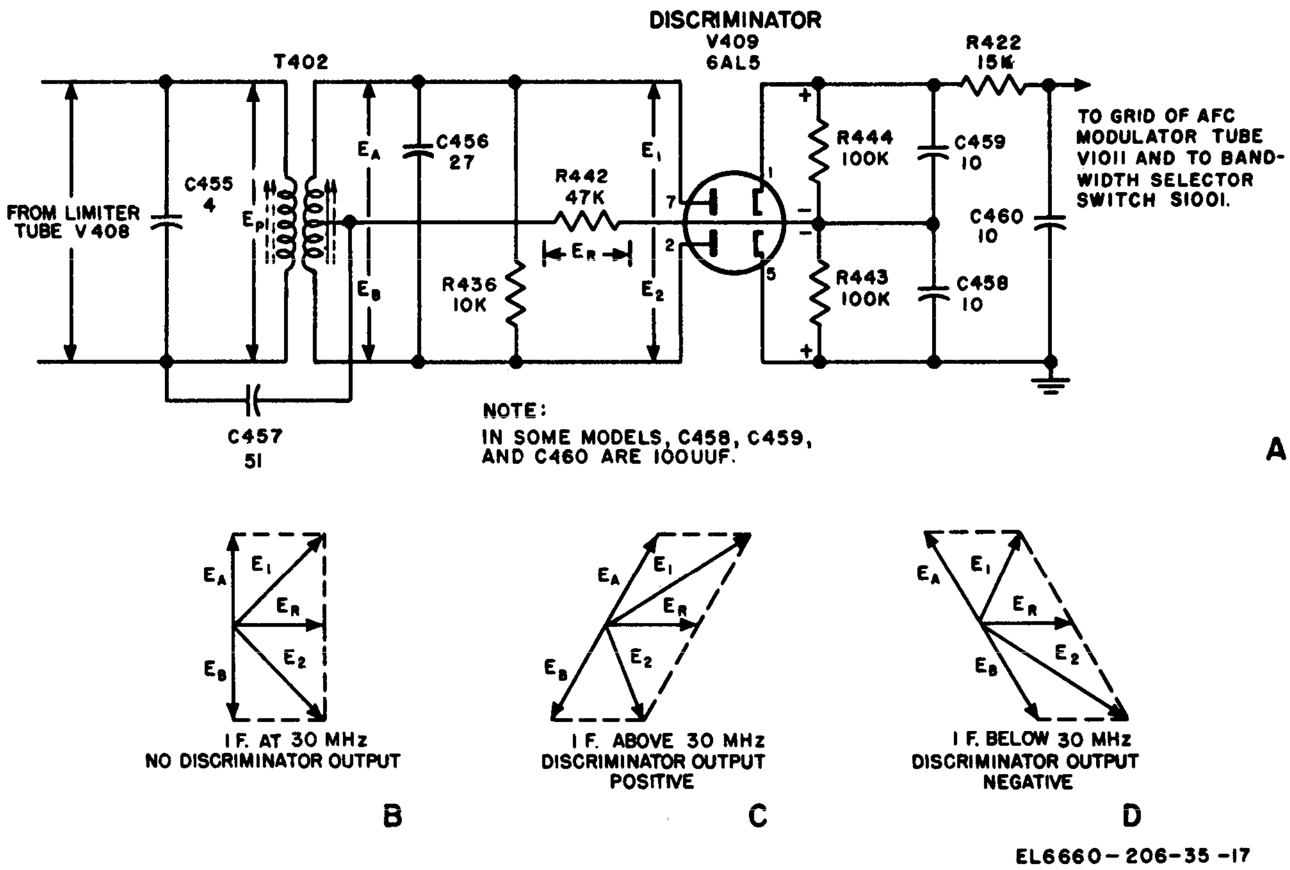


Figure 2—17. Discriminator, simplified schematic and vector diagrams.

(2) The signal voltage applied across rf isolating resistor R442 through C457 is approximately equal to, and in phase with, the signal voltage across the primary of T402. This assumption may be made since the reactance of C457 and C458 at 30 MHz is small. These voltages are in phase, and either may be used as a reference voltage. The voltage induced in the secondary coil to T402 is 180° out of phase with the applied voltage in the primary coil.

(3) At resonance (30 MHz), the primary voltage and the secondary current are in phase. Because of the impedance of the winding, the secondary current causes a high reactive voltage to be developed across the secondary of the transformer, ($E_A + E_B$). This reactive voltage leads the secondary current by 90° and is therefore 90° out of phase with the primary voltage (shown as E_R in B, fig. 2-17). The reactive voltage lags the reference voltage at one plate of V409 and leads the reference voltage by 90° at the other plate. The secondary voltages, E_A and E_B, are 180° out of phase with each other and 90° out of phase with the reference voltage E_R across R442. As shown in B, figure 2-17, voltage E_1 applied to one diode will be the vector sum of the voltage across half of the secondary (E_A), and the voltage across R442 (E_R). Because E_A and E_R are out of phase, they must be added vectorially. Similarly, E_2, the voltage applied to the second diode, is the vector sum of E_B and E_R. Since E_A and E_B are of equal magnitude, and the phase angle between each of these and E_R is 90°, the resultant voltages, E_1 and E_2 are of equal magnitude. These equal voltages are rectified by the diodes. The output voltages developed across resistors R443 and R444 are equal in magnitude but opposite in polarity. Since the outputs are of opposite polarity, the sum is zero, and there is no discriminator output when the input is exactly 30 MHz. Capacitors C458 add C459 bypass any if. signal that may appear in the output. Resistor R436 is placed across the secondary of T402 to widen the bandwidth.

(4) The operation of the discriminator above 30 MHz is as follows: When the incoming if. signal is above 30 MHz, the tuned circuit, consisting of the secondary of T402 and C456, is no longer at resonance, so that the series circuit presents an inductive reactance to the induced secondary voltage. Because the series circuit acts inductively, the current through the series circuit lags the induced voltage. E_A and E_B are still 180° out of phase with each other, but they have a new phase relationship with E_R (C, fig. 2–17). In this case, E_1 the vector sum of E_A and E_R, is greater than E_z the vector sum of E_B and E_R, E_1 and E_2 are applied to discriminator V409, and corresponding voltages are obtained across resistors R444 and R443. Since the polarities of the voltages across the resistors are opposite, they tend to cancel each other. However, the output across R444 is greater than the output across R443. Therefore, the algebraic sum (the net output of the discriminator) will be a positive voltage when the incoming signal is above 30 MHz.

(5) The operation of the discriminator below 30 MHz, is as follows: When the if. input to the tuned secondary circuit of T402 is below 30 MHz this circuit presents a capacitive reactance to the induced secondary voltage. Voltages E_A and E_B form a new phase relationship with E_R so that E_2, the vector sum of E_B and E_R, is greater than El, the vector sum of E_A and E_R (D, fig. 2-17). In this case, the voltage across R443 is greater than the voltage across R444. The output of the discriminator, therefore, is a negative voltage when the incoming signal is below 30 MHz.

2-12. Modulation Amplifierolif.km, Cathode Follower, and Pulse Preamplifier Circuits

NOTE

In Rawin Receivers R-301B/GMD-l and R-301C/GMD-1, V1001B is a cathode follower. In Rawin Receiver R-301D/GMD-1, V1001B is a puke preamplifier.

a. Bandwidth Selector Switch. Bandwidth selector switch S1001 (fig. 2-18 and 2-19), a double-pole double-throw (dpdt) switch, connects the output of the detectors in the if. amplifier to V1001. When this switch is in the BROAD position, the output of the broad am. detector is applied to the grid of modulation amplifier V1001A, and the broad fm detector output is applied to the grid of cathode follower V1001B (pulse preamplifier in Rawin Receiver R-301D/GMD-1). When S1001 is set to SHARP position, the grid of modulation amplifier V1001 A receives the output of the sharp am. detector and the grid of cathode follower V1001B (pulse

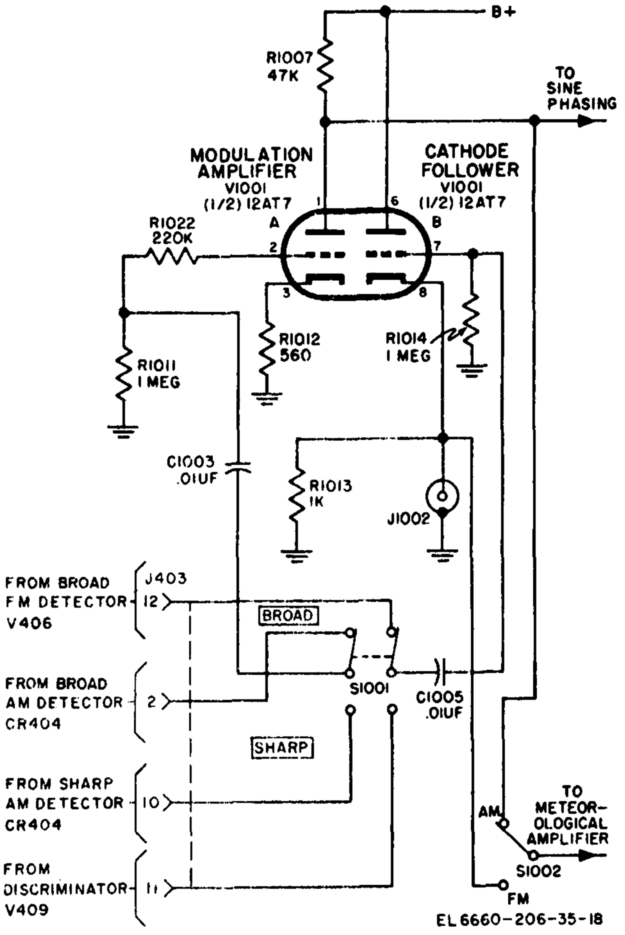


Figure 2-18. Modulation amplifier and cathode follower (R-301B/GMD-l and R-301C/GMD-1), simplified schematic diagnal.

preamplifier in Rawin Receiver R-301D/GMD-1) receives the fm output from discriminator V409. When the rawin set is used in the rawinsonde system, switch S1001 is normally positioned in the BROAD position.

b. Modulation ***Amplifier.*** The modulation amplifier consists of V1001A and associated circuit components. The am. output of the if., either broad or sharp, is coupled to the grid of V1001A through C1003. The grid resistor is R1011, and R1012 is the cathode-bias resistor. Resistor R1022 in the grid input circuit is used to prevent excessive gain. The am. output signal is amplified and applied to the sine phasing circuit located in the input of the sine amplifier (para 2-18a) of the antenna positioning system. It also is applied to the input of the meteorological amplifier (para 2-32) of the meteorological data transmission system, when S1002 is in the AM position. Switch S1OO2 (fig. 2–18) is normally in the AM position; the FM position is not used unless radiosonde that uses frequency modulation is employed. The FM position in the B and C models of the receiver connects the fm output from V1001B to the meteorological amplifier. In the D model of the receiver, the fm signal is amplified by V1001B (fig. 2-19), applied to V1002B (e below), and then applied to the meteorological amplifier.

c. ***Cathode Follower.*** The cathode follower circuit, V1OO1B (fig. 2–18), provides a low impedance takeoff point for the signal applied to the meteorological amplifier and to J1OO2. When S1OO1 is in the BROAD position, the fm broad output is coupled to the grid of V1OO1B through C1OO5. The grid bias for this section is developed across R1014. When S1OO1 is in the SHARP position, discriminator V409 output is connected to the grid of V1OO1B. The signal applied to the grid of V1OO1B causes an increase or decrease in plate current flow which produces a corresponding voltage drop across R1013. The signal which is taken off the cathode follows the input grid signal. The output at the cathode is applied through the FM position of S1OO2 (if an fm radiosonde is used) to the meteorological amplifier. Jack J1OO2 provides output from the cathode of V1OO1B for connection to external test equipment.

d. Pulse Preamplifier. The signal from S1OO1 is applied to the grid of V1OO1B through C1OO5 (fig. 2–1 9). The signal is amplified and inverted by the tube and appears across plate load resistor R1106. From here it is applied through C1037 to the grid of dual polarity pulse stage V1002B. Resistor R1013 provides the operating bias between grid and cathode. Resistor R1014 provides the necessary dc leakage path between grid and ground to prevent blocking.

e. Dual Polarity Pulse Stage. This stage (R-301D/GMD-l only) makes available a choice of polarity of fm signal pulses for application to the meteorological amplifier. The plate and cathode resistors, R1107 and R1024 (fig. 2-20), are of the same value, and develop signal pulse voltages that are equal but of opposite polarity. The signal at the cathode is delivered to one terminal of a single-pole, double-throw, switch S1009; the plate signal is fed through dc blocking capacitor C1038 to another terminal. Either

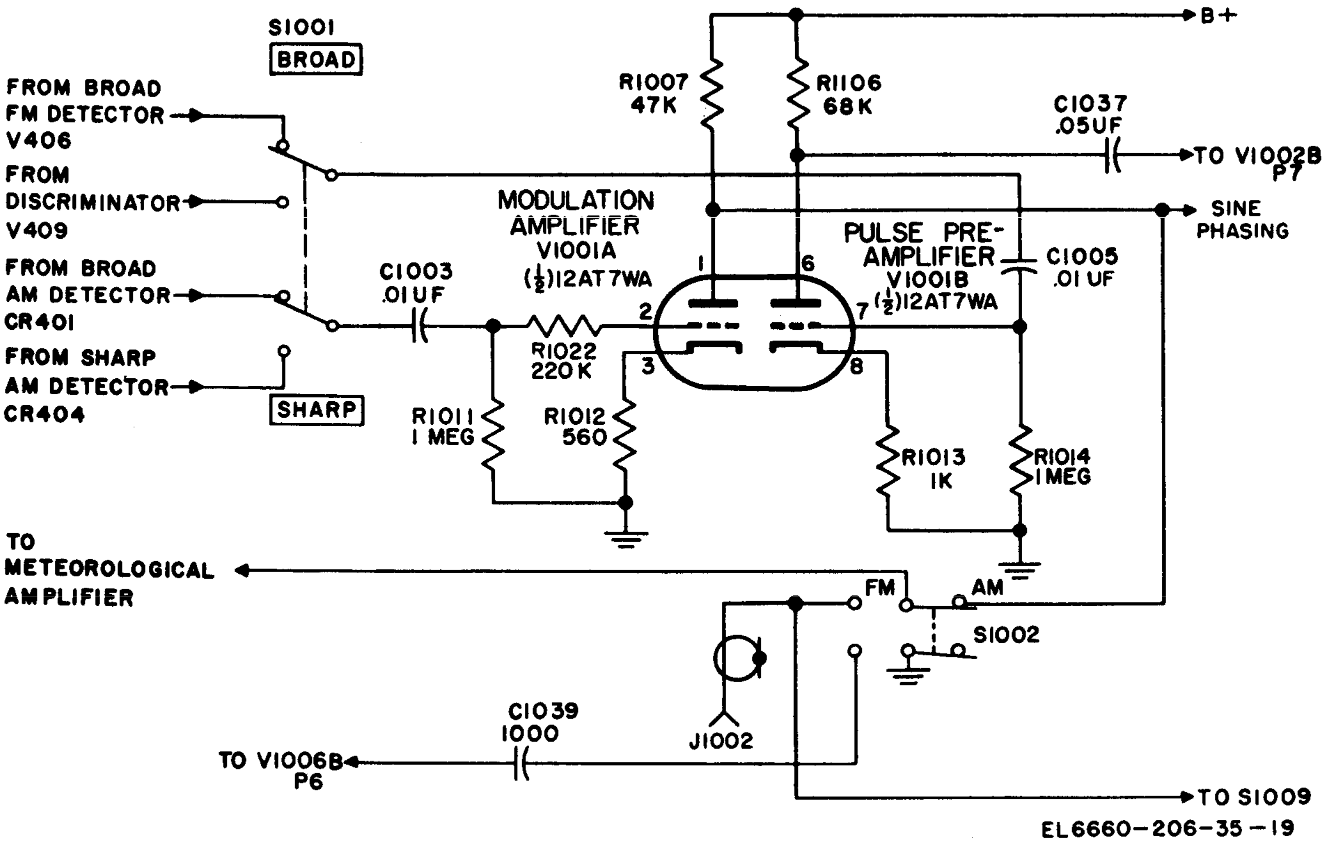


Figure 2—19. Modulation amplifier and pulse preamplifier (R—301D/GMD—1), simplified schematic diagram.

signal may be selected by throwing the switch to the desired pulse polarity. The polarity at the cathode (CF) agrees with that delivered to the grid by V1OO1B; the inverted polarity of the signal pulse (INV) is taken from the plate circuit. Cathode resistor R1024 also serves as a biasing resistor, and R1028 is the grid return. This stage provides for future applications of the rawin set.

2-13. Service Motor Circuit

a. Service Meter Operation. The service meter circuit consists of SERVICE METER M1OO2, METER SELECTOR switch S1OO3, and associated circuit component (fig. FO-22 or FO-23). This circuit provides a convenient means of checking currents and voltages in the rawin set. Through the various settings of METER SELECTOR switch S1OO3, SERVICE METER M1OO2 can be connected to read the output of 10 different circuits. Connections for reading external dc voltage and an OFF position are also provided. A block diagram of the service meter circuit is shown in figure 2-8.

b. Service Meter. SERVICE METER M1OO2 is a dc milliammeter located on the front panel of the receiver. A specially calibrated dial permits direct reading of the meter for all the positions of METER SELECTOR switch S1003. For the three positions of switch S1003 marked A on the receiver front panel, the meter is read directly in a full-scale reading from -200 to +200 volts. For the three positions of switch S1003 marked B, the meter reading should fall within the green block on the meter dial. For the remaining positions of this switch marked C, the meter should read within the center diamond on the meter dial, and preferably at the center of this diamond.

c. ***Meter Selector Switch.*** METER SELECTOR switch S1003 is a 5-section, 12-position switch, located on the front panel of the receiver. This switch connects SERVICE METER M1002 for any of the indications listed in table 2-1.

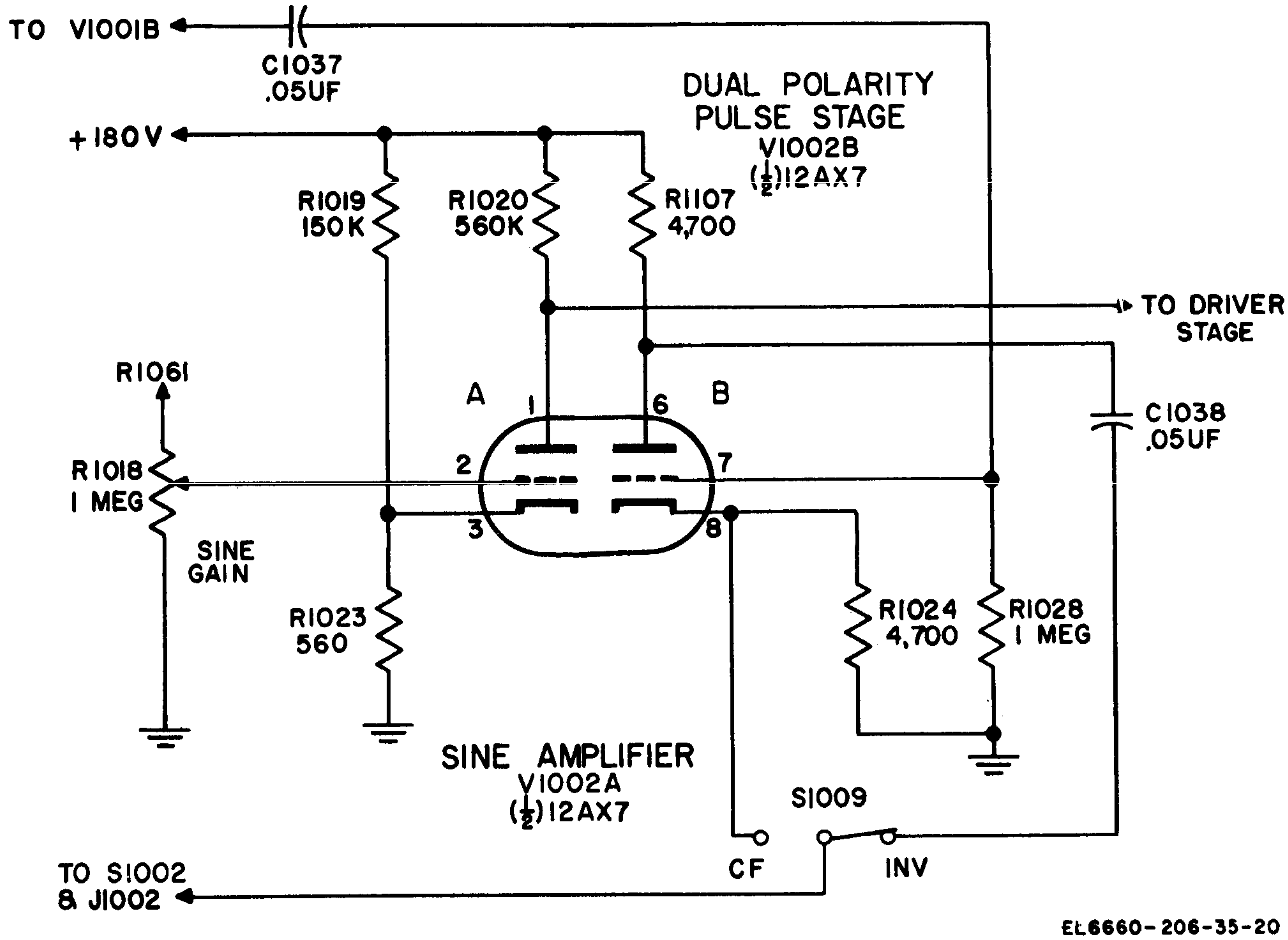


Figure 2—20. Dual polarity pulse stage (R—301D/GMD—1), simplified schematic diagram.

Table 2—1. Service Meter Indications

Position of S1003	Circuit quantity indicated
1. EXT TEST (DC)	External dc voltage readings through J1003 and J1004.
2. B−	−105 volts dc regulated, power supply.
3. B+	+180 volts dc regulated, power supply.
4. INJECTION	Mixer input to if. amplifier.
5. OSC GRID	Local oscillator grid voltage.
6. PEAK PULSE	Output of meteorological amplifier.
7. AFC BAL	Ac output of afc output tube.
8. SHARP FM	Output of discriminator V409 in if. amplifier.
9. AC ERROR	Output of sine amplifier circuit.
10. AZ ERROR	Output of azimuth phase sensitive detector.
11. EL ERROR	Output of elevation phase sensitive detector.
12. OFF	Meter disconnected.

2-14. Afc and Oscillator Tuning Circuits

a. *Afc Modulator.*

(1) The magnitude and polarity of the dc output voltage of discriminator V409 is determined by the difference in frequency between the received signal and the output of the local oscillator. This voltage is positive or negative, depending on whether the difference between the local oscillator frequency and the received signal is greater or less than 30 MHz.

(2) The combination of R1069 and C1025 (fig. 2-21) forms an integrating network and makes the afc circuit insensitive to meteorological modulation pulses. This is necessary because these pulses may be in the order of 60 per second, and if amplified, they would energize local oscillator drive motor B501 and cause the system to be unstable. Resistor R107O is the grid resistor for V1011A.

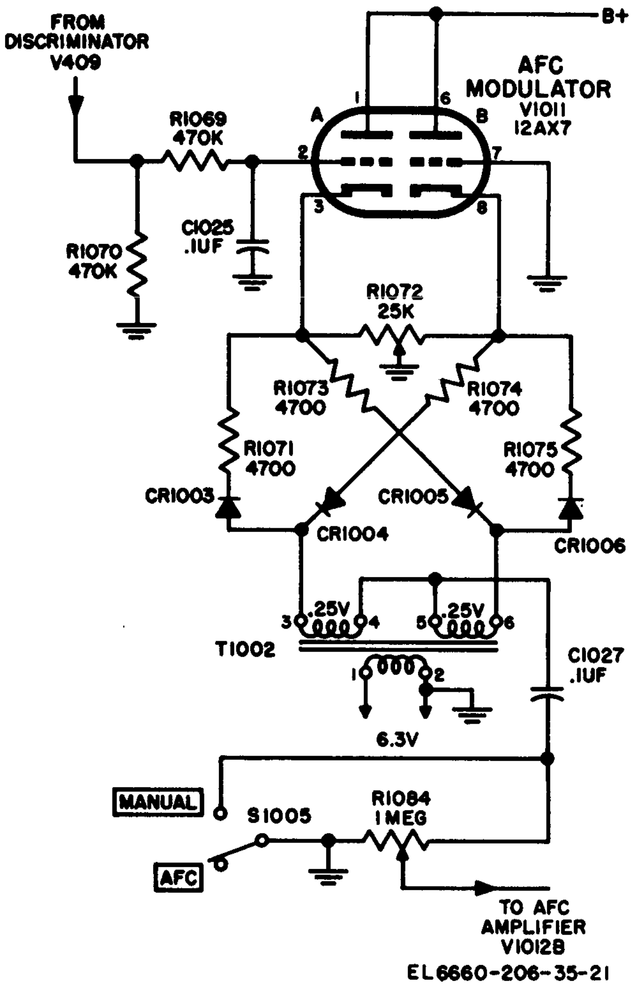


Figure 2—21. Afc modulator, simplified schematic diagram.

(3) Afc modulator V1011 is a twin-triode with a modulator network in its cathode circuit. When the if. is exactly 30 MHz, no voltage is applied to the grid of V1011A. Since the grid of V1011B is grounded, both grids operate at the same potential. Cathode biasing potentiometer R1072 compensates for any inherent unbalance in the tube or the modulator network, and with both grids at ground potential, the cathode voltages are equal.

(4) The reference voltage applied to the primary of T1OO2 is taken from the 6.3-volt ac filament circuit. On the half-cycle when current flows through CR1OO5, R1073, R1071, and CR1OO3 no current flows through CR1OO4, R1074, R1075, and CR1OO6. Both grids of V1011 are at ground potential so that no potential difference exists across R1072. Since the two halves of each branch of the modulator network are symmetrical, the voltage drop across CR1OO3 and R1071 is the same as the voltage drop across CR1OO5 and R1073. The potential at the center tap (terminals 4 and 5) of the secondary of transformer T1002 is the same as the potential at the junction of resistors R1071 and R1073. The functioning of this circuit on the alternate half-cycle is the same, except that the previously unenergized branch now carries current and the branch that was carrying current now is deenergized. Since the same potential exists at each cathode, the same potential also appears at the center tap of the transformer on both alternations, and no ac component appears across gain potentiometer R1084.

(5) If the frequency difference between the received signal and the local oscillator output is above or below 30 MHz, the voltage at the grid of V1011A is either positive or negative. This causes more or less current to flow through V1011A than through V1011B, and causes a potential difference to exist across R1072. When the frequency difference causes a positive voltage at the grid of V1011A, the cathode voltage of V1011A (as measured at the junction of R1071 and R1073) is positive with respect to the cathode voltage of V1011B (as measured at the junction of R1074 and R1075). This results in a voltage difference across R1072. Under these conditions, during the half-cycle of reference voltage when current flows through the CR1OO5, R1073, R1071, and CR1OO3 branch, the voltage at the center tap of the transformer again is equal

to the voltage at the junction of R1071 and R1073. However, this voltage is not the same as the voltage which appears at the center tap of the transformer on the alternate half-cycle. As a result, an ac component appears at the center top of the transformer with a frequency determined by the input frequency (60 Hz) to the transformer. This ac component shifts 180° in phase either way depending on the polarity of the voltage applied to the grid of V1011A. The amplitude of the output is equal to the voltage difference across R1072. This output voltage is impressed across R1084 through dc blocking capacitor C1027 for application to afc amplifier V1012B. AFC-MANUAL switch S1005 disables the afc output in the MANUAL position by shorting R1084.

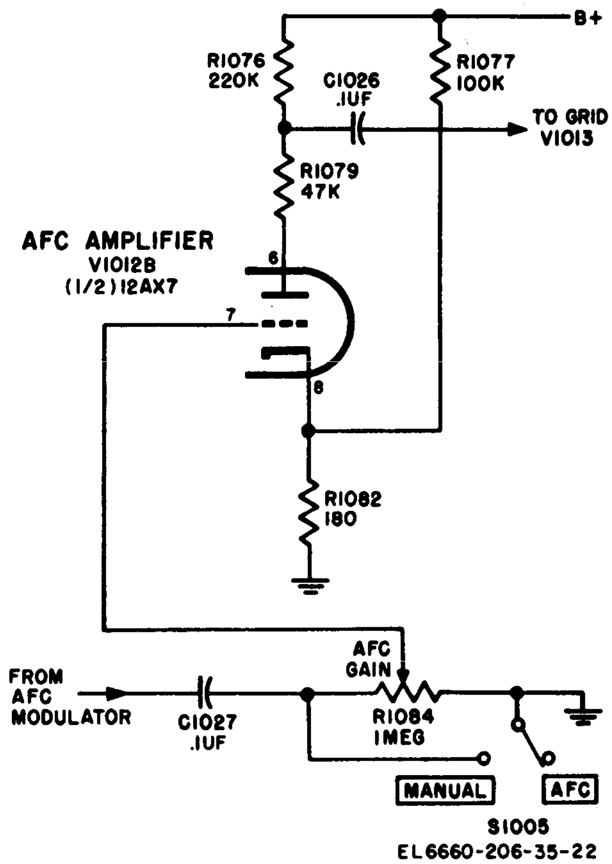


Figure 2—22. Afc amplifier, simplified schematic diagram.

b. Afc Amplifier. The afc modulator output signal from AFC GAIN potentiometer R1084 is fed to the grid of afc amplifier V1012B when MANUAL-AFC switch S1005 is in the AFC position (fig. 2-22). When this switch is in the MANUAL position, the modulator output is short-circuited and permits manual control of the local oscillator. Bias for V1012B is provided by cathode resistor R1082. The amplifier output is taken from the junction of plate load resistors R1079 and R1076. The amplified signal (60 Hz) is coupled through C1026 to the grid of afc output tube V1013. Resistor R1077 aids in maintaining a constant cathode bias.

c. *Afc Output.* The signal from afc amplifier V1012B is fed to the grid of output tube V1013 (fig. 2-23) through C1026. This tube also serves as a phase inverter for the afc signal. The cathodes of V1013 and V1014 are grounded through a common cathode resistor, R1085. An increase in the grid voltage at V1013 increases the current through V1013 and the cathode bias will increase for both tubes. This increasing bias makes the grid of V1014 more negative and reduces the plate current in this tube at the time the plate current of V1013 is increasing. The amplified 60-Hz deviation signal developed in the afc modulator is applied to the motor windings in the plate circuits in push-pull. This causes motor B501 to rotate in a direction determined by the relative phase of the applied signal compared to that on the quadrature winding of the motor. The speed at which the motor rotates is a function of the amplitude of the applied signal. Geared to the motor is the local oscillator tuning plunger which changes the plate-grid capacity of the local oscillator and changes the operating frequency until a 30 MHz if. again is produced. A cam which is coupled mechanically to the shaft of B501 operates afc limit switch S501 at the extreme limits of the oscillator frequency range (1,625 and 1,675 MHz). The closing of this switch connects the grid of V1013 to ground and prevents afc signals from operating the tuning motor. The oscillator is brought back into operating range by means of the manual tuning circuit.

d. Manual Tuning.

(1) TUNING switch S1007 (fig. 2-23) allows manual tuning of the oscillator. Setting S1007 to either its INCREASE FREQ or DECREASE FREQ position applies *6.3* volts ac to one-half of the primary of T1004, the center tap of which is grounded. This induces 10 volts ac in the secondary.

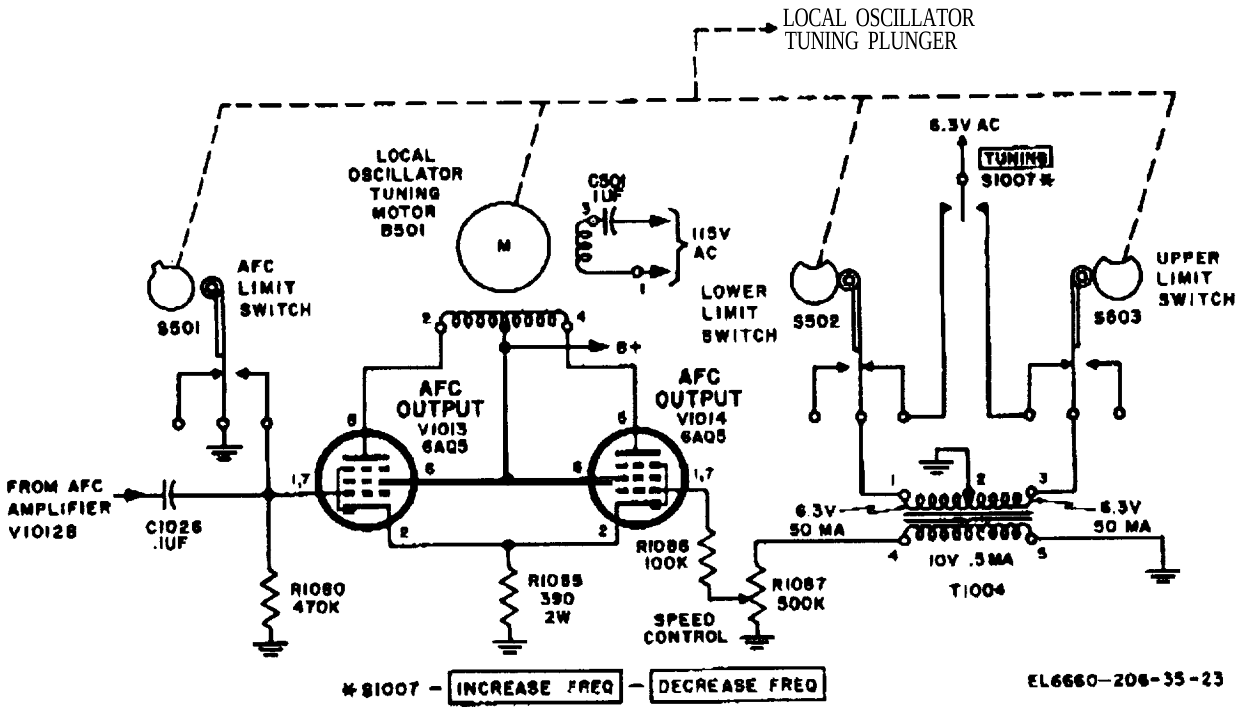


Figure 2-23. Afc output circuit, simplified schematic diagram.

(2) The primary sections of this transformer are wound so that the output across the secondary is, in one case, in phase with the primary voltage, and in the other case, 180° out of phase with the primary voltage. The output of the secondary of T1004 is applied to the grid of V1014 through SPEED CONTROL potentiometer R1087 and resistor R1086 This potentiometer determines the amount of voltage applied to the grid and thus determiner the speed of manually controlled operation. The voltage applied to the grid of afc output tube V1014 is applied inversely to afc output tube V1013 by common cathode resistor R1085, and the two output tubes function as push-pull amplifiers. This causes the tuning motor to rotate and increase of decrease the oscillator frequency.

(3) Resistor R1086 in the grid circuit of afc output tube V1014 permits balancing of the grid circuit resistances of V1013 and V1014. Switch S803 in the control-recorder duplicates the function of S1007. Microswitch S502 is connected in series with one side of the primary of T1004 and S503 is in series with the other side. A cam, associated with each microswitch, is mechanically coupled to B501. At the lower limit of the oscillator (1,625 MHz), the spring operated lever of S502 falls into the groove of its associated cam. This opens the circuit of the primary of T1004 and prevents further rotation in this direction. Microswitch S503 functions in the same manner as the upper limit of the oscillator.

NOTE

FREQUENCY-MEGACYCLES dial M501 is calibrated at the transmitter frequency (1,655 to 1,705 MHz) which is 30 MHz higher than the oscillator frequency.

e. Afc Antihunt Circuit. To minimize hunting, antihunt generator G501 is coupled to tuning motor B501 (fig. 2-24). An increase in the speed of rotation of B501 increases the speed of rotation of G501. Since the speed of rotation of antihunt generator G501 determines the magnitude of its output, increasing its speed increases the ac voltage developed across R1083. This voltage, applied to the grid of antihunt amplifier V1012A, is 180° out of phase with the afc error voltage on the grid of afc amplifier V1012B (b above). The amplified output of V1012A, from

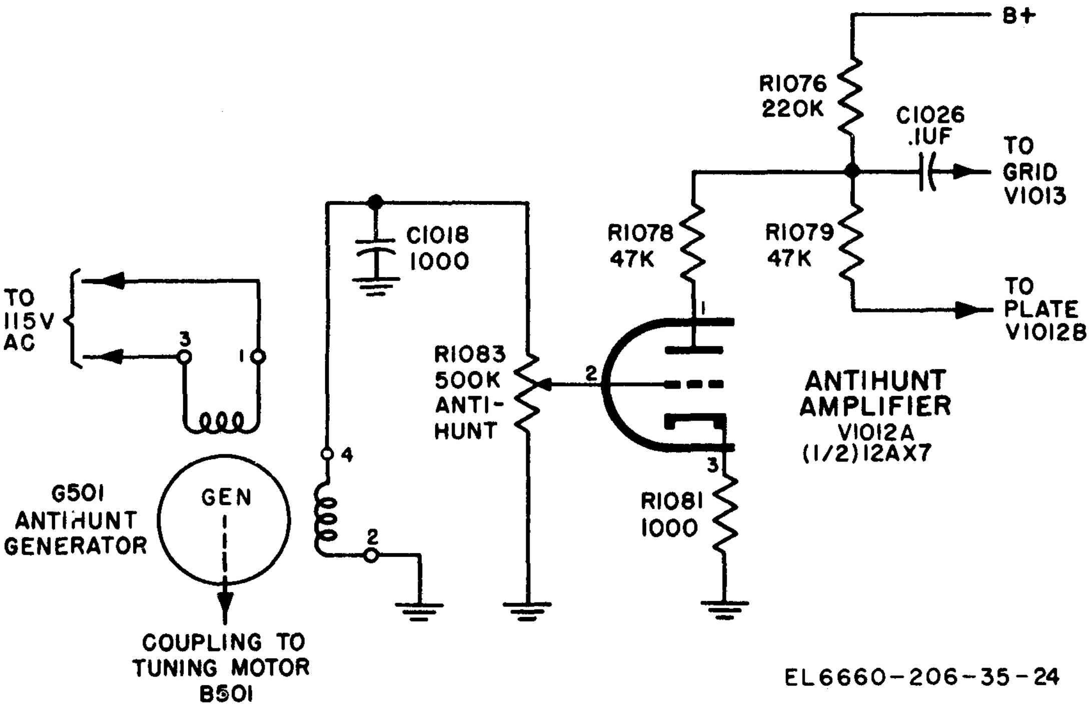


Figure 2-24. Antihunt circuit, simplified schematic diagram.

the junction of plate load resistors R1078 and R1076, is mixed with the output of V1012B. This arrangement results in an output from V1012 which is reduced by an amount proportional to the antihunt voltage. The net output is then fed to the grid of afc output tube V1013 through C1026. Potentiometer R1083 determines the amount of the negative feedback (antihunt) voltage used. The desired response of the system is obtained by the relative settings of antihunt potentiometer R1083 and afc gain control R1084. Capacitor C1018 prevents parasitic oscillations in the antihunt circuit when R1083 is turned completely clockwise.

f. Oscillator Tuning Meters. Meter M501 on the receiver is mechanically linked to local oscillator tuning motor B501 (fig. 2-25), and indicates the frequency of the local oscillator. When S804 in the control-recorder is depressed, M801 is placed in series with. R1088 between the -105-volt supply and ground. Since this meter is shunted by R501, its reading is a function of the potentiometer setting. Potentiometer R501 is geared to tuning motor B501 and the local oscillator tuning slug. Therefore, M801 indicates the oscillator frequency, and is used for remote tuning of the local oscillator from the control-recorder.

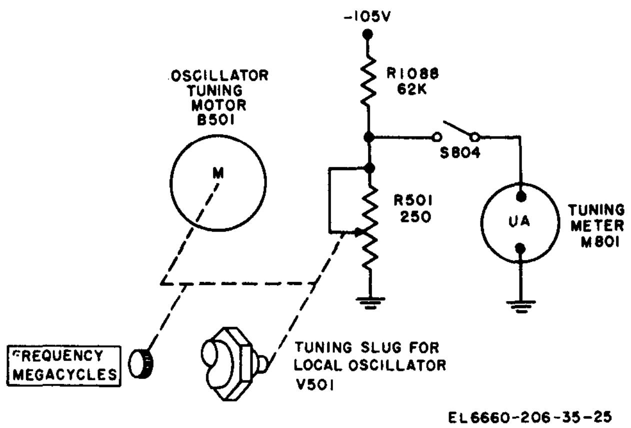


Figure 2-25. Remote tuning, simplified schematic diagram.

2-15. Power Supply

a. Block Diagram. The power supply consists of two rectifier circuits (fig. 2-26). One circuit furnishes +180 volts regulated dc for the receiver circuits and for the sine amplifier and reference amplifier circuits in the antenna positioning system. The other circuit supplies -105 volts regulated dc for the local oscillator, TUNING METER M801 in the control-recorder, and for the antenna control. A 115 volt ac input power

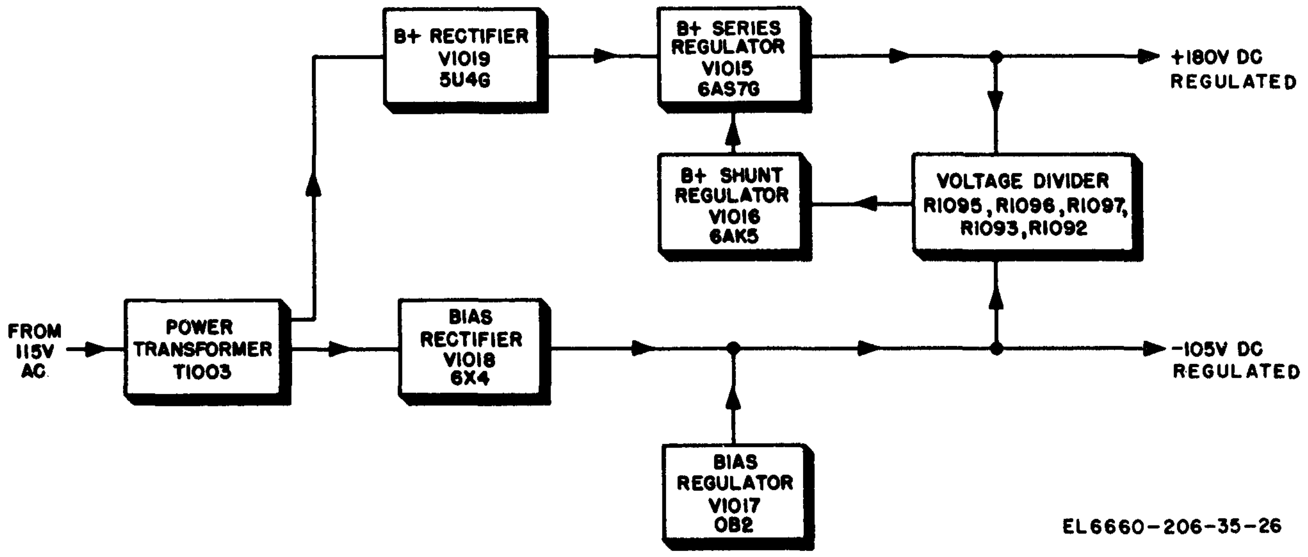


Figure 2-26. Power supply, block diagram.

transformer, T1003, supplies the required voltages to the two rectifier circuits. Tube V1018, connected as a half-wave rectifier, supplies -105 volts dc. A gas-filled voltage regulator tube, V1017, is placed across this voltage to maintain a constant output of -106 volts dc. Full-wave rectifier V1019 supplies the +180 volts dc. Series regulator V1015 and shunt regulator V1016 are used to maintain this voltage constant. Constant bias is applied to the shunt regulator tube control grid by means of voltage divider R1095, R1096, R1097, R1093, and R1092.

b. Regulated 180-Volt Positive Supply. The double diode, V1019 (fig. 2-27) is connected as a full-wave rectifier. The output of this rectifier is filtered by an lc (inductance-capacitance) filter which consists of C1029, C1030, and L1001. This filtered output is applied to the plates of series regulator V1015, a twin-triode connected in parallel. An output of +180 volts is taken from the cathode of this tube. A voltage divider network, R1095, R1096, R1097, R1093, and R1092, is placed between the cathode of V1015 and the regulated -105 volts dc. Three-section capacitor C1032 provides additional filtering in this network. Changes in potential at the cathode of V1015 result in a proportional change in the grid voltage of shunt regulator V1016. The resultant change in current through plate load resistor R1089 changes the plate voltage of V1016 and the grid voltage of series regulator V1015. The change in grid voltage on V1015 changes the impedance of this tube, causing the voltage drop across it to vary in such a manner as to maintain the cathode voltage constant. The effect of this action may be seen by analyzing a change in line voltage. An increase in line voltage increases the output of rectifier V1019. This raises the plate and cathode voltage of series regulator V1016. Raising the cathode voltage of V1015 increases the voltage drop across the voltage divider network. Since the low end of this divider is held constant, an increase in the voltage of the high end of the divider results in an increased voltage drop across each component. Capacitor C1031 causes the entire change in voltage at the cathode of V1015 to be reflected at the grid of V1016. This improves the regulation against rapid changes in voltage. The resultant increase in voltage at the grid of V1016 increases the current flow through that tube and decreases the plate voltage. This decrease in plate voltage decreases the voltage at the grid of V1015 and results in an increase in the voltage drop across V1015. The circuit constants are chosen so that the increase in the voltage drop across V1015 compensates for the rise in the voltage applied to that tube. The net effect of this circuit is to hold the output voltage constant at a level determined by the setting of B+SET potentiometer R1093. Voltage divider resistora R1090 and R1091 drop the line voltage from 180 volts to 60 volts at the screen grid of V1016.

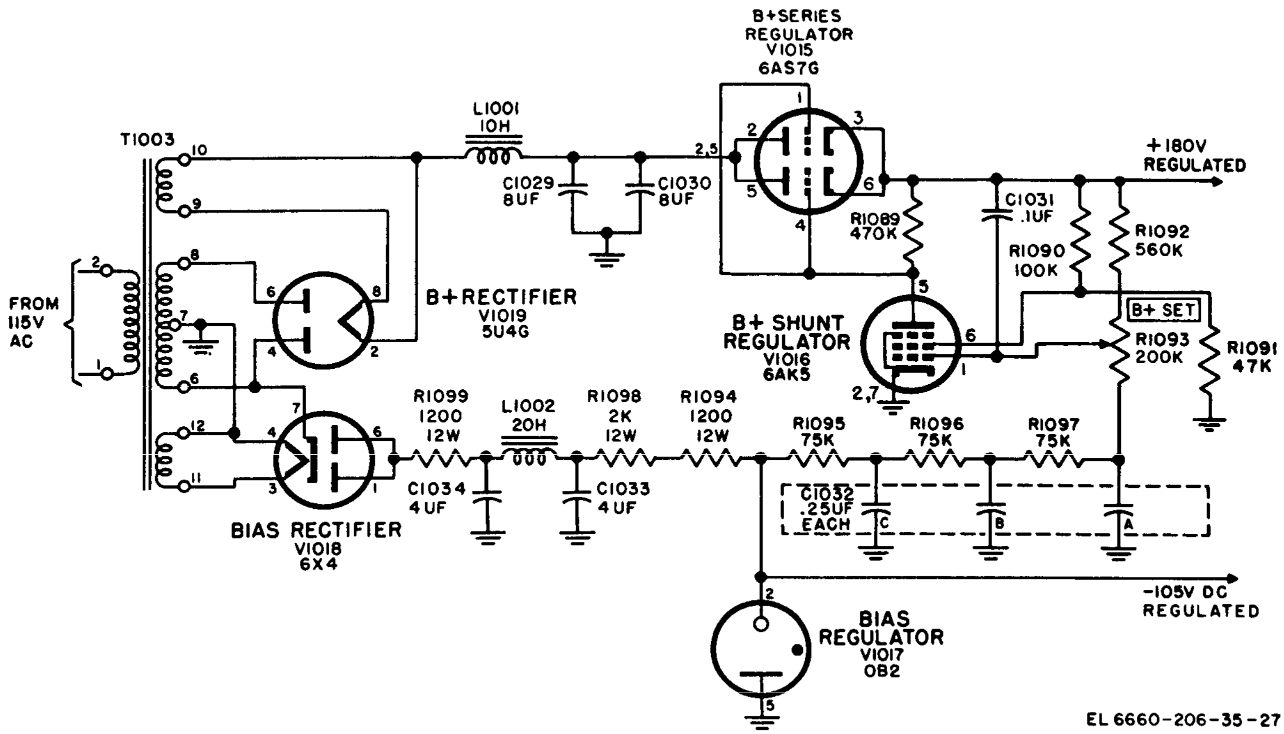


Figure 2-27. Power supply, simplified schematic diagram.

c. Regulated 105-Volt Negative Supply. Twin-diode V1018 (fig. 2-27), is connected as a half-wave rectifier. The output from V1018 is filtered by a combination resistance, inductance, capacitance filter that consists of R1099, R1098, R1094, L1002, C1033, and C1034. Regulator V1017 maintains the output at a constant potential of -105 volts.

Section III. ANTENNA POSITIONING SYSTEM

2-16. General

Figure 2-28 is a block diagram of the antenna positioning system. Note that the azimuth and elevation component stages are functionally identical. Where the azimuth and elevation units contain similar stages, only the elevation components are described. To illustrate the functioning of the various circuits, it is assumed that the antenna is in error in a clockwise direction (aimed to the right of the radiosonde) and in a downwind direction from the line through the axis of the antenna and the radiosonde. The complete block diagram (fig. 2-29) shows the separate stages of the individual circuits. The waveforms are similar to those that would result from an error as described and would cause the antenna to be positioned upward and counterclockwise to eliminate the error.

2-17. Block Diagram

a. Sine Amplifier Circuit.

(1) The output of modulation amplifier V1001A (meteorological pulses modulated by the 34 Hz error voltage) is applied to sine amplifier V1002A. The output circuit of V1002A bypasses the meteorological component of the signal to ground before applying the signal to driver V1003A. The signal voltage at the output of V1003A is applied to the A sections of the azimuth sine output and elevation sine output tubes V1004 and V1005. After passing through driver-inverter V1003B, the inverted signal is fed to the B sections of V1004 and V1005. The push-pull output of V1004 and V1005 is an amplified 34 Hz sine voltage for application to the azimuth and elevation phase discriminator circuits, respectively.

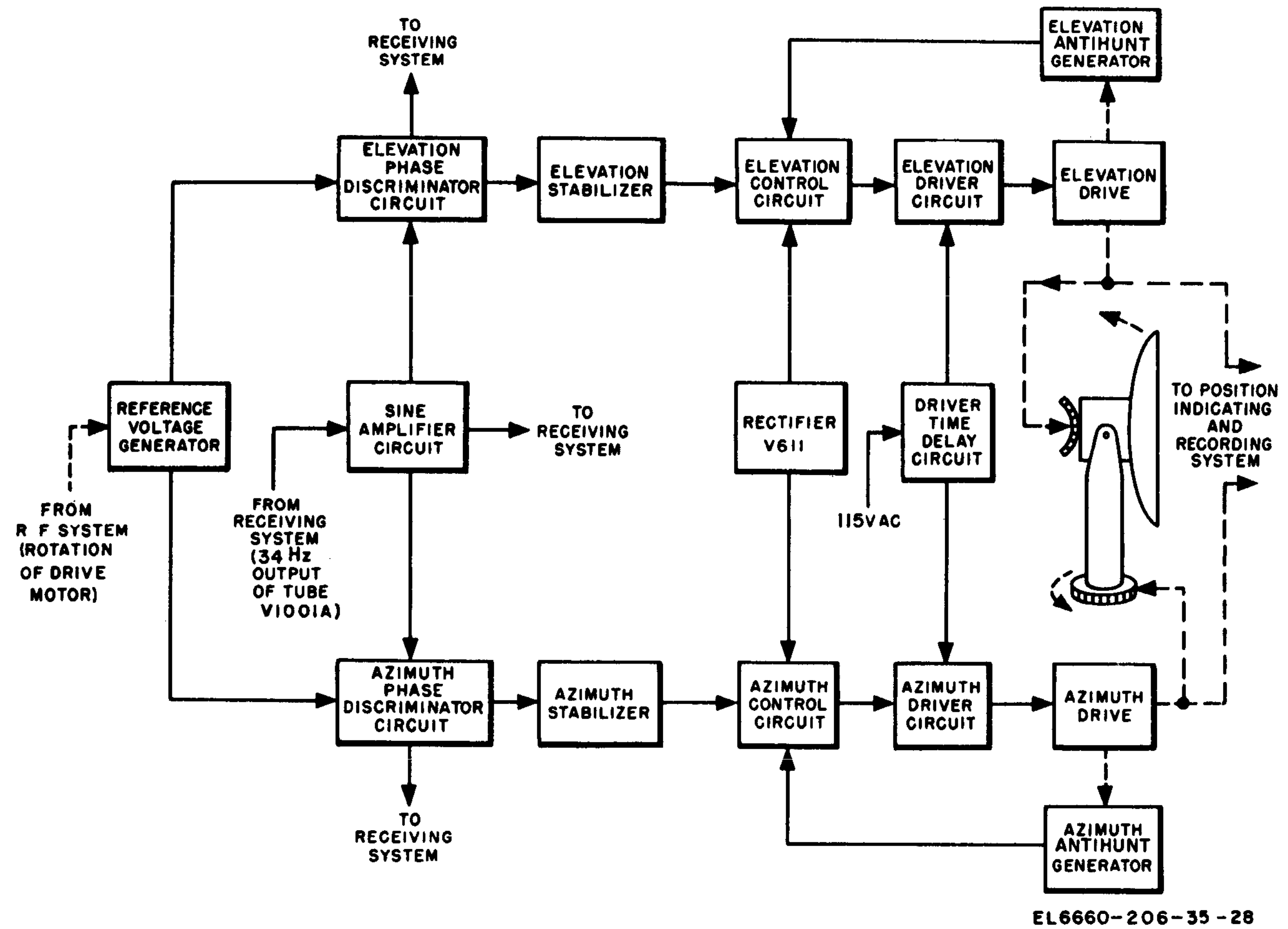


Figure 2-28. Antenna positioning system, simplified block diagram.

(2) The elevation sine output can be sampled by the service meter circuit for test and alignment purposes. The use of two output tubes permits the application of an error signal to both the azimuth and elevation discriminators without any interaction.

b. Reference Voltage Generator. Reference voltage generator G101 is driven by the antenna scanner assembly drive motor. The two 34 Hz outputs of this generator are 90° out of phase and are connected to reference amplifiers in the elevation and azimuth phase discriminator circuits. One output represents an azimuth reference voltage and the other an elevation reference voltage. These two voltages are equivalent to the direction of the antenna lobe in azimuth and elevation.

c. Elevation Phase Discriminator Circuit. The phase discriminator compares two ac voltages (of the same frequency). The output is a dc component which is a function of the phase and magnitude of the two input signals. The phase discriminator consists of elevation reference amplifier V609 and a phase-sensitive detector circuit that contains two duo-diode tubes, V601 and V602; two transformers, T601 and T602; and associated circuit components in a balanced bridge arrangement. One ac input to the phase-sensitive detector circuit is the elevation reference voltage from reference voltage generator G101 and amplifier V609. This permits the error signal to be referred directly to the antenna lobe angle (para 2-5). The other ac input is obtained from elevation sine output stage V1005. The output of the phase-sensitive detector circuit is pulsating voltage, the dc component of which is a function of the magnitude and the phase (with respect to the reference voltage) of the error signal. The dc component is used to trigger the elevation control circuit (through the elevation stabilizer) which

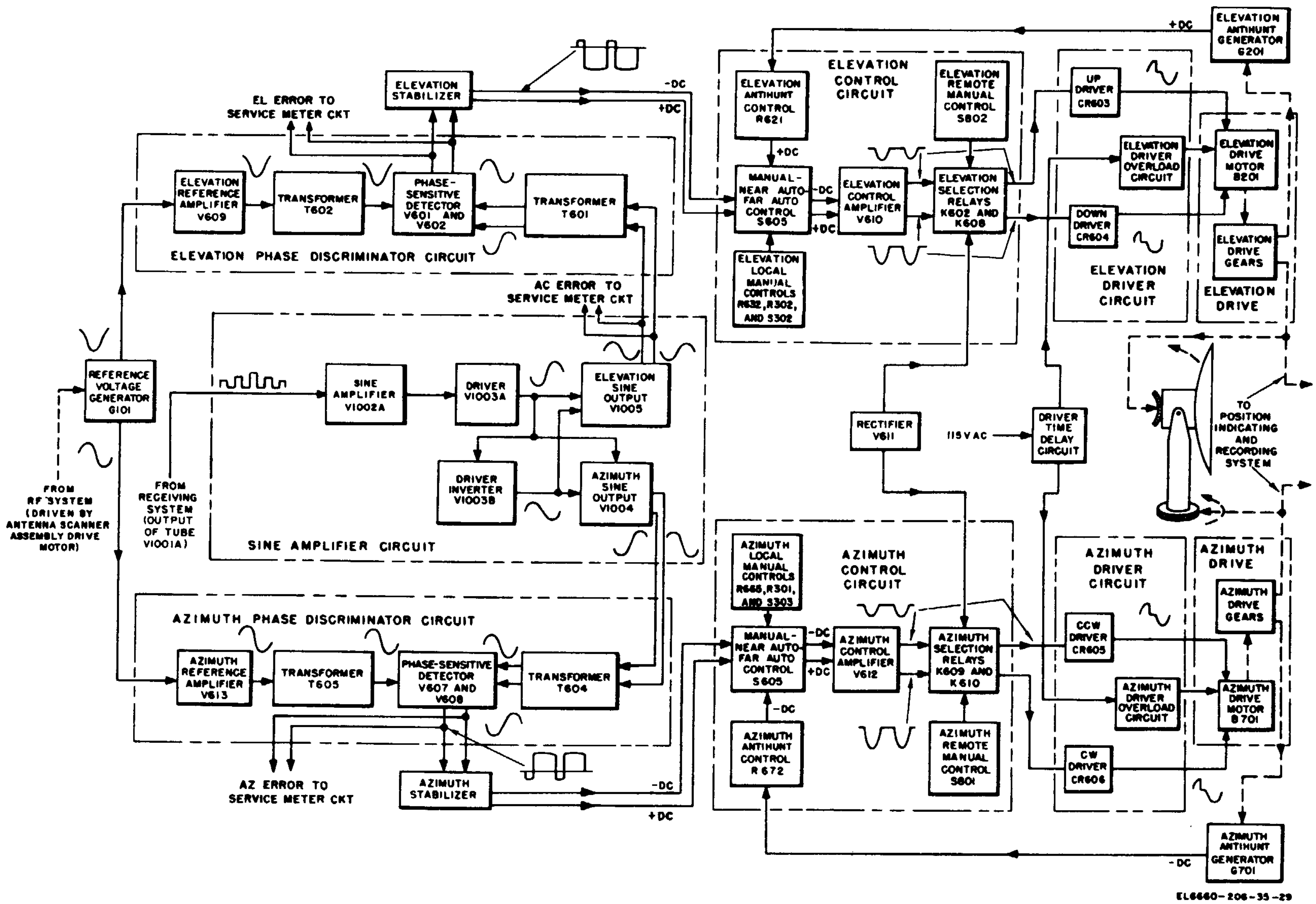


Figure 2—29. Antenna position system, overall block diagram.

supplies to the elevation drive motor a proportionate amount of current to position the antenna in elevation. The waveforms shown for this circuit assume that a 45° error signal is being delivered from the sine amplifier circuit. The comparison of the error voltage and the reference voltage in the bridge network formed by phase-sensitive detectors V601 and V602 is indicated.

d. Elevation Stabilizer. The elevation stabilizer, an rc network introduces an attenuation-phase characteristic which tends to eliminate instability or hunting in the antenna positioning system. The output of this circuit has a dc component, the magnitude and polarity of which are a function of the magnitude and phase of the two inputs to phase-sensitive detectors V601 and V602.

e. Elevation Control Circuit.

(1) When the rawin set is operating in automatic control, elevation control amplifier V610 receives the error voltage from the elevation stabilizer and converts the error voltage into two voltages. The magnitudes and phase of these voltages depend on the magnitude of the error, and the relative amplitudes depend on the phase of the error voltage. These voltages, in turn, control the outputs of the up and down driver circuits to the elevation drive motor. The drive motor, therefore, turns in accordance with the magnitude of the error as well as with the sense or phase of the error.

(2) When local-manual control is used, a bias voltage, the magnitude of which is determined by the setting of ELEVATION control R632, is applied to elevation control amplifier V610. ELEVATION control R302, located on the left side of the housing, is connected in parallel with R632 and performs the same function. For FAR AUTO control, a voltage from elevation antihunt generator G201, whose value varies in proportion to the speed of the elevation drive, is introduced through elevation antihunt control R621 and selector switch S605. This voltage is applied as negative feedback to V610. The antihunt voltage minimizes hunting caused by the momentum of the antenna reflector. The output of elevation control amplifier V610 is applied to the elevation driver circuit through elevation selection relays K602 and K608.

(3) The elevation selection relays also permit remote-manual control of the elevation drive from S802 in the control-recorder. When operating in remote-manual control, the relays disconnect the grids of the up driver and down driver tubes from the elevation control amplifier V610, and connect a high negative bias voltage to the grid of one of the driver tubes, and a small negative bias voltage to the grid of the other. These negative voltages are obtained from rectifier V611.

f. Elevation Antihunt Generator G201. Elevation antihunt generator G201, geared to elevation drive motor B201, produces a dc voltage proportional to its speed. The output of this generator is applied to the cathodes of elevation control amplifier V610 as a negative feedback. The polarity of the voltage diminishes the amount of control tube excitation applied to up driver and down driver CR603 and CR604. The amount of feedback voltage is controlled by elevation antihunt control R621. In local-manual operation, the antihunt generator is disconnected from the circuit by manual-auto switch S605.

g. Elevation Driver Circuit. The elevation driver circuit consists of up driver CR603, down driver CR604, and a driver overload circuit. CR603 and CR604 are plug-in silicon controlled rectifier (SCR) circuit units (para 2-23b). The output of each driver is connected to one of the two stator windings of a split-series elevation drive motor, B201. When the output current of one driver exceeds the output current of the other driver, the drive motor will rotate. A time delay circuit prevents application of voltage to the drivers until after sufficient warm-up time. An overload circuit also protects the drive motor.

NOTE

Some early rawin sets may use thyratron tubes instead of SCR units as drivers. Thyratron tube circuits are shown schematically in figure FO-24.

h. Elevation Drive. The elevation drive consists of elevation drive motor B201 and the gears that rotate the reflector up and down in elevation. Elevation drive motor B201 is geared to the antihunt generator and to the position indicating and recording system (para 2-25).

2-18. Sine Amplifier Circuit

a. Sine Amplifier. Sine amplifier V1002A (fig. 2-30) receives the detected output of the receiving system from the modulation amplifier V1001A. This signal contains the 34 Hz error voltage produced in the rf system and the meteorological data from the radiosonde. Sine amplifier V1002A consists of one stage of voltage amplification preceded by a phase-adjusting network and gain control and followed by a network that is designed to remove the meteorological component of the signal.

(1) The 34 Hz error modulation signal is applied to the grid of the sine amplifier through a phase-adjusting network. This network consists of R1016, R1017, C1006, C1007, and SINE PHASING control R1016, arranged as a bridged T-network. The setting of R1016 determines the phase relationship between the error signal input to the network and the error signal applied to the amplifier grid. R1016 is a preset adjustment, and normally is not adjusted during operation.

(2) With the radiosonde in azimuth error only, the error voltage fed to the azimuth phase discriminator must be adjusted to be in phase with the azimuth reference voltage. Similarly, if the radiosonde is in error in elevation only, the error voltage fed to the elevation phase discriminator must be in phase with the elevation reference voltage. If the error voltage is not in proper phase relationship with the reference voltage, R1016 is adjusted for the correct phase difference. The range-of-phase adjustment is approximately ±45° although phase adjustment can also be made at the reference voltage generator, it is more convenient to make the final vernier adjustment with R1016.

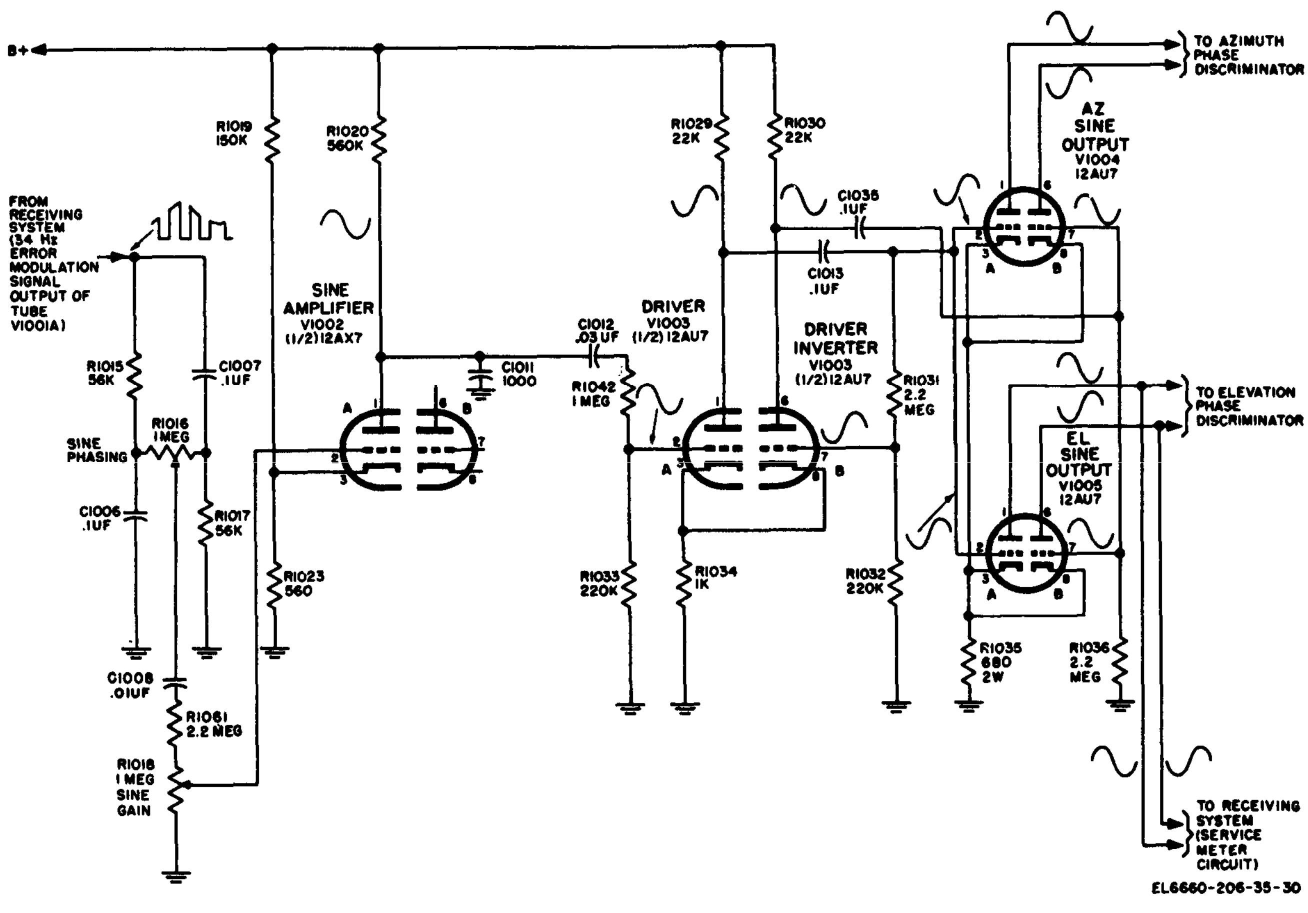


Figure 2-30. Sine amplifier circuit, simplified schematic diagram.

(3) The 34 Hz error signal from the phase-adjusting network is coupled through C1008, R1061, and SINE GAIN potentiometer R1018 to the grid of V1002A. R1018 and R1061 form a voltage divider to limit the amount of signal voltage available. SINE GAIN potentiometer R1018 is preset to prevent hunting by continuous overshooting on targets. Grid bias is obtained horn R1019 and R1023, which keep the cathode at a positive voltage level. Resistor R1020 is the plate load resistor.

b. Driver. The 34 Hz error signal output from the plate of sine amplifier V1002A is fed through C1012 to a voltage divider consisting of R1042 and R1033 (fig. 2-30). The signal from the junction of these resistors is applied to the grid of driver V1003A. This arrangement attenuates the sine signal and prevents excessive gain in the amplifier. Capacitor C1011 bypasses any remaining high-frequency signals. Common cathode resistor R1034 supplies bias for both driver V1003A and driver-inverter V1003B. Resistor R1029 is the plate load resistor. The amplified signal at the plate of driver V1003A is a sine wave, 180° out of phase with the input signal. This output is coupled through C1013 to the grid (pin 2) of azimuth sine output stage V1004, to the grid (pin 2) of elevation sine output stage V1005, and to the grid of driver-inverter V1003B.

c. Driver-Inverter. The output from driver V1003A (fig. 2-30) is applied to the grid of driver-inverter V1003B through C1013 and the voltage divider network, R1031 and R1032. The amplitude of the signal applied to this grid is about one-tenth of the amplitude of the signal applied across the divider network. This input signal is amplified and inverted by driver-inverter V1003B. Since the input signal is derived from the error signal at the plate of driver V1003A, the driver-inverter output signal is 180° out of phase with the driver output signal. The amplifier of the signal is approximately the same as that of the signal at the plate of the driver tube. The driver-inverter output signal is then applied through C1035 to the grid (pin 7) of the azimuth sine output tube V1004, and to the grid (pin 7) of elevation sine output tube V1005. Resistor R1080 is the plate load resistor for driver-inverter V1003B. Bias for this tube is furnished by R1034, which is common to driver V1003A.

d. Azimuth and Elevation Sine Output. Azimuth and elevation sine output tubes V1004 and V1005 (fig. 2-30) operate as parallel push-pull amplifiers. They provide two separate push-pull error signal outputs for application to the elevation and azimuth phase discriminator circuits. Both tubes are driven by the driver and driver inverter stages, V1003A and V1003B. The output of driver V1003A is coupled to the grids of V1004A and V1005A through C1013. The output of driver inverter V1003B is opposite in phase and approximately equal in amplitude to the output of driver V1003A, and is coupled through C1035 to the grids of V1004B and V1005B. This produces four separate error signal outputs. By paining those outputs from each tube, push-pull drive for the elevation and azimuth phase discriminators is obtained. Separate outputs are used to prevent interaction between the elevation and azimuth circuits. The output of V1005 is sampled in the service meter circuit as AC ERROR voltage. Resistor R1036 is the common grid resistor for V1004B and V1005B, and R1031 and R1032 are the common grid resistors for V1004A and V1005A. Cathode resistor R1035 is common to both V1004 and V1005.

2-19. Reference Voltage Generator and Phase Discriminator Circuits

a. Reference Voltage Generator.

(1) For automatic tracking of the radiosonde, both the azimuth and elevation drive motors must be controlled by the error voltage. This 34 Hz error voltage varies in phase and amplitude with the antenna lobe angle. This ac error voltage is changed to a dc voltage for control of the drive motors by phase discriminator circuits. These circuits compare the error signal ac voltage with an ac reference voltage (under certain phase relationships and conditions) to produce a pulsating output with a dc component that controls the drive motors.

(2) The reference voltages in the phase discriminator circuits are obtained from both phases of a two-phase, 34 Hz, ac generator, G101 fig. 2-31). This generator has two field windings, spaced 90° apart, with a rotating permanent magnet armature. Thus, two voltages 90° out of phase with each other are obtained

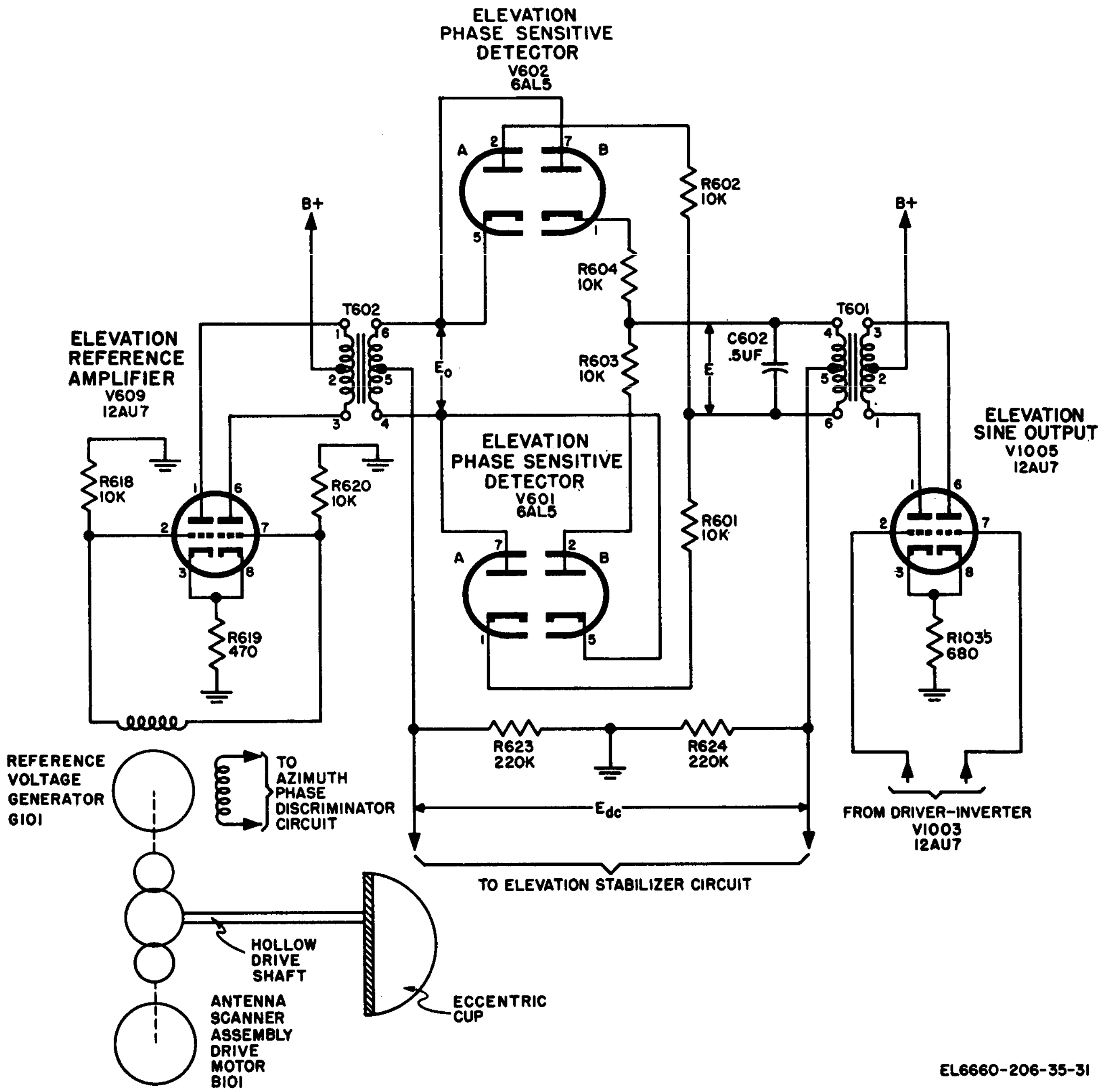


Figure 2-31. Elevation phase discriminator circuit, simplified schematic diagram.

from the field windings. One voltage is determined by the sine of the angle that the field of the armature makes with the associated field winding and the other voltage is determined by the cosine of the same angle. The armature is geared to the hollow drive shaft which rotates the eccentric cup. Because error signal voltage is generated by rotation of the cup, the association of a reference voltage to an error signal voltage can be formed.

(3) If the radiosonde position is in elevation error only, the corresponding error voltage varies as the cosine of the lobe angle. Similarly, if the radiosonde position is in azimuth error, the corresponding error voltage depends on the sine of the lobe angle. The reference voltage generator produces two voltages which are 90° out of phase with each other. Therefore, the reference voltage, which varies as the sine of the lobe angle, is termed the azimuth reference voltage; and the

phase voltage, which varies as the cosine of the angle, is termed the elevation reference voltage. Each reference voltage then is fed to the input of the corresponding azimuth or elevation phase discriminator circuit as the comparison voltage for the actual error signal voltage.

(4) If proper tracking cannot be obtained by adjustment of SINE PHASING control R1016, the phasing adjustment may be made by the rotation of the reference voltage generator casting (and thus the field windings) about the armature.

b. Elevation and Azimuth Phase Discriminator. A phase discriminator, or commutator circuit, is used to determine the exact angles in which the position of the radiosonde is in error in azimuth and elevation. By changing this information into an error voltage, control of the elevation and azimuth drive motors for the correct positioning of the antenna is obtained. This is accomplished by comparing the total error voltage that contains the elevation and azimuth error information with a reference voltage applied as an input to the circuits. The circuit can be made to extract either elevation or azimuth information from the error voltage, depending on the relative phase of the input reference voltage with respect to the error voltage input. Elevation and azimuth discriminator circuits are used to separate this information from the error signal. Except for the phase of the input reference voltage, these circuits are essentially the same. The operation of the azimuth phase discriminator is therefore similar to that given for the elevation phase discriminator. The elevation phase discriminator circuit is described in c through g below. The azimuth phase discriminator circuit functions in a similar manner. This circuit, consisting of V607, V608, and V613, can be followed in the schematic diagram, figures FO-24 or FO-25.

c. Elevation Reference Amplifier. The elevation reference voltage from G101 is applied to both grids of elevation reference amplifier V609 (fig. 2-31). This reference voltage is amplified and applied as a push-pull voltage to the primary of T602. Resistors R618 and R620 are the grid resistors, and R619 is the common cathode bias resistor for both sections of V609. The plate supply voltage is applied through the center tap of the primary of T602. Azimuth reference amplifier V613 is similar to elevation reference amplifier V609.

d. Elevation Phase-Sensitive Circuit. The elevation phase-sensitive circuit includes four diodes, V601A, V601B, V602A, and V602B and two center-tapped transformers, T601 and T602 as a bridge circuit. The elevation reference voltage is applied in push-pull to T602 and functions as one input to the bridge circuit. The other input, the elevation error signal from elevation sine output V1005, is applied in push-pull across T601. Resistors R601 to R604 are the diode load resistors, and R623 and R624 are the balanced external load resistors across which the output voltage is developed. The azimuth phase-sensitive circuit (V607 and V608) is similar.

e. Operation of Elevation Phase-Sensitive Circuit.

(1) Figure 2-32 is an equivalent circuit of phase-sensitive detector. Section A shows a positive half-cycle of elevation reference voltage E_r and error voltage E_e in phase and of equal magnitude. Under this condition, the voltages induced in the secondaries of transformers T602 and T601 cause point C to become positive with respect to A, and D to become positive with respect to F. The voltage induced between C and A is E_r. The voltage induced between D and F is E_e. The current flow, I_r caused by the voltage induced in transformer T602, follows the path indicated by the dotted arrows. The current flow, I_e, caused by the voltage induced in transformer T601, follows the path indicated by the solid arrows. Since induced voltages E_r and E_e are assumed to be equal, the resultant currents, I_r and I_e, are equal because all branches have equal and symmetrical components. The two currents, I_r and I_e, flow through branch A-D and the voltage drop in this branch is twice that in either of the branches where only one current flows.

(2) The voltage drop from A to D to C equals the voltage between A and C, and the voltage drop from A to D is twice that from D to C. Therefore, the voltage drop from A to D is two-thirds the voltage between A and C, and the voltage drop from D to C is one-third the voltage between A and C. Because E_r is equal to E_e, both may be referred to as E. The voltage from A to C, then is E; the voltage from A to D is 2/3E; and the voltage from D to C is 1/3E. To obtain the output voltage, it is necessary to find the voltage difference between B and E (the same as H and G, respectively). Add the voltages

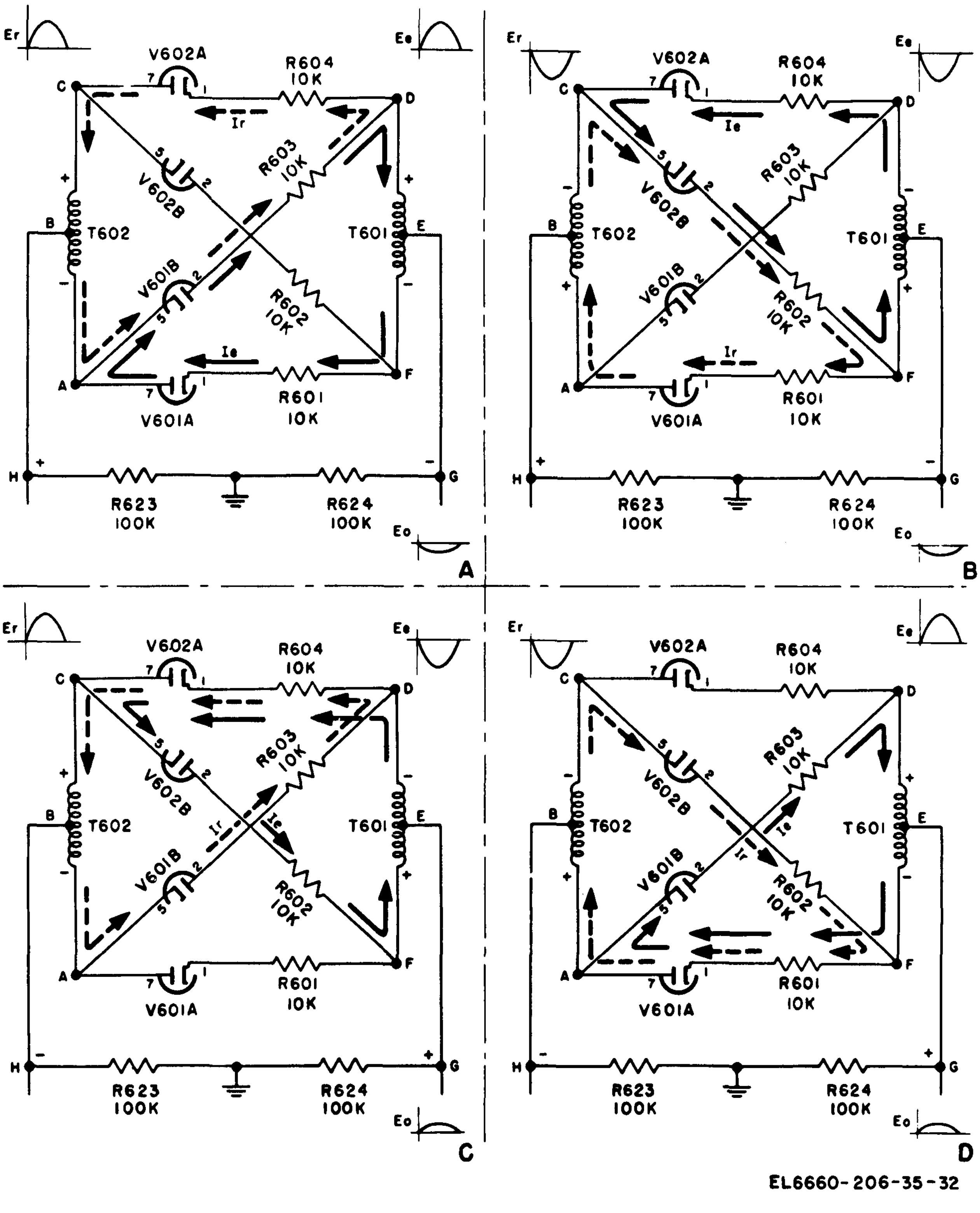


Figure 2-32. Phase-sensitive detector, equivalent circuit.

algebraically, with their correct polarities, between these two points: from B to C, there is a voltage of +1/2E; from C to D, there is a voltage drop of -1/3E; from D to E, there is a voltage drop of -1/2E. Therefore, the voltage at E with respect to B is +1/2E -1/3E -1/2E = -1/3E. The output voltage (E_O) at G with respect to H is -1/3E, 180° out of phase with the reference voltage, and with a magnitude one-third that of the reference voltage. The curve of this voltage is shown at G.

NOTE

The same result is obtained by adding the voltage drops between B and E along either of the other two paths. For example: from B to A, -1/2E; from A to D, +2/3E; from D to E, -1/2E. Therefore, E_o = -1/2E +2/3E -1/2E = -1/3E.

(3) During the alternate half-cycle (B, fig. 2-32), the current, I_r, caused by the induced voltage, E_r, flows from C to F to A as shown by the dotted arrows. The current, I_e, caused by the induced voltage E_e, flows from D to C to F as shown by the solid arrows. The two currents, I_r and I_e, now flow through branch C-F of the bridge instead of branch A-D. The circuit analysis is the same for the negative half-cycle as for the positive half-cycle. The algebraic sum of the voltage drops and rises between B and E is equal to the output voltage. For example: from B to C the voltage drop is -1/2E, from C to D the voltage drop is -1/3E, and the voltage from D to E is +1/2E. Adding the three voltages algebraically results in an output voltage, E_o, of -1/3E. A comparison of waveforms A and B in figure 2-32 shows that, while the two voltages are in phase, the output voltages have the same polarity, and G is negative with respect to H.

(4) In C, figure 2-32, induced voltages E_r and E_e are of the same magnitude but 180° out of phase. The two currents, I_r and I_e, flow through branch C-D. There is a voltage drop of 2/3E across that branch and a voltage drop of 1/3E across branches A-D and C-F. The voltage difference between B and E then is: B to C, +1/2E; C to D, -2/3E;D to E, +1/2E, The voltage at E with respect to B then is +1/2E -2/3E+1/2E or 1/3E. The output voltage, Eo, at G is in phase with the reference voltage but has a magnitude which is one-third of the reference voltage. The curve of this voltage is shown at G.

(5) During the alternate half-cycle (D, fig. 2-32), the induced voltages, E_r and E_e, are as shown at points C and D. Using the same analysis as applied to section C, E_o = +1/3E. The comparison of these results shows that while the two input voltages are 180° out of phase, the output voltages have the same polarity and G is positive with respect to H at all times.

f. Phase Analysis of Elevation Phase-Sensitive Circuit.

(1) When an error signal is either in phase of 180° out of phase with the reference voltage, the phase-sensitive circuit produces an output containing a maximum dc component. At any other phase difference between the error signal voltage and the reference voltage, the dc component value will be less than maximum. A zero dc component is obtained when the error voltage is 90° out of phase with the reference voltage.

(2) In A, figure 2-33, one wavelength, or 360° of a sine wave, is shown as a reference voltage. In B, figure 2-33, one wavelength of a cosine wave is shown as the error voltage. The period of 360° is divided into four intervals: 0° to 90°, 90° to 180°, 180° to 270°, and 270° to 360°. The four phase relationships shown in figure 2-32 exist within these four periods. Thus, in the first interval, 0° to 90°, both the reference voltage E_r and the error voltage E_e are positive. This is similar to the relationship existing in A, figure 2-32. The phase-sensitive circuit produces an output that is negative with respect to ground. In the second interval, 90° to 180°, E_r is positive and E_e is negative, a condition similar to the relationship shown in D, figure 2-32. The phase-sensitive circuit now produces an output that is positive with respect to ground. Since the magnitude of the error voltage E_e equals the magnitude of the reference voltage E_r, the amount of the negative output equals the amount of the positive output; The total dc output in the interval 0° to 180° is zero. In the interval 180° to 270°, both E_e and E_r are negative, corresponding to B, figure 2-32. The output is negative with respect to ground. In the last interval, 270° to 360°, E_r is still negative but E_e is positive, corresponding to D, figure 2-32. The output then is positive with respect to ground, and the total dc output in the interval between 180° and 360° is zero. The total output between 0° and 360° is shown in C, figure 2-33. The area bounded by the curve

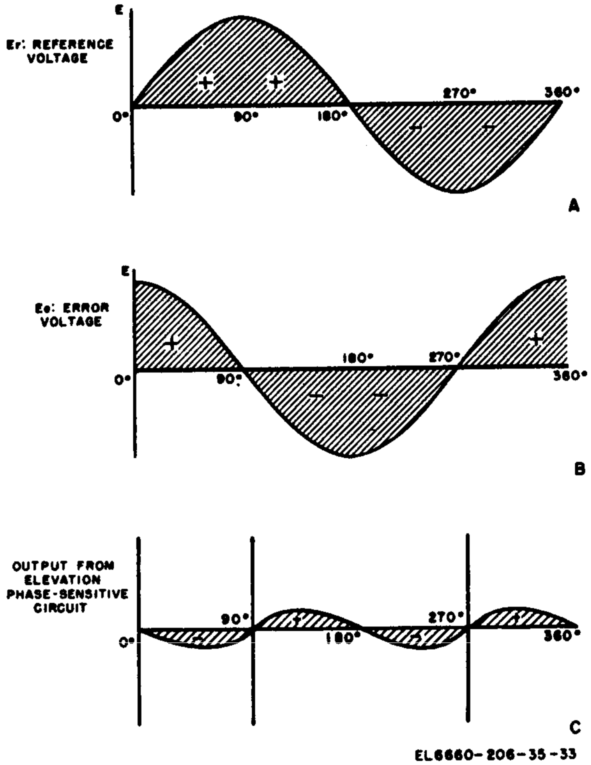


Figure 2-33. Phase-sensitive detector output, 90° phase-shifted error signal.

above and below the reference line is equal, and there is zero de output.

(3) In summary, when the error and reference voltages are in phase, the average output is a maximum negative voltage; when the voltages are 180° out of phase, the average output is a maximum positive voltage; when the voltages are either 90° or 270° out of phase, the average output is zero. In general, for angles between 270° and 90° the output voltage is negative and decreases from maximum each side of 90°; for angles between 90° and 270° the output voltage is positive, and decreases from maximum each side of 180°.

g. Error Evaluation of Elevation Phase-Sensitive Circuit.

(1) *Azimuth or elevation error only.* If the radiosonde position is in azimuth error only, an error voltage is produced that varies as the sine of the lobe angle. The error voltage then is in phase with the sine wave voltage generated by the reference voltage generator. Therefore, an error voltage that is caused by a pure azimuth error is a sine wave. By similar reasoning, the error voltage caused by elevation error only, which is 90° out of phase with the azimuth error voltage, corresponds to a cosine wave and is in phase with the other reference voltage generated. The effective angle of the receiving lobe (fig. 2-34) may be determined as follows: A reference line is drawn through the point made by the intersection of the electrical axis of the reflector with the vertical plane containing the radiosonde. A line is drawn toward the radiosonde from this point to the point of intersection of the beam axis of the lobe with the vertical plane containing the radiosonde. The angle formed by these two lines is the effective angle of the receiving lobe. As the lobe rotates because of the eccentric cup, the intersection of the lobe axis with the vertical plane rotates in a circular fashion. Therefore, the effective angle changes as the antenna scanner assembly rotates.

(2) *Azimuth and elevation error combined.* If the target is in error both in azimuth and elevation, a phase-shifted error voltage will be generated. The error voltage consists of a sine and a cosine component. The sine component represents the azimuth error component of the total error, and the cosine component identifies the elevation error component of the total error.

(3) *Evaluation of error information.* The same phase-shifted error voltage is applied as one of the inputs to both the elevation and azimuth phase-sensitive circuit. If the reference voltage applied to the elevation circuit is a cosine wave, a dc output will be obtained which will be proportional only to the amount of the elevation error. This is so because only the cosine component of the error voltage is in phase with the reference voltage applied. Similarly, since the reference voltage applied to the azimuth circuit is in phase with the sine component of the phase-shifted error voltage input, a dc output is obtained. The value of this voltage depends only on the magnitude of the azimuth error component of the tots! error voltage and is therefore proportional to the amount of the azimuth error. Thus, both azimuth and elevation error information can be extracted by the corresponding azimuth and elevation circuits and fed to the related drive motor circuits.

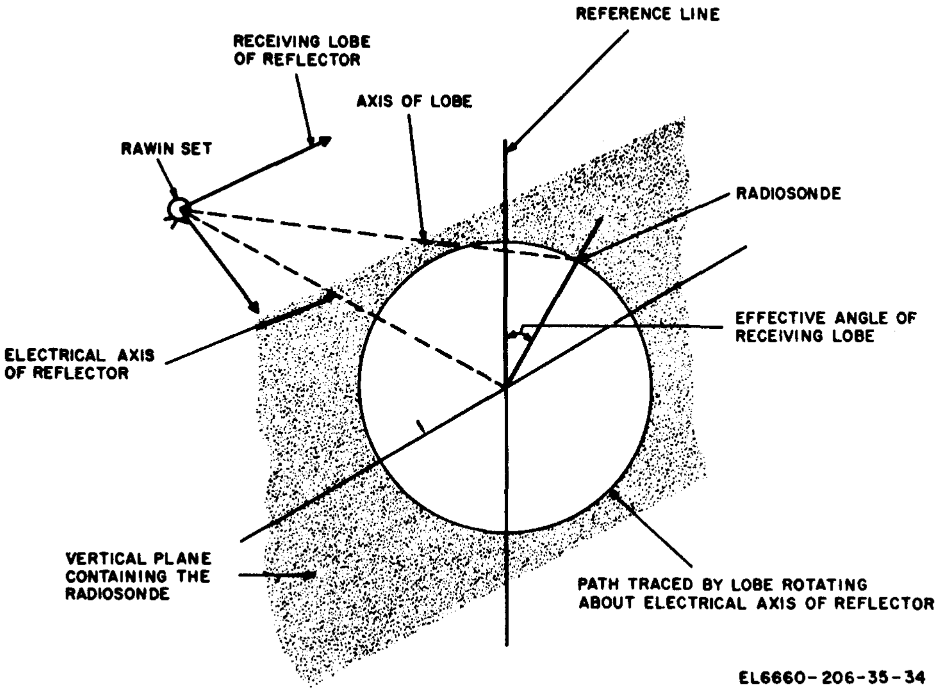


Figure 2–34. Effective angle of the receiving lobe.

2-20. Elevation and Azimuth Stabilizer

a. General. The elevation and azimuth stabilizers function in a similar manner. Therefore, only the elevation stabilizer (fig. 2-35) is described.

(1) When elevation error information is initially supplied to the elevation positioning system, the system moves the reflector in elevation to correct for this error. However, because of the inertia of the system, the motion of the reflector cannot be stopped suddenly, and its momentum carries it past the correct position. This introduces another error to the elevation components but in a direction opposite to the original error. The elevation components then operate to bring the reflector back down to the proper setting. Again the system cannot be stopped suddenly, and the reflector once more overshoots its position. An error is now formed in the same direction as in the original error and causes the elevation components to attempt to bring the reflector back up to the correct position. This oscillation around the position of zero error becomes successively smaller until the reflector is in position which no longer introduces error to the system.

(2) A drive system that is controlled in part by the rate of change of the error input is a stabilized system. The driving of this torque system is made up of two components. One depends on the magnitude of the error (error torque) and the other depends on the magnitude of the rate of change of the error (error-rate torque). Initially, as the elevation drive motor accelerates (because of the error torque component) to correct the position of the reflector, the error-rate torque component at first aids the error torque, but by changing its direction at a certain acceleration of the reflector, it holds back the reflector. In this manner, the reflector is either completely prevented from overshooting its final position, or the amount of overshoot is kept so low as to permit the reflector to reach the correct setting in a minimum of swings.

b. Function of Elevation Stabilizer.

(1) If the error is constant (no hunting), the error signal is a 34 Hz sinusoidal voltage. If the error changes (through overshooting during hunting) at a frequency rate of N Hz, then the frequency of the sinusoidal error voltage produced is either 34 +N Hz or 34 -N Hz. Thus, in

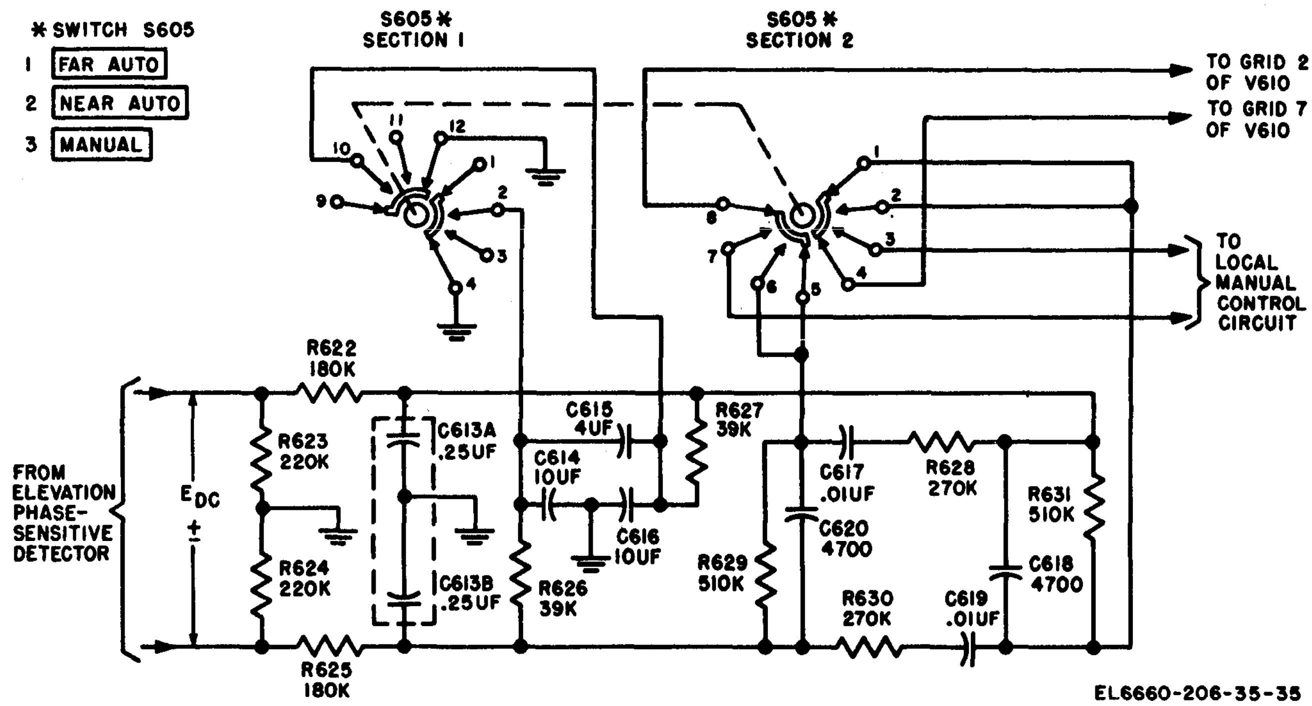


Figure 2-35. Elevation stabilizer, schematic diagram.

effect, the rate of change of the error, amplitude modulates the error voltage. The carrier frequency becomes the frequency of the error voltage (34 Hz for a constant error) and the sideband frequencies become the sum and difference of the error change frequency (N Hz) and the error voltage frequency.

(2) Any system that produces an output that is controlled by the rate at which an error can change can be considered as an error-rate system and used to minimize and diminish the hunting tendencies of the tracking system. The lattice rc network (fig. 2-35), which consists of R628 and C617, and R630 and C619 as the shunt arms of the lattice, and R631 and C618, and R629 and C620 as the series arms of the lattice, is used for this purpose, and is described in c below.

c. Elevation Stabilizer Description.

(1) The two integrating circuits, R622 and C613A, and R625 and C613B, filter the ripple content of the error signal. A second pair of integrating circuits, R627 and C616, and R626 and C614, provides additional filtering. After filtering, the error voltage is applied to the error-rate or stabilizing lattice rc network. This network adds the error-rate factor to the output voltage so that the resultant voltage is proportional to the error when constant. A phase shift of the output voltage, depending on the frequency at which the error changes, is also introduced. This compensates for the effect of inertia and for the lag error that exists because of mechanical friction in the system.

(2) Switch S605 selects a longer or shorter time constant for automatic tracking operation at far or near range. For automatic tracking at far range, S605 is placed in the FAR AUTO position. Capacitors C614, C615, and C616 are connected in the circuit to give a long time constant with a comparatively slow tracking response. When switch S605 is in the NEAR AUTO position, C614, C615, and C616 are shorted to ground through contacts 2 and 4, and 10 and 12 of section 1, and the time constant is greatly reduced. This permits the rawin set to respond to rapid changes in the position of the radiosonde. When S605 is set to MANUAL, the stabilizer is disconnected from V610. Manually controlled voltages are applied to V610 through contacts 3 and 4, and 7 and 8 of section 2 of S605.

2-21. Elevation and Azimuth Control Circuits

a. General. The elevation and azimuth control circuits provide automatic, local-manual, and remote-manual control of the movement of the reflector. Because the two circuits are similar, only the elevation control circuit will be described. The azimuth control circuit, consisting of V612 and the CW and CCW drivers, can be followed in the schematic diagram, figure FO-24 or FO-25.

b. Elevation Control. Elevation control amplifier V610 (fig. 2-36), is a twin triode which receives the error voltage output of the elevation stabilizer through switch S605. The elevation control amplifier supplies two controlling voltages to the up or down drivers. The magnitude and relative phase of the voltages depend on the magnitude and polarity of the error. Therefore, the outputs of the drivers which feed the field windings of the elevation drive motor are proportional to the magnitude and polarity of the error. Figure 2-37 shows an equivalent circuit of one section of V610 as a half-wave rectifier. A variable impedance, R_v, represents the plate resistance of the tube. Changes in the value of R_v are equivalent to changes in the error voltage applied to the drivers in the actual circuit. An increase in R_v is equivalent to a change of error voltage in the negative direction, and a decrease corresponds to a change of error voltage in the positive direction. Output voltage E_o lags current I. Current I leads applied voltage E by an amount

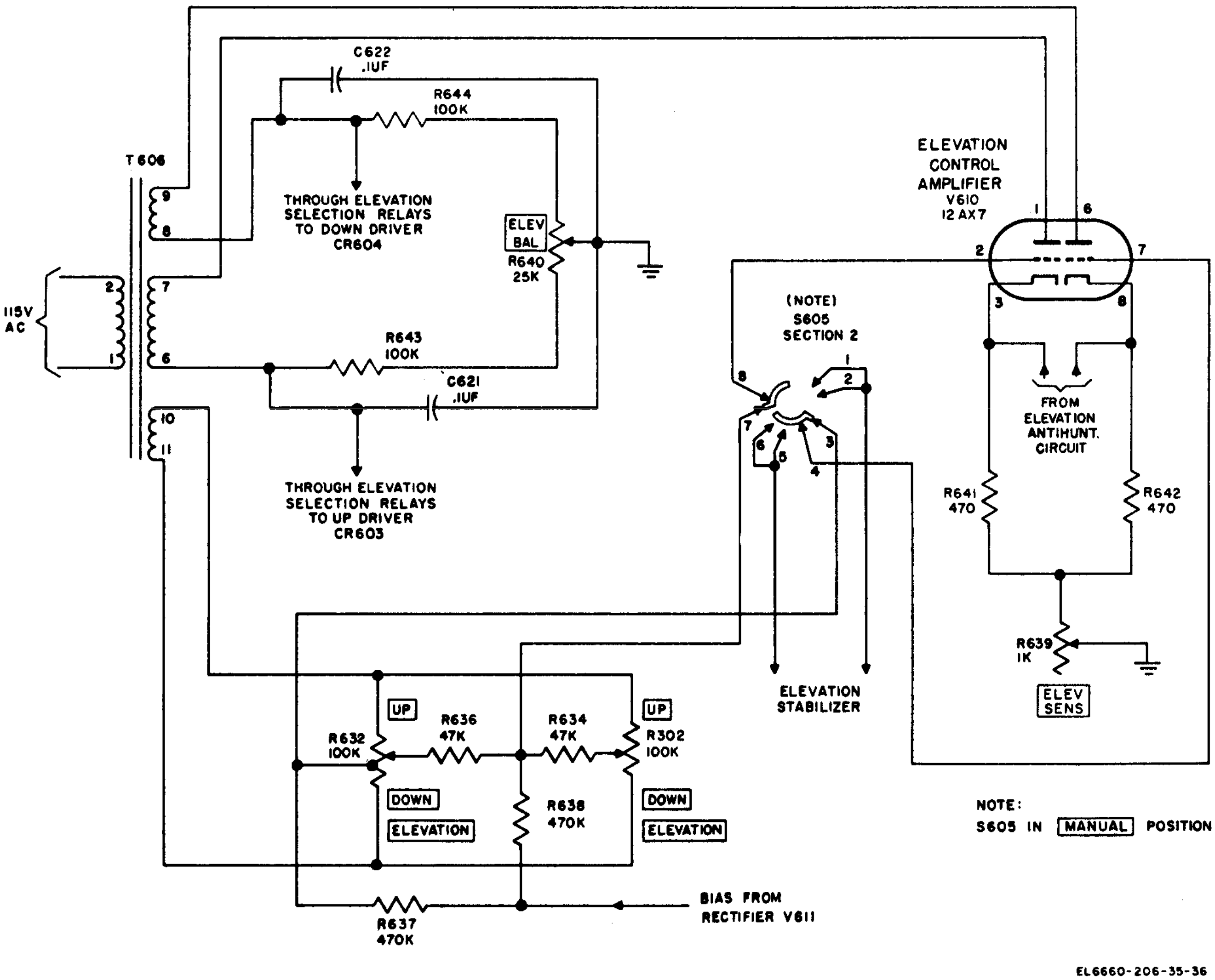


Figure 2-36. Elevation control circuit, schematic diagram.

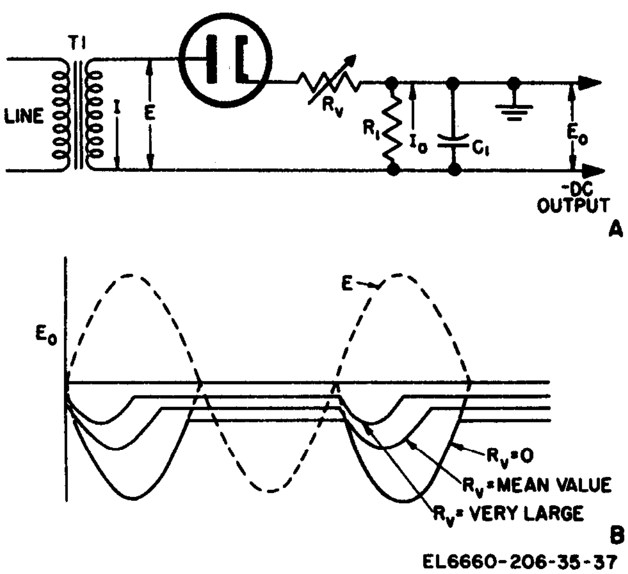


Figure 2-37. Elevation control amplifier, equivalent circuit.

depending on the value of R_v. Therefore, output voltage E_o lags applied voltage E by amounts that depend on the value of R_v. If R_v increases, the angle of the phase lag decreases (becomes zero when R_v becomes zero), but the magnitude of the output voltage increases (becomes equal to the applied voltage E when R_v becomes zero). Because the value of R_v corresponds to the value of the dc component of the error voltage, an output voltage is obtained, the magnitude and phase of which depend on the magnitude of the error. The phase of the output voltage in controlling the drivers is explained in paragraph 2-23b. The displacement of the flat portion of the curves from the axis in figure 2-37 is a result of the filtering action of the rc circuit. This effect is not great, but is deliberately exaggerated to illustrate clearly the effect of increases in R_v.

c. Automatic Tracking.

(1) When switch S605 is set to either FAR AUTO or NEAR AUTO, contacts 1 or 2 and 4, and 5 or 6 and 8 apply the error voltage output of the stabilizer circuit in push-pull to the grids of V610 (fig. 2-36). Plate power is obtained from two secondary windings of T606. This is equivalent to a balanced arrangement of the half-wave rectifier circuit (figure. 2-37). Because of the push-pull characteristic of the input to each grid, when R_v of one section is increased, R_v of the other section is decreased. Therefore, when one output voltage is increasing in magnitude and has a decreasing phase angle lag, the other output voltage is decreasing in magnitude and has an increasing phase angle lag. The amount of the change in magnitude and phase of these output voltages depends on the magnitude and phase of the error. Output resistors R643 and R644 (fig. 2-36) correspond to R_1 in figure 2-37. The output voltages across these resistors control the operation of either the up driver or down driver, and cause the elevation drive motor to position the reflector correctly in elevation to reduce the error.

(2) Cathode resistors R641 and R642 establish the initial fixed bias for V610. ELEV BAL potentiometer R640 provides manual adjustment to compensate for differences in the two sections of V610 and associated circuits. ELEV SENS potentiometer R639 adjusts the dc threshold voltage in automatic tracking. The inputs to the cathodes of V610 are from the antihunt circuit (para 2-22b).

d. Local-Manual Control.

(1) When switch S605 is set to MANUAL, contacts 3 and 4, and 7 and 8 connect the manual control network to the input of elevation control amplifier V610 (fig. 2-36). ELEVATION control R632 is center-tapped to provide a voltage divider network across terminals 10 and 11 of transformer T606. The voltage at the center tap is always one-half the voltage across the transformer winding.

NOTE

In some models, the center tap is taken from the junction of two equal value resistors across R632. These resistors are R633 and R635 as shown in figure FO-24.

(2) The voltage at the center of the voltage divider at any instant of the voltage cycle is one-half the output of the transformer winding. The potential difference between the arm of the potentiometer and the center of the voltage divider is equal to the voltage at the center of the voltage divider minus the voltage introduced by the setting of R632. This potential difference is applied across grid resistors R637 and R638. Thus, if the potentiometer is centered, there is no

difference of potential across these resistors. In this condition; both sections of V610 conduct equally.

(3) If R632 is moved from center, a difference of potential is established across R637 and R638. This potential difference is applied to one grid of V610, and is applied as 180° out of phase to the other grid. Elevation control amplifier V610 normally is conducting at saturation in manual control. Only the negative portions of these grid voltages will affect the conduction. A fixed bias voltage is obtained from rectifier V611. The output voltages from V610 are applied through the selection relays to the elevation drivers to move the reflector either up or down. Thus, local-manual control is accomplished by manually adjusting R632 to either the right or left of the center setting. Potentiometer R302, located on the left side of the housing, is connected in parallel with R632 and has the same function.

e. Remote-Manual Control. The position of the antenna may be controlled remotely with switch S802 at the control-recorder. Switch S802 is a spring-actuated switch which is normally in a neutral position, but can be pressed to either DOWN or UP position. In Rawin Set AN/GMD-1B, S802 is duplicated by switch S302 on the left side of the housing.

(1) When S802 or S302 is pressed to DOWN (fig. 2-38), 115 volts ac is applied to K602. The operated relay produces the following results:

(a) Contacts 7 and 5 break and disconnect CR604 from the output of the control circuit. Contacts 5 and 6 make and apply a negative voltage from the junction of R645 and R654 to CR604.

(b) Contacts 2 and 4 break, disconnecting CR603 from the output of the control circuit. Contact 3 and 4 make and apply a negative

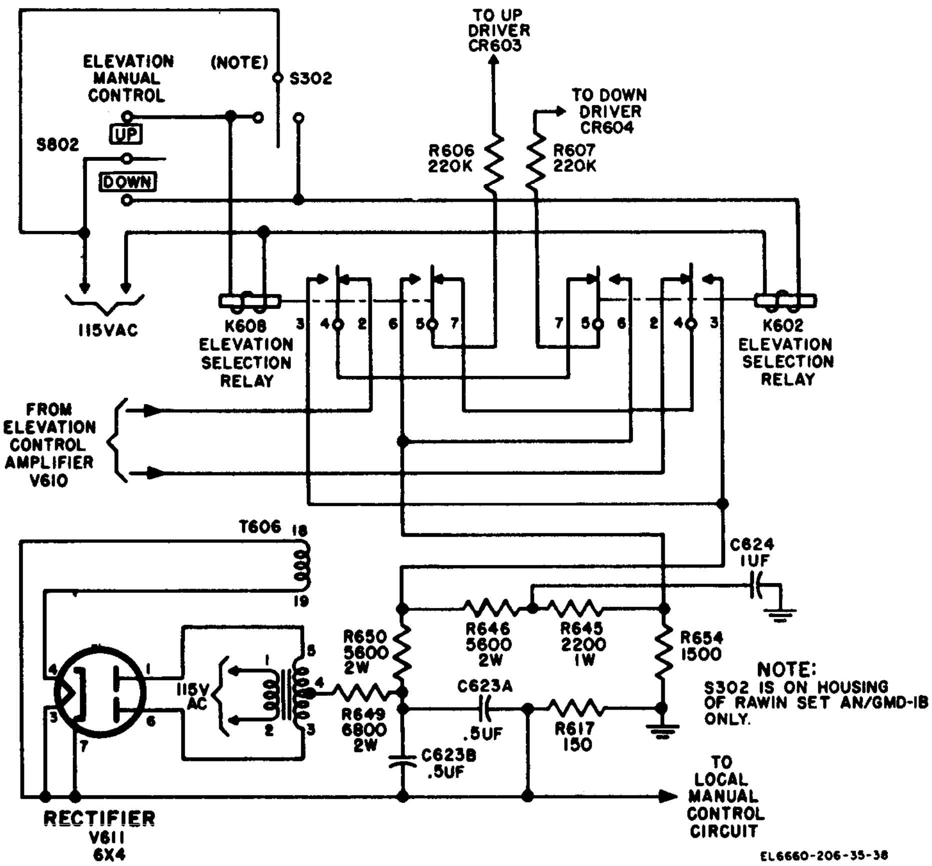


Figure 2-38. Elevation selection relays, simplified schematic diagram.

voltage from the junction of R650 and R646 to CR603. This voltage is more negative than the voltage applied to CR604.

(2) The voltage applied to down driver CR604 switches this circuit to a conducting state in series with one stator winding of the elevation drive motor. The more negative voltage applied to up driver CR603 keeps this circuit (in series with the other stator winding) switched off. Under this condition, the reflector moves downward.

(3) When S802 or S302 is pressed to UP, K608 operates. This produces a switching action which is the opposite to that described in (2) above. Under this condition, the reflector moves upward.

2-22. Time Delay and Antihunt Generator

a. Time Delay Circuit.

NOTE

The time delay circuit was designed to protect thyratron tube drivers used in some antenna controls. This circuit is not required and has no function when used with silicon controlled rectifier (SCR) drivers. FO-24 is a schematic diagram of the antenna control using thyratron tubes which require the time-delay circuit. The following description applies only to the circuits shown in this schematic diagram and in figure 2-39.

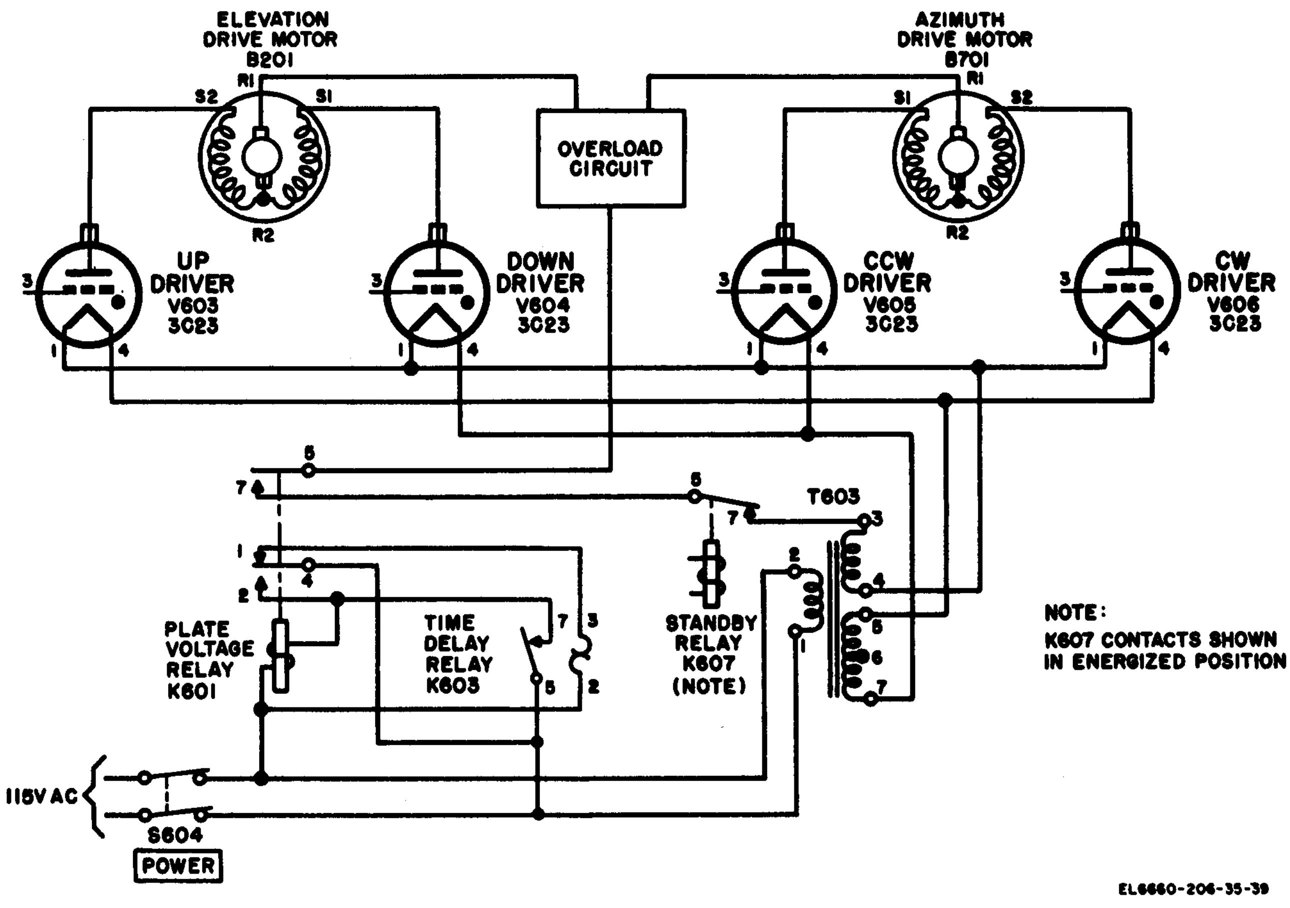


Figure 2-39. Time-delay circuit, used with thyratron tube, simplified schematic diagram.

(1) The time-delay circuit consists of time-delay relay K603 and plate voltage relay K601 (fig. 2-39). This circuit delays the application of plate voltage to driver tubes V603 through V606 until after the tube filaments reach correct operating temperature. Power is applied through POWER switch S604 to transformer T603 and to the thermal element contacts 2-3, of relay K603 (through contacts 1-4 of relay K601). Filament power from secondary winding 5-7 of T603 is applied to all drive tubes, and the thermal element of K603 starts to heat. At this time, K601 is restored since contacts 5-7 of K603 are open. Plate power from secondary winding 3-4 of T603 cannot be applied to the thyratrons since contacts 5-7 of K601 are open. (For this description, it is assumed that standby relay K607 is operated and contacts 5-7 are closed.)

(2) After a delay of approximately 30 seconds, the thermal element of K603 heats sufficiently to close contacts 5-7. This action operates K601. Contacts 1-4 open to remove power from the thermal element of K603 and allow this element to cool. Contacts 2-4 close to complete the operating path for K601 and to effectively remove K603 from the circuit. Contacts 5-7 close to complete the plate circuit for all thyratrons. Relay K601 operates until power is removed by POWER switch S604.

b. Elevation Antihunt Generator.

(1) Elevation antihunt generator G201 (fig. 2-40), is a permanent magnet, self-excited, tachometer-type generator. G201 is geared to the elevation drive motor and rotates at the same speed as the drive motor. The voltage produced by the antihunt generator is proportional to its speed and is 2.1 volts per 100 r/min. In Rawin Set AN/GMD-1A, the generator runs at half the speed as the elevation drive motor. The output of the antihunt generator is applied to the cathodes of the elevation control amplifier as a negative feedback voltage. As the elevation drive motor accelerates to move the reflector and reduce the error, a comparatively high voltage is generated by the elevation antihunt generator. When this voltage is applied as feedback to the cathodes of V610, it reduces the output of the tube. This changes the voltage controlling the operation of the elevation drivers and has the effect of slowing down the movement of the reflector. Slowing

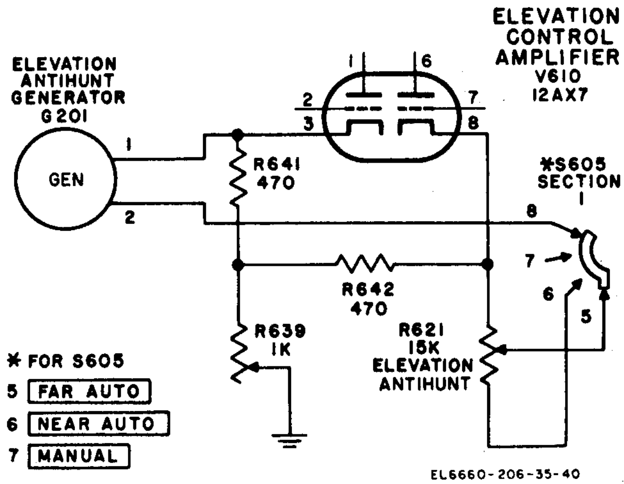


Figure 2-40. Elevation antihunt circuit, simplified schematic diagram.

down the elevation drive motor causes a smaller voltage to be produced by the elevation antihunt generator. The resulting control voltage from V610 is applied to the drivers, and the movement of the reflector is accelerated slightly. Through successively smaller amounts of acceleration and deceleration, the reflector is brought to the position where an error is no longer indicated. The reflector is prevented from overshooting or hunting excessively for the correct position. This form of antihunt protection is in addition to that provided by the elevation stabilization network.

(2) Switch S605 selects the required amount of feedback. The output of the elevation anti hunt generator is applied through contact 8 of S605 to contacts 5 or 6 (fig. 2-40). One end of R621 is connected to the cathode (pin 8) of V610, and the moving arm and the other end of the potentiometer are connected to contacts 5 and 6 of S605. In the FAR AUTO position of S605, the desired attenuation of the antihunt generator output is introduced by adjusting the moving arm of the potentiometer connected to contact 5 of S605. In the NEAR AUTO position, the center arm of this potentiometer is disconnected and the full resistance of the potentiometer is connected to the circuit through contact 6 of S605. In the MANUAL position, the antihunt circuit is not used, and the output of the antihunt generator is disconnected from the circuit.

2-23. SCR Driver Circuits

a. General. The elevation and azimuth driver circuits receive control information and move the antenna in elevation and azimuth. Because of the similarity of the elevation circuit to the azimuth circuit, only the elevation driver circuit is described. The elevation driver circuits, which contain the motor direction- and speed-control circuits and the drive motors, are described in *b* through *d* below. The overload circuit, and the motor standby circuit are described in *e* and *f* below.

b. Elevation Driver Circuit Description. The elevation driver circuit (fig. 2-41) controls the current flowing through the windings of elevation drive motor B201. The circuit consists of two silicon controlled rectifier (SCR) switching units, CR603 and CR604, drive motor B201, and transformer T603. B201 is a reversible dc motor with a split stator winding. The 115 volts from the secondary of T603 is applied in series through either CR603 or CR604, the stator and rotor windings of B201, and the overload and thermal relay circuits. Resistors R605, R608, and capacitors C604, C606 are filter circuits to protect against any line surges. The input to each driver is filtered by R606, R607 and C605, C607 to bypass spurious noise signals.

NOTE

The five-volt secondary of T603 was required in early rawin sets using thyratron tubes with filaments. Although this secondary winding is shown connected to each driver, this circuit is not used with the SCR switching units.

c. SCR Switching Units.

(1) Each SCR switching unit, CR603 and CR604, consists of a silicon controlled rectifier and an associated control circuit (fig. 2-42). The characteristics of the SCR are such that it conducts continuously so long as a voltage of the proper polarity is applied, and that conduction ceases after removal of this voltage. When connected in an ac circuit, the diode effect of the SCR results in conduction during most of the half cycle in which the potentials on the anode and gate are positive with respect to the cathode, and in nonconduction or turn-off when the ac waveform applied to the anode and gate crosses the zero voltage level and swings negative. This method of turn-on and turn-off is known as phase commutation.

(2) If the gate-junction voltage is held equal to or more negative than the cathode, the SCR

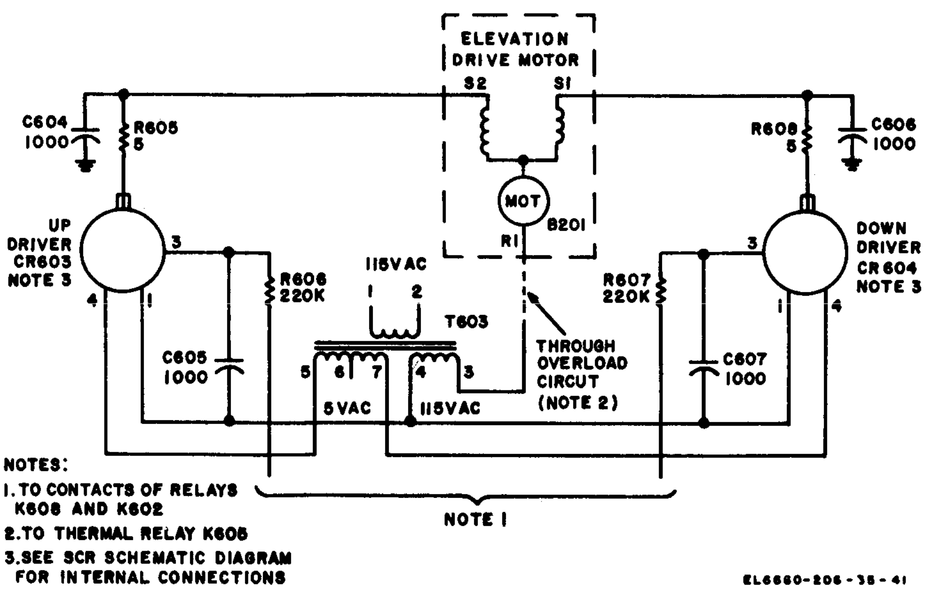


Figure 2-41. Elevation driver circuit, simplified schematic diagram.

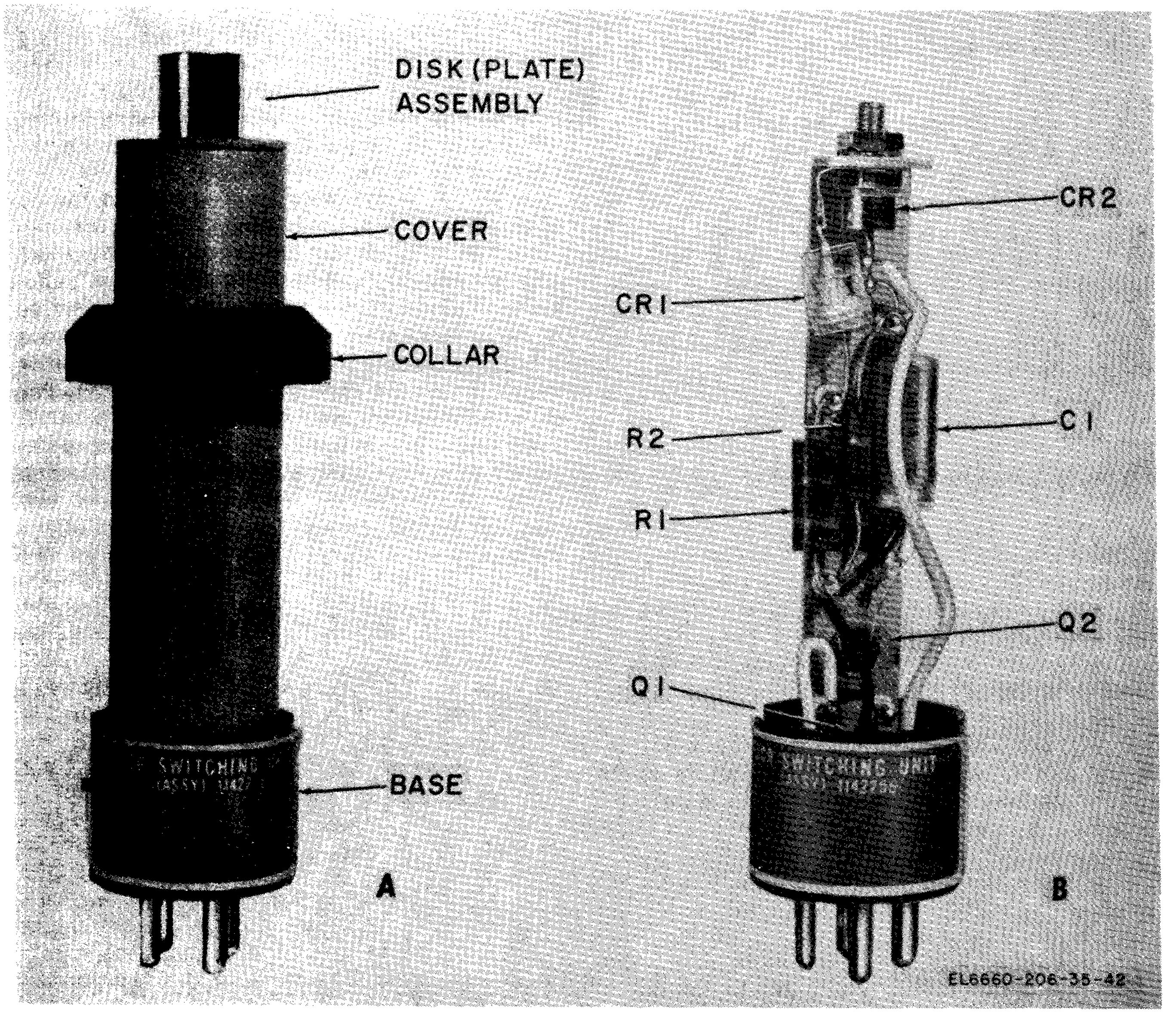


Figure 2-42. SCR switching unit and component parts.

will not start conduction when the anode voltage swings positive unless the peak inverse voltage of the diode is exceeded. However, although the gate has the ability to control the start of conduction, it lacks the ability to turn off the SCR once conduction has begun. In the phase commutation mode of operation, the positive phase starts current flow and the negative phase stops current flow. Because the gate and the anote must be positive at the same time in order to start conduction, it is possible to utilize a combination of phase commutation and phase ac gate bias to control the flow of current through the SCR. If the bias voltage alternates in phase with the anode voltage, the SCR conducts throughout the positive half cycle. If the bias voltage alternates out of phase with the anode voltage, little or no current will flow. By controlling the phase of the bias voltage in relationship to the phase-commutating voltage, an infinite degree of control can be obtained.

(3) The ac potential is applied through the motor to the anode (cap terminal) of the SCR (fig. 2-43). The return is through the cathode (pin 1 of the SCR base) to transformer T603. The bias signal (error voltage) is applied to the base of Q1 through pin 3 of the SCR base. The bias signal is amplified by a Darlington amplifier consisting of Q1 and Q2, and impressed on the

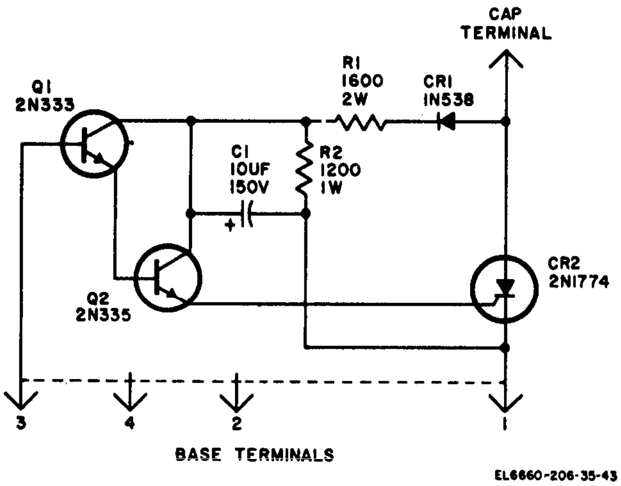


Figure 2-43. SCR switching unit, schematic diagram.

gate of CR2. Operating potential for the two transistors is obtained from T603. Diode CR1, resistors R1 and R2, and capacitor C1 comprise a half-wave rectifier, filter, and voltage divider for this purpose.

(4) The signal applied to the base of Q1 is used to control the current flow through the SCR and through the windings of the motor as described in *d* below. However, even at zero error, some current is allowed to flow on each positive half cycle. This current must be made equal in both stator windings of the motor in order to bring the motor to a stop and to provide tight control of the drive mechanism. The range of the change in current from zero to the value needed to overcome the initial reluctance of the motor's stator-armature system makes a zero-current null impractical. In this system, sufficient current flows at all times to overcome the magnetic reluctance of the motor and to maintain an equal drive force in both directional windings. This method provides for control with a low amplitude error signal, and results in accurate positioning of the antenna.

d. Function of Elevation. Driver.

(1) Two voltages (para 2-21c), are obtained from the half-wave rectifier action of the two sections of elevation control amplifier V610. These voltages are applied to the up driver and down driver. The phase and relative magnitude of these voltages depend on the sense and magnitude of the error. Assume that the radiosonde is in a position requiring the reflector to tilt up to track the radiosonde. The magnitude and phase of the ac potential applied to the base of the up driver, are such that, during each cycle, current in the drive motor flows for a longer period of time through the stator winding connected to the up driver than it does in the stator winding connected to the down driver. The drive motor turns and tilts the reflector upward. Similarly, if the radiosonde is in a position to require the reflector to be tilted downward, the down driver conducts for a longer period than the up driver, and the drive motor moves the reflector downward. Depending on the phase and magnitude of the ac potential applied to the drivers, more or less current is supplied to the stator windings of the drive motor to cause the motor to turn in one direction or the other.

(2) In figure 2-44, E_a is the voltage applied to the anode of the SCR. A, figure 2-44 shows the phase of the half-wave rectified voltage, E_g, from one section of V610 when the error is such as to cause conduction of the SCR for approximately one-half the positive half-cycle of the V610 plate voltage swing (as indicated by the shaded portion). As the error decreases, the magnitude of the rectified output voltage of control tube V610 increases in a negative direction and the effective opposing phase lag between the output voltage and the lead voltage decreases. Here the phase lag is the same as the lag that exists between the output voltage and the anode voltage applied to the driver because the anode voltage is obtained from the same transformer

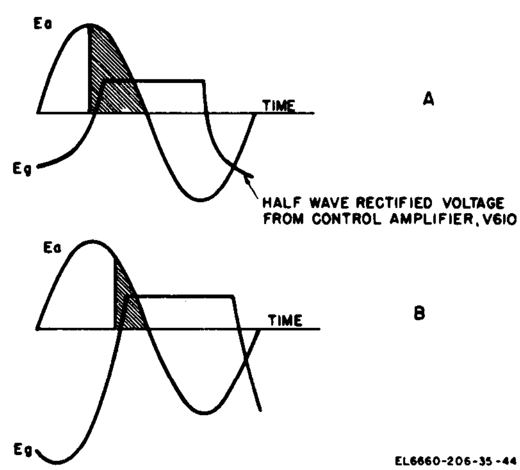


Figure 2-44. SCR conduction curves.

supply as the load voltage of the control tube. Therefore, as the error decreases, the negative bias on the SCR gate increases, and the period of conduction of the driver decreases as shown in B, figure 2-44. No matter which driver is controlling the direction of the movement of the reflector, the amount of movement is determined by the magnitude of the error. The sense of the error determines which driver has control over the motion or direction of rotation of the elevation drive motor. On local-manual control and remote-manual control, the drivers are made to conduct or to be maintained in a balanced conduction by a voltage applied under operator control.

e. Drive Motor Overload Circuit.

(1) If an abnormal electrical or mechanical condition causes excess current flow through a motor drive circuit, the overload circuit (fig. 2-45) will open. All current through the drive motor also flows through the overload circuit. Excessive current through either SCR or through both SCR's will trip the circuit. Since the overload circuits for CR603 and CR604 are identical, the description below applies to both units.

(2) Current flows from T603 through contacts of standby relay K607, plate-voltage relay K601, overload K606 in its normal deenergized position, the thermal element of relay K605, through the motor windings and the SCR circuit, and back to T603. Ac power for overload relay K606 is applied only when thermal-overload relay K605 closes. Heat generated by current flow causes the thermal element of K605 to bend, bringing contact 5 toward contact 7. When the current exceeds 4.5 amperes for 10 seconds, the contacts close and ac power is applied to overload indicator DS601 and overload relay K606. Simultaneously, contacts 5 and 8 of K606 open the drive circuit and contacts 4 and 2 close the holding circuit through OVERLOAD RESET switch S601 to the coil of K606.

(3) Relay K606 remains closed until OVERLOAD RESET switch S601 is opened manually, or the local or remote MOTORS-STANDBY switch is actuated. Antenna Control C-578A/GMD-1, C-578B/GMD-1, and C-578C/GMD-1* manufactured prior to 1970 can be reset only by means of reset switch S601. In all models, reset cannot be accomplished until the heat in K605 has dissipated enough to automatically reset its own contacts. Overload indicator lamp DS601 lights whenever K606 is energized.

f. Motors Standby Circuit.

(1) When the rawin set is in a standby condition, a motors standby circuit removes

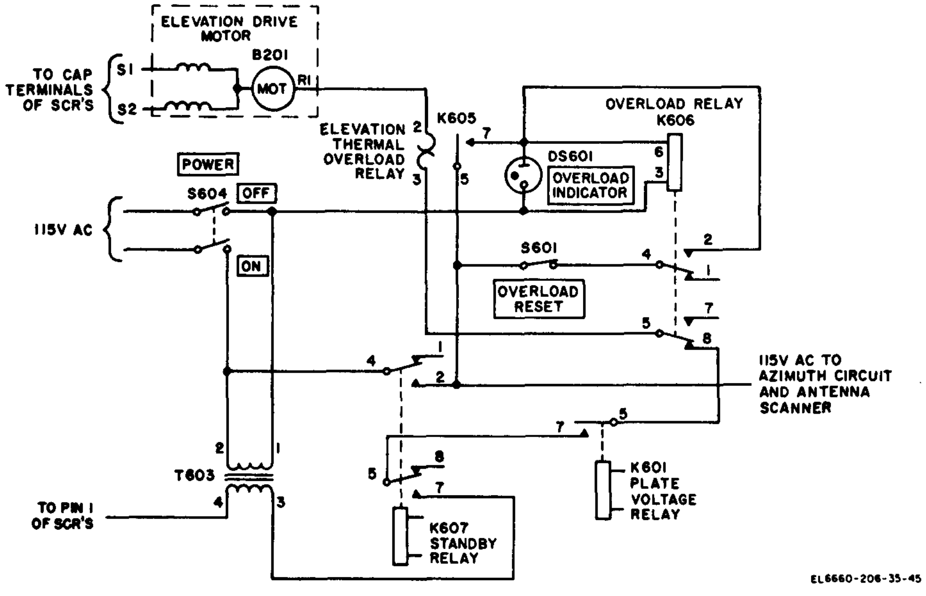


Figure 2-45. Overload circuit, simplified schematic diagram.

power from the antenna scanner assembly drive motor, the elevation and azimuth drive motors, and the SCR's. This is accomplished by relay K607 which is controlled locally by MOTORS switch S602 in the antenna control, and remotely by MOTORS STANDBY switch S805 in the control-recorder. When S602 and S805 are in the position shown in figure 2-46, 115 volts ac energizes K607. Contacts 7 and 5 of K607 close the circuit through the drive motors to the SCR units (fig. 2-45). Simultaneously, contacts 2 and 4 close and apply 115 volts to the antenna scanner assembly drive motor. If either S805 or S602 is set to the standby position, K607 is deenergized and contacts 7 and 5, and 2 and 4 open to remove power from the antenna scanner assembly motor and drive motors. In this condition, DS603, 1801, and R806 are connected in series with the coil of K607 across the line voltage, and both lamps light to indicate that the rawin set is in the standby condition,

(2) The neon glowlamps have a high resistance and draw a small current, so that the total current flowing through this circuit in the standby condition is insufficient to energize K607. Resistor R806 shunts the lamps and eliminates any glow which may be caused by leakage current after the lamps are supposed to be extinguished. When both S805 and S602 are set to the position indicated in figure 2-46, the full-line voltage is applied to K607 and power is applied to the elevation and azimuth drive motors and to the antenna scanner assembly drive motor.

(3) Operation of antenna scanner drive motor B101 is controlled by the motors standby

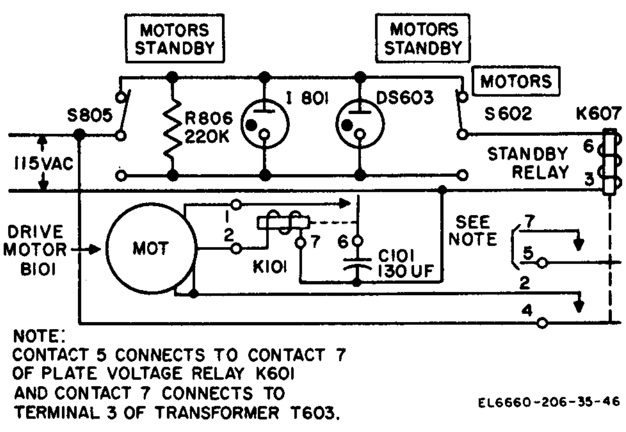


Figure 2-46. Motors standby circuit, simplified schematic diagram.

circuit and relay K101. The 115 volt ac power is applied to B101 in series with the coil of relay K101. Relay K101 energizes and connects starting capacitor C101 to the motor starting winding when the field current exceeds 3.2 amperes. Relay K101 deenergizes and disconnects C101 and the starting winding when the field current drops below 2.5 amperes. K101 is energized through contacts 2 and 4 of relay K607.

2-24. Elevation and Azimuth Drive

a. Elevation Drive.

(1) Elevation drive motor B201 is a split-stator, reversible, dc motor rated at one-twentieth of a horsepower at 5,000 r/min. This motor is located in the elevation unit and drives the antenna reflector up and down through the elevation drive system. An SCR driver circuit is connected in series with each stator winding of the motor (fig. 2-41). The error signal causes a heavier conduction in one driver and sets up a strong magnetic field through that winding. The motor then rotates in the direction determined by that winding. The duration of current flow is controlled by the voltages applied to the driver as described in paragraph 2-23b.

(2) A simplified gearing diagram of the elevation drive is shown in figure 2-47. The elevation drive consists of elevation drive motor B201, elevation antihunt generator G201, elevation synchro transmitter B202, the elevation angle indicator, limit stop switches, and counterbalance springs, gears, and shafts.

(3) The elevation drive motor is geared to the drive pinion which meshes with a gear segment (fig. 2-47). This gear segment is fixed to the yoke and therefore is stationary. As the drive pinion rotates, it walks along the gear segment and the entire elevation unit rotates. The antenna reflector is mounted on the elevation unit. Thus, rotation of the elevation drive motor positions the antenna reflector in elevation.

(4) The ratio between the drive motor and the elevation drive is 4,950 to 1, or 1,237.5 revolutions of the drive motor are required for 90° movement of the antenna reflector. A 1:1 gear ratio is provided between the drive motor and the antihunt generator. In Rawin Set AN/GMD-1A, a 2:1 ratio is used. Elevation

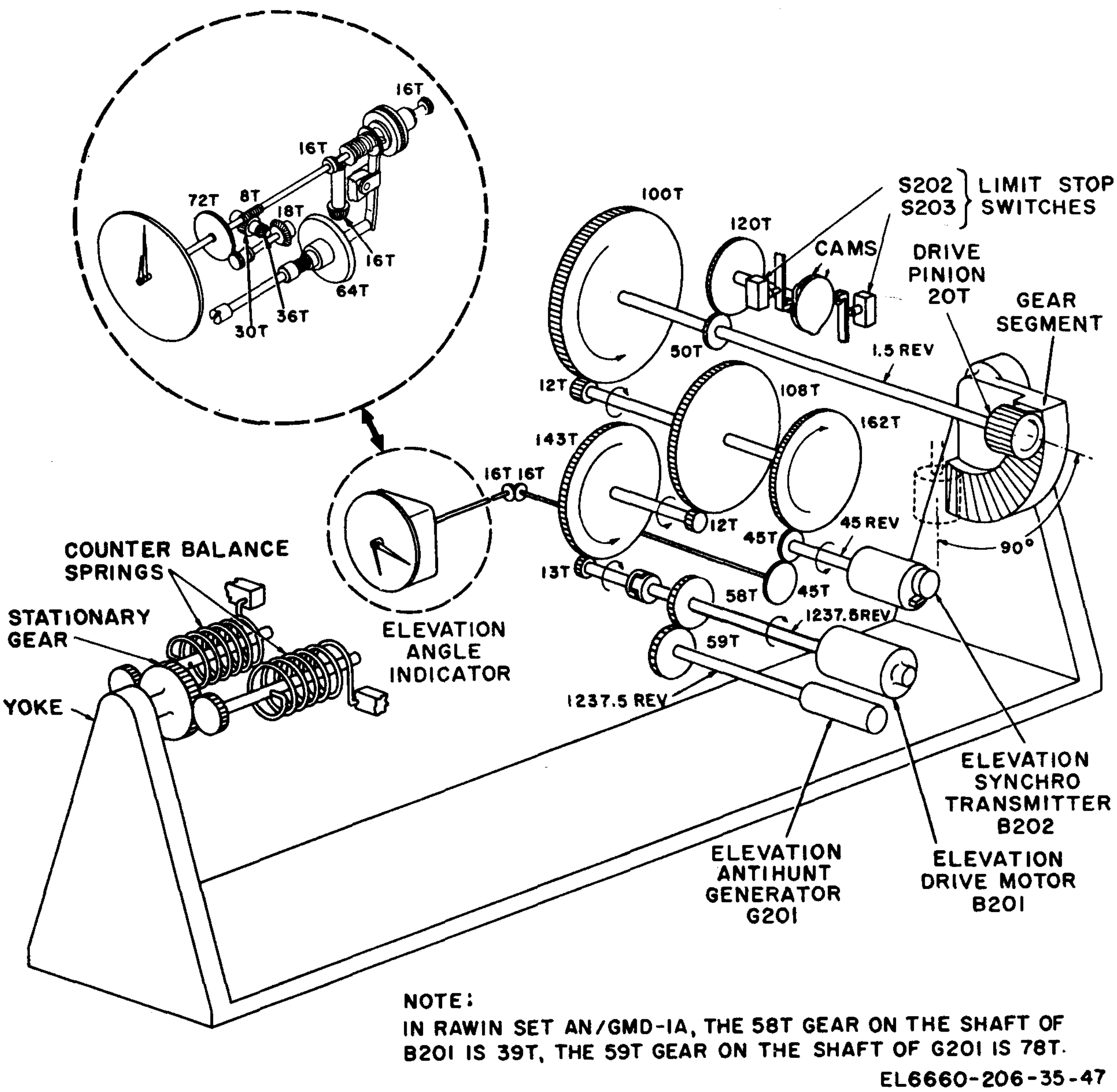


Figure 2-47. Elevation drive gearing, simplified diagram.

antihunt generator G201 is part of the elevation antihunt circuit (para 2-22b). Elevation synchro transmitter B202 and the elevation angle indicator are part of the position indicating and recording system (para 2-27a). Two limit stop switches, S202 and S203, are operated by cams when the antenna reflector reaches a minimum elevation of -7° or a maximum elevation of 92°. Two counterbalance springs in the elevation drive reduce the load on the elevation drive motor.

b. Azimuth Drive. A simplified gearing diagram of the azimuth drive is shown in figure 2-48. The azimuth drive, mounted in the azimuth unit, consists of azimuth drive motor B701, azimuth antihunt generator G701, azimuth synchro transmitter B702, the azimuth angle indicator, the main shaft, gears, and other shafts. The azimuth drive motor is geared to the main shaft. The azimuth driver circuit is similar to the elevation driver circuit (para 2-23b). The ratio between the drive motor and the main shaft is 4,950 to 1, and a 1:1 gear ratio is provided between the drive motor and the antihunt generator. In Rawin Set AN/GMD-1A, a 2:1 ratio is used. Azimuth antihunt generator G701 is part of the azimuth

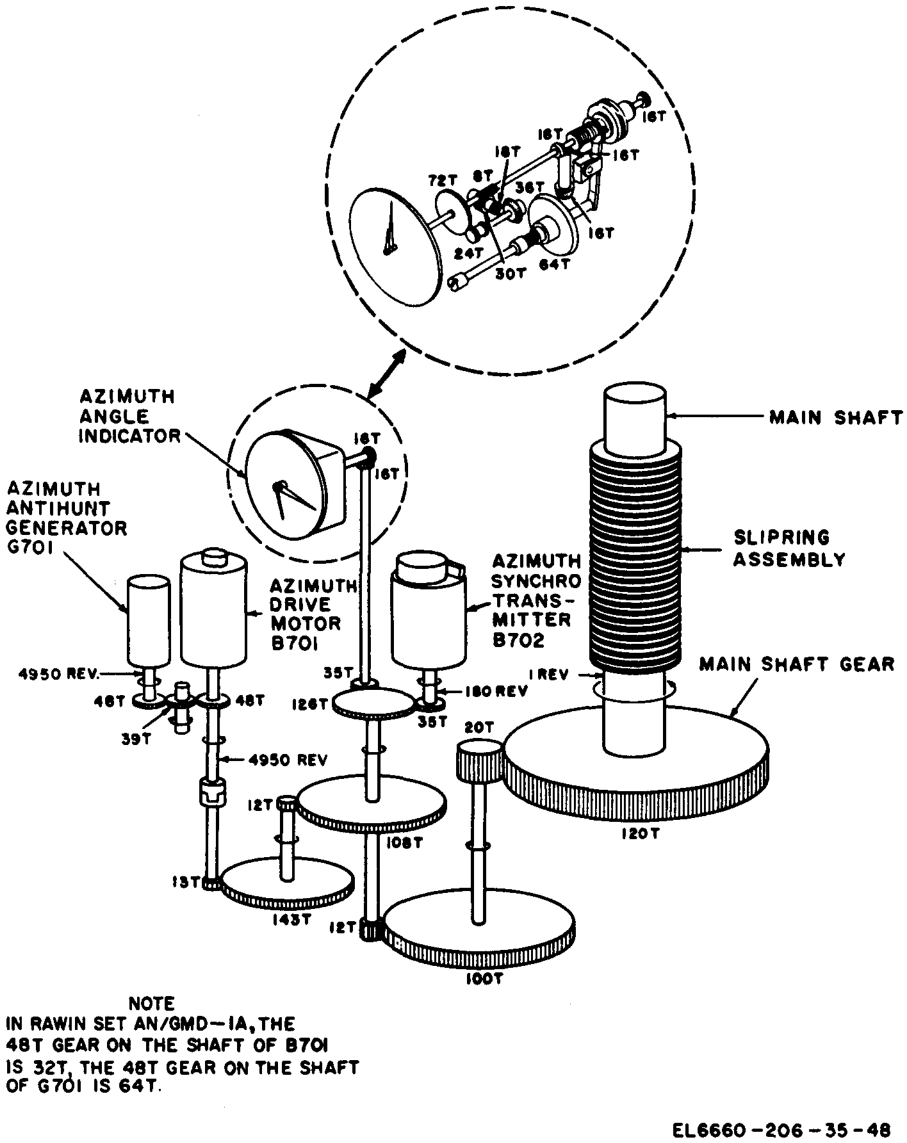


Figure 2-48. Azimuth drive gearing, simplified diagram.

antihunt circuit. This circuit is identical to the elevation antihunt circuit (para 2-22b). Azimuth synchro transmitter B702, and the azimuth angle indicator are part of the position indicating and recording system (para 2-27b). Stationary brushes make continuous contact with a revolving slipring assembly on the main shaft. Each slipring is wired on the inside to terminal boards at the top of the main shaft. Cables are used to connect these terminal boards to other rotating elements.

Section IV. POSITION INDICATING AND RECORDING SYSTEM

2-25. General

a. The position indicating and recording system (fig. 2-49) consists of an elevation angle indicating group, an azimuth angle indicating group, an angle reset group, a print cycle motor power supply, a print cycle motor group, a time setting and indicating group, and a printing indicating group. Azimuth and elevation angle data inputs from the antenna positioning system are applied to a control-recorder which indicates and records the correct angles and time intervals. A complete schematic diagram of the control-recorder is shown in figure FO-26 or FO-27. Circuit differences between Control-Recorder C-577E/GMD-1, and early model control-recorders are described in this section.

b. In the elevation angle indicating group, elevation angle data is received from the vertical movement of the reflector, and indicators are positioned to indicate the elevation angle of the target. In the azimuth angle indicating group, azimuth angle data is received from the reflector movement in azimuth, and indicators are positioned to indicate azimuth angle of target. The angle reset group permits manual resetting of the azimuth and elevation angle printing wheels and the angle indicators in the control-recorder. The print cycle motor power supply provides power to run the print cycle motor and to activate the relays used to operate the control-recorder. The print-cycle motor group regulates the time elapsed between printings and provides the time setting and indicating group with an accurate time signal every 0.1 minute. The time setting and indicating group operates every 0.1 minute to advance the time indicator and the time printing wheels. The printing group operates the printing hammers at 1, 2, or 10 times per minute, depending on the setting selected.

2-26. Block Diagram

Figure 2-50 and 2-51 shows the block diagram of the position indicating, and recording system. This system is used to indicate and record the elevation and azimuth angles of the reflector. When the rawin set is tracking the radiosonde automatically, these angles represent the position of the radiosonde. The printed record of the varying elevation and azimuth angles is used to compute wind direction and speed.

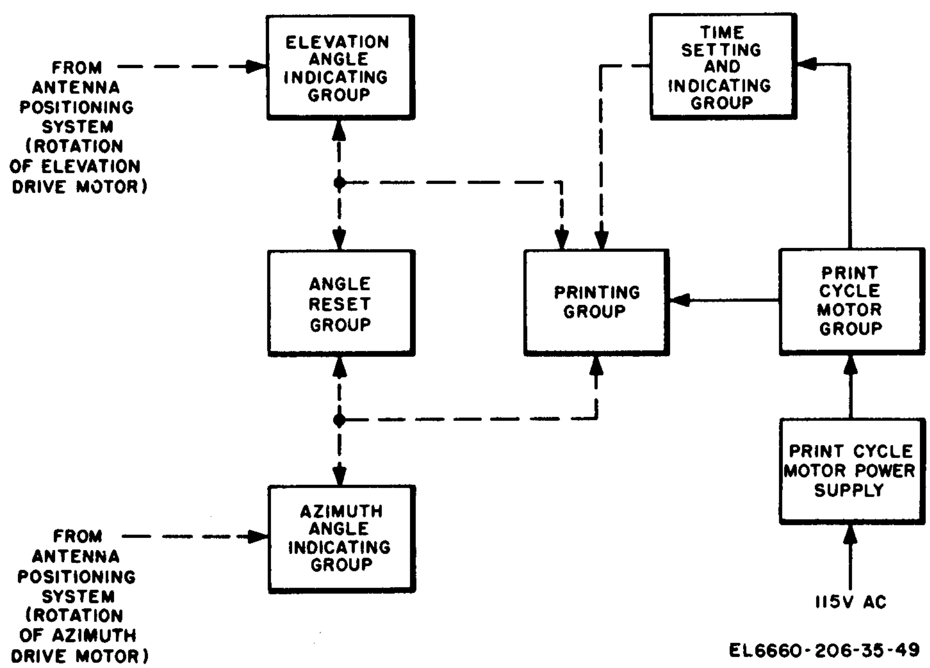


Figure 2–49. Position indicating and recording system, simplified block diagram.

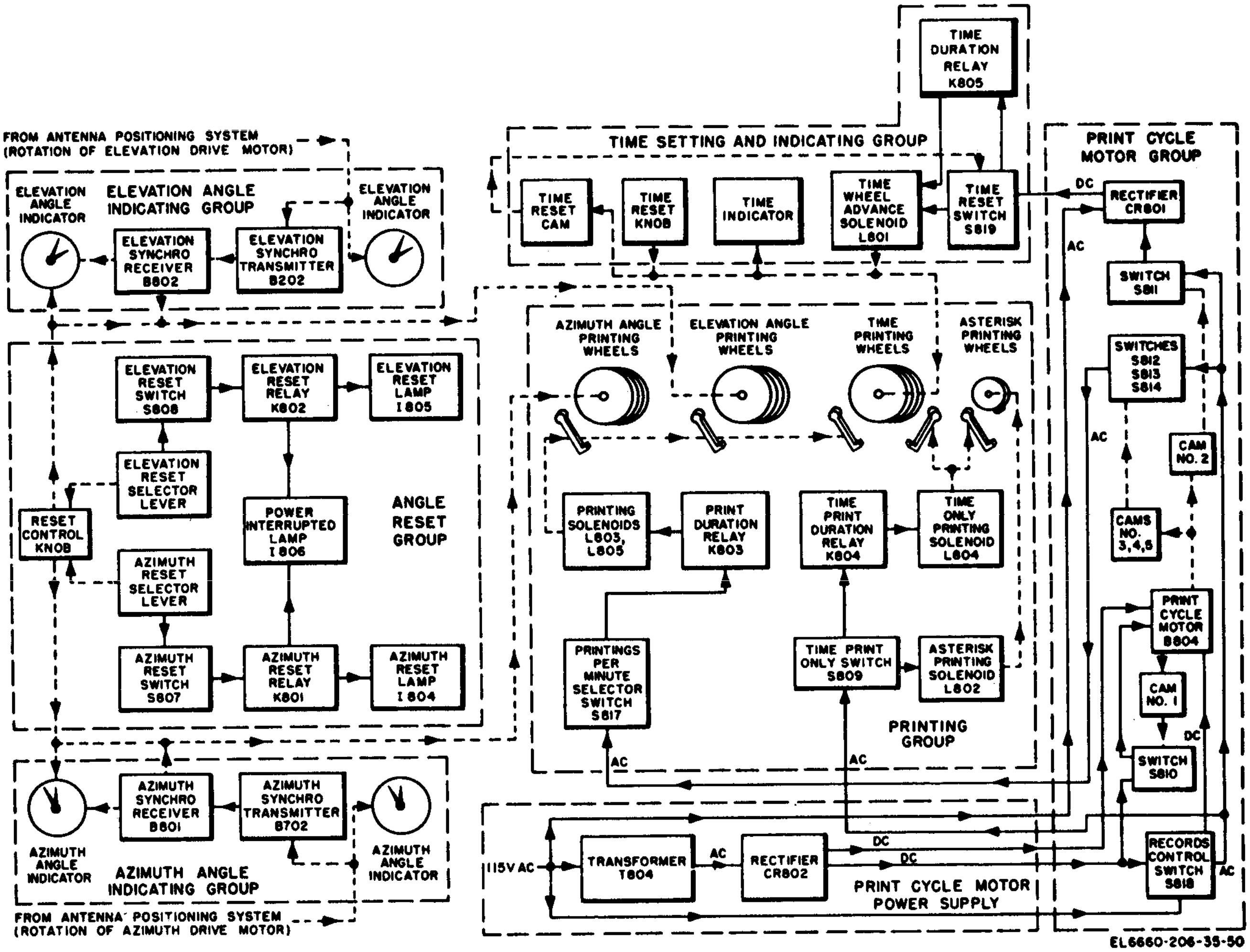


Figure 2–50. Position indicating and recording system, (AN/GMD-1A and AN/GMD-1B), complete block diagram.*

a. Elevation Angle Indicating Group. This group includes an elevation angle indicator and a synchro transmitter (located on the elevation unit) which are geared to the elevation drive, a synchro receiver (located in the control-recorder) which is electrically positioned by the synchro transmitter, and an elevation angle indicator which is mechanically positioned by the synchro receiver. The elevation synchro receiver also positions the elevation angle printing wheels located in the printing group.

b. Azimuth Angle Indicating Group. This group includes an azimuth angle indicator and a synchro transmitter (located in the azimuth unit) which are geared to the azimuth drive, a synchro receiver (located in the control-recorder) which is electrically positioned by the synchro transmitter, and an azimuth angle indicator which is mechanically positioned by the synchro receiver. The azimuth synchro receiver also positions the azimuth angle printing wheels located in the printing group.

c. Angle Reset Group. The angle reset group permits manual resetting with the RESET control knob of the azimuth angle and the elevation angle printing wheels, and the two angle indicators in the control-recorder. When either RESET SELECTOR level is held down, close reset switch S807 or S808 actuates self-locking reset relay K801 or K802, and either reset lamp 1804 or 1805 lights. If power is interrupted, the reset relays release, and both reset lamps extinguish. When power is applied again, POWER INTERRUPTED lamp 1806 will light. This warns the operator that power has been interrupted, and that he must reset both angles.

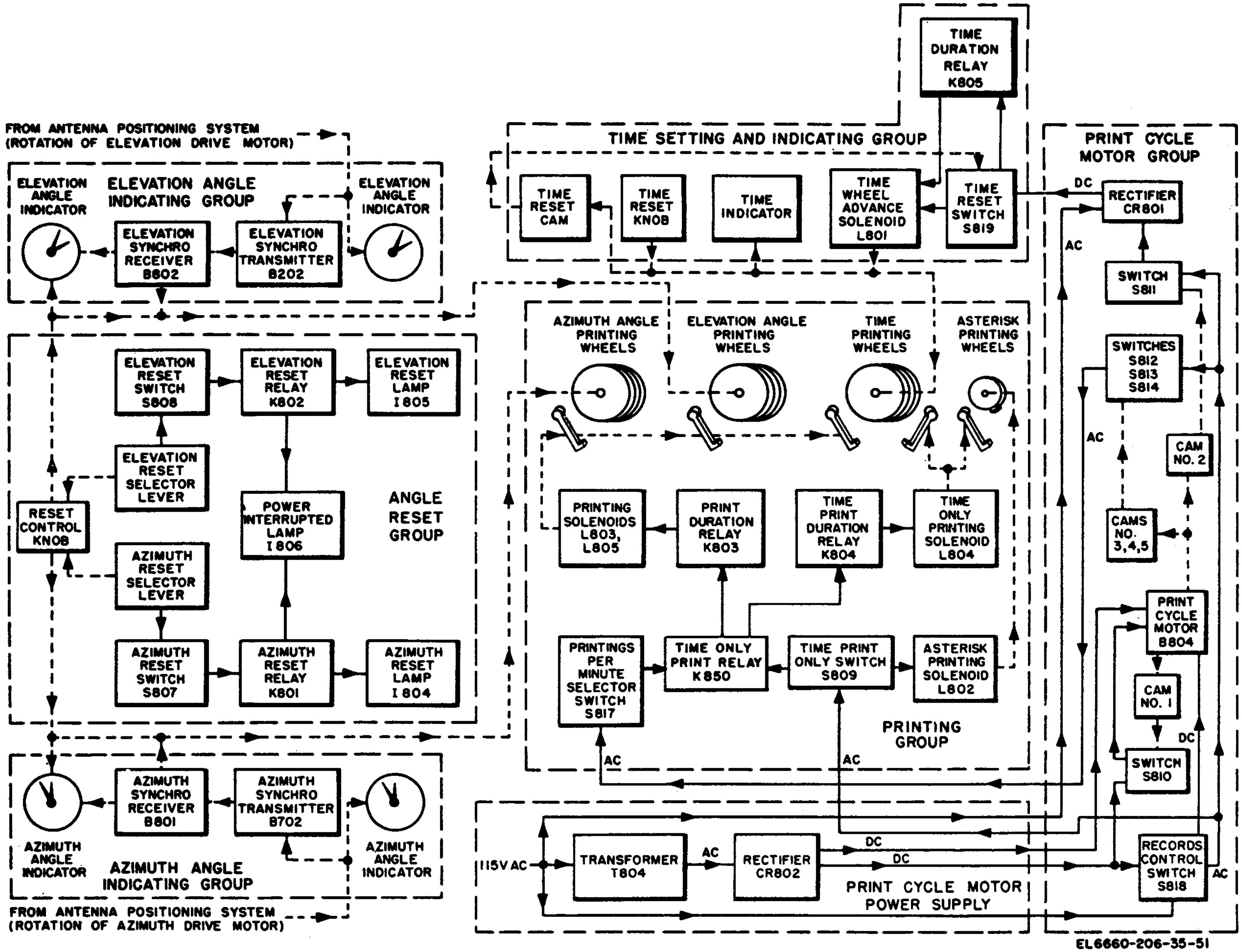


*Figure 2–51. Position indicating and recording system, (AN/GMD–1B**), complete block diagram.*

d. Print Cycle Motor Group. The print cycle motor group regulates the time elapsed between printings. This group also provides an accurate time signal every 0.1 minute to the time setting and indicating group. Print cycle motor B804 rotates at a constant speed of one r/rein, using a chronometric movement in the motor. Five cam-operated switches are controlled by B804. Switch S810 provides zero reference adjustment for time printing. Switches S812, S813, and S814 set up intervals of 10, 2, and 1 times per minute for printing. These intervals are selected by PRINTINGS PER MINUTE switch S817 in the printing group. Switch S811 energizes rectifier CR801 to apply power to time wheel advance solenoid L801 in the time setting and indicating group. L801 positions the time indicator and time printing wheels in the printing group. Power to the print cycle motor group is applied through RECORDS CONTROL switch S818.

e. Time Setting and Indicating Group. The dc, rotary-type, time wheel advance solenoid, L801, operates every 0.1 minute to advance the time indicator and time printing wheels in the printing group. A TIME RESET knob resets the time indicator and the time printing wheels. At the same time, a time reset cam opens switch S819 to deenergize time wheel advance solenoid L801 and prevent printing while the time printing wheels are being reset.

f. Printing Group.

(1) *Rawin Set AN/GMD–1A and AN/GMD-1B*.* The printing interval selected by PRINTINGS PER MINUTE switch S817 is used to time the operation of print duration relay K803 (fig. 2-50). Printing solenoids L803 and L805 are energized through the contacts of K803 and operate the printing hammers at 1, 2, or 10 times per minute, depending on the setting selected. Operation of the print duration relay, K803, deenergizes the printing solenoids. When the printing hammers operate, a record of the azimuth angle, the elevation angle, and the time is made on the paper tape. Manually operated TIME PRINT ONLY switch S809 energizes two solenoids: time only printing solenoid L804 and asterisk printing solenoid L802. Solenoid L804 operates the printing hammers which strike only the time and asterisk printing wheels. Solenoid L802 positions the asterisk printing wheel. Time print duration relay K804 deenergizes L804.

(2) *Rawin Set AN/GMD–1B**.* Control-Recorder C-577E/GMD-1, supplied with Rawin Set AN/GMD-1B**, uses a time only print relay, K850, to apply power to the relays and solenoids of the printing group (fig. 2-51). The output of PRINTINGS PER MINUTE selector switch S817 is routed directly to the asterisk printing solenoid L802 and time print duration relay K804, and through the normally closed contacts of K850 to print duration relay K803. This arrangement utilizes the time only printing solenoid to drive the time print hammer for all time prints. It eliminates mechanical drive of the time print hammer during normal cycle printing. When the TIME PRINT ONLY switch is depressed, power is supplied through S809 to asterisk printing solenoid L802 and to time only print relay K850. When K850 closes, power is applied to time print duration relay K804 and through its contacts to time only printing solenoid L804.

g. Print Cycle Motor Power Supply. The print cycle motor power supply is used to supply power for print cycle motor B804. Transformer T804 is used with rectifier CR802 to change the 115 volt ac input to dc voltage for the motor.

2-27. Angle Indicating and Reset Groups

a. Elevation Angle Indicating Group.

(1) An elevation angle indicator in the elevation unit is geared to elevation drive motor B201 (fig. 2-47). This indicator is set manually to correspond to the elevation angle of the reflector. The long pointer of the indicator rotates at four times the speed of the reflector. The short pointer makes one revolution for each change of 2° in the elevation angle.

(2) Elevation synchro transmitter B202 in the elevation unit is geared to the elevation drive motor (fig. 2-52), and its rotor makes 45 revolutions for a 90° change in the elevation angle of the reflector. Rotation of the synchro transmitter rotor produces changes in the voltages across its stator windings. The stator of synchro transmitter B202 is connected to the stator of elevation synchro receiver B802 in the control-recorder. Voltage changes between the stator windings of the synchro transmitter are impressed across the equivalent stator windings of the synchro receiver which results in identical rotation of the synchro receiver rotor.

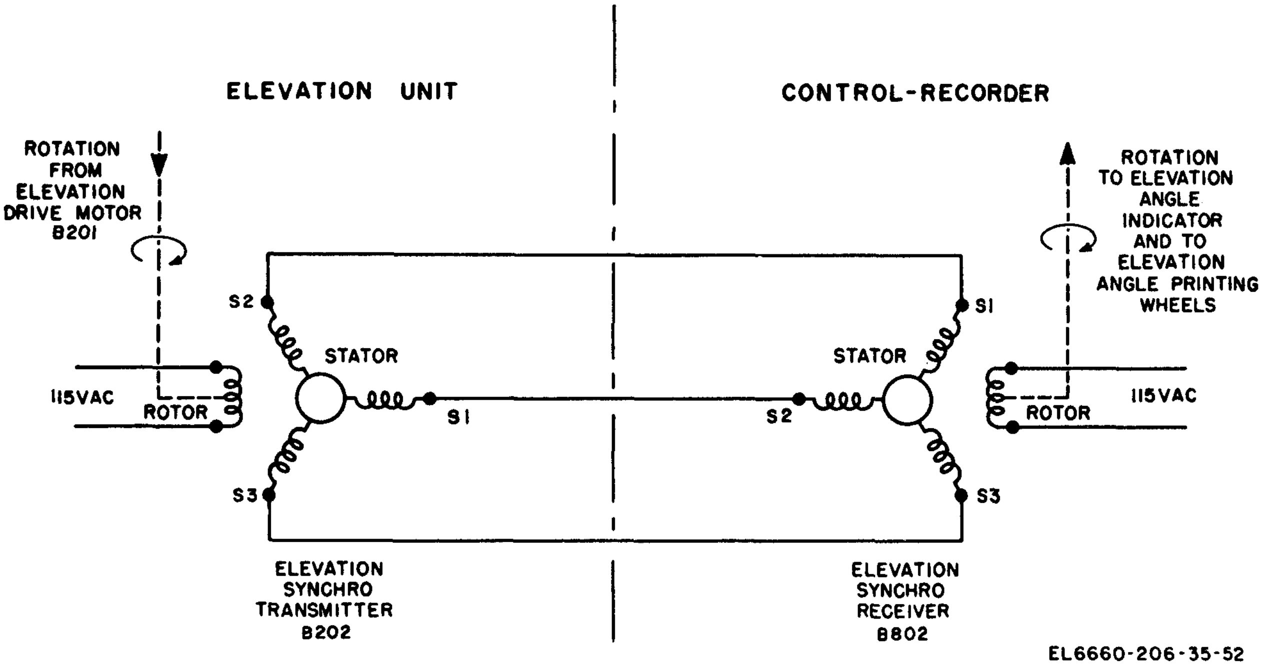


Figure 2-52. Connections between elevation synchro transmitter and receiver.

NOTE

If a power failure occurs or if manual pushing of the pedestal is attempted the indicators may get out of step with the antenna by 2° or some multiple of 2°.

(3) The rotor of synchro receiver B802 is geared to the elevation angle indicator of the control-recorder and to the elevation angle printing wheels (fig. 2-52). As the elevation drive motor rotates the reflector, an elevation angle indicator in the elevation unit and a similar angle indicator in the control-recorder indicate the changing elevation angle. Also, the elevation angle printing wheels are positioned to the same changing elevation angle.

b. Azimuth Angle Indicating Group.

(1) An azimuth angle indicator in the pedestal is geared to azimuth drive motor B701 (fig. 2-48). This indicator is set manually to correspond to the azimuth angle of the reflector with respect to true north. The long pointer of the indicator rotates at the same speed as the reflector. The short pointer makes one revolution for each change of 2° in the azimuth angle.

(2) Synchro transmitter B702 in the azimuth unit also is geared to the azimuth drive motor and makes 180 revolutions for one revolution of the antenna reflector. Rotation of the synchro transmitter rotor produces changes in the voltages across its stator windings. The stator of synchro transmitter B702 is connected to the stator of azimuth synchro receiver B801 in the control-recorder (similar to the elevation connections of figure 2-52). Voltage changes between the stator windings of the synchro transmitter are impressed across the equivalent stator windings of the synchro receiver, which results in identical rotation of the synchro receiver rotor. The rotor of synchro receiver B801 is geared to the azimuth angle indicator of the control-recorder and to the azimuth angle printing wheels. As the azimuth drive motor rotates the reflector, an azimuth angle indicator in the azimuth unit and a similar angle indicator in the control-recorder indicate the changing azimuth angle. Also, the azimuth angle printing wheels are positioned to the same changing azimuth angle.

c. Reset Group.

(1) Figure 2-53 is a mechanical diagram of the elevation reset group, and figure 2-54 shows

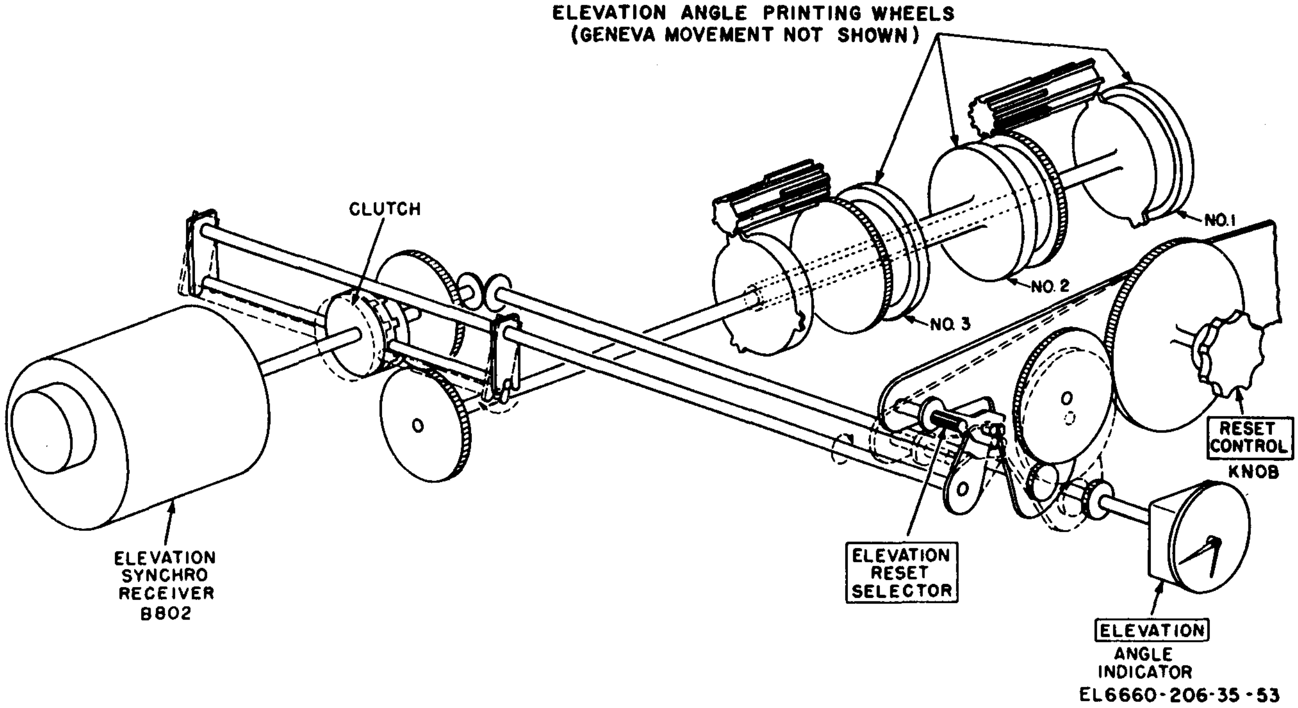


Figure 2-53. Elevation synchro receiver, elevation reset mechanism, and elevation angle printing wheels, mechanical diagram.

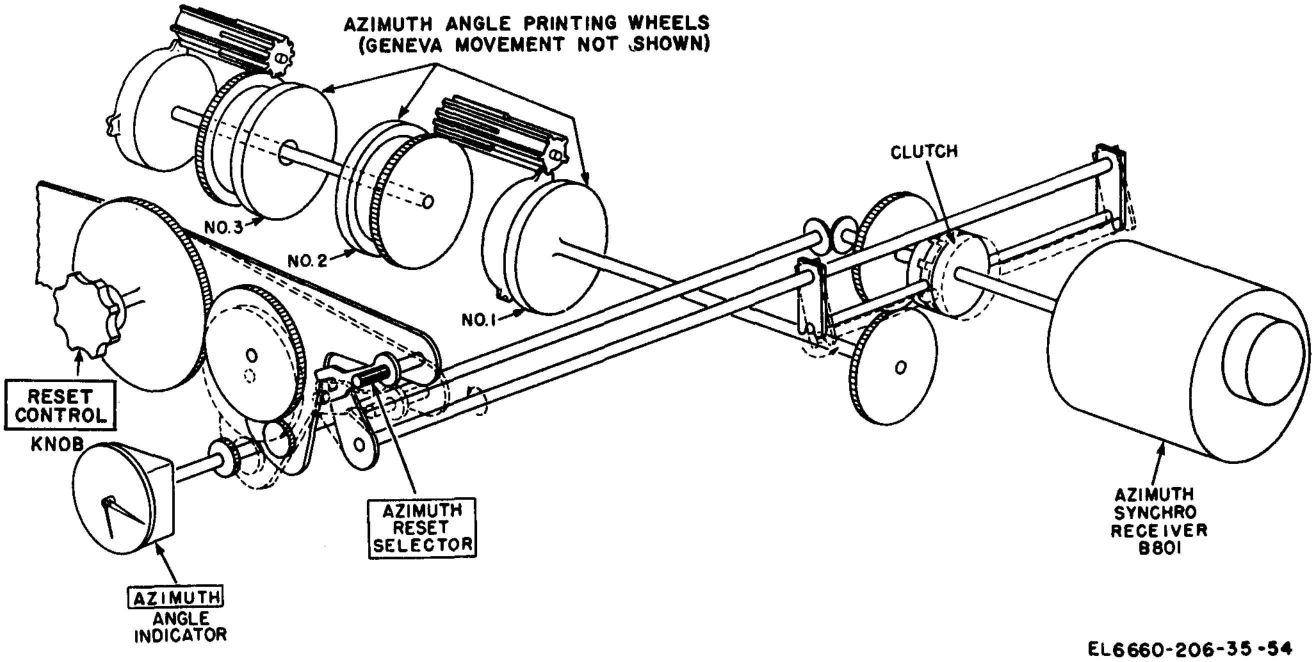


Figure 2-54. Azimuth synchro receiver, reset mechanism, and angle printing wheels, mechanical diagram.

the azimuth reset group. Depressing the ELEVATION RESET SELECTOR lever has two effects; it opens a clutch that disconnects the elevation synchro receiver, and it meshes the RESET CONTROL knob gears with the elevation angle indicator gears and the gear train of the elevation angle printing wheels. Dash lines in fiie 2-53 indicate the position of the components when the ELEVATION RESET SELECTOR lever is depressed. When the ELEVATION RESET SELECTOR lever is depressed, rotation of the RESET CONTROL knob results in simultaneous rotation of the elevation angle indicator and of the elevation angle printing wheels.

(2) Depression of the ELEVATION RESET SELECTOR lever also closes S808 (fig. 2-55), and energizes K802. Contacts 3 and 4 of K802 apply power to ELEVATION reset lamp 1805. Relay K802 remains energized through contacts 5 and 6 as long as the power supply is uninterrupted. If the power is interrupted, K802 releases, and when power again is applied, POWER INTERRUPTED lamp 1806 lights because power is applied through contacts 2 and 4 of relay K8002. This warns the operator that the power was interrupted. The time printings made after power is interrupted are no longer synchronized with the original starting time of the flight. Computations of wind speed partly based on these time readings will be inaccurate.

(3) The azimuth reset group (fig. 2-54 and 2-55) operates similarly to the elevation reset group.

2-28. Print Cycle Motor Power Supply and Motor Group

a. Print Cycle Motor Power Supply.

(1) The main components of the print cycle motor power supply (fig. 2-56) are T804 and CR802. The 115 volt ac line voltage is applied to the primary of T804 when power is applied to the control-recorder. This voltage is stepped down to 33 volts and applied to CR802. This bridge rectifier converts the voltage to approximately 24 volts dc .

(2) The output of rectifier CR802 is applied to print cycle motor B804 and to the junction of one contact of RECORDS CONTROL switch S818 and one contact of S810. Power is applied to B804 when the RECORDS CONTROL switch is in the FLIGHT position or when S810 is closed. Switch S810 is opened by cam no. 1 when print cycle motor B804 has rotated the cam to the zero time position. Cam no. 1 permits the setting of the time printing wheels and the TIME indicator to zero. This is done while RECORDS CONTROL switch S818 is in STANDBY or BASELINE CHECK (contacts

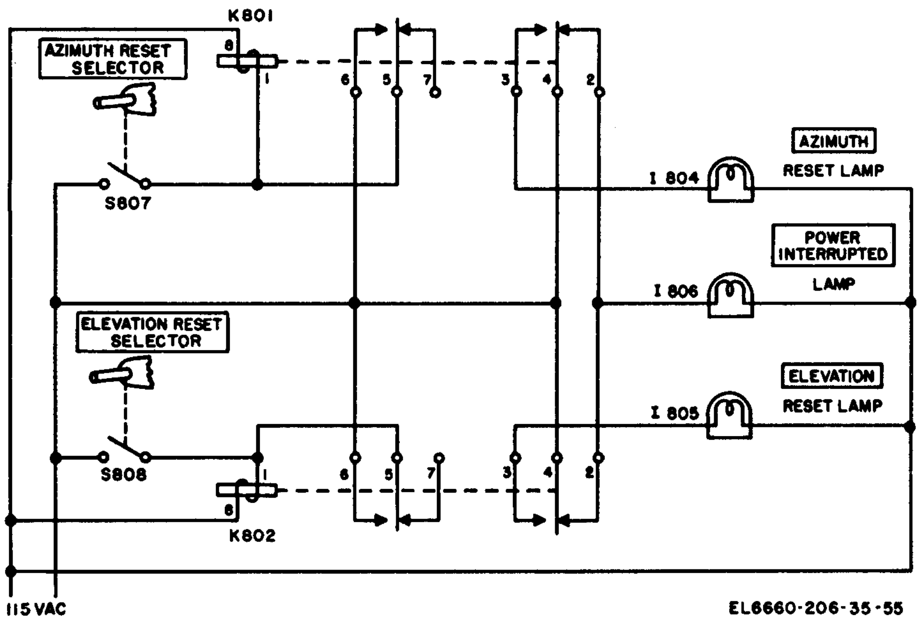


Figure 2-55. Reset group, simplified schematic diagram.

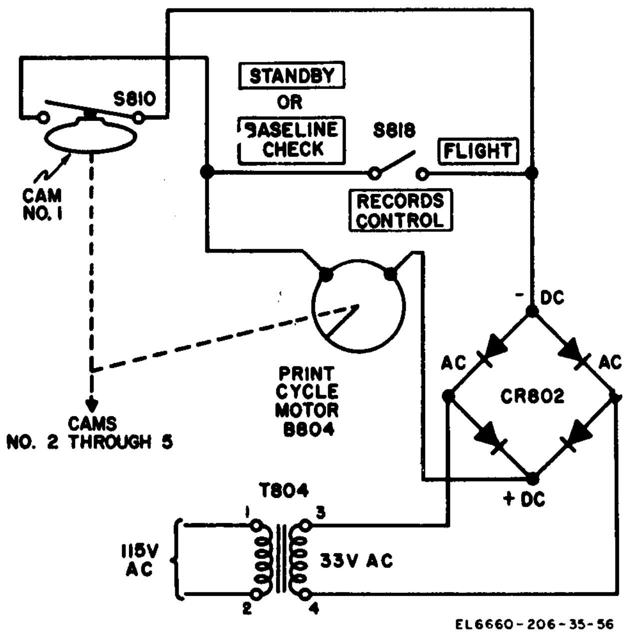


Figure 2-56. Print cycle motor, power supply, and cam no. 1, simplified schematic diagram.

open). With the contacts of switch S818 open, print cycle motor B804 will continue to run, and will stop at zero position when cam no. 1 opens S810. At the signal to launch the radiosonde, the RECORDS CONTROL switch is set to the FLIGHT position to start the print cycle motor.

b. Print Cycle Motor Group.

(1) Print cycle motor. The print cycle motor is equipped with a chronometric movement which maintains a constant speed at one r/min, regardless of fluctuations in the applied voltage. The motor output shaft is geared in a 1:1 ratio to the camshaft and causes this shaft to rotate at one r/min. A speed adjustment of the motor governor is provided which is similar to a clock adjustment.

(2) *Cams no. 3,4, and 5.*

(a) Cam no. 5 has one notch, cam no. 4 has two, and cam no. 3 has 10. Switches S814, S813, and S812 (fig. 2-57 or 2-58) are actuated when their spring-loaded plunger arms drop into the notches of cams no. 5, 4, and 3. Since the cams revolve at exactly one r/min, S814 is actuated once each minute; S813, two times per minute; and S812, 10 times per minute. The correct switch is selected by rotating PRINTINGS PER MINUTE switch S817 to the rate desired. Arcing at the contacts of S817 is minimized by capacitor C804.

(b) Printing solenoids L803 and L805 are connected to the 115 volt ac power source through the normally closed contacts of K803, K850, S817, the selected cam-operated switch

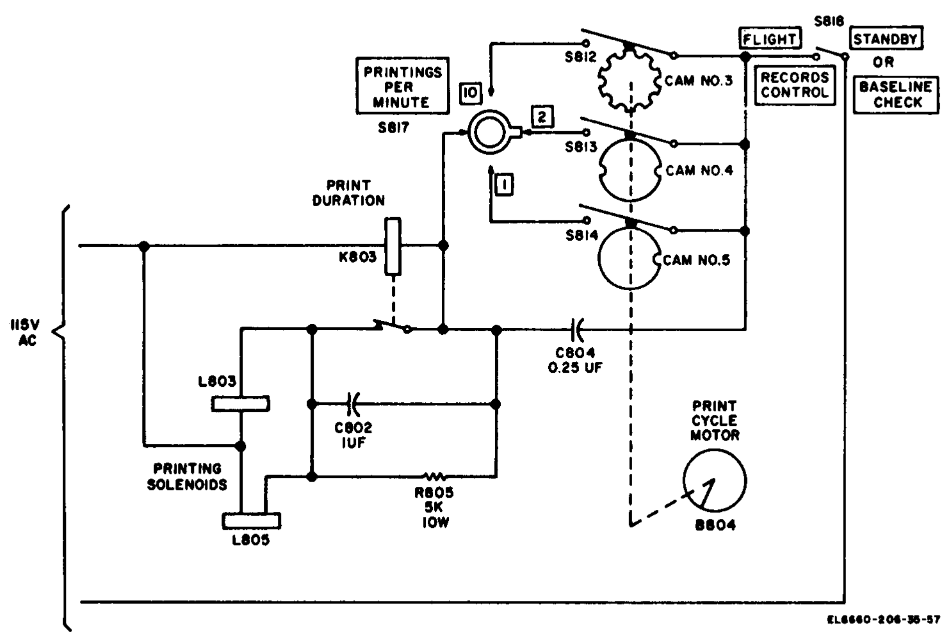


Figure 2-57. Print cycle motor and cams no. 3,4, and 6 (except C-577E/GMD-1B), simplified schematic diagram.*

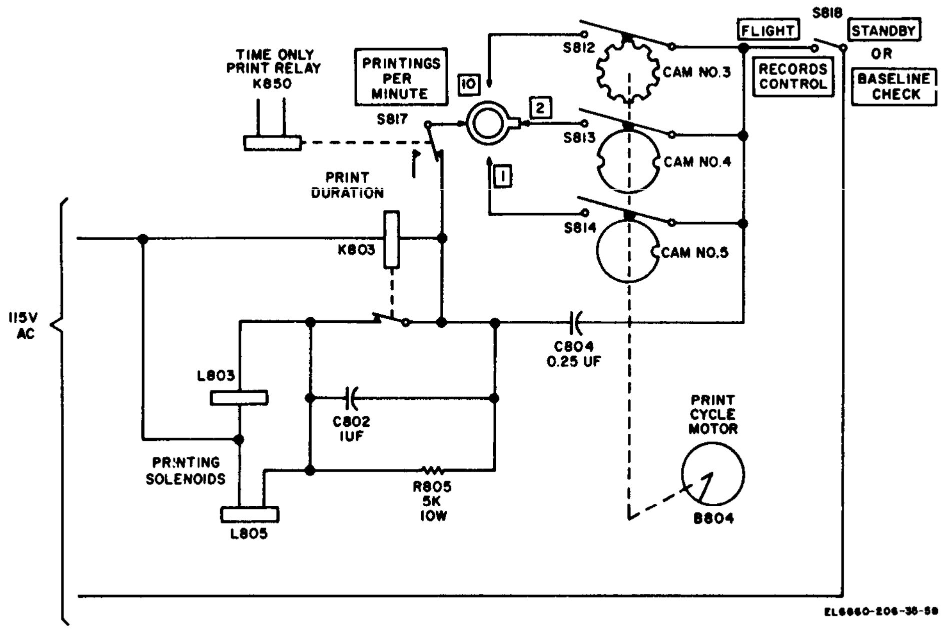


*Figure 2-58. Print cycle motor and cams no. 3,4, and 5 (C-57WGM-1B**), simplified schematic diagram.*

(S813 in fig. 2-58), and RECORDS CONTROL switch S818 (in FLIGHT position). In control-recorders other than C-577E/GMD-1, K850 is not used (fig. 2-57). For example, when S818 is in FLIGHT position and S817 is set to position 2, the printing solenoids will be energized twice each minute, since cam no. 4 causes S813 to close twice each minute. When the RECORDS CONTROL switch is placed in the STANDBY or BASELINE CHECK position, print cycle motor B804 and cams no. 3,4, and 5 will continue to rotate until the zero time position is reached *(a* above). Thus, when S818 is again placed in the FLIGHT position, the printing cycle will start at zero time.

(3) *Cam no. 2.* Cam no. 2 (fig. 2-59 or 2-60), also mounted on the cam shaft, has 10 notches. Each notch closes S811 and applies 115 volts ac to selenium rectifier CR801. The dc output of this rectifier is applied to L801 through S819 (normally closed) and the contacts of time duration redlay K805 (also normally closed). The armature of L801 is mechanically linked to the TIME indicator and to the printing wheels (fig. 2-61). Each movement of the armature advances the TIME indicator and time printing wheels by 0.1 minute. This action is relatively fast and is completed before K805 (fig. 2-59 or 2-60) is energized. Relay K805 now pulls in and breaks the current through L801 before the relatively slow-moving cam switch opens. This short duration of current prevents overheating the solenoid winding. Relay K805 will release and its contacts mate again when the cam opens S811. Switch S819 is opened by a cam mounted on the time reset shaft when this shaft is rotated. This arrangement prevents L801 from operating while the time reset shaft is being rotated. Series resistor R810 establishes the correct current through the coil of K805 to pull in the armature. Capacitor C803 absorbs the inductive kick of the relay coil when the contacts open. After K805 has pulled in, R809 provides a path around the opened contacts for enough current to hold the relay in an energized condition until cam no. 2 opens S811.

2-29. Time Setting and Indicating Group

a. Time Wheel Advance Solenoid L801. The operating circuit for time wheel advance solenoid L801 is shown in figure 2-59 or 2-60. When RECORDS CONTROL switch S818 is at FLIGHT and the print cycle motor is running, the solenoid operates every 0.1 minute. The solenoid causes the TIME indicator (fig. 2-61) and the time printing wheels to advance.

b. TIME Indicator. The sealed, counter-type TIME indicator can be positioned either by the

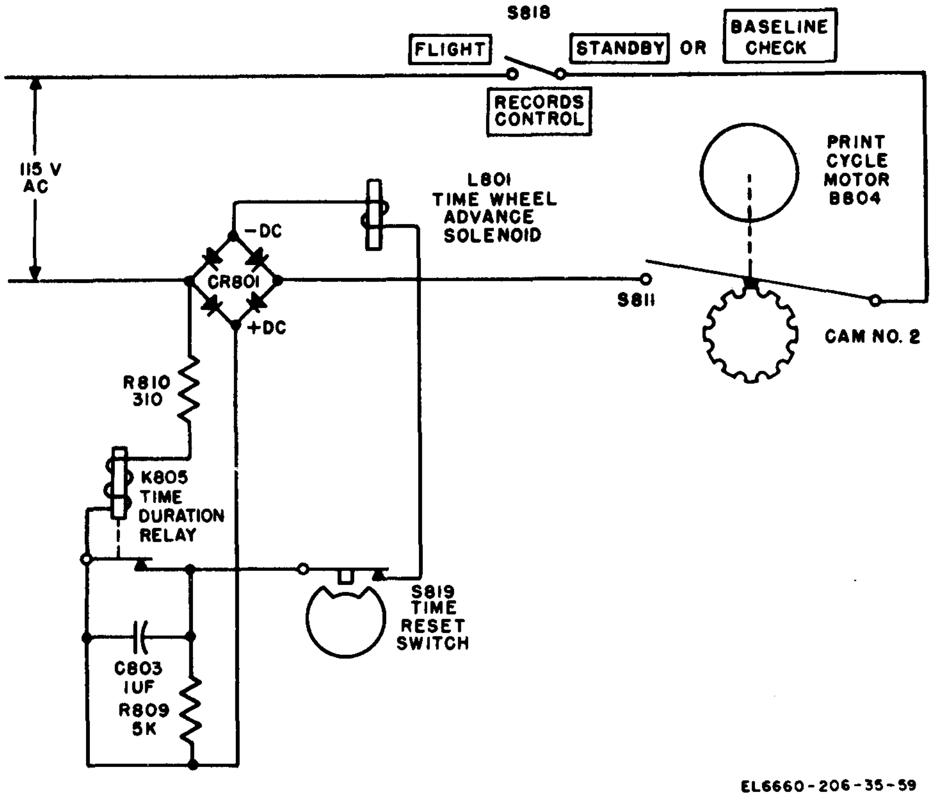


Figure 2-59. Print cycle motor and cam no. 2 (except C-577E/GMD-1), simplified schematic diagram.

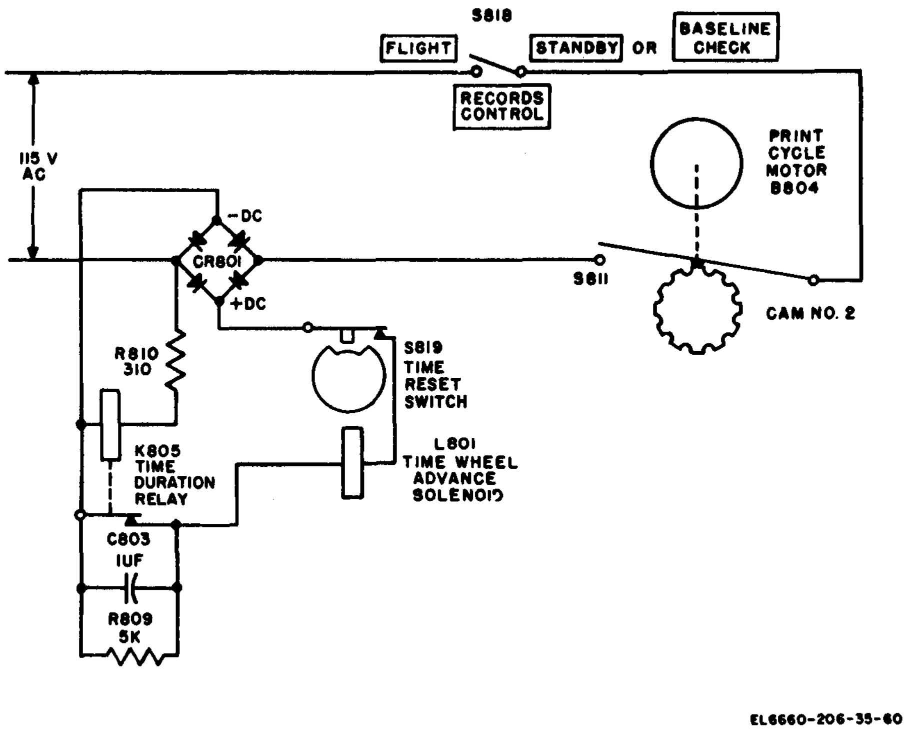


Figure 2-60. Print cycle motor and cam no. 2 (C-577E/GMD-1), simplified schematic diagram.

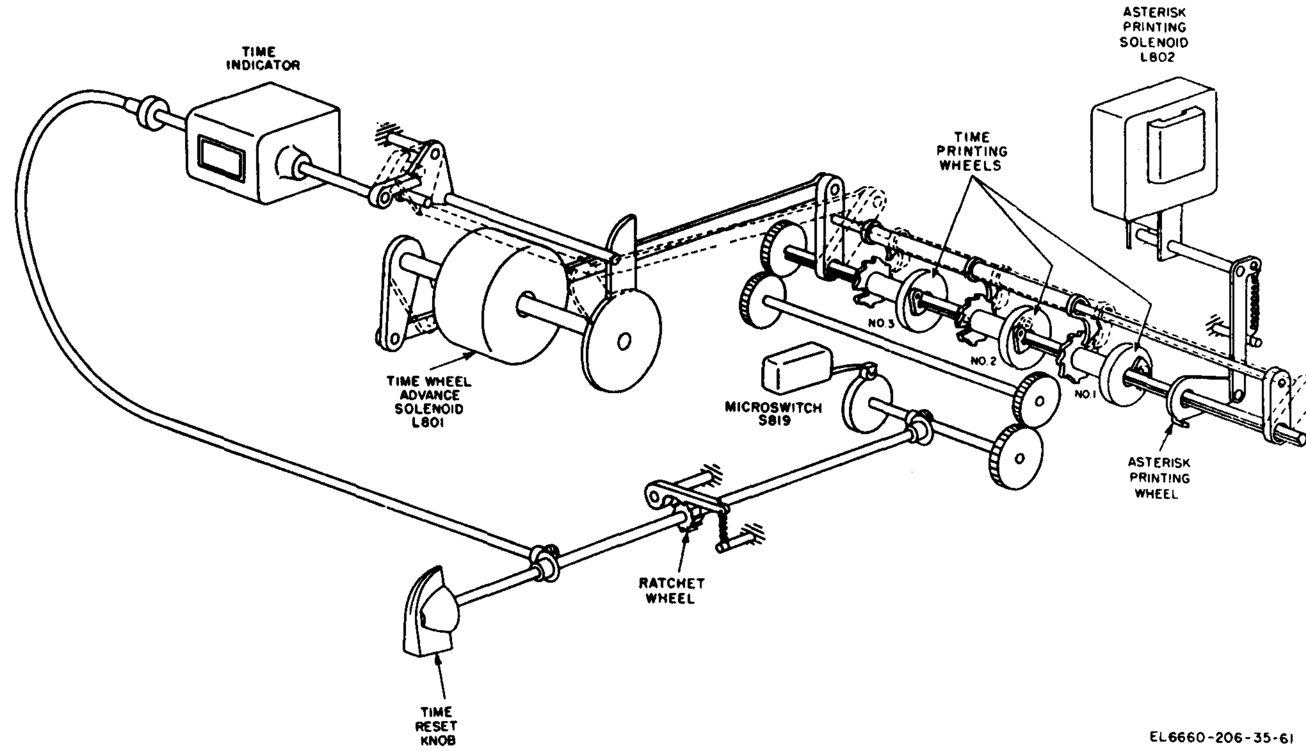


Figure 2-61. Time setting and indicating group, mechanical diagram.

TIME RESET knob or by time wheel advance solenoid L801.

c. TIME RESET Knob. The TIME RESET knob is mounted on a shaft equipped with a ratchet wheel and can be rotated only in a clockwise direction. The knob is connected through a flexible shaft to the TIME indicator, and through gears to the time wheels. Rotation of the knob turns both.

2-30. Printing Group

The printing group is separated into an electrical components description *(a* below) and a description of the printing wheels *(b* below). Other components associated with printing, such as paper feed and ribbon winding, are described in *c* and *d* below.

a. Electrical Components.

(1) *Printing solenoids L803 and L805, and print duration relay K803.*

(a) When RECORDS CONTROL switch S818 (fig. 2-58) is in the FLIGHT position, printing solenoids L803 and L805 can be energized by closing one of the cam-operated switches (S812, S813, or S814). The contacts of K803 are normally closed. When current flows through L803 and L805, relay K803 is energized, but not before the solenoids operate. Relay K803 opens the circuit of solenoids L803 and L805, This causes a quick release of printing solenoids L803 and L805, which results in a striking action of the printing hammers. When relay K850 is energized, this circuit will not operate during time only printing. Resistor R808 and capacitor C802 form a spark-suppression network across the contacts of K803. Resistor R808 is large enough to prevent L803 and L805 from operating when the contacts of K803 are open.

(b) Figure 2-62 or 2-63 shows the mechanical action of printing solenoids L803 and L805. When the plungers of these solenoids move up (shown in dotted lines), the two semicircular levers are pushed upward. These levers are fastened to a shaft on which are mounted two hammers. One hammer strikes the elevation angle printing wheels, and the other strikes the azimuth angle printing wheels. The time printing hammer (fig. 2-63) is free on the shaft and is not

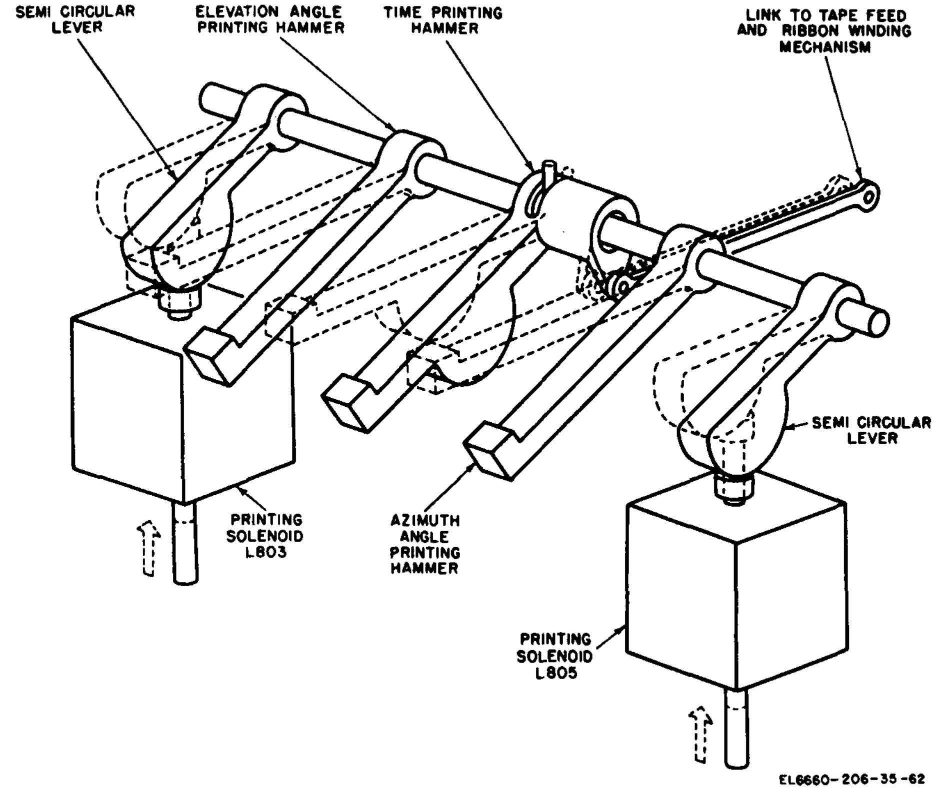


Figure 2-62. Printing solenoids L803 and L805 (except C-577E/GMD-1), mechanical diagram.

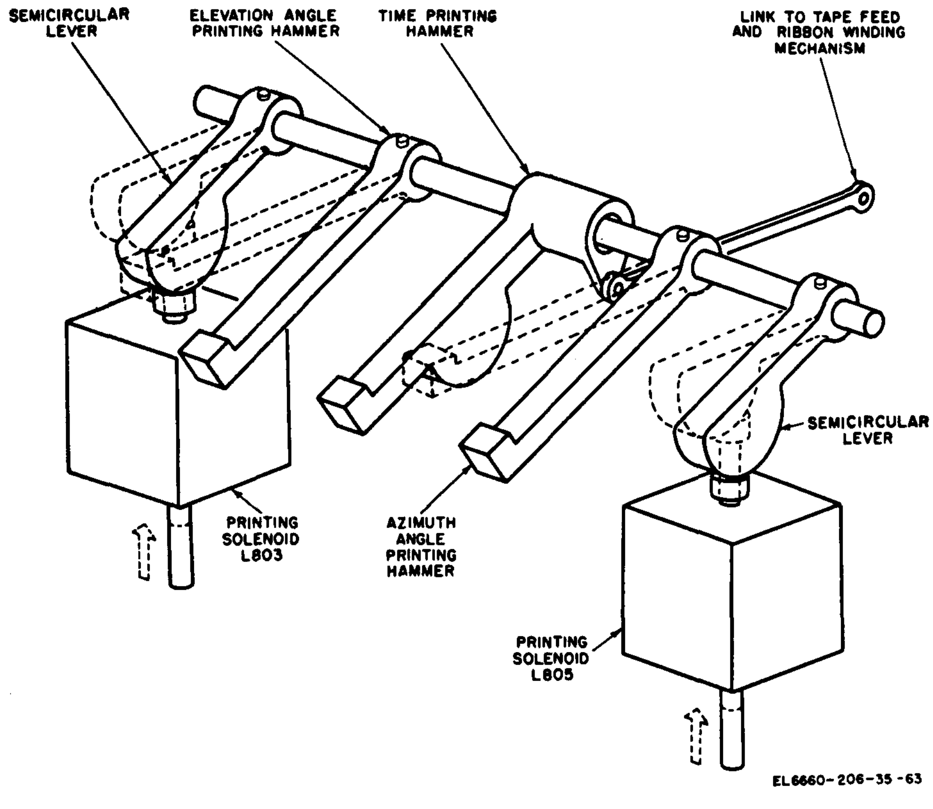


Figure 2-63. Printing solenoids L803 and L805 (C-577E/GMD-1), mechanical diagram.

actuated by L803 and L805. This hammer is actuated by time only printing solenoid L804 ((3) below) which is energized at the same time as L803 and L804. Consequently, time is printed through the action of L804 each time the angles are printed. In control-recorders other than C-577E/GMD-1 (fig. 2-62), a pin mounted on the shaft causes the time printing hammer to be pushed upward and to strike the time printing wheels. This hammer is connected to a link that moves the tape and ribbon mechanisms. The ribbon is between the top surface of the paper tape and the printing wheels. Therefore, when the hammers strike the printing wheels, the elevation angle, the time, and the azimuth angle are printed on the paper tape.

(2) *Time only and asterisk printing circuits.* Asterisk printing solenoid L802 (fig. 2-64 or 2-65) is energized when either TIME PRINT ONLY switch S809 and RECORDS CONTROL switch S818 are closed or remote time print only switch S931 is closed. In Control-Recorder C-577E/GMD-1 (fig. 2-65), time only print relay K850 is energized at the same time. The

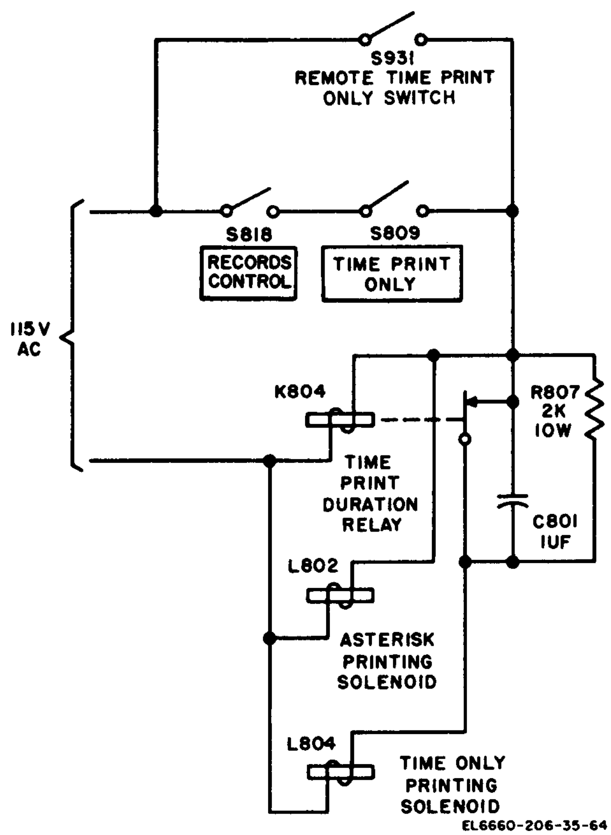


Figure 2-64. Time only and asterisk printing solenoids (except C-577E/GMD-1), simplified schematic diagram.

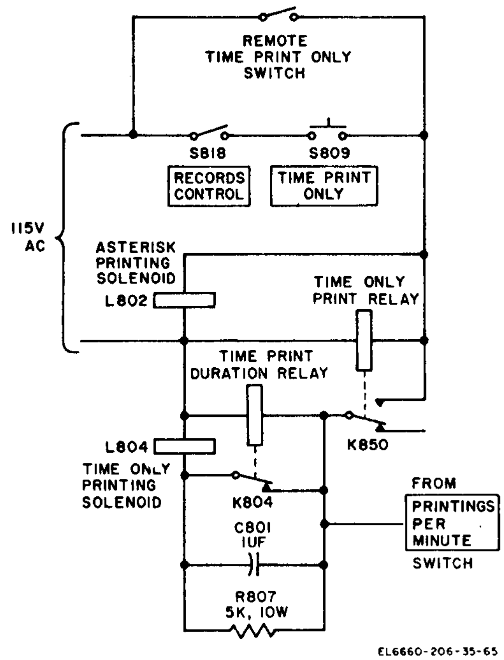


Figure 2-65. Time only and asterisk printing solenoids (C-577E/GMD-1), simplified schematic diagram.

energized relay applies power to time print duration relay K804 and time only printing solenoid L804. In control-recorders other than C-577E/GMD-1, K850 is not used, and K804 and L804 are energized at the same time as L802 (fig. 2-64). Time only printing solenoid L804 always operates immediately before K804 becomes energized and removes power from L804. This arrangement produces a quick operation and release of L804. Resistor R807 and capacitor C801 form a spark-suppression network across K804. Resistor R807 is large enough to prevent L804 from operating when the contacts of K804 are open.

(3) *Action of solenoid L804.* Figure 2-66 or 2-67 shows the mechanical action of time only printing solenoid L804. When this solenoid operates and its plunger moves up (shown in dotted lines), the time printing hammer is pushed upward. This hammer operates independently of the other two (a(2) above) and strikes the time printing wheels and the asterisk printing wheel. The asterisk printing wheel is rotated to a printing position by operation of the asterisk printing solenoid as described in (4) below. Thus, operation of time only printing solenoid L804 produces a record of the time wheel setting and an asterisk.

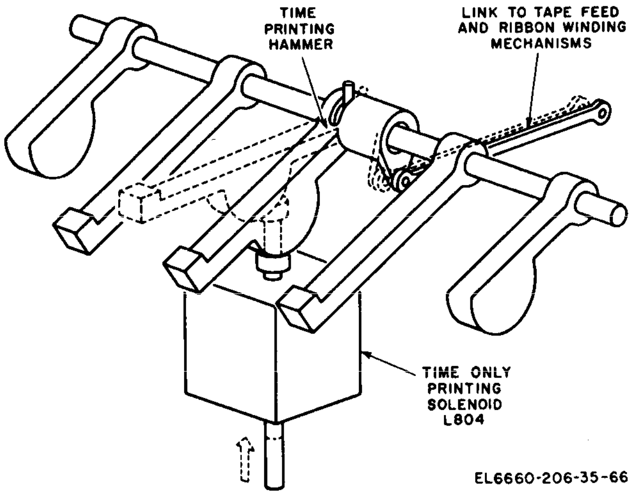


Figure 2-66. Time only printing solenoid (except C-577E/GMD-1), mechanical diagram.

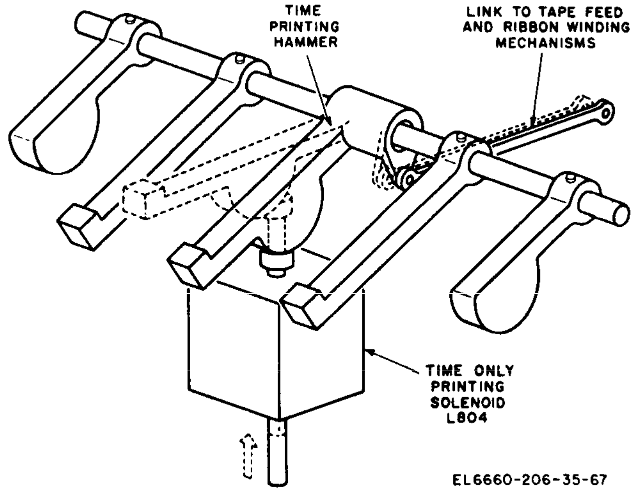


Figure 2-67. Time only printing solenoid (C-577E/GMD-1), mechanical diagram.

(4) Action of solenoid L802 and asterisk printing wheel. Asterisk printing solenoid L802 (fig. 2-68) is linked to the asterisk printing wheel. When L802 is energized, the asterisk printing wheel rotates slightly so that the asterisk type face is oriented downward. Since operation of L802 is simultaneous with the operation of L804 and K804 ((2) above), the time printing hammer strikes at the instant when the asterisk is in printing position. Consequently, the asterisk is turned to a printing position and the time printing hammer strikes the time printing wheels and the asterisk. When the printed tape is studied, the time printings introduced manually are shown by an asterisk. Thus, they are differentiated from the printings that take place automatically.

b. Printing Wheels.

(1) *Elevation angle printing wheels.* The three elevation angle printing wheels (fig. 2-53) are positioned mechanically by the elevation synchro receiver or by the RESET CONTROL

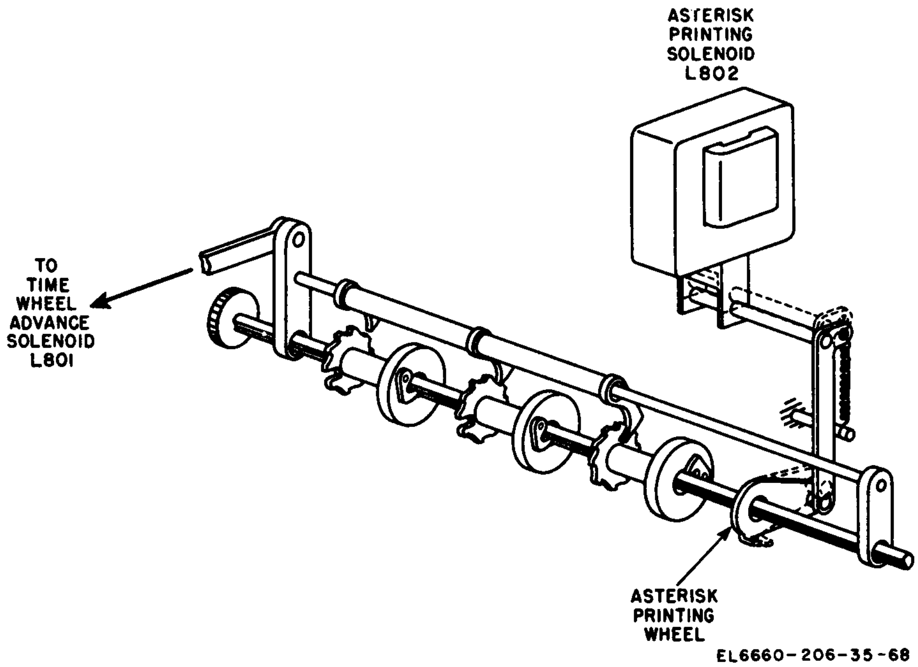


Figure 2-68. Asterisk printing solenoid and printing wheel, mechanical diagram.

knob. The wheel on the right (no. 1) prints hundredths, the center wheel (no. 2) prints the units digits, and the wheel on the left (no. 3) prints the tens digits. The elevation synchro receiver drives wheel no. 1 which is attached to a disk with two gear teeth placed 180° apart. One of these gear teeth engages a pinion every time wheel no. 1 makes one-half of a revolution. The pinion, in turn, advances wheel no. 2 one indicated degree. Wheel no. 2 is attached to a disk with three gear teeth placed 120° apart. At every one-third of a revolution of wheel no. 2, one of the three gear teeth engages a pinion, and the pinion positions wheel no. 3.

(2) *Azimuth angle printing wheels.* The three azimuth angle printing wheels (fig. 2-54) are positioned mechanically by the azimuth synchro receiver or by the RESET CONTROL knob. The wheel on the right (no. 1) prints hundredths of a degree, the center wheel (no. 2) prints the units digits, and the wheel on the left (no. 3) prints the tens and hundreds digits. The azimuth synchro receiver drives wheel no. 1 which is attached to a disk with two gear teeth placed 180° apart. Every time wheel no. 1 makes one-half of a revolution, one of the gear teeth on the disk engages a pinion, and the pinion positions wheel no. 2. Wheel no. 2 is attached to a disk with three gear teeth placed 120° apart. At every one-third of a revolution of wheel no. 2, one of the three gear teeth engages a pinion, and the pinion positions wheel no. 3.

(3) *Time printing wheels.* The three time printing wheels (fig. 2-61) are positioned mechanically by the time wheel advanced solenoid. The wheel on the right (no. 1), prints tenths of a minute, the center wheel prints the units digits, and the wheel on the left prints the tens digits. When the time wheel advance solenoid operates, a link causes rotation of a shaft that mounts three pawls. The pawl on the right advances a ratchet wheel which is attached to wheel no. 1, each time the solenoid operates. One groove in this ratchet wheel is deeper than the others, and when the pawl falls into this deep groove, it permits the center pawl (which is shorter) to engage the ratchet wheel attached to wheel no. 2. In this manner, wheel no. 2 is positioned once for every complete revolution of wheel no. 1. The pawl that positions the ratchet wheel attached to wheel no. 3 is still shorter than the other two pawls and engages the ratchet wheel only when the center pawl falls into the deep groove. Thus, wheel no. 3 is positioned once for every complete revolution of wheel no. 2.

c. Paper Tape Feed Mechanism. The paper tape on which the angle and time recordings are made advances after each printing. Operation of the time printing hammer causes the tape to advance. Figure 2-69 is a mechanical diagram of

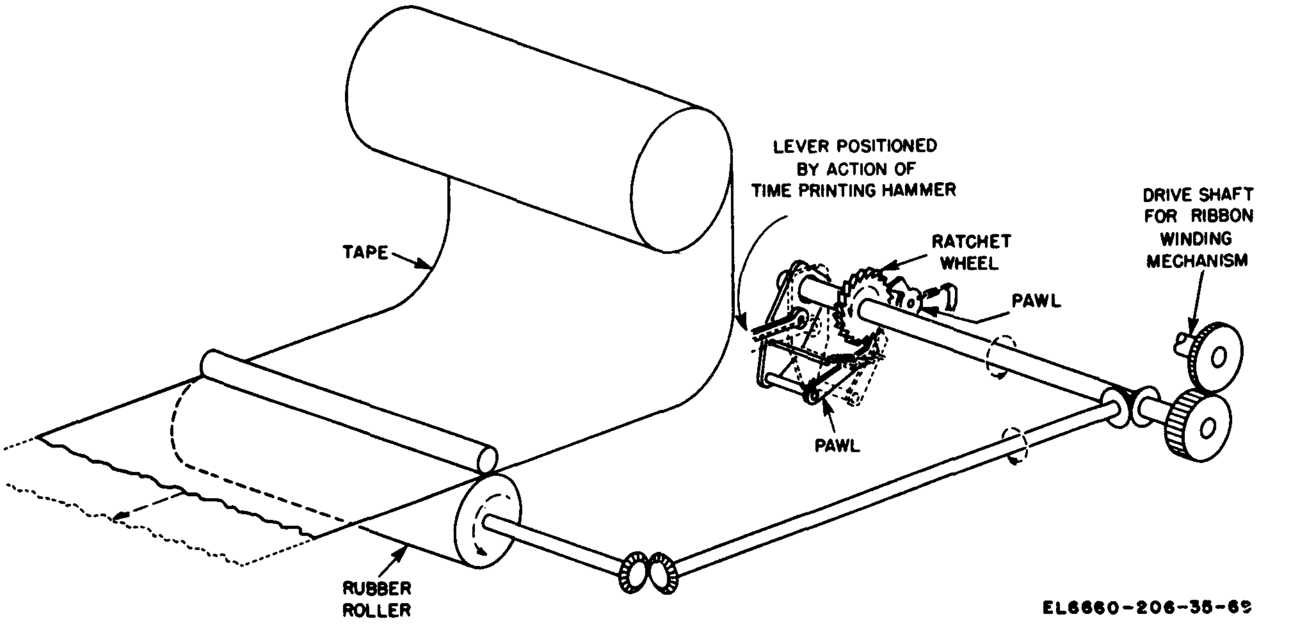


Figure 2-69. Paper feed mechanism, mechanical diagram.

the tape feed mechanism. At each printing, a pawl engages a ratchet mounted on a shaft geared to a rubber roller. Rotation of the rubber roller advances the tape into positions to receive the next printing. Two wire springs exert pressure on the paper to present a constant load to the rubber roller when it is advancing the paper.

d. Ribbon Winding Mechanism. The printing ribbon moves after each printing and, when it is fully wound on one of the spools, the direction of ribbon travel is reversed. Figure 2-70 is a diagram of the ribbon-winding mechanism. A shaft, driven by the paper feed mechanism, is geared to one of the spools. In figure 2-70, solid lines indicate that the ribbon is moving to the left. When the ribbon is fully wound on the left-hand spool, a rivet on the right-hand end of the spool moves a lever which shifts the gear train so that the right-hand ppool starts winding the ribbon. This causes the ribbon to travel to the right as indicated by the dotted lines and arrows.

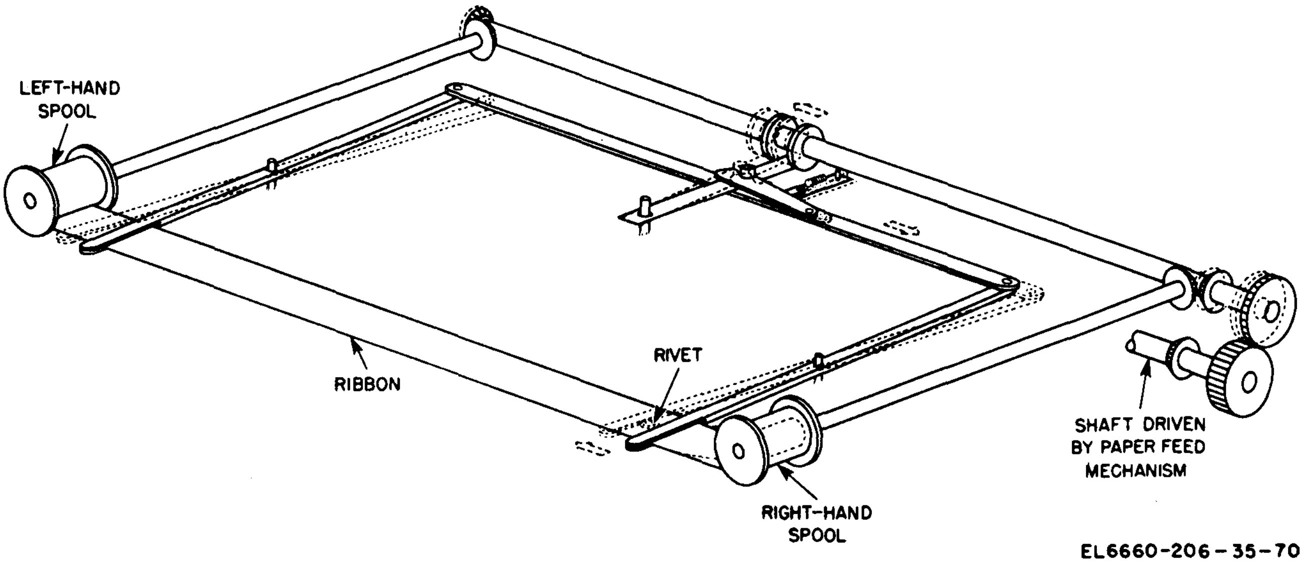


Figure 2-70. Ribbon winding mechanism, mechanical diagram.

Section V. METEOROLOGICAL DATA TRANSMISSION SYSTEM

2-31. General

The output of the receiving system (para 2-38) is applied to the meteorological amplifier (fig. 2-71). This amplifier rejects the 34 Hz error modulation signals and shapes and amplifies the meteorological pulses. A loudspeaker allows monitoring of the meteorological amplifier output. The output pulses are applied through the control-recorder (not shown). Input and output wave shapes to each stage are included on the block diagram.

2-32. Block Diagram

a. The signal from the receiving system is applied to the grid of first pulse amplifier V1006A (fig. 2-71). This stage amplifies the negative portion of the input signal and rejects the sinusoidal content of the modulation frequency (34 Hz). The amplified positive pulses at the output of V1006A are applied to second pulse amplifier V1006B.

b. The pulses are amplified and inverted by V1006B and applied to cathode follower V1007A. The cathode follower applies the signal to limiter V1007B without inverting the pulses. The pulses at the output of the limiter are of constant amplitude, regardless of amplitude variations in the input signal. The output of V1007B triggers meteorological multivibrator V1008.

c. The multivibrator produces square waves of constant amplitude and width. These pulses are applied to audio output tube V1009 for power amplification. The output of V1009 is applied

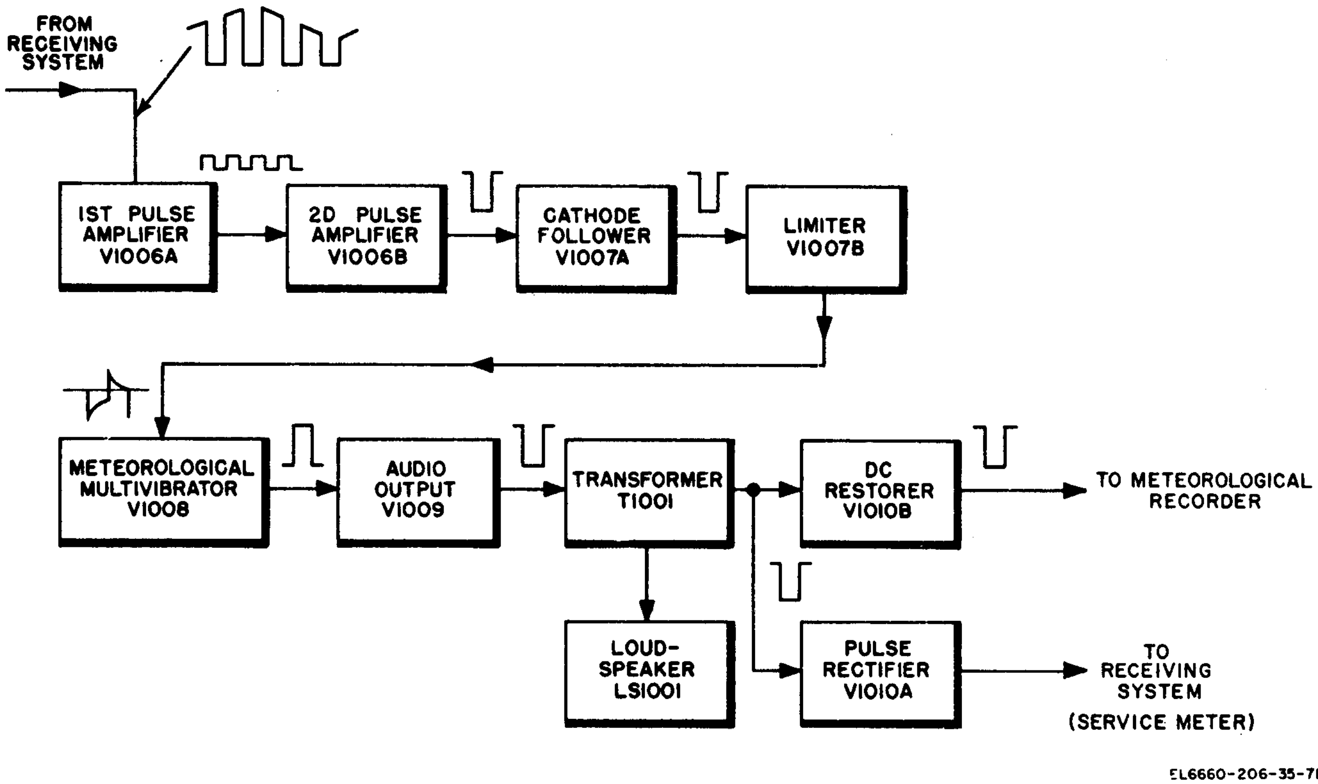


Figure 2-71. Meteorological amplifier, block diagram.

through T1001 to loudspeaker LS1001. T1001 also applies the signal to pulse rectifier V1010A and to dc restorer V1010B. V1010A rectifies the output pulse and applies it to the service meter circuit in the receiving system for sampling. V1010B supplies the dc reference for the negative square pulse output of the meteorological amplifier. This output pulse is applied through the control-recorder to the meteorological recorder.

2-33. First Pulse Amplifier

First pulse amplifier (fig. 2-72) V1006A is one-half of a twin triode. The signal from V1001 (para 2-12b) or V1002B (para 2-12c) in the receiving system (depending on the rawin set model) is applied to V1006A through C1015 and R1048. The grid of V1006A is connected to B+ through R1049, and the cathode is grounded. Therefore, V1006A conducts at saturation in the steady-state condition (no signal). The negative meteorological pulses in the applied signal cause the tube to cut off for the duration of each pulse. The rise in plate voltage produces a positive square wave. The sine modulation and positive content of the applied signal have no effect on the meteorological amplifier, because V1006A is conducting at saturation in the steady-state condition. Resistor R1045 is the plate load resistor. The positive square wave at the plate is applied to the second pulse amplifier.

2-34. Second Pulse Amplifier

The positive square wave output of V1006A is applied through C1016 and R1043 to the grid of second pulse amplifier V1006B (fig. 2-72). Resistors R1047 and pulse set control R1051 form a voltage-dividing network between B+ and ground. The cathode of V1006B is connected through R1102 to arm R1051, and the cathode voltage can be adjusted from approximately 0 to +30 volts. The grid is connected through R1043 to the junction of R1101 and R1050 and is approximately +10 volts. R1051 is adjusted so that the cathode is held more positive than the grid, and the tube operates below cutoff in the steady-state condition. The tube conducts only for the duration of the positive pulses applied to the grid. Noise and other undesired pulses which are normally of smaller amplitude are rejected. Resistor R1046 is the plate load resistor. The signal is amplified and inverted and the negative pulse output is applied through C1017 to V1007A. In Rawin Receiver R-301D/GMD-1, with S1002 in the FM position,

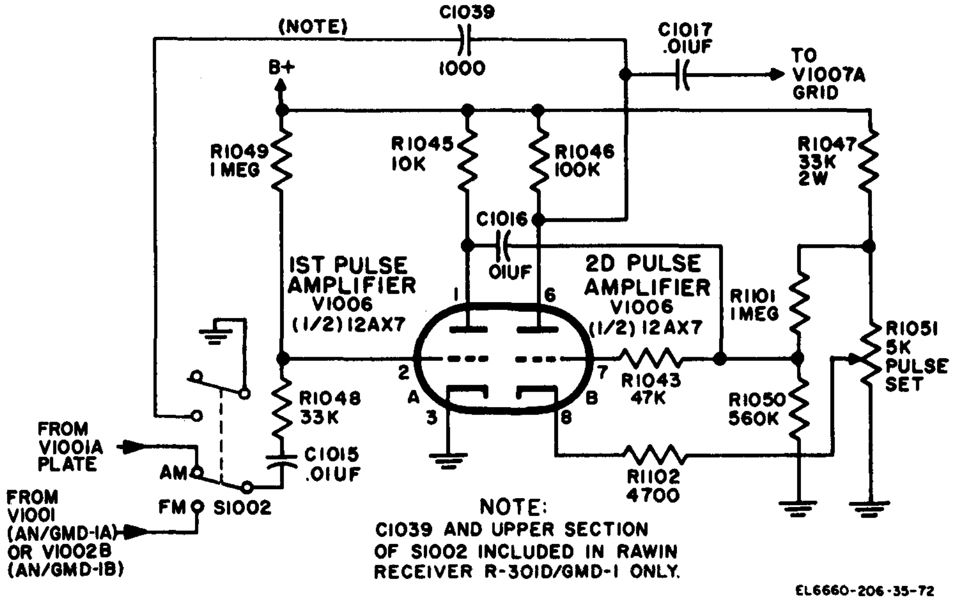


Figure 2-72. First and second pulse amplifiers, simplified schematic diagram.

C1039 is connected between the plate of V1006A and ground. This enables the meteorological channel to accept fm pulses of 200 microsecond duration. The normal am. pulse lengths are 50 microseconds.

2-35. Cathode Follower

Cathode follower V107A is one-half of a twin triode (fig. 2-73). The negative pulse from V1006B is applied through C1017 to the grid of V1007A. The grid is biased positive by a voltage divider, R1052 and R1056, connected between B+ and ground. V1007A is connected as a cathode follower and conducts constantly in the steady-state condition. The negative pulses applied to the grid decreases the voltage drop across R1053. The cathode voltage follows the grid voltage, and a negative square pulse is produced at the cathode. Since R1053 is common to the cathode-follower and limiter stages, the output puke across the cathode resistor is coupled directly to limiter V1007B.

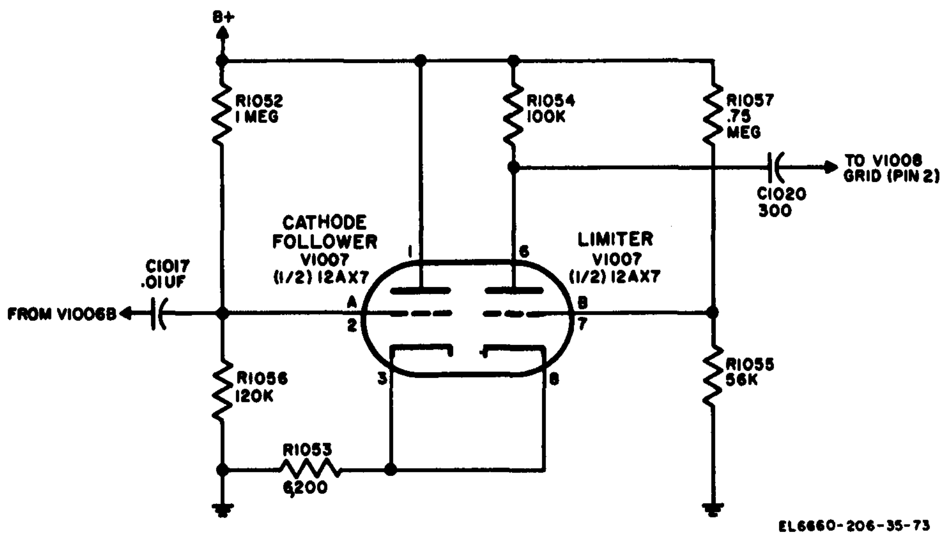


Figure 2-73. Cathode follower and limiter, simplified schematic diagram.

2-36. Limiter

The grid of limiter V1007B (fig. 2-73) is biased positive from a voltage divider, R1057 and R1055. In the steady-state condition, the cathode is more positive than the grid because of the voltage drop across R1053. Therefore, V1007B operates at cutoff. When negative pulses applied to the cathode drives the cathode less positive than the grid, the tube conducts. The pulse amplitudes are sufficient to drive the tube to saturation. Conduction of V1007B produces a voltage drop across plate load resistor R1054, and a negative pulse output. The stage effectively limits the output pulses, and because the tube operates from cutoff to saturation, and variations in the amplitude of the input pulses do not affect the amplitude of the output pulses.

2-37. Meteorological Multivibrator

a. Meteorological multivibrator V1008 (fig. 2-74) is a monostable multivibrator. In the steady-state condition, V1008A operates at cutoff, because of the bias developed across common cathode resistor R1063. In the steady-state condition, V1007B conducts because of the positive grid voltage obtained from voltage divider R1058 and R1103.

b. The negative pulse from V1007B is differentiated by C1020 and R1064, the grid resistor for V1008A. This network produces a series of negative pulses alternating with positive pulses. Since V1008A is operating at cutoff only, the leading edge of a positive pulse will trigger the multivibrator. This positive pulse overcomes the negative bias on the grid of V1008A, and causes this section to conduct. Conduction in V1008A produces a drop in plate voltage due to current flow in plate load resistor R1060. The lower plate voltage is coupled to the grid of V1008B through C1022, thereby causing this section to cut off. This condition continues until the charging time constants of the circuit (determined by R1058 and R1103, and C1021 and C1022) bring the grid of V1008B above the cutoff point and reestablish the steady-state condition. Cathode resistor R1063 is common to both sections of V1008. Capacitor C1021 also is a shaping capacitor which eliminates spikes in the waveform of the pulse at the plate of V1008A. Resistor R1059 is the plate load resistor for V1008B. For each trigger pulse at the grid of V1008A, a positive pulse of constant duration and amplitude is produced at the plate of V1008B. The output pulses are applied to audio output stage V1009.

2-38. Audio Output and Loudspeaker

a. Audio Output Stage. The audio output stage (fig. 2-75) uses a beam power amplifier V1009. A voltage divider that consists of R1062 and R1104 applies a bias of about -15 volts to the grid through R1065. Resistor R1065 limits grid current in case of overload. The positive square pulse from V1008 is coupled through C1036 and R1065 to the grid of V1009. Under a no-signal input, the tube is operating near cutoff. The degenerative and self-biasing effect of cathode resistor R1105 limits

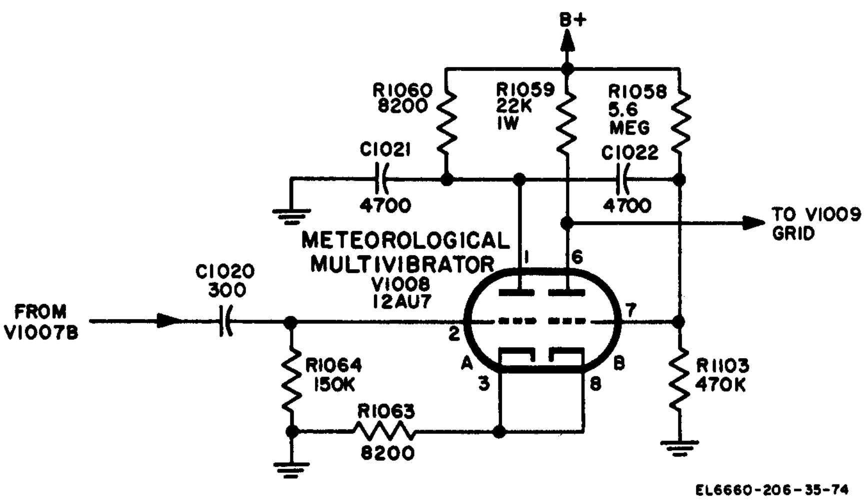


Figure 2-74. Meteorological multivibrator, simplified schematic diagram.

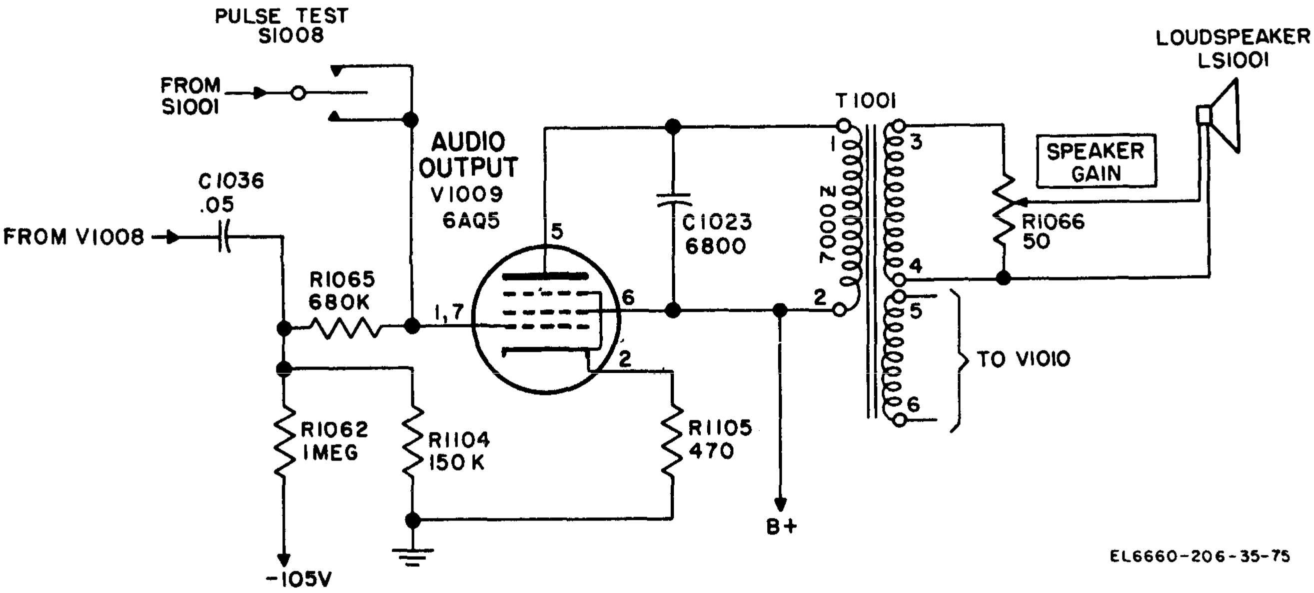


Figure 2-75. Audio output circuit simplified schematic diagram.

plate current during positive grid swings. In the plate circuit, the higher frequency components of the output signal are bypassed by C1023. The low frequency components are applied to the primary of T1001. This pulse transformer has two secondary windings, one applies the signal to the loudspeaker and the other applies the signal to V1010.

b. Loudspeaker. The signal induced in one secondary of T1001 drives loudspeaker LS1001. SPEAKER GAIN potentiometer R1066 is connected across this secondary winding as a volume control. The output, at a frequency of 5 to 200 Hz is used to check the presence of a meteorological pulse. Pulse test switch S1008 applies the output from the if, amplifier directly to the grid of V1009, bypassing the meteorological amplifier. The normal modulated if. amplifier output level is sufficient to produce an audible signal in the loudspeaker. It is possible to determine whether the absence of meteorological pulses is caused by failure in the meteorological amplifier or in the preceding circuits.

2-39. Dc Restorer

Another secondary winding of T1001 is connected between the plate of dc restorer V1010B and ground (fig. 2-76). Damping resistor R1067 is connected across the secondary winding. V1010B supplies a dc reference to the meteorological amplifier. It functions as a negative clamping circuit and only permits an output which is negative with respect to the grounded cathode. When terminal 5 of T1001 is positive with respect to terminal 6, there is no output voltage because the diode conducts and effectively places the plate at ground potential. When terminal 5 is negative with respect to terminal 6, the diode does not conduct because the plate is more negative than the cathode. These negative output pulses are applied through the control-recorder to the meteorological recorder.

2-40. Pulse Rectifier

Pulse rectifier V1010A (fig, 2-77) is connected between the pulse output line to the control-recorder and the service meter circuit. For the duration of each negative pulse output, V1010A conducts since the cathode is negative with respect to the plate. C1024 and R1068 form a long time-constant circuit. The peak pulse voltage developed in this charging circuit is applied to the SERVICE METER when the METER SELECTOR switch is in the PEAK PULSE position (fig. 2-5 or 2-6).

2-41. Meteorological Amplifier Output

The output of the meteorological amplifier from V1010B is connected by cable to the control-recorder. From there, the signal is applied through meteorological cable W921 to Radiosonde AN/TMQ-5(*).

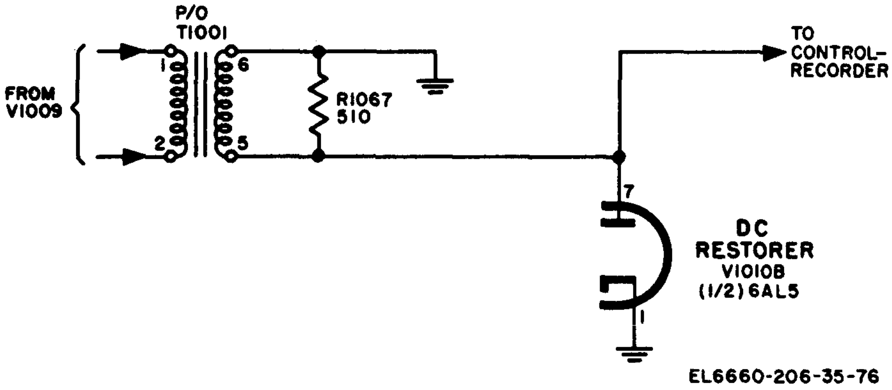


Figure 2-76. Dc restorer, simplified schematic diagram.

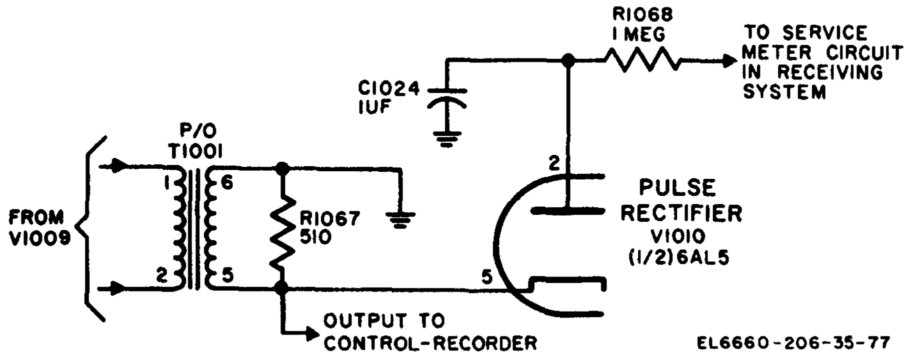


Figure 2-77. Pulse rectifier, simplified schematic diagram.

Section VI. Ac POWER DISTRIBUTION

2-42. General

TM section describes the 115 volt ac power distribution in the rawin set. The 115 volt ac supply is connected to the control-recorder (fig. FO-3), and distributed to other components of the rawin set and to the meteorological recorder through interconnecting cables. Separate power switches are located on the control-recorder, antenna control, receiver, and meteorological recorder.

a. Fuses. Fuses located in the various unit protect the ac circuits against current overloads. The various fuse locations and ratings are listed in TM 11-6660-206-12.

b. Dial Lights. After MAIN POWER switch S806 (fig. FO-3) is closed, dial lamps 1807, DS701, and DS201 will illuminate the angle indicators on the control-recorder, azimuth unit, and elevation unit. When POWER switch S604 is closed, indicator lamp DS602 on the antenna control will light. When POWER switch S1004 and DIAL LIGHT switch S1006 are closed, dial lamp DS501 on the receiver will light. These dial and indicator lamps provide visual indications of the presence of 115 volts ac in the various units.

c. Power Receptacles. Two utility power receptacles for 115 volts ac are available. Utility outlet J602 is on the front panel of the antenna control. A second utility outlet, J702, is located on the azimuth unit. In Rawin Set AN/GMD-1A, J702 supplies power to a heater lamp placed inside the azimuth unit for the elimination of moisture.

d. Power Switches.

(1) *MAIN POWER switch S806.* MAIN POWER switch S806 on the control-recorder is the main power switch for the rawin set. Circuits that are energized by switch S806 are described in paragraph 2-43.

(2) *POWER switch S604.* After MAIN POWER switch S806 is placed at ON, POWER switch S604 is used to apply 115 volts ac to the antenna control. Circuits that are energized by switch S604 are described in paragraph 2-44.

(3) *POWER switch S1004.* After MAIN POWER switch S806 is placed at ON, POWER switch S1004 is used to apply 115 volts ac to the receiver. Circuits that are energized by this switch are described in paragraph 2-44.

(4) Meteorological recorder power switch. MAIN POWER switch S806 controls the application of 115 volts ac to the meteorological recorder. Refer to the technical manual for the meteorological recorder being used for a description of the ac power circuits.

2-43. Circuits Energized by Main Power Switch S806

a. General. Figure FO-3 shows the circuits energized by MAIN POWER switch S806. The power distribution for the different models of the rawin set are shown in figures FO-4, FO-5 and FO-6.

b. Control-Recorder Circuits.

(1) With MAIN POWER switch S806 closed, 115 volts ac is applied from receptacle J803 through main fuses F801 and F802 on the rear of the control-recorder. These main fuses are for the entire rawin set. Indicator lamp 1802 or 1803 are blown fuse indicators. Indicator lamp 1807 illuminates the angle indicators on the control-recorder. Fuses F803 and F804 protect the circuits to elevation synchro receiver B802, azimuth synchro receiver B801, print cycle motor power supply transformer T804 and the reset group and printing group.

(2) From the control-recorder, 115 volts ac connects to the other components of the rawin set through B and W of J801, and to the meteorological recorder through A and B of J802. MOTORS STANDBY switch S805, ELEVATION switch S802, and AZIMUTH switch S801 apply 115 volts ac to the antenna control circuits in the rawin set. These are operator-controlled switches. These control circuits are shown in figures FO-4, FO-5, and FO-6.

c. Azimuth Unit Circuits.

(1) From the control-recorder, 115 volts ac is applied through cable W901 to B and W of J703 on the azimuth unit. The ac circuits in the azimuth unit are distributed to the other units of the rawin set through sliprings and interconnection wiring, Fuse F701 is in series with receptacle J702, dial light DS701 (E708 in some models), and the heater circuit consisting of HR701 and thermostat S702 (K701 in some models).

(2) The rotor of azimuth synchro transmitter B702 is connected through fuse F702 to the 115 volt ac supply. Fuse F702 also protects the rotor of elevation synchro transmitter B202. B202 is connected through pin N of P702, J303, TB702-25 (E704-25 in some models), and E707-25. The 115 volt ac supply is applied from TB702 in the azimuth unit to P702 and to J303 in the housing.

d. Units Mounted Within or On Housing. The housing distributes the 115 volt ac supply to the antenna control, the receiver, and the elevation unit.

(1) *Antenna control.* From pins P and J of J303, the 115 volt ac supply leads to pins G and H of P304 and J604 into the antenna control. The only circuit energized at this time is power receptacle J602 through fuse F603. POWER switch S604 must be closed before any of the other ac circuits in the antenna control are energized,

(2) *Receiver*. From pins N and H of J303 the 116 volt ac supply leads to pins V and W of P302 and J1005 into the receiver. POWER switch S1004 must be closed before any of the receiver ac circuits are energized.

(3) *Elevation unit.* From pins N and H of J303, the 115 volt ac supply leads to pins C and

B of J302, P952, P951, and J201 to the elevation unit. The ac supply is connected within the elevation unit to terminal board TB201 (E201 in some models), where it is distributed to elevation dial light DS201 (E202 in some models) and the rotor elevation synchro transmitter B202. A heater circuit is used to reduce the accumulation of moisture within the elevation unit. This circuit consists of heater HR201 and thermostat S204.

(4) *Housing*. In the Rawin Set AN/GMD-1B housing, 115 volts ac is made available for the proposed ranging equipment at two jacks J305 and J306.

2-44. Circuits Energized by POWER Switches S604 and S1004

a. General. Figure 2-78 shows the circuits energized by POWER switches S604 and S1004. The ac power distribution for the different models of the rawin set are shown in figures FO-4, FO-5, and FO–6.

b. Circuits Energized by S604.

(1) With POWER switch S806 on the control-recorder closed, 115 volts ac is present at pins G and H of J604. When POWER switch S604 is closed, indicator lamp DS602 (I602 on some models) should light to indicate that 115 volts ac is present. In parallel with this circuit are the primary windings of power transformer T606 and transformer T603. T603 is used as a filament transformer in some models which use thyratron driver tubes.

(2) The time-delay circuit consisting of K603 and K601, controls the circuits in the secondary of power transformer T606, and will energize when thermal relay K603 closes. Other ac circuits within the antenna control will not be energized until associated control devices are automatically or manually operated. These include the thyratron overload relay circuit (in those models using thyratron tubes), the motors standby circuit and the manual control relays for moving the reflector.

(3) Blower motor B301, located in the housing, receives its power through switch S604, and is controlled by thermostat S303 (K301 in some models). All ac circuits energized by switch S604 are protected by fuses F601 and F602 located in the antenna control.

c. Circuits Energized by S1004. With MAIN POWER switch S806 (fig. FO-3) closed, 115 volts ac is present at pins V and W of J1005, When POWER switch S1004 is closed, 115 volts ac is applied to power transformer T1003. One of the windings of the two-phase local oscillator tuning motor B501 is connected through J501 and P1004 to switch S1004. Capacitor C501 provides the necessary 90° phase shift for this winding of the motor. Local oscillator antihunt generator G501 is also connected to J501 with B501. All of these components are protected by fuses F1001 and F1002 located in the receiver.

2-45. Power Distribution Differences

a. General. This paragraph describes the differences in ac distribution between the different models of rawin sets. Rawin Set AN/GMD-1A power distribution is shown in figure FO-4. The ac power distribution for Rawin Set AN/GMD-1B* is shown in figure FO-5. The distribution for Rawin Set AN/GMD-1B** is shown in figure FO-6.

b. Circuit Differences in Models.

(1) In Rawin Set AN/GMD-1B*, three automatically controlled heater elements have been installed, HR701 in the azimuth unit, HR201 in the elevation unit, and HR101 in the antenna scanner assembly. In some sets of this model, a manually controlled heater element, HR702, has been installed in the azimuth unit.

(2) Terminal boards E702, E703, E704, E706, and E707 in the azimuth unit are numbered differently. In Rawin Set AN/GMD-1A, the terminals are numbered in sequence, while in Rawin Set AN/GMD-1B**, the terminals are numbered to match the slipring numbers. In the housing of Rawin Set AN/GMD-1B*, external jacks J305 and J306 have been added to connect various circuits to proposed ranging equipment. The 115 volt ac supply is available at these jacks when MAIN POWER switch S806 is placed at ON (closed).

(3) In Rawin Set AN/GMD-1B**, terminal boards E702 and E703 in the azimuth unit are changed to TB705 and TB706. The circuit for

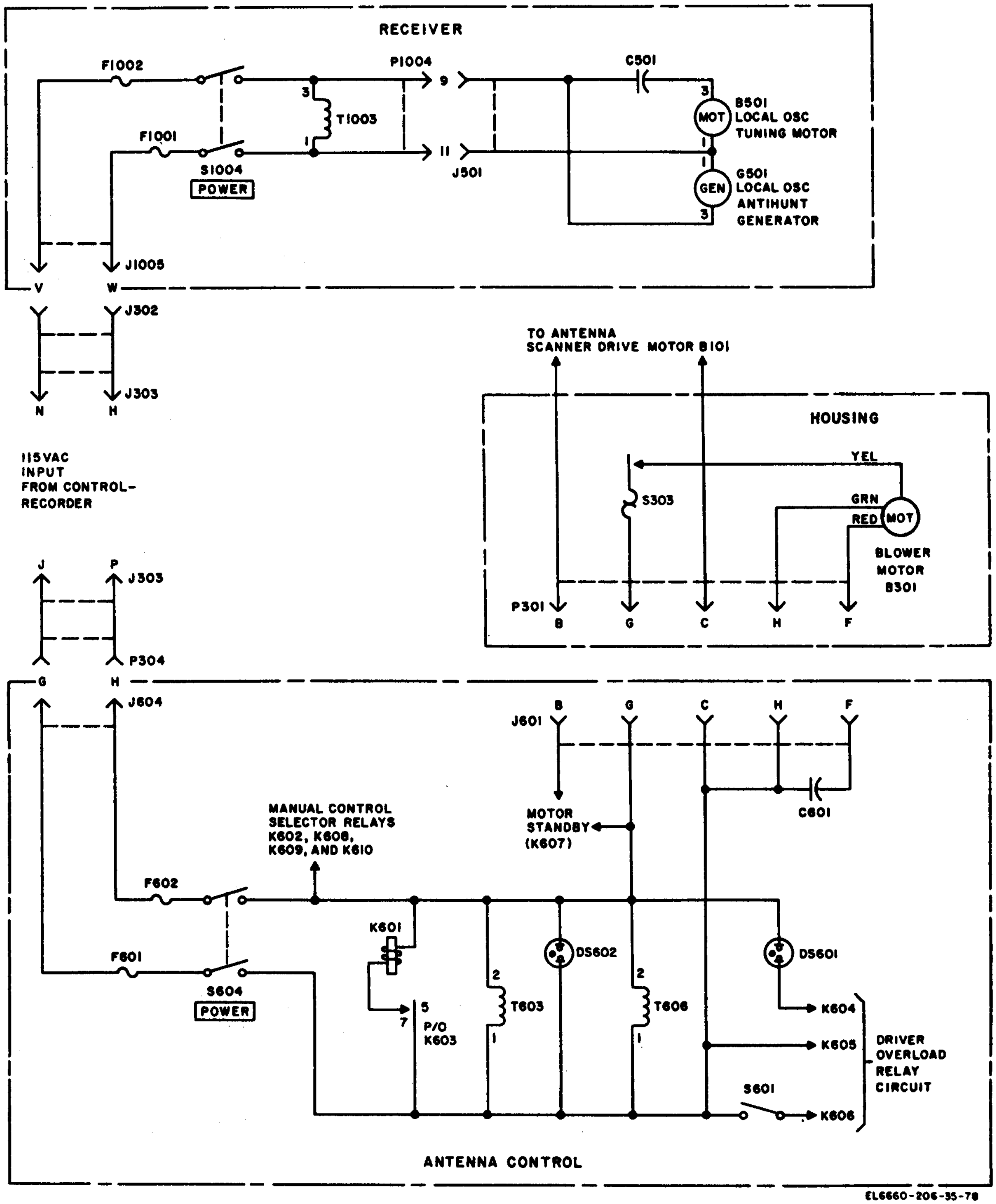


Figure 2-78. Circuits energized by POWER switches S604 and S1004.

heater HR702 has been eliminated. In the control-recorder, pins A and B on J802 are reversed. Other circuit differences consist of circuit symbol number changes as follows:

From	To
J803	P801
K701	S702
E708	DS701
E202	DS201
HR702	HR201
K702	S204
E201	TB201
K301	S303
1601	DS601
1602	DS602
1603	DS603
E101	TB101
K102	S101

Section VII. COMPLETE BLOCK DIAGRAM

2-46. General

The complete block diagrams of Rawin Sets AN/GMD-1A, AN/GMD-1B*, and AN/GMD-1B** (fig. FO-7, FO-8, and FO-9) coordinate the block diagrams of the individual systems within the rawin set. The relationship of each system to the overall operation of the rawin set is presented.

2-47. Purpose of Complete Block Diagram

The purpose of the complete block diagram is twofold: First, it is intended for use by the repairman who has previously studied this particular equipment but who has not worked with it for some time. In this respect, the diagram serves as a quick review of the operation of the set. Secondly, a technician who has never seen the set but who has the knowledge of fundamental radar principles can use this diagram to obtain the necessary information for a basic understanding of the equipment. The diagram also can aid in troubleshooting procedures. The repairman can follow the path of a signal from system to system and from circuit to circuit without referring to the detailed schematic diagrams. After the location of a trouble has been traced to an individual circuit by this block diagram, reference can be made to the specific schematic diagram and troubleshooting chart that apply to that circuit.

2-48. Complete Block Diagram Description

a. In each block diagram, the five groups of blocks enclosed in heavy solid lines represent the major systems of the rawin set. A second type of block is used to indicate the component circuits of the various systems. Each circuit is inclosed by a broken line which consists of alternate dashes, one long and two short. The final breakdown within a system is the individual stage block which comprise each component circuit. A thin solid line incloses each stage.

b. Interconnections within and between systems are classified according to electrical and mechanical connection. The electrical connections are shown as solid lines, with arrowheads showing the directions in which the signal flows. In mechanical components, dash lines are used to represent the gears and shafts that actually connect one part to another, and arrowheads show the direction in which motion is transmitted. Except where the power input forms an integral part of the circuit, ac and dc power connections within the various systems have been omitted.

c. Significant input and output waveforms are shown to aid in understanding the function of each circuit. Note that the complete block diagram groups the component parts of the rawin sets in accordance with their function, not their physical location.

CHAPTER 3

DIRECT SUPPORT MAINTENANCE

Section I. GENERAL

3-1. Scope of Maintenance

a. This chapter provides the data, instructions, and procedures required by direct support maintenance personnel for Rawin Set AN/GMD-1(*). It includes instructions for trouble-shooting and repair procedures. This chapter provides replacement procedures which must be performed at direct support.

b. Direct support maintenance of Rawin Set AN/GMD-1(*) includes-

(1) Maintenance and troubleshooting techniques (para 3-3 through 3-10)

(2) Equipment performance checklist (para 3-11 through 3-16)

(3) Antenna assembly troubleshooting, and repair (para 3-17 through 3-20)

(4) Receiver troubleshooting, repair and adjustment (para 3-21 through 3-38)

(5) Antenna control troubleshooting and repair (para 3-39 through 3-48)

(6) Housing, azimuth, elevation unit trouble-shooting and repair (para 3-49 through 3-76)

(7) Control recorder troubleshooting repair, and adjustment (para 3-77 through 3-101).

3-2. Tools, Test Equipment, and Materials Required

Table 3-1 lists the tools and test equipment required for direct support maintenance as indicated by the maintenance allocation chart for the equipment (TM 11-6660-206-12, Appendix C). Refer to TM 11-6660-206-35P for repair parts and special tools required for direct support of the Rawin Set AN/GMD-1(*).

Table 3-1. Test Equipment Required

Federal stock number	*Test equipment nomenclature*
6625-669-1215	Crystal Rectifier Test Set TS-268E/U
6625-911-6368	Counter, Electronic Digital Readout AN/USM-207
6625-669-4031	Generator, Sigma, 4N/USM-44
6625-192-5094	Audio Vacillator TS-382/U
6625-783-5965	Generator, Signal AN/URM-127
6625-646-9409	Multimeter, ME-26B/U
6625-643-1670	Multimeter, Electronic ME-30A/U
6625-242-5023	Multimeter, TS-352B/U

Table 3-1. Test Equipment Required (Continued)

Federal stock number	Test equipment nomenclature
6625-228-2201	Oscilloscope, AN/USM-281A
6625-519-1954	Oscilloscope, AN/USM-32
6625-566-4990	Wattmeter, AN/URM-98
6625-243-5174	Test Set, TS-538/U
6625-376-4939	Test Set, Electron Tube TV-7/U
5180-605-0079	Tool Kit, Electronic Equipment TK-100/G

3-3. Maintenance Techniques

a. General. The information in this chapter will aid the repairman in detecting abnormal operation, locating and correcting equipment trouble causing abnormal operation, and checking the serviceability of repaired equipment in a minimum amount of time. Instructions for performing preventive maintenance and lubrication are contained in TM 11-6660-206-12. This information also will aid in keeping the equipment in good working order so breakdowns and interruptions in operation will be kept to a minimum.

b. Detecting Faulty Operation. Indications of normal and abnormal operations are given in the various tables following. Also, normal readings that should be obtained on meters and the functioning of controls are listed in the first section of each troubleshooting and repair chapter.

c. Locating Trouble. The tables referenced in (1) through (3) below aid in rapidly locating the cause of trouble in the rawin set.

(1) *Equipment performance checklist.* An equipment performance checklist (table 3-8) enables the repairman to locate trouble based on the indications obtained when starting the equipment.

(2) *System symptom troubleshooting tables.* A system symptom troubleshooting table is located in each system troubleshooting and repair chapter; These tables are based on symptoms which indicate the location of trouble in the system. The system symptom troubleshooting table isolates trouble quicker than the system step-by-step troubleshooting tables ((3) below).

(3) *System step-by-step troubleshooting tables.* A system step-by-step troubleshooting table is located in each system troubleshooting and repair chapter. These tables consist of a series of steps for evaluating all phases of operation of the particular system. Generally, the system step-by-step tables are more comprehensive than the symptom tables ((2) above) and should be used if the symptom table does not isolate the trouble.

d. Correcting Trouble. The following information is included to aid in correcting the equipment trouble causing the faulty operation.

(1) Corrective measures are given in each table.

(2) Paragraphs covering the removal and replacement of parts follow each troubleshooting table.

3-4. Troubleshooting Techniques

a. General. To be effective, troubleshooting must be systematic. Generally, it is necessary to perform a sequence of operational checks, observations, and measurements before the cause of the trouble is revealed. If the proper sequence is followed, first the trouble will be traced to either a system or a component, then to a portion of the system or component, and finally to the defective part. This sequence is referred to as sectionalization, localization, and isolation of a trouble.

b. Sectionalization. The first step in troubleshooting is to sectionalize trouble either to a system, a component, or a chassis. Sectionalization can be accomplished through visual checks and operational checks and measurements in the equipment performance checklist. When troubleshooting with the components of the rawin set interconnected, proceed from the troubleshooting table referenced in these procedures.

c. Localization. After the trouble has been sectionalized, the equipment performance checklist will give a corrective measure or reference a system troubleshooting table. The referenced troubleshooting table will localize the trouble to a part (usually a stage) of the system.

d. Isolation. After trouble has been localized to a part, use visual inspection (e below), waveform analysis (para 3-6), voltage and resistance measurement (para 3-7), and parts substitution (para 3-9) to determine the defective part.

e. Visual Inspection. Troubles are sometimes caused by defects that are easy to see. Check as many of the following visible defects as may apply to the troubleshooting problem:

(1) Worn, broken, or disconnected cables or plugs.

(2) Binding controls or switches.

(3) Burned-out fuses.

(4) Wires broken because of excessive vibration.

(5) Unlit tube filaments indicating defective tubes.

(6) Obvious damage or mechanical abnormalities, especially of the antenna and other rf components.

(7) Cracked or charred resistors.

(8) Bulging or leaking capacitors.

(9) Blistering of paint or other signs of overheating on transformer and choke shields, and cases of motors and generators.

(10) Discoloration of the initiation on wires, solenoid windings, and windings of chokes and transformers. Under heavy overload, some wires may melt and result in no visible evidence other than a slight discoloration of the insulation surrounding the wire.

3-5. Troubleshooting Data

a. General. A list of the specific troubleshooting data which help to locate troubles in each particular system is given in the referenced data paragraph in the first section of each troubleshooting and repair chapter. The following troubleshooting data are supplied and should be consulted when necessary.

b. Complete Block Diagrams. The complete block diagrams (FO-7 and FO-8) give the electrical and mechanical interrelationship among the systems, components, and stages of the rawin set. By observing the symptoms and reasoning the proper causes, it is often possible to trace the cause of faulty operation to a trouble in a particular block.

c. Cabling Diagrams. A diagram of the cabling between components of the rawin set is shown in TM 11-6660-206-12.

d. Interconnection Diagrams. Interconnection diagrams (Fig. 3-19, 3-44, 3-45, and FO-12 through FO-20) show all the interconnections between the components of the rawin set. These diagrams show the number and terminating point of each wire.

e. Complete Schematic Diagrams. A complete schematic diagram is given for each major component of the rawin set. This type diagram shows all the circuitry in the component and can be used to determine the faulty part in a particular component.

f. Simplified Schematic Diagrams. Simplified schematic diagrams are located in the theory part of this manual and are functional segments of complete schematic diagrams. The electrical and mechanical functioning of the circuits can be followed easier with these diagrams than with the complete schematic diagrams.

g. Wiring Diagrams. Wiring diagrams are protided for all the major components of the rawin set to enable the repairman to trace from part to part within various components.

h. Voltage and Resistance Diagrams. Voltage and resistance diagrams are provided for each major component of the radar set. This type diagram gives normal voltage and resistance measurements at all tube sookets and at other significant points. Read the notes on each of these diagrams carefully so that the conditions under which the readings were obtained can be accurately duplicated.

i. Resistor and Capacitor Color Code Diagrams. Resistor and capacitor color code diagrams (figs. FO-1 and FO-2) are provided to aid maintenance personnel in determining the value and tolerance of resistors and the value, voltage rating, and tolerance of capacitors.

j. Reference Designation Number Location Table. To aid in parts location, a block of reference designation numbers has been assigned to each major component of Rawin Set AN/GMD-1(*). For example, all parts in Control-Recorder C-577(*)/GMD-1 are numbered from 800 to 899; that is, resistors in this component are designated R801, R802, etc., and capacitors are designated C801, C802, etc. Table 3-2 lists the block of reference designations assigned to each component.

Table 3-2. Component Reference Designators

Reference designation numbers	Components
100 - 199	Antenna scanner assembly and mixer assembly
200 – 299	Elevation Unit
300 – 399	Housing
400 – 499	If. amplifier (receiver)
500 - 599	Local oscillator (receiver)
600 - 699	Antenna control
700 - 799	Azimuth unit
800 - 899	Control-recorder
900 – 999	External cabling and connectors
1000 – 1099	Receiver

3-6. Waveform Analysis
(fig. 3-21 and 3-22)

a. By using an oscilloscope, waveforms may be observed at various significant points in the circuits of the rawin set. The normal waveforms should be obtained at these points and are shown on waveform illustrations in each system troubleshooting and repair chapter. Comparison of the observed waveforms often locates the trouble quickly.

b. Use the appropriate oscilloscope (table 3-1) and follow the operating instructions in the technical literature for the oscilloscope to obtain the waveforms. Before comparing the observed waveforms with the normal waveforms, carefully read all notes on the illustrations to duplicate exactly the conditions under which the waveforms were observed. If an observed waveform does not closely resemble the normal waveform, trouble is indicated.

c. A departure from the normal waveform indicates trouble between the point at which the waveform is observed to be normal and that at which the waveform is observed to be abnormal. For example, if a waveform is observed to be normal at the grid of a stage and abnormal at the plate of the same stage, it is an indication that trouble is in that stage. When trouble is indicated in a stage, replace the tube before making any further tests. If replacing the vacuum tube does not correct the trouble. place the orginal tube back in the tube socket and take voltage and resistance measurements (para 3-7) at the tube socket pins.

d. When a waveform at a certain point is observed to be abnormal, the cause may be the absence of a signal from another component. The point at which to start checking waveforms is at the component input. To determine that a signal is reaching the grid of the first tube in a particular channel when a test jack is not provided, remove the first tube in the channel and insert the oscilloscope test lead into the grid connection of the tube socket.

3-7. Voltage and Resistance Measurements
(fig. 3-20)

a. Voltage and resistance measurements aid in determining circuit conditions and in evaluating clues in the course of troubleshooting.

b. Compare the measured values of voltage and resistance with the normal values given in the voltage and resistance diagrams in each troubleshooting and repair chapter. Use the specific multimeter on which the normal readings were obtained. Use the 10 west possible meter scale when obtaining measurement. Carefully read the notes on the diagrams to insure exact conditions under which the normal readings were obtained.

c. When measuring voltages greater than 500, observe the following precautions:

(1) Shut off the power.

(2) Discharge high-voltage capacitors.

(3) Connect the multimeter leads to the test points.

(4) Step away from the multimeter.

(5) Turn on the power.

(6) Note the reading on the multimeter.

(7) Turn off the power.

(8) Discharge the high-voltage capacitors.

(9) Remove the multimeter test leads from the test points.

3-8. Replacing Parts
(fig. 3-13 and 3-14)

Careless replacement of parts often creates new troubles. When replacing parts, observe the following precautions:

a. Before a part is unsoldered, note the position of the leads. If a part, such as a transformer or a switch, has a number of connections, tag each lead to make the proper connections when replacing the part. Be careful not to damage other leads by pulling or pushing them away.

b. Make well-soldered joints. A carelessly soldered joint may create a new trouble and is one of the most difficult troubles to locate. Be careful not to allow drops of solder to fall into the equipment because they may cause a short circuit.

c. When a part is replaced in the rf or if. circuits, place it exactly the same as the original part. A part that has the same electrical value but different physical size may cause trouble in high-frequency circuits. In such circuits, use the same type capacitor for replacement and the same length lead because of the self-resonant frequencies of different capacitors. When replacing parts in high-frequency circuits, use the same grounds as in the original wiring to insure proper grounding. Failure to observe these precautions when replacing parts in high-frequency circuits may result in decreased gain or unwanted spurious oscillations.

3-9. Parts Substitution

a. Do not substitute parts indiscriminately. Substitute only when all of the following have been checked:

(1) The trouble has been isolated to a specific stage.

(2) The tube has been replaced.

(3) All voltage readings are normal.

(4) All resistance readings are normal.

b. Examples of other troubles are open bypass or coupling capacitors, capacitors that have changed value, and an interstage transformer with shorted turns.

c. When an open capacitor is suspected, connect a known good capacitor of equal value across the capacitor and check the operation of the component.

d. When all other possibilities of trouble have been ruled out, substitute a good part for the one which is suspected of being defective.

3-10. Intermittent

a. If the operation of a component is intermittently faulty, the trouble may often be difficult to locate when the component is functioning normally. To aid in locating the trouble, lightly tap each part of the suspected stage or portion of the component with an insulated rod while listening to the audio output.

b. Intermittent operation can be caused by loose connections, broken wires, or parts (including vacuum tubes with internal defects). Observing erratic behavior of one of the controls may locate intermittent troubles.

c. Intermittent may sometimes be located when the component or stage is heated. This can be done by blocking off the air intake and exhaust at the housing dust shields for a short time. The suspected stage might be covered and thereby limit the flow of air around it. This procedure often causes the defective part to break down under the increased ambient operating temperature.

Section II. EQUIPMENT PERFORMANCE CHECKLIST

3-11. General

The equipment performance checklist (para 3-16) aids in detecting abnormal operation of the rawin set and locates faulty parts that cause abnormal operation.

a. Follow the step-by-step starting procedures while carefully observing the Normal indications listed for each step.

b. If the normal indications are not obtained, check the *Abnormal indications* column.

c. Perform the checks in the *Corrective measures* column for the particular abnormal indications obtained.

3-12. Reference Data

A cross-reference data table 3-3 can be used by maintenance personnel when the equipment performance checklist is used for troubleshooting the rawin system.

3-13. Fusesand Interlocks

a. Fuses. Refer to TM 11-6660-206-12 for the table that lists the fuses in the ac power circuits. The table also lists the voltage and current rating of each fuse, the circuit it protects, and the component with figure references for location purposes. MAIN FUSES indicators 1802 and 1803, on the front panel of the control-recorder, show if either main fuse F801 or F802 is blown. These two fuses are in the ac lines that supply power to the entire set.

CAUTION

Always replace a blown fuse with one that has the same rating. If a replacement fuse blows, do not install another, fuse until the trouble has been remedied.

b. Interlocks. No interlocks are in the rawin set; therefore, it is important to remove power from the portion of the set being worked on. If in doubt as to which power switch to place in the off position, use MAIN POWER switch S806 on the control-recorder or remove power at its source.

3-14. Test Equipment Required

Table 3-4 lists the test equipment required for troubleshooting Rawin Set AN/GMD-1(*) when using the equipment performance checklist on the starting procedure.

3-15. Preliminary Checks and Control Settings

Preliminary operations that must be completed before proceeding with the equipment performance checklist para 3-16) are outlined in a through *c* below.

Table 3-3. Cross-Reference Data

Reference	*Data*
Paragraph 2-18 (TM 11-6660-206-12)	Tubes, fuses, and their location.
Paragraph 2-42	Ac power distribution theory.
Figure 4-2	Control-recorder, top view.
(TM 11-6660-206-12)	Rawin set cabling diagram.
(TM 11-6660-206-12)	If. amplifier tube location.
(TM 11-6660-206-12)	Receiver (less if. amplifier), tube and fuse location.
(TM 11-6660-206-12)	Antenna control, tube and fuse location.
(TM 11-6660-206-12)	Azimuth unit, fuse location.
(TM 11-6660-206-12)	Control-recorder, front panel view.
(TM 11-6660-206-12)	Receiver, front panel view.
(TM 11-6660-206-12)	Antenna control, front panel view.
(TM 11-6660-206-12)	System components location.
(TM 11-6660-206-12)	Complete block diagram of AN/GMD-1A.
Figure FO-8	Complete block diagram of AN/GMD-1B.
Figure FO-3	Ac circuits energized by S806.
Figure 2-78	Ac circuits energized by S604 and S1004.
Figure FO-4	Ac power distribution schematic diagram (AN/GMD-1A).
Figure FO-5	Ac power distribution schematic diagram (AN/GMD-1B*).
Figure FO-6	Ac power distribution schematic diagram (AN/GMD-1B**).

Table 3-4. Test Equipment for Troubleshooting at Starting Procedure Level

Test equipment	*Common name*	*Technical manual*
Multimeter TS-352B/U	Multimeter	TM 11-6625-203-12
Test Set, Electron Tube TV-7/U	Tube tester	TM 11-6625-274-12
Test Set TS-538(*)/U[a]	Testset	TM 11-6625-213-12

[a]Supplied with Rawin Set AN/GMD11(*).

a. Additional damage will be caused if power is applied to equipment in which a complete or partial short circuit exists. When any of the following conditions apply, check for short circuits before applying power to the equipment:

(1) A replaced fuse has blown.

(2) Smoke observed coming from a component.

(3) Overheated parts observed or smelled.

(4) A defective component being serviced apart from other components of the rawin set and the nature of the trouble is not known.

(5) Abnormal symptoms reported from operational tests indicate possible partial or complete short circuits.

b. Check with the operator for indications of the location of trouble, check the cabling of the set, and set the switches and controls as indicated in tables 3-5, 3-6, and 3-7.

c. A signal source must be provided and should be set up prior to the operation of the rawin set. Because of its use during normal operation of the rawin set, the radiosonde is recommended as a signal source. Prepare the radiosonde as outlined in the technical manual for the radiosonde. An alternate signal source may be produced by Test Set TS-538(*)/U.

3-16. Equipment Performance Checklist

Table 3-8 lists the procedures for determining if malfunctions exist in the rawin set. The procedures give both normal and abnormal indications. If an abnormal indication is observed, instruction for the corrective action is also given.

Table 3-5. Control-Recorder Settings

Switch or control	*Position*
MAIN POWER switch S806	OFF
RECORDS CONTROL switch S818	STANDBY
PRINTINGS PER MINUTE selector switch S817	Desired rate
1 REV TO RESET TIME knob*	Rotate clockwise 1 revolution to reset the TIME indicator to 0.

*Do not operate RESET TIME knob when operating in FLIGHT position.

Table 3-6. Receiver Settings

Switch	*Position*
POWER switch S1004	OFF
DIAL LIGHT switch S1006	ON
AFC-MANUAL switch S1005	AFC
METER SELECTOR switch S1003	PEAK PULSE

Table 3-7. Antenna Control Settings

Switch or control	*Position*
POWER switch S604	OFF
MANUAL-NEAR AUTO-FAR AUTO switch S605	MANUAL
AZIMUTH control R665	Pointer straight up.
ELEVATION control R632	Pointer straight up.

Table 3-8. Equipment Performance Checklist

Step	Procedure	Normal indications	Abnormal indications	Corrective measures
1	Set MAIN POWER switch S806 of the control-recorder to ON. Allow a 15-minute warmup period.	Control-recorder angle indicator lamp 1807 lights.	Either or both MAIN FUSES indicators 1802 and 1803 light.	Replace main fuses on rear of control-recorder.
			Angle indicator lamp 1807 does not light; indicators 1802 and 1803 do not light.	Check angle indicator lamp with multimeter; replace if necessary (para 2-28b). If angle indicator lamp 1807 is good, check MAIN POWER switch S806 for continuity with power cable CX-2043/U removed (fig. FO-27. Replace MAIN POWER switch S806 if necessary.
		Control-recorder POWER INTERRUPTED lamp 1806 lights.	Control-recorder POWER INTERRUPTED lamp 1806 does not light.	Replace RECORDER FUSES F803 or F804. If this does not correct trouble, check indicator lamp 1806 with the multimeter; replace if necessary (fig. FO-27).
		Azimuth unit angle indicator lights.	Azimuth unit angle indicator does not light.	Replace fuse F701. If this does not correct trouble, check indicator lamp DS708 with the multimeter (fig. FO-30); replace if necessary.
		Elevation unit angle indicater lights.	Elevation unit angle indicator does not light.	Replace fuse F702. If this does not correct trouble, check indicator lamp DS201 with multimeter (fig. 3-43); replace if necessary.
2	Set POWER switch S1004 of the receiver to ON.	Receiver dial lamp illuminates M501.	Dial lamp does not light.	Replace fuse F1001 or F1002 (fig. 3-9). If this does not correct trouble, check dial lamp DS501 with the multimeter; replace if necessary (fig. FO-23). a. If trouble is still present, observe receiver tubes; if lighted, proceed to c following; if not check to see that P302 is seated properly in J1005 (fig. 3-9). *b.* If trouble continues, check switch S1004 and replace if necessary (fig. FO-5).

Table 3-8. Equipment Performance Checklist-Continued

Step	*Procedure*	*Normal indications*	*Abnormal indications*	*Corrective measures*
				c. If switch S1004 is good, check power transformer T1003 and replace if necessary (fig. FO-23).
				d. If power transformer T1003 is good, check DIAL LIGHT switch S1006; replace if necessary.
3	Set POWER switch S604 of the antenna control to ON.	POWER INDICATOR DS602 lamp lights.	POWER INDICATOR lamp DS602 does not light.	Replace fuse F601 or F602 (fig. 3-23).
				a. If this does not correct trouble, check POWER INDICATOR lamp DS602; replace if necessary (fig. FO-15).
				If POWER INDICATOR lamp is good, check to see that P304 is seated properly into J604 (fig. 3-23).
				b. If trouble continues, check POWER switch S604; replace if necessary (fig. FO-15).
4	Observe MOTORS STANDBY lamp 1603; if lighted, set MOTORS switch S602 to opposite position.	MOTORS STANDBY lamp does not light, antenna scanner assembly drive motor B101 can be heard rotating.	Lamp remains lighted, antenna scanner assembly drive motor B101 does not rotate.	Check S805, S602, and K607 with multimeter and replace if necessary (fig. FO-6).
				Check for 115V ac at L and M of J301 located on the housing; access to this jack is made by removing the cable. If voltage is present, trouble exists in antenna scanner assembly (fig. FO-6).
5	Set MOTORS switch S602 of the antenna control to opposite position.	MOTORS STANDBY lamps DS603 and 1801 should both light, antenna scanner assembly drive motor B101 should stop rotating.	MOTORS STANDBY lamp DS603 does not light.	Replace lamp DS603, in antenna control.
			MOTORS STANDBY lamp I801 does not light.	Replace lamp I801, in control-recorder.
			Both MOTORS STANDBY lamps do not light, drive motor B101 continues to rotate.	Check items in 4.

Table 3-8. Equipment Performance Checklist-Continued

Step	Procedure	Normal indications	Abnormal indications	Corrective measures
6	Push down on control-recorder ELEVATION RESET SELECTOR lever S808.	ELEVATION lamp 1805 lights.	ELEVATION lamp 1805 does not light.	Check lamp 1805, switch S808, and relay K802 with the multimeter and and replace if necessary (fig. FO-6).
7	Push down on control-recorder AZIMUTH RESET SELECTOR lever S807.	AZIMUTH lamp 1804 lights, POWER INTERRUPTED lamp 1806 goes out.	AZIMUTH lamp 1804 does not light, POWER INTERRUPTED lamp 1806 goes out.	Check lamp 1804 with the multimeter; replace if necessary (fig. FO-6).
			AZIMUTH lamp 1804 does not light, POWER INTERRUPTED lamp 1806 stays on.	Check switch S807 and relay K801 with the multimeter and replace if necessary (fig. FO-6).
8	Move each ELEVATION manual control of the antenna control to UP, check each control separately for normal indications. (After each is checked, return control to center position.)	Reflector will move upward, elevation angle indicators on elevation unit and control-recorder will move with reflector.	Reflector does not move.	If the reflector does not move with the operation of any of the controls or switches, check CR603 or V611 and their associated circuits. If a control or switch does not cause the reflector to move, check it with a multimeter and replace if necessary (fig. FO-25).
			Reflector moves but ELEVATION angle indicator on control-recorder does not operate.	Check connector J801 for tight connection, and B802 for loose or broken connectors. Check the mechanical linkage between B802 and the ELEVATION angle indicator (fig. 3-52).
9	Move each ELEVATION manual control of the antenna control to DOWN, check each control separately for normal indications. (After each is checked, return control to its center position.)	Reflector will move downward, elevation angle indicator on elevation unit and control-recorder will move with reflector.	Reflector does not move.	Same as step 8, except check CR604 instead of CR603 and K608 instead of K602; use same references for parts removal and replacement (fig. FO-25).
			Reflector moves but ELEVATION angle indicator on control-recorder does not move.	Check connector J801 for tight connection, and B802 for loose or broken connectors. Check the mechanical linkage between B802 and the ELEVATION angle indicator (fig. 3-52).
10	Move each AZIMUTH manual control of the antenna control to CCW, check each control separately	Reflector will move counterclockwise, azimuth angle indication on azimuth unit and control-	Reflector does not move.	If the reflector does not move with the operation of any of the controls, check CR605 or V611

Table 3-8. Equipment Performance Checklist-Continued

Step	*Procedure*	*Normal indications*	*Abnormal indication*	*Corrective measures*
	for normal indications. (After each is checked, return the control to its center position.)	recorder will move with reflector.		and their associated circuit. If a control or switch does not cause the reflector to move, check it with a multimeter and replace if necessary. (fig. FO-25).
			Reflector moves but AZIMUTH angle indicator on control-recorder does not move.	Check connector J801 for tight connection, and B801 for loose or broken connectors. Check the mechanical linkage between B801 and AZIMUTH angle indicator (fig. 3-49).
11	Move each AZIMUTH manual control of the antenna control to CW, check each control separately for normal indications. (After each is checked, return the control to its center position.)	Reflector will move clockwise, azimuth angle indicaters on azimuth unit and control-recorder will indicate azimuth angle.	Reflector does not move.	Same as step 10, except check CR606 instead of CR605 (fig. FO-25).
			Reflector moves but AZIMUTH angle indicator on control-recorder does not move.	Check connector J801 for tight connection and B801 for loose or broken connectors. Check the mechanical linkage between B801 and AZIMUTH angle indicator (fig. 3-49).
12	Move the reflector by using the manual controls of the antenna control as necessary to orient the reflector toward the signal source (para 3-15c).			
13	Operate TUNING switch S1007 of the receiver as necessary to set FREQUENCY MEGACYCLES meter M501 to 1,680 MHz.	FREQUENCY MEGACYCLES meter M501 positions to 1,680 MHz.	FREQUENCY MEGACYCLES meter M501 does not move.	Check S1007 with multimeter; replace if necessary (fig. FO-23).
14	Observe TUNING METER M1001.	TUNING METER M1001 indicates between 60 and 70.	TUNING METER M1001 reading is low, or 0.	Operate TUNING switch S1007 to increase reading. If trouble continues, replace CR 101 (para 3-33) in mixer assembly. Check to see that P1001 is seated properly into J403. Check and redate if necessary, tubes V401 though V405 of the if. amplifier (fig. 3-16).

Table 3-8. Equipment Performance Checklist - Continued

Step	*Procedure*	*Normal indications*	*Abnormal indications*	*Corrective measures*
			TUNING METER M1001 reading is high.	Move the reflector by using the manual controls as necessary to orient the reflector away from the signal source until the meter reading is normal.
15	Turn SPEAKER GAIN control R1066 for desired sound level.	An audible signal (5 to 200 cps) is heard.	Little or no sound is heard.	Check V1009, B1008, V1007, V1006, V1001 (fig. 3-9). R1006, T1001, LS1001, S1002, and associated circuits (fig. FO-23). Replace if necessary.
16	Operate the manual controls as necessary to position the reflector slightly away from the signal source; then turn switch S605 of the antenna control to NEAR AUTO.	Reflector positions and stays directly toward signal source.	Reflector does not position toward signal source.	Check V601, V602, V607, V608, V609, V613 (fig. FO 3-23), V1002, V100, V1004, V1005 (fig. 3-9), S605, and associated circuits (fig. FO-25). Replace if necessary.
17	Return switch S605 to MANUAL and operate the manual controls as necessary to obtain a reading between 60 and 70 on TUNING METER M1001.			
18	Set METER SELECTOR switch S1003 to AC ERROR.	Meter reads within diamond C.	Meter does not read within specified area.	Check phasing adjustment of reference voltage generator (TM 11-6660-206-12). Check and replace if necessary, tubes V1005, V1003, V1002, and V1001 (fig. 3-9) on the receiver chassis. Check circuits associated with these tubes. If trouble continues, report to higher level maintenance.
19	Set switch to S1003 to AZ ERROR.	Meter reads within diamond C.	Meter does not read within specified area.	Check and replace if necessary, tubes V607, V608, V613 (fig. 3-23), and associated circuits (fig. FO-25).
20	Set switch S1003 to EL ERROR.	Meter reads within diamond C.	Meter does not read within specified area.	Check and replace if necessary, tubes V601, V602, V609 (fig. 3-23), and associated circuits (fig. FO-25).
21	Sat switch S1003 to B-.	Meter readd -105.	Meter does not read specified voltage.	Check and replace if necessary, tubes V1017, V1018, (fig. 3-9), and associated circuits (fig. FO-25).

Table 3-8. Equipment Performance Checklist - Continued

Step	Procedure	Normal indications	Abnormal Indications	Corrective measures
22	Set switch S1003 to B+.	Meter reads +180 volts (approx).	Meter does not read within 10 percent of 180.	Check adjustment of R1093 (TM 11-6660-206-12). Check and replace if necessary, tubes V1019, V1015, V1016 (fig. 3-9), and associated circuits (fig. FO-23).
23	Set switch S1003 to INJECTION.	Meter reads within green block B.	Meter does not read within specified area.	Check and replace if necessary, CR101 (para 3-33) in the mixer assembly. Check cabling.
24	Set switch S1003 to OSC GRID.	Meter reads within green block B.	Meter does not read within specified area.	Check R502 (fig. 2-10) with multinieter; replace if necessary.
25	Set switch S1003 to PEAK PULSE.	Meter reads within green block B.	Meter does not read within specified area.	Check adjustment of R1051 (para 3-38). Check and replace if necessary tubes V1010, V1009, V1008, V1007, V1006, V1001, and associated circuits (fig. FO-23).
26	Set switch S1003 to AFC BAL.	Meter reads within diamond C.	Meter does not read within specified area.	Check and replace if necessary tubes V1013, V1014, V1012, V1011, and associated circuits (fig. FO-23).
27	Set switch S1003 to SHARP FM.	Meter reads within diamond C.	Meter does not read within specified area.	Check and replace if necessary switch S1001 (fig. 3-10).
28	Move RECORDS CONTROL switch S818 control-recorder to FLIGHT, and PRINTINGS PER MINUTE switch S817 to 10.	Control-recorder should print elevation, azimuth angles, and time to agree with readings of the ELEVATION, AZIMUTH and TIME indicators at a rate of 10 times per minute.	Printings do not agree with indicators.	Report to general support level maintenance.
29	Set switch S817 to 2.	Same as step 28, except rate of printings will be two per minute.	Same as step 28	Same as step 28.
30	Set switch S817 to 1.	Same as step 28, except rate of printings will be one per minute.	Same as step 28.	Same as step 28.
31	Return switch S817 to desired printing rate. Refer to TM 11-6660-206-12 for stopping procedure.			

Section III. ANTENNA ASSEMBLY TROUBLESHOOTING AND REPAIR

3-17. General

This section provides maintenance personnel with troubleshooting and repair procedures for the telescope and antenna assembly of the rawin set. The four components involved are the telescope, telescope mounting bracket, reflector, and antenna scanner assembly. Troubles that occur with the telescope, telescope mounting bracket, or the reflector are mechanical and will be noticed by visual inspection during the installation and orientation of the rawin set. Correction of troubles with the antenna scanner assembly are discussed below. A test setup for bench troubleshooting of the antenna scanner assembly is shown in figure 3-1. Figure 3-2 shows location of components for AN/GMD-1A and figure 3-3 for AN/GMD-1B.

3-18. Repair and Adjustment of Antenna Scanner Assembly

a. Drive Motor B101. Procedures leading to the isolation of trouble to the antenna scanner assembly drive motor B101 and associated components (starting relay K101 and capacitor C101) are outlined in step 4 of table 3-8. For replacement of these components, remove the antenna scanner assembly (*d* below) and refer to paragraph 3-19.

b. Reference Voltage Generator G101. If trouble has been isolated to reference voltage generator G101 or associated circuitry (step 26, para 3-46b), perform the sine gain and phasing adjustment outlined in TM 11-6660-206-12. If

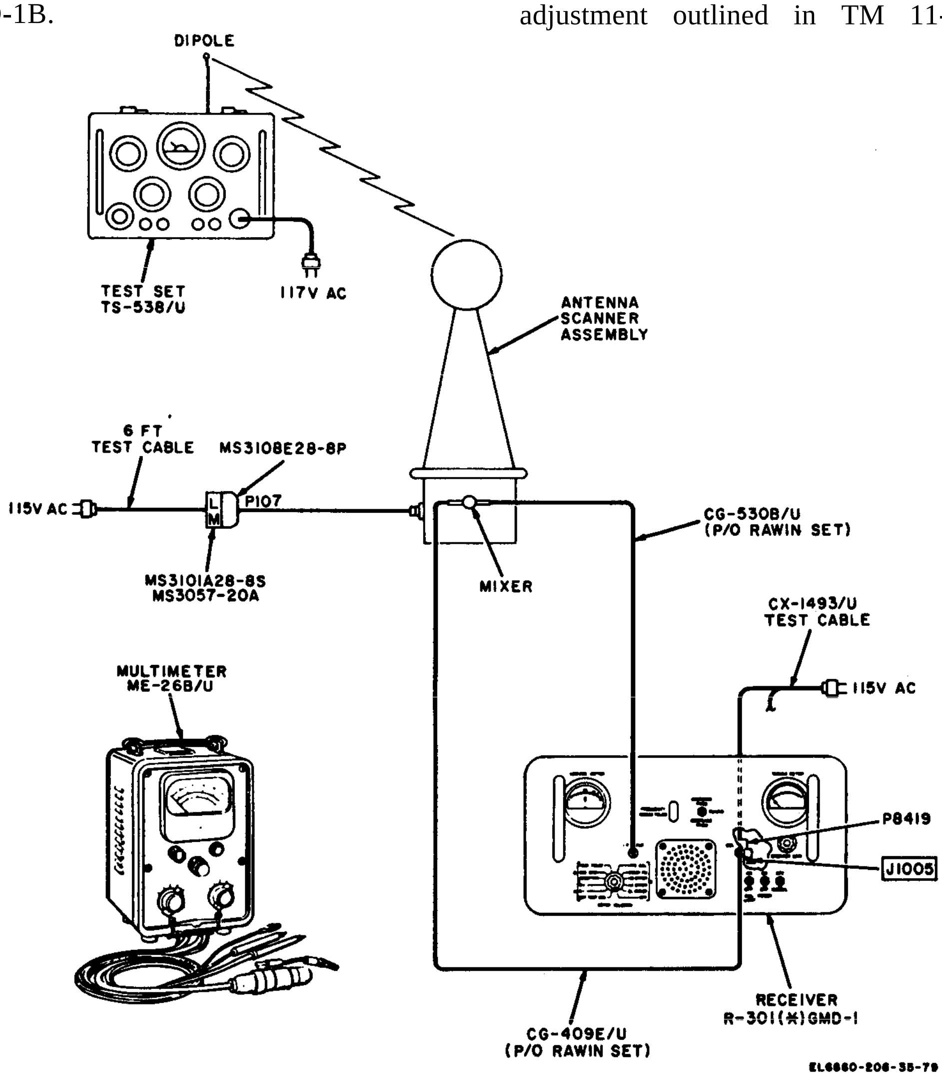


Figure 3-1. Antenna scanner assembly test setup for troubleshooting.

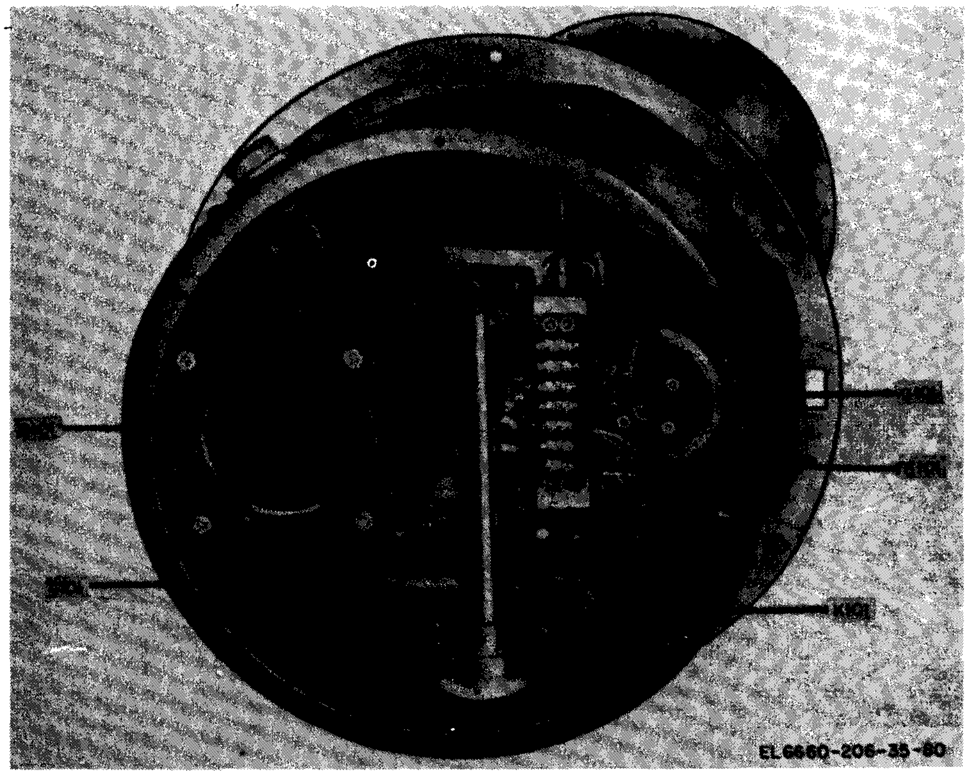


Figure 3-2. Antenna scanner assembly (AN/GMD-1A), cover removed.

the trouble cannot be corrected, check the continuity of the windings of G101. This may be done by disconnecting the antenna scanner cable from the housing at J301 and checking continuity across pins A and H (elevation) and C and D (azimuth) of the connector at the end of the cable. For replacement of G101, remove the antenna scanner assembly (fig. 3-2) (*d* below) and refer to paragraph 3-19.

c. Dipole Antenna and Transmission Line. When a satisfactory signal is not received during normal operation a receiver sensitivity check is made using Test Set TS-538/U (fig. 4-2, para 4-10). If a signal is received when injecting a signal into the mixer assembly then trouble exists in the dipole antenna or line. Repair or replace the part required as follows.

d. Removal of Antenna Scanner Assembly.

(1) Disconnect the mixer cables from the receiver and remove the mixer assembly.

(2) Disconnect antenna scanner from the housing.

(3) Loosen the six captive bolts that secure the antenna scanner assembly to the center of the reflector.

(4) Raise the assembly to clear the support hook and withdraw the assembly. Be careful not to damage the cable.

e. Replacement of Antenna Scanner Assembly.

(1) Position the antenna scanner assembly in the reflector opening. Be careful not to damage the cable.

(2) Insert and tighten the six captive bolts that secure the antenna scanner assembly.

(3) Connect antenna scanner to the housing.

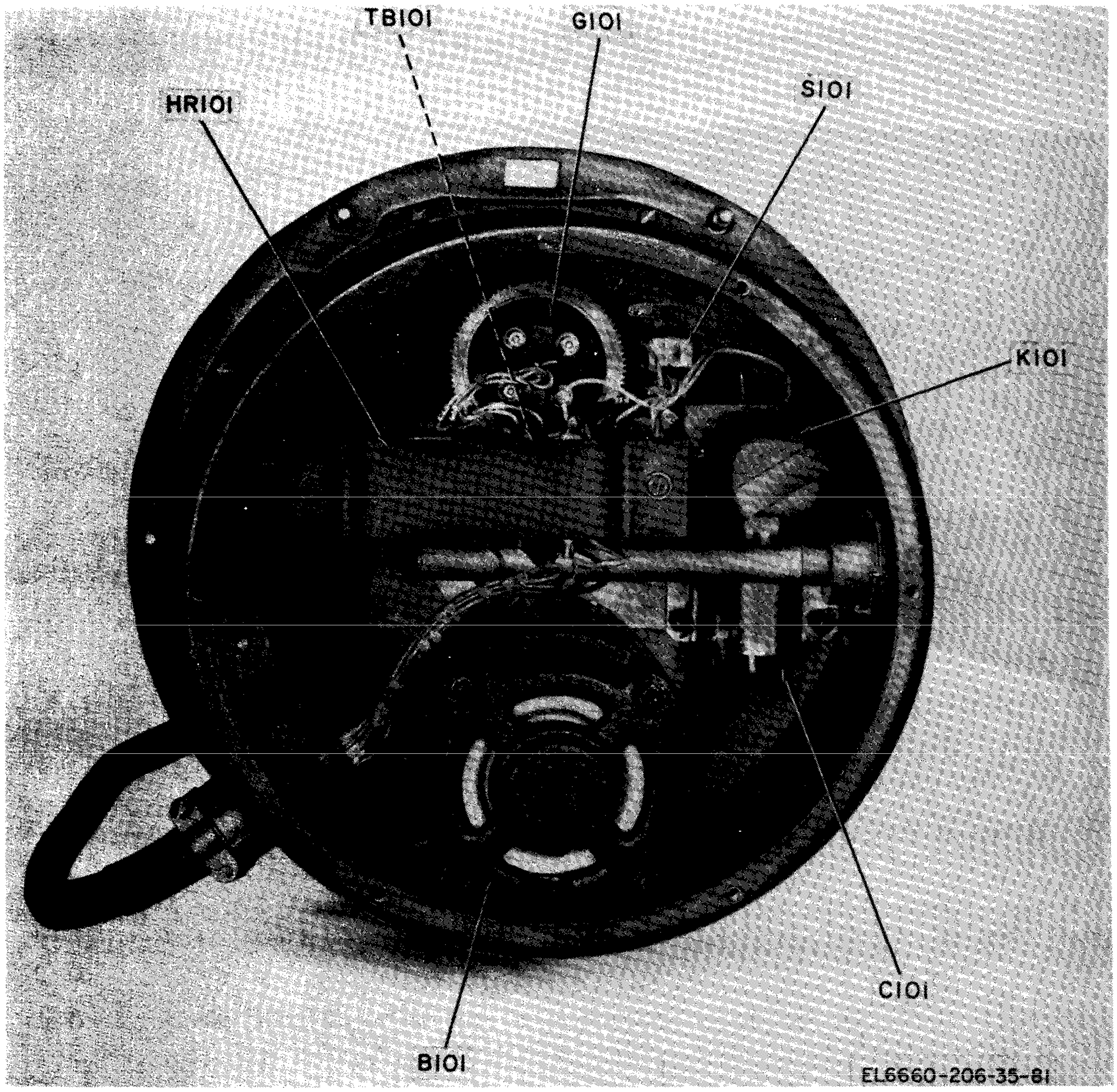


Figure 3-3. Antenna scanner assembly (AN/GMD-1B), cover removed.

3-19. Removal and Replacement of Antenna Dipole Assembly

a. Removal of Antenna Dipole Assembly (fig. 3 - 4①).

(1) Remove the front half of the radome (27) by removing the 12 screws (17), washers (23), and nuts (26). Carefully remove gasket (22).

(2) Remove the four screws (18) that hold the hemisphere (21) to the mounting plate (25).

(3) Unscrew the dipole antenna (19) quarter-wave stub (52) as one assembly.

b. Replacement of Antenna Dipole Assembly.

(1) Obtain a replacement antenna dipole assembly.

(2) Screw the dipole antenna (19) quarter-wave stub (52) assembly into the transmission line (51).

(3) Place the hemisphere (21) onto the mounting plate (25) and secure it into place with four screws (18) lockwashers and nuts.

(4) Place gasket (22) against rim of rear half of radome.

(5) Place front half of radome onto rear half being sure that gasket remains in place. Align the screw holes of each half of the radome so they match.

(6) Secure the radome together with 12 screws (17), washers (23), and nuts (26).

3-20. Removal and Replacement of Voltage Reference Generator G101

a. Removal of Voltage Reference Generator (fig. 3-4 ①).

(1) Remove six screws (44) and bottom cover (46) from antenna scanner assembly.

(2) Loosen four setscrews from coupling (1) and slide coupling down shaft (3).

(3) Remove four screws (41) holding transmission line (43) to side cover (50).

(4) Remove seven screws holding side cover (50) to frame.

(5) Swing side cover (50) away from frame. The antenna scanner cable will prevent complete removal of side cover (50).

(6) Tag and remove four leads located on the end of voltage reference generator (G101).

(7) Remove all leads from one side of TB101 (side that generator wires go to) for easy removal of generator. (Remove HR101 mounting screws on AN/GMD-1B) (fig. 3-3.)

(8) Reach through hole in motor mounting plate with a number six allen wrench and loosen two setscrews from generator gear (fig. 3-4 ②) and remove generator gear.

(9) Remove three screws and washers located under generator gear (fig. 3-4 2) holding voltage reference generator to antenna scanner assembly.

NOTE

The phasing adjustment shaft (3, fig. 3-4 ①) may be rotated in order to turn the voltage reference generator and make removal of screws easier.

(10) Slide voltage reference generator out of scanner assembly.

b. Replacement of Voltage Reference Generator (G101).

(1) Slide voltage reference generator through motor mounting plate (fig. 3-4 2) of antenna scanner assembly and align with three mounting holes (which can be seen before voltage reference generator is reinstalled).

(2) Replace three screws and washers which mount voltiage reference to motor mounting plate of antenna scanner assembly.

(3) Reach through hole in mounting plate and slide generator gear onto voltage reference generator shaft.

(4) Tighten two setscrews which hold generator gear on voltage reference generator shaft.

(5) Replace all leads (previously removed) on TB101.

(6) Replace all leads (as marked) to voltage reference generator (fig. 3-5).

(7) Replace side cover (50, Fig. 3-4 ①) to frame of antenna scanner assembly using seven screws previously removed.

(8) Align transmission line (43) to side cover (50), reinstall four screws (41), and tighten.

(9) Slide coupling (1) up shaft (3), align with worm shaft (49), and tighten setscrews.

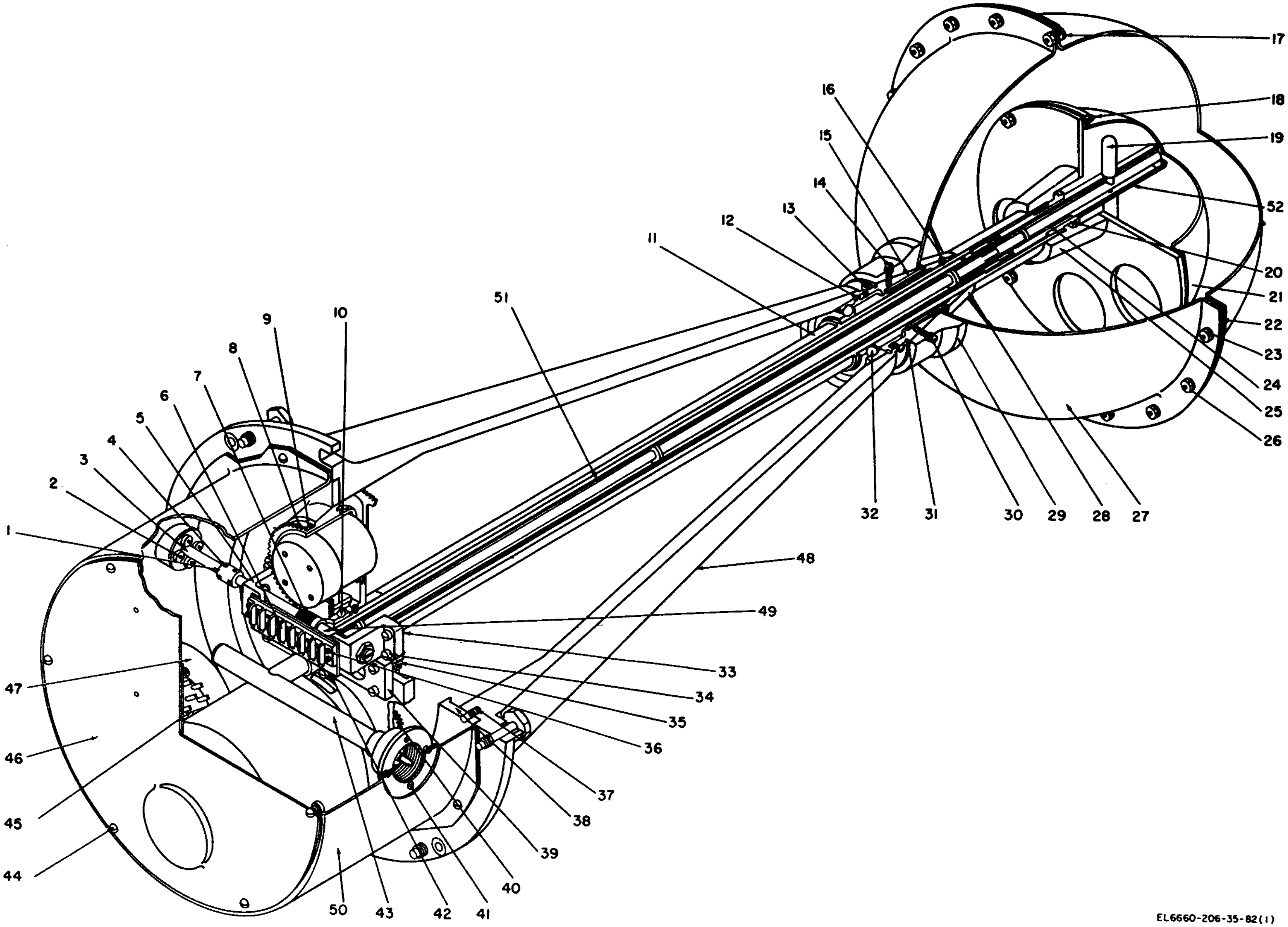


Figure 3–4 (1). Antenna scanner assembly, disassembly and reassembly (sheet 1 of 5).

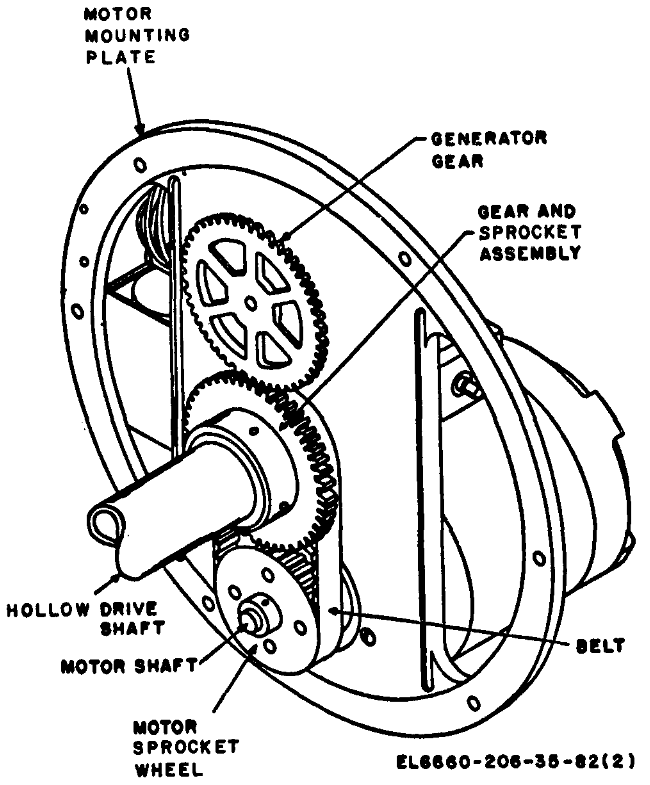


Figure 3-4 ②. Antenna scanner assembly, disassembly and reassembly (sheet 2 of 5).

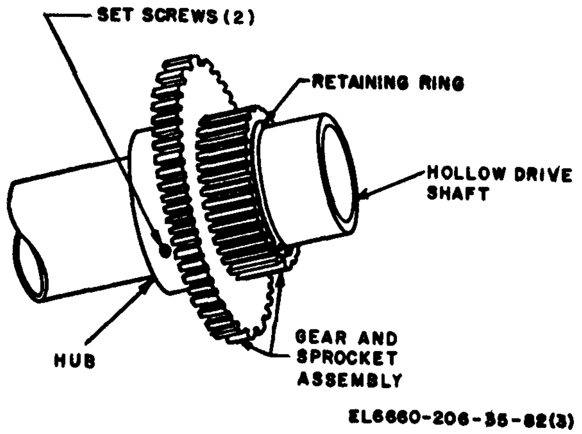


Figure 3-4 ③. Antenna scanner assembly, disassembly and reassembly (sheet 3 of 5).

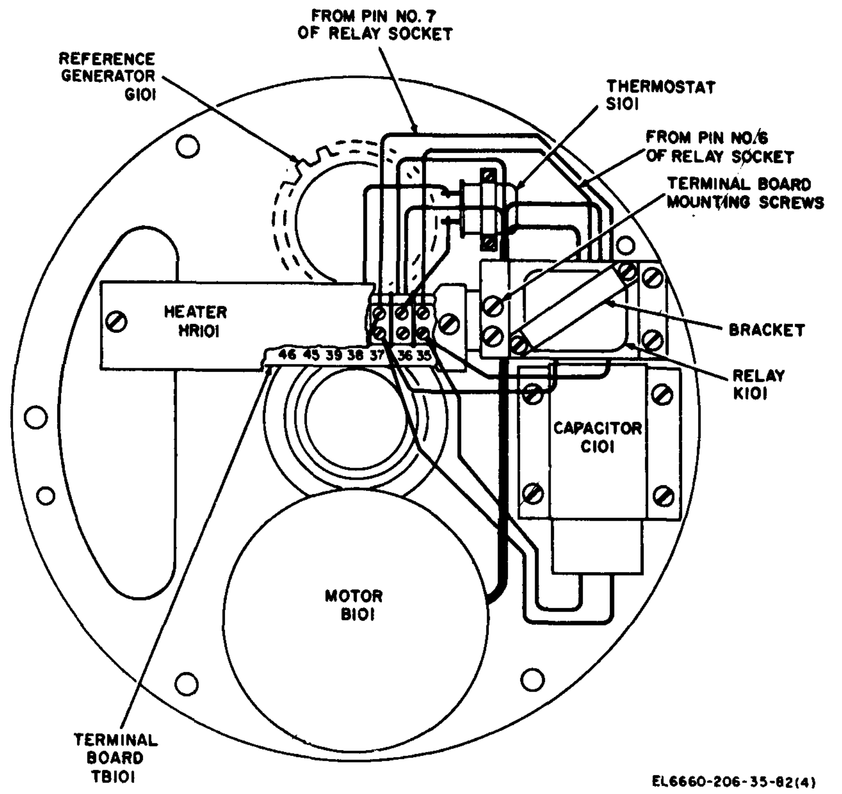


Figure 3-4 ④. Antenna scanner assembly, disassembly and reassembly (sheet 4 of 5).

(10) Replace bottom cover (46) to bottom of antenna scanner assembly and reinstall six screws (44) to hold cover in place.

(11) Refer to TM 11-6660-206-12 for instructions on phase adjustment of reference generator.

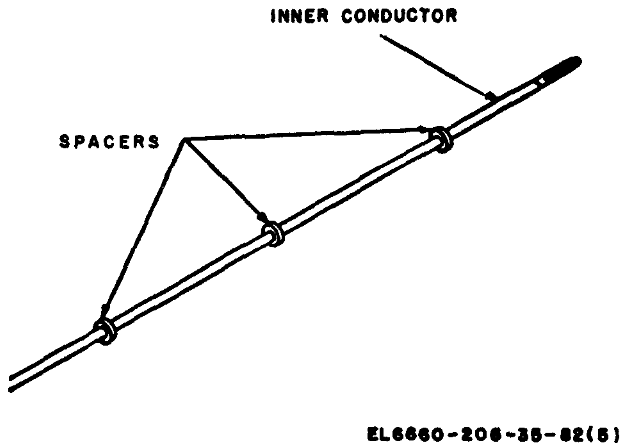


Figure 3-4 (5). Antenna scanner assembly, disassembly and reassembly (sheet 5 of 5).

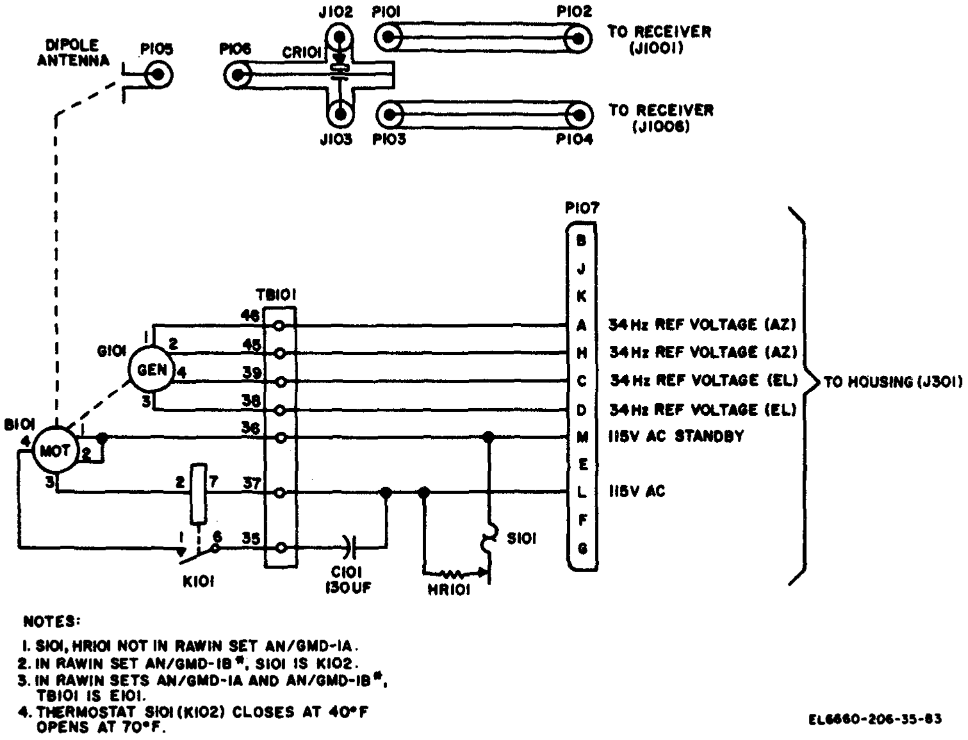


Figure 3-5. Antenna scanner assembly and mixer assembly, schematic diagram.

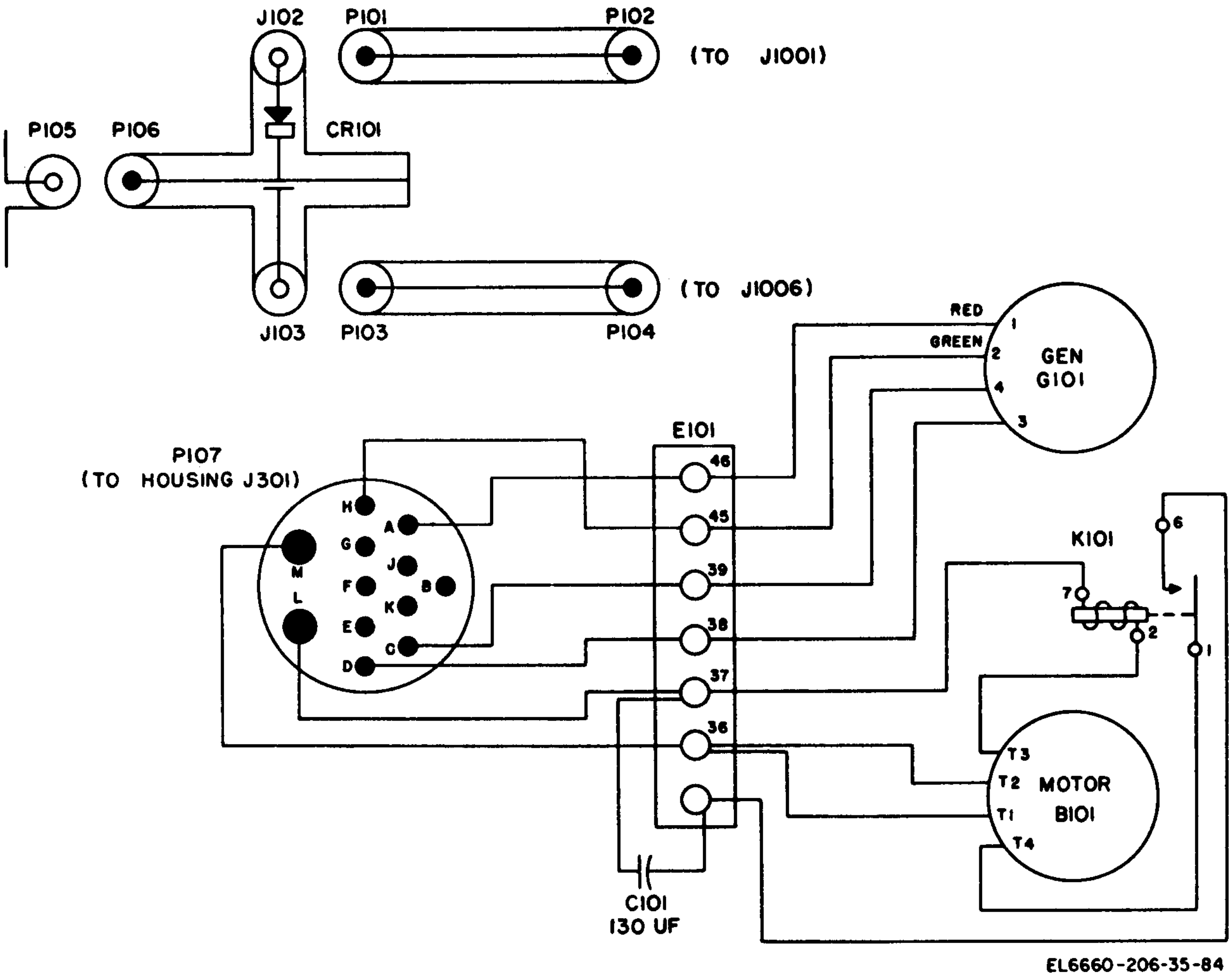


Figure 3-6. Antenna scanner assembly AN/GMD-1A, wiring diagram.

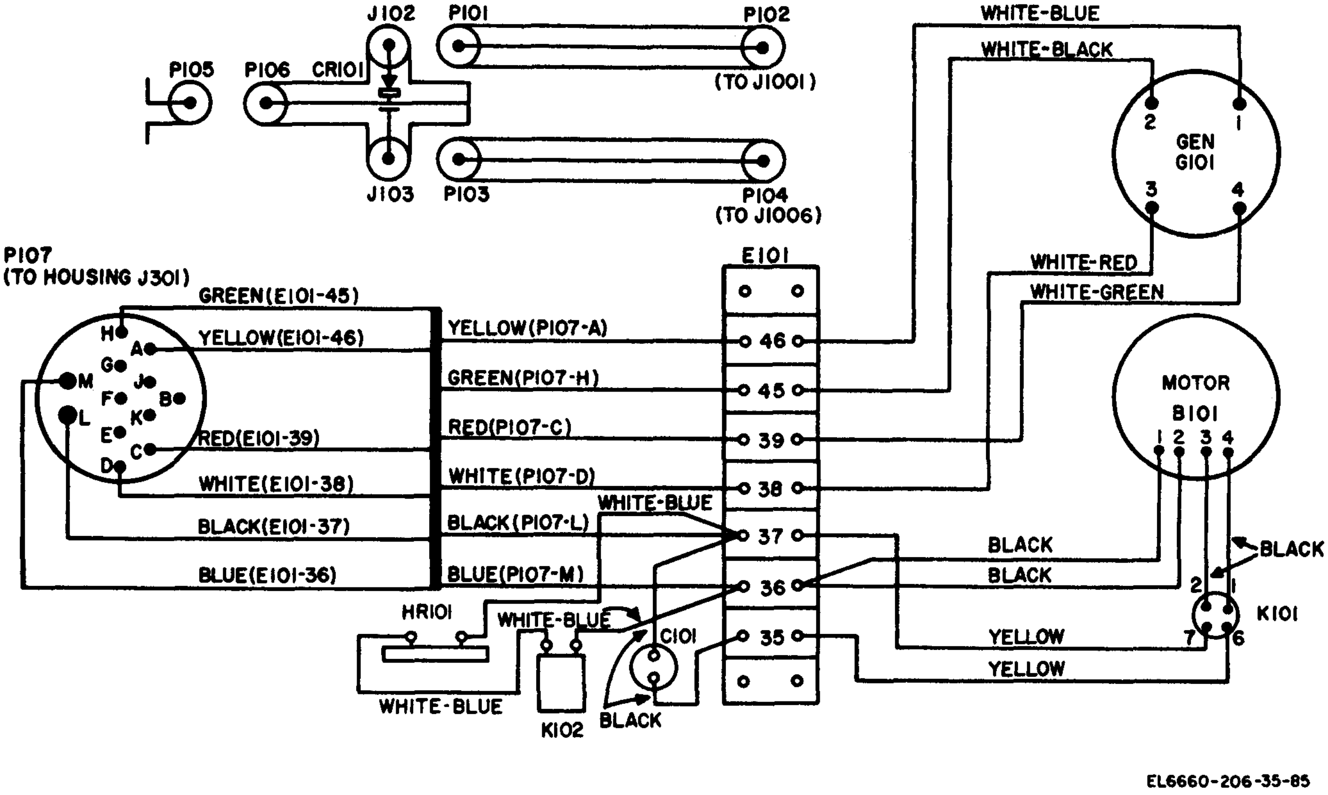


Figure 3-7. Atenna scanner assembly AN/GMD-1B, wiring diagram.

Section IV. RECEIVER TROUBLESHOOTING

3-21. General

a. This section covers the servicing of the receiver which can be bench tested as described in paragraph 3-26 or when interconnected in the Rawin Set as outlined in TM 11-6660-206-12. Reference data in table 3-9 includes illustrations for the operator's and organizational manual TM 11-6660-206-12, and illustrations for direct support maintenance which are used as guides and aids when troubleshooting, testing and locating test points and specific resistance, current and voltage values for various components and waveform analysis charts which supplement the narrative maintenance procedures.

b. DC resistance measurements of coils, relays and transformers are covered in detail in table 3-12. The list of test equipment required for troubleshooting the receiver is located in table 3-13.

3-22. Controls and Adjustments

Receiver controls and adjustments, location, and function are listed in table 3-10.

3-23. Receiver Meter Selector and Service Meter

Receiver METER SELECTOR switch positions and SERVICE METER functions and normal indication readings are listed in table 3-11.

Table 3-9. Reference Data, Receiver

Reference	*Data*
TM 11-6660-206-12	Rawin Set AN/GMD-1(*), cabling diagram.
TM 11-6660-206-12	If. amplifier (receiver), tube location.
TM 11-6660-206-12	Receiver (lass if. amplifier), tube and fuse location.
TM 11-6660-206-12	Receiver, front view.
TM 11-6660-206-12	Receiver, top view, parts identified.
TM 11-6660-206-12	Rawin Set AN/GMD-l(*), system functional block diagram.
Fig. 2-4	Receiving system, block diagram.
Fig. 2-5	Receiving system, complete block diagram, AN/GMD-1A.
Fig. 2-6	Receiving system, complete block diagram, AN/GMD-lB.
Fig. 3-11	Receiver (except R-301D/GMD-1**) bottom view, parts identified.
Fig. 3-12	Receiver (R-301D/GMD-l**) bottom view, parts identified.
Fig. 3-13	Receiver (except R-301D/GMD-l**) bottom view, location of resistors and capacitors.
Fig. 3-14	Receiver (R-301D/GMD-l**) bottom view, location of resistors and capacitors.
Fig. 3-15	Receiver R-301D/GMD-1** resistor-capacitor board layout.
Fig. 3-17	IF amplifier, bottom view.
Fig. 3-20	IF amplifier voltage and resistance wiring diagram.
Fig. 3-21	Receiver AFC circuits and waveforms.
Fig. 3-22	Receiver meteorological circuits and waveforms.
Fig. FO-21	If. amplifier, schematic diagram.
Fig. FO-22	Rawin Receivers R-301B/GMD-1 and R-301C/GMD-1, complete schematic diagram.
Fig. FO-23	Rawin Receiver R-301D/GMD-1, schematic diagram.
Fig. FO-26	Control-recorder, schematic diagram.
Fig. FO-4	Ac power distribution schematic diagram AN/GMD-1A.
Fig. FO-5	Ac power distribution schematic diagram AN/GMD-1B.
Fig. FO-6	Ac power distribution schematic diagram AN/GMD-1B**.

Table 3-10. Receiver Control and Adjustement Functions

Controls and adjustments	Location (fig. no.)	Function
1. POWER switch S1004	Controls 1 through 8; refer to TM 11-6660-206-12.	Connects 115 volt ac power to the receiver when set to ON.
2. FREQUENCY MEGACYCLES meter M501.		Indicates local oscillator frequency plus 30 MHz. (This is equivalent to the radiosonde frequency.) Lamp 1501 illuminates the dial and indicates that 115 volt ac power is connected to the receiver.
3. TUNING switch S1007		Provides manual tuning for the local oscillator by applying 6.3 volts ac to either half of the primary of T1004.
4. AFC-MANUAL switch S1005		In the MANUAL position, short-circuits the output of the afc modulator and permits manual control through the output stage. In the AFC position, taps a portion of the afc modulator output signal from AFC GAIN potentiometer R1084 and feeds this signal to the grid of afc amplifier V1012B.
5. TUNING METER M1001		By reading the voltage drop across R1009, one of the resistors that comprise the detector load, meter indicates avc voltage.
6. SERVICE METER M1002		Indicates currents and voltages of various circuits in rawin receiver and external dc readings, according to setting of METER SELECTOR switch S1003.
7. METER SELECTOR switch S1003.		Connects SERVICE METER to indicate current or voltage in 10 different circuits (para 2-13)of rawin set or furnish external dc readings.
8. DIAL LIGHT switch S1006		Switches dial lamp I501 on and off.
9. BROAD BW-SHARP BW switch S1001.	Controls 9 through 16; refer to TM 11-6660-206-12.	A double-pole, double-throw switch that connects the output of the detectors to modulation amplifier V1001A, or to cathode follower V1001B. (In Rawin Receiver R-301D/GMD-1, the outputs of the fm detectors are fed to pulse preamplifier V1001B.)
10. AM-FM switch S1002		Applies the AM output of modulation amplifier V1001A or the fm output of cathode follower V1001B to the meteorological data transmission system. (In Rawin Receiver

Table 3-10. Receiver Control and Adjustment Functions-Continued

Controls and adjustments	Location (fig. no.)	Function
		R-301D/GMD-1, cathode follower V1001B is replaced by pulse preamplifier V1001B.)
11. PULSE POLARITY selector switch. S1OO9.		Enables the rawin receiver to receive an fm pulse of either polarity by feeding a negative pulse to first pulse amplifier V1006A of the meteorological data transmission system when either a positive or negative fm pulse is received from the radiosonde.
12. MOD BAL potentiometer R1072		A cathode-biased potentiometer that compensates for any inherent unbalance in afc modulator V1011 or in the modular network.
13. AFC GAIN potentiometer R1084		Taps a portion of the signal from afc modulator V1011 and feeds the attenuated signal to the grid of afc amplifier V1012.
14. SPEED CONTROL R1087		Determines the speed of manually tuning local oscillator V501 by determining the amount of voltage applied to the grid of afc output V1014.
15. ANTI HUNT control R1083		Determines the amount of negative feedback (antihunt) voltage used, by determining the amount of voltage fed to antihunt amplifier V1012.
16 B+ SET potentiometer R1093		Determines the level of the B+ output voltage of the receiver power supply.
17. TUNING METER M801	Controls 17 through 19; refer to TM 11-6660-206-12.	Meter is calibrated in microampere and shows maximum deflection when receiver is tuned to radiosonde frequency. The reading is controlled by potentiometer R501, which is mechanically connected to local oscillator tuning motor R501.
18. TUNING switch S803		Remotely energizes local oscillator tuning motor B501.
19. DEPRESS TO SHOW DIAL POSITION switch S804.		Places TUNING METER M801 across R501, which is mechanically connected to local oscilla tor tuning motor B501. TUNING METER M801 will read maximum when the local oscillator is on the correct frequency.

Table 3-11. Receiver Service Meter Function

Switch position	Meter function and reading
EXT TEST (DC)	External dc voltage readings through J1003 and J1004 (fig. 2-41 and 2-42).
B-	Indicates output of -105 volts dc regulated, power supply. The normal reading -105.[a]
B+	Indicates output of +180 volts dc regulated, power supply. The normal reading +180 volts (approx).[a]
INJECTION	Indicates mixer input to if. amplifier. The normal reading is within green block B.
OSC GRID	Indicates local oscillator V501 grid voltage. The normal reading is within green block B.
PEAK PULSE	Indicates the output of the meteorological amplifier. The normal reading is within green block B (when meteorological signal is being received).
AFC BAL	Indicates the afc output. The normal reading is within diamond C.
SHARP FM	Indicates the output of discriminator V409 in the if. amplifier. The normal reading is within diamond C.
AC ERROR	Indicates the output of the sine amplifier circuit. The normal reading is within diamond C.
AZ ERROR	Indicates the output of azimuth phase-sensitive detectors V607 and V608. The normal reading is within diamond C.
EL ERROR	Indicates the output of elevation phase-sensitive detectors V601 and V602. The normal reading is within diamond C.
OFF	Meter is disconnected. No reading.

[a]Meter is read in 10—volt divisions directly from —200 to +200 volts.

3-24. Dc Resistances of Transformers, Coils and Relays

When maintenance and troubleshooting is required in the receiver and the trouble is isolated to a specific piece part use table 3-12. This table gives the normal value of resistance measurements and location of test points.

3-25. Test Equipment Required

When the receiver requires bench testing or alignment, use table 3-13 to determine the test equipment required. Use figure 3-8 for the test setup.

3-26. Test Setup for Bench Servicing Receiver

Follow the directions in a through d below, to connect Rawin Receiver R-301(*)/GMD-1 to bench service the receiver.

a. Set MAIN POWER switch S806 on the control-recorder to OFF.

b. Remove the receiver as follows:

(1) Turn off MAIN POWER.

Table 3-12. Dc Resistance of Transformer, Coils, and Relays, Receiver

Transformer, coils, and motors	*Location (fig. No.)*	*Terminals (fig. FO-23)*	*Dc resistance (ohms)*
T1002	3-11	1-2	135
		2-3	9
		5-6	9
T1003	3-11	1-3	1
		3-4	Less than 1
		4-5	Less than 1
		6-7	30
		7-8	32
		8-9	Less than 1
		9-10	Less than 1
		11-12	Less than 1
T1004	2-41 and 2-42	1-2	18
		2-3	20
		4-5	200
L1001	3-11		100
L1002	3-13 3-14		250

Table 3-13. Test Equipment Required, Receiver

Test equipment	*Common name*	*Technical manual*
Crystal Rectifier Test Set TS-268/U.	Crystal tester	TM 11-1242
Electronic Multimeter ME-30A/U	Vtvm	TM 11-6625-320-12
Multimeter TS-352B/U	Multimeter	TM 11-6625-366-15
Test Set, Electron Tube TV-7/U	Tube taster	TM 11-6625-274-12
Test Set TS-538(*)/U[a]	Test set	TM 11-6625-213-12
Oscilloscope AN/USM-32	Oscilloscope	TM 11-5123
Signal Generator AN/USM-44A	Signal generator	TM 11-6625-508-10
Electronic Multimeter ME-26/U	Vtvm	TM 11-6625-200-15
250-ohm, l/2-watt resistor	None	This manual (para 16b(l))
2 feet of coaxial cable RG-58/U or RG-62/U.	Pickup lead	This manual (para 16b(2))
Male BNC connector	Adapter	This manual (para 16b(3))
If. cable W131[a]	If. cable	TM 11-6660-206-12

Table 3-13. Test Equipment Required, Receiuer-Continued

Test equipment	Common name	Technical manual
Osacillator cable W121[a]	Oscillator cable	TM 11-6660-206-12
Adapter for Test Set TS-538(*)/U[a]	Adapter	TM 11-6660-206-12
Power Cable Assembly CX-1493/U	Receiver and antenna control test cable.	TM 11-6660-206-12

[a]Supplied with Rawin Set AN/GMD-1(*).

(2) Disconnect if. cable and oscillator cable from IF INPUT, J1001 and OSC OUTPUT J1006 on the receiver panel.

(3) Unfasten (18) screws from front panel.

(4) Withdraw receiver from the housing until lock is engaged.

(5) Disconnect internal receiver cable plug P302 from J1005, on AN/GMD-1B models, disconnect P305 from J1002 top of receiver chassis.

(6) Remove receiver from housing by pulling out on chassis lock while withdrawing receiver chassis.

c. Setup Test Set (TS-538/U), reference TM 11-6660-206-12, Chapter 2, and the receiver and antenna control test cable to connect ac power to the receiver through J1005 (fig. 3-8).

d. The receiver becomes operational when connected as shown in fig. 3-8.

(1) Test Set TS-538/U is used to measure the sensitivity of the rawin receiver by providing a signal, the output power of which is accurately calibrated from -107 to -20 decibels referred to 1 milliwatt in 600 ohms (dbm).

(2) The spare mixer assembly is made to function on the bench in the same manner as the operating mixer assembly would function in the rawin set.

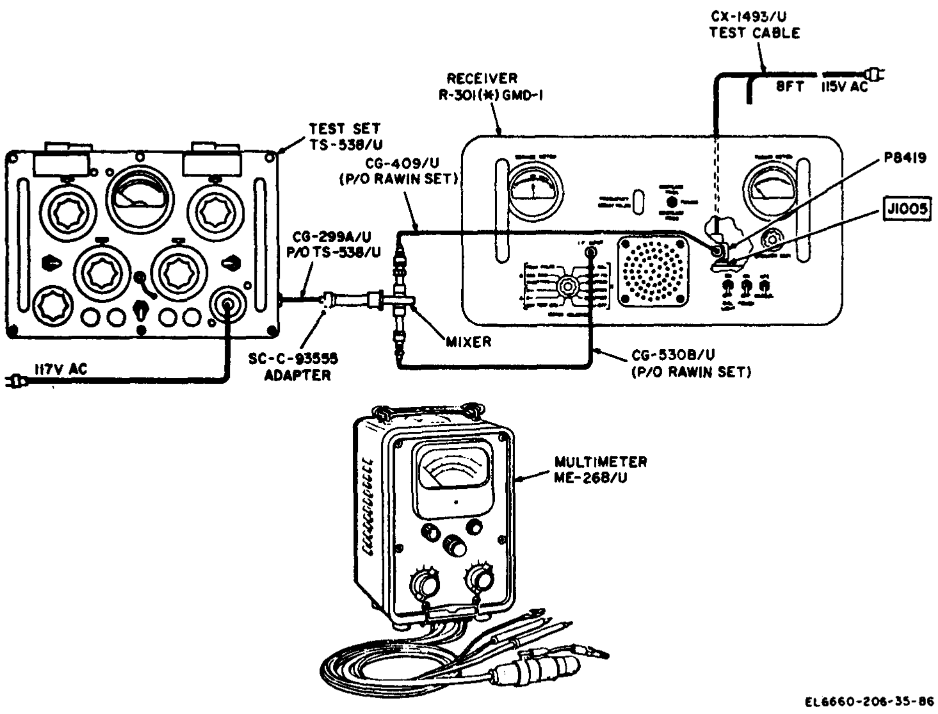


Figure 3-8. Receiver test setup for troubleshooting.

(3) The if. and oscillator cables are connected to the receiver being tested so that the sensitivity of the receiver may be measured with the monitor loudspeaker or with an oscilloscope.

3-27. Symptom Troubleshooting

a. General Troubles that have been sectionalized to the receiving system can be isolated more rapidly by following a procedure based on symptoms that localize the trouble to a channel, circuit, or stage. The symptoms in table 3-14 consist of indications obtained on the receiving system SERVICE METER M1002, TUNING METER M1001, and TUNING METER M801. Troubleshoot the receiving system based on symptoms as follows:

(1) Observe the indications obtained on M1002, M1001, and M801.

(2) Compare the indications obtained with those listed in each of the symptoms.

(3) If the indications obtained correspond to those listed in a particular symptom, follow the procedure given to isolate the trouble.

(4) If the trouble cannot be isolated by symptom troubleshooting, refer to the step-by-step troubleshooting table following:

b. Stepby-Step Troubleshooting. The step-by-step troubleshooting procedures listed in table 3-14 are normally performed with the receiver installed in the rawin system.

Table 3-14. Symptom Troubleshooting, Receiver

Symptom	Probable cause	Corrective measures
1. Indicator 1501 does not light when POWER switch S1004 and DIAL LIGHT switch S1006 are set to ON. Receiver is inoperative.	Indicator lamp 1501 burned out. Fuse F1001 or F1002 defective, or broken leads to fuse holders.	Replace lamp 1501.
		Check leads to fuse holders; repair if necessary.
		Check fuses F1001 and F1002; replace if necessary.
2. Meter M1001 orM801 reads low (below 60) or zero. The readings of M1002 in the INJEG TION and OSC GRID positions of switch S1003 are low (to the left of green block B) or zero.	A defect in the oscillator circuit.	Make voltage and resistance measurements of oscillator circuit, tube V501. Also check tubes V1017 and V1018. Refer to figure FO-10. If local oscillator circuit conditions are normal but the output is low, check oscillator injection connecion in mixer or pickup loop on oscillator assembly.
3. No reading on SERVICE METER M1002.	Meter M1002 defective	Check meter and replace, if necssary.
	Loose or defective connection to meter M1002.	Check meter connections and repair, if necessary.
4. Meter M1002 reads low or zero when switch S1003 is at INJECTION.	Defective local oscillator.	Check voltage of local oscillator circuit. Refer to figure FO-10. Check circuit between local oscillator and mixer assembly.
	Defective crystal CR101	Check crystal CR101; replace if necessary.
		If trouble still exists, replace the crystal.

Table 3-14. Symptom Troubleshooting, Receiver-Continued

Symptom	Probable cause	Corrective measures
5. Meter M1001 reads low.	One of the following defective: tubes V401 through V405, crystal CR401, tube V407, crystal CR404, crystal CR101.	Set switch S1003 to INJECTION and check reading on meter M1002. If reading is normal, trouble is in if. amplifier. If reading is low, trouble is in mixer circuit. If trouble is in if. amplifier, check to see whether present with switch S1001 set to both SHARP BW and BROAD BW or BROAD BW only. Replace defective components as necessary.
6. Local oscillator frequency cannot be varied either manually or automatically.	Oscillator tuning motor B501 defective.	Check motor B501; replace if faulty.
	Tube V1013 or V1014 defective.	Replace tubes V1013 and V1014 one at a time. If trouble is not eliminated, replace original tubes and make voltage and resistance readings. (Refer to figure FO-10.)
	Local oscillator V501 defective. . . .	Inspect local oscillator and servo assembly for mechanical defects. Make voltage and resistance tests. Refer to figure FO-10. If trouble is in the oscillator, replace it.
7. Operating TUNING switch S1007 or S803 to either position results in no change m meter M801 or M1001 indication; the local oscillator tracks normally on afc.	TUNING switch S1007 or S803 defective.	Check switches S1007 and S803; replace if defective.
8. Local oscillator frequency does not track automatically but can be varied by manual TUNING switches S1097 and S803.	Tube V1011 or V1012 defective. . .	Replace tubes V1011 and V1012, one at a time. If trouble is not eliminated, replace original tubes and make voltage and resistance tests. Refer to figure FO-10. Check switch S1005; replace, if necessary, Check potentiometer R1087; replace, if necessary.
		Replace tubes V408 and V409, one at a time. If trouble is not eliminated, replace original tubes and troubleshoot associated circuits.
9. Local oscillator tracks on automatic and manual control, but no change in indications on meter M801.	Meter M801 defective.	Check meter M801; replace if necessary.

Table 3-14. Symptom Troubleshooting, Receiver-Continued

Symptom	*Probable cause*	*Corrective measures*
	Switch S804 defective	Check switch S804; replace if necessary.
	Potentiometer R501 defective	Check potentiometer R501; replace if necessary.
10. Poor manual control of local oscillator frequency.	Potentiometer R1087 defective	Check potentiometer R1087; replace if necessary.
11. Hunting of local oscillator frequency when AFC-MANUAL switch is at ON.	ANTI HUNT potentiometer R1083 defective.	Check potentiometer R1083; replace if necessary.
	Afc antihunt generator G501 defective.	Replace G501, paragraph 3-20.
	Antihunt amplifier V1012 defective.	Replace V1012. If trouble is not eliminated, replace original tube and troubleshoot associated circuit.
12. Receiver lacks sensitivity.	Loose parts in local oscillator assembly.	Set S1003 to OSC GRID. Meter M1002 should read +50 or higher throughout the tuning range of the receiver. If readings are low but not zero, check the oscillator assembly for loose parts. If reading is zero, check grid and cathode connections of V501. Check filament connections. If local oscillator is defective, replace it.

3-28. Step-by-Step Troubleshooting

a. General. The receiving system step-by-step troubleshooting table consists of a series of steps to evaluate all phases of operation of the receiving system. In general, use this table if the trouble cannot be isolated by symptom troubleshooting. Troubleshoot the receiving system by using the step-by-step troubleshooting table 3-15, fig. FO-23, and proceed as listed below:

(1) Locate the test point given in step 1.

(2) Connect the test equipment and set the controls as directed.

(3) Set the controls on the rawin set as directed in the rawin set controls column.

(4) Compare the indications obtained on the test equipment with the indications given or referenced in the Normal indications column.

(5) If the indications obtained on the test equipment are normal, proceed either to the next step or as directed in the Normal indications column.

(6) If the indications obtained are abnormal, proceed as directed in the Corrective measures column.

b. Step-by-Step Troubleshooting. Refer to table 3-15.

Table 3—15. Step-by-Step Troubleshooting, Receiver

Step	*Test point*	*Test equipment*	*Rawin set controls*	*Normal indications*	*Corrective measures*
1	Observe reading on meter M1002.	None.	Place S1003 at B—.	—105 volts dc.	Be sure that S806 and S1004 switches are ON. Make sure that the power cable from the ac power supply to the control-recorder and the main cable from the control-recorder to the housing are connected. Make sure that P302 of the housing unit is plugged into J1005 of the receiver.
					Check fuses F1001 and F1002 in the receiver; replace if necessary.
					Check tubes V1017 and V1018; replace if necessary.
2	Pin 2 V1017.	Multimeter.		—105 volts dc 56K ohms.	Make voltage and resistance measurements to locate defect.
3	Observe reading on meter M1002.	None.	Place S1003 at B+.	+180 volts dc.	Check adjustment of R1093 (para 3—35).
					Same as step 1 except check V1015, V1016, and V1019 instead of V1017 and V1018 and replace if necessary.
4	Pin 3 V1015.	Multimeter.		+180 volts dc 10K ohms.	Make voltage and resistance measurements to locate defect.
5	Observe reading on meter M1002.	None.	Place S1003 at OSC GRID.	Within green block B.	Check V501 circuit by making voltage and resistance measurements. Troubleshoot the receiver power supply; check tubes V1017 and V1018 and replace if necessary.

Table 3—15. Step-by-Step Troubleshooting, Receiver—Continued

Step	*Test point*	*Test equipment*	*Rawin set controls*	*Normal indications*	*Corrective measures*
6	Observe reading on meter M1002.	None.	Place S1003 at INJECTION.	Within green block B.	Check local oscillator V501, injection connection P1005 of the receiver. If trouble is in local oscillator, replace tube V501.
					Check crystal CR101 (fig. 3—19); replace if necessary.
7	Observe reading on M801 or M1001.	Test Set TS—538(*)/U or radiosonde.	Place AFC-MANUAL switch S1005 to MANUAL.	Between 60 and 70.	Check motor B501 by observing gear train for movement while depressing S1007. If trouble is in B501, replace and retest (para 3—21). Check local oscillator V501 (step 6).
			Operate TUNING switch S1007 or S803 to either position.		
8	Observe reading on meter M801 or M1001.	Test set or radiosonde. . . .	Place AFC-MANUAL switch S1005 at AFC.	Between 60 and 70.	Check afc adjustments.
9	Observe reading on meter M1001.	Test set or radiosonde and vtvm.	Place S1003 at SHARP FM.	Within diamond C.	Check tubes V407, V408, and V409 of the if. strip. If trouble is not corrected, replace original tubes and perform voltage and resistance measurements (fig. 3—20). If trouble is in an if. amplifier component other than a tube or diode, refer to para 5—6.

Table 3—15. Step-by-Step Troubleshooting, Receiver—Continued

Step	*Test point*	*Test equipment*	*Rawin set controls*	*Normal indications*	*Corrective measures*
10	Pin 4 T1002.	Oscilloscope and vtvm. ...	Place AFC-MANUAL switch S1005 at AFC.	Waveform (fig. 3—21). ...	Check V1011. If trouble is not eliminated, replace original tube and perform voltage and resistance measurements (fig. 3—16, FO—10, FO—11). Replace defective component.
11	Pin 6 V1012B.	Oscilloscope and vtvm.		Waveform (fig. 3—21). ...	Check V1012. If trouble is not eliminated, replace original tube and perform voltage and resistance measurements (fig. 3—16, FO—10, FO—11). Replace defective component.
12	Junction of resistors R1076, R1078, R1079.	Oscilloscope and vtvm.		Waveform (fig. 3—21). ...	Continue troubleshooting as in step 11.
13	Pin 1 V1013.	Oscilloscope and vtvm.		Waveform (fig. 3—21). ...	Check V1013. If trouble is not eliminated, replace original tube and perform voltage and resistance measurements (fig. 3—16, FO—10, FO—11). Replace defective component.
14	Pin 2 V1013.	Oscilloscope and vtvm.		Waveform (fig. 3—21). ...	Check V1013. If trouble is not eliminated, replace original tube and perform voltage and resistance measurements (fig. 3—16, FO—10, FO—11). Replace defective component.
15	Pin 5 V1013.	Oscilloscope and vtvm.		Waveform (fig. 3—21). ...	Continue troubleshooting as in step 14.

Table 3—15. Step-by-Step Troubleshooting, Receiver—Continued

Step	Test point	Test equipment	Rawin set controls	Normal indications	Corrective measures
16	Pin 2 V1014.	Oscilloscope and vtvm.		Waveform (fig. 3—21).	Check V1014. If trouble is not eliminated, replace original tube and perform voltage and resistance measurements (fig. 3—16, FO—10, FO—11). Replace defective component.
17	Pin 5 V1014.	Oscilloscope and vtvm.		Waveform (fig. 3—21).	Continue troubleshooting as in step 16.
18	Pin 2 V1012.	Oscilloscope and vtvm.		Waveform (fig. 3—21).	Check V1012. If trouble is not eliminated, replace original tube and perform voltage and resistance measurements (fig. 3—16, FO—10, FO—11). Replace defective component.
19	Pin 1 V1012.	Oscilloscope and vtvm.		Waveform (fig. 3—21).	Same as step 18.
20	Observe reading on meter M1001.	Test Set TS—538(*)/U or radiosonde.	Switch S1001 at SHARP and BROAD.	Between 60 and 70.	Set S1003 to PEAK PULSE and check reading on meter M1002. If reading is low (to the left of the green block B) in both positions of S1001, check if. amplifier tubes V405 through V401 in the order given. If trouble is present with S1001 in the SHARP BW position, check crystal CR404 (fig. 3—17) and V407. If trouble is present with S1001 in the BROAD BW position, check crystal CR401 (fig. 3—17).

Table 3—15. Step-by-Step Troubleshooting, Receiver—Continued

Step	Test point	Test equipment	Rawin set controls	Normal indications	Corrective measures
					If trouble continues, set S1003 to AC ERROR; if reading is outside diamond C, replace V1001. If tube is good, replace and check associated circuit.

NOTE

The following steps must be performed with the receiver installed in the rawin system.

Step	Test point	Test equipment	Rawin set controls	Normal indications	Corrective measures
21	Pin 1 to grd of sine amplifier V1002A (fig. 3–10).	Vtvm and test set.	METER SELECTOR switch S1003 at AC ERROR and MANUAL-NEAR AUTO-FAR AUTO switch S605 (TM 11–6660–206–12) to NEAR AUTO.	SERVICE METER M1002 reads within diamond C (when meteorological signal is being received).	If the antenna does not track automatically, troubleshoot V1002 circuits (fig. 3–10). Make voltage and resistance measurements (fig. 3–20 and FO–12).
				TUNING METER reads 10 to 70 ma. Vtvm reads 70 volts for AN/GMD–1A and 90 volts for AN/GMD–1B.	If the antenna does not track in azimuth only. Check V1014. If trouble is not eliminated, replace original tube and perform voltage and resistance measurements (fig. 3–16, FO–10, FO–11). Replace defective component.
22	Pin 1 to grd and pin 6 to grd of driver inverter V1003 (fig. 3–10).	Vtvm and test set.	Same as step 21.	SERVICE METER and TUNING METER readings same as step 21. Vtvm reads 125 Vdc.	Same as step 21, except troubleshoot V1002 circuits.
23	Pin 1 to grd and pin 6 to grd of azimuth and elevation sine output tubes V1004 and V1005, (fig. 3–10).	Vtvm and test set.	Same as step 21.	SERVICE METER and TUNING METER readings same as step 21. Vtvm reads +180 Vdc.	Same as step 21, except troubleshoot V1004 and V1005 circuits.

Table 3–15. Step-by-Step Troubleshooting, Receiver—Continued

Step	Test point	Test equipment	Rawin set controls	Normal indications	Corrective measures
24	Pin 1 to grd and pin 6 to grd of elevation sine output tube V1005 (fig. 3–10).	Vtvm and test set.	Same as step 21.	SERVICE METER and TUNING METER readings same as step 21. Vtvm reads +180 Vdc.	If the antenna tracks in azimuth but does not track in elevation, troubleshoot V1005 circuits (fig. 3–10). Make voltage and resistance measurements (fig. 3–20 and FO–12).
25	Pin 1 to grd and pin 6 to grd of azimuth sine output tube V1004 (fig. 3–10).	Vtvm and test set.	Same as step 21.	SERVICE METER and TUNING METER readings same as step 21. Vtvm reads 180 Vdc.	If the antenna tracks in elevation but does not track in azimuth, troubleshoot V1004 circuits (fig. 3–10). Make voltage and resistance measurements (fig. 3–20 and FO–12).

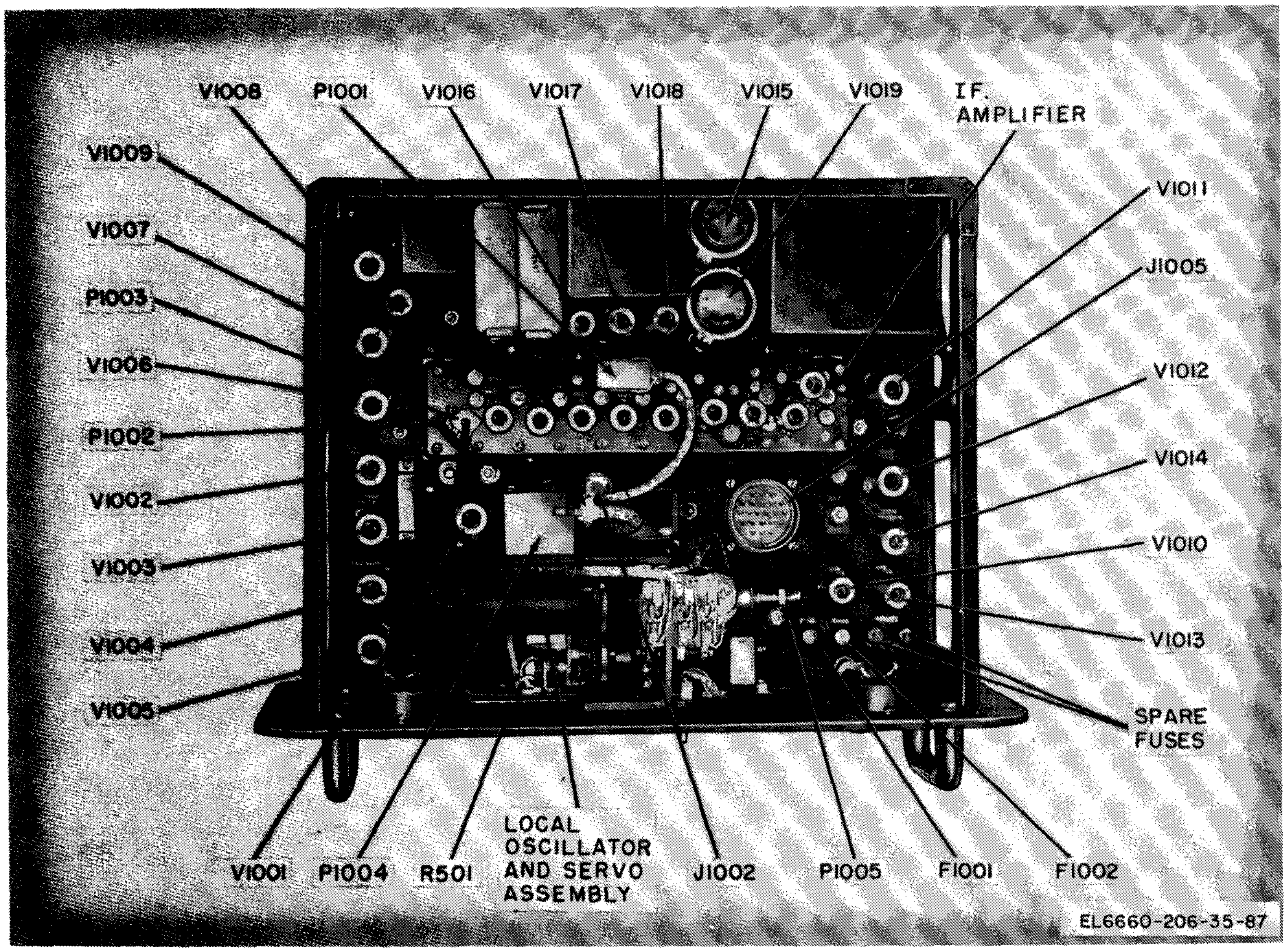


*Figure 3–9. Receiver (except R–301D/GMD–1**), top view.*

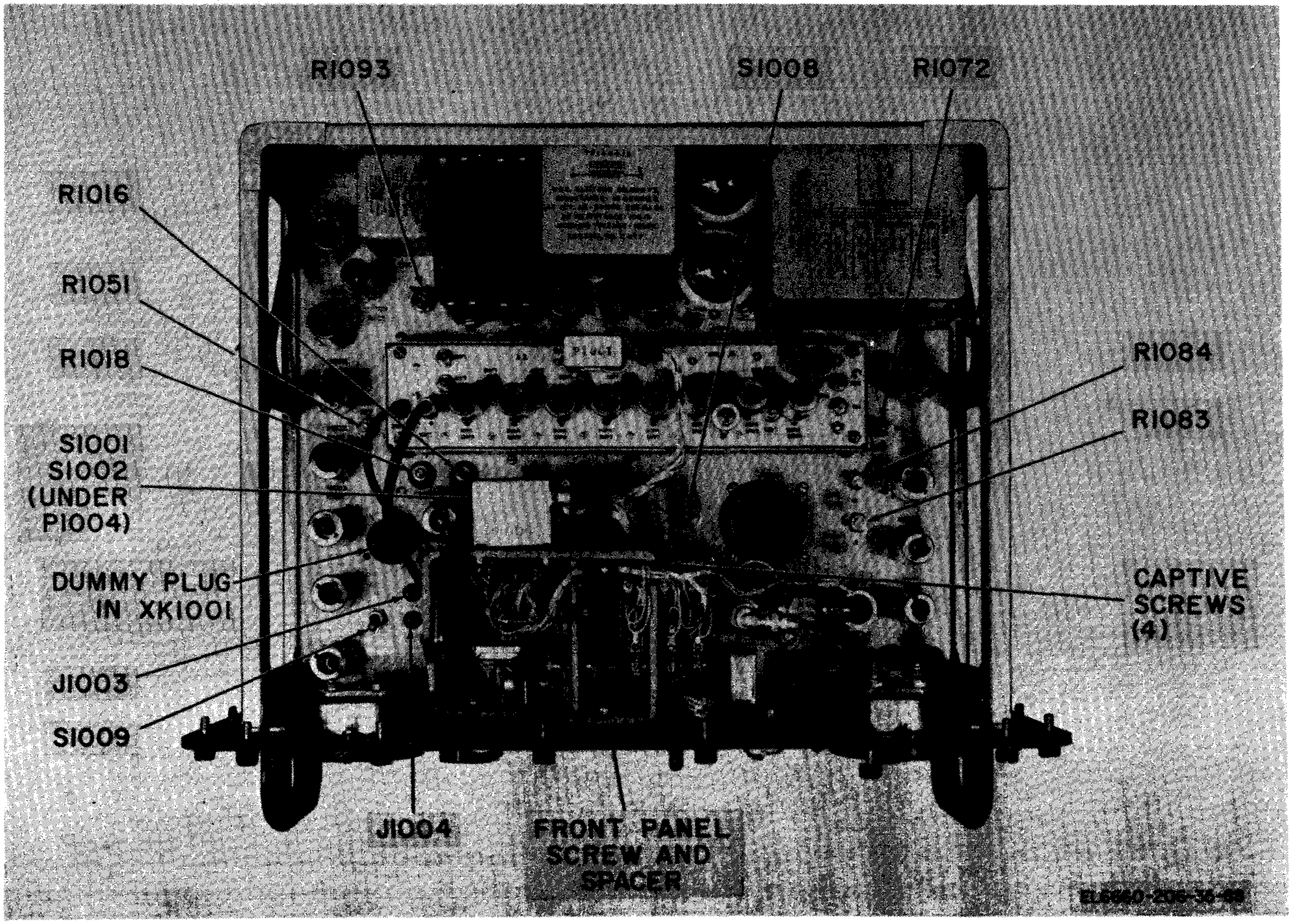


*Figure 3-10. Receiver (R-301D/GMD-1**), top view.*

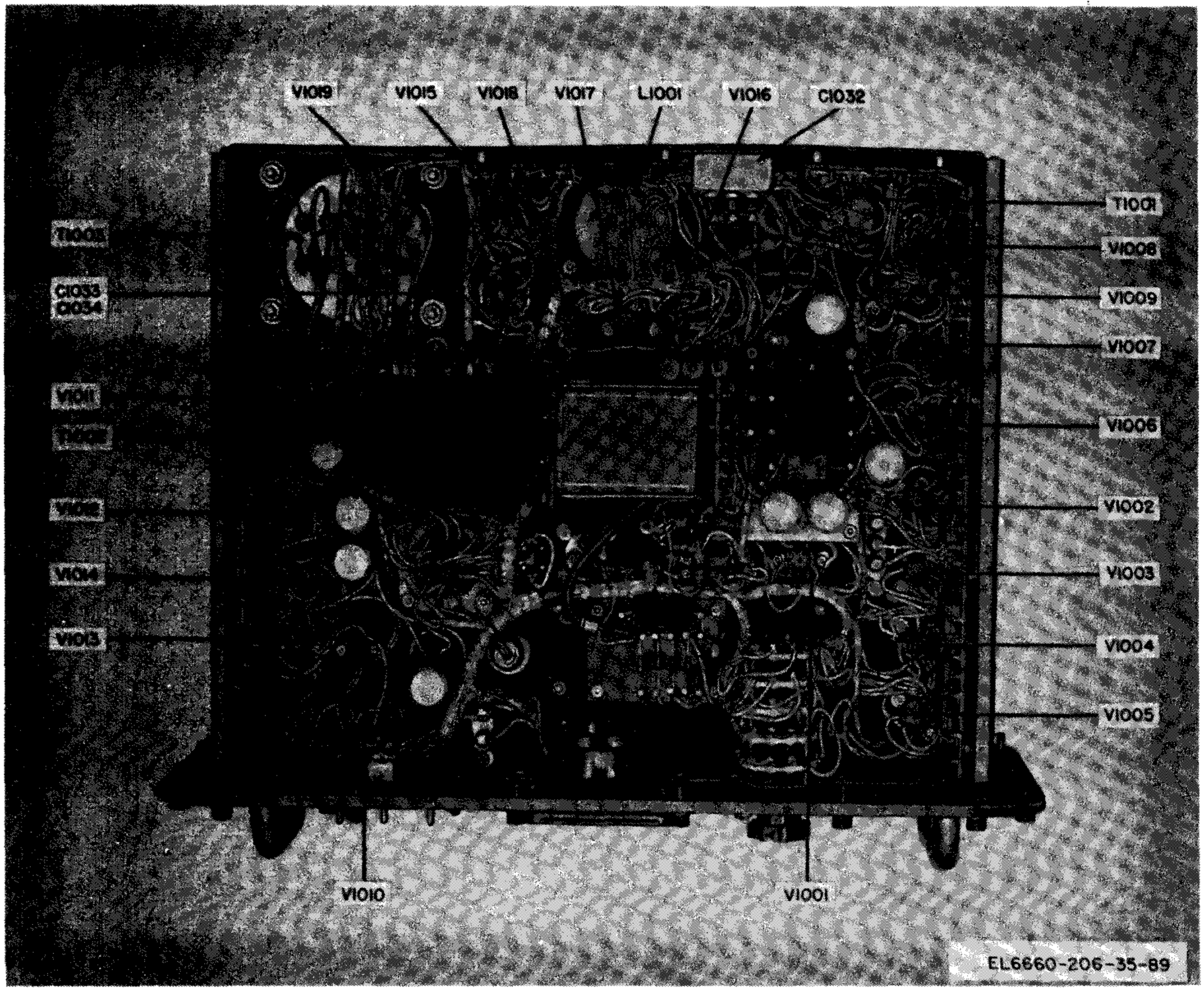


*Figure 3-11. Receiver (except R-301D/GMD-1**), bottom view, parts identified.*

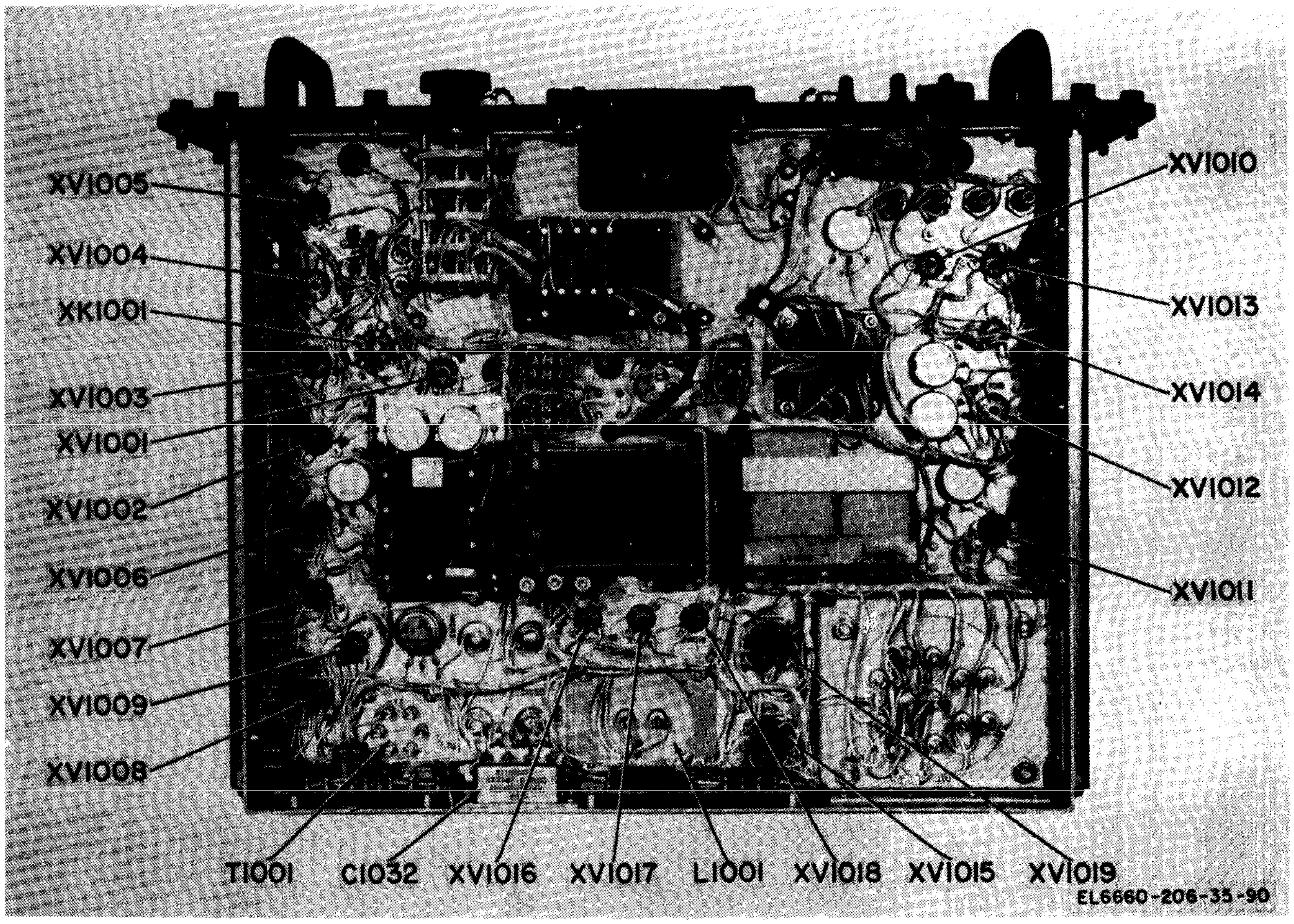


*Figure 3-12. Receiver (R-301D/GMD-1**), bottom view, parts identified.*

Section V. RECEIVER REPAIR

3-29. General

This section contains removal and replacement procedures for the local oscillator and servo assembly, if. amplifier, and crystal diode.

3-30. Removal and Replacement of Local Oscillator-Servo Assembly and Motor-Generator

a. Removal of Local Oscillator-Servo Assembly.

(1) Remove the receiver from the housing (para 3-26).

(2) Remove and retain the front panel screw and spacer (fig. 3-10) that hold the servo assembly mounting bracket (fig. 5-2) to the receiver. front panel.

(3) Loosen the four captive screws (fig. 3-10) that hold the servo assembly mounting bracket (fig. 5-2) to the receiver chassis.

(4) Disconnect P1005 and J502, and P1004 and J501 (fig. 3-10).

(5) Remove the local oscillator and servo assembly from the receiver and place it on the workbench.

(6) Loosen the filament lead locknut (1, fig. 5-3) and remove the filament connector.

(7) Loosen the bellows setscrew (fig. 5-2).

(8) Remove R502 (fig. 5-2) and the grid and cathode leads by removing the two terminal screws of R502. Label these leads. The lead with the green tracer is grid and the lead with the brown tracer is cathode.

(9) Remove the large nut (15, fig. 5-3) on the motor-generator end of the local oscillator assembly (fig. 5-2).

(10) Remove the local oscillator assembly (fig. 5-2) from the servo assembly mounting bracket.

b. Replacement of Local Oscillator-Servo Assembly.

(1) Replace the local oscillator assembly (fig. 5-2) into the servo assembly mounting bracket oriented as shown in figure 5-2.

(2) Replace the large nut (15, fig. 5-3) on the motor-generator end of the local oscillator assembly.

(3) Replace R502 (fig. 5-2) and the grid and cathode leads that were removed in *a* above.

(4) Tighten the bellows setscrews.

(5) Replace the filament connector (fig. 5-3) and tighten the filament lead locknut (1).

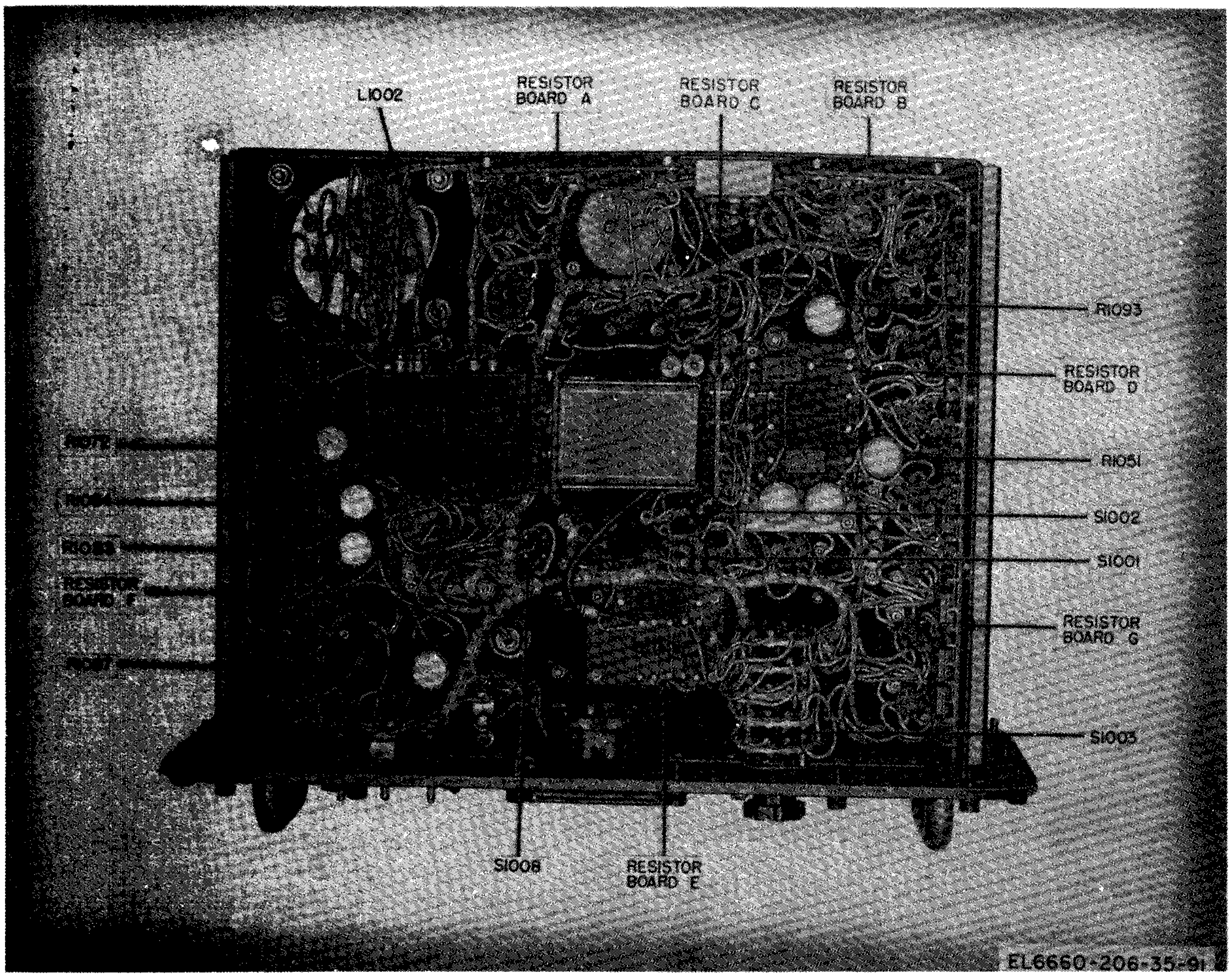


*Figure 3-13. Receiver (except R-301D/GMD-1**), bottom view, location of resistors and capacitors.*

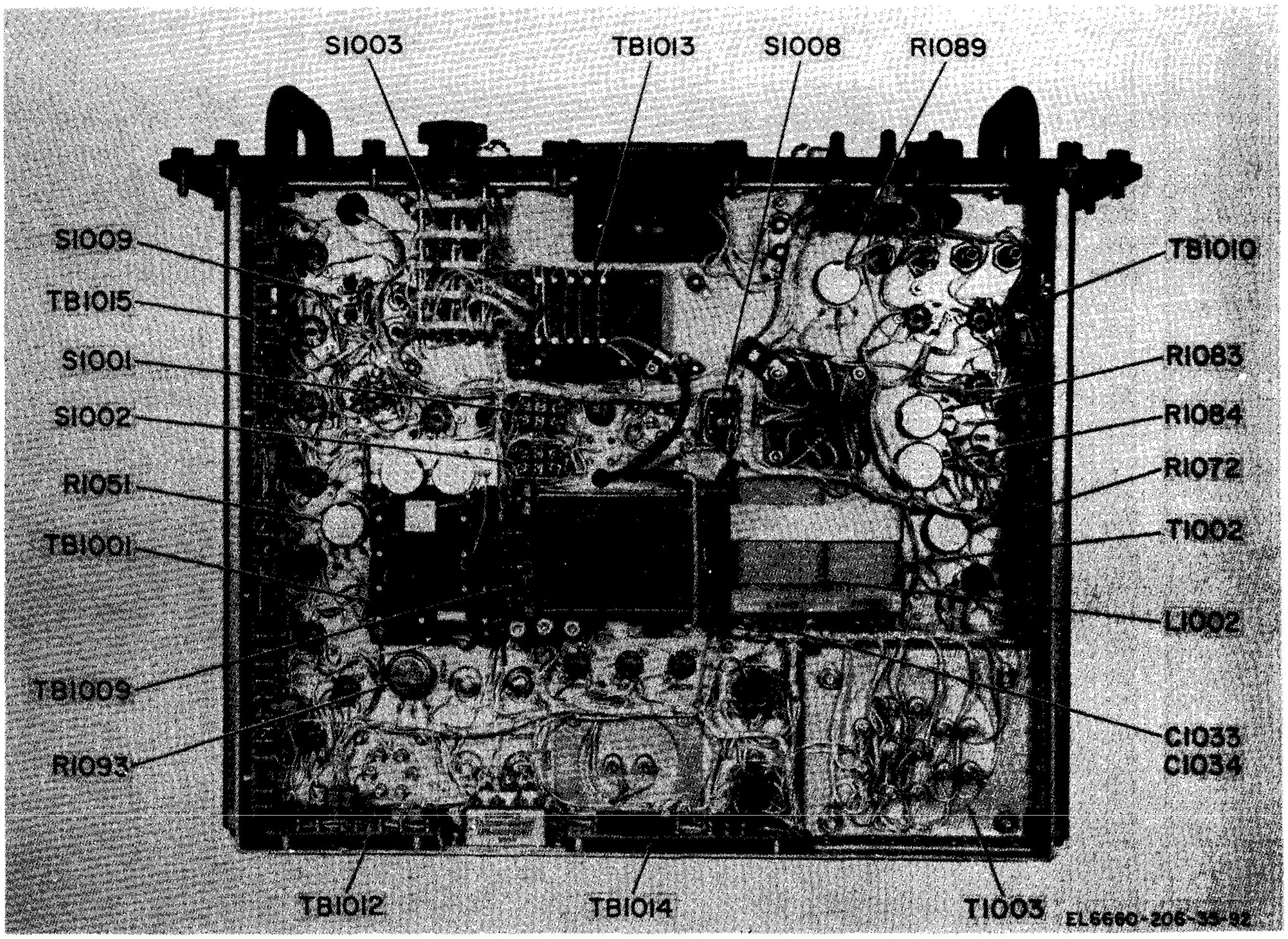


Figure 3-14. Receiver (R-301D/GMD-1), bottom view, location of resistors and capacitors.*

(6) Replace the local oscillator and servo assembly in the receivers shown in figure 3-10.

(7) Connect P1004 to J501, and P1005 to J502.

(8) Secure the four captive screws that hold the servo assembly mounting bracket (fig. 5-2) to the receiver chassis.

(9) Replace the front panel spacer and screw that hold the servo assembly mounting bracket to the receiver front panel.

(10) Replace the receiver in the housing.

c. Removal of Motor-Generator.

(1) Disconnect and tag the motor-generator (G501-B501) wires that connect to jack J501 (fig. 3-18) terminals 9 and 11.

(2) Disconnect and tag the wires that are connected to terminals of capacitor C501.

(3) Loosen the two allen setscrews that fasten the bellows to the motor shaft.

(4) Loosen and remove the seven screws, washers, and nuts that mount the motor-generator to the servo assembly mounting bracket and remove the motor-generator.

d. Replacement of Motor-Genemtor.

(1) Place motor-generator into servo assembly housing and replace seven screws, washers, and nuts that secure the motor-generator to the servo assembly housing.

(2) Slide the bellows onto the motor-generator shaft and tighten two allen setscrews.

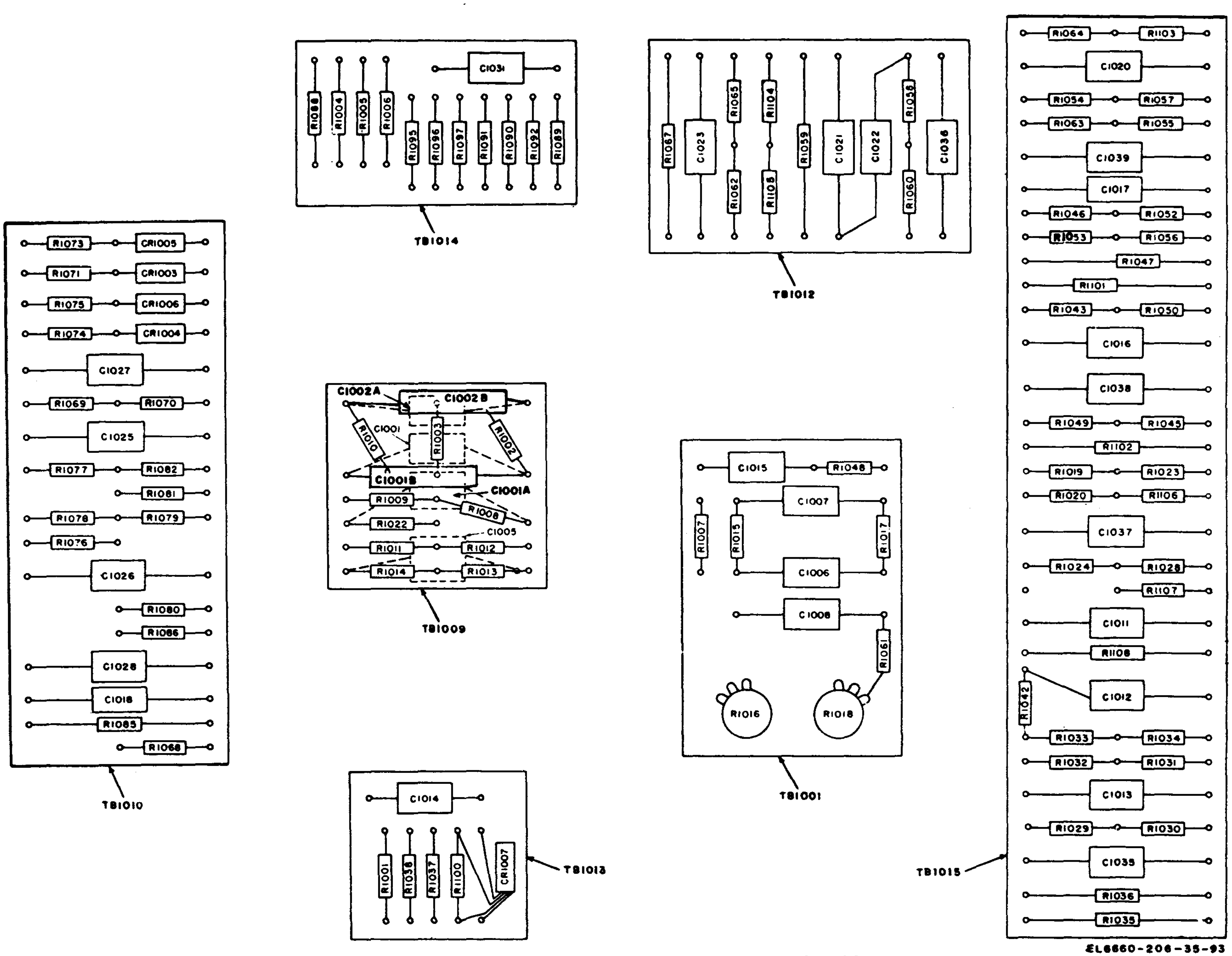


*Figure 3–15. Receiver R–301D/GMD–1** resistor-capacitor board layout.*

(3) Reconnect the wires to terminals of capacitor C501.

(4) Reconnect the motor-generator (G501-B501) wires to jack J501 (fig. 3-18) terminals 9 and 11.

3-31. Removal and Replacement of IF Amplifier

a. Removal of IF Amplifier.

(1) Disconnect cable plug P1001 (fig. 3-9) from J403 (fig. 3-16).

(2) Disconnect coaxial cable from J401 and single conductor cable from J402.

(3) Loosen four captive screws (located at each comer, top of unit) and remove the if. amplifier from the receiver (fig. 3-9).

b. Replacement of IF Amplifier.

(1) Replace if. amplifier into receiver (fig. 3-9) and tighten four captive screws located at each comer, top of unit.

(2) Reconnect coaxial cable to J401 and single' conductor cable to J402.

(3) Reconnect cable plug P1001 to J403 (fig. 3-16).

3-32. Removal and Replacement of Crystal Diode CR101

a. Unscrew the knurled nut (fig. 2-7).

b. Withdraw the mixer fitting (if. arm).

c. Lift out the crystal (fig. 3-19).

d. Place a finger on the crystal holder while inserting the new crystal to protect it from damage by static electricity discharge.

e. Replace the mixer fittings and tighten the knurled nut *(a* above).

Section VI. RECEIVER ADJUSTMENT AND ALIGNMENT

3-33. General

a. This section contains all the adjustments of the receiving system. The adjustments in the Rawin Receiver R-301(*)/GMD-1 are made with the components interconnected with the other components of the rawin set.

b. The following receiving system adjustments are in the Rawin Receiver R-301(*)/GMD-1:

(1) B+ SET potentiometer R1093 (para 3-36).

(2) SPEAKER GAIN control R1066 (TM 11-6660-206-12). (A front panel control used by the operator.)

NOTE

Before making the pulse set adjustment as outlined in paragraph 3-38, refer to TM 11-6660-206-12 for the proper operating procedure for the rawin set.

(3) PULSE SET potentiometer R1051 (para 3-38).

(4) Afc adjustments (para 3-36).

c. Receiver system adjustments in the Rawin Receiver R-301(*)/GMD-1 which cannot be performed at direct support are:

(1) If. alignment.

(2) Local oscillator adjustment.

3-34. Tools and Test Equipment Required

The tools and test equipment required to align the receiving system are listed in table 3-16.

Table 3-16. Tools and Test Equipment, Receiver

Test equipment	*Common name*	*Technical manual*
Multimeter ME-26/U	Vtvm	TM 11-6625-200-15
Test Set TS-538(*)/U[a]	Test set	TM 11-6625-213-12
Oscilloscope AN/USM-281A	Oscilloscope	TM 11-6625-1703-15
Signal Generator AN/USM-44	Signal generator	TM 11-6625-508-10

[a]Supplied with Rawin Set AN/GMD-1(*).

3-35. B+ SET Potentiometer R1093

Before proceeding with the receiving system alignment, adjust B+ SET potentiometer R1093 (TM 11-6660-206-12).

a. Place S1003 in the B+ position.

b. Connect the vtvm between pin 3 of V1015 (fig. 3-12) and the chassis with the meter set to a high voltage range.

c. Adjust R1093 to give an indication of +180 volts dc. Allow time for the indication to stabilize.

3-36. Afc Adjustment

a. General. The proper operation of the afc circuit depends on the correct balance of the sharp fm discriminator. To check this balance, place the receiver in normal operating condition (TM 11-6660-206-12, fig. 1-8) but with no signal being received. Note the indication of the SERVICE METER (M1002) with the METER SELECTION switch (S1003) in the SHARP FM position. Indications on the meter greater than one division (10 volts) in either a positive or negative direction indicate that sharp fm discriminator. V409 should be aligned (TM 11-6660-206-12). A no-signal sharp fm discriminator output that is too large (more than 10 volts) will cause erroneous automatic tuning or creeping. The adjustment of the afc of the receiver is outlined in the following steps:

b. Procedure.

(1) Set METER SELECTOR switch S1003 to SHARP FM.

NOTE

If indication on M1002 exceeds one division when no signal is being received, higher level maintenance is required. If indication does not exceed one division, set METER SELECTOR switch S1003 to AFC BAL.

(2) Adjust AFC GAIN control R1084 (fig. 3-10) to the full CW position (maximum gain).

(3) Adjust MOD BAL control R1072 (fig. 3-10) to obtain a minimum reading on M1002.

(4) Set AFC-MANUAL switch S1005 to MANUAL.

(5) Adjust SPEED CONTROL R1087 to the full CW position (maximum manual speed).

(6) Adjust afc ANTI HUNT control R1083 (fig. 3-10) to the full CCW position (no feedback).

(7) Adjust afc ANTI HUNT control R1083 so that the tuning dial moves at the desired speed when TUNING switch S1007 is operated.

(8) Set METER SELECTOR switch S1003 to OFF.

(9) Set AFC-MANUAL switch S1005 to AFC.

(10) Connect the output of Test Set TS-538(*)/U (fig. 3-8) through the adapter to the receiver mixer or operate the test set as a target.

(11) Adjust the OSCILLATOR FREQUENCY control of the test set to 1,680 MHz.

(12) Adjust RF POWER SET control on the teat set until the meter is at the SET POWER point. Rotate the OUTPUT POWER dial to -80 dbm.

(13) Tune the receiver to 1,690 MHz.

(14) Manually vary the frequency of the receiver on each side of 1,680 MHz. Make certain the afc returns the tuning to 1,680 MHz. If hunting occurs, reduce the setting of AFC GAIN control.

(15) Check the remote tuning indication by observing the reading of TUNING METER M801 on the panel of the control-recorder. As the local oscillator is tuned throughout the frequency range, the reading should increase smoothly, when S804 is depressed.

(16) If the reading of TUNING METER is erratic, proceed as follows:

(a) Disconnect P1004 (fig. 3-18) from J501.

(b) Check the variation of potentiometer R501 with an ohmmeter. Replace if necessary.

(c) Reconnect P1004 to J501.

(17) If the TUNING METER indication reverses when tuning is made in one direction, proceed as follows:

(a) Disconnect P1004 from J501 (fig. 3-18).

(b) Loosen the two screws on potentiometer R501 mounting bracket on the oscillator chassis to allow the gear that rotates the shaft of the potentiometer to be meshed.

(c) Tune the receiver manually toward the low-frequency direction until FREQUENCY MEGACYCLES meter M501 indicates 1,655 MHz.

(d) Connect an ohmmeter across the two end terminals of R501 and rotate the shaft until minimum resistance is obtained.

(e) Engage the gears and tighten the mounting screws.

(f) Connect P1004 to J501.

(18) Check the adjustment by tuning the receiver throughout the frequency range and noting the indication of meter M801 when S804 is depressed.

(19) If the indication is still defective, check and trace the circuit.

3-37. PULSE SET Potentiometer R1051

a. General. PULSE SET potentiometer R1051 is adjusted to provide a separation of the noise in the received signal from the audible signal. PULSE SET potentiometer R1051 is adjusted so that noise pulses are just prevented from being audible.

b. Procedure. To adjust P1051, proceed as outlined in procedures (1) through (7) below:

(1) Set AM-FM switch S1002 (fig. 3-10) for the type of signal to be received.

(2) Refer to TM 11-6625-213-12 for connections to Test Set TS-538(*)/U.

(3) Refer to the starting procedure for Test Set TS-538(*)/U in TM 11-6625-213-12. Place REPETITION RATE control at 10 Hz instead of 5 Hz.

(4) Refer to the procedure that uses the monitor loudspeaker as an indicator to measure the sensitivity of Rawin Receiver R-301(*)/GMD-1. During the procedure, keep the REPETITION RATE control at 10 Hz.

(5) In the procedure in TM 11-6625-213-12, make sure that the OUTPUT POWER dial on the test set is set so that the reading on the OUTPUT POWER dial does not exceed 90 db below 1 mW (-90 dbm).

(6) Place METER SELECTOR switch S1003 in the PEAK PULSE position.

(7) Adjust PULSE SET potentiometer R1051 (fig. 3-10) so that the reading on SERVICE METER M1002 is within the green block B with the least clockwise rotation of R1051.

3-38. Receiver Alignment

a. Preliminary Setup. Before performing any of the procedures (steps *b* through *h),* complete the following preliminary steps:

(1) Connect the receiver to a power source as described in paragraph 3-26.

(2) Set the POWER switch to ON.

(3) Check to see that the FREQUENCY MEGACYCLE dial is illuminated. The illumination of this dial indicates that alternating current (at) power is applied to the receiver.

(4) Check the output of the +180-volt direct-current (dc) regulated power supply by placing the METER SELECTOR switch in the B+ position and reading the indication on the SERVICE METER. If the SERVICE METER does not read +180 volts, adjust the B+ SET potentiometer ((5) through (7) below). If the SERVICE METER indicates +180 volts, continue with the adjustments by following the adjustments and alignment procedures given in *b* through *h* below.

(5) Place the METER SELECTOR switch in the B+ position.

(6) Connect the dc probe of the vtvm to pin 3 of V1015 (fig. FO-10) and connect the ground connection of the vtvrn to the chassis of the receiver with the vtvrn set to measure at least +180 volts.

(7) Adjust R1093 (fig. 3-10) to give a reading of +180 volts dc on the vtvm. Allow time for the reading to stabilize.

(8) Set the POWER switch to OFF.

b. 15 MHz Trap.

(1) Disconnect the coaxial cable connector from jack J401 which is the coaxial plug mounted on the if. amplifier chassis (fig. 3-16) located in the center of the receiver.

(2) Set switches and controls on the signal generator AN/USM-44 and make connections to the signal generator as follows:

(a) Set the power switch (TM 11-6625-508-10) to ON.

(b) Rotate the FREQUENCY RANGE knob to band A.

(c) Adjust the output attenuator control to set the OUTPUT meter pointer to maximum.

(d) Rotate the tuning knob until the 15 MHz mark is opposite the frequency reference line in the carrier frequency dial window.

(e) Set the modulation selector switch to 1000.

(f) Adjust the MOD. LEVEL knob until the PERCENT MODULATION meter indicates 30.

(g) Connect Cord CG-409/U, supplied with the signal generator, between RF OUTPUT jack on the signal generator and jack J401 (fig. 3-16) on the if. amplifier.

(3) Set the switches and controls on the vtvm ME-26 (TM 11-6625-200-15) and make connections to the vtvm as outlined in *(a)* through *(d)* below.

(a) Remove the line cord from the compartment in the vtvm, and connect the line plug to an ac socket.

(b) Set the FUNCTION switch to AC.

(c) Set the RANGE switch to 10V.

(d) Connect the black test lead between the COMMON binding post on the vtvm and the receiver chassis (ground).

(4) Remove tube V403 from the if. amplifier (fig. 3-16) and connect the ac probe of the vtvm to pin 1 of the tube socket. (fig. 3-17).

(5) Set the POWER switch on the receiver to ON. Adjust the MICROVOLTS control (TM 11-6625-508-10) on the signal generator to obtain a midscale indication on the vtvm.

(6) Use a screwdriver to adjust L418 (fig. 3-16) for minimum deflection on the vtvm.

(7) Remove all power, disconnect the vtvm and signal generator, and replace tube V403.

c. IF Amplifier.

(1) Connect the vtvm and set the controls on the vtvm as in *b(3)(a)* above.

(2) Set the FUNCTION switch (TM 11-6625-200-15) on the vtvm to -DC.

(3) Connect the dc probe of the vtvm to the center terminal of switch S1008 (fig. 3-10).

(4) Connect the signal generator and set its controls as instructed in b(2) above, except as directed in (6) below.

(5) Disconnect the if. cable from the IF INPUT on the receiver front panel.

(6) Connect one end of the spare if. cable (taken from the accessories case) to the IF INPUT and connect the other end, in series with a 250-ohm resistor, through cable CG-530B/U to RF OUTPUT jack (TM 11-6625-508-10) on the signal generator.

(7) Set BROAD-SHARP switch S1001 to SHARP.

(8) Set the MOD. SELECTOR switch (TM 11-6625-508-10) on the signal generator to EXT. MOD.

(9) Set the signal generator to 30 MHz as outlined in *(a)* through *(c)* below:

(a) Rotate the FREQUENCY RANGE knob (TM 11-6625-508-10) to band B.

(b) Rock the range knob slightly to check the detent position so that the desired frequency band coil contacts are engaged.

(c) Turn the tuning knob until the 30.0 MHz mark is opposite the frequency reference line in the carrier frequency dial window.

NOTE

Adjust the output attenuator control on the signal generator to keep the output of the signal generator at a level where the vtvm indication is about half scale for the remainder of the if. alignment procedure.

(10) Set the POWER switch on the receiver to ON.

(11) Adjust L412, L410, L409, L407, L405, and L401 (TM 11-6660-206-12) on the if. amplifier chassis, for maximum deflection on the vtvm.

(12) Reset the output attenuator control (TM 11-6625-508-10) on the signal generator in accordance with the note preceding and repeat the procedure given in step (11) above.

(13) Remove all power and disconnect the vtvm and signal generator; replace the if. cable in the IF INPUT.

d. Sharp Fm Discriminator.

(1) Connect the vtvm and set its controls as in b(3) above, with the exception of the setting for the FUNCTION switch. Set the FUNCTION switch to ±DC.

(2) Connect the dc probe of the vtvm to the junction of resistors R1069 and R1070 located on resistor board F (fig. 3-13).

(3) Connect the signal generator and set its controls as in b(2) above, with the exception of the setting for the range knob. Set the range knob to band B.

(4) Set the POWER switch on the receiver to ON.

(5) Adjust the output attenuator control on the signal generator for a low indication (2 volts) on the vtvm.

(6) Adjust the secondary of transformer T402 (fig. 3-16) located on the receiver for zero indication on the vtvm.

(7) Turn the tuning knob on the signal generator USM-44 until the 30.4 MHz mark is opposite the frequency dial window.

(8) Adjust the output attenuator control on the signal generator for 10-microvolt output.

(9) Adjust the primary of transformer T402 (fig. 3-16) for a maximum indication on the vtvm. (Note this reading.)

(10) Adjust the tuning knob of the signal generator until the 29.6 MHz mark is opposite the frequency reference line in the carrier frequency dial window.

(11) Note the indication on the vtvm. The absolute value of this indication and that obtained in (9) above should be equal but opposite in polarity.

(12) If the indications obtained in (11) above are equal to the indications obtained in (9) above, proceed to (13) below. If the indications obtained in (9) and (11) above are not equal, but are opposite in polarity, adjust the tuning knob (TM 11-6625-508-10) of the signal generator until the 29.6 MHz mark is opposite the frequency reference line in the carrier frequency dial window, and adjust the primary of transformer T402 (fig. 3-16) for a maximum indication on the vtvm. Repeat the procedures given in (7) through (12) above until the indication of the vtvm for 29.6 MHz is equal in amplitude but opposite in polarity to the indication for 30.4 MHz frequency setting of the tuning knob.

(13) Turn the tuning knob on the signal generator until the 30 MHz mark is opposite the frequency reference line in the carrier frequency dial window. The indication on the vtvm should be zero; if not, repeat procedure (6) above.

(14) Set the power switch on the signal generator to off. If the indication on the vtvm is more than *0.05, readjust transformer T402 (fig. 3-16) ((7) through (13) above).

(15) If alignment of the broad fm detector is to follow, do not disconnect the test equipment; otherwise, remove all power and disconnect the vtvm and signal generator.

e. Broad Fm Detector.

NOTE

The alignment of the broad fm detector depends on the correct previous alignment of the if. amplifier (*c* above).

(1) Set switch S1001 on the receiver to the BROAD position.

(2) Connect the vtvm and set its controls as instructed in b(3) above, except set the FUNCTION switch to +DC, and the RANGE switch to 100V.

(3) Connect the vtvm dc probe to the junction of C1005 and S1001 (fig. 3-13) on the receiver.

(4) Connect the signal generator and set its controls except the range knob as instructed in b(2) above. Set the range knob for band B.

(5) Disconnect the if. cable from the IF INPUT and connect the spare if. cable from the accessories case to the IF INPUT.

(6) Connect the other end of the if. cable ((5) above) in series with a 250-ohm, low-watt, noninductive resistor, through cable CG-530B/U to the signal generator RF OUTPUT jack (TM 11-6625-508-10).

(7) Adjust the signal generator output attenuator control to obtain 100-microvolt output.

(8) Turn the tuning knob on the signal generator until the 30 MHz mark is opposite the frequency reference line in the carrier frequency dial window.

(9) Set the receiver POWER switch (TM 11-6660-206-12) to ON.

(10) Observe the vtvm and turn the signal generator tuning knob slowly to produce a lower frequency (carrier frequency dial).

(11) Record the lowest voltage reading observed in the voltage dip.

(12) Observe the vtvm and turn the signal generator tuning knob to produce a higher frequency and record the maximum voltage obtained.

(13) Readjust the signal generator to obtain a 100-microvolt output at 30 MHz (MICROVOLTS control and tuning knob).

(14) Adjust L414 (fig. 3-16) until the vtvm reads midway between the recorded maximum and minimum values ((11) and (12) above).

NOTE

The reading obtained by the adjustment given in (14) above indicates the center point of the broadband discriminator.

(15) Recheck the alignment of the if. amplifier and discriminator (*c* and *d* above) to be sure that the peak of the if., the center of the narrowband discriminator, and the center of the broadband discriminator all occur at 30 MHz.

f. Local Oscillator Operational Check.

(1) Place the local oscillator and servo assembly in the receiver chassis in the area where it is normally mounted (fig. 3-9).

(2) Stand the local oscillator and servo assembly on the motor-generator end until the normal operational check and the adjustments covered in *h* below are completed.

(3) Connect plug P1004 (fig. 3-9) and P1005 to J501 and J502 (fig. 3-18), respectively.

(4) Obtain the spare mixer, the if. cable, and the oscillator cable from the accessories case and connect the test set to the receiver (fig. 3-8).

(5) Connect the receiver to its power source by the use of the receiver and antenna control test cable.

(6) Set the receiver POWER switch to ON.

(7) Operate the receiver front panel METER SELECTOR switch to the OSC GRID position.

(8) Check for oscillation. Receiver SERVICE METER M1002 should indicate a point halfway (or higher) to green area B on the meter scale.

(9) If the local oscillator tube does not oscillate, perform *(a)* through *(c)* below.

(a) Check the connection of the filament leads (fig. 5-2). Press on the filament connector (fig. 5-3) to assure a good connection.

(b) Check the tightness of the cathode cavity (fig. 5-3).

(c) Replace the local oscillator tube (TM 11-6660-206-12) with a tube (type 5675) known to be good.

g. Preliminary Local Oscillator Frequency Adjustment. The procedure for adjustment of the local oscillator frequency described in (1) through (12) below is performed after reviewing *f* above. The receiver is connected for bench servicing (para 3-26) with the test setup illustrated in figure 3-8.

(1) Operate the test set as directed in TM 11-6625-213-12), except set OUTPUT POWER dial for -35 dbm.

(2) Set the receiver POWER switch to ON.

(3) Depress the receiver TUNING switch as necessary until the FREQUENCY MEGACYCLE dial indicates 1,680 MHz.

(4) Adjust the test set FREQUENCY METER dial through its entire frequency range and observe receiver TUNING METER M1001. The meter should indicate two responses, 60 MHz apart, as the test set FREQUENCY METER dial is adjusted.

(5) Note the higher frequency setting of the test set FREQUENCY METER dial response on receiver TUNING METER M1001 ((4) above). If the higher frequency response results when the test set FREQUENCY METER dial is between 1,660 and 1,700 MHz, follow the procedures starting with (8) below. If the higher frequency response results above the 1,700 MHz setting on the FREQUENCY METER dial, follow the procedure given in (6) following. If the higher frequency response results below the 1,660 MHz setting, follow the procedures given in (7) below.

(6) When the higher frequency response noted in (5) above is above the 1,700-MHz setting:

(a) Loosen the setscrews on the end of the bellows (fig. 5-2) nearest the local oscillator assembly.

(b) Compress the bellows and hold them to prevent the oscillator tuning shaft from turning; then depress the receiver TUNING switch to INCREASE FREQ until the dial indicates the highest dial frequency.

(c) Compress the bellows (fig. 5-2) about one-eighth inch and tighten the bellows setscrews.

(d) Depress the TUNING switch to DECREASE FREQ until the dial indicates 1,680 MHz.

(e) Recheck the test set dial setting that produces the higher frequency response ((2) above). If it is lower than 1,700 MHz, follow the procedure starting with (8) below. If the higher frequency response occurs above 1,700 MHz, repeat *(a)* through *(d)* above until the higher frequency response is below 1,700 MHz.

(7) When the higher frequency setting noted in (3) above is below 1,660 MHz:

(a) Loosen the setscrews on the end of the bellows (fig. 5-2) nearest the local oscillator assembly.

(b) To prevent the oscillator tuning shaft from turning, compress the bellows and hold them; then depress the TUNING switch on the receiver to DECREASE FREQ until the dial indicates the lowest frequency.

(c) Compress the bellows (fig. 5-2) about one-eighth inch and tighten the bellows setscrews.

(d) Depress the TUNING switch on the receiver to INCREASE FREQ until the dial indicates 1,680 MHz.

(e) Recheck the test set dial setting that produces higher frequency response (5) above. If it is higher than 1,660 MHz, follow the procedure starting with (8) below. If it is lower than 1,660 MHz repeat *(a)* through *(d)* above until the higher response frequency is above 1,660 MHz.

(8) Fabricate a pickup lead to provide variable coupling from the output of receptacle J502 (fig. 5-2) to the antenna of the test set. Use about two feet of small coaxial cable such as RG-55/U or RG-62/U. Terminate one end of the cable in a male BNC connector.

(9) Strip back 2 inches of the shield from the unterminated end of the fabricated cable ((8) above). Do not remove the insulation from the center conductor.

(10) Disconnect the cable from J502 (fig. 5-2) on the local oscillator assembly and replace it with the connector end of the fabricated pickup lead ((8) and (9) above).

(11) Install the test set TS-538/U (TM 11-6625-213-12).

(12) Place the stripped end of the fabricated pickup lead near the antenna of the test set: do not allow the center conductor of lead to make contact with the antenna.

(13) Rotate the test set R.F. POWER SET CONTROL to OFF.

(14) Move the test set POWER switch to OFF.

(15) Vary the position of the pickup lead with respect to the antenna of the test set, until the power monitor meter pointer deflects two-thirds full scale.

NOTE

If the pickup lead has no short or open circuit, and if the local oscillator tube is oscillating normally, a low current reading can be obtained without touching the pickup lead to the antenna.

(16) Depress the TUNING switch as necessary to bring the FREQUENCY MEGACYCLES dial reading to 1,680 MHz.

(17) Rotate the test set FREQUENCY METER dial slowly until a dip is noted on the test set power monitor meter. Carefully adjust the FREQUENCY METER dial until the meter shows the lowest dip. The FREQUENCY METER dial should be at 1,650 MHz ±2; if not, repeat steps (1) through (12) above. If the measured frequency as indicated on the FREQUENCY METER dial does fall within this range, peform the procedures in *(a)* through *(d)* below.

(a) Note the frequency as indicated on the test set FREQUENCY METER dial. The

receiver FREQUENCY MEGACYCLES dial must be set to indicate a frequency exactly 30 MHz above the indicated frequency on the test set FREQUENCY METER dial.

(b) Loosen the two setscrews on the end of the bellows (fig. 5-2) nearest the local oscillator assembly.

NOTE

Do not allow the local oscillator tuning shaft to turn during the following operation.

(c) With the receiver TUNING switch adjust the FREQUENCY MEGACYCLES dial until it indicates a frequency exactly 30 MHz higher than the frequency noted in *(a)* above.

(d) Tighten the two loosened setscrews *(b)* above.

h. Final Local Oscillator Frequency and Output Adjustment.

NOTE

Before performing the final frequency and output adjustment of the local oscillator assembly as described in (1) through (19) below complete the procedures outlined in *g* above. The receiver is connected for bench servicing (para 3-26) with the local oscillator assembly positioned as in f(2) above.

(1) Set the receiver POWER switch to ON.

(2) Tune the oscillator to its lowest frequency by depressing the receiver TUNING switch to DECREASE FREQ until the FREQUENCY MEGACYCLES dial reaches its lowest limit.

(3) Loosen the two setscrews on the end of the bellows (fig. 5-2) nearest the local oscillator assembly and adjust the bellows until there is 1 3/64-inch clearance between the end of the bellows and the local oscillator assembly bushing on the end of the plate plunger (fig. 5-3).

(4) Retighten the two loosened setscrews ((3) above).

(5) Depress the receiver TUNING switch to INCREASE FREQ until the FREQUENCY MEGACYCLES dial indicates 1,680 MHz.

(6) Set the receiver METER SELECTOR switch to OSC GRID.

(7) Loosen the filament lead locknut (fig. 5-3) and the cathode plunger locknut (fig. 5-3) and adjust the cathode plunger for maximum grid current.

NOTE

Push in on the filament connector (fig. 5-3) while tightening its locknut.

(8) Tighten the two loosened locknuts ((7) above).

(9) Connect Cord CG-171A/AP (supplied with the test set) between J1 on the test set (TM 11-6625-213-12) and the rf input connection on the spare mixer; use the adapter supplied with the rawin set.

NOTE

An adapter for making the connection to the mixer and the spare mixer is stored in the accessories case of the rawin set.

(10) Use the spare if. and oscillator cables from the accessories case to connect the spare mixer to the receiver IF INPUT and OSC output jacks (TM 11-6625-213-12).

(11) Adjust the test set output to -100-dbm level by turning the test set OUTPUT POWER dial to the -100dbm mark.

(12) Set the test set FREQUENCY METER dial to 1,680 MHz.

(13) Depress the receiver TUNING switch as necessary to obtain a maximum indication on the receiver TUNING METER. The FREQUENCY MEGACYCLES dial should indicate 1,680 MHz; if not, perform the procedures given in *(a)* through (c) below.

(a) Loosen the two setscrews on the end of the bellows (fig. 5-2) nearest the local oscillator assembly.

NOTE

Do not allow the local oscillator tuning shaft to turn during the following operation.

(b) Depress the receiver TUNING switch until the FREQUENCY MEGACYCLES dial indicates 1,680 MHz.

(c) Tighten the two loosened setscrews (fig. 5-2).

(14) Set the receiver METER SELECTOR switch to INJECTION.

(15) Loosen the knurled locknut under J502 (fig. 5-2), and adjust the insertion depth of the pickup loop by screwing it in or out and observing the indication on the receiver SERVICE METER. Adjust the insertion depth to obtain a reading within the green area of the meter throughout the frequency tuning range of the local oscillator.

(16) Tighten the knurled locknut under J502 (fig. 5-2).

(17) Repeat (13) above.

(18) Disconnect all the test and alignment accessories.

(19) Reinstall the local oscillator and servo assembly in the receiver chassis (para 3-21).

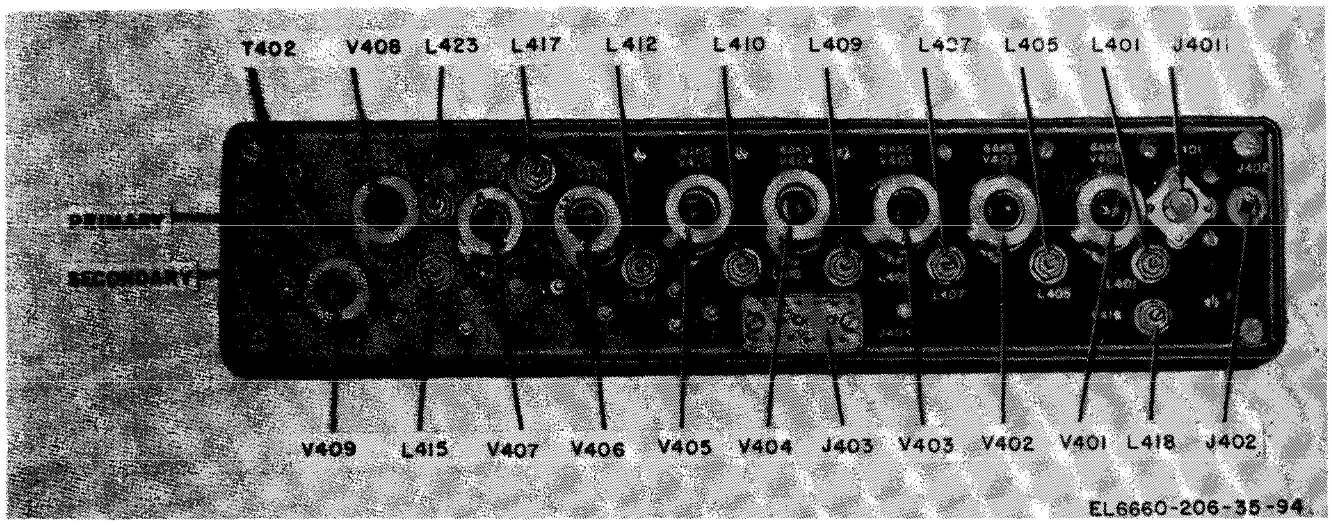


Figure 3-16. IF amplifier, top view.

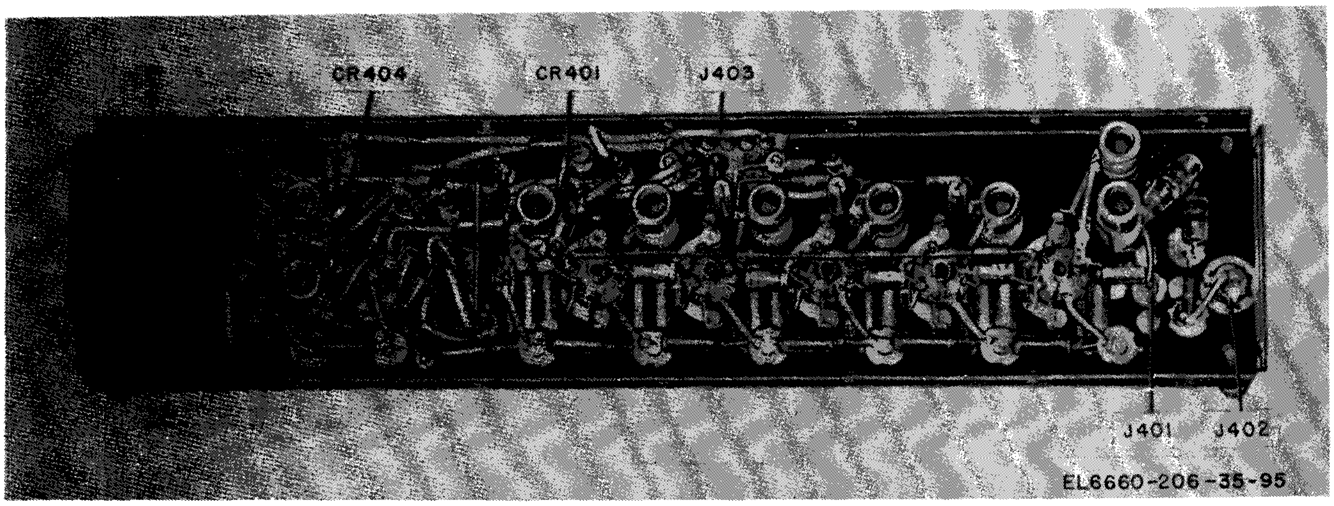


Figure 3-17. IF amplifier, bottom view.

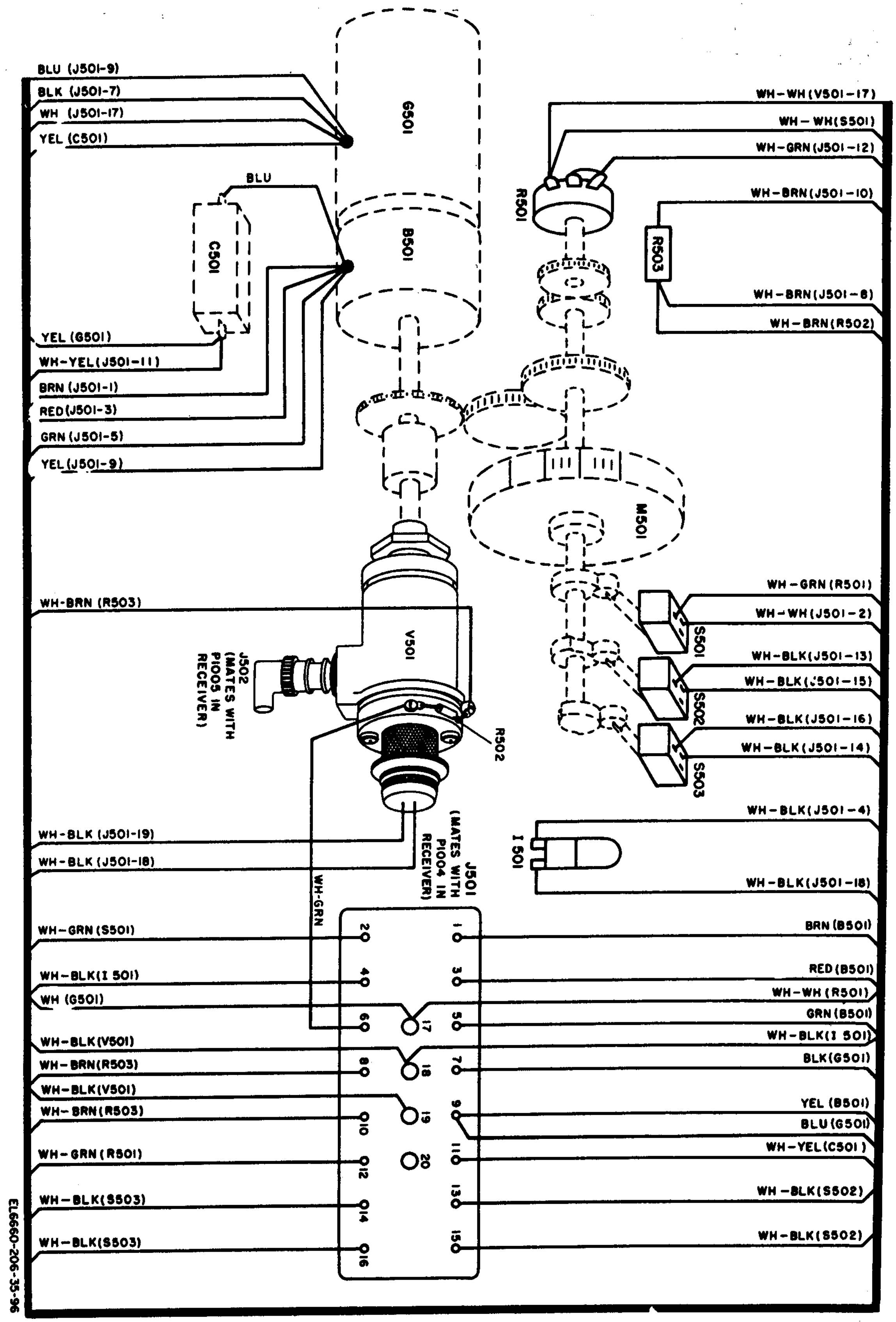


Figure 3-18. Local oscillator and servo assembly (AN/GMD-1A, AN/GMD-1B**) wiring diagram.

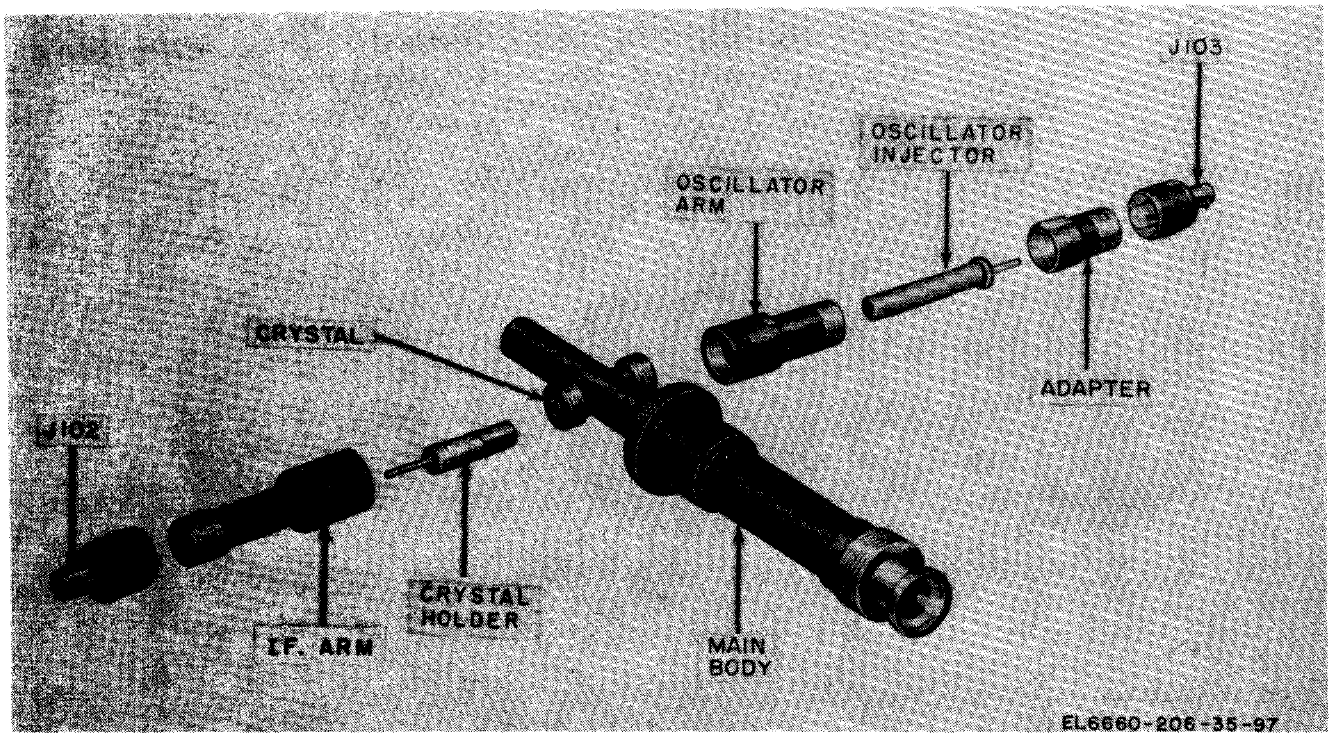


Figure 3-19. Mixer assembly, exploded view.

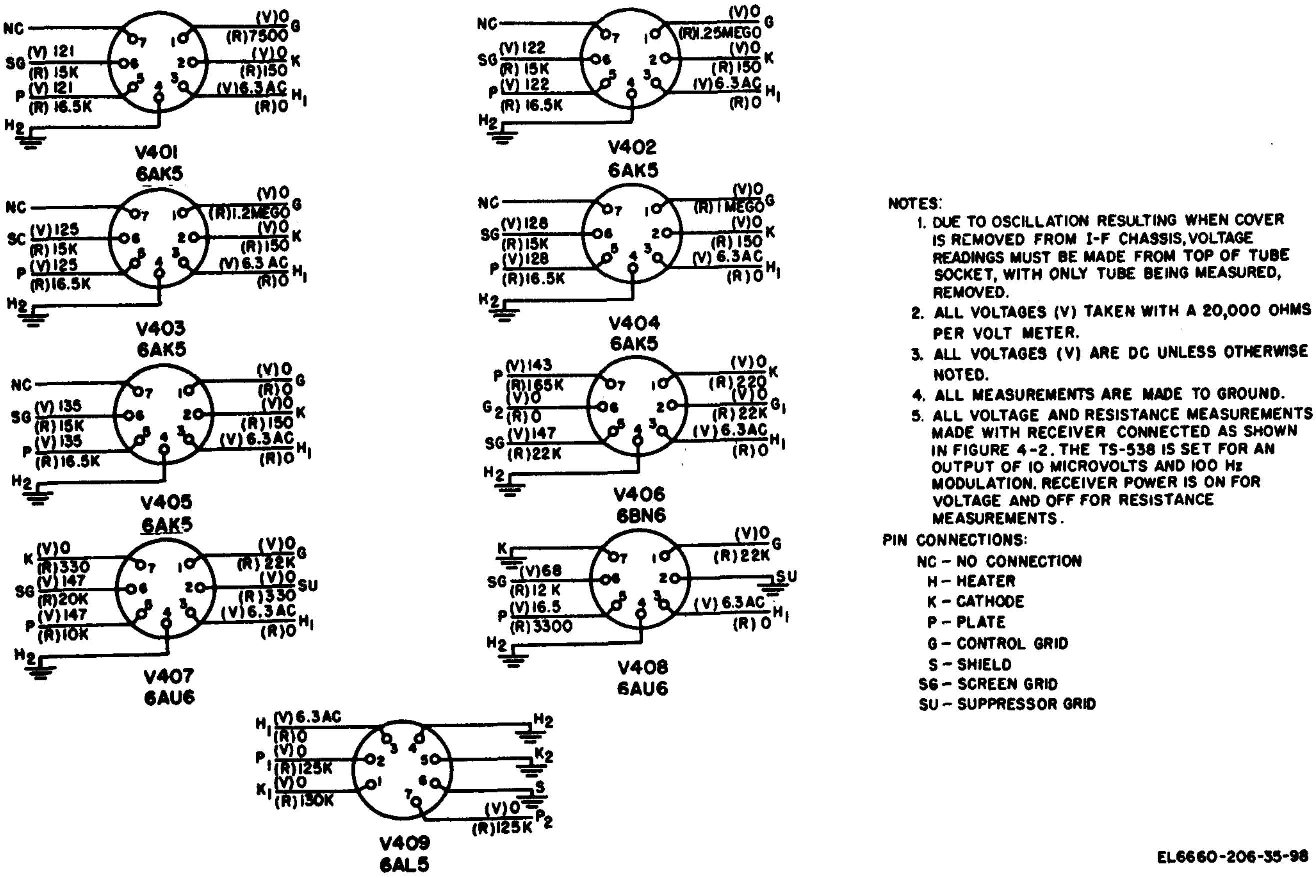


Figure 3-20. IF amplifier voltage and resistance wiring diagram.

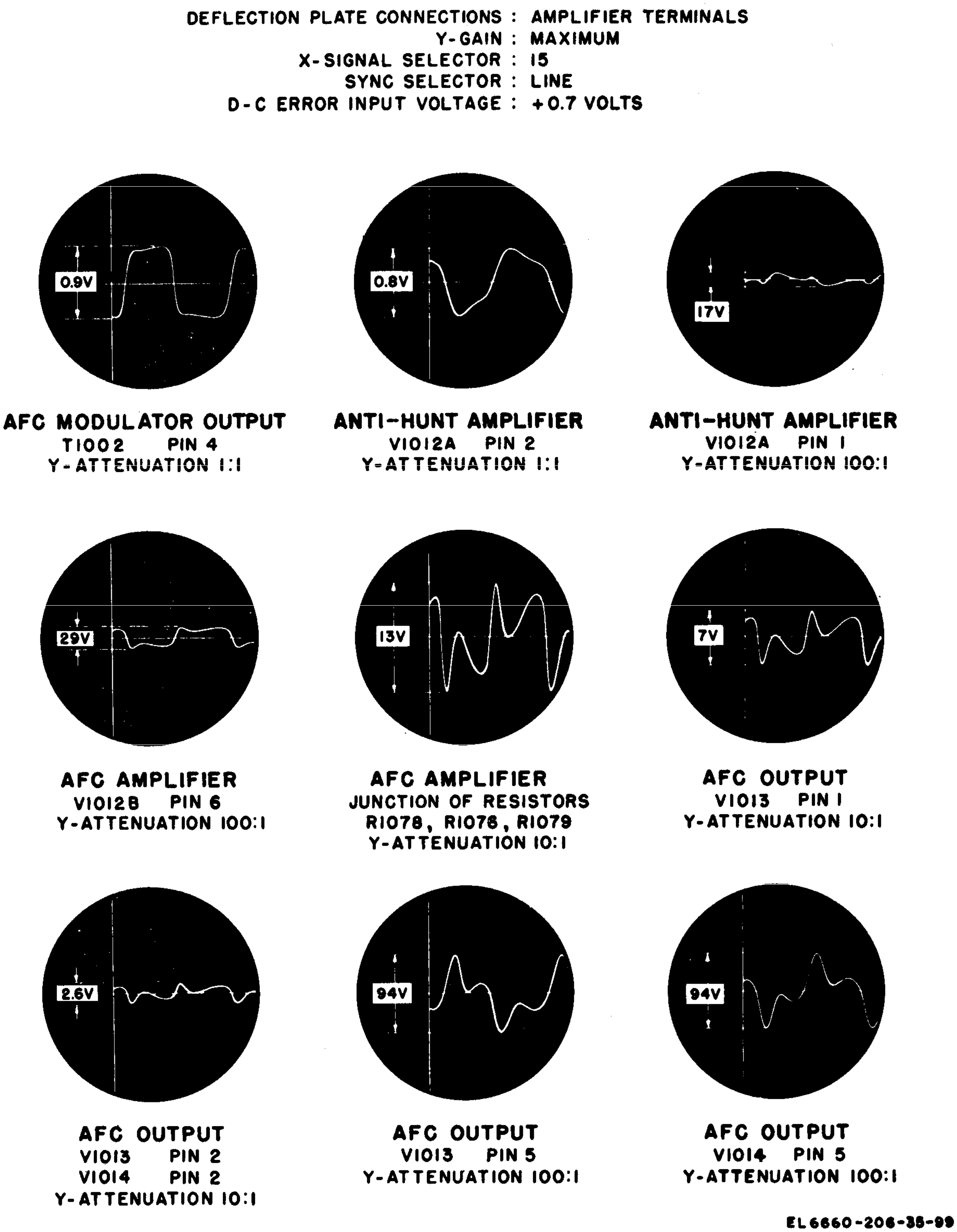


Figure 3-21. Receiver AFC circuits and waveforms.

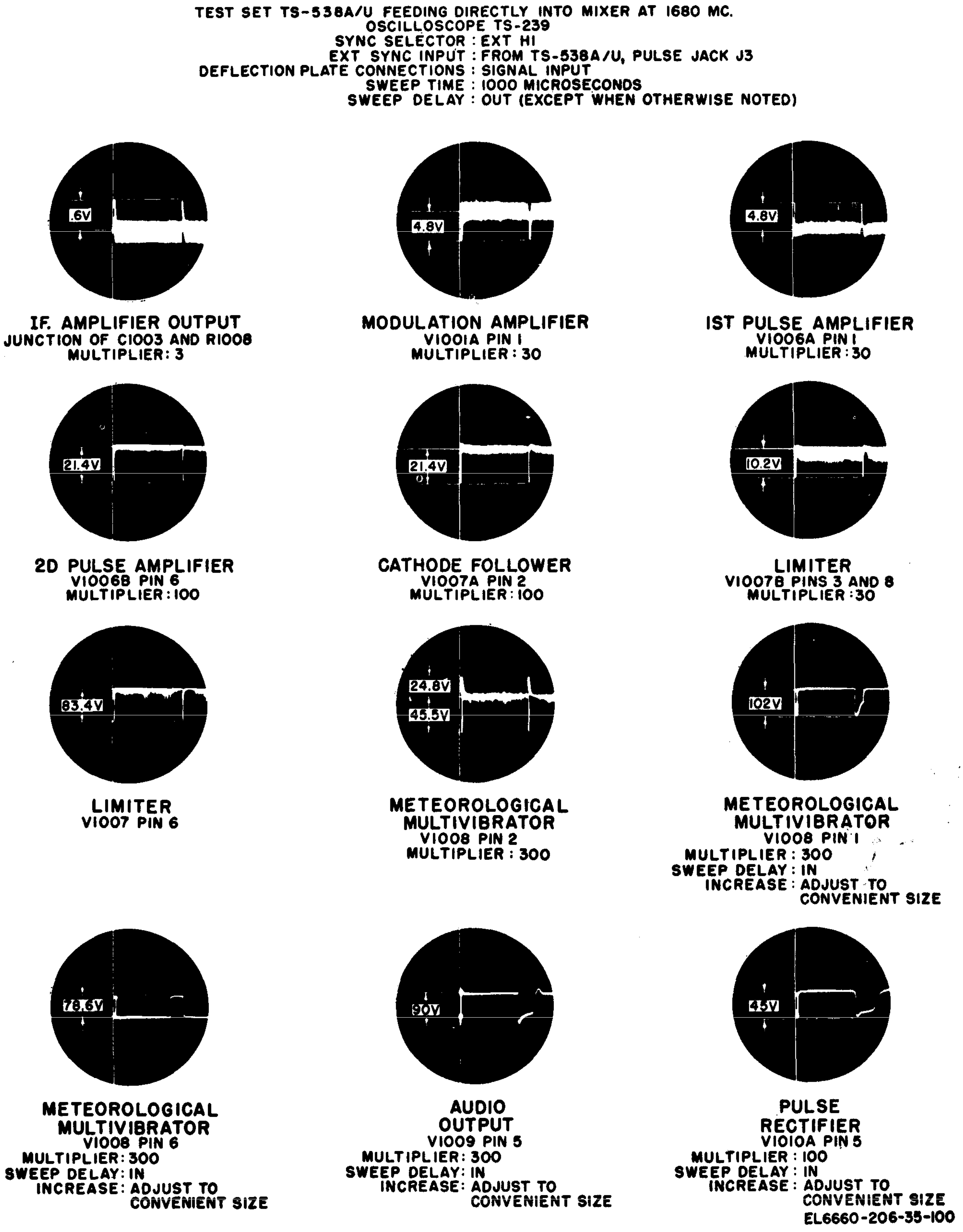


Figure 3-22. Receiver meteorological circuits and waveforms.

Section VII. ANTENNA CONTROL TROUBLESHOOTING

3-39. General

a. This section provides maintenance personnel with troubleshooting and repair procedures for the antenna control assembly of the rawin set.

b. Antenna control reference data that will be helpful when troubleshooting or repairing the antenna control are listed in table 3-17.

Table 3-17. Reference Data, Antenna Control

Reference	*Data*
TM 11-6660-206-12	Rawin Set AN/GMD-1(*), cabling diagram.
Fig. 3-24	Antenna control, tube and fuse location.
TM 11-6660-206-12	Rawin Set AN/GMD-1(*), system functional block diagram.
TM 11-6660-206-12	Systems components location.
Fig. 2-29	Antenna positioning system, complete block diagram.
Para 2-16 through 2-24	Antenna positioning system theory.
Fig. FO-4.	Ac power distribution, schematic diagram (AN/GMD-1A).
Fig. FO-5	Ac power distribution, schematic diagram (AN/GMD-1B*).
Fig. FO-6	Ac power distribution, schematic diagram (AN/GMD-1B**).
Fig. FO-24	Antenna Control C-578A/GMD-1, C-578B/GMD-1, C-578C/GM-1*, schematic diagram.
Fig. FO-25	Antenna Control C-578C/GMD-1**, schematic diagram.

3-40. Controls and Adjustments

Antenna. controls and adjustments, location and operational functions for the antenna control and used in conjunction with troubleshooting are listed in table 3-18.

Table 3-18. Controls and adjustments, Antenna Control

Controls and adjustments	*Location (fig.)*	*Function*
POWER switch S604	TM 11-6660-206-12 (fig. 2-43)	In ON position, connects antenna control to the ac power source.
OVERLOAD RESET switch S601	...	When in nonlocking RESET position, resets overload relay of servo system.
MOTORS switch S612	...	Operates elevation and azimuth drive motors and antenna scanner assembly drive motor in one position. Operates standby relay, which prevents operation of all three motors, but permits immediate operation of the rawin set in the other position. Actual position for each function depends on setting of MOTORS STANDBY switch S805 in control-recorder.
MOTORS STANDBY switch S805	TM 11-6660-206-35 (fig. 3-53)	Permits operation of elevation and azimuth drive motors and antenna scanner assembly drive motor, is one position. Operates the standby relay which prevents operation of all three motors but permits immediate operation of the rawin set, when required, in the other

Table 3-18. Controls and adjustments, Antenna Control-Continued

Control and adjustments	Lpcation (fig.)	Function
		position. Actual position for each function depends on setting of MOTORS switch in antenna control. When the rawin set is equipped with Control-Recorder C-577E/GMD-1, the MOTORS STANDBY switch can be used to reset overload relay K606 in the antenna control. Turning the switch to the standby position releases relay K606.
ELEVATION local manual controls R302 and S302.	TM 11-6660-206-35 (fig. 3-34 and 3-35)	Moves antenna assembly up or down.
AZIMUTH local manual controls R301 and S301. (See table 1-7, TM 11-6660-206-12 for model differences.)	....	Moves antenna assembly clockwise or counterclockwise.
ELEVATION local manual control R632.	TM 11-6660-206-12 (fig. 2-43)	Moves antenna assembly up or down.
AZIMUTH local manual control R665	....	Moves antenna assembly clockwise or counterclockwise.
Remote ELEVATION MANUAL CONTROL switch S802.	TM 11-6660-206-35 (fig. 3-53)	Moves antenna assembly up or down (AB-159E/GMD-1).
Remote AZIMUTH MANUAL CONTROL switch S801.	....	Moves antenna assembly clockwise or counterclockwise (AB-159E/GMD-1).
MANUAL-NEAR AUTO-FAR control S605.	TM 11-6660-206-12 (fig. 2-43)	In MANUAL position, permits manual positioning of the antenna assembly through use of ELEVATION and AZIMUTH controls R632 and R665 of antenna control (TM 11-6660-206-12). ELEVATION and AZIMUTH controls R302, S302, R301 and S301 of housing (fig. 3-34 and 3-35), or ELEVATION MANUAL controls of control-recorder S802 and S801 (fig. 3-53). In NEAR AUTO position, permits rapid automatic control of antenna assembly when balloon-borne radiosonde is nearby and radiosonde movements with respect to main assembly are sudden. In FAR AUTO position, permits slow automatic control of antenna assembly when balloon-borne radiosonde is distant and its movements with respect to main assembly are gradual. Automatic positions permit manual positioning by use of ELEVATION and AZIMUTH MANUAL controls of the control-recorder and switches S302, S301.

Table 3-18. Controls and adjustments, Antenna Control-Continued

Controls and adjustments	Location (fig.)	Function
Reference voltage generator G101 (phase adjustment).	TM 11-6660-206-12	Provides two reference voltages with phase relationship compared to the received error signal to provide an error voltage for automatic tracking in azimuth and elevation.
SINE PHASING R1016	TM 11-660-206-35 (Fig. 3-10)	Establishes a reference phase relationship between the received error signal and generated reference voltage.
SINE GAIN R1018	TM 11-6660-206-35 (fig. 3-10)	Adjusts the amount of received error signal applied to sine amplifier V1002A.
ELEV SENS potentiometer R639.	TM 11-6660-206-12 (fig. 2-44)	Adjusts the dc threshold voltage in automatic tracking and establishes the residual current for drivers V603 and V604.
AZ SENS potentiometer R658		Adjusts the dc threshold voltage in automatic tracking and establishes the residual currant for drivers V605 and V606.
ELEV BAL potentiometer R640		provides manual adjustment to compensate for differences in the two sections of elevation control amplifier V610 and associated circuits.
AZ BAL potentiometer R657		Provides manual adjustment to compensate for differences in the two sections of azimuth control amplifier V612 and associated circuits.
ELEV ANTI HUNT potentiometer R621.		Adjusta the output of elevation antihunt generator G201 when MANUAL-NEAR AUTO-FAR AUTO control S605 is in the FAR AUTO position.
AZ ANTI HUNT potentiometer R672.		Adjusts the output of azimuth antihunt generator G701 when MANUAL-NEAR AUTO-FAR AUTO control S60S is in the FAR AUTO position.

3-41. Dc Resistance of Antenna Control Transformers and Relays

When maintenance and troubleshooting is required in the Antenna Control unit to determine whether replacement transformers and relays are needed use table 3-19.

3-42. Test Equipment Required

When the Antenna Control unit requires maintenance use table 3-20 to determine test equipment required for troubleshooting. The Antenna Control unit cannot be removed and tested on the bench.

Table 3-19. Dc Resistance of Transformers and Relays, Antenna Control

Transformers, relays, or motors	Location (fig. 3-23)	Terminals (fig. FO-25)	Dc Resistance (ohms)
T601, T602 T604, or T605		1 - 2	520
		1 - 3	1,100
		2 - 3	580
		4 - 5	580
		4 - 6	1,100
		5 - 6	520
T603		1 - 2	Less than 1
		3 - 4	Less than 1
		5 - 7	Less than 1
T606		1 - 2	Less than 1
		3 - 4	110
		4 - 5	110
		6 - 7	Less than 1
		8 - 9	Less than 1
		10-11	Less than 1
		12-13	Less than 1
		14-15	Less than 1
		16-17	Leas than 1
		18-19	Less than 1
K601		3 - 6	420
K602, K608, K609, or K610		1 - 8	450
K606		3 - 6	420
K607		3 - 6	420

Table 3-20. Test Equipment Required, Antenna Control

Test equipment	Common name	Technical manual
Multimeter, Electronic ME-26B/U	Vtvm	TM 11-6625-200-15
Multimeter TS-352B/U	Multimeter	TM 11-6625-366-15
Teat Set, Electron Tube TV-7/U	Tube tester	TM 11-6625-274-12
Teat Set TS-538(*)U[a]	Test set.	TM 11-6625-213-12

[a]Test equipment supplied with rawin set.

3-43. Test Setup

The antenna control unit must be installed in the rawin system in order to accomplish a complete troubleshooting procedure at this level. There is no special test setup required.

3-44. Test Point Checks

Use a multimeter (TS-352B/U) to measure the balance and sensitivity currents as listed in table 3-21. Use figure FO-25 to locate the test points.

Table 3-21. Test Point Checks, Antenna Control

Test point (fig. FO-25)	Normal indication
ELE BAL	Zero
AZ BAL	Zero
ELE SENS	0.7 ma
AZ SENS	0.7 ma
ELE SENS AN/GMD-1B**	2 ma
AZ SENS AN/GMD-1B**	2 ma

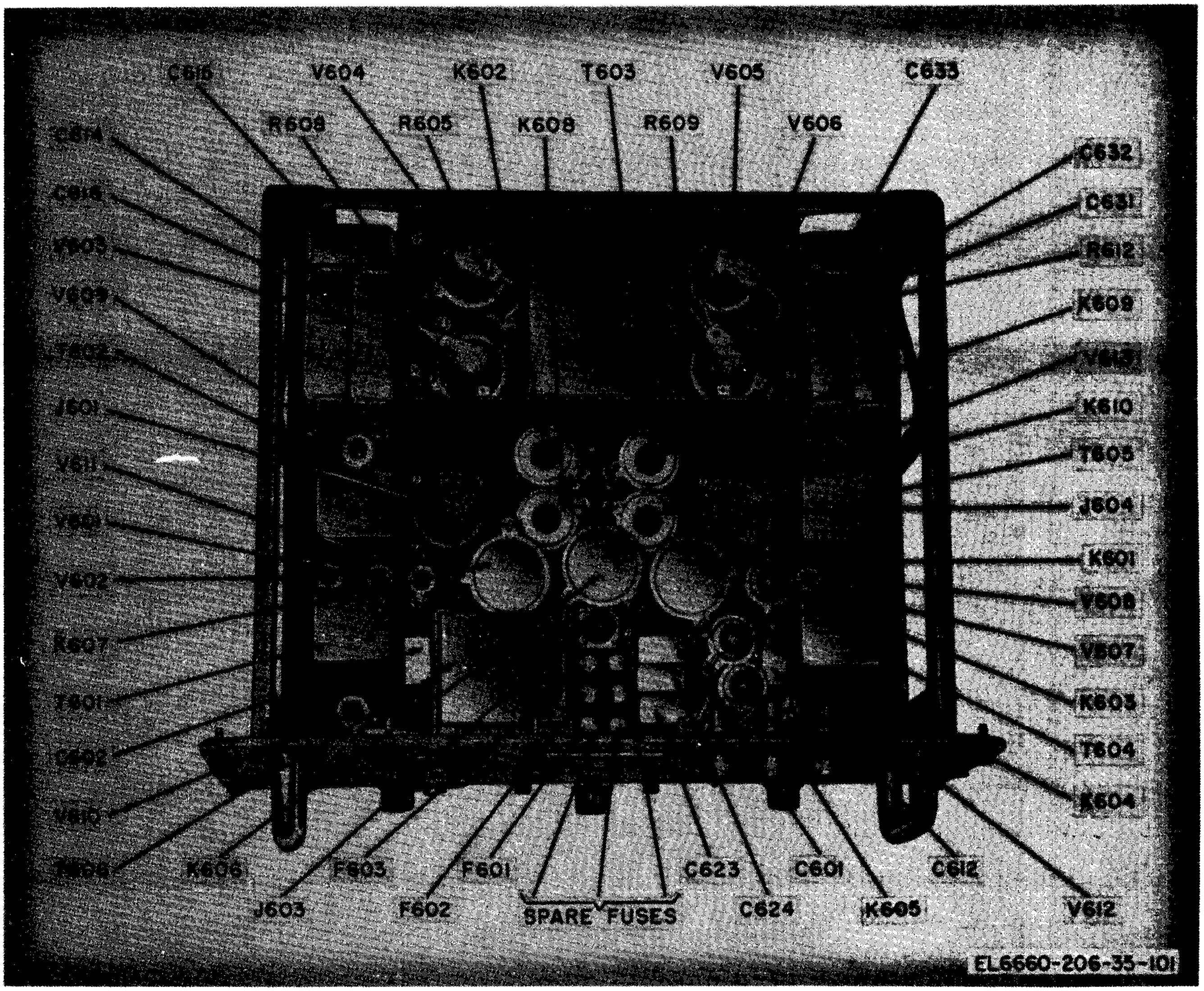


*Figure 3-23. Antenna control (except C-578C/GMD-1**), top view.*

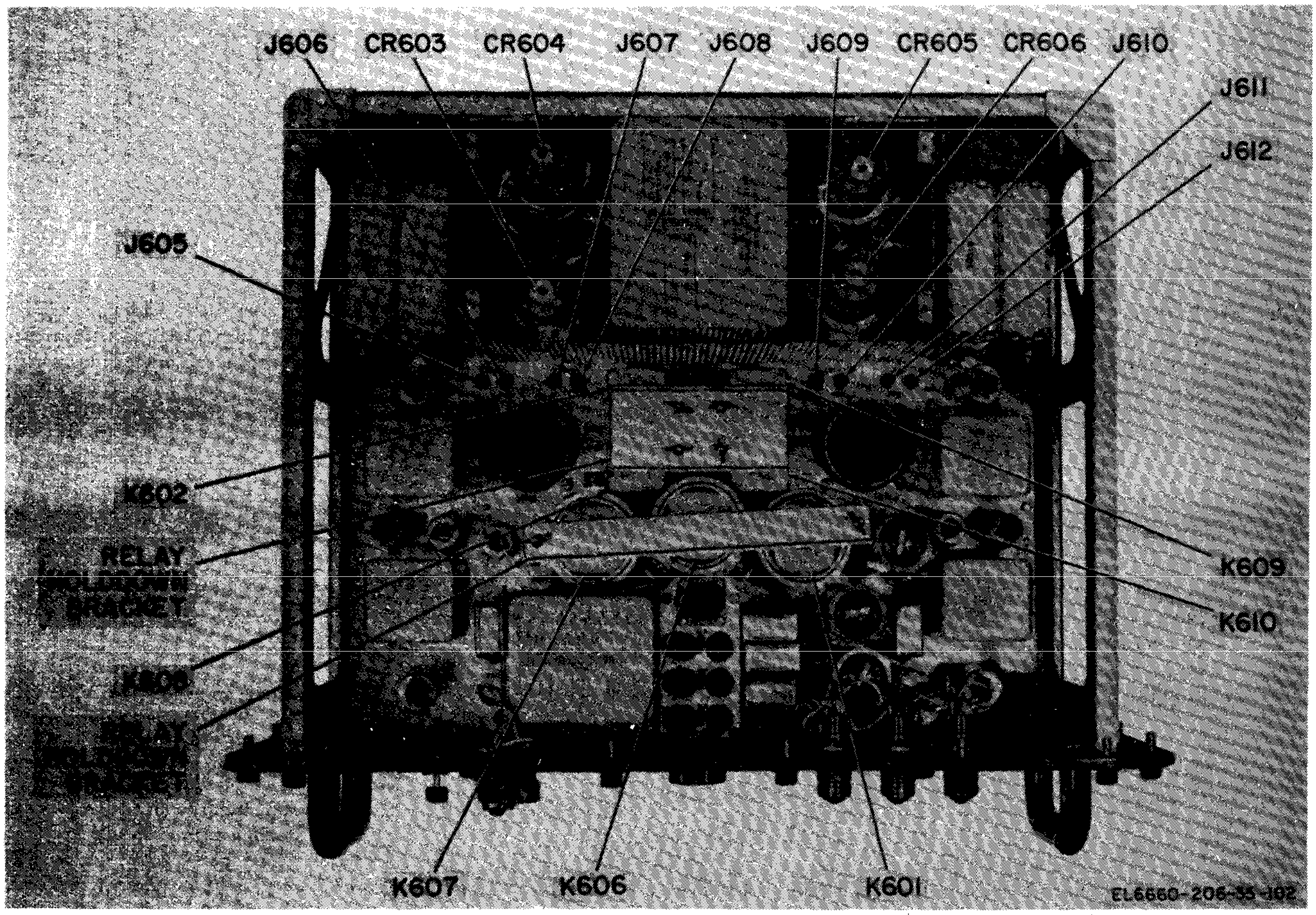


*Figure 3-24. Antenna control C-578C/GMD-1**, top view.*

3-45. Symptom Troubleshooting

a. General. Troubles that have been sectionalized as probable to the antenna control unit can be localized to a circuit or a stage by using the procedure shown in the antenna control symptom troubleshooting table 3-22. The symptoms consist of indications on TUNING METER M1001, SERVICE METER M1002 when METER SELECTOR switch S1003 is in the AC ERROR, EL ERROR, AZ ERROR position, and MOTORS STANDBY LAMP 1603. To troubleshoot the antenna control unit, observe the meter and lamp indications and the physical movements of the antenna. Troubleshoot the antenna control unit based on symptoms as follows:

(1) Observe the indications of M1001, M1002, 1603, and the physical movement of the antenna.

(2) Compare the indications with those in the *Symptoms* column.

(3) If the indications obtained correspond to those listed in a particular symptom, follow the procedure given in that step in the *Corrective measures* column to isolate the trouble.

(4) If the trouble cannot be isolated by symptom troubleshooting, refer to the step-by-step troubleshooting chart (*b* below).

WARNING

The antenna control chassis has many exposed terminals that carry 115-volts ac power.

b. Step-by-Step Troubleshooting. Refer to table 3-22.

Table 3-22. Symptom Troubleshooting, Antenna Control

Symptom	*Probable cause*	*Corrective measures*
1. Rawin set does not track automatically. No reading on SERVICE METER when METER SELECTOR switch is at AC ERROR. TUNING METER M1001 reading normal (10 to 70 ma).	If SERVICE METER reads normal in PEAK PULSE position of S1003, trouble is in the sine amplifier.	Check one at a time V1002, V1003, V1004, and V1005 (TM 11-6660-206-12). Make voltage and resistance measurements of sine amplifier circuits (fig. FO-10 and FO-11).
2. MOTORS STANDBY lamp 1603 does not light with MOTORS switch S602 or S805 in either position.	Lamp 1603 burned out	Check lamp 1603 (TM 11-6660-206-12) with multimeter; replace if necessary.
	Switch S602 or S805	Check switches S602 and S805 (TM 11-6660-206-12); replace if defective.
	Relay K607	Check relay K607 ; replace if necessary.
3. MOTORS STANDBY lamp 1801 does not light MOTORS STANDBY switch S805 or S602 in either position.	Lamp 1801 burned out	Check lamp 1801 (TM 11-6660-206-12); replace if necessary.
	Switch S805 or S602	Check switches S805, (TM 11-6660-206-12) and S602, (TM 11-6660-206-12); replace if defective.
		Check relay K607 (fig. 3-23); replace if necessary.
4. Rawin set does not track automatically or manually; elevation and azimuth drive motor do not operate.	Relay K607 and/or switches S602 and S805.	Check relay K607 (fig. 3-23) and switches S602 and S805 (TM 11-6660-206-12).
	Relay K601 and/or relay K603 . . .	Check relays K601 and K603 (fig. 3-23); repair or replace if necessary.
5. Rawin set does not respond to remote manual controls S801 and S802.	Rectifier V611 defective or output low.	Replace tube V611 (TM 11-6660-206-12). If trouble is not eliminated, replace original tube. Take voltage and resistance readings (figs. 3-29 and 3-30) to locate defective parts (fig. 3-31).
6. Antenna cannot be positioned upward by any electrical control.	CR603	Replace CR603 (TM 11-6660-206-12). If trouble is not eliminated, replace original CR603 and troubleshoot stage (figs. 3-25 and 3-27).
7. Antenna cannot be positioned downward by any electrical means.	CR604	Replace CR604 (TM 11-6660-206-12). If trouble is not eliminated, replace original CR604 and troubleshoot stage (figs. 3-25 and 3-27).
8. Antenna cannot be positioned upward or downward by any electrical means.	Elevation drive motor B201	See table 3-33.
	Elevation stow lock locked	Unlock elevation stow lock (fig. 3-41).

Table 3-22. Symptom Troubleshooting, Antenna Control-Continued

Symptom	Probable cause	Corrective measures
	Limit switch S201 defective	Check limit switch S201, replace if necessary.
9 Antenna cannot be positioned upward or downward by means of ELEVATION potentiometer R632 or R302.	ELEVATION potentiometer R632 or R302.	Check potentiometers R632 (fig. 3-27) and R301 ELEVATION UP/DOWN control (fig. 3-35); replace if necessary.
10. Antenna cannot be positioned upward or downward either automatically or by ELEVATION potentiometers R632 and R302.	Tube V610	Replace tube V610 (TM 11-6660-206-12). If trouble is not eliminated, replace original tube and troubleshoot stage (figs. 3-25 end 3-27).
	ELEV SENS potentiometer R639 or ELEV BAL potentiometer R640 defective.	Check potentiometers R639 and R640 (fig. 3-27); replace if defective.
11. Antenna does not track automatically in elevation.	Tube V601, V602, V609, or V1005	Check each tube (TM 11-6660-206-12) one at a time. If trouble continues, make voltage and resistance measurements (fig. FO-10 and FO-11).
	Interconnecting cables W301A and W301C or connectors J1005, P302, P301, and J601.	Check tightness of connectors J1005 (fig. 3-9), P302, P301 (fig. 3-32), and J601 (fig. 3-23). Check continuity of cables W301A and W301C (TM 11-6660-206-12).
	Contacts (1, 2, 4, 5, 6, and 8, section 2) in switch S605.	Check contacts of switch S605 (fig. 3-27).
12. Antenna cannot be positioned downward by means of elevation switches S802 and S802.	Relay K602	Check relay K602 (fig. 3-23); repair or replace if necessary.
13. Antenna cannot be positioned downward or upward by means of elevation switch S302 or S802.	Switch S302 or S802	Check switch S302 (fig. 3-35) or S802 (TM 11-6660-206-12); replace if necessary.
14. Antenna cannot be positioned upward by means of elevation switches S302 end S802.	Relay K608	Check relay K608 (fig. 3-23); repair or replace if necessary.
15. Antenna hunts in elevation when controlled automatically.	ELEV ANTI HUNT potentiometer, R621.	Check potentiometer R621 (fig. 3-27); replace if necessary.
	Broken lead to elevation anti-hunt generator (3201 (fig. 3-41) or generator defective.	Check leads to generator G201 (fig. 3-41) and repair if broken; teat generator if bad. &e table 3-33.
	Contacts (6 and 6, section 1) of switch S605.	Check contacts of switch S605 (fig. 3-27); repair or replace switch if necessary.

Table 3-22. Symptom Troubleshooting, Antenna Control-Continued

Symptom	Probable cause	Corrective measures
16. Antenna cannot be positioned clockwise by any electrical control.	CR606	Replace CR606 (TM 11-6660-12). If trouble is not eliminated, replace original CR606 and troubleshoot the stage (figs. 3-25 and 3-27).
17. Antenna cannot be positioned counterclockwise by any electrical means,	CR605	Replace CR605. If trouble is not eliminatad, replace original CR605 and troubleshoot stage (figs. 3-25 and 3-27).
18. Antenna cannot be positioned clockwise or counterclockwise by any electrical means.	Azimuth stow lock locked	Unlock azimuth stow lock (fig. 3-37).
19. Antenna cannot be positioned counterclockwise by means of azimuth switches S303 and S801.	Relay K609	Check relay K609 (fig. 3-23); repair or replace if necessary.
20. Antenna cannot be positioned clockwise by means of azimuth switches S303 and S801.	Relay K610	Check relay K610 (fig. 3-23); repair or replace if necessary.

NOTE

To check reference designator differences on equipment refer to TM 11-6660-206-12.

Symptom	Probable cause	Corrective measures
21. Antenna cannot be positioned clockwise or counterclockwise by means of azimuth switch S303 or S801 (TM 11-6660-206-12).	Switch S303 or S801	Check switch S303 (fig. 3-35) or S801 (TM 11-6660-206-12); replace if necessary.
22. Antenna does not track automatically in azimuth.	Tube V607, V608, V613, or V1004	Test each tube (TM 11-6660-206-12) one at a time. Make voltage and resistance measurements (fig. FO-10 and FO-11) to locate defective pert (fig. 3-15 and 3-31).
	Interconnecting cables W301A and W301B or connectors J1005, P302, P304, and J604.	Check tightness of connector J1005 (fig. 3-9), P302, P304 (fig. 3-32), and J604 (fig. 3-23). Check continuity of cables W301A and W301B (TM 11-6660-206-12).
	Contacts in slipring assembly in azimuth unit.	Check contacts of slipring assembly (fig. 3-37). Refer repairs to higher level.
	contacts (1, 2, 4, 5, 6, and 8, section 3) in switch S605.	Check contacts of switch S605 (fig. 3-27); replace if necessary.
23. Antenna cannot be positioned clockwise or counterclockwise by means of azimuth potentiometer R665 or R301.	Potentiometer R665 or R301	Check potentiometer R665 (fig. 3-27) or R301 (fig. 3-34); replace if necessary.

Table 3-22. Symptom Troubleshooting, Antenna Control-Continued

Symptom	Probable cause	Corrective measures
24. Antenna cannot be positioned clockwise or counterclockwise either automatically or by means of azimuth potentiometer R665 and R301.	Tube V612	Replace V612 (TM 11-6660-206-12). If trouble is not eliminated, replace original tube and troubleshoot stage (figs. 3-25 and 3-27).
	AZ SENS potentiometer R658 or AZ BAL potentiometer R657.	Check potentiometers R658 and R657 (fig. 3-27); replace if defective.
25. Antenna hunts in azimuth when controlled automatically.	AZ ANTI HUNT potentiometer R672.	Test potentiometer R672 (fig. 3-27); replace if defective.
	Broken lead to azimuth antihunt generator G701 or defective generator.	Check leads to G701 (fig. 3-37); repair if necessary. Check generator G701, if defective see table 3-30.
	Contacts (1, 2, 4, section 4) in switch S605.	Check contacts of switch S605 (fig. 3-27); replace if defective.
26. Elevation and azimuth drive motor circuits do not open automatically when subjected to overload, causing one or both motors to burn out .	Defective relay K604, K605, or K606, or switch S601.	Check relays K604, K605, and K606 (fig. 3-23) and switch S601 (TM 11-6660-206-12); repair or replace if defective.
27. Rawin set does not track automatically, in elevation, azimuth, or both.	Sine gain and phasing adjustment, reference voltage generator G101, or associated circuitry.	Perform sine gain and phasing adjustment (TM 11-6660-206-12); if trouble continues, refer to paragraph 3-18.

3-46. Step-by-Step Troubleshooting

a. General. The antenna control unit step-by-step troubleshooting table 3-23 isolates troubles to a particular stage or component after the trouble has been localized by the use of the antenna control unit symptom troubleshooting chart. Troubleshoot the antenna control unit using the step-by-step troubleshooting chart as follows:

(1) Locate the test point given in the *Step* column.

(2) Connect the test equipment and set the controls on the test equipment as directed in the *Test equipment* column.

(3) Set the controls on the rawin set as directed in the *Rawin set controls* column.

(4) Compare the indications obtained on the test equipment with the indications given or referenced in the *Normal indications* column.

(5) If the indications obtained on the test equipment are normal, proceed either to the next step or as directed in the *Normal indications* column.

(6) If the indications are abnormal, proceed as directed in the *Corrective measures* column.

WARNING

The antenna control chassis has many exposed terminals that carry 115-volts ac power.

b. Step-by-Step Troubleshooting. Refer to table 3-23.

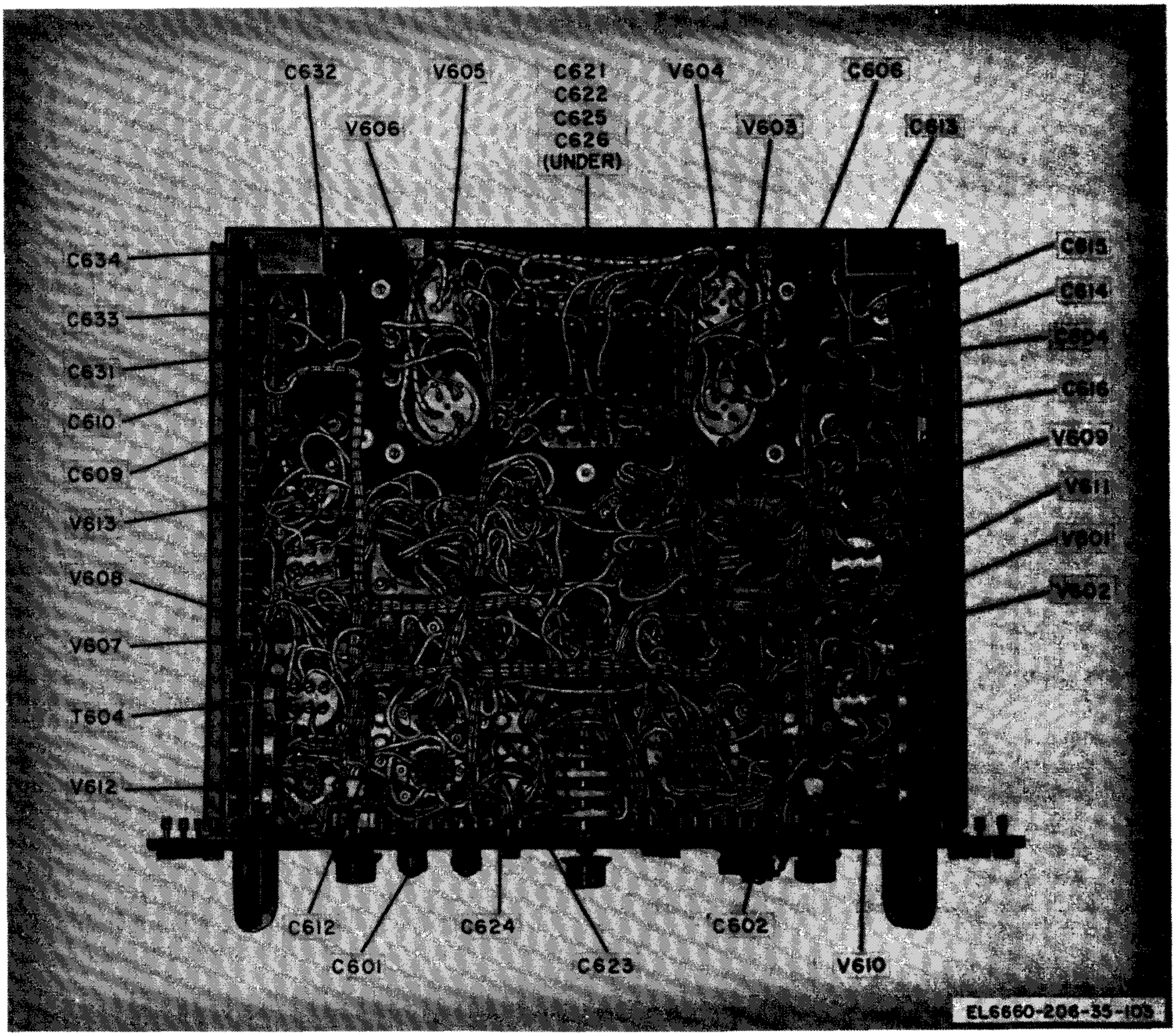


*Figure 3-25. Antenna control (except C-578C/GMD-1 * *), bottom view, location of capacitors.*

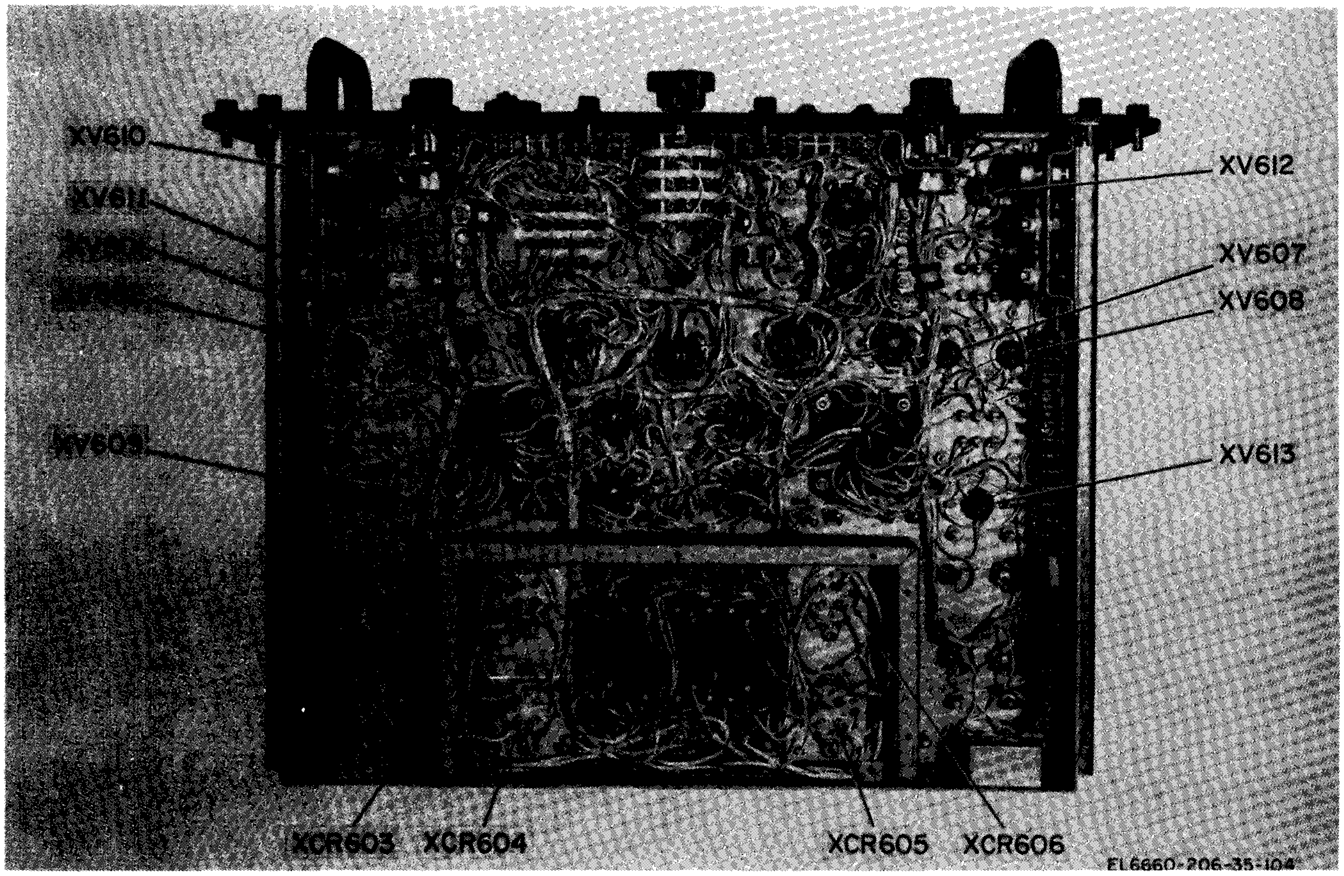


*Figure 3-26. Antenna control C–578C/GMD-1**, bottom view, location of capacitors.*

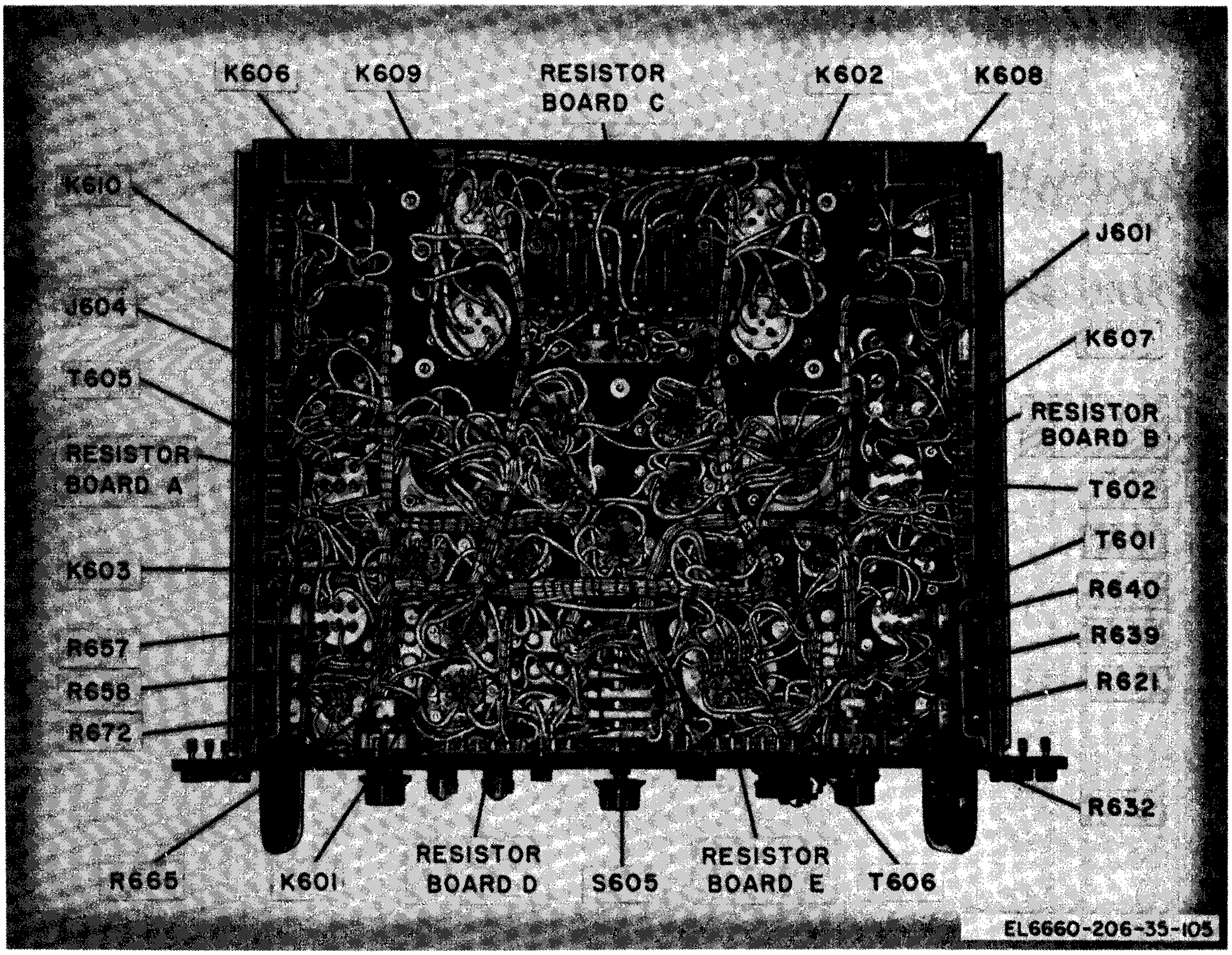


*Figure 3-27. Antenna control (except C-578C/GMD-1**), bottom view, location of relays and resistors.*

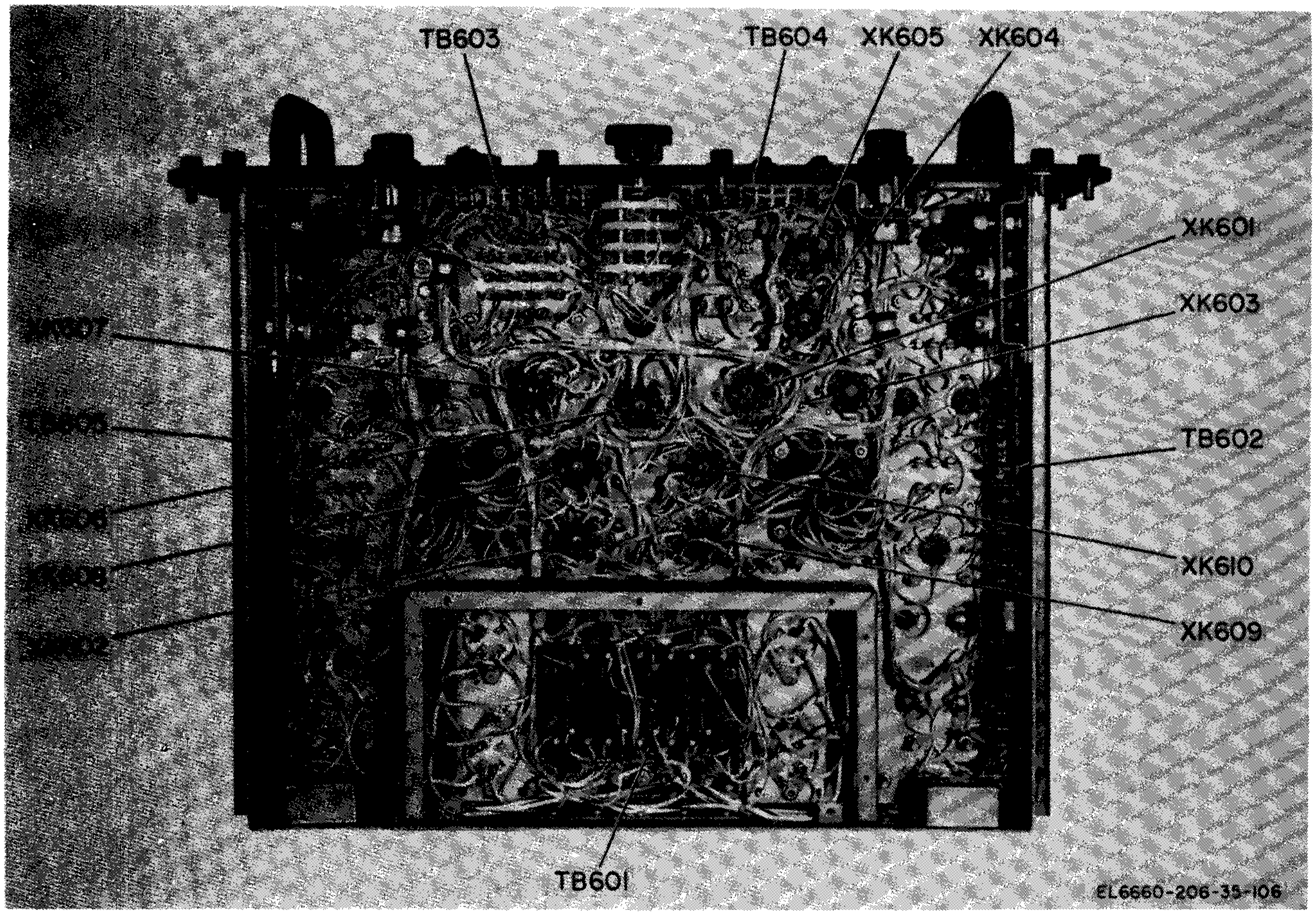


*Figure 3-28. Antenna control C-578C/GMD-1**, bottom view, location of relays and resistors.*

Table 3—23. Step-by-Step Troubleshooting, Antenna Control

Step	Test point	Test equipment	Rawin set controls	Normal indications	Corrective measures
1			Normal operating procedure (TM 11–6660–206–12).		Table 3–8, steps 1, 2, and 3.
2	Terminals G and H, of P304 (fig. 3–32).	Set multimeter controls to measure 115 vac.	....	105 to 129 Vac	Troubleshoot the ac power circuits (fig. 2–78 and FO–4).
3	MOTORS STANDBY lamps I603 and I801 (TM 11–6660–206–12).		Steps 4 and 5, table 3–8.		Steps 4 and 5, table 3–8.
4			MANUAL-NEAR AUTO-FAR AUTO switch S605 (TM 11–6660–206–12) to MANUAL.	The antenna should move upward and downward in elevation. Vtvm reads –75 volts at pins 1 and 6.	If the antenna does not move upward or downward, troubleshoot elevation control amplifier circuit V610 (fig. 3–23). Make voltage and resistance measurements (fig. 3–29).
			Set ELEV SENS control R639 and AZ SENS potentiometer R658 (fig. 3–27) fully counterclockwise. Set ELEV BAL control R640 (TM 11–6660–206–12). Set AZ BAL potentiometer R657 (TM 11–6660–206–12).		
			Turn ELEVATION potentiometers R302 (fig. 3–34) and R–632 (fig. 3–27) clockwise and counterclockwise.		
5	Pins 1 and 6 to grd of V612 (fig. 3–25).	Vtvm	Turn AZIMUTH potentiometers R301 (fig. 3–34) and R665 (fig. 3–27) clockwise and counterclockwise.	The antenna should move clockwise and counterclockwise. Vtvm reads –73 volts at pins 1 and 6.	If the antenna does not move clockwise or counterclockwise, troubleshoot azimuth control amplifier circuit V612 (fig. 3–23). Make voltage and resistance measurements (fig. 3–29).

Table 3-23. Step-by-Step Troubleshooting, Antenna Control—Continued

Step	Test point	Test equipment	Rawin set controls	Normal indications	Corrective measures
6	Pins 1 to 8 and 2 to grd of elevation selection relay K608 (fig. 3-27).	Vtvm	Operate elevation switches S302 (fig. 3-35) and S802 (TM 11-6660-206-12) to UP.	The antenna should move upward. Vtvm reads 115 Vac between pins 1 and 8 and -75 volts between pin 2 and grd.	If the antenna does not move upward, troubleshoot elevation selection relay K608 circuit (fig. 3-23).
7	Pin 1 to 8 and pin 2 to grd of elevation selection relay K602 (fig. 3-27).	Vtvm	Operate elevation switches S302 (fig. 3-35) and S802 (TM 11-6660-206-12) to DOWN.	The antenna should move downward. Vtvm reads 115 Vac between pins 1 and 8 and -75 Vac between pin 2 and grd.	If the antenna does not move downward, troubleshoot elevation selection relay K602 circuit (fig. 3-23).
8	Pin 1 to 8 and 2 to grd of azimuth selection relay K609 (fig. 3-27).	Vtvm	Operate azimuth switches S303 and S801 to CCW.	The antenna should move counterclockwise. Vtvm reads 115 Vac between pins 1 and 8 and -75 Vac between pin 2 and grd.	If the antenna does not move counterclockwise, troubleshoot azimuth selection relay K609 circuit (fig. 3-23).
9	Pin 1 to 8 and pin 2 to grd of azimuth selection relay K610 (fig. 3-27).	Vtvm	Operate MANUAL CONTROL-AZIMUTH switches S303 and S801 to CW.	The antenna should move clockwise. Vtvm reads 115 Vac between pins 1 and 8 and -75 Vac between pin 2 and grd.	If the antenna does not move clockwise, troubleshoot azimuth selection relay K610 circuit (fig. 3-23).
10	Pin 2 to grd and pin 7 to grd of elevation phase sensitive detectors V601 and V602 (fig. 3-25).	Vtvm and test set.	METER SELECTOR switch S1003 at EL ERROR and MANUAL-NEAR AUTO-FAR AUTO switch S605 (TM 11-6660-206-12) at NEAR AUTO.	SERVICE METER M1002 reads within diamond C (when meteorological signal is being received).	If the antenna tracks in azimuth but does not track in elevation, troubleshoot V601 and V602 circuits (fig. 3-25). Make voltage and resistance measurements (fig. 3-29).
				TUNING METER reads 10 to 70 ma. Vtvm reads -17.5 Vdc on pin 2 or 35 Vac on pin 7.	
11	Pin 1 to grd and pin 6 to grd of elevation reference amplifier V609 (fig. 3-25).	Vtvm and test set.	Same as step 14	SERVICE METER AND TUNING METER readings same as step 14. Vtvm reads 180 Vdc.	Same as step 14, except troubleshoot V609 circuit.

Table 3—23. Step-by-Step Troubleshooting, Antenna Control—Continued

Step	Test point	Test equipment	Rawin set controls	Normal indications	Corrective measures
12	Pin 2 to grd and pin 7 to grd of azimuth phase sensitive detectors V607 and V608 (fig. 3—25).	Vtvm and test set.	METER SELECTOR switch S1003 at AZ ERROR and MANUAL-NEAR AUTO-FAR AUTO switch S605 (TM 11—6660—206—12) at NEAR AUTO.	SERVICE METER and TUNING METER readings same as step 14. Vtvm reads −17.5 Vdc on pin 2 or 35 Vac on pin 7.	Same as step 16, except troubleshoot V607 and V608 circuits.
13	Pin 1 to grd and pin 6 to grd of azimuth reference amplifier V613 (fig. 3—25).	Vtvm and test set.	Same as step 17.	SERVICE METER and TUNING METER readings same as step 14. Vtvm reads 180 Vdc.	Same as step 16, except troubleshoot V613 circuit.

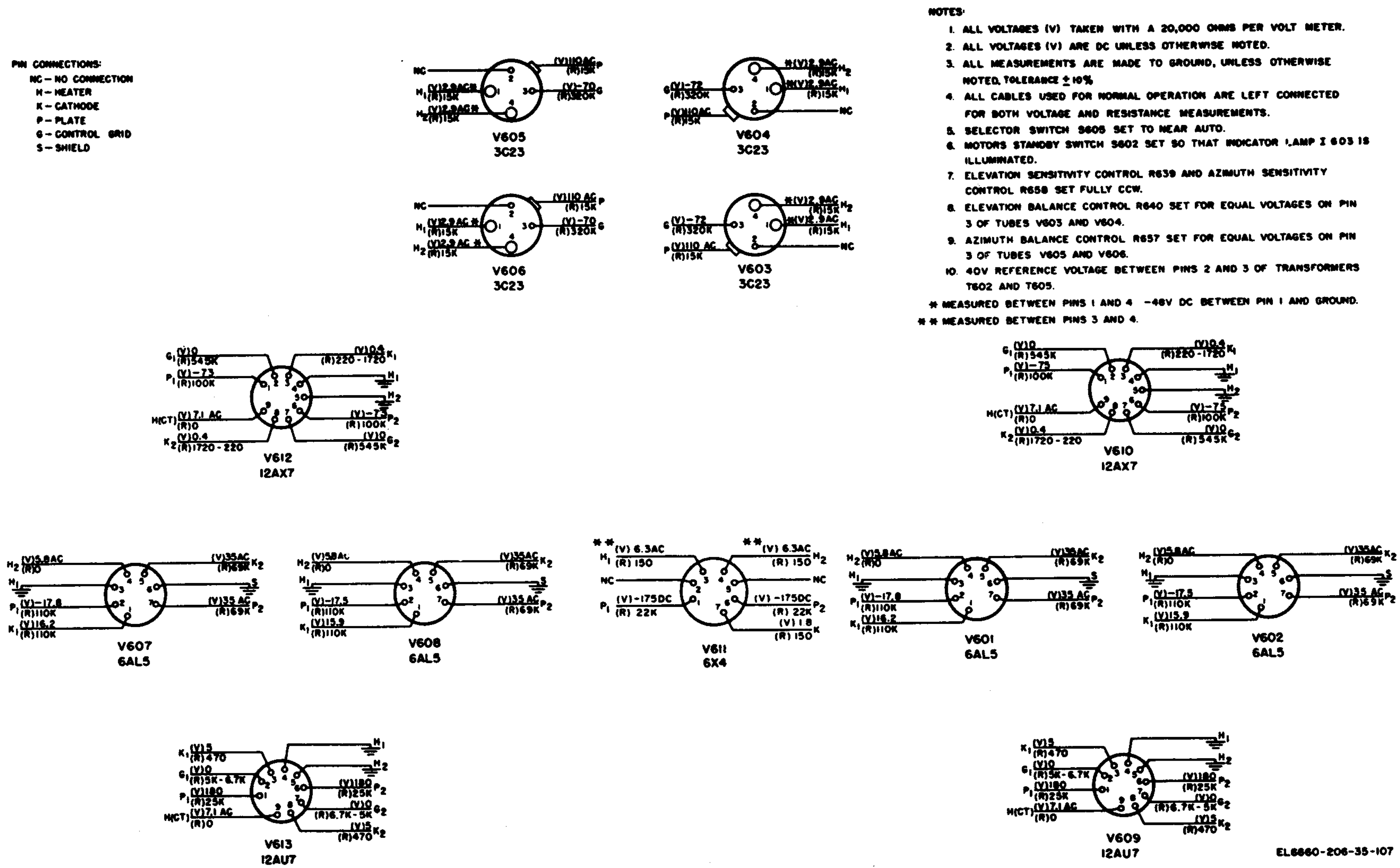


Figure 3–29. Antenna control C–578A/GMD–1 and C–578B/GMD–1, voltage and resistance diagram.

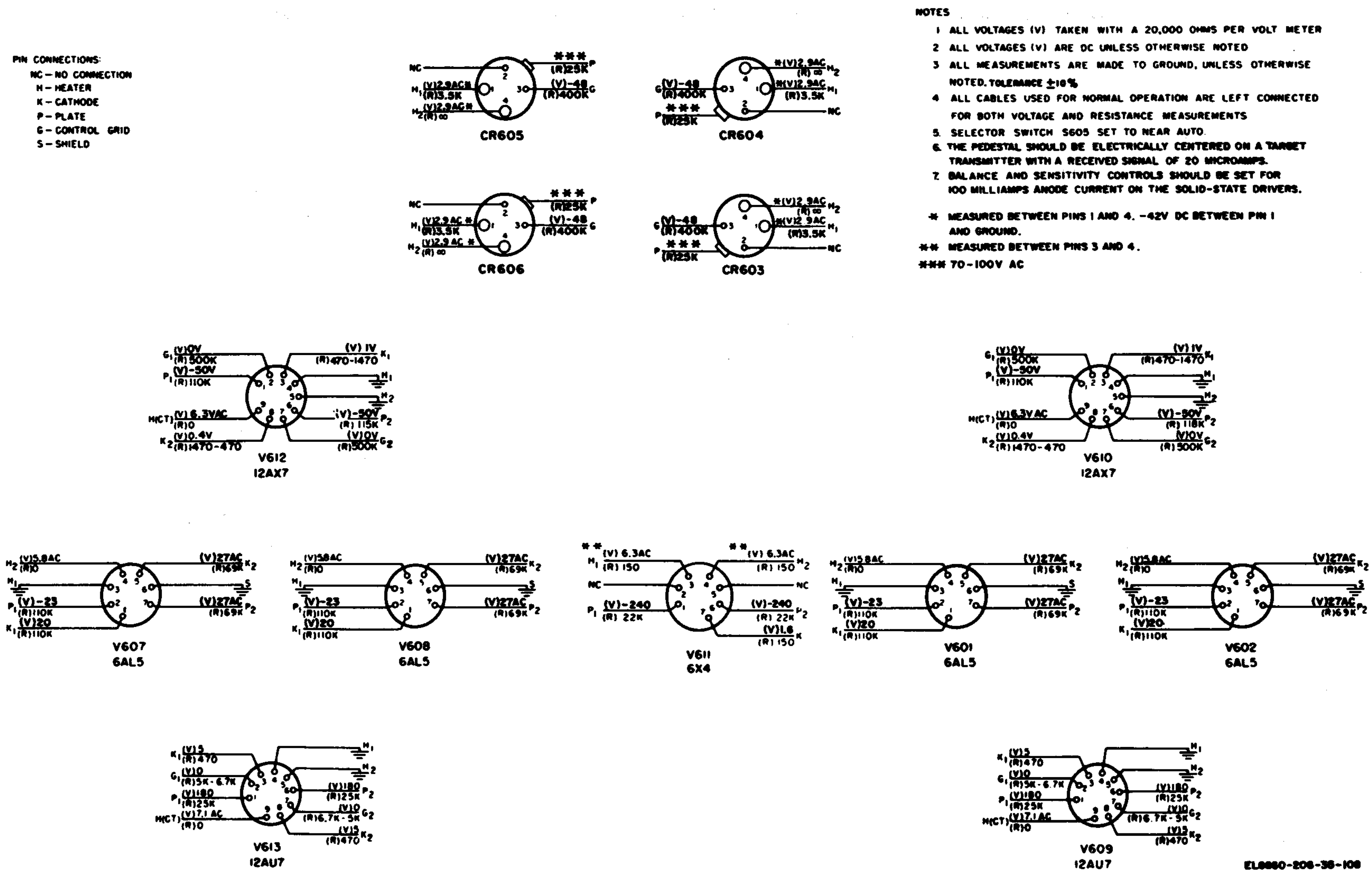


Figure 3—30. Antenna control C—578C/GMD—1, voltage and resistance diagram.

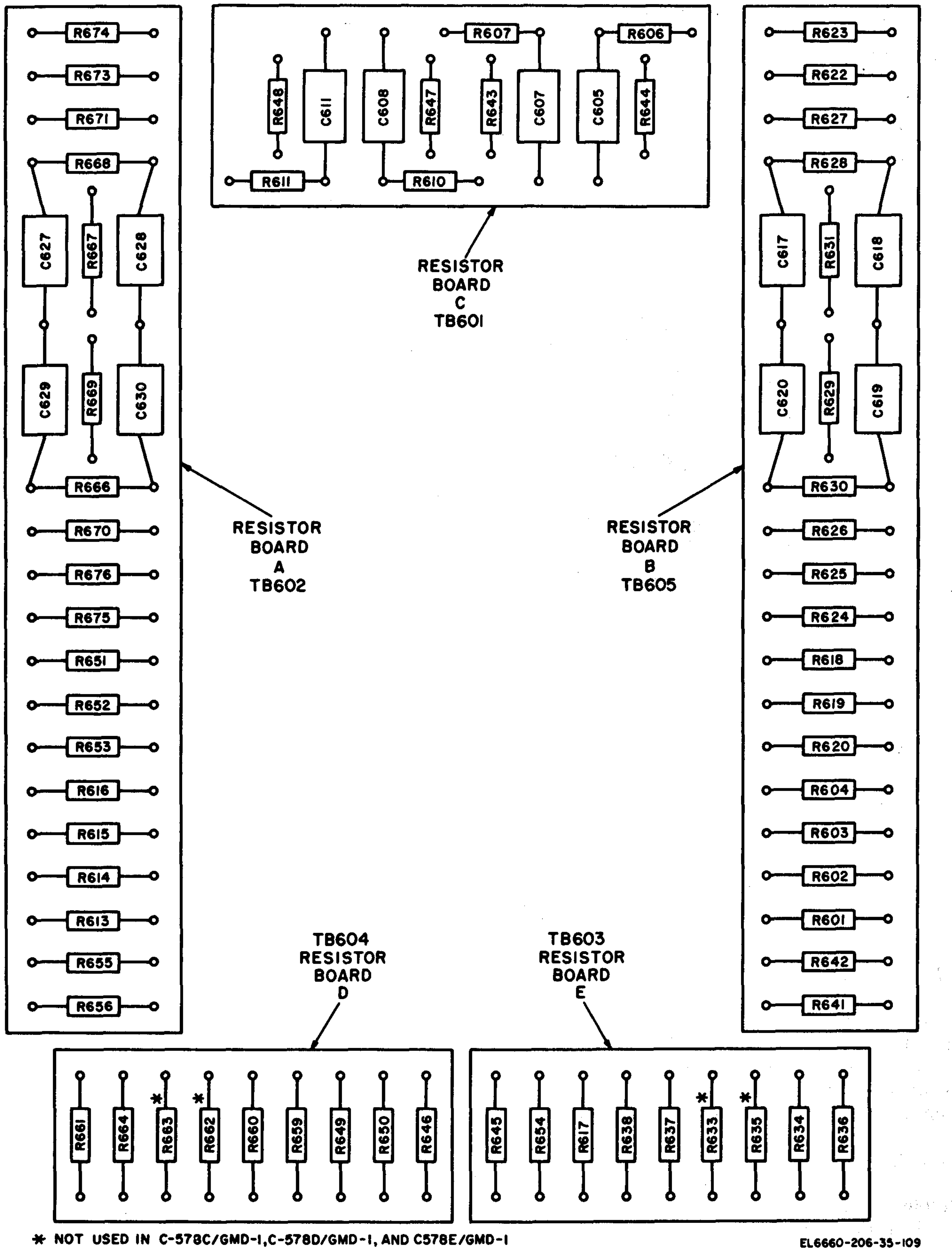


*Figure 3-31. Antenna control C-578C/GMD-1**, resistor and capacitor board layout.*

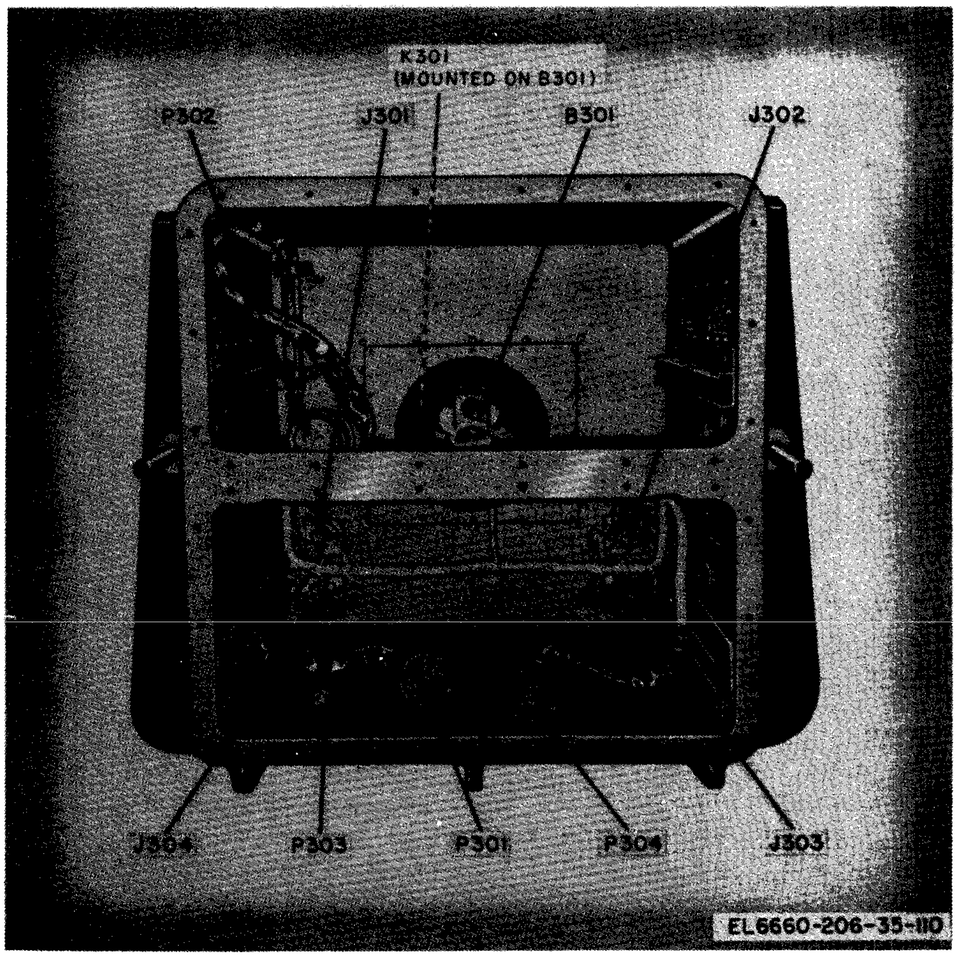


Figure 3-32. Housing (AN/GMD-1A), internal view (except AB-159E).

Section VIII. ANTENNA CONTROL REPAIR

3-47. General

There are four SCR switching units used in the receiver: two for the elevation driving circuits and two for the azimuth driving circuits. Each SCR switching unit contains a silicon-controlled rectifier and associated control circuitry.

3-48. SCR Switching Unit

Table 3-24 isolates problems pertaining to the SCR switching units in the antenna control unit.

NOTE

Before changing any SCR switching unit, the antenna control unit must be cautiously pulled out beyond the limit stop.

WARNING

Dangerous voltages are present on the antenna control unit. Turn POWER switch off before changing SCR switching units.

Table 3-24. SCR Switching Unit Troubleshooting

Symptom	*Probable cause*	*Corrective measure (fig. 3-24)*
Antenna will not move in upward direction (manual mode).	CR603 up driver SCR unit.	Replace CR603.
Antenna will not move in downward direction (manual mode).	CR604 down driver SCR unit.	Replace CR604.
Antenna will not move in counter-clockwise direction (manual mode).	CR605 driver SCR unit.	Replace CR605.
Antenna will not move in clockwise direction (manual mode).	CR606 driver SCR unit.	Replace CR606.
Antenna moves upward or downward when no signal is received (automatic mode).	CR603 defective when antenna moves downward-CR604 when antenna moves upward.	Replace CR603 or CR604.
Antenna moves clockwise or counter-clockwise when no signal (automatic mode).	CR605 when antenna moves in clockwise direction-CR606 when antenna moves in counter-clockwise direction.	Replace CR605 or CR606.

Section IX. HOUSING TROUBLESHOOTING AND REPAIR

3-49. General

a. This section covers the servicing of the housing assembly which can be accomplished when interconnected in the Rawin Set as outlined in TM 11-6660-206-12. Reference data in table 3-25 includes instructions for the operator's and organizational manual TM 11-6660-206-12 and illustrations for direct support maintenance which are used as guides and aids when troubleshooting, testing and locating specific repair parts items. Included also are illustrations for locating test points and specific resistance, current and voltage values for various components.

b. Dc resistance measurements of the blower motor B301 are listed in table 3-26.

Table 3-25. Reference Data, Housing

Reference	*Data*
TM11-6660-206-12	Rawin Set AN/GMD-1 (*), cabling diagram.
TM 11-6660-206-12	Rawin Set AN/GMD-1 (*), system functional block diagram.
Fig. FO-4	Ac power distribution, schematic diagram (AN/GMD-lA).
Fig. FO-5	Ac power distribution, schematic diagram (AN/GMD-1 B*).
Fig. FO–6	Ac power distribution, schematic diagram (AN/GMD-1B* *).
Fig. 3-36	Housing (AN/GMD-1A), schematic diagram.
Fig. FO-16	Housing (AN/GMD-1A), wiring diagram.
Fig. FO-17	Housing (AN/GMD-1B*), wiring diagram.
Fig. FO-18	Housing (AN/GMD-1B*), schematic diagram.

3-50. Dc Resistance Measurements

Use a muitimeter to measure the dc resistance of the motor as listed in table 3-26.

3-51. Test Equipment Required

Multimeter ME-26B/U (TM 11-6625-200-15) is used to obtain resistance and voltage indications during troubleshooting procedures.

3-52. Test Setup

Troubleshooting of the housing assembly must be accomplished with the housing assembly assembled to the rawin system. No special test setup is required. The antenna control unit can be removed to replace or repair specific items.

3-53. Troubleshooting Procedures

Table 3-27 lists procedures for troubleshooting the housing unit assembly.

WARNING

When troubleshooting housing assembly, dangerous voltages are present on TB302, B301, connectors, pins, end switches.

Table 3-26. De Resi.stance-Motor, Housing

Motor	*Location*	*Terminals*	*Dc resistance (ohms)*
B301	Fig. FO-16 and FO-17	YEL-RED	315
		RED-GRN	715
		YEL-GRN	400

Table 3-27. Housing Unit Troubleshooting

Symptom	*Probable cauee*	*Corrective measures*
1. Units in housing overheating.	Blower motor not operating. Broken lead to B301 blower motor.	Repair broken lead (fig. 3-33).
	Defective thermostat S303.* See table 1-7, TM 11-6660-206-12.	Replace thermostat S301 (fig. 3-33).
	115 volts ac across YEL-GRN terminals and YEL-RED terminals-motor does not run.	Replace blower motor B301 (fig. 3-33).
NOTE The following steps must be performed with the housing unit installed in the rawin system.		
2. Antenna cannot be positioned clockwise or counter. clockwise by means of azimuth switch S301.	Switch S301. See table 1-17, TM 11-6660-206-12 for model differences.	Check switch S301 (fig. 3-33); replace if necessary.
3. No power to antenna control unit.	No ac power at pins G and H of P304.	Troubleshoot ac power circuit. Repair as necessary.

* S303 opens at 0°±3°C. on temperature fall. Closes at 11°C. maximum on temperature rise.

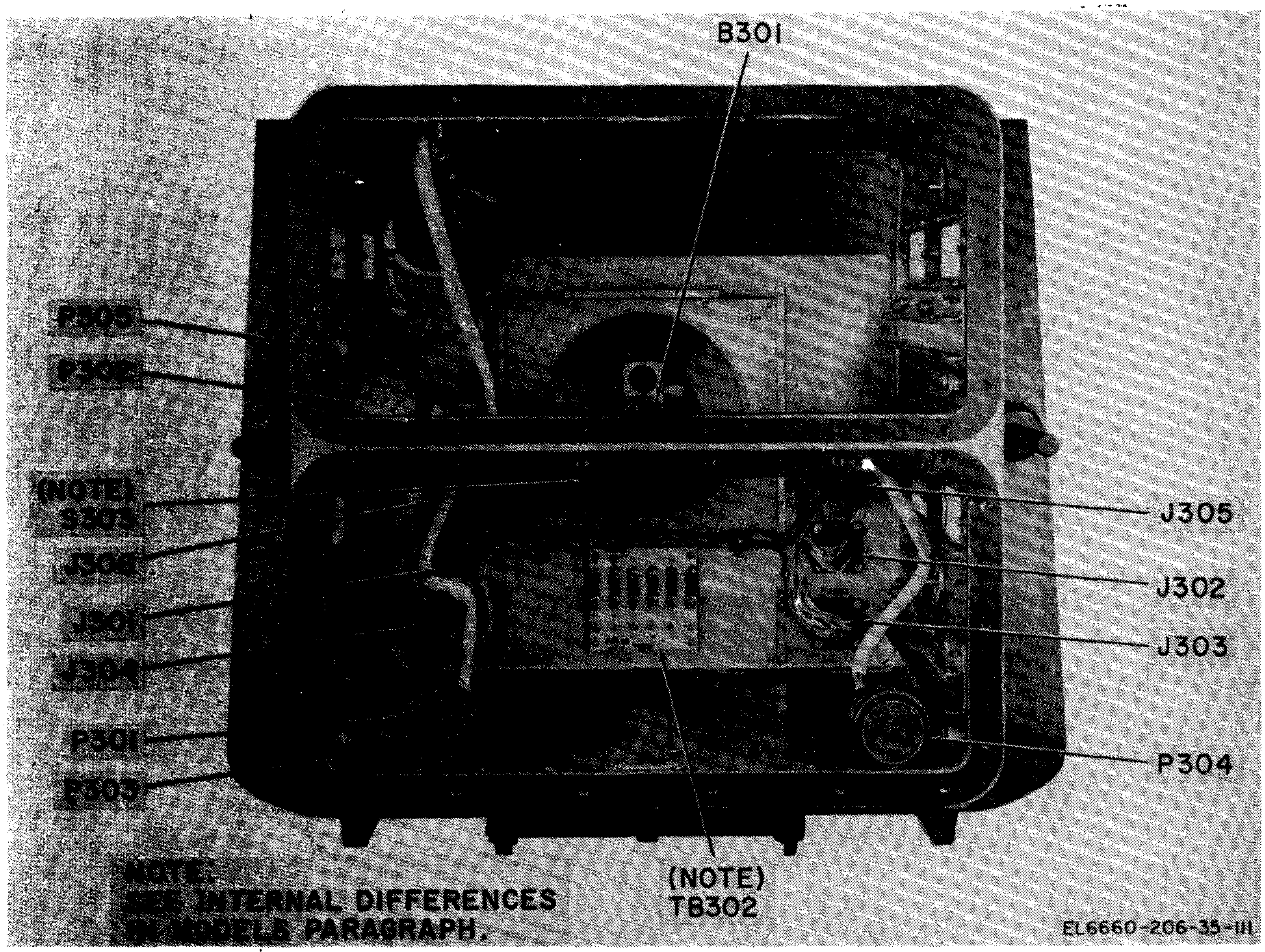


Figure 3-33. Housing (AN/GMD-1B), internal view AB-159E.

3-54. Removal and Replacement of Blower Motor B301 (fig. 3-33 and 3-34).

a. Removal of Blower Motor.

(1) Remove 17 screws and washers from ventilating cover located on rear of housing TM 11-6660-206-12 (fig. 1-20). Remove cover and gasket.

(2) Remove and tag three wires on end of motor (fig. 3-36).

(3) Remove setscrew from fan blade and slide fan blade from shaft.

(4) Remove two screws and washers running through mounting bracket to motor, and remove motor from housing.

b. Replacement of Blower Motor.

(1) Align motor with two mounting holes on mounting bracket (fig. 3-33) and replace two screws and washers.

(2) Replace fan blade to motor shaft and tighten setscrew.

(3) Replace three wires to terminals on motor.

(4) Replace ventilating cover and gasket to rear of housing using 17 screws and washers.

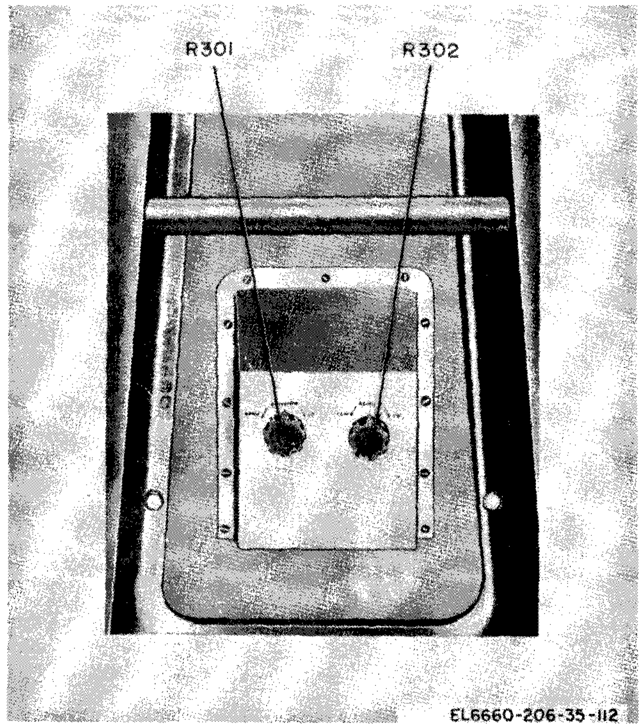


Figure 3-34. Housing (AN/GMD-1A), left side view.

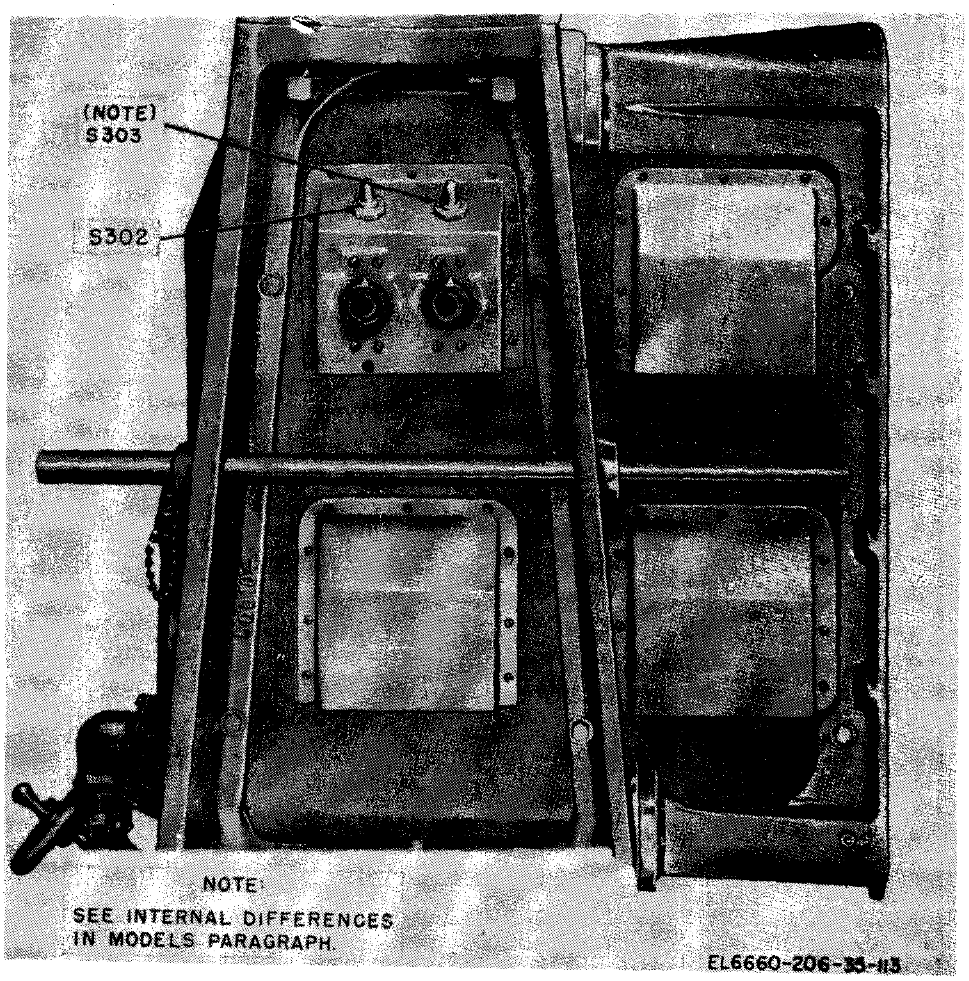


Figure 3-35. Housing (AN/GMD-1B), left side view.

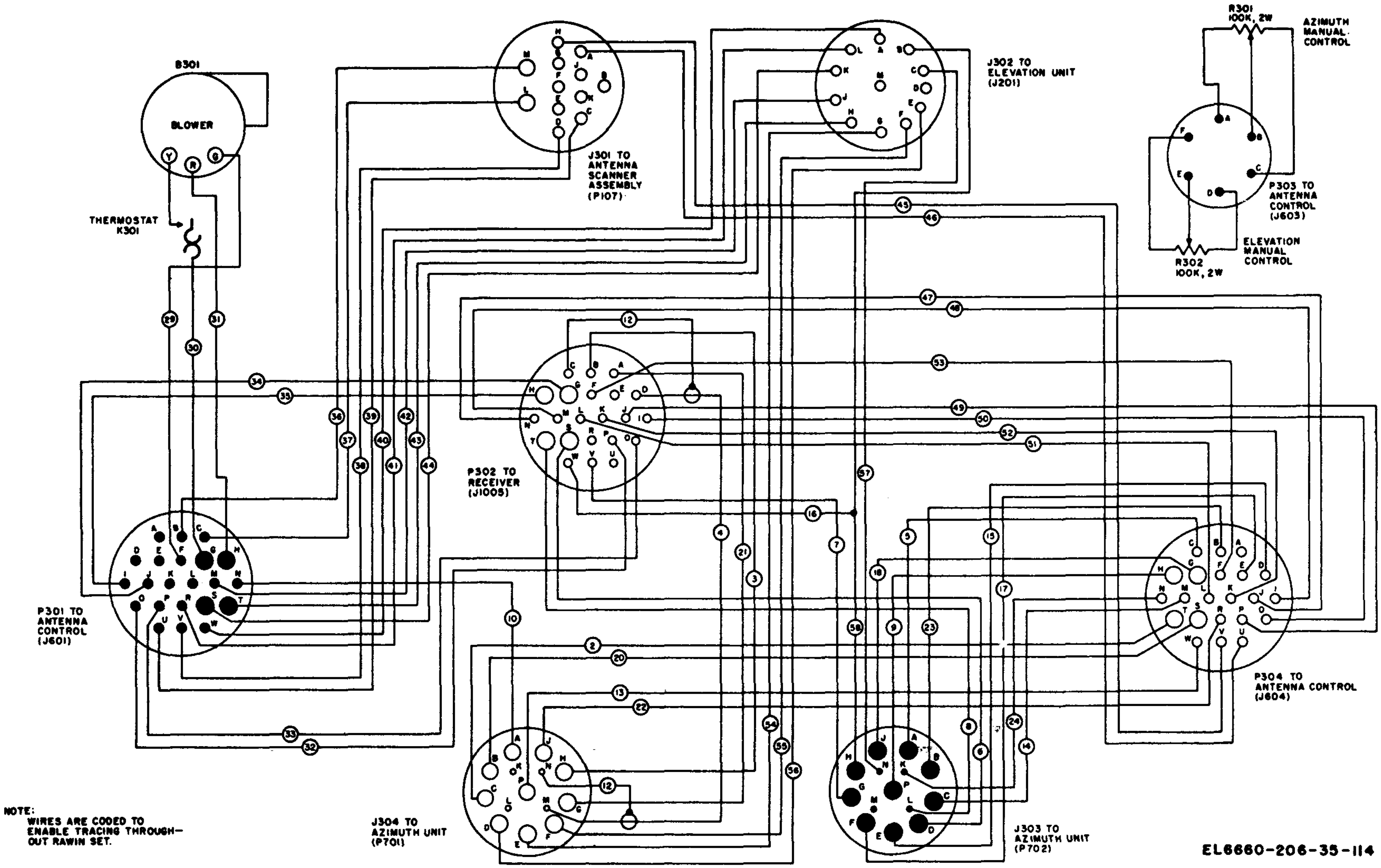


Figure 3–36. Housing (AN/GMD–1A), schematic diagram.

Section X. AZIMUTH UNIT TROUBLESHOOTING AND REPAIR

3-55. Reference Data

Table 3-28 lists reference data used when troubleshooting or repairing the azimuth unit.

WARNING

Dangerous voltages in the azimuth unit when access covers are removed, 115-volt ac power is exposed at fuses F701 and F702, at the sliprings, and the contact springs (fig. 3-38).

3-56. Dc Resistance Measurements

The dc resistance of specific parts in the azimuth unit are listed in table 3-29.

Table 3-28. *Reference Data, Azimuth Unit*

Reference	*Data*
TM1l-6660-206-12	Rawin Set AN/GMD-l(*), cabling diagram,
TM 11-6660-206-12	Rawin Set AN/GMD-l(*), system functional block diagram.
TM1l-6660-206-12	System components location.
Fig. FO-4	Ac power distribution schematic diagram (AN/GMD-lA).
Fig. FO-5	Ac power distribution schematic diagram (AN/GMD-lB).
Fig. FO-6	Ac power distribution schematic diagram (AN/GMD-lB**).

Table 3-29. De Resistance, Motors, Generator, and Heater, Azimuth Unit

Motors, generator, and heater	*Location (fig)*	*Terminals*	*Dc resiatance (ohms)*
B701	3-37	R1-S1	10
	3-40	R1-S2	10
		S1-S2	10
B701 (AN/GMD-lB**)	3-38	10-E706 (R1)	
	FO-30	2-E706 (S1)	10
		10-E706 (Rl)	
		20-E706 (S2)	10
		2-E706 (S1)	
		20-E706 (S2)	10
B702	3-37	R1-R2	12.5
	3-40	S1-S2	21
		S2-S3	21
		S1-S3	21
G701	3-37 3-40	1-2	210
G701 (AN/GMD-lB**)	3-38	l-TB703	
	FO-30	2-TB703	210
HR701	4-5	HR701	80

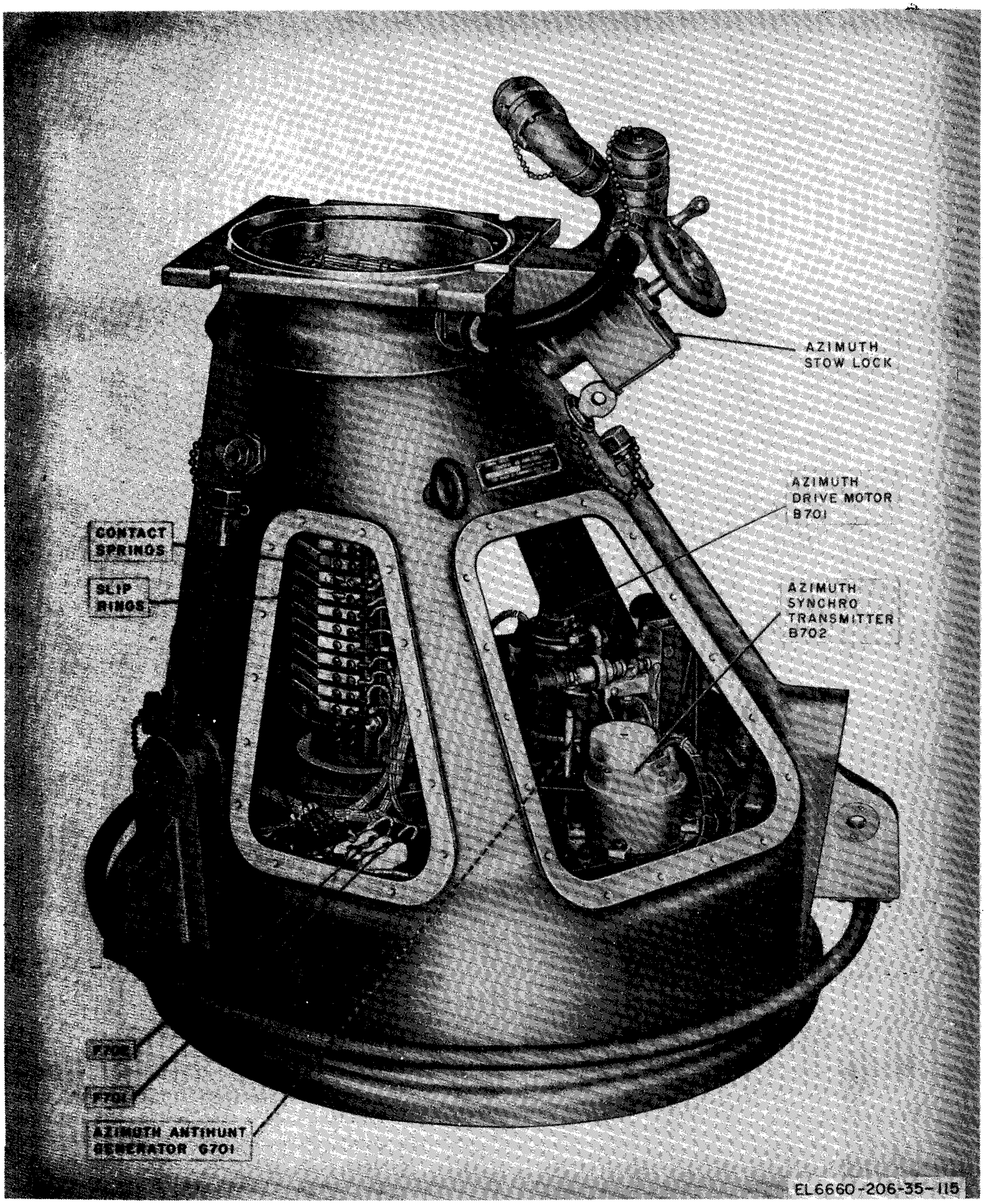


Figure 3–37. Azimuth unit (except pedestal AB-159E/GMD-1) covers removed.

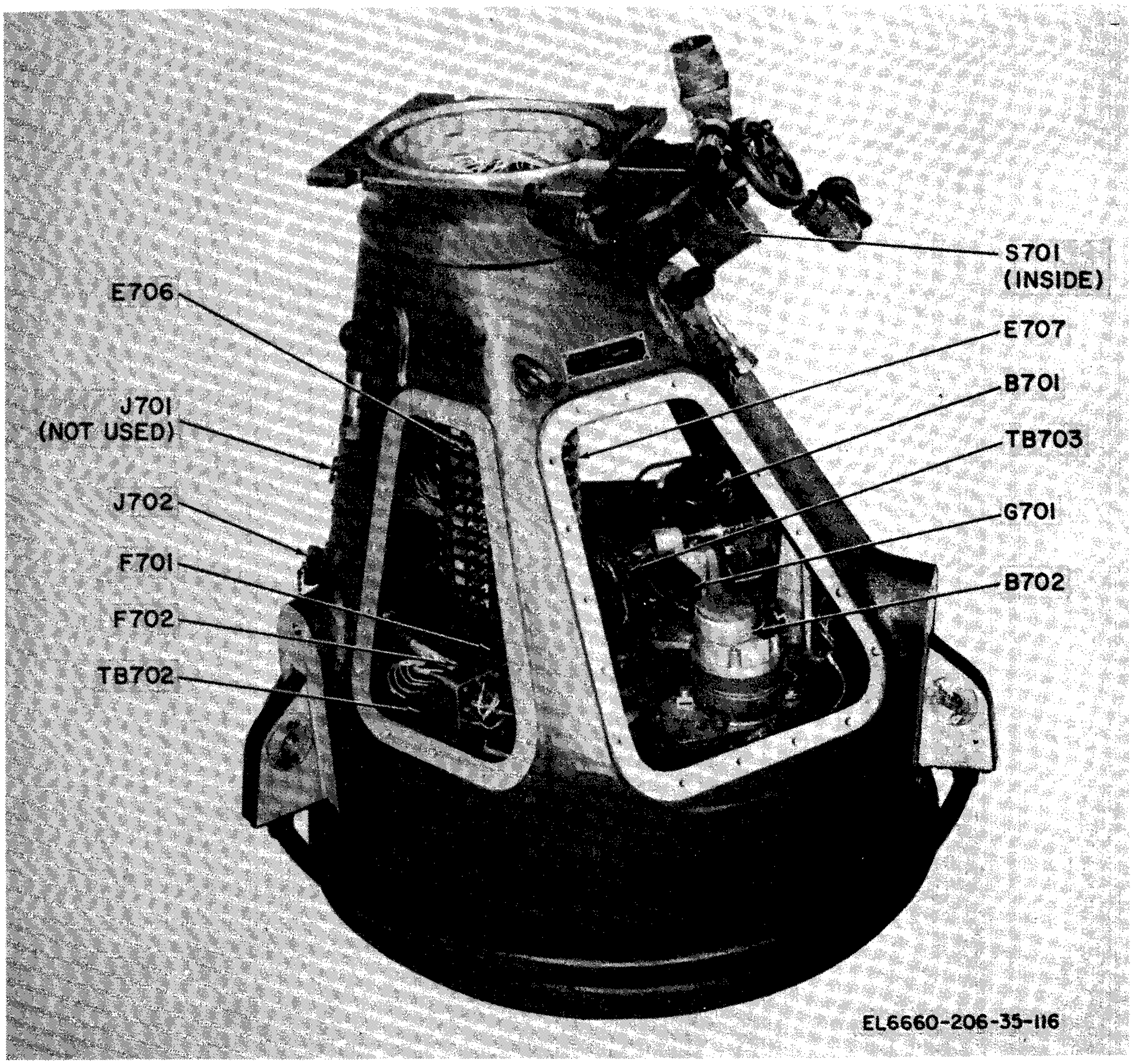


Figure 3-38. Azimuth unit, pedestal AB-159E, covers removed.

3-57. Test Equipment Required

Multimeter TS–352/U (TM 11-6625-366-15).

3-58. Test Setup

Troubleshooting of the azimuth unit must be accomplished with azimuth unit assembled to the rawin system. No special test setup is required.

3-59. Troubleshooting Procedure

A step-by-step procedure is provided in table 3-30. This table is based on troubleshooting the azimuth unit installed in the pedestal. Resistance measurements are taken with P701, P702, and J703 disconnected from the operating system. Voltage readings are taken with P701, P702, and J703 interconnected to an operating system.

Table 3-30. Azimuth Unit Troubleshooting

Symptom	*Probable cause*	Corrective measures
1. Antenna cannot be positioned clockwise or counter-clockwise by electrical means. Drive motor does not run.	Azimuth stow lock control locked.	Unlock stow lock (fig. 3-38).
	Azimuth stow lock switch S701. . .	Replace defective stow lock switch.
	Broken lead to azimuth drive motor B701 (fig. 3-38).	Repair broken lead.
	Contacts in slipring assembly in azimuth unit.	Troubleshoot sliprings in azimuth circuit. Repair as necessary (fig. 3-38).
	Defective drive motor B701. Voltage across R1 and S1 (terminals 10 and 2 of E706) or R1 and S2 (terminals 10 and 20 of E706) (fig. 3-38) is normal 30-60 volts dc.	Replace defective motor B701.
2. Indicator on azimuth unit not synchronous with indicator on control-recorder.	Broken lead to azimuth synchro transmitter B702.	Repair broken lead.
	No voltage across R1 and R2 (fig. FO-30) of transmitter B702. Normal voltage is 115 Vat.	Troubleshoot transmitter B702 circuit. Repair as necessary.
	No voltage across S1 and S2 (fig. FO-30) of transmitter B702.	Replace transmitter.
	No voltage across S2 and *S3* (fig. FO-30) of transmitter B702.	Replace transmitter.
	No voltage across S1 and S3 (fig. FO-30) of transmitter B702.	Replace transmitter.
3. Antenna hunts in azimuth when controlled automatically.	Broken lead to azimuth antihunt generator G701.	Repair broken lead.
	No voltage across 1 and 2 (fig. FO-30) of G701 generator. Terminals 1 and 2 of TB703 should be from 1 to 115 volts dc (AB-159E/GMD-l). Terminals 6 and 7 of E701 (AB-159B, C/GMD-l). Terminals 13 and 22 of E701, (AB-159D /GMD-l).	Replace G701 generator.

3-60. Removal and Replacement of Azimuth Antihunt Generator Assembly (fig. 3-38)

a. General. The azimuth antihunt generator assembly. (fig. 5-12 ②) consists of the antihunt generator with the generator gear (48) attached.

b. Removal of Azimuth Antihunt Generator Assembly.

(1) Remove the 17 screws that hold the cover containing the indicator window on the azimuth unit and remove the cover.

(2) Disconnect and tag the generator wires that are fastened to terminal board TB703.

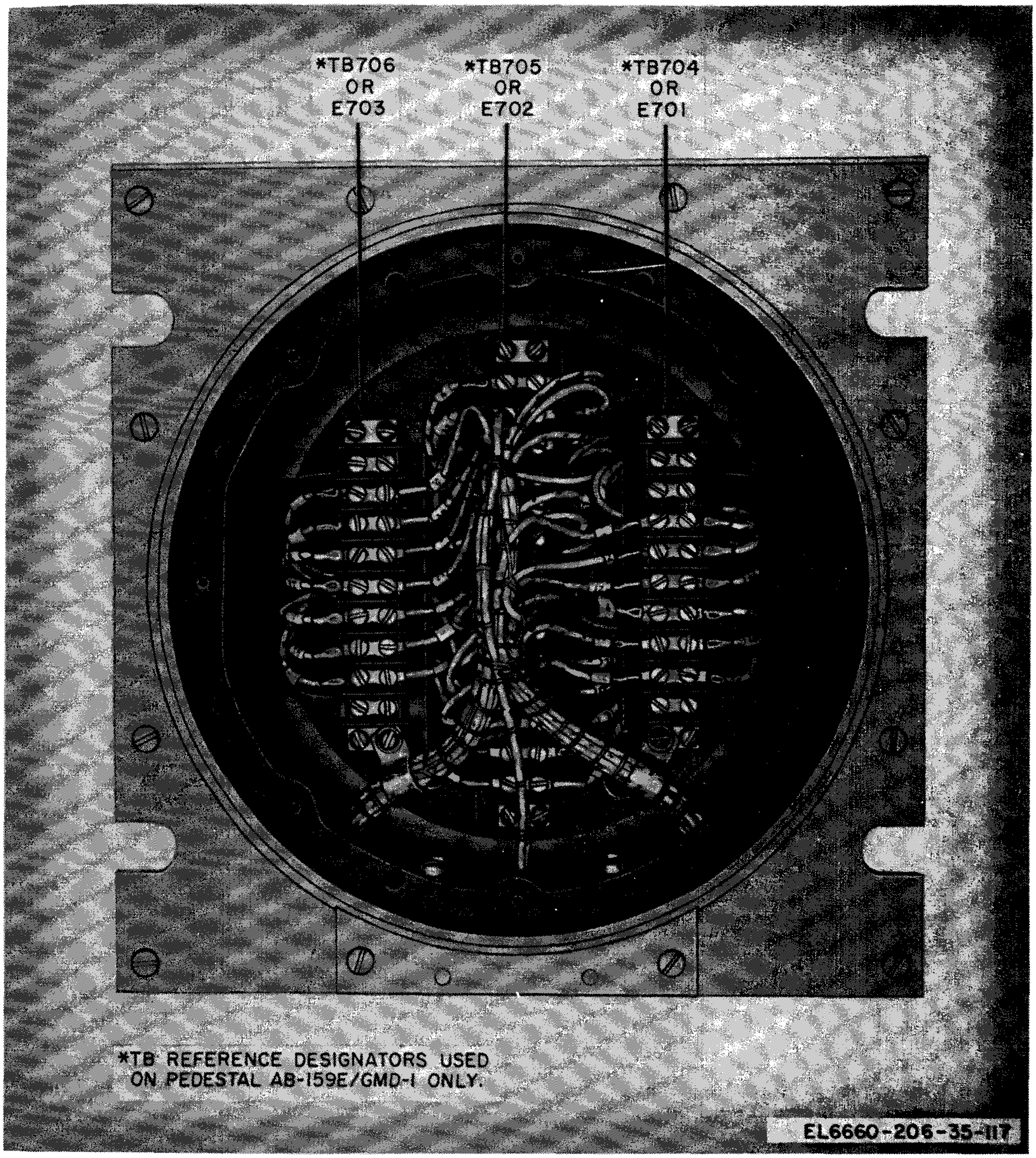


Figure 3-39. Azimuth unit, top view, cover removed.

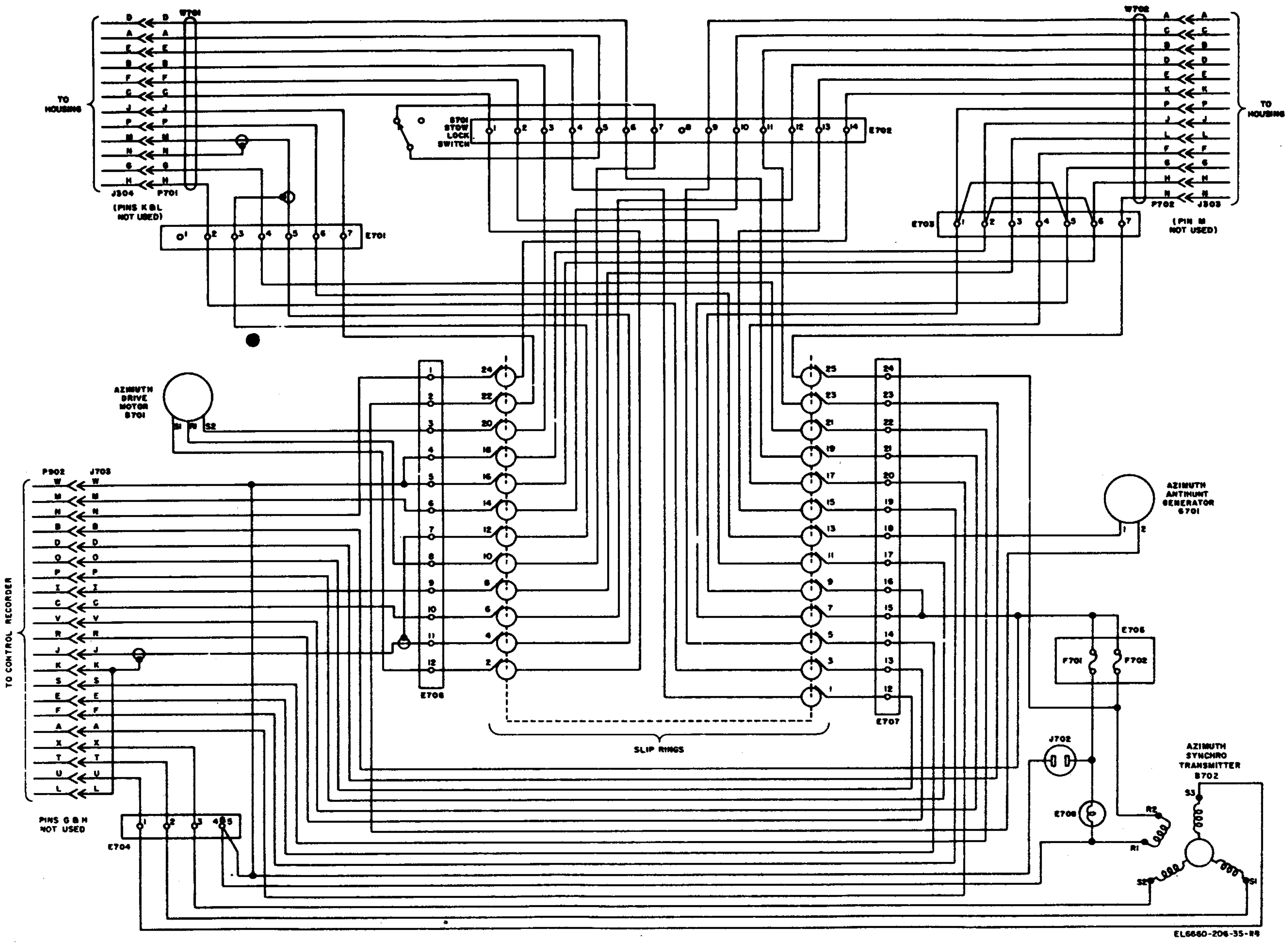


Figure 3–40. Azimuth unit (pedestal AB–159A, AB–159B, and AB–159C/GMD–1), schematic diagram.

(3) Remove the cable clamp from the generator wires.

(4) Remove the three screws (45, fig. 5-12 ②) and washers (46 and 47) that secure the generator to the mounting plate (44) and lift the generator off the mounting plate.

c. Replacement. of Azimuth Antihunt Generator Assembly.

(1) Position the antihunt generator assembly to the motor mounting plate (44).

(2) Mesh the generator gear (48) with the idler gear (38).

(3) Replace and tighten the three screws (45) and washers (46 and 47) that secure the generator to the motor mounting plate (44).

(4) Replace the generator wires removed in *b* (2) above to terminal board TB703.

(5) Replace the cable clamp removed in *b* (3) above.

3-61. Removal and Replacement of Azimuth Drive Motor Assembly

(fig. 3-38)

a. General. The azimuth drive motor assembly consists of the drive motor (fig. 5-12 ①) with the motor shaft coupling attached.

b. Removal of Azimuth Drive Motor Assembly.

(1) Remove the 17 screws that hold the cover containing the indicator window on the azimuth unit and remove the cover.

(2) Disconnect and tag the motor wires that are fastened to terminal board E706.

(3) Remove the cable clamps from the motor wires.

(4) Remove the four screws (11, fig. 5-12 ①) that secure the motor to mounting plate (44) and lift the motor off the mounting plate.

c. Replacement of Azimuth Drive Motor Assembly.

(1) Position the drive motor assembly to the motor mounting plate (44).

(2) Mesh the motor gear with the idler gear (38, fig. 5-12 ②) and shaft coupling (8, fig. 5-12 ①).

(3) Replace and tighten the four screws (11) that secure the motor to the motor mounting plate (44).

(4) Replace the motor wires removed in *b* (2) above to terminal board E706.

(5) Replace the cable clamps removed in *b* (3) above.

3-62. Removal and Replacement of Azimuth Synchro Transmitter Assembly

(fig. 3-38)

a. General. The azimuth synchro transmitter assembly consists of the transmitter (fig. 5-12 ①) with drive gear (17) attached.

b. Removal of Azimuth Synchro Transmitter Assembly.

(1) Remove the 17 screws that hold the cover located to the left of the azimuth indicator window and remove the cover.

(2) Disconnect and tag the wires attached to the top of the transmitter.

(3) Remove the four screws (11, fig. 5-12 ①), washers and mounting lugs (13 and 14) that secure the transmitter to the synchro mounting plate (18) and lift the transmitter off the mounting plate.

c. *Replacement of Azimuth Synchro Transmitter Assembly.*

(1) Position the synchro transmitter assembly to the synchro mounting plate.

(2) Mesh the transmitter gear (17) with the synchro drive gear (54).

(3) Replace and tighten the four screws (11) washers and mounting lugs (13 and 14) that secure the transmitter to the mounting plate.

(4) Replace the transmitter wires removed in *b(2)* above.

3-63. Removal and Replacement of Azimuth Interlock Switch

a. Removal of Azimuth Interlock Switch.

(1) Remove the four screws (14, fig. 5-14) holding the cover plate and gasket.

(2) Remove two screws (9) lockwashers, nuts, and four flat washers (10) holding interlock switch in place.

(3) Tag leads, unsolder, and remove switch.

b. Replacement of Azimuth Interlock Switch.

(1) Resolder tagged leads previously removed to interlock switch.

(2) Mount switch to housing (11, fig, 5-14) using two screws (9), lockwashers, nuts, and four flat washers (10).

(3) Replace cover (16), four screws (14), and four lockwashers (15), and gasket (17) to stow lock housing.

Section XI. ELEVATION UNIT ASSEMBLY TROUBLESHOOTING AND REPAIR

3-64. Reference Data

Table 3-31 lists reference data that will be used when troubleshooting or repairing the elevation unit assembly.

3-65. Dc Resistance Measurements

The dc resistances for specific parts in the elevation unit are listed in table 3-32.

Table 3-31. Reference Data, Elevation Unit

Reference	*Data*
TM1l-6660-206-12	*Rawin* Set AN/GMD-l(*), cabling diagram.
TM1l-6660-206-12	Rawin Set AN/GMD-l(*), system functional block diagram.
TM1l-6660-206-12	Systems components location.
Fig. FO-4	Ac power distribution, schematic diagram (AN/GMD-lA).
Fig. FO-5	Ac power distribution,, schematic diagram (AN/GMD-lB*).
Fig. FO-6	Ac power distribution, schematic diagram (AN/GMD-lB**).
Fig. 3-42	Elevation unit (AN/GMD-lA) schematic diagram.
Fig. 3-43	Elevation unit (AN/GMD-1B) schematic diagram.
Fig. 3-44	Elevation unit (AN/GMD-lA) wiring diagram.
Fig. 3-45	Elevation unit (AN/GMD-lB) wiring diagram.

Table 3-32. *Dc* Resistance Measurements, Elevation Unit

Generator and motor	Location *(fig.)*	Terminals	*Dc resistance (ohms)*
G201 AN/GMD-lA	3-42	1-2	210
G201 AN/GMD-lB	3-43	40 TB201 (1) 41 TB201 (2)	210
B201 AN/GMD-lA	3-42	R1-S1	10
		R1-S2	10
		S1-S2	10
		55 TB201(R1) 56 TB201(S1)	10
		55 TB201(R1) 54 TB201(S2)	10
		56 TB201(S1) 54 TB201(S2)	10
B202 AN/GMD-lA	3-42	R1-R2	12.5
AN/GMD-lB	3-43	S1-S2	21.0
		S2-S3	21.0
		S1-S3	21.0
HR201 AN/GMD-lB	3-43	HR201	80

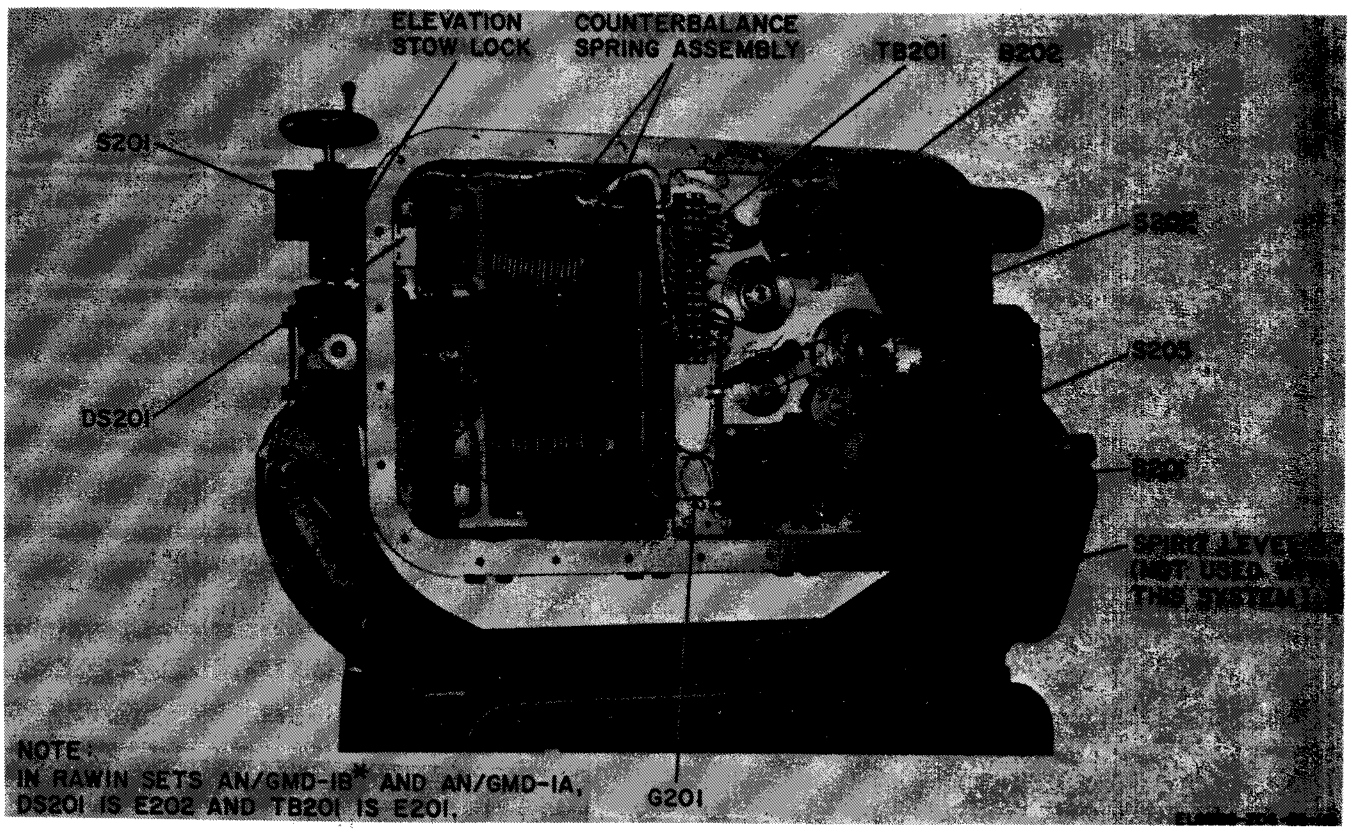


Figure 3-41. Elevation unit assembly, cover removed.

3-66. Test Equipment Required

Multimeter TS-352B/U (TM 11-6625-366-15). The multimeter is used to obtain resistance and voltage indications during troubleshooting procedures.

3-67. Test Setup

Troubleshooting of the elevation unit must be accomplished with the elevation unit assembled to the rawin system.

3-68. Troubleshooting Procedures

Table 3-33 lists procedures for troubleshooting the elevation unit assembly.

WARNING

When the access cover is removed from the elevation unit (fig. 3-41), 115-volts ac power is exposed at terminal board TB201 or E201.

Table 3-33. Elevation Unit Troubleshooting

Symptom	*Probable cause*	*Corrective measure*
1. Antenna cannot be positioned up or down by electrical means. Drive motor does not run.	Elevation stow lock control locked.	Unlock stow lock (fig. 3-41).
	Elevation stow lock switch S201.	Replace defective stow lock switch.
	Broken lead to elevation drive motor B201.	Repair broken lead.
	Defective drive motor. Voltage across R1 and S2 terminals 55 and 54 of TB201 R1 and S1 (terminals 55 and 51 of TB201, fig. 3-43) is normal 30-60 volts dc.	Replace defective motor B201.
2. Indicator on elevation unit not synchronised with indicator on control-recorder.	Broken lead to elevation synchro transmitter 13202.	Replace broken lead.
	No voltage across R1 and R2 of B202 transmitter (terminals 30 and 31 of TB201, fig. 3-43). Normal voltage is 115 Vac.	Troubleshoot transmitter B202 circuit. Repair as necessary.
	No voltage across S1 and S2 of B202 transmitter (terminals 11 and 1 of TB201, fig. 3-43).	Replace transmitter.
	No voltage across S1 and S3 of B202 transmitter (terminals 11 and 19 of TB201, fig. 3-43).	Replace transmitter.
	No voltage across S2 and S3 of B202 transmitter (terminals 1 and 19 of TB201, fig. 3-43).	Replace transmitter.
3. Antenna hunts in elevation when controlled automatically.	Broken lead to elevation antihunt generator G201.	Check leads to generator 201 (fig. 3-41) and repair if broken.
	No voltage across 1 and 2 (terminals 40 and 41 of TB201, fig. 3-43). Should be from 1-115 volts ac.	Replace generator G201.
4. Antenna moves downward when above zero degrees and power switch OFF.	Loose counterbalance springs.	Readjust counterbalance springs (para 3-76).

Table 3-33. Elevation Unit Troubleshooting-Continued

Symptom	*Prabable cause*	*Corrective measure*
5. Antenna will not stop at 90 (+ 0.5-0) degrees when traveling upward.	Limit switch S202 (fig. 3-43) defective or cam not adjusted.	Adjust position of upper cam or replace microswitch.
6. Antenna will not stop at -3 (+ 0-0.5) degrees when traveling downward.	Limit switch S202 (fig. 3-43) defective or cam not adjusted	Adjust position of lower cam or replace microswitch.

3-69. Removal and Replacement of Counterbalance Spring Assemblies (fig. 5-15)

a. General. Two identical counterbalance spring assemblies (fig. 5-15) are mounted in the elevation unit housing, one at each side of the inner wall. The elevation unit should be placed in the vertical position (in relation to the yoke) (TM 11-6660-206-12) to remove tension on the counterbalance springs before attempting to remove the counterbalance spring assembly.

NOTE

If the elevation unit assembly is separate from the remainder of the rawin set, place the assembly on a firm working surface with the elevation unit mounting flange (TM 11-6660-206-12) down and rotate the yoke until it is perpendicular with the working surface.

b. Removal.

(1) Remove the back cover of the elevation unit (TM 11-6660-206-12) by removing the 26 bolts that hold the cover on.

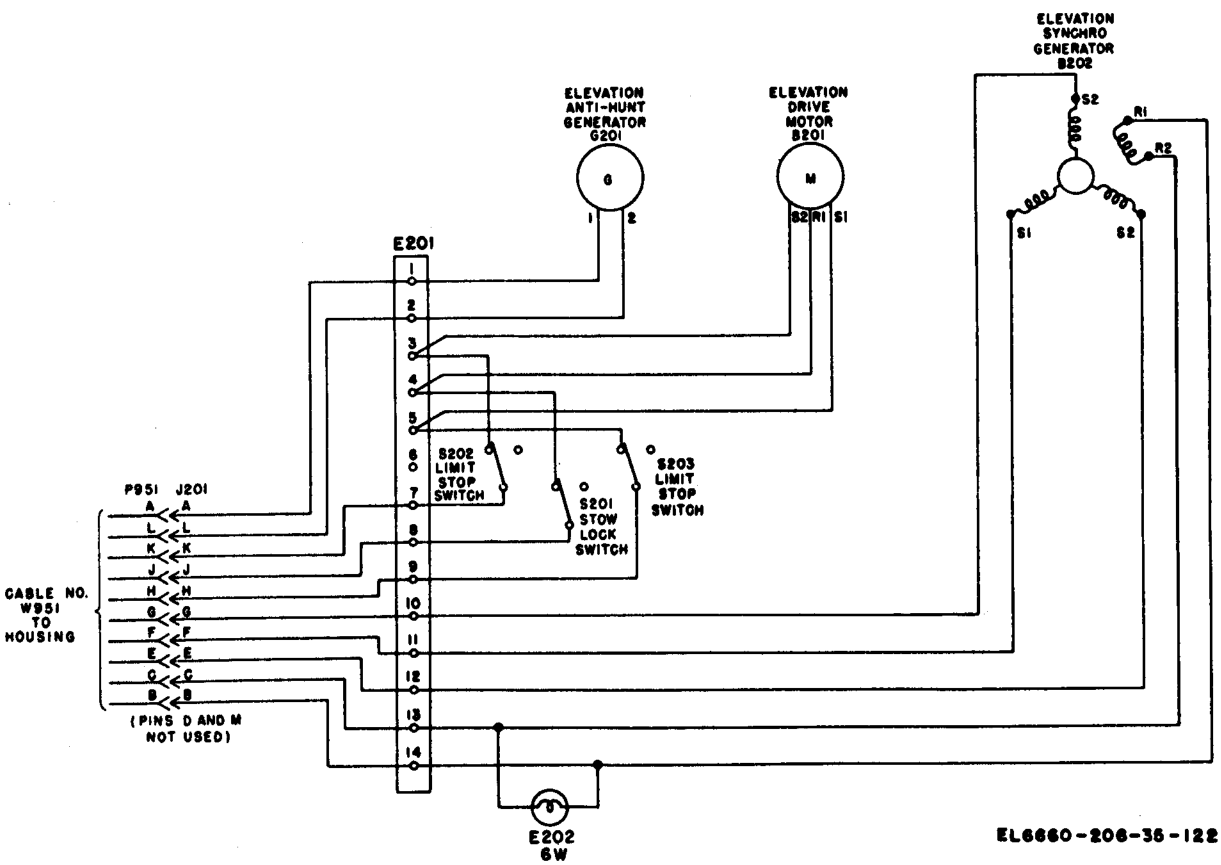


Figure 3-42. Elevation unit (AN/GMD-1A), schematic diagram.

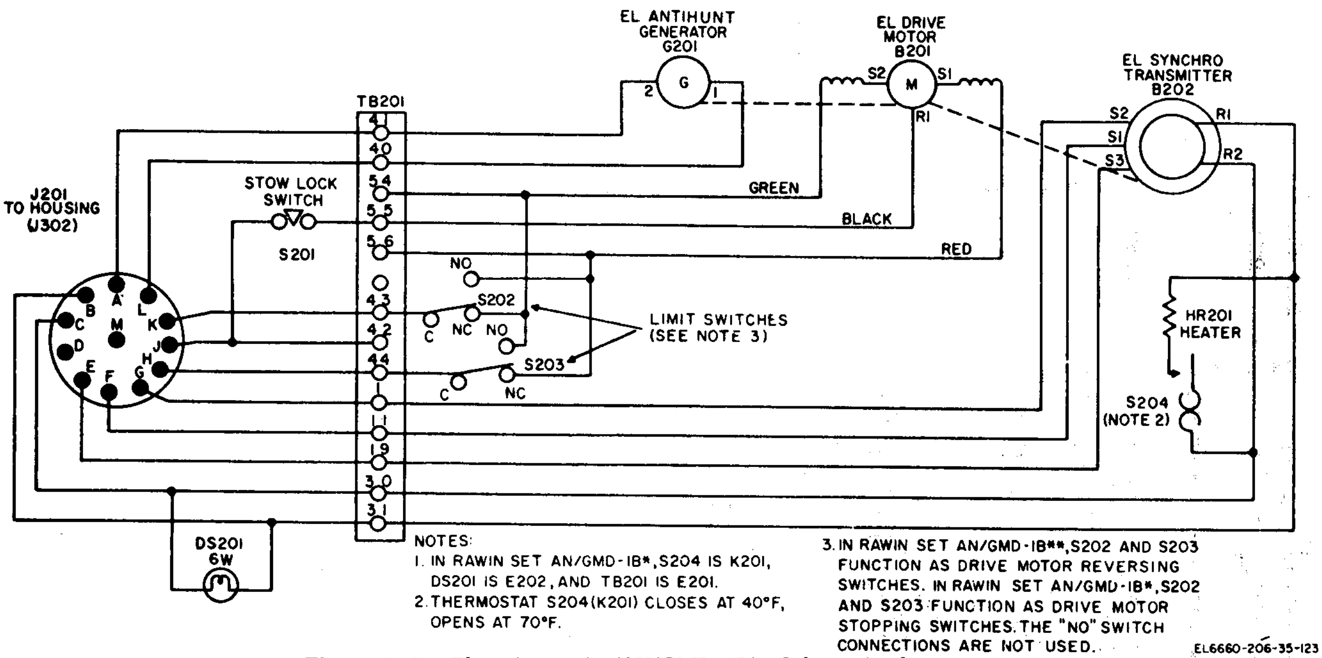


Figure 3-43. Elevation unit (AN/GMD-1B), Schematic diagram.

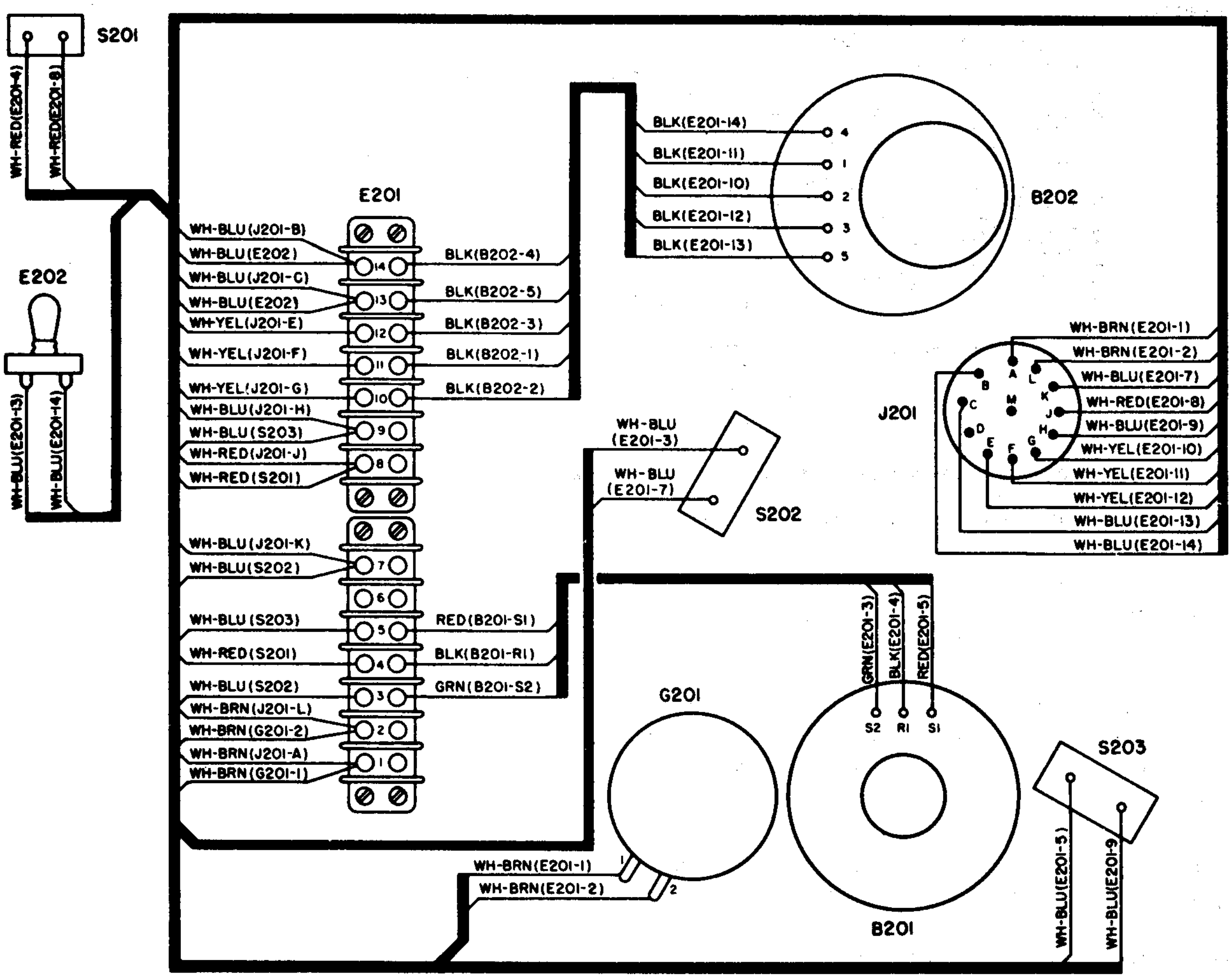


Figure 3-44. Elevation unit (AN/GMD-1A), wiring diagram.

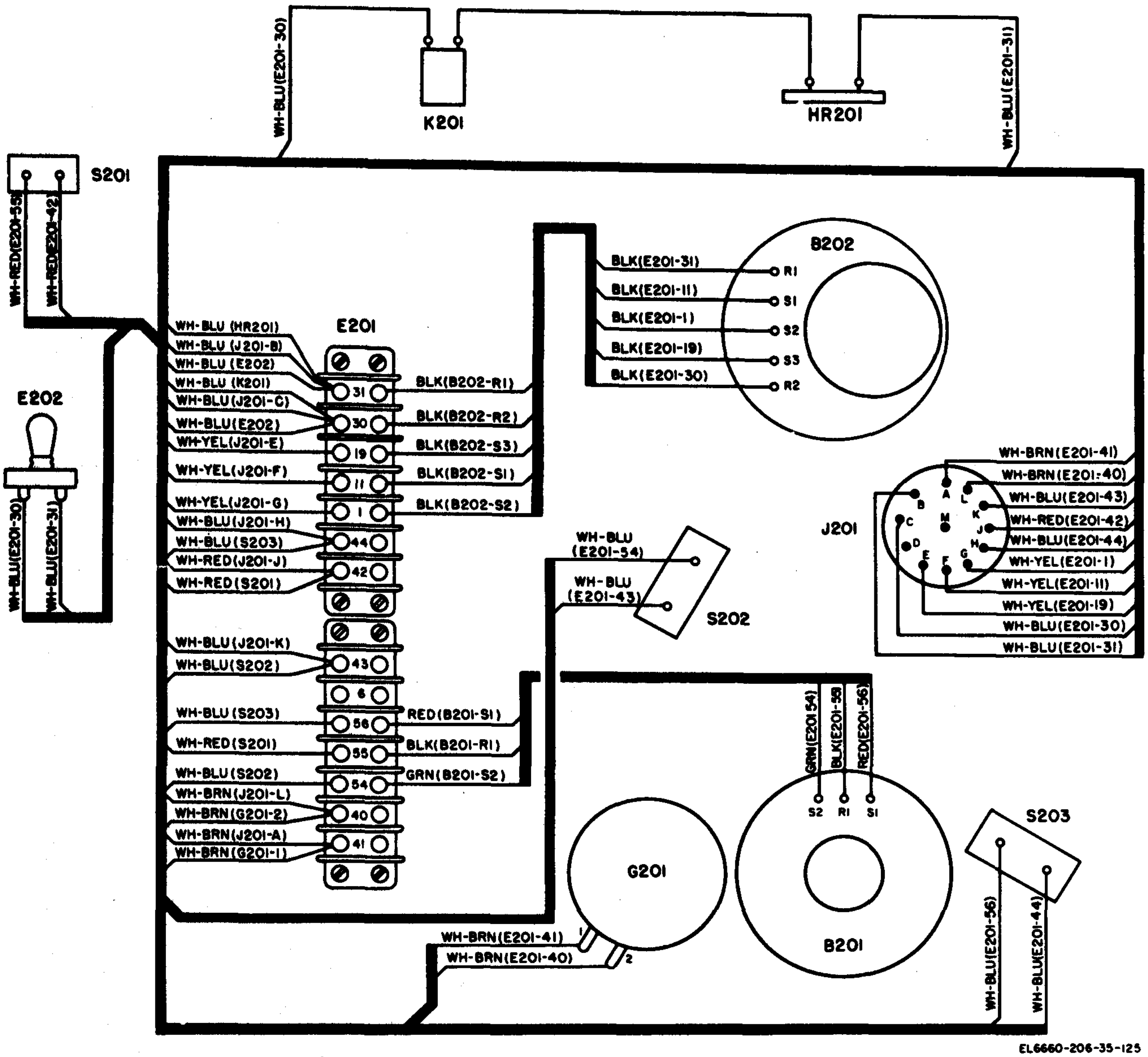


Figure 3-45 ① . Elevation unit (AN/GMD-1B), wiring diagram (Sheet 1 of 2).

(2) Loosen the hexagon nut on both counterbalance spring shafts as far as they will go without removing (fig. 3-46).

(3) Attach a spring from the nearest housing handle to one of the holes in the drive plate (fig. 3-46) to hold the counterbalance spring (fig. 3-47) compressed.

(4) Insert pins of spanner wrench (fig. 3-47) into alternate holes of the drive plate.

(5) Move adjusting plate away from drive plate but not off shaft spline.

(6) Apply counterclockwise pressure with spanner wrench and turn drive plate until pins in drive plate turn and no tension is evident.

(7) Repeat steps (3) through (6) above for removal of tension on other counterbalance spring assembly.

(8) Remove the four screws that secure the support frame of the counterbalance spring assembly (fig. 5-15 ①), and then remove the assembly from the elevation unit housing.

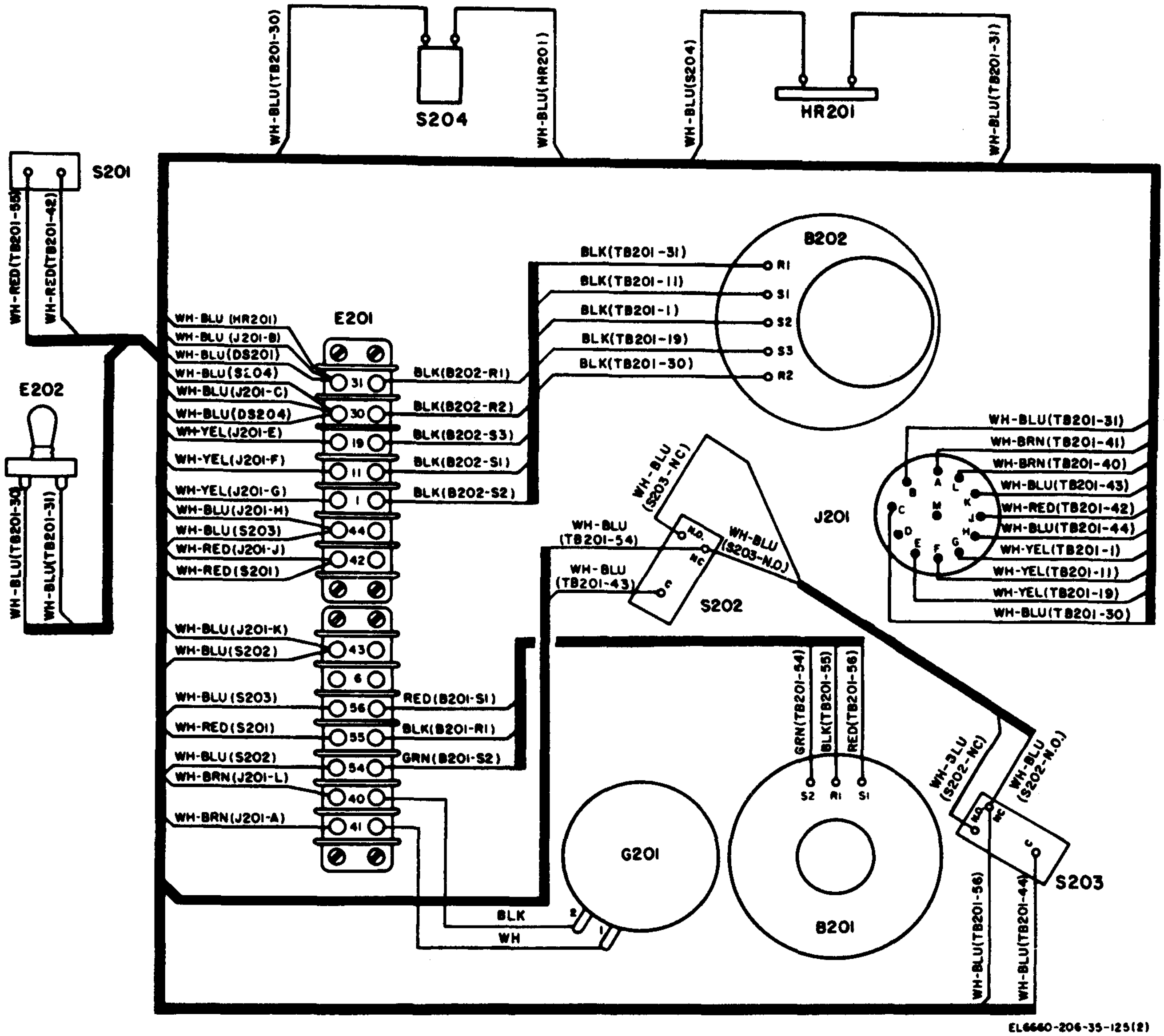


*Figure 3-45 ②. Elevation unit (AN/GMD-1B**) wiring diagram (Sheet 2 of 2).*

c. Replacement.

(1) Fit the support frame of the counter-balance spring assembly to the inner wall of the elevation unit housing.

(2) Mesh the counterbalance spring gear with the trunnion stationary gear (17, fig. 5-15 ①).

(3) Replace the washers and tighten. the four screws that secure the support frame of the counterbalance spring assembly to the elevation unit housing.

(4) Adjust counterbalance spring, follow procedure in paragraph 3-70.

(5) Replace the back cover of the elevation unit.

3-70. Counterbalance Spring Adjustment

a. Position elevation assembly to the 90 degree position.

b. Loosen the hexagon nut on both counterbalance spring shafts as far as they will go without removing (fig. 3-46).

c. Attach a spring from the closest housing handle to one of the holes in the drive plate (fig. 3-46) to hold the counterbalance spring (fig. 3-47) compressed.

d. Insert pins of spanner wrench (fig. 3-47) into alternate holes of the drive plate.

e. Move adjusting plate away from drive plate but not off shaft spline.

f. Apply clockwise pressure with spanner wrench and turn drive plate until pins in drive plate are moved three holes from start.

g. Move adjusting plate toward drive plate, engage pins into holes and tighten nut and washer.

h. Repeat adjustment on other counterbalance spring.

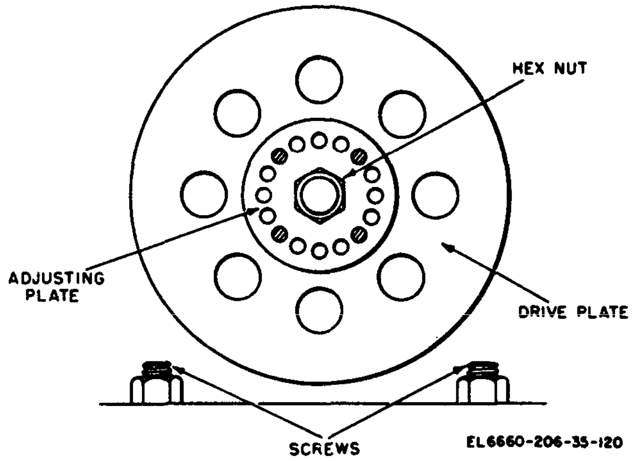


Figure 3-46. Counterbolonce spring *assembly drive plate.*

i. Set control-recorder MAIN POWER switch and antenna control POWER switch to ON.

j. Operate ELEVATION UP-DOWN switch until antenna is on 75 degrees.

k. Check the downward travel time between 75 degrees and 15 degrees with a stopwatch.

l. Check the upward travel time between degrees and 75 degrees with a stopwatch.

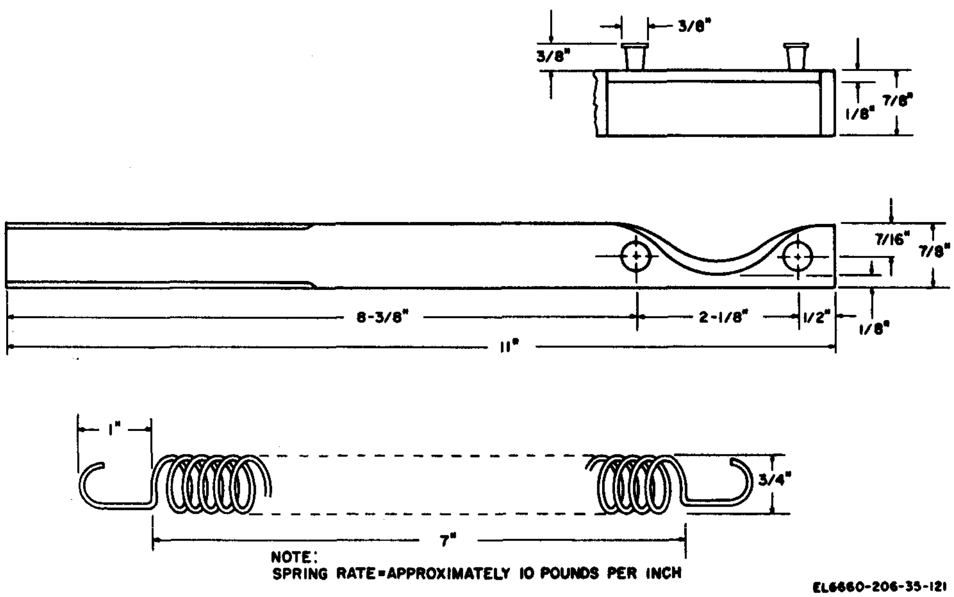


Figure 3-47. Counterbalance spring adjusting tool.

NOTE

The time of travel in steps *k* and *l* above should not vary more than 5 percent. If the downward travel is faster than the upward travel, return the antenna to 90 degrees and tighten counterbalance springs by turning adjusting plates clockwise. If the downward travel is slower than the upward travel, turn the adjusting plates counterclockwise.

3–71. Removal and Replacement of Elevation Angle Indicator Assembly

a. General. The elevation angle indicator assembly is mounted in the elevation unit (TM 11-6660-206-12). It is not necessary to remove the elevation unit assembly from the housing to remove the elevation angle indicator assembly.

b. Removal of Elevation Angle Indicator.

(1) Remove the back cover of the elevation unit (TM 11-6660-206-12) by removing the 26 bolts that hold the cover on.

(2) Remove the upper (nearer the stow lock assembly) counterbalance spring (para 3-69).

(3 Loosen the driving clutch setscrews (fig. 5-15 ②) and slide the driving clutch back on the shaft away from the elevation angle indicator assembly approximately 3 inches.

(4) Remove the four screws that secure the elevation angle indicator assembly mounting plate to the elevation unit housing.

(5) Lift the elevation angle indicator assembly out of the elevation unit housing.

c. Replacement of Elevation Angle Indicator.

(1) Fit the elevation angle indicator (fig. 5-15 ①) into the elevation unit housing.

(2) Replace the four screws that secure the elevation indicator assembly to the elevation unit housing. Do not tighten the screws at this time.

(3) Slide the driving clutch on the shaft until it engages the elevation angle indicator assembly driven clutch.

(4) Align the driving and driven clutches and tighten the four screws replaced in (2) preceding.

(5) Check the position of the driving clutch as described in paragraph 5-28aj, and tighten the driving clutch setscrews.

(6) Replace the upper counterbalance spring assembly (para 3-69).

(7) Replace the cover on the elevation unit and secure the 26 bolts that hold the cover on.

3-72. Removal and Replacement of Elevation Drive Assembly

a. General. The elevation drive assembly (TM 11-6660-206-12) is mounted on a frame secured to its mounting flange in the elevation unit by 10 screws. The elevation drive assembly consists of the elevation synchro transmitter, elevation drive motor, elevation anti hunt generator, and the elevation drive gearing. The elevation unit must be removed (TM 11-6660-206-12) before removing the elevation drive assembly.

b. Removal of Elevation Drive Assembly.

(1) Remove the elevation unit assembly from the housing (TM 11-6660-206-12).

(2) Remove the back cover of the elevation unit (TM 11-6660-206-12) by removing the 26 bolts that hold the cover on.

(3) Remove the two counterbalance spring assemblies (para 3-69).

(4) Loosen the driving clutch gear setscrews (fig. 5-15, ②) and slide the driving clutch back on the shaft away from the elevation angle indicator assembly approximately 3 inches.

(5) Disconnect and tag all leads of the elevation unit harness that are fastened to terminal board TB201 (fig. 3-41).

(6) Remove the 10 screws (37, fig. 5-15, sheet 2) and washers (38) that secure the frame of the elevation drive assembly to the elevation unit housing.

(7) Lift the elevation drive assembly out of the elevation unit, and remove the two dowel pins (39) from the elevation drive assembly frame.

c. Replacement of Elevation Drive Assembly.

(1) Fit the elevation drive assembly (fig. 5-15 ②) frame to the elevation housing; be sure to align the holes for dowel pins (39).

(2) Mesh the output pinion (35) on the shaft with the trunnion gear segment (30).

(3) Replace the washers (38) and tighten the 10 screws (37) that secure the elevation drive assembly frame to the elevation unit housing.

(4) Slide the driving clutch along the shaft until it engages the driven clutch of the elevation angle indicator and then tighten the driving clutch setscrew. (Refer to para 5-28aj, for proper placement of the driving clutch.)

(5) Replace all leads of the elevation unit harness removed in *b(5)* above to terminal board TB201.

(6) Replace the two dowel pins (39) that secure the elevation drive assembly frame to the elevation unit.

(7) Replace the counterbalance spring assemblies (para 3-69).

(8) Replace the cover on the elevation unit and secure the 26 bolts that hold the cover on.

(9) Replace the elevation unit on the housing (TM 11-6660-206-12).

3-73. Removal and Replacement of Elevation Antihunt Generator

a. General. To remove the elevation antihunt generator, the elevation drive assembly (fig. 3-41) must be removed (para 3-72).

b. Removal of Elevation Antihunt Generator.

(1) Disconnect and tag the antihunt generator leads from terminal board (TB201).

(2) Remove the screw, lockwasher, and flat washer from the two cable clamps holding generator leads.

(3) Remove the four screws (37, fig. 5-16 ①) lockwashers (38), and flat washers (36) that secure the antihunt generator.

(4) Lift the antihunt generator out of the frame.

c. Replacement of Elevation Antihunt Generator.

(1) Position the elevation antihunt generator to the drive frame while meshing the generator gear (39, fig. 5-16 ①) with the pinion on the motor shaft coupling.

(2) Replace the screw, lockwasher, and flat washer along with the cable clamps holding the generator leads onto the elevation drive assembly.

(3) Replace the antihunt generator leads on terminal board TB201.

3-74. Removal and Replacement of Elevation Drive Motor

a. Removal of Elevation Drive Motor.

(1) Remove three cable clamps holding the motor leads (fig. 3-41) to the drive assembly.

(2) Disconnect and tag the four leads from the terminal board (TB201).

(3) Remove the four bolts (79, fig. 5-16 ②) and lockwashers (80) holding the elevation drive motor.

(4) Pull the motor sharply to disconnect the motor shaft coupling (82) from the drive shaft coupling (84) and insert (83).

b. Replacement of Elevation Drive Motor.

(1) Position the elevation drive motor into position by aligning motor shaft coupling (82) with drive shaft-coupling (84) and insert (83).

(2) Replace the four bolts (79) and lockwashers (80) to hold the elevation drive motor in place.

(3) Replace the four leads to the terminal board (TB201).

(4) Replace the three cable clamps after the motor leads have been installed.

3-75. Removal and Replacement of Elevation Synchro Transmitter (fig. 3-41)

a. Removal of Elevation Synchro Transmitter.

(1) Disconnect and tag the elevation synchro transmitter leads from the top of the transmitter.

(2) Remove three lugs (9, fig. 5-16 ①), lockwashers (10), and screws (11).

(3) Lift the elevation synchro transmitter out of the drive assembly.

b. Replacement of Elevation Synchro Transmitter.

(1) Position the elevation synchro transmitter into the drive assembly frame. Align the synchro gear with the drive assembly gears carefully.

(2) Replace the three lugs (9, fig. 5-16 ①), lockwashers (10), and screws (11).

(3) Replace the leads on top of the elevation synchro transmitter.

3-76. Removal and Replacement of Elevation Stow Lock Assembly

a. General. The elevation stow lock assembly houses interlock switch S201, and is located on the outside of the elevation unit housing (fig. 5-15).

b. Removal of Elevation Stow Lock Assembly.

(1) Remove the back cover of the elevation unit (TM 11-6660-206-12) by removing the 26 bolts that secure the cover.

(2) Disconnect and tag the two interlock switch leads from terminal board TB201. (It will be necessary to remove the lacing from harness.)

(3) Remove the four screws (8, fig. 5-15 ①) and lockwashers (9) that secure the elevation stow lock assembly to the elevation unit housing.

(4) Slide the elevation stow lock assembly off the two dowel pins that secure it to the elevation unit housing.

c. Replacement of Elevation Stow Lock Assembly.

(1) Replace the two leads of the interlock switch on terminal board TB201 (TM 11-6660-206-12). (Retie the harness lacing.)

(2) Fit the elevation stow lock assembly on the two dowel pins and press flush with the elevation unit housing.

(3) Replace the washers and tighten the four screws that secure the stow lock assembly to the elevation unit housing.

(4) Replace the cover on the elevation unit and secure the 26 bolts that hold the cover on.

Section XII. CONTROL-RECORDER TROUBLESHOOTING

3-77. Reference Data

Table 3-34 lists the reference data that is used when troubleshooting or repairing the control-recorder.

3-78. Controls and Adjustments

Control and adjustment or indicators on the Control-Recorder that are functional parts of the recording system and used in conjunction with troubleshooting procedures on the control-recorder are listed in table 3-35.

3-79. Dc Resistance of Transformers, Coils, and Relays

When maintenance and troubleshooting is required in the Control-Recorder and isolated to specific parts use table 3-36 which gives the normal value of resistance measurements.

Table 3-34. Reference Data, Control-Recorder

Reference	Data
Fig. 2-50	Position indicating and recording system, complete block diagram.
Fig. 2-51	Position indicating and recording system, complete block diagram. Contract E-190-69(N).
Para 2-61 through 2-75	Position indicating and recording system theory.
Fig. 2-52 through 2-70	Position indicating and recording system, simplified schematic and mechanical diagrams.
Fig. FO-4	Ac power distribution, schematic diagram (AN/GMD-lA).
Fig. FO-5	Ac power distribution, schematic diagram (AN/GMD-lB*).
Fig. FO-6	Ac power distribution, schematic diagram (AN/GMD–lB**).
Fig. FO-20	Control-recorder C-577B/GMD-l and C-577D/GMD-l wiring diagram.
Fig. FO-32	Control-recorder C-577E/GMD-l, wiring diagram.
Fig. 3-42	Elevation unit schematic diagram, Rawin Set AN/GMD-lA.
Fig. 3-43	Elevation unit schematic diagram, Rawin Set AN/GMD-lB.
Fig. 3-44	Elevation unit(AN/GMD-lA), wiring diagram.
Fig. 3-46	Elevation unit (AN/GMD-lB), wiring diagram.
Fig. 3-40	Azimuth unit schematic diagram, Pedestals AB-159A/GMD-1, AB-159B/GMD-1, and AB-159C/GMD-l.
Fig. FO-29	Azimuth unit Pedestal AB-159D/GMD-l, schematic diagram.
Fig. FO-30	Azimuth unit Pedestal AB-159E/GMD-l, schematic diagram.
Fig. FO-18	Azimuth unit wiring diagram, Pedestal AB-159A/GMD-1, AB-159B/GMD-1, and AB-159C/GMD-l.
Fig. FO-19	Azimuth unit wiring diagram, Pedestal AB-159D/GMD-l.
Fig. FO-31	Azimuth unit wiring diagram, Pedestal AB-159E/GMD-l.

Table 3-35. Controls and Adjustments, Control-Recorder

Contro1s and adjustments or indicators	*Location (fig.)*	*Function*
RECORDS CONTROL switch S818.	2-58 3-53	In FLIGHT position, control-recorder automatically prints azimuth and elevation angles and time on paper tape, in accordance with setting of PRINTING PER MINUTE selector switch. In BASELINE CHECK position, radiosonde signal is fed to meteorological recorder in normal fashion, and control-recorder function is deactivated.

Table 3-35. Controls and Adjustments, Control-Recorder - Continued

Controls and adjustments or indicators	*Location (fig.)*	*Function*
		In STANDBY position, signal input to meterological recorder is shorted, and control-recorder printings are deactivated; this position is used just prior to launching a balloon. This switch does not control chart feed in meteorological recorder.
PRINTINGS PER MINUTE selector switch S817.		In zero position, control-recorder does not print. When set to other positions, control-recorder prints as many times per minute as setting selected (once each minute in setting 1, twice each minute in setting 2, and 10 times each minute in setting 10).
AZIMUTH angle indicator	3-53	Indicates azimuth angle of antenna assembly with respect to north. Long pointer, indicates degrees; short pointer indicates hundredths of degrees.
TIME indicator	3-53	Indicates time in minutes and 10ths of minutes with respect to an arbitrary initial zero setting.
1 REV TO RESET TIME knob.	3-53	One clockwise revolution of knob sets TIME indicator and time-printing wheels to zero.
RESET CONTROL knob	3-53	When ELEVATION RESET SELECTOR lever is pushed down, rotation of knob sets ELEVATION angle indicator and elevation angle printing wheels to any desired angle. When AZIMUTH RESET SELECTOR lever is pushed down, rotation of knob sets AZIMUTH angle indicator and azimuth angle printing wheels to any desired angle.
TIME PRINT ONLY PUSH switch S809.	2-65 3-53	Pressing pushbutton causes control-recorder to print only time and asterisk on paper tape.
PAPER RELEASE lever	3-53	Lever is pushed down to permit pulling paper tape to read recent printings.
Azimuth unit angle indicator.	TM 11-6660-260-12	Indicates azimuth angle of antenna assembly with respect to north. Long pointer indicates degrees; short pointer indicates hundredths of degree.

Table 3-35. Controls and Adjustments, Control-Recorder Continued

Controls and adjustments or indicators	*Location (fig.)*	*Function*
Azimuth angle setting adjustment.		Screwdriver adjustment to Set azimuth angle indicator.
Elevation unitangle indicator.		Indicates elevation angle of antenna assembly with respect to zero level. Long pointer indicates degrees; short pointer indicates hundredths of degree.
Elevation indicator adjustment screw.		Screwdriver adjustment to rotate elevation angle indicator.
ELEVATION angle indicator.	3-53	Indicates elevation angle of antema assembly with respect to zero level. Long pointer indicates degrees; short pointer indicates hundredths of degrees.
ELEVATION RESET SELECTOR lever S808.	3-53	When lever is pushed down, RESET CONTROL knob is connected through gears to ELEVATION angle indicator and to elevation angle printing wheels.
AZIMUTH RESET SELECTOR lever S807.	3-53	When lever is pushed down, RESET CONTROL knob is connected through gears to AZIMUTH angle indicator and h azimuth angle printing wheels.
ELEVATION lamp, green 1805.	3-53	Lamp lights after ELEVATION angle indicator has been set to desired angle and ELEVATION RESET SELECTOR lever is released. Lamp goes out if power supply is interrupted, and does not light until ELEVATION angle indicator is re. set and power is restored.
AZIMUTH lamp, green 1804	3-53	Lamp lights after AZIMUTH angle indicator has been set to desired angle and AZIMUTH RESET SELECTOR lever is released. Lamp goes out if power supply is interrupted, and doea not light until AZIMUTH angle indicator is reset and power is restored.

Table 3-36. Dc Resistance of Transformers, Coils and Relays, Control-Recorder

Transformers Coils, or relays	*Location (fig.)*	*Terminals*	*Dc resistance (ohms)*
T804	3-53	1-2	Less than l
		3-4	Less than l
		5-6	Lees than l

Table 3-36. Dc Resistance *of Transformer, Coi18 and Relaw Control-Recorder-Continued*

Tranformers Coils, or relays	*Location (fig.)*	*Terminals*	*Dc resistance (ohms)*
K801 , K802, K803, K804, or K805	3-49	1-8.	420
L801, L802, L803, L804, and L805	3-59		9
B801 and B802.	3-51	S1-S2	20
		S2-S3	20
		S1-S3	20
		R1-R2	12

3-80. Test Equipment Required

When the control-recorder requires maintenance and troubleshooting, use the test equipment listed iri table 3-37.

3-81. Test Setup

When troubleshooting the control-recorder on a bench setup, make connections to the rawin system as shown in fig. 3-48. Use Multimeter ME-26 to check electronic components as outlined in the Symptom Chart 3-38.

3-82. Symptom Troubleshooting

a. General. Trouble that has been sectionalized to the control-recorder can usually be isolated more rapidly by following a procedure based on symptoms that localize the trouble to a channel, circuit, or stage. The symptoms that are given consist of indications obtained by blown fuses, indicator lamps, defective printing or no printing of angle and time data, disagreement of indicated and recorded angles, and disagreement between the angle indicators located on the control-recorder and the other angle irdcators in the rawin set. To troubleshoot the control-recorder based on symptoms, proceed as follows:

(1) Observe indicator lamps 1802,1803,1805, and 1804, printing on tape, and the angle indicators.

(2) Compare the indications obtained with those listed in each of the symptoms.

(3) If the indications obtained correspond to those listed in a particular symptom, follow the procedure given in that particular subparagraph to isolate the trouble.

(4) If the trouble cannot be isolated by symptom troubleshooting, refer to the step-by-step troubleshooting (table 3-39).

WARNING

When the control recorder is removed from the case, 115 volts ac power is exposed at many terminals. Extreme caution must be maintained.

b. Symptom Troubleshooting. Refer to table 3-38.

Table 3-37. *Test Equipment Required, Control-Recorder*

Test equipment	*Common name*	*Technical manual*
Multimeter TS-352B/U	Multimeter	TM 11-6625-366-15
Test Set TS-538(*)/U[a]	Test set	TM 11-6625-213-12

[a]Test equipment supplied with rawin set.

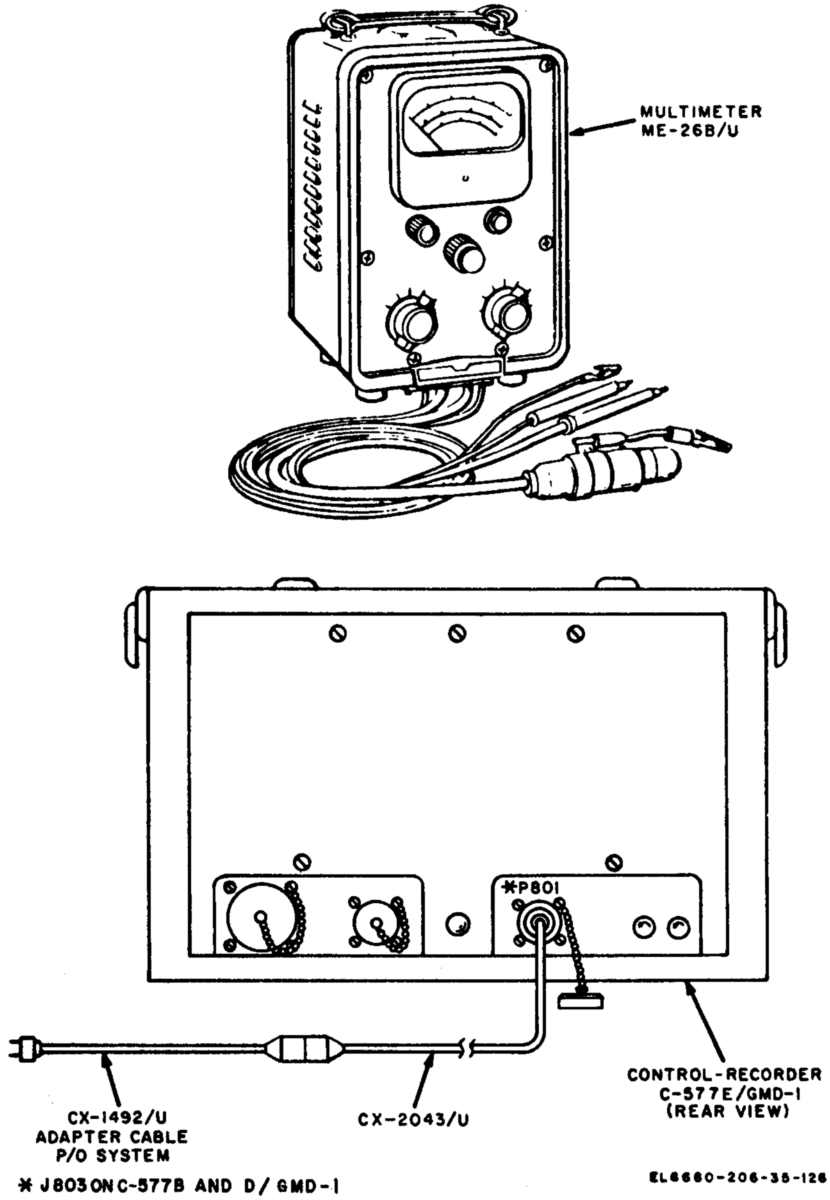


Figure 3-48. Control-recorder test setup.

Table 3-38. Symptom Troubleshooting, Control-Recorder

Symptom	*Probable cause*	*Corrective measure*
1. Position indicating and recording system is completely inoperative.	MAIN POWER switch S806 defective.	Check switch S806 (fig. 3-53) and replace if necessary.
	RECORDER FUSES F803 or F804 blown.	Check RECORDER FUSES F803 and F804 (fig. 3-53) and replace if necessary. If new fuses burn out, troubleshoot control-recorder ac power circuit before replacing fuses.

Table 3-38. Symptom Troubleshooting, Control-Recorder-Continued

Symptom	*Probable cause*	*Corrective measure*
2. Position indicating and recording system is completely inoperative. MAIN FUSE indicator 1802 or 1803 is lighted.	MAIN FUSES F801 or F802 blown.	Check fuses F801 and F802 (fig. 3-49) and replace if necessary. If new fusea burn out, troubleshoot ac power circuits of rawin set.
3. ELEVATION RESET SELECTOR lever depressed, and ELEVATION indicator lamp 1805 does not light.	Lamp 1805 burned out	Check lamp 1805 (fig. 3-53) and replace if necessary.
	Switib S808 defective	Check switch S808 (fig. 3-53) and replace if necessary.
	Relay K802 defective	Check relay K802 (fig. 3-49) and repair or-replace if necessary.
4. AZIMUTH RESET SELECTOR depressed, and AZIMUTH indicator lamp 1804 does not light.	Lamp 1804 burned out	Check lamp 1804 (fig. 3-53) and replace if necessary.
	Switch S807 defective	Check switch S807 (fig. 3-53) and replace if necessary.
	Relay K801 defective	Check relay K801 (fig. 3-49) and replace if necessary.
5. No periodic printings of elevation and azimuth angle and time.	PRINTINGS PER MINUTE switch S817 defective, or one or more of cam-operated sensitive switches S812, S813, or S814 defective.	Check various printing speeds by rotating S817 (fig. 3-53). If printings occur in some other position of this switch, either switch contacts in this position are defective, or cam-operated switches S812, S813, and S814 (fig. 3-56) corresponding to this position are defective or out of adjustment.
	Print duration relay K803 defective.	Check relay K803 (fig. 3-49) and replace if necessary.
	Prhting solenoid L803 or L805 defective.	Check continuity of L803 (fig. 3-55); if defective, higher level maintenance is required.
6. Periodic printing of time but not of elevation and azimuth angles.	Relay K850 defective	Check normally closed contacts of relay K850. Replace if defective.
7. No time and asterisk print occurs when TIME PRINT ONLY PUSH switch S809 or remote time print switch S931 is depressed.	Switch S809 or switch S931 defective.	If both time and asterisk printings are obtained with one switch (TM 11-6660-206-12) and not the other, switch that causes no printing is defective. Check this switch and replace if necessary.
8. Asterisk is printed but no time is printed when TIME PRINT ONLY PUSH switch S809 or remote time-print switch S931 is depressed.	Relay K850 is defective	Check continuity of K850 coil. Replace if defective.

Table 3-38. Symptom Troubleshooting, Control-Recorder-Continued

Symptom	*Probable cause*	*Corrective measure*
9. Time is printed, but no asterisk is printed when TIME PRINT ONLY PUSH switch S809 is depressed.	Asterisk printing solenoid L602 defective.	Check continuity of solenoid L602 (fig. 3-55); if defective, higher level maintenance is required.
10. Time counter does not advance each 0.1 minute.	Time-wheel advance solenoid L601 defective.	Check continuity of solenoid L801 (fig. 3-55); if defective, higher level maintenance is required.
	Sensitive switch S810 defective.	Check S810 (fig. 3-52) for continuity; replace if defective.
11. Rawin set operates, but no angle and time indication are obtained in position indicating and recording system.	RECORDS CONTROL switch S818 defective.	Check switch S818 (fig. 3-53) and replace if necessary.
12. ELEVATION or AZIMUTH angle indkxtor on control-recorder rotates in direction opposite to that of correapondlng angle indicator on elevation or azimuth unit.	Synchro transmitters or receivers are wired incorrectly.	Higher level maintenance is required.
13. Indicated and recorded angles do not agree.	Slipping in linkage between print units and indicators.	Higher level maintenance is required.
14. Prhting hammers are actuated by solenoid plungere but do not strike ribbon, or printing action embosses tape.	Spring incorrectly adjusted	Remove control-recorder from caae. Remove access panel (fig. 3-53) and paper chute. Adjuzt spring (fig. 3-55) by turning adjusting nut clockwise or counterclockwise for best compromise between printing and embossing of paper tape.

NOTE

The following steps are performed with the control recorder installed in the rawin system.

15. Antenna cannot be positioned clockwise or counter-clockwise by means of azimuth switch S801.	Switch S801	Check switch S801 (fig. 3-53); replace if necessary.
16. Antenna cannot be positioned up or down by means of elevation switch S802.	Switch S802	Check switch S802 (fig. 3-53); replace if necessary.
17. MOTORS STANDBY lamp 1801 does not light with MOTORS STANDBY awitchee S805 or S602 in either position.	Lamp 1801 burned out	Check lamp 1801 (fig. 3-53); replace if necessary.
	Switch S805 or S602	Check switches S805 and S602; replace if defective.
		Check relays K607; replace if necessary.

3-83. Step-by-step Troubleshooting

a. General. The control-recorder step-by-step troubleshooting table consists of a series of steps designed to evaluate all phases of operation of the control-recorder. In general, use this table if the trouble cannot be isolated by symptom troubleshooting (para 3-82). To troubleshoot the control-recorder system by use of the step-by-step troubleshooting table proceed as follows:

(1) Locate the test point given in step 1.

(2) Connect the test equipment and set its controls as directed in the *Test equipment* column.

(3) Set the controls on the rawin set as directed in the *Rawin set controls* column.

(4) Compare the indications obtained on the test equipment with the indications that are given or referenced in the *Normal indications* column.

(5) If the indications obtained on the test equipment are normal, proceed either to the next step or as directed in the *Normal indications* column.

(6) If the indications obtained are abnormal, proceed as directed in the *Corrective measures* column.

b. Step-by-Step Troubleshooting. Refer to table 3-39.

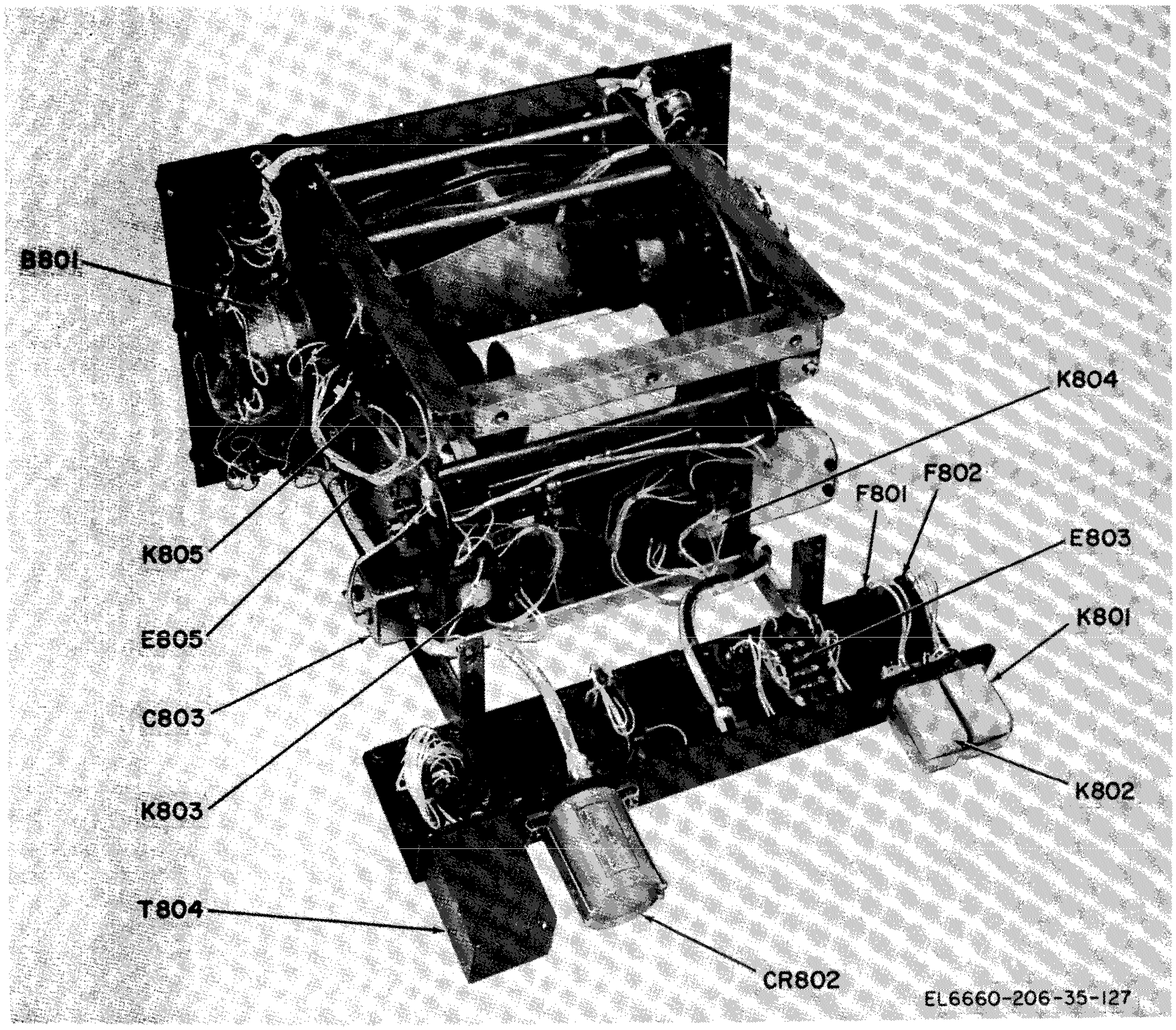


Figure 3-49. Control-recorder, internal view.

Table 3—39. Step-by-Step Troubleshooting, Control-Recorder

Step	Test point	Test equipment	Rawin set controls	Normal indications	Corrective measures
1			Normal operating procedure (TM 11—6660—206—12).		Steps 1, 6, 7, 8, 9, 10, and 11, paragraph 3—16.
2	Pins 1 to 8 of relay K802 (fig. 3—49).	Set multimeter controls to measure 115 volts ac.	ELEVATION RESET SELECTOR lever is depressed.	ELEVATION indicator lamp I805 lights. Multimeter indicates 115 volts ac.	Troubleshoot elevation reset circuit of control-recorder (fig. FO—26 and FO—27).
3	Pins 1 to 8 of relay K801 (fig. 3—49).	Same as step 2.	AZIMUTH RESET SELECTOR lever is depressed.	AZIMUTH indicator lamp I804 lights.	Troubleshoot azimuth reset circuit of control-recorder (fig. FO—26 and FO—27).
4			Depress ELEVATION RESET SELECTOR lever and rotate RESET CONTROL knob.	Simultaneous rotation of elevation angle indicator and elevation angle printing wheels.	Higher level maintenance is required.
5			Depress AZIMUTH RESET SELECTOR lever and rotate RESET CONTROL knob.	Simultaneous rotation of azimuth angle indicator and azimuth angle printing wheels.	Higher level maintenance is required.
6			Place PRINTING PER MINUTE switch S817 at 0 (fig. 3—53). Place RECORDS CONTROL switch S818 on FLIGHT.	TIME indicator will indicate increments of time, and control-recorder will not print.	Place PRINTINGS PER MINUTE switch S817 at position 10. If control-recorder prints and TIME indicator does not move, higher level maintenance is required. If control-recorder does not print and time indicator does not move, troubleshoot print-cycle motor B804 and power supply (fig. FO—26 and FO—27).
7	Across coil of K803 (fig. 3—49).	Set multimeter controls to measure 115 volts ac.	Test various printing speeds by rotating S817 (fig. 3—53).	Time indicator moves and control-recorder periodically prints elevation and azimuth angle and time. Multimeter indicates 115 volts ac.	If no printing occurs, check continuity of relay K803 and relay K850 (fig. FO—26 and FO—27) and replace if necessary.

Table 3-39. Step-by-Step Troubleshooting, Control-Recorder—Continued

Step	*Test point*	*Test equipment*	*Rawin set controls*	*Normal indications*	*Corrective measures*
					If printing occurs in some portions of S817 (fig. 3—53) and not in other positions, check contacts of the switch and switches S812, S813, and S814 (fig. FO—26) and FO—27).
					If elevation angle does not print, check continuity of L803 (fig. FO—26 and FO—27) if defective, higher level maintenance is required.
					If azimuth angle does not print, check continuity of L805 (fig. FO—26 and FO—27); if defective, higher level maintenance is required.
			Depress TIME PRINT ONLY switch S809 (fig. 3—53).	Time and asterisk print.	If time is printed but no asterisk is printed, check continuity of L802 (fig. FO—26 and FO—27); if defective, higher level maintenance is required.
					If neither time nor asterisk is printed, check continuity of L804 (fig. FO—26 and FO—27); if defective higher level maintenance is required.
					If asterisk is printed but no time is printed, check continuity of K850 coil and normally open contacts (fig. FO—26 and FO—27). Replace if necessary.

Table 3–39. Step-by-Step Troubleshooting, Control-Recorder—Continued

Step	Test point	Test equipment	Rawin set controls	Normal indications	Corrective measures
9			Place PRINTING PER MINUTE switch S817 (Fig. 3–53) at 10.	Elevation and azimuth and time is printed 10 times a minute, and time counter advances every 0.1 minute.	If elevation or azimuth angle does not print, refer to step 7 above. If time does not print, refer to step 8 above. If time indicator does not move, check continuity of L801 (fig. FO–26 and FO–27) and contacts of S819.
10			Move rawin set antenna in azimuth and elevation by depressing S801 and S802 (fig. 3–53).	Elevation and azimuth angle indicators rotate, and printed elevation and azimuth angles agree with indicated angles.	If indicated and recorded angles in elevation and azimuth do not agree, higher level maintenance is required.

Section XIII. CONTROL-RECORDER REPAIR

3-84. General

a. The control-recorder consists of 10 major assemblies, 3 printing units, and a ribbon shelf, all of which are shown in figure 3-50. Paragraphs 3-85 through 3-97 cover removal and replacement of the assemblies and unita, and paragraphs 5-30 through 5-42 cover the disassembly and assembly of the removed assemblies and printing units.

b. Figure 3-50, which shows the assemblies and printing units removed with each component identified by a letter. Figures 5-13 through 5-24, show the removed assemblies and printing units disassembled, parta are identified by a number assigned to the assembly in which the part is located. For example. the azimuth synchro receiver and clutch assembly is identified as B. figure 3. Parts of this assembly are identified as 3, 4, and 5, figure 5-13.

NOTE

For each exploded view, a legend is provided with an arbitrary number-letter for each item, also included is the name of the corresponding item. Where applicable, the reference symbol is indicated in parentheses after the item.

c. Before the control-recorder can be disassembled, the two paper spools and the ribbon must be removed (TM 11-6660-206-12), and the control-recorder chassis must be removed from its case. To remove the control-recorder from its case, unfasten the six thumbscrews on the front panel of the control-recorder and the four screws at the rear. Remove the control-recorder chassis by sliding it out of the case. To replace the control-recorder, slide the chassis into the case and secure the thumbscrews on the front panel and the screws at the rear of the case.

3-85. Removal and Replacement of Synchro Receiver and Clutch Assemblies

a. Gereral. The azimuth and elevation synchro receiver and clutch assemblies (B801 and B802) are identical and the procedures for removal and replacement are the same. These assemblies (A and B, fig. 3-50) are mounted on each side of the control-recorder chassis.

b. Removal.

(1) Tag and disconnect the synchro leads at the terminal board (E805 shown for the azimuth synchro on fig. 3-50).

(2) Unfasten the upper and lower mounting plates (fig. 3-50).

(3) Slowly withdraw the synchro receiver; tilt it downward at the gear end to disengage the clutch drive gear (fig. 3-51) from the printing wheel drive gear and the clutch yoke. With the clutch yoke disengaged from the lug on the thrust gear assembly, withdraw the entire assembly from the control-recorder chassis.

c. Replacement.

(1) Insert the synchro receiver into its mounting hole on the control-recorder chassis.

(2) Tilt the gear end downward until the clutch yoke (fig. 3-51) engages the lug on the thrust gear assembly. Press the synchro receiver further into the hole; slowly bring the gear end up to level until the clutch drive gear meshes with the printing wheel drive gear.

(3) Replace the synchro upper and lower mounting plates (fig. 3-50); align the mounting lugs with the slots on the synchro flange, and replace, but do not tighten the three mounting plate screws.

(4) Check the meshing of the clutch chive gear (fig. 3-51) and the printing wheel drive gear; tighten the three mounting plate screws.

(5) Replace the leads in their proper place on the terminal board (E808 shown for the azimuth synchro receiver and clutch assembly (B, fig. 3-50).

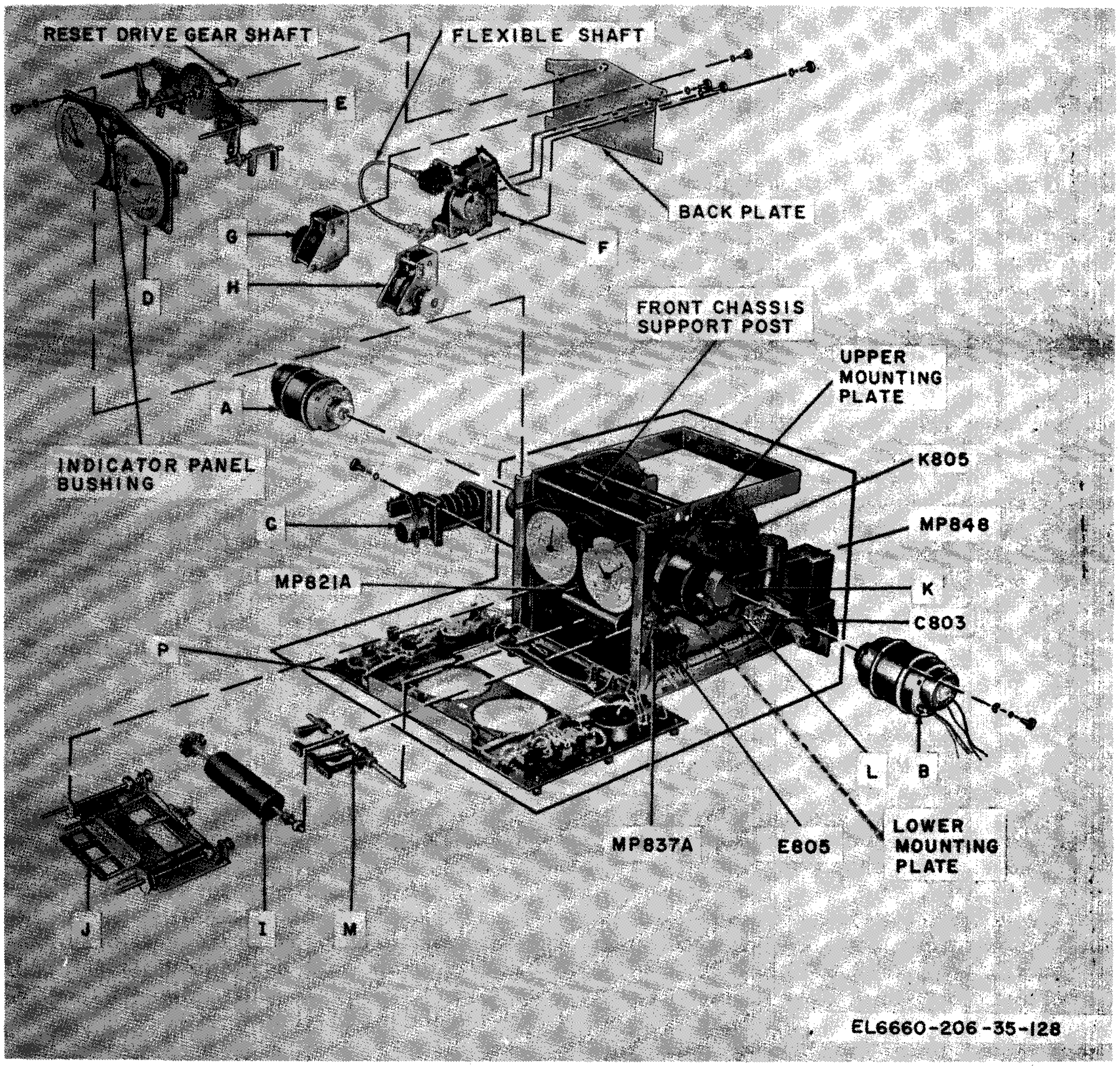


Figure 3-50. Control-recorder, mojor assemblies, exploded view.

A	Elevation synchro receiver and clutch assembly
B	Azimuth synchro receiver and clutch assembly
C	Print-cycle motor and minute cam assembly
D	Indicator panel assembly
E	Reset assembly
F	Time-print umt
G	Elevation print unit
H	Azimuth rint unit
I	Paper feed roller assembly
J	Ribbon shelf
K	Upper drive shaft assembly
L	Lower drive shaft assembly
M	Hammer shaft assembly
P	Control anel assembly
E805	Terminal board

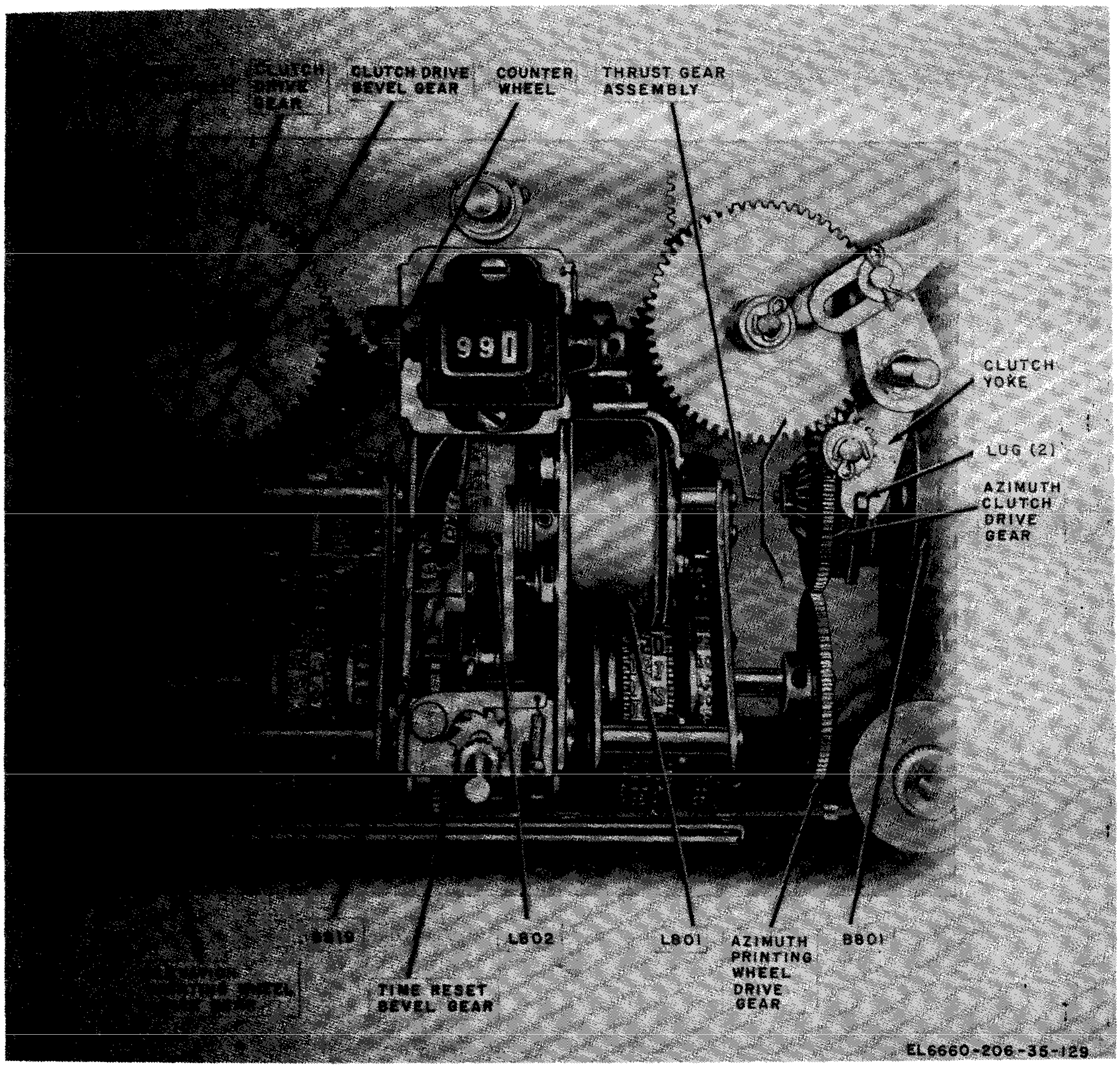


Figure 3-51. Control-recorder, front view, printing section.

3-86. Removal and Replacement of Print-Cycle Motor and Minute Cam Assembly

a. General. The print-cycle motor and minute cam assembly (C, fig. 3-50) is mounted on the left side of the control-recorder chassis.

b. Removal.

(1) Tag and remove the seven wires attached to microswitches S810 through S814 on the minute cam assembly (fig. 5-18).

(2) Tag and remove the two print-cycle motor leads attached to the top terminals of minute cam assembly terminal board E801.

(3) Remove the four screws that secure the sideplates of the assembly to the control-recorder chassis, and lift the assembly away.

c. Replacement.

(1) Fit the sideplates of the assembly to the control-recorder chassis.

(2) Replace and tighten the four screws that secure the sideplates to the control-recorder chassis.

(3) Reconnect the two print-cycle motor leads to terminal board E801 (fig. 5-18).

(4) Reconnect the seven wires removed from the microswitches (b(l) above.

3-87. Partial Disassembly of Front Panel

a. General. The control panel assembly (P, fig. 3-50) consists of the control panel on which are mounted the front panel controls, switches, lamp indicators, and meter. The control panel assembly is secured to the front of the control-recorder chassis.

b. Removal.

(1) Loosen the setscrews on the RESET CONTROL and time reset knobs and remove the knobs.

(2) Remove the six screws that hold the panel (four of which also hold the bumpers).

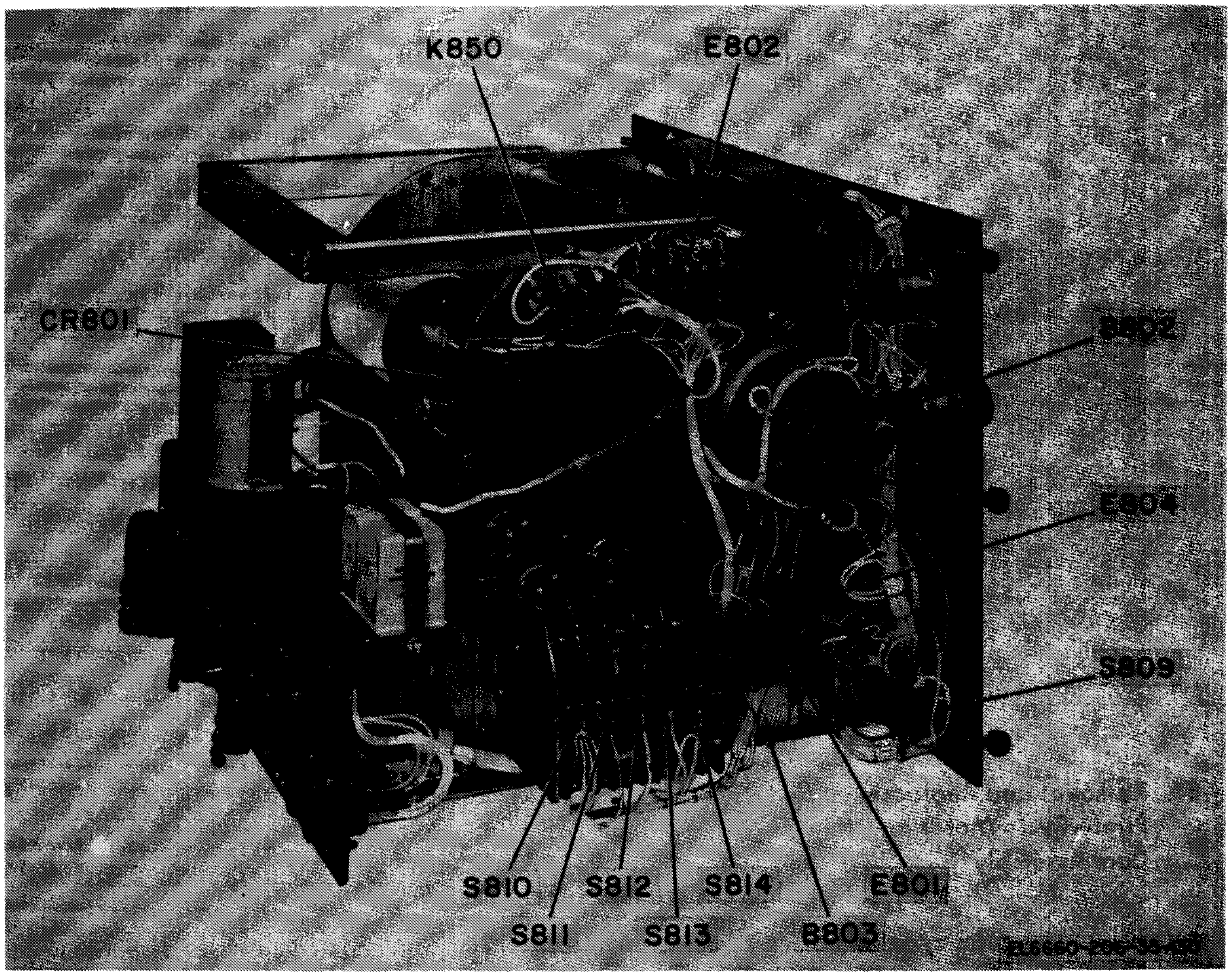


Figure 3-52. Control-recorder C–577E/GMD-1, left side view.

(3) Move the control panel away from the chassis; be careful not to put too much strain on the wiring.

c. Replacement.

(1) Lift the control panel assembly (P, fig. 3-50) and place it against the front of the control-recorder chassis so that the mounting holes are aligned.

(2) Replace and secure the six screws (including the four bumpers) that were removed b(2) above.

(3) Replace the RESET CONTROL and time reset knobs; tighten the setscrews that hold the knobs in place.

3-88. Removal and Replacement of Indicator Panel Assembly

a. General. The indicator panel assembly (D, fig. 3-50) is mounted behind the control panel assembly. It contains the azimuth and elevation angle indicators.

b. Removal.

(1) Remove the control panel assembly (para 3-87 *b)*.

(2) Remove the four screws that secure the indicator panel assembly to the control-recorder chassis.

(3) Remove the flexible shaft (fig. 3-50) by loosening the two setscrews on each end of the flexible shaft.

(4) Press the time reset shaft (fig. 3-53) slightly to the left to disengage the time reset bevel gear (fig. 3-51) from the shaft guide.

(5) Slide the indicator panel assembly away from the chassis off the angle indicator reset shaft (fig. 3-53).

c. Replacement.

(1) Fit the bushing at the top center of the indicator panel (fig. 3-53) to the angle indicator reset shaft and slide the panel along the shaft until the clutch lever shaft bushings on the panel are flush with the ends of the clutch lever shafts (fig. 3-51).

(2) Press the time reset shaft (fig. 3-53) to the left to allow the shaft guide to clear the time reset bevel gear (fig. 3-51), and slide the panel back until it is flush with the mounting lugs on the chassis.

(3) Check the meshing of the reset pinions (fig. 3-51) on the reset assembly with the center shaft reset pinion (17, fig. 5-20) on the indicator panel assembly.

(4) Replace and tighten the four mounting screws (fig. 3-53) that secure the indicator panel assembly to the chassis.

(5) Attach the flexible shaft (fig. 3-50) to the counter wheel (fig. 3-51) and tighten the two setscrews.

(6) Mesh the flexible shaft drive bevel gear with the time reset bevel gear (fig. 3-51), and replace and tighten the two screws that secure the bevel gear bracket to the front tie bracket (29, fig. 5-23 ②).

3-89. Removal and Replacement of Reset Assembly

a. General. The reset assembly (E, fig. 3-50) consists of a walking beam (18, fig. 5-22) on which are mounted the angle indicator reset gearing (2, 7, and 8) and the elevation and azimuth synchro receiver clutch yokes (15). The reset assembly is on the front of the control-recorder chassis, behind the indicator panel assembly (D, fig. 3-50).

b. Removal.

(1) Remove the control psnel assembly (para 3-87 *b)*.

(2) Remove the indicator panel assembly (para 3-88 *b)*.

(3) Remove the cotter pin (12, fig. 5-22) and washer (3) from the two studs on the bearing brackets (11) and slide the clutch release link (4) off the walking beam selector posts (20).

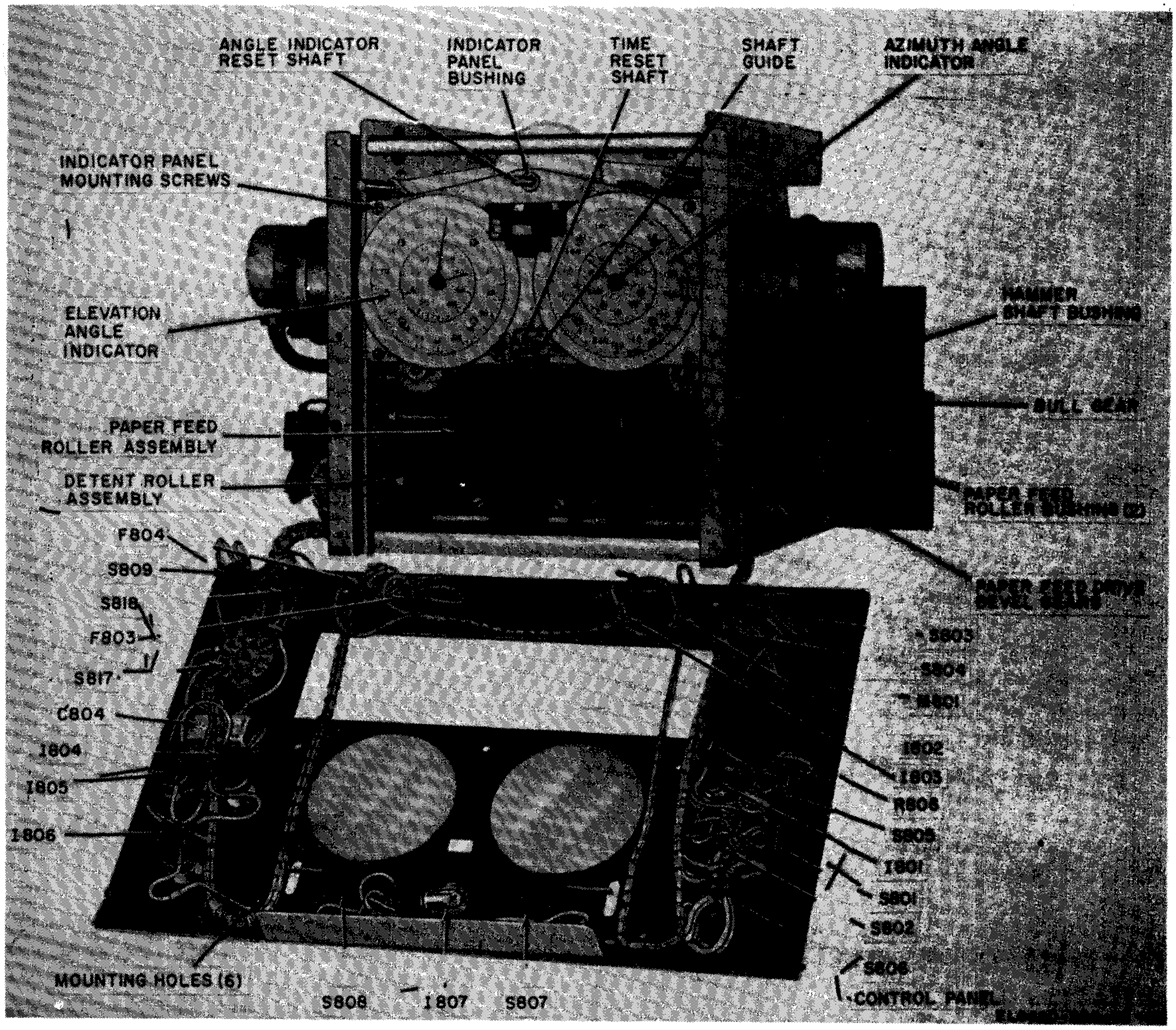


Figure 3-53 ① . Control-recorder, control panel detached (sheet 1 of 2).

(4) Remove the two screws that secure the front chassis support post (fig. 3-50) and remove the post from the control-recorder chassis.

(5) Lift the reset assembly (E, fig. 3-50) away from the control-recorder chassis.

(6) Remove the clutch yokes (15, fig. 5-22) and clutch yoke shafts (14) from the bushings on the backplate (fig. 3-50).

c. Replacement.

(1) Replace the clutch yoke shafts (14), fig. 5-22), with the clutch yokes (15) attached, into the bushings on the backplate.

(2) Fit the reset drive gear shaft (9) to the bushing on the backplate.

(3) Align the clutch release links (4) with the studs on the bearing brackets (11).

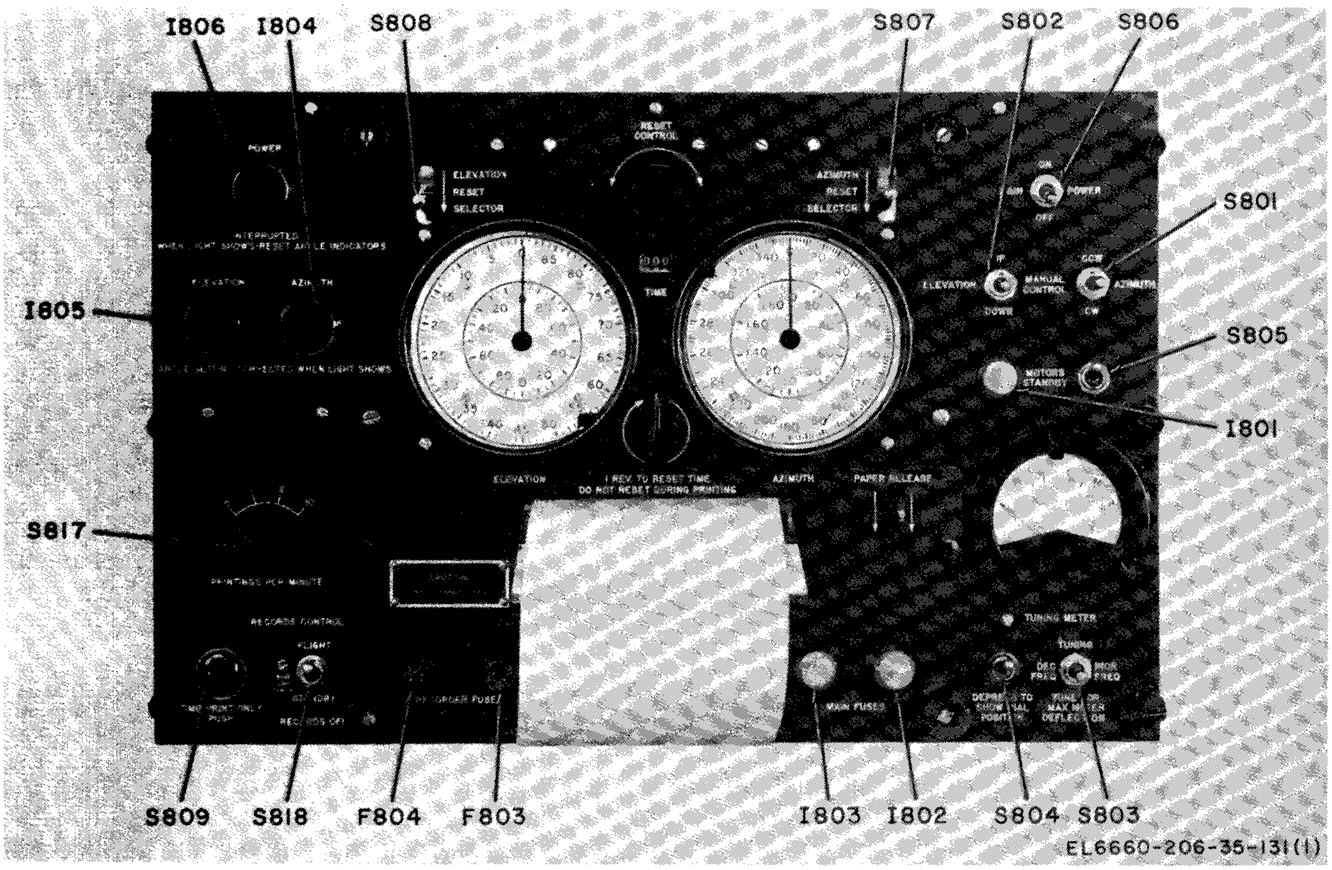


Figure 3-53 ② . Control-recorder, front view (sheet 2 of 2).

(4) Replace the washers (3) and cotter pins (12) on the studs on the bearing brackets (11).

(5) Fit the front chassis support post (fig. 3-50) to the chassis, and replace and tighten the two screws that secure the post.

(6) Replace the indicator panel assembly (para 3-88c).

(7) The stop collars (1, 16, and 17, fig. 5-22) on the reset assembly now may be aligned by the procedure described in *(a)* through (g) below:

(a) Check the meshing of the clutch drive bevel gears (fig. 3-51) with the center shaft drive bevel gears (21, fig. 5-20).

(b) Check the meshing of reset pinions (7, fig. 5-22) with the center shaft reset pinions (17, fig. 5-20) on the indicator panel assembly.

(c) Check the meshing of the reset drive gear (2, fig. 5-22) on the walking beam (18) with the intermediate reset gears (8).

(d) Slide the indicator panel stop collar (1) against the bushing on the indicator panel.

(e) Slide the backplate stop collar (16) against the bushing on the backplate.

(f) Slide the walking beam stop collar (17) against the bushing on the walking beam (18).

(g) Allow for free running of all gears, and retighten the setscrews on the stop collars (1, 16, and 17) and the reset drive gear (2).

(8) Replace the control panel assembly (para 3-87c).

3-90. Removal and Replacement of Time-Print Unit

a. General. The time-print unit (F, fig. 3-50), is mounted on the backplate of the control-recorder directly behind the indicator panel assembly (D).

b. Removal.

(1) Remove the control panel assembly (para 3-87b).

(2) Remove the indicator panel assembly (para 3-88b).

(3) Tag and remove the leads of the asterisk solenoid (66, fig. 5-23 ③) leads, the time reset switch leads, and the time-advance solenoid leads horn terminal board E802 (fig. 3-52).

(4) Remove the four screws at the rear of the backplate (fig. 3-50) that secure the time-print unit to the backplate.

(5) Remove the cable clamp that holds the leads that were removed ((3) above) from the time-print unit.

(6) Lift the time-print unit away from the backplate.

c. Replacement.

(1) Fit the time-print unit to the backplate (fig. 3-50), and replace and tighten the four screws that secure the unit to the backplate.

(2) Reconnect the asterisk solenoid leads and the time setting solenoid leads in the proper location on terminal board E802 (fig. 3-52), and replace the cable clamp (removed during procedure given in b(5) above).

(3) Replace the indicator panel assembly (para 3-88c).

(4) Replace the control panel assembly (para 3-87c).

3-91. Removal and Replacement of Azimuth Print Unit

a. General. The azimuth print unit (H, fig. 3-50) *is* mounted on the backplate, to the right of the time-print unit (F, fig. 3-50).

b. Removal.

(1) Remove the control panel assembly (para 3-87b).

(2) Remove the indicator panel assembly (para 3-88c).

(3) Remove the time-print unit (para 3-90b).

(4) Remove the two screws that secure the azimuth print unit frame to the backplate (fig. 3-50).

(5) Remove the azimuth print unit from the backplate.

c. Replacement.

(1) Fit the azimuth print unit to the backplate (fig. 3-50); align the locating holes in the rear of the azimuth print unit frame with the dowel pins at right of center on the backplate.

(2) Check the meshing of the azimuth clutch drive gear (fig. 3-51) with the azimuth printing wheel drive gear, and press the unit firmly against the backplate.

(3) Replace and tighten the two screws that secure the azimuth print unit to the backplate; use the shorter screw at the bottom.

(4) Replace the time-print unit (para 3-90b).

(5) Replace the indicator panel assembly (para 3-88c).

(6) Replace the control panel assembly (para 3-87c).

3-92. Removal and Replacement of Elevation Print Unit

a. General. The elevation print unit (G, fig. 3-50) is mounted on the backplate, to the left of the time-print unit (F, fig. 3-50).

b. Removal.

(1) Remove the control panel assembly (para 3-87b).

(2) Remove the indicator panel assembly (para 3-88c).

(3) Remove the two screws (at the rear of the backplate) that secure the print unit frame to the backplate.

(4) Remove the elevation print unit from the backplate.

c. Replacement.

(1) Fit the elevation print unit to the backplate (fig. 3-50); align the locating holes in the rear of the print unit frame with the dowel pins at left of center on the backplate.

(2) Check the meshing of the elevation clutch drive gear (fig. 3-51) with the elevation printing wheel drive gear, and press the unit firmly against the backplate (fig. 3-50).

(3) Replace and tighten the two screws that secure the elevation print unit to the backplate. Use the shorter screw at the bottom.

(4) Replace the indicator panel assembly (para 3-88c).

(5) Replace the control panel assembly (para 3-87c).

3-93. Removal and Replacement of Paper Feed Roller Assembly

a. General. The paper feed roller assembly (I, fig. 3-50) conaiste of a rubber feed roller and shaft (2, fig. 5-26), two stop collars (1 and 4), a bevel drive gear (3), and a detent gear (5) which are mounted on the roller shaft. The shaft is supported by two bushing (fig, 3-53) mounted on the control-recorder chassis.

b. Removal.

(1) Remove the access panel (TM 11-6660-266-19) by releasing the two Dzus fasteners.

(2) Loosen the setscrews from the detens gear (5, fig. 5-26) and the left stop collar (1).

(3) Disengage the roller of the detent roller assembly (fig. 3-53) from the detent gear and move the detent gear (5, fig. 5-26) and left stop collar (1) along the shaft to the right.

(4) Remove the three screws located on the outer left side of the control-recorder chassis that secure the paper feed roller bushing (fig. 3-53).

(5) Slide the bushing off the shaft.

(6) Slide the paper feed roller assembly to the left, free of the paper feed roller bushing on the right side of the control-recorder chassis, and remove the assembly through the access panel opening.

c. Replacement.

(1) Insert the paper feed roller assembly through the access panel opening with the detent gear (5, fig. 5-26) end of the assembly toward the bft side of the control-recorder chassis.

(2) Move *the* assembly into its normal operating position (fig. 3-53) by first inserting the left end *of the roller* shaft through the hole left by the *paper* feed roller bushing *(b(4)* above), and then moving the assembly to the right into the bushing on the right side of the control-recorder chassis.

(3) Replace the paper feed roller bushing that m removed *(b(4)* above) and secure it with its three mounting screws.

(4) Position the paper feed roller assembly in each bushing and center; slide the left and right stop collars (1 and 4, fig. 5-26) against the chassis and tighten the setscrews.

(5) Engage the paper feed drive bevel gears (fig. 3-53) and tighten the setscrews that hold the bevel gear (3, fig. 5-26) on the paper feed roller shaft.

(6) Engage the detent gear (5, fig. 5-26) with the detent roller assembly (fig. 3-53) and tighten the detent gear setscrews.

(7) Replace the access panel (TM 11-6660-206-12).

3-94. Removal and Replacement of Ribbon Shelf

a. General. The ribbon shelf (J, fig. 3-50), consists of mechanical components necessary to move the ribbon after each printing is made (ribbon drive), and reverse the direction of movement (ribbon shift) when either end of the ribbon is reached. The ribbon shelf is mounted on two brackets located horizontally along the center of each side of the control-recorder chassis.

b. Removal.

(1) Remove the control panel assembly (para 3-87 *b)*.

(2) Remove the indicator panel assembly (para 3-88b).

(3) Remove the reset assembly (para 3-89b).

(4) Remove the time-print unit (para 3-90b).

(5) Remove the elevation print unit (para 3–92b).

(6) Remove the azimuth print unit (para 3-91b).

(7) Remove the four screws that secure the backplate (fig. 3-50) to its mounting brackets on each side of the control-recorder chassis.

(8) Drive the two dowel pins located at the upper comers of the backplate out toward the red of the control-recorder chassis.

(9) Remove the backplat.e from the control-recorder chassis.

(10) Remove the paper feed roller assembly (para 3-93b).

(11) Remove the four screws from the four mounting holes (fig. 5–27) at each comer of the ribbon shelf.

(12) Drive the two dowel pins down through the holes at each side of the ribbon shelf.

(13) Slide the ribbon shelf forward out of the control-recorder chassis.

c. *Replacement.*

(1) Slide the ribbon shelf into the control-recorder chassis and align the dowel pin holes (fig. 5–27) over the dowel pin holes on the ribbon shelf mounting brackets.

(2) Replace the two dowel pins that were removed (b(12) above) and tap them lightly.

(3) Replace and tighten the four screws that were removed *(b(* 11) above).

(4) Replace the paper feed roller (para 3–93c).

(5) Fit the backplate (fig. 3–50) against its mounting brackets, and repIace the two dowel pins that were removed (b(18) above).

(6) Replace and tighten the four screws that were removed *(b(7)* above).

(7) Replace the azimuth print unit (para 3–91c).

(8) Replace the elevation print unit (para 3–92c).

(9) Replace the time-print unit (para 3–90c).

(10) Replace the reset assembly (para 3–89c).

(11) Replace the indicator panel assembly (para 3-88c).

(12) Replace the control panel assembly (para 3-87c).

3-95. Removal and Replacement of Upper Drive Shaft Assembly

a. General. The upper drive shaft assembly (K, fig. 3-50) consists of a shaft (fig. 3-55) on which are mounted two bevel drive gears (2 and 5, fig. 3-54) for driving the ribbon spools, the left and right ribbon shift collars (3 and 4) for shifting the ribbon shaft, and a paper feed drive gear (6) that engages the lower drive shaft bull gear (fig. 3-53). The removal and replacement procedures are more easily performed from the rear of the control-recorder.

b. Removal.

(1) Loosen the two setscrews on the paper feed drive gear (6, fig, 3-54) located on the outer right side (as viewed from the front) of the control-recorder chassis and slide the gear off the shaft.

(2) Loosen the setscrew on the left and right bevel drive gears (2 and 5) and on the left and right ribbon shift collars (3 and 4).

(3) Drive the upper drive shaft (1) out of the bushing in the right side as viewed from the front of the control-recorder chassis. Hold the bevel gears and collars while the shaft is withdrawn from the control-recorder chassis.

c. Replacement.

(1) Insert the upper drive shaft (1, fig. 3-54) in ita bushing at the right side of the control-recorder chassis and slide the right bevel drive gear (5) and the right ribbon shift collar (4) on the shaft oriented as shown on figure 3-54.

(2) Slide the shaft farther into the chassis until its end is slightly to the left of the shift arm (fig. 5-27) and slide the left ribbon shift collar 3) and the left bevel drive gear (2) on the shaft oriented as shown on figure 3-54.

(3) Insert the shaft in the bushing in the anel at the left side of the chassis.

(4) Slide the paper feed drive gear (6) on the shaft until the edge of its collar is flush with the end of the upper drive shaft (1) and mesh it with the bull gear (fig. 3-53) on the lower drive shaft; tighten the setscrews on the paper feed drive gear (6).

(5) Align the left and right ribbon shift collars (3 and 4) with the shift arm (fig. 5-23) and tighten the setscrews. This is done by operating the shift arm, by hand, back and forth and positioning the stop collars so that the upper drive shaft moves equally, side to side, so that the paper feed drive gear (6, fig. 3-54) and the bull gear (17, fig. 3-54) on the lower drive shaft mesh at all times.

(6) Align the left and right bevel drive gears (2 and 5, fig. 3-54) with the matching ribbon feed drive gear (8, fig. 5-27) on the ribbon shelf. To do this, operate the shift arm on the ribbon shelf, by hand, and check the mesh of the gears as the shift arm is shifted from left to right.

(7) Tighten the setscrews on the left and right bevel drive gears (2 and 5).

3-96. Removal and Replacement of Drive Shaft Assembly

a. General. The lower drive shaft assembly (L, fig. 3-50) consists of the components shown in figure 3-54. This assembly is used for paper feed and ribbon drive.

b. Removal.

(1) Remove the control panel assembly (para 3-87b).

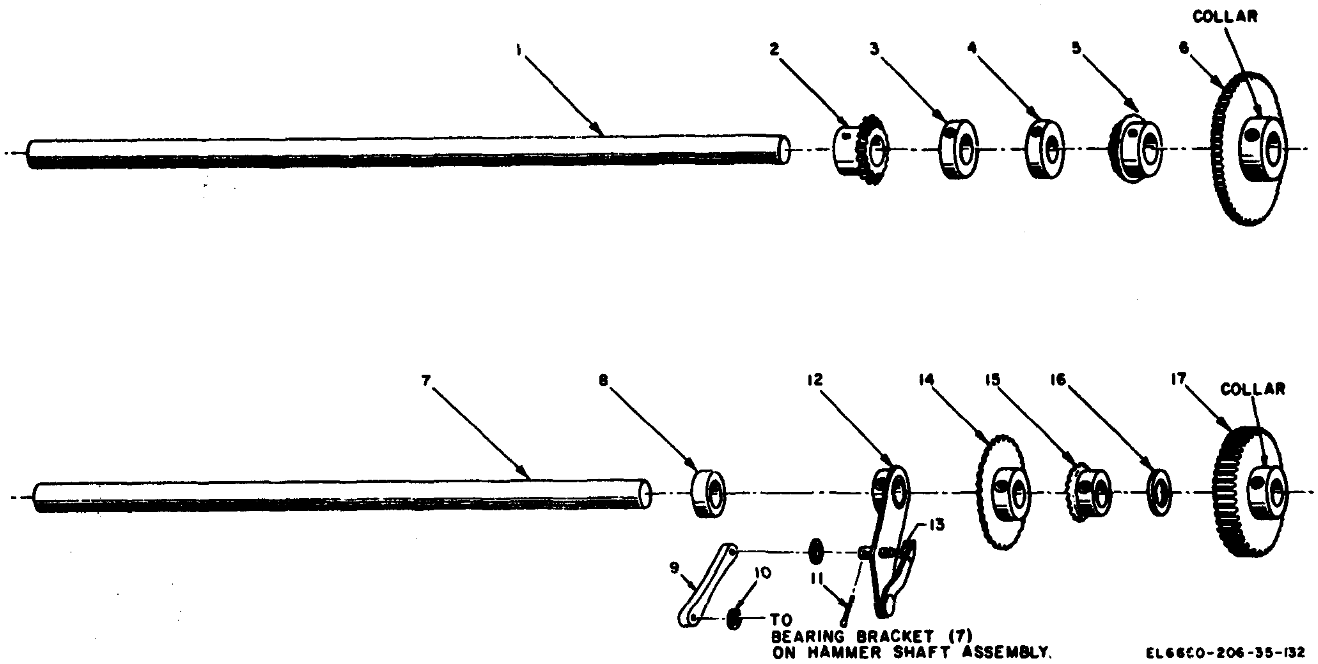
(2) Remove the indicator panel assembly (para 3–88b).

(3) Remove the reset assembly (para 3-89b).

(4) Remove the time-print unit (para 3-90b).

(5) Remove the elevation print unit (para 3-92b).

(6) Remove the azimuth print unit (para 3-91b).



1 Upper drive shaft
2 Left bevel drive gear
3 Left ribbon shift collar
4 Right ribbon shift collar
5 Right bevel drive gear
6 Paper feed drive gear
7 Lower drive shaft
8 Bearing bracket stop collar
9 Connecting link
10 Washer (No. 15)
11 Cotter pin (3/64x 1/2 inch stainless steel)
12 Bearing bracket
13 Spring (0884)
14 Ratchet wheel
15 Paper feed drive bevel gear
16 Spacer
17 Bull gear

Figure 3-54. Drive shaft assemblies, exploded view.

(7) Remove the paper feed roller assembly (para 3-93b).

(8) Remove the ribbon shelf (para 3-94b).

(9) Remove the upper drive shaft assembly (para 3-95b).

(10) Loosen the two setscrews on the bull gear (17, fig. 3-54) located on the outer right side (as viewed from the front) of the control-recorder chassis and slide the gear off the shaft.

(11) Slide the spacer (16) (location same as (10) above) off the shaft.

(12) Loosen the two setscrews on the paper feed drive bevel gear (15).

(13) Loosen the two setscrews on the ratchet wheel (14).

(14) Loosen the two setscrews on the bearing bracket stop collar (8).

(15) Remove the cotter pin (11) and washer (10) from the stud on the bearing bracket (12) and release the connecting link (9) from the stud on the beaxing bracket by moving the ratchet wheel and the bearing bracket to the right along the shaft.

(16) Withdraw the lower drive shaft (7) through the panel at the right side of the chassis. Hold the bearing bracket stop collar, beaxing bracket, ratchet wheel, and txwel gew while the shaft is being withdrawn.

c. Replacement.

(1) Insert the lower drive shaft (7, fig. 3-54) in the bushing in the panel at the right side of the control-recorder chassis and slide it through.

(2) Place the bearing bracket stop collar (8), the bearing bracket (12), the ratchet wheel (14), and the paper feed drive bevel (15) on the shaft oriented as shown on figure 3-54.

(3) Slide the shaft into the bushing in the panel at the left side of the chassis.

(4) Slide the spacer (16) and bull gear (17) on the shaft and position the bull gear so that the end of its collar is flush with the end of the lower drive shaft (7) and tighten the setscrews on the bull gear.

(5) Position the lower drive shaft (7) toward the left side of the control-recorder chassis as far as it will go; then slide the bearing bracket stop collar (8) against the bearing bracket and tighten the setscrews on the stop collar.

(6) Mesh the paper feed drive bevel gear (15) with the rear bevel gear on the paper feed intermediate shaft (fig. 3-55).

(7) Slide the bearing bracket (12, fig. 3-54) to the left while lifting the connecting link (9) into position so that it slides on to the stud on

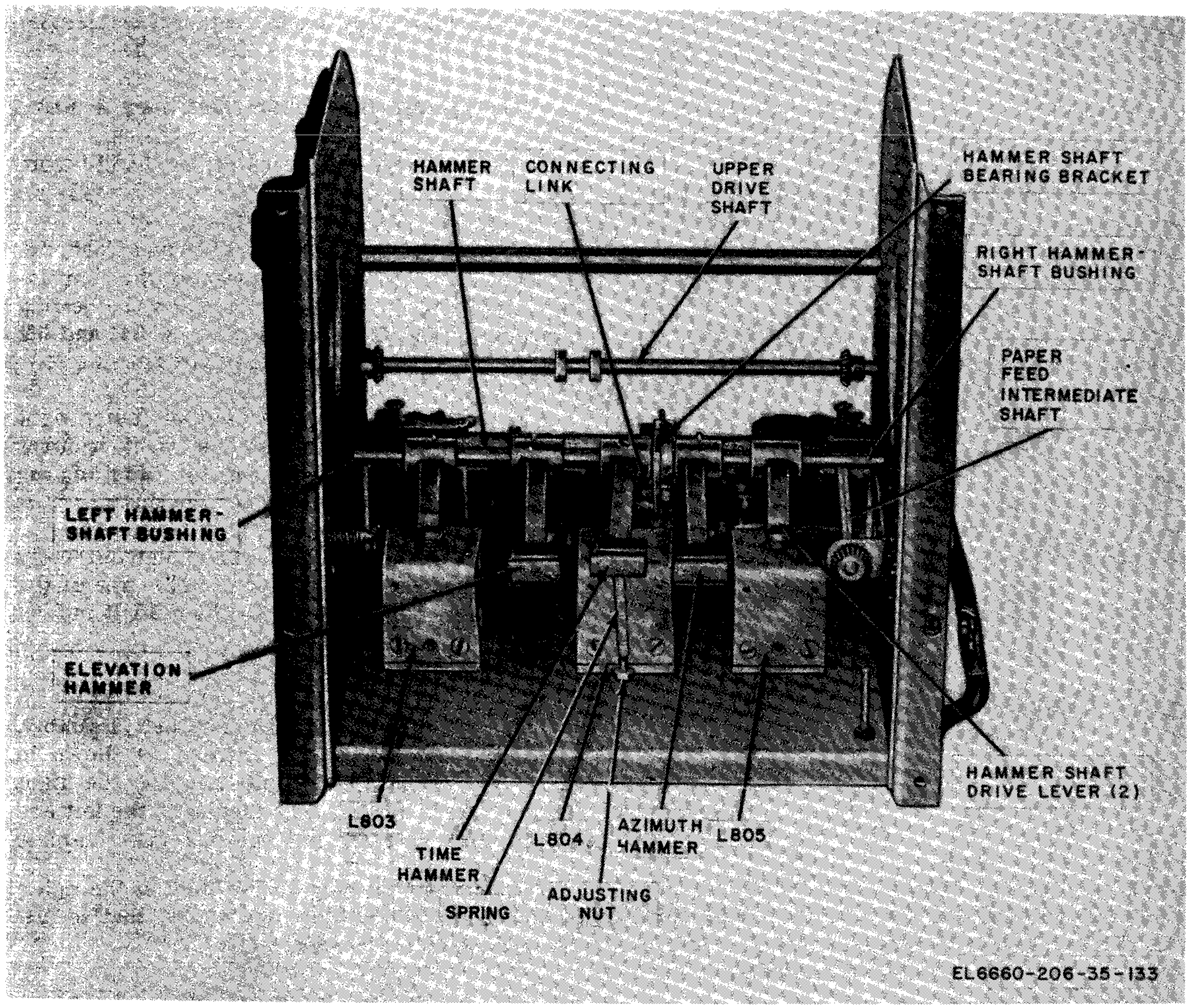


Figure 3-55. Control-recorder, front view, control panel removed.

the bearing bracket. Tighten the setscrew in the bearing bracket.

(8) Replace the washer (10) on the stud and fix the cotter pin (11) in place through the stud.

(9) Hold the pawl on the bearing bracket (12) downward and slide the ratchet wheel (14) against the bearing bracket; then release the pawl so that the spring (13) will pull the pawl against the teeth of the ratchet wheel. Tighten the setscrew on the ratchet wheel.

(10) Replace the upper drive shaft (para 3-95c).

(11) Replace the ribbon shelf (para 3-94c).

(12) Replace the paper feed roller assembly (para 3-93c).

(13) Replace the azimuth print unit (para 3-91c).

(14) Replace the elevation print unit (para 3-92c).

(15) Replace the time-print unit (para 3-90c).

(16) Replace the reset assembly (para 3-89c).

(17) Replace the indicator panel assembly (para 3-88c).

(18) Replace the control panel assembly (para 3-87c).

3-97. Removal and Replace mentof Hammer Shaft Assembly

a. General. The hammer shaft assembly consists of the hammer shaft (fig. 3-55), on which are mounted the time, elevation, and azimuth printing hammers, two hammer shaft drive levers and a bearing bracket attached to which is a connecting link for driving the Iower drive shaft (para 3-97), The hammer shaft is supported by two bushings at the sides of the chassis.

b. Removal.

(1) Remove the control panel assembly (para 3-87b).

(2) Remove the indicator mmel assembly (para 3-88b).

(3) Remove the reset assembly (para 3-89b).

(4) Remove the time-print unit (para 3-90b).

(5) Remove the elevation print unit (para 3-92b).

(6) Remove the azimuth print unit (para 3-91b).

(7) Remove the paper feed roller assembly (para 3-93b).

(8) Remove the ribbon shelf (para 3-94b).

(9) Disengage the spring (5, fig. 5-28) from the time hammer.

(10) Remove the two cotter pins (6M, fig. 5-24 and 11, fig. 3-54) that secure the connecting link (9, fig. 3-54) to the studa on the bearing brackets (7, fig. 5-24 and 12, fig. 3-54) and lift off the connecting link and washers.

(11) Remove the three screws (outer right side of chassis) that secure the right hammer shaft housing (fig. 3-55) in the side of the chassis and slide the bushing off the shaft.

(12) To remove the hammer shaft assembly from the chassis, slide it to the right, free of the left hammer shaft bushing, and then lift it out.

c. Replacement.

(1) To replace the hammer shaft assembly, insert the hammer shaft, oriented as shown in figure 3-55, into the hole left by the right hammer shaft bushing and then slide the left end of the shaft into the left hammer shaft bushing.

(2) Fit the bushing on the shaft at the right; replace and tighten the three screws that secure the bushing to the chassis.

(3) Fit the connecting link (9, fig. 3-54) on the bearing bracket (12, fig. 3-54 and 7, fig. 5-24) studs; replace the washers and cotter pins (11, fig. 3-54 and 6, fig. 5-28).

(4) Fasten the spring (5) to the time-print hammer:

(5) Replace the ribbon shelf (para 3-94c).

(6) Replace the paper feed roller assembly (para 3-93c).

(7) Replace the azimuth print unit (para 3-91c).

(8) Replace the elevation print unit (para 3-92c).

(9) Replace the time-print unit (para 3-90c).

(10) Replace the reset assembly (para 3-89c).

(11) Replace the indicator panel assembly (para 3-88c).

(12) Replace the control panel assembly (para 3-87c).

(13) Place the control-recorder in operation (TM 11-6660-206-12) (out of its case) and check the adjustment of the spring (5M, fig. 5-24). It should be tight enough to pull the hammer down sufficiently to advance the ribbon and cause the paper to feed properly. (Does not type over and types clearly.)

Section XIV. CONTROL-RECORDER ADJUSTMENT

3-98. General

This section covers the adjustment of the control-recorder when the components of the rawin set are interconnected. Both adjustment procedures outlined in paragraphs 3-100 and 3-101 are performed with power on. The complete alignment and testing of the rawin set is described in chapter 5.

3-99. Tools and Test Equipment Required

There is no test equipment required in the adjustment of the print-cycle motor governor or printing hammer spring on the control-recorder unit. A stop watch with a minimum running time of 1 hour and increments of 1/10 of a minute is required.

3-100. Adjustment of Print-Cycle Motor Governor

The TIME indicator on the front panel of the control-recorder indicates the elapsed time during a balloon flight, to the nearest 0.1 minute. The elapsed time during a flight is used to compute wind direction and velocity and to assure accurate computations. The TIME indicator must not vary more than 0.2 minute in 1 hour. The accuracy of the TIME indicator should be checked monthly and corrected, if required, in the manner outlined in procedures *a* through *h*.

a. Use a reasonably accurate watch or clock vvith a sweep second hand as a time standard,

b. Turn the 1 REV TO RESET TIME knob (TM 11-6660-206-12, fig. 1-23) to zero the TIME counter.

c. Set the RECORDS CONTROL svmtch to STANDBY.

d. Set the PRINTINGS PER MINUTE switch to zero.

e. Turn the RECORDS CONTROL switch to FLIGHT when the sweep second hand of the timing watch passes through the zero second point.

f. After 1 hour has elapsed, note the reading of the TIME indicator as the sweep second hand passes through zero. The readings of the watch and indicator should agree within 0.2 minute. If the reading is not within 0.2 minute, remove the cover from the governor of the print-cycle motor B803 (fig. 3–52).

g. If the TIME indicator reading is too high, move the lever on the front of the governor clockwise; if the reading is too low, move the lever counterclockwise.

h. Repeat the instructions given in procedures *b* through *g* above until the TIME indicator is correctly adjusted.

3-101. Adjustment of Printing Hammer Spring

a. The tension on the printing hammer spring must be adjusted correctly to ensure that the printing hammers strike the paper with the proper force.

b. To adjust the tension on the printing hammer spring, usc the procedures outlined in (1) through (5).

(1) Remove the control-recorder from the case (TM 11-6660-206-12).

(2) Remove the access panel and the paper chute.

(3) Adjust printing hammer spring (5, fig. 3-55) by turning the adjusting nut clockwise or counterclockwise for the best compromise between printing and embossing of the paper tape.

(4) Replace the paper chute and the access panel.

(5) Replace the control-recorder in the case.

CHAPTER 4

DIRECT SUPPORT TESTING PROCEDURES

Section I. ANTENNA-SCANNER ASSEMBLY

4-1. General

This section contains the testing procedures to be used by direct support maintenance personnel to determine if the antenna-scanner assembly is performing satisfactorily.

4-2. Test Equipment and Materials

a. Test Equipment.

(1) Test Set TS-538/U.

(2) Multimeter TS-352B/U.

(3) Receiver R-301(*)/GMD-l.

(4) Cable Assembly CX-1493/U.

b. Materials.

(1) Connector MS3101A28–8S (or equivalent).

(2) Cable Clamp MS3057-20A.

(3) Insulated wire AWG 16.

(4) Zero Mist Circuit Cooler-GC No. 8667 GC Electronics 72653 or equivalent.

4-3. Test Connections and Conditions

a. Fabricate test cable as shown in figure 4-1.

b. Remove bottom cover from antenna-scanner assembly.

c. Connect antenna-scanner and test equipment as shown in figure 4-1.

4-4. Initial Equipment Settings

None.

4-5. Test Procedure

Refer to table 4-1 for test procedure.

Table 4-1. Antenna Scanner Assembly

Step no.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance Standard
1	None	Controls may be in any position.	*a.* Inspect entire scanner assembly for loose or missing screws, bolts, and nuts.	*a.* Screws, bolts, and nuts will be tight; none missing.
			b. Coaxial receptacle for damaged center contact and attaching threads.	*b.* Center contact will be tight, centered and free of damage (no nicks, scratches, etc.). Attaching threads must be free of nicks, scoring and excessive wear.

Table 4-1. Antenna Scanner Assembly-Continued

Step no.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance Standard
2	TS-352 B/U Multimeter FUNCTION: OHMS SCALE : RX1	controls may be in any position. NOTE GMD-lA has no heater in scanner assembly.	*a.* Connect multimeter to terminals 36 and 37 of TB101. See fig. 4-1.	*a*. 7.5 ohms.
			b. Spray Zero Mist Circuit Cooler or equivalent on thermostat S101 and check resistance at terminals 36 and 37 of TB101. See fig. 4-1.	*b*. 6.5 ohms.
3	None	controls may be in any position.	*a.* Connect the antenna scanner assembly as shown in fig. 4-1.	a. Motor will operate freely; no evidence of binding.
	TS-352B/U Multimeter FUNCTION: AC VOLTS Voltage scale: 50V		*b.* Connect teat leads to terminals 45 and 46 of TB101. Refer to fig. 4-1, step *3b*.	*b*. Meter indicates 13 volts minimum.
			c. Connect test leads to terminals 38 and 39 of TB101. Refer to fig. 4-1, step 3c.	*c*. Meter indicates 13 volts minimum.
4	TS-538/U Test Set POWER: ON FREQUENCY METER DIAL: 1680 REPETITION RATE:200 MODULATION: ON OUTPUT POWER: 50 DBM	Receiver POWER switch: ON DIAL LIGHT: ON FREQUENCY METER: 1680	Connect coaxial cables from mixer on antenna to IF-INPUT and OSC-OUTPUT in accordance with fig. 4-1.	200 Hz pure tone with no distortion.

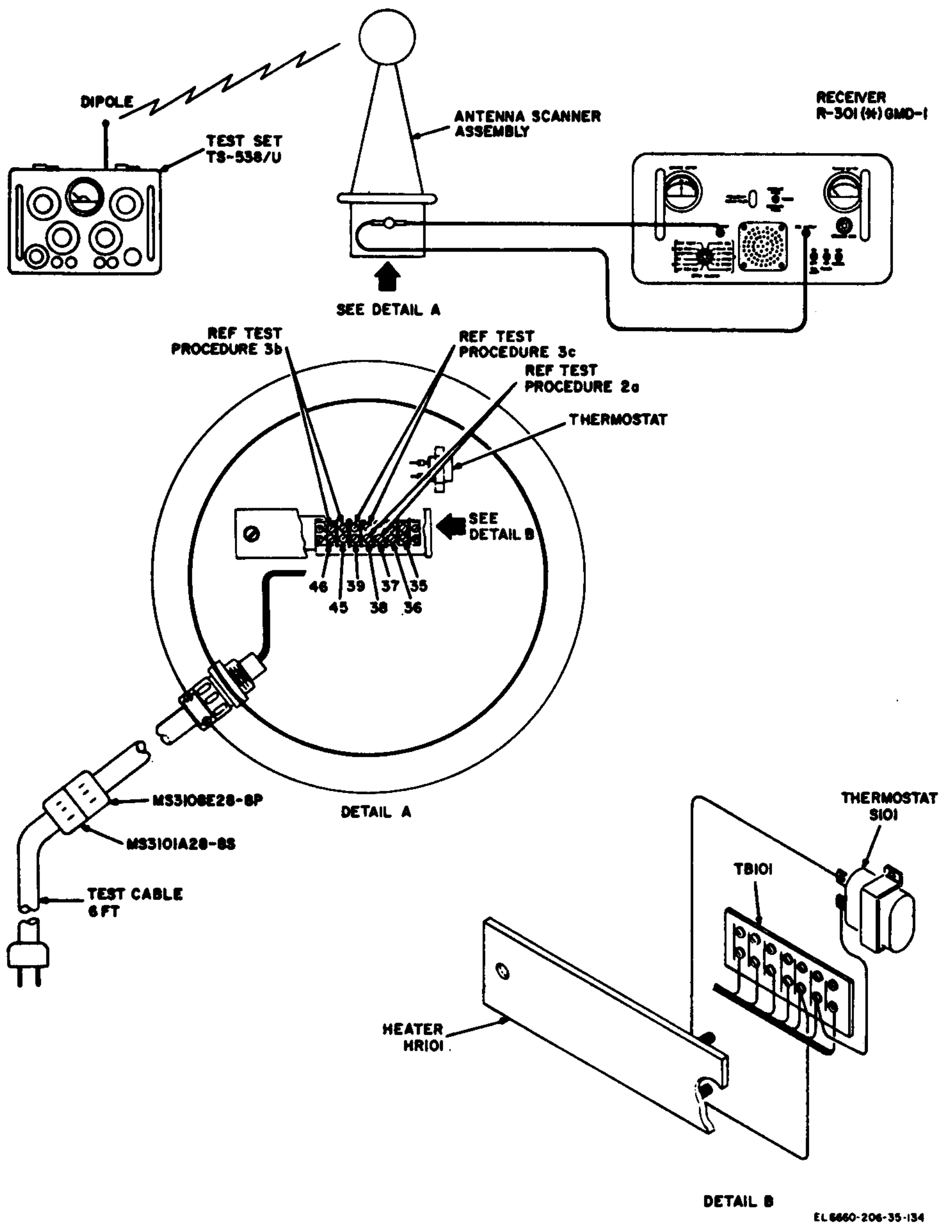


Figure 4-1. Antenna scanner, test connection diagram.

Section II. RECEIVER

4-6. General

This section covers the testing procedures to be used by direct support maintenance personnel to determine if the receiver is performing satisfactorily.

4-7. Test Equipment and Materials

a. Test Set TS-638/U.

b. Operational AN/GMD-l system.

4-8. Test Connections and Conditions

Connect the equipment as shown in figure 4-2.

4-9. Initial Equipment Settings

All power switches off.

4-10. Test Procedure

Refer to table 4-2 for test procedure.

Table 4-2. Receiver

Step no.	Control settings: *Test equipment*	Control settings: *Equipment under test*	*Test procedure*	*Performance standard*
1	None	POWER ON-OFF switch : Off	*a*. Inspect all controls and mechanical assemblies for Iome or mi8sing screws, bolte, and nuts.	*a.* Screws, bolts, and units will be tight; none missing.
			b. Inspect all connector for looeeneee, damaged or mieeing pins, and protective covem.	*b.* No looseness or damage evident. Protection covem and attaching chaina intact; none missing.
			c. Impact all toggle switches for damaged or miaaing dust and moist we boots.	*c.* Boots intact, no damage evident, none missing.
			d. Impact meters for broken glass; proper needle position.	*d.* No broken glaas; needle position proper.
2	None	POWER ON-OFF SWITCH: OFF	*a*. Turn ON-OFF DIAL LIGHT switch to ON; then to OFF.	*a.* Operates freely to both positions.
			b. Turn ON-OFF POWER switch to ON; then to OFF,	*b.* Operates freely to both positions.
			c. Turn AFC-MANUAL switch to AFC; then to MANUAL.	*c.* Operates freely to both positions.
			d. Turn INCREASE FREQ/DECREASE FREQ TUNING switch to INCREASE FREQ; then to DECREASE FREQ positions.	*d.* Operates from TUNING (center) to both positions; returns to TUNING positions.
			e. Rotate meter adector switch to each position.	*e.* Operates freely to all positions.
			f. Rotate speaker gain control clockwise and counterclockwise.	*f.* Operates freely in both directions.

Table 4-2. ReceiveHontinued

Step no.	Control settings: *Test equipment*	Control settings: *Equipment under tent*	*Test procedure*	*Performance Standard*
3	TS-538/U Test Set FREQUENCY METER: 1680 MODULATION: ON REPETITION RATE: 200 CPS OUTPUT POWER: -90 DBM	Control-Recorder MAIN POWER ON-OFF switch: ON Receiver S1001 : SHARP S1002: AM S1009 : CF AFC : MANUAL POWER : ON	*a.* Connect equipment as shown in fig. 4-2. METER SELECTOR switch to:	*a.* None. SERVICE METER:
			b. B+	*b.* 170 to 190 VDC
			c. B -	*c.* -95 to -115 VDC
			d. INJECTION	*d.* Within green block B.
			e. OSC GRID	*e.* Within green block B.
			f. SHARP FM	*f.* Within green diamond C.
			g. AC ERROR	*g.* Within green diamond C.
			h. PEAK PULSE	*h.* Within green block B.
4	TS-538/U Test set MODULATION: OFF	Operate TUNING switch for FREQUENCY MEGACYCLE setting of 1680.	Adjust TS-538/U frequency for peak indication on receiver TUNING METER.	TS-538/U frequency indication 1678 to 1682 MHZ.
5	TS-538/U Test set FREQUENCY METER: 1660 MODULATION: ON REPETITION RATE: 200 CPS OUTPUT POWER: -90 DBM		Set METER SELECTOR switch :	
			a. INJECTION	*a.* Within green block B.
			b. OSC GRID	*b.* Within green block B.
			c. SHARP FM	*c.* Within green diamond C.
			d. AC ERROR	*d.* Within green diamond C.
			e. PEAK PULSE	*e.* Within green block B.
6	TS-538/U Test set MODULATION: OFF	Operates TUNING switch for FREQ UENCY MEGACYCLE setting of 1660.	Adjust TS-538/U Test Set frequency for peak indication on receiver TUNING METER .	TS-538/U Test Set frequency indkation 1658 to 1662 MHZ.
7	TS-536/U Test Set FREQUENCY METER: 1700 MODULATION: ON REPETITION RATE: 200 CPS OUTPUT POWER : -90 DBM		Set METER SELECTOR switch:	
			a. INJECTION	*a.* Within green block B.
			b. OSC GRID	*b.* Within green block B.
			c. SHARP FM	*c.* Within green diamond C
			d. AC ERROR	*d.* Within green diamoild C.
			e. PEAK PULSE	*e.* Within green block B.

Table 4-2. Receiver-Continued

Step no.	Control setttnes *Test equipment*	*Equipment under test*	*Test procedure*	*Performance Standard*
8	TS-538/U Test Set MODULATION: OFF	Operate TUNING switch for FRE-QUENCY MEGA-CYCLE setting of 1700.	Adjust TS-538/U Test Set frequency for peak indication on Feceiver TUNING METEFL	TS-638/U Test Set frequency indication 1698 to 1702 MHZ.
9	None	POWER: ON	Turn DIAL LIGHT ON-OFF switch to ON.	Dial light is on.

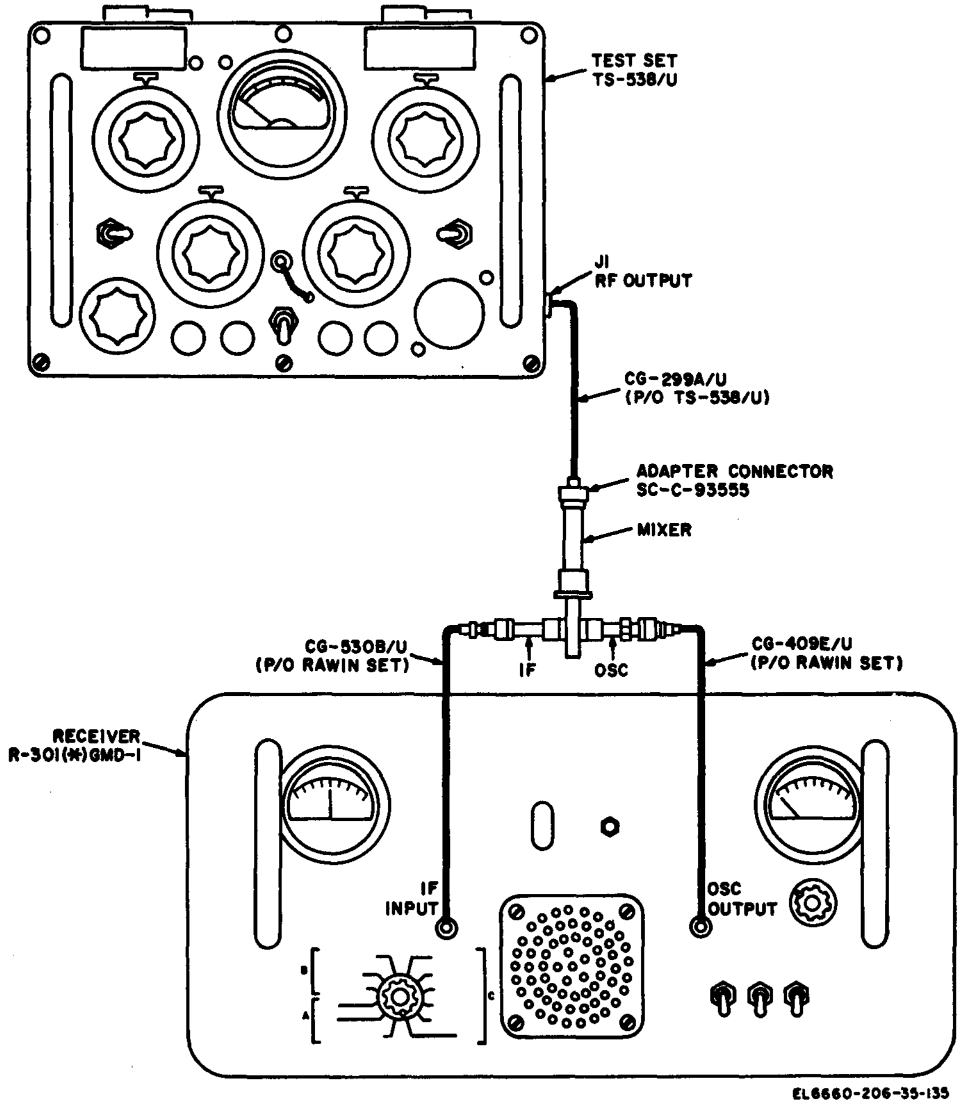


Figure 4-2. Receiver, test connection diagram.

Section III. ANTENNA CONTROL

4-11. General

This section covers the testing procedures to be used by direct support maintenance personnel to determine if the antenna control is performing satisfactorily. The antenna control operational tests are made when the control unit operates as part of the rawin system. Teat Set TS-538/U is used as a target transmitter at a predetermined distance to simulate a radiosonde transmitter.

4-12. Test Equipment and Materials

a. Test Set TS-538/U.

b. Operational AN/GMD-l system.

c. Multimeter TS-352B/U.

4-13. Test Connections and Conditions

After the visual checks have been made on the antenna control unit (steps 1 through 3, table 4-3), loosen the 16 lock type screws from the front panel and extend the antenna control unit out to the limit of its lock position. Connect Multimetm TS/352B/U (step 4, table 4-3) into the appropriate jacks (fig. 4-3).

4-14. Initial Equipment Settings

All power switches off.

4-15. Test Procedure

Refer to table 4-3 for test procedure.

Table 4-3. Antenna Control

8teP no.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	None	POWER ON-OFF switch: OFF	*a*. Inspect all controls and mechanical assemblies for louse or missing screws, bolts, and nuts.	*a.* Screws, bolts, and nuts will be tight; none missing.
			b. Inspect connector for looseness, damaged or missing pins and protective cover.	*b.* No looseness or damage evident. Protective cover and attaching chain intact.
			c. Inspect all toggle switches for damaged or missing dust and moisture boots.	*c.* Boots intact, no damage evident; none missing.
			d. Impact all control knobs for looseness or damage.	*d.* No looseness or damage evident.
2	None	POWER ON-OFF switch : OFF	*a*. Turn ON-OFF POWRR switch to ON; then OFF.	*a.* Operates freely to both positions.
			b. Turn RESET-NORMAL OVERLOAD RESET switch to RESET. See figure 4-3.	*b.* Operates to NORMAL position when released.
			c. Turn MOTORS switch to STANDBY then MOTORS position.	*c.* Operates freely to both positions.
			d. Turn ELEVATION UP-DOWN control to DOWN, then UP, then center position.	*d.* Operates freely to both positions. Detent evident at center position.

Table 4-3. Antenna Control

Step no.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance Standard
			e. Turn MANUAL-NEAR AUTO-FAR AUTO to each position.	*e.* Operates freely to each position.
			f. Turn CW-CCW AZIMUTH control CCW, then CW, then center position.	*f.* Operates freely to both positions. Detent evident at center position.
			Inspect all indicator lights for damage, looseness and proper lamp.	*g.* No looseness or damage evident; proper lamp installed.
3	None	Antenna Control Unit POWER switch : ON MOTORS STAND-BY switch: MOTORS	*a.* Operate MANUAL-NEAR AUTO-FAR AUTO control to MANUAL position.	*a.* Antenna will not move.
			b. Operate ELEVATION UP-DOWN control to the UP position.	*b.* Antenna moves upwards and increases in speed as control is operatad tiward the UP position. Antenna will stop at 90° as indicated on elevation indicator.
			c. Operate ELEVATION UP-DOWN control to the DOWN position.	*c.* Antenna moves downward and increases in speed as control is operated toward the DOWN position. Antenna will stop at aero degrees as indicatid on elevation indicator.
			d. Operate AZIMUTH CW-CCW control to the CW position.	*d.* Antenna moves clockwise and increases in speed as control is operated toward CW position. Antenna will stop when control is returned to center position.
			e. Operate AZIMUTH CW-CCW control to the CCW position.	*e.* Antenna moves counterclockwise and increases in speed as control ia turned toward CCW position. Antenna will stop when control ia returned to canter position.
		TS-538/U Test set FREQUENCY METER: 1680 MODULATION: ON REPETITION RATE: 200 OUTPUT POWER: -90 DBM POWER: ON	*f.* Operate MANUAL-NEAR AUTO-FAR AUTO control to NEAR AUTO position.	*f.* Antenna will automatically move toward the test set.
			g. Operate ELEVATION UP-DOWN control to the UP position.	*g.* Antenna will not move.
			h. Operate ELEVATION UP-DOWN control to the DOWN position.	*h.* Antenna will not move.

Table 4-3. Antenna Control-Continued

Step no.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance Standard
			i. Operate AZIMUTH CW-CCW control to CW position.	*i.* Antenna will not move.
			j. Operate AZIMUTH CW-CCW control to the CCW position.	*j.* Antenna will not move.
			k. Operate MANUAL-NEAR AUTO-FAR AUTO control to the FAR AUTO position.	*k.* Antenna reflector will move automatically toward the test set.
			l. Operate ELEVATION UP-DOWN control to the UP position.	*l.* Antenna will not move.
			m. Operate ELEVATION UP-DOWN control to the DOWN position.	*m.* Antenna will not move.
			n. Operate AZIMUTH CW-CCW control to the CW position.	*n.* Antenna will not move.
			o. Operate AZIMUTH CW-OCW control to the CCW position.	*o.* Antenna will not move.
			p. Operate MOTORS-STAND-BY switch to the STANDBY position.	*p.* MOTORS INDICATOR light will come on and antenna will not move regardless of which control is turned.
4	TS-532 B/U Multimeter FUNCTION: VOLTS SCALE: 10	Same as Step 2	*a.* Connect multimeter to ELE BAL test points. See figure 4-3.	*a.* 0 volts
	FUNCTION: MILLIAMPS SCALE: 10		*b.* Connect multimeter to ELE + and - (SENS) test points. See figure 4-3.	*b.* 2 milliamperes
	FUNCTION: VOLTS SCALE: 10		*c.* Connect multimeter to AZ BAL test points. See figure 4-3.	*c.* 0 Volts
	FUNCTION: MILLIAMPS SCALE: 10		*d.* Connect multimeter to AZ + and - (SENS) test points. See figure 4-3.	*d.* 2 milliamperes

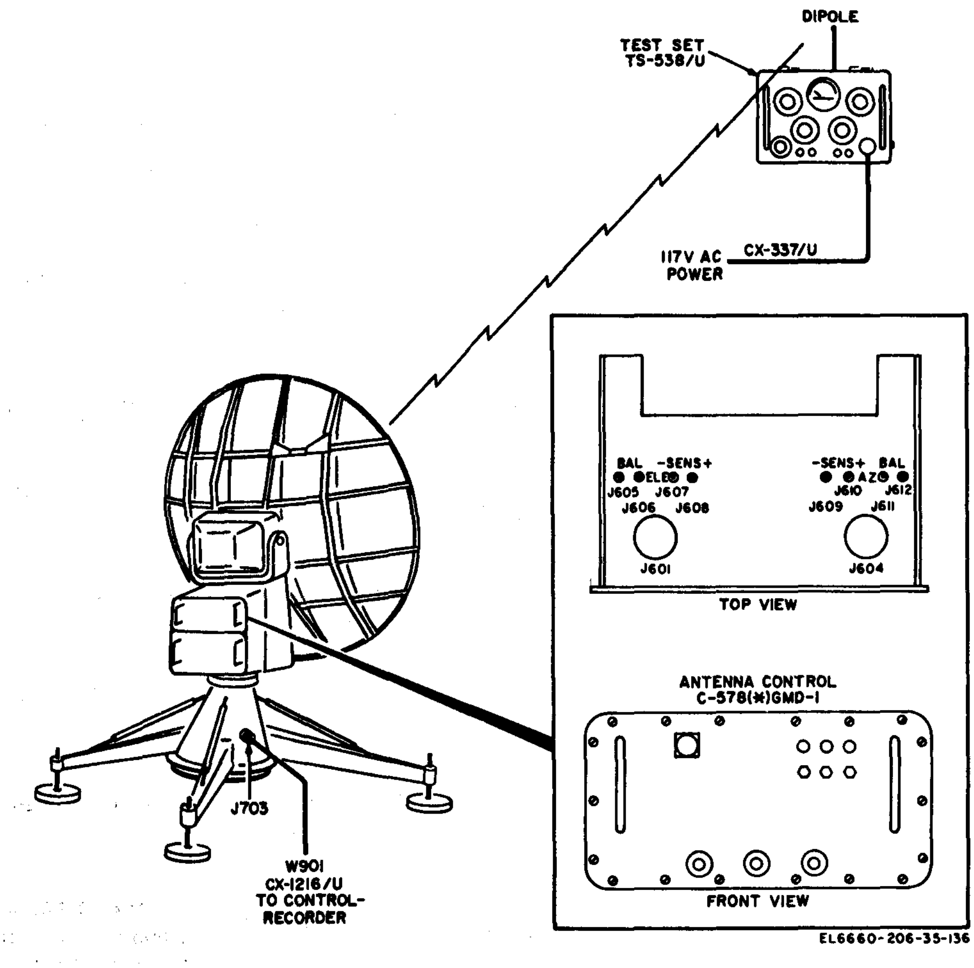


Figure 4-3. Antenna control, test connection diagram.

Section IV. HOUSING

4-16. General

This section covers the testing procedures to be used by direct support maintenance personnel to determine if the housing assembly is performing satisfactorily.

4-17. Test Equipment and Materials

a. Multimeter TS-352B/U.

b. Zero Mist Circuit Cooler–GC No. 8667 GC Electronics (72653) or equivalent.

c. Operational AN/GMD-l system.

4-18. Test Connections and Conditions

The receiver and antenna control units will be installed into the housing after the visual checks have been accomplished in order to perform the electrical checks (fig. 4-4).

4-19. Initial Equipment Settings

All power switches off.

4-20. Test Procedure

Refer to table 4-4 for test procedure.

Table 4-4. Housing

Step no.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance Standard
1	None	Control-Recorder MAIN POWER ON-OFF switch: OFF	*a.* Inspect all controls and mechanical assemblies for loose or missing screws, bolts, and nuts.	*a.* Screws, bolts, and nuts will be tight; none missing.
		NOTE Housing AN/GMD-1A does not have ELEVATION UP-DOWN switch and AZIMUTH CW-CCW switch.	*b.* Inspect all connectors for loose, damaged or missing pins. Covers and chains intact.	*b.* No looseness or damage evident. Protective covers and attaching chains intact; none missing.
			c. Inspect all interior wiring for damage or loose connections.	*c.* No damage or looseness evident.
			d. Inspect terminal board TB-302 for damage or loose connections.	*d.* No damage or loose terminals evident.
			e. Inspect fan motor for free movement.	*e.* Fan motor turns freely; no evidence of binding.
2		Control Recorder MAIN POWER ON-OFF switch: OFF	*a.* Turn ELEVATION UP-DOWN switch to DOWN, then to UP.	*a.* Operates freely to both positions; returns to center position when released.
			b. Turn ELEVATION UP-DOWN control to DOWN, then to UP, then to mid-center position.	*b.* Operates freely to both positions. Detent evident at center position.
			c. Turn AZIMUTH CW-CCW switch to CCW, then to CW.	*c.* Operates freely to both positions; returns to center position when released.
			d. Turn AZIMUTH CW-CCW control to CCW, then to CW.	*d.* Operates freely to both positions. Detent evident at center position.
			e. Inspect all toggle switches for damaged or missing dust and moisture boots.	*e.* Boots intact no damage evident; none missing.
			f. Inspect levels for damage and looseness.	*f.* No damage or looseness evident.
3	TS-352B/U Test Set FUNCTION: OHMS SCALE: RX100		*a.* Connect multimeter to pins G and F of P301 cable. See Fig. 4-4.	*a.* 0 ohms.
			b. Spray Zero Mist Circuit Cooler or equivalent on thermostat S303 and check pins G and F of P301 cable.	*b.* 365 ohms.

Table 4-4. Housing-Continued

Step no.	Test equipment	Control settings: Equipment under test	Test procedure	Performance Standard
4	None	Antenna Control Unit POWER: OVERLOAD RE-SET: NORMAL MOTORS STAND-BY: MOTORS Control-Recorder MAIN POWER ON-OFF switch : ON MANUAL-NEAR AUTO-FAR AUTO switch: MANUAL	*a.* Operate AZIMUTH CW-CCW control to the CW position.	*a.* Antenna moves clockwise and increazes in speed as control is operated toward CW position. Antenna will stop when control is returned to center position.
			b. Operate AZIMUTH CW-CCW control to the CCW position.	*b.* Antenna moves counterclock-wise and increases in speed as control is operated toward CCW position. Antenna will stop when control is returned to center position.
			c. Operate ELEVATION UP-DOWN control to the UP position.	*c.* Antenna moves upward and increaees in speed as control is operated toward the UP position. Antenna will stop at 90° as indicated on elevation indicator or when control is returned to center.
			d. Operate ELEVATION UP-DOWN control to the DOWN position.	*d.* Antenna moves downward and increazes in speed es control is operated toward DOWN position. Antenna will atop at zero degrees as indicated on the elevation indicator or when control is returned to center.
			e. Turn AZIMUTH CW-CCW switch to the CCW position.	*e.* Antenna moves counterclock-wise at one speed as long as switch is held.
			f Turn AZIMUTH CW-CCW switch to the CW position.	*f.* Antenna moves clockwiee at one speed es long as switch is held.
			g. Turn ELEVATION UP-DOWN switch to the UP position.	*g.* Antenna moves upward at one speed as long as switch ia held.
			h. Turn ELEVATION UP-DOWN switch to the DOWN position.	*h.* Antenna moves, downward at one speed as long es switch is held.
			i. Check to insure fan is operat-ing.	*i.* Fan will be operating properly.

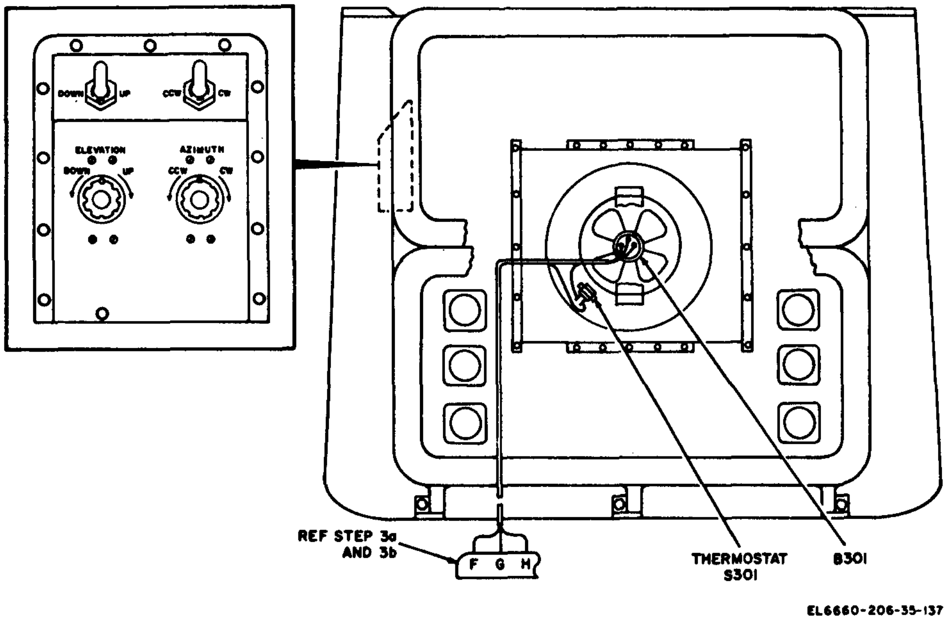


Figure 4-4. Housing, test connection diagram.

Section V. AZIMUTH UNIT

4-21. General

This section covers the testing procedures to be used by direct support personnel to determine if the azimuth unit is performing satisfactorily when operating as part of the rawin system.

4-22. Test Equipment and Materials

a. Mukimeter TS-352B/U.

b. Zero Mist Circuit Cooler-GC No. 8667 GC Electronics (72653) or equivalent.

c. Operational AN/GMD-l system.

4-23. Test Connections and Conditions

Remove all covers from the azimuth unit, which is installed in the pedestal unit, before performing the manual and electrical tests outlined in table 4-5.

4-24. Initial Equipment Settings

All power switches off.

4-25. Test Procedures

Refer to table 4-5 for test procedure.

Table 4-5. Azimuth Unit

Step no.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance Standard
1	None	Control-Recorder MAIN POWER ON-OFF switch: OFF	*a.* Inspect all mechanical assemblies for loose or missing screws, bolts, and nuts.	*a.* Screws, bolts, and nuts will be tight; none missing.
			b. Inspect all wiring for damage and loose connections.	*b.* No damage or looseness evident.

Table 4-5. Azimuth Unit-Continued

Step no.	*Control settings* *Test equipment*	*Equipment under test*	*Test procedure*	*Performance* standard
			c. Inspect azimuth angle indicator for damage.	*c.* Dial not damaged, numbers legible and hands tight.
			d. Inepect geara for broken or missing teeth.	*d.* No broken or missing teeth evident.
2	TS-362B/U Multimeter FUNCTION: OHMS SCALE: RX1	Azimuth drive assembly mounted in system for this check.	*a.* Connect multimeter to terminale 1 and 2 as shown in figure 4-5.	*a.* 85 ohms.
			b. Spray Zero Mist Circuit Cooler or equivalent on thermostat and check terrninala 1 and 2 ae shown in figure 4-5.	*b.* 10.5 ohms.
3	None	NOTE	Antenna Control Unit Controls:	
		Azimuth drive assembly mounted in pedestal for this test. Antenne Control Unit POWER: ON OVERLOAD RESET: NORMAL MOTORS STANDBY: MOTORS Control-Recorder MAIN POWER ON-OFF switch: ON Azimuth stow lock control fully counterclockwise.	*a.* Operate AZIMUTH CW-CCW control from the center position to CW position.	*a.* Antenna moves in a clockwise direction and increeeee in speed as control is operated toward the CW position.
			b. Operate AZIMUTH CW-CCW control center position to CCW position.	*b.* Antenna movae in a counterclockwise direction and increases in speed as control is operated toward the CCW position.
			c. Turn AZIMUTH CW-CCW switch to the CCW position.	*c.* Antenna moves in a counterclockwise direction at one speed as long as switch is held.
			d. Turn AZIMUTH CW-CCW switch to the CW position.	*d.* Antenna moves in a clockwise direction at one speed as long as switch is held.
			e. Operate AZIMUTH stow lock control fully clockwise.	*e.* None.
			f. Operate AZIMUTH CW-CCW control to CW, then CCW.	*f.* Antenna will not move.
			g. Operate AZIMUTH CW-CCW switch to CW, then CCW.	*g.* Antenna will not move.

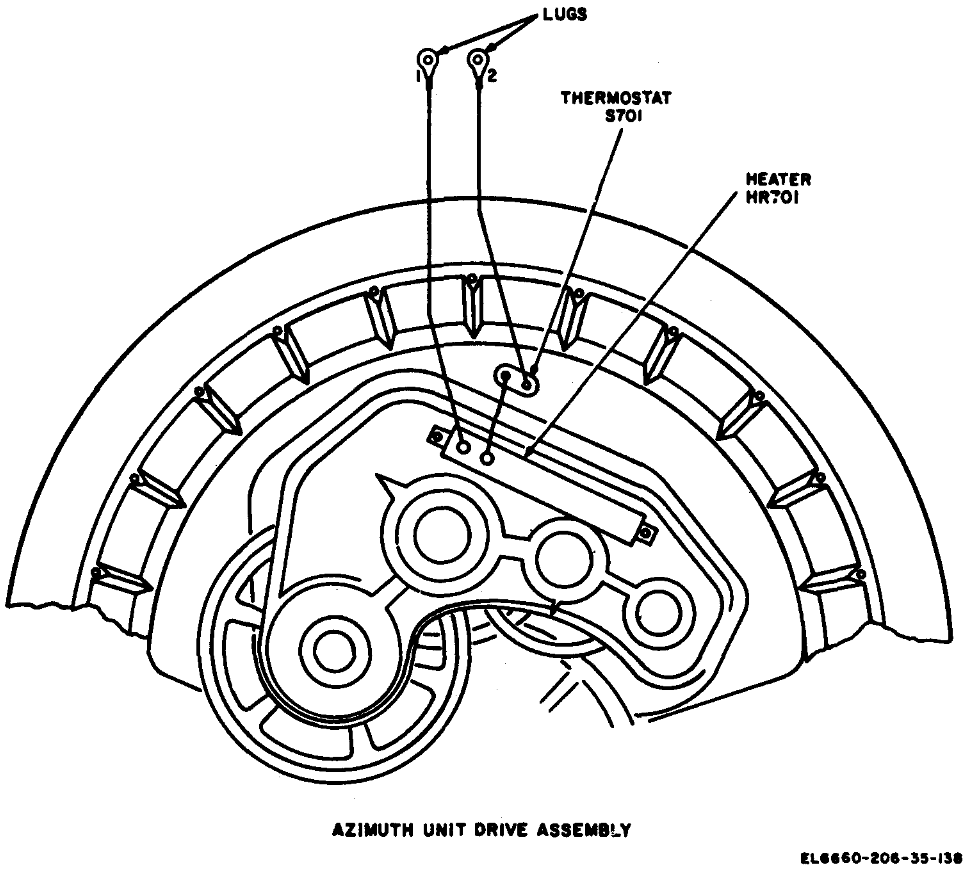


Figure 4-5. Azimuth unit, test connection diagram.

Section VI. ELEVATION UNIT ASSEMBLY

4-26. General

This section covers the testing procedures to be used by direct support personnel to determine if the elevation unit assembly is performing satisfactorily when operating as part of the rawin system.

4-27. Test Equipment and Materials

a. Multimeter T8-352B/U.

b. Zero Mist Circuit Cooler-GC No. 8667-GC Electronics (72663) or equivalent.

c. Operational AN/GMD-l system.

4-28. Test Connections and Conditions

Remove the cover from the elevation unit aasembly which is installed on the antenna. Perform visual inspection, mechanical, and electrical tests as outlined in table 4-6.

4-29. Initial Equipment Settings

All power switches off.

4-30. Test Procedure

Refer to table 4-6 for test procedure.

Table 4-6. Elevation Unit Assembly

Step no.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance Standard
1	None	Control-Recorder MAIN POWER ON-OFF switch: OFF	*a.* Inspect entire elevation mechanical assemblies for loose or missing screws, bolts, and nuts.	*a.* Screws, bolts, and nuts will be tight and none missing.
			b. Inspect terminal board TB201 for loose or disconnected wiring.	*b.* No loose or disconnected wiring.
			c. Inspect limit switches S201, S202, and S203 for looseness and damage. See figure 4-6.	*c.* No looseness or damage evident.
			d. Inspect gears for damaged or missing teeth.	*d.* No damaged or missing teeth.
			e. Inspect counterbalance spring aaaemblies for broken springs.	*e.* No evidence of damage.
			f. Inspect elevation indicator dial for broken glass, damaged face, and proper needle position.	*f.* No obvious damage to glass, face, or needles.
			g. Inspect all indicator lights for damage; looseness, and correct lamp.	*g.* No looseness or damage evident and proper lamp installed.
2	TS-S52B/U Multimeter FUNCTION: OHMS SCALE: RX1	NOTE GMD-lA has no heater or thermostat . Elevation drive will have thermostat check made on the bench.	*a.* Connect multimeter to terminals 30 and 31 of TB201 as ahown in figure 4-6.	*a.* 13 ohms.
			b. Spray Zero Mist Circuit Cooler or equivalent to thermostat S204 and check terminals 30 and 31 with a multimeter.	*b.* 11.5 ohms.
3	None.	Antenna Control Unit POWER switch: ON MOTORS STAND-BY switch: MOTORS Control-Recorder MAIN POWER ON-OFF switch: ON	Antenna Control Unit: *a.* Operate ELEVATION UP-DOWN control to the UP position.	*a.* Antenna moves upward and stops at 90 degrees as indicated on elevation indicator dial.
			b. Operate ELEVATION UP-DOWN control to the DOWN position.	*b.* Antenna moves downward and stops at zero degrees as indicated on the elevation indicator dial.

Table 4-6. Elevation Unit Assembly-Continued

Step no.	Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
			c. Check to insure elevation indicator light is on.	*c.* None.
			d. Check to insure antenna is in zero degree position and rotate elevation stow lock control fully clockwise.	*d.* Antenna is locked in place and power to B201 motor is removed.
			e. Rotate elevation stow lock control fully counterclockwise.	*e.* None.
			f. Operate ELEVATION UP-DOWN control to the UP position.	*f.* Antenna will move upward to insure elevation stow lock comtrol switch is operating.

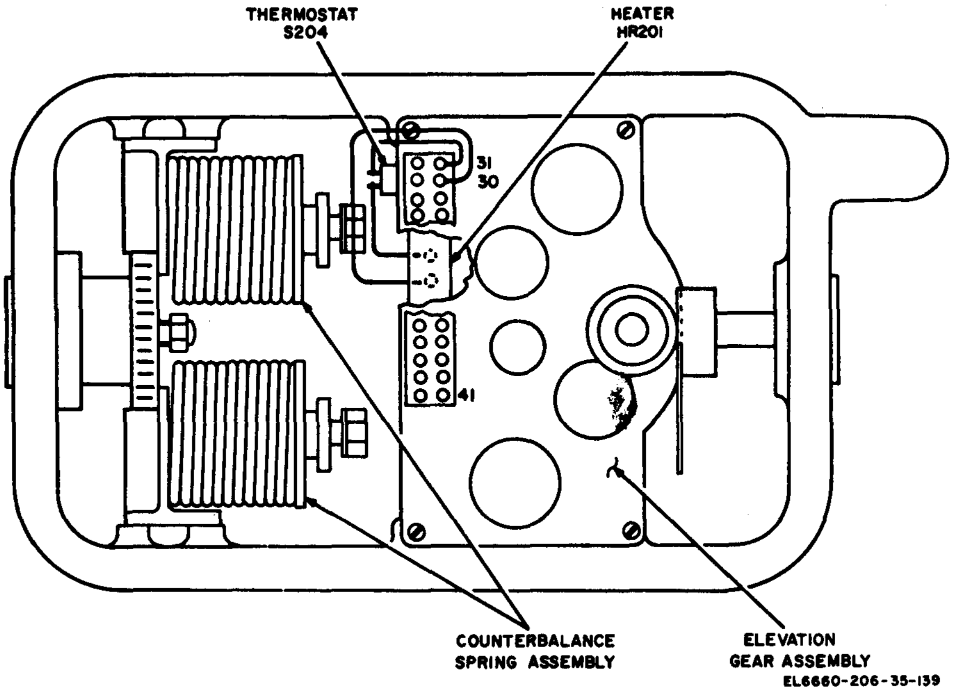


Figure 4-6. *Elevation unit assembly, test connection digram.*

Section VII. CONTROL-RECORDER

4-31. General

This section covers the testing procedures to be used by direct support personnel to determine if the control-recorder is performing satisfactorily when operating as part of the rawin system.

4-32. Test Equipment and Materials

a. Test Set TS-538/U.

b. Operational AN/GMD-l system.

4-33. Test Connections and Conditions

The control-recorder must be connected to the rawin system as shown in figure 4-7 to complete the electrical tests required in table 4-7.

4-34. Initial Equipment Settings

All power switches off.

4-35. Test Procedure

Refer to table 4-7 for test procedure.

Table 4-7. Control Recorder

Step no.	*Test equipment* (Control settings)	*Equipment under test* (Control settings)	*Test procedure*	*Performance standard*
1	None	Control-Recorder MAIN POWER ON-OFF switch: OFF	*a*. Inspect all controls and mechanical assemblies for loose screws, bolts, and nuta.	*a*. Screws, nuts, and bolts will be tight; none missing.
			b. Inspect all connectors for looseness, damaged, or missing pins.	*b*. No looseness, damage, or missing pins evident.
			Inspect all meters and indicators for broken glass and proper needle position.	*c*. No broken glass and needle position proper.
2	None	Control-Recorder MAIN POWER ON-OFF switch: OFF	*a*. Set MAIN POWER ON-OFF switch to ON, then OFF. See figure 3-53.	*a*. Operates freely in both positions.
			b. Set ELEVATION MANUAL CONTROL switch to UP, DOWN, then release.	*b*. Operates freely in both positions and returns to center position.
			c. Set AZIMUTH CW-CCW switch to CCW, CW, then release.	*c*. Operates freely in both positions and returns to center position.
			d. Set MOTORS STANDBY switch up, then down to STANDBY.	*d*. Operates freely in both positions.
			e. Rotate PRINTINGS PER MINUTE switch to 0,1,2, and 10 positions.	*e*. Operates freely in all four positions with detent evident at each position.

Table 4-7. Control Recorder-Continued

Step no.	*Control settings: Test equipment*	*Control settings: Equipment under test*	*Test procedure*	*Performance standard*
			f. Set BASELINE CHECK-FLIGHT-STANDBY switch to FLIGHT, BASELINE CHECK and STANDBY positions.	*f.* Operates freely in three positions.
			g. Set TUNING-DEC. FREQ-INC FREQ switch to DEC FREQ, then to INC FREQ.	*g.* Operates freely in both positions, then returns to center position.
			h. Hold DEPRESS TO SHOW DIAL POSITION switch down, then release.	*h.* Operates freely in both positions then returns to UP position.
			i. Operate PAPER RELEASE lever down, then release.	*i.* Paper will pull freely from unit when down, hold paper securely when up.
			j. Depress ELEVATION RESET SELECTOR lever and rotate RESET CONTROL clockwise.	*j.* Elevation indicator dial rotates to any selected position.
			k. Depress AZIMUTH RESET SELECTOR lever and rotate RESET CONTROL clockwise.	*k.* None.
			l. Rotate RESET TIME control one full turn clockwise.	*l.* None.
3	None	Control-Recorder MAIN POWER ON-OFF switch: ON Antenna Control Unit POWER switch: ON MOTORS STAND-BY switch: MOTORS ELEVATION UP-DOWN control: Rotate until elevation unit indicator is at zero degrees. AZIMUTH CW-COW control: Rotate until azimuth unit indiator is at zero degrees.	*a.* Set MAIN POWER ON-OFF switch to the ON position.	*a.* POWER, azimuth and elevation lamp will go on.
			b. Rotate RESET TIME switch clockwise one full turn.	*b.* Time indicator will manually return to zero.
			c. Set FLIGHT-BASELINE CHECK-STANDBY switch to BASELINE CHECK.	*c.* None.
			d. Depress ELEVATION RESET SELECTOR lever and rotate RESET CONTROL until elevation indicator pointers are at zero degrees.	*d.* Elevation indicator pointers are on zero degree, POWER indicator light off, and ELEVATION indicator light will go on.
			e. Depress AZIMUTH RESET SELECTOR lever and rotate RESET CONTROL until azimuth indicator pointers are at zero degrees.	*e.* Azimuth indicator pointers are on zero degrees, POWER indicator light off, and AZIMUTH indicator light goes on.
			f. Hold ELEVATION UP-DOWN MANUAL CONTROL switch to UP or DOWN position until elevation unit indicator loated on antenna is at 45 degrees.	*f.* Elevation indicator on control-recorder unit indicates 45 degrees.

Table 4-7. Control Recorde-Continued

Step no.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
			g. Hold AZIMUTH CW-CCW switch clockwise until azimuth unit indicator located on the pedestal is on 100 degrees.	*g.* Azimuth indicator on control-recorder unit indicates 100 degrees.
			h. Set MOTORS STANDBY switch up or down whichever position indcator light goes on.	*h.* MOTORS STANDBY indicator light will go on and ELEVATION and AZIMUTH MANUAL CONTROL switches will not operate antenna.
			i. Set MOTORS STANDBY switch to opposite position of step *h.*	*i.* MOTORS STANDBY indicator light will go off and AZIMUTH and ELEVATION MANUAL CONTROL switches will operate antenna.
4	TS-538/U Test FREQUENCY METER: 1680 POWER: ON REPETITION RATE: 200 OUTPUT POWER: MAXIMUM MODULATION: ON	Receiver POWER: ON	a. Hold DEC. FREQ.-INC. FREQ- switch for maximum deflection on TUNING METER.	*a.* TUNING METER will indicate maximum deflection.
			b. Turn DEPRESS TO SHOW DIAL POSITION switch to down position.	*b.* TUNING METER will indicate center of male.
			c. Set BASELINE CHECK-FLIGHT-STANDBY switch to FLIGHT position. Turn PRINTINGS PER MINUTE switch to 10 position.	*c.* Printer will start printing azimuth, elevation, and time at the rate of 10 printouts per minute.
			d. Depress TIME PRINT ONLY switch, hold in for at least 12 seconds then release.	*d.* Printer will print time only for the period switch is held in, then resume azimuth and elevation printouts.
			e. Turn PRINTINGS PER MINUTE switch to 2 position for 1 minute, then 1 position for 1 minute.	*e.* Printer will print two printouts per minute, then one printout per minute.
			f. Operate BASELINE CHECK-FLIGHT-STANDBY switch to STANDBY then FLIGHT position.	*f.* Printer will stop printing in STANDBY position, then start printing in FLIGHT position.

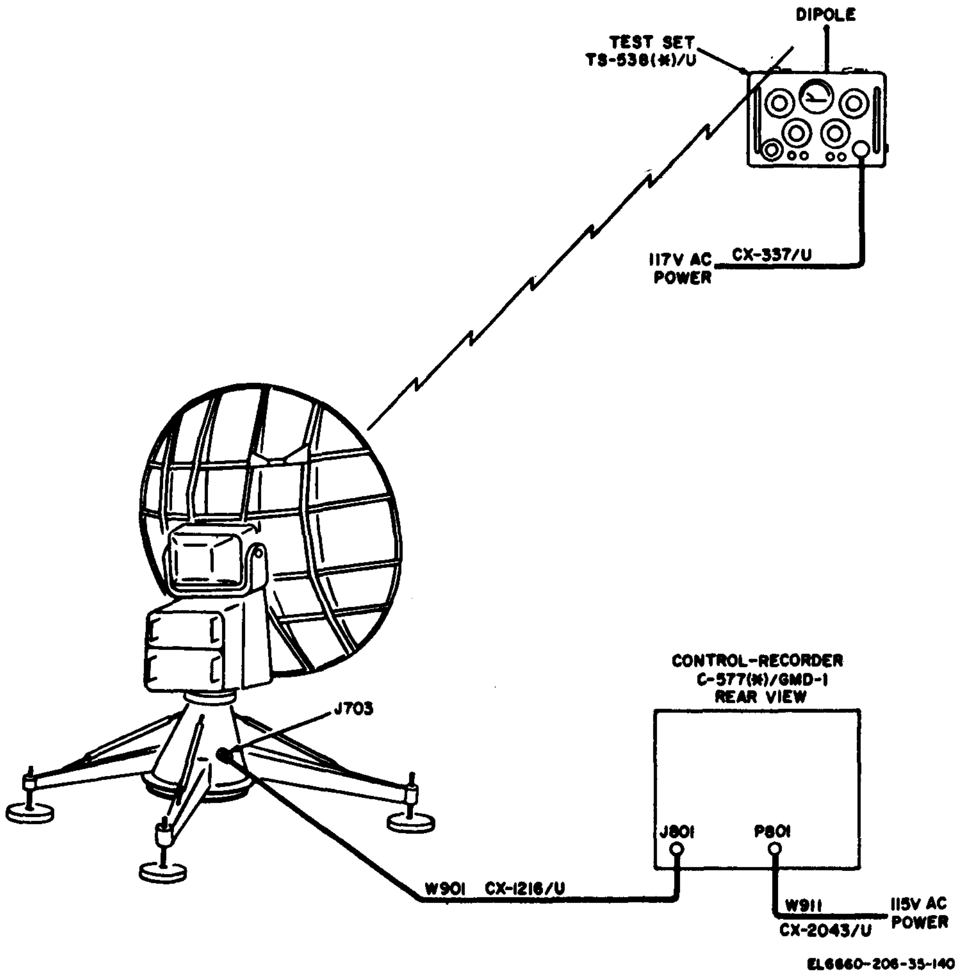


Figure 4-7. Control-recorder, test connection diagram.

CHAPTER 5

GENERAL SUPPORT MAINTENANCE

Section I. GENERAL

5-1. Scope of Maintenance

This chapter provides the data, instructions, and procedures required by general support maintenance personnel as indicated by the maintenance allocation chart for the equipment (TM 11-6660-206-12, Appendix C). It includes instructions for replacement of general support maintenance parts and instructions for troubleshooting and repair procedures. This chapter supplements those instructions in previous chapters of this manual where general support is referenced. This chapter provides replacement procedures which must be performed at general support.

5-2. General Support Maintenance of Rawin Set AN/GMD-1(*)

Maintenance of the set includes-

a. Disassembly, repair, and test of Antenna Scanner Assembly (para 5-3 and 5-4).

b. Bench test, removal, replacement of components, including final test procedures in receiver (para 5-10 through 5-16).

c. Removal and replacement of components and test procedures for Antenna Control unit (para 5-17 and 5-18).

d. Removal and replacement of mechanical components in the azimuth unit (para 5-19 through 5-30).

e. Removal and replacement of components in the elevation unit (para 5-31 through 5-40).

f. Disassembly, removal, replacement of mechanical components, and testing of Control-Recorder (para 5-41 through 5-55).

Table 5-1. Test Equipment and Material Required

Test equipment and material	*Common name*	*Techncal manual*
Pulse Generator Set AN/UPM-15	Pulse generator	TM 9-6625-949-50
Frequency Meter AN/URM-32	Frequency meter	TM 11-5120
Power Supply PP-1243/U	Power supply	TM 11-5120
Wavemeter FR-91A/U	Wavemeter	TM 11-6625-293-12
Sweep Generator SG-336/U	Sweep generator	TM 11-6625-406-12
Attenuator Kay Model 20	Attenuator	
Oscillscope AN/USM-281A	Oscilloccope	TM 9-6625-2362-12

Table 5-1. Test Equipment and Material Required-Continued

Test equipment and material	*Common name*	*Technical manual*
Adapter, BNC Jack to Double Banana Plug 1269	Adapter	
Socket Extender 1447	Extender	
Resistor, composition 250-ohm ±10%, 1/2w	Resistor	
Receptacle, connector UG-290/U	Connector	

Section II. ANTENNA ASSEMBLY

5-3. General

This section provides general support maintenance personnel with the additional information required to dissasemble, repair, reassemble, and test the antenna scanner assembly.

5-4. Disassembly of Antenna Scanner Assembly

The directions in *a* through *y* below cover the disassembly of an antenna scanner assembly.

a. Remove the six screws (44, fig. 3-4 (1)) that fasten the bottom cover (46) to the side cover (50).

b. Remove the front half of the radome (27) by removing the 12 screws (17), washers (23) and nuts (26).

c. Remove the four screws (18) that fasten the hemisphere (21) to the mounting plate (25).

d. Unscrew the dipole antenna (19) and quarter-wave stub (52) as one assembly.

e. Use a 1-inch socket wrench to remove the clamping nut (20) at the antenna end of the hollow drive shaft (11). Hold the hollow drive shaft stationary while loosening the clamping nut.

f. Slide the mounting plate (25) off the hollow drive shaft.

g. Hold the hollow drive shaft stationary and remove the rotating joint (28) by loosening the two setscrews (16).

h. Remove the four screws (14) from the radome hub (29) and lift the hub and the rear half of the radome (27) off the rotating joint housing (15).

i. Remove the four screws (13) from the rotating joint housing (15) and remove the housing and the gasket (31).

j. Remove the snaprinj (12).

k. Remove the two screws, washer and nuts that fasten the heater (fig. 3-4 (4)).

l. Tag and disconnect the wire leads of cable W101 from the terminal board (6, fig. 3-4 (1)).

m. Disconnect the phasing adjustment shaft (3) by loosening the two setscrews on the worm gear side of the phase adjustment coupling (1).

n. Remove the four screws (41) that fasten the transmission line and support stub assembly (43) to the aide cover (50).

o. Remove the seven mounting screws that fasten the side cover (50) to the motor mounting plate (38); remove the side cover.

p. Remove the transmission line and support stub assembly (43) by removing the four screws that fasten the square flange retainer (42) to the transmission line housing (39).

q. Remove the transmission line, (51) by loosening and removing the four mounting screws from the transmission line housing (39).

r. Remove the six mounting screws (37) that fasten the motor mounting plate (38) to the pylon (48).

s. Remove the motor mounting plate (38) with the hollow drive shaft (11) attached.

t. Remove the four adjustment screws (34) that fasten the worm gear and terminal board bracket (33). Lift the bracket aside to permit access to the bearing.

CAUTION

Use a wooden or phenolic dowel to tap the drive shaft to prevent damage to the hollow drive shaft (11) and its bearing.

u. Gently tap the hollow drive shaft (11) to dirve it from its bearing in the motor mounting plate (38).

v. Remove the retaining ring (fig. 3-4③) from the hollow drive shaft (11, fig. 3-4①).

w. Loosen the two setscrews located on the hub (fig. 3-4 ③) of the hollow drive shaft gear and sprocket assembly and remove the assembly from the hollow drive shaft. If the motor sprocket wheel (fig. 3-4 2) is difficult to remove (*x* below), use a gear puller that will apply force to the hub rather than to the outer tim. The motor sprocket wheel is not sturdy enough to withstand much force.

x. Loosen the two setscrews located on the hub of the motor sprocket wheel (fig. 3-4②) and remove the motor sprocket wheel.

y. Remove the transmission line inner conductor (fig. 3-4⑤) from the outer conductor by withdrawing the inner conductor toward the motor mounting plate (38, fig. 3-4①).

NOTE

If the Teflon spacers are worn or damaged, replace as necessary.

5-5. Reassembly of Antenna Scanner Assembly (fig. 3-4)

The directions in *a* through *x* below, cover the reassembly of a disassembled antenna scanner assembly.

a. Reassemble the transmission line inner conductor (fig. 3-4 **5**) and three spacers into the outer conductor of the transmission line (51, fig. **3-4①**).

b. Install the motor sprocket wheel (fig. **3-4②**) on the motor shaft and tighten the setscrews in the sprocket wheel.

c. Install the gear and sprocket assembly (fig. 3-4 **3**) on the hollow drive shaft and tighten the two setscrews.

d. Install the retaining ring on the hollow drive shaft.

e. Place the belt on the motor sprocket wheel (fig. 3-4 @) and insert the hollow drive shaft in its bearing in the motor mounting plate (38, fig. **3-4①**).

f. Rotate the hollow drive shaft; at the same time, allow the belt to ride into position on the gear and sprocket assembly and motor sprocket wheel.

NOTE

Check for proper alignment of the gears. If adjustment is necessary, move the motor sprocket wheel or the reference generator gear to align with their mating drive shaft parts.

g. Replace the worm gear and terminal board bracket (33, fig. 3-4 **1** and secure with the four adjustment screws (34).

h. Apply Grease, Aircraft and Instrument (MIL-G-3278) to the bearing (32) on the dipole antenna end of the hollow drive shaft.

i. Align the pylon (48) mating holes with those on the motor mounting plate (38) and secure with the six mounting screws (37).

j. Replace the transmission line and support stub assembly (43) in the hollow drive shaft and secure the transmission line housing (39) to the square flange retainer (42).

k. Replace the side cover (50) on the motor mounting plate (38) and secure with its eight mounting screws.

l. Secure the transmission line and support stub assembly (43) to the side cover (50) with the four mounting screws (41).

m. Connect the phasing adjustment shaft (3) to the wormshaft (49) and tighten the two setscrews in the phase adjustment coupling (1).

n. Connect the wire leads of cable W101 (as tagged during disassembly) to the terminal board (6).

o. Replace and secure the heater (fig. 3-4 (4)) to the heater mounting brackets.

p. Replace the snapring (12) to the hollow drive shaft on the dipole antenna side of the bearing (32).

q. Replace the rotating joint housing (15) and the gasket (31) on the hollow drive shaft (11) and secure with the four screws (13).

r. Replace the rear section of the radome (27) and the radome hub (29) onto the rotating joint housing (15) and secure with the four screws (14) through the radome hub.

s. Replace the rotating joint (28) on the hollow drive shaft (11) and secure with the two setscrews (16).

t. Slide the mounting plate (25) onto the hollow drive shaft (11).

u. Replace the clamping nut (20) at the antenna end of the hollow drive shaft; use a 1-inch socket wrench to tighten the nut. It will be necessary to hold the hollow drive shaft (11) while tightening the nut.

v. Replace the dipole antenna (19) and the quarter-wave stub (52) into the end of the hollow drive shaft (11).

w. Replace the hemisphere (21) on the mounting plate (25) and secure with the four screws (18).

x. Replace the front half of the radome (27) and secure it with the 12 screws (17), washers (23), and nuts (26).

y. Replace the bottom cover (46) on the side cover (50) and secure with the six screws (44).

5-6. Removal and Replacement of Scanner Drive Motor

a. Removal of Scanner Drive Motor B101.

(1) Disassemble antenna scanner as directed in para 5-4, steps *a* through *i*.

(2) Disconnect the phasing adjustment shaft (3, fig. **3-4**(1)) by loosening the two setscrews on the worm gear side of the phase adjustment coupling.

(3) Remove the four screws (41) that fasten the transmission line and support stub assembly (43) to the side cover (50).

(4) Remove the seven mounting screws that fasten the side cover (50) to the motor mounting plate (38) and remove the side cover.

(5) Remove the six mounting screws (37) that fasten the motor mounting plate (38) to the pylon (48). Remove pylon.

(6) Tag and, remove the four motor leads. Two leads are connected to terminal board TB101 (6) and two leads are connected to relay K101.

(7) Remove the cable clamps holding the motor wires.

(8) Loosen the two setscrews located on the hub of the motor spocket wheel (fig. 3-4 (2)) and slide motor sprocket wheel off shaft.

(9) Remove the four mounting screws that fasten the motor to the motor mounting plate (38, fig. **3-4**(1)) and remove motor.

b. Replacement of Scanner Drive Motor B101.

(1) Align scanner drive motor B101 with mounting holes on motor mounting plate (fig. 3-4 **3**).

(2) Reinstall the four mounting screws that fasten the motor.

(3) Slide motor sprocket wheel (40, fig. 3-4 **2**) onto motor shaft and tighten two setscrews.

(4) Reconnect the two leads to terminal board TB101 (6, fig. 3-4 (1)) and two leads to relay K101, Refer to figure 3-4 (4) motor lead hookup.

(5) Reinstall cable clamp to hold the motor wires in place.

(6) Assemble antenna scanner as directed in para 5-5, steps *q* through *y* above.

5-7. Disassembly and Reassembly of Scanner Drive Motor

(fig. 5-1)

The directions in *a* and *b* below cover the disassembly and reassembly of a scanner drive motor.

a. Disassembly of Scanner Drive Motor.

(1) Tag and remove the four motor leads. Two are connected to terminal board TB101 (fig. 3-4 ④) and two are connected to the relay.

(2) Remove the four mounting screws that fasten the motor to the motor mounting plate (38, fig. 3-4 ①) and remove the motor.

(3) Remove the four mounting screws (8, fig. 5-1) that hold the endbells (1 and 7) to the field housing (5).

(4) Rest the assembly on the endbell (1), with the shaft vertical; remove the endbell (7).

(5) Remove the field housing (5) from the remaining assembly.

(6) Remove the shaft and armature (4) from the endbell (1).

(7) Remove the spacing washers (6), the spring thrust washer (2), and the ball bearing assembly (3) from the shaft and armature (4).

b. Reassembly of Scanner Drive Motor.

(1) Replace the ball bearing assembly (3, fig. 5-1), the spring thrust washer (2), and the spacing washers (6) on the shaft and armature (4).

(2) Insert the shaft and armature (4) into the endbell (1).

(3) Rest the assembly on the endbell (1), with the shaft vertical; replace the field housing (5).

(4) Replace the endbell (7).

(5) Replace the four mounting screws (8) that hold the endbells (1 and 7) to the field housing (5). (The four mounting screws are inserted through the endbell (1) and fasten to the endbell (7).)

(6) Replace the motor on the motor mounting plate (38, fig. 3-4 ①) and replace and tighten the four mounting screws that secure the motor to the motor mounting plate.

(7) Connect the motor leads, two to terminal board TB101 (fig. 3-4 ④) and two to relay K101.

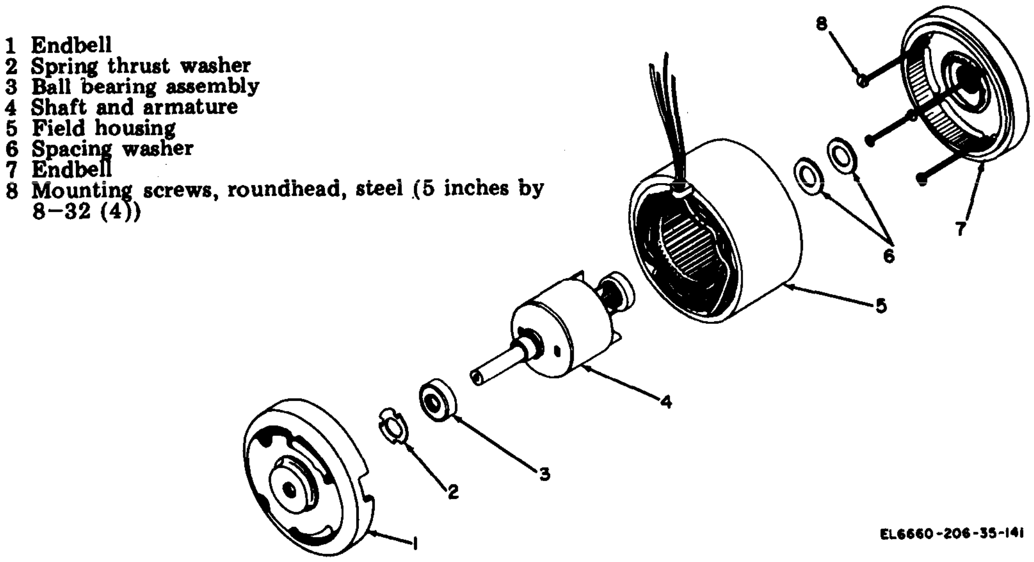


Figure 5-1. Antenna scanner drive motor, exploded view.

5-8. Removal and Replacement of Scanner Drive Motor Belt

a. Removal of Scanner Drive Motor Belt.

(1) Disassemble antenna scanner as directed in paragraph 5-4 steps *a* through *i* above.

(2) Loosen setscrews from gear and sprocket assembly (fig. 3-4 ②).

(3) Loosen setscrews from motor sprocket wheel (fig. 3-4 ②).

(4) Slide gear and sprocket assembly along hollow drive shaft away from motor mounting plate, simultaneously slide motor sprocket wheel from motor.

(5) Remove scanner drive motor belt from motor sprocket wheel and slide belt down hollow drive shaft (11, fig. 3-4 ①).

b. Replacement of Scanner Drive Motor Belt.

(1) Slide gear and sprocket assembly (fig. 3-4 ②) and belt to bottom of hollow drive shaft and tighten setscrews.

(2) Place belt around motor sprocket wheel, reinstall motor sprocket wheel, reinstall motor sprocket wheel to motor shaft, and tighten setscrews.

NOTE

Rotate the hollow drive shaft at the same time to allow the belt to ride into position on the gear and sprocket assembly and motor sprocket wheel.

(3) Slide pylon (48, fig. 3-40) over hollow drive shaft (11).

(4) Replace four screws (13) in the rotating joint housing (15).

(5) Reinstall the radome hub (29) and rear half of the radome (27) onto the rotating joint housing (15).

(6) Hold the hollow drive shaft (11) stationary, reinstall the rotating joint (28) and tighten the two setscrews.

(7) Slide the mounting plate (26) onto the hollow drive shaft (11).

(8) Reinstall the clamping nut (20) into the hollow end of the hollow drive shaft (11) and tighten using a 1-inch socket wrench.

(9) Screw the dipole antenna (19) and quarter-wave stub into the transmission line (51) and tighten.

(10) Reinstall hemisphere (21) to mounting plate (25) using four screws (18).

(11) Reinstall front half of radome (27) to rear half using twelve screws (17), washers (23), and nuts (26).

(12) Align aide cover (50) with motor mounting plate (38) and reinstall seven mounting screws.

(13) Align phasing adjustment shaft (3) with wormshaft (49), slide phase adjustment coupling (1) to connect shafts together, and tighten four setscrews in coupling (1).

(14) Align the transmission line and support stub assembly (43) to side cover (60) and reinstall four screws (41).

(15) Reinstall bottom cover (46) to side cover (50) and reinstall six mounting screws.

5-9. Test Procedures

Follow the test procedures listed in chapter 4, section I to determine if the antenna scanner assembly is performing satisfactorily.

Section III. RECEIVER

5-10. General

This section includes instructions and information for bench testing the receiver, which supplements those instructions in previous chapters where general support maintenance is referenced. Troubleshooting procedures in paragraphs 5-11 through 5-16 are used for bench testing the receiver.

5-11. Bench Troubleshooting of Receiver

Connect the receiver for bench testing (fig. 3-8) use special cable CX-1493/U to connect the receiver to an ac source. Use table 3-15 for step-by-step troubleshooting of the receiver as supplemented by the procedures in *a* through *h* below.

a. Omit the first group of corrective measures under step 1, but follow the corrective measures for checking the tubes and fuses.

b. Follow steps 2 through 5.

c. In step 6 under *Corrective measures,* if trouble is found to be in the local oscillator, replace local oscillator tube V501 (para 5-10).

d. In step 7 under Test *point,* observe the reading on M1001 only; under *Test equipment,* use Test Set TS-538(*)/U only; under *Rawin set controls,* use the TUNING switch on the receiver only; and under *Corrective measures,* if the trouble is in B501, replace the motor-generator (para 5-13).

e. In step 8 under *Test point,* observe reading on meter M1001 only.

f. In step 9 under *Test equipment,* use the test set and the vtvm, and under *Corrective measures,* if the trouble is in an if. amplifier component, replace the defective component.

g. Follow steps 10 through 19.

h. In steps 20 under *Test equipment,* use Test Set TS-538(*)/U only.

5-12. Removal and Replacement of Local Oscillator Tube and Local Oscillator Assembly

Local oscillator tube V501 may be removed by two methods. The first method is the removal of local oscillator tube V501 without removing the local oscillator servo assembly (fig. 5-2). This method is used when trouble has definitely been determined to be in the local oscillator tube. The second method is the removal of the local oscillator and servo assembly (fig. 5-2) when. the entire local oscillator servo assembly is suspected of a defect. Refer to paragraph 3-30 for removal and replacement instructions.

a. Removal of Local Oscillator Tube V501 (2, fig. 5-3).

(1) Loosen but do not remove the filament lead locknut (1B, fig. 5-3).

(2) Remove the filament connector (1A).

(3) Loosen the cathode plunger locknut (1D).

(4) Unscrew the cathode plunger and locking bushing (1C) and remove it with the local oscillator tube (2) from the cathode ring (4). The cathode cavity (1E) is not removed from the cathode plunger and locking bushing (1C) during this operation.

NOTE

To allow the cathode cavity (1E) to pass the flat washers (3), it may be necessary to equally loosen the four screws (3) that hold the local oscillator assembly. Remove the local oscillator tube (2) from the cathode plunger and locking bushing (1C).

(5) Remove the local oscillator tube (2) from the cathode plunger and locking bushing (1C).

b. Replacement of Local Oscillator.

(1) Insert the filament connector (1A, fig. 5-3) through the filament lead locknut (1B) and into the cathode plunger and locking bushing (1C).

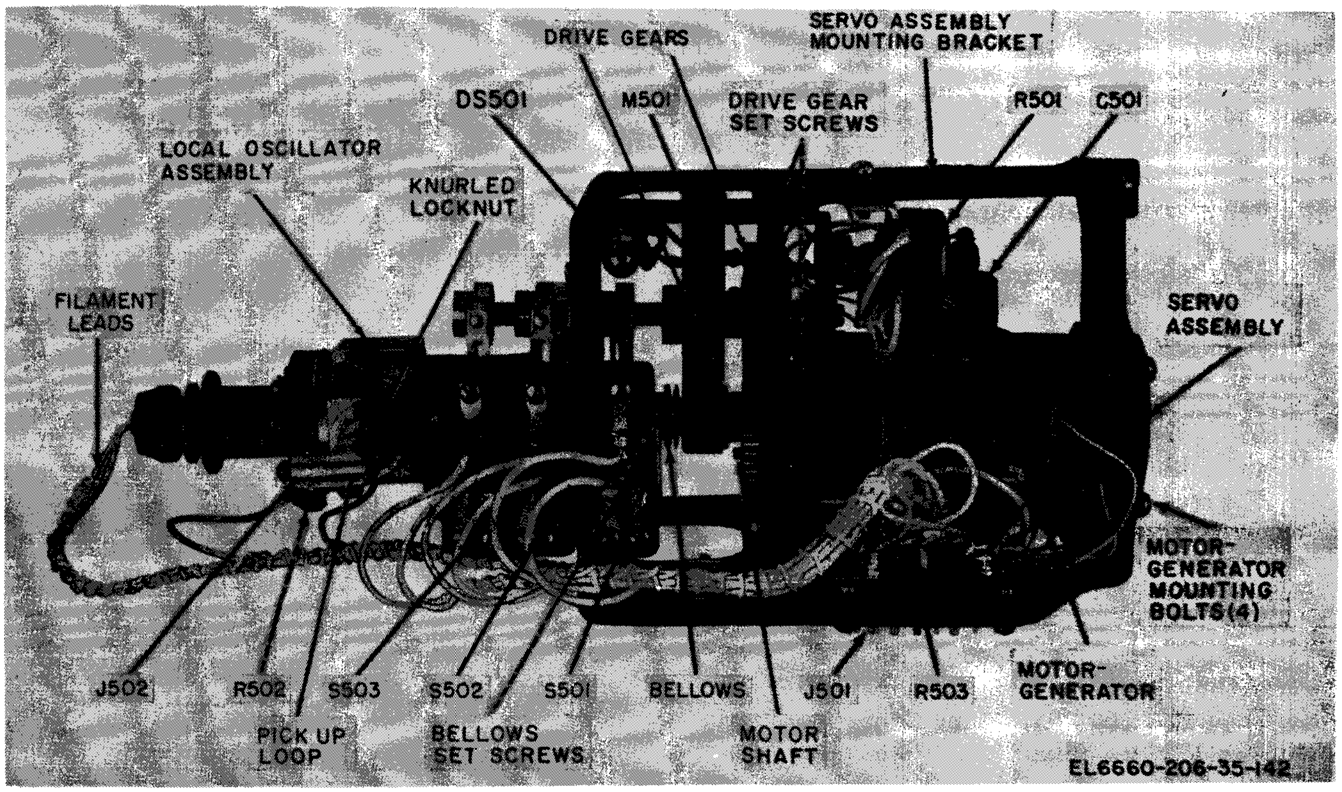


Figure 5-2. Local oscillator and servo assembly, top view.

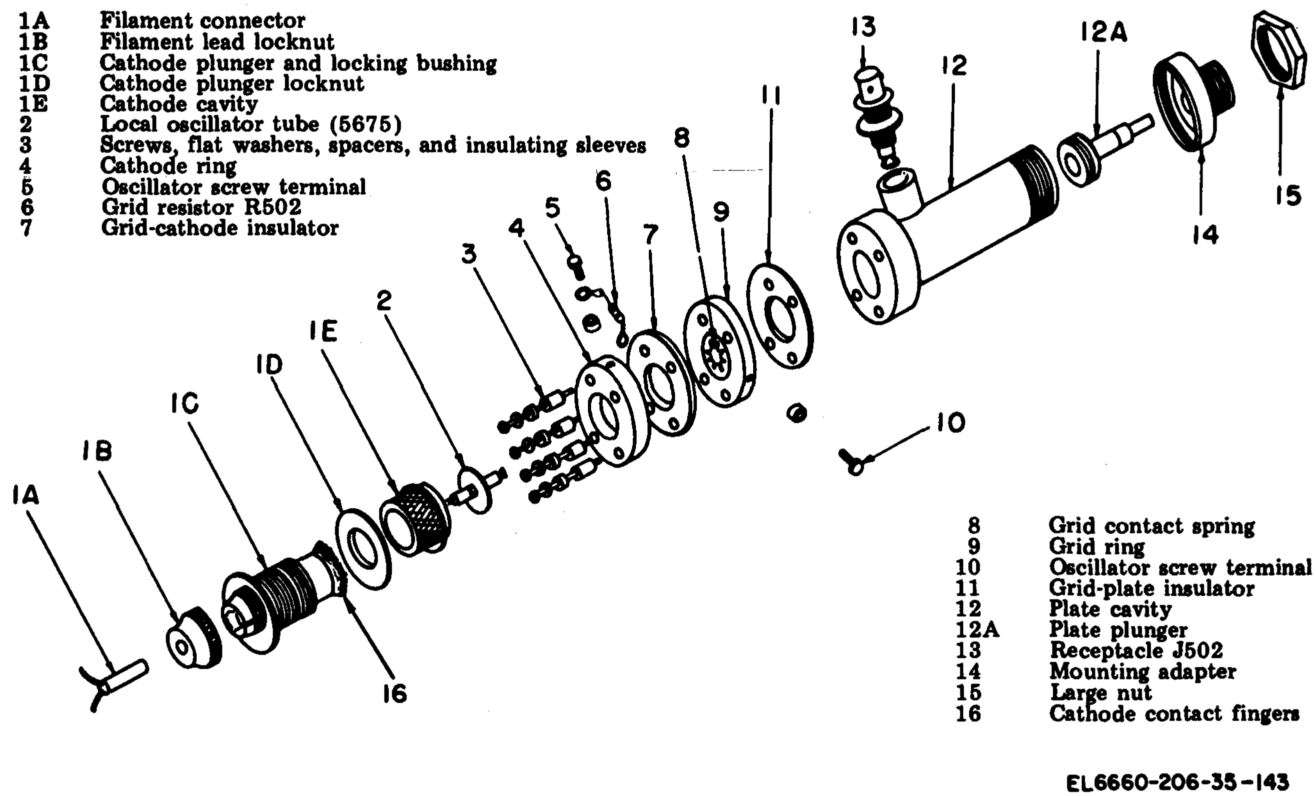


Figure 5-3. Local oscillator assembly, exploded view.

(2) Insert the local oscillator (2) filament leads in the filament connector (1A).

(3) Push the local oscillator tube (2) through the cathode contact fingers (16) until the grid disk of the tube is flat against the insulating ring attached to the cathode cavity (1E) all the way around the grid disk. Be careful that the filament connector does not lose contact with the filament leads during this operation.

CAUTION

To prevent twisting of the filament cable and resultant breakage of the local oscillator tube, make sure that the filament connector (1A) and the local oscillator tube (2) both turn freely in the cathode plunger before an attempt is made to install the cathode plunger and locking bushing (1C) with the local oscillator tube (2) into the cathode ring (4).

(4) Install the cathode plunger and locking bushing (1C) with the local oscillator tube (2) by threading the cathode plunger into the cathode ring (4) (hold the filament connector leads so they do not turn with the assembly). Be sure that the tube is aligned with and is entering the plate receptacle of the plate cavity (12) by properly threading the cathode plunger into the cathode ring (4).

(5) Tighten the cathode plunger locknut (1D).

(6) Apply a slight pressure to the cable end (extending out of cathode plunger (1C) of the filament connector (1A) to assure that it is touching the base of the local oscillator tube (2), and tighten the filament lead locknut (1B).

5-13. Removal and Replacement of Servo Assembly

a. Removal of Servo Assembly.

(1) Remove the local oscillator and servo assembly as outlined in paragraph 3–30.

(2) Disconnect and tag the motor-generator wires” that connect to jack J501 (fig. 5-2) terminals 9 and 11.

(3) Disconnect and tag the wires that are connected to the terminals of capacitor C501.

b. Removal of Motor-Generator.

(1) Loosen the two Allen setscrews that fasten the drive gear to the motor shaft.

(2) Loosen and remove the bolts that mount the motor-generator to the servo assembly mounting bracket and remove the motor-generator.

c. Replacement of Motor-Generator.

(1) Place the motor-generator on the servo assembly mounting bracket and secure it with the mounting bolts loosened previously.

(2) Secure the drive gear to the motor shaft with the two Allen setscrews.

d. Replacement of Servo Assembly.

(1) Connect capacitor C501 with the wires removed previously.

(2) Connect the motor-generator wires to J501 removed previously.

(3) Replace the local oscillator and servo assembly (para 3-30).

5-14. IF Amplifier Alignment and Tests

The IF amplifier alignment and tests are performed with the amplifier installed in a rawin receiver.

a. Test Equipment and Materials.

(1) Multimeter ME-26( )/U (vtvm).

(2) Socket extender, part number 1447 (05276), FSN 5935-065-3030.

(3) Signal generator SG-336/U.

(4) Signal generator AN/USM-44A.

(5) Attenuator Kay Model 20.

(6) Oscilloscope AN/USM-281A.

(7) Electronic voltmeter ME-30( )/U.

(8) Adapter, BNC Jack to Double Banana Plug (05276) FSN 5939-053-9454.

(9) Resistor, composition 250 ohm ±10%, 1/2 watt, RC20BF251K.

(10) Receptacle connector UG-290/U (2 each).

(11) Fabricate a special connector jack by soldering a connector receptacle to each end of the 250-ohm resistor ((7) above).

b. Initial Test Equipment Settings.

(1) Rejection ratio of 15 MHz trap. Refer to table 5-2 for test equipment settings and test procedures.

(2) Broad am. bandwidth alignment. Refer to table 5-3 for test equipment settings and test procedures.

(3) Sharp am. bandwidth alignment. Refer to table 5-4 for test equipment settings and test procedures.

(4) Sharp fm. detector bandwidth alignment. Refer to table 5-5 for test equipment settings and test procedures.

Table 5-2. Rejection Ratio of 16 MHz Trap

	Control settings			
Step no.	*Test equipment*	*Equipment under test*	*Test procedure*	*Performance standard*
1	Socket extender		Install socket extender between zocket XV403 and tube V403.	None.
2	ME-30( )/U Scale 0.001		Connect ME-30( )/U to pin 1 of V408.	None.
3	AN/USM-44A Power: ON Frequency: 15MHz Modulation: 400 Hz, 30% Output Level: Maximum		Connect output of AN/USM-44A to input jack (J401) using special purpose cable CG-501/U in series with special connector jack (para 6-14a).	None.
4	ME-30( )/U Set for mid scale	If. amplifier	*a.* Adjust L418 for minimum indication. *b.* Note meter indication. *c.* Record ATTN dB setting.	*a.* None. *b. None.* *c. None.*
5	AN/USM-44A Frequency: 30 MHz Modulation: 400 Hz, 30% Output Level: As Required		*a.* Adjust ATTN control to obtain same meter indication noted in step *4b*. *b.* Remove extender and replace tube V403 in its socket.	*a.* Minimum of 30 dB more than that recorded in step 4c. *b.* None.

Table 5-3. Broad AM Bandwidth Alignment

Step no.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	AN/USM-44A Frequency: 30 MHz Modulation: None output Level: 50µV		Connect the equipment as described in table 5-2, step 30.	None.
2	*ME-26(*)/U FUNCTION: - RANGE: 1V		Connect to Broad Bandwidth output as shown in fig. 5-5.	None.
3		If. amplifier	Adjust L401, L405, L407, L409, L410 and L412 for a maximum negative dc voltage.	None.
4	AN/USM-44/A Frequency: 30 MHz Modulation: None output Levsl: As required.		*a.* Adjust output for a negative 1.0 volt. *b.* Remove input signal to If. amplifier.	*a.* AN/USM-44A output 20 µV maximum. *b.* ME-26( )/U maximum indication 0.40 volts.
5	AN/USM-281A POWER: Horizontal DISPLAY: EXT SENS Coupling: DC VOLTS/DIV.: As required SG-336/U CENTER FREQUENCY: 30 MHz Sweep : WIDE ATTENUATION: Max. CRYSTAL MARKERS: 29.6 MHz IN 29.975 MHz In 30.35 MHz: In Kay MODEL 20 20 ATTENUATION: Max		*a.* Connect the equipment as shown in figure 5-4. *b.* Increase sweep rate until oscilloscope trace is steady. *c.* Adjust oscilloscope horizontal sweep until 29.6 MHz and 30.35 MHz markers are spaced 0.75 division. (This calibrates the horizontal sweep for 1 MHz per division). *d.* Set vertical gain for a 1 volt amplitude. Decrease Kay attenuation if necessary.	*a.* None. *b.* None. *c.* None. *d.* Bandwidth 2 MHz ± 0.3 MHz at the 3 dB down points (defined as the point where the amplitude is 0.7 of the original amplitude). This is equal to a bandwidth curve of 2 ± 0.3 division wide.

Table 5-4. Sharp AM Bandwidth Alignment

Step no.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	AN/USM-44A frequency: 30 MHz Modulation: None Output Level: 5 μV		*a.* Connect the equipment as described in table 5-2, step 3a.	a. None.
			b. Connect to Sharp. AM as shown in figure 5-5.	*b.* None.
	ME-26( )/U FUNCTION: RANGE: 1V	*If. amplifier*	*c.* Adjust L423 and L415 for maximum meter ME-26( )/U deflection.	*c.* None.
	AN/USM-44A Output Level: As required.		*d.* Set output level for a 1 volt indication on ME-26( )/U.	*d.* AN/USM/44A output setting 6.6 μV maximum.
			e. Remove input signal to If. amplifier.	*e.* Maximum voltage 0.6 on ME-26( )/U
2	AN/USM-281A POWER: On Horizontal DISPLAY: EXT SENS Coupling: VOLTS/DIV: As required		a. Connect the equipment es shown in figure 5-4.	*a.* None.
	SG-336/U CENTER FREQUENCY: 30 MHz Sweep: WIDE ATTENUATION: Max. CRYSTAL MARKERS: 29.6 MHz In 29.975 MHz In 30-35 MHz In		*b.* Increase sweep rate until oscilloscope trace is steady.	*b.* None.
			c. Adjust oscilloscope horizontal sweep until 29.6 MHz and 30.35 MHz markers are spaced 0.75 division. (This calibrated the horizontal sweep for 1 MHz per division).	*c.* None.
			d. Sat vertical gain for a 1 volt amplitude. Decrease Kay attenuation if necessary.	*d.* Bandwidth 0.75 MHz at the 3 dB down points (defined as the point where the amplitude is 0.7 of the original amplitude.)

Table 5-5. Sharp FM Detector Bandwidth Alignment

Step no.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	AN/USM-281A POWER: On SG-336/U CENTER FREQUENCY: 30 MHz ATTENUATION: Max. CRYSTAL MARKERS: 29.6 MHz In 29.975 MHz In 30-35 MHz In		*a.* Connect equipment as shown in figure 5-4.	*a.* None.
			b. Connect vertical input of oscilloscope to Sharp Fm as shown in figure 5-5.	*b.* None.
			c. Adjust oscilloscope for an optimum display of the Sharp FM detector S-curve. (Reduce attenuation if required.)	*c.* None.

Table 5-5. Sharp FM Detector Bandwidth Alignment-Continued

Step no.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
			d. Adjust 1A23, L415, L421 and L422 as required to produce an oscilloscope trace as shown in figure 5-6. L421 is used to set amplitude and L422 is used to set center frequency. (If two peaks are found using L421 the one with slug furthest in shall be used.)	*d.* Amplitude of peaks A and B approximately equal and fall at 29.6 MHz and 30.35 MHz marker as shown in figure 5-6.
			e. Adjust variable horizontal input attenuator on the oscilloscope so the 29.6 MHz and 30.35 MHz are 1.5 division apart. (Each division thus represents 0.5 MHz.)	*e.* None.
			f. Change vertical input lead of oscilloscope to Broad FM detector output as shown in figure 5-5. Readjust oscilloscope controls (except Horizontal input attenuator) as necessary to produce optimum Broad FM S-curve. Adjust L417 as necessary to obtain the display shown in figure 5-7.	*f.* The 29.975 MHz marker shall be no more than 1 division from the S reference crossover point.
			g. Recheck Sharp AM indication in table 5-4, step 1d.	

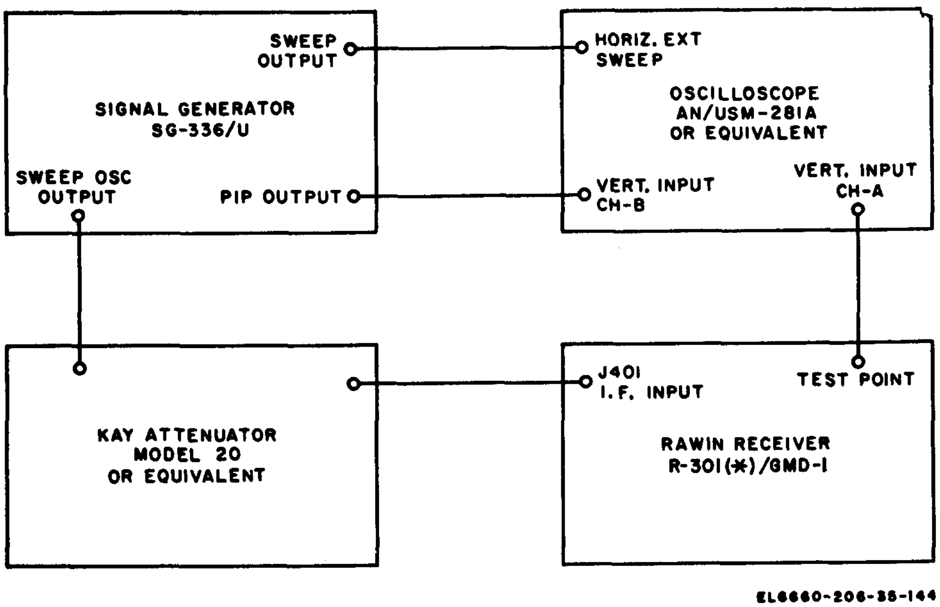


Figure 5-4. IF. amplifier test setup.

EL6660-206-35-145

Figure 5—5. IF. test connection diagram.

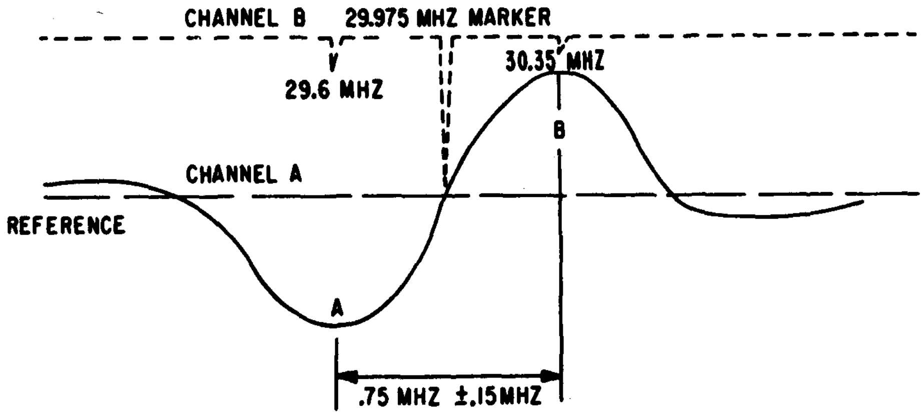


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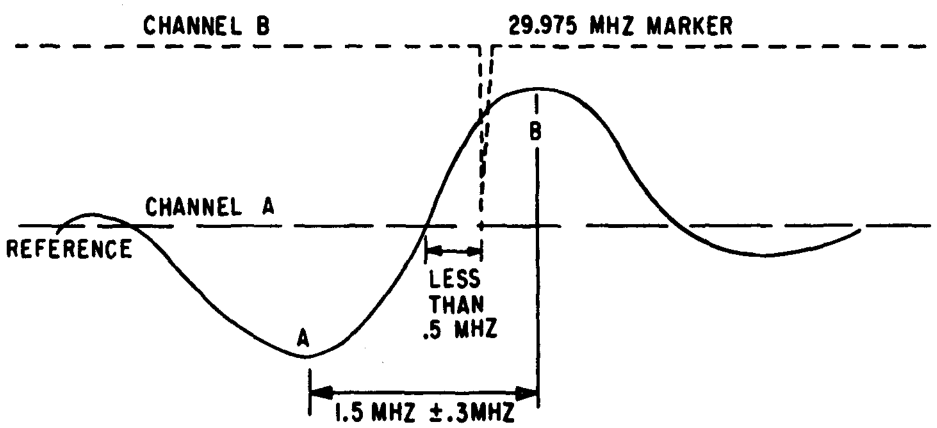
Figure 5-6. Sharp FM bandwidth aligned sinewave.



EL6660-206-35-147

Figure 5-7. Broad FM bandwidth aligned sinewave.

5-15. Local Oscillator Alignment and Test

The alignment and testing of the local oscillator is performed with the local oscillator disconnected from the servo and removed from the receiver.

a. Test Equipment and Materials. Wavemeter FR-91/U.

b. Local Oscillator Alignment.

(1) Remove mounting adapter (14, fig. 5-3 from plate cavity (12)).

(2) Remove plate plunger (12A).

(3) Connect white-brown wire from RF tuner to cathode ring (4) of cavity.

(4) Connect white-green wire from RF tuner to grid ring (9) of cavity.

(5) Connect filament plug to cavity.

(6) Connect ground jumper from local oscillator to receiver.

(7) Connect cable assembly CG-409/U from J502 (13) to rf input of wavemeter FR-91/U.

(8) Turn receiver power on and allow 15 minutes for warmup.

(9) Adjust wavemeter to 1650 MHz.

(10) Adjust cavity slug (inside plate cavity (12)) to 1650 MHz as indicated by a peak on the wavemeter.

(11) Install plate plunger (12A) into plate cavity (12).

(12) Replace and tighten mounting adapter (14).

(13) Rotate plate plunger (12A) shaft 1/2-turn clockwise and record frequency.

(14) Return plate plunger shaft to 1650 MHz position.

(15) Rotate plate plunger shaft 1/2-turn counterclockwise, record frequency.

(16) Range of frequencies for (13) and (15) above should be 1630 MHz to 1670 MHz. If this range is not obtained, remove mounting adapter (14) and plate plunger (12A).

(17) Adjust cavity slug by rotating 1/8-turn. Repeat procedures in (11) through (15) above.

(18) Turn receiver power off.

(19) Install local oscillator in servo assembly (fig. 5-2), tighten large nut (15, fig. 5-3) and setscrews in bellows (fig. 5-2).

b. Local Oscillator Test.

(1) Turn receiver power on.

(2) Turn receiver dial to 1660 MHz. Wavemeter shall indicate 1660 MHz ±2 MHz.

(3) Turn receiver dial to 1700 MHz. Wavemeter shall indicate 1700 MHz ±2 MHz.

5-16. Test Procedures

The test procedures listed in chapter 4, section II are used to determine if the rawin receiver is performing satisfactorily.

Section IV. ANTENNA CONTROL

5-17. General

Each Antenna Control unit requires an operational check prior to system operation and during periods of maintenance checks and services. Follow the operational procedures described in detail in the Operator's and Organizational Maintenance Manual (TM 11-6660-206-12). When operational procedures indicate trouble in the alignment and tracking circuits follow the test procedures below.

5-18. Test Procedures for SCR Switching Units

a. A preliminary setup is performed after SCR units have been repaired or replaced.

b. With Rawin Set AN/GMD-1(*) in operation and MOTORS-STANDBY switch in the STANDBY position, remove IF Cable from J1001 and the Oscillator Cable from J1006 in the receiver.

CAUTION

The antenna control power switch must be in the OFF position and the receiver power ON.

(1) Remove the plate cap from the SCR switching unit to be tested.

(2) Set the function switch of Multimeter TS-352B/U to DC-MA and the range switch to 500 ma.

(3) Connect the multimeter PLUS lead to the clip and the NEGATIVE lead to the SCR cap (fig. 5-8).

CAUTION

To avoid accidental grounding of the plate cap during test, wrap electrical insulating tape around the plate cap.

(4) Turn the Antenna Control unit power switch to ON and set MANUAL-AUTO selector switch to the FAR-AUTO position.

(5) Place MOTORS-STANDBY switch to OPERATE and perform a quick go no-go test on each SCR unit as follows:

(a) Adjust the AZ or EL SENS control counterclockwise until a reading of less than 50 ma is indicated on the multimeter.

(b) Adjust the AZ or EL SENS control clockwise until a reading of more than 150 ma is indicated on the multimeter.

(c) If these conditions are met, the SCR unit under teat is satisfactory.

c. If a complete alignment and adjustment of the antenna control unit is necessary follow the procedures described in the Operator's and Organizational Maintenance Manual (TM 11-6660-206-12) using one of the methods which is dependent on the test equipment available to the maintenance personnel.

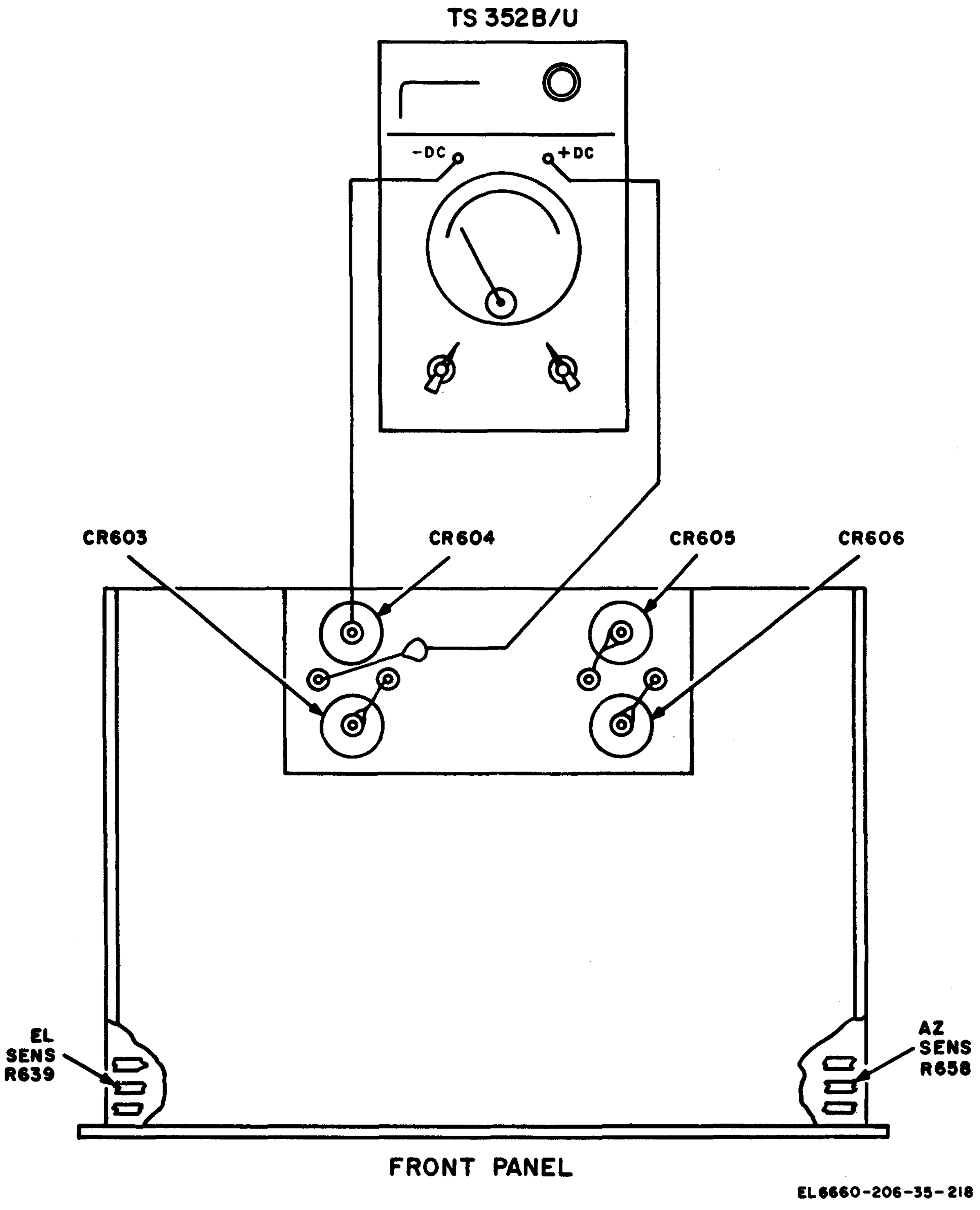


Figure 5-8. SCR switching unit, connection diagram.

Section V. AZIMUTH UNIT

5-19. General

a. The azimuth unit houses the azimuth drive assembly, the turntable assembly, the azimuth angle indicator, and the azimuth stow lock assembly. Before removing the azimuth drive assembly or the turntable assembly, remove the antenna reflector, elevation unit and yoke, and the receiver and antenna control housing from the azimuth unit (TM 11-6660-206-12). The following units may be removed from the azimuth unit without first removing the components mounted on the turntable:

(1) Azimuth drive motor (fig. 5-12 ①).

(2) Azimuth synchro transmitter (fig. 5-12 **1**).

(3) Azimuth antihunt generator (fig. 5-12 **2**).

(4) Azimuth angle indicator (fig. 5-13).

(5) Azimuth stow lock assembly (fig. 5-14).

b. The azimuth drive motor brushes and anti-hunt generator brushes may be replaced without removing the components from the azimuth unit (TM 11-6660-206-12).

c. General support maintenance of the azimuth unit includes-

(1) Removal and replacement of turntable assembly (para 5-20 and 5-21).

(2) Removal and replacement of azimuth angle indicator assembly (para 5-22).

(3) Removal and replacement of stow lock assembly (para 5-23).

(4) Disassembly and reassembly of turntable (para 5-24).

(6) Disassembly and reassembly of azimuth drive (para 5-25 and 5-26).

(6) Disassembly and reassembly of azimuth indicator (para 5-27 and 5-28).

(7) Disassembly and reassembly of azimuth stow lock (para 5-29).

(8) Test procedures (para 5-30).

5-20. Removal and Replacement of Turntable Assembly

a. Genenral The turntable assembly (fig. 5-9) consists of the turntable slipring assembly (6) and the main shaft drive gear (16). Terminal boards E701, E702, and E703 (TB701, TB702 and TB703 for AN/GMD-1B**) (fig. 3-39) are located at the top of the assembly under the cover plate. The directions in *b* and *c* cover the removal and replacement of the turntable assembly with the stow lock assembly mounted. To remove and replace the stow lock assembly, refer to paragraph 5-29.

b. Removal.

(1) Remove the azimuth drive assembly (para 5-21).

(2) Remove the terminal boards with the spring contacts (fig. 3-37) by removing the four bolts that secure the terminal board mounting plate to the casting inside the azimuth unit.

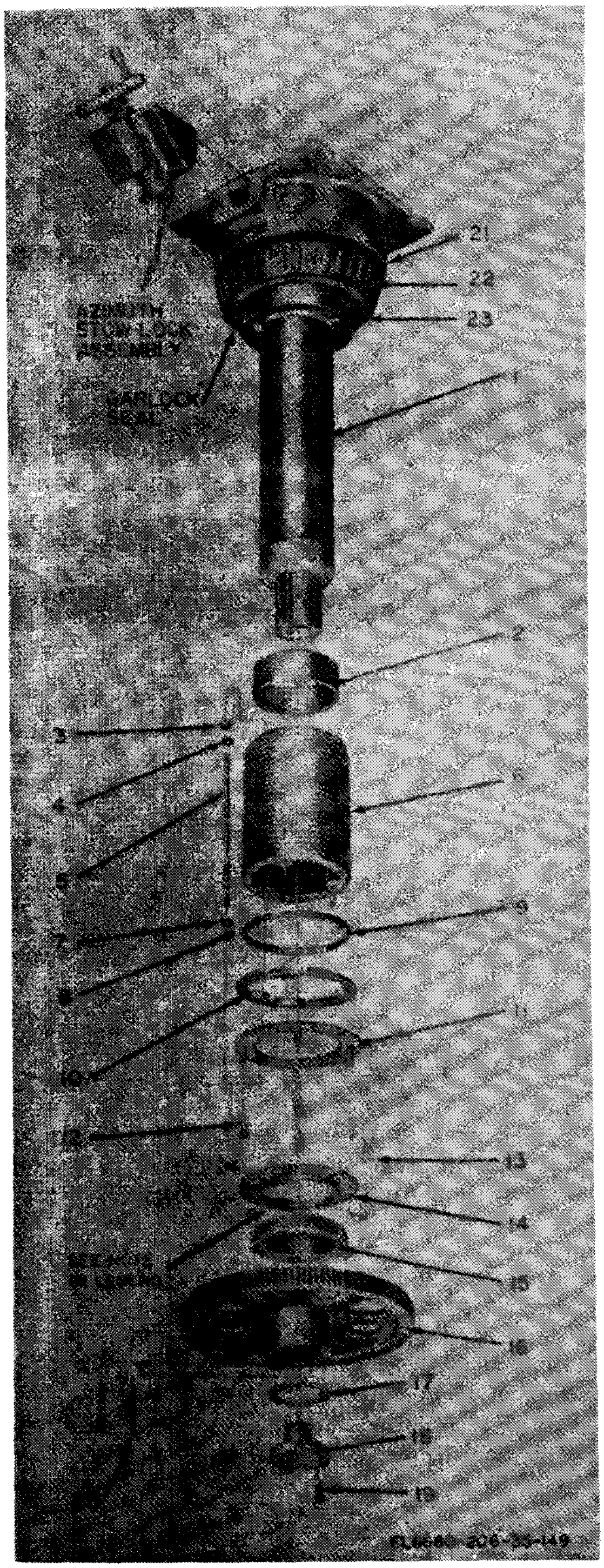
(3) Remove the lockpin lock screw (19, fig. 5-9) from the retaining screw (18).

(4) Remove the retaining screw (18, and washer (17).

(5) Remove the roll pins (20) by turning the Allen-head screw insert clockwise until the outer tubing used for the pins drop out.

NOTES

1. In pedestals bearing Order No. 1590-Phila-55, the roll pins are removed by driving them out.
2. On Pedestal AB-159C/GMD-1, hand-pins are used instead of roll pins and Allen-head inserts. The pins must be removed with a gear puller along with the drive gear (16). Removal of the drive gear from the main shaft may be accomplished only at depots that have hydraulic press facilities.



1 Main shaft
2 Spacer
3 Nut
4 Lockwasher
5 Studs (3)
6 Slipring assembly
7 Lockwasher (3)
8 Nut (3)
9 Contact rings
10 Insulating rings
11 Support plate
12 Retaining springs (4)
13 Retaining pins (4)
14 Retaining plate
15 Lower bearing
16 Drive gear
17 Washer
18 Retaining screw
19 Lockpin lock screw
20 Roll pin
21 Gasket
22 Upper bearing
23 Seal

NOTE

On some models an oil seal (0702, FSN 5330-599-7265) is located between items 14 and 15.

Figure 5-9. Turntable, exploded view.

(6) Remove the drive gear (16) from the main shaft (1).

CAUTION

When removing the turntable assembly, be very careful not to damage the insulating rings (10).

(7) Lift the turntable assembly up and out of the azimuth unit.

(8) Remove the lower bearing (15) from the azimuth unit housing.

c. Replacement.

(1) Insert the turntable assembly in the hole at the top of the azimuth unit housing.

(2) Fit the lower bearing (15) on the main shaft (1) and hold it against the retaining plate while lowering the turntable assembly into place.

(3) Slide the drive gear (16) on the shaft.

(4) Place the Allen-head screw of the roll pins (20) into the outer tubing.

(5) Insert the roll pin assemblies into the two keyways.

NOTE

On Pedstal AB-159/GMD-1, drive in the handpins.

(6) Replace the washer (17) and the retaining screw (18) on the shaft.

(7) Tighten the retaining screw to align the lockpin holes in the retaining screw and the shaft.

(8) Replace the lockpin lock screw (19) in the retaining screw.

NOTE

If the lubricant leaks down the shaft from the turntable upper bearing, remove the power at the control-recorder. Push a 0.025-inch feeler gage or a smooth strip of 1/32-inch (thickness not critical) metal up between the shaft and the casting of the azimuth unit at a number of places around the circumference of the casting. If the neoprene gasket of the Garlock seal is folded over, it will be reseated by this operation.

(9) Replace the terminal boards (fig. 3-37) with the attached spring contacts and mounting plates inside the azimuth housing.

(10) Replacement of the azimuth drive assembly (para 5-21).

5-21. Removal and Replacement of Azimuth Drive Assembly

a. General. The azimuth drive assembly (fig. 5-12) is mounted on a frame that is secured to the azimuth unit housing.

b. Removal of Azimuth Drive Assembly.

(1) Remove the cover plates from the azimuth unit housing (TM 11-6660-206-12).

(2) Remove the azimuth angle indicator assembly (para 5-22).

(3) Remove and tag all leads in the azimuth unit housing harness that are attached to the components of the azimuth drive assembly.

(4) Remove the 24 screws that secure the bottom plate to the azimuth unit and remove.

(5) Remove the 12 screws that secure the azimuth drive assembly (fig. 5-12) to the azimuth unit housing and remove the azimuth drive assembly from the azimuth unit housing.

(6) Remove two dowel pins used for aligning the azimuth drive assembly to the azimuth unit housing.

c. Replacement of Azimuth Drive Assembly.

(1) Fit the azimuth drive assembly (fig. 5-12 1) through the bottom of the azimuth unit housing and line up the screw holes on the azimuth drive assembly with those on the azimuth unit housing (fig. 3-38).

(2) Replace 12 screws and washers that secure the azimuth drive assembly to the azimuth unit housing. Do not tighten the screws at this point.

(3) Mesh the pinion attached to the final drive gear (24, fig. 5-12 ①) with turntable drive gear (16, fig. 5-9) with a minimum backlash and no evidence of binding in either direction of rotation.

(4) Tighten the 12 screws and washers previously installed in step (2) above.

(5) Drill two new holes (.3680-inch drill) through the azimuth drive assembly frame (fig. 5-12 ①) and azimuth unit (at opposite ends of azimuth drive assembly near mounting hardware) to a 3/4-inch depth.

(6) Ream the two holes using a .3740(+.0003,-0) inch diameter reamer.

(7) Install two dowel pins in holes through azimuth drive unit assembly frame and azimuth unit.

(8) Replace all leads removed in step b(3) above to their proper location.

(9) Replace azimuth angle indicator (para 5-22).

(10) Replace the cover plates on the azimuth unit.

5-22. Removal and Replacement of Azimuth Angle Indicator Assembly

a. General. The azimuth angle indicator assembly (TM 11-6660-206-12) is mounted on a bracket that is secured to the azimuth unit casting. The azimuth angle indicator is similar to the azimuth angle indicator in the control-recorder (fig. 3-53). The procedures in *b* and *c* below cover the removal and replacement of the azimuth angle indicator. Refer to paragraphs 5-27 and 5-28 for the disassembly and reassembly procedure.

b. Removal of Azimuth Angle Indicator Assembly.

(1) Remove the cover plates from the azimuth unit.

(2) Remove the four screws that secure the indicator mounting bracket to the casting of the azimuth unit.

(3) Lift the azimuth indicator assembly up to disengage the synchro drive gear (54, fig. 5-12 ②) from the azimuth indicator drive gear (10, fig. 5-13 @) and remove the assembly from within the azimuth unit.

(4) Remove two dowel pins used for aligning the azimuth angle indicator (fig. 5-13 1) assembly to the azimuth drive assembly (fig. 5-12 1).

c. Replacement of Azimuth Angle Indicator Assembly.

(1) Align the azimuth indicator assembly (fig. 5-13 1) to the azimuth drive unit (fig. 5-12 @).

(2) Mesh the synchro drive gear (54, fig. 5-12 2), with the azimuth indicator drive gear (10, fig. 5-13 ①). When the gears are meshed, push the assembly down into place.

(3) Replace and tighten the four screws that secure the indicator mounting bracket to the casting of the azimuth unit (TM 11-6660-206-12).

(4) Drill two holes (.180-inch drill) through the azimuth angle indicator assembly (fig. 5-13 ②) and casting of the azimuth unit (at opposite ends of the azimuth angle indicator assembly mounting hardware) to a 1/2-inch depth.

(5) Ream the two holes using a .187(+.0003,-0) inch diameter reamer.

(6) Install the two dowel pins in the holes through the azimuth angle indicator assembly and azimuth drive unit.

5-23. Removal and Replacement of Azimuth Stow Lock Assembly

a. General. The azimuth stow lock assembly is mounted on the main shaft turntable; it houses interlock switch S701.

b. Removal of Azimuth Stow Lock Assembly.

(1) Remove the cover from the turntable on top of the azimuth unit (fig. 3-39) by removing the eight screws that secure it.

(2) Disconnect and tag the two interlock switch leads from terminal board TB705.

(3) Remove the four screws and washers that secure the housing (11, fig. 5-14) of the stow lock assembly to the turntable assembly.

(4) Lift the stow lock assembly off the two dowel pins that position the assembly to the turntable assembly.

(5) Remove two dowel pins.

c. Replacement of Azimuth Stow Lock Assembly.

(1) Replace the two leads from the interlock switch (S701) to terminal board TB705 (fig. 3-39).

(2) Replace four screws and washers that mount azimuth stow lock assembly to pedestal.

NOTE

Before tightening screws, turn handwheel (3, fig. 5-14), make sure stow lock shaft (8) moves freely in and out of pedestal housing without binding.

(3) Drill two new holes (.242-inch drill) through azimuth stow lock housing (11) and pedestal (one on each side near elevation stow lock mounting hardware) to a 5/8-inch depth.

(4) Remove azimuth stow lock assembly and ream two holes .2505(+.0003,-0) inch diameter.

(5) Ream two holes in pedestal to .250(+.0003,-0) inch diameter.

(6) Replace azimuth stow lock assembly to pedestal housing and replace four mounting screws.

(7) Install two dowel pins in hole through stow lock assembly and pedestal housing.

(8) Replace cover on turntable top and replace eight screws that secure it.

5-24. Disassembly and Reassembly of Turntable Assembly

a. General. The procedures in *b* and *c* below cover the disassembly and reassembly of a dismounted turntable assembly. If any of the sliprings become damaged, it is not necessary to completely disassemble the turntable assembly; however the assemblies mounted on the azimuth unit (TM 11-6660-206-12) must be removed before attempting the repair of the sliprings (*d* below).

b. Disassembly of Turntable Assembly.

(1) Depress the retaining plate (14, fig 5-9) and remove the four retaining pins (13) from the main shaft (1).

(2) Slide the retaining plate (14) off the main shaft.

(3) Remove the four retaining springs (12) from the posts on the support plate (11).

(4) Remove the three nuts (8) and lockwashers (7) from the slipring studs (5) and slide the support plate (11) off the main shaft (1).

NOTE

The slipring assembly (6) is made up of a number of insulating rings (10) and contact rings (9); these rings are removed one at a time.

(5) Slide one the insulating rings (10) off the studs (5).

(6) Unsolder and tag the lead attached to the inside of one of the contact rings (9) and slide the ring off the studs (5).

(7) Repeat the procedures given in (5) and (6) preceding until all insulating and contact rings are removed from the main shaft.

(8) Remove the three studs (5) from the last insulating ring.

(9) Remove the nut (3) and lockwasher (4) from each stud (5).

(10) Slide the spacer (2) off the main shaft (1).

c. Reassembly of Turntable Assembly.

(1) Slide the spacer (2, fig. 5-9) on the main shaft (1).

(2) Replace the nut (3) and lockwasher (4) on each stud (5).

(3) Insert the studs (5) in the holes on one of the insulating rings (10). Slide the studs in from the flat side of the insulating ring.

(4) Slide the insulating ring (10) with studs on the main shaft (1) flat side up.

(5) Fit one of the contact rings (9) on the collar of the insulating ring (10) and solder the proper lead to the contact ring.

(6) Slide the next insulating ring over the shaft flat side up and on the studs.

(7) Slide the next contact ring over the shaft ((5) preceding) on the studs and fit it to the insulating ring. Solder the proper lead to the contact ring.

(8) Repeat the procedures given in (6) and (7) above, until all rings are reassembled.

(9) Slide the support plate (11) on the shaft and on the studs (5).

(10) Place the retaining springs (12) on the support plate studs.

(11) Fit the retaining plate (14) on the shaft and press against the retaining springs. Replace the retaining pins (13) in the holes on the main shaft.

d. Repair of Slipring Broken Connections.

(1) Remove the cover plates from the azimuth unit (TM 11-6660-206-12).

(2) Lay the azimuth unit on its side.

(3) Remove the retaining pins (13, fig. 5-9) and slide the retaining plate (14) down on the main shaft (1).

(4) Remove the nuts (3 and 8) and lock-washers (4 and 7) from the studs (5) at both ends of the slipring assembly (6).

(5) Carefully spread the sliprings apart at the defective point and resolder the broken connection.

(6) Carefully compress the sliprings together and replace the lockwahers (4 and 7) and the nuts (3 and 8) on the studs at both ends of the slipring assembly (6).

(7) Slide the retaining plate (14) back on the main shaft (1).

(8) Replace the retaining pins (13).

(9) Turn the azimuth unit back on its base.

(10) Replace the cover plates on the azimuth unit.

5-25. Disassembly of Azimuth Drive Assembly

a. General. The azimuth drive assembly (fig. 5-12) consists of the azimuth synchro transmitter, azimuth drive motor, azimuth antihunt generator, and the azimuth drive gearing. The procedures in *b* through *e* below cover the disassembly of an azimuth drive assembly.

b. Disassembly of Azimuth Aynchro Transmitter. The azimuth aynchro transmitter is replaced as a complete unit when found to be defective. To remove the azimuth synchro transmitter from the drive assembly, remove the four screws (12, fig. 5-12 @) and washers (13) from the mounting lugs (14), and lift the azimuth synchro transmitter out of the synchro mounting plate (18) on the frame of the azimuth drive assembly.

c. Disassembly of Azimuth Drive Motor.

(1) Remove the four screws (11, fig. 5-12 **1)** that secure the azimuth drive motor and motor mounting plate (44) to the frame.

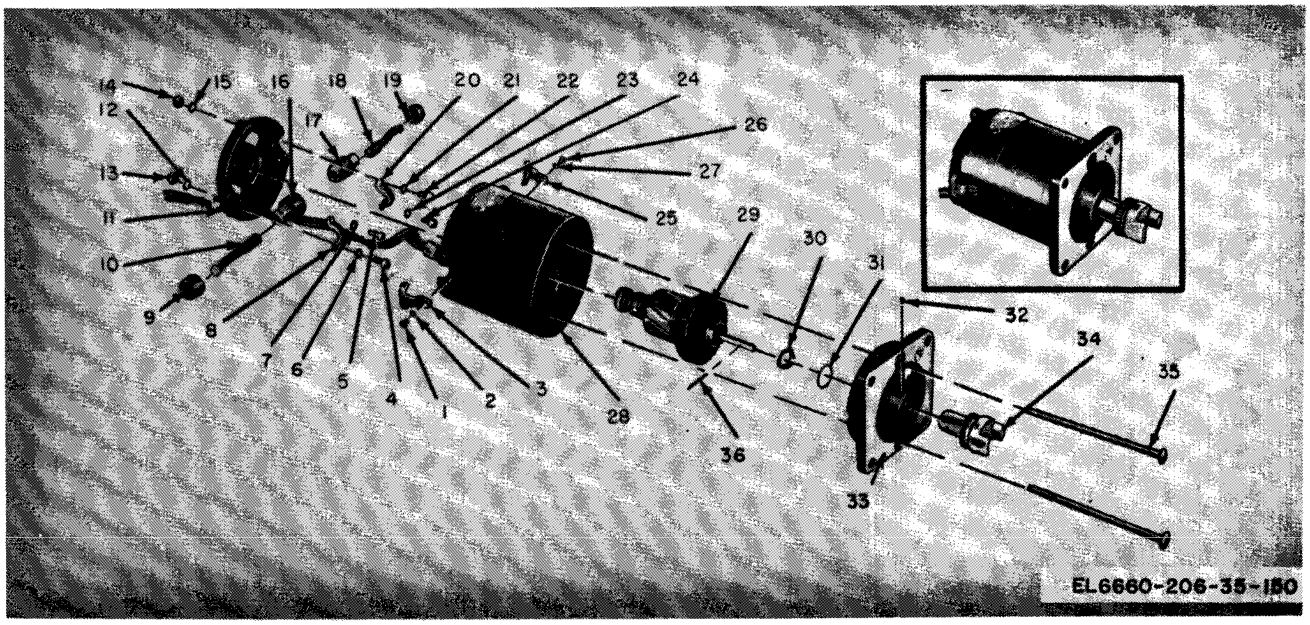
(2) Lift the motor up sharply to disconnect the coupling on the azimuth drive motor shaft from the shaft coupling (8).

(3) Remove the two screws (1 and 26, fig. 5-10) and washers (2 and 27) that secure the brush cap clamps (3 and 25) on the left endbell, and then remove the two brush holder caps (9 and 19) and the two brushes (10 and 18).

(4) Drive the pin (36) out of the motor shaft coupling (34) and slide the coupling off the armature shaft.

(5) Remove the retaining nut (13 and 14) and washer (12 and 15) from the through bolts (35) and withdraw the bolts from the end plate (33).

(6) Place the blade of a screwdriver in the slot and pry the end plate (33) away from the housing (28).



1 Screw	19 Brush holder cap
2 Washer	20 Brush holder clamp
3 Brush cap clamp	21 Washer
4 Screw	22 Screw
5 Screw	23 Washer
6 Washer	24 Screw
7 Washer	25 Brush cap clamp
8 Brush holder clamp	26 Screw
9 Brush holder cap	27 Washer
10 Brush	28 Housing
11 Endbell	29 Armature
12 Washer	30 Spring
13 Retaining nut	31 Washer
14 Retaining nut	32 Oilhole screws (2)
15 Washer	33 End plate
16 Brush holder	34 Motor shaft coupling
17 Brush holder	35 Through bolts
18 Brush	36 Pin

Figure 5-10. Azimuth drive motor, exploded view.

(7) Slide the armature (29) out of the housing (28).

(8) Remove the spring (30) and washer (31) from the bearing hole in the end plate (33).

(9) Remove the two oilhole screws (32) from the end plate (33).

(10) Remove the two oilhole screws from the endbell (11).

(11) Pry the endbell (11) away from the housing (28).

(12) Remove the screws (4, 5, 22, and 24) and washers (6, 7, 21, and 23) that secure the brush holder clamps (8 and 20), and then remove the two clamps and two brush holders (16 and 17).

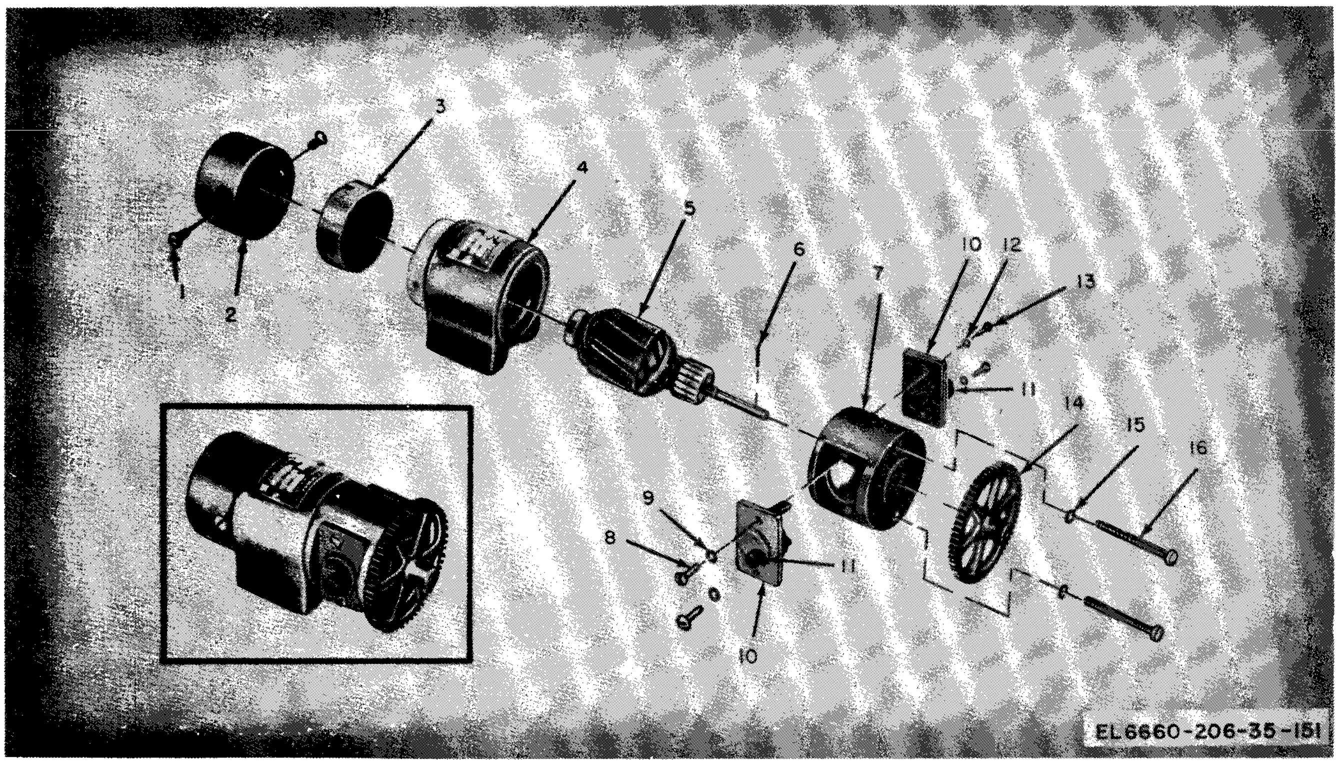
(13) Slip the contact spring off each brush holder (16).

d. Disassembly of Azimuth Antihunt Generator.

(1) Remove the three screws (45, fig. 5-12 **2)** that secure the azimuth antihunt generator to the motor mounting plate (44) and lift the generator off the frame.

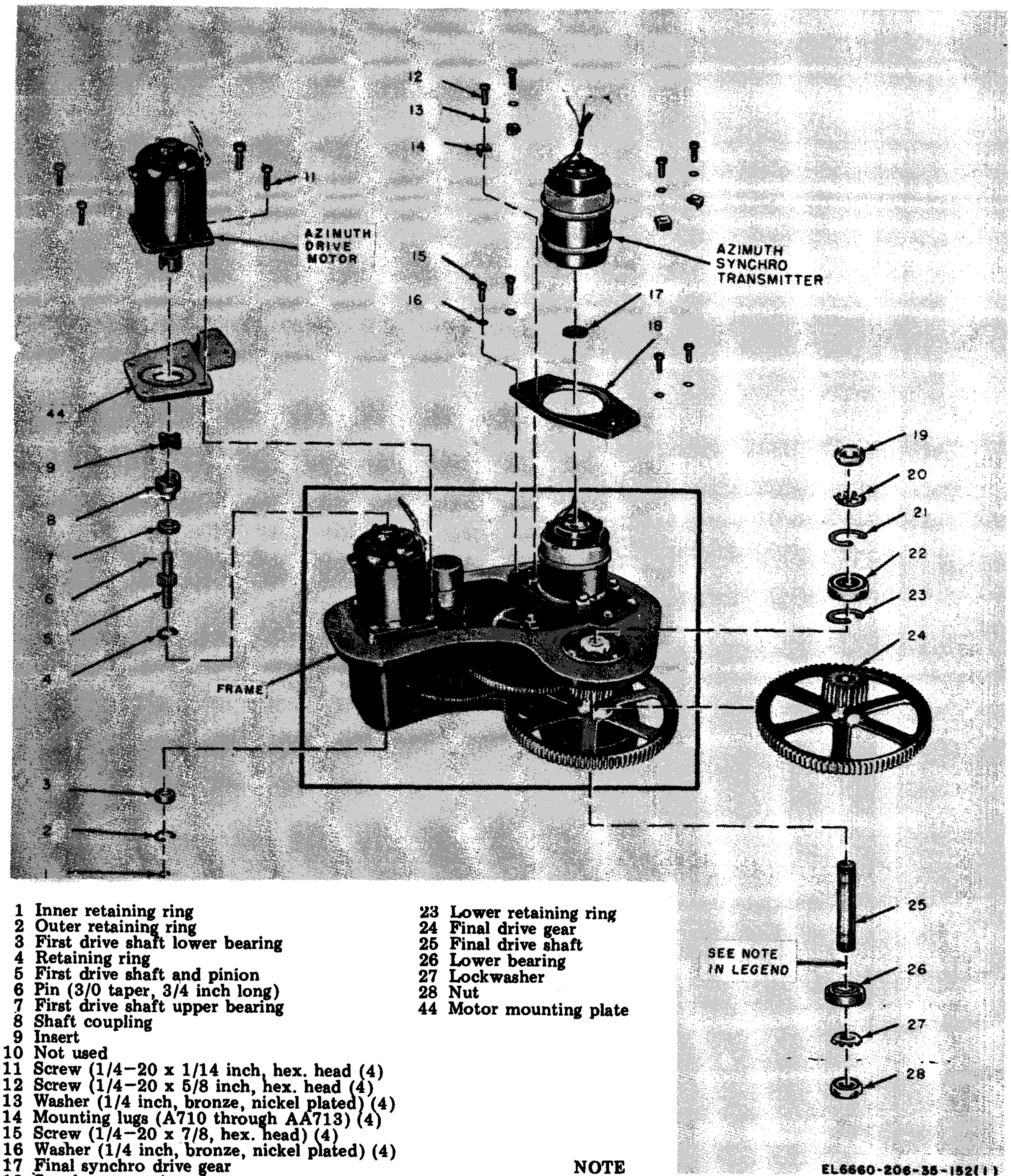
(2) Remove the two screws (13, fig. 5-11) and the two washers (12) that secure the brush holder (10) and lift the brush holder off the right endbell (7).

(3) Remove the two screws (8) and the two washers (9) that secure the brush holder (10), and lift the brush holder off the right endbell (7).



1 Screws (2)
2 Left endbell
3 Magnet
4 Armature housing
5 Armature
6 Pin
7 Right endbell
8 Screws (2)
9 Washers (2)
10 Brush holder
11 Brush cap
12 Washers (2)
13 Screws (2)
14 Generator gear
15 Washers (2)
16 Screws (2)

Figure 5-11. Azimuth antihunt generator, exploded view.

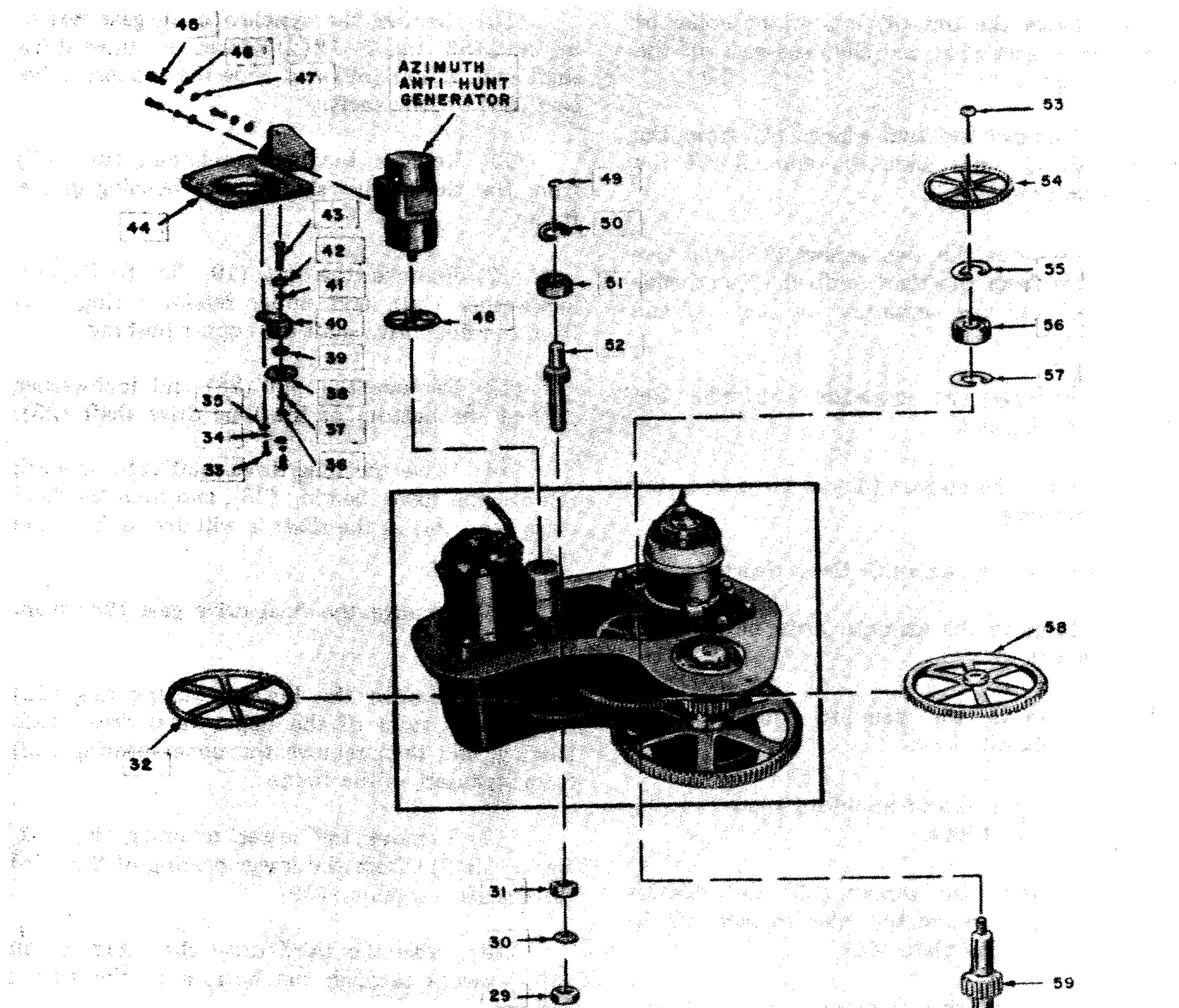


1 Inner retaining ring
2 Outer retaining ring
3 First drive shaft lower bearing
4 Retaining ring
5 First drive shaft and pinion
6 Pin (3/0 taper, 3/4 inch long)
7 First drive shaft upper bearing
8 Shaft coupling
9 Insert
10 Not used
11 Screw (1/4–20 x 1/14 inch, hex. head (4)
12 Screw (1/4–20 x 5/8 inch, hex. head (4)
13 Washer (1/4 inch, bronze, nickel plated) (4)
14 Mounting lugs (A710 through AA713) (4)
15 Screw (1/4–20 x 7/8, hex. head) (4)
16 Washer (1/4 inch, bronze, nickel plated) (4)
17 Final synchro drive gear
18 Synchro mounting plate
19 Nut
20 Lockwasher
21 Upper retaining ring
22 Upper bearing
23 Lower retaining ring
24 Final drive gear
25 Final drive shaft
26 Lower bearing
27 Lockwasher
28 Nut
44 Motor mounting plate

NOTE

On some models a spacing collar (SC–B–94016, FSN 6660–615–7909) is located between items 25 and 26.

Figure 5-12 (1). Azimuth drive assembly, exploded view (sheet 1 of 2).



29 Nut
30 Lockwasher
31 Second drive shaft lower bearing
32 First drive gear
33 Screw (8–32 x 5/8 inch, roundhead, steel) (2)
34 Washer (No. 8, lock, bronze, nickel plated)
35 Washer (No. 8, brass, nickel plated)
36 Retaining nut (10–32, hex., brass, nickel plated)
37 Washer (No. 10, brass, nickel plated)
38 Idler gear
39 Lower bearing
40 Idler bracket
41 Spacer
42 Upper bearing
43 Idler shaft
44 Motor mounting plate
45 Screw (same as 33) (3)
46 Washer (same as 34) (3)
47 Washer (same as 35) (3)
48 Generator gear
49 Inner retaining ring
50 Outer retaining ring
51 Second drive shaft and upper bearing
52 Second drive shaft and pinion
53 Synchro drive gear retaining nut (3/8–16, hex., stainless steel)
54 Synchro drive gear
55 Upper retaining ring
56 Third drive shaft upper bearing
57 Lower retaining ring
58 Second drive gear
59 Third drive shaft and pinion
60 Third drive shaft lower bearing
61 Lower retaining ring

Figure 5–12 (2). Azimuth drive assembly, exploded view (sheet 2 of 2).

(4) Drive the pin (6) out of the collar of the generator gear (14) and slide the gear off the armature shaft.

(5) Remove the two screws (1) from the left endbell (2) and slide the endbell off the armature housing (4).

(6) Remove the two screws (16) and two washers (15) from the right endbell (7) and slide the endbell off the armature housing (4) and armature shaft.

(7) Remove the armature (5) from the armature housing (4).

(8) Slide the magnet (3) off the end of the armature housing.

e. Disassembly of Azimuth Drive Gearing.

(1) Remove the azimuth drive motor (c(1) and (2) above).

(2) Remove the azimuth antihunt generator (d(1) above).

(3) Lift the motor mounting plate (44, fig. 5-12 **2)** off the frame.

(4) Remove the screws (33) and washers (34 and 35) that secure the idler bracket (40) to the motor mounting plate (44).

(5) Remove the retaining nut (36) and washer (37) from the idler shaft (43), and then remove the idler gear (38).

(6) Remove the idler shaft from the idler bracket (40).

(7) Remove the lower bearing (39), spacer (41), and upper bearing (42) from the bearing hole of the idler bracket.

(8) Remove the azimuth synchro transmitter (*b* above).

(9) Remove the four screws (15, fig. 5-12 **1)** and washers (16) that secure the synchro mounting plate (18), and lift the plate off the drive frame.

(10) Remove the synchro drive gear retaining nut (53, fig. 5-12 ②) from the third drive shaft and pinion (59) and slide the synchro drive gear (54) off the shaft.

(11) Remove the upper retaining ring (55) from the third drive shaft upper bushing in the frame.

(12) Remove the nut (19, fig. 5-12 @ **),** lockwasher (20), and upper retaining ring (21) from the final drive shaft (25) upper bushing.

(13) Remove the nut (28) and lockwasher (27) at the bottom of the final drive shaft (25).

(14) Drive the final drive shaft (25) upward; remove the lower bearing (26), and hold the final drive gear (24) as the shaft is withdrawn from the frame.

(15) Remove the final drive gear (24) from the frame.

(16) Remove the lower retaining ring (23) from the bottom of the upper final drive shaft bearing, and then remove the upper bearing (22) from its insert in the frame.

(17) Remove the lower retaining ring (61, fig. 5-12 ②) from the lower bearing of the third drive shaft and pinion (59).

(18) Drive the third drive shaft and pinion (59) upward through the bottom of the frame; remove the third drive shaft lower bearing (60) from its insert in the frame, and then remove the second drive gear (58) as the shaft is withdrawn from the frame.

(19) Remove the lower retaining ring (57) from the third drive shaft upper bearing (56); remove the upper bearing (56) from its insert in the frame.

(20) Remove the inner and outer retaining rings (49 and 50) from the second drive shaft upper bearing (51) and the bearing insert in the frame.

(21) Remove the nut (29) and lockwasher (30) at the bottom of the second drive shaft and pinion (52).

(22) Drive the second drive shaft and pinion (52) upward through the bottom of the frame, and remove the second drive shaft lower bearing (31) from its insert in the frame.

(23) Remove the first drive gear (32) as the second drive shaft and pinion (52) is withdrawn.

(24) Remove the second drive shaft upper bearing (51) from the second drive shaft.

(25) Remove the inner and outer retaining rings (1 and 2, fig. 5-12 @) from the first drive shaft lower bearing (3) and the bearing insert in the frame.

(26) Remove the retaining ring (4) from the top of the first drive shaft lower bushing in the frame.

(27) Drive the first drive shaft and pinion (5) upward through its lower bushing in the frame.

(28) Remove the first drive shaft lower bearing (3) from its insert in the frame.

(29) Drive the pin (6) out of the shaft coupling (8) and remove the coupling from the shaft .

(30) Remove the insert (9) from the shaft coupling (8).

5-26. Reassembly of Azimuth Drive Assembly

a. Reassembly of Azimuth Drive Gearing. The procedures in (1) through (28) below cover the reassembly of a disassembled azimuth drive gearing (para 5-25).

(1) Fit the first drive shaft lower bearing (3, fig. 5-12 ①) in the first drive shaft insert in the frame and replace the retaining rings (1, 2, and 4).

(2) Insert the first drive shaft and pinion (5) in the lower bearing.

(3) Insert the first drive shaft upper bearing (7) in its insert in the frame.

(4) Replace the insert (9) in the shaft coupling (8) and fit the coupling to the first drive shaft and pinion (5). Replace the pin (6) that secures the coupling to the shaft.

(5) Fit the second drive shaft lower bearing (31, fig. 5-12 ②) in the second drive shaft insert in the frame.

(6) Fit the first drive gear (32) to the second drive shaft and pinion (52) bushing in the frame; mesh the gear with the first drive shaft and pinion (5, fig. 5-12, sheet 1). Insert the second drive shaft and pinion (52, fig. 5-12 ②) through the first drive gear (32) and into the second drive shaft lower bearing (31).

(7) Fit the second drive shaft upper bearing (51) in its insert in the frame; replace the inner and outer retaining rings (49 and 50).

(8) Replace the lockwasher (30) and nut (29) on the lower end of the second drive shaft and pinion (52) beneath the bottom plate of the frame.

(9) Replace the third drive shaft upper bearing (56) in its insert in the frame and replace the upper and lower retaining rings (57, 55).

(10) Fit the second drive gear (58) to the third drive shaft and pinion (59) bushing in the frame and hold it in place.

(11) Mesh the second drive gear (58) with the second drive shaft and pinion (52).

(12) Insert the third drive shaft and pinion (59) through the gear and into the third drive shaft upper bearing (56).

(13) Replace the third drive shaft lower bearing (60) in its insert in the frame; replace the lower retaining ring (61) in its insert in the frame.

(14) Replace the synchro drive gear (54) on the upper end of the third drive shaft and pinion (59), and replace the synchro drive gear retaining nut (53).

(15) Fit the lower retaining ring (23, fig. 5-12 ①) in the final drive shaft upper bearing insert in the frame; replace the upper retaining ring (21).

(16) Fit the final drive gear (24) to the final drive shaft (25) bushing and hold in place; mesh

the gear with the third drive shaft and pinion (59, fig. 5-12 ②2).

(17) Insert the final drive shaft (25, fig. 5-12 ①) through the bottom of the frame, through the final drive gear (24), and into the upper bearing (22).

(18) Fit the lower bearing (26) in its insert in the frame; replace the lockwasher (27) and the nut (28) on the lower end of the shaft beneath the bottom plate of the frame.

(19) Fit the synchro mounting plate (18) to the frame; align the pins on the plate with the locating holes on the frame.

(20) Replace the washers (16), and insert and tighten the four screws (15) that secure the synchro mounting plate (18) to the frame.

(21) Fit the upper bearing (42, fig. 5-12 @) in the bearing hole on the idler bracket (40).

(22) Insert the idler shaft (43) in its bearing.

(23) Slide the spacer (41) on the shaft.

(24) Fit the lower bearing (39) on the idler shaft (43) and in the bearing hole on the idler bracket.

(25) Fit the idler gear (38) to the idler shaft (43) and replace the washer (37) and retaining nut (36).

(26) Fit the idler bracket (40) to the motor mounting plate (44) and replace the washers (34 and 35) and the two screws (33) that secure the bracket to the motor mounting plate (44).

b. Reassembly of Azimuth Antihunt Generator. The procedures in (1) through (10) cover the reassembly of a disassembled azimuth antihunt generator (para 5-25d).

(1) Fit the magnet (3, fig. 5-11) to the armature housing (4).

(2) Fit the left endbell (2) to the armature housing (4) and replace and tighten the two screws (1) that secure the left endbell to the housing.

(3) Slide the armature shaft into the buahing on the right endbell (7).

(4) Slide the armature (5) into the housing and fit the right endbell (7) to the armature housing (4).

(5) Replace the two washers (15) and tighten the two screws (16) that secure the right endbell (7) to the armature housing (4).

(6) Fit the brush cap (11) to the right endbell, replace the two washers (12), and tighten the two screws (13) that secure the cap to the right endbell.

(7) Slide the generator gear (14) on the armature shaft, align the holes for pin (6) in the gear and the shaft, and replace the pin (6).

(8) Fit the generator to the motor mounting plate (44, fig. 5-12 @).

(9) Mesh the generator gear (48) with the idler gear (38).

(10) Replace and tighten the three screws (45) and washers (46 and 47) that secure the generator to the motor mounting plate (44).

c. Reassembly of Azimuth Drive Motor. The procedures in (1) through (17) below cover the reassembly of a disassembled azimuth drive motor (para 5-25), and mounting of an assembled motor on the frame (fig. 5-6 ①).

(1) Slip a contact spring on each brush holder (16 and 17, fig. 5-10).

(2) Fit the brush holders on the endbell (11).

(3) Fit the brush holder clamps (8 and 20) to the brush holders (16 and 17).

(4) Replace the four screws (4, 5, 22, and 24) and washers (6, 7, 21, and 23), to secure the two clamps.

(5) Fit the endbell (11) to the housing (28).

(6) Slide the shaft of the armature (29) through the housing (28) into the endbell (11).

(7) Replace the washer (31) and spring (30) on the shaft of the armature.

(8) Slide the bushing of the end plate (33) on the shaft of the armature (29) and fit the end plate (33) to the housing (28).

(9) Align the holes for the through bolts (35); replace the screws (12) and washers (15), and then tighten the retaining nuts (13 and 14).

(10) Slide the motor shaft coupling (34) on the end of the armature shaft; align the locating holes in the coupling and armature shaft, and replace the pin (36).

(11) Replace the two oilhole screws (32) in the end plate (33).

(12) Replace the two brushes (10 and 18) into the brush holders (16 and 17).

(13) Set the two brush holder caps (9 and 19) over the brush springs and secure the brush holder caps with the brush cap clamps (3 and 25), screws (1 and 26), and washers (2 and 27).

(14) Fit the azimuth drive motor to the mounting plate (44, fig. 5-12 @) on the frame.

(15) Align and engage the motor shaft coupling (34, fig. 5-10) with the shaft coupling (8, fig. 5-12 @).

(16) Replace and tighten the four screws (11) that secure the motor and mounting plate (44) to the frame.

(17) Check the meshing of the first drive shaft and pinion (5) and the antihunt idler gear.

d. Reassembly of Azimuth Synchro Transmitter. The azimuth synchro transmitter is replaced as a unit (para 5-21). To replace the azimuth synchro transmitter on the drive flame, use the procedure given in (1) through (5) below:

(1) Fit the azimuth synchro transmitter to the synchro mounting plate (18, fig. 5-12 @) on the frame.

(2) Check the meshing of the synchro drive gears (54, fig. 5-12 ②) and final synchro drive gear (17, fig. 5-12 @).

(3) Locate the four mounting lugs (14) and align the holes in the motiting lugs (14) with, those in the synchro mounting plate (18).

(4) Replace the four washers (13) on the mounting lugs (14).

(5) Replace and tighten the four screws (12) that secure the mounting lugs (14) to the synchro mounting plate (18).

5-27. Disassembly of Azimuth Angle Indicator Assembly

The procedures in *a* through *ae* below cover the disassembly of an azimuth angle indicator.

a. Remove the three screws (1, fig. 5-13 ①) that secure the mounting plate (2) to the mounting bracket (3).

b. Slide the indicator unit forward, and withdraw the center shaft (11, fig. 5-13 ②) from the driving clutch (12).

c. Remove the retaining ring (13) from the transfer arm pin (14) and remove the arm pin and the transfer arm (15).

d. Slide the driven clutch (16) and driven clutch spring (17) off the center shaft (11).

e. Remove the four bearing support plate screws (18) that secure the bearing support plate (19) to the backplate (20) and lift the bearing support plate from the backplate.

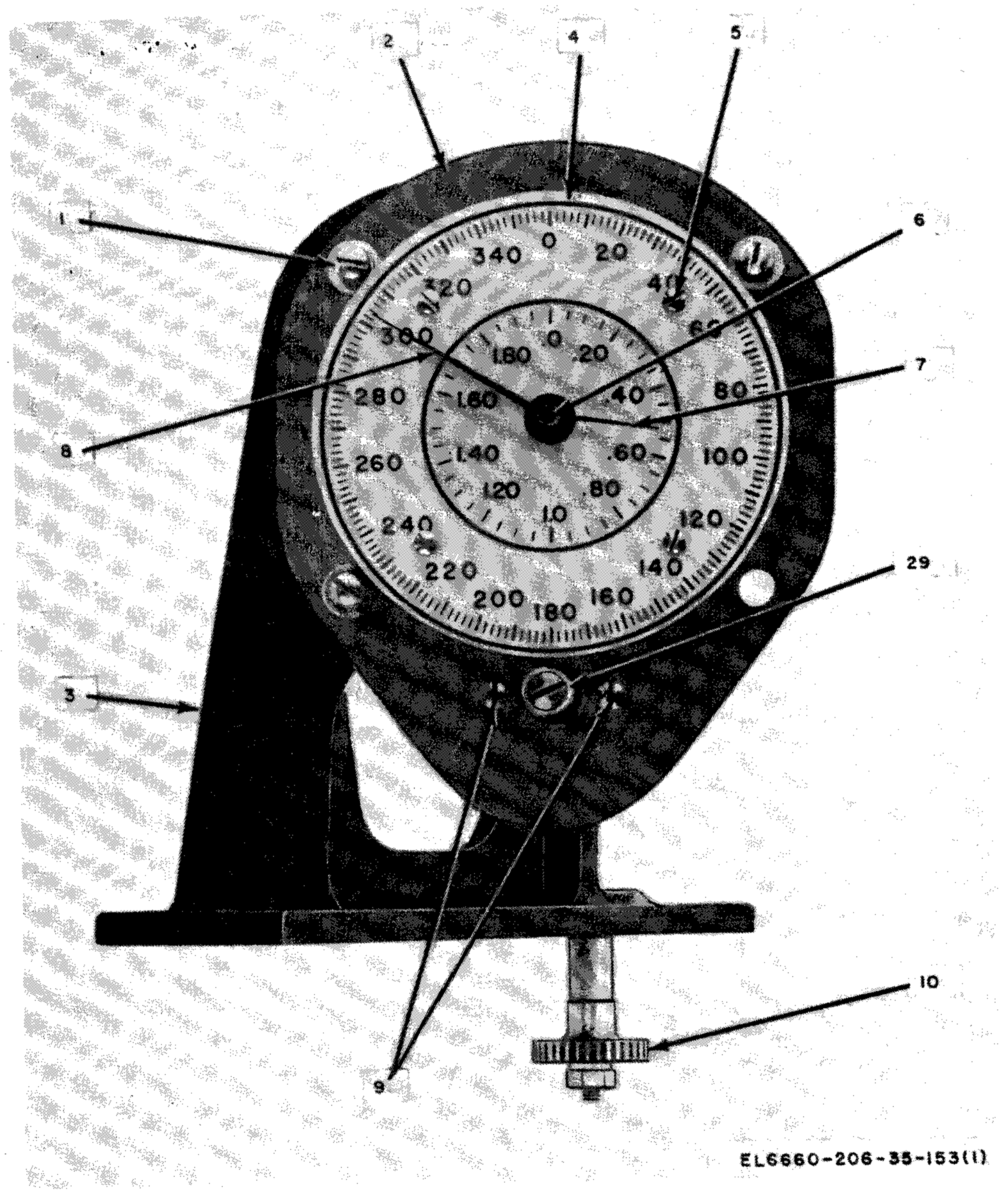
f. Remove the two bearing post screws (21) that secure the bearing post (22) to the bearing support plate (19).

g. Loosen the setscrews and remove the bevel gears (23) from the intermediate reset shaft (24).

h. Remove the intermediate reset shaft (24) from the bearing post (22).

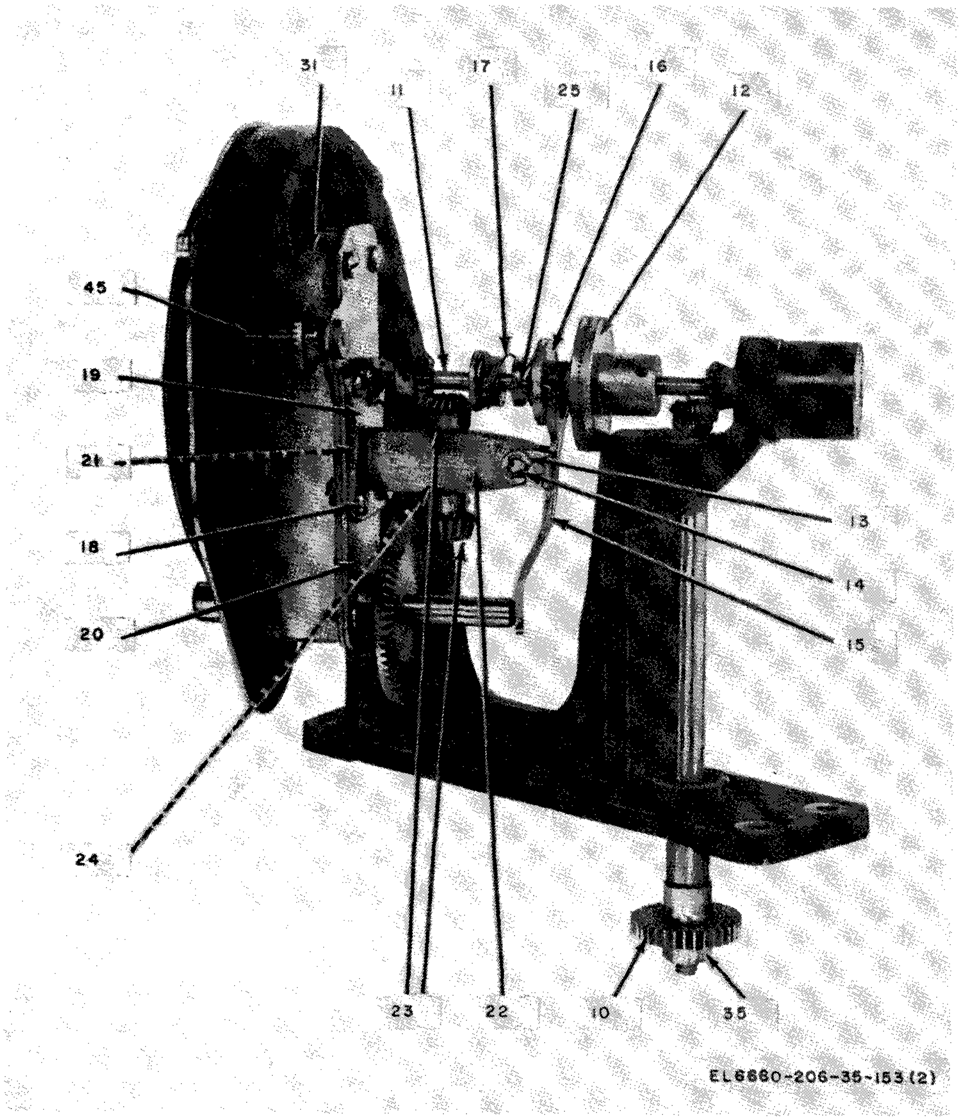
i. Drive the center shaft pin (25) out of the center shaft.

j. Loosen the two setscrews on the center shaft stop collar (26, fig. 5-13 ③) and slide the collar off the center shaft.



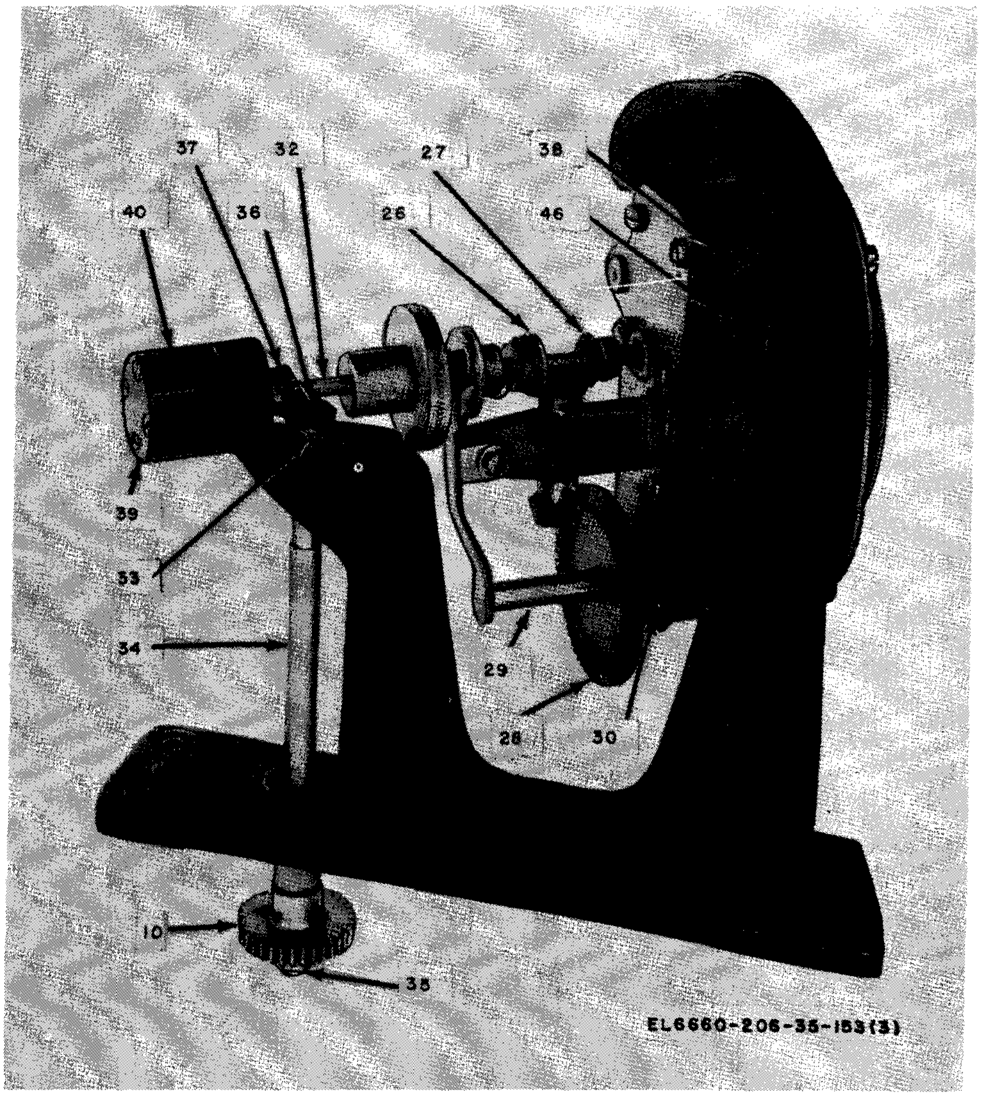
1 Mounting screw (3)
2 Mounting plate
3 Mounting bracket
4 Dial
5 Dial mounting screws (4)
6 Center shaft nut
7 Decimal degree hand
8 Degree hand
9 Sideplate mounting screws (8)
10 Drive gear

Figure 5-13 (1). Azimuth angle indicator (sheet 1 of 4).



10 Drive gear
11 Center shaft
12 Driving clutch
13 Retaining ring
14 Transfer arm pin
15 Transfer arm
16 Driven clutch
17 Driven clutch spring
18 Bearing support plate screws (4)
19 Bearing support plate
20 Backplate
21 Bearing post screws (2)
22 Bearing post
23 Bevel gears
24 Intermediate reset shaft
25 Center shaft pin
31 Right sideplate

Figure 5-13 (2). Azimuth angle indicator (sheet 2 of 4).



10 Drive gear
26 Center shaft stop collar
27 Center shaft bevel gear
28 Reset bevel gear
29 Reset shaft
30 Backplate screws (4)
32 Driving clutch shaft
33 Vertical shaft pin
34 Vertical drive shaft
36 Hex. nut
36 Vertical drive shaft bevel gear
37 Drivin clutch shaft bevel gear
38 Left sideplate
39 Grease cup screw (4)
40 Grease cup

Figure 5-13 ③. Azimuth angle indicator (sheet 3 of 4).

k. Loosen the two setscrews on the center shaft bevel gear (27) and slide the gear off the center shaft.

l. Loosen the two setscrews on the reset bevel gear (28) and remove the gear from the reset shaft (29).

m. Remove the four backplate screws (30) that hold the backplate (20, fig. 5-13 ② to the right and left sideplates (31, fig. 5-13 **2**) and (38, fig. 5-13 ③); remove the backplate.

n. Remove the center shaft nut (6, fig. 5-13 ①); then remove the degree hand (8) and decimal degree hand (7) from the center shaft.

o. Remove the four dial mounting screws (5) that secure the dial (4) to the dial posts and lift the dial off the posts.

p. Lift the center wheel gear (14, fig. 5-13 ④) off the center shaft.

q. Loosen the two setscrews on the reset shaft stop collar (42) and withdraw the reset shaft from the bearing hole in the mounting plate (2, fig. 5-13 ①). This will release the reset shaft stop collar (42, fig. 5-13 ④) and the reset shaft spring (43).

r. Remove the setscrew on the intermediate drive shaft gear (44) and remove the gear. Remove the intermediate drive shaft bevel gear (50) with the intermediate drive shaft (45).

s. Loosen the two setscrews on the intermediate drive shaft bevel gear (50) and remove the gear from the shaft.

t. Remove the four screws (9, fig. 5-13) that secure the left sideplate (38, fig. 5-13 **3**) to the mounting plate, and the four sideplate mounting screws (9, fig. 5-13 ②) that secure the right sideplate (31, fig. 5-13 **2**) to the mounting plate (2, fig. 5-13 ①). Two screws (9) are shown in figure 5-13 ① and the remaining six are covered by dial (4)).

u. Separate the mounting plate (2) from the right and left sideplates.

v. Slide the left sideplates (38, fig. 5-13 ③) off the worm shaft (46, fig. 5-13 **4**).

w. Remove the two setscrews from the worm wheel (47) and remove the worm wheel from the worm shaft (46).

x. Place the right sideplate (31, fig. 5-13 ②) over the open jaws of a vise with the worm shaft bevel gear (48, fig. 5-13 ④) up and drive the worm shaft (46) out with a center punch.

NOTE

The worm (49) is pinned to the center shaft and is not to be removed.

y. Loosen the two setscrews on the driving clutch (12, fig. 5-13 ②) and remove the driving clutch from the driving clutch shaft (32, fig. **5-9** ③).

z. Drive the vertical shaft pin (33) out of the vertical drive shaft bevel gear (36) on the vertical drive shaft (34).

aa. Pull the vertical shaft out with a gear puller.

ab. Remove the hexagonal nut (35) and lock-washer from the vertical shaft and remove the drive gear (10).

ac. Remove the driving clutch shaft (32) by pulling it out of the grease cup bearing.

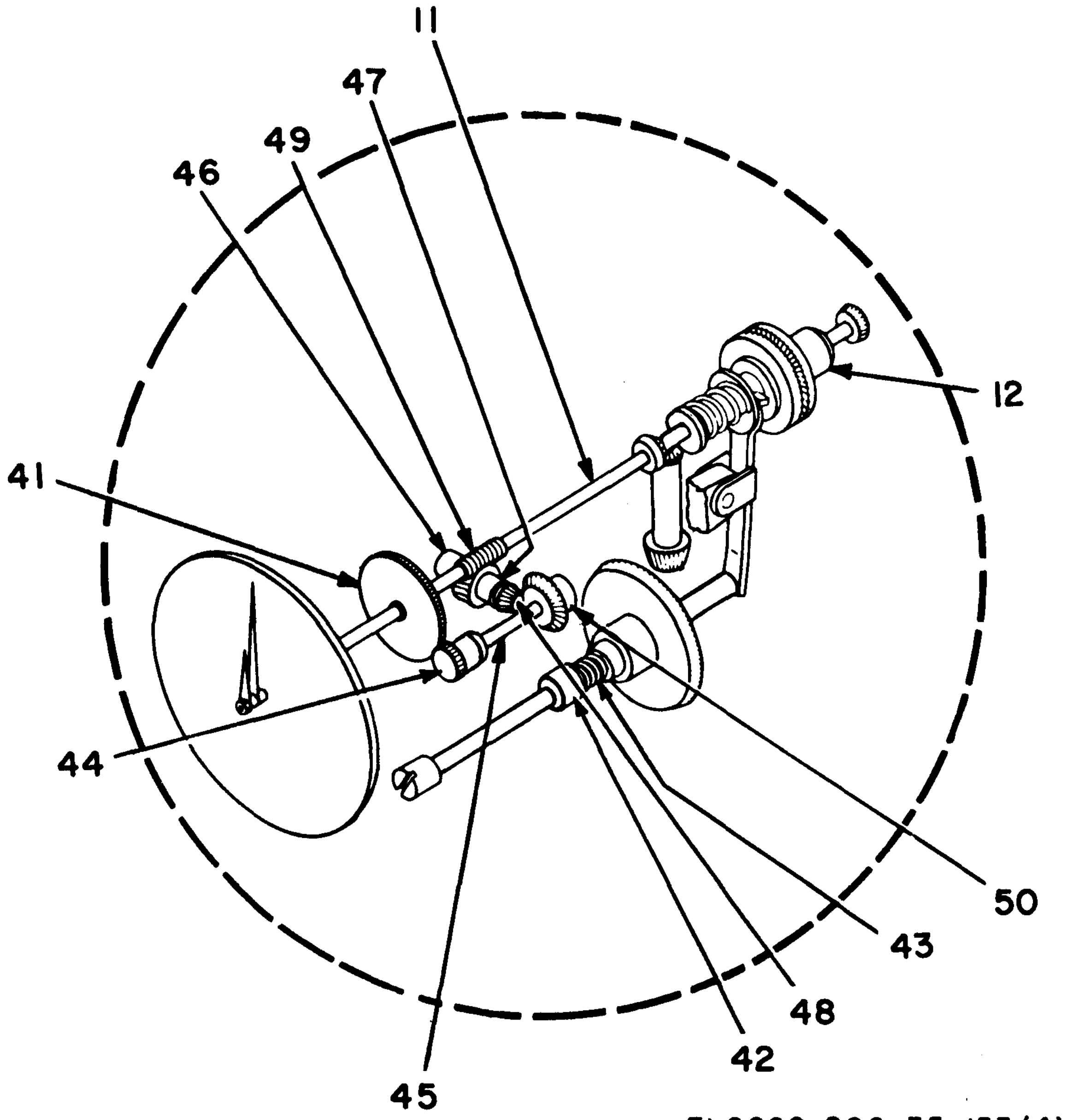
ad. Loosen the two setscrews in the driving clutch shaft bevel gear (37) on the driving clutch shaft and remove the bevel gear.

ae. Loosen the four grease cup screws (39) at the rear of the grease cup (40) and remove the cup from the mounting bracket (3, fig. 5-13 ①).

5-28. Reassembly of Azimuth Angle Indicator Assembly

The directions in *a* through *aj* below cover the reassembly of a disassembled azimuth angle indicator (para 5-22).

a. Replace the grease cup (40, fig. 5-13 ③) on the mounting bracket (3, fig. 5-13 ①) and secure with the four grease cup screws (39, fig. 5-13 ③).



41	Center wheel gear	46	Worm shaft
42	Reset shaft stop collar	47	Worm wheel
43	Reset shaft spring	48	Worm shaft bevel gear
44	Intermediate drive shaft gear	49	Worm
45	Intermediate drive shaft	50	Intermediate drive shaft bevel gear

Figure 5-13 (4). Azimuth angle indicator (sheet 4 of 4).

b. Replace the driving cluth shaft bevel gear (37) on the driving clutch shaft (32). Do not tighten the two setscrews on the bevel gear at this time.

c. Replace the driving clutch shaft (32) in the grease cup bearing.

d. Replace the drive gear (10) lockwasher and hexagonal nut (35) on the vertical drive shaft (34).

e. Hold the vertical drive shaft bevel gear (36) over the bearing hole in the top of the mounting bracket and insert the vertical drive shaft (34) through the bearing holes in the mounting bracket and into the vertical drive shaft bevel gear (36).

f. Pin the bevel gear to the vertical shaft; use the vertical shaft pin (33).

g. Hold the driving clutch shaft (32) into the grease cup bearing as far as it will go, and engage the vertical drive shaft bevel gear (36) and driving clutch shaft bevel gear (37); then tighten the setscrews on the driving clutch shaft bevel gear (37) on the driving clutch shaft (32).

h. Replace the driving clutch (12, fig. 5-13 **2)** on the driving clutch shaft (32, fig. 5-13 **3).** Do not tighten the two setscrews on the driving clutch at this time.

i. Insert the worm shaft (46, fig. 5-13 ④**)** into the right sideplate (31, fig. 5-13, sheet 2) and tap the worm shaft bevel gear (48, fig. 5-13 **4)** on to the worm shaft (46).

j. Push the worm wheel (47) on the worm shaft (46) until the worm wheel fits against the right sideplate (31, fig. 5-13 ②**).** This should allow the worm shaft (46, fig. 5-13 ④**)** to turn freely. Tighten the two setscrews on the worm wheel (47).

k. Slide the left sideplate (38, fig. 5-13 ③**)** on the worm shaft (46, fig. 5-13 **4).**

l. Join the mounting plate (2, fig. 5-13 ①**)** with the right and left sideplates (31, fig. 5-13 ②**),** (38, fig. 5-13 ③ **).** Fit the side-plates over the dowel pins on the mounting plate. Secure the sideplates to the mounting plate with the eight sideplate mounting screws (9, fig. 5-13 **1).**

m. Replace the intermediate drive shaft gear (44, fig. 5-13 ④**)** on the intermediate drive shaft (45). Do not tighten the setscrews on the intermediate drive gear at this time.

n. Place the intermediate drive shaft bevel gear (50) on the intermediate drive shaft (45) and insert the intermediate drive shaft in the bearing hole in the mounting plate.

o. Push the intermediate drive shaft gear (44) on to the end of the intermediate drive shaft (45) that extends through the mounting plate; leave approximately 1/64-inch end play on the intermediate drive shaft and tighten the setscrews on the intermediate drive gear.

p. Insert the reset shaft (29, fig. 5-13 ③**)** into the bearing hole in the mounting plate.

q. Insert the center shaft (11, fig. 5-13 ②**)** into the bearing hold in the mounting plate.

r. Slide the center wheel gear (41, fig. 5-13 ④**)** on to the end of the center shaft that extends in front of the mounting plate.

s. Replace the dial (4, fig. 5-13 ①**)** and secure with the four dial mounting screws (5).

t. Replace the degree hand (7) and decimal degree hand (8) and secure with the center shaft nut (6).

u. Hold the reset shaft (29, fig. 5-13 ③**)** to prevent it from dropping out, and slide the reset shaft stop collar (42, fig. 5-13 ④**)** and reset shaft spring (43) onto the reset shaft and hold them in place.

v. Fit the backplate (20, fig. 5-13 ②**)** over the reset shaft (29, fig. 5-13 ③**),** the center shaft (11, fig. 5-13 **2** and the intermediate drive shaft (45, fig. 5-13 ④**)** and secure the backplate with two backplate screws (30, fig. 5-13 ③**)** at each end. Do not replace the four center screws at this time.

w. Slide the reset bevel gear (28, fig. 5-13 ③**)** onto the reset shaft (29) and leave approximately 1-1/8 inch of shaft extending out of the bevel gear. Tighten the setscrews on the bevel gear and stop collar.

x. Mesh the intermediate drive shaft bevel gear (50, fig. 5-13 ④) with the worm shaft bevel gear (48) and tighten the setscrews on the intermediate drive shaft bevel gear.

y. Slide the center shaft bevel gear (27, fig. 5-13 3) onto the center shaft (11, fig. 5-13 2) as far as it will go. Do not tighten the setscrews on the center shaft bevel gear at this time.

z. Insert the intermediate reset shaft (24) into the bearing post (22) and place the bevel gears (23) at each end of the intermediate reset shaft, and then tighten the setscrews in each bevel gear.

aa. Join the bearing post (22) and the bearing support plate (19) with the shortest bevel gear facing the end of the bearing plate with the U-cutout, and secure them with the two bearing post screws (21).

ab. Fasten the bearing support plate (19) to the backplate (20) with the four bearing support plate screws (18). Place the U-shaped cutout toward the center shaft (11) bearing hole in the backplate.

ac. Mesh the center shaft bevel gear (27, fig. 5-13) with the bevel gear (23, fig. 5-13 2) and tighten the setscrews on the center shaft bevel gear.

ad. Slide the center shaft stop collar (26, fig. 5-13 ③), large end first, onto the center shaft to approximately 1/64 of an inch from the bevel gear (23, fig. 5-13 ②). Tighten the two setscrews on the stop collar.

ae. Replace the center shaft pin (25).

af. Slide the driven clutch spring (17) and driven clutch (16) onto the center shaft. Hold the driven clutch on the center shaft by hand at this time.

ag. Insert the yoke of the transfer arm (15) behind the collar on the driven clutch. Align the holes on the transfer arm with the holes on the bearing post (22); insert the transfer arm pin (14) that holds the transfer arm to the bearing post and secure it with the retaining ring (13).

ah. Fit the mounting plate (2, fig. 5-13 ①) onto the mounting bracket (3) and insert the three mounting screws (1): align the driving and driven clutches (12, fig. 5-13 ②) and tighten the three mounting screws on the mounting plate.

ai. Slide the driving clutch (12 along the driving clutch shaft (32, fig. 5-13 3) until it clears the mounting bracket (3, fig. 5-13 ①) by approximately 1/64 of an inch.

aj. Check the following for correct placement of parts:

(1) Turn the drive gear (10) to see that all moving parts of the azimuth angle indicator assembly rotate freely.

(2) Depress the reset shaft (29, fig. 5-13 3) and turn either clockwise or counterclockwise. The driving and driven clutches should disengage and the dial hands should move with rotation of the reset shaft.

(3) Release the reset shaft and check to see that the driving and driven clutches reengage when the reset shaft is released. When the reset shaft is released, there should be no pressure on the reset arm.

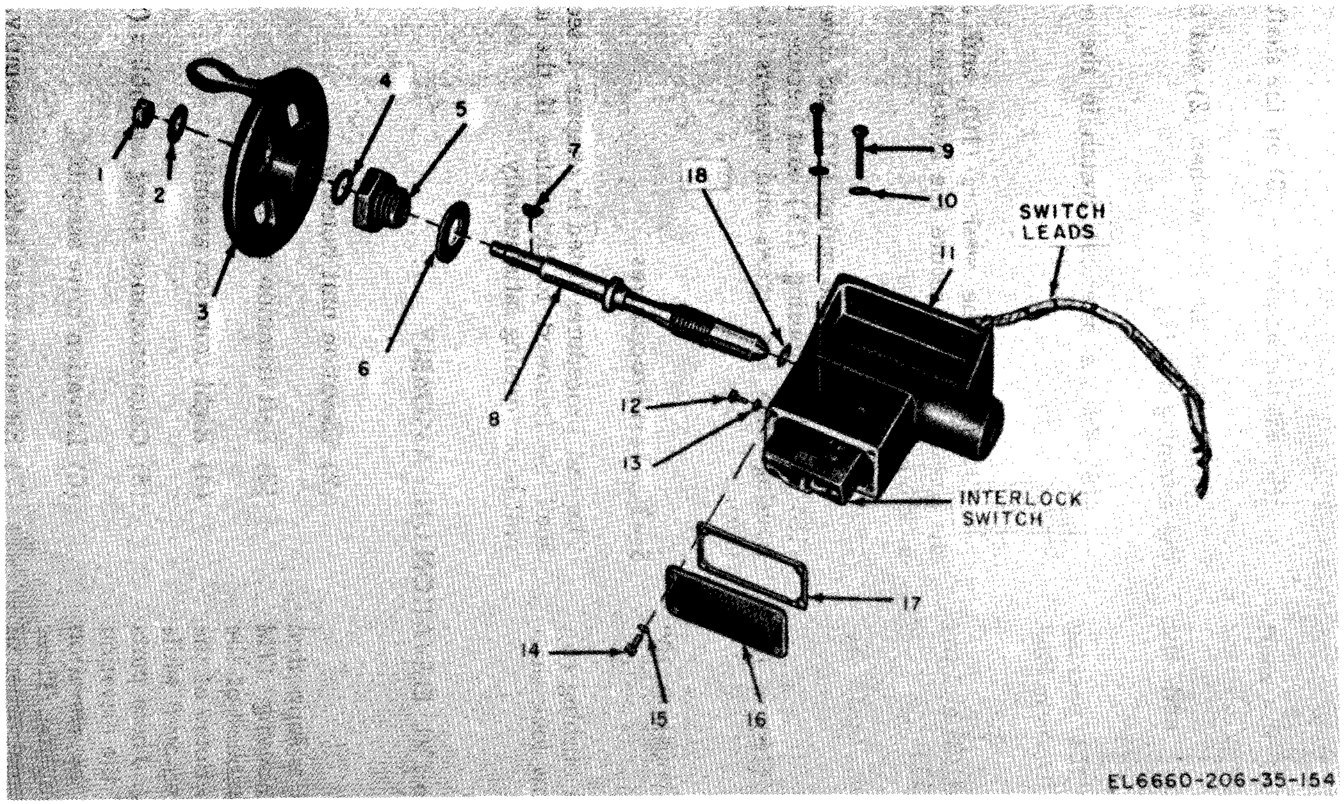
(4) Correct any binding or excessive play by moving the bevel gears and stop collars until parts rotate freely.

5-29. Disassembly and Reassembly of Azimuth Stow Lock Assembly
(fig. 5-14)

The procedures in *a* and *b* below cover the disassembly and reassembly of an azimuth stow lock assembly (para 5-23).

a. Disassembly of Azimuth Stow Lock Assembly.

(1) Remove the four screws (14, fig. 5-14) and washers (15) that secure the cover plate (16) to the housing and lift the cover plate and the gasket (17) off the housing (11).



1 Nut (5/16–18, hex., stainless steel)
2 Lockwasher (5/16 inch, brass, nickel plated)
3 Handwheel
4 Packing ring
5 Bushing
6 Gasket
7 Key
8 Stow lock shaft
9 Screw (6–32 x 1-1/8 inch, binding head, brass nickel plated) (2)
10 Washer (No. 6, brass, nickel plated (2)
11 Housing
12 Lockscrew (6–32 x 1/4 inch, binding head, brass, nickel plated)
13 Lockwasher (No. 6, bronze, nickel plated)
14 Screw (8–32 x 3/8 inch, fillister head, brass, nickel plated) (4)
15 Washer (4)
16 Cover plate
17 Gasket
18 Packing ring (same as 4)

Figure 5–14. Azimuth stow lock assembly, exploded view.

(2) Remove the two screws (9) and washers (10) that secure the interlock switch, and then remove the interlock switch from the housing.

(3) Remove the nut (1) and lockwasher (2) from the stow lock shaft (8).

(4) Slide the handwheel (3) off the shaft and remove the key (7) from the keyway.

(5) Remove the lockscrew (12) and the lockwasher (13) from the bushing (5).

(6) Remove the bushing (5), the packing ring (4), and the gasket (6) from the stow lock shaft.

(7) Remove the stow lock shaft (8) and the packing ring (18) from the housing (11).

b. Reassembly of Azimuth Stow Lock Assembly.

(1) Replace the packing ring (18) in the housing (11).

(2) Insert the stow lock shaft (8) in the housing (11).

(3) Replace the gasket (6), the bushing (5), and the packing ring (4) on the stow lock shaft (8).

(4) Replace the lockwasher (13) and the lockscrew (12) that secure the bushing (5) to the housing.

(5) Replace the key (7) on the shaft.

(6) Fit the handwheel (3) on the shaft,

(7) Replace the lockwasher (2) and tighten the retaining nut (1).

(8) Fit the interlock switch in the housing (11).

(9) Replace the washers (10), and tighten the screws (9) that secure the switch in the stow lock housing.

(10) Replace the gasket (17) and cover plate (16) on the housing (11) and secure to the housing with the screws and washers (14) and (15).

5-30. Test Procedures

The test procedures listed in chapter 4, section V shall be followed to determine if the azimuth unit is performing satisfactorily.

Section VI. ELEVATION UNIT ASSEMBLY

5-31. General

a. Description. The elevation unit is supported by a yoke mounted on the housing (TM 11-6660-206-12). The main assemblies of the elevation unit are listed in *b* below. Some of the parts of the elevation unit may be removed while the unit is installed on the housing. These parts are listed in *c* below. Some parts of the elevation unit may be removed only after the elevation unit has been removed from the housing. These parts are listed in *d* below. The normal order of removing the assemblies of the elevation unit is outlined in *e* below.

b. Main Assemblies of Elevation Unit.

(1) Elevation stow lock assembly.

(2) Elevation unit housing.

(3) Left trunnion assembly.

(4) Right trunnion assembly.

(5) Counterbalance spring assemblies (2).

(6) Elevation drive assembly.

(7) Elevation angle indicator assembly.

c. Elevation Unit Assemblies That May be Removed While Elevation Unit is Installed on Housing.

(1) Counterbalance spring assemblies.

(2) Elevation stow lock assembly.

(3) Elevation angle indicator assembly.

d. Elevation Unit Assemblies That May be Removed Only After Elevation Unit Has Been Removed From Housing.

(1) Elevation unit housing.

(2) Elevation drive assembly.

(3) Left trunnion assembly.

(4) Right trunnion assembly.

e. Normal Order of Removing Elevation Unit Assemblies.

(1) Counterbalance springs (para 3-69).

(2) Elevation angle indicator assembly (para 3-71).

(3) Elevation drive assembly (para 5-34).

(4) Left trunnion assembly (para 5-32).

(5) Right trunnion assembly (para 5-33).

(6) Elevation stow lock assembly (may be removed independently of other components) (para 5-35).

5-32. Removal and Replacement of Left Trunnion Assembly

(fig. 5-11)

To remove the left trunnion assembly, the elevation unit assembly must be removed (TM 11-6660-206-12) from the housing.

a. Removal.

(1) Remove the counterbalance spring assemblies (pare 3-69).

(2) Remove the lockpin (19, fig. **5-15①**) from the gear retaining bolt (18).

(3) Remove the gear retaining bolt (18) from the trunnion shaft (6).

(4) Slide the stationary gear (17) off the trunnion shaft.

(5) Remove the key (16) from the trunnion shaft.

(6) Remove the bearing nuts (13 and 15) and bearing washer (14) from the trunnion shaft.

(7) Remove the spacer (12) and seal (11) from the trunnion shaft.

(8) Remove the four screws (4) and washers (5) from the trunnion shaft flange.

(9) Slide the trunnion shaft off the two dowel pins (3), and out of the elevation unit.

(10) Slide the seal (7) off the trunnion shaft.

(11) Remove the trunnion shaft bearing (10) from the housing.

(12) Remove the two dowel pins (3) from the yoke.

(13) Remove the grease plug (2) and lock-washer (1) from the trunnion shaft.

b. Replacement.

(1) Replace the grease plug (2) and lock-washer (1) on the trunnion shaft (6).

(2) Slide the seal (7) on the trunnion shaft.

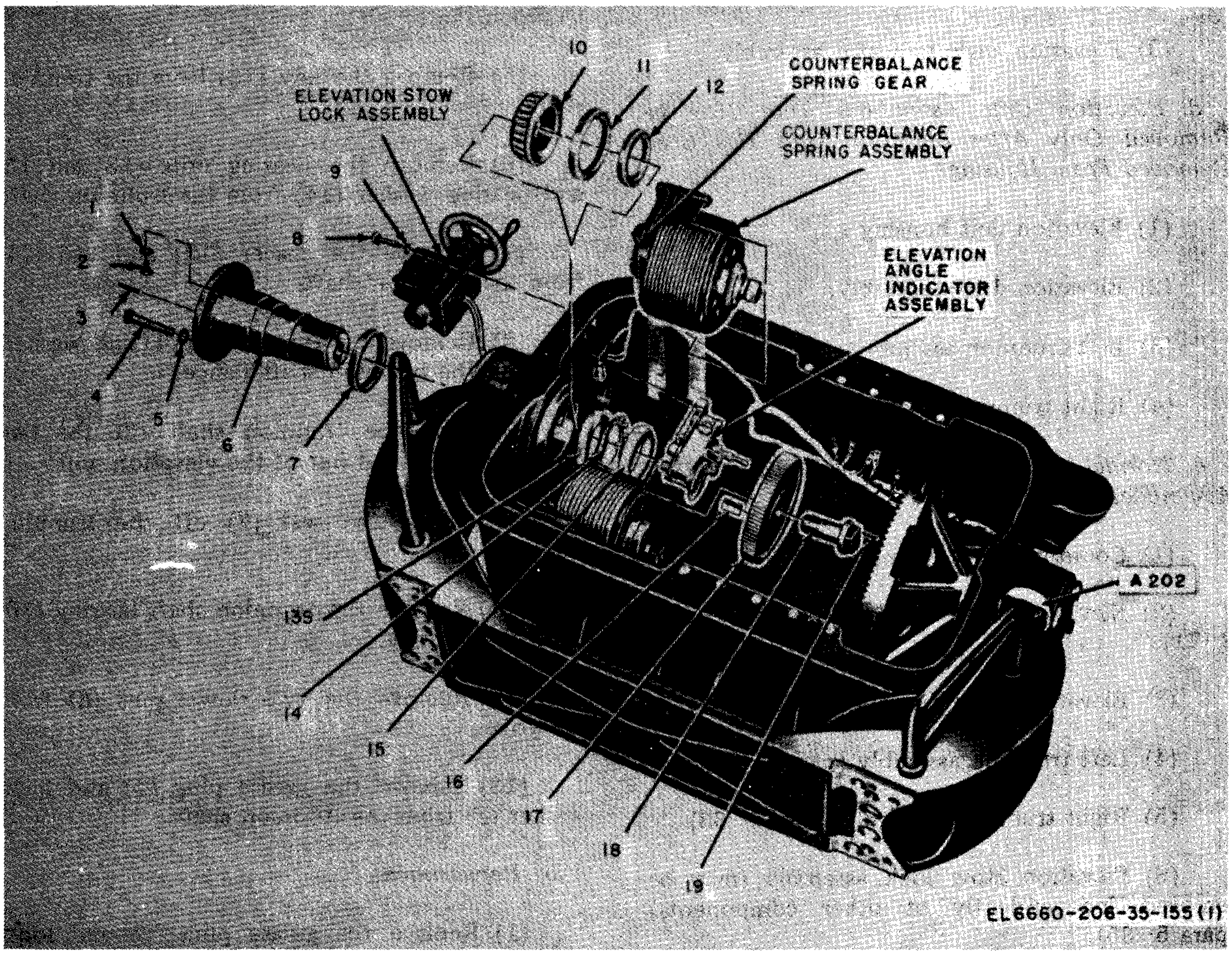
(3) Insert the trunnion shaft through the yoke and into the elevation unit housing.

(4) Replace the four screws (4) and washers (5) that secure the trunnion shaft flange to the yoke.

(5) Replace the two dowel pins (3) in the trunnion shaft flange.

(6) Slide the trunnion shaft bearing (10) on the trunnion shaft, and fit it in the bearing hole in the housing.

(7) Slide the seal (11) and spacer (12) on the trunnion shaft, and fit them in the bearing hole.



1 Lockwasher (1/4-inch, bronze, nickel plated)
2 Grease plug (1/4-28 x 1/2 inch, hex. head, brass, nickel plated)
3 Dowell pin (not used on some models)
4 Screw (3/8-16 x 1 inch, hex. head, stainless steel)
5 Washer (3/8-inch, bronze, nickel plated)
6 Trunnion shaft
7 Seal
8 Screw (1/4-20 x 7/8 inch, hex. head, stainless steel) (4)
9 Lockwasher (same as 1)
10 Trnnion shaft bearing
11 Seal
12 Spacer
19 Bearing nut
14 Bearing washer
15 Bearing nut
16 Keys
17 Stationary gear
18 Gear retaining bolt
19 Lockpin

Figure 5-15 @. Elevation unit, exploded view (sheet 1 of 2).

(8) Replace the bearing nuts (13 and 15) and bearing washer (14) on the trunnion shaft.

(9) Replace the key (16) in the keyway on the trunnion shaft.

(10) Slide the stationary gear (17) on the trunnion shaft.

(11) Replace the gear retaining bolt (18).

(12) Replace the lockpin (19) on the gear retaining bolt.

(13) Replace the counterbalance spring assemblies (para 3-69).

(14) Replace the cover of the elevation unit and secure the 26 bolts that hold the cover on.

(15) Mount the elevation unit assembly on the housing (TM 11-6660-206-12).

5-33. Removal and Replacement of Right Trunnion Assembly

(fig. 5-11)

To remove the right trunnion assembly, the elevation unit assembly must be removed (TM 11-6660-206-12) from the housing.

a. Removal.

(1) Remove the elevation drive assembly (para 5-34).

(2) Remove the bearing nut (34, fig. 5-15 **2**) from the right trunnion shaft (26).

(3) Remove the bearing lockwasher (33) and the bearing nut *(32)* from the right trunnion shaft (26).

(4) Remove the spacer (31) from the right trunnion shaft.

(5) Remove the trunnion gear segment (30).

(6) Remove the seal (29) from the trunnion bearing hole in the elevation unit housing.

(7) Remove the four screws (23), washers (24), and cable clip (25) from the trunnion flange.

(8) Slide the trunnion shaft off the two dowel pins (20), and remove the shaft from the elevation unit.

(9) Remove the trunnion shaft bearing (28) from the bearing hole in the elevation unit housing.

(10) Remove the seal (27) from the yoke side of the bearing hole.

(11) Remove the grease plug (21) and the lockwasher (22) from the right trunnion shaft (26).

b. Replacement.

(1) Replace the grease plug (21, fig. 5-15 **2)** and washer (22) in the trunnion shaft.

(2) Replace the seal (27) in the yoke side of the bearing hole.

(3) Insert the right trunnion shaft (26) through the yoke and into the elevation unit housing.

(4) Replace the washer (24), cable clip (25), and four screws (23) that secure the trunnion flange to the yoke.

(5) Replace the two dowel pins (20) on the trunnion flange.

(6) Slide the bearing (28) on the trunnion shaft, and fit it in the bearing hole inside the elevation unit.

(7) Replace the seal (29) in the bearing hole.

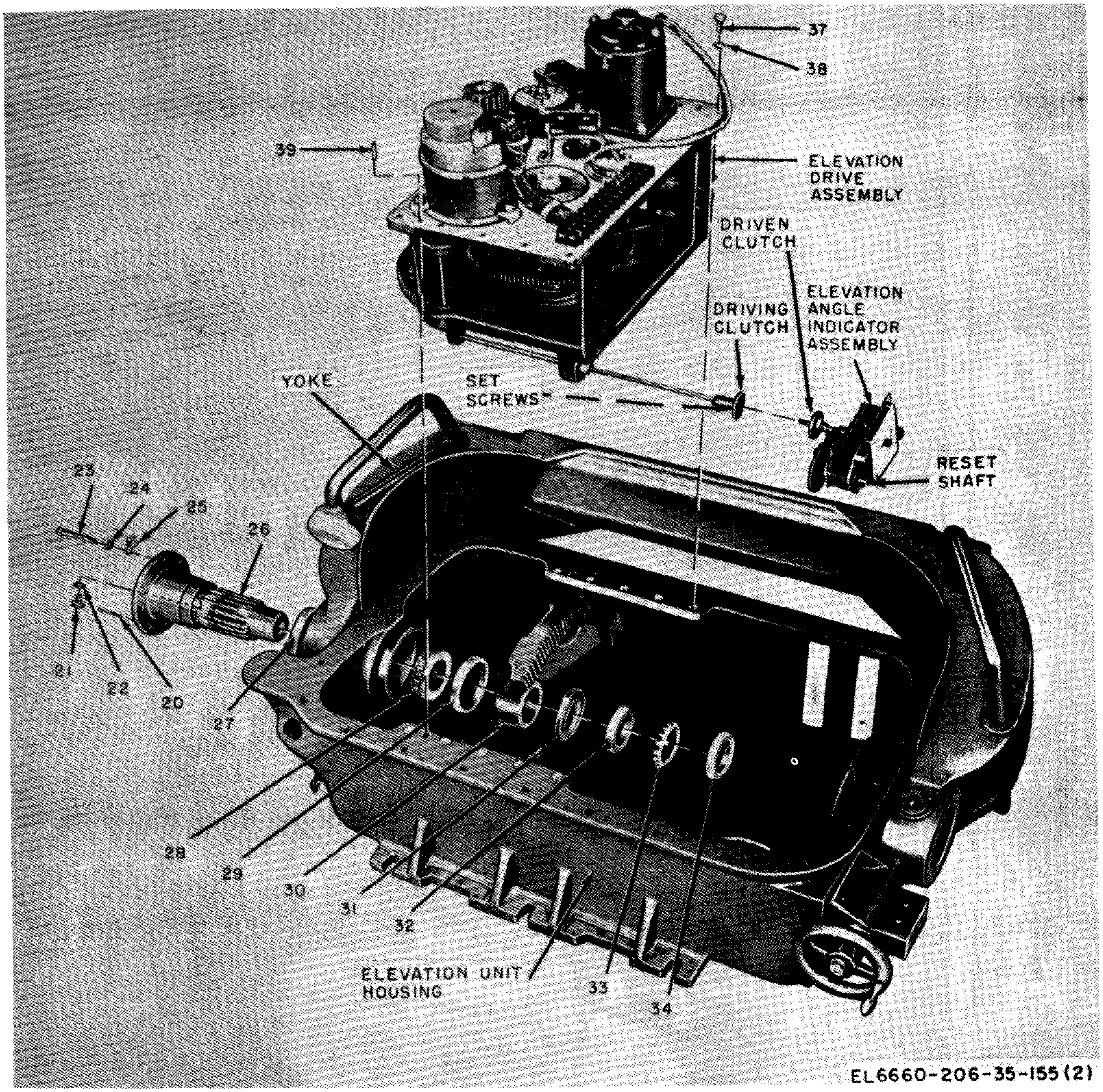
(8) Fit the trunnion gear segment (30) on the trunnion shaft.

(9) Replace the spacer (31) on the shaft.

(10) Replace the bearing nut (32) and bearing lockwasher (33) on the shaft.

(11) Replace the bearing nut (34) on the shaft.

(12) Replacement of the elevation drive assembly (para 5-34).



20 Dowel pin (2)
21 Grease plug (1/4-28 x 1/2 inch, hex. head, brass, nickel plated)
22 Lockwaaher (1/4-inch, bronze, nickel plated)
23 Screw (3/8-16 x 1-inch, hex. head, stainless steel) (4)
24 Washer (3/8-inch bronze, nickel plated)
25 Cable clip
26 Right trunnion shaft
27 Seal
28 Trunnion shaft bearing
29 Seal
30 Trunnion gear segment
31 Spacer
32 Bearing nut
33 Bearing lockwasher
34 Bearing nut
35 Output pinion
36 Not used
37 Screws (1/2-20 x 1 inch, hex. head, stainless steel)
38 Washers (1/2 inch, brass, nickel plated)
39 Dowel pin

Figure 5-15 @. Elevation unit, exploded view (sheet 2 of 2).

(13) Replace the cover on the elevation unit, and secure the 26 bolts that hold the cover on.

5-34. Removal and Replacement of Elevation Drive Assembly

a. General. The elevation drive assembly (TM 11-6660-206-12) is mounted on a frame secured to its mounting flange in the elevation unit by 10 screws. The elevation drive assembly consists of the elevation synchro transmitter, elevation drive motor, elevation antihunt generator, and the elevation drive gearing. The elevation unit must be removed before removing the elevation drive assembly.

b. Removal of Elevation Drive Assembly.

(1) Remove the elevation unit assembly from the housing (TM 11-6660-206-12).

(2) Remove the back cover of the elevation unit by removing the 26 bolts that hold the cover on.

(3) Remove the two counterbalance spring assemblies (para 3-69).

(4) Loosen the driving clutch gear setscrews (fig. 5-15 ②) and slide the driving clutch back on the shaft away from the elevation angle indicator assembly approximately 3 inches.

(5) Disconnect and tag all leads of the elevation unit harness that are fastened to terminal board TB201 (fig. 3-35, TM 11-6660-206-12).

(6) Remove the 10 screws (37, fig. 5-15 **2)** and washers (38) that secure the frame of the elevation drive assembly to the elevation unit housing.

(7) Lift the elevation drive assembly out of the elevation unit, and remove the two dowel pins (39) from the elevation drive assembly frame.

c. Replacement of Elevation Drive Assembly.

(1) Fit the elevation drive assembly (fig, 5-15 **2)** frame to the elevation unit housing.

(2) Mesh the output pinion (35) on the shaft with the trunnion gear segment (30) with a minimum backlash and no evidence of binding in either direction of rotation.

(3) Replace the washers (38) and tighten the 10 screws (37) that secure the elevation drive assembly frame to the elevation unit housing.

(4) Drill two holes (.242 inch drill) through elevation drive assembly frame and elevation unit housing (at opposite ends of elevation drive assembly near mounting hardware).

(5) Ream the two holes using a .3740 (+.0003, -0) inch diameter reamer.

(6) Install two dowel pins in the holes through elevation drive assembly and elevation unit housing.

(7) Slide the driving clutch along the shaft until it engages the driven clutch of the elevation angle indicator and then tighten the driving clutch setscrew. (Refer to paragraph 5-28 for proper placement of the driving clutch.)

(8) Replace all leads of the elevation unit harness removed in b(5 preceding to terminal board TB201 (fig. 5-15 **2).**

(9) Replace the counterbalance spring assemblies (para 3-69).

(10) Replace the cover on the elevation unit and secure the 26 bolts that hold the cover on.

(11) Replace the elevation unit on the housing (TM 11-6660-206-12).

5-35. Removal and Replacement of Elevation Stow Lock Assembly

a. Removal of Elevation Stow Lock Assembly.

(1) Remove the back cover of the elevation unit (TM 11-6660-206-12) by removing the 26 bolts that secure the cover.

(2) Disconnect and tag the two interlock switch leads from terminal board TB201. (It will be necessary to remove the lacing from harness.)

(3) Remove the four screws (8, fig. 5-15 **1)** and lockwashers (9) that secure the

elevation stow lock assembly to the elevation unit housing.

(4) Slide the elevation stow lock assembly off the two dowel pins that secure it to the elevation unit housing.

(5) Remove two dowel pins.

b. Replacement of Elevation Stow Lock Assembly.

(1) Replace the two leads of the interlock switch on terminal board TB201 (fig. 3-41). Relate leads into harness.

(2) Replace four screws (8, fig. 5–15 (1)) and lockwashers (9) that secure elevation stow lock assembly to the elevation unit housing.

NOTE

Before tightening screws, turn handwheel and make sure stow lock shaft moves freely in and out of elevation housing without binding.

(3) Drill two new holes (.242 inch drill) through elevation stow lock assembly housing (fig. 5-15 (1)) and elevation unit assembly frame (one on each side near elevation stow lock mounting hardware) to a 5/8-inch depth.

(4) Remove elevation stow lock assembly and ream two holes .2505 (+.0003-0) inch diameter.

(5) Ream two holes in elevation unit assembly frame .250 (+.0003,-0) inch diameter.

(6) Replace stow lock assembly to elevation unit assembly frame and tighten four mounting screws (8, fig. 5–15 (1) and lockwashers (9)).

(7) Install two dowel pins in holes through stow lock assembly and elevation unit frame.

(8) Replace back cover on elevation unit and replace 26 bolts to secure cover.

5-36. Disassembly of Elevation Drive Assembly

a. General. The elevation drive assembly consists of the elevation synchro transmitter, elevation drive motor, elevation antihunt generator, and the elevation drive gearing. The directions in *b* through *e* below cover the disassembly of a removed elevation drive assembly (para 5-34).

b. Disassembly of Elevation Synchro Transmitter. The elevation synchro transmitter is replaced as a complete unit when found to be defective. To remove the elevation synchro transmitter from the elevation drive assembly, remove the three screws (11, fig. 5–16 (1)) and lockwashers (10) on the mounting lugs (9). Disconnect and tag the synchro leads from terminal board TB201 (fig. 5-22), and lift the elevation synchro transmitter off the frame.

c. Disassembly of Elevation Drive Motor. The elevation drive motor is identical with the azimuth drive motor. To remove the elevation drive motor from the elevation drive assembly, remove the four screws (79, fig. 5-16 (2)) and lockwashers (80) that secure the motor to the frame. Disconnect the motor leads from the terminal board on the frame, and tag the disconnected leads. Pull the motor up sharply to disconnect the motor shaft coupling (82) from the drive shaft coupling (84) and the insert (83). To disassemble the elevation drive motor, follow the procedure given for disassembling the azimuth drive motor (para 5-25).

d. Disassembly of Elevation Antihunt Generator. The elevation antihunt generator is identical with the azimuth antihunt generator (fig. 5-12). To remove the elevation antihunt generator from the elevation drive assembly, follow the procedures given in (1) through (3) following. To disassemble the elevation antihunt generator, refer to the disassembly procedure for the azimuth antihunt generator (para 5-25).

(1) Disconnect the antihunt generator leads from the terminal board on the frame and tag the disconnected leads.

(2 Remove the four screws (37, fig. 5-16 1) and washers (36 and 38) that secure the antihunt generator to the frame.

(3) Lift the generator and mounting plate (41) out of the frame.

e. Disassembly of Elevation Drive Gearing.

(1) Remove the retaining nut (19, fig. 5-16 1) and lockwasher (20) from the camshaft (28) and lift the limit switch actuator arms away from the camshaft.

(2) Remove the three screws (21) and washers (22) on the cam top plate (23).

(3) Remove the cam top plate (23) and upper cam (24) from the cam spindle (27).

(4) Remove the spacer (25) and lower cam (26) from the cam spindle (27).

(5) Remove limit stop switch S202.

(6) Remove limit stop switch S203.

(7) Loosen the driving clutch (50) setscrews and slide the clutch off the clutch drive shaft (49).

(8) Loosen the two setscrews on the clutch drive shaft coupling (48), and remove the clutch drive shaft (49) from the coupling.

(9) Remove the retaining ring (47) from the coupling bearing insert.

(10) Loosen the setscrew in the other end (narrow end) of the clutch drive shaft coupling (48).

(11) Remove the retaining ring (45) from the coupling bearing (46).

(12) Drive the pin (43) out of the second miter gear (6) on the second miter gear shaft (44).

(13) Drive the second miter gear shaft (44) back through the second miter gear (6) and the bushing, and press the second miter gear (6) flush with the bushing.

(14) Drive the first miter gear shaft (3) out of the miter gear bearing bracket near the top of the frame.

(15) Drive the pin (4) out of the first miter gear (1), and slide the gear off the first miter gear shaft (3).

(16) Drive the pin (5) out of the indicator drive gear (7), slide the gear off the first miter gear shaft (3), and remove the shaft from the bearings.

(17) Remove the coupling bearing (46) from the frame.

(18) Remove the clutch drive shaft coupling (48) from its bearing hole on the frame.

(19) Remove the indicator drive gear shaft spacer (42) from the bearing hole on the frame.

(20) Remove the bearing (2) from its bearing bracket insert.

(21) Remove the retaining nut (58), lockwasher (57), and washer (56) from the bottom of the main drive shaft (12).

(22) Remove the main drive gear (55) from the main drive shaft (12).

(23) Remove the bottom retaining ring (54) from the lower main drive shaft (12) insert.

(24) Remove the top retaining rings (51 and 52) from the lower main drive shaft insert and lower bearing (53).

(25) Remove the retaining ring (18) at the bottom of the cam drive pinion (17).

(26) Drive the main drive shaft (12) upward from the bottom of the frame.

(27) Remove the cam drive pinion (17), key (13), spacer (16), and upper bearings (14 and 15) from the shaft.

(28) Remove the retaining nut (35) and the lockwaaher (34) from the camshaft (28).

(29) Remove the cam drive gear (33) from the camshaft (28).

(30) Remove the retaining ring (32) from the bottom of the camshaft insert.

(31) Drive the camshaft (28) upward through the bottom of the frame, and remove the upper bearing (29) and spacer (30) as the shaft is withdrawn.

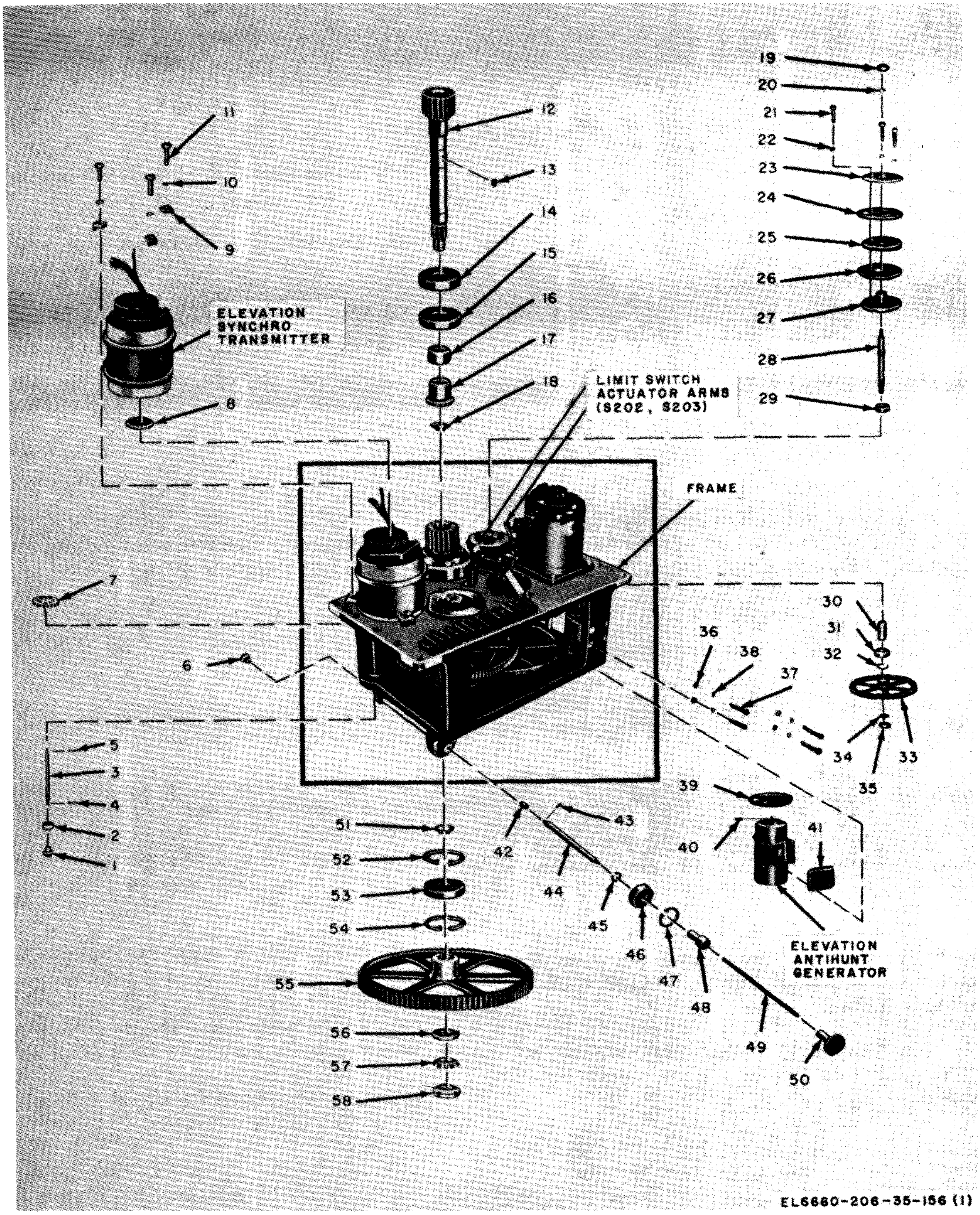


Figure 5–16 (1). Elevation drive assembly, exploded view (sheet 1 of 2).

Key for Figure 5-16 ①

1 First miter gear
2 Bearing
3 First miter gear shaft
4 Pin (8/0—5/16 inch long, stainless steel)
5 Pin (same as 4)
6 Second miter gear (same as 1)
7 Indicator drive gear
8 Synchro gear
9 Lugs
10 Lockwasher (1/4-inch, bronze, nickel plated)(3)
11 Screws (1/4—20 x 7/8 inch, hex. head, stainless steel)(3)
12 Main drive shaft
13 Key
14 Upper bearing
15 Upper bearing
16 Spacer
17 Cam drive pinion
18 Retaining ring
19 Retaining nut (1/4—20, hex. stainless steel)
20 Lockwasher (same as 10)
21 Screw (10—32 x 7/8 inch, fillister head, stainless steel)(3)
22 Washer (No. 10, bronze, nickel plated)(3)
23 Cam top plate
24 Upper cam
25 Spacer
26 Lower cam
27 Cam spindle
28 Camshaft
29 Upper bearing
30 Spacer
31 Lower bearing
32 Retaining rings
33 Cam drive gear
34 Lockwasher
35 Retaining nut
36 Washer (No. 8, bronze, nickel plated)(4)
37 Screw (8—32 x 5/8 inch, brass nickel plated)(4)
38 Washer (same as 36)(4)
39 Generator gear
40 Pin (8/0 x 5/8 inch long, stainless steel)
41 Mounting plate
42 Spacer (not used on some models)
43 Pin (same as 4)
44 Second miter gear shaft
45 Retaining ring
46 Coupling bearing
47 Retaining ring
48 Clutch drive shaft coupling
49 Clutch drive shaft
50 Driving clutch
51 Top retaining ring
52 Top retaining ring
53 Lower bearing
54 Bottom retaining ring
55 Main drive gear
56 Washer
57 Lockwasher
58 Retaining nut

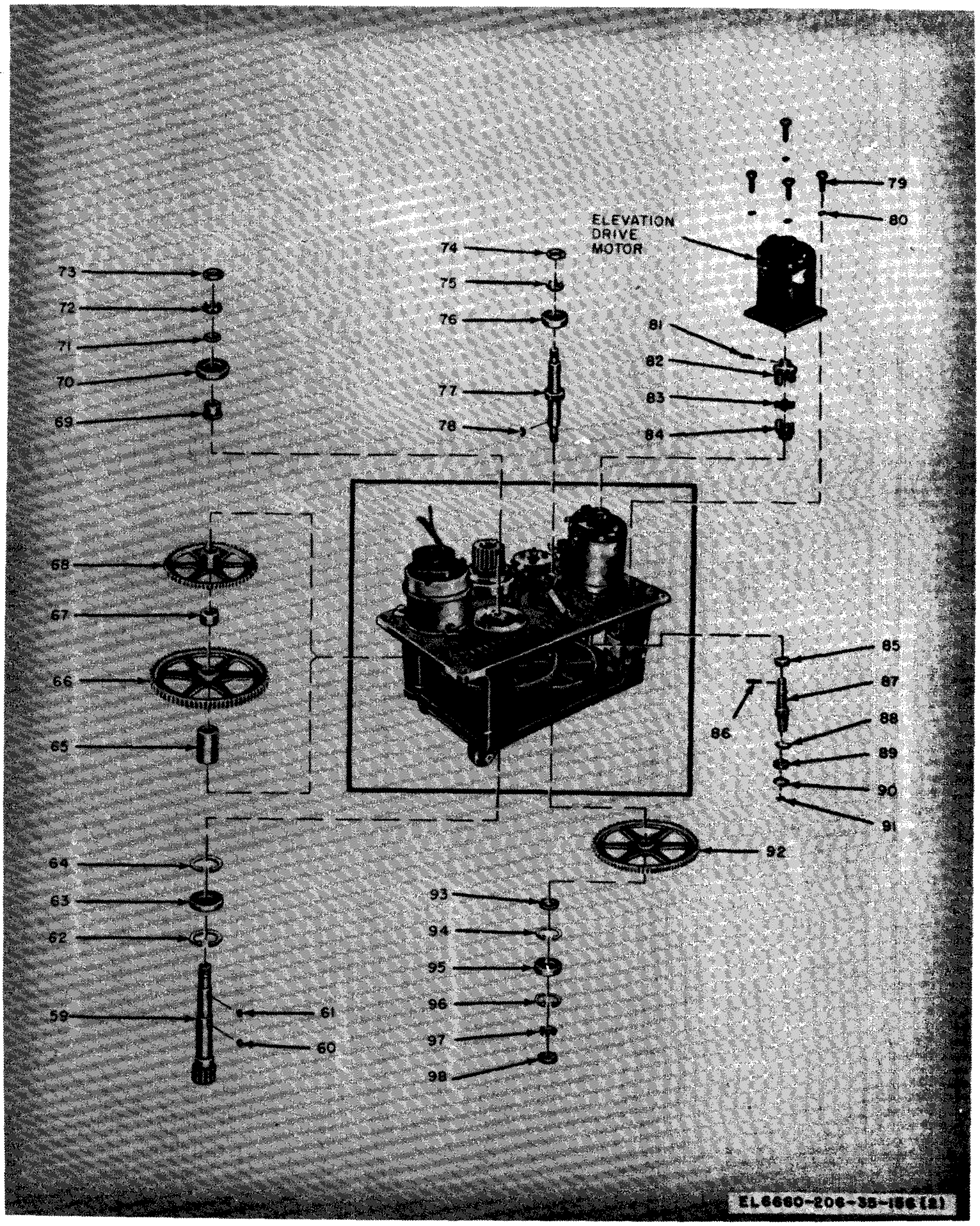


Figure 5-16 (2). Elevation drive assembly, exploded view (sheet 2 of 2).

Key for Figure 5-16 ②

59 Third drive shaft
60 Key
61 Key
62 Retaining ring
63 Lower bearing
64 Retaining ring
65 Spacer
66 Second drive gear
67 Spacer
68 Synchro drive gear
69 Spacer bushing
70 Upper bearing
71 Washer
72 Lockwasher
73 Retaining nut
74 Retaining nut
75 Lockwasher
76 Upper bearing
77 Second drive shaft
78 Key
79 Screw (1/4–20 x 7/8 inch, hex. head, stainless steel)(4)
80 Lockwasher (1/4 inch, bronze, nickel plated)(4)
81 Pin (5/0 x 5/8 inch long, stainless steel)
82 Motor shaft coupling
83 Insert
84 Drive shaft coupling
85 Upper bearing
86 Pin (3/0 x 3/4 inch long, stainless steel)
87 Motor lower coupling shaft
88 Retaining ring
89 Lower bearing
90 Outer retaining ring (same as 88)
91 Inner retaining ring
92 First drive gear
93 Spacer
94 Upper retaining ring
95 Lower bearing
96 Lower retaining ring (same as 94)
97 Lockwasher (same as 72)
98 Retaining nut (same as 73)

(32) Remove the lower bearing (31) from its insert in the frame.

(33) Remove the retaining nut (74, fig. 5-16 ②) and lockwasher (75) at the top of the second drive shaft (77).

(34) Remove the retaining nut (98), lockwasher (97), and retaining ring (96) at the bottom of the second drive shaft (77).

(35) Drive the second drive shaft (77) upward from the bottom of the frame, remove the first drive gear (92) and key (78) from the shaft and remove the upper bearing (76) as the shaft is withdrawn.

(36) Remove the upper and lower retaining rings (94 and 96) and lower bearing (95) from the bottom insert in the frame.

(37) Remove the retaining nut (73), lockwasher (72), and washer (71) at the top of the third drive shaft (59).

(38) Remove the retaining rings (62 and 64) at the top and bottom of the third drive shaft lower bearing insert.

(39) Drive the third drive shaft (59) downward from the top of the frame and remove the synchro drive gear (68), key (61), spacer (67), second drive gear (66), key (60), and spacer (65) as the shaft is withdrawn.

(40) Remove the lower bearing (63) from the shaft.

(41) Remove the spacer bushing (69) from the upper bearing (70).

(42) Remove the upper bearing (70) from its insert in the frame.

(43) Remove the inner and outer retaining rings (91, 90 and 88) from the lower bearing (89) and its insert in the frame.

(44) Drive the motor lower coupling shaft (87) upward from the bottom of the frame, and remove the lower bearing (89) as the shaft is withdrawn.

(45) Drive the pin (86) out of the drive shaft coupling (84) and remove the coupling and upper bearing (85) from the shaft.

(46) Remove the insert (83) from the coupling.

5-37. Reassembly of Elevation Drive Assembly (fig. 5-16)

a. General. The directions in *b* through *e* below cover the reassembly of a disassembled elevation drive assembly.

b. Reassembly of Elevation Drive Gearing.

(1) Place the motor lower coupling shaft (87, fig. 5-16 ②) in its upper and lower bearing inserts.

(2) Slide the upper bearing (85) on the shaft and fit it in its insert.

(3) Slide the lower bearing (89) on the shaft and fit it in its insert.

(4) Replace the inner and outer retaining rings (90 and 91) in the bottom of the lower bearing (89) and the bearing insert.

(5) Replace the retaining ring (88) in the top of the lower bearing (89) insert.

(6) Slide the drive shaft coupling (84) on the motor lower coupling shaft (87), align the locating holes, and drive the pin (86) through the coupling and shaft.

(7) Fit the insert (83) on the drive shaft coupling (84).

(8) Replace the upper retaining ring (94) in the second drive shaft (77) lower insert, fit the lower bearing (95) in its insert in the frame.

(9) Put the second drive shaft (77) through the upper bearing (76) insert.

(10) Place the key (78) in the keyway and fit the first drive gear (92) and spacer (93) on the second drive shaft (77).

(11) Drive the second drive shaft (77) through the lower bearing (95), and mesh the

first drive gear (92) with the drive pinion on the motor lower coupling shaft (87).

(12) Slide the upper bearing (76) on the second drive shaft (77) and fit it in the insert.

(13) Replace the lower retaining ring (96), in the bottom of the lower bearing (95) insert.

(14) Replace the lockwasher (75) and the retaining nut (74) on the top of the second drive shaft (77).

(15) Replace the lockwasher (97) and the retaining nut (98) on the bottom of the second drive shaft (77).

(16) Fit the two upper bearings (14 and 15, fig. 5-16 ①) on the main drive shaft (12)

(17) Fit the spacer (16) on the main drive shaft (12) flush against the upper bearings (14 and 15).

(18) Insert the key (13) in the keyway in the main drive shaft (12) and slide the cam drive pinion (17) on the shaft.

(19) Replace the retaining ring (18) at the bottom of the cam drive pinion (17).

(20) Replace the top retaining ring (52) at the top of the main drive shaft lower insert.

(21) Fit the lower bearing (53) in its insert; replace the top and bottom retaining rings (51 and 54) at the top and bottom of the lower bearing (53).

(22) Insert the main drive shaft (12) in the lower bearing (53) and fit the upper bearings (14 and 15) in their inserts in the frame.

(23) Replace the main drive gear (55) on the main drive shaft (12); replace the washer (56), lockwasher (57), and retaining nut (58).

(24) Fit the lower bearing (31) in its insert and replace the retaining ring (32).

(25) Fit the spacer (30) and upper bearing (29) in the camshaft (28) insert.

(26) Insert the camshaft (28) in the upper and lower bearings (29 and 31) with the flange on the camshaft flush with the upper bearing (29).

(27) Fit the cam drive gear (33) on the camshaft (28), mesh it with the cam drive pinion on the main drive shaft (12), and replace the lockwasher (34) and retaining nut (35).

(28) Fit the lower bearing (63, fig. 5-16 ②) on the third drive shaft (59).

(29) Insert the third drive shaft (59) and lower bearing (63) in its lower insert.

(30) Slide the spacer (65) on the third drive shaft (59).

(31) Insert the retaining ring (64) at the top of the lower bearing (63) insert.

(32) Insert the key (60) in the third drive shaft (59) and fit the second drive gear (66) on the shaft.

(33) Slide the spacer (67) on the third drive shaft (59).

(34) Insert the key (61) in the third drive shaft (59) and fit the synchro drive gear (68) on the shaft.

(35) Fit the spacer bushing (69) in the upper bearing (70) and insert the bearing in its insert in the frame.

(36) Insert the third drive shaft (59) in the upper bearing (70).

(37) Replace the washer (71), lockwasher (72), and retaining nut (73) at the top of the third drive shaft (59).

(38) Check the meshing of the second drive pinion on the third drive shaft (59) with the main drive gear (55, fig. 5-16 ①) and check the meshing of the second drive gear (66, fig. 5-16 **2**) with the pinion on the second drive shaft (77).

(39) Insert the first miter gear shaft (3, fig. 5-16 ①) through its bearing hole on the miter gear bracket at the bottom of the frame and

through the insert on the upper bearing bracket near the top of the frame.

(40) Fit the indicator drive gear (7) on the first miter gear shaft (3) and replace the pin (5) through the gear and shaft.

(41) Fit the bearing (2) on the first miter gear shaft (3) and press it into the bearing hole.

(42) Press the second miter gear (6) into its bearing hole on the miter gear bearing bracket on the frame.

(43) Fit the first miter gear (1) on the first miter gear shaft (3) and replace the pin (4).

(44) Fit the clutch drive shaft coupling (48) on the second miter gear shaft (44); insert the shaft through the coupling bearing bracket into the miter gear bearing bracket and then into the second miter gear (6).

(45) Replace the pin (43) in the second miter gear (6).

(46) Fit the clutch drive shaft coupling (48) in the coupling bearing (46) and replace the retaining ring (45).

(47) Replace the coupling bearing (46) in the coupling bracket in the frame.

(48) Replace the retaining ring (47) in the coupling bearing hole.

(49) Insert the clutch drive shaft (49) in the clutch drive shaft coupling (48).

(50) Tighten the two setscrews on the clutch drive shaft coupling (48).

(51) Slide the driving clutch (50) on the clutch drive shaft. This clutch will be positioning when mounting the elevation drive assembly (para 5-34).

c. Reassembly of Elevation Antihunt Generator. The elevation antihunt generator is identical with the azimuth antihunt generator (fig. 5-11). To reassemble the elevation antihunt generator, refer to the reassembly prcocedure for the azimuth antihunt generator (para 5-26). To replace the elevation antihunt generator on the elevation drive assembly. follow the Procedure outlined in (1) through (3) below.

(1) Fit the elevation antihunt generator and mounting plate (41, fig. 5-16 ~) to the drive frame while meshing the generator gear (39) with the pinion on the motor shaft coupling (82, fig. 5-16 ②) on the drive motor shaft.

NOTE

If the elevation drive motor is not mounted, mesh the generator gear (39, fig. 5-16 @) with the pinion on the motor shaft coupling (82, fig. 5-16 ②) in *d* below.

(2) Replace the four screws (37, fig. 5-16 1) and washers (36 and 38) that secure the elevation antihunt generator to the frame.

(3) Replace the elevation antihunt generator leads in their proper location on the terminal board on the frame.

d. Reassembly of Elevation Drive Motor. The elevation drive motor is identical with the azimuth drive motor (fig. 5-10). To reassemble the elevation drive motor, follow the procedure given for reassembling the azimuth drive motor (para 5-26). To replace the elevation drive motor on the elevation drive assembly, use the procedure outlined in (1) through (4) below.

(1) Fit the elevation drive motor (fig. 5-16 2) on the frame while engaging the motor shaft coupling (82) to drive shaft coupling (84) and insert (83).

(2) Check the meshing of the pinion on the motor shaft coupling (82) with the generator gear (39, fig. 5-16).

(3) Replace and tighten the four screws (79, fig. 5-16 2) and washers (80) that secure the elevation drive motor to the frame.

(4) Replace the motor leads in their proper location on the terminal board on the frame.

e. Reassembly of Elevation Synchro Transmitter. The elevation synchro transmitter is replaced as a complete unit. To replace the elevation synchro transmitter on the elevation drive assembly, use the procedure outlined in (1) through (4) below.

(1) Fit the elevation synchro transmitter (fig. 5-16 ①) to the mounting plate.

(2) Mesh the synchro gear (8) with the indicator drive gear (7) and the synchro drive gear (68, fig. 5-16 @').

(3) Replace the lugs (9, fig. 5-16 ①) and replace and tighten the three screws (11) and lockwashers (10).

(4) Reconnect the motor leads to their proper places on the terminal board on the frame.

5-38. Disassembly and Reassembly of Elevation Angle Indicator Assembly

The elevation angle indicator in the elevation unit is similar to the azimuth angle indicator in the azimuth unit. To disassemble a removed elevation angle indicator assembly (para 3-71), follow the procedure given in paragraph 5-27c through *x*. To reassemble a disassembled elevation angle indicator assembly, follow the procedure given in paragraph 5-28i through *ag*. Check the reassembled elevation angle indicator assembly as described in paragraph 5-28aj.

5-39. Disassembly and Reassembly of Elevation Stow Lock Assembly

The elevation stow lock assembly is similar to the azimuth stow lock assembly. To disassemble and reassemble a removed elevation stow lock (para 5-36), refer to the procedure outlined in paragraph 5-29.

5-40. Test Procedures

The test procedures listed in chapter 4, section VI shall be followed to determine if the elevation drive assembly is performing satisfactorily.

Section VII. CONTROL-RECORDER

5-41. General

This section provides general support maintenance personnel with supplemental information from previous chapters where general support is referenced.

5-42. Disassembly and Reassembly of Azimuth and Elevation Synchro Receiver and Clutch Assemblies

a. General. The azimuth and elevation synchro receiver and clutch assemblies are identical, and the procedures for disassembly and reassembly are the same. The synchro receivers are replaced as a complete unit when found to be defective. No provision is made for replacing individual parts. Disassembly of the clutch portion of the removed azimuth or elevation synchro receiver and clutch assemblies (para 3-85) is described in *b* below.

b. Disassembly of Clutch Assembly (fig. 5-17).

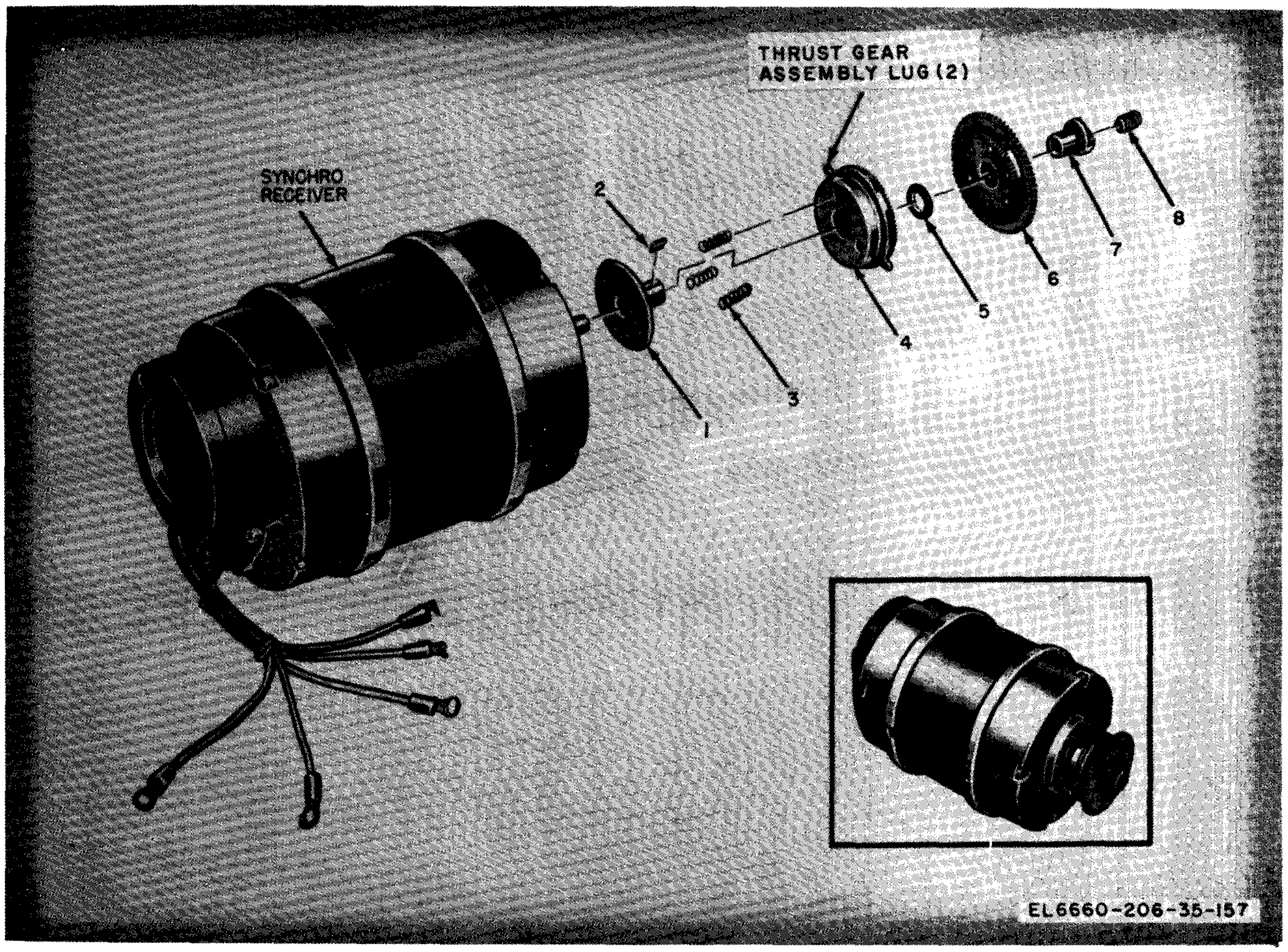
(1) Use an Allen wrench to loosen the setscrew (8) in the end of the checknut (7).

(2) While holding the clutch drive gear (6) in place, use an open-end wrench on the flat section of the checknut to remove the checknut.

(3) Remove the clutch drive gear (6) and the bearing washer (5).

(4) Remove the thrust gear assembly (4). Be careful not to lose the three compression springs (3) which now are free.

(5) Remove the key (2) from the synchro receiver adapter shaft and remove the adapter shaft (1).



1 Adapter shaft
2 Key
3 Compression spring
4 Thrust gear assembly
5 Bearing washer, brass (1/4 inch ID x 1/2 inch OD x 0.016 inch thick)
6 Clutch drive gear
7 Checknut
8 Setscrew (1/4 inch −28 x 1/4 inch)

Figure 5-17. Synchro receiver and clutch assembly, clutch disassembled.

c. Reassembly of Clutch Assembly (fig. 5-17).

(1) Slip the synchro adapter shaft (1) on the shaft of the synchro receiver shaft; align the slot in the adapter shaft with the keyway in the shaft of the synchro receiver.

(2) Insert the key (2) in the keyway.

(3) Place the three compression springs (3) in the retaining holes in the thrust gear assembly (4).

(4) Turn the synchro receiver so that the shaft end faces downward and slide the adapter shaft into the thrust gear assembly; line up the key on the shaft with the keyway in the thrust gear assembly.

(5) Slip the bearing washer (5) on the shaft.

(6) Replace the clutch drive gear (6) on the shaft, and mesh the teeth of the crown gear on the clutch drive gear with those of the crown gear on the thrust gear assembly.

(7) Replace and tighten the checknut (7).

(8) Replace and tighten the setscrew (8) in the end of the checknut.

(9) Mount the azimuth or elevation synchro receiver and clutch assemblies as described in paragraph 3-85.

5-43. Disassembly of Print-Cycle Motor and Minute Cam Assembly

(fig. 5-18 and 5-19)

The directions in *a* and *b* below cover the disassembly of a removed print-cycle motor and minute cam assembly (para 3-86). The print-cycle motor is replaced as a complete unit when found to be defective.

a. Removing Print-Cycle Motor B804. To remove B804 (fig. 5-18) from the minute cam assembly, proceed as directed in (1) through (4) below:

(1) Tag and remove the two print-cycle motor leads from terminal board E801.

(2) Remove the two screws (2) and washers (3) that secure the print-cycle motor to the motor sideplate.

(3) Loosen the two setscrews that secure motor drive gear (1) to the motor shaft.

(4) Slide the motor out of the motor sideplate. Hold the motor drive gear while the motor shaft is being withdrawn.

b. Disassembly of Minute Cam Assembly,

(1) Remove the four screws (42, fig. 5-19) and washers (43) that secure terminal board E801 (44) to the terminal board mounting bracket (45).

(2) Remove the two screws (41) and washers (40) that secure the terminal board mounting bracket (45) to the motor sideplate (37), and lift the bracket away from the plate.

(3) Remove the two nuts (46) and washers (47) that secure the tie rods (53 and 54) to the left sideplate (35).

(4) Remove the screws (33 and 39) and washers (34 and 38) in each end of the spacing post (36), and lift the left sideplate (35) off the assembly.

(5) Remove the spring (24) from the cam-shaft (32).

(6) Remove the spacing post (36) from the motor sideplate (37).

(7) Slide the camshaft (32) out of the bushing on the motor sideplate.

(8) Slide the washer (31) off the camshaft.

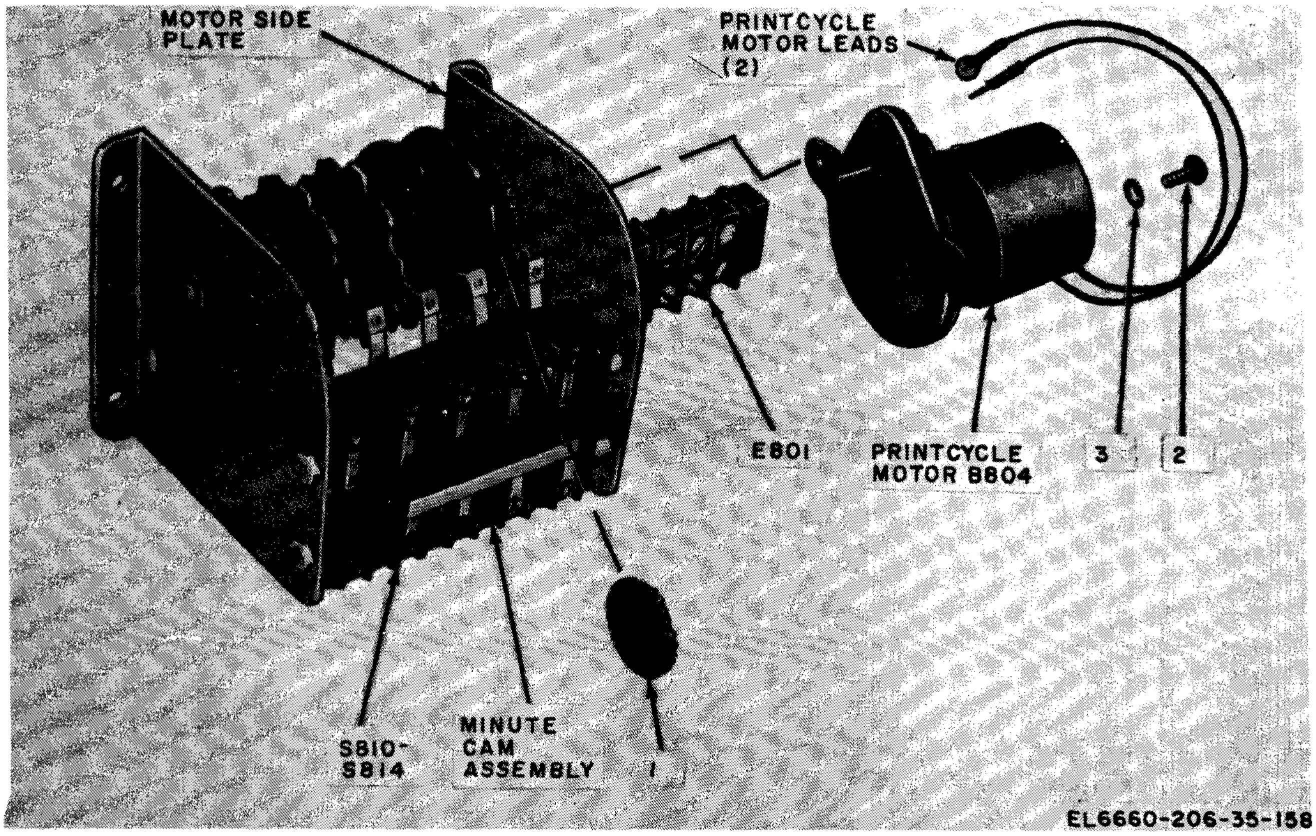
(9) Loosen the two setscrews on each of the cams (25 through 29) and on the camshaft drive gear (30), and withdraw the camshaft.

(10) Remove the four screws (60) and washers (59) that secure the bus bar (58) lugs to the microswitches, and lift the bus bar away from the switches. Remove the screw (60) and washer (59) from the microswitch (48).

(11) Slide the microswitches (48 through 52) off the tie rods (53 and 54).

(12) Unscrew the tie rods (53 and 54) from the bushings on the motor sideplate.

(13) Remove the screw (57), the washer (56), and the lug (55) from each switch.



1 Motor drive gear 0841)
2 Screw (4-40 x 3/16 inch, roundhead, steel (2))
3 Washer, No. 4 (2)

Figure 5-18. Print-cycle motor and minute cam assembly, drive gear and motor removed.

5-44. Reassembly of Print-Cycle Motor and Minute Cam Assembly

(fig. 5-18 and 5-19)

The directions in *a* and *b* below cover the reassembly of a disassembled print-cycle motor and minute cam assembly (para 5-43). The print-cycle motor is replaced as a complete unit when defective.

a. Reassembly of Minute Cam Assembly.

(1) Screw the two tie rods (53 and 54, fig. 5-19) into the threaded bushings on the motor sideplate (37).

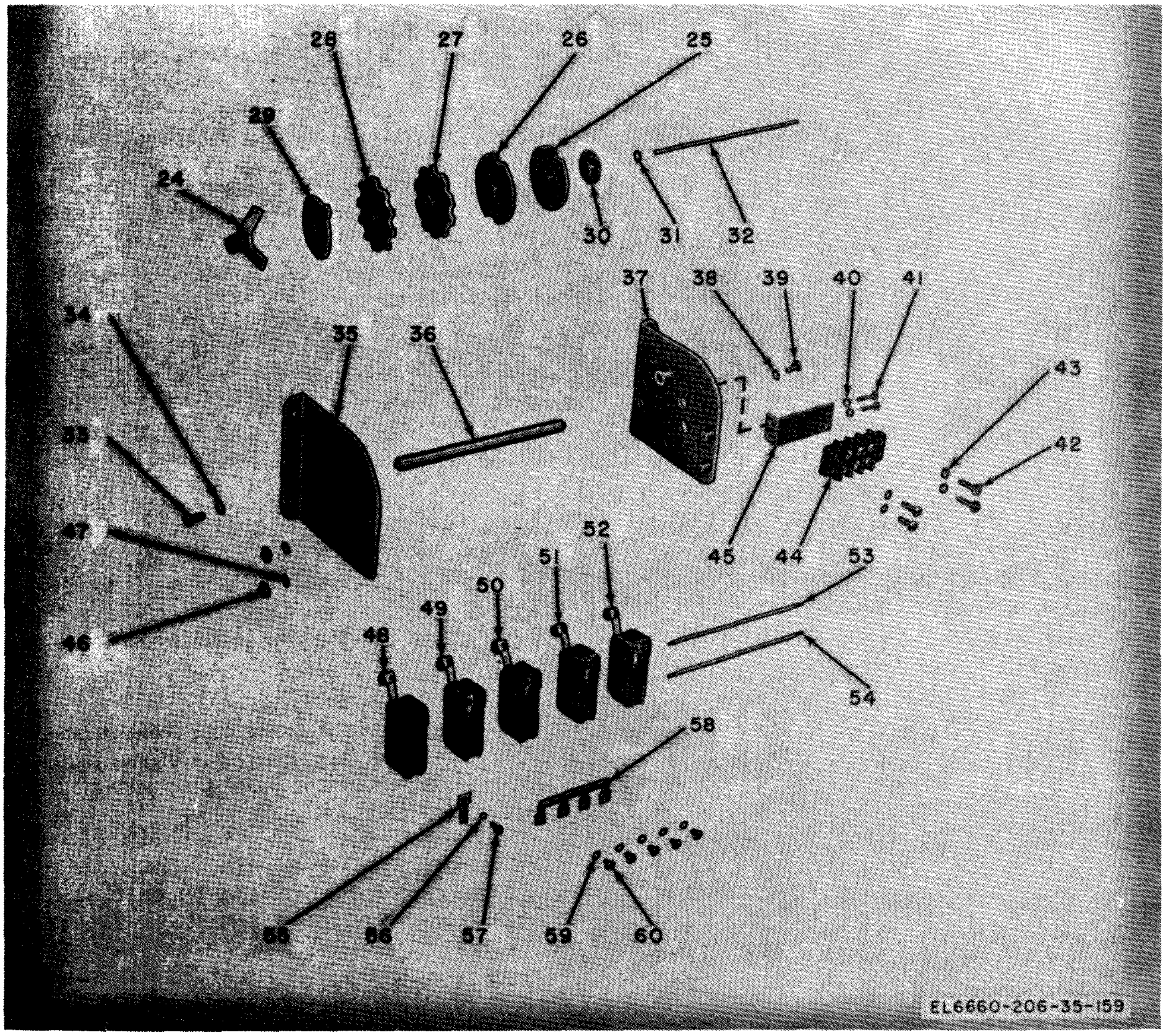
(2) Replace the lugs (55), washers (56), and screws (57) on the microswitches (48 through 52). Slide the switches on the tie rods; begin with microswitch S810 (52) and follow with microswitches S811 (51), S812 (50), S813 (49), and S814 (48).

(3) Fit the bus bar (58) to the microswitches (48 through 52), replace four of the washers (59), and tighten four of the screws (60) to the bus bar. Replace the washer (59) and tighten the screw (60) on the microswitch (48).

(4) Insert the spacing post (36) into the hole on the motor sideplate (37), and replace and tighten the screw (39) and washer (38) that secure the spacing post to the motor sideplate.

(5) Assemble the washer (31), the camshaft drive gear (30), the minute cam (25), 1/2-minute cam (26), 1/10-minute cams (27 and 28), positioning cam (29), and spring (24) on the camshaft (32). Do not tighten the setscrews at this point. The collar of tie positioning cam (29) should face the other cams.

(6) Insert the gear end (camshaft drive gear 30) of the camshaft (32) in the bushing on the motor sideplate (37).



4 through 23 not used
24 Spring
25 Minute cam
26 1/2-minute cam
27 1/10-minute cam
28 1/10-minute cam
29 Positioning cam
30 Camshaft drive gear
31 Washer
32 Camshaft
33 Screw (10–32 x 5/16 inch, binding head, steel)
34 Washer, No. 10
35 Left sideplate
36 Spacing post
37 Motor sideplate
38 Washer, No. 10
39 Screw (10–32 x 5/16 inch, binding head, steel)
40 Washer, No. 6 (2)
41 Screw (6–32 x 1/4 inch, binding head, steel (2))
42 Screw (6–32 x 1/2 inch, binding head, steel (4))
43 Washer, No. 6 (4)
44 Terminal board (E801)
45 Terminal board mounting bracket
46 Nut 6–32 hex., steel (2)
47 Washer, No. 6 (2)
48 Microswitch (S814)
49 Microswitch (S813)
50 Microswitch (S812)
51 Microswitch (S811)
52 Microswitch (S810)
53 Tie rod
54 Tie rod
55 Lug (5)
56 Washer, No. 4 (5)
57 Screw (4–40 x 3/16 inch, roundhead, steel (5)
58 Bus bar
59 Washer, No. 4
60 Screw (4–40 x 3/16 inch, roundhead, steel)

Figure 5-19. Minute cam assembly, exploded view.

(7) Fit the left sideplate (35) on tie rods (53 and 54), camshaft (32), and spacing post (36).

(8) Replace the two washers (47) and tighten the two nuts (46) that secure the tie rods (53 and 54) to the left sideplate (35).

(9) Replace the washer (34) and screw (33) that secure the spacing post (36) to the left sideplate (35).

(10) Slide the camshaft drive gear (30) against the bushing on the motor sideplate (37), and tighten the two setscrews.

(11) Hold the camshaft drive gear (30) against the bushing and align the minute cam (25) with the roller on the microswitch (52) actuating arm, and tighten the two setscrews.

(12) Align the other cams (26 through 29) with their respective rollers, and tighten the setscrews.

(13) Fit the terminal board mounting bracket (45) against the motor sideplate, replace the two washers (40), and tighten the two screws (41) that secure the bracket to the plate.

(14) Fit the terminal board (44) to the bracket (45), and replace the four washers (43) and tighten the four screws (42) that secure the terminal' board to the bracket.

b. Replacement of Print-Cycle Motor.

(1) Fit the motor on the motor sideplate (fig. 5-18).

(2) Slide the motor drive gear (1) on the motor shaft, and mesh the motor drive gear with the camshaft drive gear (30, fig. 5-19).

(3) Replace the washers (3, fig. 5-18), and tighten the two screws (2) that secure the motor to the motor sideplate.

(4) Tighten the two setscrews that secure the motor drive gear to the motor shaft.

(5) Replace the motor leads in the proper location on the cam unit terminal board E801 (44, fig. 5-19).

5-45. Disassembly of Indicator Panel Assembly

(fig. 5-20 and 5-21)

The directions in *a* and *b* below cover the disassembly of a dismounted indicator panel assembly (para 3-88).

a. Disassembly of Elevation Angle Indicator.

(1) Remove the center shaft retaining nut (32, fig. 5-20).

(2) Remove the decimal degree hand (31) and degree hand (30) from the center shaft (12).

(3) Remove the four screws (1) from the dial face (2), and remove the dial face from the dial posts on the front plate (9).

(4) Lift off the center wheel (8) from the center shaft (12).

(5) Remove the four screws (3) and washers (4) that secure the front plate (9) of the gearing assembly to the indicator panel (20), and lift the assembly away from the panel.

(6) Loosen the setscrew in the center wheel drive pinion (7) and remove the pinion from the intermediate shaft and bevel gear (11).

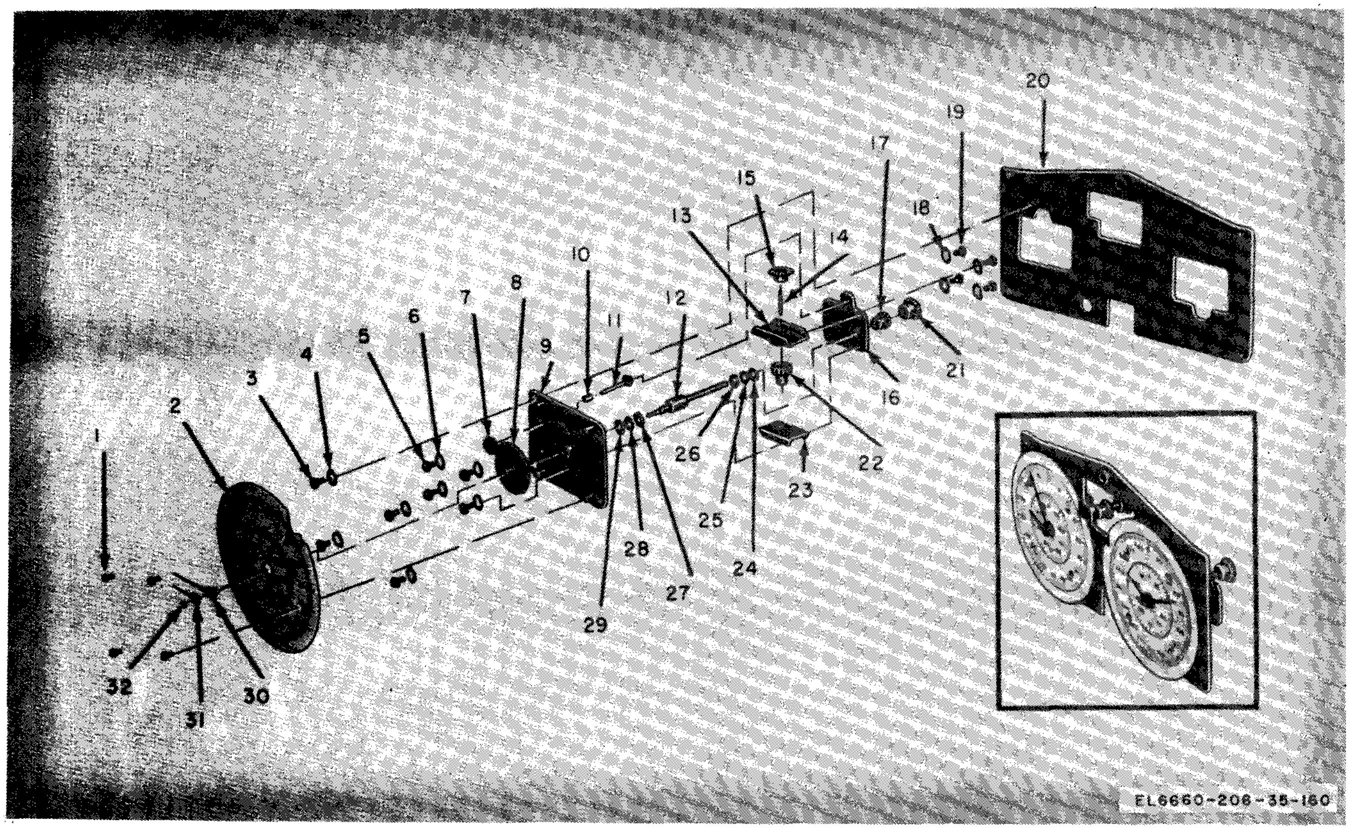
(7) Remove the four screws (5) and washers (6) that secure the front plate (9) to the top and bottom plates (13 and 23), and separate the front plate from the top and bottom plates.

(8) Loosen the two setscrews on the center shaft drive bevel gear (21) and remove the gear from the center shaft (12).

(9) Loosen the two setscrews on the center shaft reset pinion (17) and remove the pinion from the shaft.

(10) Slide the center shaft out of the bushing in the rear plate (16).

(11) Remove the front and rear spacers (24 through 29) from the center shaft (12).



1 Screw (4-40 x 1/8 inch, roundhead)
2 Dial face
3 Screw (6-32 x 1/4 inch, binding head (4))
4 Washer No. 6 (4)
5 Screw (6-32 x 3/16 inch, binding head (4))
6 Washer, No. 6 (4)
7 Center wheel drive pinion
8 Center wheel
9 Front plate
10 Intermediate shaft collar
11 Intermediate shaft and bevel gear
12 Center shaft
13 Top plate
14 Worm gear shaft
15 Worm shaft bevel gear
16 Rear plate
17 Center shaft reset pinion
18 Washer No. 6 (4)
19 Screw (6-32 x 3/16 inch, binding head (4))
20 Indicator panel
21 Center shaft drive bevel gear
22 Worm gear
23 Bottom plate
24 Rear spacer
25 Rear spacer
26 Rear spacer
27 Front spacer
28 Front spacer
29 Front spacer
30 Degree hand
31 Decimal degree hand
32 Center shaft retaining nut 2-56, hex.

Figure 5-20. Indicator panel assembly, elevation angle indicator, exploded view.

NOTE

The worm gear pinned to the center shaft should not be removed. The worm gear and shaft should be replaced as one aasembly.

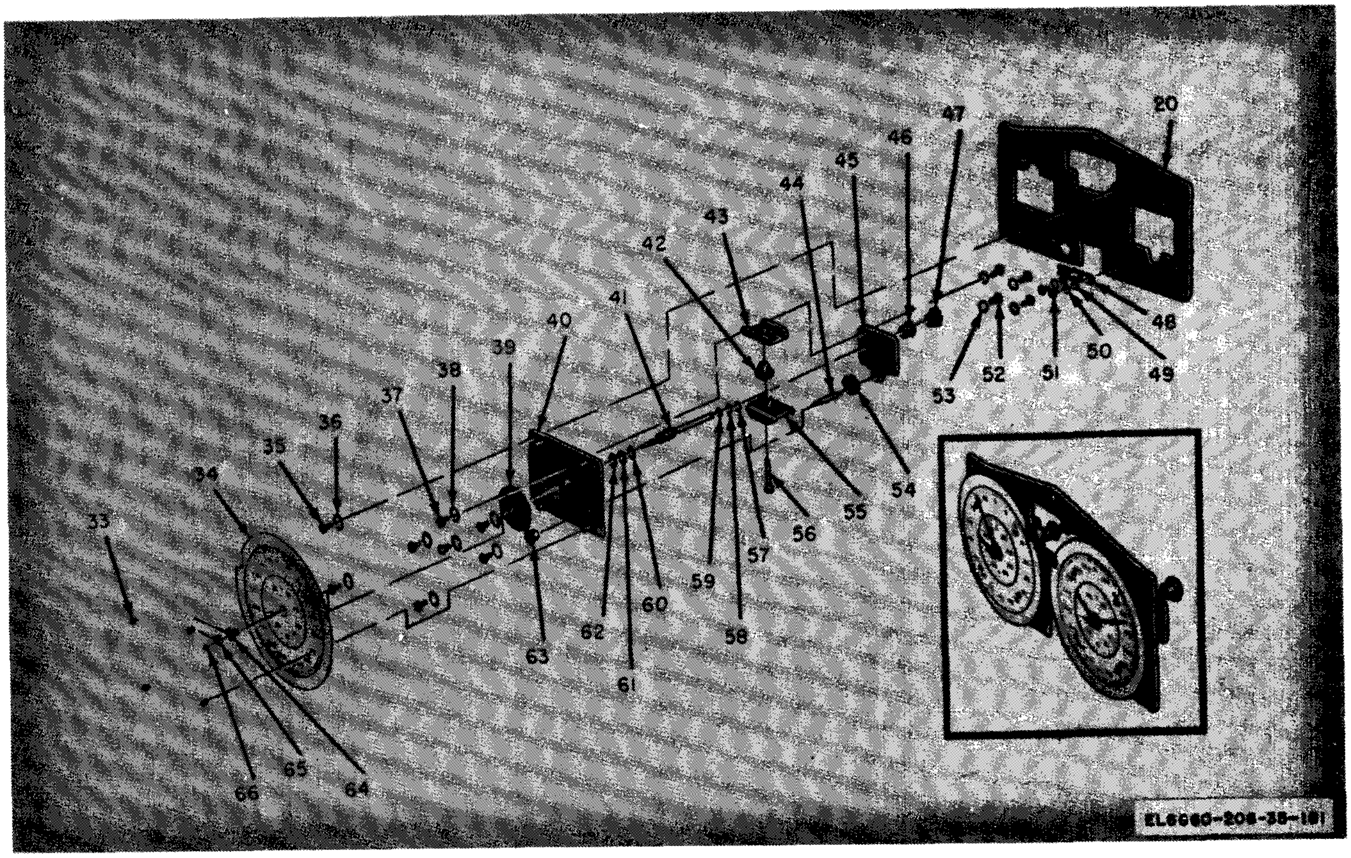
(12) Loosen the two setscrews in the worm gear (22).

(13) Loosen the two setscrews in the worm shaft bevel gear (15).

(14) Drive the worm gear shaft (14) up out of the worm shaft bevel gear (15) through the top plate (13) and remove the bevel gear and worm gear from the assembly.

(15) Remove the intermediate shaft and bevel gear (11) from the bushing in the bottom plate (16).

(16) Loosen the setscrews in the intermediate shaft collar (10) and remove the collar from the intermediate shaft and bevel gear (11).



20 Indicator panel
33 Screw (4-40 x 1/8 inch, roundhead (4))
34 Dial face
35 Screw (6-32 x 1/4 inch, binding head (4))
36 Washer No. 6 (4)
37 Screw (6-32 x 3/16 inch, binding head (4))
38 Washer, No. 6 (4)
39 Center wheel
40 Front plate
41 Center shaft
42 Worm gear
43 Top plate
44 Intermediate shaft
45 Rear plate
46 Center shaft reset pinion
47 Center shaft drive bevel gear
48 Shaft guide
49 Washer, No. 6
50 Washer, No. 6
51 Screw 6-32 x 3/16 inch, binding head (2))
52 Screw 6-32 x 3/16 inch, binding head)
53 Washer, No. 6
54 Intermediate shaft bevel gear
56 Bottom plate
56 Worm gear shaft
57 Rear spacer
58 Rear spacer
59 Rear spacer
60 Front spacer
61 Front spacer
62 Front spacer
63 Center wheel drive pinion
64 Degree hand
65 Decimal degree hand
66 Center shaft retaining nut, 2-56 hex.

Figure 5-21. Indicator panel assembly, azimuth angle indicator, exploded view.

(17) Remove the four screws (19) and washers (18) in the rear plate and lift the top and bottom plates (13 and 23) off the pins on the rear plate.

b. Disassembly of Azimuth Angle Indicator.

(1) Remove the center shaft retaining nut (66, fig. 5-21).

(2) Remove the decimal degree hand (65) and the degree hand (64) from the center shaft (41).

(3) Remove the four screws (33) from the dial face (34), and remove the dial from the dial posts on the front plate (40).

(4) Lift the center wheel (39) off the center shaft (41).

(5) Remove the four screws (35) and washers (36) that secure the front plate (40) of the gearing assembly to the indicator panel, and lift the assembly away from the panel.

(6) Loosen the setscrew in the center wheel drive pinion (63) and remove the pinion from the intermediate shaft (44).

(7) Remove the four screws (37) and washers (38) that secure the front plate (40) to, the top and bottom plates (43) and (55), and separate the front plate from the top and bottom plates.

(8) Loosen the two setscrews on the intermediate shaft bevel gear (54), and remove the intermediate shaft (44) from the bushing in the bottom plate.

(9) Loosen the two setscrews on the center shaft drive bevel gear (47) and remove the gear from the center shaft (41).

(10) Loosen the two setscrews on the center shaft reset pinion (46) and remove the pinion from the center shaft (41).

(11) Slide the center shaft away from the bushing in the rear plate (45).

(12) Remove the front and rear spacers (57 through 62) from the center shaft (41).

NOTE

The worm gear pinned to the center shaft should not be removed from the shaft. The worm gear and shaft should be replaced as an assembly.

(13) Loosen the two setscrews on the worm gear (42) and slide the worm gear shaft (56) out of the bushing in the bottom plate (55).

(14) Remove the four screws (52) and washers (53) on the rear plate and lift the top and bottom plates (43 and 55) off the pins on the rear plate.

(15) Remove the two screws (51) and washers (50 and 49) that secure the shaft guide (48) to the indicator panel (20).

5-46. Reassembly of Indicator Panel Assembly

(fig. 5-20 and 5-21)

The directions in a and *b* below cover the reassembly of a disassembled indicator panel assembly (para 5-45).

a. Reassembly of Elevation Angle Indicator.

(1) Align the locating holes in the top and bottom plates (13 and 23, fig. 5-20) with the pins on the rear plate (16).

(2) Replace the four washers (18) and tighten the four screws (19) that secure the rear plate (16) to the top and bottom plates (13 and 23).

(3) Replace the intermediate shaft and bevel gear (11) in the intermediate shaft bushing on the rear plate (16).

(4) Align the worm shaft bevel gear (15) and worm gear (22) with the worm shaft bushing on the top plate (13).

(5) Insert the worm gear shaft (14) through the bottom plate (23), the worm gear (22), the bottom plate (23), and the worm shaft bevel gear (15).

(6) Tighten the setscrews on the worm gear.

(7) Reassemble the front. and rear spacers (24 through *29)* on the center shaft.

(8) Insert the center shaft (12) in the center shaft bushing on the rear plate; mesh the center shaft worm with the worm gear (22).

(9) Align the locating holes in the top and bottom plates (13 and 23) with the pins on the front plate (9), and insert the intermediate shaft (11) in the bushing on the front plate (9).

(10) Slide the intermediate shaft collar (10) on the intermediate shaft (11).

(11) Replace the four washers (6) and tighten the four screws (5) that secure the front plate to the top and bottom plates.

(12) Slide the intermediate shaft collar (10) against the bushing on the front plate; allow clearance for free running, and tighten the setscrew on the collar.

(13) Mesh the worm shaft bevel gear (15) with the intermediate shaft and bevel gear (11), and tighten the two setscrews on the worm shaft and bevel gear (15).

(14) Replace the center shaft reset pinion (17) on the center shaft (12) and tighten the two Setscrews. (This may be repositioned when mounting the indicator panel assembly (para 3-88).

(15) Replace the center shaft drive bevel gear (21) on the center shaft and tighten the two setscrews. (This may be repositioned when mounting the indicator panel assembly (para 3-88).

(16) Replace the center wheel drive pinion (7) on the intermediate shaft, and tighten the setscrew.

(17) Replace the center wheel (8) on the center shaft; mesh it with the center wheel drive pinion (7).

(18) Replace the gearing assembly on the indicator panel (20); replace the washers (4), and tighten the four screws (3) that secure the front plate (9) to the indicator panel (20).

(19) Place the dial face (2) on the dial posts on the front plate (9); align the holes in the dial face with the tapped holes in the dial posts. Replace and tighten the four screws (1) on the dial face.

(20) Replace the degree hand (30) on the center shaft.

(21) Replace the decimal degree hand (31) on the center shaft.

(22) Replace and tighten the center shaft retaining nut (32).

b. Reassembly of Azimuth Angle Indicator.

(1) Fit the shaft guide (48, fig. 5-21) to the plate (20) and replace the washers (49 and 50) and screws (51).

(2) Align the locating holes in the top and bottom plates (43 and 55) with the pins in the rear plate (45); replace the four washers (53) and tighten the four screws (52) that secure the rear plate to the top and bottom plates.

(3) Align the worm gear (42) with the bushing on the bottom plate (55), and insert the worm gear shaft (56) through the bushing in the bottom plate, through the worm gear, and into the bushing on the top plate (43).

(4) Tighten the two setscrews on the worm gear.

(5) Reassemble the front and rear spacers (57 through 62) on the center shaft (41).

(6) Insert the center shaft (41) in the center shaft bushing on the rear plate (45); mesh the center shaft worm with the worm gear (42).

(7) Align the intermediate shaft bevel gear (54) with the bushing on the rear plate (45).

(8) Insert the intermediate shaft (44) through the intermediate shaft bevel gear (54) and into the bushing on the rear plate (45).

(9) Mesh the intermediate shaft bevel gear (54) and the worm gear (42), and tighten the setscrews on the intermediate shaft bevel gear (54).

(10) Slide the front plate (40) onto the center shaft (41) and intermediate shaft (44).

(11) Align the locating holes in the top and bottom plates (43 and 55) with the pins in the front plate (40).

(12) Replace the four washers (38) and tighten the four screws (37) that secure the front plate to the top and bottom plates.

(13) Replace the center shaft reset pinion (46) on the center shaft (41), and tighten the two setscrews. (This may be repositioned when mounting the indicator panel (para 3-88).

(14) Replace the center shaft drive bevel gear (47) on the center shaft, and tighten the two setscrews. (This may be repositioned when mounting the indicator panel (para 3-88).

(15) Replace the center wheel drive pinion (63) on the intermediate shaft (44), and tighten the setscrew.

(16) Replace the center wheel (39) on the center shaft (41); mesh it with the center wheel drive pinion (63).

(17) Replace the gearing assembly on the indicator panel (20, fig. 5-20); replace the washers (36, fig. 5-21) and tighten the four screws (35) that secure the front plate (40) to the indicator panel.

(18) Place the dial face (34) on the dial posts on the front plate (9, fig. 5-20); align the holes in the dial face with the tapped holes in the dial posts. Replace and tighten the four screws (33, fig. 5-21) on the dial face.

(19) Replace the degree hand (64) on the center shaft.

(20) Replace the decimal degree hand (65) on the center shaft.

(21) Replace and tighten the center shaft retaining nut (66).

5-47. Disassembly and Reassembly of Reset Assembly
(fig. 5-22)

The direction in *a* and *b* below cover the disassembly and the reassembly of a dismounted reset assembly (para 3-89).

a. Disassembly of Reset Assembly.

(1) Remove two of the cotter pins (10, fig. 5-22) and the two washers (5) from the two reset pinion shafts (21), and slide the two reset pinions (7) off the shafts.

(2) Remove two of the cotter pins (10) and the two washers (6) from the two intermediate reset gear shafts (22), and remove the two intermediate reset gears (8) from the shafts.

(3) Loosen the setscrew on the indicator panel stop collar (1) and slide the collar off the reset drive gear shaft (9).

(4) Loosen the two setscrews on the reset drive gear (2) and slide the gear off the reset drive gear shaft (9).

(5) Slide the reset drive gear spacer (19) off the shaft.

(6) Loosen the setscrews in the backplate stop collar and the walking beam stop collar (16 and 17), and remove the reset drive gear shaft (9) from the walking beam.

(7) Slide the two clutch release links (4) with the clutch yoke (15) and connecting parts off the walking beam selector posts (20).

(8) Loosen the two setscrews on the bearing bracket (11) and slide the bracket off the clutch yoke shaft (14).

(9) Drive out the dowel pins (13) that hold the clutch yoke (15) to the clutch yoke shaft (14), and remove the yoke from the shaft.

(10) The two clutch release links (4) may be separated from the two bearing brackets (11) by removal of the cotter pins (12) and washers (3) from the bearing bracket studs.

b. Reassembly of Reset Assembly.

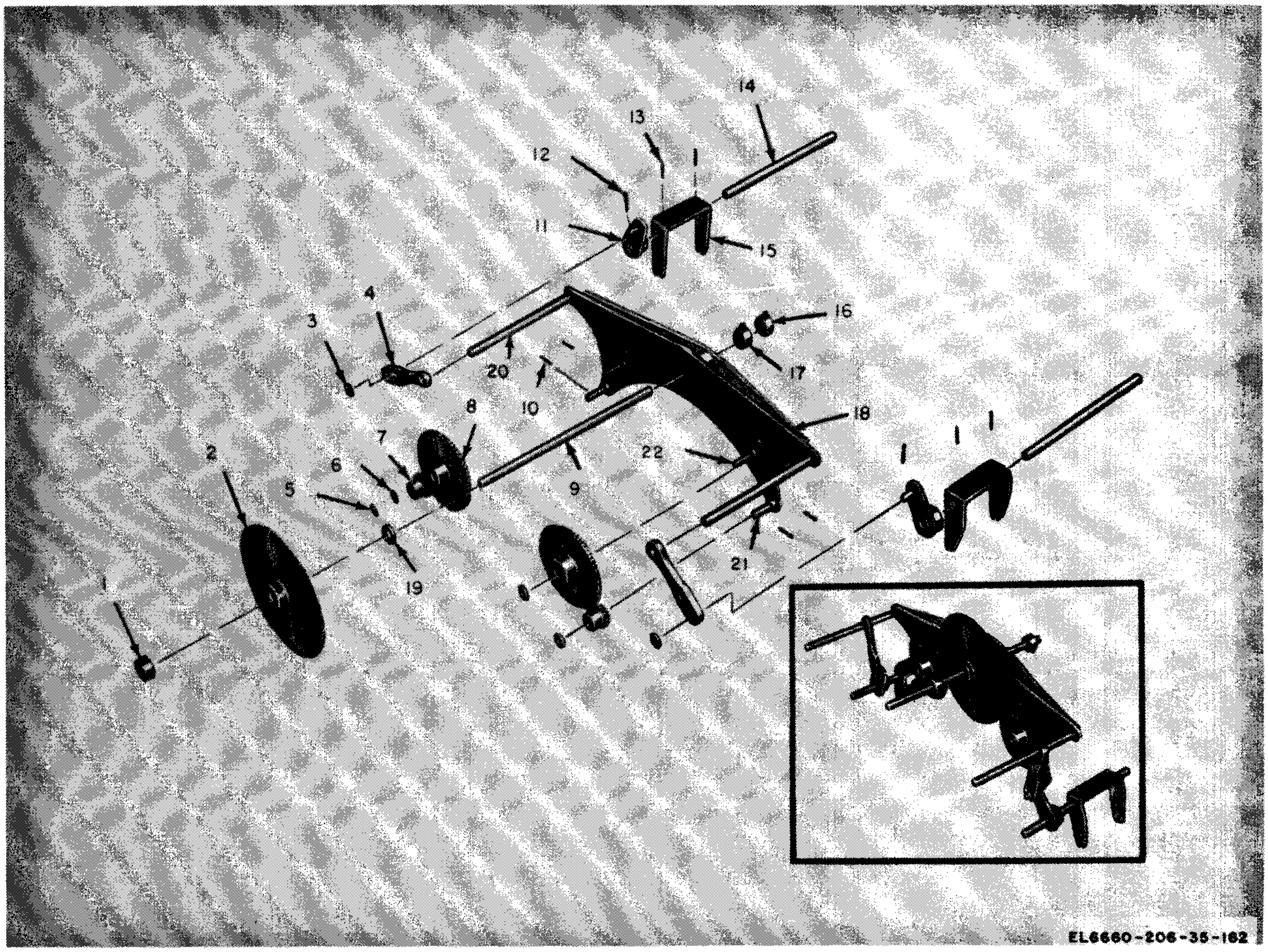
(1) Slide the reset drive gear shaft (9) into the bushing on the walking beam (18).

(2) Slide the spacer (19) on the reset drive gear shaft (9).

(3) Slide the reset drive gear (2) on the reset drive gear shaft (9).

(4) Slide the indicator panel stop collar (1) on the reset drive gear shaft (9).

(5) Slide the backplate and walking beam stop collars (16 and 17) on the reset drive gear shaft (9).



1 Indicator panel stop collar
2 Reset drive gear
3 Washer, No. 6 (2)
4 Clutch, release link (2)
5 Washer, No. 10 (2)
6 Washer, No. 10 (2)
7 Reset pinion (2)
8 Intermediate reset gear (2)
9 Reset drive gear shaft
10 Cotter pin (3/64 inch x 1/2 inch (4))
11 Bearing bracket (2)
12 Cotter pin, same as 10 (2)
13 Dowel pin (5/0 x 9/16-inch taper (4))
14 Clutch yoke shaft (2)
15 Clutch yoke (2)
16 Backplate atop collar
17 Walking beam stop collar
18 Walking beam
19 Reset drive gear spacer
20 Walking beam selector post (2)
21 Reset pinion shaft (2)
22 Intermediate reset gear shaft (2)

Figure 5-22. Reset assembly, exploded view.

(6) Replace the two intermediate reset gears (8) on the intermediate reset gear shafts (22); mesh the gears with the reset drive gear (2).

(7) Replace the two washers (6) and two of the cotter pins (10) on the intermediate reset gear shafts (22) to secure the intermediate reset gears (8).

(8) Replace the two reset pinions (7) on the reset pinion shafts (21); mesh the pinions with the intermediate gears.

(9) Replace the two washers (5) and two of the cotter pins (10) on the reset pinion shafts (21).

(10) Slide the clutch release links (4) on the walking beam selector posts (20).

NOTE

Do not tighten the setscrews on the stop collars (1, 16, and 17) on the reset drive shaft until the walking beam and indicator panel are replaced on the chassis and the collars can be aligned for proper gear meshing with the indicator panel assembly (para 3-89).

(11) Reassemble each clutch yoke by replacing the clutch yoke (15) and the bearing bracket (11) on the clutch yoke shaft (14) and inserting the dowel pins (13) that hold the clutch yoke in place; tighten the bearing bracket setscrews.

(12) Connect each clutch yoke (15) and its assembly to the clutch release links (4) by inserting the stud on the bearing bracket (11) in the hole on the free end of the clutch release link; replace the washer (3) and the cotter pin (12).

(13) Refer to paragraph 3-89 for the procedure to mount the reset walking beam.

5-48. Disassembly of Time-Print Unit
(fig. 5-23)

The directions in *a* through *ae* below cover the disassembly of a removed time-print unit (para 3-90).

NOTE

Figure 5-23 is presented in three parts. The first part shows items 1 through 26, the second part shows items 27 through 61, and the third part shows items 62 through 74.

a. Remove the two screws and washers on the left-side plate and remove the time reset switch S819 (fig. 3-51).

b. Remove the four screws (12, fig. 5-23 ①) and washers (11) that secure the counter bracket 8 to the frame (17), and lift the bracket off the frame.

c. Remove the two screws (6) and lockwashers (5) that secure the counter (4) to the counter bracket (8) and lift the counter off the bracket.

d. Remove the setscrew (2) on the counter wheel (3), and remove the wheel from the counter shaft; loosen the setscrew on the counter arm (7) and remove the counter arm from the counter shaft.

e. Loosen the setscrew in the collar (1) and remove the collar.

f. Disengage the transfer-bracket (10) and the spring (9).

g. Remove the four screws (27, fig. 5-23 ②) and washers (28) that secure the front tie bracket (29) and the assembly *(h* below) to the frame (17), and lift the bracket out of the frame.

h. Remove the parts from the front tie bracket (29) as directed in (1) through (4) below.

(1) Drive the dowel pin (33) out of the reset shaft bevel gear (31) and slide the gear off the reset shaft (34).

(2) Loosen the setscrew on the ratchet gear (30) and slide the gear off the reset shaft (34).

(3) Slide the reset shaft (34) out of the bushing on the front tie bracket (29).

(4) Disengage the ratchet arm spring (32) from the arm and spring stud on the front tie bracket (29).

i. Remove the four screws (65, fig. 5-23 ③) and washers (64) that secure the asterisk solenoid (66) to the frame (17), and slide the solenoid out of the frame.

j. Remove the cotter pin (62) and washer (72) from the plunger stud (74).

k. Remove the cotter pin (57) and washer (73) from the asterisk symbol level (58, fig, 5-23).

l. Disengage the asterisk link spring (71, fig, 5-23 ③) from the spring stud and the asterisk symbol link (70), and remove the link from the plunger stud (74) and the asterisk symbol level (58, fig. 5-23@) studs.

m. Remove the asterisk solenoid plunger (63, fig, 5-23 ③) from the frame (17).

n. Remove the time solenoid (16) as directed in (1) through (4) below.

(1). Disengage the spring (15, fig, 5-23 ①) from the solenoid drive arm (47, fig. 5-23 ②).

(2) Remove the two nuts (13) and washers (14) from the mounting studs on the time solenoid (16).

(3) Loosen the two setscrews on the solenoid drive arm (47, fig. 5-23 ②).

(4) Remove the time solenoid (16, fig. 5-23 ①) from the frame.

o. Remove the spring (15) from the solenoid drive arm (47, fig. 5-23 ②).

p. Loosen the two setscrews on the time reset cam (40) and on the reset bevel gear (41).

q. Loosen the setscrew on the reset drive gear (43) and drive the intermediate reset shaft (42) out of the frame (17, fig. 5-23 ①). Remove the parts from the shaft as the shaft is withdrawn from the frame.

r. Loosen the two setscrews on the drive gears (23 and 26).

s. Disengage the lock-pawl springs (25) from the lock pawls (21).

t. Drive the intermediate shaft (24) out of the frame (17). Remove the parts from the shaft as it is withdrawn from the frame.

u. Remove the two screws (67, fig. 5-23 ③) and washers (68) at the side of the frame and slide the spacer comb (69) out of the frame.

v. Remove the two lockscrews (39, fig. 5-23 ②) and washers (38) at the side of the frame, and drive out the lock-pawl shaft (22, fig. 5-23) that holds the lock pawls (21). Remove the parts from the shaft as it is withdrawn from the frame.

w. Loosen the two setscrews on the print wheel drive gear (61, fig. 5-23 ②).

x. Loosen the setscrews that secure the two bushings (49) at each end of the pivot wheel shaft (56).

y. Remove the bushings (49) released in the procedure given in *x* above. If necessary, drive the pivot wheel shaft (56) first to the left and then to the right to move the bushings out of the frame.

z. Remove from the frame all parts (44 through 61) that now remain connected to the saddle (48).

aa. Remove the pivot wheel shaft (56) with the printing wheel assembly (57 through 61) from the saddle (48). The printing wheel assembly (57 through 61) may now be removed from the shaft.

ab. Remove the cotter pins (46) and washers (44) from the studs on the solenoid drive arm (47) and the saddle (48), and remove the link (45) from the drive arm and saddle.

ac. Remove the push-pawl assembly (50 through 55) as outlined in (1) through (4) below.

(1) Loosen the two setscrews that secure the shaft bushings (49) at each end of the push-pawl shaft (54).

(2) Drive the push-pawl shaft (54) to the right in the saddle (48) until the bushing (49) at the right is free; drive the shaft to the left to free the bushing at the left.

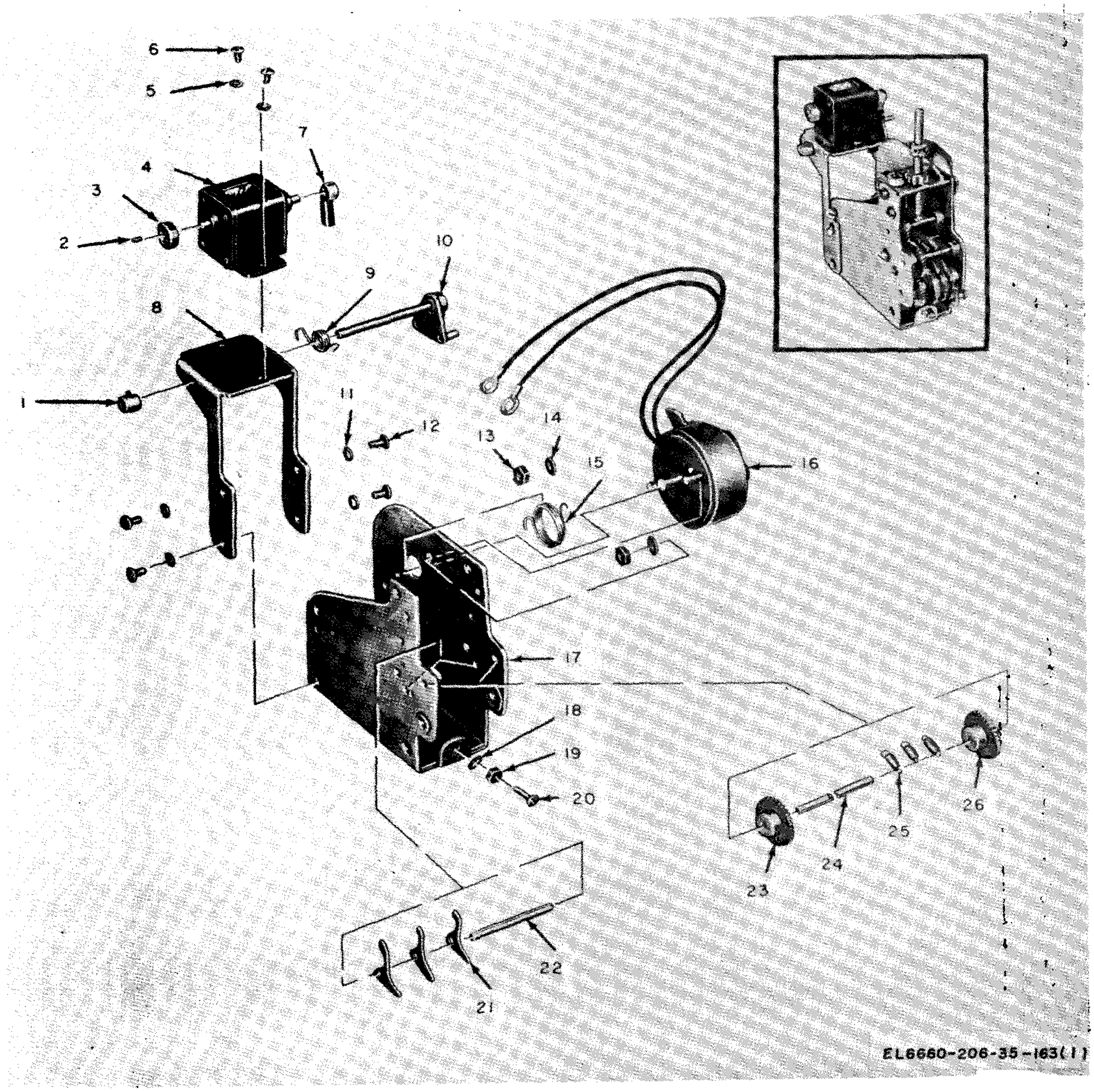
(3) Remove the push-pawl assembly from the saddle (48) and slip the spring (55) off the end of the shaft (54).

NOTE

The shaft and locknut, unscrewed as directed in (4) below, have a left-hand thread.

(4) Remove the three pawls (52) and the two spacers (51 and 53) from the shaft. Hold the flat section of the shaft with a wrench and unscrew the locknut (50).

ad. Remove the two screws (35), washers (36), and spacer (37) from the frame (17).



1 Collar
2 Setscrew (for 4)
3 Counter wheel (for 4)
4 Counter
5 Lockwasher, No. 6 (2)
6 Screw (6–32 x 1/2 inch (2))
7 Counter arm
8 Counter bracket
9 Spring
10 Transfer bracket
11 Washer, No. 6 (4)
12 Screw (6–32 x 1/4 inch, binding head, steel (4))
13 Nut (2)
14 Washer (2)
15 Spring
16 Time solenoid
17 Frame
18 Washer, No. 6
19 Nut, 6–32, Hexagonal
20 Stop screw (6–32 x 3/4 inch)
21 Lock pawl (3)
22 Lock-pawl shaft
23 Intermediate drive gear
24 Intermediate shaft
25 Lock-pawl springs
26 Drive gear

Figure 5-23 ①. Time-print unit, exploded view (sheet ① of 3).

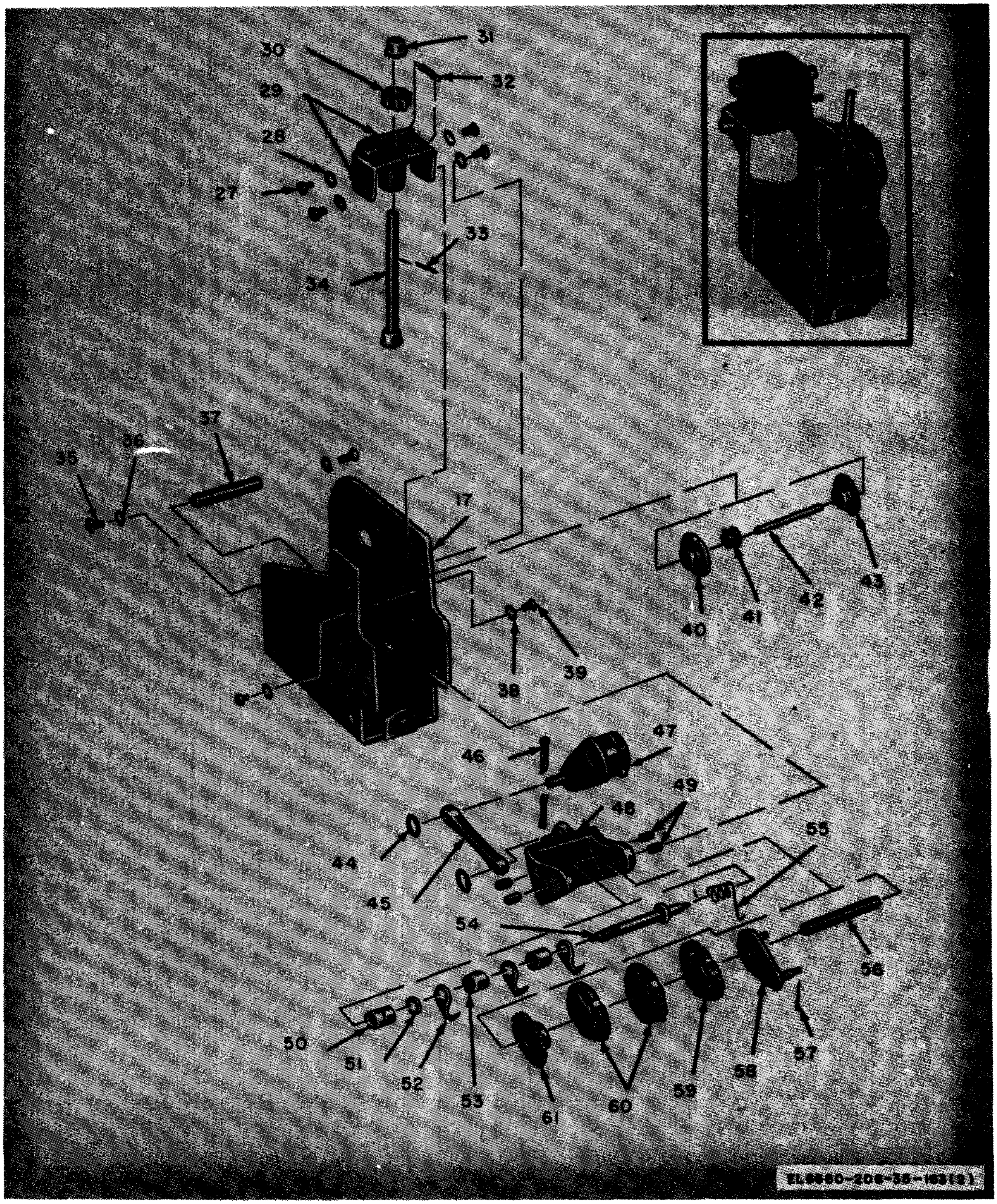


Figure 5-23 ②. Time-print unit, exploded view ***(sheet ② of*** *3).*

Key for Figure 5-23 ②.

27 Screw (6-32 x 1/4-inch, binding head (4))
28 Washer, No. 6 (4)
29 Front tie bracket
30 Ratchet gear
31 Reset shaft bevel gear
32 Ratchet arm spring
33 Dowel in (7/0 x 1/2-inch)
34 Reset shaft
35 Screw, same as 27 (2)
36 Washer, No. 6 (2)
37 Spacer
38 Washer, No. 8 (2)
39 Lock screw (8-32 x 1/4-inch, binding head (2))
40 Time reset cam
41 Reset bevel gear
42 Intermediate reset shaft
43 Reset drive gear
44 Washer (2)
45 Link
46 Cotter pin (3/64 inch x 1/2 inch (2))
47 Solenoid drive arm
48 Saddle
49 Bushing (4)
50 Locknut
51 Spacer
52 Push Pawl (3)
53 Spacer
54 Push-pawl shaft
55 Push-pawl spring
56 Pivot wheel shaft
57 Cotter pin (3/64 inch x 1/2 inch)
58 Asterisk symbol level
59 Print wheel
60 Print wheels (2)
61 Print wheel drive gear

ae. Remove the stop screw (20), washer (18), and nut (19) from the frame (17).

5-49. Reassembly of Time-Print Unit

(fig. 5-23)

NOTE

Figure 5–23 is presented in three parts. The first part shows items 1 through 26, second part shows items 27 through 61, and the third part shows items 62 through 73.

The directions in *a* through *at* below cover the reassembly of a disassembled time-print unit (para 5-48).

a. Replace the push pawls (52, fig. 5-23) and spacers (51 and 53) on the push-pawl shaft (54) and tighten the locknut (50).

b. Slip the push-pawl spring (55) on the shaft (54) and insert the push-pawl shaft in the saddle (48). Align the shaft in the bushing (49) at the left, and insert the drive in the bushing at the right (49). Be sure that the shaft rotates freely in the bushings.

c. Engage the u-loop of the push-pawl spring (55) with the pawl at the right, and engage the other end of the spring with the saddle (48).

d. Tighten the two setscrews in the bushings (49) at each end of the push-pawl shaft.

e. Replace the print wheel assembly (57 through 61) in the saddle (48) as directed in (1) through (3) following.

(1) Slide the print wheel drive gear (61), the print wheels (59 and 60), and the asterisk symbol level (58) on the pivot wheel shaft (56), and orient as shown in figure 5-23 ②.

(2) Insert the pivot wheel shaft with the parts assembled as directed in (1) preceding, in the saddle; engage the push pawls (52) with the ratchet teeth on the print wheels (59 and 60).

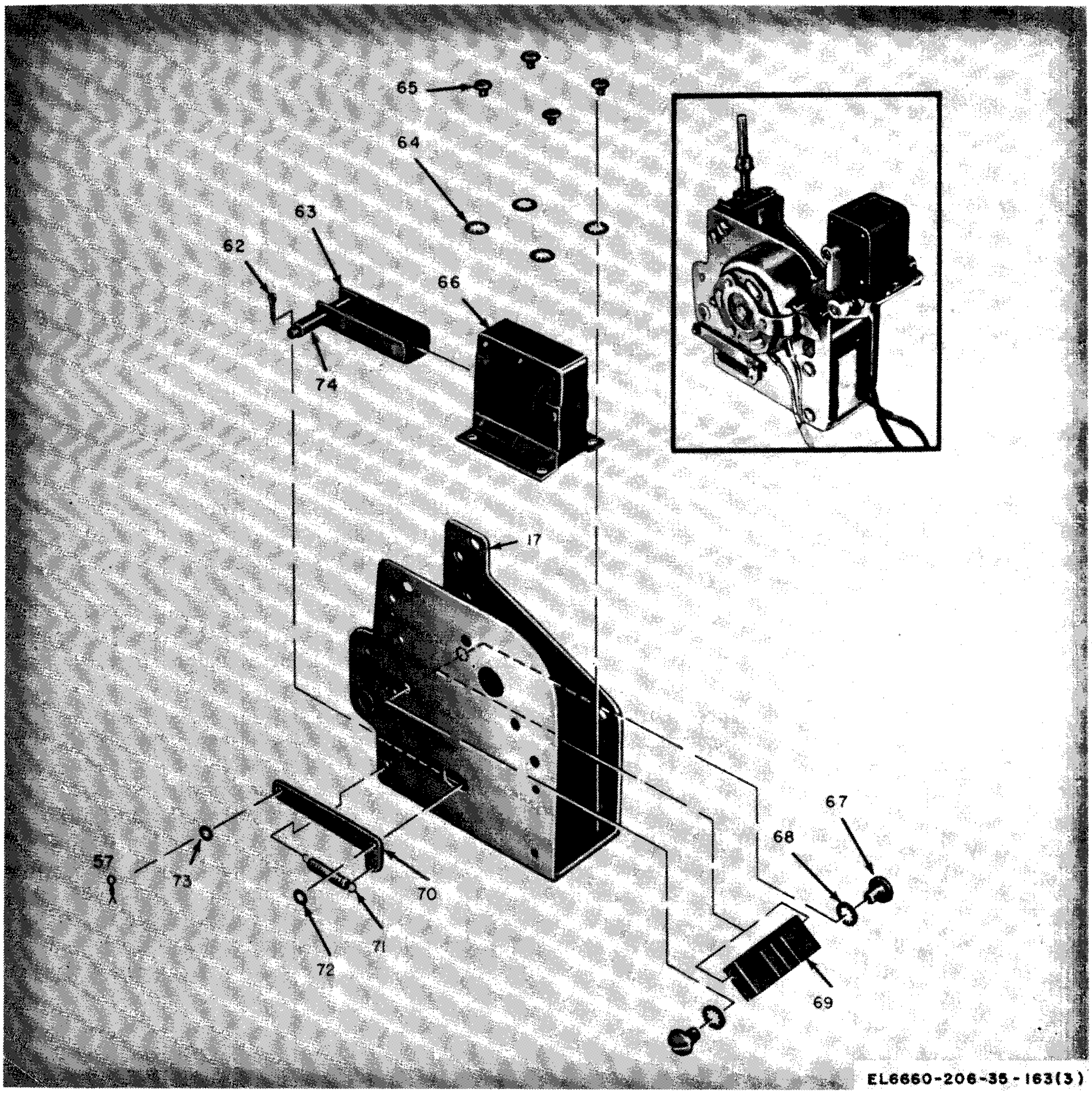
(3) Align the pivot wheel shaft (56) with the holes in the sides of the saddle (48), and insert the assembly (48 through 61) in the frame (17); drive in the bushings (49) at each end of the pivot wheel shaft (56) through the holes in the frame.

f. Tighten the two setscrews on the print wheel drive gear (61) and the two setscrews that hold the bushings (49).

g. Place the plunger stud through the slot in the frame.

h. Slide the asterisk solenoid (66, fig. 5-23 ③) into the frame (17); mate the asterisk solenoid plunger (63) with the asterisk solenoid (66).

i. Align the asterisk solenoid (66) mounting holes with the mounting holes on the frame (17).



17 Frame
57 Cotter pin 3/6.4-inch x l/2-inch)
62 Cotter pin (3/64-inch x 1/2-inch)
63 Asterisk solenoid plunger
64 Washer No. 4 (4)
65 Screw (4-40 x 1/4-inch (4))
66 Asterisk solenoid
67 Screw (3-32 x 3/8-inch (2))
68 Washer, No. 8 (2)
69 Spacer comb
70 Asterisk symbol link
71 Asterisk link spring
72 Washer, No. 4
73 Washer, No. 4
74 Plunger stud

Figure 5-23 (3). Time-print unit, exploded view (sheet (3) of 3).

j. Replace the screws and washers (65 and 64) that secure the asterisk solenoid, and tighten the screws.

k. Place the asterisk symbol link (70) on the plunger stud (74) and the asterisk symbol lever (58) stud.

l. Replace the cotter pins (62 and 57) and washers (72 and 73) on the studs (*k* above).

m. Fasten the asterisk link spring (71) to the asterisk symbol link (70) and to the spring stud.

n. Replace the time solenoid (16, fig. 5-23) on the frame, and replace the two washers (14) and nuts (13).

o. Slide the solenoid drive arm (47, fig. 5-23 ②) on the armature shaft, and tighten the two setscrews on the collar.

p. Slip the spring (15, fig. 5-23 @) on the arm, and hook the **U** -loop end on the link on the time solenoid (16).

g. Slide the link (45, fig. 5-23 @) on the studs of the solenoid drive arm (47) and saddle (48), and replace the washers (44) and cotter pins (46).

r. Place the spacer comb (69, fig. 5-23 ③) on the frame, and replace the screws (67) and washers (68). Do not tighten the screws.

s. Slide the lock-pawl shaft (22, fig. 5-23 ①) in from the left, and slide the lock pawls (21) on the shaft.

t. Align the pawls with the slots on the spacer comb (69, fig. 5-23 ③).

u. Replace and tighten the lockscrews (39, fig. 5-23) and washers (38).

v. Tighten the screws (67, fig. 5-23 ③) that secure the spacer comb (69).

w. Slide the intermediate shaft (24, fig. 5-23 @) in through the hole on the left side of the frame.

x. Slide the drive gear (26) and the lock-pawl springs (25) on the intermediate shaft (24). Slip the other end of the springs on the notches of the lock pawls (21).

y. Slide the intermediate drive gear (23) on the intermediate shaft (24).

z. Drive the intermediate shaft (24) into the bushing on the left.

aa. Check the meshing of the intermediate drive gear (23) with the print wheel drive gear (61, fig. 5-23 ②) and tighten the setscrews on the intermediate drive gear.

ab. Slide the intermediate drive gear (23, fig. 5-23 ①) against the frame (17) at the right and tighten the setscrews.

ac. Slide the intermediate reset shaft (42, fig. 5-23 @) into the frame (17, fig. **5–23**①) from the right.

ad. Slip the reset drive gear (43, fig. 5-23@), the reset bevel gear (41), and the time reset cam (40) on the intermediate reset shaft (42).

ae. Drive the reset shaft (42) with the assembled parts (*ad* above) through the frame and into the hole on the left side of the frame (17).

af. Slide the reset drive gear (43) against the frame at the right. Check the meshing of the reset drive gear (43) with the drive gear (26, fig. **5–23**①) and tighten the setscrews.

ag. Slide the time reset cam (40, fig. 5-23 ②) to the left side of the frame (17) and tighten its setscrews.

ah. Slide the reset bevel gear (41) against the time reset cam (40) but do not tighten setscrews.

ai. Reassemble the front tie bracket (29) as directed in (1) through (5) below.

(1) Slide the reset shaft (34) into the bushing on the front tie bracket (29).

(2) Slide the ratchet gear (30) on the shaft and fit it against the bracket.

(3) Make allowance for free running of the shaft and tighten the setscrew on the ratchet gear (30).

(4) Slide the reset shaft bevel gear (31) on the reset shaft (34), align the pinholes, and drive the dowel pin (33) through the bevel gear and shaft.

(5) Fasten the ratchet arm spring (32) to the ratchet arm and the spring stud on the front tie bracket (29).

aj. Replace the front tie bracket (29) on the frame.

ak. Check the meshing of the reset bevel gear that is attached to the end reset shaft (34) with the reset bevel gear (41), and tighten the setscrews on the reset bevel gear (41).

al. Replace the counter (4), the lockwashers (5, fig. **5-23①**), and tighten the two screws (6) that secure the counter to the front tie bracket (29, fig. **5-23②).**

am. Slide the counter wheel (3, fig. **5-23①**) on the countershaft, and replace and tighten the setscrew (2) that secures the wheel to the shaft.

an. Slide the counter arm (7) on its shaft on the counter (4) and tighten the setscrew.

ao. Fit the counter bracket (8) to the frame (17), and replace the washers (11); tighten the four screws (12) that secure the bracket to the frame.

ap. Insert the transfer bracket (10) through the spring (9) and the counter bracket (8).

aq. Replace the collar (1) and tighten the setscrew.

ar. Check the operation (manually) of the arm on the time solenoid (16), the transfer bracket (10), and the counter arm (7); the counter should respond with each operation.

as. Replace the washer (18), the nut (19), and the stop screw (20) in the frame (17).

at. Replace the spacer (37, fig. 5-23 @) in the frame (17, fig. 5-23) and replace the washers (39, fig. 5-23) and screws (35).

au. Replace the time reset switch S819 (fig. 3-51) on the left-side plate and secure it with the two screws and washers removed (para 5-48a).

au. Refer to paragraph 3-90 for the procedure to mount the time-print unit.

5-50. Disassembly and Reassembly of Elevation Print Unit Equipped With Geneva Pinion Movement

(fig. 5-24)

The directions in *a* end *b* below cover the disassembly and reassembly of a removed elevation print unit (para 3-92) equipped with the Geneva pinion movement.

a. Disassembly.

(1) Remove the pin (19, fig. 5-24) on the collar of the type drive gear (1) and slide the gear off the shaft of the shaft and wheel assembly (17).

(2) Remove the two screws (8) and washers (9) that secure each of the spacing posts (10), and remove the spacing posts from the frame (18).

(3) Remove the three screws (2) and washers (3) that secure each type drive shaft bushing (4) to the frame (18), and slide the bushings off the shaft.

Key for Figure 5-24.

1 Type drive gear
2 Screw (2-5 x 3/16-inch, binding head (6))
3 Washer, No. 2(6)
4 Type drive shaft bushing
5 Screw (2-56 x 3/16-inch, roundhead (6))
6 Washer, No. 2 (6)
7 Sideplate (2)
8 Screw (6-3 x 3/16-inch, binding head (4))
9 Washer, No. 6 (4)
10 Spacing post (2)
11 Geneva and pinion assembly unite to tens)
12 Geneva and pinion assembly decimal to units)
13 Spacer
14 Tens type wheel
15 Units type wheel
16 Decimal point indicator
17 Shaft an wheel assembly
18 Frame
19 Pin

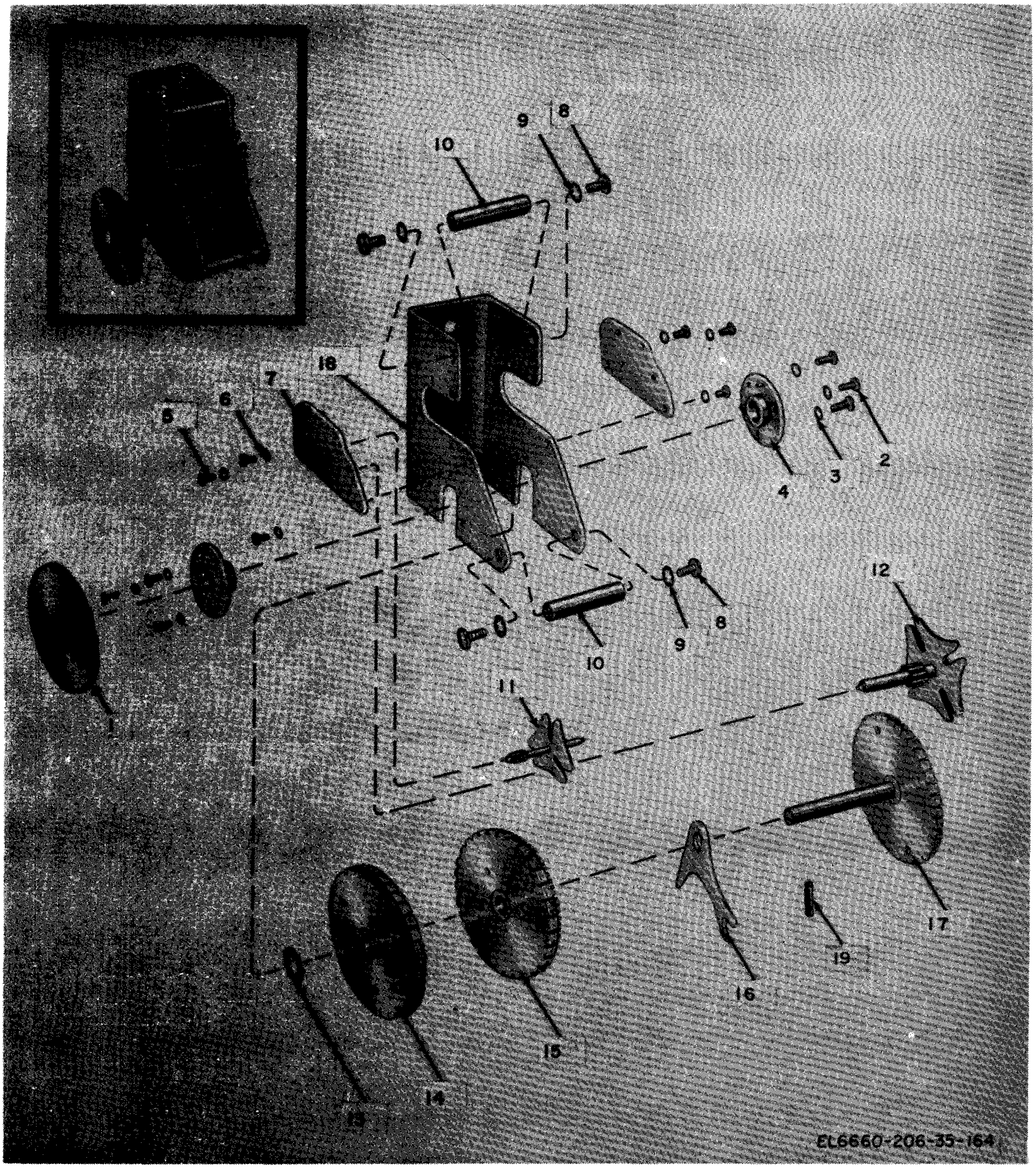


Figure 5-24. Elevation print unit equipped with Geneva movement, exploded view.

(4) Remove the shaft and wheel assembly (17), the type wheels (14 and 15), the decimal point indicator (16), and the spacer (13) from the frame (18).

(5) Slide the type wheels, the spacer, and the decimal point indicator off the shaft.

(6) Remove the three screws (5) and washers (6) from each of the two side plates (7), and remove the plates from the frame (18).

(7) Remove both of the Geneva and pinion assemblies (11 and 12) from between the sideplates (7).

b. Reassembly.

(1) Replace one of the sideplates (7); secure it to the frame with the screws (5) and washers (6).

(2) Place the end of the Geneva and pinion assembly (11) in the lower bushing hole on the mounted sideplate (7).

(3) Place the end of the Geneva and pinion assembly (12) in the upper bushing hole on the mounted sideplate (7).

(4) Replace the opposite sideplate (7) and secure it to the frame screws (5) and washers (6). Be sure to get the shaft ends of the Geneva and pinion assemblies (11 and 12) into the proper bushing holes.

(5) Slide the decimal point indicator (16), the units type wheel (15), the tens type wheel (14), the spacer (13), and the type drive shaft bushings (4) on the shaft of the wheel assembly (17).

(6) Place the wheel and shaft assembly, with the items mounted on it as directed in (5) preceding, in the frame (18). Position the completed assembly so that the flanges of the bushings are outside the frame.

(7) Line up the numbers type wheels and the decimal point to 00-00 with their corresponding Geneva and pinion assemblies before engaging the pinions on assemblies 11 and 12.

(8) Replace the screws (2) and washers (3); secure the type drive shaft bushings (4) to the frame.

(9) Replace the spacing posts (10) and secure them with the screws (8) and washers (9). The lower spacing post should engage the U-prongs on the decimal point indicator (16).

(10) Replace the type drive gear (1) on the shaft and replace the pin (18).

(11) Refer to paragraph 3-92 for the procedure to mount the elevation print unit.

5-51. Disassembly and Reassembly of Azimuth Print Unit Equipped With Geneva Pinion Movement (fig. 5-25)

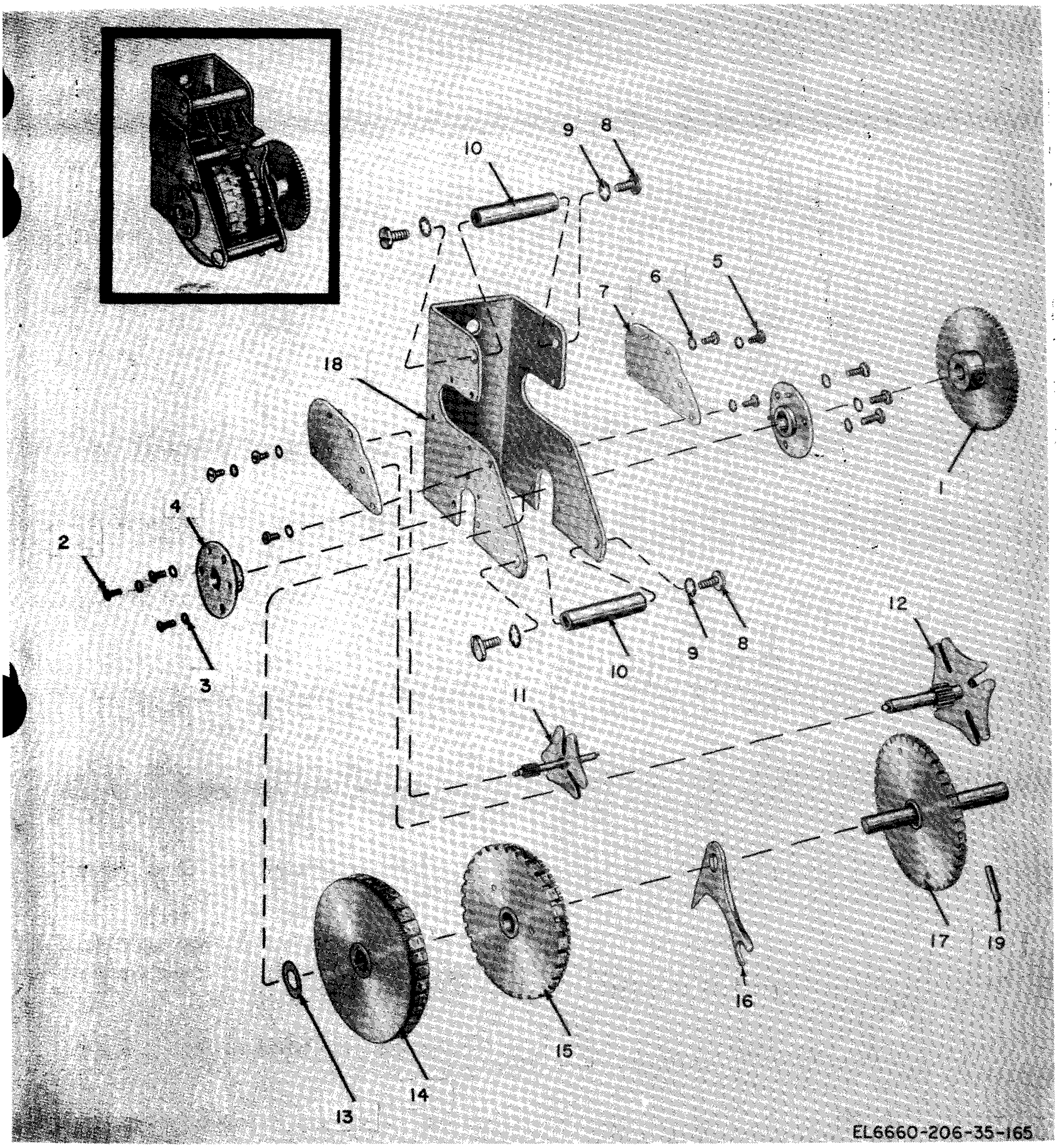
The disassembly and reassembly procedures for the azimuth print unit are similar to the procedures used to disassemble and reassemble the elevation print unit (para 5-50). The item numbers for parts of the azimuth unit (fig. 5-25) are identical with the corresponding parts of the elevation unit (fig. 5-24).

5-52. Dissassembly and Reassembly of Paper Feed Roller Assembly (fig. 5-26).

The directions in *a* and *b* below cover the disassembly and reassembly of a removed paper feed roller assembly (para 3-93).

a. Disassembly.

(1) Loosen the setscrews on the bevel gear (3, fig. 5-26) and the right stop collar (4). The setscrews on the detent gear (5) and the left stop collar (1) were loosened when the paper feed roller assembly was dismounted (para 3-93b).



1 Type drive gear
2 Screw (2-56 x 3/16 inch, binding head)
3 Washer, No. 2
4 Type drive shaft bushing
5 Screw (2-56 x 3/16 inch, roundhead)
6 Washer, No. 2
7 Sideplate
8 Screw (6-32 x 3/16 inch, binding head)
9 Washer. No. 6
10 Spacing post
11 Geneva and pinion assembly unit to tens)
12 Geneva and pinion assembly decimal to units)
13 Spacer
14 Tens type wheel
15 Units type wheel
16 Decimal point indicator
17 Shaft and wheel assembly
18 Frame

Figure 5-25. Azimuth print unit equipped with Geneva movement, exploded view.

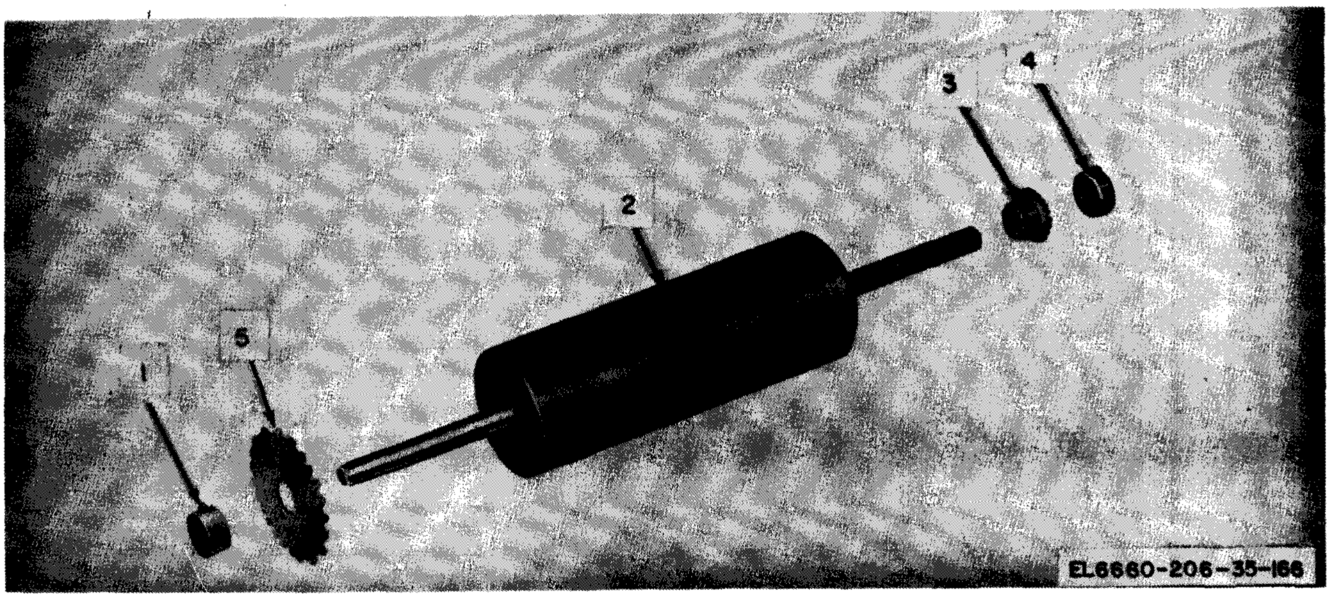


Figure 5-26. Paper feed roller, assembly,exploded view.

(2) Slide the stop collars (1 and 4), the bevel gear (3), and the detent gear (5) off the shaft.

NOTE

The roller (2) is not removable from the shaft; if replacement becomes necessary, replace the complete roller and shaft assembly.

b. Reassembly.

(1) Slide the bevel gear (3) and the collar (4) on the shaft at one end of the roller. Do not tighten the setscrews on either the bevel gear or the right stop collar at this time.

(2) Slide the detent gear (5) and the collar (1) on the shaft at the other end of the roller. Do not tighten the setscrews on the detent gear or the collar at this time.

(3) Refer to paragraph 3-93 for the proper procedure to tighten the setscrews.

5-53. Disassembly and Reassembly of Ribbon Shelf
(fig. 5-27)

The directions in *a* and *b* below cover the disassembly and reassembly of a removed ribbon shelf (para 3-94).

a. Disassembly.

(1) Remove the three screws (4, fig. 5-27) and washers (3) that secure the ribbon holddown clip (10) to the paper guide plate, and lift the clip off the plate.

(2) Loosen the setscrews on each bobbin (1) and slide the bobbins off the shafts (2).

(3) Loosen the setscrews on each ribbon feed drive gear (8) and slide the gears off the shafts (2).

(4) Loosen the setscrew on each stop collar (5).

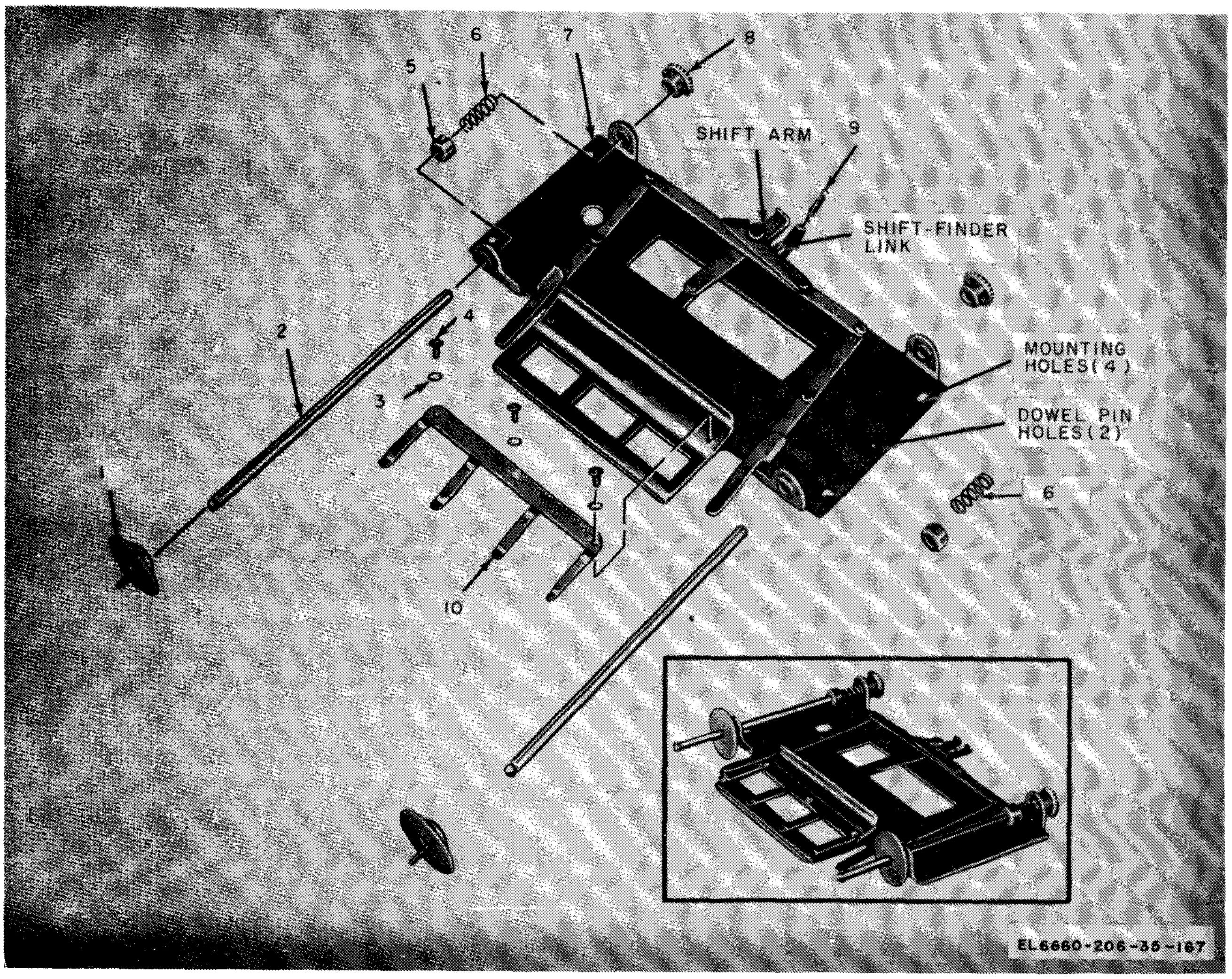
(5) Hold the springs (6) and the stop collars (5) and slide the shafts (2) out of the bushings on the ribbon shelf (7).

(6) Disengage the spring (9) from the shift finder link.

(7) Remove the ribbon holddown clip (10) by removing the three screws (4) and washers (3).

b. Reassembly.

(1) Slide both of the ribbon feed shafts (2, fig. 5-27) into the bushings at the rear of the ribbon shelf.



1 Bobbin (2)
2 Ribbon feed shaft (2)
3 Washer No. 4 (3)
4 Screw (4-40 x 1/16 inch, binding head (3))
5 Stop collar (2)
6 Spring (2)
7 Ribbon shelf
8 Ribbon feed drive gear (2)
9 Spring
10 Ribbon holddown clip

Figure 5-27. Ribbon shelf, exploded view.

(2) Slide the spring (6) and stop collar (5) on each shaft, and slide the shaft through the front bushing.

(3) Fit the ribbon feed drive gear (8) on each shaft, the rear of the gear flush with the end of the shaft, and tighten the setscrews.

(4) Pull the ribbon feed shaft forward and slide the stop collar (5) against the spring (6) until it is compressed to approximately one-fourth inch; tighten the setscrew on the collar.

(5) Slide the bobbin (1) on each shaft and tighten the setscrews.

(6) Place the ribbon holddown clip (10) on the paper guide plate on the shelf (7); replace the three washers (3) and replace and tighten the three screws (4).

(7) Fasten the spring (9) to the shift finder link.

(8) Replace the ribbon holddown clip (10) and the washers (3), and secure with the three screws (4).

(9) Refer to paragraph 3-97 for the procedure to mount the ribbon shelf.

5-54. Disassembly and Reassembly of Hammer Shaft Assembly
(fig. 5-28)

The directions in *a* and *b* below cover the disassembly and reassembly of a removed hammer shaft assembly (para 3-97).

a. Disassembly of Hammer Shaft Assembly.

(1) Tap the taper pins (1, fig. 5-28) out of the hammer castings and hammer shaft drive levers.

(2) Loosen the setscrews on the hammers (3 and 8) and the drive levers (2 and 10).

(3) Loosen the two setscrews on the bearing bracket (7).

(4) Slide the hammer shaft drive levers (2), the azimuth and elevation hammers (3 and 8), and the bearing bracket (7) off the shaft (4).

(5) To remove the timer hammer (9) from the shaft (4), follow the procedures given in *(a)* through *(d)* below.

(a) Brace the shaft and stop stud and center punch the staked end of the stop stud.

(b) Drill to a depth slightly below the staking in the stud; use a no. 28 drill.

(c) Knock the stud out of the shaft; use a drift pin.

(d) Slide the time hammer (9) off the shaft.

b. Reassembly of Hammer Shaft Assembly.

(1) Slide the time hammer (9, fig. 5-28) on the shaft (4) and align it with the stop stud hole in the shaft. The bushing side of the hammer should be facing the right side of the shaft.

(2) Orient the hammer shaft (4) so that the two holes that are used to position the azimuth hammer (8) and the right hammer shaft drive lever (10) are at the right of the hole used to position the time hammer (9). These two holes are nearer the hole used for positioning the time hammer (9) than the two holes used to position the elevation hammer (3) and the left hammer shaft drive lever (2).

(3) Tap the stop stud into the hole through the bottom of the shaft.

(4) Brace the shaft and stud. Center punch the stud and use a staking punch to stake the top of the stud.

(5) Slide the bearing bracket (7) on the time hammer bushing and orient with the stud facing the time hammer.

(6) Slide the elevation hammer (3) on the shaft from the left side.

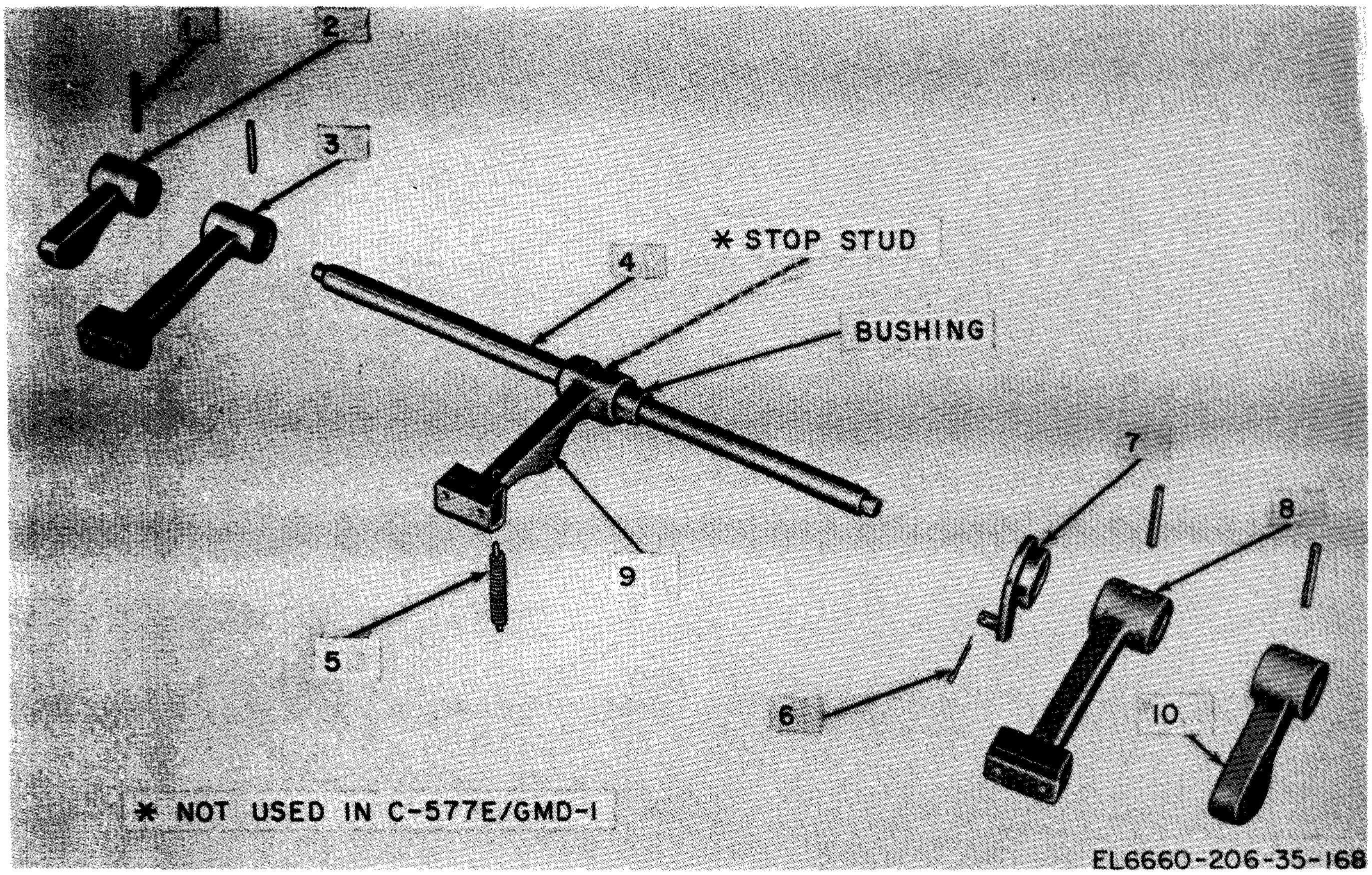
(7) Slide the azimuth hammer (8) on the shaft from the right side.

(8) Slide the hammer shaft drive levers (2 and 10) on each end of the shaft.

(9) With the stop stud pointing down and the hammer rubbers pointing up, align the holes in each hammer and drive lever with the corre-spending holes on the hammer shaft, and drive the taper pins (1) in lightly.

(10) Tighten the setscrews on the hammers and drive lever.

(11) With the bearing bracket pointing down approximately 90° from the timer hammer (9), tighten the setscrews on the bearing bracket. (If necessary, reposition the bearing bracket when



1 Taper pin (4)
2 Left hammer shaft drive lever
3 Elevation hammer
4 Shaft
5 Spring (0851)
6 Cotter pin
7 Bearing bracket
8 Azimuth hammer
9 Time hammer
10 Right hammer shaft drive lever

Figure 5-28. Hammer shaft assembly, exploded view.

the hammer shaft assembly is mounted (para 3–97).)

(12) Refer to paragraph 3-97 for the procedure to mount the hammer shaft assembly.

5-55. Test Procedures

The test procedure in chapter 4, section VII shall be followed to determine if the control-recorder is performing satisfactorily.

CHAPTER 6

DEPOT MAINTENANCE

Section I. GENERAL

6-1. Scope of Maintenance Techniques

a. This chapter provides the additional data, instructions, procedures, techniques, and tests required for depot maintenance.

b. Rawin sets or components received at the depot for scheduled maintenance and overhaul are first inspected, tested, and then rebuilt as necessary in accordance with the maintenance allocation chart. The procedures consists of those beyond the capabilities of the lower levels of maintenance to restore the equipment to a serviceable condition.

6-2. Tools, Test Equipment, and Materials Required

a. Table 6-1 lists the test equipment, and material (in addition to the items called out in chapters 3 and 5) required to accomplish depot level of maintenance.

b. The special tools required for depot level maintenance are listed in table 6-2 and are illustrated in figure 6-1.

Table 6-1. Test Equipment and Material Required

Tools, test equipment and material model or part number	Common name	Technical manual
Teat Set, Electron Tube TV-2/U	Tube tester	TM 11-6625-316-12
Dial indicator .0001 inch graduation	Dial indicator	
Machined Guide Plate SM-C-282606	Guide plate	
Machined Guide Plate SM-C-282607	Guide plate	

Table 6-2. Special Tools Required, but not Supplied, for Depot Level Maintenance

Nomenclature	Use
Drill jig	For drilling two holes in end of turntable shaft during installation of turntable assembly.
Drill jig	For drilling four holes inside of turntable shaft to receive pins which secure slip ring assembly on turntable assembly.
Punch	For inserting four pine into turntable shaft during reassembly of turntable assembly.
Alignment rod	Maintaining alignment of trunnion shafts during insertion in elevation housing assembly. (Trunnion assembly installation procedure.)

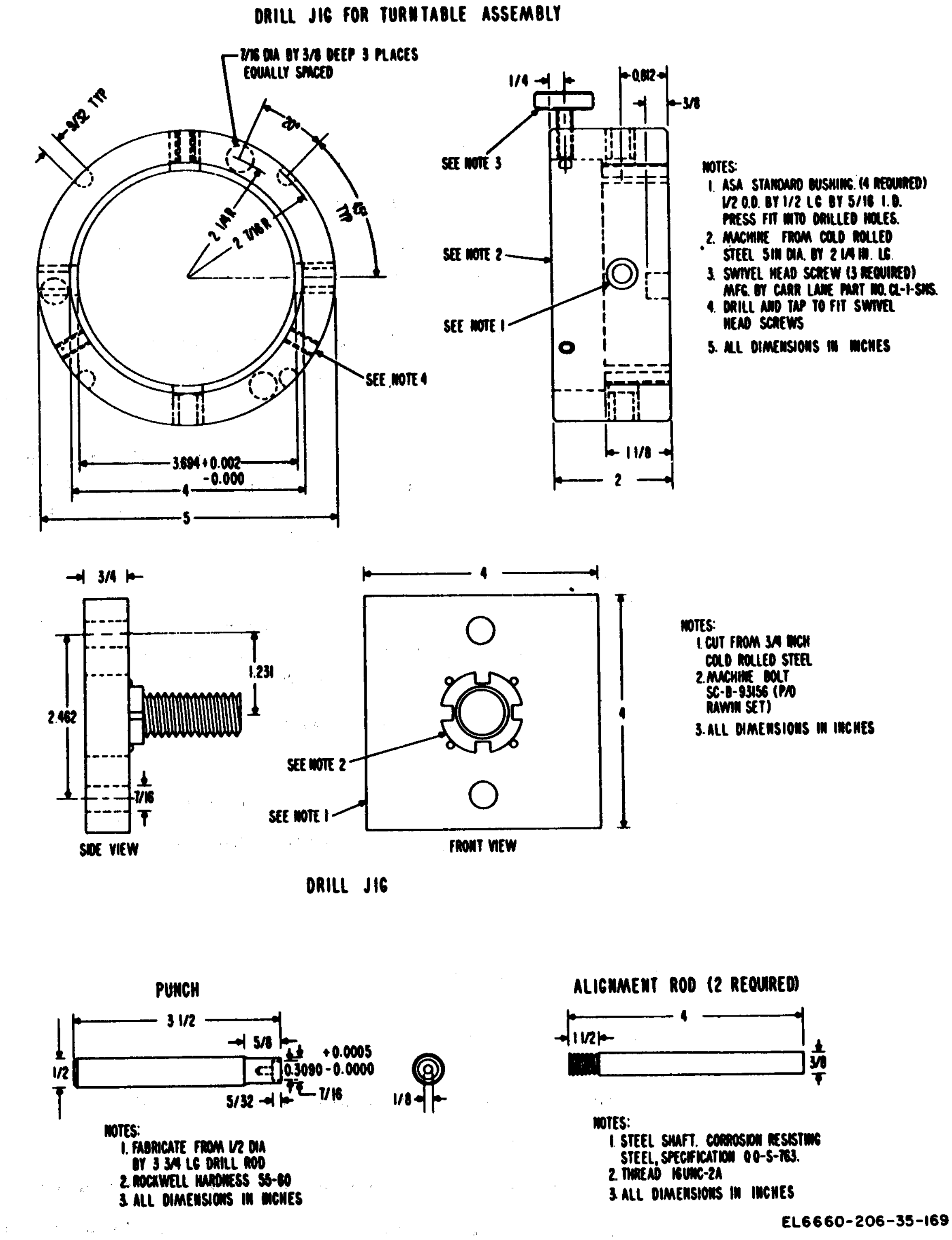


Figure 6-1. Special tools.

Section II. MAINTENANCE TECHNIQUES

6-3. General

This section provides the maintenance techniques required to troubleshoot, align, adjust, remove, repair, replace assemblies, subassemblies and parts for the rawin set at the depot level of maintenance. These techniques are in addition to those provided for direct support and general support levels of maintenance.

6-4. Disassembly and Reassembly of Mechanical Assemblies

a. Disassembly of Antenna Scanner Assembly. Refer to chapter 5, paragraph 5-4 for disassembly procedures for the antenna scanner assembly.

b. Reassembly of Antenna Scanner Assembly. Refer to chapter 5, paragraph 5-5 for reassembly procedures for the antenna scanner assembly.

c. Disassembly of Turntable Assembly. Refer to chapter 5, paragraph 5-24 for disassembly procedures for the turntable assembly.

d. Reassembly of Turntable Assembly. To reassemble the turn table assembly (using new parts) refer to the Repair Parts and Special Tools List for parts data.

WARNING

Use insulated gloves to protect hands when handling hot or cold parts.

(1) Place main shaft (1, fig. 6-2) in insulated box packed with dry ice. Pack dry ice inside and over shaft (to speed cooling) and allow to cool for 1/2 hour.

(2) Place inner race and bearings of upper bearing (2) in oven or oil pot, heated to 250°F. (121.1°C) and allow to heat for 1 hour.

(3) Remove main shaft (1) from dry ice. Wipe dry ice and frost from shaft and stand shaft on large end.

(4) Place gasekt (3) on cold turnable shaft and tap around edge of seal until it seats.

(5) Remove inner race and bearings of upper bearing (2) from oven.

(6) Measure outside of shaft and inside of bearing with precision calipers to be sure parts will fit together.

(7) Position upper bearing (2) level, with wide end down, and then slide bearing over shaft (1) and press into firm seat.

(8) Hold bearing against seat until shrinkage locks it in place.

(9) Slide slip ring spacer (4) over end of shaft.

(10) Locate bundle of wires from slip ring assembly (5) numbered 1-8-9-10-17-18-19-26 and proceed as follows:

(a) Position slip ring assembly above end of main shaft (1) so that bundle of wires located in step (10) is over number 1 hole in bell of shaft.

(b) Slide slip ring assembly part way onto shaft.

(c) Press three bundles of wires to lay along shaft.

(d) Slide spacer (4) up and over three bundles of wires to slip ring assembly (5).

(e) Block up bottom of spacer (4) to hold spacer collar approximately 8 inches above bell of shaft.

(f) Feed wires through numbered holes in bell of main shaft (1), two wires at a time, as follows:

Wire numbers	*Hole number*
1-8-9-10-17-18-19-26	1
5-6-7-14-15-16-23-24-25-27	2
2-3-4-11-12-13-20-21-22-28	3

(g) Straighten wires on inside of main shaft (1).

(h) Hold slip ring assembly and remove blocking from spacer and slip ring assembly.

(i) Lower slip ring assembly to shaft bell while feeding wires through holes.

(j) When slip ring assembly is seated, bundle wires inside shaft.

(11) Position drill jig (fig. 6-1) over end of shaft, tighten three knurled screws in jig, and proceed as follows:

(a) Position shaft in drill press so that shaft is level.

(b) Using jig, drill and ream four 5/16-inch diameter holes, 5/16-inch deep. (Use a drill with a l18-degree chamfer.)

(c) Remove drill jig.

(d) Ream four holes to 0.309-inch diameter by 7/32-inch deep.

(12) Place four retaining springs (6) on four dowel pins protruding from slip ring assembly.

(13) Place retaining plate (7) over end of shaft with flat side toward slip rings and orient four lugs on retaining spring in line with four drilled holes in shaft.

(14) Turn slip ring assembly so that four dowel pins protruding from slip ring assembly are aligned with four holes in retaining spring.

(15) Compress retaining spring (6) so that dowel pins in slip ring assembly pass through holes in retaining spring.

(16) Press four roll pins (8) into four holes in shaft, using punch.

(17) Allow slots in lugs of retaining spring to engage grooves in four pins in shaft.

(18) Place main shaft assembly (1) on its side with rectangular hole facing upward and with guide plate (9) facing you.

NOTE

Subparagraphs (19) through (38) below are applicable to Pedestal AB-159D/GMD-1*, AB-159E/GMD-1**.

(19) Position terminal board TB704 (10) with spring insulator (11) underneath at left of opening. Install terminal board TB704 (numbers on right side) with two screws, washers, and lockwashers in lower two holes and one screw, and lockwasher in upper left hole. Leave upper right hole open.

(20) Install terminal board TB706 (12) with spring insulator (13) at right of opening. Install terminal board TB706 (numbers on left side) with three screws, washers, and lockwashers. Leave upper left hole open.

(21) Remove seven screws beside numbered terminals on right side of terminal board TB704 (10).

(22) Place lockwasher on each of seven screws.

(23) Locate seven wires with numbers corresponding to numbers on terminal board TB704 (10) and dress them toward terminal board TB704.

(24) Connect seven wires to correspondingly numbered terminals on right side of terminal board TB704.

(25) Remove eight screws beside numbered terminals on left side of terminal board TB706 (12).

(26) Place a lockwasher on each of eight screws.

(27) Locate eight wires with numbers correspending to numbers on terminal board TB706 and dress them toward terminal board TB706.

(28) Connect eight wires to correspondingly numbered terminals on left side of terminal board TB706.

(29) Dress 15 connected wires to inside of shell.

(30) Dress remaining 13 unconnected wires toward right side of opening.

(31) Mount jumper electrical lead (14) between terminals 7 and 9 on right side of terminal board TB706, using screws and lockwashers.

(32) Mount jumper electrical lead (14) between terminals (16 and 18) on right side of terminal board TB706, using screws and lockwashers.

(33) Install terminal board TB705 (15) with spring insulator (16), in center of opening. Install terminal board TB705 (numbers on right side) using four screws, washers, and lockwashers.

(34) Remove 13 screws from numbered terminals on right side of terminal board TB705.

(35) Place a lockwasher on each of 13 screws.

(36) Connect 13 wires to correspondingly numbered right-side terminals of terminal board TB705.

(37) Install electrical clamp (17) on open mounting hole in upper right corner of terminal board TB704 using screw, washers, and lockwasher.

(38) Install electrical clamp (18) on open mounting hole in upper left comer of terminal board TB704 using screw, washers, and lockwasher.

e. Instalhtion of Turntable Assembly. To install the turntable assembly, see figure 6-3 and proceed as follows:

(1) Clean upper and lower bearing outer races (4 and 5) in dry cleaning solvent (Specification P-S-661). Dry with compressed air.

WARNING

Use insulated gloves to protect hands when handling hot or cold parts.

(2) Place the following items in an oven preheated to 250°F. (121.2°C.) and allow parts to heat for 1 hour:

(a) Frame (1).

(b) Lower bearing inner race and bearing (2).

(c) Drive gear (3).

(3) Place the following parts in an insulated box packed with dry ice and allow to cool for 1/2 hour:

(a) Upper bearing outer race (4).

(b) Lower bearing inner race and bearing (2).

(c) Upper seal (6).

(d) Lower seal (7).

(e) Turntable assembly (8) (with upper bearing and slip ring assembly installed) as shown in figure 6-2.

NOTE

Pack dry ice around and over parts to speed cooling. Leave packed in dry ice until removed for immediate installation.

(4) Remove frame (1) from oven.

(5) Set frame (1) large end up on cardboard.

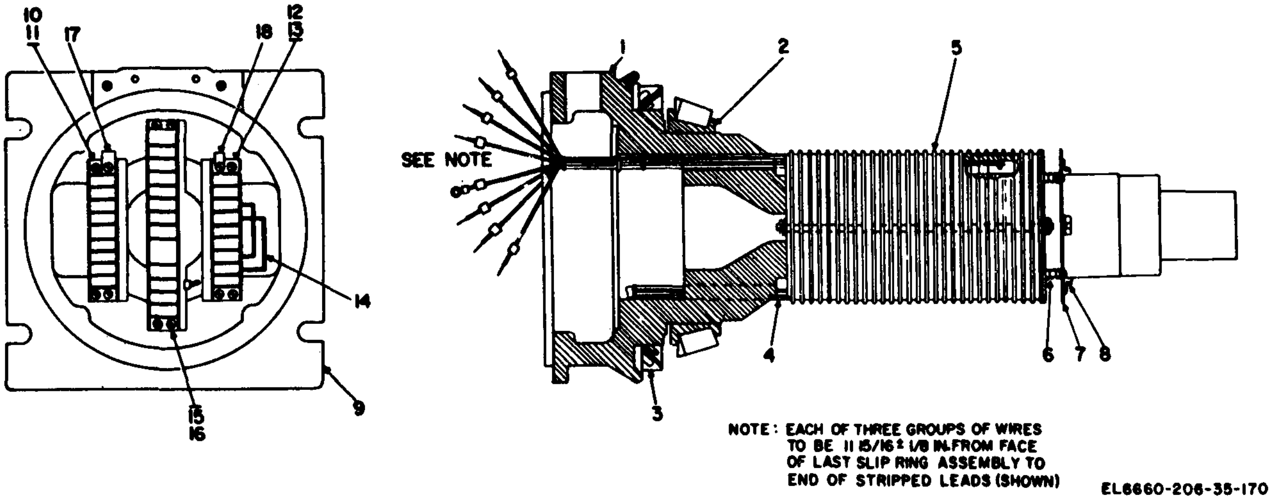
NOTE

In all steps which require turning or moving the frame, set frame on cardboard to prevent marring of surfaces.

CAUTION

Rubber flange in grease seal is brittle when frozen. Do not flex rubber flange.

(6) Remove upper seal (6) from insulated box. Wipe off dry ice and frost.



1 Main shaft	10 Terminal board TB704
2 Upper bearing	11 Spring insulator
3 Gasket	12 Terminal board TB706
4 Sapcer	13 Spring insulator
5 Slipring assembly	14 Jumper (electrical lead)
6 Retaining spring	15 Terminal board TB705
7 Retaining plate	16 Spring insulator
8 Roll pin	17 Electrical clamp
9 Guide plats	18 Electrical clamp

Figure 6-2. Turntable assembly, reassembly.

(7) Insert upper seal into top opening of frame. Press down on seal all the way around to be sure it is seated firmly.

(8) Remove upper bearing outer race (4) from insulated box. Wipe off dry ice and frost.

(9) Turn upper bearing outer race so that narrow end is down, level the race, and then insert onto seat in top opening of frame.

NOTE

Do not force race into seat. If it does not fit, preheat and recool parts.

(10) Hold upper race in position for 30 seconds or until it becomes locked in place by thermal expansion.

CAUTION

Rubber gasket in grease seal is brittle when frozen. Do not flex gasket.

(11) Remove lower seal (7) from insulated box. Wipe dry ice and frost from seal.

(12) Insert lower seal through side opening of frame and into seat at bottom of frame.

(13) Tap seal lightly all around, with wooden handle, to seat firmly.

(14) Invert frame (1) so that it rests on its small end.

(15) Remove lower bearing outer race (5) from insulated box. Wipe off dry ice and frost.

(16) Insert race in seat outside of large end of frame with narrow end down.

(17) Tap into proper seat with wooden handle. Hold at least 30 seconds for expansion to secure race in position before performing next operation.

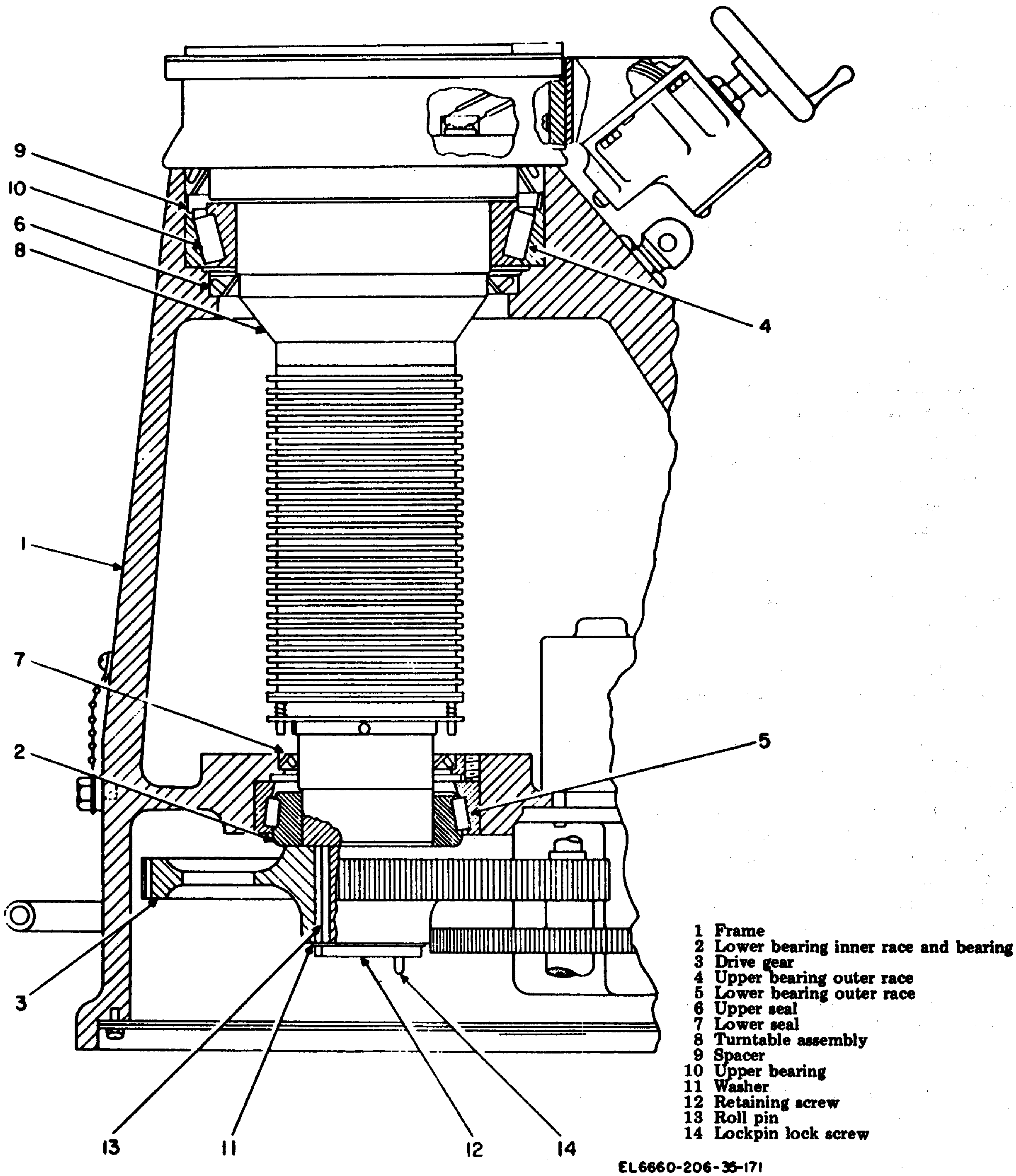


Figure 6-3. Turntable assembly, installation.

(18) Invert frame (1) so that it rests on its large end.

(19) Insert spacer (9) into top opening of frame so that spacing collar rests on upper bearing outer race (4).

(20) Two men are required to install turntable assembly. One man stands on a box beside frame (1) and supports turntable assembly by turntable flange. The second man guides end of shaft through large and small grease seals while first man slowly lowers turntable assembly. Proceed as follows:

CAUTION

Rubber gaskets in large and small seals are brittle. A slight bump during insertion of turntable assembly will fracture rubber gasket. At this stage of assembly, seals are locked in place by thermal expansion and cannot be removed if damaged. Be slow and careful.

(a) Lower the turntable assembly until upper bearing (10) is seated in upper bearing outer race (4).

(b) Carefully invert frame so that tunrtable flange rests on cardboard padding.

(c) Remove lower bearing inner race and bearing (2) from oven. Place small roller bearing (small end down) over end of turntable shaft. Press into firm seat. Immediately remove drive gear (3) from oven and place gear on end of shaft with narrow hub up. Quickly slip washer (11) onto retaining screw (12) and tighten into end of shaft to draw gear and bearing into a firm seat. Wait at least 5 minutes before performing the following operations:

(d) Set frame on small end on drill-press table. Remove retaining screw (12) and washer (11) from end of turntable shaft.

(e) Screw drill jig (fig. 6-1) into end of turntable shaft.

(f) Drill two 7/16-inch diameter by 2-3/4-inch deep holes (located 180 degrees apart) through holes in drill jig. Remove drill jig.

(g) Remove drilling chips from holes.

(h) Drive two roll pins (13) into holes in end of turntable shaft until flush with drive gear hub (3).

(i) Put large flat washer (11) on machine bolt (12). Turn machine bolt into end of turntable shaft and tighten bolt.

(j) Drill and ream 5/32-inch diameter by 17/32-inch deep hole from face of bolt head through one pilot hole in machine bolt head.

(k) Press lockpin lock screw (14) into hole in head of machine bolt.

NOTE

Apply grease (Specification MIL-G-3278) to all gears and to stow lock shaft in azimuth assembly during reassembly. Apply oil (Specification MIL-L-644) to all drive bearings in indicator drive assembly after reassembly.

(21) Lubricate the assembly as instructed in *h* below and then refer to paragraph 6-10 for backlash checks.

f. Disassembly of Azimuth Drive Assembly. Refer to chapter 5, paragraph 5-25 for disassembly procedures for the azimuth drive assembly.

g. Reassembly of Azimuth Drive Assembly. Refer to chapter 5, paragraph 5-26 for reassembly procedures for the azimuth drive assembly. The following procedures are required if new bearings or parts are used during reassembly.

(1) Before installing drive motor and antihunt generator, perform the following adjustment:

(a) On underside of drive motor and antihunt generator mounting plate, loosen two slotted screws in idler bracket.

(b) Adjust position of idler bracket to give uniform mesh of idler gear with both motor and antihunt generator pinions.

(c) Spin motor shaft through several revolutions to check freedom from bind.

(d) Tighten two screws in idler bracket.

(2) Using a dial indicator, check that backlash measurements are within limits specified in figure 6-4.

h. Lubrication of Assembled Azimuth Assembly. Insert zerk fitting in upper and in lower turntable bearing grease fittings. Using grease gun, pack bearings with grease (Military Specification MIL-G-3278). Remove zerk fittings and install plugs. Rotate unit to expel excess grease and wipe area clean.

i. Removal of Left and Right Trunnions. Refer to chapter 5, paragraphs 5-32 and 5-33 for removal procedures for the left and right trunnion assembly.

j. Installation of Left and Right Trunnions. The trunnion shafts, sector gear, and counterbalance gear are assembled by heating and cooling mating parts so that expansion and contraction of the parts, in reaching equilibrium temperature, produces a tight fit. To accomplish assembly, using new parts, refer to figure 6-5 in this section for special process parts assembly sequence and then proceed as follows:

WARNING

Use insulated gloves to protect hands when handling hot or cold parts.

(1) Place the following parts in an insulated box packed with dry ice:

(a) Right and left trunnion shafts (7 and 8).

NOTE

Check surfaces and shoulders of shafts for burro and sharp edges. Use emery cloth to smooth.

(b) Right and left bearing rings (2).

(2) Pack dry ice inside cavities of parts and cover each part with dry ice.

NOTE

Allow parts to cool for at least 1 hour so that they reach a temperature of -60°F. (-51.1°C).

(3) Immerse elevation housing assembly (1) in hot water or hot oil that is maintained at 160°F. (71.1°C) for 1 hour.

(4) Immerse segment gear (14) and inner races and bearings (5 and 6, and 9 and 10) in S.A.E. 10 oil that is maintained at 160°F. (71.1°C) for a minimum of 20 minutes. Leave in hot oil until needed in installation sequence.

(5) Install two machined guide plates, pn SM-C-282606 and pn SM-C-282607, on bottom of yoke, using slotted flat-head screws.

(6) Set yoke upright on level surface with yoke resting on guide plates (handles toward you).

(7) Position a heat lamp adjacent to each yoke bore. Heat yoke bores with heat lamp for 20 minutes (minimum) before starting assembly procedure. Leave heat lamps in place and operating during assembly procedure to maintain temperature of yoke.

(8) Install stow lock assembly on elevation housing.

(9) Inspect yoke bore and perimeter of bore for burrs and sharp edges which could complicate assembly. Use emery cloth to smooth burrs and sharp edges if necessary.

(10) Remove elevation housing assembly (1) from hot water and support housing on working surface. Perform the following:

(a) Remove two bearing rings (2) from dry ice and press into left and right seats from inside housing.

(b) Cool left and right outer seals (3 and 4) 10 minutes (maximum).

NOTE

Rubber gasket in seal becomes brittle if too cold. Do not attempt to insert seal unless gasket is pliable.

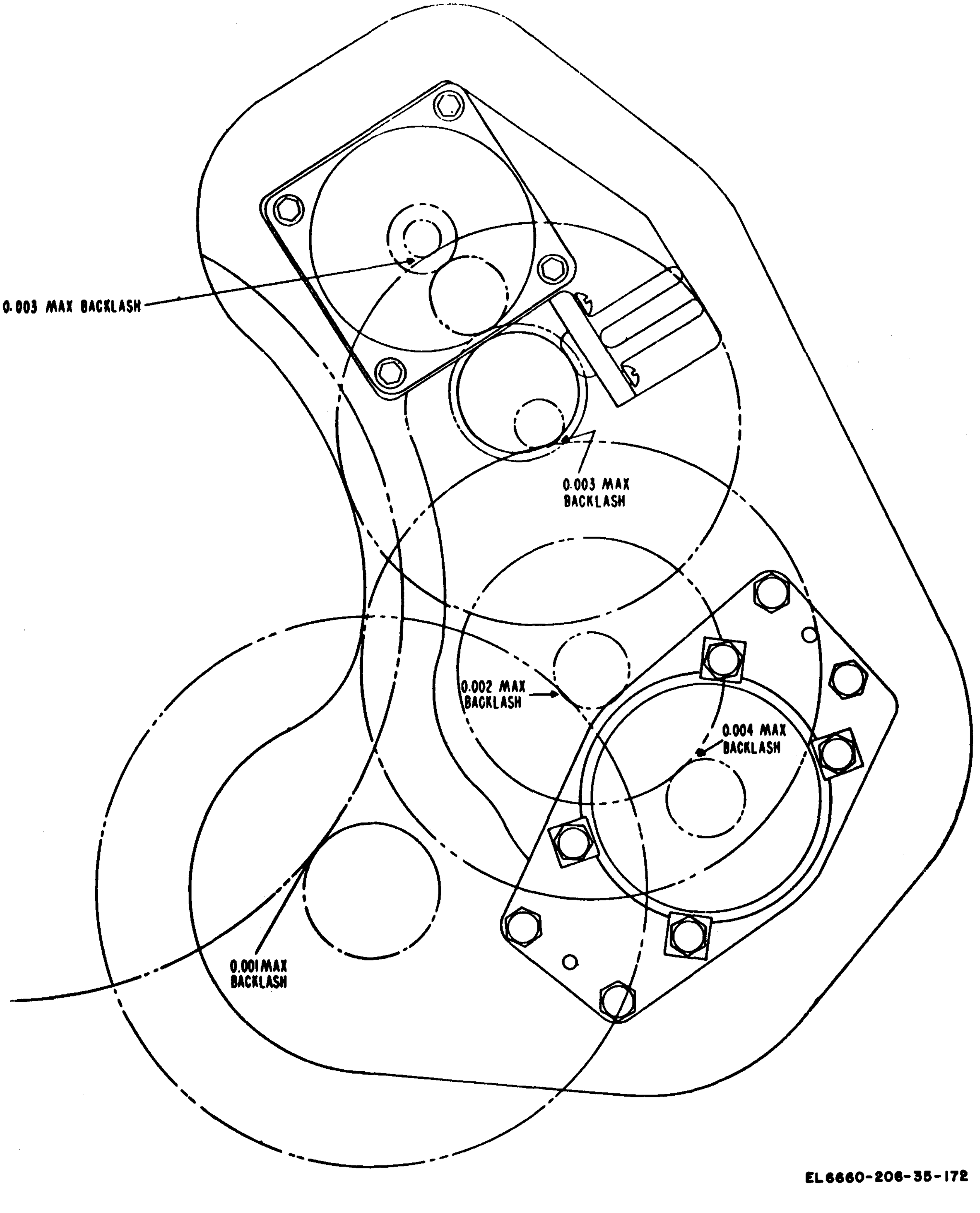
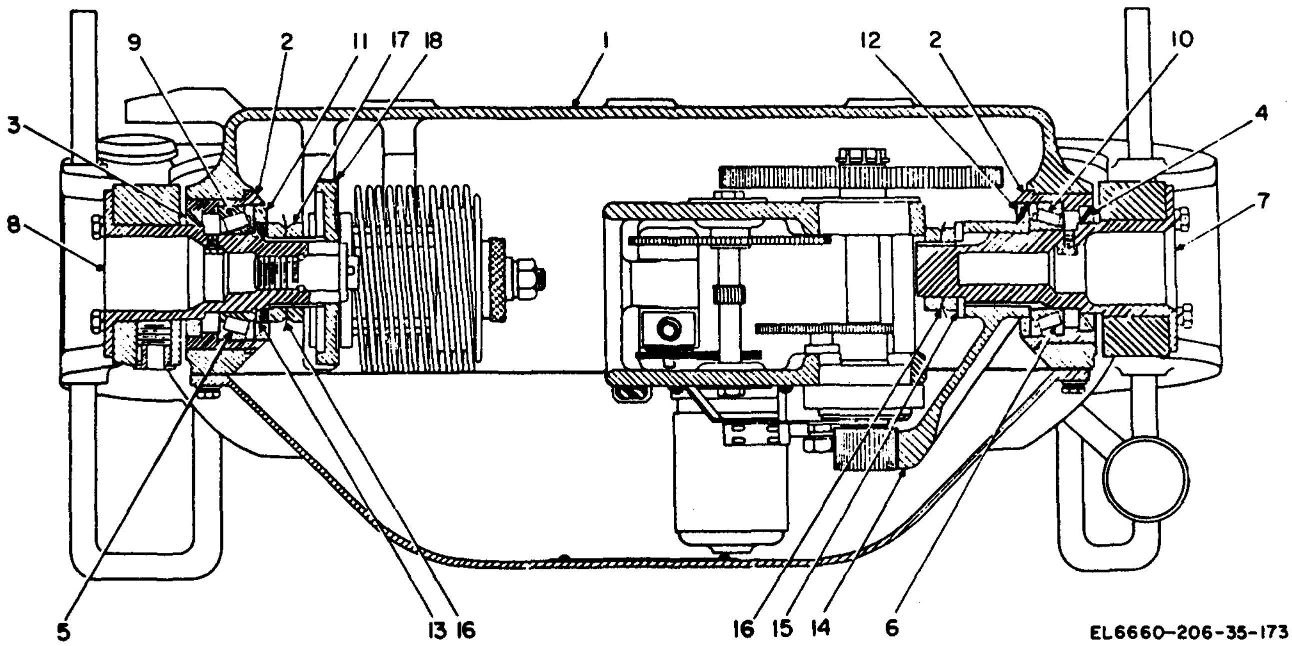


Figure 6-4. Azimuth drive assembly backlash tolerances.



1 Elevation housing assembly
2 Bearing ring
3 Seal
4 Seal
5 Bearing
6 Bearing
7 Trunnion shaft
8 Trunnion shaft
9 Bearing
10 Bearing
11 Inner seal
12 Inner seal
13 Flat washer
14 Segment gear
15 Spacer
16 Lockwasher
17 Locknut
18 Center gear

Figure 6-5. Elevation assembly, trunnion reassembly.

(c) Insert outer seal (3 and 4) from outside casting.

(d) Remove two bearing outer races (5 and 6) from dry ice. Wipe dry ice and frost from two bearing outer races.

(e) Insert bearing outer races against right and left shoulders of bearing rings (2), from inside casting. Pack with grease (Military Specification MIL-G-3278).

(f) Position elevation housing assembly (1) between yoke arms so that stop lug on housing is on upper right and opening of housing is facing you.

(g) Block up housing so that its shaft holes line up between shaft holes in yoke.

NOTE

Careful alignment is necessary to allow easy assembly.

(11) To install right trunnion shaft, perform the following steps:

(a) Turn two 3/8-inch diameter by 4-inch long alignment rods (fig. 6-1) into two upper threaded holes around right yoke bore to maintain alignment during insertion of right trunnion shaft.

(b) Quickly remove splined right trunnion shaft (7) from insulated box and wipe off frost and dry ice.

(c) Line up index mark beside bolt hole in trunnion shaft flange with lower front bolt hole in yoke journal.

(d) Slip splined trunnion shaft part way into bore and align so that alignment rods in two upper yoke bolt holes engage two upper bolt holes on trunnion shaft flange.

CAUTION

Trunnion shaft should slide into bore without excessive binding if yoke and housing bores are properly aligned. If undue resistance is felt, quickly remove Trunnion shaft. Retool trunnion shaft and reheat yoke journal. Check for burrs in bore and on trunnion shaft. Check for sharp edges on trunnion shaft shoulder and yoke bore.

(e) Slide trunnion shaft into bore until trunnion shaft flange seats against yoke journal.

(f) Remove two alignment rods.

(g) Install and tighten four bolts and washers in trunnion shaft flange to seat flange against yoke.

(h) Pack left trunnion shaft cavity with dry ice to keep it cold for succeeding operations.

(12) To install left trunnion shaft, perform the following steps:

(a) Turn two 3/8-inch diameter by 4-inch long alignment rods (fig, 6-1), into two upper threaded holes around left yoke bore to maintain alignment during insertion of left trunnion shaft.

(b) Quickly remove left trunnion shaft (8) from insulated box and wipe off frost and dry ice.

(c) Align left trunnion shaft so that slot on end of shaft is horizontal and grease fitting in cavity is toward rear.

(d) Slip left trunnion shaft part way into bore so that two alignment rods engage two upper holes in trunnion shaft flange.

CAUTION

Trunnion shaft should slide into bore without excessive binding if yoke and housing bores are properly aligned. If undue resistance is felt, quickly remove trunnion shaft. Retool trunnion shaft and reheat yoke bore. Check for burrs in bore and on trunnion shaft. Check for sharp edges on shoulder of trunnion shaft and yoke bore.

(e) Slide left trunnion shaft into bore until flange seats against yoke.

(f) Remove two alignment rods.

(g) Install and tighten four bolts and washers in trunnion shaft flange to seat flange against yoke.

(h) Pack left trunnion shaft cavity with dry ice to keep it cold for succeeding operations.

(13) Shim equally between housing and yoke on each side. Turn stow lock wheel clockwise to advance stow lock shaft fully into stow lock bushing and them proceed to the following steps:

NOTE

If stow lock shaft and bushing are misaligned, adjust shims between housing and yoke a maximum of 1/32 inch. If this shim adjustment is insufficient to provide alignment of stow lock, remove stow lock and place shims under stow lock base.

(a) Remove two bearing inner races and bearings (9 and 10) from hot oil and insert over trunnion shafts against shoulders in right and left sides of casting. Pack bearings with grease (Military Specification MIL-G-3278).

(b) Place two inner seals (11 and 12) over trunnion shafts and seat against bearings on right and left sides.

(c) Place flat washers (13) over left trunnion shafts.

(d) Tap around edge of washer with wooden hammer handle to aid seating inside grease seal.

CAUTION

Do not overtighten locknut on left trunnion shaft or yoke will be distorted.

(e) Install locknut on left trunnion shaft and tighten until bearing outer race is seated.

CAUTION

Before performing the following operations, make sure that inner seal (12) is in place in right side. After sector gear, step (14) following, has shrunk onto trunnion shaft its removal is not practical.

(14) Perform the following steps for sector gear installations:

(a) Remove segment gear (14) from hot oil.

(b) Position sector gear on splines of right trunnion shaft (7) so that rear of sector is 3-1/4 inches from rear of housing. In this position outer top end of sector gear is within three degrees of centerline through trunnions.

(c) Slide sector gear hub into inner seal (12).

(d) Install spacer (15) over right trunnion shaft against sector gear.

(e) Install locknut on threaded end of right trunnion shaft.

CAUTION

Do not overtighten locknut on right trunnion shaft, or yoke will be distorted.

(f) Tighten locknut on right trunnion shaft until right bearing is properly seated and sector gear hub is seated against bearing race.

(15) Insert a lever between yoke and housing. Pry on each end of housing to see if there is any end play in bearings.

NOTE

If there is end play in bearings, it indicates that bearings are not firmly seated. Tighten locknut on side which appears loose.

(16) Place lockwasher (16) on each trunnion shaft with lockwasher inner finger in shaft keyway. Install locknut (17) on each shaft and tighten until lockwasher outer finger is aligned with one slot in side of locknut. Bend lockwasher outer finger into locknut slot.

(17) Place two machine keys in two keyways in left trunnion shaft. Slide counterbalance center gear (18) over keys and onto shaft. Install and tighten bolt in end of left trunnion shaft to retain counterbalance center gear.

NOTE

Apply grease (Military Specification MIL-G-3278) to all gears, stow lock shaft and to counterbalance springs. Apply oil (Specification MIL-L-644) to all drive bearings in indicator drive assembly after reassembly.

(18) Install elevation indicator assembly. Refer to chapter 3, paragraph 3-71c.

(19) Install two counterbalance spring and gear assemblies. Refer to chapter 3, paragraph 3-69.

(20) Place a sensitive dial indicator (from a fixed point) to one tooth of gear on upper counterbalance spring assembly. Orient dial indicator so that its shaft is tangent to gear. Turn gear on upper counterbalance spring assembly back and forth and check that backlash is between 0.002 and 0.004 inch.

NOTE

If backlash is excessive, remove upper counterbalance spring assembly and place shim under base. Reinstall upper counterbalance spring assembly.

(21) Repeat step (20) to check backlash between gear on lower counterbalance spring assembly and counterbalance center gear.

(22) Drill and ream, for light press fit of 0.1575-inch diameter locating pin, through pilot hole in flange of machine bolt that secures counterbalance center gear (18) to left trunnion shaft. Drill hole 17/32-inch deep.

(23) Insert locating pin through hole in machine bolt flange and into gear face to keep machine bolt from loosening.

(24) Mount yoke, with attached guide plates, on a level surface. Install spirit level in throat of yoke. Adjust screws in ends of level until bubble is centered. Rotate yoke 180 degrees and check that bubble remains centered.

(25) Install wiring harness assembly using six plastic cable clamps and screws.

NOTE

Refer to chapter 5, paragraph 5-37 for elevation drive reassembly instructions.

(26) Lay yoke and housing on bench so that opening on housing is upward. Place reassembled elevation drive assembly in position so that drive pinion meshes with sector gear.

(27) Turn drive motor shaft so that centerline of one tooth of drive pinion is exactly aligned with center of root of mating sector gear (fig. 6-6).

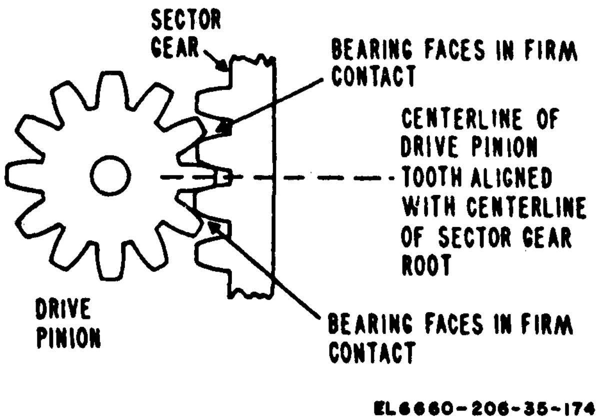


Figure 6-6. Positioning of elevation drive pinion.

(28) Shift elevation drive assembly to improve mesh between pinion and segment gear until bearing faces of two teeth adjacent to tooth aligned in step (27) are both in contact with bearing faces of segment gear. (This adjustment corresponds to zero backlash.)

(29) Tighten eight cap screws in mounting flange of elevation drive assembly.

(30) Drill and ream one hole for 0.2505-inch diameter by 3/4-inch long dowel pin through pilot hole in each mounting flange of elevation drive assembly.

(31) Drive 0.2505-inch diameter by 3/4-inch long dowel pin into holes drilled in step (30).

(32) Lubricate the assembly as instructed in paragraph h preceding after installation of the drive assembly and then refer to paragraph 6-10 for backlash checks.

k. Disassembly of Elevation Drive Assembly. Refer to chapter 5, paragraph 5-36 for disassembly procedures for the elevation drive assembly.

l. Reassembly of Elevation Drive Assembly. Refer to chapter 5, paragraph 5-37 for reassembly procedures for the elevation drive assembly.

NOTE

When new parts are used in the reassembly of the elevation drive assembly, perform the following backlash check:

Use a dial indicator to check that backlash measurements are within limits specified in figure 6-7. (If backlash between antihunt generator gear and mating gear is incorrect, adjust with shims under antihunt generator.)

m. Lubrication of Assembled Elevation Assembly. Insert zerk fitting in each trunnion bearing. Using grease gun, pack bearings with grease (Military Specification MIL-G-3278). Remove zerk fittings and install plugs. Rotate unit to expel excess grease and wipe area clean.

6-5. Cleaning and Lubrication

a. Cleaning.

(1) *General.* While disassembling mechanical assemblies or subassemblies for repair or for parts replacement, you should clean the parts thoroughly to allow a detailed inspection for evidence of excessive wear, structural damage, and general deterioration. The cleaning methods that you use must be thorough without being too harsh or injurious. The use of water, pressurized steam,

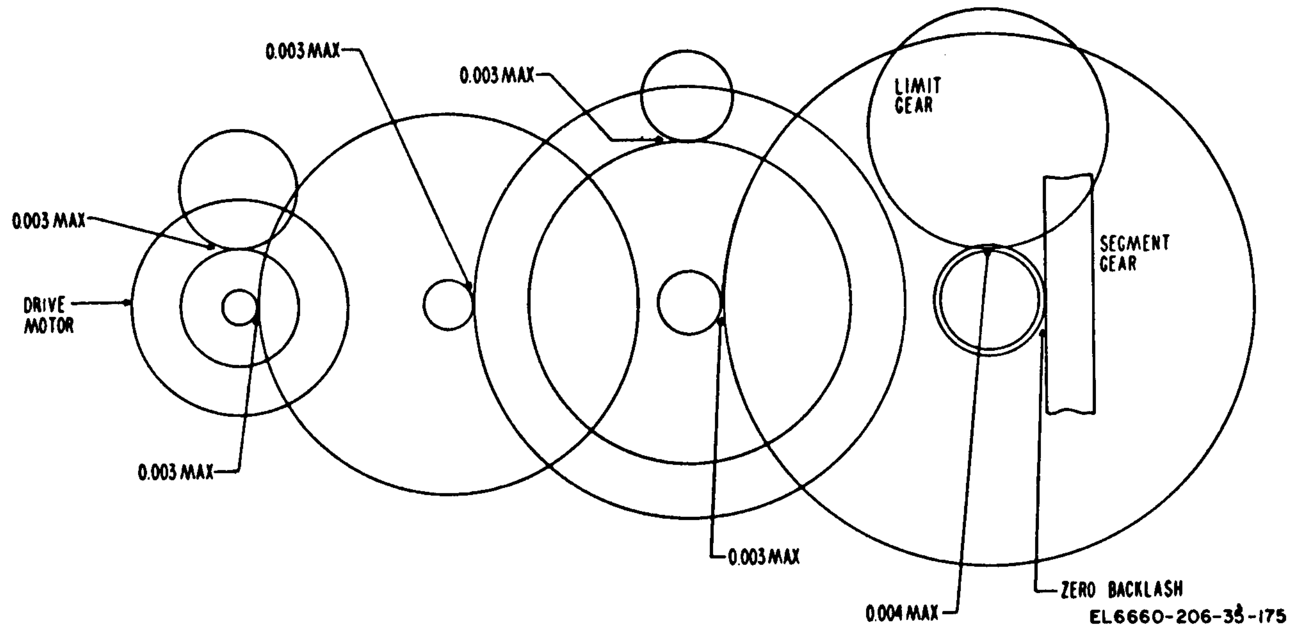


Figure 6-7. Elevation drive assembly backlash tolerances.

abrasive agents, and sandblasts should be avoided unless you are positively certain there is no danger of reducing the quality or length of service of the parts. Painting, corrosive resistant compounds, or other surface refinishing processes should be limited to the needs of protection and efficiency in operation, and not simply to improve general appearance.

(2) *General cleaning.* General cleaning instructions for various types of parts are given in the following paragraphs. During a detailed inspection of parts after cleaning you may note that some parts, although mechanically serviceable for reuse, require a partial or complete refinishing to increase their corrosion-resistant properties. Refer to table 6-4 for preservation instructions for these parts.

WARNING

You are cautioned to wear protective clothing to prevent toxic burns during prolonged use of dry cleaning solvents. Perform your work in a well-ventilated area and observe fire regulations.

(3) *Drive mechanism parts.* Clean gear cases, housings, shafts, and gears in an ample solution of dry cleaning solvent (Federal Specification P-S-661). Immerse small parts completely and use a lintless cloth to wash larger parts. Be sure you completely flush out old lubricants and foreign matter. Unless otherwise specified in the reassembly instructions, apply a light coat of grease (Specification MIL-G-3278) to the contacting (mating) surfaces of gears and shafts.

WARNING

Use extreme caution in handling trichloroethylene. The solution is poisonous. Use it only in a well-ventilated area. Be careful to avoid splashing or spilling. Be especially careful to protect your mouth, eyes, and nose. It can be fatal if you breathe the fumes excessively or get even a small amount in the mouth. Trichloroethylene and toluol ((4) below) are flammable.

(4) *Electrical chassis, housing, frames, and mountings.* Clean corroded or rusted areas with sandpaper, emery cloth, or steel wool. Wipe or brush clean of foreign matter with a dry cloth or brush, or blow clean with air pressure not exceeding 25 psi. If a cleaning solvent is necessary, use trichloroethylene (Federal Specification O-T-634) sparingly and wipe clean of any

deposited film. Refer to table 6-4 for instructions on refinishing serviceable parts. Toluol (Federal Specification TT-T-548) is recommended for cleaning the equipment transit cases.

NOTE

Do not use solvent on electrical component parts or terminal boards. Clean with soft, dry brush or compressed air.

(5) *Reflector and main assembly supports.* Remove corrosion, rust, and deteriorated paint with a wire brush or with sandpaper or like materials. Clean the parabolic reflector and main assembly supporting members with a moderate amount of water and, as necessary, cleaning compound (Federal Specification P-C-431), or dry cleaning solvent (Federal Specification P-S-661). Wipe away film deposits or residue thoroughly after cleaning. Refer to table 6-4 for instructions on refinishing serviceable parts.

b. Lubrication. Lubrication is accomplished during component reassembly. The reassembly instructions (para 6-4) denote the appropriate steps during reassembly when the lubricant should be applied. Refer to TM 11-6660-206-12 for detailed lubrication instructions for the rawin set.

6-6. Checking Wear Tolerance

Precision parts suspected of excessive wear, as determined from faulty adjustment checks, should be checked against the wear tolerance data in table 6-3. If critical dimensions are not within tolerance specified in the table, or are borderline, replace the worn part with a new part.

Table 6-3. Wear Tolerance Data

NOTES

ID inside diameter
OD outside diameter
GD diameter of gear mounting surface
BD diameter of bearing mounting surface
All dimensions are in inches

Name	*Part number*	*Critical dimension and tolerance*	*Concentricity limits (TIR)*
Receiver group			
Rf tuner assembly:			
Spur gear	SC-B-93481	ID 0.3755 0.3750	
Gear	SC-A-87995	OD 0.3759 +0.0000 -0.0003	
Gear	SC-A-87994	ID 0.3750 +0.0004 -0.0000	
Pedestal group			
Elevation assembly:			
Spur gear	SC-C-93061	ID 1.0625 1.0630	

Table 6-3. Wear Tolerance Data-Continued

Name	*Part number*	*Critical dimension and tolerance*	*Concentricity limits (TIR)*
Shaft	SC-D-93059	BD 2.3750 +0.0005 -0.0000	0.001
		BD 2.8770 +0.0000 -0.0005	0.001
Shaft	SC-D-93067	BD 2.3750 +0.0005 -0.0000	0.001
Shaft	SO-D-93067	BD 2.8770 +0.0000 -0.0005	0.001
Counterbalance assembly:			
Spur gear	SC-C-93275	ID 0.9375 0.9370	
Shaft	SC-C-93276	BD 0.9370 0.9365	
		OD 0.9817 0.9842	
Elevation indicator assembly:			
Gear assembly	SM-B-341039	ID 0.1570 +0.0005 -0.0002	0.0005
Bevel gear	SM-B-3410S4	ID 0.1260 +0.0005 -0.0000	
Shaft	SC-B-99016	GD 0.1870 +0.0002 -0.0002	0.003
		BD 0.1560 +0.0000 -0.0005	
Elevation drive assembly:			
Spur gear	SC-C-93298	ID 0.2500 0.2608	
Shaft	SC-D-93292	GD 0.9844 0.9842	0.001
		GD 1.0009 1.0004	0.001
		GD 1.1813 1.1811	
Spur gear	SC-B-93286	ID 1.0016 1.0010	

Table 6-3. Wear Tolerance Data-Continued

Name	*Part number*	*Critical dimension and tolerance*	*Concentricity limits (TIR)*
Shaft	SC-B-93291	GS 0.3748 +0.0000 -0.0003	0.001
Bushing	SC-B-93297	ID 0.4995 0.5000	0.0005
		OD 0.6692 0.6690	0.0005
Spur gear	SC-C-93333	GD 0.3751 0.3749	0.0002
Shaft	SC-C-39287	BD 0.1237 0.1235	
Shaft	SC-B-93285	BD 0.1248 0.1246	
Spur gear	SC-B-93311	ID 0.1250 0.1245	0.0005
Gear Case assembly:			
Sleeve bearing	SC-C-93321	ID 2.4409 2.4111	0.0005
		OD 2.7505 2.7510	0.0005
Sleeve bearing	SC-C-93322	ID 2.4411 2.4409	0.0005
		OD 2.7605 2.7610	0.0005
Sleeve bearing	SC-C--93320	ID 0.8754 0.8752	0.005
		OD 1.0635 1.0630	0.0005
Azimuth indicator assembly:			
Shaft	SC-B-98522	BD 0.1876 0.1873	
Azimuth indicator subassembly:			
Gear assembly	SM-B-341039	ID 0.1570 +0.0005 -0.0002	0.0005
Gear assembly	SM-B-341040	ID 0.1260 +0.0005 -0.0000	

Table 6-3. Wear Tolerance Data-Continued

Name	Part number	Critical dimension and tolerance	Concentricity limits (TIR)
Shaft	SC-B-99016	BD 0.1560 +0.0000 -0.0005	
		OD 0.1870 +0.0002 -0.0002	
Azimuth drive assembly:			
Shaft	SC-C-94013	BD 0.7875 0.7873	
		GD 0.6694 0.6692	
		GD 0.6875 0.6870	
Spur gear	SC-C-94022	GD 0.3751 0.3749	
Spur gear	SC-C-94011	GD 0.4725 0.4723	
		GD 0.5000 0.4995	
		GD 0.4725 0.4720	
Spur gear	SC-C-93302-1	ID 0.6872 0.6876	
Motor-generator assembly:			
Spur gear	SM-D-282617	ID 0.2500 0.2505	
Spur gear	SC-C-94033	ID 0.2500 0.2495	
Shaft	SC-B-94034	OD 0.2501 0.2498	
Turntable assembly:			
Shaft	SM-D-282623	BD 2.4620 2.4625	
Housing assembly:			
Roller	SC-B-61343	ID 0.5015 0.5010	

Table 6-3. Wear Tolerance Data-Continued

Name	*Part number*	*Critical dimension and tolerance*	*Concentricity limits (TIR)*
Control-recorder group			
Drive shaft assemblies (upper and lower):			
Shaft	SC-B-98857	OD 0.3126 +0 -0.002	
Gear assembly	SM-B-282353	1.545 +0.003 -0.003	
Gear	SM-B-282259	OD 1.550 +0 -0.002	
Wheel and rocket assembly	SC-B-98966	1.375 +0.005 -0.005	
Synchro receiver:			
Gear	SC-B-98656	OD 1.360 +0.002 -0.002	
Gear	SC-B-98648	OD 1.750 +0.003 -0.003	
Prnt cycle motor:			
Gear	SC-B-98796	OD 0.850 +0.005 -0.005	
Indicator panel assembly:			
Gear	SM-C-98684	OD 1.542 +0 -0.001	
Shaft	BC-B-98682	OD 0.187 +0 -0.0002	
		GD 0.1560 +0 -0.0005	
Gear	SM-B-282301	OD 0.600 +0.001 -0.001	
Shaft	SM-B-282307	OD 0.1870 +0.0005 -0.0005	
		GD 0.1250 +0 -0.0005	
Gear assembly	SM-B-282322	OD 0.1875 +0.0005 -0.0005	

Table 6-3. Wear Tolerance Data-Continued

Name	*Part number*	*Critical dimension and tolerance*	*Concentricity limits (TIR)*
Time print unit:			
Gear	SC-B-98614	OD 0.850 +0.005 -0.005	
Gear	SC-B-98615	OD 0.850 +0.005 -0.005	
Shaft	SC-B-98759	OD 0.250 +0.005 -0.005	
Shaft	SC-B-98767	OD 0.125 +0 -0.001	

6-7. Painting and Refinishing Disassembled Parts

a. When painted parts require a touchup or refinish as a result of scratches or deteriorated finish, apply a coat of zinc chromate primer (Military Specification MIL-P-8585) as a base before applying new paint. Refer to the following specifications for the selection of paint (enamel) and the applicable color for parts listed in table 6-3.

b. After primer application has been accomplished, apply semigloss olive drab no. X24087 per Federal Standard 595 (final films C or M) or lusterless olive drab no. X34087 per Federal Standard 595 (final film Q) as applicable.

c. The parts listed in column one of table 6-4 require parts preservation finishes (painted or plated) as noted in column three of the table. The types of finishes are selected from Military Specification MIL-F-14072. When refinishing reusable parts that are listed in column one of the table, note the process designation given in column three and then refer to MIL-F-14072 for instructions.

Table 6-4. Parts Preservation Data

NOTE

Designations for finishes are applicable to Military Specification MIL-F-14072.

Name	*Part number*	*Type of finish*
Equipment accessories		
Case and cover assemblies:		
CY-734/GMD-1	SM-D-373999 and SM-D-374001	P513C
CY-735(*)/GMD-1	SM-D-373996 and SM-D-373995	P513C
CY-736/GMD-1	SM-D-373991 and SM-D-373990	P513C

Table 6-4. Parts Preservation Data-Continued

Name	Part number	Type of finish
Equipment accessories-Continued		
CY-737A/GMD-1	SM-D-374010 and SM-D-374009	P513C
CY-1895/GMD-1	SM-D-374002 and SM-D-374003	P513C
Speed wrench	SC-D-93535	P213C
Cable reel holder	SC-D-87937	P513C
Antenna group		
Ring	SC-B-93178-1	P213C
Housing	SC-D-61372	P513C
Rigid coupling	SC-B-93943	M312
Capacitor mounting	SC-B93947	M312
Adjustment screw	SC-B-93950	M312
Mounting base	SC-D-93262-1	P513C
Threaded insert	R907SB9	M225
Lock ring insert	RL31SB9	M225
Telescope mounting	SC-D-93871	E300
Telescope mounting	SC-C-93872	P513C
Telescope mounting	SC-C-93873	P513C
Spacer	SC-D-192331-1	E300
Spacer	SC-D-192331-6	E300
Collar	SC-B-93877	P513C
Antenna control group		
Bushing	SC-B-93592	M352
Detent	SC-B-93 151	M312
Panel lens	SM-B-109127	M313 and E311
Lampholder	SM-B-109128	M312 and E311
Lock	SC-B-176391	M352
Connector	SC-B-93585	P513A and E513
Connector	SC-B-93388	P513A and E513
Cover support	SC-B-93593	M313A and M312

Table 6-4. Parts *Preservation* Data-Continued

Name	Part number	Type of finish
Antenna group-Continued		
Bracket	SC-C-93617	E300
Frame assembly	SC-D-93621	E513
Clip	12	M352
Frame	SC-D-93606	E513
Plate	SC-C-93601	E513
Spring	SC-B-93638	M312
Roller	SC-B-61343	E300
Panel	SC-D-99062	P513C
Receiver group		
Clamp	6325	M351
Bracket assembly	SC-C-93429	M264
Bracket	SC-C-93401	E300
Bracket	SC-C-93403	E300
Lock shaft	10061	M352
Frame	SM-B-282509	M312
Dial assembly	SC-B-87990	E511
Antenna	SC-B-93663	M311
Sleeve	SC-B-93664	M311
Cathode ring	SC-B-93656	M311
Contact holder	SC-B-93684	M311
Contact assembly	SC-B-93678	M311
Adapter shaft	SM-B-282482	M311
Extension	SM-B-282484	M311
Captive screw	SC-B-93507	M312
Line section	SC-B-93700	M311
Connector adaptor	SC-B-93699	M311
Line section	SC-B-93697	M311
Line section	SC-B-176448	M311
Line section	SC-B-93690-1	M311
Line section	SC-C-93709	M311

Table 6-4. Parts Preservation Data-Continued

Name	*Part number*	*Type of flnish*
	Pedestal group	
Azimuth assembly:		
Chain assembly	8	P213C
Chain assembly	SC-B-93179	P513C
Cover	SM-B-192249	E513
Swing link	SM-B-109172	M352 and M312
Stud	SM-B-109171	M362 and M312
Terminal	SC-B-93986	M311
Terminal	SC-B-176473	M311
Spring	SC-B-93985	M311
Contact	SC-B-61349	M311
Gear assembly	SC-B-99013	M352 and M312
Azimuth indicator subassembly:		
Collar	SC-B-98527	M312
Gear assembly	SC-B-99007	M312
Collar	SC-B-99005	M312
Pinion	SC-B-98995	M312
Gear	SC-B-98997	M312
Gear	SC-B-98996	M312
Collar	SC-B-99011	M312
Collar	SC-B-98998	M312
Bearing plate	SC-B-99004	M312
Anchor post	SC-B-99003	M312
Gear assembly	SM-B-341037	M312
Gear	SM-B-341041	M312
Gear assembly	SM-B-341040	M312
Plate assembly	SC-B-99023	M312
Side plate assembly	SC-B-99025	M312
Bracket assembly	SC-B-99028	M312

Table 6-4. Parts preservation Data-Continued

Name	*Part number*	*Type of finish*
Pedestal group-Continued		
Plate assembly	SC-B-99018	M312
Antenna drive assembly:		
Clamp	SC-B-93069-1	M226
Detent	SC-B-93151	M312
Housing assembly	SM-D-373922	M312
Swing link	SM-B-109172	M312
Bus bar	SM-B-192245	M312
Stud	SM-B-109171	M312
Gear assembly	SC-B-99013	M312
Shaft	SM-B-373199	E513
Coupling	SM-B-373198	E513
Frame assembly	SC-D-93277	E513
Elevation indicator aasembly:		
Gear assembly	SM-B-341037	M312
Gear assembly	SC-B-99007	M312
Collar	SC-B-98998	M312
Collar	SC-B-99011	M312
Shaft	SC-B-99012	E300
Bevel gear	SC-B-98996	M312
Bevel gear	SC-B-98995	M312
Bevel gear	SC-B-98997	M312
Bevel gear	SM-B-341041	M312
Collar	SC-B-98687	M312
Gear assembly	SM-B-341035	M312
Collar	SC-B-99005	M312
Bevel gear	SC-B-98997	M312
Bearing plate	SC-B-99004	M312
Anchor peat	SC-B-99003	M312

Table 6-4. Parts Preservation Data-Continued

Name	Part number	Type of finish
Cover plate	SC–B–99039	M312
Side plate assy	SC–B–99025	M312
Bracket assembly	SC–B–99028	M312
Plate assembly	SC–B–99023	M312
Elevation drive assembly:		
Mounting bracket	SC–B–93312	M225
Mounting bracket	SC–B–93294	M224
Angle bracket	SC–B–93069–2	M226
Cover	SM–B–192249	E513
Gear case assembly:		
Hook	SC–B–93243	P513C
Ring lock	RL28SB8	M225
Threaded insert	R106SB8	M225
Ring lock	RL31SB9	M225
Threaded insert	R907SB9	M225

6-8. Stenciling Procedures

a. Stenciling shall be accomplished with semi-gloss enamel conforming to Specification TT–E-529 or with quick-drying ink (for non-porous surfaces only) conforming to Specification MIL–I–16557, or silk screening.

b. Lithographing, lettering, or rubber stamping will be accomplished with permanent ink. Stamping ink for textile shall conform to Specification MIL-I-6903.

6-9. Tropicalization Procedures

Tropical climates and areas containing high moisture result in the development of fungus growth and electrical leakage as a result of formation of moisture on insulating material. Tropicalization restricts development of the above conditions. When replacing terminal boards or wiring, areas where changes have been accomplished should be tropicalized as described in the moisture and fungus-resistant treatment procedures in Military Specification MIL–V–173.

CAUTION

Do not tropicalize high voltage circuits, as this would, destroy the effectiveness of any existing arc resistant fungicide.

6-10. Backlash Checks and Tolerances

Refer to paragraph 6-4 for the checks and tolerances applicable after overhaul of major assemblies of the rawin set.

6-11. Testing Procedures.

a. Refer to chapters 4 and 5 for the procedures used to test individual assemblies of the rawin Set.

b. Refer to chapter 7 for depot overhaul standards (DOS) for the rawin set.

c. *Test Procedure for SCR Switching Units*. The material (or equivalent) shown in table 6–5 is required to fabricate the SCR test set shown in figure 6–8. The preliminary setup procedures (1) through (12) below must be performed after fabrication or repair of the SCR test set.

WARNING

Always operate switch S1 (fig. 6–8) to the OFF position when making preliminary adjustments and during removal or installation of an SCR unit. Dangerous voltages are present.

(1) Position adjustable tap of resistor R7 for maximum resistance.

(2) Install a silicon rectifier (1A, 300 Piv) in test socket XCR2 (anode to cap, cathode to pin 1).

(3) Operate POWER switch S1 to on, and note meter indication.

(4) Operate POWER switch S1 to off.

(5) Loosen adjustable tap of R7 and move tap to decrease resistance.

(6) Operate POWER switch S1 to on and observe meter indication.

(7) Repeat (4) through (6) preceding until meter indicates 150mA.

(8) Operate POWER switch S1 to off.

(9) Install SCR in test socket.

(10) Operate POWER switch S1 to on.

(11) Operate BIAS ADJ from CCW to CW. Meter indication should vary from 0 mA to 150 mA.

(12) Operate POWER switch S1 to off.

d. *SCR Test Procedure*.

(1) Install SCR unit in test socket.

(2) Operate POWER switch S1 to on.

(3) Operate BIAS ADJ from CCW to CW. Meter indication should vary from 0 mA to 150 mA.

(4) Operate POWER switch S1 to off.

Table 6—5. SCR Test Set, Material Required

Symbol desig	*Description*	*Mil spec or other part no.*
S1	Switch, power	MS35058-22
	Lampholder	SM-B-109128
	Lens	SM-B-109127–1
	Lamp, Glow	NE51
T1	Transformer (l15V/l15V, 0.7A)	Triad N–53M
T2	Transformer (l15V/12.6V, 0.6A)	Triad F-25X

Table 6-5. SCR Test Set, Material Required-Continued

Symbol desig	*Description*	*other part no.*
XCR2	Socket, Electron Tube	SC-B-176509
	Plug, Power	UP120M
M	Meter (300 mA)	Simpson Model 2123
R1	Resistor (220 ohms, lW)	RC32GF221J
R2	Resistor (1K ohms, Vara)	CLAROSTAT 43-1000
R3, R4	Resistor (750 ohms, 2W)	RC42GF751J
R5	Resistor (47K ohms, lW)	RC32GF473J
R6	Resistor (56 ohms, 7.5W)	RW78U560
R7	Resistor (5K ohms, SOW Vara)	OHMITE 0569
	Capacitor (100UF, 50V)	SPRAGUE 1310

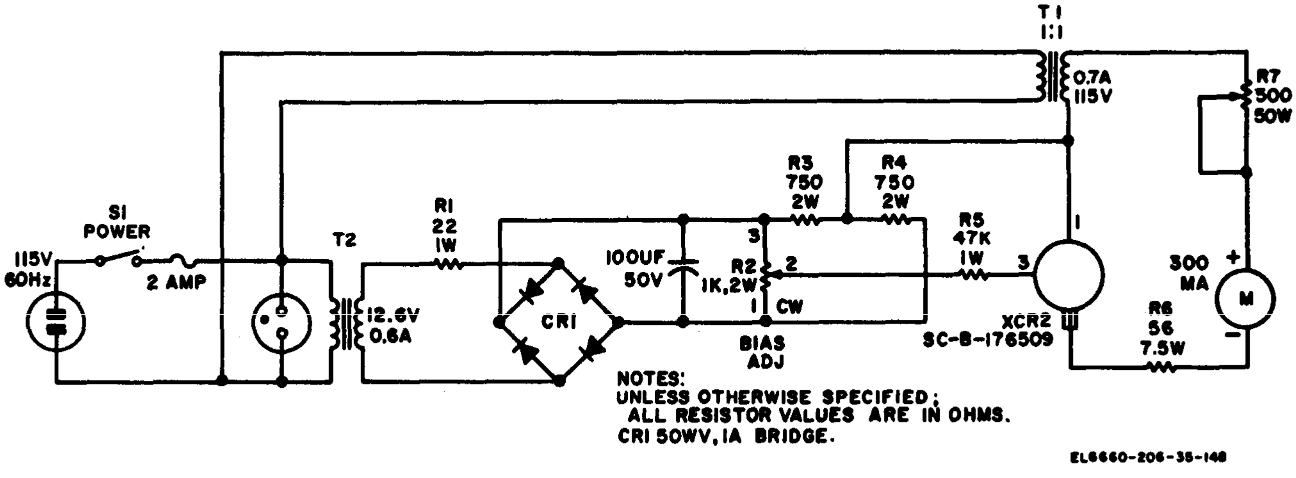


Figure 6-8. SCR switching unit test get diagram.

CHAPTER 7

DEPOT OVERHAUL STANDARDS

Section I. GENERAL

7-1. Applicability of Depot Overhaul Standards

The tests outlined in this chapter are designed to measure the performance capability of overhauled equipment. The equipment must meet the listed standard before you reissue it or return it to stock. It may also be used as a guide for testing equipment that has been repaired by direct-support and general-support maintenance personnel if the proper tools and test equipment are available. In this chapter you will find depot overhaul standards for the Rawin Set AN/GMD–1(*).

a. Antenna Scanner Assembly, P/O Antenna AS-452(*)/GMD-1.

b. Receiver, Radio R–301(*)/GMD–1.

(1) Amplifier, IF, P/O Receiver, Radio R–30l(*)/GMD–1.

(2) Local Oscillator and Servo Assembly, P/O Receiver, Radio R–301(*)/GMD-1.

c. Control, Antenna C–578(*)/GMD–1.

d. Pedestal, Antenna AB–159(*)/GMD–1.

(1) Azimuth Unit, P/O Pedestal AB–159(*)/GMD–1.

(2) Elevation Unit, P/O Pedestal AB-159(*)/GMD–1.

e. Control-Recorder C–577(*)/GMD–1.

7-2. Modification Work Orders

The performance standards listed in the tests assume that all applicable modification work orders have been performed. You will find a list of current modification work orders in. DA Pam 310–7.

7-3. Test Facilities, Test Equipment, Tools, and Materials

The test facility normally will be a standard electronics equipment shop equipped with sturdy work benches. You should have available a complete operable Rawin Set AN/GMD-lB(*). This set will be needed when you check components such as the Antenna Scanner, Antenna Control, and the Control-Recorder. The required test equipment is listed immediately before each procedure. Make sure that you have the required test equipment and the proper tools before starting a procedure.

Section II. BENCH TESTING OF MAJOR COMPONENTS

7-4. General

.Bench testing of a major component shall not be made until a physical check is performed. This check will consist of mechanical integrity, loose or missing parts, and manual operation of switches and potentiometers.

7-5. Elevation Gear Tests

a. Test Equipment and Material. None required.

b. Test Connections and Conditions.

(1) Counterbalance springs disconnected. Refer to paragraph 3–69.

(2) Elevation unit face down (surface on which antenna is mounted) on a bench.

(3) No power to be used.

(4) All movement shall be done by hand.

c. *Step-by-step Tests and Performance Standards*. Refer to table 7-1 for step-by-step procedures and standards.

Table 7–1. Elevation Gear Tests and Standards

Tests	*Step-by-step instructions*	*Performance standards*
1. Gear test, 10 degrees elevation,	*a*. Provide a stationary reference (mark with crayon) next to first drive gear. (fig. 7-1).	*a.* None.
	b. Move yoke to a position equivalent to 10 degrees elevation.	*b.* **N**
	c. Turn first drive gear counterclockwise one quarter turn and mark the tooth adjacent to the stationary reference mark.	*c.* None.
	d. Slowly turn first drive gear clockwise until yoke just starts to move.	*d.* The number of teeth that pass the reference mark shall not exceed five.
	e. Erase previous mark on gear tooth.	*e.* None.
	f. Turn first drive gear clockwise one quarter turn and mark the tooth adjacent to the stationary reference mark (a above).	*f.* None.
	g. Slowly turn first drive gear counterclockwise until yoke just starts to move.	*g.* The number of teeth that pass the reference mark shall not exceed five.
	h. Erase previous mark on gear tooth.	*h.* None.
2. Elevation Gear Teat (30 degrees elevation).	a. Move yoke to a position equivalent to 30 degrees elevation.	*a.* None.
	b. Turn first drive gear counterclockwise one quarter turn and mark the tooth adjacent to the ‘stationary reference mark (step la).	*b.* None.
	c. Slowly turn first drive gear clockwise until yoke just starts to move.	*c.* The number of teeth that **pass** the reference mark shall not exceed five.
	d. Erase previous mark on gear tooth *(b* above).	*d.* **None.**
	e. Turn first drive gear clockwise one quarter turn and mark the tooth adjacent to the stationary reference mark (step *1a).*	*e.* None.
	f. Slowly turn first drive gear counterclockwise until yoke just starts to move.	*f.* The number of teeth that pass the reference mark shall not exceed five.
	g. Erase previous mark on gear tooth (e above).	*g.* **None.**

Table 7–1. Elevation Gear Tests and Standards-Continued

Tests	*Step-by-step instructions*	*Performance standards*
3. Elevation Gear Test (60 degrees elevation).	a. Move yoke to a position equivalent to 60 degrees elevation.	a. None.
	b. Turn first drive gear counterclockwise one quarter turn and mark the tooth adjacent to the stationery reference mark (step la).	*b.* None.
	c. Slowly turn first drive gear clockwise until yoke' just starts to move.	*c.* The number of teeth that peas the reference mark shall not exceed five.
	d. Erase previous mark on gear tooth *(b* above).	*d.* None.
	e. Turn first drive gear clockwise one quarter turn and mark tooth adjacent to the stationery reference mark (step 1a).	*e.* None.
	f. Slowly turn first drive gear counterclock. wise until yoke just starts to move.	*f.* The number of teeth that pass the reference mark shall not exceed five.

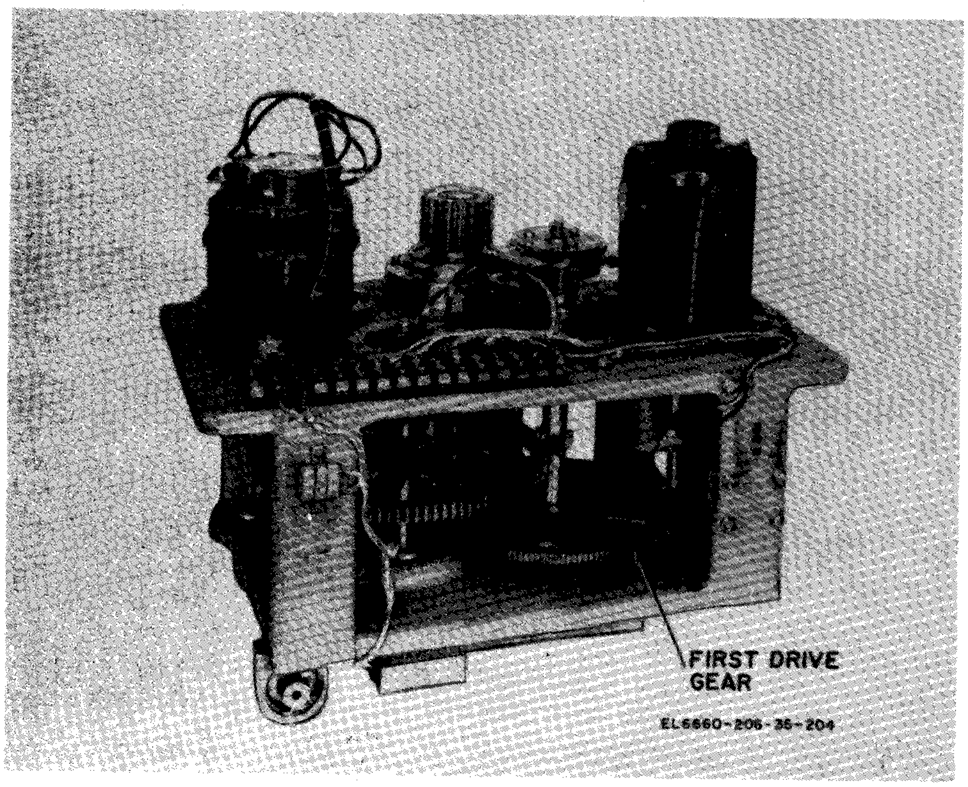


Figure 7–1. Elevation drive assembly.

7-6. Azimuth Gear Tests

a. Test Equipment and Material.

(1) Dial indicator, graduated 0.0001 inch.

(2) Vee type block (six inch) or similar type support.

b. Test Connections and Condition.

(1) Position pedestal assembly on its side. Support the turntable end on a six inch Vee type block. Underside of drive must be accessible and turntable free to turn.

(2) Mount dial indicator on a fixed support with the dial plunger bearing (at right angle) upon the edge of the turntable flange.

(3) No power to be used.

(4) All movement shall be done by hand.

c. Step-by-step Tests and Performance Standards. Refer to table 7-2 for step-by-step procedures and standards.

Table 7-2. Azimuth Gear Tests and Standards

Tests	*Step-by-step instructions*	*Performance standards*
1. Gear teat, O degrees azimuth.	Refer to paragraph 7-6b for teat connections and conditions.	
	a. Turn shaft of drive motor until dial indicator deflection indicates the turntable has just begun to move.	*a.* None.
	b. Place an index mark on the first drive shaft pinion (fig. 7-2) at center of contact with first drive gear.	*b. None.*
	c. Turn first drive shaft and pinion manually until dial indicator deflection indicates the turntable has just begun to move.	*c.* None.
	d. Count the teeth on the first drive shaft pinion between index mark and near center of contact with first drive gear.	*d.* Total backlash of gear train shall be lens than five teeth.
2. Gear teat, 60 degrees azimuth.	*a.* Erase index mark from first drive shaft pinion and rotate first drive shaft and pinion until turntable has rotated 60 degrees.	a. None.
	b. Repeat steps la through *d*.	*b.* Total backlash of gear train shall be lens than five teeth.
3. Gear test, 120 degrees azimuth.	*a.* Erase index mark from first drive shaft pinion and rotate first drive shaft and pinion until turntable has rotated to the 120 degree position.	a. None.
	b. Repeat steps la through *d*.	*b.* Total backlash of gear train shall be lees than five teeth.
4. Gear teat, 180 degrees azimuth.	*a.* Erase index mark from first drive shaft pinion and rotate first drive shaft and pinion until turntable has rotated to the 180 degree position.	*a.* None.
	b. Repeat steps la through *d*.	*b.* Total backlash of gear train shell be leas than five teeth.

Table 7-2. Azimuth Gear Tests and Standards-Continued

Tests	*Step-by-step instructions*	*Performance standards*
5. Gear test, 240 degrees azimuth.	*a*. Erase index mark from first drive shaft pinion and rotate first drive shaft and pinion until turntable has rotated to the 240 degree position.	*a*. None.
	b. Repeat steps la through *d*.	*b*. Total backlash of gear train shall be leas than five teeth.
6. Gear test, 300 degrees azimuth.	*a*. *Erase* index mark from first drive shaft pinion and rotate first drive shaft and pinion until turntable has rotated to the 300 degree position.	*a*. None.
	b. Repeat steps la through *d*.	*b*. Total backlash of gear train shall be less than five teeth.

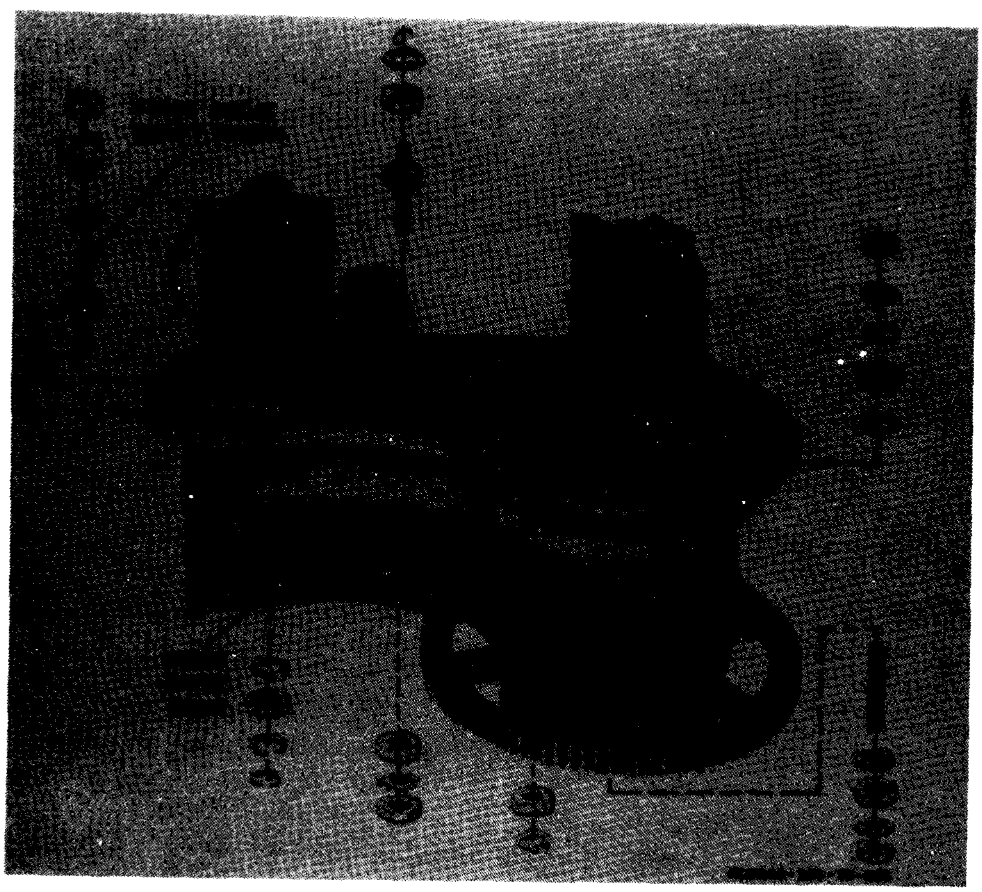


Figure 7-2. Azimuth drive assembly.

7-7. If. Amplifier Tests

a. Test Equipment and Material.

(1) Multimeter ME-26()/U vtvm.

(2) Socket extender, part number 1447 (05276), FSN 5935-065-3030.

(3) Signal generator SG-336/U.

(4) Signal generator AN/USM-44A.

(5) Attenuator Kay Model 20.

(6) Oscilloscope AN/USM-281A.

(7) Electronic voltmeter ME-30()/U.

(8) Adapter, BNC Jack to Double Banana Plug (05276) FSN 5939-053-9454.

(9) Resistor, composition 260 ohm ±10% l/2W, RC20BF251K.

(10) Receptacle Connector UG-290/U (2 each).

(11) Fabricate a special connector jack by soldering a connector receptacle, to each end of the 250-ohm resistors.

b. Test Connections and Conditions. Tests are performed with If. amplifier installed in a rawin receiver.

(1) If. amplifier test setup, figure 7–3, as required.

(2) If. amplifier test point diagram, figure 7-4, as required.

(3) If; amplifier bandwidth test setup, figure 7–5, as required.

(4) Sharp FM bandwidth aligned sinewave, figure 7-6, as required.

(5) Broad FM bandwidth aligned sinewave, figure 7-7, as required.

c. Step-by-step Tests and Performance Standards. Refer to table 7–3 for step-by-step procedures and standards.

Table 7-3. If. Amplifier Tests and Standards

Tests	Step-by-step instructions	Performance standards
1.15 MHz Trap Rejection.	Connect the equipment as shown in figure 7-3. Use AN/USM-207 counter as required to cheek the AN/USM-44A output frequency. Insert tuba extender between socket and V403.	
	Signal Generator AN/USM-44A Frequency: 15.00 MHz Modulation: 400 Hz, 30% Output Level: 1.5 Volta	
	a. Attenuator, Kay Model 20Adjust to obtain a 0.6 VA-C reading on the ME-26 ( )/U.	*a.* Record attenuation.
	b. Signal Generator Frequency: 30.00 MHz Modulation 400 MHz	*b.* Mnimum of 30 dB higher than in a above.
	Attenuator: Adjust to obtain a 0.6 VAC reading on the ME-26( )/U. Record the indication.	
	Remove tube extender and replace V403 in its socket.	

Table 7-3. If. Amplifier Tests and Standards—Continued

Tests	*S instructions*	*Performance standards*
2. Broad AM Bandwidth......	Connect the equipment as shown in figure 7−3. Use the counter as required to check the signal generator output frequency. Connect DC probe of ME−26 ( )/U set for −1.0 volt dc measurement to TP1 and common lead to TP5, figure 7−4.	
	Signal Generator Frequency: 30.00 MHz Modulation: None Output Level: Set output level for 1.0 volt on ME−26 ( )/U.	Signal generator output level shall be 20.0 uV maximum.
3. Sharp AM Gain and Bandwidth.	Connect the equipment as shown in figure 7−3. Use the counter as required to check the signal generator output frequency. Connect DC probe of ME−26( )/U set for −1.0 volt dc measurement to TP2 and common lead to TP5, figure 7−4.	
	a. Signal Generator Frequency: 30.00 MHz Modulation: None Output Level: Set output level for a 1.0 volt indication on ME−26 ( )/U. Record signal generator output level.	*a.* Signal generator output level shall be 20 uV maximum.
	b. Remove input signal to If. amplifier.	*b.* ME−26( )/U maximum indication 0.40 volt.
	Connect the equipment as shown in figure 7−5.	
	Oscilloscope AN/USM−281A Input lead to TP2, common to TP5, figure 7−4. Adjust as required to obtain a steady trace.	
	Signal Generator SG−336/U Center Frequency: 30 MHz Sweep: Wide Attenuation: Max. Crystal Markers: 29.6 MHz In 29.975 MHZ In 30.35 MHz In	
	Attenuator KAY Model 20 Attenuation: Max.	
	Adjust oscilloscope horizontal sweep until 29.6 MHz and 30.35 MHz markers are spaced 0.75 division.	

Table 7-3. If. Amplifier Tests and Standards—Continued

Tests	Step-by-step instructions	Performance standards
	c. Set vertical gain on oscilloscope for a 1 volt amplitude (decrease attenuation if necessary).	c. Bandwidth 2 MHz ± 0.3 MHz at the 3 dB down points (point where amplitude is 0.7 of original amplitude is equal to a bandwidth of 2 ± 0.3 division wide).
4. Sharp FM Bandwidth.	Connect the equipment as shown in figure 7-5.	
	Oscilloscope AN/USM–281A Connect input lead to TP3, common to TP5, figure 7–4.	
	Signal Generator SG–336/U Center Frequency: 30 MHz Sweep: Wide Attenuation: Max. Crystal Markers: 29.6 MHz In 29.975 MHz In 30.35 MHz In	
	Adjust oscilloscope for an optimum display of the Sharp FM discriminator S-curve (Reduce attenuation if necessary). If required L423, L415, L421, and L422 may be adjusted to obtain the display shown in figure 7–6. Be sure to lock coils after adjustment.	Amplitude of peaks A and B approximately equal and fall at 29.6 MHz and 30.35 MHz as shown in figure 7–6.
	Adjust variable horizontal input attenuator on the oscilloscope so the 29.6 MHz and 30.35 MHz markers are 1.5 divisions apart. Each division thus represents 0.5 MHz.	
5. Broad FM Bandwidth	Connect the equipment as shown in figure 7–5.	
	Oscilloscope AN/USM–281A Connect input lead to TP4, and common lead to TP5, figure 7–4.	
	Signal Generator SG–336/U Center Frequency: 30 MHz Sweep: Wide Attenuation: Max. Crystal Markers: 29.6 MHz In 29.975 MHz In 30.35 MHz In	
	Adjust oscilloscope to produce optimum Broad FM S-curve, figure 5–7.	The 29.975 marker shall be no more than 1 division from the S-reference crossover point.

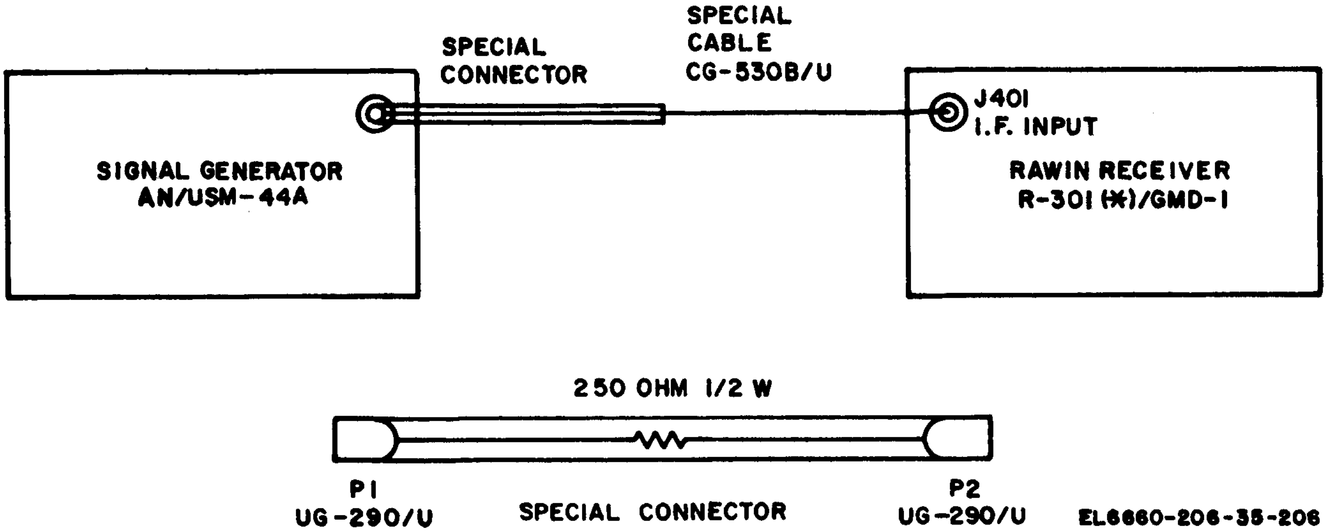


Figure 7—3. If. amplifier test setup.

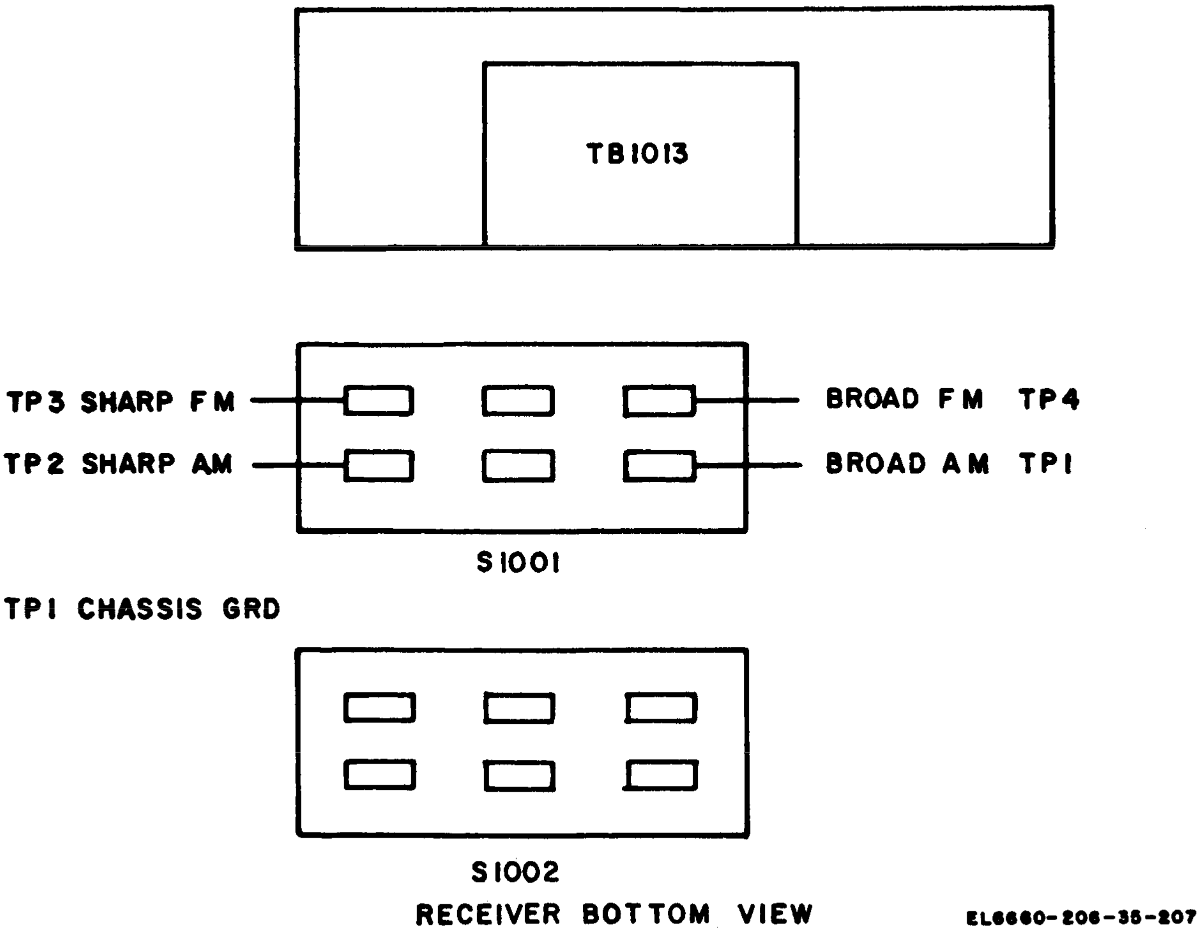


Figure 7—4. If. amplifier test point diagram.

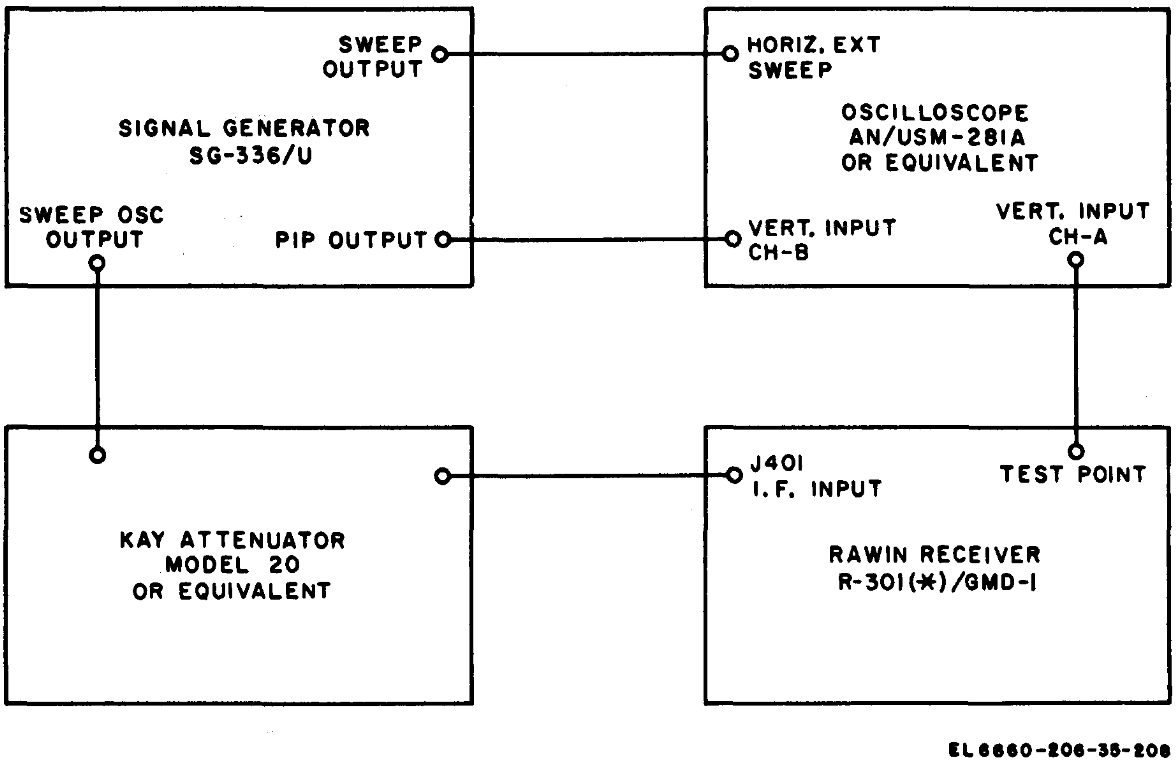


Figure 7—5. If. amplifier bandwidth test setup.

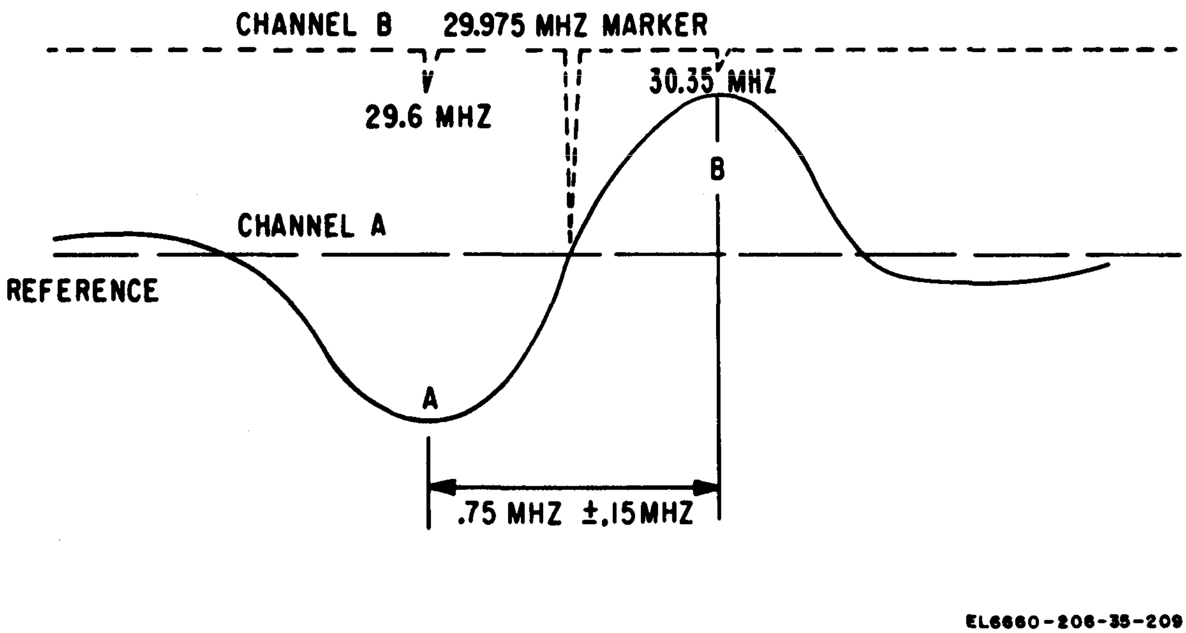


Figure 7—6. Sharp FM bandwidth aligned sinewave.

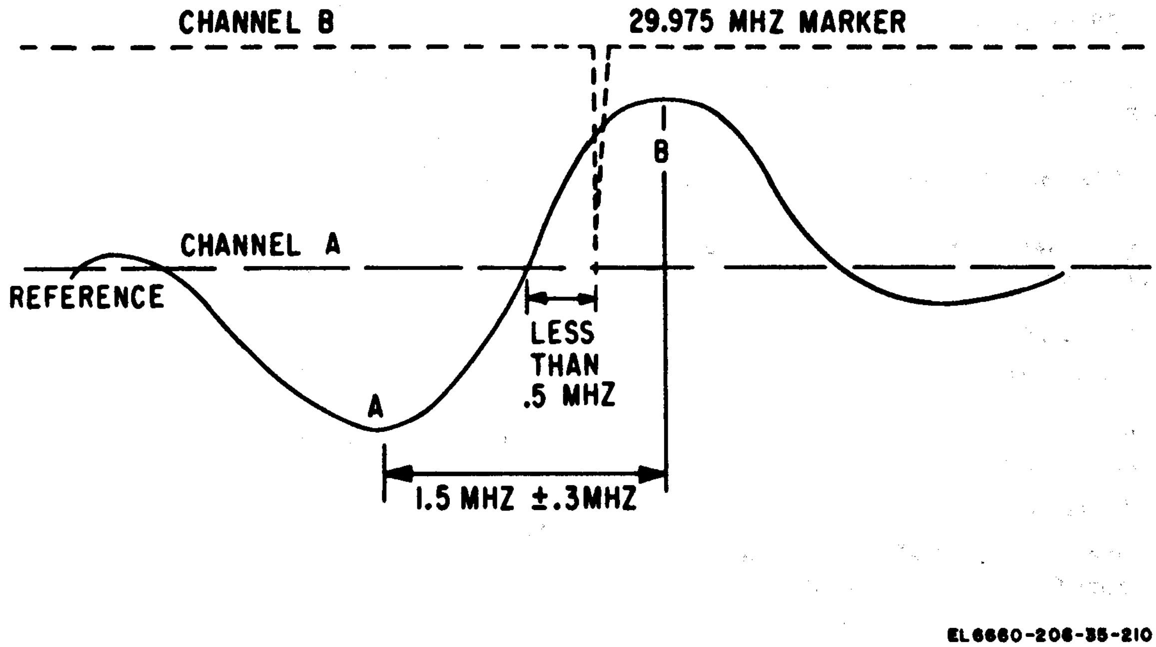


Figure 7-7. Broad FM bandwidth aligned sinewave.

7-8. RF Tuner Tests

a. Test Equipment and Material.

(1) Wavemeter FR-91/U

(2) Cable assembly CG-409/U

b. Test Connections and Conditions.

(1) Connect cable assembly CG–409/U from J502 to rf input of wavemeter FR-91/U. Tests are performed with tuner installed in a rawin receiver.

c. Step-by-Step Tests and performance standards. Refer to table 7-4, for step-by-step procedures and standards.

Table 7-4. Rf Tuner Tests and Standards

Step-by-step instructions	*Performance standards*
Connect equipment as described in paragraph *7-8b.*	
Receiver power: On 15 minutes minimum warmup	
a. Tune receiver dial to 1660 MHz	*a*. Wavemeter indicates 1660 MHz ± 2 MHz
b. Tune receiver dial to 1700 MHz	*b*. Wavemeter indicates 1700 MHz ± 2 MHz

7-9. SCR Switching Units Test

a. Teat *Equipment and Material.* SCR teat set (fig. 6-8).

b. Test Connections and Conditions. None

c. Step-by-step Tests and Performance Standards (para. 6-11).

SCR test set

Power: Off

Install SCR unit in test socket

Power: On

Operate BIAS ADJ from CCW to CW:	Meter indications should vary from 0 mA to 150 mA.

Power: off

7-10. Antenna Scanner Tests

a. Test Equipment and Materials.

(1) Multimeter TS-352B/U.

(2) Teat Set TS-538( )/U.

(3) Zero Mist Circuit cooler or equivalent.

b. Test Connections and Conditions. Refer to figure 7-8 and figure 7-9.

c. Step-by-step Tests and Performance Standards. Refer to table 7-5 for step-by-step procedures and standards.

7-11. Control-Recorder Tests

a. *Test Equipment and Material.*

(1) Cable Assembly, Power, Electrical CY-2043/U

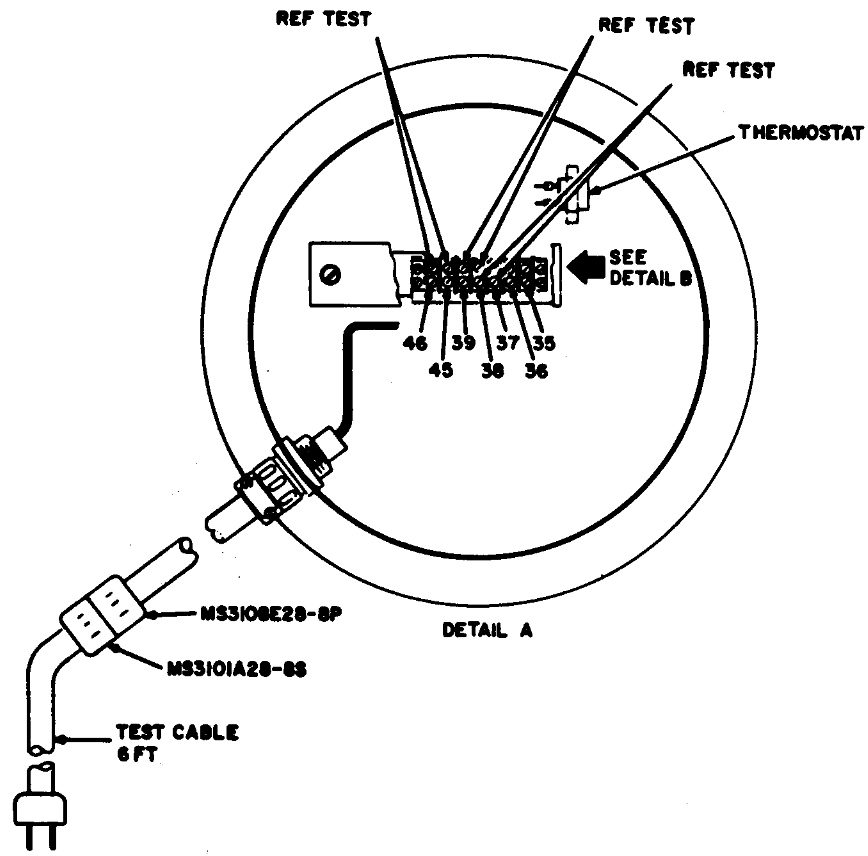
(2) Cable Assembly Adapter, Power, Electrical CX-1492/U

b. Test Connections and Conditions. Refer to figure 7-10.

c. Step-by-step Tests and performance Standards. Refer to table 7–6 for step-by-step pro*cedures* and standards.

Table 7–5. Antenna Scanner Tests and Standards

Tests	Step-by instructions	Performance standards
1. Heater and and thermostat	*a.* Connect TS–352B/U multimeter to terminals 36 and 37, figure 7–8. Set multimeter to OHMS R x 1.	*a.* 5 to 9 ohms.
	b. Spray Zero Mist Circuit Cooler or equivalent on thermostat S101.	*b.* 0.5 to 1.0 ohms less than the reading in a. above.
2. Reference generator	*a.* Connect the antenna scanner assembly as shown in figure 7–9.	*a.* Motor operates freely: no evidence of binding.
	b. Connect TS–352B/U test leads to terminals 45 and 46, figure 7–8.	*b.* Meter indicates 13 volts minimum.
	c. Connect TS–352B/U test leads to terminals 38 and 39, figure 7–8.	*c.* Meter indicates 13 volts minimum.
3. Functional	*a.* Connect the antenna scanner assembly as shown in figure 7–9.	*a.* None.
	b. TS–538 ( )/U Test Set Power: On Frequency: 1680 MHz Repetition rate: 200 Modulation: On Output Power: 50 DBM	*b.* Audible tene same frequency as pulsed RF REP rate (appreximately 200 Hz).



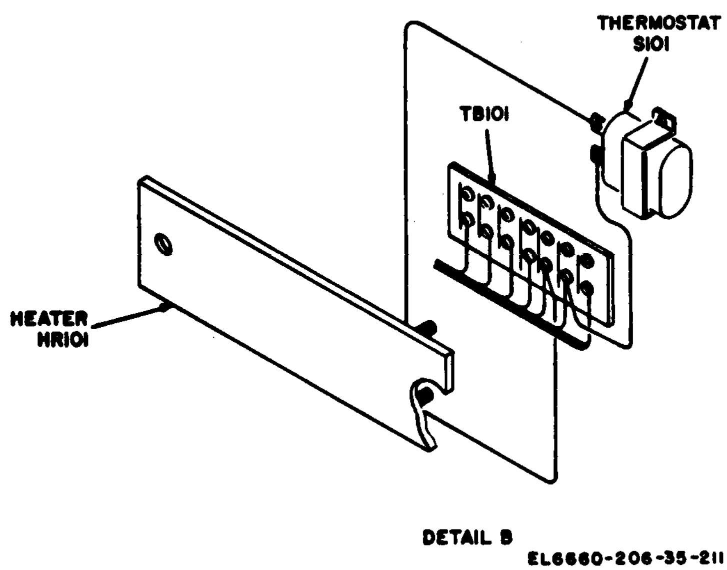


Figure 7—8. Antenna scanner test setup.

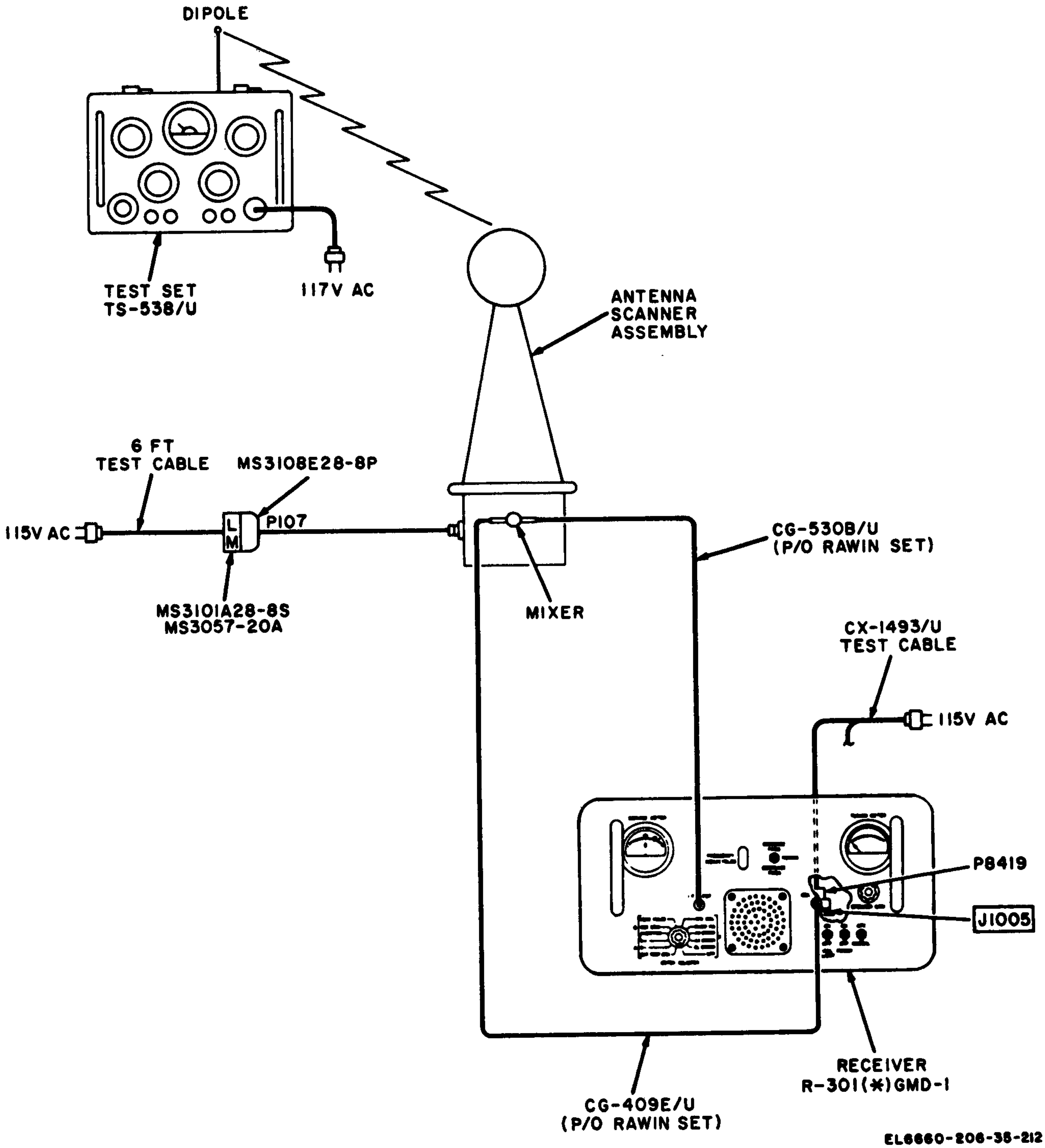


Figure 7—9. Antenna scanner functional test setup.

*Table 7-6. **Control-Recorder Tests and Standards***

Tests	*Step-by-step instructions*	*Performance standards*
1. Printings per minute	Connect the Control-Recorder as shown in figure 7−10.	
	a. Operate the walking beam.	*a.* Red pilot light goes out. Green azimuth and elevation pilot lights come on.
	PRINTINGS PER MINUTE : 10	
	b. BASELINE CHECK-FLIGHT STANDBY switch: FLIGHT	*b.* Printer will print azimuth, and elevation and time at rate of 10 printouts per minute.
	c. Depress TIME PRINT ONLY: Hold in for 12 seconds.	*c.* Time only printed for 12 seconds.
	BASELINE CHECK-FLIGHT STANDBY switch: STANDBY	
	PRINTINGS PER MINUTE: 2	
	d. BASELINE CHECK-FLIGHT STANDBY switch: FLIGHT	*d.* Printer will print azimuth, elevation and time at rate of 2 printouts per minute.
	BASELINE CHECK-FLIGHT STANDBY switch: STANDBY PRINTINGS PER MINUTE: 1	
	e. BASELINE CHECK-FLIGHT STANDBY switch: FLIGHT	*e.* Printer will print azimuth, elevation and time at rate of 1 printout per minute.
	BASELINE CHECK-FLIGHT STANDBY switch: STANDBY PRINTINGS PER MINUTE: 0	
	BASELINE CHECK-FLIGHT STANDBY switch: FLIGHT	
	f. Press TIME PRINT ONLY	*f.* Printer will print time only with asterisk on the right of time print. Time digits evenly spaced (a straight line can be drawn between each set of digits without touching any of the characters).
	g. Depress paper release	*g.* Paper pulls freely from roll through front opening.

NOTE

All printouts should be even and of the same intensity.

2. Chronometric motor timing.	*a.* Turn on, timer and stop watch for 15 minutes.	*a.* Maximum error in 15 minutes ± 1 second.

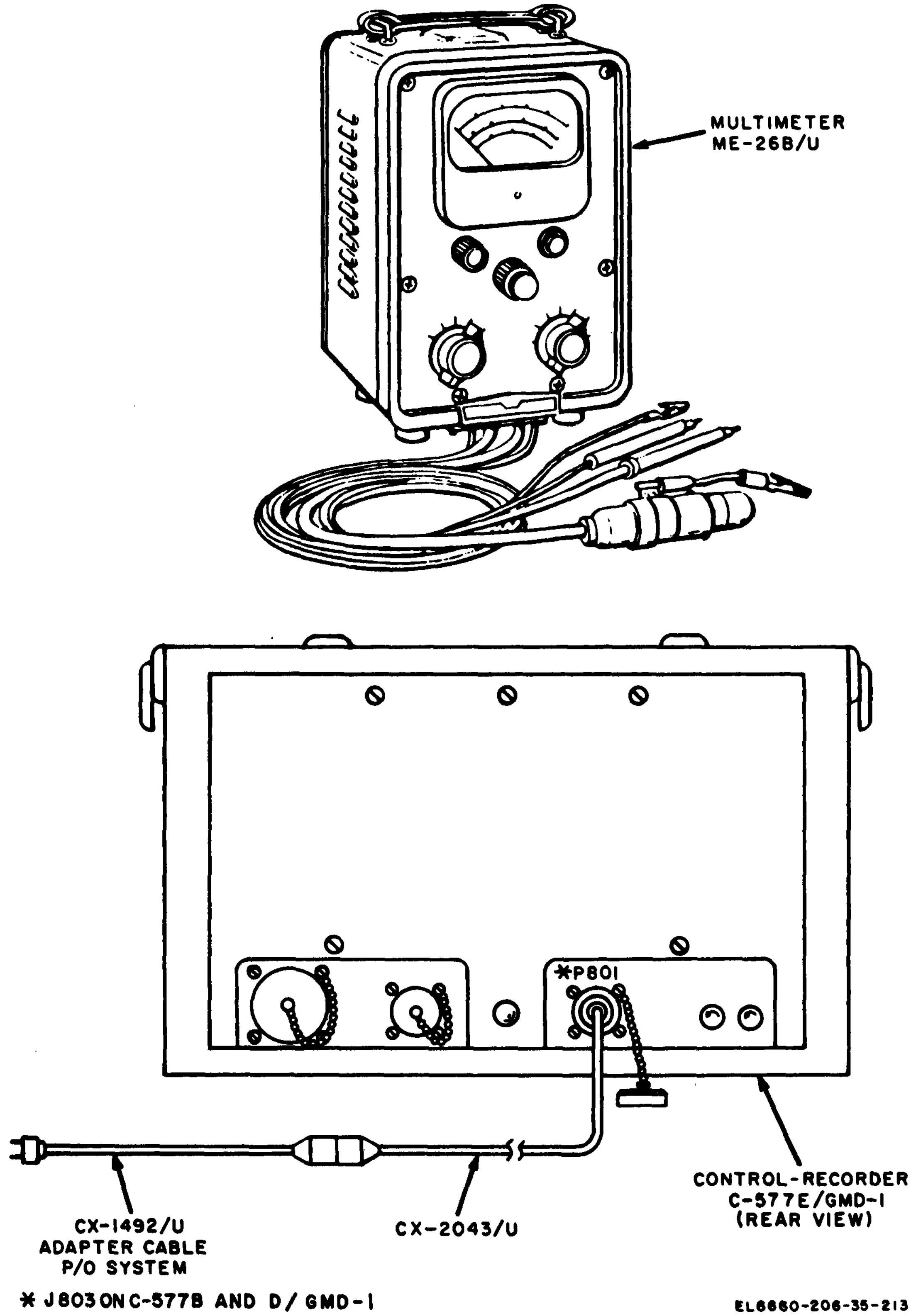


Figure 7—10. Control-recorder test setup.

7-12. Receiver Tests

a. Test Equipment and Material.

(1) Test Set TS-538( )/U.

(2) Adapter SC-C-93555.

(3) Mixer Assembly.

(4) Cable Assembly CG-409/U.

(5) Cable Assembly CG-530B/U.

(6) Test Cable CX–1493/U.

(7) Receiver decoupling network material: See figure 7-12.

Symbol desig	*Description*	*Mil spec or other part no.*
C1	Capacitor, Variable. . . . . 4-33 uuF	BUD MC-1852
CR1	Diode. Crystal	1N70
H1, H2 . .	Clip, Alligator	Mueller 63C
P1, P2 . . .	Plug, Banana..	H. H. Smith 285
R1	Resistor, Composition 560K ± 10%, l/2w	RC203F564K

b. Test Connections and Conditions. Refer to figure 7-11. Variations in use as applicable as given in table 7-7.

c. Step-by-Step Tests and Performance Standards. Refer to table 7-7 for step-by-step procedures and standards.

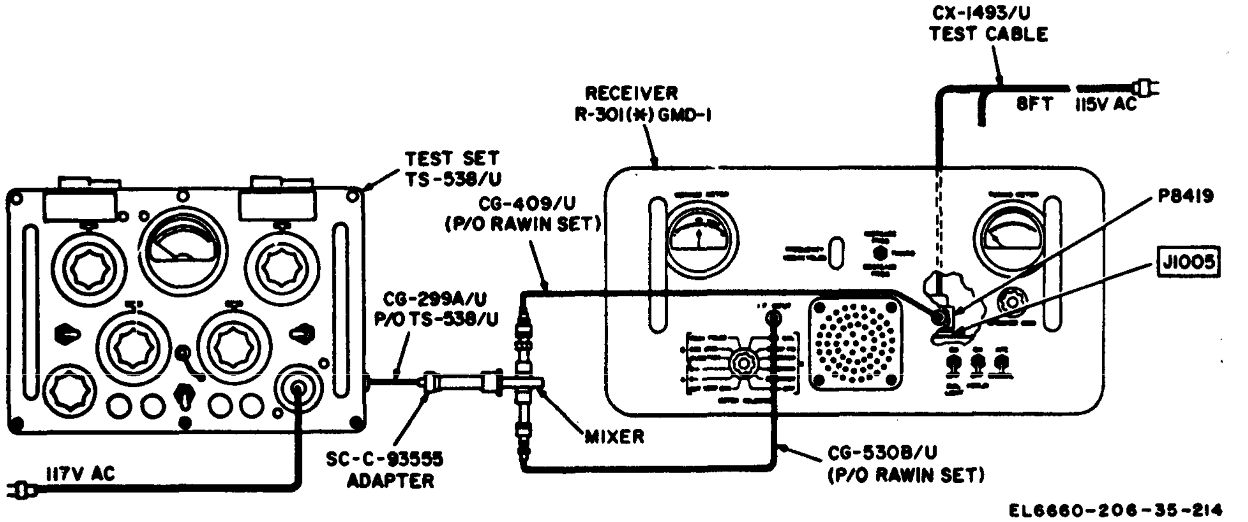


Figure 7–11. Receiver test setup.

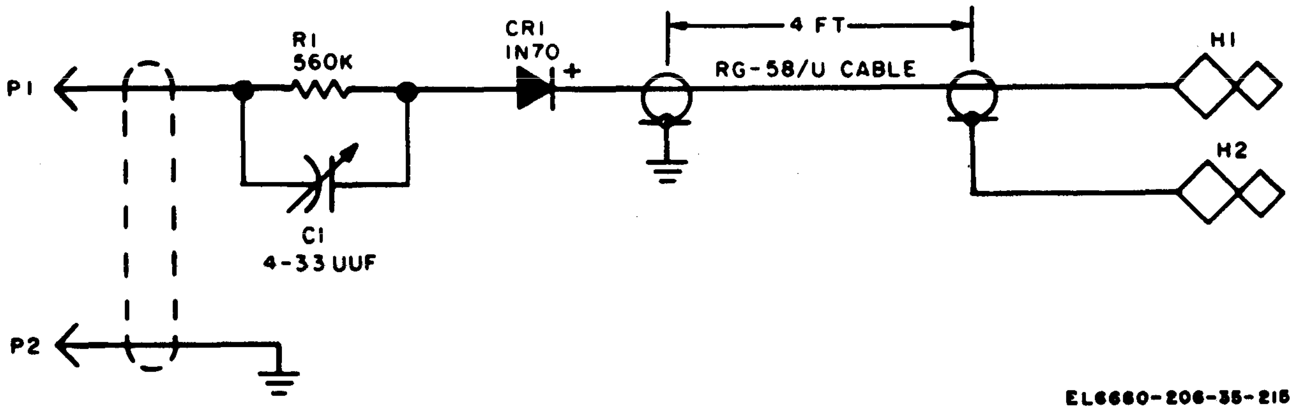


Figure 7-12 Receiver decoupling network.

Table 7-7. Receiver Tests and Standards

Tests	*Step-by-step instructions*	Performance standards
Preliminary	Connect the equipment as shown in figures 7-11.	
	Receiver control settings: S1001: SHARP S1002: AM S1009: CF (D model only) AFC: MANUAL POWER: ON	
	TS-538( )/U Ted Set FREQUENCY METER: 1680 MHz MODULATION: ON REPETITION RATE : 200 CPS OUTPUT: POWER : -90 DBM	
lA.1680 MHZ	Receiver METER SELECTOR switch	
	a. B+	*a.* 170 to 190 VDC
	b. B -	*b.* -95 to -116 VDC
	c. INJECTION	*c.* Within green block B.
	d. OSC GRID	*d.* Within green block B.
	e. SHARP FM	*e.* Within green diamond C.
	f. AC ERROR	*f.* Within green diamond C.
	g. PEAK PULSE	*g.* Within green diamond C.
	Test Set MODULATION: OFF	
	Operate receiver TUNING switch for 1680 MHz.	
	h. Adjust Test Set frequency for peak indication on receiver TUNING METER.	*h.* Test Set frequency indication 1676 to 1682 MHz.
	Test Set FREQUENCY METER: 1660 MHZ MODULATION : ON REPETITION RATE: 200 CPS OUTPUT POWER: -90 DBM	
lB.1660 MHz	Receiver METER SELECTOR switch	
	a. Indention	a. Within green block B.
	b. OSC GRID	*b.* Within green block B.
	c. SHARP FM	*c.* Within green diamond C.
	d. AC ERROR	*d.* Within green diamond C.
	e. PEAK POISE	*e.* Within green diamond C.
	Test Set MODULATION: OFF	
	Operate receiver TUNING twitch for 1660 MHz.	
	f. Adjust Test Set frequency for peek indication on receiver TUNING METER.	*f.* Test Set frequency indication 1658 MHz to 1662 MHz.

Table 7-7. ***Receiver Tests and Standards—Continued***

Tests	*Step-by-step instructions*	*Performance standards*
1C. 1700 MHz	Test Set FREQUENCY METER: 1700 MHz MODULATION: ON REPETITION RATE: 200 CPS OUTPUT POWER: –90 DBM	
	Receiver METER SELECTOR switch	
	a. INJECTION	*a.* Within green block B.
	b. OSC GRID	*b.* Within green block B.
	c. SHARP FM	*c.* Within green diamond C.
	d. AC ERROR	*d.* Within green diamond C.
	e. PEAK PULSE	*e.* Within green diamond C.
	Test Set MODULATION: OFF	
	Operate receiver TUNING switch for 1700 MHz.	
	f. Adjust Test Set frequency for peak indication on receiver TUNING METER.	*f.* Test Set frequency indication 1698 MHz to 1702 MHz.
2. AFC	Connect the equipment as shown in figure 7-11.	
	Receiver power on, test equipment power off.	
	Receiver METER SELECTOR switch	
	a. SHARP FM	*a.* SERVICE METER indicates between –1 and +1.
	Test Set POWER: ON FREQUENCY METER: 1680 MHz MODULATION: ON OUTPUT POWER: –90 DBM	
	Receiver control settings S1001: BROAD S1005: AFC POWER: ON	
	Operate receiver TUNING switch to receiver signal from Test Set.	Note frequency.
	b. Detune receiver 0.5 MHz below frequency obtained in *a* above.	*b.* Receiver shall return to frequency noted in *a* above.
	c. Detune receiver 0.5 MHz above frequency obtained in *a* above.	*c.* Receiver shall return to frequency noted in *a* above.

*Table 7-7. **Receiver Tests and Standards—Continued***

Tests	*Step-by-step instructions*	*Performance standards*
3. Sensitivity	Connect the equipment as shown in figure 7-11 .Connect AN/USM-281A oscilloscope to J1005, (pin D signal and pin C ground) in parallel with a 0.01 μf capacitor.	
	Receiver control settings METER SELECTOR: OFF Dial Light: OFF AFC : As required S1001: SHARP S1002: AM S1008: As required S1009: CF (D Model only) Speaker Gain: As required	
	Test Set FREQUENCY METER: 1680 MHz OUTPUT POWER: −80 DBM MODULATION : ON REPETITION RATE: 200 CPS	
	Operate receiver TUNING switch for a peak TUNING METER indication.	
	Oscilloscope, adjust as necessary to obtain pulse display.	
	Test Set. adjust output power until pulses on the oscilloscope just disappear (become erratic). Adjust output power until the pulses just re-appear (become stable).	
	a. Record Test Set output power	*a.* −90 DBM maximum
	b. Receiver METER SELECTOR: PEAK PULSE	*b.* Within green block B.
	c. Test Set ATTENUATOR: −90 DBM Vary REPETITION RATE: 200 to 10 CPS. FREQUENCY METER: 1700 MHz OUTPUT POWER: −80 DBM MODULATION: ON REPETITION RATE: 200 CPS	*c.* Pulse s hall not disappear from osc scope
	Operate receiver TUNING switch for a peak TUNING METER indication.	
	Oscilloscope, adjust as necessary to obtain pulse display.	
	Test Set, adjust outpower until pulses on the oscilloscope just disappear (become erratic). Adjust output power until the pulses just re-appear (become stable).	

Table 7-7. ***Receiver Tests and Standards—Continued***

Tests	Step-by-step instructions		Performance standards
	d. Record Test Set output power		*d.* −90 DBM maximum.
	e. Receiver METER SELECTOR:	PEAK PULSE	*e.* Within green block B.
	f. Test Set ATTENUATOR:	−90 DBM	*f.* Pulse shall not disappear from oscilloscope.
	Vary REPETITION RATE:	200 to 10.	
	FREQUENCY METER:	1660 MHz	
	OUTPUT POWER:	−80 DBM	
	MODULATION:	ON	
	REPETITION RATE:	200 CPS	
	Operate receiver TUNING switch for a peak TUNING METER indication.		
	Oscilloscope, adjust as necessary to obtain pulse display.		
	Test Set, adjust output power until pulses on the oscilloscope just disappear (become erratic). Adjust output power until the pulses just re-appear (become stable).		
	g. Record Test Set output power.........		*g.* −90 DBM maximum.
	h. Receiver METER SELECTOR:	PEAK PULSE	*h.* Within green block B.
	i. Test Set ATTENUATOR:	−90 DBM	*i.* Pulse shall not disappear from oscilloscope.
	Vary REPETITION RATE:	200 to 10.	
4. Meteorological Multivibrator.	Connect the equipment as shown in figure 7-11. Connect AN/USM−281A oscilloscope to J1005, (pin D signal and pin C ground) in parallel with a 0.01 μf capacitor.		
	Receiver control settings		
	METER SELECTOR:	OFF	
	Dial Light:	Off	
	POWER:	ON	
	AFC:	MANUAL	
	S1001:	SHARP	
	S1002:	AM	
	S1008:	As required	
	S1009:	CF	
	Speaker Gain:	As required	
	Frequency:	As required	
	Test Set		
	FREQUENCY METER:	1680 MHz	
	OUTPUT POWER:	−90 DBM	
	MODULATION:	ON	
	REPETITION RATE:	200 CPS	
	Oscilloscope adjust as required.		

Table 7-7. Receiver Tests and Standards—Continued

Tests	*Step-by-step instructions*	*Performance standards*
	a. Operate receiver TUNING switch for a peak TUNING METER indication.	*a.* Pulse amplitude, 25 to 60 volts. Pulse width, 1200 to 2500 μs.
	NOTE Pulse width at 50% amplitude.	
	b. Test Set REPETITION RATE: 30 CPS	*b.* Pulse amplitude, 25 volts minimum. Pulse width, 1200 to 2500 μs.
	Connect AN/UPM−15 pulse generator through receiver decoupling network (fig. 7−12 to the center arm of S1008.	
	Connect counter input to J1005 pin D.	
	Connect oscilloscope to receiver decoupling network.	
	Test Set FREQUENCY METER: 1680 CPS OUTPUT POWER: −84 DBM MODULATION : ON REPETITION RATE: 200 CPS	
	c. Pulse generator, increase pulse width 20 μs while observing counter.	*c.* Counter readout shall be stable and within ± 1 count.
	d. Pulse generator PRF: 50 pps Amplitude: +10 volts Width: Vary , 1 μs to 20 μs, observe counter.	*d.* Counter readout shall be stable. Note readout.
	e. Repeat *d* above for an amplitude of −10 volts.	*e.* Counter readout shall be stable and within ± 1 count of *d* above.
	Test Set REPETITION RATE: 100 CPS	
	f. Pulse generator PRF: 50 pps Amplitude: +10 volts Width: Vary, 1 μs to 20 μs, observe counter.	*f.* Counter readout shall be stable. Note readout.
	g. Repeat *f* above for an amplitude of −10 volts.	*g.* Counter readout shall be stable and within ± 1 count of *f* above.
	Test Set REPETITION RATE: 20 CPS	

Table 7-7. Receiver Tests and Standards—Continued

Tests	Step-by-step instructions		Performance standards
	h. Pulse generator		*h.* Counter readout shall be stable. Note readout.
	PRF:	50 pps	
	Amplitude:	+10 volts	
	Width:	Vary, 1 μs to 20 μs, observe counter.	
	i. Repeat *h* above for an amplitude of −10 volts.		*i.* Counter readout shall be stable and within ± 1 count of *h* above.
	Test Set		
	REPETITION RATE:	10 CPS	
	j. Pulse generator		*j.* Counter readout shall be stable. Note readout.
	PRF:	50 pps	
	Amplitude:	+10 volts	
	Width:	Vary, 1 μs to 20 μs, observe counter.	
	k. Repeat *j* above for an amplitude of −10 volts.		*k.* Counter readout shall be stable and within ± 1 count of *j* above.
	Test Set		
	REPETITION RATE:	20 CPS	
	l. Pulse generator		*l.* Counter readout shall be stable. Note readout.
	PRF:	500 pps	
	Amplitude:	+10 volts	
	Width:	Vary, 1 μs to 20 μs, observe counter.	
	m. Repeat *l* above for an amplitude of −10 volts.		*m.* Counter readout shall be stable and within ± 1 count of *l* above.
	Test Set		
	REPETITION RATE:	100 CPS	
	n. Pulse generator		*n.* Counter readout shall be stable. Note readout.
	PRF:	500 pps	
	Amplitude:	+10 volts	
	Width:	Vary, 1 μs to 20 μs, observe counter.	
	o. Repeat *n* above for an amplitude of −10 volts.		*o.* Counter readout shall be stable and within ± 1 count of *n* above.
	Test Set		
	REPETITION RATE:	200 CPS	
	p. Pulse generator		*p.* Counter readout shall be stable. Note readout.
	PRF:	500 pps	
	Amplitude:	+10 volts	
	Width:	Vary, 1 μs to 20 μs, observe counter.	

Table 7-7. Receiver Tests and Standards—Continued

Tests	*Step-by-step instructions*	*Performance standards*
	q. Repeat *p* above for an amplitude of —10 volts.	*q*. Counter readout shall be stable and within ± 1 count of *p* above.
	r. Pulse generator PRF: 2000 pps Amplitude: +10 volts Width: Vary, 1 μs to 20 μs, observe counter.	*r*. Counter readout shall be stable. Note readout.
	s. Repeat *r* above for an amplitude of —10 volts.	*s*. Counter readout shall be stable and within ± 1 count of *r* above.
	Test Set REPETITION RATE: 100 CPS	
	t. Pulse generator PRF: 2000 pps Amplitude: +10 volts Width: Vary, 1 μs to 20 μs, observe counter.	*t*. Counter readout shall be stable. Note readout.
	u. Repeat *t* above for an amplitude of —10 volts.	*u*. Counter readout shall be stable and within ± 1 count of *t* above.
	Test Set REPETITION RATE: 20 CPS	
	v. Pulse generator PRF: 2000 pps Amplitude: +10 volts Width: Vary, 1 μs to 20 μs, observe counter.	*v*. Counter readout shall be stable. Note readout.
	w. Repeat *v* above for an amplitude of —10 volts.	*w*. Counter readout shall be stable and within ± 1 count of *v* above.
5. Audio output	Connect the equipment as shown in figure 7-11. Connect ME-30A/U voltmeter to T1001 terminal 4 and R1066-arm. Receiver control settings METER SELECTOR: As required Dial Light: Off POWER: ON AFC: MANUAL S1001: SHARP S1002: AM S1008: As required S1009: CF SPEAKER GAIN: Maximum Frequency: As required	

Table 7–7. Receiver Tests and Standards—Continued

Tests	Step-by-step instructions	Performance standards
	TS–538( )/U Test Set FREQUENCY METER: 1680 MHz REPETITION RATE: 200 CPS MODULATION : ON OUTPUT POWER : –20 DBM	
	a. Operate receiver TUNING switch to peak TUNING METER indication.	*a.* ME–30A/U 1.18 Vac minimum.
	b. SPEAKER GAIN: Minimum	*b.* ME–30A/U 70 Vac maximum.
6. AGC	Connect the equipment as shown in figure 7–11 . Insert jumper cable between P1001 and J403. Connect ME–26( )/U to P1001 and ground.	
	Receiver control settings METER SELECTOR: As required Dial Light: Off POWER: ON AFC: MANUAL S1001: SHARP S1002: AM S1008: As required S1009: CF SPEAKER GAIN: As required Frequency: As required	
	TS–538( )/U Test Set FREQUENCY METER: 1680 MHz REPETITION RATE: 200 CPS MODULATION: ON OUTPUT POWER: –20 DBM	
	a. Operate receiver TUNING switch to peak TUNING METER.	*a.* Record ME–26( )/U indication.
	b. Test Set OUTPUT POWER: –89 DBM	*b.* Record ME–26( )/U indication.
	c. Divide indication obtained in *a* above by the indication obtained in *b* above.	*c.* volts.
	d. Connect oscilloscope input to P1001 pin 10. Time base: 50 ms Adjust oscilloscope triggering and vertical gain for a dc level change indication as If. input to receiver is removed and reconnected. With oscilloscope properly adjusted, observe the down swing of the dc level as the If. cable is re-installed. Measure the dc recovery time between the 0 and the 90% points.	*d.* 100 ms maximum.

7-13. Antenna Control Tests

a. Test Equipment and Material,

(1) Test Set TS-538( )/U.

(2) Multimeter TS–352B/U.

(3) Special cable to interconnect J601 to housing P301. (Cable length sufficient to permit location of antenna control on test bench.)

(4) Special cable to interconnect J604 to housing P304. (Cable length same as (3) above.)

b. Test Connections and Conditions. Antenna control must be connected to an operating rawin set. To enable bench testing, fabricate special cables *a(3)* and (4) above, and connect antenna control to the rawin set.

c. Step-by-step Tests and Performance Standards. Refer to table 7–8 for step-by-step procedures and standards.

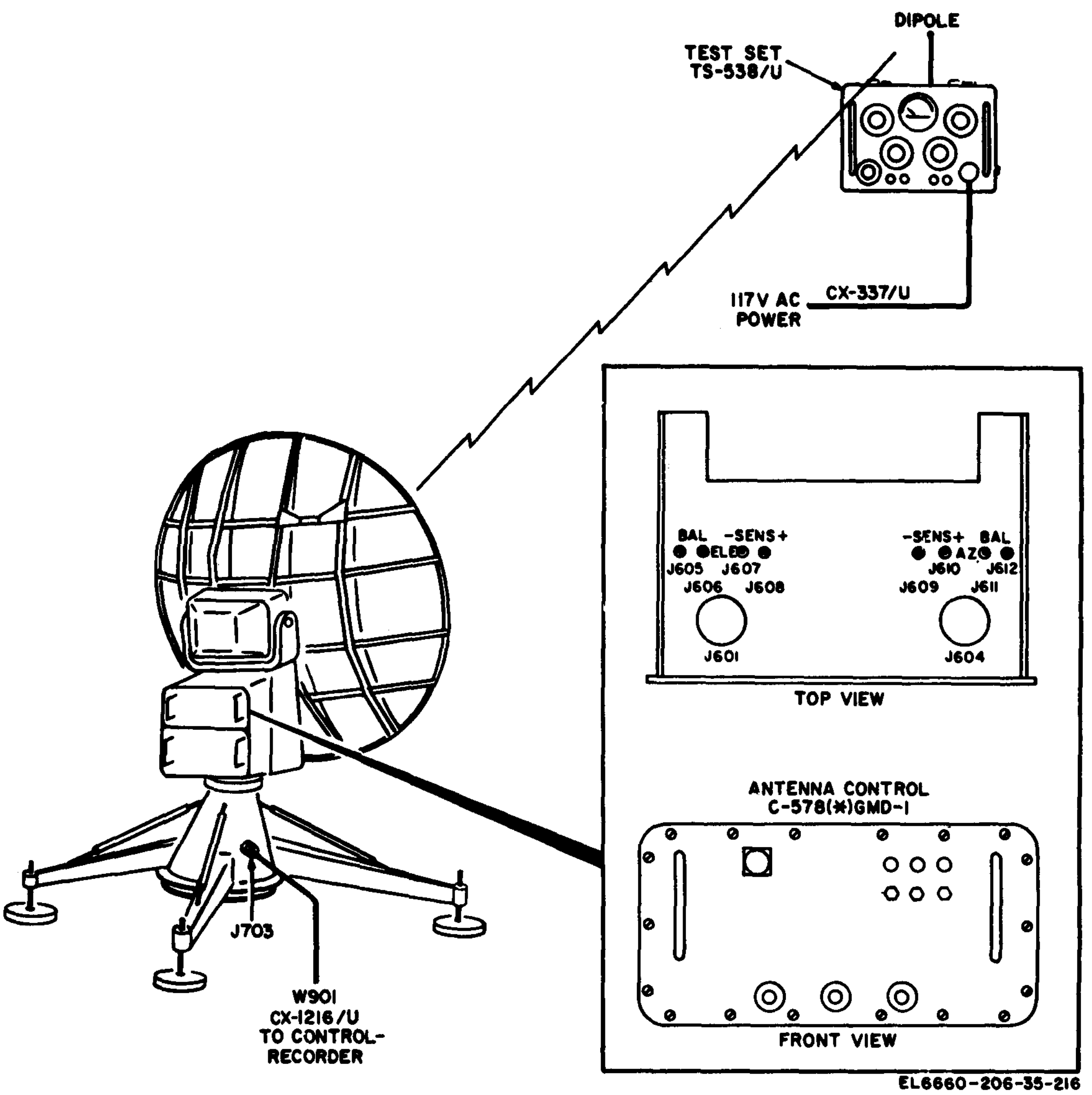


Figure 7-13. Antenna control test setup.

Table 7-8. Antenna Control Tests and Standards

Tests	*Step-by-step instructions*	*Performance standards*
1A. Elevation balance.	Antenna control POWER: OFF MANUAL-NEAR AUTO-FAR AUTO : FAR AUTO MOTORS STANDBY : MOTORS Multimeter set for 10 VDC range Insert multimeter probes in ELE BAL jacks, J605 and J606. POWER : ON	
	a. Multimeter indication	a. O volts
	CAUTION Do not operate MANUAL-NEAR AUTO-FAR AUTO when multimeter is connected to BAL jacks. POWER : OFF MOTORS STANDBY : STANDBY	
lB. Sensitivity	Multimeter .set for 0–500 mA range. Remove thermal relay K605. POWER : ON MOTORS STANDBY : MOTORS (allow 1 minute for stabilization). Insert multimeter probes in ELE SENS jacks J607 and J608.	
	b. Multimeter indication.	*b.* 200 mA to±20 mA
	Replace thermal relay K605.	
2A. Azimuth balance.	Antenna control POWER: OFF MANUAL-NEAR AUTO-FAR AUTO : FAR AUTO MOTORS STANDBY : MOTORS Multimeter set for 10 VDC range. Insert multimeter probes in AZ BAL jacks, J611 and J612. POWER : ON	
	a. Multimeter indication	*a.* 0 volts
	CAUTION Do not operate MANUAL-NEAR AUTO-FAR AUTO when multimeter is connected to BAL jacks. POWER: OFF MOTORS STANDBY: STANDBY	

*Table 7-8. **Antenna Control Tests and Standards—Continued***

Tests	Step-by-step instructions	Performance standards
	Multimeter set to 0—500 mA range.	
	Remove thermal relay K605. POWER: ON MOTORS STANDBY: MOTORS (allow 1 minute for stabilization).	
	Insert multimeter probes in AX SENS jacks J609 and J610.	
2B. Azimuth sensitivity	*b.* Multimeter indication	*b.* 200 mA ±20 mA
	Replace thermal relay K604	
3. Manual control	*a.* MANUAL-NEAR AUTO-FAR AUTO: MANUAL	*a.* Antenna does not move.
	b. Operate ELEVATION UP-DOWN control: UP	*b.* Antenna moves upwards and increases in speed as control is operated toward UP position. Antenna stops at 90° as indicated on elevation indicator.
	c. Operate ELEVATION UP-DOWN control: DOWN	*c.* Antenna moves downward and increases in speed as control is operated toward the DOWN position. Antenna stops at zero degrees as indicated on elevation indicator.
	d. Operate AZIMUTH CW-CCW: CW	*d.* Antenna moves clockwise and increases in speed as control is operated toward CW position. Antenna stops when control is returned to center position.
	e. Operate AZIMUTH CW-CCW: CCW	*e.* Antenna moves counterclockwise and increases in speed as control is operated toward CCW position. Antenna stops when control is returned to center position.
4. Automatic control	Test Set TS—538( )/U FREQUENCY METER: 1680 MHz MODULATION: ON REPETITION RATE: 200 CPS OUTPUT POWER: —90 DBM	
	Antenna control MANUAL-NEAR AUTO-FAR AUTO: NEAR AUTO	
	a. POWER: ON	*a.* Antenna automatically moves toward test set.

*Table 7-8. **Antenna Control Tests and Standards—Continued***

Tests	*Step-by-step instructions*		*Performance standards*
	b. Operate ELEVATION UP-DOWN control:	UP then DOWN	*b.* Antenna does not move.
	c. Operate AZIMUTH CW-CCW control:	CW then CCW	*c.* Antenna does not move.
	d. MANUAL-NEAR AUTO-FAR AUTO:	FAR AUTO	*d.* Antenna automatically moves toward test set.
	e. Operate ELEVATION UP-DOWN control:	UP then DOWN	*e.* Antenna does not move.
	f. Operate AZIMUTH CW-CCW control:	CW then CCW	*f.* Antenna does not move.
	g. Operate MOTORS STANDBY:	STANDBY	*g.* MOTORS INDICATOR light comes on and antenna will not move regardless of which control is operated.

Section III. SYSTEM TESTING

7-14. General

This section contains the depot overhaul standards for system testing of the rawin set. Table 7-9 lists reference data that should be helpful in performing the various tests.

*Table 7-9. **Reference Data, System Test***

Tests	*Standards table*
Receiver Operation	7-10
Antenna Control	7-11
Control–Recorder	7-12
Remove and Local Indicator Tracking	7-13
Automatic Tracking	7-14
Receiver Tuning	7-15
Rotational Speed of Antenna	7-16

7-15. Pedestal Operation Tests

a. Test Equipment and Material. Multimeter TS–352/U.

b. Test Connections and Conditions. AN/GMD–1 with all units interconnected.

c. Step-by-step Tests and Performance Standards. Refer to table 7–10 for step-by-step procedures and standards.

Table *7-10. **Pedestal Tests and Standards***

Tests	***Step-by-step instructions***		***Performance standards***
	Antenna Control Mode switch Pedestal	**MANUAL**	
1. Azimuth and elevation control-manual mode.	***a.* AZIMUTH control**	**CW and CCW**	***a.* Antenna moves in correct direction.**
	***b.* ELEVATION control**	**UP and DOWN**	***b.* Antenna moves in correct direction.**
	Antenna Control Mode switch Pedestal	**NEAR AUTO**	
2. Azimuth and elevation control-Near auto mode.	***a.* AZIMUTH control**	**CW and CCW**	***a.* Antenna does not move.**
	***b.* ELEVATION control**	**UP and DOWN**	***b.* Antenna does not move.**
	Antenna Control Mode switch Pedestal	**FAR AUTO**	
3. Azimuth and elevation control-Far auto mode.	***a.* AZIMUTH control**	**CW and CCW**	***a.* Antenna does not move.**
	***b.* ELEVATION control**	**UP and DOWN**	***b.* Antenna does not move.**
	Pedestal slewing switches		
4. Azimuth, elevation (slewing) switches AN/GMD−1B(*).	***a.* Azimuth**	**CW and CCW**	***a.* Antenna moves in correct direction. Antenna control mode switch has no effect.**
	***b.* Elevation**	**UP and DOWN**	***b.* Antenna moves in correct direction. Antenna control mode switch has no effect.**
5. Elevation limit switches	***a.* Up limit switch stops antenna up movement.**		***a.* Antenna stops and oscillates 90° (+5°, −0°).**
	***b.* Down limit switch stops antenna down movement.**		***b.* Antenna stops and oscillates −3° (+0°, −0.5°).**
	***c.* Turn azimuth stow lock in a maximum of two turns.**		***c.* Azimuth movement stops.**
	***d.* Turn elevation stow lock in a maximum of two turns.**		***d.* Elevation movement stops.**
	Multimeter TS−352/U 250V ac scale		
6. Convenience Outlets Antenna Control Pedestal Base.	***a.* Measure ac voltage at antenna control convenience outlet.**		***a.* 115 VAC.**
	***b.* Measure ac voltage at pedestal base convenience outlet.**		***b.* 115 VAC. Azimuth and elevation dial lights are energized.**

7-16. Receiver Operation Tests

a. Test Equipment and Material.

(1) Test Set TS-538( )/U.

(2) Test target antenna.

(a) Coaxial cable, RG9B/U.

(b) Stand-off insulators, 1-9/16 (E. F. Johnson Type 135-20 or equivalent).

(c) Coaxial connector UG-21/U.

(d) 16-inch square piece of plywood.

(e) Solder lugs, cable clamps and miscellaneous hardware.

(f) Fabricate teat antenna es follows:

(1) Strip back 3½ inches of the outer robber insulation on a 55-foot length of RG9B/U cable. Use care not to damage the inner wire braid.

(2) Push the wire braid back to the outer rubber insulation.

(3) Part the strands of the wire braid at the rubber insulation, and allow the polyethylene covered inner conductor to protrude.

(4) Stretch the wire braid back to its original length.

(5) Bend the inner conductor end the wire braid so they point 180” from each other, forming a Tee with the remainder of the cable.

(6) Tin the wire braid with solder, using care not to melt the polyethylene insulation on the inner conductor.

(7) Wrap the junction of the Tee with elctrical tape (Scotch no. 33 or equivalent).

(8) Solder a solder lug to the end of the inner conductor and another to the end of the wire braid. The length from the junction of the Tee to the end of each of the solder lugs will be 3½ inches, for a total length of 7 inches tip-to-tip.

(9) Mount two stand-off insulators *(b* above) on the vertical center line of the target so their centers are 3 3/8 inches above and below the horizontal center line, respectively. Mount one stand-off insulator 1 inch to left of center on the horizontal axis.

(10) Connect the solder lugs on the ends of the test antenna to the stand-off insulators so the polyethylene covered center conductor is pointing vertically upwards, the wire braid is pointing vertically downward and the remainder of the cable is pointing along the horizontal center line of the plywood.

(11) Connect a cable clamp to the antenna cable one inch from the Tee junction and mount the clamp to a stand-off insulator.

(12) Terminate the other end of the cable with a UG-21/U connector.

b. Test Connections and Conditions.

(1) Install test target antenna approximately 220 feet from rawin antenna at a height of 40 feet above the center line of the rawin antenna. Test target antenna must be rotatable 45 degrees clockwise and counterclockwise for polarization checks.

(2) Connect Test Set TS–538( )/U to the test target antenna. Adjust to–

(a) 1680 MHz.

(b) -20 DBM (initial step).

(c) 20 pps (internal modulation).

(3) Center rawin antenna automatically on the test target antenna.

(4) Ground the control-recorder.

(5) Rawin set on receiver. tuning meter should indicate 20 to 30 microampere (minimum warmup 10 minutes). Readjust attenuator as necessary to obtain this indication.

(6) Control-recorder, RECORDS CONTROL to BASELINE CHECK.

c. Step-by-step Tests and performance Standards. Refer to table 7–11 for step-by-step procedures and standards.

Table 7-11. Receiver Operation Tests and Standards

Tests	*Step-by-step* instructions	*Performance standards*
Rawin Receiver R-301(*)/GMD-1.	Receiver POWER: ON AFC/MANUAL: AFC	
1. Preliminary tests.	a. Operate DIAL LIGHT witch.	a Dial light is energized.
	b. Operate INCREASE FREQ and DECREASE FREQ *switch.*	*b.* Tuning dial moves in the correct direction.
	TUNING dial: 1680 MHz S1002: **AM** S1001: SHARP	
2. Tuning and audio test	*a.* METER SELECTOR AZ ERROR	*a.* None.
	b. Adjust antenna in azimuth	*b.* SERVICE METER indicates approximately zero.
	c. METER SELECTOR EL ERROR	*c.* **None.**
	d. Ajust antenna in elevation..	*d.* SERVICE METER indicates approximately zero.
	e. Rotate SPEAKER GAIN control clockwise.	*e.* Sound shall increase.
	Control-Recorder	
	f. METER SELECTOR PEAK PULSE	*f.* SERVICE METER indicates in green B block (only when meteorological data is received).
	g. METER SELECTOR OSC GRID	*g.* SERVICE METER indicates in green B block.
	h. METER SELECTOR INJECTION	*h.* SERVICE METER indicates in green B block.
	i. METER SELECTOR B-	*i.* -105 ±5V dc.
	j. METER SELECTOR B+	*j.* +180 ±20V dc.

Table 7-12. Antenna Control Tests and Standards

Tests	*Step-by-step instructions*	*Performance standards*
Preliminary Operations..	Control-Recorder RECORDS CONTROL: STANDBY PRINTINGS PER MINUTE : 0 MOTORS STANDBY: STANDBY	

Table 7–12. Antenna Control Tests and Standards—Continued

Tests	*Step-by-step instructions*		*Performance standards*
	Antenna Control MOTORS STANDBY:	On	
	Mode switch:	MANUAL	
	AZIMUTH control:	CW	
mode ıual.	*a.* POWER:	ON	*a.* Antenna moves clockwise within 20 to 40 seconds.
	b. AZIMUTH control:	CCW	*b.* Antenna moves counterclockwise.
	c. ELEVATION control:	UP	*c.* Antenna moves up.
	d. ELEVATION control:	DOWN	*d.* Antenna moves down.
2. Near auto mode	*a.* Mode switch:	NEAR AUTO	*a.* None.
	b. AZIMUTH control:	CW and CCW	*b.* Antenna does not move with operation of azimuth control.
	c. ELEVATION control:	UP and DOWN	*c.* Antenna does not move with operation of elevation control.
3. Far auto mode	*a.* Mode switch:	FAR AUTO	*a.* None.
	b. AZIMUTH control:	CW and CCW	*b.* Antenna does not move with operation of azimuth control.
	c. ELEVATION control:	UP and DOWN	*c.* Antenna does not move with operation of elevation control.

Table 7–13. Control—Recorder Tests and Standards

Tests	*Step-by-step instructions*		*Performance standards*
	Control–Recorder TIME indicator:	000	
	PRINTINGS PER MINUTE :	10	
	RECORDS CONTROL:	FLIGHT	
1. Print outs, timed and manual	*a.* Print out 1 minute.................................. During print out press TIME PRINT ONLY several times.		*a.* Print out starts 00.0 and prints each 0.1 minute interval. Prints time and asterisk for each operation.
	b. PRINTINGS PER MINUTE :	2	*b.* Print out starts 00.0 and prints each 0.5 minute interval.
	Print out 1 minute. During print out press TIME PRINT ONLY several times.		Prints time and asterisk for each operation.

Table 7-13. Control-Recorder Tests and Standards-Continued

Tests	*Step-by-step instructions*	*Performance standards*
	c. PRINTINGS PER MINUTE : 1 Print out 2 minutes. During print out press TIME PRINT ONLY several times.	*c.* Print out starts 00.0 and prints each 1 minute interval. Prints time and asterisk for each operation.
2. Manual control of antenna. . .	*a.* MANUAL CONTROL AZIMUTH: CW and CCW	*a.* Antenna moves in correct direction.
	b. MANUAL CONTROL ELEVATION: UP and DOWN	*b.* Antenna moves in correct direction.
Control-Recorder Tuning. . .	*a.* Operate remote tuning switch to DEC FREQ	a. Receiver tuning dial moved in correct direction.
	b. Operate remote tuning switch to INC FREQ	*b.* Receiver tuning dial moves in correct direction.

Table 7-14. Remote and Local Indicator Tracking Tests and Standards

Tests	*Step-by-step* instructions	*Performance standards*
	Position antenna in azimuth	Control-Recorder Indicator (degrees)
1. Azimuth Indicators	*a.* Azimuth unit indicator (degrees): 00.00	*a.* 00.00 ±2.0
	b. Position antenna: 60.00	*b.* 60.00 ±2.0
	c. Position antenna: 120.00	*c.* 120.00 ±2.0
	d. Position antenna: 180.00	*d.* 180.00 ±2.0
	e. Position antenna: 240.00	*e.* 240.00 ±2.0
	f. Position antenna: 300.00	*f.* 300.00 ±2.0
		Control-Recorder Indicator (degrees)
2. Elevation Indicator	*a.* Elevation unit indicator (degrees): 00.00	*a.* 00.00 ±2.0
	b. Position antenna: 30.00	*b.* 30.00 ±2.0
	c. Position antenna: 60.00	*c.* 60.00 ±2.0
	d. Position antenna: 90.00	*d.* 90.00 ±2.0

Table 7–15. ***Automatic Tracking Tests and Standards***

Tests	*Step–by–step instructions*	*Performance standards*
Automatic Tracking .	Orient antenna on target antenna automatically (adjustment of sine gain, phase, antihunt, balance, and sensitivity may be required).	
1. Clockwise to counterclockwise.	*a.* Rotate antenna in a clockwise direction–about 6 degrees.	*a.* None.
	b. Allow antenna to reset automatically on target and print out position.	*b.* Record print out position.
	c. Repeat *a* and *b* above five times.	*c.* Average error of the five prints shall not exceed 0.05 degree.
2. Counterclockwise to clockwise.	*a.* Rotate antenna in a counterclockwise direction–about 6 degrees.	*a.* None.
	b. Allow antenna to reset automatically on target and print out position.	*b.* Record print out position.
	c. Repeat *a* and *b* above five times.	*c.* Average error of the five prints shall not exceed 0.05 degree.
3. Up to down	*a.* Operate antenna in an up direction–about 6 degrees.	*a.* None.
	b. Allow antenna to reset automatically on target print out position.	*b.* Record print out position.
	c. Repeat *a* and *b* above five times.	*c.* Average error of the five prints shall not exceed 0.05 degree.
4. Down to up	*a.* Operate antenna in a down direction–about 6 degrees.	*a.* None.
	b. Allow antenna to reset automatically on target and print out position.	*b.* Record print out position.
	c. Repeat *a* and *b* above five times.	*c.* Average error of the five prints shall not exceed 0.05 degree.

Table 7-16. ***Receiver Tuning Tests and Standards***

Tests	*Step–by–step instructions*	
	Target vertically polarized. Orient antenna on target automatically.	
	Receiver AFC/MANUAL AFC	
1. Static accuracy and data transmission error.	*a.* Rotate antenna 3 degrees off target clockwise.	*a.* None.
	b. Allow antenna to reset automatically on target. Print out position.	*b.* Record print out.
	c. Rotate antenna 3 degrees off target counterclockwise.	*c.* None.

*Table 7-16. **Receiver Tuning Tests and Standards—Continued***

Tests	*Step-by-step instructions*		*Performance standards*
	d. Allow antenna to reset automatically on target. Print out position.		*d.* Record print out.
	e. Repeat steps *a*, *b*, *c*, *d* and *e* above 10 times.		*e.* Average error of the 20 prints shall not exceed 0.05 degree.
	Orient antenna on target automatically.		
2. Receiver tuning, target polarized vertical.	*a.* Tune receiver:	1660 MHz	*a.* Record print out.
	b. Tune receiver:	1658 MHz	*b.* Print out shall be within 0.05 degree of *a* above.
	c. Tune receiver:	1662 MHz	*c.* Print out shall be within 0.05 degree of *a* above.
	d. Tune receiver:	1680 MHz	*d.* Record print out.
	e. Tune receiver:	1678 MHz	*e.* Print out shall be within 0.05 degree of *d* above.
	f. Tune receiver:	1682 MHz	*f.* Print out shall be within 0.05 degree of *d* above.
	g. Tune receiver:	1700 MHz	*g.* Record print out.
	h. Tune receiver:	1698 MHz	*h.* Print out shall be within 0.05 degree of *g* above.
	i. Tune receiver:	1702 MHz	*i.* Print out shall be within 0.05 degree of *g* above.
3. Receiver tuning, target polarization. 45 degrees left.	*a.* Tune receiver:	1660 MHz	*a.* Record print out.
	b. Target polarization: left of vertical.	45 degrees	*b.* Print out shall be within 0.05 degree of *a* above.
	c. Target polarization: right of vertical.	45 degrees	*c.* Print out shall be within 0.05 degree of *a* above.
Receiver tuning, target polarization. 45 degrees right.	*a.* Tune receiver:	1680 MHz	*a.* Record print out.
	b. Target polarization: left of vertical.	45 degrees	*b.* Print out shall be within 0.05 degree of *a* above.
	c. Target polarization: right of vertical.	45 degrees	*c.* Print out shall be within 0.05 degree of *a* above.
5. Receiver tuning, target polarization.	*a.* Tune receiver:	1700 MHz	*a.* Record print out.
	b. Target polarization: left of vertical.	45 degrees	*b.* Print out shall be within 0.05 degree of *a* above.
	c. Target polarization: right of vertical.	45 degrees	*c.* Print out shall be within 0.05 degree of *a* above.

Table 7–16. Receiver Tuning Tests and Standards—Continued

Tests	*Step-by-step instructions*	*Performance standards*
6. Signal strength	*a.* Tune receiver: 1680 MHz	*a.* None.
	b. Reduce target (TS–538( )/U output power for minimum audio at receiver approximately –38 DBM.	*b.* Record printout.
	c. Increase TS–538( )/U output power to maximum.	*c.* Print out shall be within 0.05 degree of *b* above.

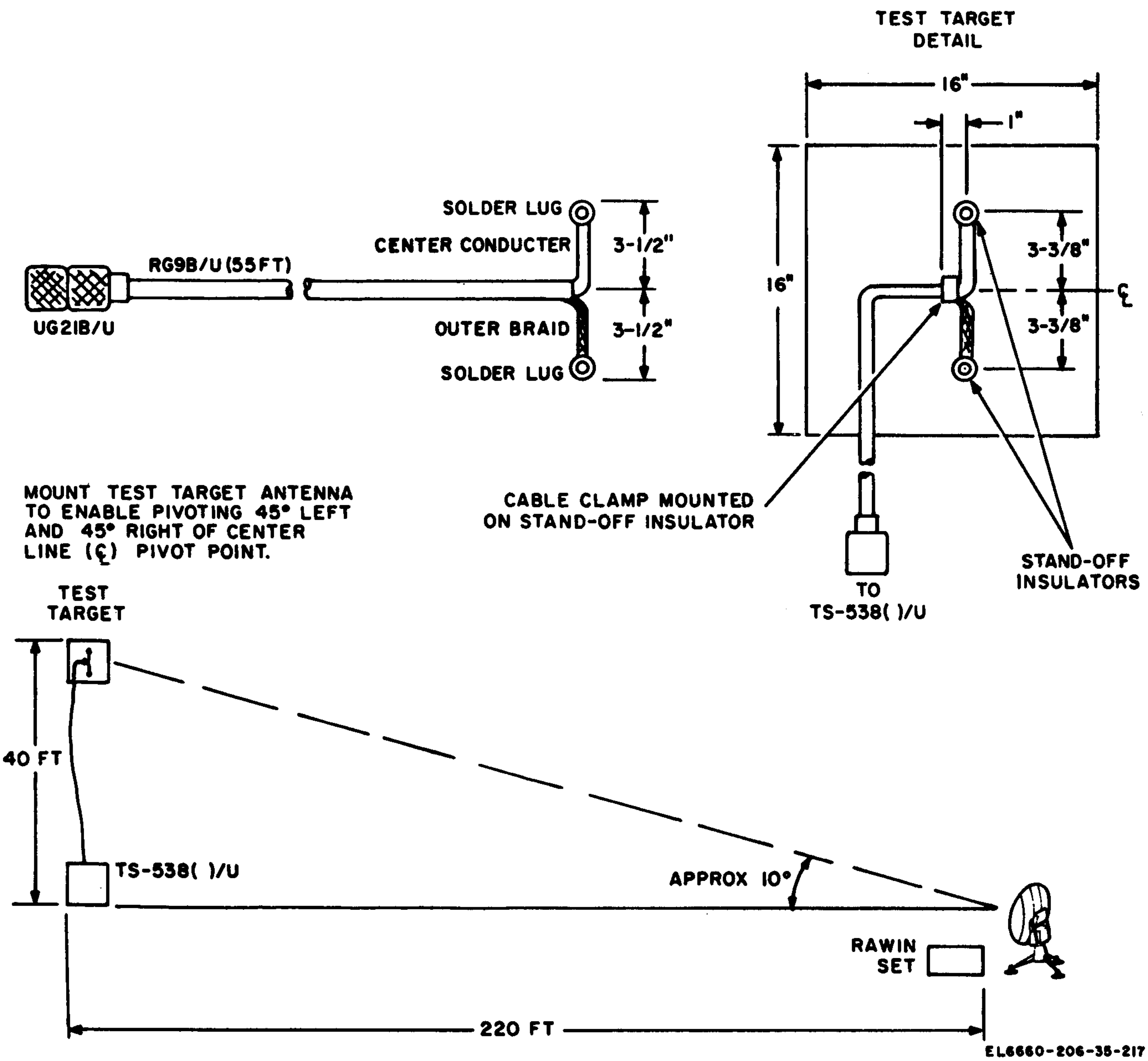


Figure 7–14. Test target antenna.

Table 7-17. ***Rotational Speed of Antenna Tests and Standards***

Tests	*Step-by-step instructions*	*Performance standards*
	Antenna Control Mode: MANUAL	
1. Azimuth	***a.*** **AZIMUTH control: CW (max)**	***a.*** **360 degrees rotation, 60 seconds maximum.**
	b. **AZIMUTH control: CCW (max)**	***b.*** **360 degrees rotation, 60 seconds maximum.**
2. Elevation	***a.*** **ELEVATION control: UP (max)**	***a.*** **Measure time to travel 60 degrees, 10 seconds maximum.**
	b. **ELEVATION control: DOWN (max)**	***b.*** **Measure time to travel 60 degrees, 10 seconds maximum.**
	c. **Compare difference between *a* and *b* above.**	***c.*** **Maximum difference shall not exceed ten percent.**

APPENDIX A
REFERENCES

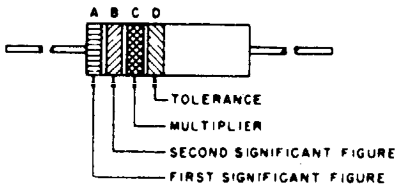
DA Pam 310-1	Consolidated Index of Army Publications and Blank Forms.
MIL-M-19590	Marking of Commodities and Containers to Indicate Radioactive Materials.
MIL-STD-12	Abbreviations for Use on Drawings and untechnical Type Publications.
MIL-STD-15-1	Graphical Symbols for Electrical and Electronic Diagrams.
MIL-STD-17	Mechanical Symbols.
TB-750-237	Identification of Radioactive Items in the Army Supply System.
TM 9-6625-2362-12	Operator's Manual: Oscilloscope AN/USM-281,
TM 11-1242	Crystal Rectifier Test Sets TS-268/U, TS-268A/U, TS-268B/U, TS-268C/U, TS-268D/U, and TS-268E/U.
TM 1l-5120	Frequency Meters AN/URM-32 and AN/URM-32A and Power Supply PP-1243/U.
TM 1l-5123	Oscilloscope AN/USM-32.
TM 11-6625-200-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Multimeters ME-264A/U (NSN 6625-00-360-2493), ME-26B/U and ME-26C/U (6625-00-646-9409), and ME-26D/U (6625-00-913-9781).
TM 1l-6625-213-12	Operator's and Organizational Maintenance Manual: Test Sets TS-538/U, TS-538A/U, TS-538B/U, and TS-538C/U (NSN 6625 -00-243-5 174).
TM 11-6625-274-12	Operator's and Organizational Maintenance Manual: Test Sets, Electron Tube TV-7/U, TV-7A/U (NSN 6625-00-376-4939), TV-7B/U, and TV-7D/U (6625-00-820-0064).
TM 11-6625-293-12	Operation and Organization Maintenance: Wavemeter FR-91A/U.
TM 11-6625-316-12	Operator and Organization Maintenance Manual: Test Sets, Electron Tube TV-2/U, .TV-2A/U, TV-2B/U and TV-2C/U.
TM 11-6660-219-12	Operator and Organizational Maintenance Manual Including Repair Parts and Special Tools Lists: Radiosonde Baseline Check Sets AN/GMM-1 and AN/GMM-1A.

TM 11-6625-320-12	Operator's and Organizational Maintenance Manual: Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U, ME-30C/U and ME-30E/U.
TM 11-6625-366-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual: Multimeter TS-352/U (NSN 6625-00-553-0142).
TM 11-6625-368-10	Operator's Manual: Pulse Generator Sets AN/UPM-15 and AN/UPM-15A.
TM 11-6625-406-12	Operator and organizational Manual: Signal Generator SG-336/U (to be published).
TM 11-6625-433-15	Organizational, Direct Support, General Support and Depot Maintenance Manual: Wattmeters AN/URM-98 and AN/URM-98A (NSN 6625-00-566-4990) (to be published).
TM 11-6625-508-10	Operator's Manual: Signal Generator AN/USM-44 and AN/USM-44A (to be published).
TM 11-6625-683-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Signal Generator AN/URM-127 (NSN 6625-00-783-5965).
TM 11-6625-700-10	Operator's Manual: Digital Readout, Electronic Counter AN/USM-207 (NSN 6625-00-911-6368).
TM 11-6625-935-12	Organizational Maintenance Manual: Audio Oscillators TS-312/FSM-1, TS-312A/FSM-1, and TS-382/U; and Signal Generator TS-312B/FSM-1.
TM 11-6660-206-12	Operator's and Organizational Maintenance Manual: Rawin Sets AN/GMD-1A (NSN 6660-00-224-6137), AN/GMD-1B (NSN 6660-00-599-8257), AN/GMD-1C (NSN 6660-01-077-7797), and AN/GMD-1D (NSN 6660-01-072-9995).
TM 11-6660-206-20P	Organizational Maintenance Repair Parts and Special Tools List: Rawin Sets AN/GMD-1A, AN/GMD-1B and AN/GMD-1C.
TM 11-6660-206-34P	Direct Support, General Support, and Depot Maintenance Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools) for Rawin Sets AN/GMD-1A (NSN 6660-00-224-6137) and AN/GMD-1B (NSN 6660-00-599-8252).
TM 11-6660-263-10	Operator's Manual, Meteorological Data Processing Groups OL-192/GMD-1 (NSN 6660-01-065-4467) and OL-192A/GMD-1 (NSN 6660-01-065-4466).
TM 11-6660-263-20P	Organizational Maintenance Repair Parts and Special Tools Lists for Meteorological Data Processing Groups OL-192/GMD-1 (NSN 6660-01-065-4467) and OL-192A/GMD-1 (NSN 6660-01-065-4466).
TM 11-6660-263-24-1	Organizational, Direct Support, and General Support Maintenance Manual for Meteorological Data Processing Groups OL-192/GMD-1 (NSN 6660-01-065-4467) and OL-192A/GMD-1 (NSN6660-01-065-4466).
TM 11-6660-263-242	Organizational, Direct Support, and General Support Maintenance Manual for Meteorological Data Processing Groups OL-192/GMD-1 (NSN 6660-01-065-4467) and OL-192A/GMD-1 (NSN 6660-01-065-4466). Calculator, Programmable CP-1387/U (NSN 7420-01-026-2686) (HP 9825A Desktop Computer).
TM 11-6660-263-24-3	Organizational, Direct Support and General Support Maintenance Manual: Meteorological Data Processing Groups OL-192/GMD-1 (NSN 6660-01-065-4467) and OL-192A/GMD-1 (NSN 6660-01-065-4466): Reader/Perforator RP-263/GMD-1 (NSN 6660-01-068-8642) (Remex Tape Reader/Perforator RAB 612XBA).
TM 11-6660-263-24-4	Organizational, Direct Support, and General Support Maintenance Manual: Meteorological Data Processing Groups OL-192/GMD-1 (NSN 6660-01-065-4467) and OL-192A/GMD-1 (NSN 6660-01-065-4466): Cable Assembly, Special Purpose CX-13096/U.
TM 11-6660-263-34P	Direct Support and General Support Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools) for Meteorological Data Processing Groups OL-192/GMD-1 (NSN 6660-01-065-4467) and OL-192A/GMD-1 (NSN 6660-01-065-4466).

INDEX

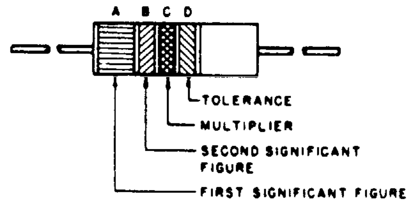
COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS

COMPOSITION-TYPE RESISTORS



BAND A— Equal Width Band Signifies Composition-Type

WIREWOUND-TYPE RESISTORS



BAND A— Double Width Signifies Wire-wound Resistor

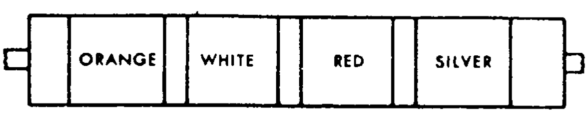
COLOR CODE TABLE

BAND A		BAND B		BAND C		BAND D*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1		
BROWN	1	BROWN	1	BROWN	10		
RED	2	RED	2	RED	100		
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000	SILVER	± 10
GREEN	5	GREEN	5	GREEN	100,000	GOLD	± 5
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	SILVER	0.01		
WHITE	9	WHITE	9	GOLD	0.1		

EXAMPLES OF COLOR CODING

BAND

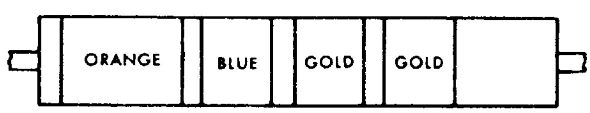
A B C D*



3 9 X100 ± 10%

BAND

A B C D*



3 6 X0.1 ± 5%

NOMINAL RESISTANCE	3,900 Ohms	3.6 Ohms
RESISTANCE TOLERANCE	± 10 percent	± 5 percent

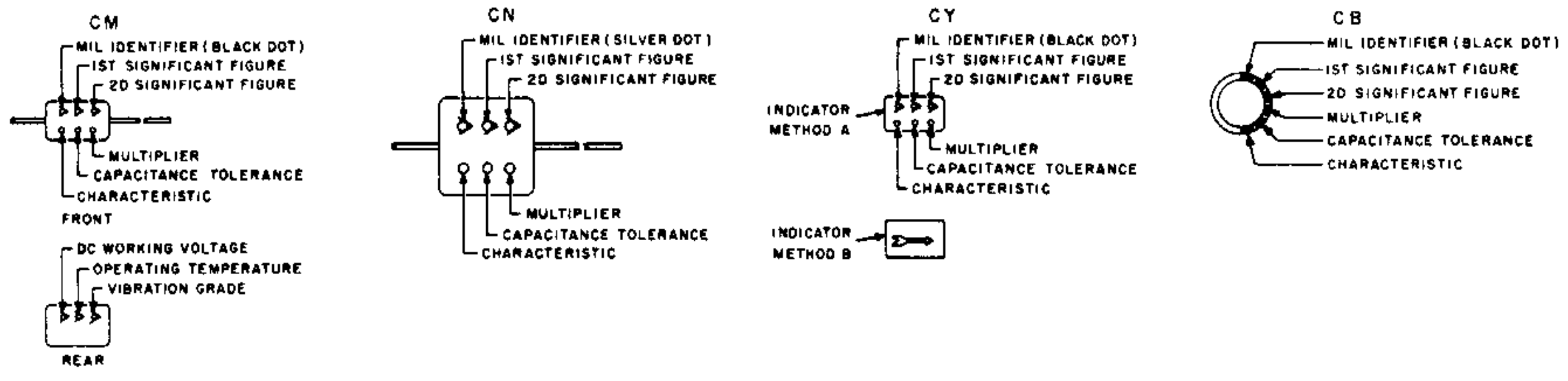
STD-R2

*If Band D is omitted, the resistor tolerance is ± 20%, and the resistor is not Mil-Std.

Figure FO–1. MIL-STD resistor color code markings.

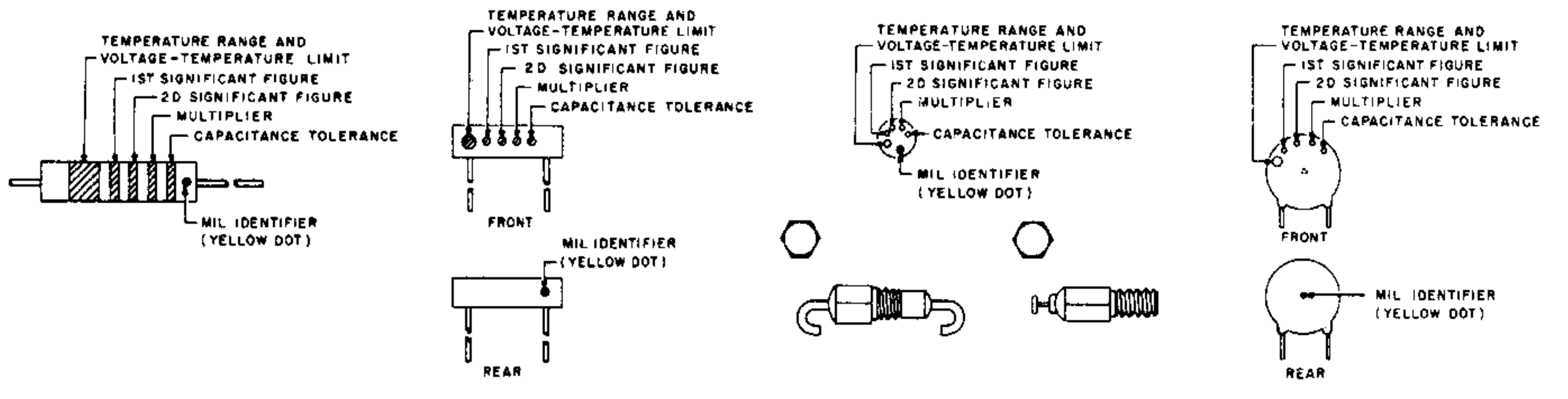
COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

GROUP I Capacitors, Fixed, Various-Dielectrics, Styles CM, CN, CY, and CB



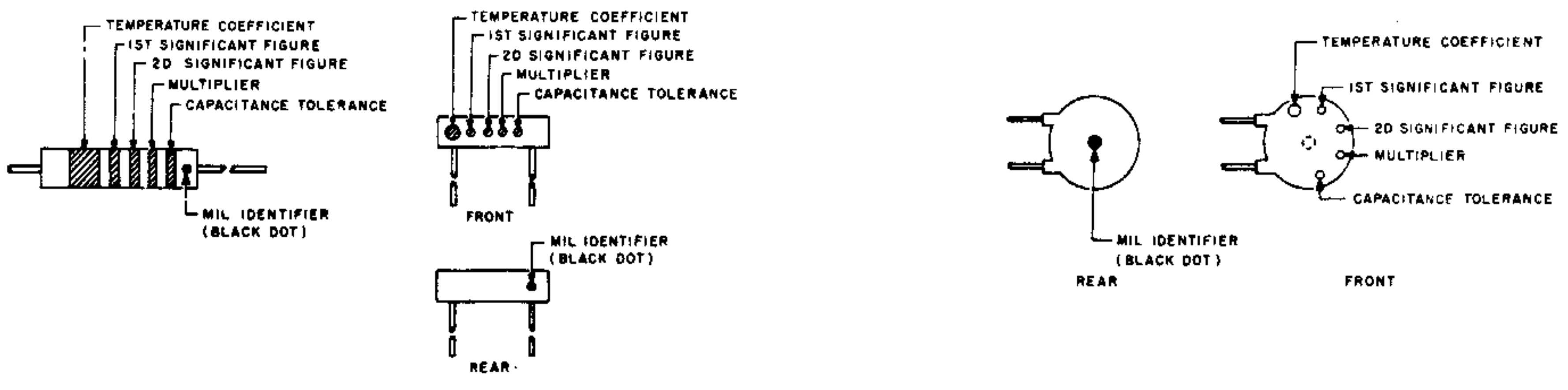
MICA-DIELECTRIC — PAPER-DIELECTRIC — GLASS-DIELECTRIC, GLASS CASE — MICA, BUTTON TYPE

GROUP II Capacitors, Fixed Ceramic-Dielectric (General Purpose) Style CK



AXIAL LEAD — RADIAL LEAD — FEED-THROUGH — STAND-OFF — DISK-TYPE

GROUP III Capacitors, Fixed, Ceramic-Dieletric (Temperature Compensating) Style CC



AXIAL LEAD — RADIAL LEAD — DISK-TYPE

COLOR CODE TABLES

TABLE I – For use with Group I, Styles CM, CN, CY and CB

COLOR	MIL ID	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE				CHARACTERISTIC[2]				DC WORKING VOLTAGE	OPERATING TEMP. RANGE	VIBRATION GRADE
					CM	CN	CY	CB	CM	CN	CY	CB	CM	CM	CM
BLACK	CM, CY CB	0	0	1			± 20%	± 20%		A				−55° to +70°C	10–55 cps
BROWN		1	1	10					B	E		B			
RED		2	2	100	± 2%		± 2%	± 2%	C		C			−55° to +85°C	
ORANGE		3	3	1,000		± 30%			D			D	300		
YELLOW		4	4	10,000					E					−55° to +125°C	10–2,000 cps
GREEN		5	5		± 5%				F				500		
BLUE		6	6											−55° to +150°C	
PURPLE (VIOLET)		7	7												
GREY		8	8												
WHITE		9	9												
GOLD				0.1			± 5%	± 5%							
SILVER	CN				± 10%	± 10%	± 10%	± 10%							

TABLE II – For use with Group II, General Purpose, Style CK

COLOR	TEMP. RANGE AND VOLTAGE – TEMP. LIMITS[3]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE	MIL ID
BLACK		0	0	1	± 20%	
BROWN	AW	1	1	10	± 10%	
RED	AX	2	2	100		
ORANGE	BX	3	3	1,000		
YELLOW	AV	4	4	10,000		CK
GREEN	CZ	5	5			
BLUE	BV	6	6			
PURPLE (VIOLET)		7	7			
GREY		8	8			
WHITE		9	9			
GOLD						
SILVER						

TABLE III – For use with Group III, Temperature Compensating, Style CC

COLOR	TEMPERATURE COEFFICIENT[4]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE		MIL ID
					Capacitances over 10uuf	Capacitances 10uuf or less	
BLACK	0	0	0	1		± 2.0uuf	CC
BROWN	−30	1	1	10	± 1%		
RED	−80	2	2	100	± 2%	± 0.25uuf	
ORANGE	150	3	3	1,000			
YELLOW	−220	4	4				
GREEN	−330	5	5		± 5%	± 0.5uuf	
BLUE	−470	6	6				
PURPLE (VIOLET)	−750	7	7				
GREY		8	8	0.01			
WHITE		9	9	0.1	± 10%		
GOLD	+100					± 1.0uuf	
SILVER							

1. The multiplier is the number by which the two significant (SIG) figures are multiplied to obtain the capacitance in uuf.
2. Letters indicate the Characteristics designated in applicable specifications: MIL–C–5, MIL–C–91, MIL–C–11272, and MIL–C–10950 respectively.
3. Letters indicate the temperature range and voltage-temperature limits designated in MIL–C–11015.
4. Temperature coefficient in parts per million per degree centigrade.

STO–C2

Army-Ft Monmouth,NJ-MON 524-61

Figure FO–2. MIL-STD capacitor color code markings.

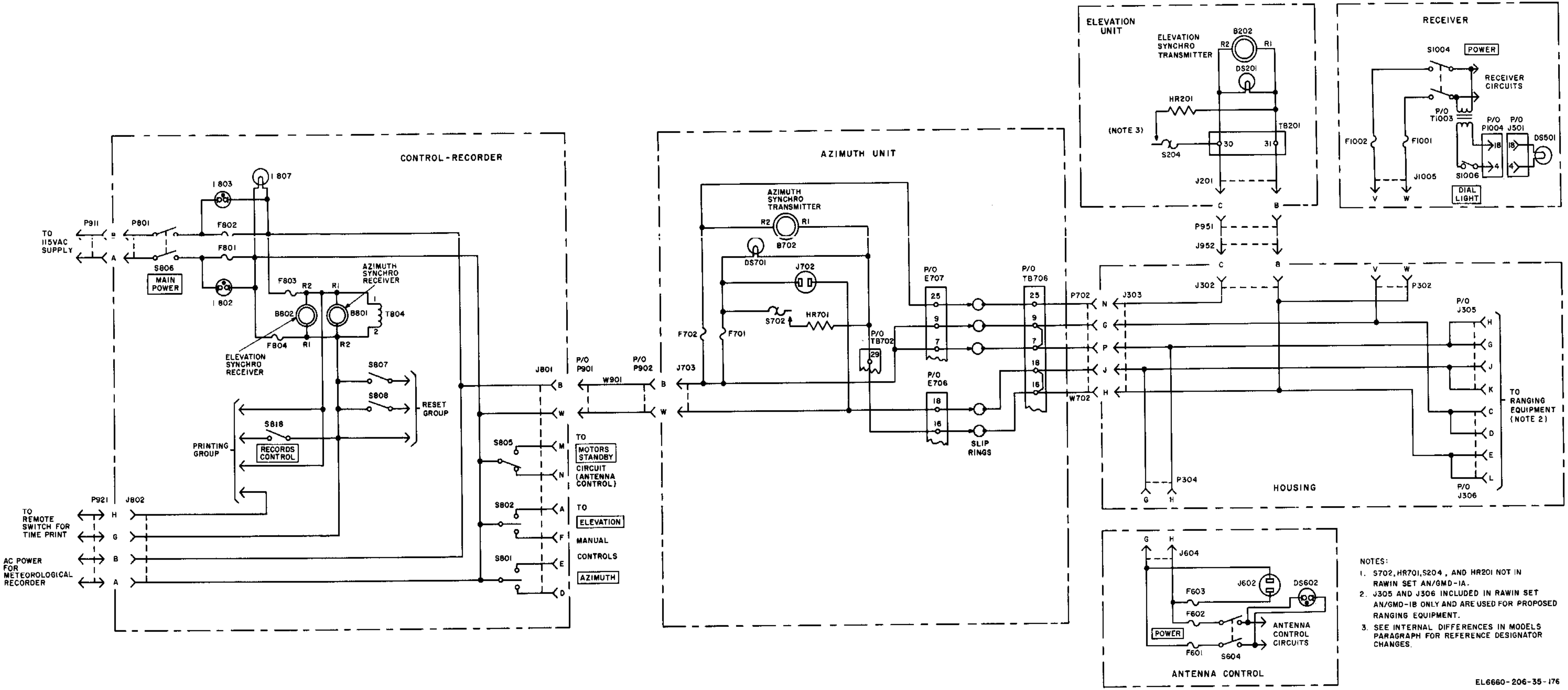


Figure FO–3. Circuits energized by MAIN POWER switch S806.

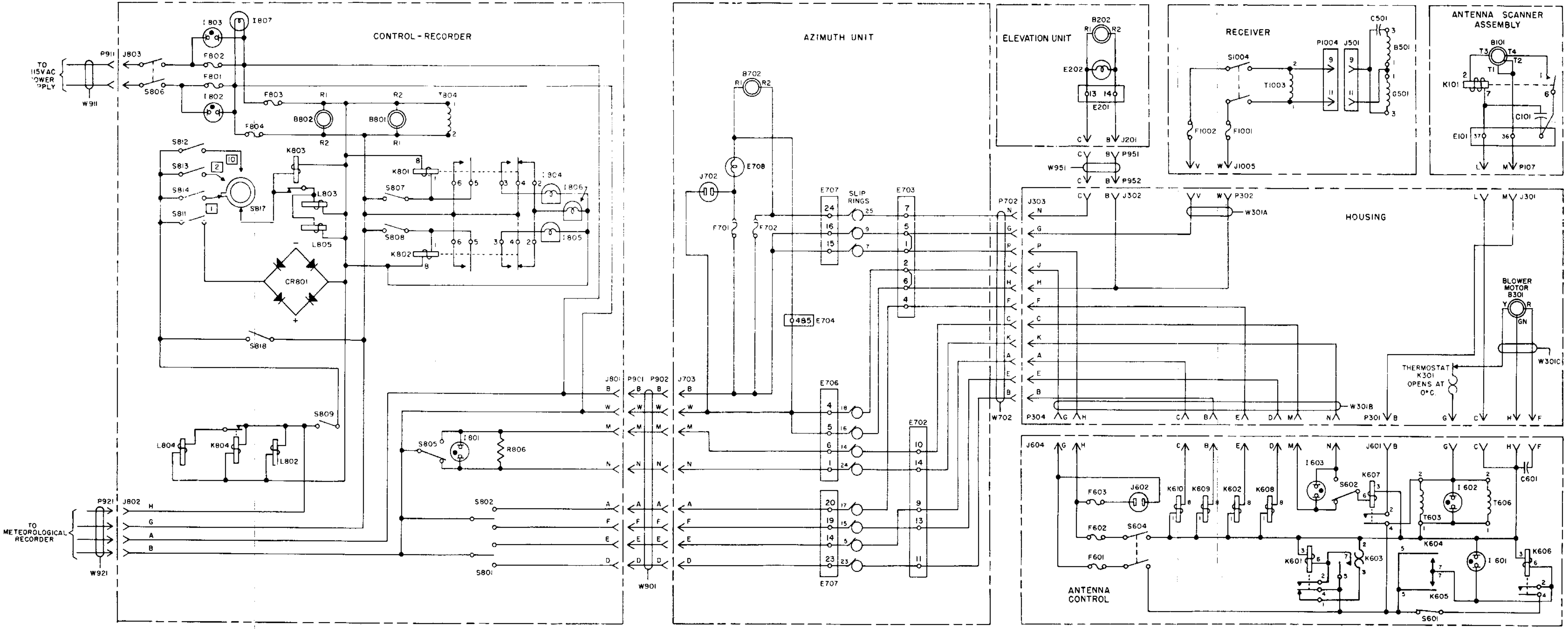
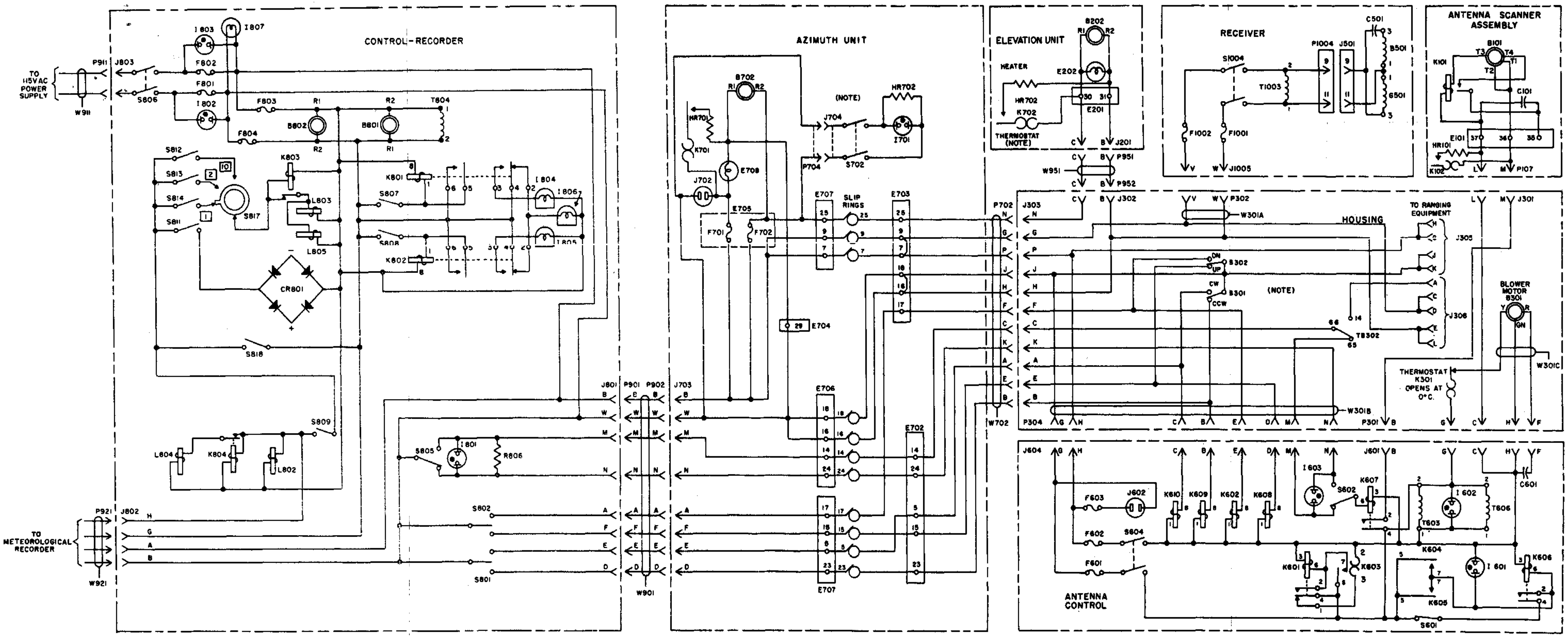


Figure FO-4. Rawin set AN/GMD-1A, ac power distribution diagram.



NOTE:
CIRCUIT INCLUDING P704, J704, S702, I701, AND HR702 FOUND ON LATER MODELS. SEE INTERNAL DIFFERENCES IN MODELS PARAGRAPH.

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Figure FO-5. Rawin set AN/GMD-1B, ac power distribution diagram.*

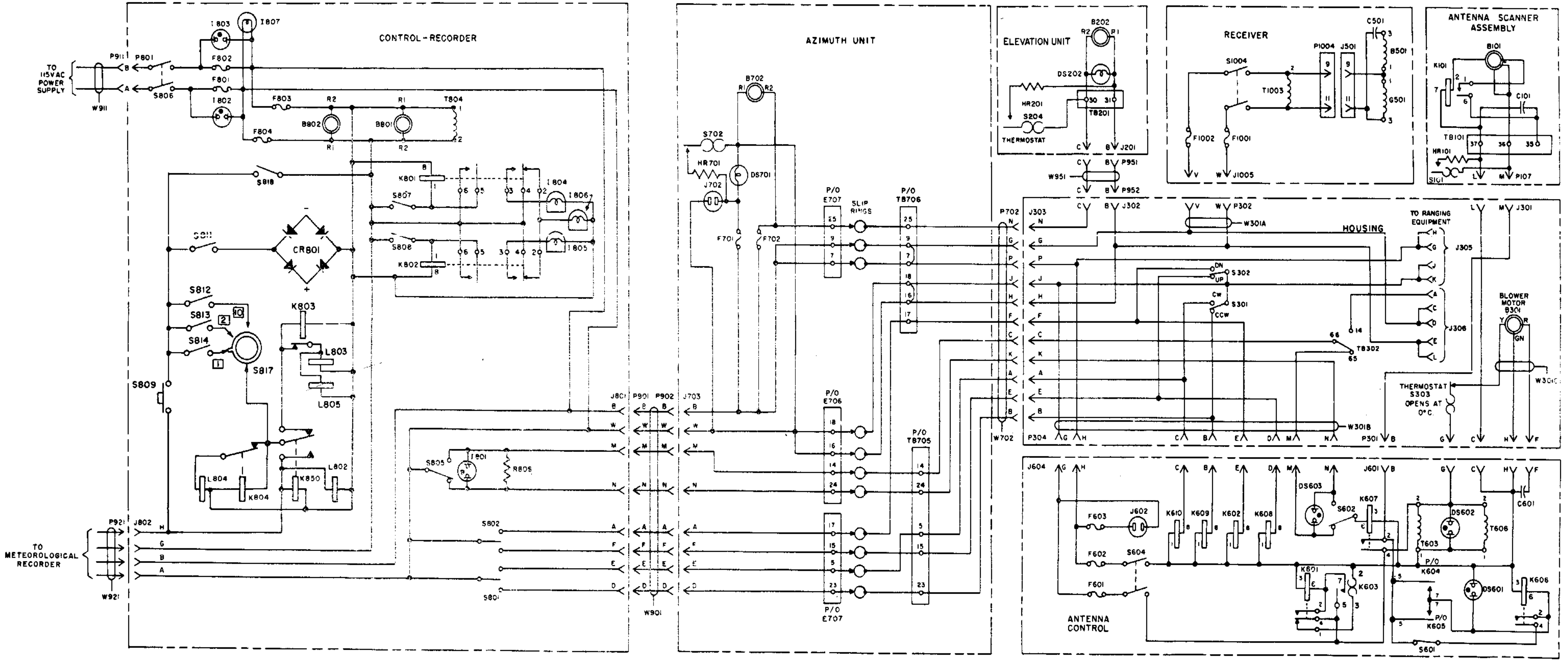

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*Figure FO-6. Rawin set AN/GMD-1B**, ac power distribution diagram.*

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Figure FO-7. Rawin set AN/GMD-1A, complete block diagram

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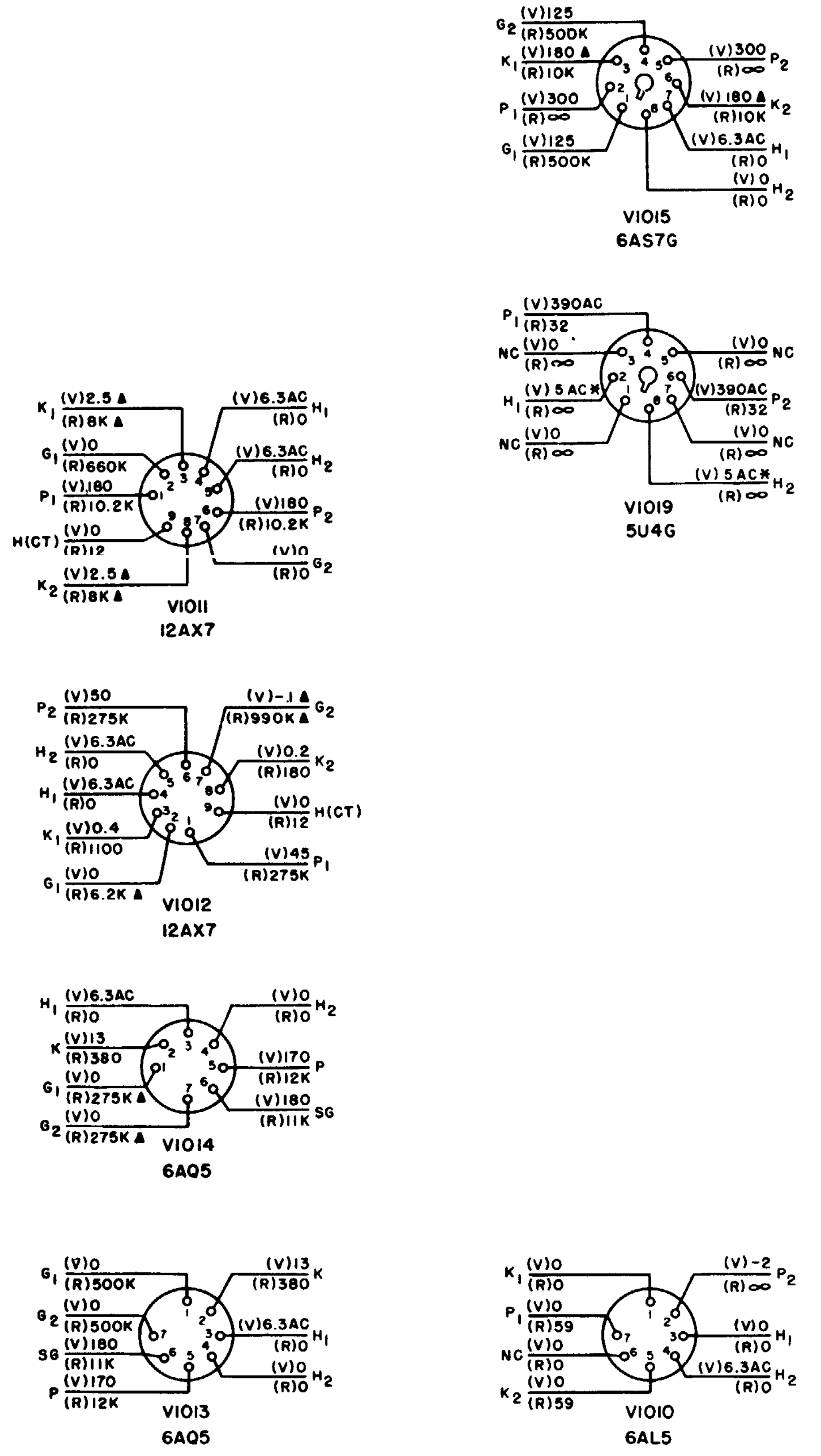
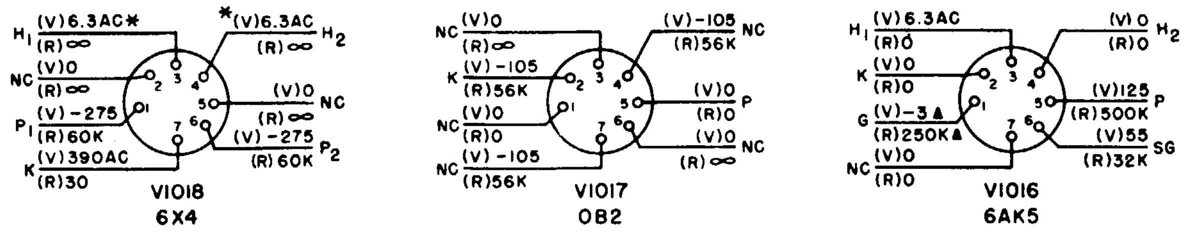
Figure FO-8. Rawin set AN/GMD-1B*, complete block diagram.

Figure FO-9. Rawin set AN/GMD-1B**, complete block diagram.





NOTES:

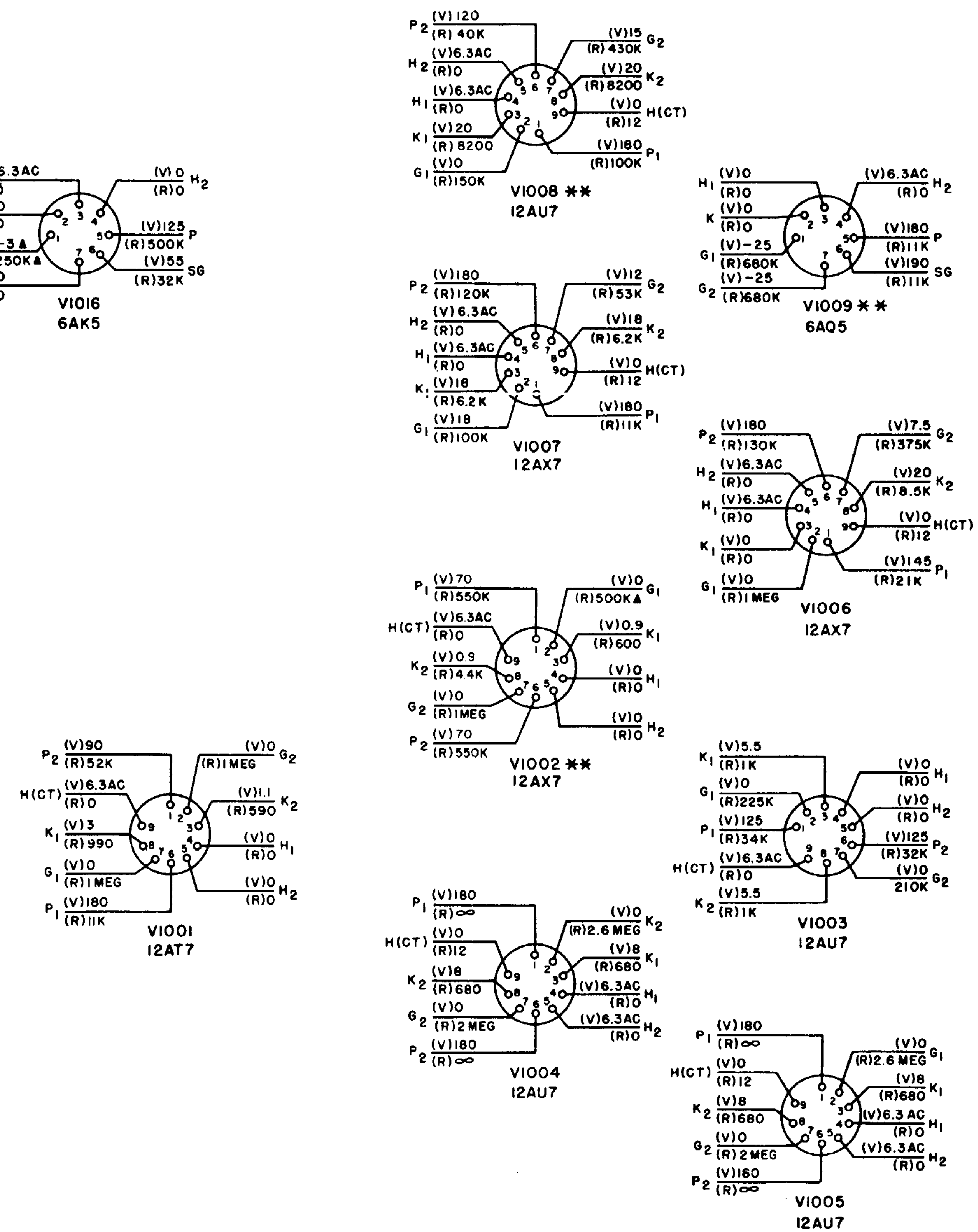
1. ALL VOLTAGES (V) TAKEN WITH A 20,000-OHMS-PER-VOLT METER.
2. ALL MEASUREMENTS ARE MADE TO GROUND, UNLESS OTHERWISE NOTED.
3. ALL CABLES USED FOR NORMAL OPERATION ARE LEFT CONNECTED FOR BOTH VOLTAGE AND RESISTANCE MEASUREMENTS.
4. SERVICE METER IN OFF POSITION.
5. POWER SWITCH ON FOR VOLTAGE AND OFF FOR RESISTANCE.
6. DIAL LIGHT SWITCH ON.
7. ALL READINGS DC UNLESS OTHERWISE NOTED. TOLERANCE IS ±10%.

▲ THESE READINGS VARY WITH SETTINGS OF POTENTIOMETERS.

* READINGS TAKEN BETWEEN PINS THUS MARKED.

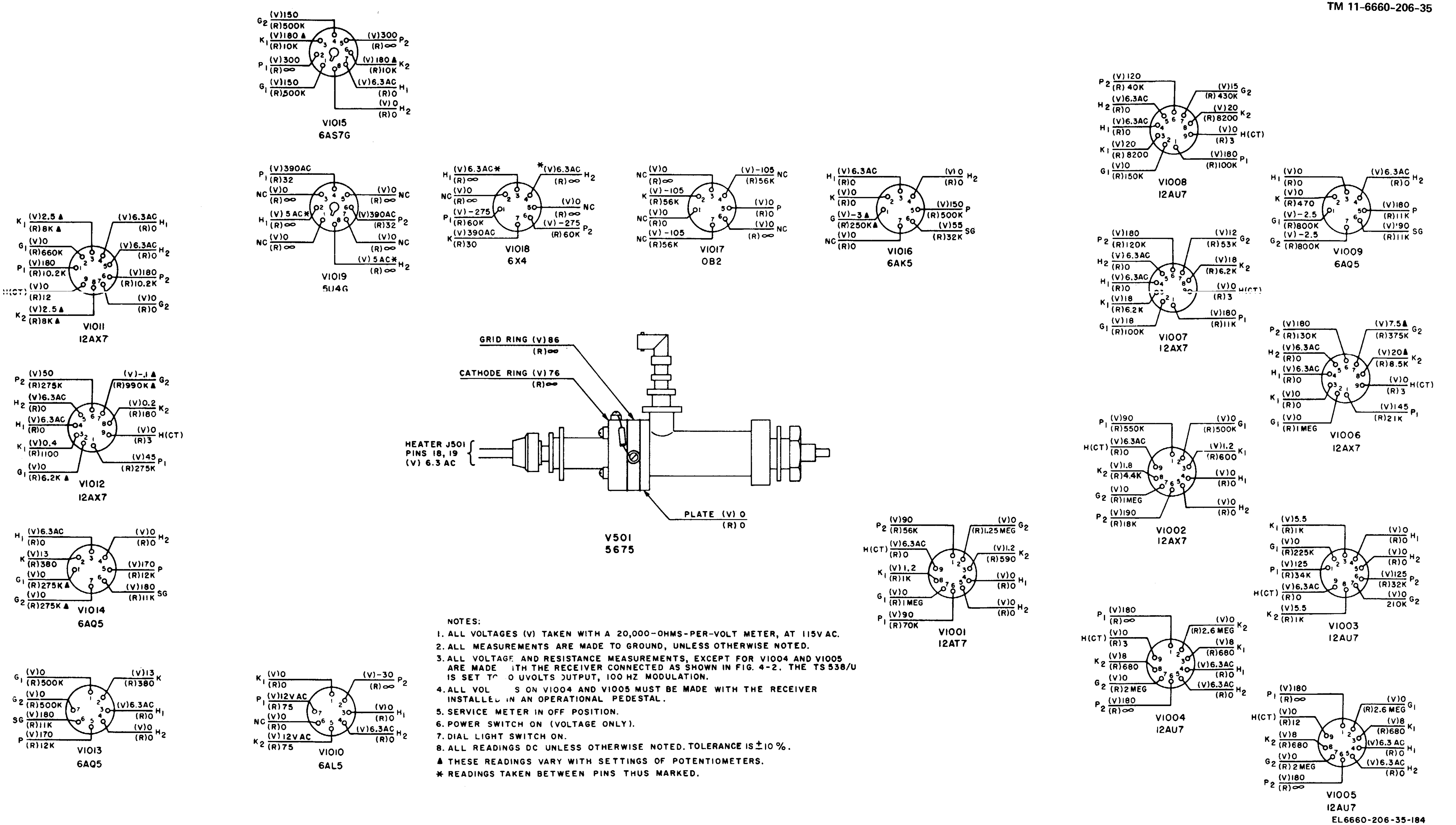
** THE VOLTAGE AND RESISTANCE VALUES IN CHART BELOW APPLY TO THOSE RECEIVERS PROCURED ON ORDER NO. 3066-PHILA-52 AND HAVING SERIAL NUMBERS 556 TO 597 INCLUSIVE.

TUBE		PINS 1	2	3	4	5	6	7	8	9
V1002	V	70	0	0.9	0	0	0	0	0	6.3AC
	R	550K	500K	600	0	0	∞	∞	∞	0
V1008	V	180	0	20	6.3AC	6.3AC	124	10	20	0
	R	100K	150K	8200	0	0	42K	460K	8200	12
V1009	V	-7.5	4.5	0	6.3AC	180	180	-7.5		
	R	1MEG	470	0	0	20K	20K	1MEG		



EL6660-206-35-183

Figure FO-10. Rawin receiver R-301B/GMD-1, and R-301C/GMD-1, voltage and resistance diagram.



NOTES:

1. ALL VOLTAGES (V) TAKEN WITH A 20,000-OHMS-PER-VOLT METER, AT 115V AC.
2. ALL MEASUREMENTS ARE MADE TO GROUND, UNLESS OTHERWISE NOTED.
3. ALL VOLTAGE AND RESISTANCE MEASUREMENTS, EXCEPT FOR V1004 AND V1005 ARE MADE ITH THE RECEIVER CONNECTED AS SHOWN IN FIG. 4-2. THE TS 538/U IS SET T O UVOLTS OUTPUT, 100 HZ MODULATION.
4. ALL VOL S ON V1004 AND V1005 MUST BE MADE WITH THE RECEIVER INSTALLED IN AN OPERATIONAL PEDESTAL.
5. SERVICE METER IN OFF POSITION.
6. POWER SWITCH ON (VOLTAGE ONLY).
7. DIAL LIGHT SWITCH ON.
8. ALL READINGS DC UNLESS OTHERWISE NOTED. TOLERANCE IS ±10 %.

▲ THESE READINGS VARY WITH SETTINGS OF POTENTIOMETERS.

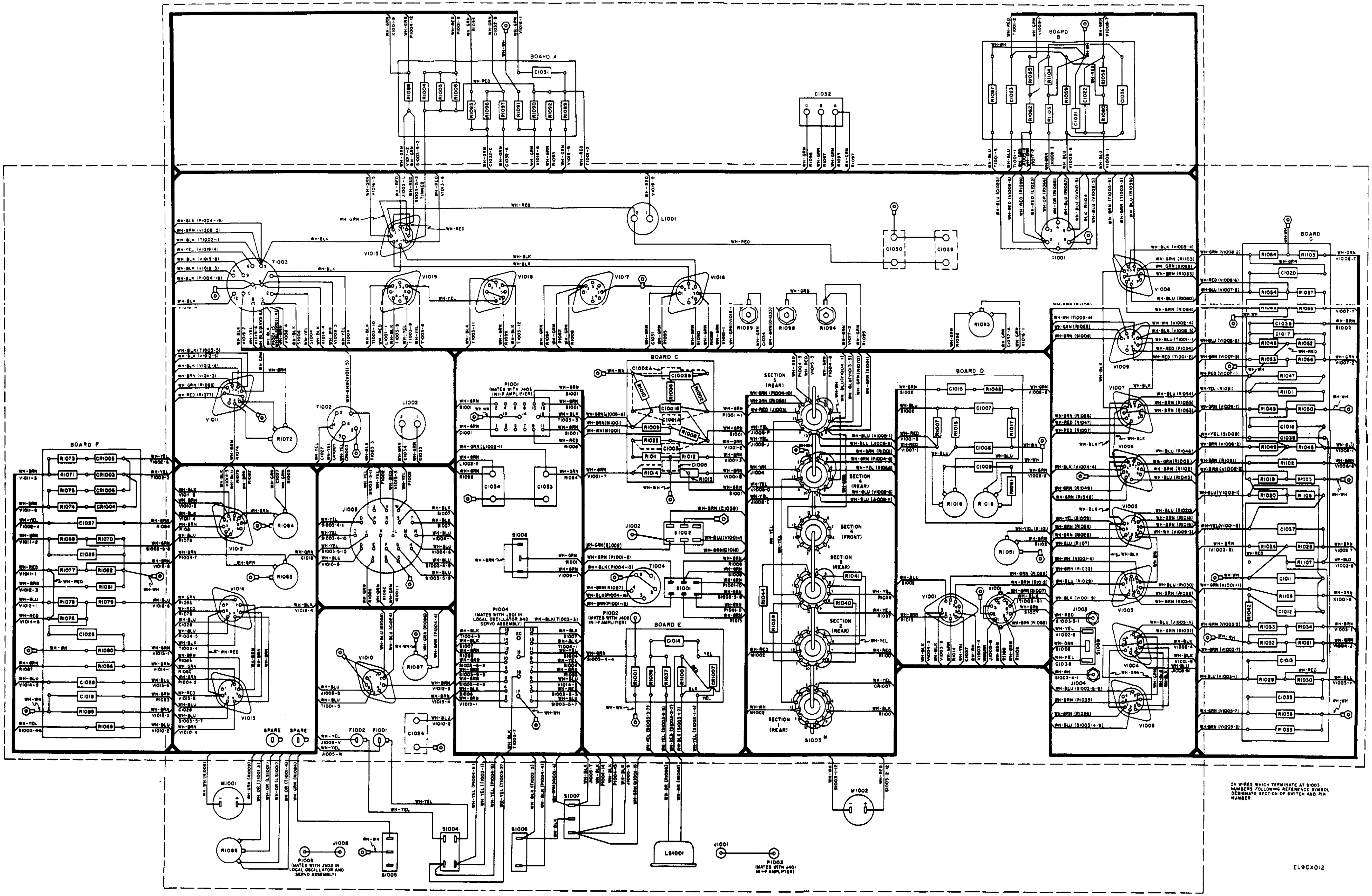
✱ READINGS TAKEN BETWEEN PINS THUS MARKED.

Figure FO-11. Rawin receiver R–301D/GMD-1, voltage and resistance diagram.

* ON WIRES WHICH TERMINATE AT S1003, NUMBERS FOLLOWING REFERENCE SYMBOL DESIGNATE SECTION OF SWITCH AND PIN NUMBER.
** THESE COMPONENTS ARE REMOVED FROM CIRCUIT BY A MODIFICATION WORK ORDER.

EL6660-206-35-185

Figure FO-12. Rawin receiver R-301B/GMD-1, R-301C/GMD-1, wiring diagram.



FO-13. Rawin Receiver R-301D/GMD-1*, Wiring Diagram.

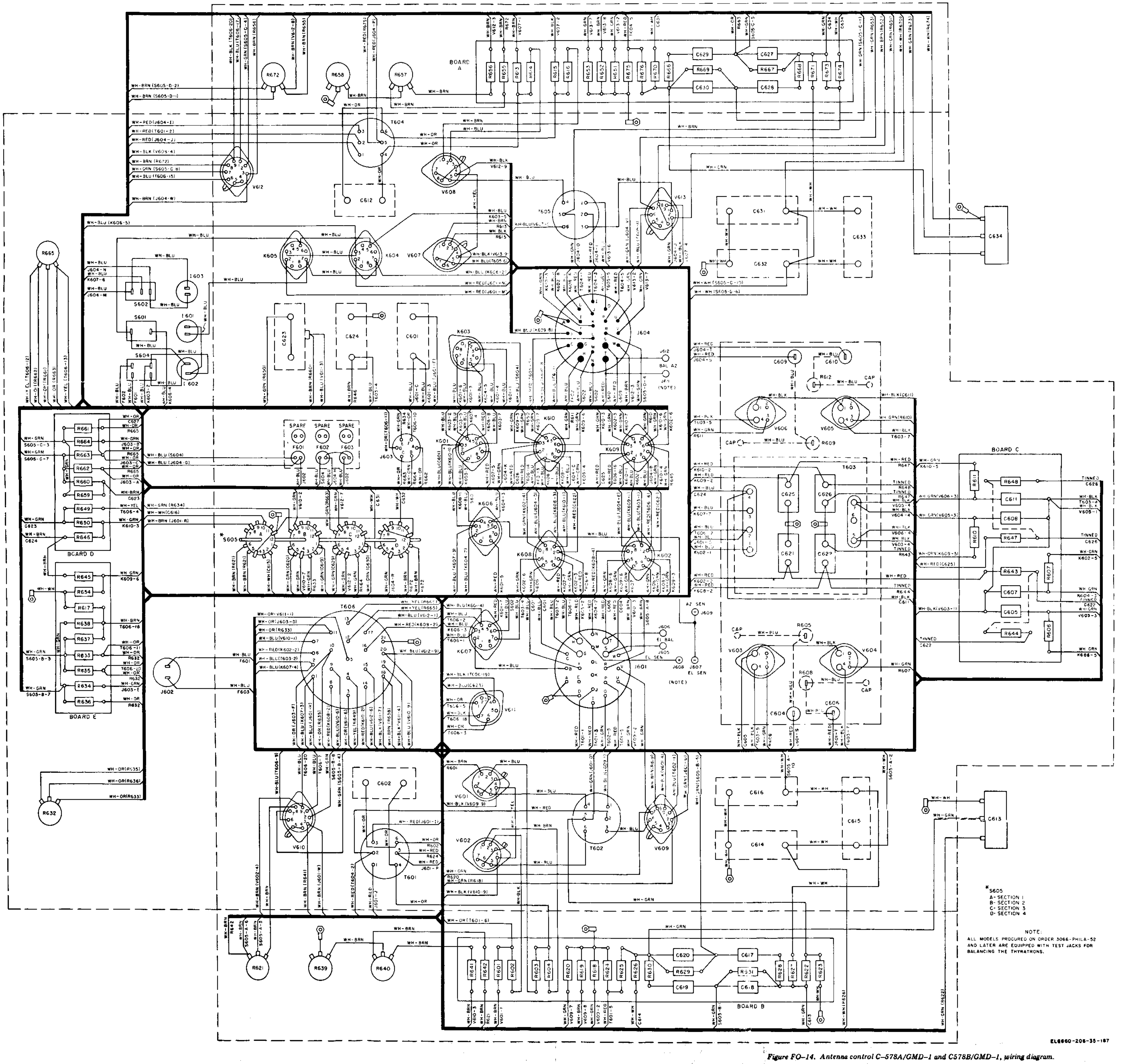


Figure FO-14. Antenna control C-578A/GMD-1 and C578B/GMD-1, wiring diagram.

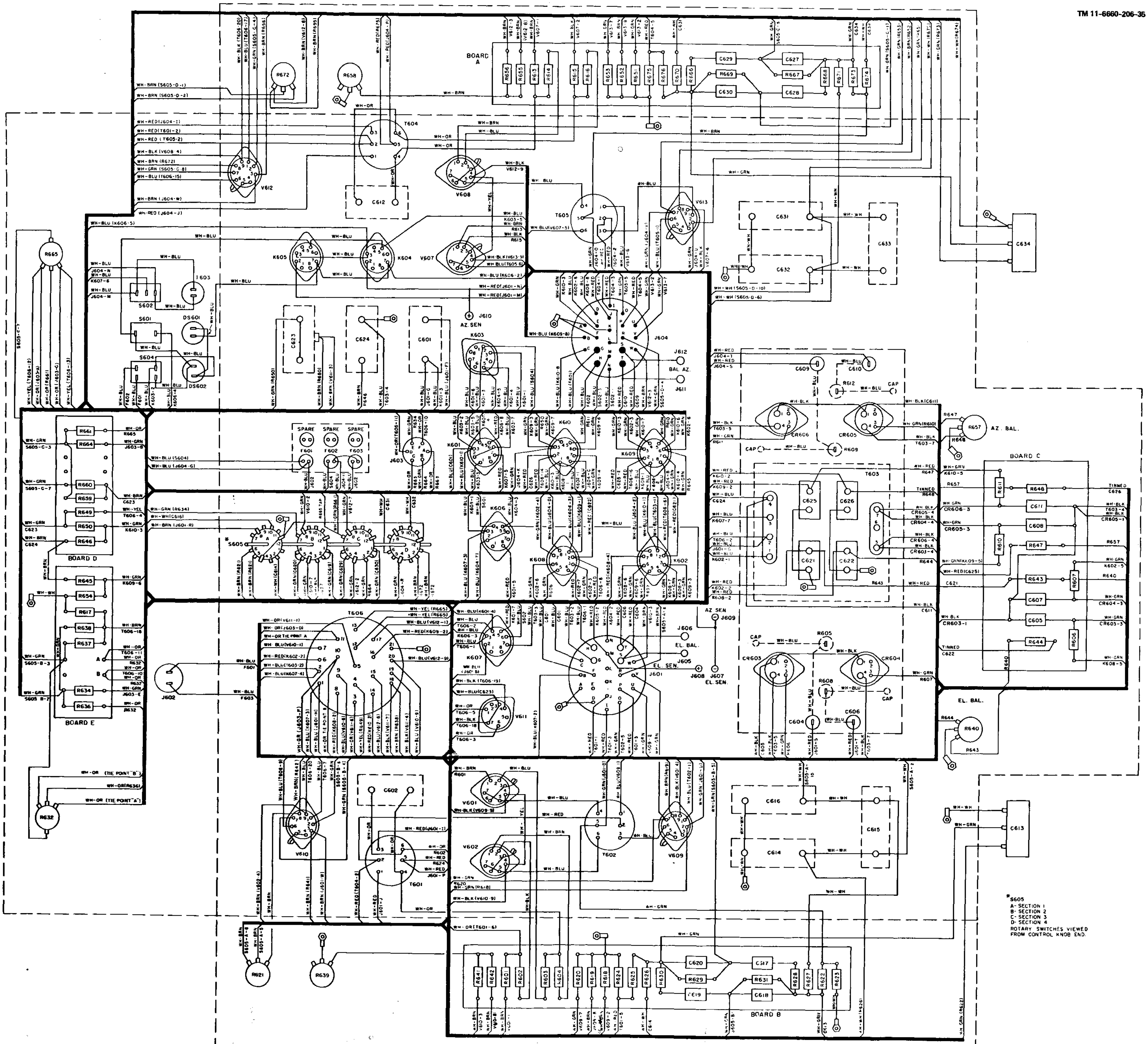


Figure FO-15. Antenna control C-578C/GMD-1, wiring diagram.*

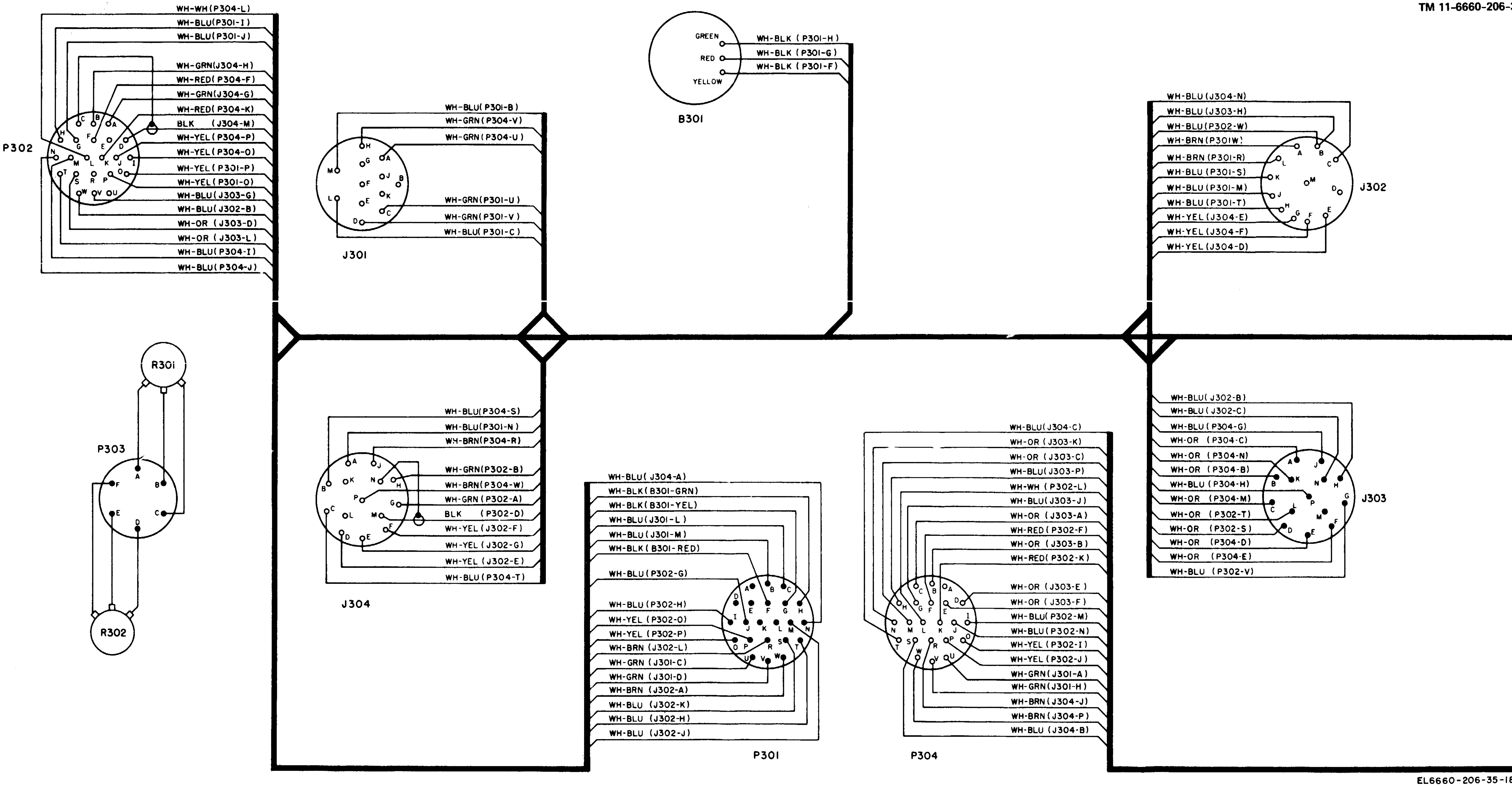


Figure FO-16. Housing (AN/GMD-1A), wiring diagram.

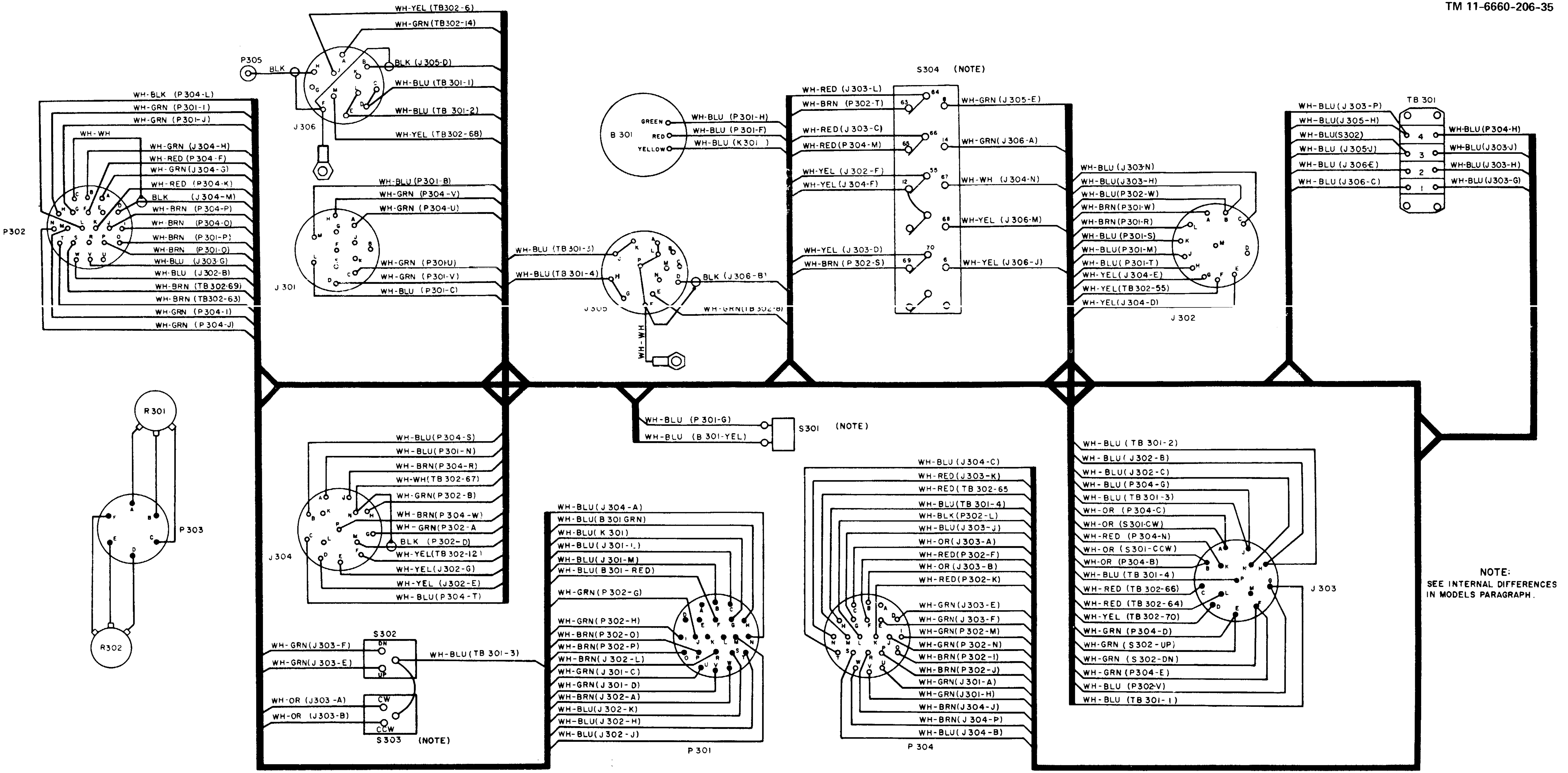


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Figure FO-17. Housing (AN/GMD-1B), wiring diagram.*

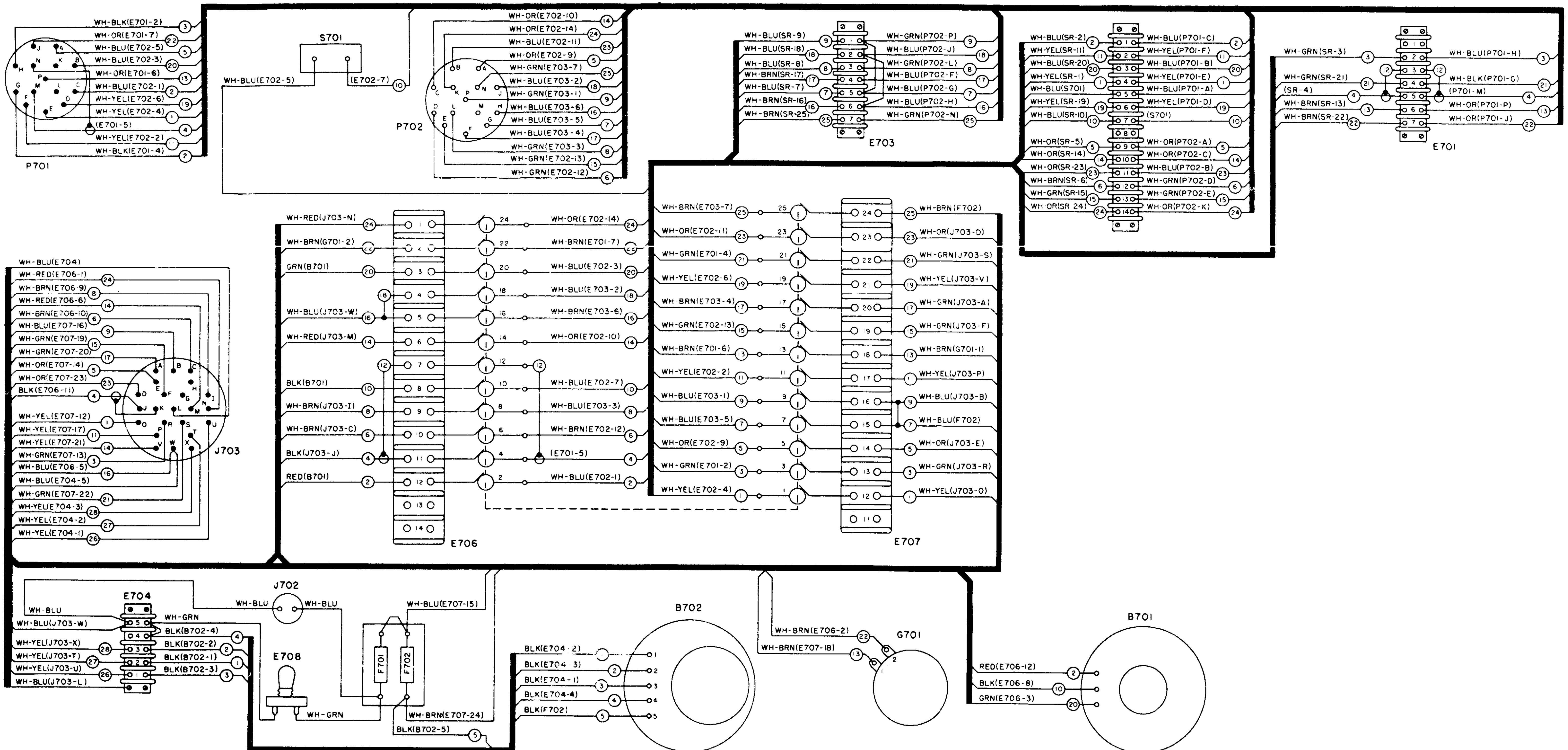


Figure FO-18. Azimuth unit (Pedestals AB-159A/GMD-1, AB-159B/BMD-1, AB-159C/GMD-1), wiring diagram.

EL6660-206-35-192

Figure FO-19. Azimuth unit (Pedestal AB-159D/GMD-1), wiring diagram.

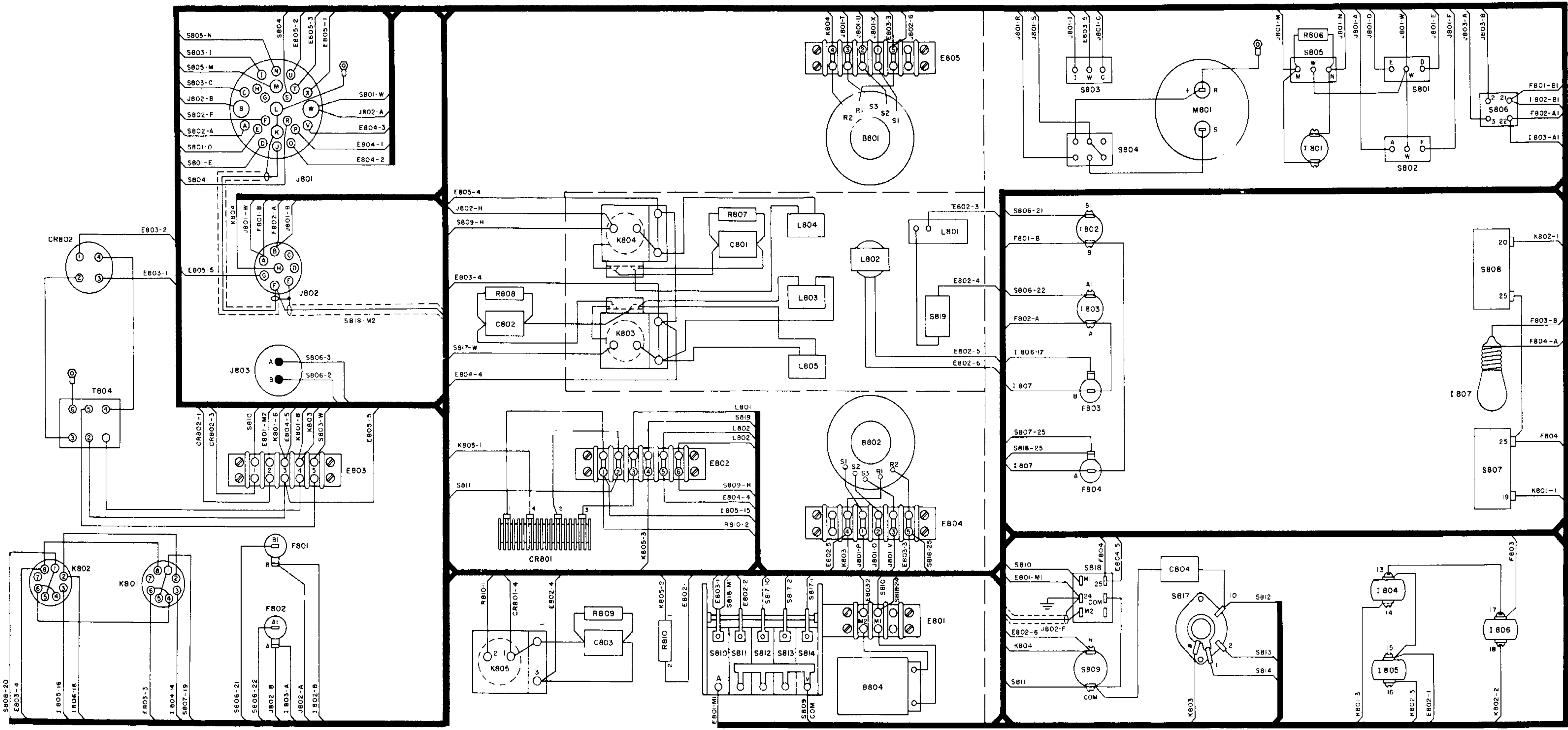
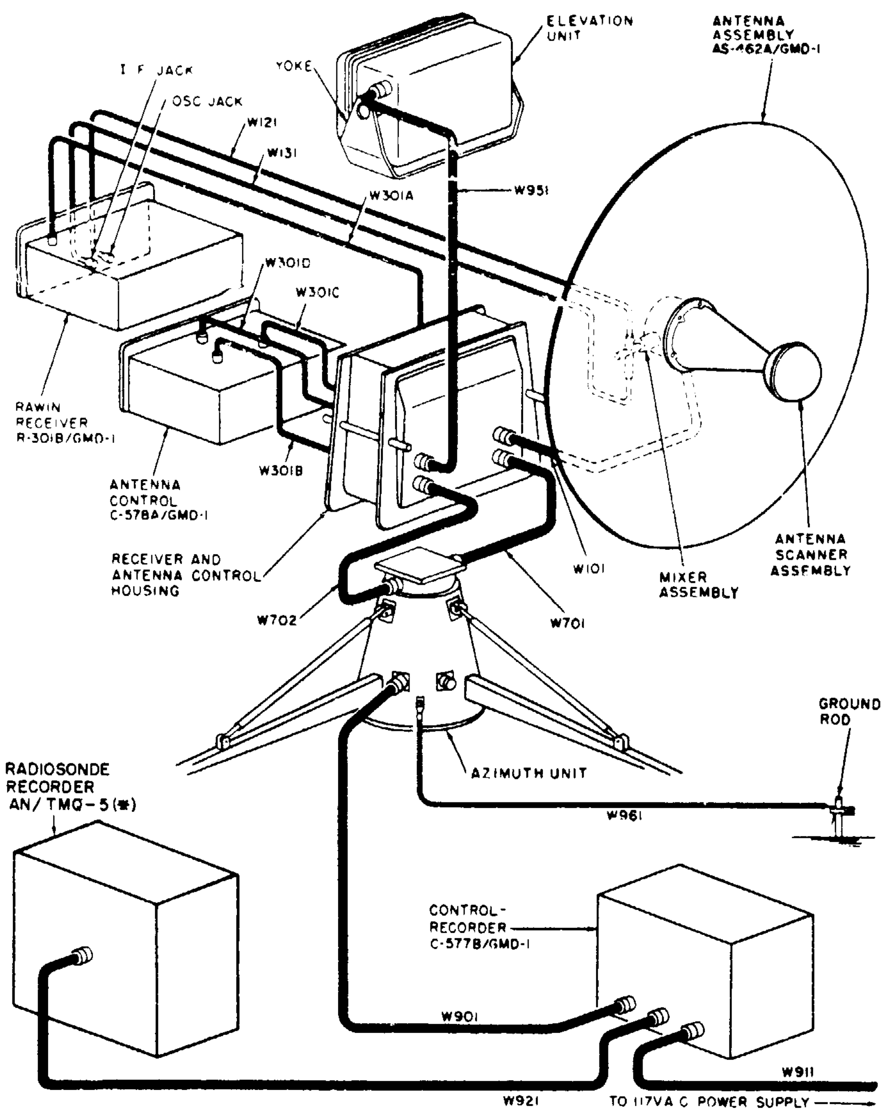
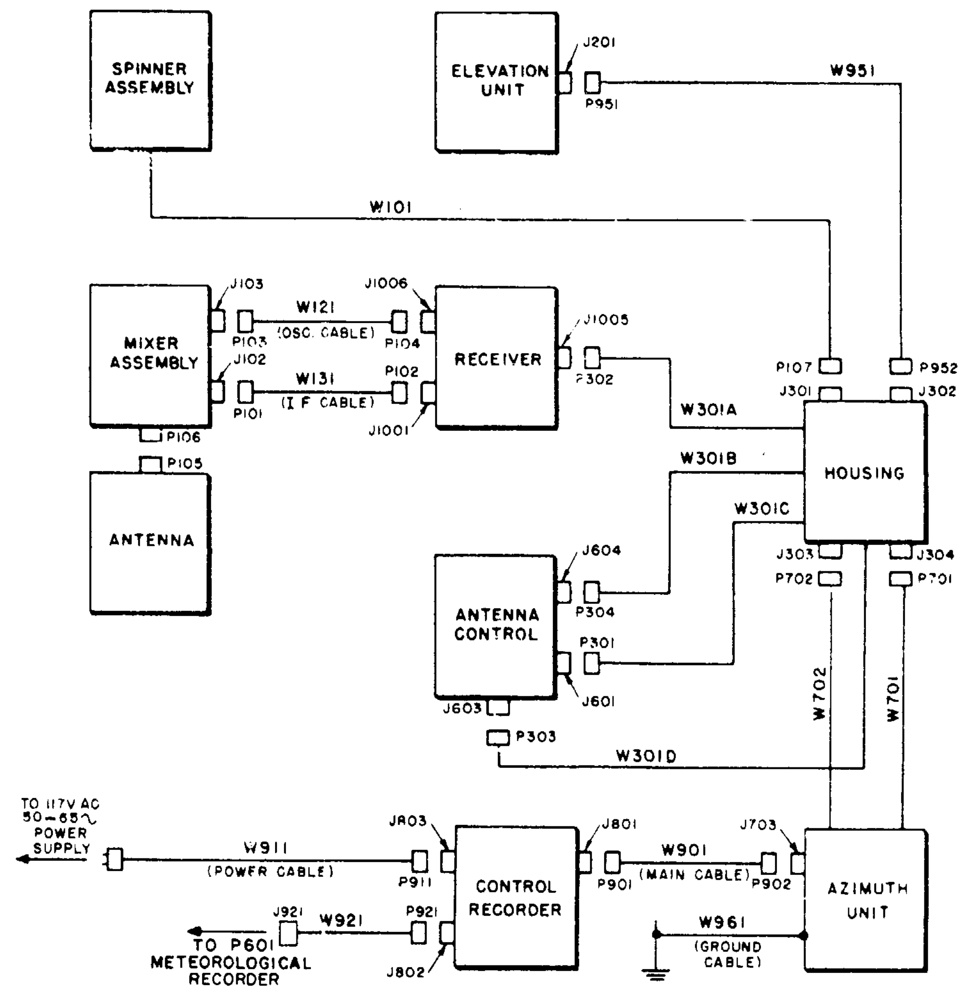

EL6660-206-35-193

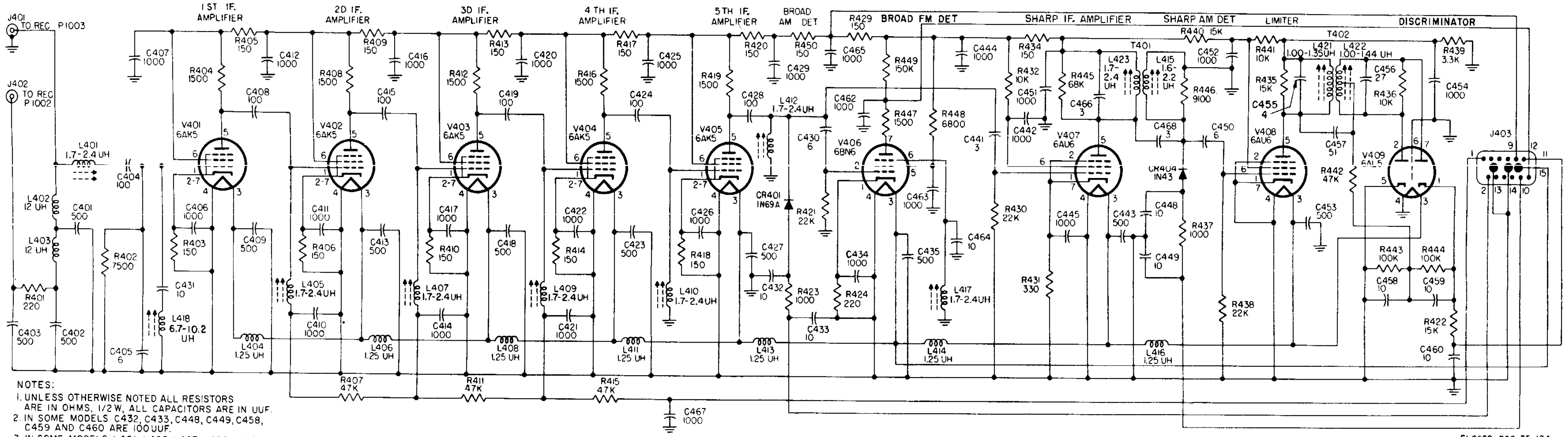
Figure FO-20. Control-Recorder C-577B/GMD-1 and C-577D/GMD-1, wiring diagram.





EL9DX001

FO-20.1. Rawin Set AN/GMD-1A. Cabling Diagrams.



NOTES:
1. UNLESS OTHERWISE NOTED ALL RESISTORS ARE IN OHMS, 1/2W, ALL CAPACITORS ARE IN UUF.
2. IN SOME MODELS C432, C433, C448, C449, C458, C459 AND C460 ARE 100 UUF.
3. IN SOME MODELS L401, L405, L407, L409, L410, L412, L417 AND L423 ARE 1.8-2.8UH.
4. IN SOME MODELS L415 IS 1.5-2.1 UH, L418 IS 7.1-10.1 UH, AND L421 IS 1.15-1.58UH.

EL6660-206-35-194

Figure FO-21. Complete i.f. amplifier, schematic diagram.

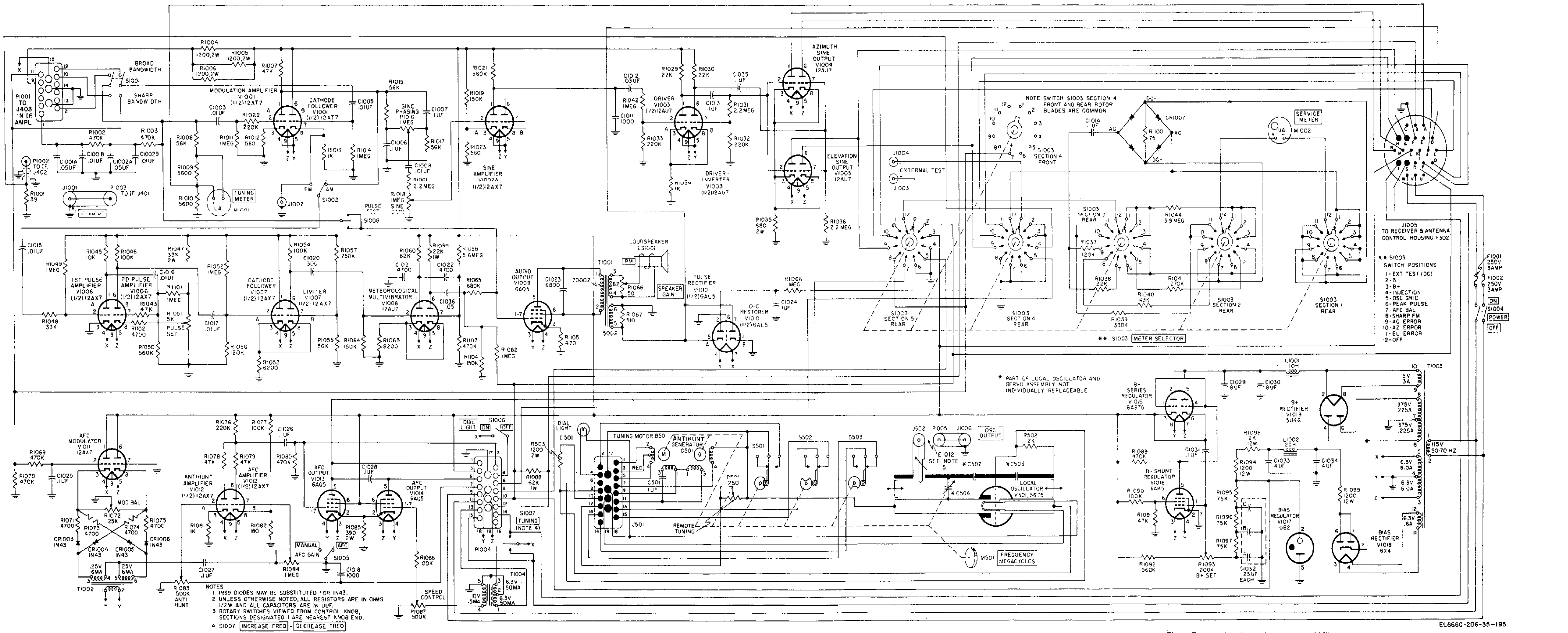


Figure FO-22. Rawin receiver R–301B/GMD– and R–301C/GMD–1, schematic diagram.

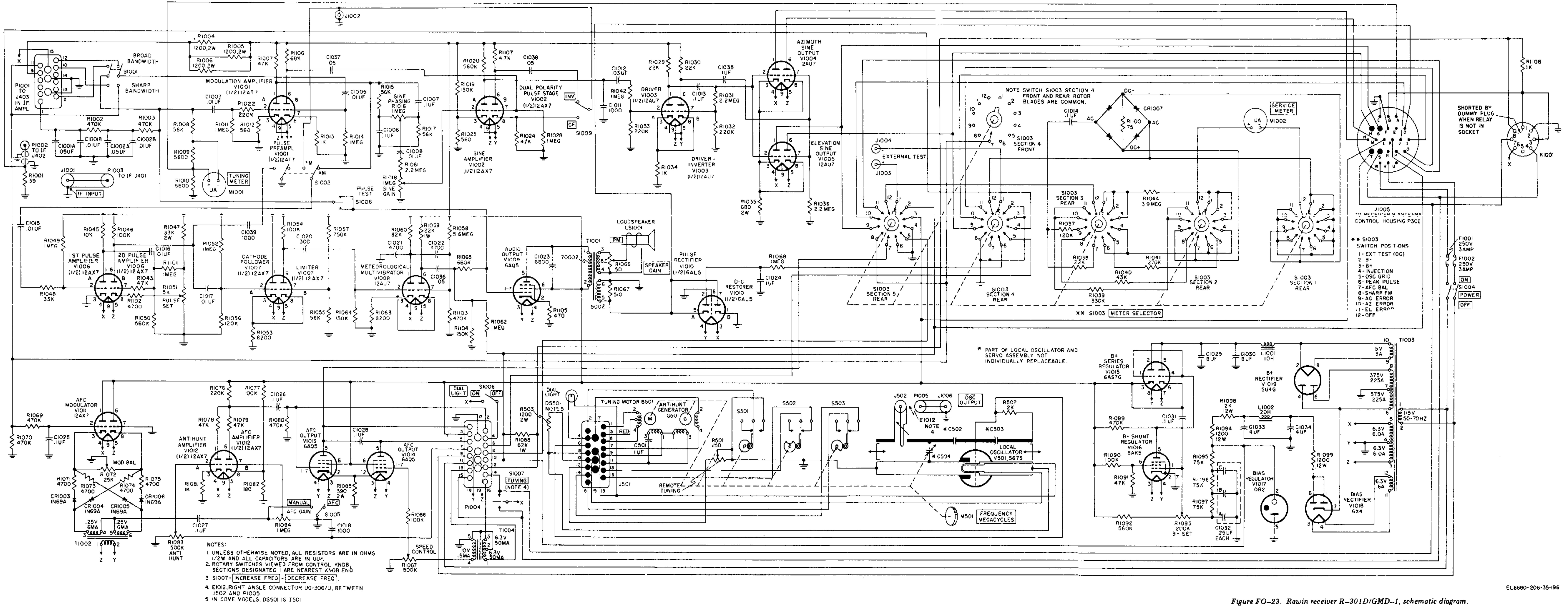
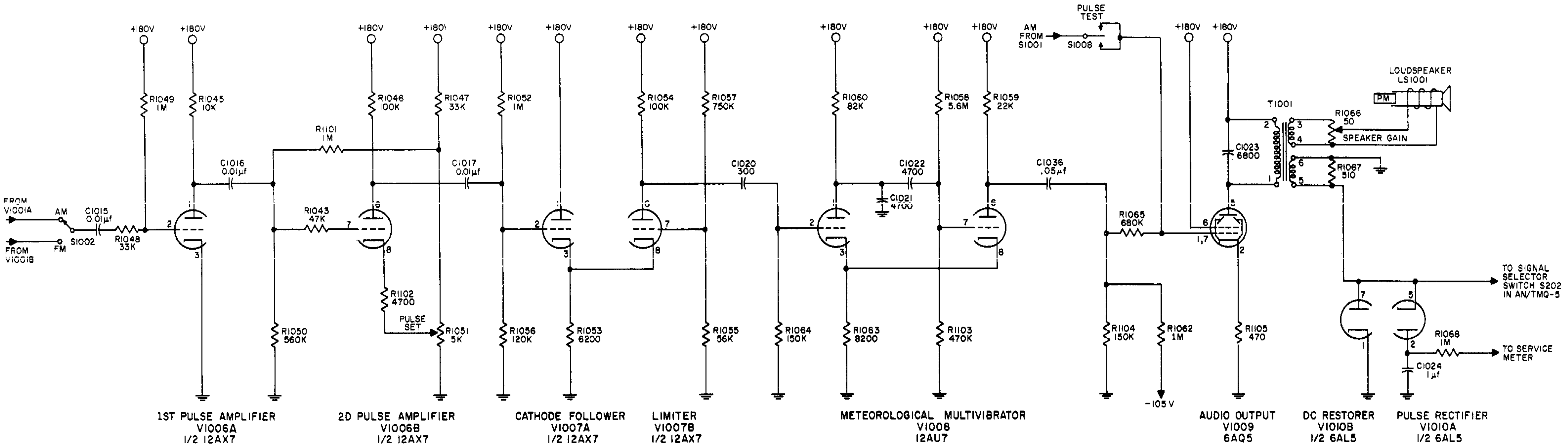


Figure FO-23. Rawin receiver R-301D/GMD-1, schematic diagram.



NOTE

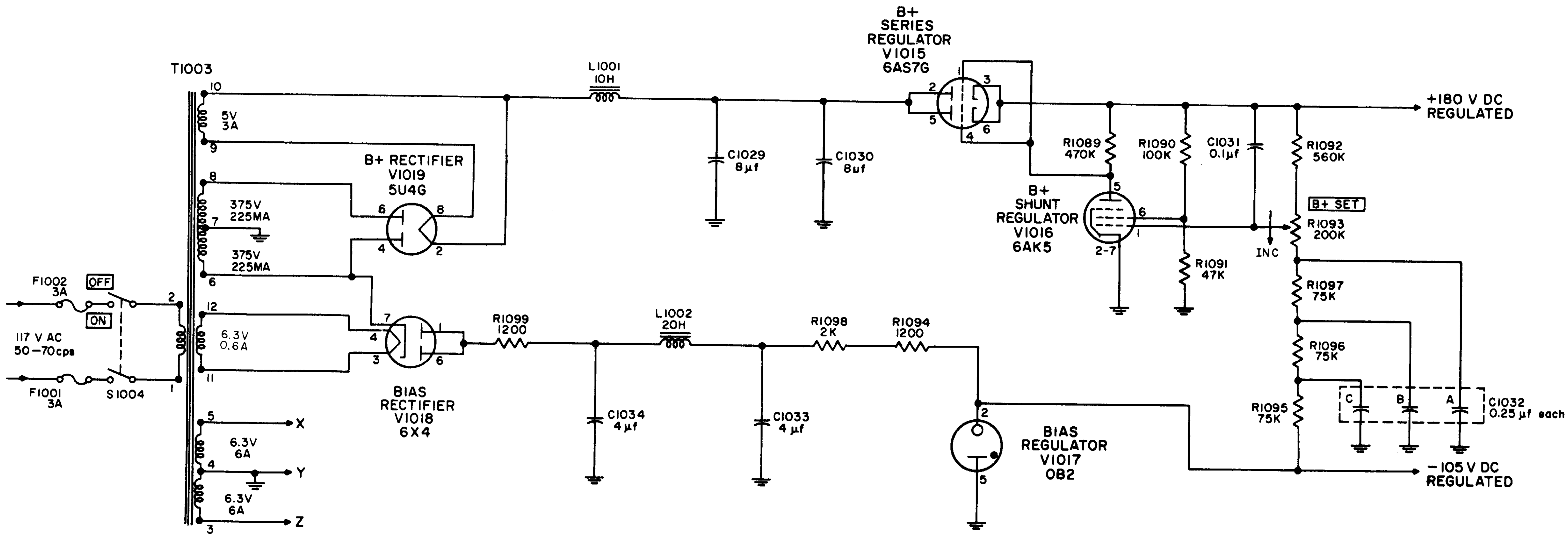
UNLESS OTHERWISE NOTED, ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS ARE IN UUF.

NOTE

ON CERTAIN MODELS, R470 IS DELETED AND THE GRID RESISTANCES ARE CHANGED.

EL9DX002

FO-23.1. Meteorological Channel, Simplified Schematic Diagram.

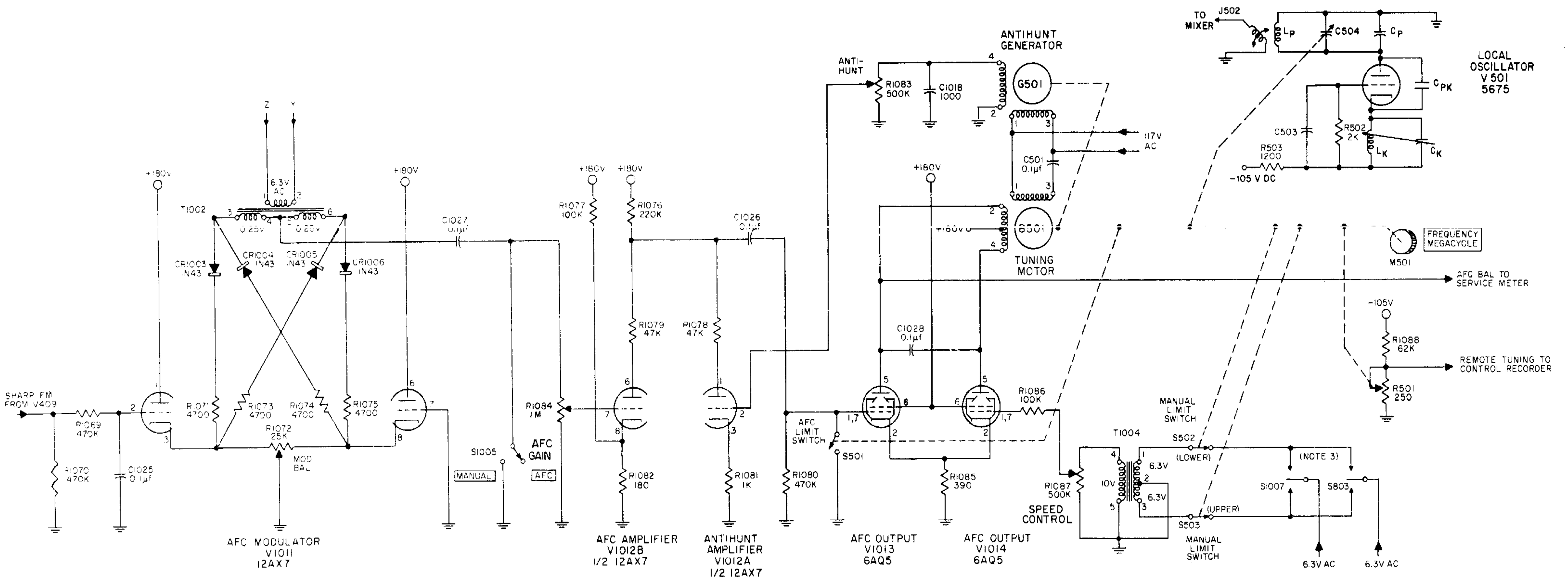


NOTE

UNLESS OTHERWISE NOTED, ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS ARE IN UUF.

FL9DX003

FO-23.2 Receiver Power Supplies, Simplified Schematic Diagram.

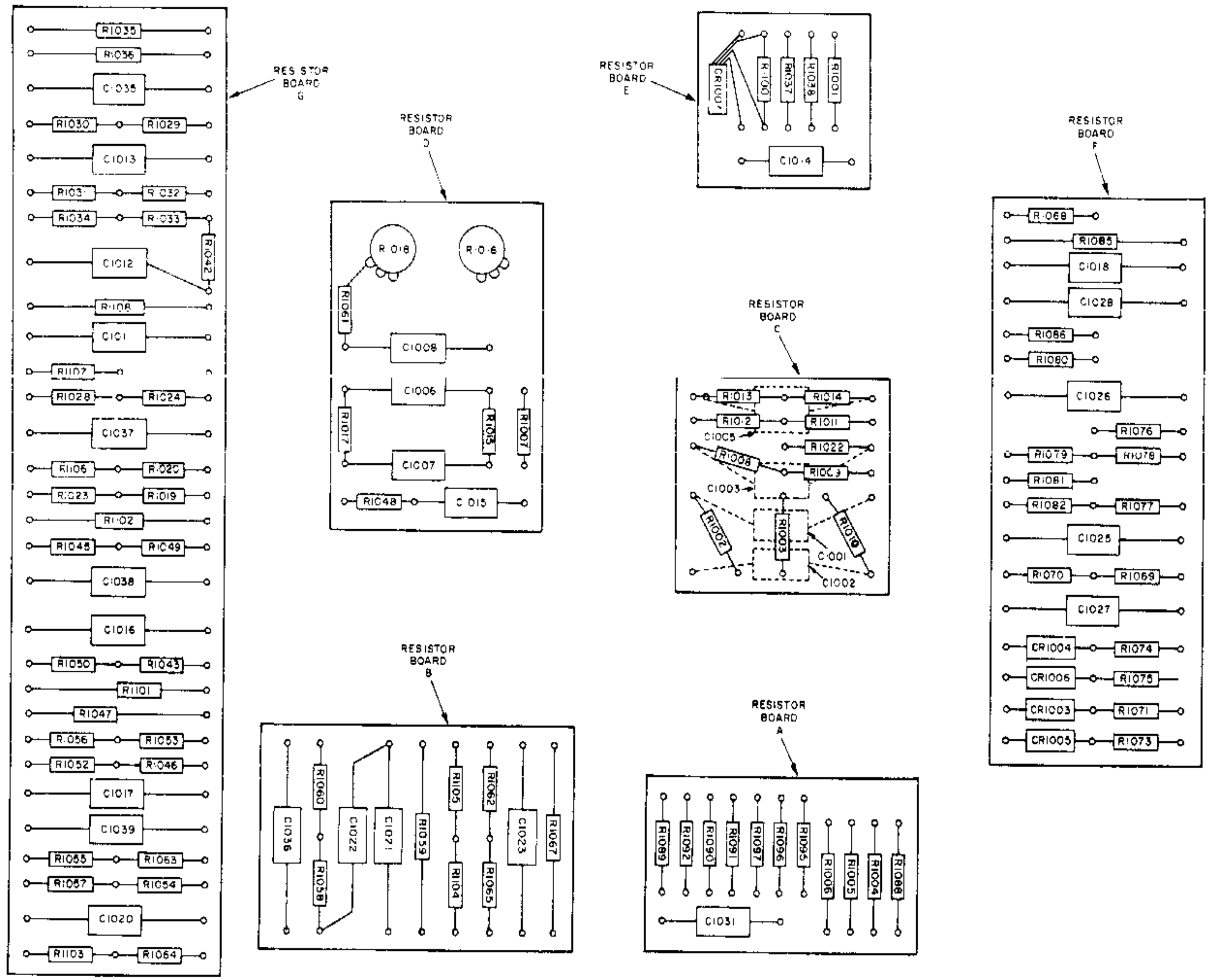


NOTES

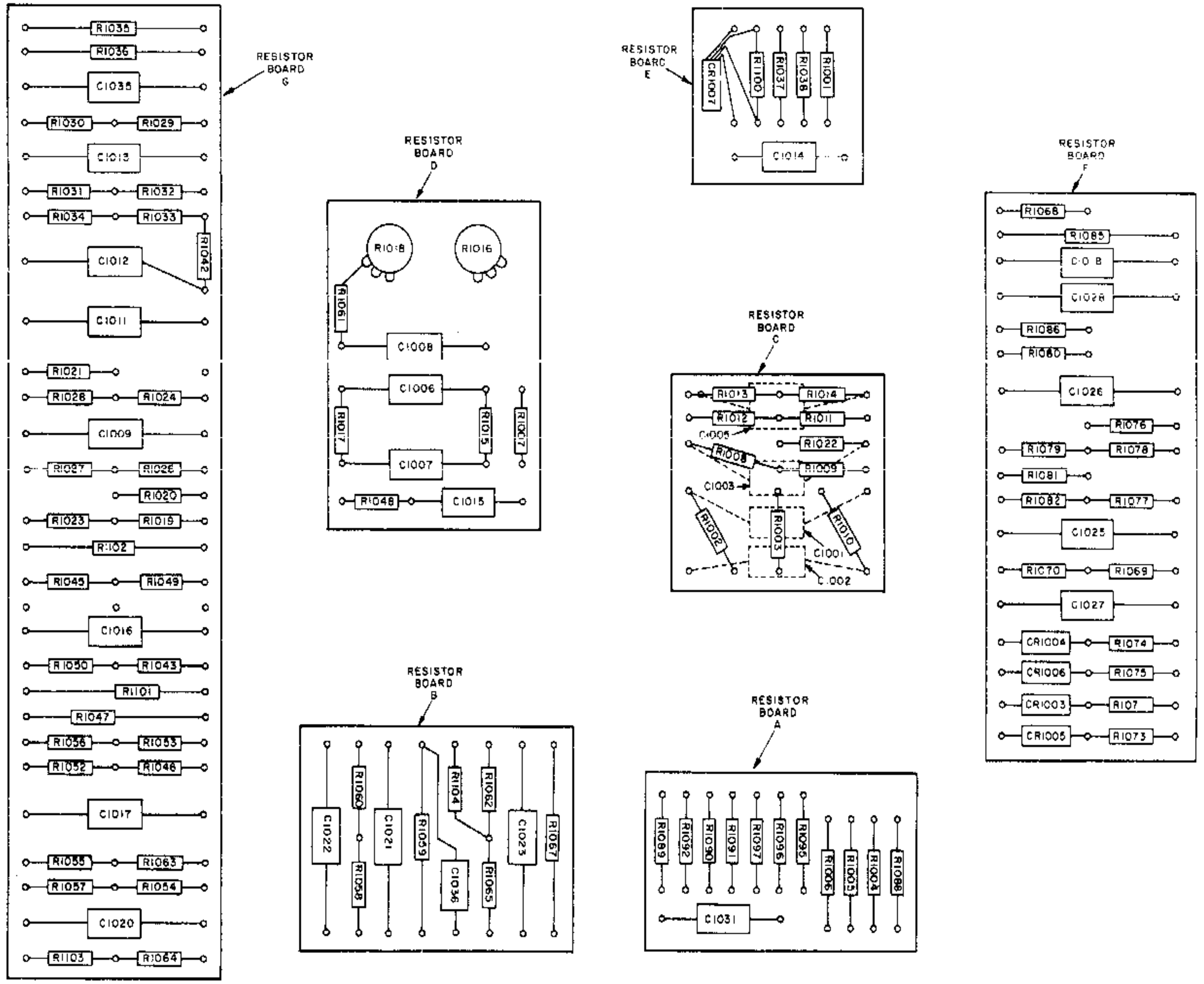
1. UNLESS OTHERWISE NOTED, ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS ARE IN UUF.
2. 1N69 DIODES MAY BE SUBSTITUTED FOR 1N43.
3. S1007 AND S803 INCREASE FREQ - DECREASE FREQ

EL9DX004

FO-23.3. Manual and AFC Circuit, Simplified Schematic Diagram.



Rawin receiver R-301D/GMD-1.



Rawin receivers R-301A/GMD-1, R-301B/GMD-1, and R-301C/GMD-1.

EL9DX005

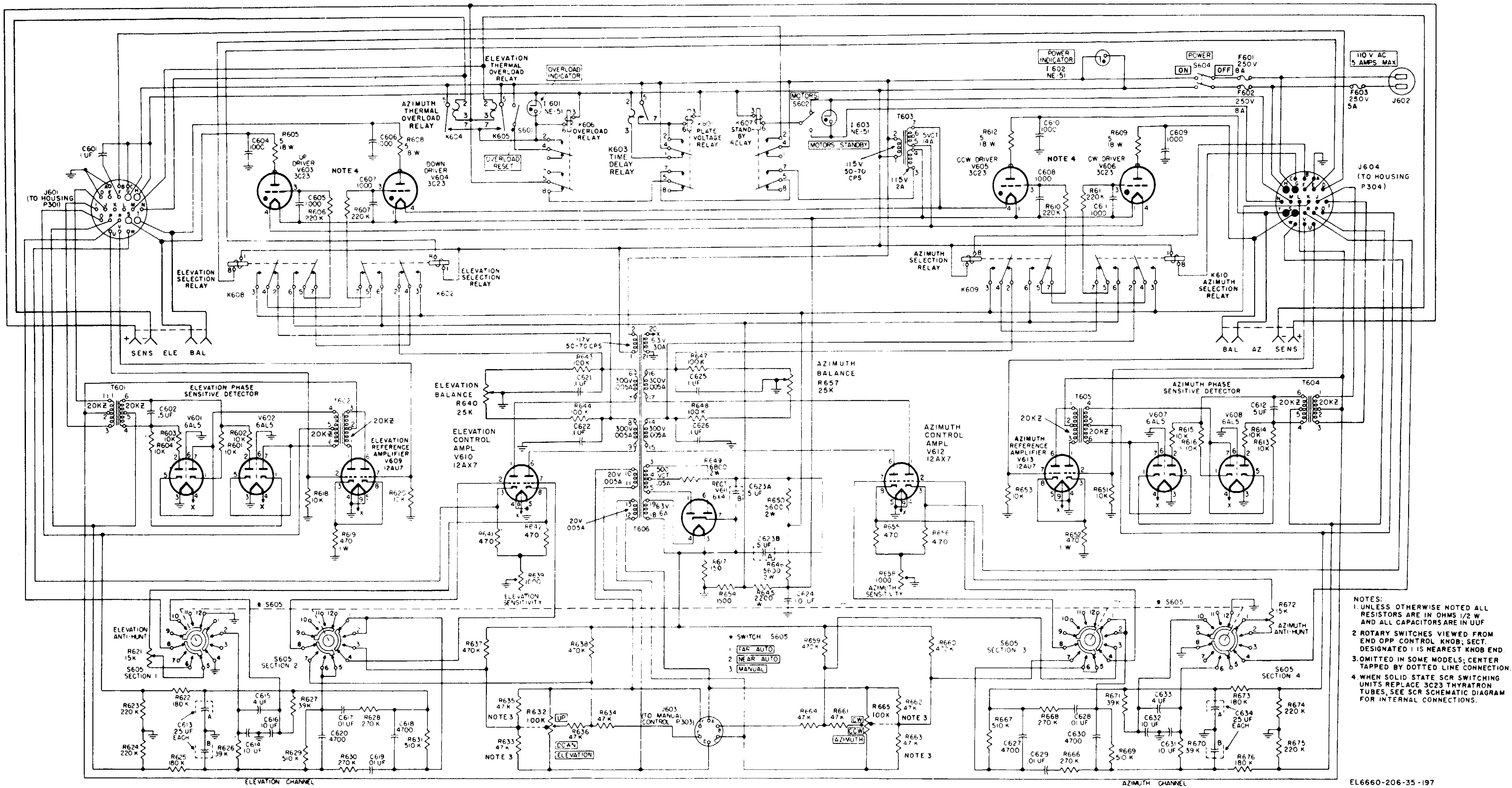
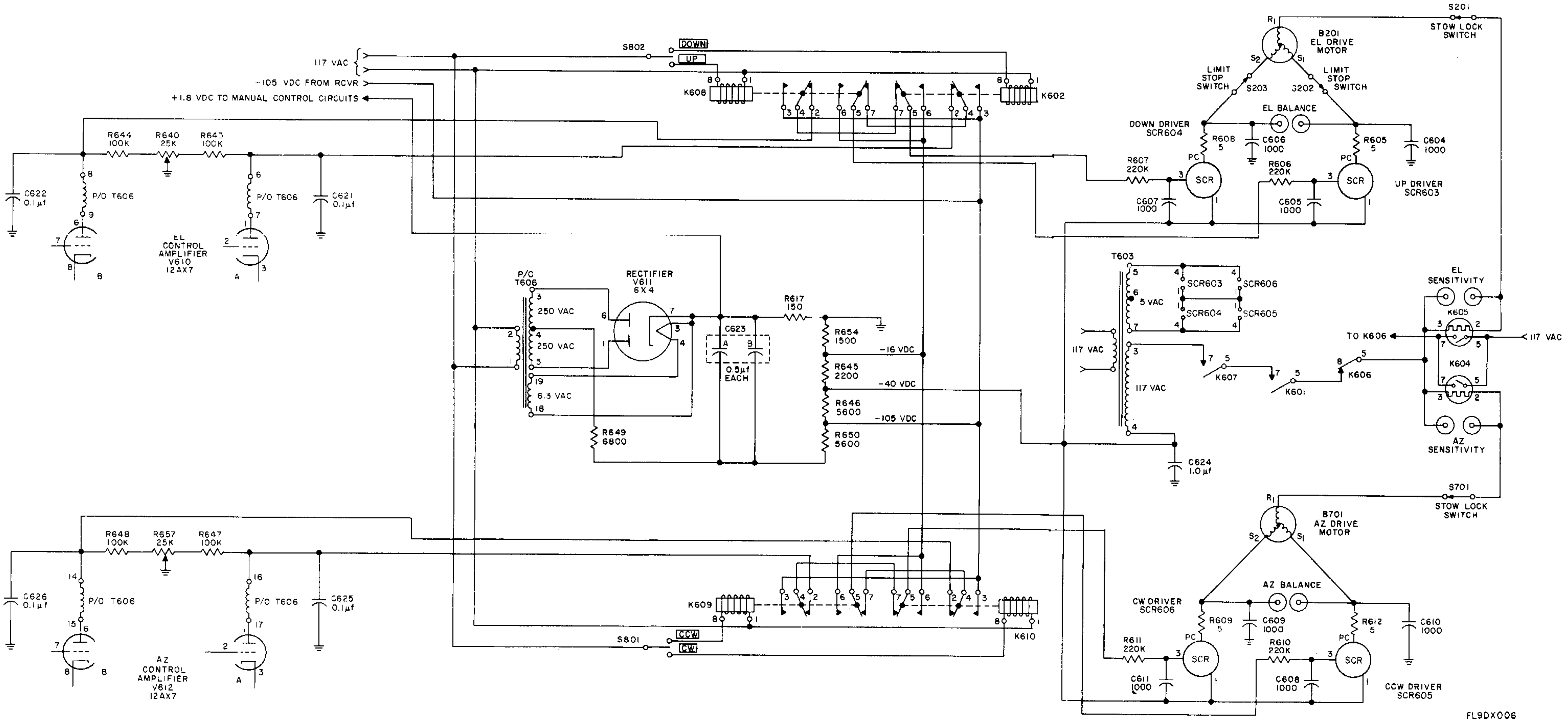
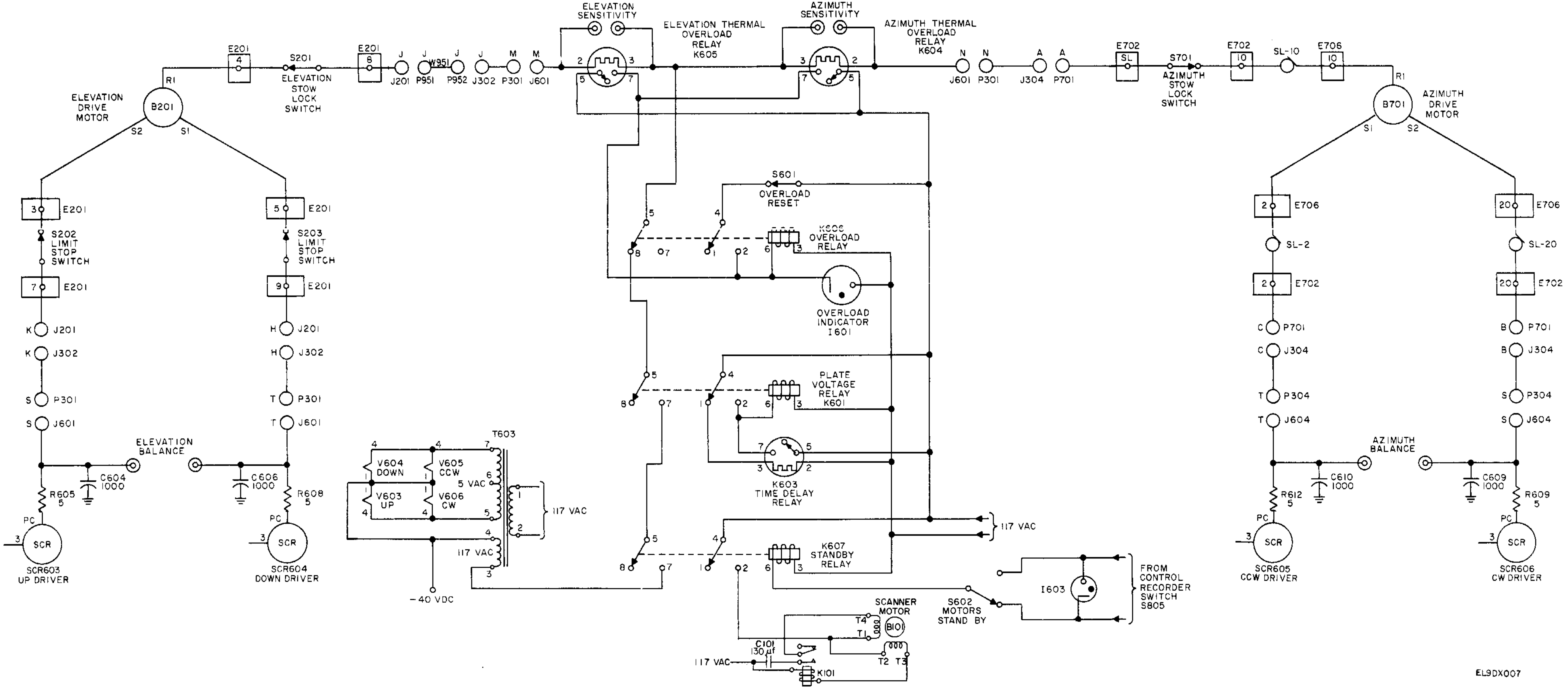


Figure FO–24. Antenna control C–578A/GMD–1, C–578B/GMD–1, and C–578C/GMD–1, schematic diagram.*

*Figure FO-25. Antenna control C-578C/GMD-1**, schematic diagram.*

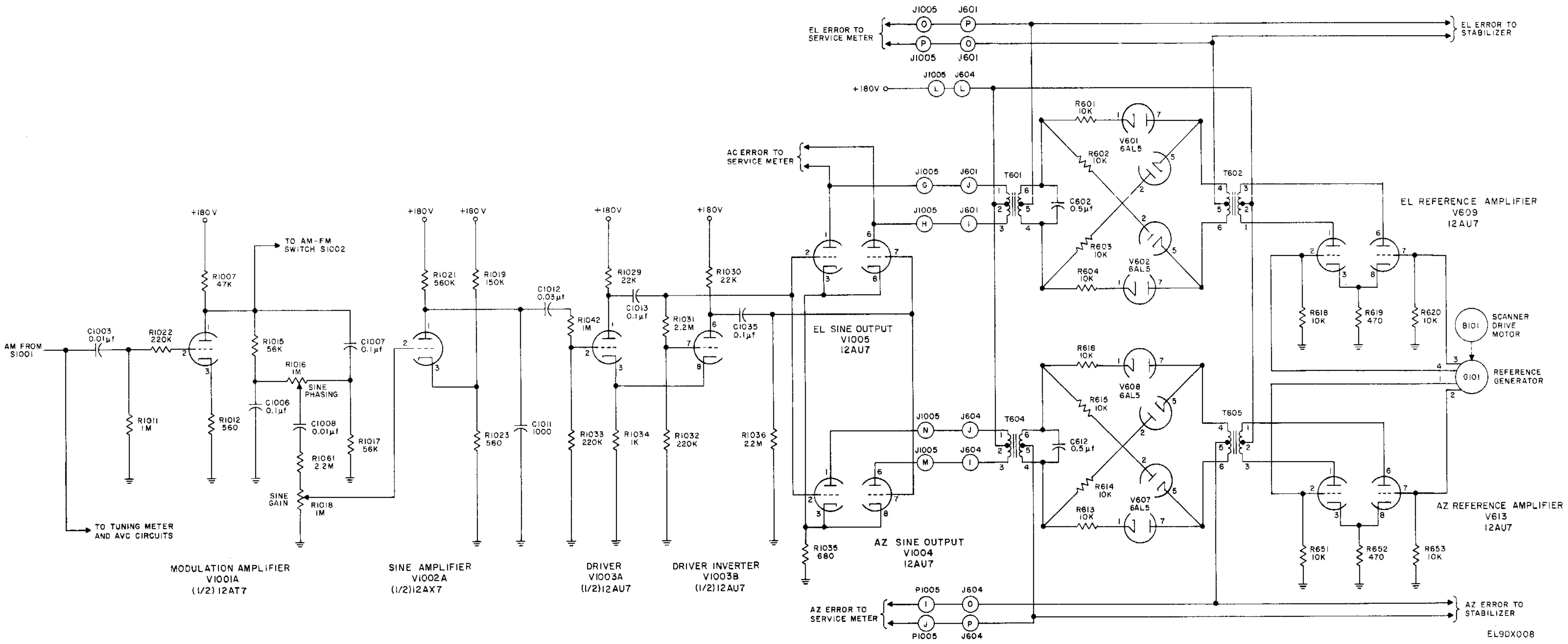


FO-25.1. Remote Manual Bias Rectifier, and Drivers, Simplified Schematic Diagram.

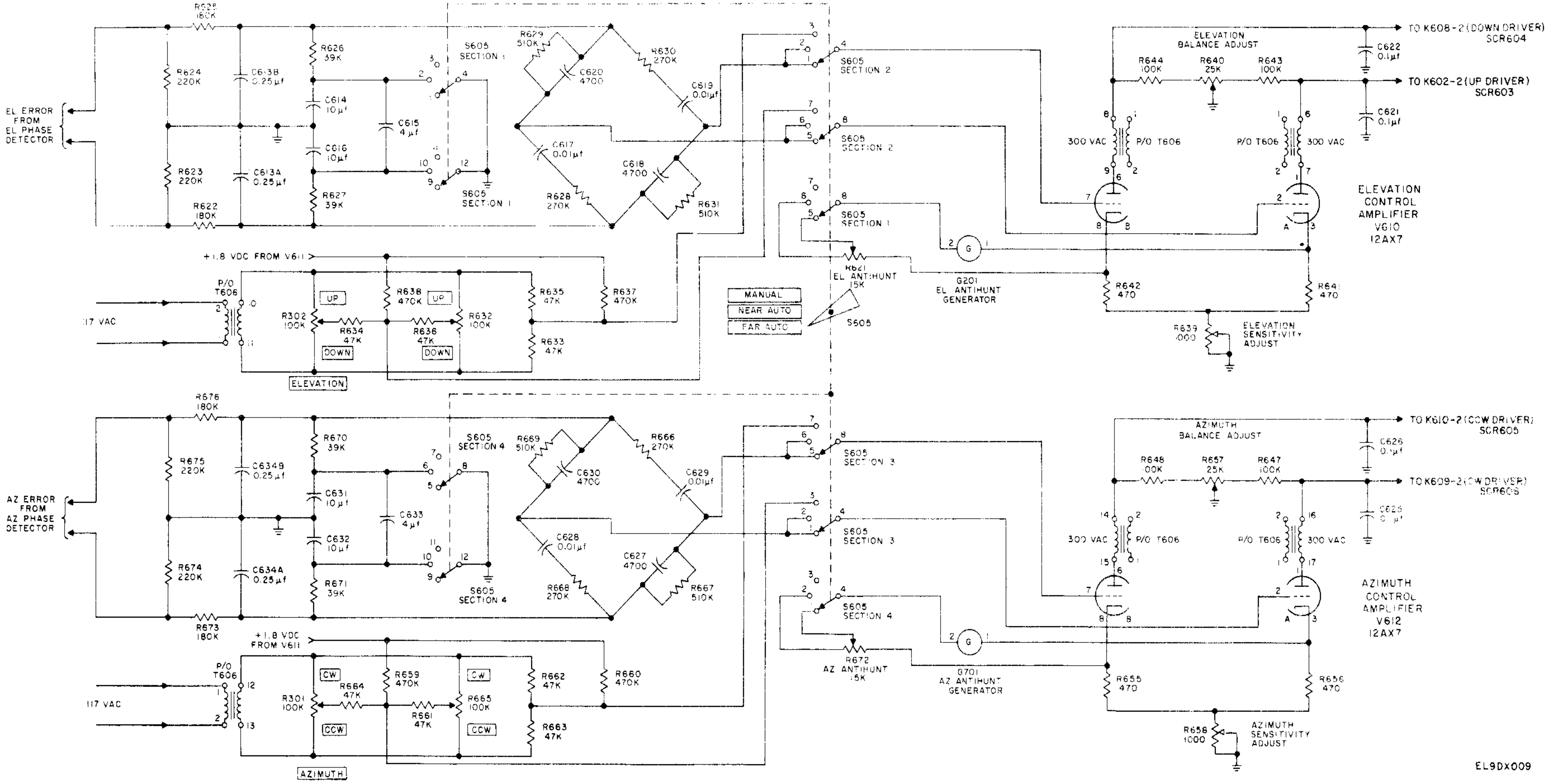


EL9DX007

FO-25.2. Drivers and Plate Control Circuits, Simplified Schematic Diagram.



FO-25.3. Sine Channel and Phase Detectors, Simplified Schematic Diagram.



FO-25.4. Phase Detectors, Stabilizers, and Control Amplifiers, Simplified Schematic Diagram.

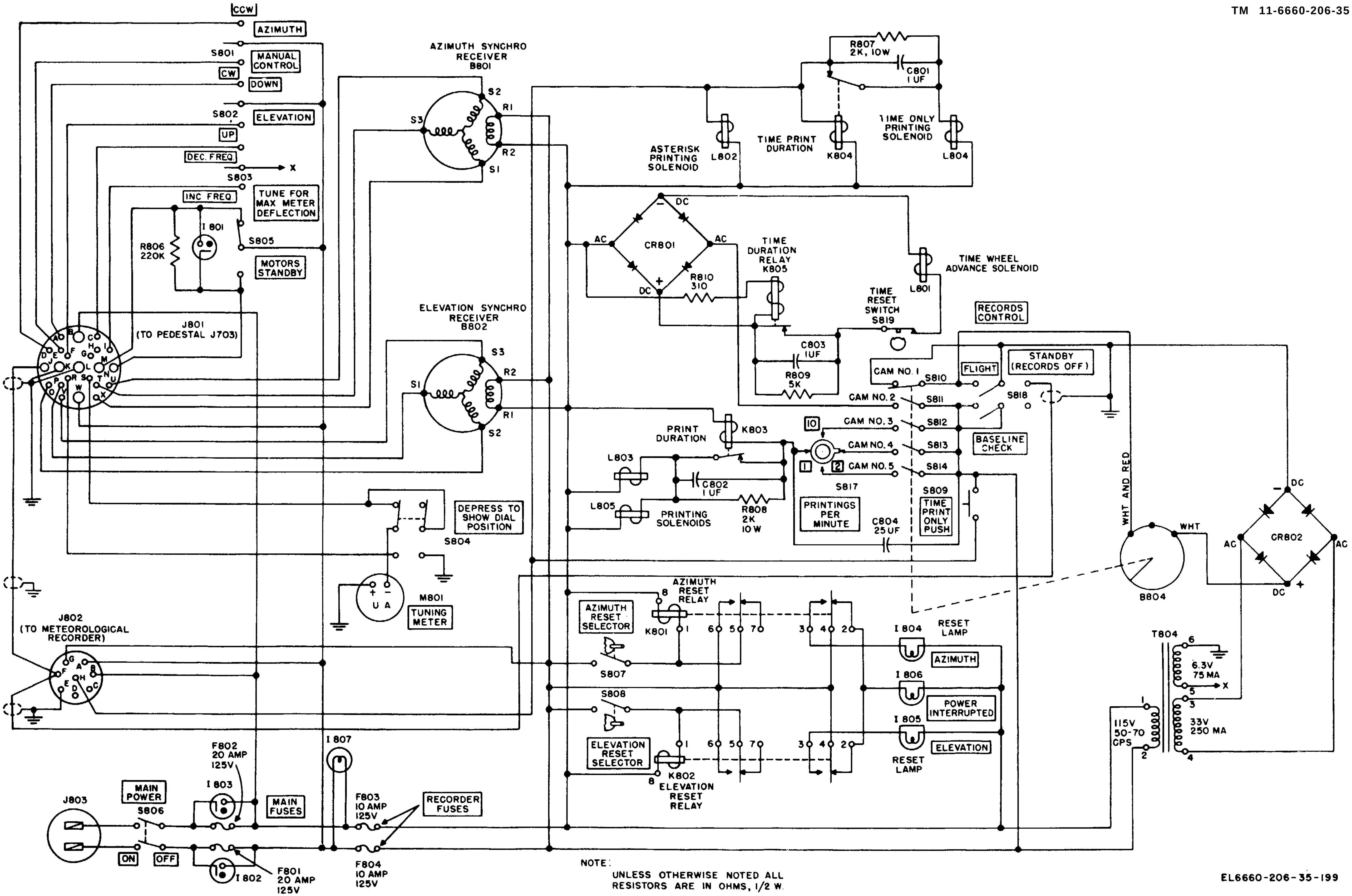
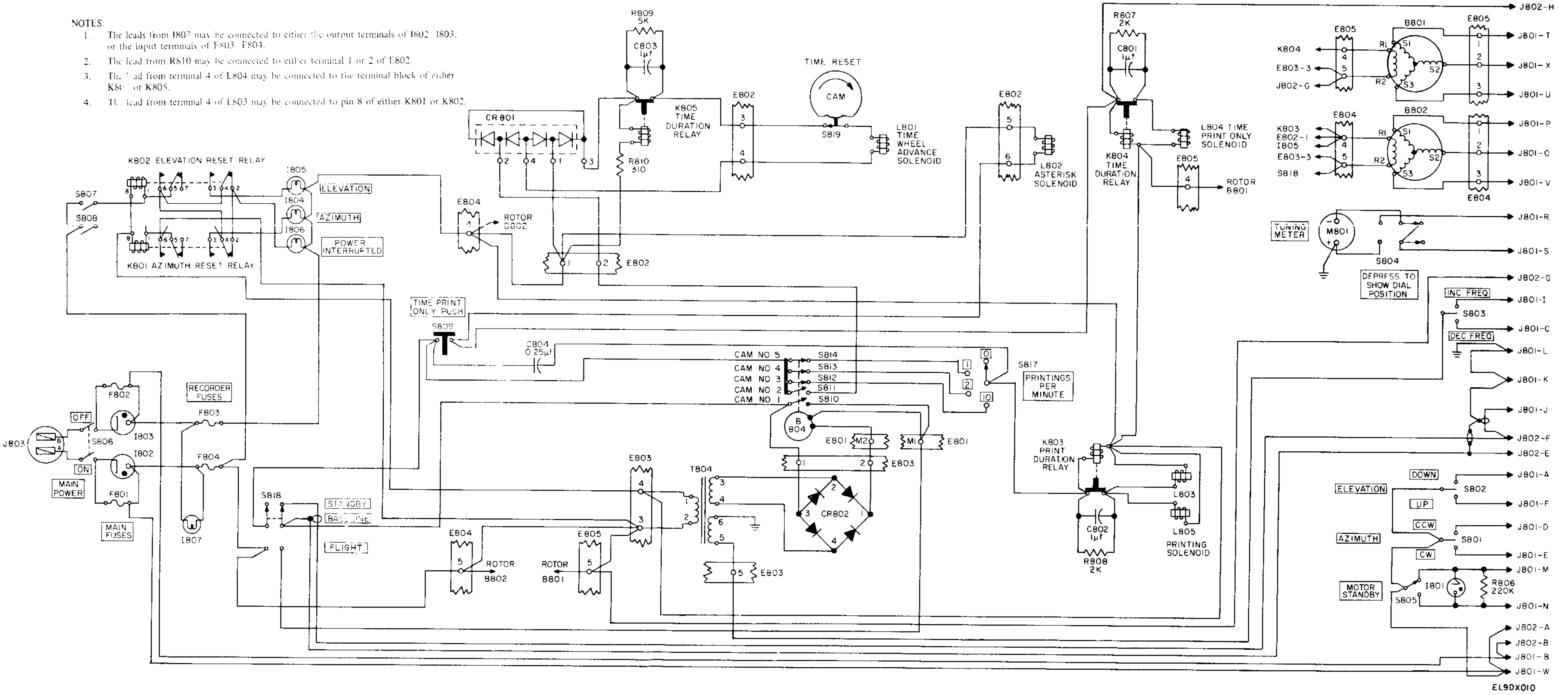


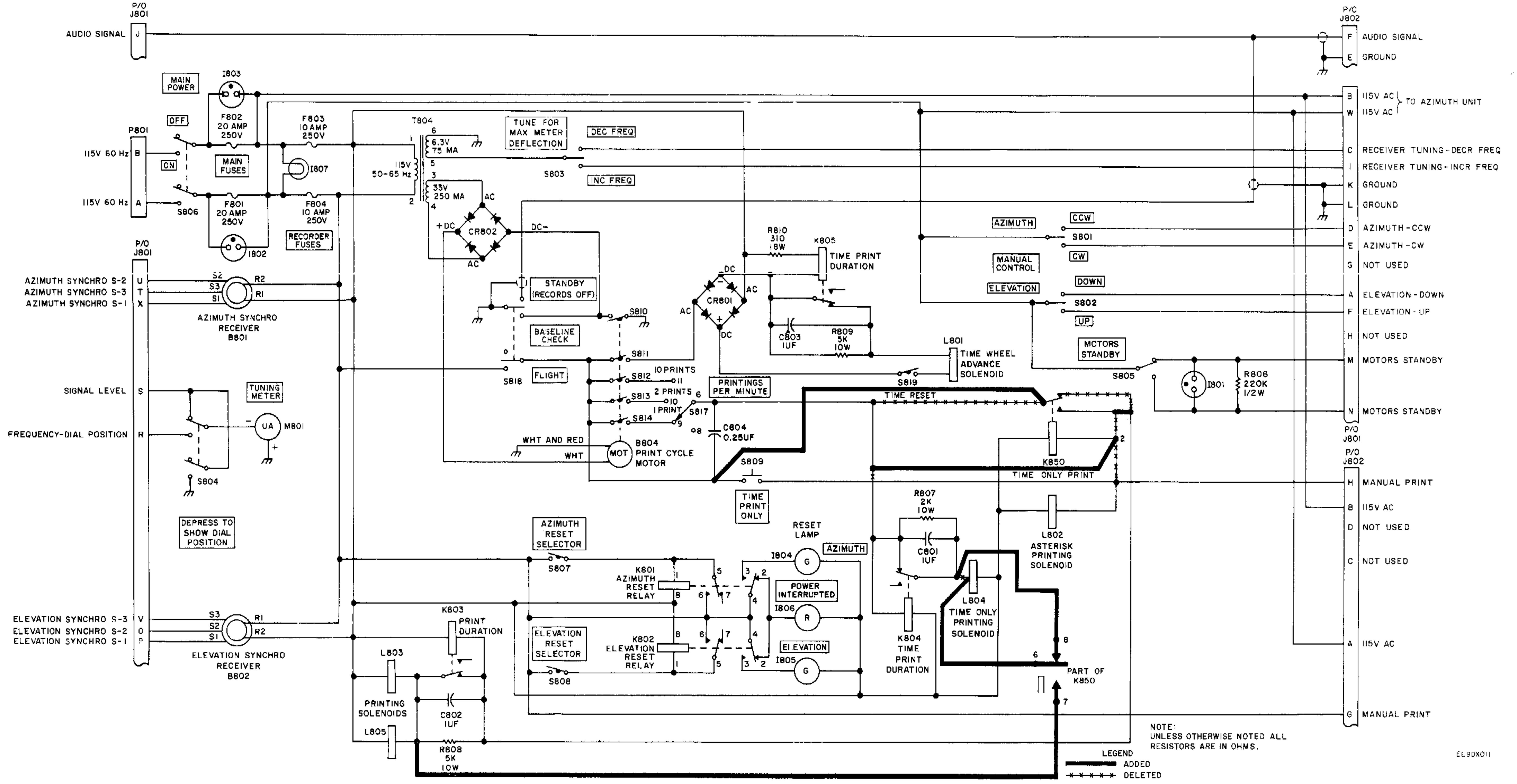
Figure FO–26. Control-Recorder C–577B/GMD–1 and C–577D/GMD–1, schematic diagram.

NOTES:

1. The leads from I807 may be connected to either the output terminals of I802, I803, or the input terminals of F803, F804.
2. The lead from R810 may be connected to either terminal 1 or 2 of E802.
3. The lead from terminal 4 of L804 may be connected to the terminal block of either K804 or K805.
4. The lead from terminal 4 of E803 may be connected to pin 8 of either K801 or K802.



FO-26.1. Rawin Set AN/GMD-1 Control Recorder Wiring Diagram.



FO-27. Control-Recorder C-577E/GMD-1, Schematic Diagram.

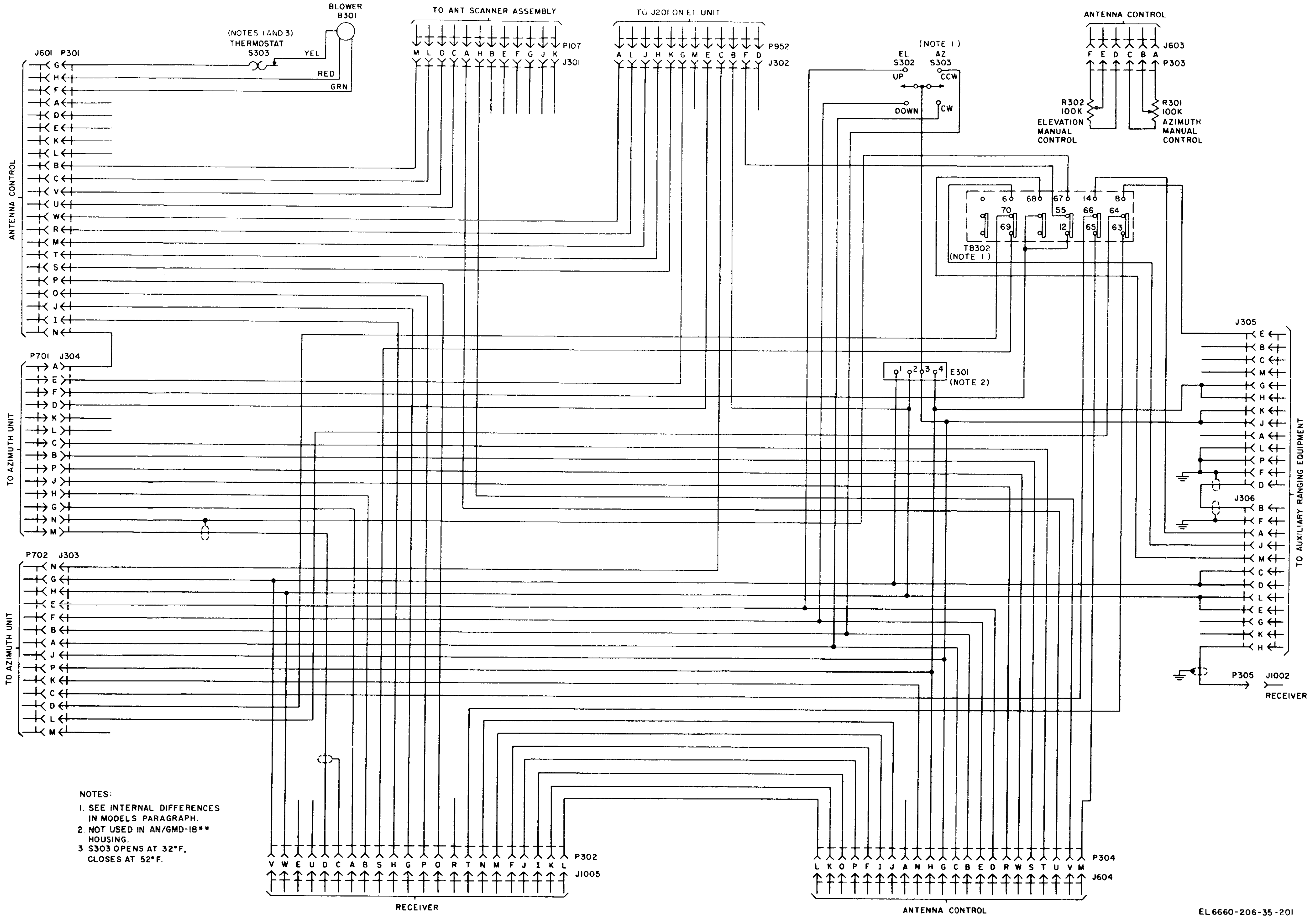


Figure FO–28. Housing (AN/GMD–1), schematic diagram.*

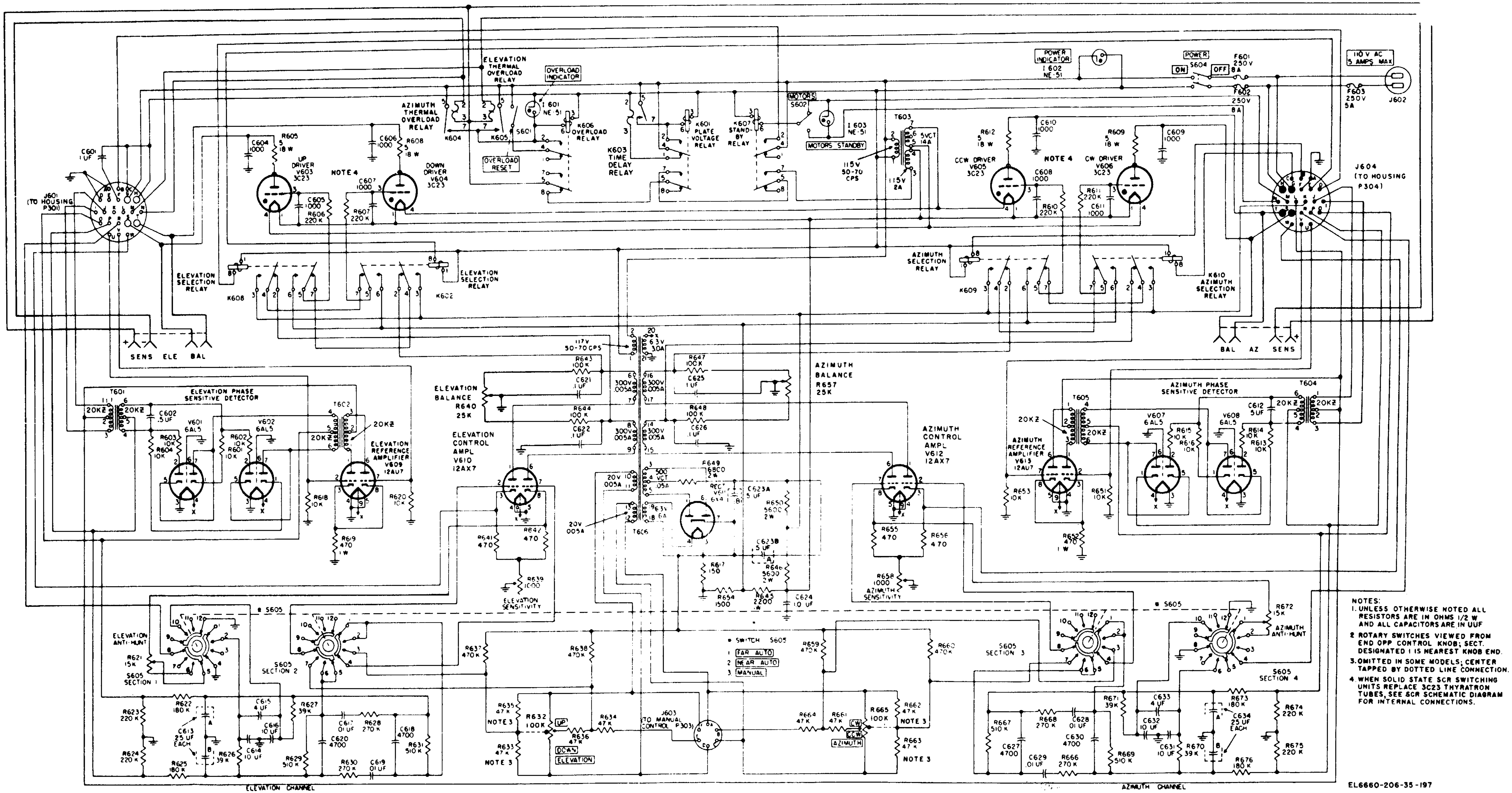
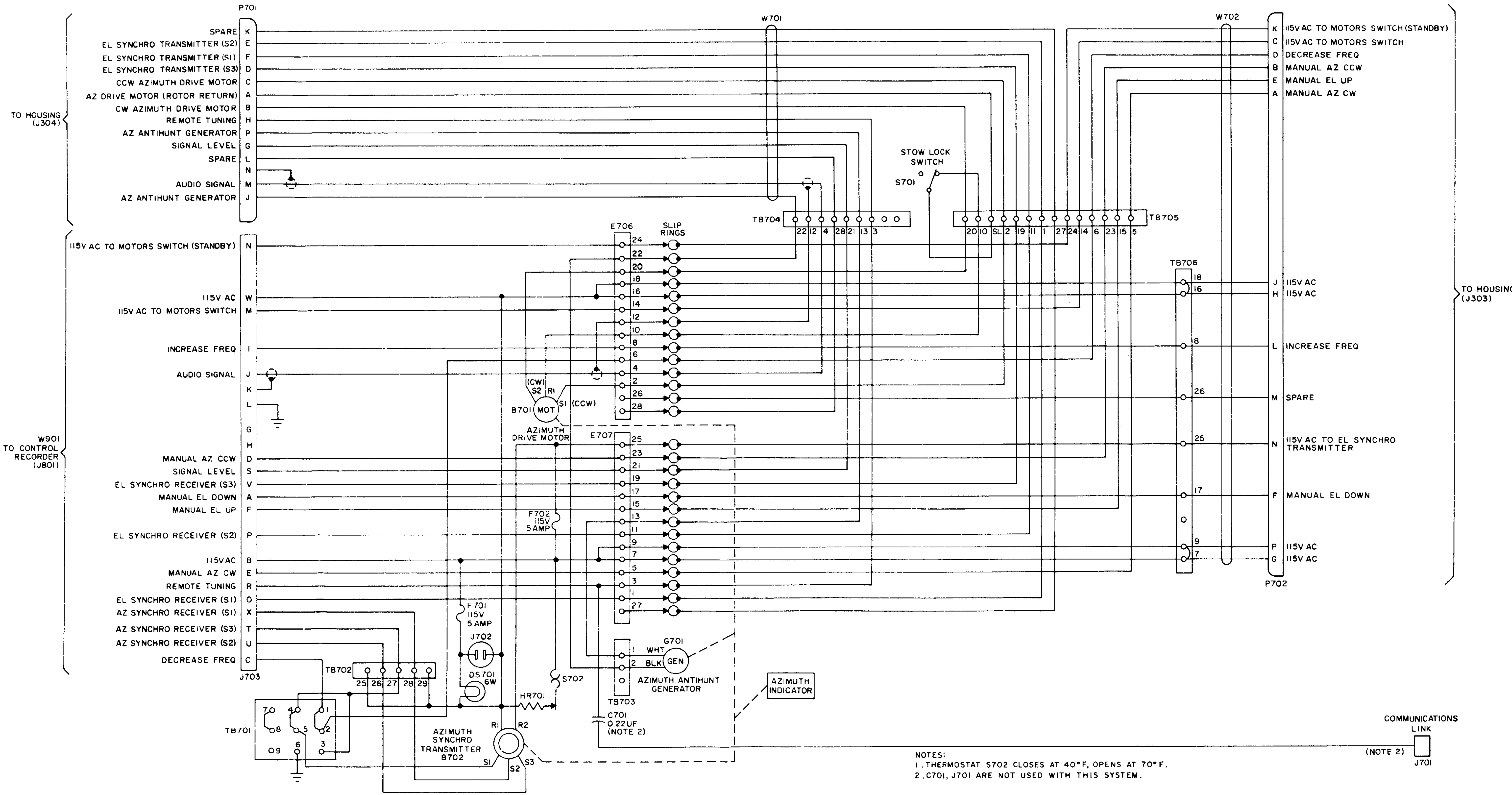


Figure FO–29. Azimuth unit (Pedestal AB–159D/GMD–1), schematic diagram.



NOTES:
1. THERMOSTAT S702 CLOSES AT 40°F, OPENS AT 70°F.
2. C701, J701 ARE NOT USED WITH THIS SYSTEM.

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Figure FO–30. Azimuth unit (Pedestal AB–159E/GMD–1), schematic diagram.

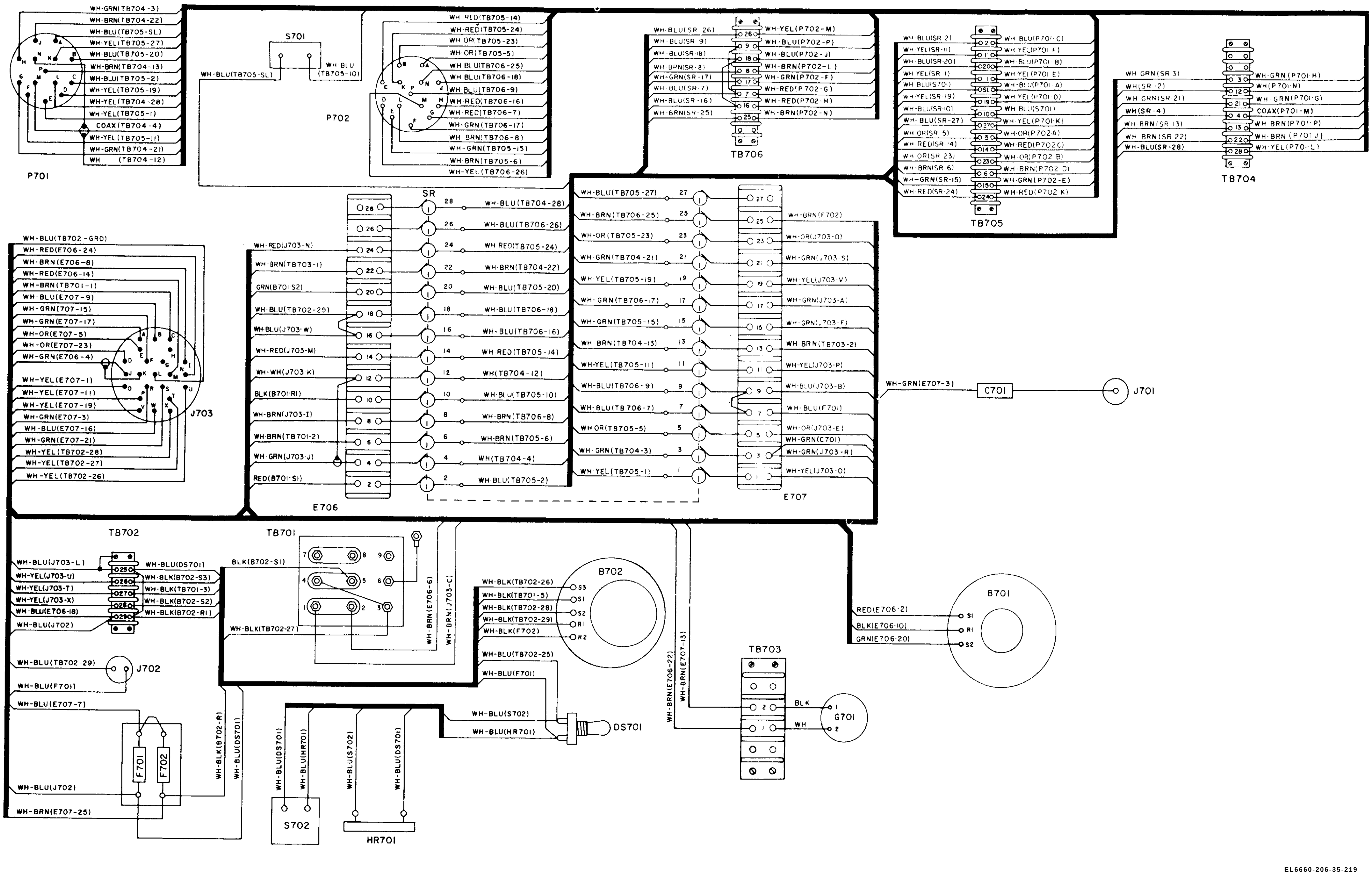

Figure FO–31. Azimuth unit (Pedestal AB–159E/GMD–1), wiring diagram.

Figure FO-32. Control-Recorder C-577E/GMD-1, wiring diagram.

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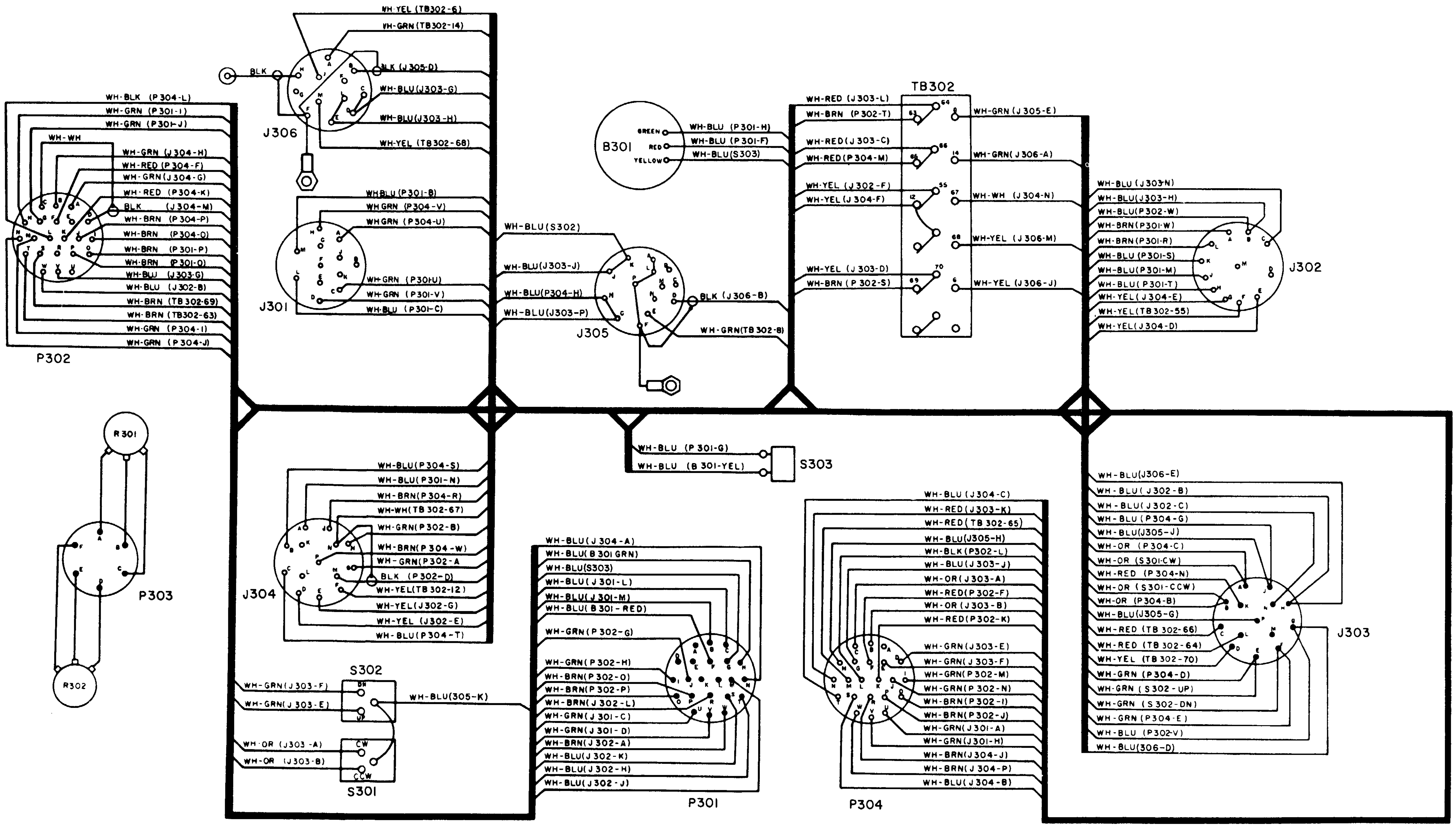

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*Figure FO-33. Housing (AN/GMD–1B**), wiring diagram.*

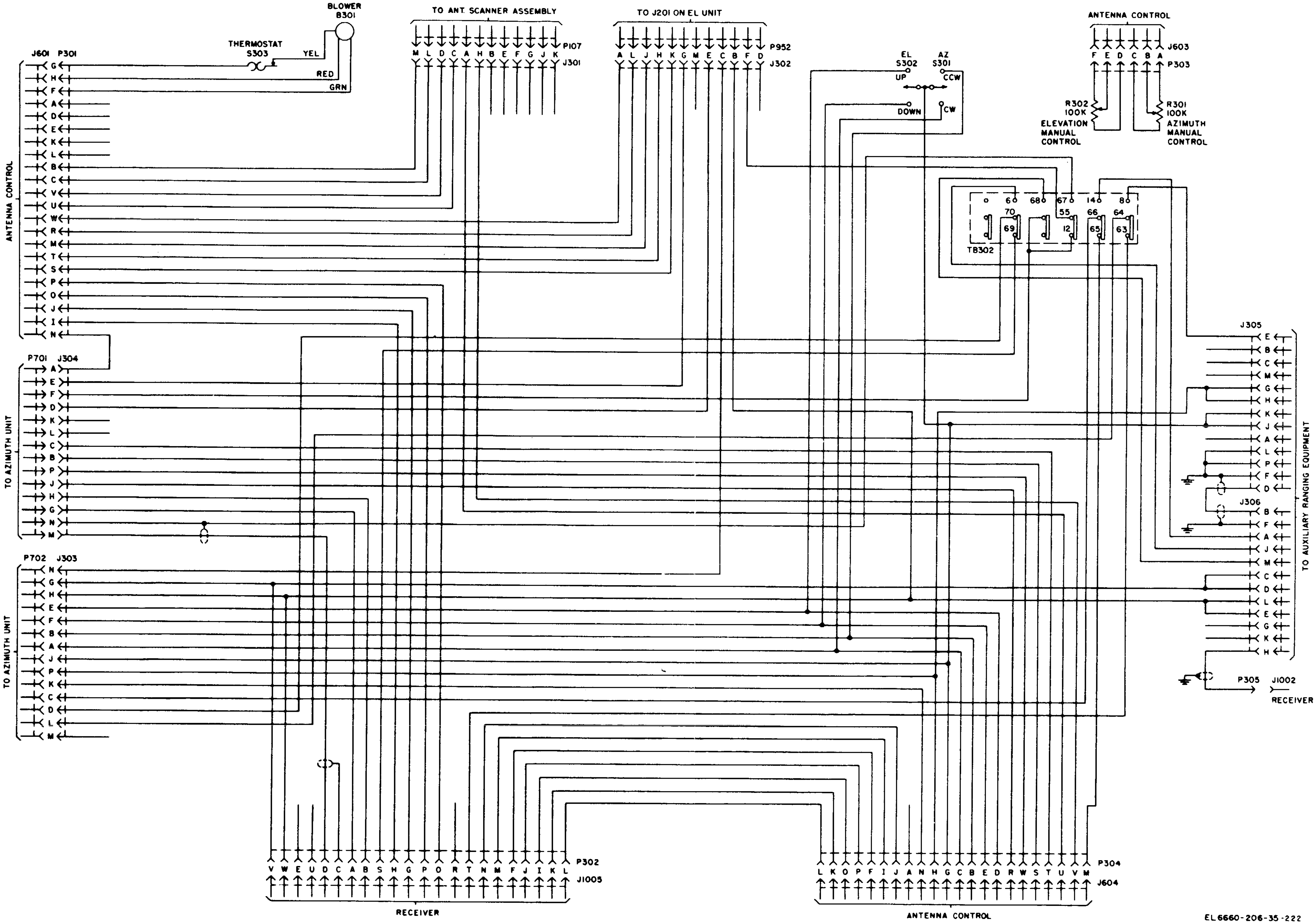

*Figure FO–34. Housing (AN/GMD–1B**), schematic diagram.*

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(2 copies each):
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6-185
6-186
6-200
6-201
6-300
6-302
6-525
6-526
6-575
6-576
6-700
6-701
7
7-100
11-117
11-158
11-500 (AA-AC)
17
17-100
29-134
29-136
37
37-100
39-51
47
57
67

NG: State AG (3); units-same as Active Army except allowance is one (1) copy to each unit.

USAR: None.

For explanation of abbreviations used, see AR 310-50.

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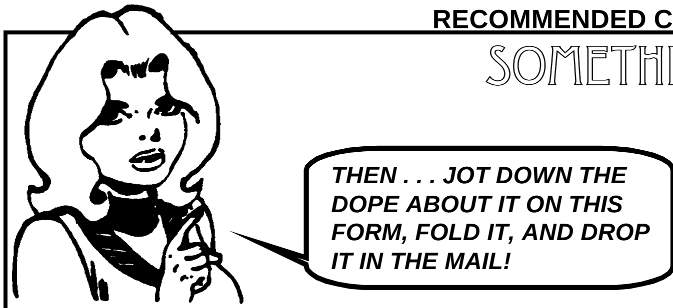

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