TM 11-6605-200-35

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

FIELD AND DEPOT MAINTENANCE MANUAL

COMPASS, MAGNETIC, AIRCRAFT J-2 SYSTEM

HEADQUARTERS, DEPARTMENT OF THE ARMY

11 MAY 1960

WARNING

HIGH VOLTAGE

is used in
this equipment.

DEATH ON CONTACT

may result if safety precautions
are not observed.

TECHNICAL MANUAL
No. 11-6605-200-35

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *11 May 1960*

COMPASS, MAGNETIC, AIRCRAFT J-2 SYSTEM

***TM 11-6605-200-35, together with TM-11-6605-200-12, 14 May 1959, supercedes TM-11-5559, 10 January 1957, including C1, 21 February 1958, and TM 11-5560, 10 January 1957.**

CHAPTER 1

INTRODUCTION

I. Scope

a. This manual covers theory and field and depot maintenance for Compass, Magnetic, Aircraft J-2 System and for the auxiliary equipment used with the *compass system*. It includes instructions appropriate to third, fourth, and fifth echelons for troubleshooting, testing, aligning, and repairing the compass system and its auxiliary equipment. It also lists tools, materials, and test equipment for third, fourth, and fifth echelon maintenance.

b. The complete technical manual for this equipment includes TM 11–6605–200-12, TM 11-6605-200-12P, and TM 11-6605-200-35P.

c. Forward all comments concerning this manual to the Commanding Officer, U. S. Army Signal Publications Agency, Fort Monmouth, N. J.

Note: For applicable forms and records, see TM 11-6605-200-12.

2. Internal Differences in Models

Internal differences in Amplifiers, Electronic Control Type A-2 are listed below. For external differences in the components of the compass system, refer to TM 11–6605–200–12.

a. Output Amplifier V403. Amplifiers, Electronic Control Type A-2 bearing a letter C after the serial number use a standard JAN-type 12SN7GT tube (FSN 5960-100-7083) for output amplifier V403. Units that do not bear the letter C use a special-type 12SN7 tube, manufacturer's part number 824476.

b. Potentiometer R419. Amplifiers, Electronic Control Type A-2 bearing serial numbers below 1650 do not contain potentiometer R419. Units bearing serial number 1650 or higher have potentiometer R419 connected in the grid circuit of output amplifier V403. The potentiometer is adjustable to correct for unbalance in output amplifier V403 (par. 40).

c. Fuses. In some Amplifiers, Electronic Control Type A-2, fuse F401 in the input circuit to power transformer T403 may be ¼ ampere. These fuses should be replaced with ¾ ampere fuses. Units with the letter B added to the serial number are supplied with ¾-ampere fuses installed.

CHAPTER 2

THEORY

3. General Theory

The compass system consists of an indicator, an amplifier, a flux valve, a compensator, and a gyro (TM 11–6605-200-12) and uses the earth's magnetic field for orientation. Block diagram analysis of the compass system is covered in paragraph 4. Circuit analysis of Amplifier, Electronic Control Type A-2 is covered in paragraph 5. Circuit analysis of the other components of the compass system is not included because all other components are maintained by replacement. To facilitate analysis of the compass system, characteristics of a gyro are covered in *a* below and characteristics of the earth's magnetic field are covered in *b* below.

a. Characteristics of Gyro. A gyro is a wheel or rotor which spins so rapidly that its spin axis tends to remain in a fixed position. The important characteristics of a gyro are: rigidity, drift, and precession.

(1) *Rigidity.* A gyro resists any force that attempts to change the direction of its spin axis. This characteristic is called *rigidity.* If a gyro is mounted in an aircraft with its spin axis oriented as shown in A, figure 1, it establishes a fixed reference position within the aircraft. A change in aircraft heading results in the aircraft assuming a new position with respect to the gyro spin axis (B, fig. 1).

(2) *Drift.* The characteristic that causes a gyro to change the direction of its spin axis is referred to as *drift.* There are two types of drift that may change the direction of the spin axis of a gyro: *random* drift, and *apparent* drift. Random drift is caused by bearing friction and rotor unbalance. Random drift may cause variations up to 8° per hour. Apparent drift is caused by the earth's rotation and may cause

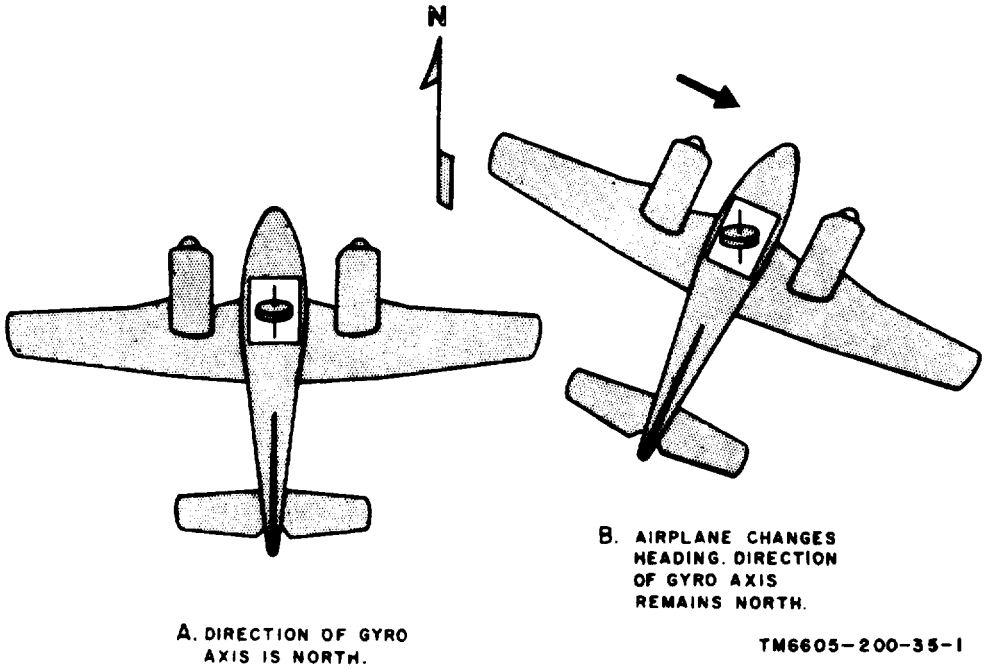


Figure 1. Rigidity characteristic of gyro mounted in an aircraft.

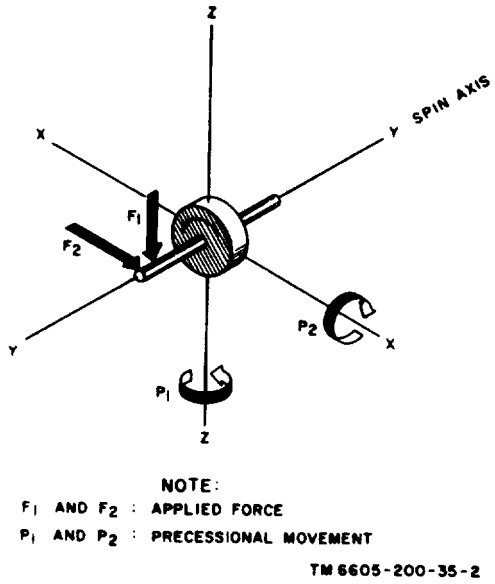


Figure 2. Precission characteristics of gyro.

variations Up to 15° per hour.

(3) *Precession.* The spin axis of a gyro may be made to move in response to an applied force. This movement of the spin axis is called *precession.* Figure 2 shows the precessional movements of a gyro rotor as a result of applied forces. The precessional movements are at right angles to the direction of the applied forces and in the direction of the gyro rotation. When force F1 is applied, perpendicular to the spin axis, in the vertical plane (YZ), the precessional movement is as indicated by P1. When force F2 is applied, perpendicular to the spin axis, in the horizontal plane (XY), the precessional movement is as indicated by P2.

b. Characteristics of Earth's Magnetic Field. The earth's magnetic field consists of stationary lines of force that surround the earth and extend high into the atmosphere (TM 11–6605-200–12). The stationary lines of force. have a horizontal component which is tangent to the earth's surface and referred to as the *magnetic meridian.* The magnetic meridian is used to orient the gyro in the compass system.

4. Block Diagram Analysis
(fig. 3)

The compass system provides a visual indication of the aircraft heading (*a* below). A detection system detects drift in the gyro (*b* below) . A compensating system stabilizes the gyro when drift or a change in leveling occurs (*c* below).

a. Aircraft Heading. The gyro is oriented with respect to the magnetic meridian (par. *3b).* The stator of the gyro unit heading synchro is fixed to the aircraft frame and changes position when the aircraft heading changes. The rotor of the gyro unit heading synchro is mechanically linked to the gyro. The aircraft heading with respect to the magnetic meridian is represented by the position of the stator and rotor of the gyro unit heading synchro. The rotor in the gyro unit heading synchro develops a signal in the stator. The signal in the stator of the gyro unit heading synchro is applied to the stator of the indicator

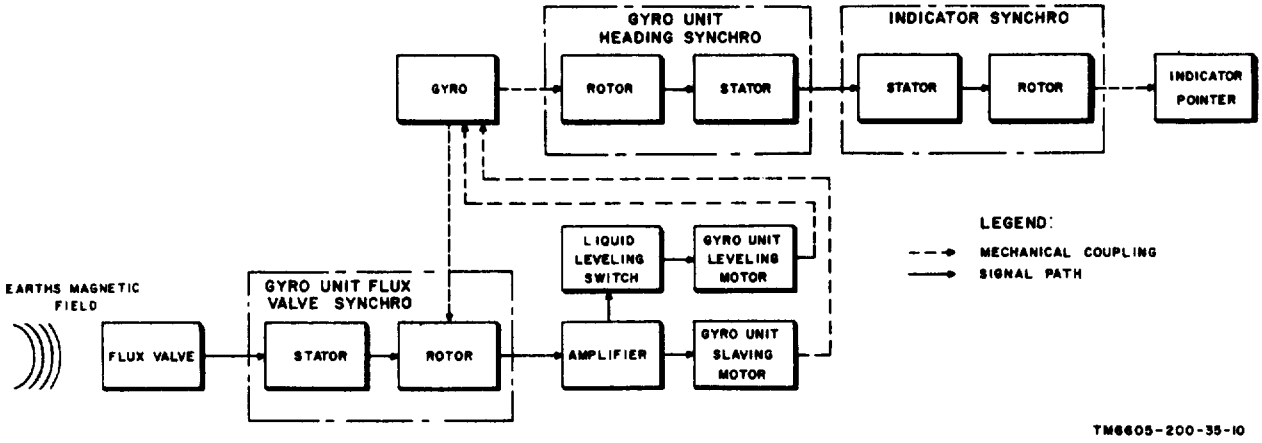


Figure 3. Compass system, block diagram.

synchro. The signal in the stator of the indicator synchro positions its rotor. The rotor of the indicator synchro mechanically positions the indicator pointer. Thus, the indicator pointer provides a visual indication of the aircraft heading.

b. Drift Detection. The rotor of the gyro unit flux valve synchro is mechanically linked to the gyro. The stator of the gyro unit flux valve synchro is fixed to the aircraft frame and changes position when the aircraft heading changes. A signal, developed in the flux valve by the earth's magnetic field, is applied to the stator of the gyro unit flux valve synchro. The position of the rotor in the gyro unit flux valve synchro determines whether a signal will be coupled from the stator to the rotor. If drift has occurred in the gyro, a signal will be developed in the rotor of the gyro unit flux valve synchro. When a signal is developed by the rotor of the gyro unit flux valve synchro, it is applied to the amplifier for amplification.

c. Stabilization.

(1) Drift. The signal from the amplifier is applied to the gyro unit slaving motor, which is mechanically linked to the gyro. The operation of the gyro unit slaving motor causes a precessional movement of the spin axis of the gyro (par. *3a* (3)). When the spin axis of the gyro is repositioned, the rotor of the gyro unit flux valve synchro, which is mechanically linked to the gyro, is repositioned so that nu signal is applied to the amplifier (*b* above).

(2) *Leveling.* If the leveling of the gyro is changed, a voltage is applied from the amplifier through the liquid leveling switch to the gyro unit leveling motor (par. *5f).* The gyro unit leveling motor is mechanically linked to the gyro. The voltage applied to the gyro unit leveling motor relevels the gyro and the signal is removed from the gyro unit leveling motor.

5. Circuit Analysis of Amplifier, Electronic Control Type A-2

a: Input Amplifier V401. The flux valve fig. 3) applies an 800-cycle signal (error signal) through the gyro unit flux valve synchro to pins E and F or connector J401 (fig. 4) to the A-section of input amplifier V401. Both sections of input amplifier V401 amplify the error signal which is coupled through transformer T401 to demodulator V402. Resistor R402 is a cathode-biasing resistor for the A-section of input amplifier V401. Resistor R406 is the plate load resistor. Resistor R407 and capacitor C403 make up a decoupling network. Capacitor C402 is a coupling capacitor and resistor R405 is the grid return for the B-section of input amplifier V401. Resistor R404 is a cathode-biasing resistor. Resistor R401 and capacitor C401 provide feedback from the B-section to the A-section of input amplifier V401. Transformer T401 provides transformer coupling from input amplifier V401 to demodulator V402.

b. Rectifier V404. Rectifier V404 supplies an 800-cycle reference signal ((1) below) for demodulator V402, and B+ voltage ((2) below) for the various stages in the amplifier.

(1) *Reference signal.* A 400-cycle voltage from the aircraft power supply is applied through pins A and C of connector J401 and fuse F401 to the primary of transformer T403. Rectifier V404 rectifies the voltage from the secondary of transformer T403 to a direct current (dc) voltage which contains an 800-cycle ripple voltage. The 800-cycle ripple voltage is coupled through capacitor C406, and through dropping resistor R410, to a tuned circuit consisting of choke L403, resistor R417, and capacitors C1 and C2. The tuned circuit converts the 800-cycle ripple voltage into a reference signal (800 cycles). The reference signal is applied in parallel through current-limiting resistors R408 and R409 to the grids of demodulator V402.

(2) *B+ voltage.* Choke L401 and capacitor C408 filter the 800-cycle ripple voltage to provide the B+ voltage for input amplifier V401. The unfiltered 800-cycle ripple voltage is applied to output amplifier V403.

c. *Demodulator V402.* The signal from V401

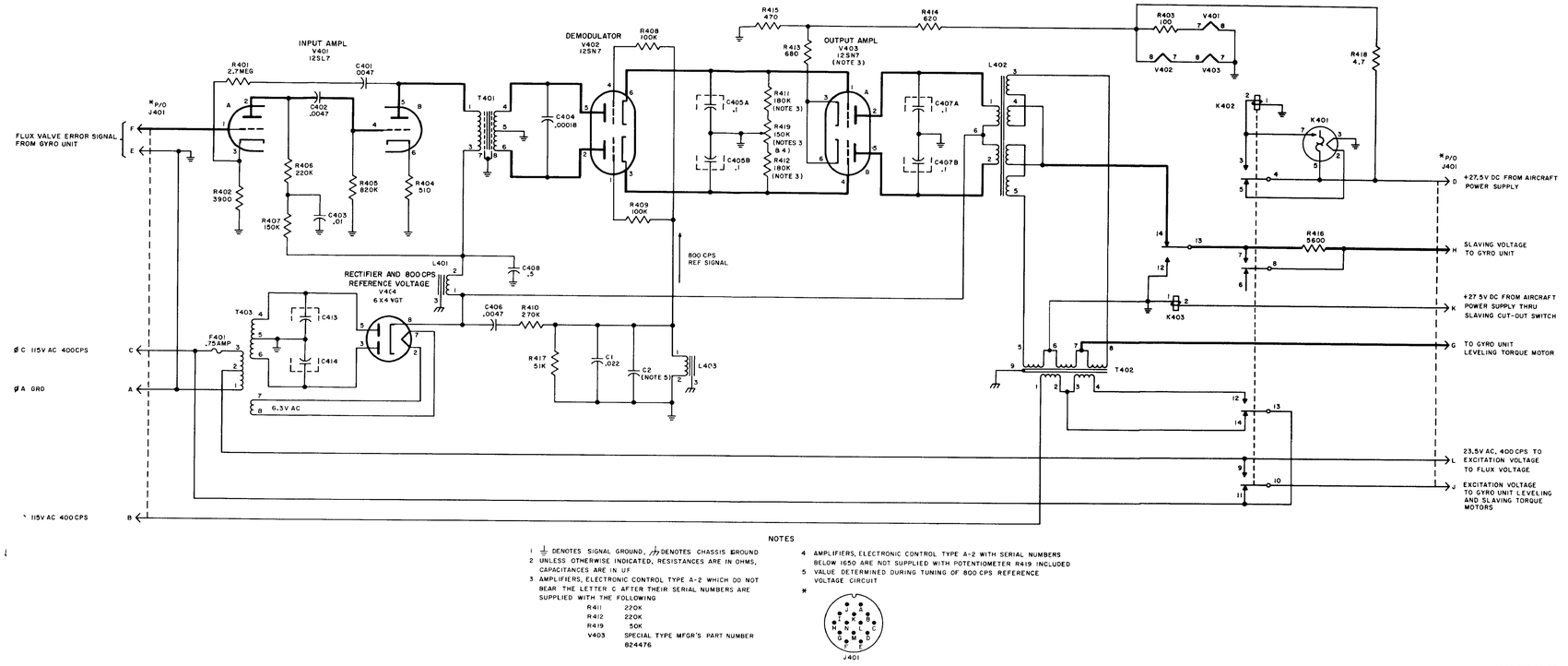


Figure 4. Amplifier, Electronic Control Type A-2, schematic diagram

(a above) is mixed with the reference signal (*b* (1) above) in demodulator V402. Demodulator V402 is a phase comparator circuit. When the input signal from V401 is in phase with the reference signal, the output. voltage developed across resistors R411, R412, and R419 (balancing potentiometer) is balanced and in effect is cancelled (no gyro drift). When the input signal from V401 is out of phase with the reference signal, a direct current (dc) output voltage is developed across either R411 or R412 (depending on the direction of gyro drift). The output voltage developed across resistors R411 and R412 is applied to push-pull output amplifier V403A and V403B, respectively *(d* below). Capacitors C405A and C405B filter the voltage developed across resistors R411, R412, and balancing potentiometer R419 to dc. Capacitor C404 and the secondary of transformer T401 forms a tuned circuit for the error signal (800 cycles).

d. Output Amplifier V403. The voltage applied in push-pull to the grids of output amplifier V403 determines whether section A or B conducts. When section A conducts, current will flow through the 1-6 winding of saturable reactor L402. If section B conducts, current will flow through the 2-6 winding of saturable reactor L402. Capacitors C407A and C407B are alternating current (at) bypass capacitors. When current flows through the 1-6 winding of saturable reactor L402, the 3-4 winding is saturated. When current flows through the 2-6 winding of saturable reactor L402, the 4-5 winding is saturated. Resistors R413 and R415 are cathode-biasing resistors. Voltage-dropping resistors R414 and R418 connect through pin D of connector J401 to 27.5 volts dc in the aircraft power supply and develop a fixed bias across resistor R415. Filament voltage for input amplifier V401, demodulator V402, and output amplifier V403 is also obtained from pin D of connector J401 through voltage-dropping resistor R418. Resistor R403 is a voltage-dropping resistor.

e. Slaving Circuit. The output of the amplifier (fig. 3) is applied to the gyro unit slaving motor to reposition the gyro when it drifts. Secondary winding 3-5 (fig. 4) of saturable reactor L402 is connected across secondary winding 5-8 of transformer T402. A 400-cycle voltage obtained from the aircraft power supply is applied through pins B and C of connector J401 to the primary winding of T402. Contacts 12, 13, and 14 of relay K402 determine whether the 400-cycle voltage is applied across the complete primary winding (1-4) or half of the primary winding (1-2). The resultant output (phase relationship of which depends on the saturated winding of saturable reactor L402 (d above)) is applied through contacts 13 and 14 of relay K403 and current-limiting resistor R416 to pin H of connector J401. The voltage from pin H of connector J401 supplies one winding of the gyro unit slaving motor (standard ac motor). The voltage for the other winding of the gyro unit slaving motor is obtained from pin J of connector J401. Contacts 9, 10, and 11 of rate relay K402 determine the amount of voltage present at pin J of connector J401.

f. Leveling Circuit. The output of the amplifier (fig. 3) is also applied through the liquid leveling switch to the gyro unit leveling motor. The voltage developed across secondary winding 6-7 of transformer T402 (fig. 4) is applied through pin G of connector J401 to one of the windings of the gyro unit leveling motor through the liquid leveling switch. The voltage for the other winding is obtained from pin J of connector J401 (e above).

g. Thermal Relay K401. Thermal relay K401 controls the dc voltage applied to rate relay K402 from pin D of connector J401 Thermal relay K401 requires approximately 3 minutes to energize.

h. Rate Relay K402. The contacts of rate relay K402 in the deenergized position provide voltages for the gyro unit slaving motor *(e* above) and the gyro unit leveling motor *(f* above) for fast slaving operation. This enables the gyro to become fully oriented within 3 minutes after power is applied. The contacts of rate relay K402 in the energized position provide voltage for the gyro unit slaving and leveling motors for slow slaving operation.

i. Slaving Relay K403. The contacts of slaving relay K403 in the deenergized position allow the voltage to be applied to the winding of the gyro unit slaving motor. When energized, slaving relay K403 grounds the winding of the gyro unit slaving motor to prevent the motor from operating.

CHAPTER 3

TOOLS AND TEST EQUIPMENT REQUIRED FOR MAINTENANCE

Section 1. TOOLS AND TEST EQUIPMENT

6. General

The tools and test equipment listed in paragraph 7 are required for third, fourth, and fifth echelon maintenance of the ccmpass system and its auxiliary equipment (par. 48-58). A compass system and a system junction box (TM 11-6605-200-12) are required in addition to the tools and test equipment listed in paragraph 7.

7. Tools and Test Equipments Required

Item	Echelon where used			References
	3	4	5	
Audio Oscillator TS-421/U		X	X	TM 11-2649
Capacitor decade (p/o Laboratory Standards AN/URM-2)		X	X	
Electronic Multimeter TS-505/U or equivalent	X	X	X	TM 11-5511
Field Tester TS-1086/U	X	X		TM 11-6625-247-15
Frequency Meter AN/USM-26		X	X	TM 11-5057
Multimeter AN/URM-105	X	X	X	TM 11-6625-203-12
Oscilloscope OS-8A/U	X	X	X	TM 11-1214
Stand, J-2 Mockup			X	Paragraphs 8 through 12
Stop Timer FM-103(1)	X	X	X	
Test jig for Amplifier, Electronic Control Type A-2	X		X	Paragraphs 13 and 14.
Test jig for Repeater Amplifier Type B-7A		X	X	Paragraphs 15 and 16.
Test Set, Electron Tube TV-2/U or equivalent			X	TM 11-2661
Test Set, Electron Tube TV-7/U or equivalent	X	X		TB 11-5083-1
Tool Equipment TE-113	X	X	X	SIG 6 TE-113
Voltmeter Meter ME-30A/U	X	X	X	TM 11-5132

Section II. STAND, J-2 MOCKUP

8. Purpose and Use

Stand, J-2 Mockup (mockup) (FSN 6605-391–0382) is available for maintenance at fifth echelon. The mockup provides a convenient means of physically locating and electrically interconnecting all components of the compass system. The mockup also provides a means of testing the operation of a repaired component in a compass system, the other components of which are known to be good.

9. Description and Data

(fig. 5)

a. Description. The mockup consists of a steel test bench with sufficient working area for locating all the components of a compass system, auxiliary equipment, and associated test equipment. The mockup includes a vertical stand for mounting the flux valve, a test panel and chassis assembly, and a turntable assembly for mounting the gyro unit. Twelve cables for interconnecting the compass system components and auxiliary equipment extend from the test panel and chassis assembly.

b. *Technical Data.*

(1) *Input power required for mock-up*

with compass system installed.

Voltage:

Ac . . . . . .115 volts ±10 percent, 400 cps, 3-phase.

Dc . . . . . .27.5 volts ±10 percent.

Power:

Ac :

Starting . . . . . .161 watts (225 watts with Repeater Amplifier Type B-7A included).

Operating . . . . . 28 watts (92 watts with Repeater Amplifier Type B-7A included).

Note: Add 3.4 watts for each auxiliary indicator used (maximum of six).

Dc :

Starting . . . . . 18.5 watts (39.1 watts with Repeater Amplifier Type B-7A included).

Operating . . . . . 16.2 watts (36.8 watts with Repeater Amplifier Type B-7A included).

(2) *Cables supplied with mockup.*

Cable number	Quantity	Used for connecting
T-100964-800	1	Dc power input
T-100964-801	1	Ac power input
T-100964-900	1	Flux valve
T-100964-901	1	Amplifier
T-100964-902	1	Gyro unit
T-100964-903	1	Repeater amplifier
T-100964-904	6	Indicators

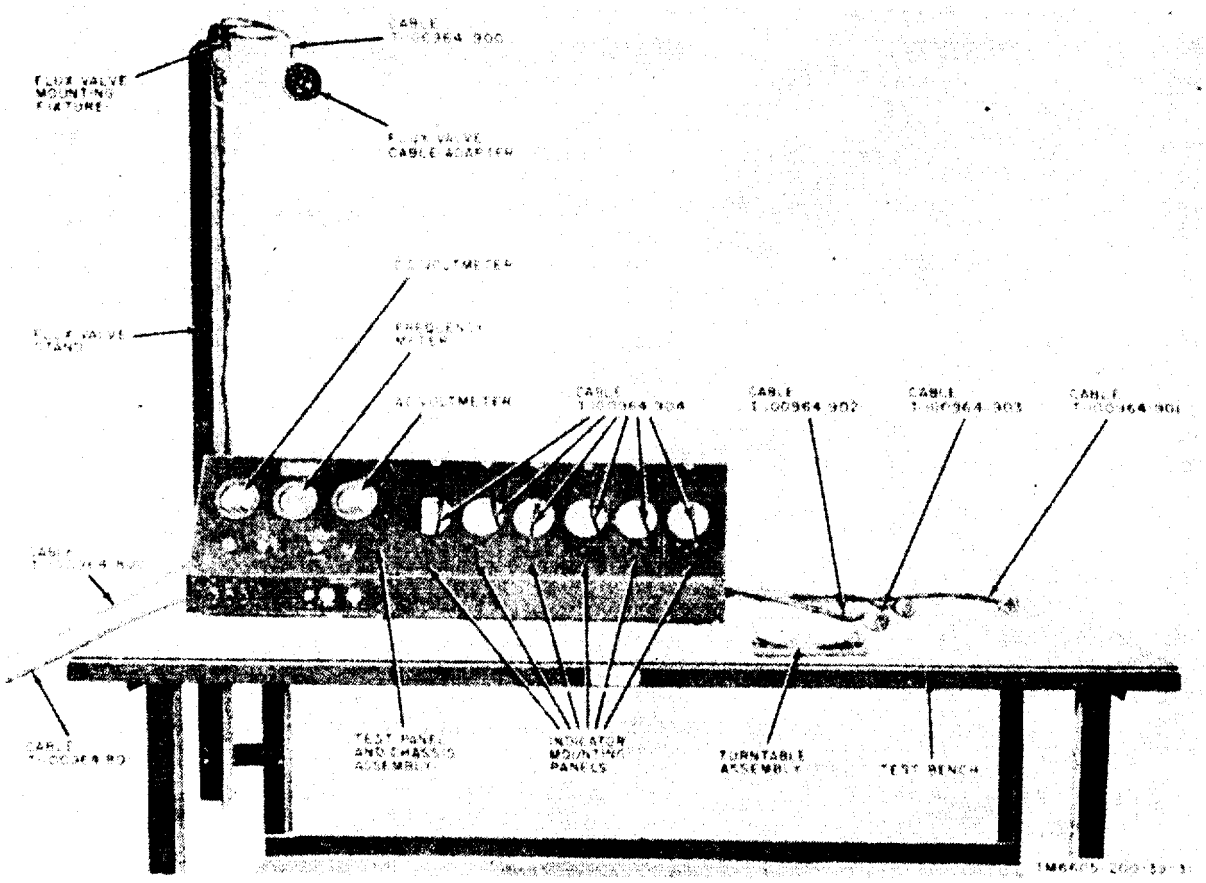


Figure 5. Stand, J-2 Mockup.

(3) *Fuses.* Three protective fuses are installed in the front of the mockup test panel. The panel markings and function of these fuses are as follows:

Panel marking	Function
DC 2A	2-ampere fuse to prevent equipment damage due to overloading the dc input.
ØB 1A	1-ampere fuse to prevent equipment damage due to overloading the ac phase B input.
ØC 3A	3-ampere fuse to prevent equipment damage due to overloading the ac phase C input.

10. Controls and Indicators
(fig, 5)

Control, indicator, or connector	Function
POWER switch	Two-position 4 pst switch: Control ac and dc input to mockup. *Position* — *Function* ON — Connects 11.5 vac, 400-cps, 3-phase. and 27.5 vac to mockup input circuit. OFF — Disconnects both ac and dc power from input circuit of mockup.
INPUT switch	Controls input signal voltage distribution to indicators. *Position* — *Function* S1 CONTROL — Connects output from heading synchro in gyro unit to indicators 4, 5, and 6, (B-7A amplifier not in use). B-7 AMPLIFIER — Connects output from heading synchro in gyro unit to indicators 4, 5, and 6, and to input circuit of B-7A amplifier when indicators 1, 2, and 3 are used.
PHASE ROTATION switch	Two-position dpst switch: Controls ac voltage input to phase rotation indicator circuit. *Position* — *Function* ON — Connects 115 vac, 400-cps, 3-phase voltage to input of phase rotation indicator circuit. OFF — Disconnects ac voltage from input of phase rotation indicator circuit.
PHASE ROTATION DIM and BRIGHT indicator lamps	Indicate phase rotation of ac input voltage.
A. C. indicator lamp	Indicates when ac input power is applied to mockup.
D. C. indicator lamp	Indicates when dc Input power is applied to mockup.
Ac voltmeter	Measures ac input voltage applied to mockup.
Dc voltmeter	Measures dc input voltage applied to mockup.
Frequency meter	.Measures frequency of ac input voltage applied to mockup.

11. Installation of Mockup

Locate the mockup convenient to an ac-dc input power source (par. *9b* (1)). External magnetic influences will affect the compass system operation; therefore, the mockup should be located where the magnetic effect of rotating machinery and other equipments are at a minimum.

a. Operate the POWER and PHASE ROTATION switches to their OFF positions.

b. Connect cable T-100964-800 to a 27.5-volt

(±10 percent) dc source of power.

c. Connect cable T–100964-801 to a 115-volt (±10 percent), 400-cps three-phase power source.

12. Installation of Compass System Components in Mockup

(fig. 5 and 6)

Components of the compass system used with the mockup are installed as follows:

a. Transmitter, Induction Compass T-611/ASN.

(1) Remove the top cover plate from the flux valve.

(2) Place the flux valve in its mounting fixture on the top of the flux valve stand.

(3) Position the holding springs on the mounting fixture over the flux valve mounting flange and tighten the thumbscrews that secure the holding springs in place.

(4) Position the flux valve cable adapter (attached to cable T-100964-900) on the top of the flux valve and tighten the thumbscrews that secure the adapter in place.

b. Control, Electrically, Driven Gyro Type S-3(*).

(1) Position the gyro unit on the turntable assembly so that the three mounting holes in the gyro unit base are aligned with the holes in the turntable assembly.

(2) Insert the three mounting bolts into the gyro unit mounting holes and tighten them to secure the gyro unit in place.

(3) Connect cable T-100964-902 to receptacle J9 on the gyro unit.

(4) Tighten the thumbscrew on the right front of the turntable assembly to lock the turntable (and gyro unit) in the desired test position.

c. Amplifier, Electronic Control Type A-2.

(1) Position the amplifier on the test bench top near the right rear corner of the bench.

(2) Connect cable T-100964-901 to receptacle J401 on the amplifier.

d. Repeater Amplifier Type B-7A.

(1) Position Repeater Amplifier Type B-7A (not shown) on the test bench top to the left of Amplifier, Electronic Control Type A-2.

(2) Connect cable T-100964-903 to receptacle J20 on the repeater amplifier.

e. *Installation of Indicator When Repeater Amplifier Type B-7A Is Not Used.*

Note. The indicator cutout on each of the indicator mounting panels will require modification to accommodate Indicator, Induction Compass Type V-7A and Type V-8.

(1) Install each indicator in one of the indicator mounting panels (marked 4, 5, or 6) and lock each indicator in place with the locking spring inside the mounting panel.

(2) Connect cable T-100964-904 to receptacle J801 of each indicator.

f. Installation of Indicators When Repeater Amplifier Type B-7A is Used.

(1) Install each compass system indicator as in e above.

(2) Install each additional indicator in one of the indicator mounting panels (marked 1, *2,* or 3), and lock each indicator in place with the locking spring inside the mounting panel.

(3) Connect cable T-100964-904 to receptacle J801 of each indicator.

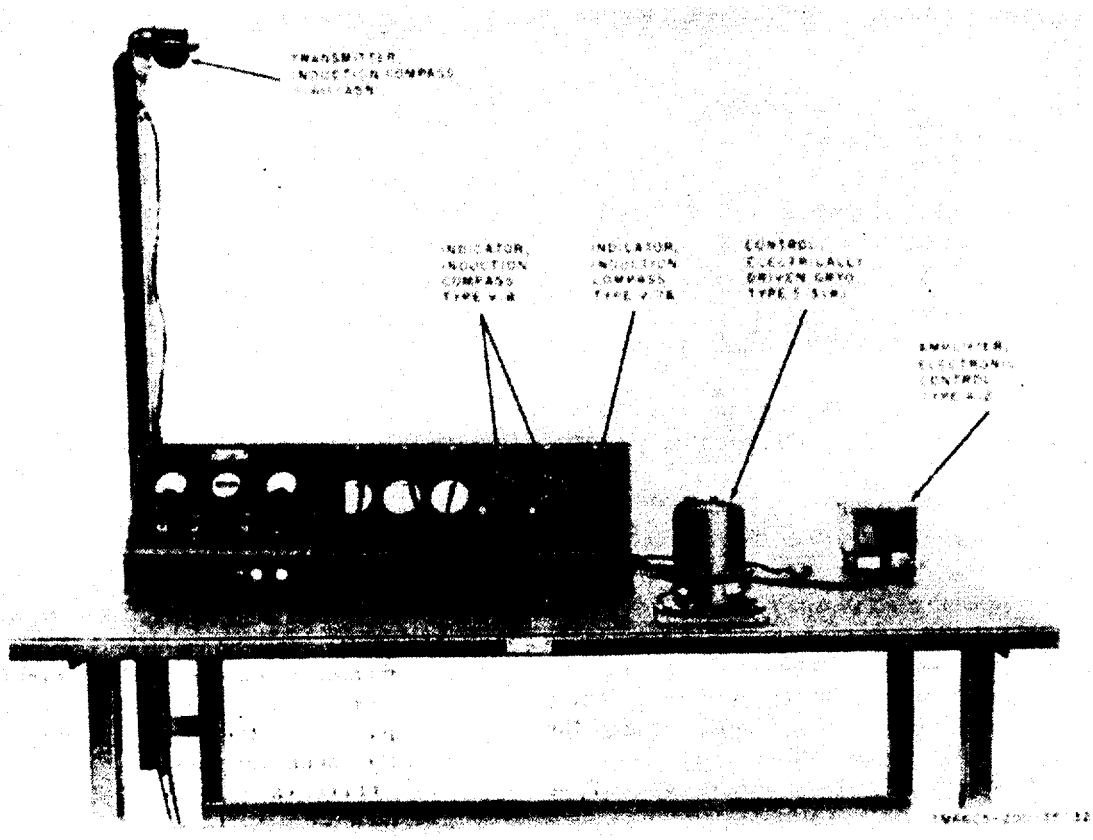


Figure 6. Stand, J-2 Mockup, with compass system components installed.

Section III. TEST JIG REQUIRED FOR AMPLIFIER, ELECTRONIC CONTROL TYPE A-2

13. General

a. A test jig must be constructed for fifth echelon final tests of Amplifier, Electronic Control Type A-2. Materials required are listed in *b* below; figure 7 is the schematic diagram, and figure 8 is a control-location diagram. The function of each control, indicator, and ccnnector is described in paragraph 14.

b. In addition to the materials listed in the following chart, a suitable chassis and a sufficient amount of shielded and unshielded wire (#20AWG) are required.

Quantity	Item	Federal stock number	Reference Designation
1	Ac voltmeter, 0 to 1 ma movement. w/ 0 to 50 and 0 to 150 vac ranges.		M2
4	Binding posts, for external meter connections	5940-242-0963	E1 through E1
1	Capacitor, fixed, 0.0047 uf ±10 percent, 500 vdcw.	5910-101-3847	C1
1	Capacitor, fixed, 0.022 uf ±10 percent, 1,200 vdcw.	5910-101-4740	C2
1	Capacitor, fixed, selected for tuning reactor L1 (par. 44).		C3
1	Connector, AN3106A-20-27S, w/adapter AN 3057-12.		P2
1	Connector, AN 3106A-14S-2S, w/adapter AN 3057-6.		P1
1	Dc voltmeter, 0 to 30 vdc scale.		M1
1	Electron tube, type 6x4	5960-166-7661	V1
1	Fuse, cartridge, 1 ampere	5920-050-0598	F1
2	Fuse, cartridge, 2 ampere	5920-280-5027	F2, F3
1	Fuseholders	5920-221-5671	
3	Knobs	5355-376-9457	
1	Potentiometer, 0 to 50,000 ohms, 1 watt.	5905-549-9885	P1
1	Reactor, fixed, 1 to 1.35 henries	5915-327-4788	L1
1	Resistor, fixed, 100K ±10 percent, ½ watt	5905-195-6761	R1
1	Resistor, fixed, 50,000 ohms ½ watt (select from stock, FSN 5905-279-3496)		R2
1	Resistor, fixed, 200K ±5 percent, 2 watts	5905-114-2249	R3
1	Resistor, fixed, 400K ½ watt (select from stock, FSN 5905-114-1710)		R4
1	Resistor, fixed, 51,000 ohms ±10 percent, ½ watt	5905-279-3496	R5
1	Resistor, fixed, 3,500 ohms ±5 percent, 10 watt	5905-229-3302	R7
1	Socket, electron tube, w/8 pins for V1	5935-201-8532	XV I
2	Switch, spdt	5930-258-4301	S2, S1
1	Switch, dpdt	5930-199-9440	S3
1	Switch, 3pst	5930-258-4296	S5
1	Switch, rotary, 5-position	5930-244-3377	S1
1	Terminal board with a minimum of four terminals	5940-199-1013	TB1
1	Transformer, primary: 115 v, 400 cps single phase: secondary: 600v at 0.02 ma, 23 v at 0.15 ma, 6.3 v at 0.06 ma	5950-648-6738	T1
1	Transformer, audiofrequency, primary: 2,880 ohms; secondary: 4,500 ohms tapped at 2,750 ohms	5950-487-7904	T2
1	Transformer, audiofrequency, primary: 500 ohms; secondary: 50,000 ohms	5950-239-9455	T3

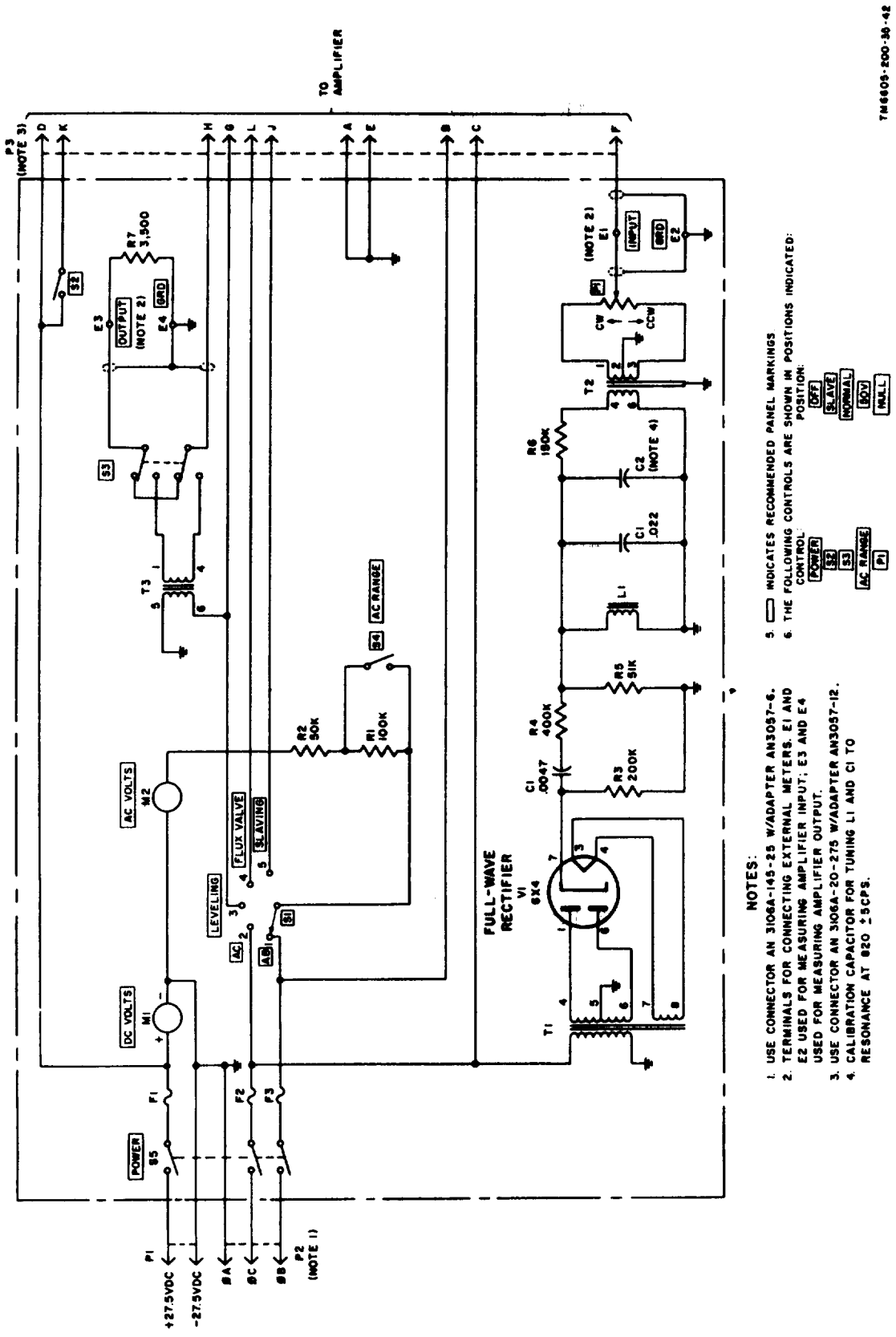


Figure 7. Schematic diagram of test jig for Amplifier, Electronic Control Type A-2.

14. Controls and Indicators

(fig. 8)

Control, indicator, or Connector	Function
POWER switch	3 pst switch: Controls application of input power to test jig. *Position* — *Function* *ON* — Connects ac and dc power to test jig. OFF — Disconnects ac and dc power from test jig.
S1 switch	Five-position rotary switch: Connects ac voltmeter on test jig to measure voltages as follows: *Position* — *Measurement* AB — Ac input to test jig (ØA to OB). AC — Ac input to teat jig (ØA to OC). LEVELING — Ac voltage output from amplifier to leveling torque motor. FLUX VALVE — Ac excitation voltage output from amplifier to flux valve. SLAVING — Ac voltage output from amplifier to slaving torque motor.
S-2 switch	Two-position spdt switch: Allows amplifier to simulate operation in the slaved and free modes. *Position* — *Function* CUTOUT — Connects dc voltage to operate relay K403 in amplifier. SLAVE — Removes dc operating voltage from relay K403 in amplifier.
AC RANGE switch	Two-position spdt switch: Connects proper resistance value to meter for range selected. *Position* — *Function* 50V — Shorts out resistor R1 in the test jig ac meter circuit. 150V — Connects resistor R1 to the test jig ac meter circuit.
S-3 switch	Two-position dpdt switch: Permits examination of the polarity of amplifier output signal for simulated clockwise and counter-clockwise changes in aircraft heading. *Position* — *Function* NORMAL — Permits measurement of output of amplifier to slaving torque motor. PHASE COMPARISON — Combines output of amiplifier to slaving and leveling torque motors, with the leveling torque output used as the reference phase.
P1 potentiometer	Adjusts input signal values to amplifier which simulate clockwise and counterclockwise changes in aircraft heading from a steady (null) position.
DC VOLTS meter	Checks the dc voltage applied from the power source to the test jig.
AC VOLTS meter	Checks the ac voltage applied from the power source to the test jig.
INPUT-GRD binding posts (E1 and E2)	Connects an ME-30A/U to measure input signal voltages applied from the test jig to the amplifier.
OUTPUT-GRD binding posts (E3 and E4)	Connects an ME-80A/U to measure output signal voltages supplied from the amplifier in response to test conditions.

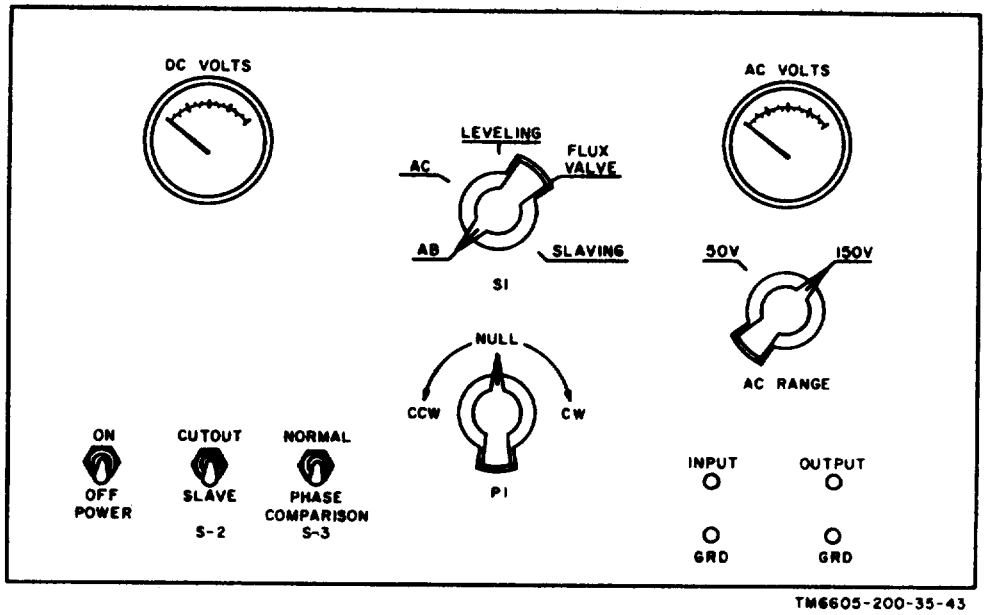


Figure 8. Control-location diagram of test jig for Amplifier, Electronic Control Type A-2.

Section IV. TEST JIG REQUIRED FOR TESTING REPEATER AMPLIFIER TYPE B-7A

15. General

a. A test jig must be constructed for fourth and fifth echelon final tests of Repeater Amplifier Type B-7A (auxiliary equipment). Materials required are listed in *b* below; figure 9 is the schematic diagram, and figure 10 is a control-location diagram. The function of each control, indicator, and connector is described in paragraph 16.

b. In addition to the items listed in the following chart, a suitable chassis and a sufficient amount of wire (#20AWG) are required.

Quantity	Item	Federal stock number	Reference Designation
2	Binding posts	5940-242-0963	E1, E2
1	Cable assembly, ac power input, 2 conductor, No. 18 AWG wire, w/appropriate connector.		W1
1	Cable assembly, dc power input, 2-conductor, No. 18 AWG wire, w/appropriate connector.		W2
1	Cable assembly, 10 conductor, w/connector AN 3106A-18-1S	5995-280-4189	W3
1	Fuse, 1 ampere	5920-050-0598	F 1
1	Fuse, 2 ampere	5920-280-5027	F 2
1	Fuse holder	5920-240-4085	
2	Knobs	5355-376-9457	
1	Potentiometer, 1,000 ohms	5905-192-1107	R 1
1	Resistor, 400 ohms ±5 percent, 8 watts	5905-186-2417	R 2
1	Switch, dpst	5930-258-4227	S 1
2	Switch, dpdt	5930-199-9440	S3, S4
1	Switch, 3pdt	5930-763-4164	S 2
1	Terminal block w/4 terminals	5940-199-1013	TB 1
1	Terminal block w/9 terminals	5940-192-6662	TB 2
1	Transformer, 115 vac primary, w/secondary winding 18 vac ±20 percent		T1

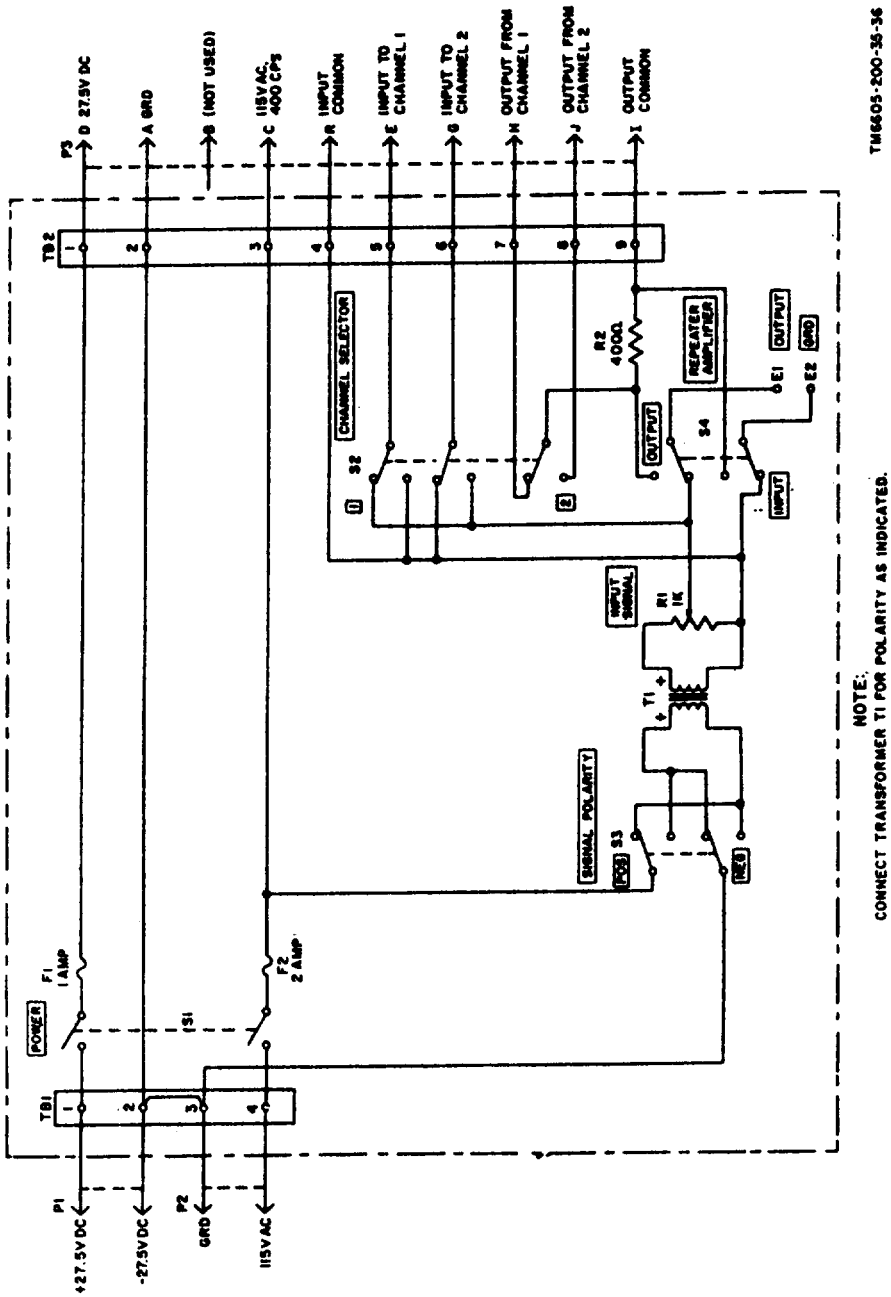


Figure 9. Test jig for Repeater Amplifier Type B-7A, schematic diagram.

16. Test Jig Controls and Indicators

(fig. 10)

Control. indicator. or connector	Function
POWER ON-OFF switch	Two-position dpst switch: Connects input power to test jig. *Position* — *Function* ON — Connects 115 vac to primary of T1 and 27.5 vdc to repeater amplifier through test jig. OFF — Disconnects sc and dc input power from test jig.
CHANNEL SELECTOR switch	Two-position 3 pdt switch: Selects the amplification channel to be tested. *Position* — *Function* 1 — Connects input signal to channel 1 and output signal to meter binding posts. 2 — Connects input signal to channel 2 and output signal to meter binding posts.
SIGNAL POLARITY switch	Two-position dpdt switch: Reverses the input ac connection to the primary of transformer T1. *Position* — *Function* POS — Connects ac ground to terminal 1 to T1. NEG — Connects ac ground to terminal 2 of T1.
REPEATER AMPLIFIER switch	Two-position dpdt switch: Connects meter to measure repeater amplifier input or output signal as required. *Position* — *Function* INPUT — Connects meter to measure input signal to repeater amplifier. OUTPUT — Connects meter to measure output signal from repeater amplifier.
INPUT SIGNAL (potentiometer)	Controls amount of Input signal voltage applied to repeater amplifier.
0UTPUT-GRD binding posts	Connects on ME-80A/U teat leads to test jig.

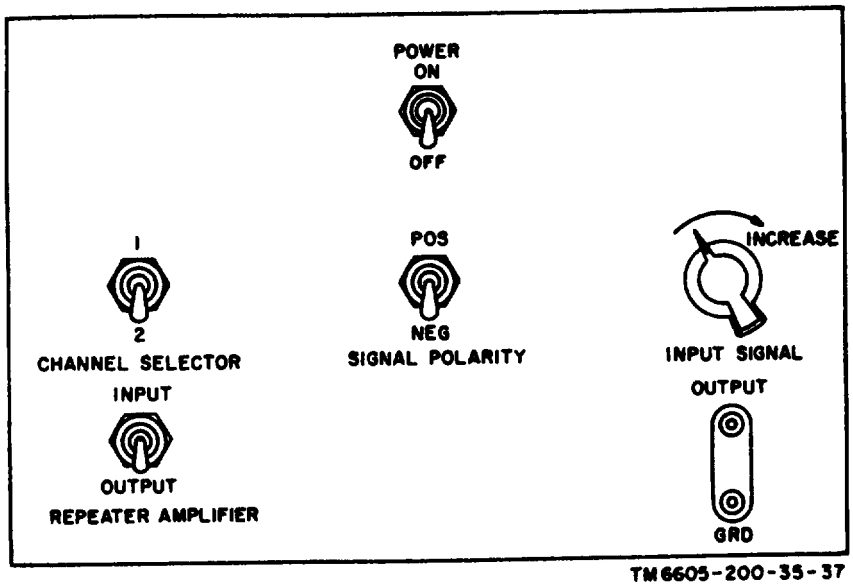


Figure 10. Control-location diagram of test jig for Repeater Amplifier Type B-7A.

CHAPTER 4

THIRD ECHELON MAINTENANCE OF COMPASS SYSTEM

Section I. INTRODUCTION

17. Scope of Maintenance

Third echelon maintenance for the compass system consists of the periodic checks outlined in paragraphs 19 through 21, and the troubleshooting, repair, testing, and calibration procedures in paragraphs 22 through 41. Except for replacing the humidity indicator plug ml the gyro unit (par. 19 *d),* no individual field or depot maintenance procedures are outlined fer the flux valve, compensator, gyro unit, and indicator; when these components become refective, as indicated by the results of system troubleshooting (par. 24), or require rebuilding (par. 18), they must be returned to the manufacturer through supply channels.

18. Maintenance Scheduling

a. General. Third echelon maintenance of the compass system is required whenever trouble is detected during flight or during the maintenance checks performed at the organibational level (TM 11–6605–200–12). In addition, scheduled periodic checks of compass system components and auxiliary equipment must be performed *(b* below). Compass system components and auxiliary equipment should be removed for periodic checks, or replaced for rebuilding, during the periodic inspection of the aircraft which is scheduled nearest the time when a compass system component is due for check or replacement. Tested components that are found to be completely serviceable should be reinstalled in the aircraft prior to completion of the aircraft inspection.

b. Test and Rebuild schedule for compass system components and Auxiliary Equipment.

Component	Hours of Operation		Months of inoperation	
	Test	Rebuilde	Test	Rebuilde
Amplifier, Electronic Control Type A-2	150-250 a		36c	
Compensator, Magnetic, Flux CN–405/ASN		On failure	18d	
Control, Electrically Driven Gym Type S-3(*)		1,500b		8
Indicator, Induction Compass Type B-7A		2,000		24
Indicator, Induction Compass Type V-8		2,000		
Repetiter Amplifier Type B-7A	150-250 a			
Transmitter, Induction Compass T-611/ASN		on failureb	18d	

a Perform third echelon periodic check of compass system (par. 19)
b When unit is replaced, perform a check of compass system calibration (par. 42).
c Perform periodic check of amplifier (par. 20).
d Perform slaving rate check in compass system test bench set-up (par. 28).
e Performed by manufacturer (par. 17).

Section II. PERIODIC CHECKS AND TROUBLESHOOTING

19. Periodic Check of Compass System

The third echelon periodic check of the compass system must be performed whenever Amplifier, Electronic Control Type A-2 and Repester Amplifier Type B-7A of an operational compass system are scheduled for test (par. 18).

a. Remove Amplifier, Electronic Control Type A-2 (par. 36) and Repeater Amplifier Type B-7A (par. 55) from the aircraft.

b. Perform the periodic check of Amplifier, Electronic Control Type A-2 (par. 20) and Repeater Amplifier Type B-7A (par. 21).

c. Replace Amplifier, Electronic Control Type

A-2 (par. 36) and Repeater Amplifier Type B-7A (par. 55) in the aircraft.

d. Perform a 25-hour check of the compass system as outlined in TM 11-6605-200-12. If the desiccant crystals of the humidity indicator plug have turned pink, use an adjustable wrench to remove the plug and replace it with a good one. (Blue crystals indicate active desiccant.)

e. Perform a check with power applied to the compass system (par. 26).

f. Perform a check of compass system calibration (par. 42 *d).*

20. Periodic Check of Amplifier, Electronic Control Type A-2

(fig. 11, 12, and 13)

The third echelon periodic check of Amplifier, Electronic Control Type A-2 is normally performed during the scheduled periodic check of the compass system (par. 19).

a. Remove the cover from the amplifier (par. 36 *b).*

b. Inspect all electron tubes for obvious defects; replace defective tubes as required (par. 29).

Note. When output amplifir tube V403 is replaced, adjustment of the output amplitler stage (par. 40) is required.

c. To reach the interior of the chassis, loosen the wing-head stud and raise the chassis from the bottom plate assembly.

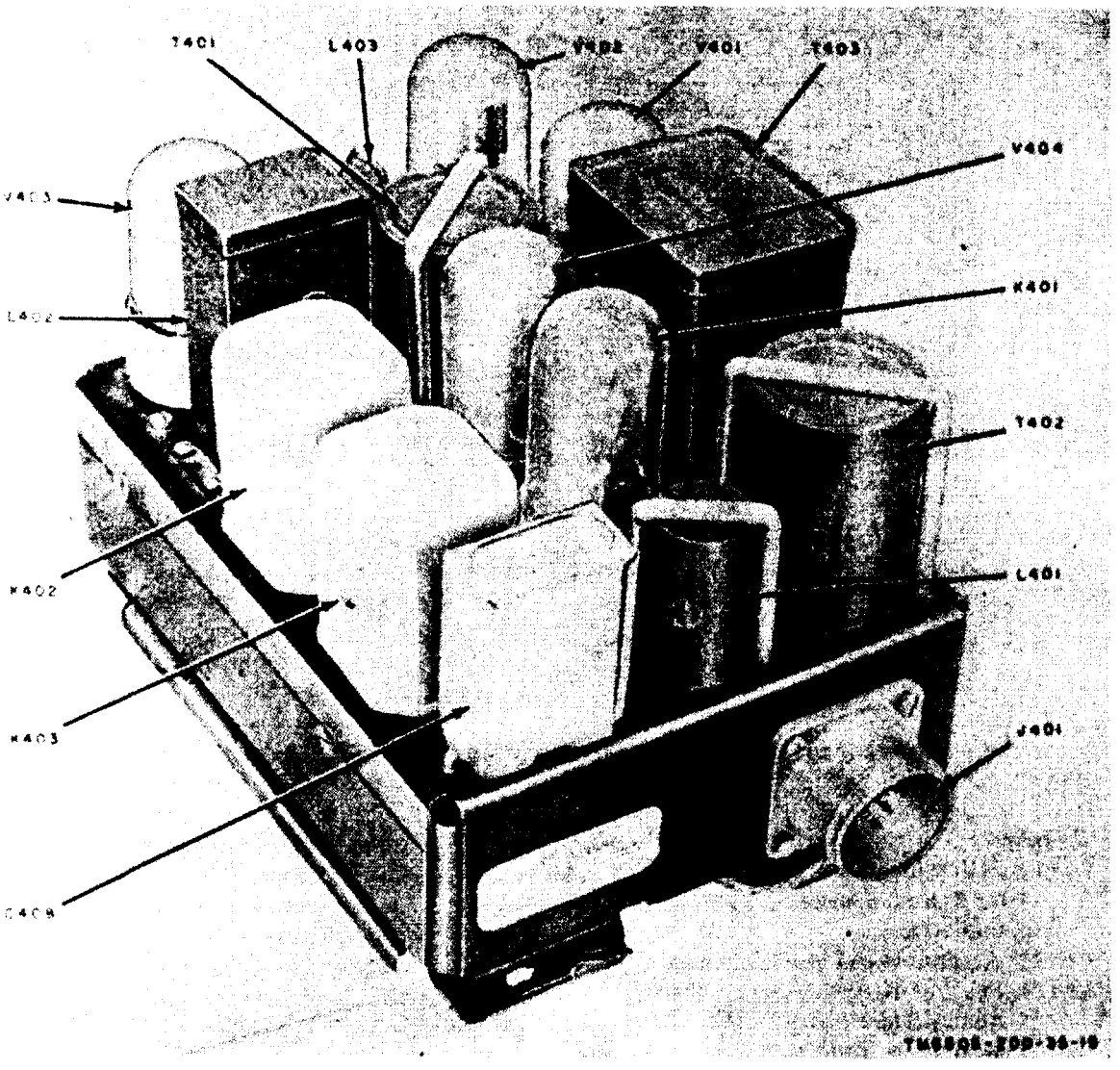


Figure 11. Amptifier, Electronic Control Type A-2, top view with cover removed.

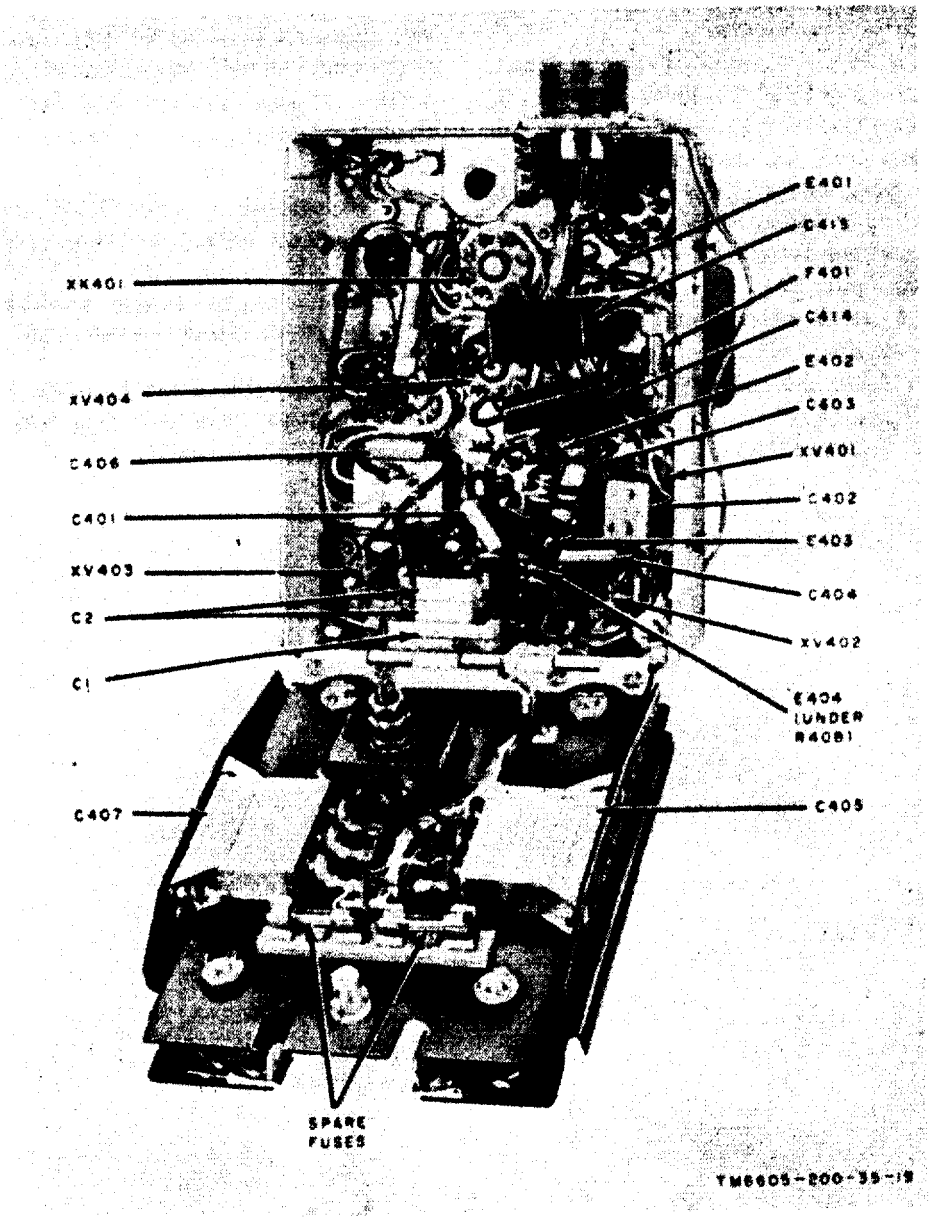


Figure 12. Amplifier, Electronic Control Type A-2, showing parts location. (excluding resistors).

d. Inspect:

(1) Shock mounts and interior wiring for cuts, kinks, breaks, fraying, and undue strain.

(2) Accessible items for looseness.

(3) Seating of readily accessible pluck out items (tubes, fuses, plug-in relays).

(4) Resistors, bushings, and insulators for cracks, chipping, blistering, moisture, and discoloration.

(5) Relay cases and interior of chassis for cleanliness and tightness.

(6) Transformers, chokes, and potentiometers for signs of overheating.

e. Perform a continuity and resistance check of the amplifier (par. 31).

f. Perform a voltage check of the amplifier (par. 32).

g. Position the bottom plate assembly on the chassis and tighten the wing-head stud.

h. Replace the cover (par. *36b).*

21. Periodic Check of Repeater Amplifier Type B-7A

(fig. 14, 15, and 16)

The third echelon periodic check of Repeater Amplifier Type B-7A is normally performed during the scheduled periodic check of the compass system (par. 19).

a. Remove the repeater amplifier chassis assembly (par. 55).

b. Inspect all electron tubes for obvious defects; replace defective tubes as required (par. 29).

c. Inspect:

(1) Shock mounts and interior wiring for

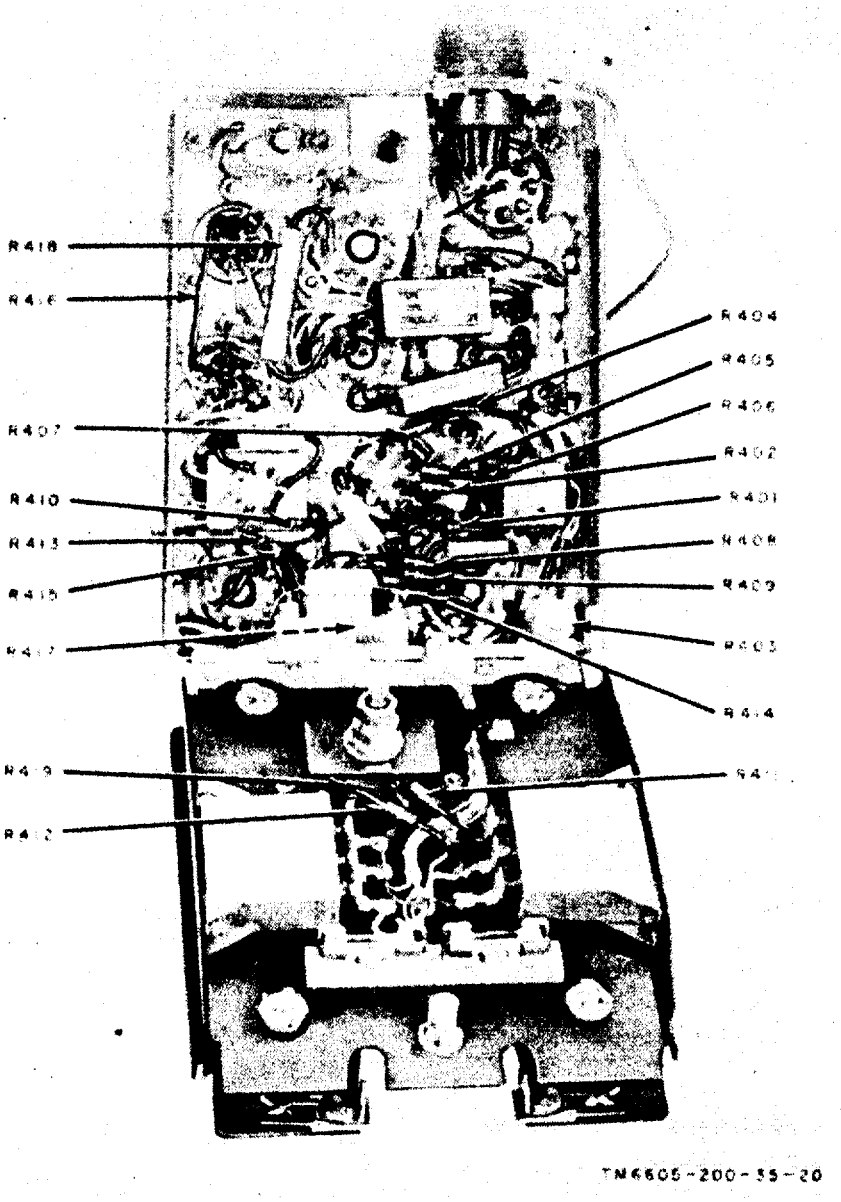


Figure 13. Amplifier, Electronic Control Type A-2, showing location of resistors.

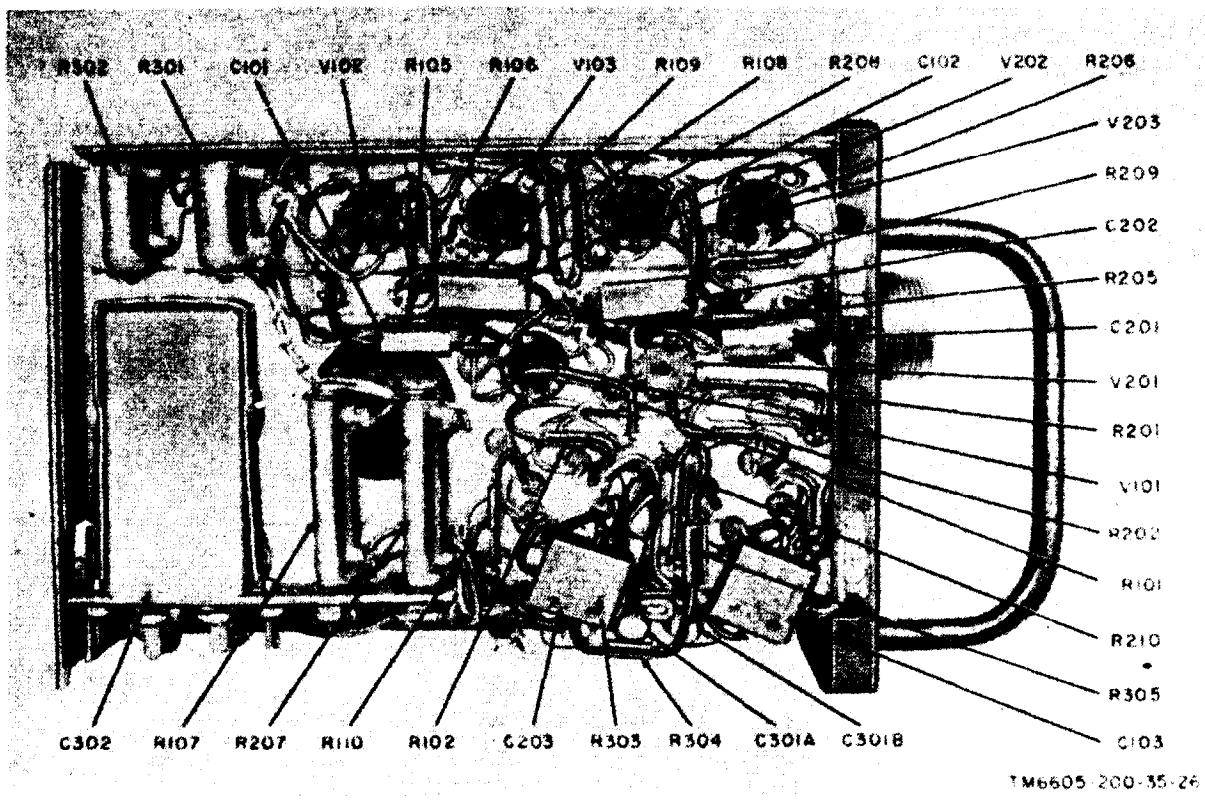


Figure 14. Repeater Amplifier Type B-7A, left side view of chassis showing parts location.

cuts, kinks, breaks, fraying, and undue strain.

(2) Accessible items for looseness.

(3) Seating of readily accessible pluck-cut itew (tubes, fuses).

(4) Resistors, bushings, and insulators for cracks, chipping, blistering, moisture, and discoloration.

(5) Interior of chassis not readily accessible for cleanliness.

(6) Transformers for signs of overheating.

d. Perform a continuity and resistance check of the repeater amplifier (par. 54).

e. Replace the repeater amplifier chassis assembly (par. 55).

22. General Troubleshooting Instructions

WARNING: When troubleshooting or making repairs in this equipment be extremely careful. Potentials as high as 310 volts ac are present internally. Use isulated test probes when making the required voltage measurements. Always remove power from tbe compass system before touching any of the internal psrts or when replacing system components.

a. Troubleshooting at the third echelon maintenance level includes all the techniques outlined for organizational maintenance and any special or additional techniques required to isolate a defective part. The troubleshooting procedures are not complete in themselves but supplement the organizational maintenance instructions (TM 11-6605-200-12). The systematic troubleshooting procedure, which begins with the operational, preflight, post flight, and 26-hour checks performed at the organizational level, must be completed by further sectionalization, localization, and isolation techniques.

b. Troubleshooting may be performed while the compass system is operating or, if necessary, after the compass system (or components of it) has been removed from service. When trouble occurs, certain observations and meas-

urements can be made which will help in determining where the trouble exists in the system. System trouble sectionalization will norreally be performed with the equipment operating in the aircraft. Troubleshooting in Amplifier, Electronic Control Type A-2 or in Repeater Amplifier Type B-7A (auxiliary equip ment), may be performed with these components either operating as parts of the system or removed from it. Paragraphs 23 through 28 describe the systematic procedures which should be used as a guide for the third echelon repairman in locating the cause of trouble in the compass system and correcting the fault.

23. Organization of Troubleshooting Procedures

a. Troubleshooting Compass, Magnetic, Aircraft J-2 System. Troubleshooting the compass system in the aircraft consists first of sectionalizing the trouble to one of the major components (flux valve, compensator, indicator, gyro unit, amplifier), to auxiliary equipment, to the system cabling, or to junction box connections. Use the compass system trouble-sectionalization chart (par. 24) as a guide. If the trouble is sectionalized to system cabling, connections, or a major component, make the necessary repairs or replacement, and perform the checks specified in the chart. When no specific check is referenced in the chart, operate the compass system to insure that the trouble has been eliminated.

CAUTION: Whenever the flux valve or gyro unit is replaced, the calibration of the compass system must he checked (par. 42). If the compensator is replaced, only the deviation error adjustment (par. 42c) need be checked.

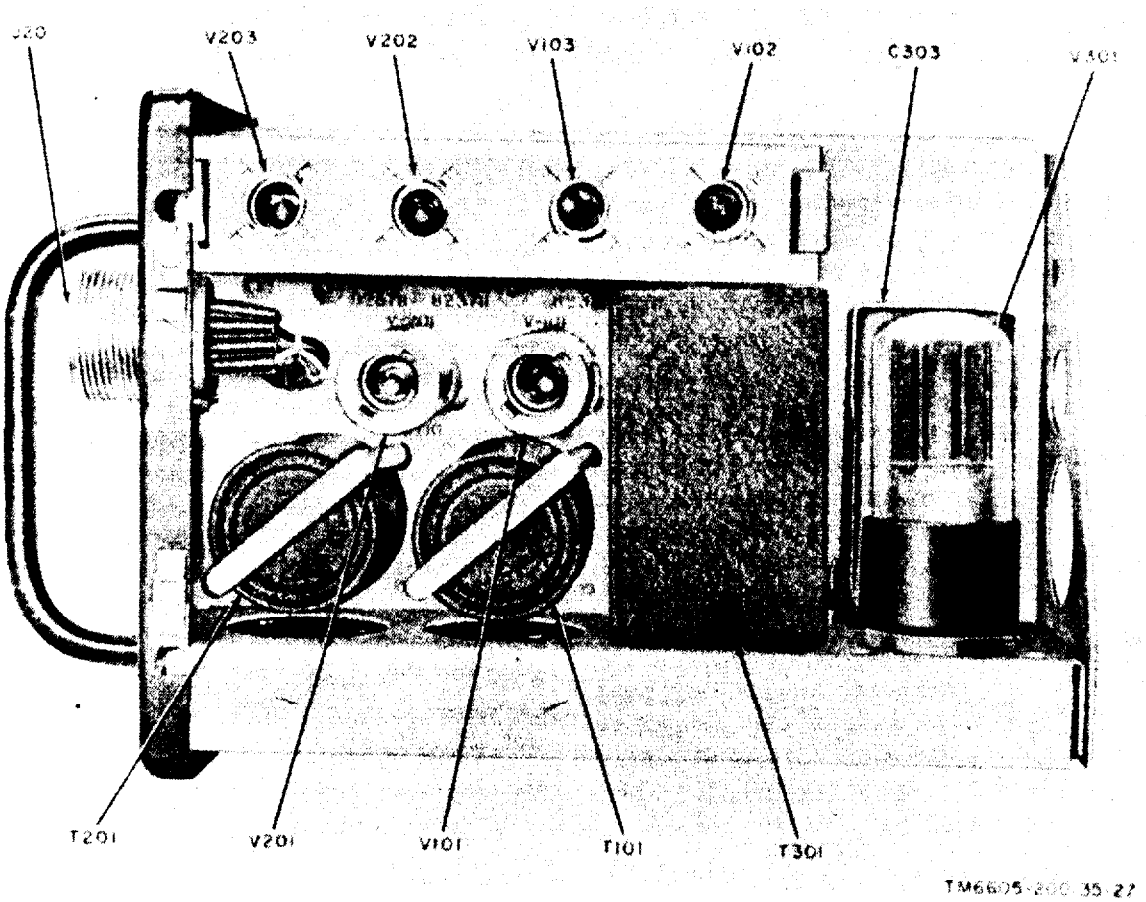


Figure 15. Repeater, Amplifier Type B-7A, right side view of chassis showing parts location.

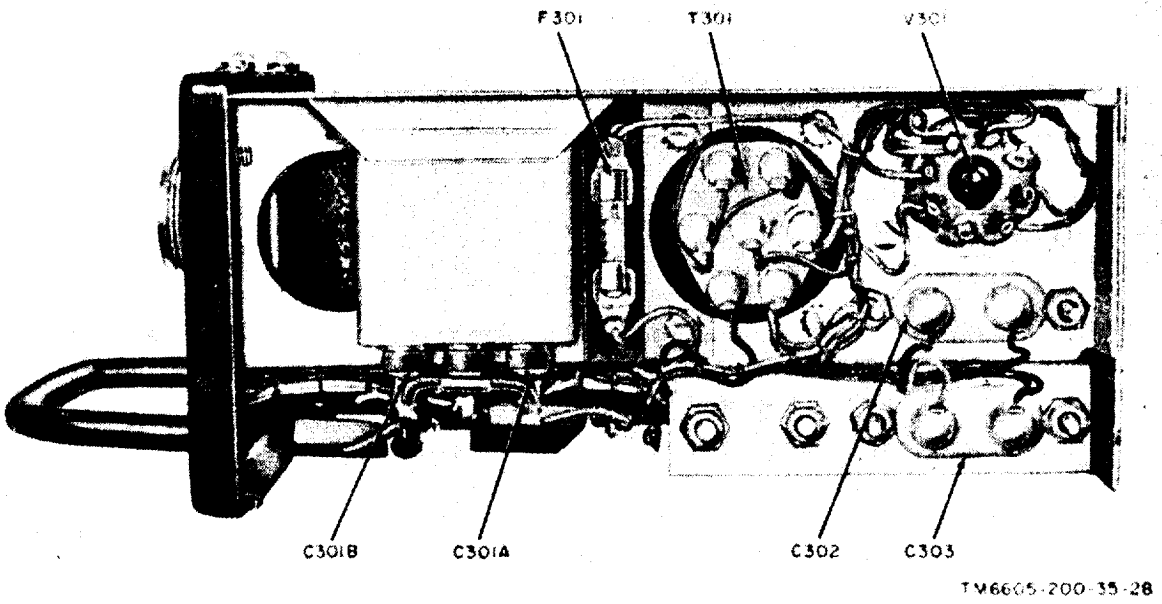


Figure 16. Repeater Amplifier Type B-7A, bottom view of chassis showing parts location.

b. Troubleshooting Amplifier and Repeater Amplifier. The second phase of troubleshooting consists of localization and isolation of troubles within the amplifier or repeater amplifier (auxiliary equipment) after removal from the aircraft. Troubles may often be caused by open or short circuits in components or wiring connections. Visual inspection can often locate such faults as a blown fuse, burned insulation, loose or broken connections, or burned-out components. Visual inspections may reveal trouble which might cause further damage to the unit if an operational check is attempted before making the necessary repairs. Prepare the amplifier for visual inspection by removing the cover (par. 36 *b)* and loosening the wing-head stud that secures the front of the chassis to the bottom plate. Prepare the repeater amplifier for visual inspection by removing the chassis assembly from its case (par. 55). If a visual inspection fails to locate any abnormal circuit conditions, perform the suggested corrective action in the amplifier troubleshooting chart (par. 30) or in the repeater amplifier troubleshooting chart (par. 53) as required. After performing amplifier or repeater amplifier repairs, reinstall the repaired unit in the aircraft and perform a slaving rate check (par. 23).

24. Compass System Trouble-Sectionalization Chart

This chart is used to sectionalize troubles that may exist in the compass system or its auxiliary equipment. The chart lists symptoms, probable troubles, and corrective measures and paragraph references to more detailed troubleshooting procedures.

Step No.	Symptom	Probable trouble	Correction
1	Fuse in amplifier or repeater amplifier continually burns out.	*a.* Defective amplifier or repeater amplifier.	*a.* Replace amplifier (par. 36) or repeater amplifier (par. 55) as required.
		b. Short circuit in compass system cabling or in system junction box.	*b.* Perform a check of compass system cables (par. 25) and troubleshoot system junction box connections (fig. 22 and 26); repair as necessary.
2	Gyro fails to start or does not slave, as indicated by lack of movement of gyro unit compass card and indicator pointers. **CAUTION: If the gyro does not start within 20 seconds, remove power from the compass system. IF ONLY SINGLE-PHASE POWER IS SUPPLIED TO THE GYRO, IT WILL BURN OUT.**	*a.* Aircraft power supply switches not operated.	*a.* Cheek the position of the aircraft power supply switches.
		b. Incorrect aircraft power supply ac voltage, phase, or frequency.	*b.* Check ac power from aircraft power supply (par. 26).
		c. Defective cable from system junction box to gyro unit.	*c.* Check gyro unit cable (par. 25) and troubleshoot system junction box connections (fig. 25 and 29); repair as necessary.
		d. Defective gyro unit	*d.* Replace gyro unit (par. 35) and perform a check of compass system calibration (par. 42).
		e. Defective amplifier	*e.* Replace amplifier (par. 36).
		f. No error signal input from flux valve to amplifier.	*f.* Check flux valve excitation voltage (par. 26). Check flux valve and flux valve cable connections (par. 27). NOTE. If flux valve is replaced, the compass system will require calibration (par. 42).
3	Gyro slaving rate too fast as indicated by excessively fast rotation of the gyro unit compass card (par. 28).	*a.* Ac voltage from aircraft power supply high.	*a.* Check ac voltage supplied to the compass system (par. 26).
		b. Defective amplifier	*b.* Replace amplifier (par. 36) and perform a slaving rate check (par. 28).
		c. Defective gyro unit	*c.* Replace gyro unit (par. 35) and perform a check of compass system calibration (par. 42).
4	Gyro slaving rate too slow as indicated by excessively slow rotation of the gyro unit compass card during initial 2 to 8 minutes of compass system operation.	*a.* Ac voltage from aircraft power supply low.	*a.* Check ac voltage supplied to tbe compass system (par. 26).
		b. Defective amplifier	*b.* Replace amplifier (par. 36) and perform a slaving rate check (par. 28).
		c. Defective flux valve or compass system cable.	c. Check flux valve and flux valve cable conncetions (par. 27). Check gyro unit cable (par. 25) and troubleshoot system junction box connections. Repair cables as required. Replace flux valve (par. 34) if required, and calibrate the compass system.
		d. Defective gyro unit	d. Replace gyro unit (par. 35) and check compass system calibration (par. 42).
5	Gyro slaves faster in one direction than in the other as indjcated by slaving rate check results (par. 28).	*a.* Defective amplifier	*a.* Replace amplifier (par. 36) and perform a slaving rate check (par. 28).
		b. Defective gyro	*b.* Replace gyro unit (par. *35)* and check compass system calibration (par. 42).

Step No.	Symptom	Probable trouble	Correction
6	Large errors in heading indication at both gyro unit compass card and indicator.	*a.* Ac voltage from aircraft power supply low.	*a.* Check the aircraft power supply ac voltage (par. 26).
		b. Slaving cutout switch on out position or defective switch.	*b.* Operate slaving cutout switch to in position; replace switch if defective.
		c. Defective amplifier _____	*c.* Replace amplifier (par. 36).
		d. Defective gyro unit _____	*d.* Replace gyro unit (par. 35) and check compass system calibration (par. 42).
		e. Defective flux valve or flux valve cable connection.	*e.* Check flux valve and flux valve cable (par. 27). Repair cable as necessary. Replace flux valve if defective (par. 34) and calibrate the compass system (par. 42).
		f. Compass system requires calibration.	*f.* Calibrate the compass system (par. 42).
7	Indicator pointer and gyro unit compass card spin.	*a.* Defective aircraft power supply.	*a.* Check output of aircraft power supply (par. 36).
		b. Defective gyro unit.	*b.* Replace gyro unit (par. 35).
8	Indicator pointer oscillates (does not indicate the steady position of the aircraft) or does not agree with heading indication on the gyro unit compass card.	*a.* Ac voltage from aircraft power supply low.	*a.* Check ac voltage output from aircraft power supply (par. 26).
		b. Defective indicator cable or defective indicator.	*b.* Check indicator cable und its connection at the system junction box (par. 25). Repair cable as necessary. Replace indicator if defective (par. 37).
		c. Defective amplifier or repeater amplifier.	*c.* Replace amplifier (par. 36) or repeater amplifier (par. 55) as required.
9	Indicator pointer sticks or tracks erratically.	Excess friction in indicator bearings.	Replace indicator (par. 37).

25. Continuity Checks of Compass System Cables (Except Flux Valve Cable),

CAUTION: This paragraph does not cover continuity checks of the flux valve cable or its connections to the system. If such checks are attempted with a multimeter when the flux valve is connected in the system, dc magnetization of the flux valve can result. Special demagnetization procedures must then be performed on the flux valve which are beyond the scope of maintenance procedures described in this manual. Refer to paragraph 27 for flux valve and flux valve cable troubleshooting procedures only when sectionalizing procedures indicate that the flux valve or flux valve cable and connections should be checked.

a. General. When sectionalizing procedures indicate that one particular cable connection is defective, make all the checks referenced in the cable continuity chart *(c* below). This will eliminate defective cables (except the flux valve cable) as possible sources of trouble and eliminate the possibility of having to disconnect and connect the cables several times.

b. Test Procedure. Disconnect the compass system cabling at the amplifier, repeater amplifier, gyro unit, and indicator. Arrange the AN/URM-105 for continuity checks. If checks indicate defective cables or connections, inspect the system connections between the applicable points, including any tie-points to aircraft power supplies and system junction box terminals. Perform the continuity checks as described in the chart *(c* below).

c. Cable Continuity Chart (fig. 24 and 30).

Item	Cable leads checked	From	To
1	115 volts ac power supply	A-phase connection (terminal 20 of system junction box).	P9-A, -G, -S.
			P20-A, Fa.
			P401-A, -E.
			P801-A, -E.
			P801-A (all indicators)
			-27.5-volt dc power supply connection
		B-phase connection (terminal 15 of system junction box).	P9-B.
		C-phase connection (terminal 17 of system junction box).	P9-C, -H.
			P20-Ca.
			P401-C.
			P801-B (all indicators)
2	28-volt dc power supply	-28-volt dc connection (terminal 20 of system junction box)	To A phase connection
		+28-volt dc connection (terminal 13 of system junction box)	P20-Da.
			P401-D
			P401-K (slaving cutout switch on free mode only)
3	Slaving control voltage	P401-H	P9-D
		P401-J	P9-F
4	Leveling torque voltage	P401-G	P9-E
5	Input to amplifier from flux valve synchro in gyro unit	P401-F	P9-N
6	Input to indicator from heading synchro in gyro unit	P801-C	P9-T
		P801-D	P9-R
7	Input signal to repeater amplifier from heading synchro in gyro unit:		
	Channel 1 input	P20-G	P9-Ta
	Channel 2 input	P20-E	P9-Ra
8	Input to auxiliary indicators from repeater amplifier	P20-C	P801-Ba
		P20-H	P801-Da
		P20-I	P801-Ea
		P20-J	P802-Ca

aReadings obtained only when a repeater amplifier is used in the compass System.

26. Operational Check of Compass System Power

CAUTION: Do not force any of the switches when operating the TS-1086/U. When switch 1 is in the FLUX VALVE CHECK position, switch 3 and rheostat 4 will operate freely; if switch 1 is in any other position and rheostat 4 is not in the OFF position, switches 1 end 3 are locked firmly in place. Rheostat 4 must be returned to the OFF position before the positions of switches 1 and 3 can be changed.

a. Power Check at Amplifier.

(1) Connect the test setup as shown in figure 17. The amplifier cable remains fixed to the compass system junction box terminals.

(2) Operate switch 1 on the TS-1086/U to the POWER CHECK position, and switch 5 to the AB position.
(3) Apply power to the compass system. The frequency meter on the TS-1086/U should indicate 400 ±40 cycles per second (cps), and the voltmeter should indicate 115 ±10 volts ac on the lower scale.
(4) Repeat (2) above for the BC and AC positions of switch 5.
(5) With switch 5 in the AC position, the ABC lamp should light; if the CBA lamp lights, phase rotation of the ac input voltage is incorrect.
(6) To check the system ground connection, operate switch 1 to the GRD CHECK position. "Connect test lead 50A7513 to the A-phase ground (aircraft structure). The ABC lamp should not light. Ifthe ABC lamp lights, the A-phase lead is not grounded. Disregard the CBA lamp for this check.
(7) Operate switch 5 to the 28V D. C. position. The voltmeter should indicate 27 ±0.5 volts dc on the lower scale. Remove power from the compass system and reconnect the cables for normal operation.

b. Flux Valve Excitation Voltage Check.

(1) Connect extension cable 47B7492 as shown in figure 17. The gyro unit cable remains fixed to the compass system junction box terminals. Do not connect the TS-1086/U for this check.
(2) Place a temporary jumper wire between pins D and I of the loose 10-pin connector plug on extension cable 47B7492.
(3) Apply power to the compass system.
(4) Use the TS-505/U to measure the voltage between either pin D or pin I of the loose 10-pin connector plug and pin A of the loose 4-pin connector plug on extension cable 47B7492. The voltage should be 23.5 ±5 volts ac.
(5) Remove power from the compass system and reconnect the cables for normal operation.

c. *Power Check at Gyro Unit.*

(1) Connect the equipment as shown in figure 18.
(2) Operate switch 1 on the TS-1086/U to the POWER CHECK position and switch 5 to the AC position.
(3) Apply power to the compass system. The frequency meter and the voltmeter on the TS–1086/U should read 400 ±40 cps and 115 ±10 volts ac, respectively.
(4) Remove power from the compass system and reconnect the cables for normal operaticn.

27. Continuity Checks of Flux Valve and Flux Valve Cable Connections

CAUTION Do not use a dc ohmmeter to check any of the windings in the flux valve.

Perform the checks in *a, b,* and *c* below in the sequence indicated until the source of trouble has been revealed.

a. Excitation Winding, Ac Continuity Checks.

Note. Do not perform this check until the amplifier-supplied excitation voltage has been checked (par. 26 *b).*

(1) Connect the equipment as shown in figure 17. Do not connect the amplifier for this check.
(2) Apply power to the compass system.
(3) Operate switch 1 on the TS-1086/U to the FLUX VALVE CHECK position and switch 3 to the CALIBRATE position.
(4) Operate rheostat 4 to the OFF position, and rotate the ADJ stop under the rheostat knob counterclockwise until it stops on the knob.
(5) Turn rheostat 4 until the pointer of the voltmeter on the TS-1086/U indicates full-scale deflection.
(6) Operate rheostat 4 to the OFF position; be careful to leave the ADJ stop. in the position established in (4) above.

Note. Do not disturb the setting of the ADJ stop for tbe remainder of this check.

(7) Operate switch 3 to the EXCITER position, and rheostat 4 against the ADJ step. The voltmeter indication must fall within the EXCITER range on the upper scale.
(8) Return rheostat 4 to the OFF position and continue with the check in *b* below.

b. Pickup Windings, Ac Continuity Checks.

(1) Operate switch 3 to the A position and rheostat 4 against the ADJ stop. The voltmeter on the TS-1086/U should indicate within the ABC portion of the upper scale.

(2) Repeat (1) above for switch 3 positions B and C.

Note. Any open or short circuits in the flux valve or flux valve cable will cause the voltmeter on thr TS-1086/U to indicate outsidr the ABC area of the scale. If this occurs, perform the additional checks in *c* and *d* below.

(3) Remove power from the compass system and reconnect the cables for normal operation.

c. Additionsl Dc Checks of Flux Valve Cable Leads.

(1) Remove power from the compass system.

(2) Visually inspect all accessible portions of the flux valve cable and the amplifier cable for any evidence of damage. Check for open connections in the system junction box (and in the flux valve junction box if one is employed).

(3) Remove the flux valve and compensator from their mounting (par. 34) and disconnect the flux valve cable leads from the flux valve. Tag or otherwise identify each lead in accordance with the flux valve terminal stud designations.

(4) Disconnect connector plug P401 from the amplifier and connector plug P9 from the gyro unit.

(5) Check continuity of the excitation winding leads by temporarily short-circuiting flux valve cable lead D to E. Check the lead continuity at amplifier connector plug P401 between pins A and L, using the AN/URM-105.

(6) Perform the indicated continuity checks in the chart below to check the flux valve pickup winding cable leads.

Place jumper wire between	Check between
Flux valve cable lugs A and C	P9 pins J and K
Flux valve cable lugs A and B	P9 pins K and L
Flux valve cable lugs B and C	P9 pins J and L

(7) Check for short circuits between each flux valve cable lugs. Continuity should not exist between any of the flux valve cable lugs.

(8) Isolate the defective lead by performing separate continuity checks of each suspected lead as indicated by the results of (5), (6), and (7) above.

Note. Because of the remote location of the flux valve lead being checked, and route connect tin appropriate length of insulated wire to the flux valve lead being checked, and route it tn the TS–505/U location. Do not withdraw the flux valve cable f:om the aircraft except when a faulty lead must he replaced.

28. Slaving Rate Check of Compass System

Note. Stop Timer FM-103(1) (par. 7) is required to *perform* the slaving rttte check below.

a. Connect the equipment as shown in figure 18.

Note. Extension cable 47B7489 is not connected for the slaving rate check.

b. Operate switch No. 1 to the SLAVE CHECK position and switch No. 2 to the 0 position.

c. Apply power to the compass system.

Note. Step *d* below must be performed during the initial 2 to 3 minutes of compa system operation (fast slaving).

d. Observe the heading indication on the indicator.

(1) Operate switch No. 2 to the 1 position and start the timer. The heading indication should increase at a minimum rate of 60° per minute.

(2) Reset the timer.

(3) Operate switch No. 2 to the R position and start the timer. The heading indication should decrease at a minimum rate of 60° per minute.

(4) Reset the timer.

e. Operate switch No. 2 to the 0 position and allow the gyro to process back to its null position. When the gyro reaches its null position, the heading indication should remain constant.

f. Note the heading indication on the indicator, operate switch No. 2 to the L position, and simultaneously start the timer. The heading indication should increase at a rate of not less than 2° nor more than 6° per minute.

g. Reset the timer, operate switch No. 2 to the 0 position, and allow the gyro to process back to its null position.

h. Note the heading indication on the indicater, operate switch No. 2 to the R position, and simultaneously start the timer. The heading indication shall decrease at a rate of not less than 2° nor more than 6° per minute.

i. Reset the timer, operate switch No. 2 to the 0 position, and allow the gyro to process back to its null position.

j. Remove power from the compass system and reconnect the gyro unit cables for normal operation.

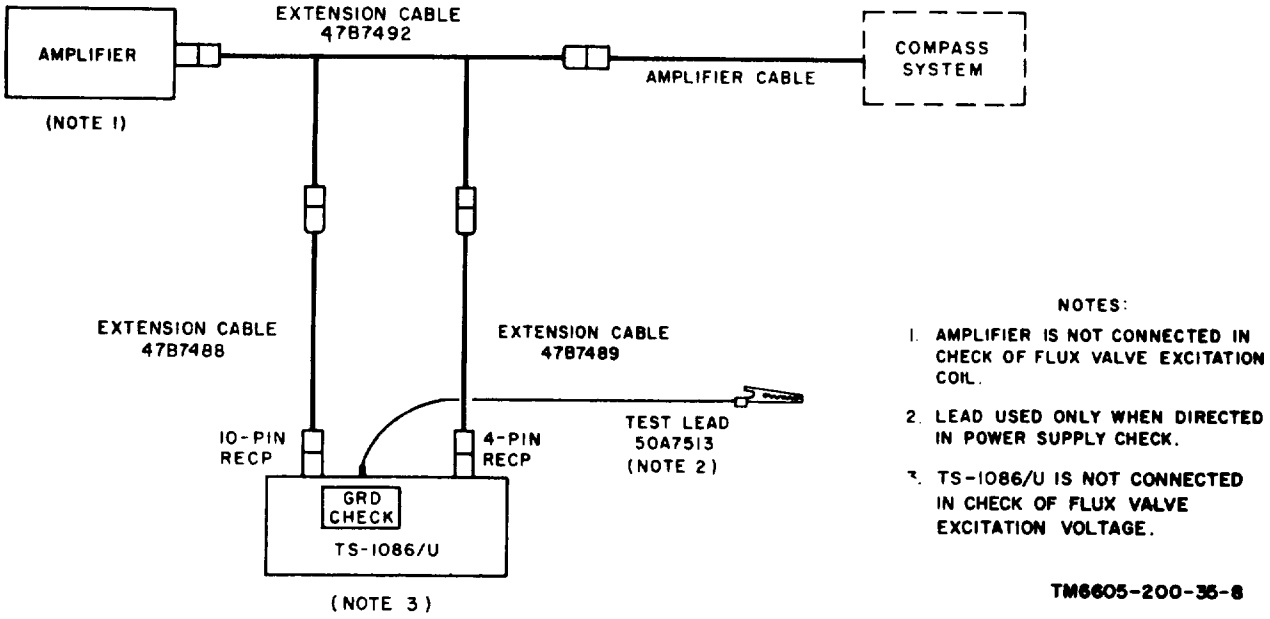


Figure 17. Test setup for operational power and flux valve checks.

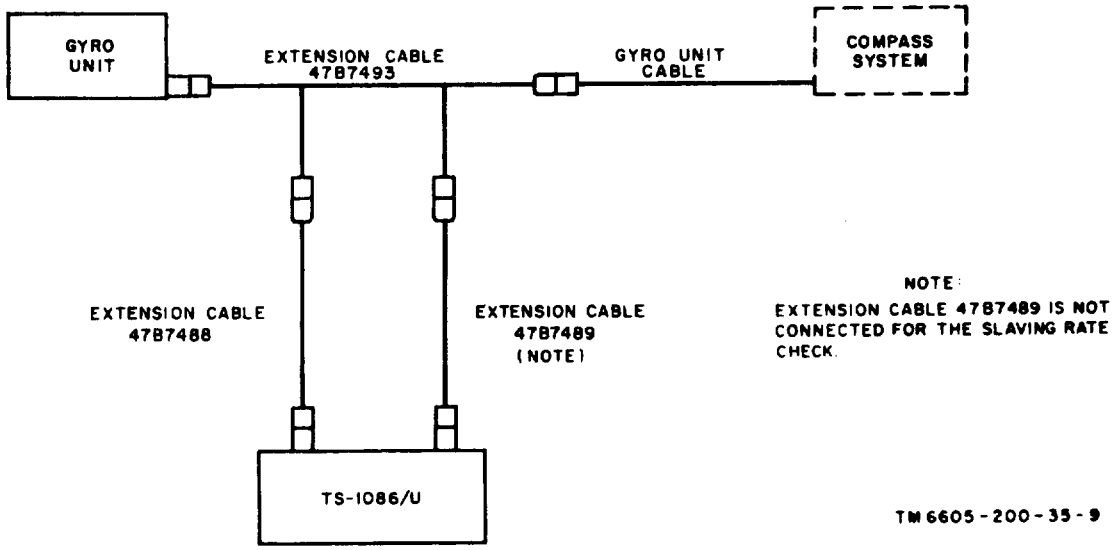


Figure 18. Test setup for power check at gyro unit and slaving rate check.

Section III. AMPLIFIER, ELECTRONIC CONTROL TYPE A-2 TROUBLESHOOTING

29. Electron Tube Testing and Replacement

When trouble occurs, visually check all wiring, connections, and circuit parts before removing any electron tubes.

Note. If output amplifier tube V403 in Amplifier, Electronic Control Type A-2 is replaced with a new tube, check the adjustment of output amplifier V403 (par. 40).

CAUTION: Never rock or rotate an electron tube when removing it from a socket; pull it straight out with a tube puller.

a. Using Tube Tester. Remove and test one tube at a time; use the TV-7/U. Discard a tube only if its defect is obvious or if the tube tester shows it to be defective. Replace the original tube, or install a new one if required, before testing the next one.

b. Tube Substitution Method. Replace a suspected tube with a new tube. If this does not correct the trouble, remove the new tube and replace the original tube. Repeat this procedure with each suspected tube until the defective tube is located.

30. Amplifier, Electronic Control Type A-2 Troubleshooting Chart

a. General. Procedures are outlined in the amplifier troubleshooting chart *(c* below) for localizing troubles to the individual circuit or component. Depending on the nature of the operational symptoms, one or more of the localization procedures will be necessary, For location of parts, refer to figure 11, 12, and 13.

b. Use of Chart. The amplifier troubleshooting chart is designed to supplement the compass system trouble-sectionalization chart (par. 24). The chart lists the symptoms which the repairman observes while making operational checks, probable troubles, and corrective acticn which can be taken. If the trouble symptoms are not known, arrange the defective amplifier in a compass system and operate the equipment. If an operational test does not produce the trouble symptom, perform a slaving rate check (par. 28) and use the chart in *c* below to locate the specific cause of trouble.

c. *Troubleshooting Chart*

Step No.	Symptom	Probable trouble	Correction
1	Amplifier fuse F401 continually burns out.	Short circuit or defective component.	Perform continuity and resistance checks of amplifier (par. 31).
2	Gyro does not slave or level.	*a.* Defective electron tubes	*a.* Check tubes (par. 29); replace defective tubes.[a]
		b. Defective thermal relay K401.	*b.* Replace thermal relay K401.
		c. Defective relay K402	*c.* Replace relay K402.
		d. Defective relay K403	*d.* Replace relay K403.
3	Gyro slaving rate too fast.	*a.* Defective thermal relay K401.	*a.* Replace thermal relay K401.
		b. Defective relay K402	*b.* Replace relay K402.
4	Large errors in heading indication at both gyro compass card and at indicator.	Defective electron tubes	Check tubes (par. 29); replace defective tubes.[a]
5	Indicator pointer oscillates (does not indicate the steady position of the aircraft).	*a.* Defective thermal relay K401.	a. Replace thermal relay K401.
		b. Defective relay K402 or K403.	b. Replace relay K402 or K403 as required.
6	Heading indication not within tolerance (±2°) but less than 30° off proper indication.	Slaving control voltage not within tolerance.	Troubleshoot 800-cps reference voltage circuit; request higher echelon maintenance if defective.

[a] If output amplifier tube V403 is replaced, calibration of the output amplifier stage must be checked (par. 43).

31. Continuity and Resistance Checks

a. General. Remove the amplifier from the aircraft (par. 36) and perform a continuity and resistance check of the circuit or part suspetted of being defective. Use the AN/URM-105 to make resistance measurements. Prepare the amplifier by loosening the wing-head stud and lifting the chassis on its rear hinge. Refer to figures 11 through 13 for location of parts and test points. If the defective part cannot be located by using the continuity and resistance chart *(b* below), connect the amplifier into a system bench test setup and proceed with the voltage checks in paragraph 32.

b. Continue and Resistance Chart

Item	Circuit or component	Check		Required resistance (ohms)	Portion of circuit or component being checked
		From	To		
1	Input amplifier V401	V401-1	J401-F	0	Amplifier input
		V401-2	T401-3	370K	R406, R407
		V401-3	J401-A	3,900	R402
		V401-4	J401-A	820K	R405
		V401-5	T401-3	2,000	T401 primary
		V401-6	J401-A	510	R404
2	Demodulator V402	V402-1	J403-1	100K	R408
		V402-2	J401-A	1,500	T401 secondary (6 to 5)
		V402-3	V403-6	490K	R411, R412, R419
		V402-4	L403-1	100K	R409
		V402-5	J401-A	1,500	T401 secondary (4 to 5)
3	Output simplifier V403	V403-1	V402-6	0	Input signal circuit
		V403-2	V403-5	11.5K	Primary of L402
		V403-3 or V403-6	J401-A	1,150	R413, R415
		V403-4	V402-3	0	Input signal circuit
4	Filament circuit of V402 and V403 (pin 7 of V403 disconnected)	V403-7	J401-A	1,100	Filaments of V402 and V403, R414, R415
5	Saturable reactor (pins 3 and 5 disconnected)	L402-3	L402-5	300	Secondary winding
6	Transformer T402 (pins 3 and 5 of L402 disconnected)	T402-4	J401-B	170	Secondnry winding
		T402-5	T402-8	400	Primary winding
7	Thermal relay K401	KV401-2	KV401-3	14	Resistance element of relay
8	Rectifier circuit (V404 removed)	XV404-2	XV404-7	1	T403 secondary (7 to 8)
		XV404-3	XV404-5	750	T403 secondary (4 to 5)
		J401-A	J401-C	13.5	T403 primnry winding and F401

32. Voltage Checks

a. General. Arrange the components of the compass system on a workbench. Place the flux valve in a mounting similar to the mounting used in an aircraft. The flux valve must be located approximately 4 feet higher than the other compass system components.

b. Connections. Connect the components as indicated in figure 30.

(1) Do not use a flux valve junction box; connect the flux valve cable directly into the system junction box.

(2) Place a temporary jumper wire in the amplifier between pin 4 of relay K402 and pin 2 of relay K403 (fig. 31). Remove the jumper after all the measurements have been made.

(3) Use a local power source (27.5 volts dc, and 115 volts ac, 3-phase) instead of the aircraft power supply.

c. Checks. For voltage measurements of 300 volts ac or less, use the ME-30A/U. Use the AN/URM-105 to measure voltages in excess of 300 volts ac and to measure dc voltages.

Item	From	To[a]	Voltage meaaured[b]		
			Centered	Clockwise[c]	Counterclockwise[d]
Input amplifier V401	Pin 1	Ground	0.	0.4 ac	0.4 ac
	Pin 2	Ground	115. dc]	115. dc	115. dc
	Pin 3	Ground	1.5 dc]	1.5 dc	1.5 dc
	Pin 4	Ground	0.035 ac	2.6 ac	2.6 ac
	Pin 5	Ground	260. dc	260. dc	260. dc
	Pin 6	Ground	1.6 dc	0.4 ac	0.4 dc
Demodulator V402	Pin 1	Ground	7.8 ac	11. ac	9. ac
	Pin 2	Ground	1. ac	94. ac	94. ac
	Pin 8	Ground	5.5 dc	21.5 dc	5.5 dc
			0.065 ac	0.3 ac	0.063 ac
	Pin 4	Ground	7.8 ac	9. ac	11. ac
	Pin 5	Ground	1. ac	90. ac	90. ac
	Pin 6	Ground	5.5 dc	5.5 dc	21.5 dc
			0.072 ac	0.063 ac	0.3 nc
Output amplifer V403	Pin 1	Ground	0.072 ac	0.063 ac	0.32 ac
	Pin 2	Ground	245. dc	260. dc	160. dc
	Pin 3	Ground	16. dc	23. dc	23. dc
	Pin 4	Ground	0.068 ac	0.32 ac	0.0063 ac
	Pin 5	Ground	245. dc	160. dc	260. dc
	Pin 6	Ground	16. dc	23. dc	23. dc
Rectifier V404	Pin 3	Ground	310. ac	310. ac	310. ac
	Pin 5	Ground	310. ac	310. ac	310. ac
Saturable reactor L402	Pin 3	Pin 4	45. ac	90. ac	3. ac
	PIn 4	Pin 5	45. ac	3. ac	90. ac
Transformer T402	Pin 5	Pin 6	45. ac	45. ac	45. ac
	Pin 6	Pin 8	45. ac	45. ac	45. ac
	Pin 6	Pin 7	15. ac	15. ac	15. ac
Tuned reactor L403	Pin 1	P[n 2	12. ac	13. ac	13.9 ac

[a] Ground connection indicates signal ground unless otherwise specified.

[b] In signal circuits, the voltage measured depends on the position of the flux valve. After setting the input signal level (pin 1 to ground on V401), check it periodically, Correct for any gyro drift (input signal variation) by rotating the flux valve as appropriate to maintain the desired input signal voltage value.

[c] Rotate flux valve clockwise until input signal is 0.4 vac.

[d] Rotate flux valve counterclockwise until input signal is 0.4 vac.

Section IV. COMPASS SYSTEM REPAIRS

33. General

The extent of repair to the compass system consists of the replacement of individual components, as required, with the following exceptions:

a. The system junction box and associated cables are repairable.

b. Amplifier, Electronic Control Type A-2 (par. 38) is repairable.

c. The humidity indicator plug on the gyro unit is a replaceable item (par. 19 *d).*

34. Replacement of Flux Valve and Compensator

Do not remove the flux valve or the compensator unless it is absolutely necessary. The compensator can be removed for replacement without removing the flux valve. However, if

the flux valve must be replaced, the compensator must be removed with it. If the flux valve is removed, the compass system must be completely recalibrated (par. 42); if only the compensator is replaced, only the deviation error adjustment (par. 42c) need be made. The flux valve and compensator are illustrated in TM 11-6605-200-12.

CAUTION: Do not lose the flux valve or compensator mounting hardware. These items are made of nonmagnetic (brass) material, and must be reused or replaced with items of similar material. Failure to observe this precaution will cause error-producing magnetic influences that distort flux valve signals.

a. Compensator Removal. Remove the six screws that mount the compensator on the flux valve and demount the compensator. Be careful not to drop the compensator.

b. Flux Valve Removal.

(1) Remove the screws and lockwashers from the flux valve mounting holes to demount the flux valve.

(2) Remove the terminal lugs from the studs on top of the flux valve. Tag or identify each lead. Leave the leads threaded through the rubber grommet in the rim cutout of the flux valve.

c. Flux Valve Replacement.

(1) If the replacement flux valve is new, detach the top cover by removing the cover screws. Remove the rubber grommet from the flux valve rim cutout.

Note. Inspect the rubber grommet through which the flux valve leads are threaded in place (*b* (2) above). If it is not damaged, use it for reinstallation. If it is damaged, replace it with the new grommet ((1) above) by disconnecting the terminal lugs and insulated sleeving, removing the damaged grommet, threading the leads through, refitting the insulated sleeving, and reconnecting the terminal lugs on the leads.

(2) Replace the rubber grommet in the flux valve rim cutout, and neatly route the leads to their proper terminals.

(3) Replace one lockwasher, the proper lead-connected terminal lug, a second lockwasher, and a hexagonal nut, in that order, on each terminal stud. Tighten the hexagonal nuts.

(4) Place the flux valve into position in its mount, align the zero index flux valve flange graduation toward the nose of the aircraft, and replace the mounting screws and lockwashers.

d. Compensator Replacement. Place the compensator into position on the flux valve, and secure it with the mounting screws.

35. Replacement of Control, Electrically Driven Gyro Type S-3 (*)

Note. Control, Electrically Driven Gyro Type S-3 (*) is illustrated in TM 11-6605-200-12.

a. Removal.

(1) Remove the screw, washer, and nut that secure the ground lead to the aircraft structure.

Note. If an elastic stop nut is used (in place of the washer and nut), it is bonded to the aircraft structure; do not destroy the bonding of the elastic stop nut to the aircraft structure.

(2) Remove the safety wire that secures the connector plug in its receptacle on the gyro unit base. Unscrew the connector plug sleeve nut and remove the plug from its receptacle.

(3) Remove the mounting bolts, nuts, and washers from the three mounting lugs on the base of the gyro unit. Two flat washers are used cn each mounting bolt; note the sequence in which they are used.

b. Replacement.

(1) Align the gyro unit mounting lugs with the three holes in its mounting surface in the aircraft. Make sure that each lug makes even contact with the mounting surface, and that the arrow marked “fore,” painted on the top of the gyro unit housing, points toward the nose of the aircraft.

(2) Replace the mounting bolts, flat washers, and nuts. The flat washers must be replaced in the sequence in which they were removed.

(3) Secure the ground lead to the aircraft structure by using the hardware that was removed during disassembly (*a* (1) above).

(4) Replace the connector plug in its receptacle on the base of the gyro unit

and finger-tighten the sleeve nut of the connector plug.

(5) Replace the safety wire that secures the connector plug in its receptacle.

36. Replacement of Amplifier, Electronic Control Type A-2

Note. Amplifier, Electronic Control Type A-2 is illustrated in TM 11-6605-200-12.

a. Removal of Amplifier.

(1) Remove the screw, lockwasher, and nut that secure the ground lead to the aircraft structure.

Note. If an elastic stop nut is used (in place of the lockwasher and nut), it is bonded to the aircraft structure; do not destroy the bonding of the elastic stop nut to the aircraft structure.

(2) Remove the safety wire which secures the connector plug in its receptacle on the front of the amplifier. Unscrew the connector plug sleeve nut and remove the connector plug from its receptacle.

(3) Remove the safety wire that secures snap slide latches (front of bottom plate) in the locked position. Unlatch the snap slide latches from the snap slide studs mounted on the aircraft structure.

(4) Raise the front of the amplifier so that the mounting plate just clears the top of the snap slide studs. Slide the amplifier forward until the two grooves in the rear of the mounting plate clear the rear mounting studs, and remove the amplifier.

b. Removal and Replacement of Amplifier Cover. Loosen the two cover screws on each side of the amplifier chassis enough to lift the cover from the amplifier. Replace the cover on the amplifier with the cutout for receptacle J401 toward the front of the chassis. Make sure that the lockwashers on the cover screws are toward the outside edge of the cover, and then tighten the cover screws.

c. Replacement of Amplifier.

(1) With the front of the amplifier slightly raised, slide the amplifier into place so that the two grooves on the rear of the mounting plate contact the two rear mounting studs. Lower the front of the amplifier so that the two snap slide studs fit through the two holes in the front of the mounting plate.

(2) Check the snap slide latches for freedom of movement in their guides, and then lock them against their studs. Replace the safety wire to secure the snap slide latches in place.

(3) Secure the ground lead to the aircraft structure by using the hardware that was removed during disassembly *(a(1)* above). Make sure that there is a clean metal-to-metal contact for a good electrical ground.

(4) Insert the connector plug into its receptacle on the front of the amplifier and finger-tighten the sleeve nut of the connector plug.

(5) Replace the safety wire between the connector plug and its receptacle to secure the plug in place.

37. Replacement of Indicator

These instructions apply for replacement of Indicator, Induction Compass Types V-7A and V-8; which are illustrated in TM 11-6605-200-12.

CAUTION: Support the indicator while it is being removed and replaced.

a. Removal.

(1) Remove the screws that secure the indicator in its mounting cutout and withdraw the indicator.

(2) Remove the safety wire from the connector plug and its receptacle on the rear of the indicator.

(3) Unscrew the connector plug sleeve nut and remove the connector from the receptacle.

b. Replacement.

(1) Insert the connector plug into its receptacle on the rear of the indicator and securely tighten the sleeve nut by hand.

(2) Replace the safety wire that holds the connector plug secure in its receptacle.

(3) Insert the indicator into its mounting cutout and replace the mounting screws.

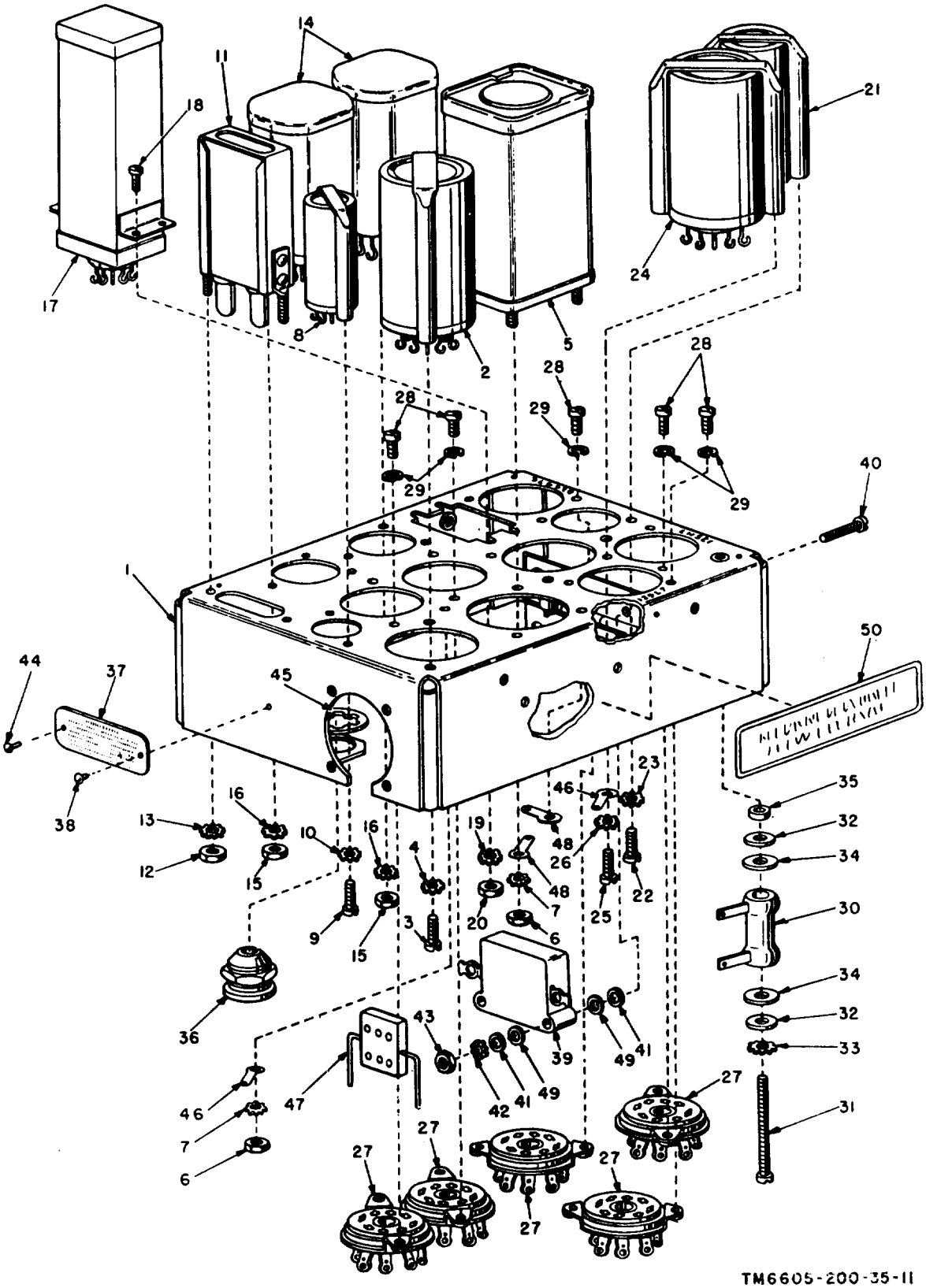


Figure 19. Amplifier, Electronic Control Type A-2 chassis and components, exploded view.

1 Chassis
2 Transformer T402
3 Screw
4 Lockwasher
5 Power transformer T403
6 Hexagonal nut
7 Lockwasher
8 Filter choke L401
9 Screw
10 Lockwasher
11 Capacitor C408
12 Hexagonal nut
13 Lockwasher
14 Relays K402 and K403
15 Hexagonal nut
16 Lockwaaher
17 Saturable reactor L402
18 Screw
19 Lockwasher
20 Hexagonal nut
21 Tuned reactor L403
22 Screw
23 Lockwasher
24 Transformer T401
25 Transformer T401 screw
26 Lockwasher
27 Tube socket
28 Screw
29 Lockwasher
30 Resistor R403
31 Screw
32 Plain washer
33 Lockwasher
34 Plain washer
35 Insulating bushing
36 Receptacle J401 and nut
37 Nameplate
38 Rivet
39 Capacitor C1
40 Screw
41 Plain washer
42 Lockwasher
43 Hexagonal nut
44 Rivet
45 Lockwasher
46 Transformer lug
47 Capacitor C2
48 Lug
49 Plain, washer
50 Decalcomania

Fig. 19 - Continued

Section V. AMPLIFIER, ELECTRONIC CONTROL TYPE A-2 REPAIRS AND ADJUSTMENTS

38. General Parts Replacement Techniques

a. After the amplifier cover is removed (par. *36b)* and the amplifier chassis is raised from the bottom plate, all of the amplifier parts are easily accessible for replacement with the exception of potentiometer R419 (par. 39). When replacing parts, refer to figures 11 through 13, 19, and 20. The following precautions apply:

(1) Before unsoldering parts, use a pair of long-nosed pliers to grasp the part lead between the part and a terminal mounting to dissipate the heat and prevent damage.

(2) Before a part is removed, note the position of its leads. Wire replacement parts in the same position as the original part.

b. When output amplifier tube V403, or resistor R411, R412, or R419 is replaced, the output amplifier must be adjusted (par. 40).

39. Replacement of Potentiometer R419 (fig. 13)

a. Removal

(1) Place the amplifier on its side and release the wing-head stud that secures the chassis to the bottom plate, and separate the chassis from the bottom plate.

(2) Unsolder the leads connected to the terminals of potentiometer R419. Tag or otherwise identify each lead.

(3) Remove each vibration isolator from the bottom plate in turn by removing the cotter pin, washers, and clevis pin.

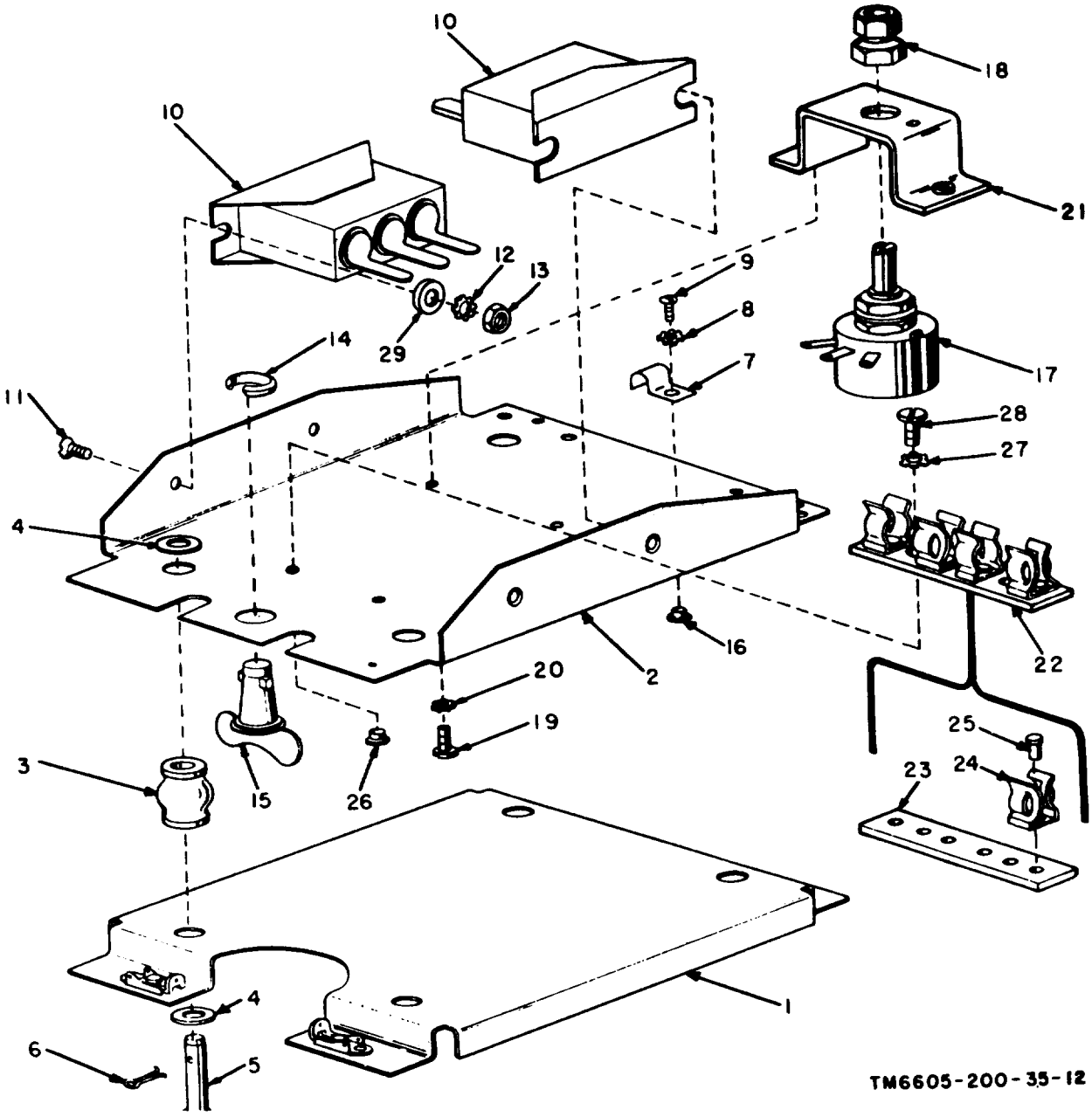
(4) Detach the mounting plate and vibration isolators from the bottom plate.

(5) Remove the screws and lockwashers that secure the potentiometer mounting bracket to the bottom plate and remove the mounting bracket.

(6) Remove the locknuts, the mounting nut, and lockwasher from the potentiometer shaft and remove potentiometer R419 from the mounting bracket.

b. Replacement.

(1) Replace potentiometer R419 in its mounting bracket and secure it in



1 Mounting plate
2 Bottom plate
3 Vibration isolator
4 Washer
5 Clevis pin
6 Cotter pin
7 Cable clip
8 Lockwasher
9 Screw
10 Capacitor
11 Capacitor screw
12 Lockwasher
13 Hexagonal nut
14 Locking ring
15 Wing-head stud
16 Insert
17 Potentiometer R419
18 Shaft lock
19 Screw
20 Lockwasher
21 Bracket
22 Spare fuse bracket
23 Mounting strip
24 Clip
25 Rivet
26 Insert
27 Lockwasher
28 Screw
29 Plain washer

Figure 20. Amplifier, Electronic Control Type A-2, bottom plate assembly, exploded view.

place by using the mounting nut and lockwasher.

(2) Replace and tighten the locknuts on the potentiometer shaft; replace the longer nut first, and then the shorter nut.

(3) Replace the potentiometer mounting bracket on the bottom plate by using the screws and lockwashers that were removed during disassembly.

(4) Reseat the mounting plate on the bottom plate by inserting the vibration isolators into the holes in the bottom plate.

(5) Place a flat washer on the clevis pin, insert the clevis pin through the vibration isolator, place the other flat washer on the clevis pin, and replace the cotter pin for each vibration isolator in turn.

(6) Solder the leads to the terminals of potentiometer R419.

(7) Reseat the chassis on the bottom plate, tighten the wing-head stud that secures them together, and restore the amplifier to the upright position.

(8) Perform the adjustment check of output amplifier V403 (par. 40).

40. Adjustment of Output Amplifier V403

Adjustment of output amplifier V403 is required whenever V403, resistor R411, R412, or potentiometer R419 is replaced.

a. Arrange the amplifier in a compass system bench test setup (par. 32 *a, b).*

b. Raise the amplifier chassis from its bottom plate.

c. Place a temporary jumper between pin 1 of input amplifier V401 and the ground shield of its connecting lead (fig. 26).

d. Set the ME-30/U on the 100-volt range. Connect test leads from pin 8 of relay K402 (fig. 31) to the INPUT and from the center teminal of potentiometer R419 to the G terminals on the ME-30/U.

e. Operate the power switch on the ME–30/U to the ON position and allow sufficient warmup time (TM 11-5132).

f. Apply input power to the test bench arrangement of the compass system.

g. Vary potentiometer R419 and adjust it for a minimum indication on the ME-30/U.

h. Remove the temporary jumper *(c* above) and secure the amplifier chassis to the bottom plate *(b* above).

Section VI. CALIBRATION OF COMPASS, MAGNETIC, AIRCRAFT J-2 SYSTEM

41. General

Calibration of the compass system is required to correct for magnetic influences which cause errors in the heading indication. Index error is produced when the magnetic north axis of the flux valve is not parallel with the longitudinal axis of the aircraft. Index error can be eliminated by proper rotation of the flux valve with relation to the aircraft. Deviation error is caused by undesirable magnetic influences within the aircraft (electrical or magnetic aircraft apparatus) and within the compass system. Deviation error can be corrected by adjustment of the compensator. A compass rose (fig. 21), which consists of a large circular concrete platform accurately marked with various magnetic headings through 360°, is generally used for compass system alignment. In addition, a nonmagnetic screwdriver (brass) is required for adjustment of the compensator. Calibrate the compass system (par. 42) when any of the following conditions occur:

a. The flux valve has loosened in its mounting, has been removed during troubleshooting, or has been replaced with a new unit.

b. The gyro unit has been replaced.

c. The location or amount of electrical equipment in the aircraft has been changed.

d. The engine has been replaced or rewired.

e. The aircraft has been subjected to concussion from shell fire or hard-landing shocks.

42. Compass System Calibration

a. Preliminary Procedures.

(1) Position the aircraft on a compass rose. Remove all equipment not actually used in the aircraft during flight.

Make sure that all equipment used in the aircraft during flight is installed. Keep the area around the compass rose clear of other aircraft, vehicles, equipment, and nonessential personnel for at least 100 yards.

Note. A magnetic sighting compass may be used to position the aircraft when a compass rose is not available. Locate and use the magnetic sighting compass a considerable distance from the aircraft. The line of sighting should coincide with the longitudinal axis of the aircraft. When a sighting is taken on the aircraft looking from front to rear, 180° must be added to or subtracted from the sighting compass reading; when sighting from resir to front, use the direct reading.

(2) Be sure that all maintenance personnel remove magnetic objects from their possession before performing the calibration procedures. Station one repairman in the aircraft to read the gyro unit compass card heading indication, to record the amount of error in heading indications, and to make necessary computations.

Note. In lieu of stationing a repairman to record observations at the gyro unit compnss card, an auxiliary indictitor (calibration indicator) may be temporarily located near the flux valve. Heading indications may be recorded from this calibration indicator, instead of from the gyro unit compass card, during the calibration procedure outlined below. A shielded cable of suitable length must be constructed to connect tbe calibration indicator into the compass system. When Repeater Amplifier Type B-7A is used, connect the calibration indicator to terminals 17, 21 through 24 of the system junction box as shown in figure 24. When Repeater Amplifier Type B-7A is not used, connect the calibration indicator to terminals 17 through 20 in the system junction box as shown in figure 30. Disconnect the calibration indicator and reconnect the compass system for normtil operation after the calibration procedure has been completed.

CAUTION: Do not exceed the maximum number of indicators that can be connected into the compass system (TM 11-6605-200-12).

(3) Carefully scribe a mark on the flux valve mounting cutout as an extension of the longest or center flux valve flange graduation. This mark is to be used as a reference and must be aligned with the flange graduation.

(4) Rotate the compensator NS and EW adjustment shafts so that the vertical grooves are aligned with the dots on. the compensator case.

(5) Operate the compass system in the slaved mode.

Note. Unless a particular type aircraft engine operation affects the flux valve sensing, the aircraft engine does not have to be operated during this alignment procedure. Excitation voltages may be supplied from an auxiliary power unit.

b. Index Error Adjustment.

Note. The index error adjustment requires that the aircraft be moved to several positions on the compass rose. Allow sufficient time at each position (approximately 3 minutes) for the gyro unit compass card to settle on a steady heading indication.

(1) Align the longitudinal axis of the aircraft with the N–S axis of the compass rose as shown in figure 21.

(2) Observe the compass card on the gyro unit and record the amount of error in the heading indication, Assign a plus (+) value if the compass card error is greater than the actual aircraft heading (clockwise from north) or a minus (-) value if it is less than the actual aircraft heading (counterclockwise from north), as determined from the compass rose.

(3) Align the longitudinal axis of the aircraft with each of the other three cardinal points on the compass rose in turn; record the error at each point.

(4) To find the index error, add the four values algebraically and divide by 4.

(5) Loosen the mounting screws in the flux valve flange sufficiently to permit rotation of the flux valve.

(6) Hold the flux valve against its mounting surface. Rotate the flux valve so that the flange graduation that is equal to the magnitude of the index error (counting from the 0° graduation) is aligned with the scribed reference mark on the flux valve mounting cutout *(a(3)* above). Rotate the flux valve in the minus (-) or counterclockwise direction (flux valve viewed from the top) if the index error is positive; rotate the flux valve in the positive (+) or clockwise direction for a negative index error. Tighten the

mounting screws in the flux valve flange.

CAUTION: When tightening the mounting screws be careful not to disturb the flux valve index error adjustment.

(7) Repeat (1) through (4) above. If the values cbtained do not algebraically add to zero, readjust the flux valve until the error is canceled.

c. *Deviation Error Adjustment.*

(1) Align the longitudinal axis of the aircraft with the N-S axis of the compass (0°).

(2) Correct for *all* directional deviation error at this position by turning the NS adjustment shaft on the compensator until the gyro unit compass card heading indication changes by an amount equal to the error, *but in the opposite direction.*

(3) Reposition the aircraft to an easterly heading (90°). Correct for *all* directional deviation error at this position by turning the EW adjustment shaft on the compensator until the gyro unit compass card heading changes by an amount equal to the error, *but in the opposite direction.*

(4) Reposition the aircraft on a southerly heading (180°). Cancel *half* the indicated error by turning the NS adjustment shaft on the compensator.

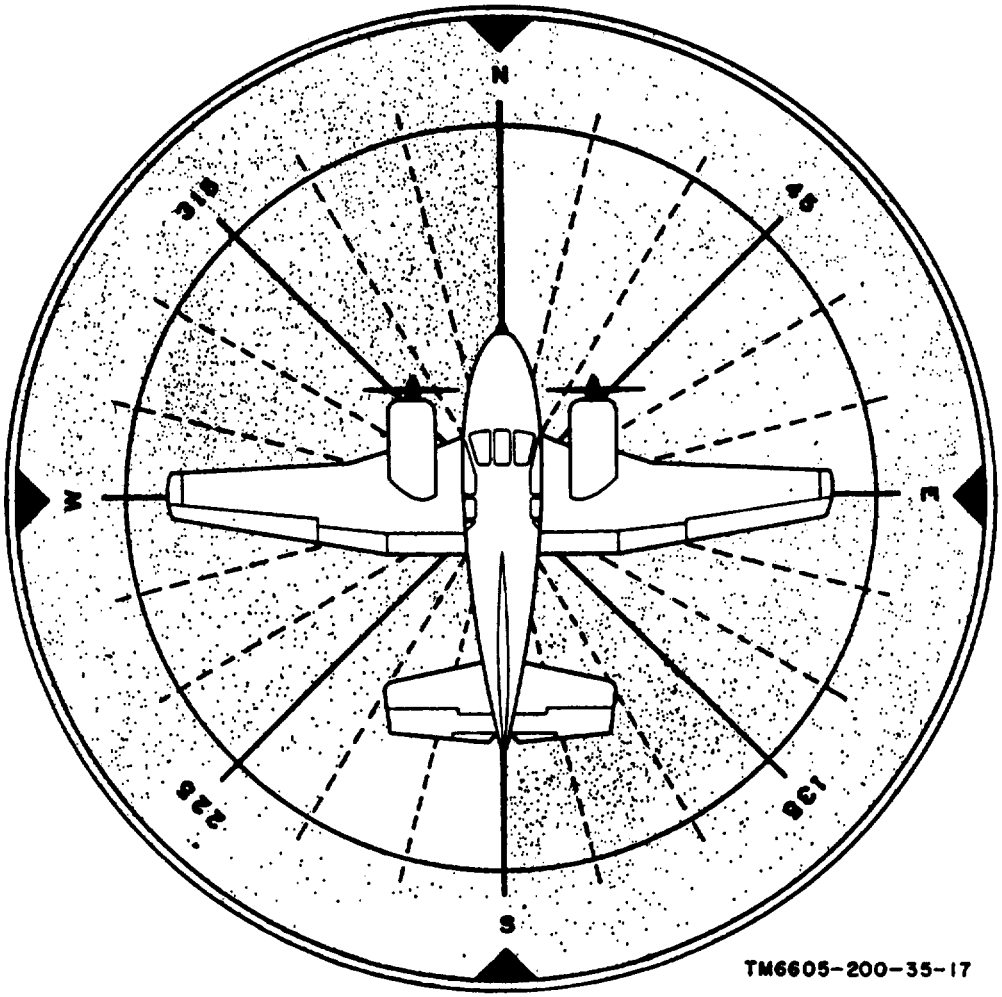


Figure 21. Typical compass rose showing magnetic headings and an aircraft aligned with magnetic meridian.

Observe the gyro unit compass card heading indication for the correct amount and direction of compensation.

(5) Reposition the aircraft on a westerly heading (270°). Cancel *half* the indicated error by turning the EW adjustment shaft on the compensator. Observe the gyro unit compass card heading indication for the correct amount and direction of compensation.

d. Final Check. Check the accuracy of the compass system calibration procedures by swinging the aircraft once around the compass rose in 30° increments. The heading indications on the gyro unit compass card should be within ±0.5° at each heading. Repeat the calibration procedures (*a* through *c* above) if any errors in excess of ±0.5° are observed.

CHAPTER

FOURTH AND FIFTH ECHELON MAINTENANCE

Section I. FOURTH ECHELON MAINTENANCE PROCEDURES

Note. Paragraph 7 lists the tools, test equipments, and test jigs required for fourth echelon maintenance.

43. Replacement of Inductor L403

(fig. 11 and 12)

a. Removal.

(1) Place the amplifier on its side and release the wing-head stud that secures the chassis to the bottom plate.

(2) Separate the chassis and the bottom plate sufficiently so that the two screws on the outside rear of the chassis that hold capacitor C1 secure and their corresponding nuts and lockwashers on the inside of the chassis are accessible. Remove the screws, nuts, and lockwashers.

(3) Lift capacitor C1 from its mounting position on the chassis.

Note. Whenever inductor L403 is replaced, the 800-cps reference voltage circuit will require tuning (par. 44). Remove tuning capacitors C1 and C2 by unsoldering their connecting leads.

(4) Unsolder the leads connected to inductor L403. Tag or otherwise identify each lead.

(5) Remove the two screws and lockwashers that secure inductor L403 to the chassis and remove inductor L403,

b. Replacement. To replace inductor L403, reverse the procedure in *a* above.

44. Tuning Procedure for 800-Cps Reference Voltage Circuit

a. Remove the reference voltage circuit consisting of inductor L403 and capacitors C1 and C2 from the amplifier (par. 43).

b. Connect inductor L403 and capacitor C1 as shown in figure 22.

c. Adjust the TS–421/U until the AN/USM-26 reads 820 ±5 cps.

d. Vary the output voltage control on the TS-421/U until the ME-30A/U reads 12 ±0.3 volts.

Note. This reading must be maintained for the duration of the tuning procedure.

e. Adjust the capacitor decade until resonance is noted on the OS–8A/U. Resonance will be indicated by a straight line pattern at an angle of 45° from the vertical (closed Lissajou figure).

f. Recheck the settings made in *d* and *e* above.

g. Select the capacitor (C2) from the chart below which equals the value measured on the capacitance decade.

Note. Capacitor C2 may be either a single capacitor or two capacitors connected in parallel.

h. Connect capacitor C2 into the circuit in place of the capacitor decade.

i. Adjust the output of the TS-421/U, if necessary, until the pattern in e above is observed on the OS-8A/U. The AN/USM-26 should read 820 ±5 cps; if it does not, repeat c through h above until the required capacitance value is obtained.

j. Connect inductor L403 and capacitors C1 and C2 permanently into the circuit.

k. Values for capacitor C2 are as follows:

Capacitance [a] (uuf)	Federal stock number
1,000	5910-101-4022
1,200	5910 -129 -9180
1,500	5910-112-8122
1,800	5910-190-118
2,200	5910-100-8049
2,700	5910-100-8055
3,300	5910-184-0788
3,900	5910-101-3857
4,700	5910-101-3846
5,600	5910-667-5639
6,800	5910-170-4373
8,200	5910-100-8082
10,000	5910-100-8142

[a] Tolerance of capacitors listed is +5 percent.

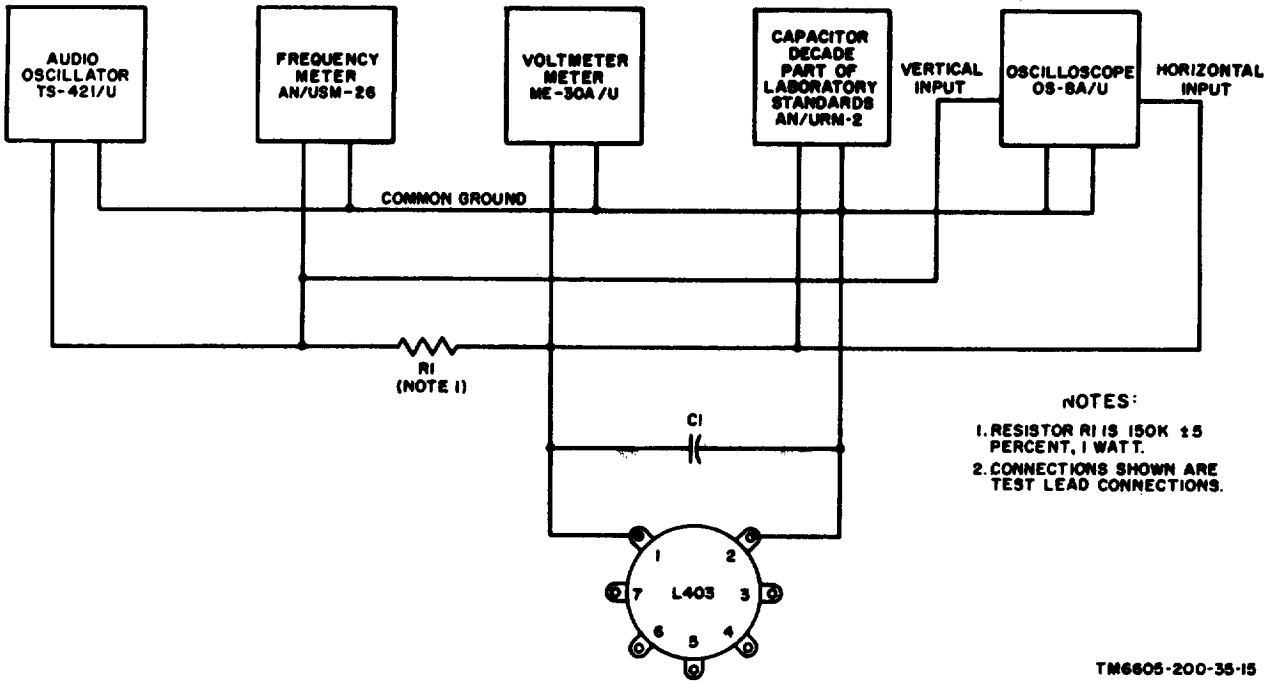


Figure 22. Test setup for tuning 800-cps reference voltage circuit.

Section II. FIFTH ECHELON MAINTENANCE PROCEDURES

Note. Paragraph 7 lists the tools, test equipments, and test jigs required for fifth echelon maintenance.

45. General

The tests outlined in paragraphs 46 through 47 are designed to measure the performance capability of repaired equipment. Equipment that meets the minimum standards stated in the tests will furnish satisfactory operation equivalent to that of a new unit.

46. Final Test of Amplifier, Electronic Control Type A-2

A power source of 115 volts ac, 400 cps, 3-phase, and 27.5 volts dc is required for the tests in *b* through *e* below.

Note. In *b* through *e* below, change the test jig control positions only when indicated in the test procedure.

a. 800-Cps Reference Voltage Circuit Test. Perform the steps outlined in paragraph *44a* through *f.* The frequency indicated on the AN/USM-26 should be 820 ±5 cycles per second.

(1) Substitute capacitor C2 for the capacitor decade.

(2) Adjust the output of the TS-421/U, if necessary, until resonance is indicated on the OS-8A/U (par. 44 *e).* The frequency indicated on the AN/USM-26 should remain 820 ±5 cps.

(3) Replace inductor L403 and capacitors C1 and C2 in the amplifier (par. 43 *b).*

b. Slaving Voltage Tests. The slaving voltage tests are designed to check the voltages applied from the amplifier to the leveling and slaving torque motors, and to the flux valve, during fast and slow slaving of the compass system.

(1) Operate the controls of the test jig for Amplifier, Electronic Control Type A-2 (fig. 8) as follows:

Control	Position
POWER	OFF
AC RANGE	150V
S1	A B
S-2	SLAVE
S-8	NORMAL

(2) Connect the equipment as shown in figure 23.

Note. Only the test jig meters are required for this portion of the test.

(3) Operate the test jig POWER switch to the ON position.

Note. If the test results in (4) through (9) below do not agree with the indicated test results, shut the equipment off, wait 2 minutes, and then resume testing at that step during which the inconsistent test result was obtained.

(4) Note the readings on the DC VOLTS and AC VOLTS meters; they should indicate 27.5 ±0.5 volts dc and 115 ±.2 volts ac, respectively.

(5) Operate switch S1 to the AC position; the meter indications should be the same as in (4) above.

(6) Operate switch S1 to the LEVELING position and the AC RANGE switch to the 50V position.

(7) Note the reading on the AC VOLTS meter; it should indicate 30 ±1.5 volts ac. This is the amplifier output to the leveling torque motor for fast slaving.

(8) Operate switch S1 to the FLUX VALVE position and note the reading on the AC VOLTS meter; it should indicate 23 ±2 volts ac. This is the flux valve excitation voltage applied from the amplifier to the flux valve during fast slaving.

(9) Operate the POWER switch to the OFF position, switch S1 to the SLAVING position, and the AC RANGE switch to the 150V position. Wait approximately 2 minutes.

(10) Operate the POWER switch to the ON position and start timer FM-103(1).

(11) Note the reading on the AC VOLTS meter while monitoring the time elapsing. The AC VOLTS meter should indicate 115 ±2 volts ac during the initial 2 to 3 minutes of operation, and then drop to a lower value.

(12) Operate the AC RANGE switch to the 50V position and note the reading on the AC VOLTS meter; it should indicate 23 ±1.2 volts ac.

(13) Operate switch S1 to the FLUX VALVE position and observe for a 23 ±1.2-volt ac indication on the AC VOLTS meter.

(14) Operate switch S1 to the LEVELING position and observe for a 15 ±0.75-volt ac indication on the AC VOLTS meter. This indicates that the amplifier output to the leveling torque motor has decreased from the fast slaving rate ((7) above) to the slow slaving rate during the initial 2 to 3 minutes of operation.

(15) Operate the test jig POWER switch to the OFF position.

c. Minimum Output and Balance Test.

(1) Connect the equipment as shown in figure 23.

(2) Operate the power ON-OFF switches of the ME–30A/U's to their ON positions and wait the specified warmup time (TM-5132).

(3) Operate the range selector switches on the ME–30A/U's to the 300-volts settings. Subsequent adjustment of the range selector switches will be necessary according to the indicated test results required in (4) through (17) below.

(4) Operate the test jig controls as follows (fig. 8) :

Control	Position
AC RANGE	150V
S1	AB
S-2	SLAVE
S-3	NORMAL
P1	NULL
POWER	ON

(5) Observe for DC VOLTS and AC VOLTS meter indications as in *b(4)* above; wait approximately 3 minutes.

(6) Adjust P1 for a minimum voltage indication on ME-30A/U No. 1.

(7) Note the reading on ME-30A/U No. 2; it should be less than 1.5 volts ac.

(8) Adjust P1 in a CW (clockwise) direction until ME-30A/U No. 1 indicates an input signal of 0.04 volt and record the voltage indicated on ME-30A/U No. 2.

(9) Adjust P1 in a CCW (counterclockwise) direction until the value recorded in (8) above is again indicated on ME-30A/U No. 2.

(10) Note the reading on ME-30A/U No. 1; the difference between this reading and the input signal of 0.04 volt noted on ME-30A/U No. 1 in (8) above should not exceed 0.02 volt.

(11) Adjust P1 in the CW and CCW directions for input signal voltages indicated on ME–30A/U No. 1 as listed below. Measure and record the output signal voltages on ME–30A/U No. 2 and determine the cliff erence (unbalance between the output signals for the CW and CCW positicns of P1 for the indicated results.

Input signal (CW and CCM)[a]	Allowable output voltage [b]	Maximum allowable unbalance [c]
0.04	5 to 15	0
0.08	10.5 to 18.5	1.5
0.2	13.5 to 19	1.5
0.4	13.5 to 20	1.5

a Observe on ME-30A/U No. 1.
b Record from M E-30A/U No. 2.
c Computed value.

(12) Operate the test jig POWER switch to OFF and wait approximately 3 minutes.

(13) Operate the range selector switch on ME-30A/U No. 2 to the 100 volts range.

(14) Operate the test jig POWER switch to ON and record the reading on ME-30A/U No. 2; the indicated voltage should be between 65 and 85 volts.

(15) Adjust P1 in a CW or CCW direction, depending on the last setting made in (11) above, for an input signal of 0.4 volt as indicated on ME–30A/U No. 1.

Note. If approximately 3 minutes have elapsed since tbe procedure in (12) above was performed, repeat (12) above before proceeding with (16) below.

(16) Record the reading on ME-30A/U No. 2; the voltage indicated should be between 65 and 85 volts.

(17) Determine the difference between the readings recorded in (14) and (16) above; it should not be more than 6 volts.

d. Slaving Cutout Relay Test.

(1) Adjust P1 in a CW direction for an input signal of 0.4 volt on ME–30A/U No. 1 and observe ME-30A/U No. 2 for a reading of approximately 18 volts ac.

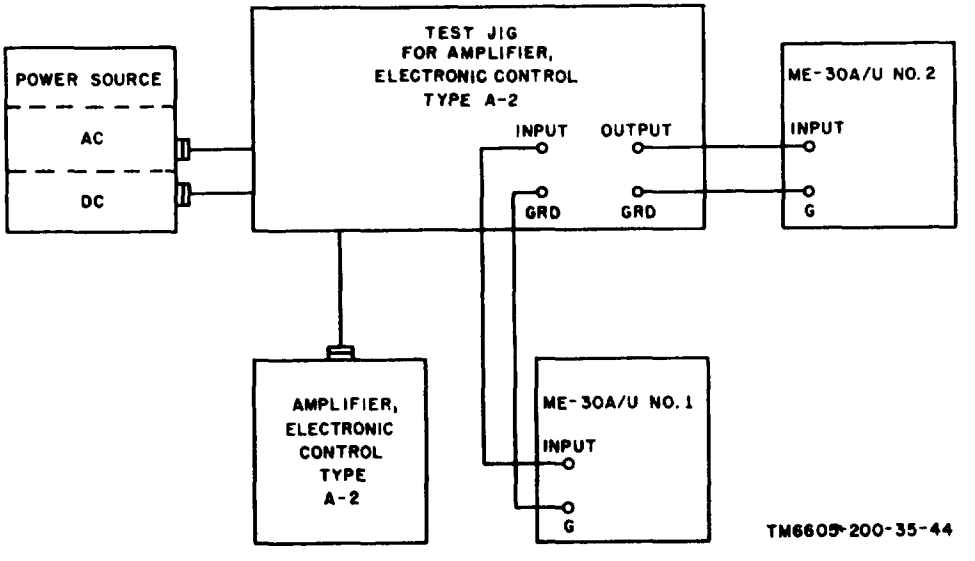


Figure 23. Test setup for final tests of Amplifier, Electronic Control Type A-2.

(2) Operate switch S-2 to the CUTOUT position and observe the reading on ME-30A/U No. 2; it should decrease from approximately 18 volts ((1) above) to 0.01 volt or less.

(3) Operate switch S-2 to the SLAVE position.

e. Polarity Test.

(1) Adjust P1 in a CW direction for an input signal of 0.08 volt on ME-30A/U No. 1.

(2) Operate switch S3 to the PHASE COMPARISON position and observe the indication on ME-30A/U No. 2; the output voltage shall increase.

(3) Repeat (1) and (2) above for a 0.08-volt CCW input signal. The output voltage indication on ME–30A/U No. 2 should decrease.

47. Slaving Rate Test for Compass, Magnetic, Aircraft J-2 System

a. Pretest Procedures.

(1) Install the compass system (and auxiliary equipment) in the mockup (par. 12).

(2) Operate the INPUT switch to the S-1 CONTROL position if Repeater Amplifier Type B-7A is *not* used in the compass system. Operate the INPUT switch to the B-7 AMPLIFIER position if Repeater Amplifier Type B-7A is used.

(3) Operate the mockup POWER switch to the ON position; the A.C. and D.C. indicator lamps should light.

(4) Note the readings on the ac and dc voltmeters; they should read 115 volts ac (±10 percent) and 27.5 volts dc (±10 percent), respectively.

(5) Note the reading on the frequency meter. It should read 400 ±40 cycles per second.

(6) Operate the PHASE ROTATION switch to its ON position; the PHASE ROTATION DIM and BRIGHT indicator lights should glow as indicated by name.

WARNING: Remove power from the mockup before attempting to correct phasing of the input of voltage.

Note. If the PHASE ROTATION indicator lights do not glow as indicated by name, the input ac voltage is incorrectly phased. For correct phasing, interchange the connections from the ac input cable W-102 to terminals B and C of terminal block E-105 (fig. 32).

(7) Operate the set course knobs on the indicator and auxiliary indicators (TM 11-6605-200-12) until the N or O degree graduations on the dial indexes are aligned with their zero bezel indexes.

(8) Check to see that the heading indications on the indicator and auxiliary indicators agree with the heading indication on the gyro unit compass card.

Note. The indicator and auxiliary indicators should maintain heading indications identical with the gyro unit compass card through the slaving rate tests.

(9) Loosen the clamp screws that secure the flux valve in its mounting fixture.

(10) Rotate the flux valve until the heading indication on the indicator, auxiliary indicators, and the gyro unit compass card all indicate N or O degrees.

(11) Loosen the holding screw on the gyro unit turntable assembly.

b. Slow Slaving Rate Test.

(1) Rotate the gyro unit from 0° heading indication to 90° in a clockwise direction.

(2) Use the timer (FM-103 (1)) to check the slaving rate during any 30° of procession but not to include the last 10°. For example, start timing at 50° and stop at 20°.

(3) The internal timed should not be less than 5 minutes nor greater than 10 minutes (3° to 6° per minute slow slaving rate).

(4) Repeat (1), (2), and (3) above for a heading of 180°.

(5) Rotate the gyro unit counterclockwise from 0° to 270°, and repeat (2) and (3) above.

c. *Fast Slaving Rate Test.*

Note. The compass system must be operated for at least 6 minutes in the slaved mode prior to performing the fast slaving rate test.

(1) Operate the POWER switch on the test bench mockup panel to the OFF position.

(2) Rotate the gyro unit in a clockwise direction to a heading indication of 90°.

(3) operate the POWER switch on the test bench mockup panel to the ON position and simultaneously start the timer.

(4) Stop the timer when the heading indication on the gyro unit compass card reaches 30°.

(5) The interval timed should not be less than 30 seconds nor greater than 1 minute.

CHAPTER 6

AUXILIARY EQUIPMENT

Section I. INTRODUCTION

48. General

Repeater Amplifier Type B-7A is used with the compass system whenever more than two Indicators, Induction Compass Type V-8 are used as auxiliary indicators (TM 11-6605-200-12). The repeater amplifier is also used when the compass system is employed to supply directional information to automatic control instruments within the aircraft.

49. Auxiliary Equipment Connections in Compass System

a. Connections When Compass System Is Not Used With Automutic Pilot. Figure 24 shows the connections in the system junction box which connect the repeater amplifier and an auxiliary indicator. A maximum of six auxiliary indicators (additional to compass system indicators) may be connected in a similar manner to terminals 17 and 21 through 24 of the system junction box. When a repeater amplifier is used in this manner, a total of nine indicators (1 main and 8 auxiliary) may be used with the compass system (TM 11–6605-200-12) .

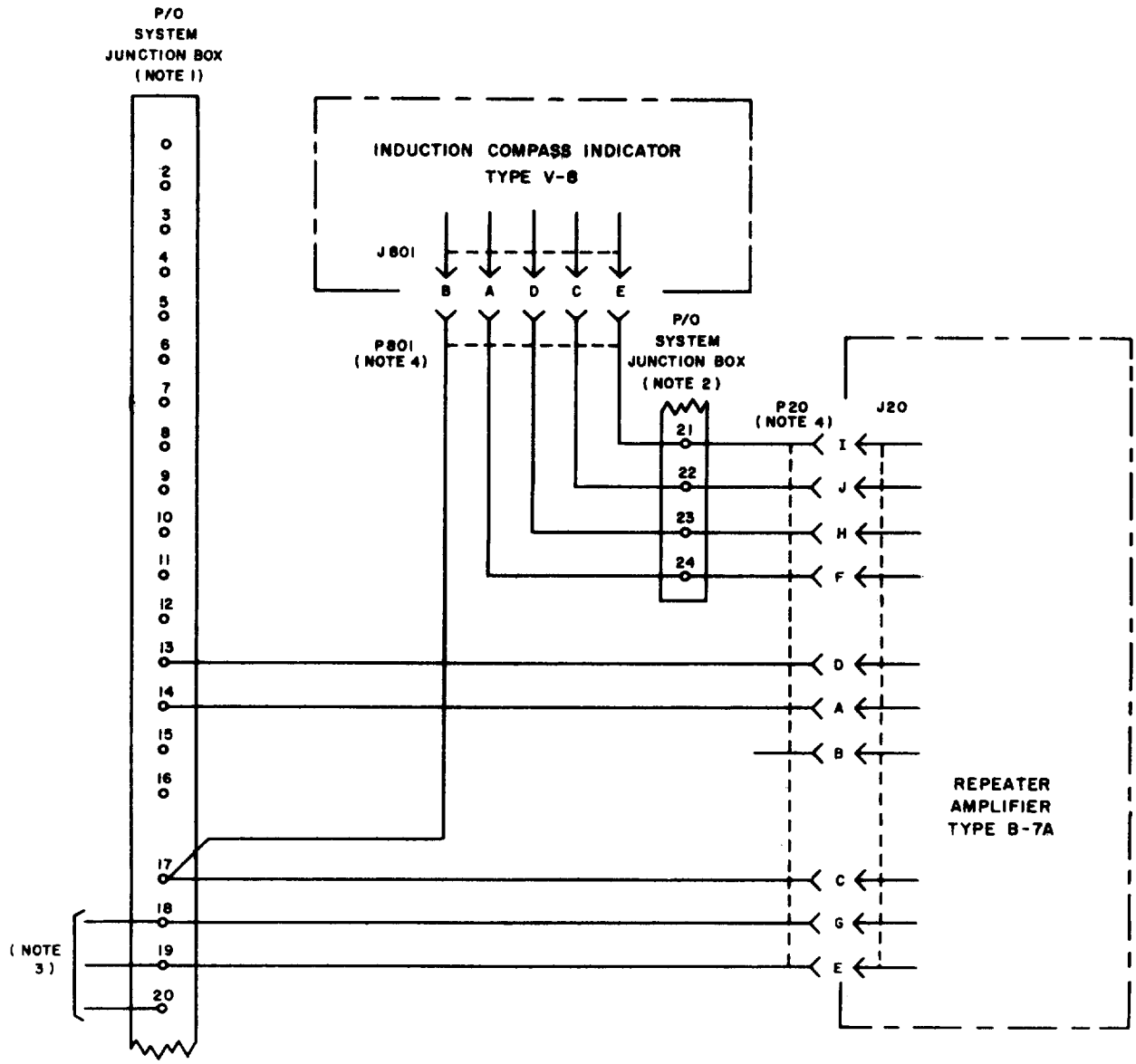
b. Connections When Compass System Is Used With Automatic Pilot. When the compass system is used to provide heading signals to an automatic pilot, the repeater amplifier is used to isolate the compass system indicators. Indicator, Induction Compass Type V-7A (main indicator) and Indicators, Induction Compaes Type V-8 (auxiliary indicators) are connected in parallel to system junction box terminals 17 and 21 through 24, as shown in figure 24. A maximum of six indicators (main indicator and five auxiliary indicators) may be connected to the terminals. The repeater amplifier isolates the compass system main and auxiliary indicators and thus prevents spurious oscillation, which might occur in the indicator circuits, from affecting the yaw channel of the automatic pilot. This isolation prevents the aircraft from oscillating when the yaw channel of the automatic pilot is engaged. Heading signals are applied directly from the heading synchro in the gyro unit, through terminals 18, 19, and 20 of the system junction box, to the yaw channel of the automatic pilot.

Section II. REPEATER AMPLIFIER TYPE B-7A, THEORY AND MAINTENANCE

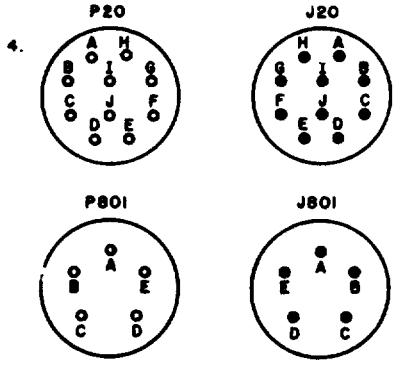
50. Repeater Amplifier Type B-7A, Block Diagram Analysis
(fig. 25)

The repeater amplifier consist of two identical channels of amplification, channel 1 and channel 2, and a common rectifier circuit. Only channel 1 and the rectifier circuit will be discussed in detail; a parenthetical reference to parts (example, (input amplifier V102 (V201)) indicates that identical parts exist in channel 1 and channel 2.

a. Amplification Channel. The input signal from the compass system (par. *4a)* is applied to channel 1 (channel 2) input amplifier V101 (V-201) where it is amplified sufficiently to drive push-pull power amplifiers V102 and V103 (V202 and V203) which, in turn, develop the power to drive six auxiliary indicators. The output of push-pull power amplifiers V102 and V103 (V202 and V203) is coupled to the auxiliary indicators by output transformer T101 (T201). Each channel of the repeater amplifier contains a 100 percent degenerative feed-



NOTES:

1. JUNCTION BOX TERMINAL NUMBERS ARE ARBITRARILY ASSIGNED. CONNECTIONS SHOWN ARE IN ADDITION TO NORMAL COMPASS SYSTEM CONNECTIONS.
2. SYSTEM JUNCTION BOX TERMINALS WHICH MAY BE USED TO CONNECT REPEATER AMPLIFIER TYPE B-7A TO INDICATORS.
3. INPUT CONNECTIONS TO YAW CHANNEL OF AUTOMATIC PILOT.
4. 

TM6605-200-35-22

Figure 24. System junction box connections required for auxiliary equipment.

back circuit which increases amplifier stability, minimizes distortion of the input signal, and provides a high impedance for isolation.

b. Rectifier Circuit. The dc operating voltage for channel 1 and channel 2 is provided by a full-wave power supply which consists of transformer T301, rectifier V301, and a capacitive filter network.

51. Repeater Amplifier Type B-7A, Schematic Diagram Analysis

(fig. 24 and 26)

a. Amplification Channel.

(1) *Input amplifier circuit.* Heading indication signals from the compass system are applied to channel 1 (channel 2) through terminal 19 (18) of the system junction box, pin E (G) of connector P20 and receptacle J20, and through grid resistor R101 (R201) to the grid of input amplifier V101 (V201). Unbypassed cathode resistor R102 (R202) provides cathode bias and is also the total degenerative feedback path from output transformer T101 (T201) *(b* below). Resistors R304 and R305 constitute a voltage divider which provides proper screen grid voltage for V101 (V201). Capacitor C301B is a screen grid decoupling capacitor for V101 (V201). The output signal is developed across plate load resistor R105 (R205); capacitor C101 (C201) bypasses transient voltages. Resistor R303 is a voltage-dropping resistor for V101 (V201)

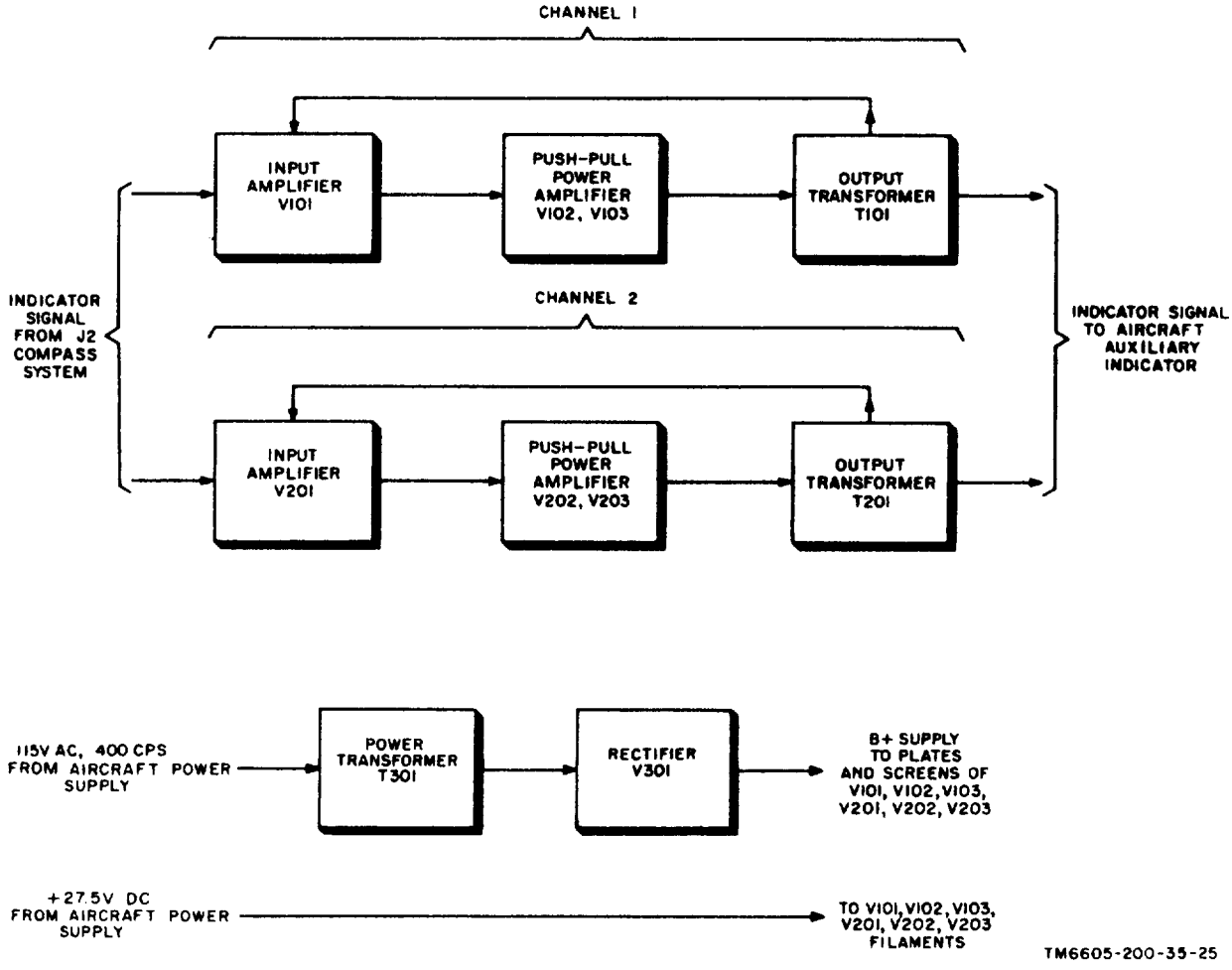
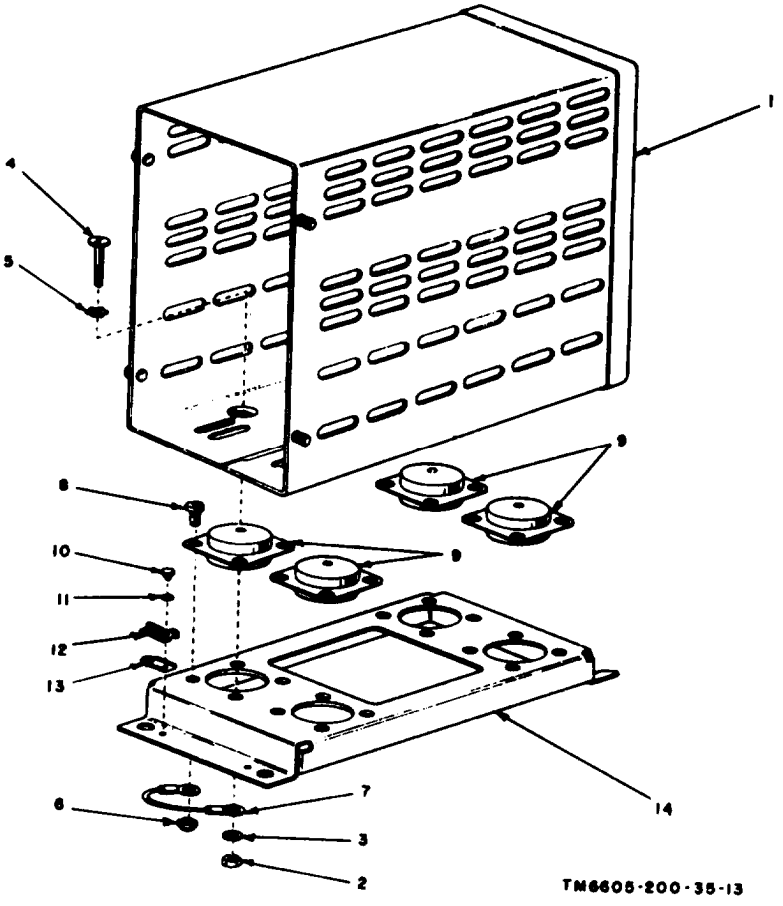


Figure 25. Repeater Amplifier Type B-7A, block diagram.

plate supply voltage. The output signal is coupled through capacitor C102 (C202) and resistor R106 (R206) to the grid of push-pull power amplifier V102 (V202).

(2) *Push-Pull amplifier circuit.* Tubes V102 and V103 (V202 and V203) constitute a push-pull amplifier circuit. The input signal at the grid of V102 (V202) is simultaneously coupled to V103 (V203) through common cathode resistor R107 (R207). This method of coupling provides the 180° phase inversion in the grid-cathode circuit of V103 (V203) required for push-pull action. Fixed bias for the control grids of power amplifiers V102 and V103 (V202 and V203) is applied through terminals 13 and 14 of the system junction box, pins D and A of connector P20 and receptacle J20, and through grid resistors R106 (R206) and R109 (R209), respectively, from the aircraft's 27.5-volt dc power supply. Resistor R108 (R209) is a screen grid-dropping resistor.



1 Case
2 Hexagonal nut
3 Lockwasher
4 Screw
5 Lockwasher
6 Self-locking nut
7 Ground strap assembly
8 Screw
9 Vibration isolator
10 Rivet
11 Washer
12 Snap slide latch
13 Snap slide guide
14 Mounting base

Figure 27. Repeater Amplifier Type B-7A case and base assembly, exploded view.

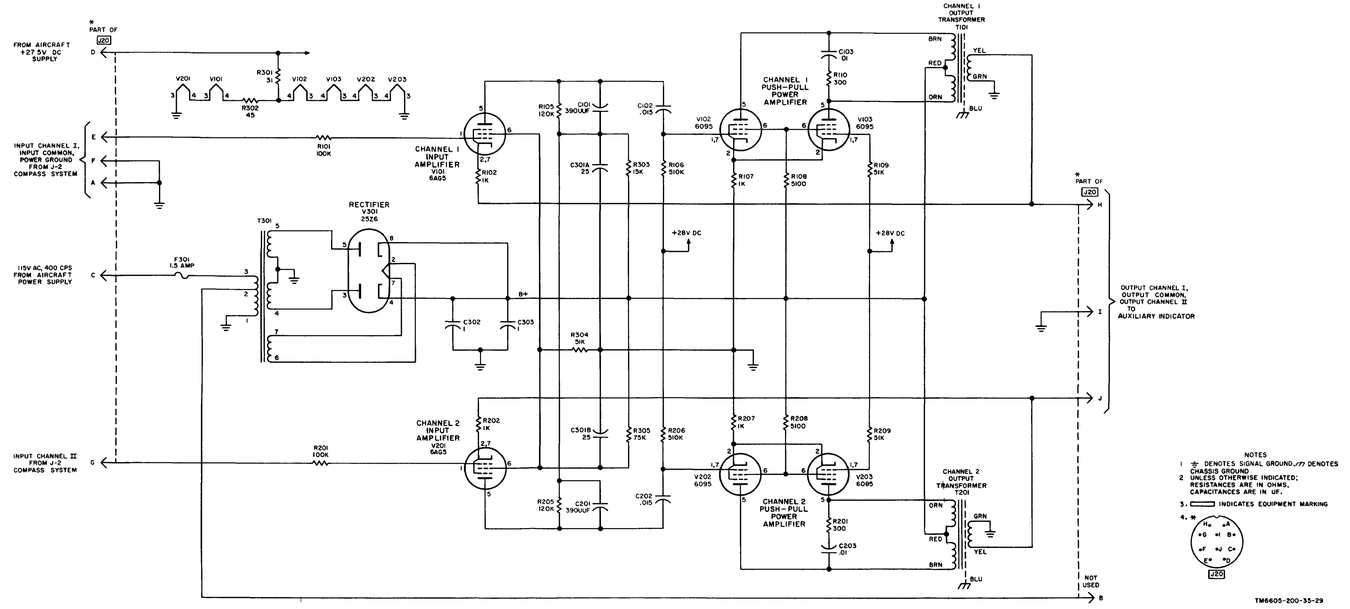


Figure 26. Repeater Amplifier Type B-7A, schematic diagram

Capacitor C103 (C203) and resistor R110 (R210) bypass undesirable high-frequency components from the output circuit. Each half of the center-tapped primary of output transformer T101 (T201) provides the plate load for powe. amplifiers V102 (V202) and V103 (V203), respectively. The amplified signal from the secondary of output transformer T101 (T201) is applied through pin H (pin J) to auxiliary indicators. The output signal from T'101 (T201) is also applied to the cathode of input amplifier V101 (V201) through cathode resistor R102 (R202) as a degenerative feedback voltage.

b. Rectifier Circuit. The rectifier circuit consisting of twin-diode rectifier V301 and transformer T301 provides the dc operating voltage for the plate and screen grid circuits of channel 1 and channel 2. Input power of 115 volts ac, 400 cps is applied to transformer T301 primary through fuse F301, pins A and C of receptacle J20 and connector P20, and through terminals 14 and 17 of the system junction box from the aircraft's ac power supply.

c. Filament Circuits. Filament voltage for amplifier tubes V101, V102, and V103 (V201, V202, and V203) is applied through terminals 13 and 14 of the system junction box, and through pins D and A of connector P20 and receptacle J20 from the aircraft's 27.5-volt dc power supply. Filament voltage for rectifier V301 is supplied from secondary winding 6-7 of transformer T301.

52. Repeater Amplifier Type B-7A, Maintenance Instructions

a. General. The tools and test equipments required for maintenance are listed in paragraph 7; maintenance scheduling is listed in paragraph 18. The third echelon periodic check of the repeater amplifier is outlined in paragraph 21. Additional field and depot maintenance procedures are detailed in paragraphs 53 through 56.

b. Repairs. All the repeater amplifier parts are readily accessible for replacement after the unit has been removed from its case (par. 55). Refer to figures 14 through 16, 27, and 28 for parts location.

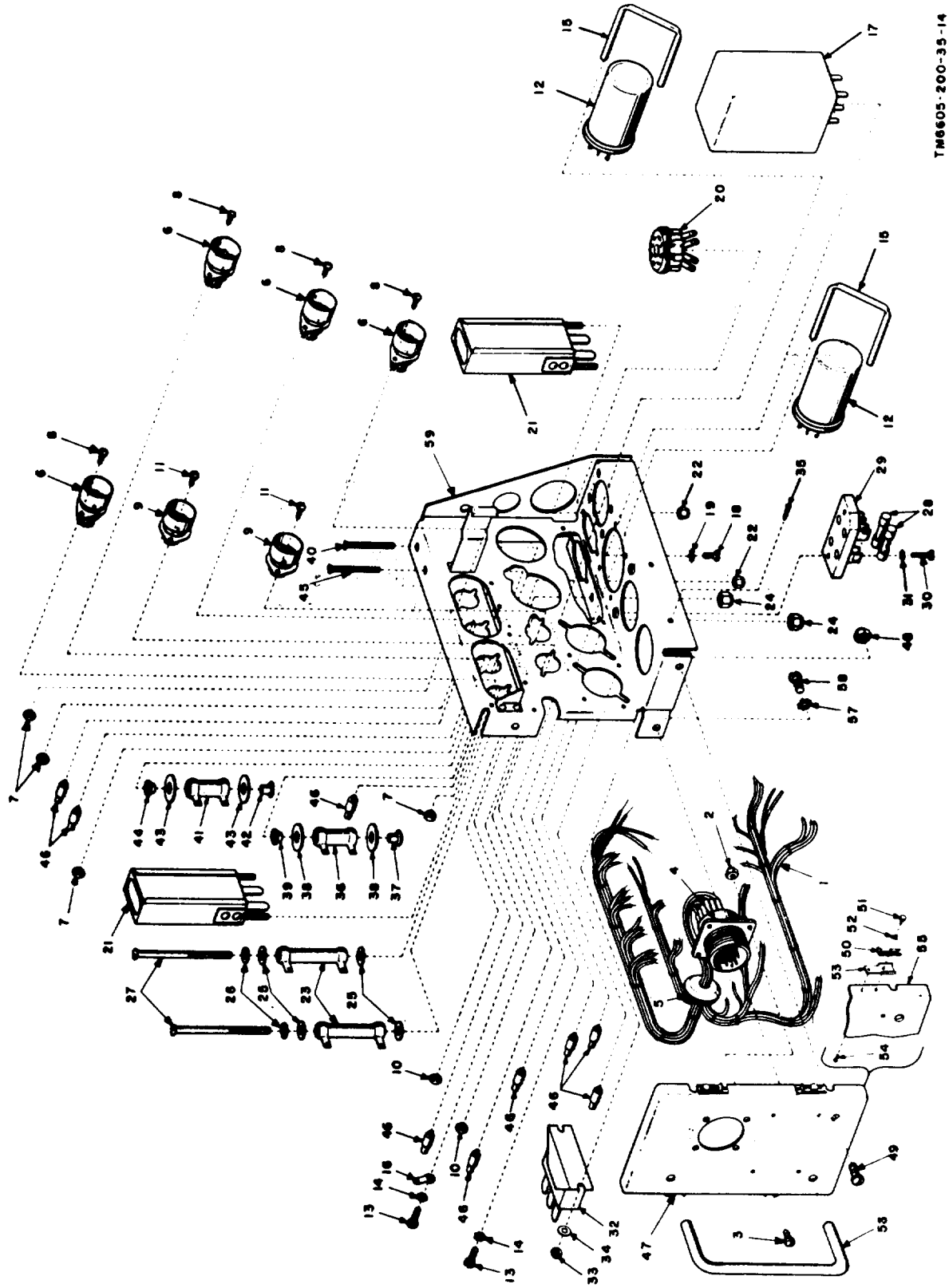


Figure 28. Repeater Amplifier Type B-7A chassis, exploded view.

1 Wiring harness assembly
2 Self-locking nut
3 Screw
4 Receptacle J20
5 Rubber grommet
6 Electron tube sockets XV102, XV103, XV202, XV203
7 Self-locking nut
8 Screw
9 Electron tube sockets XV101, XV201
10 Self-locking nut
11 Screw
12 Transformer T101, T201
13 Screw
14 Lockwasher
15 Transformer T101, T201 bracket
16 Transformer T101, T201 lug
17 Transformer T301
18 Screw
19 Lockwasher
20 Electron tube socket XV301
21 Capacitor C301, C302
22 Self-locking nut
23 Resistor R107, R207
24 Self-locking nut
25 Plain washer
26 Plain washer
27 Screw
28 Fuse F301
29 Fuse block assembly
30 Screw
31 Lockwasher
32 Capacitor C310A, C301B
33 Self-locking nut
34 Plain washer
35 Screw
36 Resistor R302
37 Nut
33 Plain washer
39 Centering washer
40 Screw
41 Resistor R301
42 Nut
43 Plain washer
44 Centering washer
45 Screw
46 Standoff terminal
47 Front cover assembly
48 Self-locking nut
49 Screw
50 Span slide latch
51 Rivet
52 Washer
53 Span slide guide
54 Countersunk rivet
55 P/o front cover assembly
56 Handle
57 Lockwasher
53 Screw
59 Chassis

Figure 28 - Continued.

53. Repeater Amplifier Type B-7A, Troubleshooting Chart (Third Echelon)

a. General. Procedures are outlined in the repeater amplifier troubleshooting chart *(c* below) for localizing troubles to the individual circuit or component. Depending on the nature of the operational symptoms, one or more of the localization procedures will be necessary.

b. Use of Chart. The repeater amplifier troubleshooting chart is designed to supplement the compass system trouble-sectionalization chart (par. 24). The chart lists symptoms which the third echelon reuairman observes while making operational checks, probable troubles, and corrective action which can be taken.

c. Troubleshooting Chart.

Item	Symptom	Probable trouble	Correction
1	All tubes light except V301; no output from channel 1 or channel 2	Fuse F301 blown	Check fuse F301; replace if defective. If fuse F301 continues to blow, refer to item 2 below.
2	Fuse F301 continues to blow.	*a.* Defective rectifier tube V301 or defective amplifier tubes in either channel 1 or channel 2.	*a.* Check V301 (par. 29); replace if defective. If V301 checks good, check tubes in channel 1 and channel 2 and replace as required.
		b. Shorted capacitor C302 or C303.	*b.* Perform a continuity and resistance check (par. 54). Replace defective component.
		c. Defective transformer T301.	*c.* Perform a continuity and resistance check (par 54). Replace T301 if defective.
		d. Defective receptacle J20.	*d.* Perform a continuity and resistance check (par. 54). Replace J20 if defective.
3	Filaments of amplifier tubes V101, V102, V103, V201, V202, V203 do not light. Filament of rectifier tube V301 does light.	*a.* Defective resistor R301.	*a.* Remove V102 and check R301 (par. 54). Replace R301 if defective.
		b. Defective receptacle J20.	*b.* Perform a continuity and resistance check (par. 54). Replace J20 if defective.
4	Filaments of amplifier tubes V101 and V102 do not light; all other tube filaments are lighted.	*a.* Defective amplifier tube V101 or V201.	*a.* Check V101 and V201 (par. 29). Replace defective tubes as required.
		b. Defective resistor R302.	*b.* Remove amplifier tubes in channel 1 and channel 2 and check R302 (par. 54). Replace R302 if defective.
5	No output from channel 1.	*a.* Defective amplifier tubes V101, V102, or V103.	*a.* Check amplifier tubes V101, V102, and V103 (par. 29). Replace defective tubes as required.
		b. Defective output transformer T101.	*b.* Perform a continuity and resistance check of T101 (par. 54). Replace T101 if defective.
6	No output from channel 2.	*a.* Defective amplifier tube V201, V202, or V203.	*a.* Check amplifier tubes V201, V202, and V203 (par. 29). Replace defective tubes as required.
		b. Defective output transformer T201.	b. Perform a contiuity and resistance check of T201 (par. 54). Replace T201 if defective.
7	Overall output from repeater amplifier is weak.	Defective amplifier tubes in amplification channels.	Check all amplifier tubes and replace as required.

54. Repeater Amplifier Type B-7A, Continuity and Resistance Checks

a. General. The continuity and resistance checks in *b* below are performed at third echelon. Remove the repeater amplifier from the system (par. 55) and perform a continuity and resistance check of the circuit or part suspected of being defective. Prepare the repeater amplifier by removing its chassis assembly from the case (par. 55). Refer to figures 14 through 16, 27, and 28 for location of parts and test points.

Note. The continuity and resistance checks listed in *b* below must be performed with all electron tubes removed from the repeater amplifier.

b. Continuity and Resistance Chart.

Item	Circuit or component	Check		Resistance (ohms)	Portion of circuit or component
		From	To		
1	Receptacle J20	All pins	Chassis ground	∞	Receptacle J20.
2	Input amplifier V101 (V201)	XV101-1	J20-E	100K	Grid resistor R101 (R201).
		(XV201-1)	(J20-G)	(100K)	
		XV101-2, 7	J20-H	1,000	Cathode resistor R102 (R202).
		(XV-201-2, 7)	(J20-J)	(1,000)	
		XV101-5	XV201-5	240K	Plate load resistors R105 and R205.
		XV101-6	XV301-4, 8	126K	Screen grid voltage-divider resistor-R304 and R305.
		(XV201-6)			
3	Push-pull amplifier V102 (V202)	XV102-1, 7	J20-D	510K	Grid resistor R106 (R206).
		(XV202-1, 7)		(510K)	
		XV102-2	J20-A, F	1,000	Cathode resistor R107 (R207)
		(XV202-2)		(1,000)	
		XV102-4	J20-D	3.1	Dropping resistor R301.
		XV102-5	XV301-4, 8	200 to 275	Primary of T101 (T201) from plate of V102 (V202) through transformer center tap to B+ supply connection.
		(XV202-5)			
		XV102-6	XV301-4, 8	5,100	Screen grid voltage supply circuit to include resistor R108 (R208).
		(XV202-6)		(5,100)	
4	Push-pull power amplifier	XV103-1, 7	J20-D	51K	Grid resistor R109 (R209).
		(XV203-1, 7)			
		XV103-2	XV102-2	0	Common cathode connection for V102 and V103 (V202 and V203).
		(XV203-2)	(XV202-2)	(0)	
		XV103-5	XV301-4, 8	200 to 275	Primary of T101 (T201) from plate of V103 (V203) through transformer center tap to B+ supply connection.
		XV203-5)			
		XV103-6	XV102-6	0	Common grid connection.
		(XV203-6)	(XV203-6)	(0)	
5	Output transformer T101 (T201)	J20-H	J20-A, F	3.1 to 4.4	Secondary of output transformer T101 (T201).
		(J20-J)			
		XV102-5	XV103-5	400 to 550	Primary of T101 (T201).
		(XV202-5)	(XV203-5)		
6	Rectifier circuit V301 (R304 disconnected)	XV301-4	J20-A, F	∞ (after C302 charges)	Filter capacitor C302.
		XV301-8	J20-A, F	∞ (after C303 charges	Filter capacitor C303.

Item	Circuit or component	Check		Resistance (ohms)	Portion of circuit or component
		From	To		
7	Transformer T301	J20-C	J20-A, F	3.2 to 4.5	Primary of T301 and fuse F301.
		XV301-5	J20-A, F	38 to 50	Secondary of T301 from terminal 5 to center tap ground.
		XV301-3	J20-A, F	38 to 50	Secondary of T301 from terminal 4 to center tap ground.
		XV301-2	XV301-7	1.6 to 2.3	Secondary winding 7-8 of T301 (filament supply for V301).
8	Filament circuit for channel 1 and channel 2 amplifier tubes.	XV101-3	XV201-4	0	Filament supply connection.
		XV101-4	J20-D	48.1	Filament supply connection and resistors R301, R302.
		XV102-3	XV103-4	0	Filament supply connection.
		XV102-4	J20-D	48.1	Filament supply connection and resistors R301, R302.
		XV103-3	XV202-4	0	Filament supply connection.
		XV201-3	J20-A, F	0	Filament supply connection.
		XV202-3	XV203-4	0	Filament supply connection.
		XV203-3	J20-A, F	0	Filament supply connection.

55. Repeater Amplifier Type B-7A, Replacement (Third Echelon)

a. General. Removal and replacement procedures for Repeater Amplifier Type B-7A are identical with those in paragraph 36a and c. for Amplifier, Electronic Control Type A-2. Removal and replacement procedures for the repeater amplifier chassis assembly are outlined in *b* and *c* below.

b. Removal of Chassis Assembly (fig. *14).*

(1) Remove the safety wire that secures the snap slide latches on the left and right sides of the repeater amplifier front panel.

(2) Unlatch the snap slide latches from their snap slide studs.

(3) Remove the chassis assembly from its case; use the handle on the front panel.

c. Replacement of Chassis Assembly.

(1) Slide the chassis assembly into its case.

(2) Check the snap slide latches for freedom of movement in their guides, and then lock them against their studs.

(3) Replace the safety wire to secure the snap slide latches in place.

56. Repeater Amplifier Type B-7A, Final Testing

A power source of 115 volts ac, 400 cps, and *27.5* volts dc is required for the test in *a* and *b* below.

Note. Final tests of the repeater amplifier are performed at fourth and fifth echelons.

a. Test Procedure.

(1) Connect the equipment as snown in figure 29.

(2) Operate the range selector switch on the ME-30A/U to the 30-volt range.

Note. As the test progresses, it will be necessary to use lower ranges on the ME-SOA/U to obtain greater accuracy.

(3) Operate the power switch on the ME-30A/U to the ON position and wait the required warmup time (TM 11-5132).

(4) Operate the switches on the test jig to positions as follows:

Switch	Position
POWER	ON
CHANNEL SELECTOR	1
SIGNAL POLARITY	POS
REPEATER AMPLIFIER	INPUT

(5) Adjust the INPUT SIGNAL potentiometer on the test jig for a 2-volt indication on the ME–30A/U.

(6) Operate the REPEATER AMPLIFIER switch on the test jig to the OUTPUT position and record the output voltage as indicated by the ME-30A/U. The voltage should be between 1.8 and 2 volts *(b* below).

(7) Operate the SIGNAL POLARITY switch on the test jig to the NEG position. The reading obtained on the ME-30A/U should be the same as for the POS position ((6) above).

(8) Operate the CHANNEL SELECTOR switch on the test jig to position 2 and repeat (5) through (7) above for channel 2.

(9) The maximum allowable unbalance between the output voltages of channels 1 and 2 is .08 volt *(b* below).

(lo) Repeat (5) through (8) above for input voltages of 4, 8, 10, and 13 volts. The output voltages which should be obtained and the maximum allowable unbalance for each input voltage are listed in *b* below.

b. Test Results.

Input voltage	Output voltage limits		Unbalance [a]
	Channel 1	Channel 2	
2	1.84 to 2	1.84 to 2	0.08
4	3.68 to 4	3.68 to 4	0.16
8	7.36 to 8	7.36 to 8	0.32
10	9.20 to 10	9.20 to 10	0.40
13	11.96 to 13	11.96 to 13	0.62

a Represents the maximum allowable difference between the channel 1 output voltage and channel 2 output voltage.

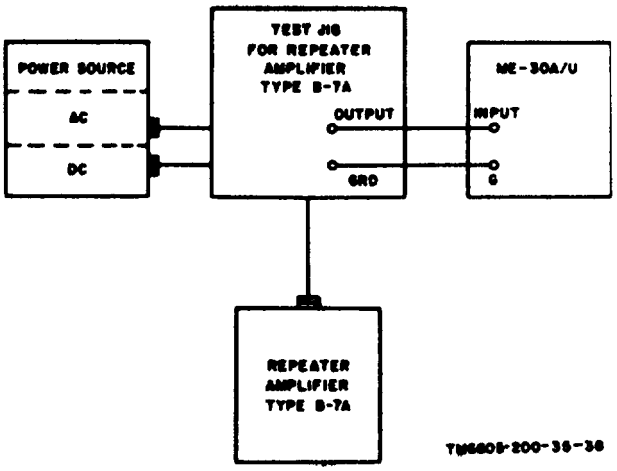


Figure 29. Test setup for final test of Repeater Amplifier Type B-7A.

Section III. INDICATOR, INDUCTION COMPASS TYPE V-8

57. General

Indicator, Induction Compass Type V-8 is used with the compass system when auxiliary indicators are required. Operationally and electrically Indicator, Induction Compass Type V-8 is identical with Indicator, Induction Compass Type V-7A; the physical differences between the two instruments are illustrated in TM 11-6606-200-12.

58. Maintenance

Scheduled maintenance for Indicator, Induction Compass Type V-8 is outlined in paragraph 18; replacement procedures are described in paragraph 37. When an auxiliary indicator becomes defective as indicated by visual inspection, the results of compass system trouble sectionalization (par. 24), or when it is scheduled for overhaul (par. 18), it is replaced by third echelon maintenance personnel and returned to the manufacturer through supply channels.

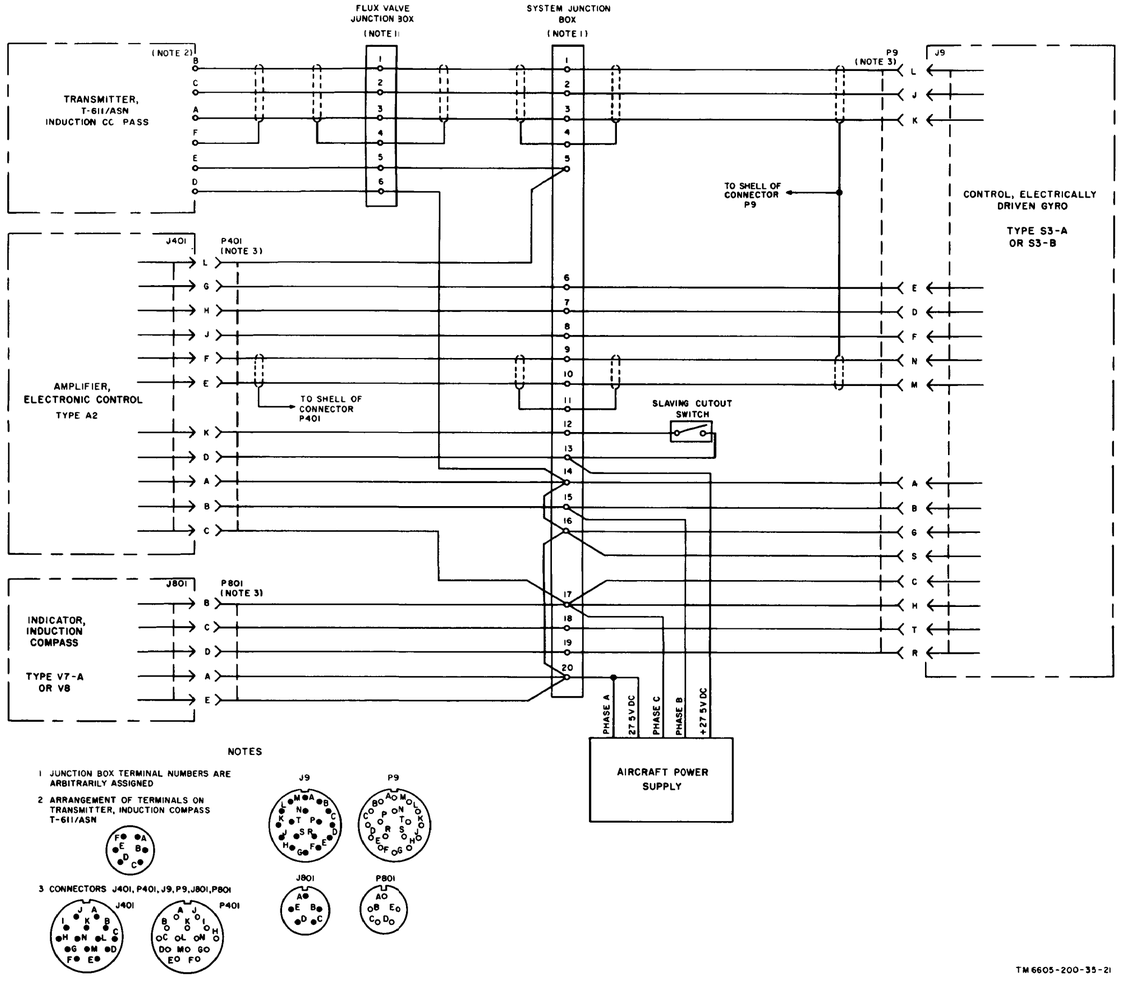


Figure 30. Compass, Magnetic, Aircraft J-2 System, connection diagram.

NOTES

1. COMPONENTS INDICATED BY DOTTED LINES ARE MOUNTED ON TOP OF CHASSIS
2. ⊂⊃ DENOTES SHIELDED CONNECTION
3. PT1 DENOTES PIGTAIL LEAD INSULATED. THE NUMBER IN PARENTHESIS AFTER PT1 INDICATES THE LEAD CONNECTION AT THE DISTANT STATION
4. TERMINAL POINTS E401 AND E402 ARE CHASSIS GROUND CONNECTIONS
5. THE BOTTOM PLATE IS CONNECTED BY A HINGE TO THE REAR OF THE CHASSIS
6. CAPACITOR C2 MAY BE ONE OR TWO CAPACITORS ACCORDING TO 800-CPS REFERENCE VOLTAGE TUNING REQUIREMENTS

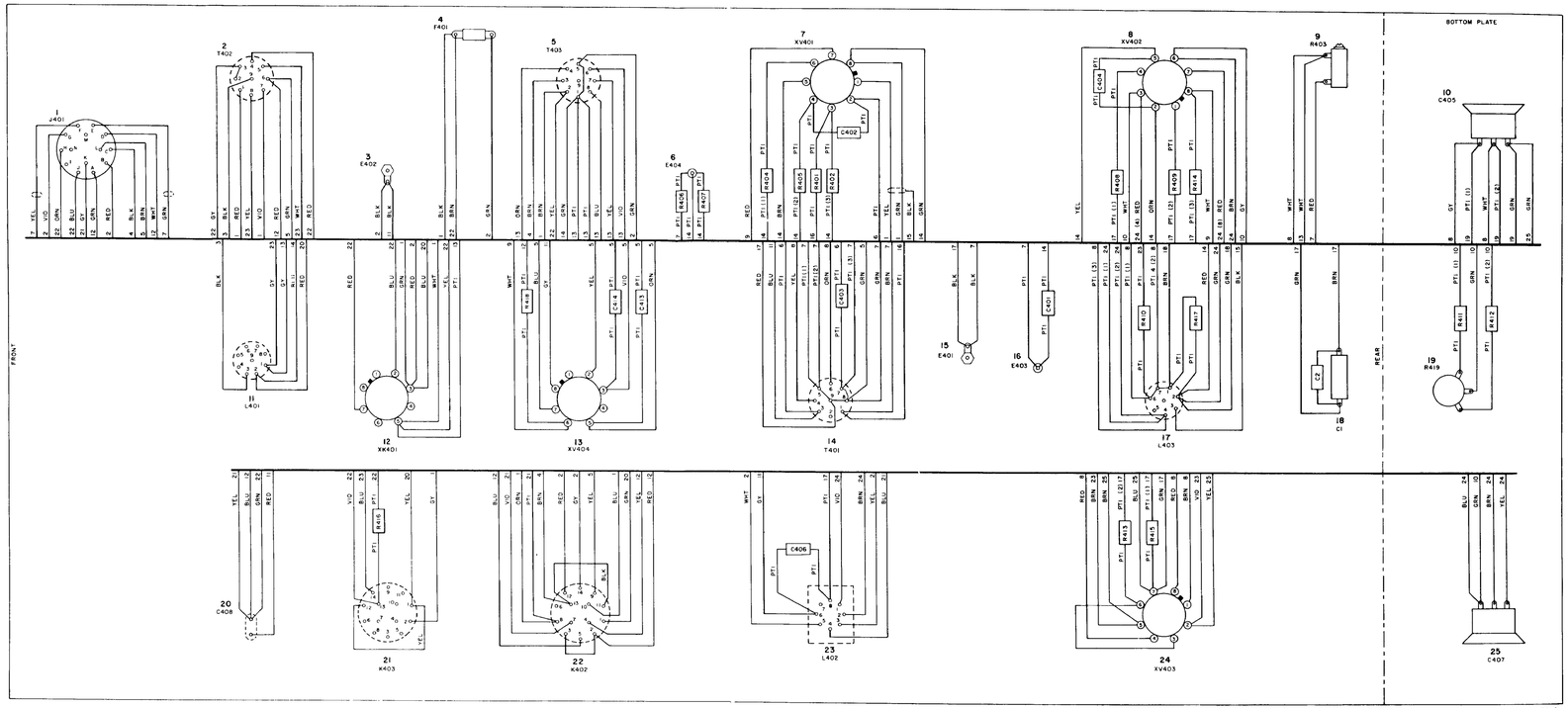
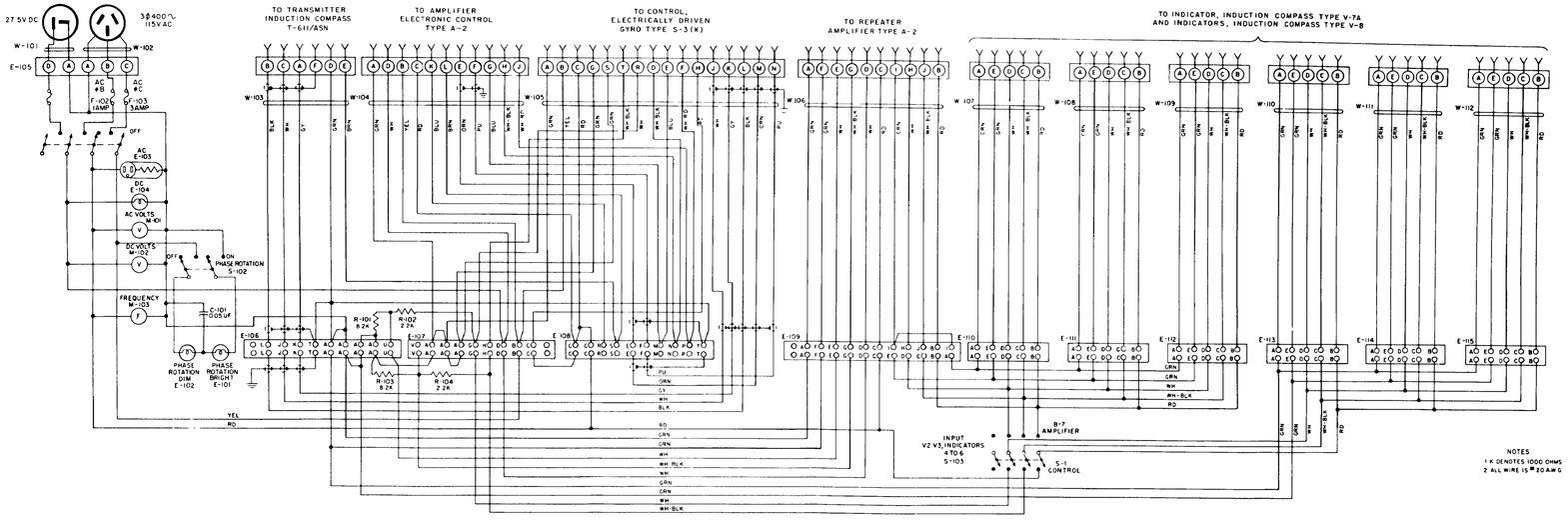


Figure 31. Amplifier, Electronic Control Type A-2, wiring diagram.



REFERENCE DESIGNATION	CABLE NO
W-101	T-100964-800
W-102	T-100964-801
W-103	T-100964-900
W-104	T-100964-901
W-105	T-100964-902
W-106	T-100964-903
W-107	T-100964-904
W-108	T-100964-904
W-109	T-100964-904
W-110	T-100964-904
W-111	T-100964-904
W-112	T-100964-904

Figure 32. Stand, J-2 Mockup, schematic diagram.

APPENDIX

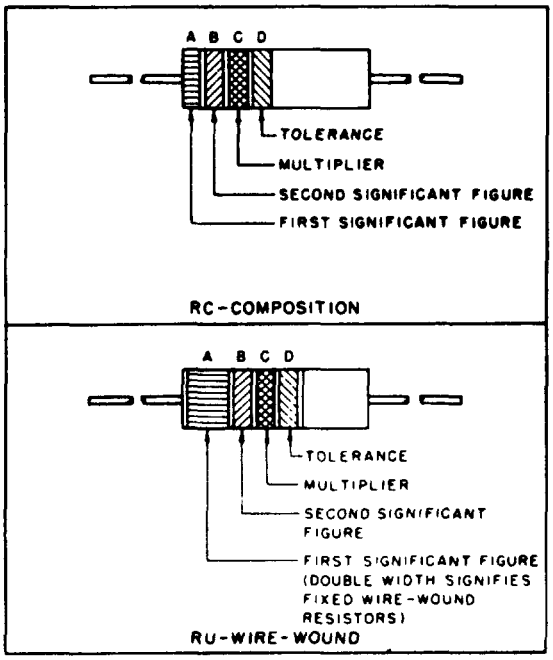
REFERENCES

The following references are applicable for field and depot maintenance personnel for Compass, Magnetic Aircraft J-2 System.

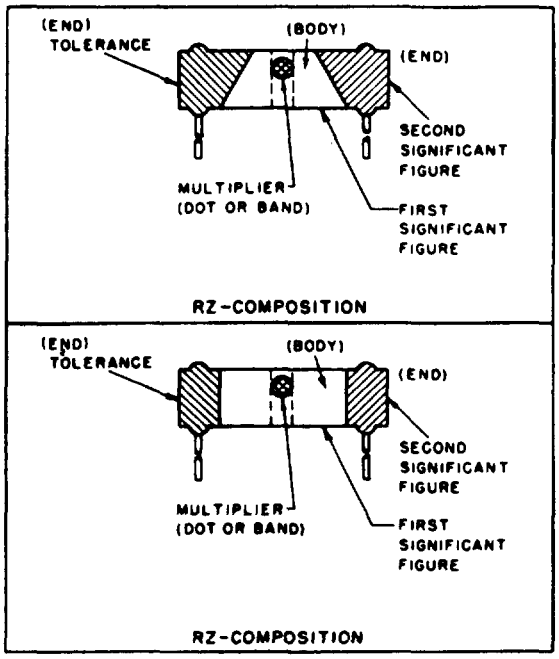
TM 11-6605-200-12	Aircraft Magnetic Compass Type J-2, Operation and Organizational Maintenance
TM 11-6605-200-12P	Operator's and Organizational Maintenance Repair Parts and Special Tools List for Aircraft Magnetic Compass Type J-2
TM 11-6605-200-35P	Field and Depot Maintenance Repair Parts and Special Tools Lists for Aircraft Magnetic Compass Type J-2
TM 11-2649	Audio Oscillator T S - 421/U (Hewlett-Packard Model 205-AG)
TM 11-5511	Electronic Multimeter TS-505/U
TM 11-6625-247-15	Operator, Organizational, Field and Depot Maintenance Manual, Gyro Magnetic Compass Test Set TS - 1086/U
TM 11-5057	Frequency Meter AN/ USM-26
TM 11-6625-203-12	Operation and Organizational Maintenance, Multimeter AN/URM-105, Including Multimeter ME-77/U
TM 11-1214	Instruction Book for Oscilloscope OS-8A/U
TM 11-2661	Electron Tube Test Sets TV-2/U, and TV-2B/ U
TM 11-5132	Electronic Voltmeter ME-30B/U and Voltmeter, Meter ME-30A/U
TB 11-5083-1	Test Data for Electron Tube Test Sets TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U

RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)



RADIAL-LEAD RESISTORS (UNINSULATED)



RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	± 20
BROWN	1	BROWN	1	BROWN	10	SILVER	± 10
RED	2	RED	2	RED	100	GOLD	± 5
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

*FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

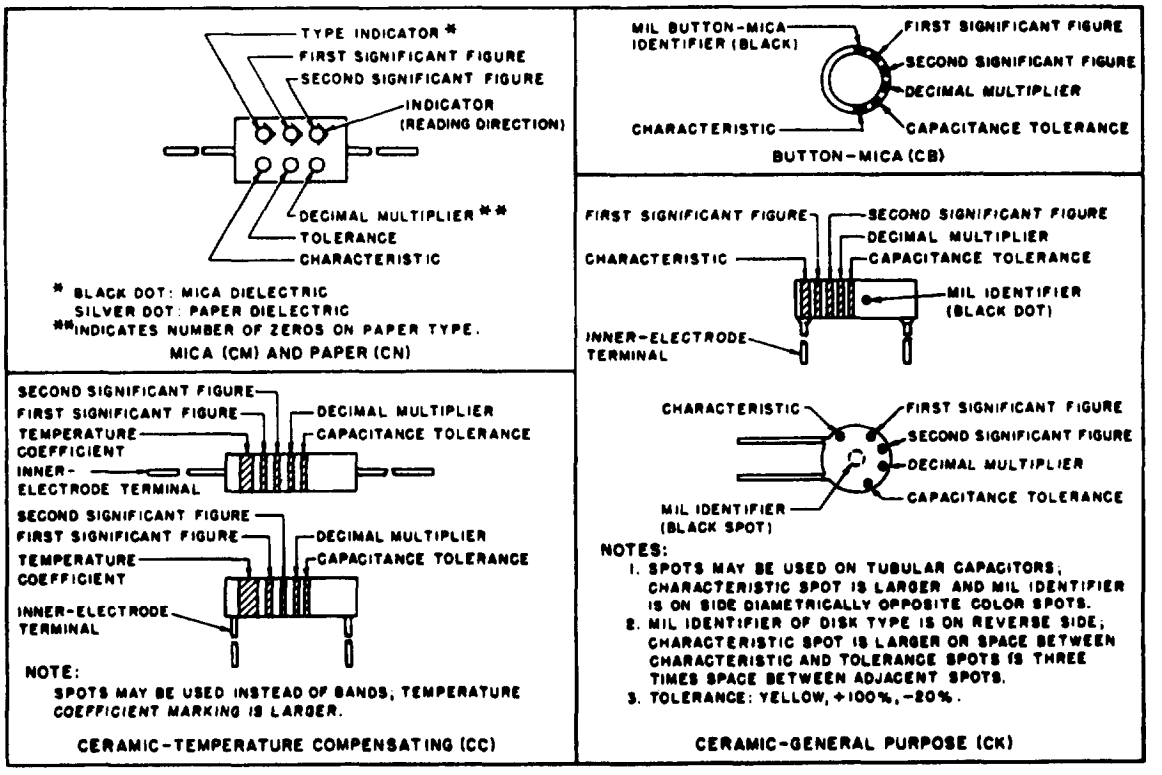
EXAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ±5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

EXAMPLES (BODY MARKING):
10 OHMS ±20 PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND, BODY COLOR ON TOLERANCE END.
3,000 OHMS ±10 PERCENT: ORANGE BODY, BLACK END, RED DOT OR BAND; SILVER END.

STD-RI

Figure 33. MIL-STD resistor color code working.

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)



CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE[2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500)[3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-CI

Figure 34. MIL-STD capacitor color code marking.

INDEX

By Order of *Wilbur M. Brucker,* Secretary of the Army:

L. L. LEMNITZER,
General, United States Army
Chief of Staff

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R. V. LEE,
Major General, *United States Army,*
The Adjutant General

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To be distributed in accordance with DA FORM 12-7 requirements for TM 11 Series (UNCL)

Plus ADDITIONAL FORMULA:

USASA (2)
Tech Svc, DA (1) except
CsigO (20)
CofT (20)
USAAVNS (5)
USASCS (5)
Units org under fol TOE:
1-7 (2)
1-57 (2)
1-107 (2)
5-16 (2)
5-36 (2)
5-92 (2)
5-216 (2)
5-343 (2)
11-155 (2)
11-500 (AA-AE) (2)
11-587 (2)
55-187 (2)
55-456 (2)
55457 (2)
55-458 (2)
1-207 (2)
5-416 (2)

NG: State AG (3)
USAR: None
For explanation of abbreviations used, see AR 320-50.

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