ATC-810
TWIN ENGINE
CPT/IFR
FLIGHT SIMULATOR

Maintenance Manual

ATC Flight Simulator Co.

1650 19th STREET
SANTA MONICA, CA. 90404

(213) 453 - 3557

WARNING

This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

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NOTE: (1) Schematics Book - 00/800.8035-0

CHAPTER

1

1. INTRODUCTION

This publication is designed for use by an experienced electronics technician to aid in the maintenance of an ATC-810 Twin Engine CPT/IFR Simulator. This publication should be used in conjunction with the ATC-810 Owner's Manual, as the reader must be familiar with the intended simulator performance characteristics and limitations prior to attempting any service procedures.

1.1 General Description

General information concerning simulator instruments, specifications and operating details is included in the Owner's Manual, and is not duplicated here.

1.2 Using this Book

Although explicit tests and adjustment procedures are included in Section 4 of this manual, the reader is urged to study the theory of operation. Be sure that you understand fully the consequences of each step before you change any internal control settings, and follow through all related procedures, if adjustment of any control is found necessary.

Section 3 contains disassembly information and important CMOS servicing pointers. Do not attempt to work on any part of the simulator without adhering to these critically important techniques.

READ INFORMATION IN SECTION 2 BEFORE ATTEMPTING ANY TEST PROCEDURES

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CHAPTER

2

2. THEORY OF OPERATION

The ATC-810 is based on state-of-the-art hybrid technology, combining a microprocessor with analog components to produce a high-performance simulator at modest cost. These components are distributed through the system, and are functionally explained in the following paragraphs.

2.1 Symbols

Most symbols used on schematic and simplified drawings will be familiar to an experienced electronics technician. However, symbols on some simplified drawings are not commonly used, and are explained on Figure 2.1.

All component references, where confusion may arise, will include the <u>output</u> pin number, e.g., IC4 (Pin 3).

2.2 System Block Diagrams

The majority of simulator circuitry is contained within the four units of the "radio stack." The major functions of each unit are illustrated on Figures 2.2 through 2.5, and are explained briefly in the following paragraphs.

2.2.1 The Audio/Transponder Unit (Figure 2.2)

This unit, at the top of the "stack," contains the microprocessor. The microprocessor executes instructions contained within the firmware ROM, which contains a set of fixed programs.

The entire set of programs is executed repeatedly at a rate of about 20 times per second. The RAM is a read-write memory for storage of variable information, and the NAV PROMs each contain coded information regarding Navaids and airports for a 22,500 square mile area.

Using the system data and address buses, the microprocessor collects data from, and issues orders to, the other units in the "stack."

2.2.2 The COM/ADF Unit (Figure 2.3)

This is the next-to-top unit of the stack, and contains a high proportion of analog components, simulating the power, fuel management and flight dynamics systems. In addition to the instruments shown, the fuel flow and HSI indicators are driven by circuits within the unit.

2.2.3 The NAV1/DME Unit (Figure 2.4)

This unit is next to the bottom of the stack.

In addition to its obvious functions of driving the VOR/ILS head (or HSI, if installed), it contains circuits which factor airplane heading and speed with wind to produce course information. A separate circuit drives the ammeter.

2.2.4 The NAV2 Unit (Figure 2.5)

This unit contains only the circuits driving the secondary VOR head.

2.3 Engine Management System

Two identical circuits are used to manage the left and right engines, respectively. The circuits accept inputs from the pilot's:

- Throttle levers
- Propeller (RPM) levers
- Mixture levers
- Engine start switches

- o Idle cutoff switches
- o Magneto switches
- o Cowl flaps.

Fault panel inputs to these circuits provide these instructor controls:

- o Cylinder head temperatures
- o Governor failures
- o Oil pressure failures.

The circuits use a combination of analog and binary techniques to process these inputs, directly driving these instruments:

- o Tachometers
- o Exhaust gas, cylinder head and oil temperatures
- o Oil and manifold pressures.

Additionally, analog and binary signals developed by these circuits are provided to other simulator systems.

2.3.1 Since the circuits for both engines are identical, only the left engine circuit (Figure 2.6) will be described in detail. Note from Figure 2.6 that except for the controls and instruments, the circuit is on the 51.663 and or 51.671 COM/ADF unit.

2.3.2 Engine Start/RPM Circuit.

The engine start switch is shown at the lower right of the drawing. Pressing (and holding) this switch applies a voltage to charge C25 to a positive level through a fairly long time constant. As the voltage gradually increases, the output of amplifier D03 (Pin 7) follows this voltage, and the tachometer and oil pressure indications gradually increase. When the voltage from D03 (Pin 7) exceeds about +1.4 volts, the output of comparator B02 switches from high to low (LENGRN*), and electronic switch D01 conducts.

The Low LENGRN* signal also provides a low to the R35-R36 OR gate, and if the magnetos are on and the idle cut off is not in the cut off position, electronic switch Q4 turns off. The off state of Q4 allows a voltage from the throttle pot to be fed through voltage follower FO2 (Pin 14) and diode CR3 to the input of DO2 (Pin 1) via R60. This positive input causes the output of DO2 (Pin 1) to go negative, providing an input to the inverting side of amplifier DO3 (Pin 7). This signal causes the output of DO3 (Pin 7) to remain positive after the starter switch is released.

The output of DO2 (Pin 1) is fed back to the wiper of R56 through R57, where it is "balanced" against the positive voltage from the RPM control through electronic switch DO1, voltage follower DO2 (Pin 7), and R55 at the base of emitter follower Q2.

The emitter follower is the real "governor" in the circuit. Changes in throttle setting, which cause changes in the input signal through R60, would tend to change the output of amplifier DO2 (Pin 1). However, if the voltage from DO2 (Pin 1) tends to go more negative due to throttle increase, the increased negative adds to the forward bias on Q2, and the increased conduction of this transistor diverts most of the additional signal. However, a change in the RPM control will "unbalance" the circuit until the output of DO2 (Pin 1) shifts by an equal and opposite amount, producing a voltage corresponding to the new RPM setting.

The fault panel governor fail control can provide a voltage of either polarity to be summed (through R58) with the pilot's RPM setting. Thus the instructor can simulate governor failures toward flat or feathered pitch.

When the simulator is "in flight," a voltage proportional to airspeed (RASP) is fed into R60 through CR4. Thus, even if the throttle for the left engine is fully closed (eliminating the signal through CR3), the engine will continue to "windmill" until the RPM control is retarded to the feather (MIN) position.

The voltage from D03 (Pin 7), a positive level proportional to RPM, is connected as an input to comparator J04 (Pin 1). The reference input to this comparator (approximately +2.5 volts) will be exceeded when the "engine speed" is greater than 750 RPM, and the signal labeled L > 750* will go low. This signal is used to enable the alternator ammeter circuit for the left engine.

The voltage from D03 (Pin 7) also is connected through R65 (LRPM) to the audio system, producing an engine sound proportional to RPM.

The D03 (Pin 7) signal also drives the oil pressure indicator through R76 and R78. Diode CR5 conducts when the voltage at the junction of these resistors exceeds about 5.5 volts (proportional to about 1600 RPM), limiting further increases in oil pressure as RPM is advanced. The fault panel oil pressure fail control is a pot connected in short with the oil pressure indicator; rotating this control counterclockwise produces an apparent decrease in oil pressure. If the control is rotated fully counterclockwise (until it clicks), a switch is opened, simulating engine failure.

2.3.3 Throttle Operation

The throttle control is shown at the bottom center of Figure 2.6. This control applies a positive voltage from a minimum (idle) value, set by R22, to a maximum of 12 volts to the left side of R34. The right side of this resistor connects to a summing point at the input of voltage follower F02 (Pin 14). Resistors R33 and R32, and electronic switch Q4 also terminate at this point. Under normal circumstances, both magnetos for the engine are ON, and R32 has no effect. However, if either magneto is switched OFF, the left end of R32 is grounded, causing about a 10% reduction in the voltage at the summing point, and a corresponding decrease in engine power.

A negative voltage proportional to engine RPM is fed to the summing point through R33. However, since this resistor is almost six times larger than R34, its effect is only one-sixth that of the throttle control, and during normal flight, its effect is minimal. If the throttle is closed, reducing engine power while the RPM is set to a relatively high level (flat pitch), the net contribution of the engine changes from thrust producing to drag inducing; the signal fed through R33 simulates this effect.

Under normal circumstances, electronic switch Q4 is OFF, and has no effect on the circuit. A high signal to either input of OR circuit R35-R36 can cause Q4 to conduct, however, grounding this summing junction and forcing the output of voltage follower F02 (Pin 14) to zero. This happens prior to engine start (when signal LENGRN* is high), or if any input to NOR gate D05 (Pin 1) goes high. The inputs to the NOR gate represent conditions causing the engine to stop:

2.3.3.1 Pin 3 goes high when fuel is exhausted.

2.3.3.2 Pin 2 goes high when the instructor has reduced oil pressure to the point where the engine will soon "seize."

2.3.3.3 Pin 5 goes high when the idle cutoff switch is in the cutoff position.

2.3.3.4 Pin 4 goes high when both magnetos are switched OFF.

The occurrence of any listed condition causes the output of voltage follower F02 (Pin 14) to go to zero (representing zero power). The signal, normally a positive level, goes several places. As an input to amplifier D03 (Pin 1), it controls the manifold pressure indicator. It is connected to the assymetric thrust detector circuit (see Paragraph 2.5.1) at the point where it leaves this drawing on the right (LTHR). Finally, it serves as the input to the mixture circuit at the top left of Figure 2.6.

2.3.4 Mixture Control Operation

The mixture control pot has the engine power signal (LTHR) connected to the top. About 40% of this signal is connected to the cathode of CR2 via the R14-R15 voltage divider. For explanation purposes, assume that the mixture control is set to full lean. In this case, both inputs to amplifier D00 (Pin 14) are zero, the output of the amplifier is zero and the exhaust gas temperature (EGT) gauge will indicate a relatively low value, due only to the current through R24. As the control is advanced toward rich, the voltages at both the inverting and noninverting inputs to D00 (Pin 14) become increasingly positive. The ratio of the resistors is such that the noninverting input has much more effect, and the voltage from the amplifier rapidly becomes more positive. Thus, indicated EGT also increases rapidly.

If the mixture control is advanced further toward rich, eventually CR2 conducts. The conduction of this diode "clamps" the noninverting input, and continued movement of the mixture lever toward rich will <u>not</u> produce further increases in the voltage at this point. However, the inverting input is not clamped, and will simply become more positive as the control is pushed all the way to full rich. The sum effect of these inputs is to produce a peak temperature somewhere near the center of the control range, decreasing for richer or leaner mixtures. The value reached at peak is a function of engine power (LTHR). The "EGT" voltage is also an input to the circuit producing the oil and cylinder head temperature indications.

2.3.5 Oil and Cylinder Head Temperature Circuit

Amplifier D00 (Pin 1) produces a negative output to both meters connected in series. The EGT signal from amplifier D00 (Pin 14) is the prime input to the circuit.

An increase in EGT produces a similar increase in both oil temperature and CHT. If the pilot "opens" the cowl flaps, however, a negative voltage is added in to amplifier D00 (Pin 1), reducing these apparent temperatures.

The fault panel cylinder head temperature control also provides an input to this amplifier, allowing the instructor to simulate abnormally low or high temperatures.

2.3.6 Right Engine Circuits

The right engine management circuit is shown in simplified form on Figure 2.7. Except for component designations, this illustration is the same as Figure 2.6, and component functioning is as described in Paragraphs 2.3.2 through 2.3.5.

2.3.7 Detailed Schematic Drawings

The detailed schematics for the left and right engine circuits are on Drawings D00-051-06630S and D00-051-06710S, sheets 2 and 3, respectively.

2.4 Fuel Management (Figures 2.8 and 2.9)

Fuel management is accomplished primarily by firmware. Four bytes in RAM represent the fuel quantity in four tanks. At system initialization, these "tanks" are "filled" in accordance with the initial transponder switch settings. Even if the simulator is equipped with an optional two tank fuel management system, the initial fuel quantity is maintained in four bytes.

2.4.1 During the simulation of flight, the thrust (or power) supplied by each engine is represented as a voltage (RTHR and LTHR). These voltages (not necessarily equal) are applied to a pair of voltage-to-frequency converters. Thus, higher power will produce a higher frequency from the associated converter. The converter outputs are applied to a pair of

14-bit counters; the least significant bit of the counter will change at a rate that is 1/16,384 of the input frequency.

2.4.2 The least significant bits of these counters are examined periodically by the firmware, and compared with the previously read bits. Any difference represents consumption of fuel, and the firmware prepares to subtract a minimal quantity from one or more of the memory locations representing fuel quantity. The least significant bits of the counters then replace the previously stored bits.

2.4.3 Prior to debiting fuel from the "tank" memory locations, the firmware interrogates the tank select valve positions set by the pilot. If crossfeed is ON, fuel is subtracted from right and left tanks equally by either engine. If crossfeed is OFF, only the right engine may draw from the right tank(s), and so forth.

2.4.4 When the memory locations representing the fuel supply for an engine are exhausted, the firmware will reset a flip-flop in the hardware, causing the fuel pressure for that engine to drop rapidly. The resulting loss of fuel will cause the associated engine to stop producing power.

2.4.5 The instructor's Fault Panel provides separate controls for simulating loss of fuel pressure to either engine. If a Fault Panel fuel pressure control is rotated partially counterclockwise (representing the failure of the fuel pump for that engine), the pilot can overcome the problem by switching the appropriate electric boost pump ON. However, if the instructor continues to rotate the control counterclockwise, the continued loss of pressure will result in lighting the appropriate BOOST INOP indicator on the annunciator panel.

2.4.6 The Fault Panel also contains two toggle switches for left or right LOW FUEL FLOW. These switches light the appropriate annunciators, but do not affect the fuel system in any other way.

2.4.7 Detailed schematic information is provided on several drawings, but primarily on sheets 2 and 3 of Drawing D00 051 0663 0S and D00 051.06710S.

2.5 Attitude Control

The attitude control system of the simulator receives inputs from the pilot's flight controls, i.e., rudder, elevator, ailerons and power settings. From these, and from a number of other signals (such as gear drag, or airframe icing from the fault panel), the attitude circuits drive the attitude displays seen by the pilot. Signals are also provided to the microprocessor, which performs the time-speed-direction calculations necessary for driving the position indicating instruments.

2.5.1 Asymmetric Thrust Circuit

Refer to Drawing D00 051 0663 0S or D00 051.06710S for the following description. The asymmetric thrust circuit is shown in area H-I/3 of the drawing, and consists of amplifiers F02 (Pin 8), F02 (Pin 7), and the associated resistors.

Two signals are summed at Pin 9 of F02; LTHR, a positive voltage representing left engine power and ASPSWR, a positive voltage (in flight only) representing the right engine RPM setting. Thus, the output at Pin 8 of F02 will be a negative voltage which increases as left engine power is increased, or as the prop pitch for the right engine is "flattened." Either condition represents a torque tending to turn the airplane to the right.

Three signals are summed at Pin 6 of F02; RTHR, a voltage representing left engine RPM setting (through electronic switch L04 [Pin 10] and R80), and the negative voltage from F02 (Pin 8). The positive voltages through R80 and R81 represent a force turning the airplane to the left.

If the "left turn" and "right turn" forces are equal, the output of F02 (Pin 7) is zero, and the airplane will "follow its nose" with little or no rudder pressure. However, if the thrust is not symmetrical, a voltage will appear at the output of F02 (Pin 7), positive for a right turn force, negative for left. This signal is connected to the rudder servo system (via P2 Pin 22), and to the pitch and turn circuits on sheets 4 and 5 of the schematic, respectively.

Refer to Sheet 5 of the 51.663 or 51.671 Drawing, area A-B/5. The THRDIF signal connected to diodes CR19 and CR20 causes the output of absolute value circuit F00 (Pin 14) to go negative if THRDIF deviates from zero.

2.5.2 Pitch Control Circuit

Refer to area A-D/5-6 of the previously referenced schematic sheet. Many of the factors affecting airplane pitch attitude are summed by amplifier J00 (Pin 7). Positive input signals (such as left thrust, LTHR) represent forces increasing pitch. Negative voltages at the inputs (those from the cowl flap controls, and from the assymetric thrust circuit through R240 and R241) represent forces tending to reduce pitch. The resistor values are selected to scale these signals properly. The output of J00 (Pin 7) is thus a voltage which increases in a positive direction for downward pitch attitudes, negative for up.

The elevator control is at the upper left of the drawing, causing buffer amplifier J00 (Pin 8) to go negative for "up." This signal, together with the output of J00 (Pin 7) and the GEARDRAG (R247) and STALL (R243) signals are summed into Pin 13 of amplifier J00 (Pin 14).

Amplifier J00 (Pin 14) has three feedback networks. On the ground, when the airplane is below stall speed, electronic switches in the L00 package are both ON, providing a short circuit feedback which maintains the output of the amplifier at zero. As the airplane accelerates through stall speed, Pin 1 of L00 goes high, opening this switch. The other switch in the package remains ON, connecting CR23 as a feedback element across the amplifier. Thus, the output of the amplifier can go positive at Pin 14, but not negative as the pilot begins "rotation." As soon as the airplane leaves the runway, the microprocessor switches the ALTØ* signal to a high level, and both L00 switches remain off for the duration of the flight. The R-C feedback network (R246, C48-C49) remains as the only feedback for the amplifier at this time, and the aircraft can be pitched up or down.

The output of J00 (Pin 14) is connected through R256 to drive the "bird" against the artifical horizon, to Sheet 4 where it is an input to the altitude circuit, and through R248 into the airspeed circuit. A voltage from the flap control is summed at the "bird" through R257 to simulate the increase in pitch that occurs when flaps are lowered.

2.5.3 Airspeed Circuit

Refer to area A-C/2 on Sheet 5 of the 51.663 Drawing, and A-J/2 on Sheet 4 of the 51.671 Drawing. The toe brake switches and the parking brake switch are shown released. If the parking brake is ON, or if both toe brakes are pressed, R271 produces a positive voltage into comparator H00 (Pin 13). The positive voltage out of the comparator is ANDed with the ALTØ signal by gate M05 (Pin 4). Thus, the brakes are effective only when the airplane is at field elevation (ALTØ goes low in flight).

The BRAKON signal from M05 (Pin 4) and its complement BRAKE* (generated by an inverter on Sheet 4) control two electronic switches in area E-F/4-5 of the drawing. Switch H04 is open when brakes are applied, while switch L01 is closed. Thus, amplifier J02 (Pin 8) has no input and low impedance feedback. When the brakes are released, the switches reverse; H04 connecting the input sum to J02 Pin 9, L01 allowing R255, C50 and CR24 to serve as the feedback elements. The diode limits the output of the amplifier to positive values; the R-C components introduce a realistic time lag in the response.

Resistors R248 through R253 are all input resistors to amplifier J02 (Pin 8). The output of the amplifier is a positive voltage which is processed further into airspeed.

Airspeed is not a linear function throughout the flight envelope. For example, a relatively small downward pitch applied at 110 KIAS causes a significant increase in airspeed; the same degree of pitch change at 160 KIAS will increase airspeed by a smaller amount. This characteristic is simulated by the circuitry in area G-I/5 of the drawing. Circuit element J01-B is a precision analog multiplier divider circuit, used here to divide the output of J02 (Pin 8) by relative airspeed (RASP). When airspeed is relatively slow, changes in the numerator (J01-B, Pin 8) will cause fairly large changes in the output (J01-B, Pin 4). As RASP increases, the denominator (J01-B, Pin 5) increases, and the same amount of change in the input results in a smaller change in output. Therefore, RASP is developed as a nonlinear function, just as it is in the aircraft.

The RASP signal is connected to voltage follower J02 (Pin 14). The positive output from this amplifier (IAS) is connected to the stall sensing comparators (J03, pins 13 and 14) and is processed further into an altitude corrected airspeed by another circuit.

The pitot-tube driven airspeed indicator on an airplane is very inaccurate at low speeds, and usually cannot be relied upon for speeds much less than V1. The limiter amplifier J02 (Pin 1) is biased with a negative input through R273, and its output remains at zero as airspeed initially increases from zero during takeoff. Thus, the airspeed indicator also displays zero readings initially. When the positive IAS voltage (through R274) exceeds the effect of the bias through R273, the output of amplifier J02 (Pin 1) goes negative, reverse biasing CR25 while forward biasing CR45. The negative current through CR45 and resistors R277 and R297 now produces an increasing airspeed indication.

The instructor panel pitot icing control can connect a negative voltage through R275, simulating the decreasing airspeed which would be displayed if ice began forming in this sensitive location. The pilot's pitot heat switch disconnects the instructor's signal when "heat" is turned on.

2.5.4 Stall Circuit

Refer to Sheet 5 of Drawing 51.663 or 51.671, area D-E/1-2. The stall detector circuit consists primarily of two comparators in the J03 package (pins 13 and 14). A bias network is connected to the inverting input of each comparator, slightly more positive at Pin 8 than Pin 10. The IAS signal is connected to pins 9 and 11. When airspeed is well above stall speed, the outputs of both comparators are high, causing the outputs of three gates in the L05 package and gate K05 (Pin 3) also to be high. As airspeed bleeds off, the output of J03 (Pin 13) goes low at about 80 knots. If the aircraft is in flight, the ALTØ signal is low, and Pin 3 of L05 goes low. This low is detected by the microprocessor as it regularly scans address B5, and the microprocessor enables the stall warning horn.

The K05 gate is not enabled at this time, since ALTØ* is high when in flight.

If airspeed continues to decay, J03 (Pin 13) also goes low (at about 75 knots), and the simulator "stalls" when the output of gate L05 (Pin 11) goes low. The low from this gate is connected to two electronic switches. Switch L01 (Pin 9) in area D/5 of the drawing turns on, connecting a positive voltage through R243 to the pitch amplifier, causing a sudden downward pitch to be indicated on the artificial horizon. R253 introduces a voltage into the airspeed circuit which initially reduces airspeed further; the effect of this input is rapidly overcome as the nose pitches down and airspeed begins to increase.

The low from gate L05 (Pin 11) at stall also turns on electronic switch L02 (Pin 9) at area G/2 of the drawing. This causes the output of high gain inverter H01 (Pin 14) to be connected into the turn circuit, and makes directional control very erratic during the stall. It also initiates a sharp bank toward the up wing, if the pilot was cross-controlling at stall entry, beginning the classic spin.

Amplifier J00 (Pin 1) in area D/2 of the drawing adjusts the bias on the comparators as flaps are lowered, so that both the stall and stall warning occur at lower airspeeds.

Gate L05 (Pin 10) is enabled only on the ground, and allows the pitch circuit only after stall speed is reached during takeoff acceleration. Gate K05 (Pin 3) is also enabled only on the ground, and locks the altimeter (ALTFRZ) until stall warning speed has been reached.

2.5.5 Turn Circuits

Refer to the lower Right quadrant of Drawing 51.663 or 51.671, Sheet 5.

The turn circuit consists of a summing amplifier H01 (Pin 7), with a power output driver (Q11 and Q12). Resistors R212 and R215-R220 form a summing network into the amplifier, combining the factors which influence the roll axis of the airplane. These factors are:

- The Rudder (R218)
- The Ailerons (R216)
- Asymmetric Thrust (R220)
- Roll Trim (R212).

Additional factors for the simulator include the instructor fault panel inputs: Asymmetrical Flaps (R217), and a variable turbulence signal from a random pulse generator (R215). R219 introduces an unstable rudder input through electronic switch L02 (Pin 9) during a stall.

All of these factors are summed at Pin 5 of electronic switch H02, which is open on the ground, disabling the roll axis. A second electronic switch, L02 (Pin 6) is closed on the ground, providing a constant load for all input signals. As soon as the airplane leaves the ground, these switches reverse; H02 (Pin 6) closes, connecting the signal sum to the amplifier, and L02 (Pin 6) opens, allowing the amplifier to load the input resistors.

A net positive sum of input signals causes a bank to the right. This occurs because of output of H01 (Pin 7) and its buffer stage goes negative, driving a current through R226 and R227 to the motor controlling the artificial horizon of the attitude indicator. The motor rotates in a direction to rotate the "horizon" to the left. The miniature airplane of the attitude indicator thus appears banked right against the horizon.

Amplifier H01 (Pin 1) is connected to monitor the voltage drop across R226 and R227. This voltage drop is due to motor current, and becomes larger if the motor lags behind the driving signal. The output of H01 (Pin 1) is summed with the other signals feeding H01 (Pin 7) and provides a "boost" feedback to minimize this lag.

When on the ground, electronic switch H02 (Pin 9) is closed, providing the only signal to H01 (Pin 7). This signal is from the wiper of the horizon follower pot, and provides a signal tending to level the horizon if it is tilted from a previous landing in an "unusual" attitude.

Now, refer to Sheet 4 of Drawing 51.6630S or 51.671, area A/2-3. This is a representation of the attitude indicator, showing the motor and the horizon follower pot. The voltage from the wiper of this pot represents bank angle, positive for a right bank, and is connected as an input to precision analog divider J01-A. Here, the bank angle is divided by airspeed (RASP, connected to Pin 5) to produce a rate-of-turn signal at the output of amplifier H01 (Pin 8). This signal is again positive for a right turn, and is one of three inputs to amplifier B00 (Pin 8). The rudder signal is also connected to this point (R179), and in flight the differential thrust signal is also connected (through electronic switch H04 and R180). The output of amplifier B00 (Pin 8) is negative for a right turn, and drives the "wings" of the turn coordinator. This signal is also summed (R230) into amplifier F00 (Pin 8), along with the bank/airspeed signal (R229) of the opposite polarity. When the pilot's inputs are correct for the classic "coordinated turn," the signals sum to zero, the output of F00 (Pin 8) is zero, and the slip indicator "ball" is centered.

Amplifiers B01 (Pin 8) and B01 (Pin 14) form an absolute-value circuit. For right turns, the output from B00 (Pin 8) is negative, connected as an input (R182) to B01 (Pin 8). This negative signal also feeds amplifier B01 (Pin 14) through R186, causing the output of this amplifier to go positive sufficiently to forward bias CR17. At this voltage (about +0.6 volts), the amplifier output stops changing, and CR28 is reverse-biased. Thus, no input is "seen" through R184, and B01 (Pin 8) responds only to the R182 input, producing a positive output proportional to the rate of right turn.

For left turns, the signal from B00 (Pin 8) is positive. This causes the output of B01 (Pin 14) to go negative, reverse biasing CR17, and forward biasing CR28. The resulting negative signal causes B01 (Pin 14) to act as a gain -1 inverter, since feedback resistor R185 is now in the circuit. Amplifier B01 (Pin 8) now "sees" two inputs: the positive going voltage from R182, and the negative going voltage through R184. Since R184 is half the value of R182, its signal has twice the effect, and the output of B01 (Pin 8) again goes positive. Thus, for a turn in either direction, the output of B01 (Pin 8) is a positive voltage proportional to the rate-of-turn.

The positive "turn" voltage from B01 (Pin 8) is connected as an input to a voltage-to-frequency converter (B04). The output from this device is a series of pulses, at a frequency dependent on turn rate. If the brakes are released (BRAKON Low), this pulse stream is connected to an external counter.

Amplfier B01 (Pin 14) produces a small positive voltage during right turns, and a varying negative voltage for left turns. This voltage is sensed by comparator B02 (Pin 2), which produces a binary output: high for left, low for right. This signal is also connected to the counter referred to in the previous paragraph, and controls the up-down direction of the counter.

The external counter (in the AUDIO-TRANSPONDER UNIT) is thus capable of counting up or down; the direction controlled by the direction of turn, the rate by the rate of turn. The microprocessor continously examines the output of this counter to determine aircraft heading.

2.5.6 Altitude Circuit

Refer to the upper half of Sheet 4, Drawing 51.663 or 51.671. Amplifier B00 (Pin 7) sums together the signals influencing altitude. The primary signal in this group is pitch (a signal which includes airspeed), and is positive for climb. Amplifier B00 (Pin 14) is a negative absolute-value circuit, introducing a negative value during turns. The remaining inputs from the fault panel represent varying levels of turbulence from a random pulse generator.

B00 (Pin 7) has a 220K feedback resistor (R158) at all times, which is shunted by another 220K resistor (R157) when the amplifier output is negative (climb). Thus, the output of the amplifier is only half as great for positive pitch angles as for negative (downward) pitch; again, this corresponds to typical aircraft performance.

The voltage from B00 (Pin 7) is buffered by voltage follower B00 (Pin 1) to drive the vertical speed indicator. The B00 (Pin 1) signal also drives an absolute-value circuit and voltage-to-frequency converter for the external altitude counter. This circuit functions in exactly the same way as the circuit described in Paragraph 2.5.5.

2.6 Audio/Transponder Unit Functions

The Audio/Transponder unit contains the microprocessor, read-only memory (ROM), random-access memory (RAM), as well as the navigational area programmable ROM (PROM) chip(s). These components cannot be serviced without extensive knowledge of microprocessors, special service equipment (such as logic analyzers) and firmware listings which are beyond the scope of this manual. Unit exchange, therefore, is the only practical method of problem analysis for these components.

These components are described briefly in the paragraphs which follow, along with more extensive descriptions of those components which can be checked by conventional methods.

The complete Audio/Transponder circuit is shown schematically on Drawing C00 051 0662 OS, Sheets 1 through 6. All references which follow refer to sheets of this drawing unless otherwise noted.

2.6.1 Circuit Description, Sheet 1

Chip L06 is the microprocessor. Key features:

- 16-Bit Address Bus (output only) A0-A15
- 8-bit Data Bus (Bidirectional) D0-D7
- E (Enable) Signal - High when Address Valid
- R/W* (Read/Write) Signal-High for Read (input) to microprocessor.

Chips K04, K05 and K06 are buffers for some of the address lines. K03, H03 and I03 are address decoders, together with additional gate/inverter logic elements. L00 and part of L01 (Pins 11 and 13) are data output tri-state buffers, enabled when the microprocessor is "writing." The remainder of L01 (Pins 3, 5, 7 and 9) and L02 are also tri-state buffers, enabled when the microprocessor is "reading" data. Chips J02, K02 and L04 are used for software/firmware development, and are not installed in user systems.

2.6.2 Circuit Description, Sheet 2

Chips G06 and H06 are ROM circuits containing the permanent program and data required for the simulator. Positions I06 and J06 are available for additional ROMs, if future expansion requires additional firmware. Chips H04 and I04 are RAM chips, collectively providing 1,024 bytes of read-write memory.

Chips B06, C06, D06 and E06 are the navigation area PROMs, containing information relating airports and navigational aids to specific geographical locations. These are plug-in components, and may be changed easily in the field. Information about available PROMs is provided in Section 9 of the ATC-810 Owner's Manual, along with information required to order custom PROMs for virtually any 150x150 nautical mile area.

Chip J04 is a decoder for some of the most significant address bits (used for chip selection), and G04 is a decoder for the map select switch, activating one NAV-PROM at a time.

2.6.3 Circuit Description, Sheet 3

Chips A07A and A07B are inverting tri-state buffers allowing the microprocessor to determine the transponder switch (S2-S5) settings when it "reads" addresses 82 and 83.

Chips E02 and F02 are 8-bit registers loaded with a binary equivalent of fuel quantity when the microprocessor "writes" data to addresses B0 and B2, respectively. Chips E03 and F03 are digital-to-analog converters, each producing a negative voltage corresponding to the "fuel" quantity in its register; these voltages drive the left and right fuel gauges, respectively.

Chips H00, G00 and I00 are special stepping-motor drive circuits, generating the sequential quadrature pulses necessary to drive these specialized motors. Specifically:

- H00 drives the ADF/RMI needle
- G00 drives the Altimeter
- I00 drives the compass rose on the heading indicator, the compass rose on the RMI, and the magnetic compass.

H00 is driven directly by the microprocessor through the J01 register chip and inverters in the H01 package. G00 and I00 are driven from the microprocessor only during system initialization; after initial altitude and heading have been set, multiplexer I01 is switched to permit inputs from other parts of the system.

G04 is an inverting buffer that permits the microprocessor to interrogate the runway selector switch (on the instructor fault panel), the transponder OFF-STBY-ON-ALT switch, and the IDENT pushbutton.

2.6.4 Circuit Description, Sheet 4

The logic on this sheet consists of four similar circuits. Each circuit includes a counter (the 592.0169 chips) and a tri-state buffer. The counters are capable of counting up or down; when a maximum or minimum is reached, the counters simply "wrap-around" and continue. The microprocessor interrogates each counter about 20 times per second; frequently enough so that the microprocessor "knows" whether counter values have increased or decreased since the previous reading.

Chips B04, C04 and D04 "track" the progress of the airplane in a North-South direction; Chips D00, C01 and D01 perform the same function for East-West. The input signals X and Y RATE and X and Y DIR are supplied from circuits in the NAV1/DME unit, described in Paragraph 2.7.4.

The A03-B03 counter circuit is controlled by signals representing airplane turn rate and turn direction (HDGRATE and HDGDIR, respectively). These signals are generated by circuits in the COM/ADF unit, described in Paragraph 2.5.5. The microprocessor only examines the four most significant bits (from A03), since the lower-order bits are not necessary for the required calculations. Chip B02 is a comparator, producing an active output (HDGR) on every eighth count of the HDGRATE signal. HDGR and HDGDIR are used to drive the heading indicators during flight, via Chip I00 on Sheet 3 (Paragraph 2.6.3).

Chips B00, B01, A02 and A01 perform the same function for altitude changes, and produce an output (ALTR) which is combined with ALTDIR to drive the altimeter stepper through Chip G00 on Sheet 3. The ALTRATE and ALTDIR signals are produced in the COM/ADF unit (Paragraph 2.5.6).

Chip K00 receives input signals from Hall-effect devices in the altimeter, the HSI and the RMI. During initialization, the microprocessor drives these displays to initial values of 0 feet elevation (both the thousands and hundreds on the altimeter indicate zero) and headings of 0° (North). When the proper values are displayed, all signals go low, and the microprocessor "knows" that initialization is complete by reading all lows at address B1.

Chip A02 is a register loaded by the microprocessor with four miscellaneous bits of information: ALTO is high when the airplane is on the ground, and does not go low until takeoff. FIELD1NST illuminates the VERIFY switch if the airplane is within a mile of the airport when the switch is pressed (nonprecision approach). The HOLD signal goes high when the FREEZE switch is pressed; note that the signal "Locks" all of the counters referred to previously. TPT1 is not used.

2.6.5 Circuit Description, Sheet 4

Chips F00 and F01 are tri-state inverters allowing the microprocessor to interrogate the fuel selector "valves" and the PRESET-TAKEOFF switch H07 performs the same function for the audio panel switches.

Register Chips C02-G02 and D02-G03 are loaded by the microprocessor with 10-bit binary values representing the position of the airplane. The outputs of these registers are connected to 10-bit D to A converters C03 and D03, whose current outputs are converted to voltages by amplifiers in the E00 package. These voltages (X DAC and Y DAC) are used by the plotter (if equipped) as arm and pen drive signals, respectively.

Register Chip I07B controls audio generators K08, J07, and K07, and the MARKER lights. The marker lights are controlled by bits loaded in this register as the microprocessor determines the airplane is over the appropriate transmitter; the 400HZ(OM) and 1300HZ(MM) tones are generated at the same time. The stall warning is generated by J07 (Pin 9), and the K07 oscillators combine to generate the pulsating gear warning (if either engine is throttled back with gear up). Amplifier I08 and its surrounding discrete components drive the speaker.

2.6.6 Circuit Description, Sheet 3

Chips B07, C07, D07 and E07 are register/7-segment display drivers; the chips store binary-coded-decimal information and generate the appropriate segment drive signals. B08, C08, D08 and E08 contain current-limiting resistors for the display modules.

Chips IC1, IC2, IC3 and IC4, the 7-segment displays, are mounted vertically on a separate small circuit board at the front of the unit.

2.7 NAV1/DME Unit Functions

The NAV1/DME unit contains the expected VOR/ILS control circuitry, along with the NAV1 frequency and DME distance displays. Additionally, the circuitry for the ammeter displays, and the pilot-to-instructor audio amplifier are contained in the unit. The circuit that combines wind velocity and direction with airplane speed and direction to produce the true course are also contained in this unit.

The complete NAV1/DME unit is shown schematically on Drawing C00 051 0664 OS, Sheets 1 through 3. All drawing references which follow refer to sheets of this drawing unless otherwise noted.

2.7.1 Circuit Description, Sheet 1

Chips G02 and H02 are address decoders, generating a single low output when the microprocessor executes a read or write command. The DME switch and multiplexer E03 permit the DME display to be slaved to NAV1 or NAV2. Register F03 is loaded by the microprocessor to control the various flags of the ILS display head, and to blank the DME when necessary. Register J00, J01 and J02 are loaded with binary data that is converted to analog by the I00, I01 and I02 DACs. These analog voltages drive the CDI, TO-FROM flag, and GS needle, respectively.

Chip F04 is a tri-state inverting buffer that connects the NAV1 frequency select switches (SW2 and SW3) to the microprocessor. Note that the switches do not directly control frequency; the microprocessor compares the previous switch value with the current value; if the new value is greater, the microprocessor computes a "higher frequency" and writes it to the display. This process continues until the microprocessor detects no change between the previous and current switch values; the pilot then is satisfied with the displayed frequency. The microprocesssor uses a value proportional to this "frequency" to access the active navigational PROM; data within the PROM represents the absolute geographical position of the Navaid or airport. Using the information available regarding the instantaneous position of the airplane and the position of the Navaid, the microprocessor performs the trigonometric calculations necessary for driving the ILS head and DME displays, repeating this process continuously about 20 times per second.

2.7.2 Circuit Description, Sheet 2

The circuit on this sheet forms the Omni Bearing Selector (OBS) resolver. Its purpose is to provide a precise input to the microprocessor regarding the pilot's OBS setting, a value required by the microprocessor for its course deviation needle-drive routine.

Amplifier G00 (Pin 1) is an oscillator producing a sinusoidal output. This signal is buffered by amplifier G00 (Pin 7) and applied as an input to phase-lock-loop (PLL) circuit F02. The other input to the PLL comes from a divide-by-4096 counter Chip, C02. The internal oscillator in the PLL (output at Pin 4) thus remains exactly 4096 times the frequency of the G00 (Pin 1) oscillator, and is locked precisely in phase with this signal.

The signal from the G00 (Pin 1) oscillator is buffered by G00 (Pin 14), and applied to the rotor of a mechanical resolver, which rotates with the OBS ring. The signal from the rotor is transformer-coupled to the two stator windings, which are exactly 120° apart. Thus, when one stator receives a maximum signal, the other receives a lesser signal. The two stator signals are summed at the input of G00 (Pin 8), generating a sinusoid whose phase changes with respect to the rotor phase as the OBS is rotated.

Amplifier G00 (Pin 8) functions as a comparator, producing a positive output as soon as the sinusoidal input signal goes positive by the smallest amount. The positive output sets flip-flop C03 on the next trigger from the PLL, and the high Q output clocks register Chips B02 and D02. The count value at the instant the resolver signals go high is "captured" by these registers, and can be read as an 11-bit quantity by the microprocessor. Thus, a 360° degree rotation of the OBS produces (to the microprocessor) binary equivalent values between 0 and 4096, and the microprocessor can resolve angular changes of about 5 minutes of arc.

2.7.3 Circuit Description, Sheet 3

The circuits on this sheet drive the ammeter. If both MASTER switches are ON, and both "alternators" are operating, the output of B01 (Pin 1) is high and the ammeter displays a reading of zero to slight charge.

Gate A00 (Pin 13) receives three inputs: RALFS* (normally high, low when the instructor "fails" the right alternator), R>750 (high when the right engine is operating at more than 750 RPM), and RMSTSW (high when the right master switch is on). The output of this gate is normally low, causing a high from inverter A01 (Pin 10). This high inhibits the RTALT INOP light on the cockpit annunciator panel and the RTALT INOP light on the instructor fault panel. If any input to A00 (Pin 13) goes low, however, both lights come on. If the right ALT pushbutton is pressed, the ammeter will display zero under these conditions. If the left alternator is still operating, high signals are present at A01 (Pin 6) and A02 (Pin 10), and the left alternator button will cause the ammeter to display an abnormally high reading (with a failed right alternator, the left will be carrying all the electrical load).

The complex-appearing switch arrangement for the pushbuttons simply protects the meter and logic circuits if both buttons are inadvertently pressed together.

2.7.4 Circuit Description, Sheet 3

Chip J03 is a register, loaded by the microprocessor with a binary value proportional to altitude. This binary value is applied to DAC I03, along with airspeed (RASP) to produce an output correction voltage from F01 (Pin 14) proportional to true speed (which increases above IAS as altitude increases). The true speed correction voltage is inverted by F01 (Pin 8) and applied to the pitch circuit in the COM/ADF unit (ASCORR). The output of F01 (Pin 14) is also summed with RASP at the input to amplifier F01 (Pin 7) generating a true speed output. A complementary analog voltage is produced by F01 (Pin 1), and both voltages are applied to the sinusoidal compass follower pot. This pot is constructed specifically to produce a voltage at one wiper proportional to the sine of that wiper position, while the other wiper (90° from the first) picks off a voltage proportional to the cosine of the shaft position. This pot is driven by the same stepping motor that drives the compass; if no wind were present, these voltages could be used to convert the airplane heading and speed (polar coordinates) to East-West and North-South (rectangular coordinates) positional information.

However, wind exists, and on the simulator is controlled by two pots on the instructor fault panel; wind velocity and wind direction. The instructor's wind direction control is a sine-cosine pot also, and thus wind is introduced also in rectangular coordinates. The components of the East-West motion of the airplane and the East-West component of the wind are summed by amplifier D01(Pin 14). The output of this amplifier is connected to an absolute-value and voltage-to-frequency converter circuit, supplying the microprocessor with information about the airplane's true course in this direction. Amplifier D00 (Pin 14) performs the same function for motion in the North-South direction, together with an identical absolute-value/VF converter. Refer to Paragraph 2.5.5 and Sheet 4 of Drawing 51.663 or 51.671 for an explanation of circuit function; Paragraph 2.6.4 explains the destination of the X and Y RATE and DIRECTION outputs.

2.7.5 Circuit Description, Sheet 3

This sheet shows the register/7-segment drivers, resistors and displays for the NAV and DME readouts, and is self-explanatory.

2.8 NAV2 Unit Functions

The NAV2 unit contains the circuits which drive the VOR display only. Since these circuits are identical with those described in Paragraph 2.7, it is suggested that the reader study the material in that section, particularly Paragraphs 2.7.1 and 2.7.2. The NAV2 unit is shown schematically on Drawing C00 051 0665 OS, Sheets 1 and 2.

2.9 Rudder Servo Circuit

The rudder servo performs two major functions. It develops a voltage proportional to rudder deflection, airspeed and differential thrust which is applied as an input to the simulator turn circuit. It also develops a tactile feedback for the rudder pedals by means of a servo motor and torque multiplication system.

Physically, the rudder servo electronics are part of a circuit board beneath the pilot's seat; the mechanical components are below the simulator platform.

2.9.1 Tactile Feedback Circuit

Refer to schematic Drawing D00 007 0180 OS for the following description. AC voltage from a transformer secondary is applied to the inverting input of comparator IC3 (Pin 14), and the noninverting input of comparator IC3 (Pin 13). IC3 (Pin 14) goes high during part of the negative half-cycle of this voltage, while IC3 (Pin 13) goes high during part of the positive half cycle. Bias voltages (about 1.2 volts) are applied to each comparator, causing a "dead band" around the zero-crossings of the ac signal.

The comparator outputs control electronic switches which act as feedback elements around two integrators, IC4 (Pin 1) and IC4 (Pin 7). When one of these switches is "closed," the output of the associated integrator drops to zero; when the switch "opens," the integrator produces a linear negative going ramp. The outputs of the two integrators are thus an alternating series of ramps, repeating at 100Hz or 120Hz, depending on power line frequency. These ramps are used to alternately enable two additional comparators, IC3 (Pin 1) and IC3 (Pin 2).

Amplifier IC4 (Pin 14) is normally biased so that its output is negative. This signal causes the output of IC3 (Pin 1) to remain low, even at the peak of the negative ramp. Similarly, IC4 (Pin 8) is biased so that its output is normally positive, keeping the output of IC3 (Pin 2) low at all times.

The signal connected to Pin 13 of IC4 and to Pin 9 of IC4 represents rudder "feedback force." In straight-and-level flight, with proper trim and no differential thrust, the airplane is balanced, and no rudder force is generated. The signal at TP4 is zero, and the outputs of IC3 (Pin 1) and IC3 (Pin 2) are both low.

If the airplane becomes unbalanced (for example, loss of the right engine), the voltage at TP4 deviates from zero. In the example, loss of the right engine causes a strong right yaw force, and the voltage at TP4 becomes positive. This signal causes IC4 (Pin 14) and IC4 (Pin 8) both to go in a negative direction. The signal from Pin 14 does nothing; the negative change from Pin 8 allows the IC3 (Pin 2) comparator to go high when the peaks of the ramp signal at Pin 5 exceed the new level at Pin 4. Thus, high pulses begin to appear at IC3 (Pin 2), whose width is a function of the signal amplitude at TP4.

These pulses cause Q2 to conduct for the duration of each high pulse, and a current flows through the LED in optical-isolator IC1. The LED illuminates during each pulse, and the SCR incorporated in the isolator is triggered. The isolator SCR provides gate current to TRIAC CR3, and a pulse of energy is fed to the rudder feedback motor (M1) beneath the platform. In this example, the motor will generate a force "pushing" the left rudder pedal back at the pilot.

If the left engine were to fail, rather than the right, the yaw forces would be reversed, and the circuit feeding Q1 would be active. This circuit functions in the same way, but provides TRIAC pulses during the opposite polarity of line voltage, and hence, torque in the opposite direction.

2.9.2 Rudder Signal Circuit

This circuit is shown along the lower half of the 7.180 Drawing. Inputs to this circuit represent airspeed, differential thrust, trim (from the rudder trim wheel on the throttle quadrant), the rudder signal (from the pot driven by the pedals) and torque (from a feedback pot sensing the motor force applied). The ALTO signal is high until airborne.

The rudder signal is connected to several places, but follow the signal to R75. This resistor provides one input to analog multiplier IC8; airspeed (via R76) is the other input. The scaled product of these two variables (at Pin 4 of IC8), is a correction factor that represents the increasing effectiveness of the rudder as speed increases. The multiplier output is summed with the rudder signal and airspeed signal (via R78 and R77, respectively at the input of amplifier IC9 (Pin 7). The output of this amplifier is a voltage proportional to rudder "yaw power" throughout the aircraft's operating envelope, and is the only signal normally appearing at the input to IC6 (Pin 14). This amplifier connects the corrected rudder signal to the turn circuit (in the COM/ADF unit) through CR12 and CR13. These diodes simulate the slack normally present in the rudder cables.

Electronic switch IC10 (Pin 6) is closed only on the ground; the extra signal from the rudder through this switch represents the nosewheel steering effectiveness on the ground.

Amplifier IC6 (Pin 8) receives the differential thrust signal, adding this voltage also to the rudder signal when engine outputs are unequal.

The trim signal is disconnected by electronic switch IC10 (Pin 10) when the ALTO signal is high. When airborne, the trim and rudder signals are summed by IC9 (Pin 1), producing an input to multiplier IC7. This circuit functions in exactly the same way as the circuit described previously, except for the addition of trim, and because of the inversion of IC9 (Pin 1), is opposite in polarity. The output of IC6 (Pin 1) is connected to IC6 (Pin 7), providing an input to the tactile feedback circuit. Differential thrust is also summed into IC6 (Pin 7) via R50.

IC9 (Pin 14) limits the maximum amount of feedback force, sensing the rudder input and the motor torque, and forward biasing Q3 or Q4 when the preset limit is reached.

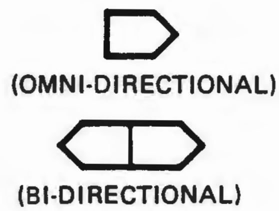
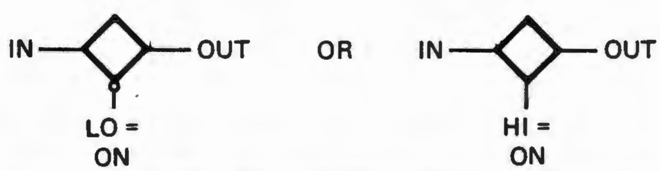
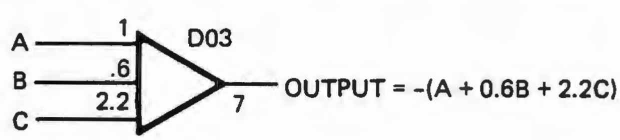
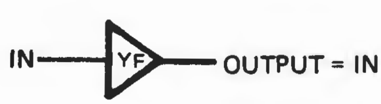
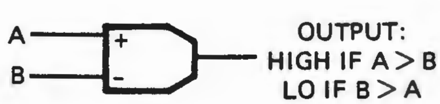
SYMBOL	DESCRIPTION
	Microprocessor Data Bus Connections
	Microprocessor Address Bus Connections
	Logic - Controlled Analog Switch (Electronic Switch)
	Summing Amplifier; referred to as D03 (pin 7) NOTE: L within Symbol means a "LAG" network is included to slow amplifier response.
	Voltage Follower - Analog Buffer
	Comparator; Inputs are Analog, Output is logic level (HI = +3V, LO = 0V)

Figure 2.1 Symbols

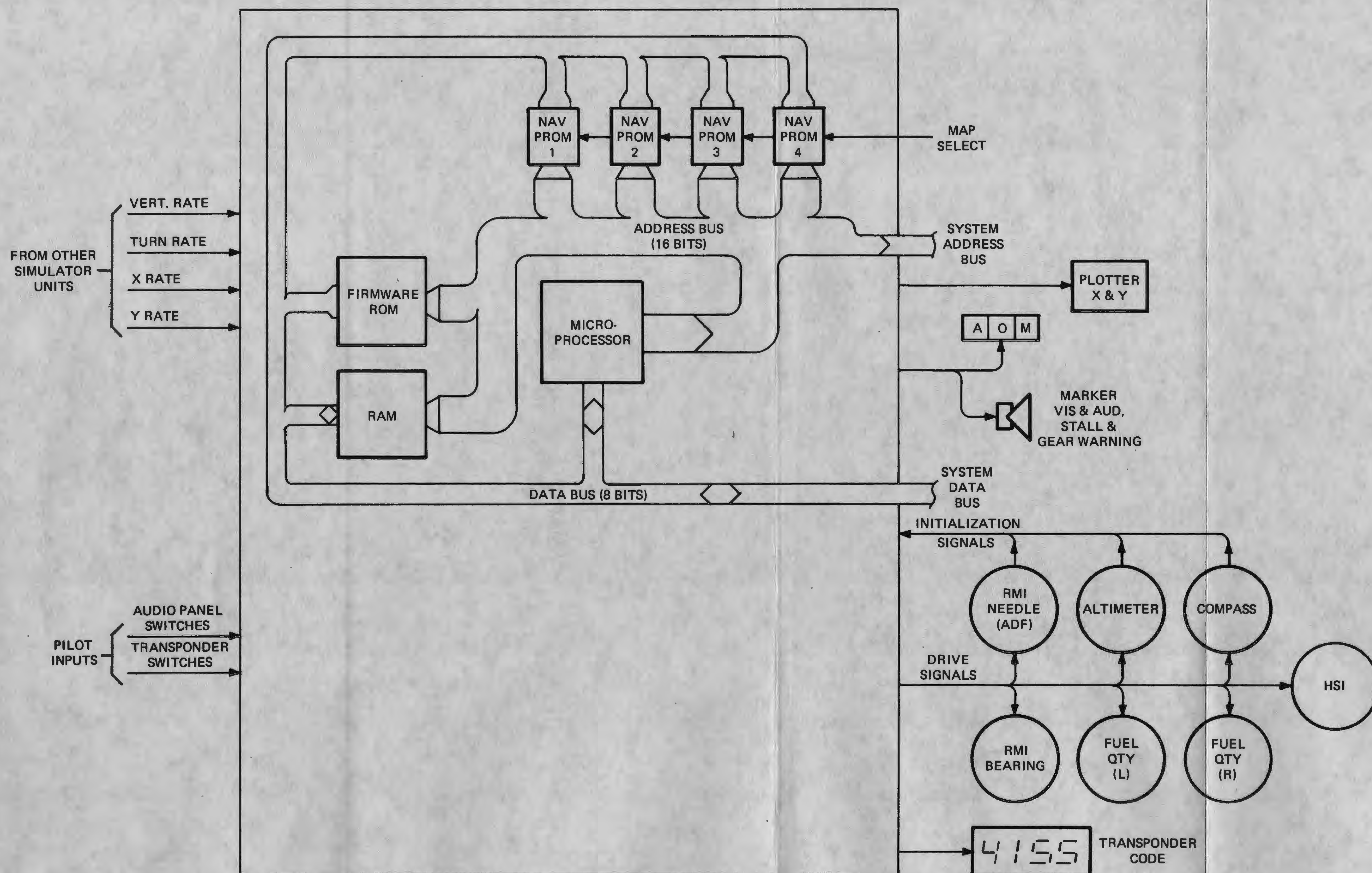


Figure 2.2 Block Diagram of Audio/XPonder Major Functions

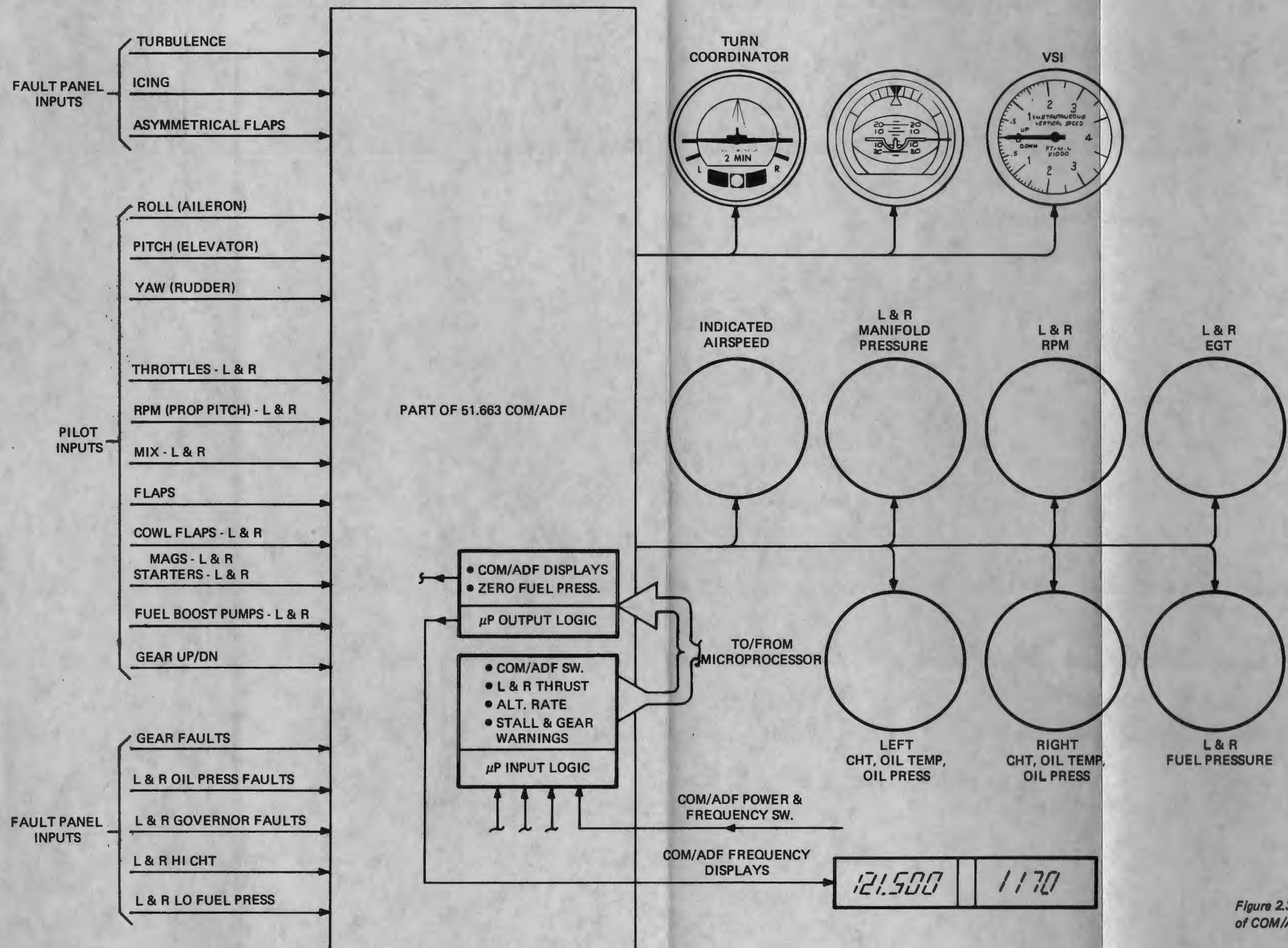


Figure 2.3 Block Diagram of COM/ADF Major Functions

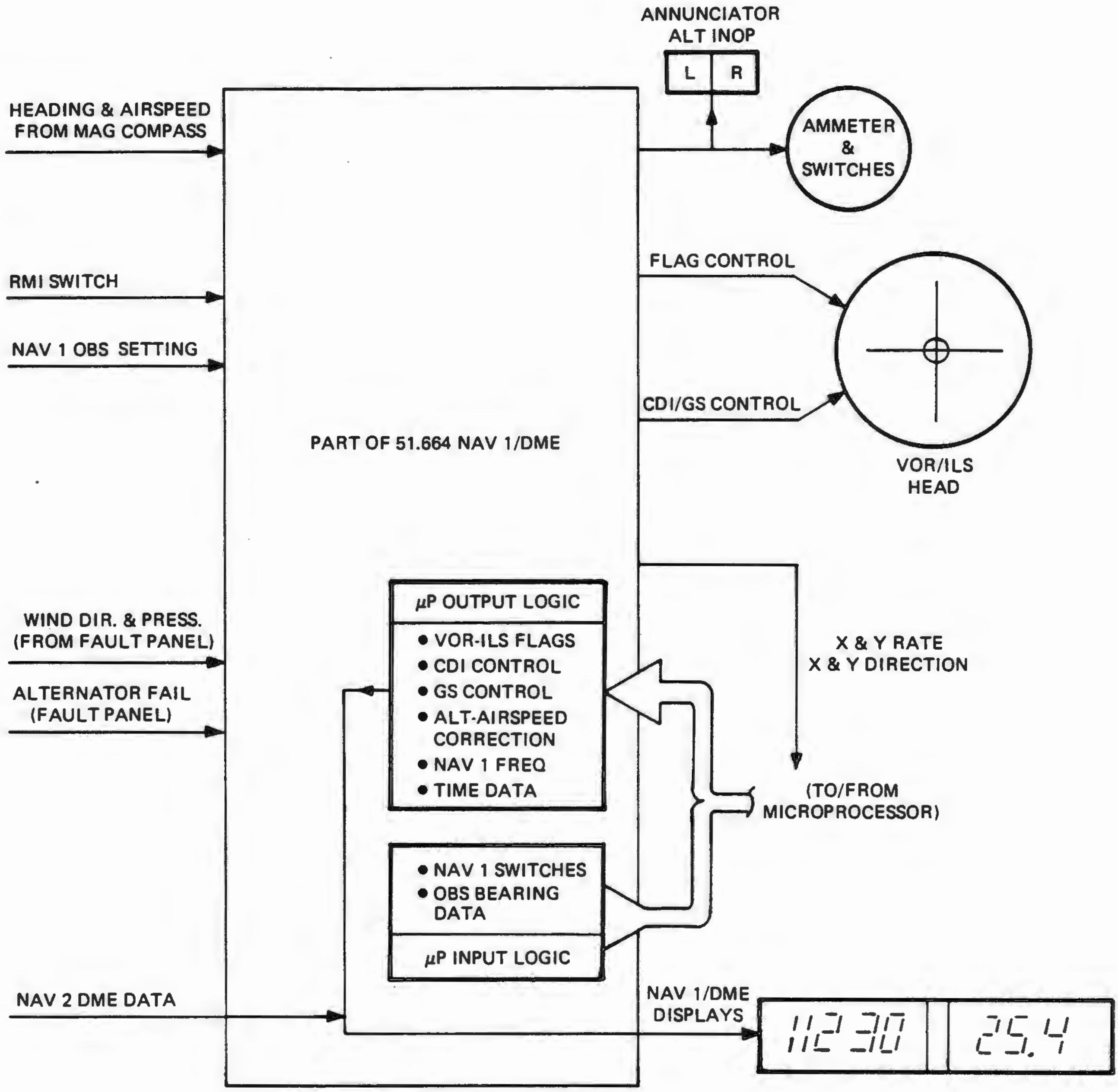


Figure 2.4 Block Diagram of NAV 1/DME Major Functions

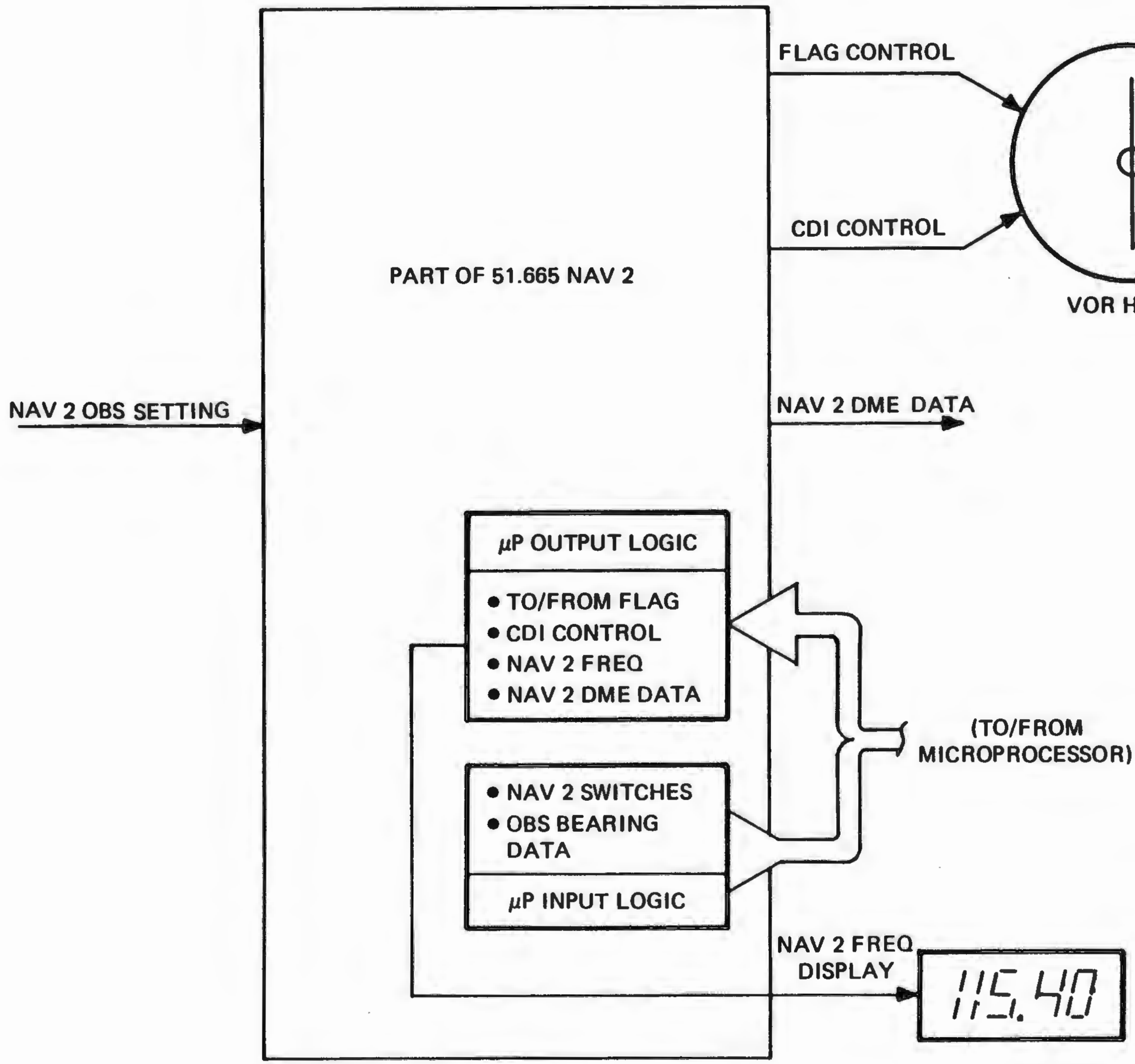


Figure 2.5 Block Diagram of NAV 2 Major Functions

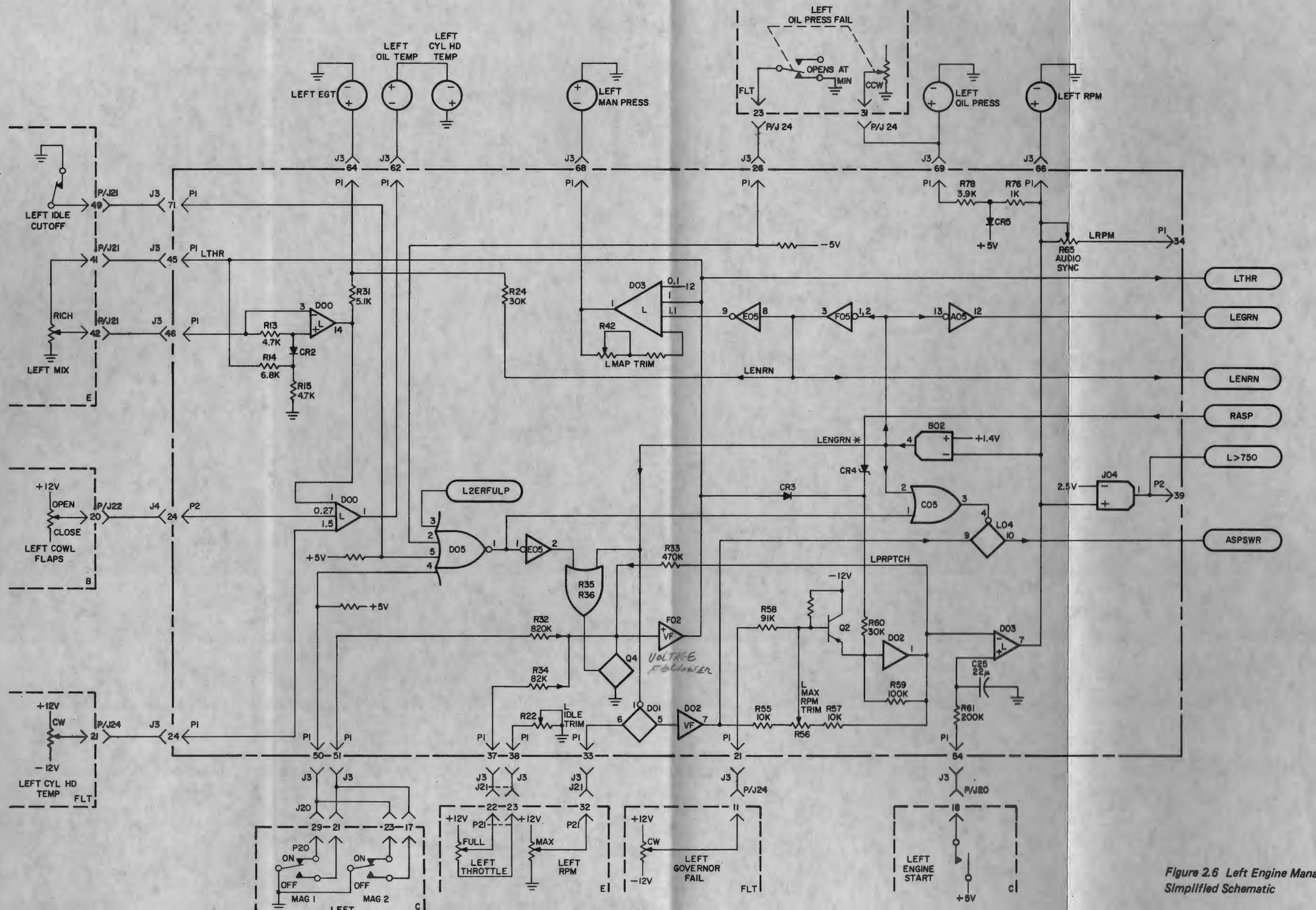


Figure 2.6 Left Engine Management Simplified Schematic

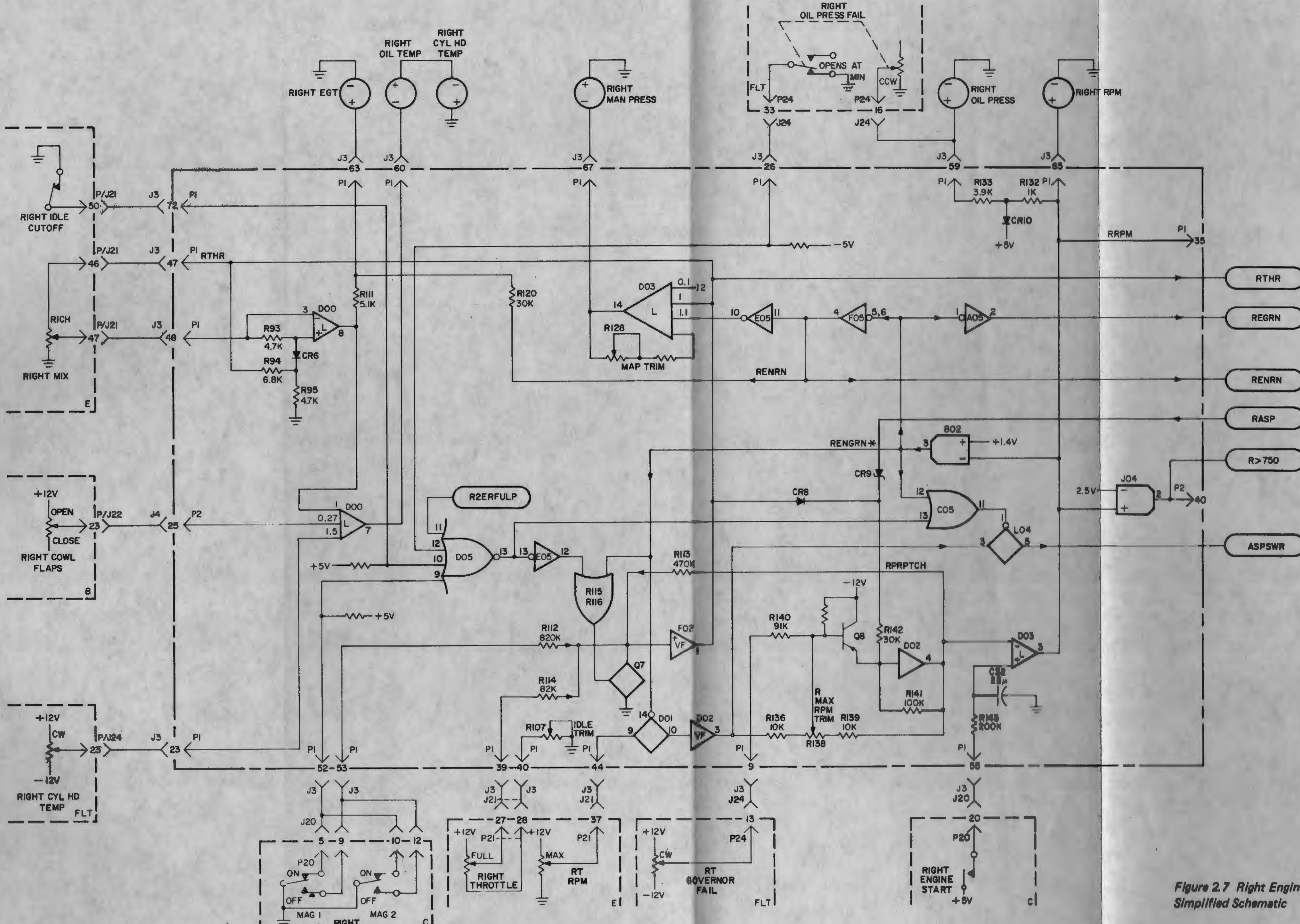


Figure 2.7 Right Engine Management Simplified Schematic

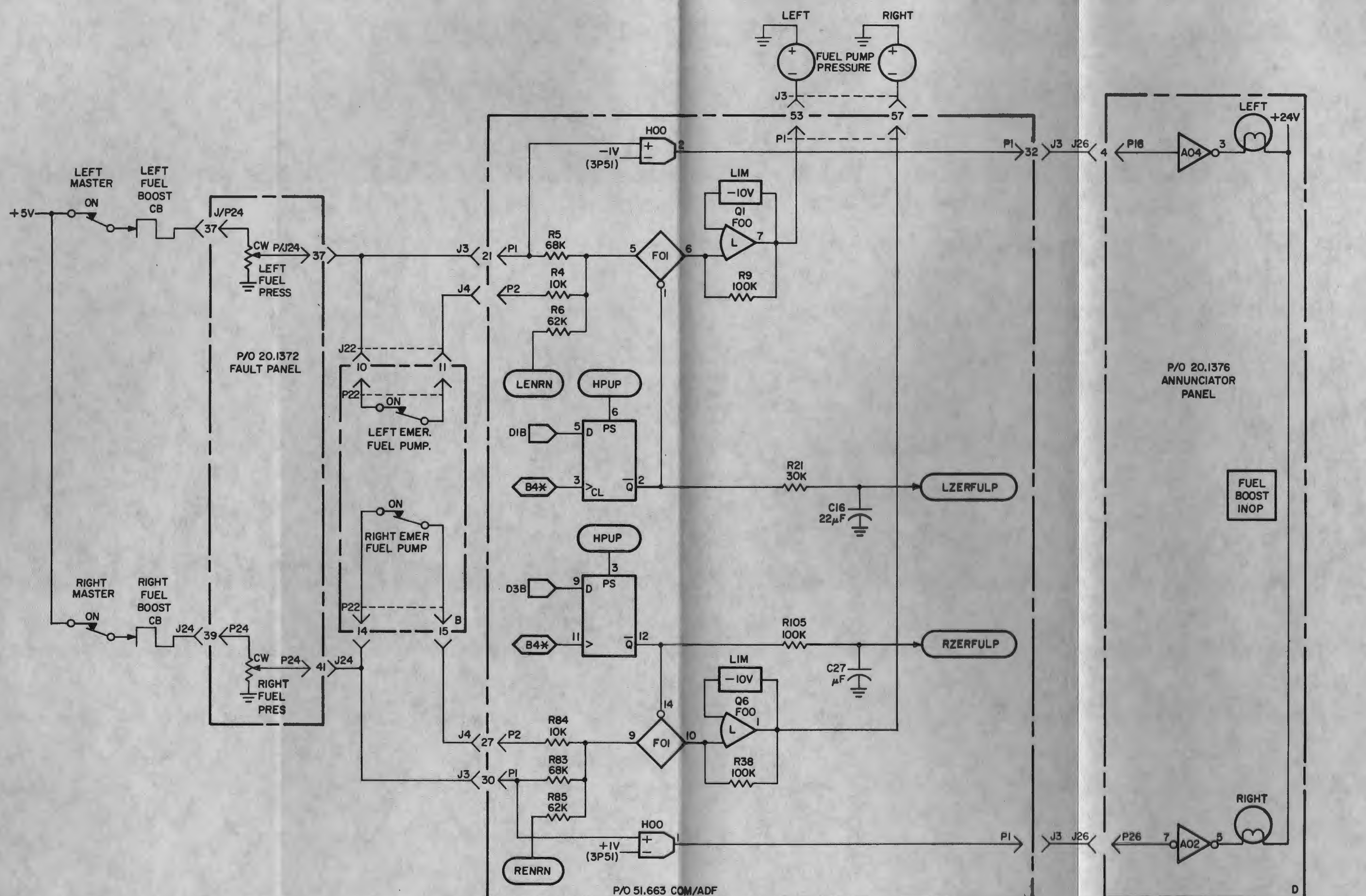


Figure 2.8 Fuel Management System Simplified Schematic (Part 1)

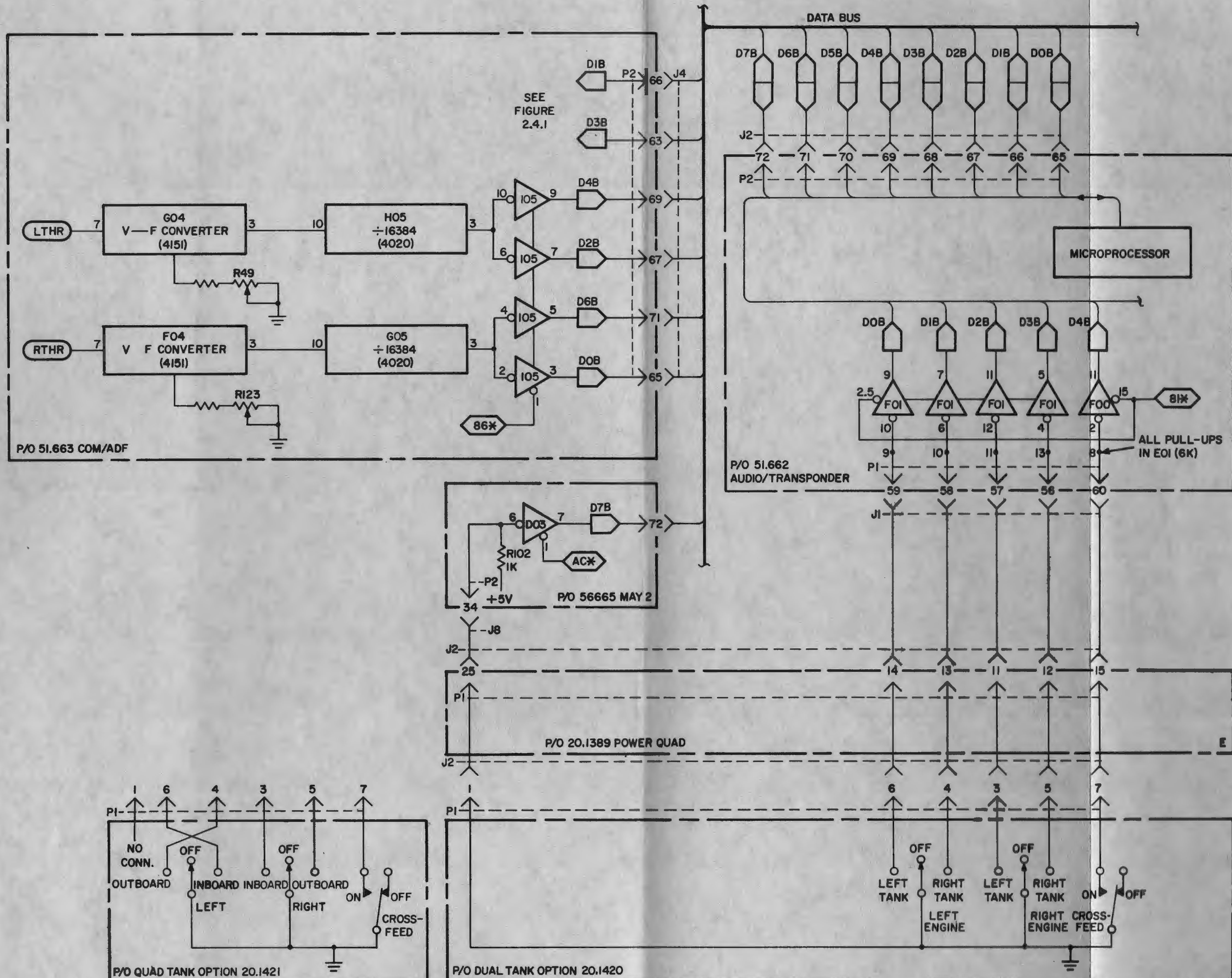


Figure 2.9 Fuel Management System Simplified Schematic (Part 2)

CHAPTER 3

3.0 BASIC SERVICE INFORMATION

3.1 Enclosure Disassembly/Reassembly

The plywood enclosure is secured with wood screws. Assembly and disassembly should be performed with care to avoid damaging screw heads or stripping the screws. At least two people are required for these procedures. Insure that the ac power cord is disconnected before disassembly or reassembly of the enclosure is attempted.

3.1.1 Detach the top canopy of the enclosure by removing the ten (10) wood screws (five (5) each side) that secure canopy to the side walls of the enclosure.

3.1.2 Remove eight (8) wood screws (four (4) each side) from shelf with attached magnetic compass that secures shelf to the enclosure walls. Gently lift shelf from enclosure walls - locate and trace the magnetic compass lead wires and unplug coupling. Remove shelf from enclosure.

3.1.3 The following procedure to unplug the rudder pedal assembly from the electronic chassis requires removal of the NAV1/DME and NAV2 Radio Displays and attached circuit boards: CAUTION! Static sensitive components on both PC boards.

3.1.3.1 Open the rear door of the enclosure by first removing the two machine screws, then pulling outward on the circular latch handle.

3.1.3.2 Move to the rear of the simulator and remove two (2) long pins from the metal chassis. The enclosed magnetic wrenches (Part No. 100-0615-0) are then used to remove the circuit boards from the instrument panel.

3.1.3.3 Unplug rudder cable from the simulator.

3.1.3.4 Move to the inside of the enclosure and open the rudder cable clamp which is flush against the bottom of the back panel. Three clips at the base of the right wall should then be opened to release the instructor fault panel cord.

3.1.4 Detach back panel from enclosure by removing ten (10) machine screws (five (5) each side) along vertical edges of back panel.

3.1.5 Detach enclosure 'Light Cover' by removing two (2) machine screws (one (1) each side). Remove screw from ground wire and slide bulb assembly from its retaining bracket. Trace the wire from the light assembly and open the two (2) clips which hold it flush against the right wall.

3.1.6 Detach the simulator from its metal chassis by removing four (4) screws (one (1) at each corner) from its base and carefully lift the unit out. After removal it is very important to set the simulator on a table <u>with the power quadrant hanging over the edge</u>.

3.1.7 Detach side walls from enclosure by lifting the side edges of the carpeting and remove ten (10) screws (five (5) each side) from the base of the metal chassis support. Then remove sixteen (16) wood screws (eight (8) each side) from the lower edge of the side walls. Lift side walls off.

3.1.8 Assembly is the reverse of disassembly.

3.2 CMOS Precautions

The ATC-810 contains many CMOS (Complementary Metal-Oxide Silicon) components. To avoid damaging these components <u>always</u> adhere to the following rules when working with CMOS circuitry:

3.2.1 Never wear synthetic fiber or wool clothing while working on CMOS. Short-sleeved cotton shirts are recommended.

3.2.2 If possible, perform service only in areas where relative humidity is at least 60%. Do not attempt to service CMOS at all if relative humidity is below 40%.

3.2.3 Always connnect test equipment chassis ground to the simulator chassis before connecting any probes to test points.

3.2.4 Before unplugging any printed-circuit cards containing CMOS components, remove any test probes, turn off and unplug the equipment. Then ground yourself to the equipment chassis by holding the metal frame while removing the circuit card.

3.2.5 While testing components on a CMOS circuit card removed from the chassis, work on a metal or conductive plastic tabletop that is also connected with a clip lead to the equipment chassis. Use battery-powered equipment to avoid shocks to yourself; malfunctioning line-powered test equipment can be extremely dangerous, especially under these conditions.

3.2.6 Conductive plastic bags are available from ATC; these bags should be used to protect CMOS circuits while removed from the chassis.

3.2.7 If circuit soldering is required, use a battery-powered low power iron or a line powered 25-30 watt iron with a three-wire cord grounding the tip. It is very important for your safety that the ground wire is in good condition. A good safety precaution is to connect a clip lead from the iron tip to the conductive plastic or metal table top.

3.2.8 When reinserting a CMOS circuit card, follow the precautions in part 4 above; make sure that the unit is unplugged, test equipment probes are removed, you are grounded to the chassis, then insert the board and push firmly into place. Use the magnetic insertion/extraction tools to firmly lever the components into full contact with the connectors.

3.3 General Service Procedures

The procedures in Section 4 provide complete alignment information for the ATC-810. However, these procedures must be performed with great care if accuracy is to be maintained. The procedures are listed in the order in which they should be performed. Steps may sometimes be skipped if you are <u>certain</u> you have made the correct jumper and switch selections, etc. Therefore, it is suggested that you read all steps of the tests and adjustments preceeding the one you are attempting to be sure of your connections and system configuration.

HOLD 49(C)

CHAPTER

4

4.0 TEST AND ADJUSTMENT PROCEDURES

4.1 Required Equipment

4.2 The following standard test equipment is required for these procedures:

4.2.1 Digital Voltmeter - Resolution at least 4 digits, accuracy at least 0.05%.

4.2.2 Oscilloscope - Bandwidth at least 5 MHz, Sensitivity 10 MV/cm.

4.2.3 Frequency Counter - Range to 5 MHz.

4.3 The following special equipment is required for these procedures:

4.3.1 Extender board and support - ATC/EAI part number 0.051.0666-0 and 0.450.1109, respectively.

4.3.2 Test jumper plug set - ATC TF 1257.

4.3.3 Fault Panel dummy plug - ATC TF 1271.

4.3.4 Jumper wires (12"/30.5cm, with female wire-wrap pin terminations for 0.025"/0.635mm stakes), two required.

4.3.5 Jumper wire set (4-terminal, 12"/30.5cm leads interconnected, terminated with female wire-wrap pins as above).

4.4 Voltage Checks and Adjustments

4.4.1 Preliminary

4.4.1.1 Before adjusting any voltages, note that the ±12V and ±5V levels are used as reference values for the analog sections of the equipment.

Therefore, if these voltages are changed, all subsequent tests must be performed, and extensive recalibration might be required. Thus, unless the voltages are significantly out of tolerance, do not adjust.

4.4.1.2 Open the rear panel of the simulator to expose the back plane test points and the power supplies. The power supplies will be on your left as you "peer from the rear"; determine if your power supplies resemble figure 4.1a (older units) or 4.1b (newer units).

4.4.1.3 Apply power to the unit as follows:

a. Both Master switches ON
b. All radios ON
c. Key switch ON

4.4.2 +5 Volt Test

Connect the DVM common lead to pin 1 or 2 of the backplane bus at connector position P7 (Ground). Connect the DVM signal lead to pin 3 or 4 of the backplane bus at any connector position (+5V). CAUTION: Avoid shorts!

DVM should indicate +5.00 Volts, ±0.01 Volt.

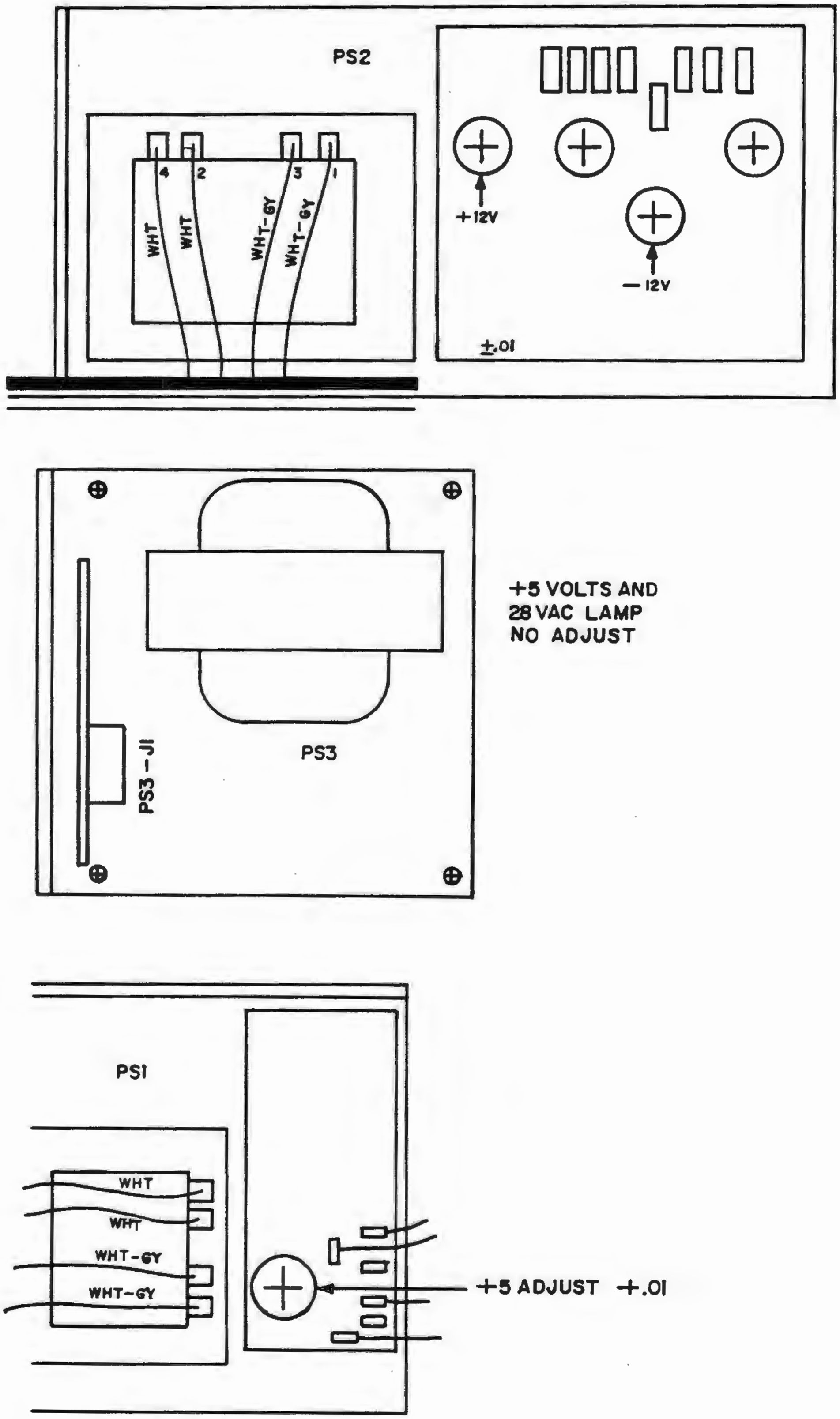
4.4.3 +5 Volt Adjustment

If adjustment is indicated by the previous step, refer to Figure 4.1 and adjust the appropriate control to wthin 0.005 Volt of +5.000.

4.4.4 +12 Volt Test

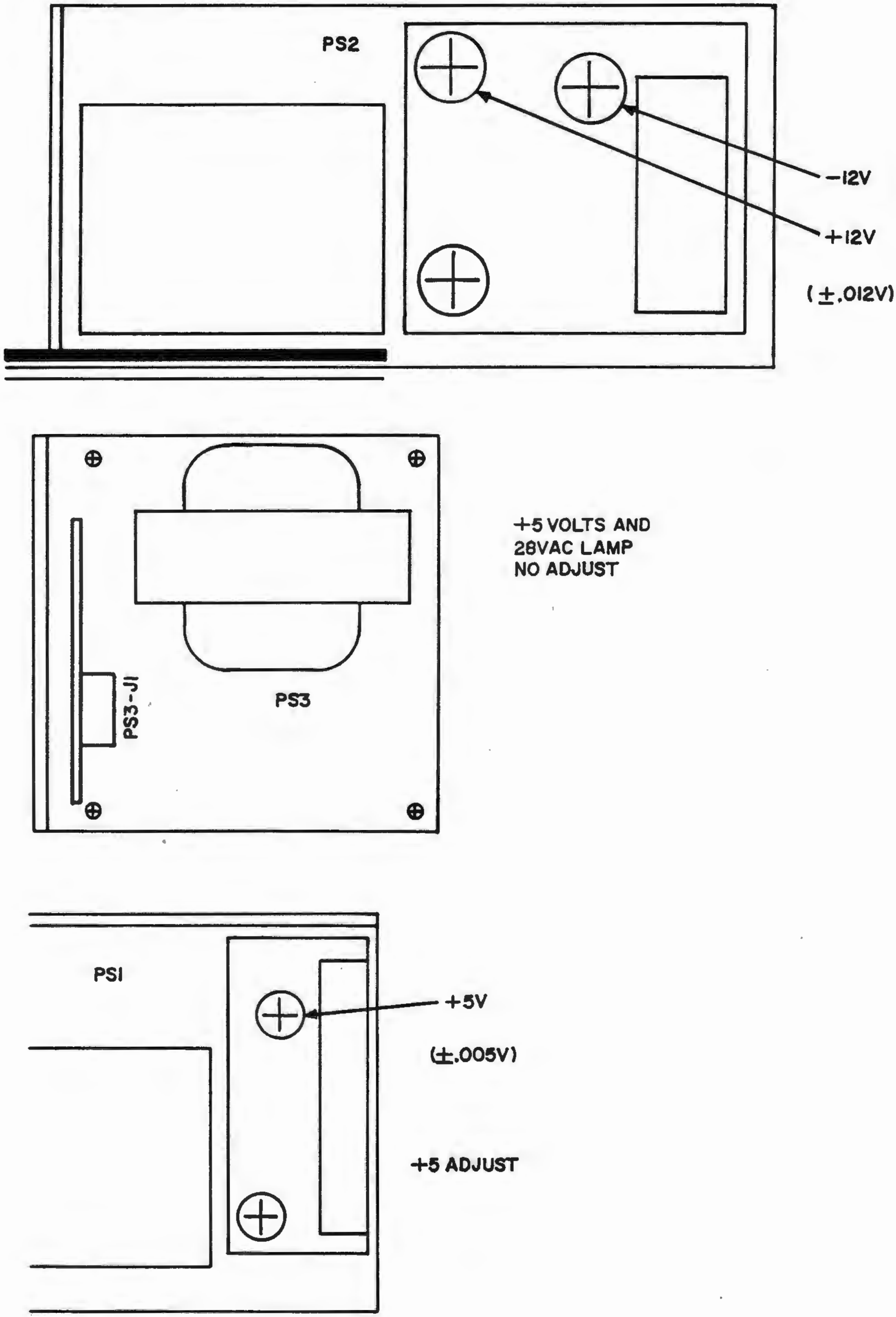
Leave the DVM common lead connected as in paragraph 4.4.2. Connect the DVM signal lead to connector position P2, pin 5 or 6 (+12V).

DVM should indicate +12.00 Volts, ±0.012 Volt.



(OLD)

Figure 4.1a



(NEW)

Figure 4.1b

4.4.5 +12 Volt Adjustment

If the previous step indicates that adjustment is required, refer to Figure 4.1 and adjust the appropriate control for a DVM reading of +12.00 Volts, ±0.012 Volt.

4.4.6 -12 Volt Test

Leave the DVM common lead connected as in the previous steps. Move the DVM signal lead to connector P1, pin 7 or 8 (-12V).

DVM should indicate -12.00 Volts, ±0.012 Volt.

4.4.7 -12 Volt Adjustment

If the previous step indicates that adjustment is required, refer to Figure 4.1 and adjust the appropriate control for a DVM reading of -12.00 Volts, ±0.012 Volt.

4.4.8 +24 Volt Test

Leave the DVM common lead connected as in the previous steps. Connect the DVM signal lead to connector J-26, pin 1. (This is the connector to the annunciator panel.)

The DVM should display between +23 and +25 Volts. There is no adjustment for this level and it is not critical. However, a significant error (more than ±3 Volts) indicates that repair or replacement of the power supply (PS3) is required.

4.4.9 Turn Keylock switch OFF.

4.4.10 Disconnect DVM.

4.5 Preliminary System Checks

Jumper Only

4.5.1 Assure Keylock switch is OFF.

4.5.2 Install Jumper wire between P1 pin 71 and P1 pin 1 (Ground). This connection allows the microprocessor to enter the TEST mode. Remove the FAULT PANEL cable and install the FAULT PANEL DUMMY PLUG.

4.5.3 Switch all radios ON. Turn keylock switch ON.

4.5.4 Set all AUDIO PANEL switches to the OFF position (center or down). Set Transponder to STBY.

4.5.6 Simultaneously press IDENT and FIELD IN SIGHT. This action causes the microprocessor to enter the basic test mode, indicated by the three MARKER indicators blinking in sequence.

4.5.7 If the MARKER indicators do not sequence, return to step 4.5.1 and verify that you have performed all the steps correctly. If the indicators still fail, and the power supplies are OK, a major fault in the microprocessor is indicated, and repair or replacement of the AUDIO/TRANSPONDER unit will be required.

4.5.8 If the MARKER indicators are sequencing, connect the DVM common lead to P3 pin 1, and the DVM signal lead to P4-29. (This is the wiper of the AILERON pot.) With the yoke released (centered), the voltage at this point should be between +10MV and -10MV. "Roll" the yoke right and left and confirm that the voltage returns to this range when the yoke is released.

4.5.9 If an excessive voltage is noted in the previous step, the AILERON pot must be loosened, and the body of the pot rotated until the smallest possible voltage is measured. Then secure the pot carefully to assure that the voltage remains within the limits.

4.5.10 Move the DVM signal lead to P4-Pin 30 (wiper of the PITCH pot). With a distance of 10.5"/26.67cm from the front of the panel to the center of the yoke, the DVM should indicate -1.5V. Use the PITCH TRIM wheel, if necessary, to aid in setting the distance.

4.5.11 If the voltage in step 4.5.10 is in error by more than 20MV, mechanical adjustment of the PITCH pot will be required, using the same technique as in step 4.5.9.

4.6 Diagnostic Test 0

4.6.1 Operate the Audio Control Panel switches (NAV1, NAV2, ADF, DME and MKR) and verify that the transponder display shows the decimal equivalent of the binary code. For example, the transponder should display 0005 if the ADF and MKR switches (only) are ON. Exercise binary codes 0 through 31.

4.6.2 A failure in this test (or in subsequent tests 4.7 through 4.13) may indicate:

a. A switch contact failure: (check with ohmmeter).

b. A connector failure: (assure that the switch makes secure contact with the main circuit board).

c. A signal buffer failure: (Trace the path on the appropriate schematic from the switch through a tri-state buffer to the data bus [D n B] with an oscilloscope. Sync the scope on the negative edge of the signal at pin 1 or 15 of the buffer chip, and check the output of the buffer. During the "window" when pin 1 or 15 is low, the output of the buffer sould "follow" the switch. For example, if the NAV2 switch does not cause the transponder to display 8 when it [only] is ON, locate the switch on the lower right corner of Schematic 51.6620S, sheet 5, and note that it is buffered by chip H07, pin 11 to D3B. Since the buffer inverts, the output at pin 11 should be high during the "window" if the switch is ON. A dual-trace scope is most useful during these checks, with one trace connected to display the pin 1 or 15 signal "window" and the other trace displaying the buffer output as the switch position is toggled. Repair is effected by chip replacement.)

4.7 Diagnostic Test 1

Turn all Audio Panel switches OFF except MKR. Reset by pushing IDENT and F.I.S., unit should go to DIAG. Test 1.

Operate each transponder code switch and each ADF frequency switch. The display above each should cycle in sequence ... 6-5-3...as the switch is rotated clockwise and in the opposite sequence...3-5-6 as it is rotated counterclockwise.

4.8 Diagnostic Test 2

Turn all Audio Control Panel switches OFF except DME. Reset by pushing VERIFY and F.I.S., unit should go to DIAG. Test 2.

Operate each COM, NAV1 and NAV2 Radio "Frequency Select" switch. The display window associated with each (indicated by lines on radio panel) should cycle in sequence...6-5-3...as the switch is rotated clockwise and in the reverse sequence (...3-5-6...) as it is rotated counterclockwise.

4.9 Diagnostic Test 3

Turn all Audio Control Panel switches OFF except DME and MKR. Reset by pushing IDENT and F.I.S., unit should go to DIAG 3.

Operate the four right most audio control switches as shown below and verify the resulting displays.

AUDIO SW NAV2	ADF	DME	MKR	XPONDER	ADF	COM	NAV1	(NAV1) DME	NAV2
				NUMERIC DISPLAYS					
0	0	0	0	0000	0000	100.00	100.00	00.0	100.00
0	0	0	1	1111	1111	111.11	111.11	11.1	111.11
0	0	1	0	2222	0222	122.22	102.22	22.2	102.22
0	0	1	1	3333	1333	133.33	113.33	33.3	113.33
0	1	0	0	4444	0444	104.44	104.44	44.4	104.44
0	1	0	1	5555	1555	115.55	115.55	55.5	115.55
0	1	1	0	6666	0666	126.66	106.66	66.6	106.66
0	1	1	1	7777	1777	137.77	117.77	77.7	117.77
1	0	0	0	8888	0888	108.88	108.88	88.8	108.88
1	0	0	1	9999	1999	119.99	119.99	99.9	119.99
1	0	1	0		0	12 .	10 .	.	10 .

4.10 Diagnostic Test 4

Turn power OFF. Remove fault panel dummy plug and install fault panel cable.

Turn power ON. Turn all Audio Control Panel switches OFF except ADF. Reset by pushing IDENT and F.I.S.; unit should go to DIAG4.

Operate the switches shown below. Verify the resulting transponder display as shown.

TRANSPONDER MODE	IDENT BUTTON	ON FAULT PANEL RUNWAY SELECT	TRANSPONDER DISPLAY
STY	OFF	1	0
STY	OFF	2	1
STY	OFF	3	2
STY	OFF	4	3
STY	ON	1	4
ON or ALT	X	1	8

4.11 Diagnostic Test 5

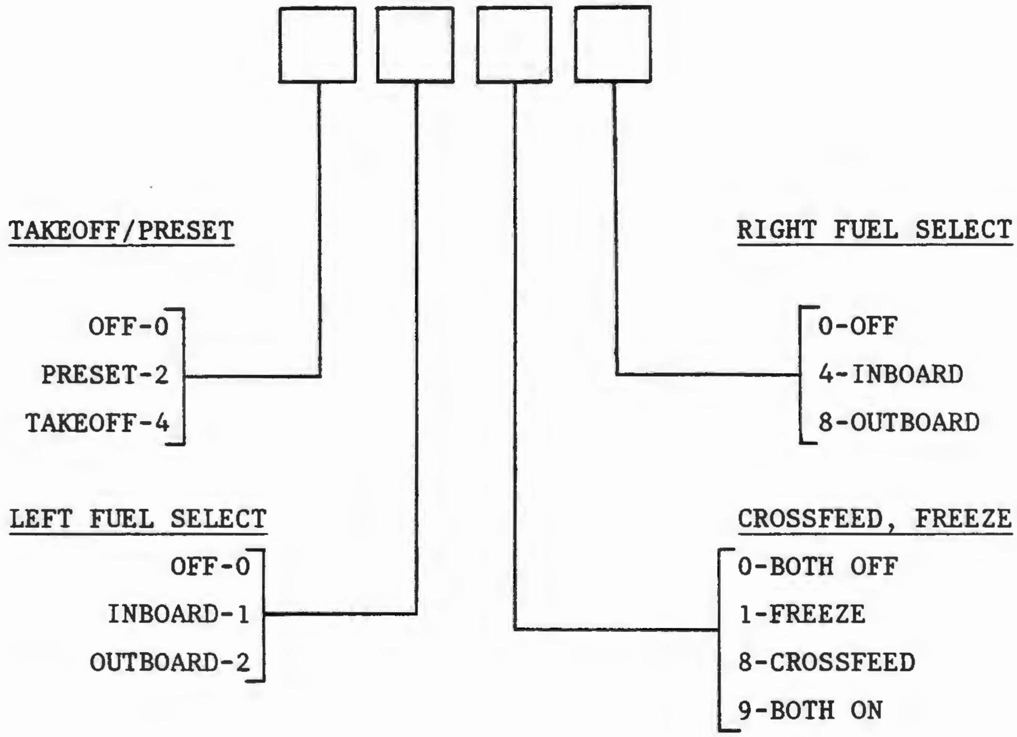
TURN TRANSPONDER TO STANDBY!

Turn all Audio Control Panel switches OFF except ADF and MKR. Reset by pushing IDENT and F.I.S., unit should go to DIAG. 5. Turn all audio switches OFF.

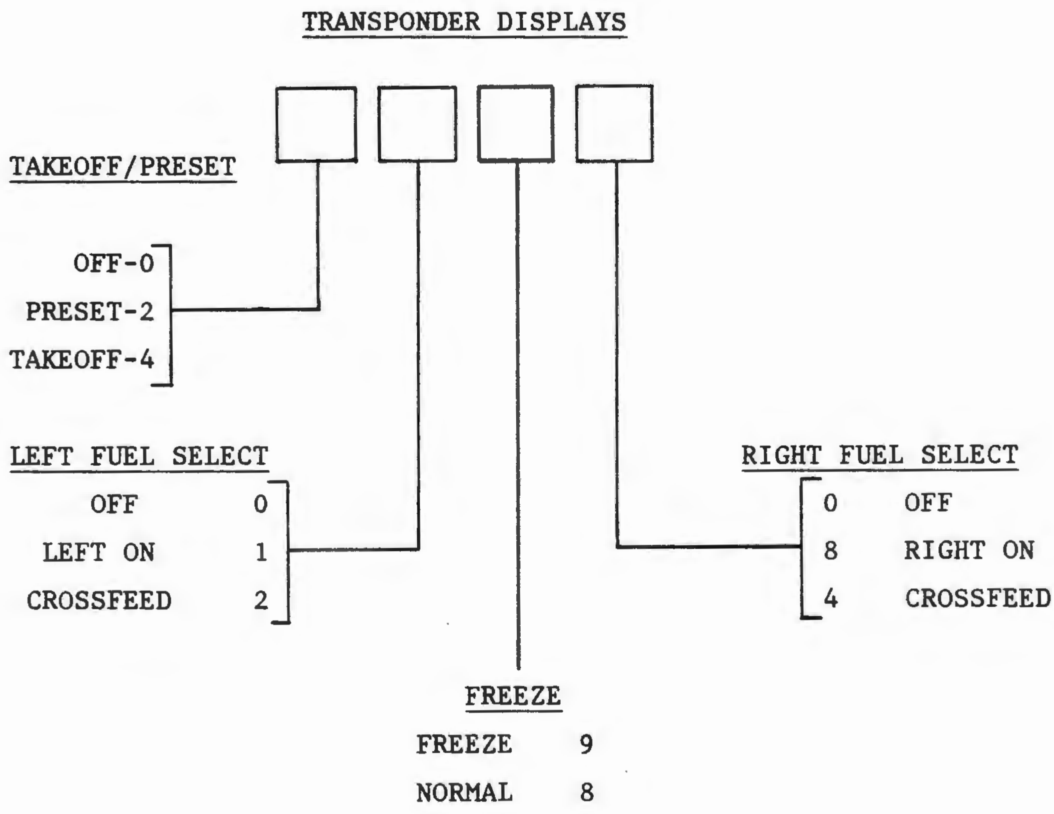
OPERATE PRESET/TAKEOFF,
LEFT ENGINE FUEL SELECT,
RIGHT ENGINE FUEL SELECT,
CROSSFEED, and FREEZE.

Verify that each switch affects one transponder display as shown below - and no other.

TRANSPONDER DISPLAYS



"B" FUEL MANAGEMENT SYSTEM



"C" FUEL MANAGEMENT SYSTEM

TRANSPONDER DISPLAYS

TAKEOFF/PRESET

OFF-0
PRESET-2
TAKEOFF-4

LEFT FUEL SELECT

LEFT ENG OFF	0
LEFT MAIN	1
RIGHT MAIN	2

RIGHT FUEL SELECT

0	RIGHT ENG. OFF
8	RIGHT MAIN
4	LEFT MAIN

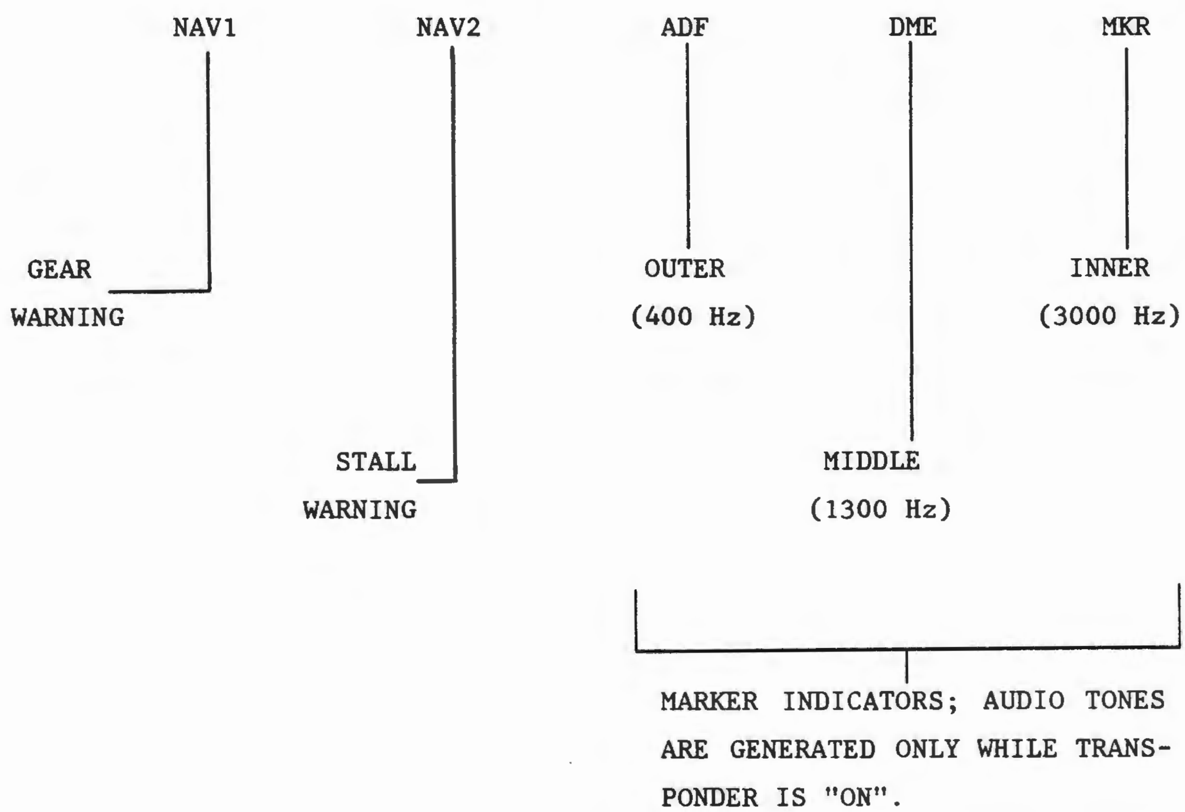
CROSSFEED FREEZE

CROSSFEED DOWN	FREEZE	9
	NORMAL	8
CROSSFEED UP	FREEZE	1
	NORMAL	0

4.12 Diagnostic Test 6

Turn all Audio Control Panel switches OFF except ADF and DME. Reset by pushing IDENT and F.I.S.; unit should go to DIAG 6. Return all switches OFF.

Operate the Audio Panel switches as shown below, verifying that each switch causes the correct marker indicator or warning. Verify that when the transponder is "ON" the marker audio tones are generated as well.



4.13 Diagnostic Test 7

Turn all Audio Control Panel switches OFF except ADF, DME and MARKER. Reset by pushing IDENT and F.I.S., unit should go to DIAG 7. Return all switches OFF.

Operate the Audio Control Panel switches as shown below. Verify that the response of the HSI/CDI needles and flags are as shown (both instruments):

NAV1	NAV2	ADF	DME	MKR	HSI NAV FLAG	CD NEEDLE	TO/FROM FLAG	CDI GS FLAG	GS NEEDLE CDI (HSI)
0	0	0	X	0	ON	CENTER	CENTER	ON	CNTR (NOT VIZ)
0	0	0	X	1	ON	CENTER	TO	ON	CNTR (NOT VIZ)
0	0	1	X	1	ON	CENTER	TO	OFF	DOWN
0	1	1	X	1	OFF	RIGHT	TO	OFF	DOWN
0	1	1	X	0	OFF	RIGHT	FROM	OFF	DOWN

Operate the DME Select switch as well, and VERIFY DME displays as shown below:

					DME SELECT SWITCH	DME DISPLAY	
0	X	X	1	X	NAV1	11.1	
0	X	X	1	X	OFF		
0	X	X	1	X	NAV2	22.2	
0	X	X	0	X	NAV2	...	
0	X	X	0	X	NAV1	...	
1	X	X	1	X	NAV1	11.1	Operate "NAV1" toggle switch before "DME"
1	X	X	1	X	NAV2	...	

4.14 Diagnostic Tests 8 and 9

4.14.1 Turn OFF power to unit and extend the audio/transponder board. Turn power ON, turn all Audio Control Panel switches to the OFF position and reset by pushing IDENT and F.I.S., unit should go to DIAG 0. Turn NAV2 switch ON and reset again. Unit should go to DIAG 8. Return NAV2 switch OFF.

4.14.2 If your system includes a plotter, continue with steps 4.14.3 and 4.14.4. If no plotter, skip to 4.14.5.

4.14.3 Operate the "DME" Audio Control switch, the transponder code and the plotter scale switch and verify the corresponding DAC output.

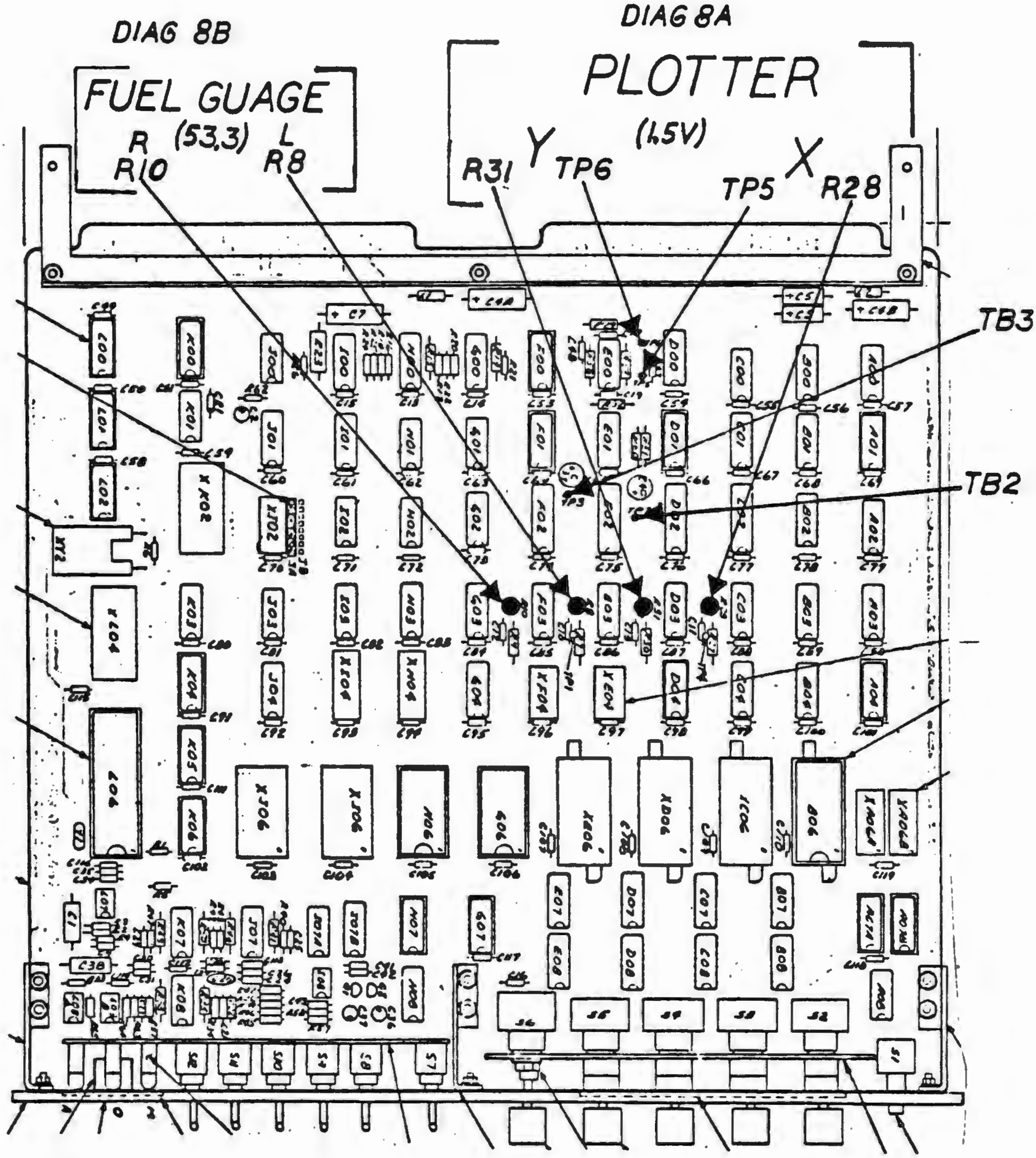
DME	MKR	TRANSPONDER CODE	PLOTTER SCALE	DAC OUTPUT (Measure with DVM) (TP5-X,TP6-Y)use Chassis GND	
0	0	0 0 0 0	15	0V ±30MV	
1	0	0 0 0 0	15	SEE Figure 4.2	R28 for X at TP5
0	0	1 7 7 7	10	1.5V ±10MV Adjust	R31 for Y at TP6
0	0	1 7 7 7	15	1.0V ±10MV OBSERVE	

4.14.4 Repeat last two steps until both scales are correct without further adjustment. Return DME switch to OFF.

4.14.5 Fuel Gauge Test

Set DAC values (transponder code, first three digits) as shown and verify fuel gauge readings as shown.

TRANSPONDER CODE	GAUGE READING	(GAL)
0 0 0 0	0	
3 6 0 0	53.3	Adjust full scale R10-right, R8-left for this reading. (See Figure 4.2)
0 5 5 0	10	± 3 GAL
1 3 2 0	20	± 3 GAL
2 0 7 0	30	± 3 GAL
2 6 4 0	40	± 3 GAL
3 4 1 0	50	± 3 GAL



51.662-0

Audio/Transponder

Figure 4.2

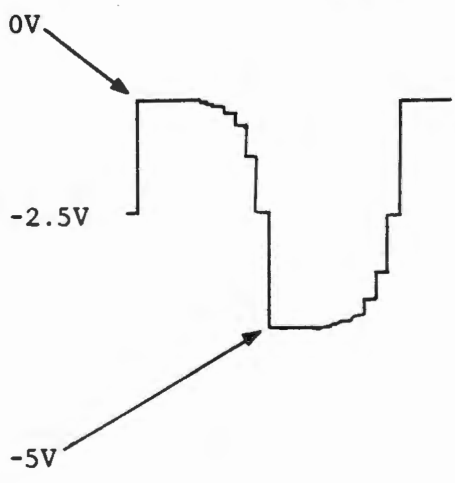
4.14.6 Airspeed/Altitude DAC Test

Turn OFF power to unit. Reinstall audio/transponder board. <u>Remove COM/ADF board</u> and jumper +5V to connector P6-17 on backplane. Extend NAV1 board. Turn power ON. Turn all Audio Control Panel switches to OFF and reset by pushing IDENT and F.I.S., unit should go to DIAG 0. Turn NAV2 switch ON and reset again. Unit should go to DIAG. 8.

Set Audio Control switches and DAC value (transponder code) as shown and verify DAC output voltage.

TRANSPONDER			ASCORR
DME	MKR	CODE	(P6-16)
0	0	0 0 0 0	0 ± .1V
0	0	3 7 7	-5 ± .25V
1	0	3 7 7	See Figure 4.3

Figure 4.3



CODE	OUTPUT (V)
200	-2.5
100	-1.25
040	- .75
020	- .38
010	- .19
004	- .09
002	- .05
001	- .02

NOTES:

1. All 8 steps can be seen (use scope - Put .01µf across scope input to filter noise).

2. Voltages are approximate. (This DAC is used for a small effect on speed with altitude.)

4.14.7 NAV1 CD/GS/T/F Test

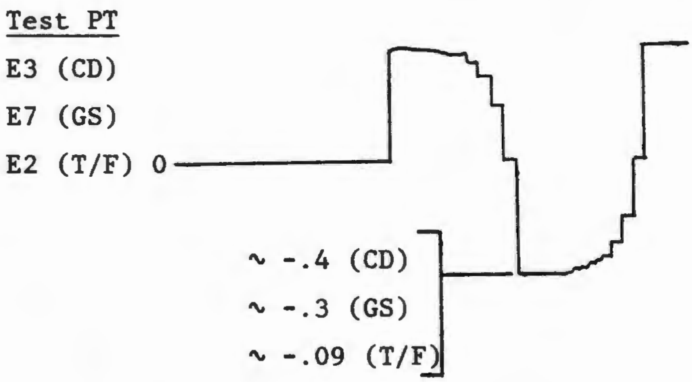
Unplug Meter, P8 (HSI).

Set Audio switches "DME" and "MKR" both OFF.

Set Transponder code to 0000.

Set "DME" switch ON and verify waveforms of Figure 4.4.

Figure 4.4 ON NAV1 BOARD



DAC waveforms with meter unplugged.

All 8 steps can be seen (use scope put .01µf across INPUT to filter noise).

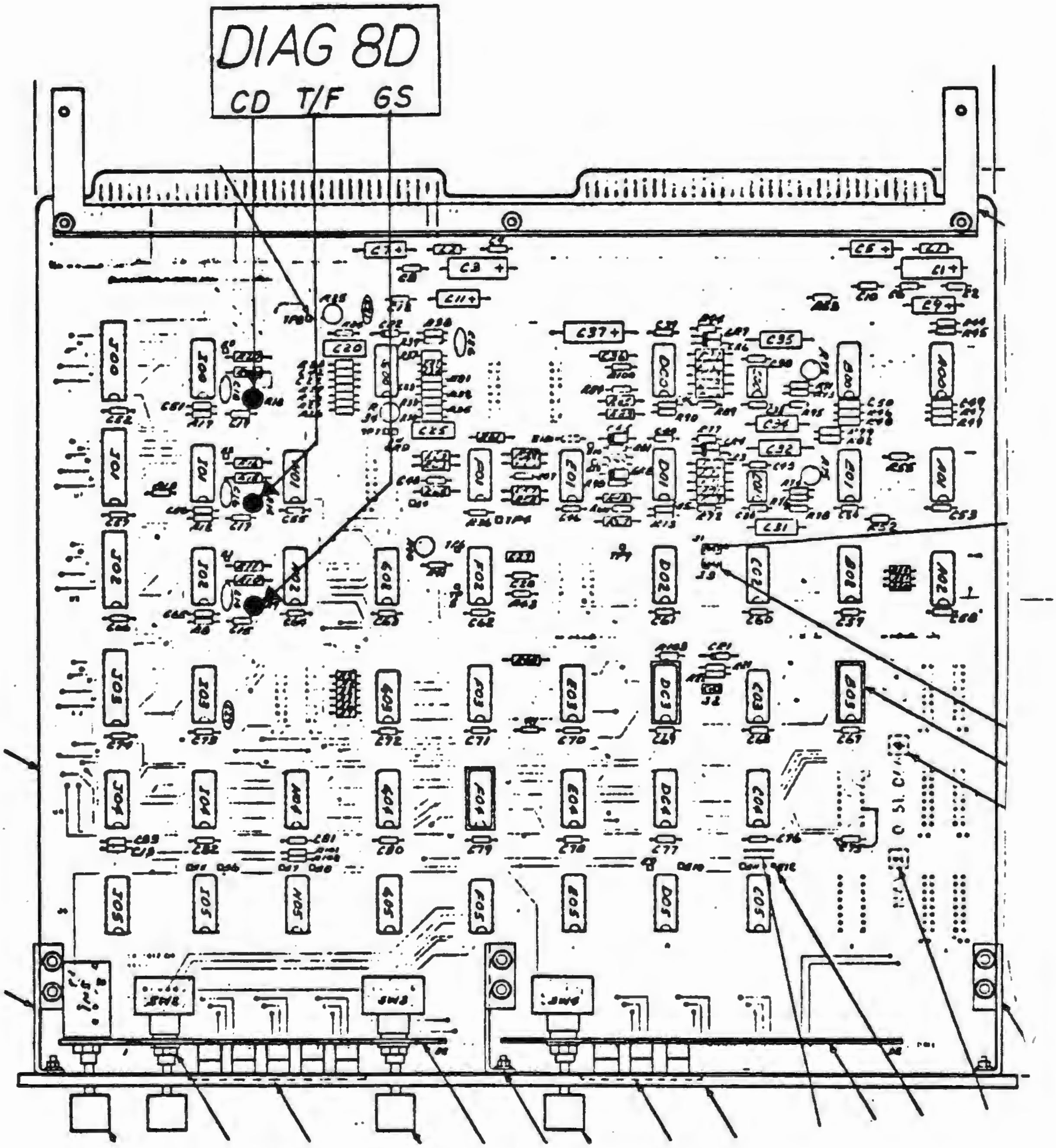
4.14.8 NAV1 CD/GS/T/F Adjust

Reinstall Meter P8

Set "DME" and "MKR" both OFF and transponder code to 2000.

Adjust pots on CD, GS and T/F DACS to center needles (flag).

Check calibration at other points on meter face by setting DAC values using transponder codes. (See Figure 4.5.)



51.664-0

NAV1/DME

Figure 4.5

	DOT ON METER FACE	R18 CDI/HSI CD DAC VALUE (±6 LSB)		R9 CDI GS DAC VALUE (±10 OCTAL)		HSI GS DAC VALUE (±)	
	4	L	0700	UP	0340		CD=R18
	3	L	1120	UP	0650		GS=R9
On	2	L	1340	UP	1160		T/F=R14
Jewell CDI,	1	L	1560	UP	1470		
Circle is	1	R	2220	DN.	2310		
first dot	2	R	2440	DN.	2620		
	3	R	2660	DN.	3130		
	4	R	3100	DN.	3440		

4.14.9 NAV1 Heading Adjust

4.14.9.1 Turn all Audio Control Panel switches OFF except NAV2 and MKR. Reset by pushing IDENT and F.I.S.; unit should go to DIAG 9. Return switches to OFF (ADF/RMI select in ADF position). (See Figure 4.6.)

4.14.9.2 Adjust R34 for 5 volts peak ±1V at TP7. (G00-1)

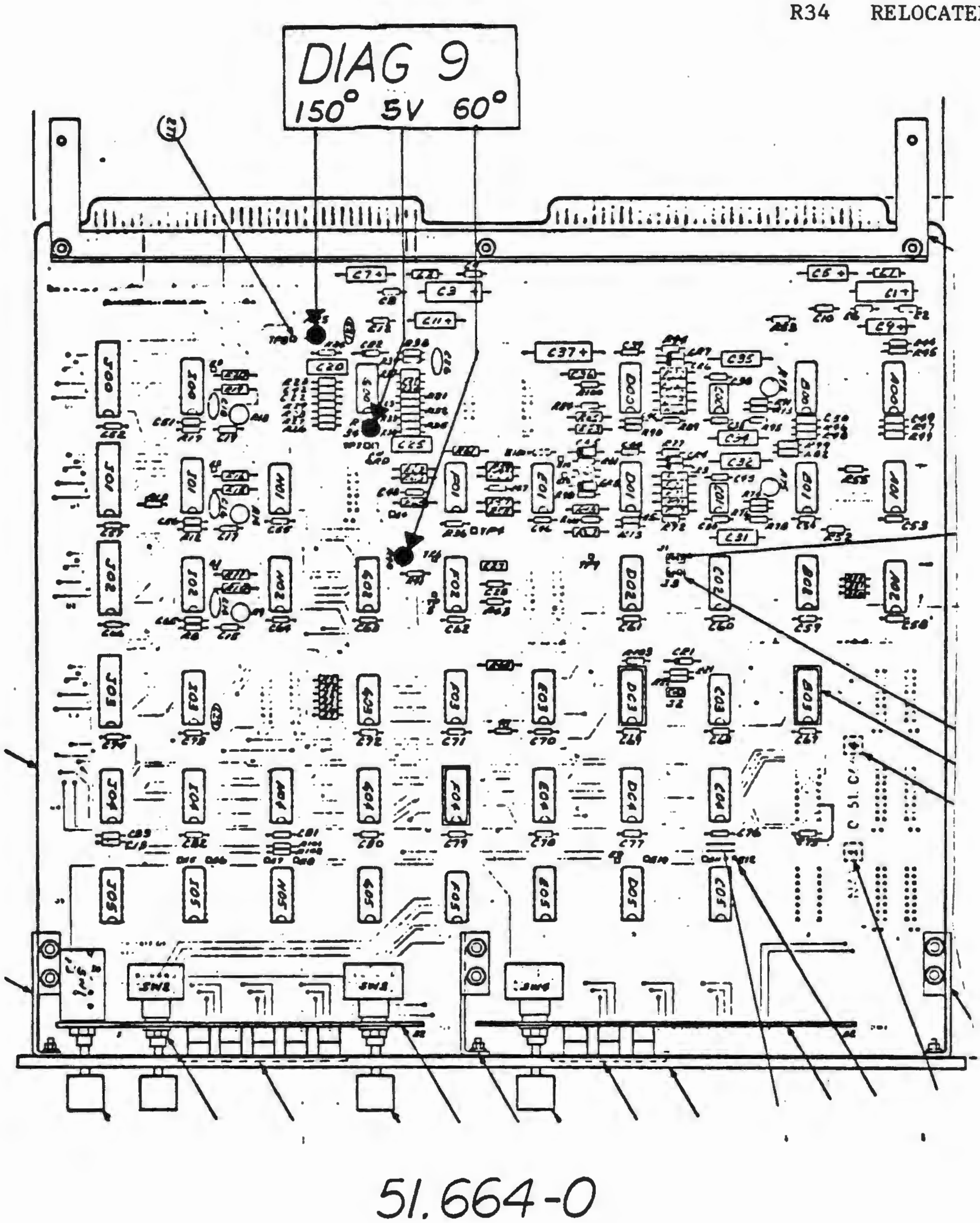
4.14.9.3 Select 60° heading on OBS. Set R40 for transponder display of 0060.

4.14.9.4 Select 150° heading on OBS. Set R25 for transponder display of 0150.

4.14.9.5 Iterate until both 60° and 150° are OK without further adjustment.

4.14.9.6 Use the OBS knob to select various headings around the dial. Verify that the indicated heading matches that shown in the transponder displays ±3 degrees.

UNITS 177 AND UP,
R34 RELOCATED



NAV1/DME

Figure 4.6

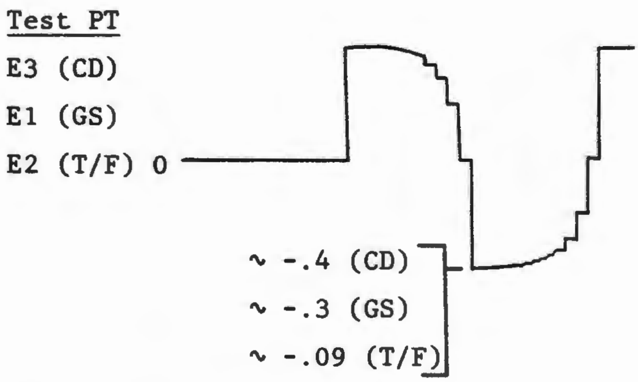
4.14.10 NAV2 CD/GS/T/F Test

4.14.10.1 Turn OFF power to unit. Reinstall NAV1 Board and put NAV2 Board on extender. Turn power ON. Turn all Audio Control panel switches OFF and reset by pushing IDENT and F.I.S., unit should go to DIAG 0. Switch NAV2 switch ON and reset. Unit should go to DIAG 8. Unplug meter P9, and return NAV2 switch to the OFF position.

4.14.10.2 Set transponder code to 0000.

4.14.10.3 Set "DME" SW. ON and verify waveforms of Figure 4.7.

Figure 4.7



DAC waveforms with meter unplugged.
All 8 steps can be seen (use scope, put .01µf across Y input to ground to filter noise).

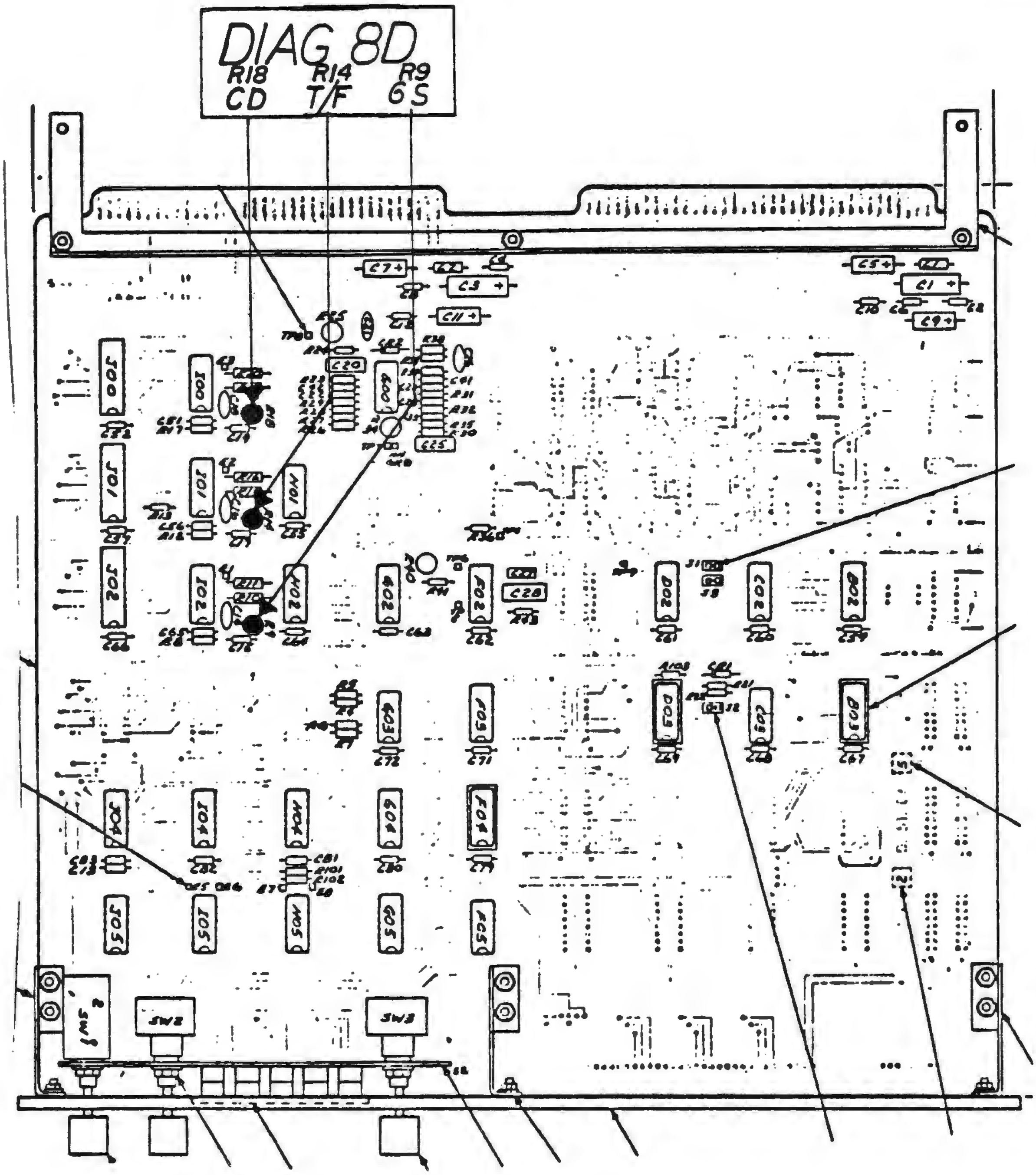
4.14.10.4 Reinstall Meter P9

4.14.11 NAV2 CD/GS/T/F Adjust

Set "DME" and "MKR" both OFF and transponder code to 2000.
Adjust pots on CD, GS and T/F DACS to center needles (flag). (See Figure 4.8.)

UNITS 177 AND UP

R34 RELOCATED



51.665-0

NAV2

Figure 4.8

Check calibration at other points on meter face.

	DOT ON METER FACE	R18 CDI/HSI CD DAC VALUE (±6 LSB)		R9 CDI GS DAC VALUE (±10 OCTAL)		HSI GS DAC VALUE (±)	
	4	L	0700	UP	0340		CD=R18
	3	L	1120	UP	0650		GS=R9
On	2	L	1340	UP	1160		T/F=R14
Jewell CDI,	1	L	1560	UP	1470		
Circle is	1	R	2220	DN.	2310		
first dot	2	R	2440	DN.	2620		
	3	R	2660	DN.	3130		
	4	R	3100	DN.	3440		

4.14.12 NAV2 Heading Adjust

Turn all Audio Control Panel switches OFF except NAV2 and MKR. Reset by pushing IDENT and F.I.S., unit should go to DIAG 9. Return switches to OFF position. Set MKR switch ON.

Adjust R34 for 5 volts peak ±1V at TP7 on NAV2 Board. (See Figure 4.9.)

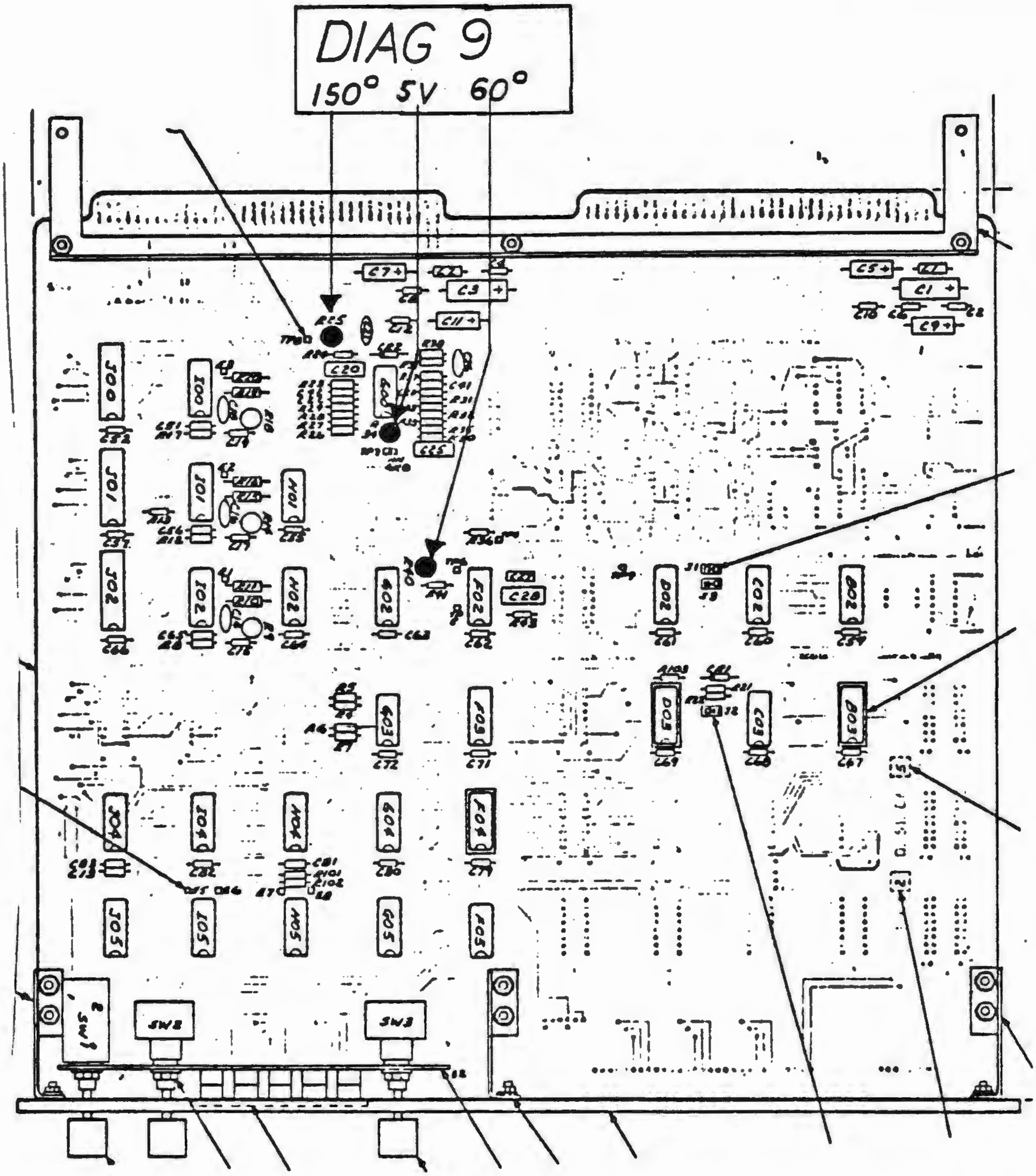
Select 60° heading on OBS.
Set R40 for transponder display of 0060.

Select 150° heading on OBS.
Set R25 for transponder display of 0150.

Iterate until both 60° and 150° are OK without further adjustment.

Use the OBS knob to select various headings around the dial. Verify that the indicated heading matches that shown in the transponder displays ±3 degrees.

UNITS 177 AND UP
R34 RELOCATED



51.665-0

NAV2

Figure 4.9

4.14.13 This completes diagnostic tests and adjustments 8 and 9. Restore the machine state as follows:

a. Turn Keylock switch OFF
b. Remove jumper from P6-3 to P6-17
c. Remove jumper from P1-1 to P1-71
d. Reinstall NAV2 board.

4.15 Diagnostic Test 10

This test checks several of the counters in the unit by incrementing or decrementing the counter value, then transferring each value to the transponder display. It is not necessary to read each value; just verify that the counter is increasing or decreasing, and can be "frozen" by the MKR switch.

4.15.1 Assure power is OFF.

4.15.2 Remove COM/ADF board and NAV1/DME board.

4.15.3 Install Test Jumper Plug set TF 1257 across P1, connecting the pins as marked.

4.15.4 Turn Keylock switch ON.

4.15.5 Turn all Audio Panel switches OFF.

4.15.6 Press IDENT and F.I.S. switches together to reset unit.

4.15.7 Switch NAV2 and DME Audio Panel switches ON.

4.15.8 Press IDENT and F.I.S again, unit should go to DIAG 10.

4.15.9 Now operate the Audio Panel switches in accordance with the following table, and observe the transponder display.

NAV1	NAV2	ADF	DME	MKR	TRANSPONDER DISPLAY	COUNTER IN TEST
		X	0	0	COUNTS UP (00-63, 3pps)	
0	0	X	1	0	COUNTS DOWN	X
		X	X	1	HOLDS PRESENT COUNT	
		X	0	0	COUNTS UP (00-63, 3pps)	
0	1	X	1	0	COUNTS DOWN	Y
		X	X	1	HOLDS PRESENT COUNT	
		0	0	0	COUNTS UP (00-15,.75pps)	
		1	0	0	HOLDS PRESENT COUNT	ALTITUDE
1	0	X	1	0	COUNTS DOWN	
		X	X	1	HOLDS PRESENT COUNT	
		X	0	0	COUNTS UP (00-15,.75pps)	
1	1	X	1	0	COUNTS DOWN	HEADING
		X	X	1	HOLDS PRESENT COUNT	

Depress "FIELD IN SIGHT" button. Lamp should light when Audio Switch "DME" is OFF and should be dark when the switch is ON.

4.15.10 This completes Diagnostic 10.

4.16 Diagnostic Test 12

Diagnostic 11 is performed later. This procedure checks the voltage-to-frequency converters.

4.16.1 Turn Keylock switch OFF.

4.16.2 Remove Rudder connector (at bottom of backplane, near center).

4.16.3 Remove Test Jumper Plug set TF1257.

4.16.4 Reinstall jumper from P1-1 to P1-71.

4.16.5 Reinstall NAV1 board.

4.16.6 Install extender in COM/ADF position, and put COM/ADF board on extender.

4.16.7 Locate and remove the following jumpers on COM/ADF board:

a. J5
b. J6
c. J7

4.16.8 Use the four-terminal jumper wire set to connect the following terminals together (see Figure 4.10):

a. TP2
b. TP1
c. J5 (side toward R260)
d. J7 (side toward R179)

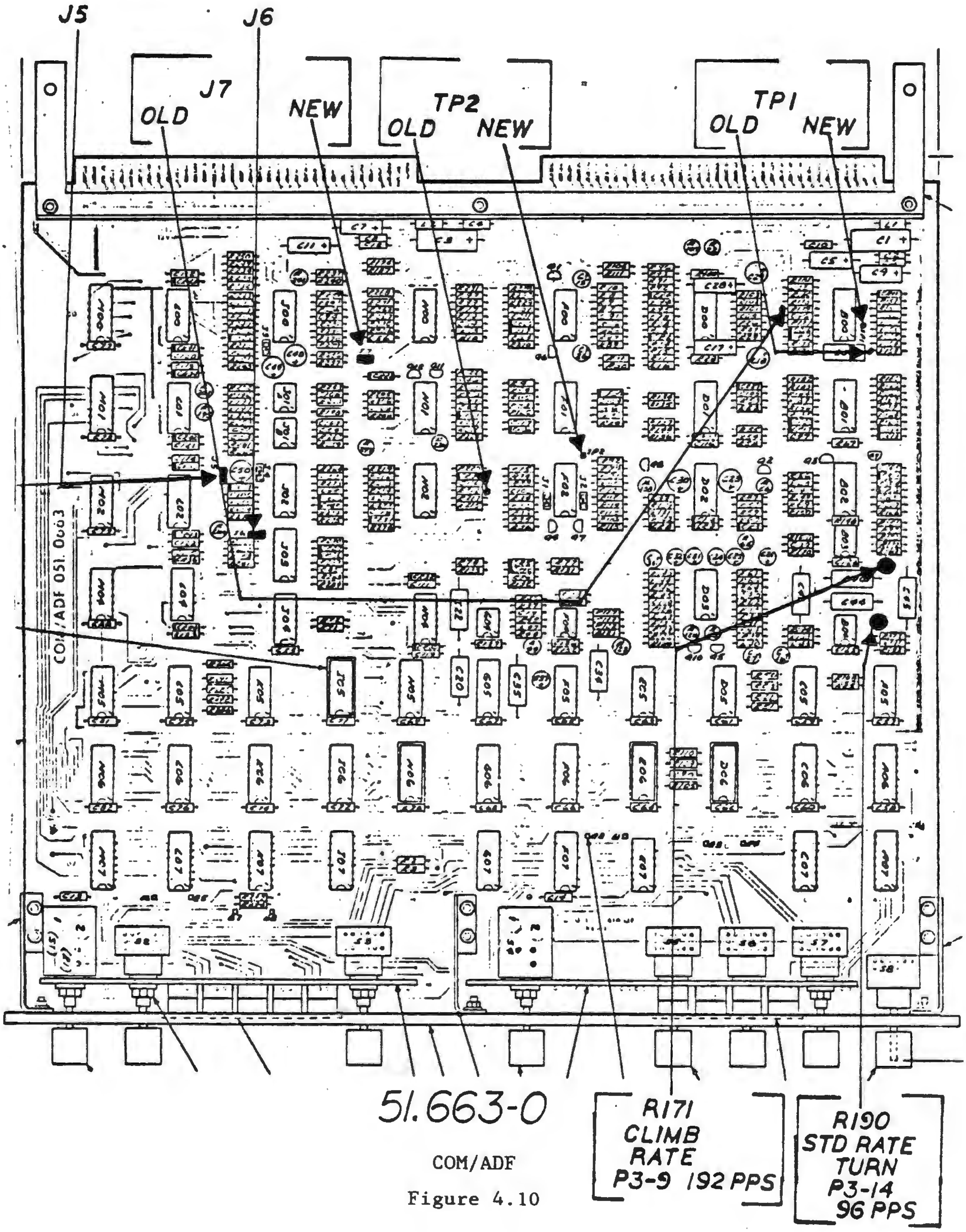
4.16.9 Set WIND VELOCITY control on fault panel to 0.

4.16.10 Turn Keylock switch ON.

4.16.11 Set all Audio Panel switches OFF, and press IDENT and F.I.S. to reset unit.

4.16.12 Set Audio Panel switches NAV2 and ADF ON, then press IDENT and F.I.S. again to select diagnostic 12.

4.16.13 The jumper changes made in steps 4.16.7 and 4.16.8 allow the ROLL TRIM wheel to control vertical speed, airspeed and the turn coordinator (the removal of J6 defeats the "stall" circuit).



COM/ADF

Figure 4.10

4.16.14 Connect one end of a Jumper wire to P8-34. This pin is used as a counter input by the microprocessor for this test.

4.16.15 Use the ROLL TRIM wheel to set the analog indicator (VSI or TURN COORDINATOR) to the value below; connect the free end of the jumper as indicated, and adjust the trim pot for the correct transponder display: See Figure 4.10a.

V/F CONVERTER	OUTPUT (TOP8-34)	TEST CONDITIONS	POT	(CARD)	FREQ. ±1 DIGIT)
ALT RATE	P3-9	CLIMB RATE = 1000 FPM	R171	(COM/ADF)	192
HDG RATE	P3-14	STD RATE TURN (R)	R190	(COM/ADF)	96

4.16.16 This completes diagnostic 12.

4.16.17 Turn Keylock switch OFF.

4.16.18 Remove the four-terminal jumper set.

4.16.19 Reinstall jumper J5, J6 and J7.

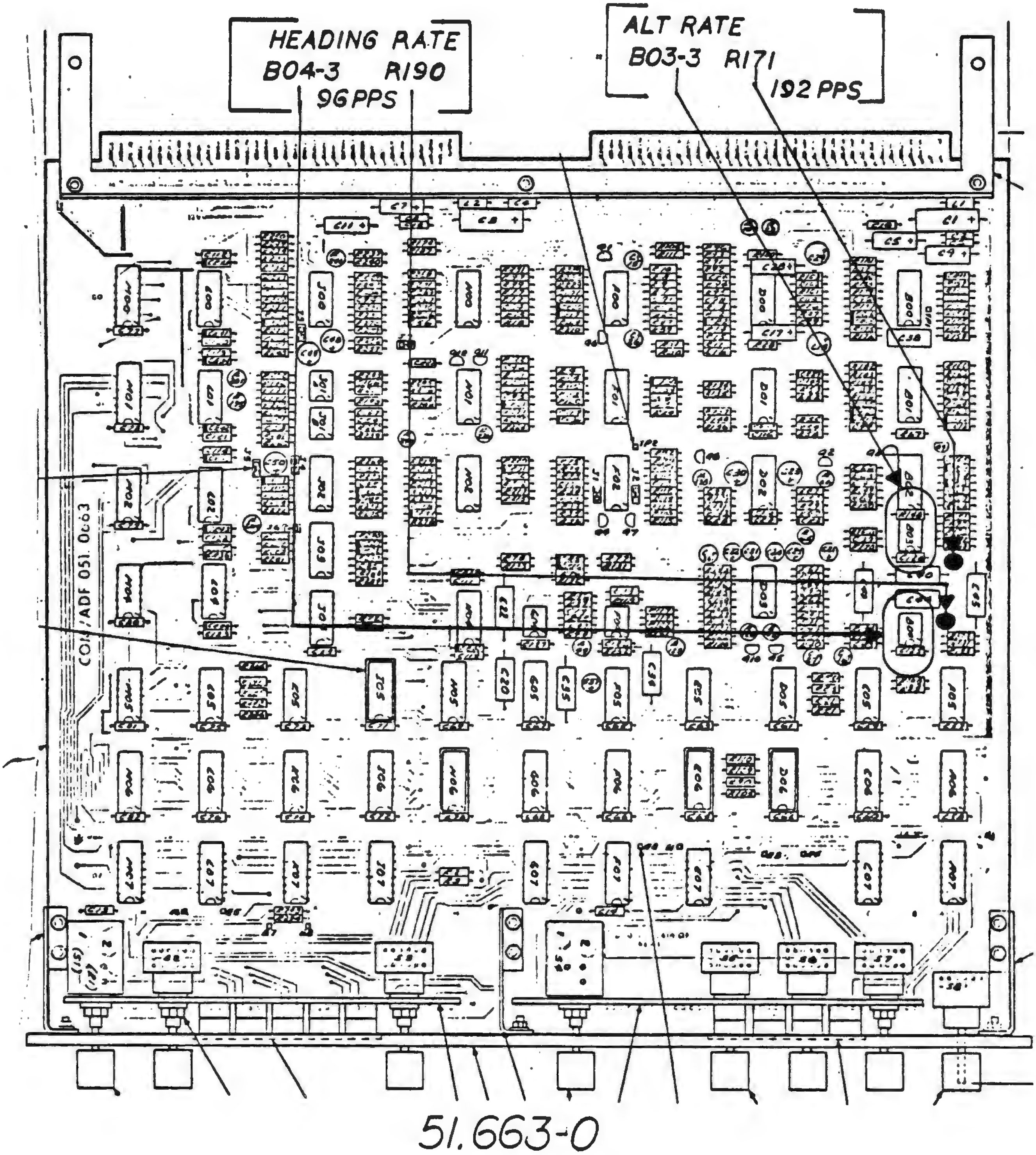
4.17 Diagnostic Test 15

This diagnostic tests the fuel pressure indicators.

4.17.1 Turn Keylock switch ON.

4.17.2 Turn all Audio Control Panel switches OFF except NAV2, ADF, DME and MKR. Reset by pushing IDENT and F.I.S., unit should go to DIAG 15.

4.17.3 Return all control panel switches OFF. Right and left fuel pressure reads 0. Switch DME ON. Left fuel pressure reads > 30psi. Switch NAV2 ON, DME OFF. Right fuel pressure > 30psi. Switch DME ON. Right and left fuel pressure > 30psi.



COM/ADF

Figure 4.10a

4.18 Diagnostic Test 11

This diagnostic is used to verify smooth mechanical operation of the altimeter and the various heading indicators. Steps 4.18.10 through 4.18.19 may be used to resynchronize the magnetic compass with the VOR/HSI indicators if this becomes necessary.

4.18.2 On Audio Control Panel, turn all switches OFF except NAV2, DME and MKR. Reset by pushing IDENT and F.I.S.; unit should go to DIAG. 11.

4.18.3 Set Audio switches and rotate the OBS knob ≈ 45° in the direction indicated. Verify altimeter, ADF needle and heading (compass and compass rose) movement shown:

NAV2	ADF	DME	MKR	(NAV2) OBS	INSTRUMENT MOVEMENT
X	0	0	1	↻	RMI NEEDLE CW
				↺	RMI NEEDLE CCW
0	0	1	0	X	HEADING DOESN'T MOVE
1	0	1	0	↻	HEADING ANGLE INCREASES
				↺	HEADING ANGLE DECREASES
0	1	0	0	X	ALTIMETER DOESN'T MOVE
1	1	0	0	↻	ALTITUDE INCREASES
				↺	ALTITUDE DECREASES

4.18.4 For each instrument in the list below, perform steps 4.18.5 through 4.18.9.

	ALTIMETER ("ADF" SW)
	RMI NEEDLE ("MKR" SW)
(These may not agree on heading angle)	RMI COMPASS ROSE ("DME" SW)
	HSI (or HI) COMPASS ROSE
	MAGNETIC COMPASS ("DME" SW)

4.18.5 Turn on Audio Control switch specified and "NAV2." Use OBS knob to set instrument pointer to a convenient starting point (north on compass, for example).

** Take note of direction of motor movement to reach starting point.

4.18.6 Turn OFF all Audio Control switches. Transponder display goes to 0000.

4.18.7 Turn ON "NAV2" and other specified Audio switch. Use OBS knob to move instrument motor...

** in same direction as noted in step 4.18.5 to minimize effects of gear backlash on results

.. thru several revolutions at varying speeds the transponder display is counting pulses issued.

4.18.8 Stop the motor when the count is at some increment of 1440 pulses (see table below) and verify the instrument pointer is at its starting position. There should be no noticeable misalignment.

4.18.9 Establish a new starting point, but approach from the other direction. Then repeat test in this direction.

	COUNT (ON TRANSPONDER DISPLAY)		
REVOLUTIONS	UP	DOWN	
1	1440	8560	
2	2880	7120	
3	4320	5680	
4	5760	4240	
5	7200	2800	
6	8640	1360	
7	0080	9920	SECOND TIME AROUND ON COUNTER
8	1520	8480	
9	2960	7040	
10	4400	5600	

4.18.10 Set "NAV2" and other Audio Control switch specified below and operate the OBS in the direction indicated. As the instrument nears its "home" position (go slowly), stop when the specified marker indicator first lights. (The magnetic sensor has been detected.)

Verify instrument position shown.

	INSTRUMENT	POSITION	AOM	
ADF	Altimeter	0 ± 5 feet	A	NOTE All 3 compass indicators may not agree.
DME	RMI Compass	NORTH ±2°	0	
MKR	RMI Needle	TICMARK±2°	M	

4.18.11 Set "NAV2" and "DME" Audio Control switches and use OBS knobs to drive compass(es).

4.18.12 Drive compass until "YCOMPS" (P6-12) is at its maximum positive voltage. (Use DVM.) P2-12

4.18.13 Fine-tune by monitoring XCOMPS (P6-11) and moving compass until it is ØV ± 30MV.

** Note direction of final motor steps **

4.18.14 The compass follower pot is now at north. If the magnetic compass dial does not agree, loosen set screw and move the dial.

4.18.15 Disconnect magnetic compass (M18).

4.18.16 Drive HI (or HSI) compass rose until it reads north. Approach from same direction as in step 4.18.13 above.

4.18.17 Disconnect HI (M5) [or HSI (M8)].

4.18.18 Drive RMI compass rose until it reads north. Approach from same direction as in step 4.18.13 above.

4.18.19 Reconnect compass and HI (or HSI).

4.19 Engine Fuel Flow and Flight Dynamics Tests and Adjustments

4.19.1 Perform the following engine operation adjustments for left and right engines.

4.19.1.1 Remove jumper at P1-71.

4.19.1.2 Turn both mags ON.

4.19.1.3 Push throttles full forward.

4.19.1.4 Push prop. controls full forward.

4.19.1.5 Push mix. controls full forward.

4.19.1.6 Pull parking brake ON (air speed = 0).

4.19.1.7 Prop. speed governor centered on fault panel.

4.19.2 (M.P. Adjust)

(See Figure 4.11)

4.19.2.1 Start engines.

4.19.2.2 Adjust R42(L) for an indication of 43 inches of manifold pressure on the left gauge.

4.19.2.3 Adjust R128(R) for an indication of 43 inches of manifold pressure on the right gauge.

4.19.2.4 Adjust EGT to 1400°F

4.19.2.5 Adjust oil pressure to 85 psi using the instructor fault panel.

4.19.3 (RPM Low)

(See Figure 4.11)

4.19.3.1 Pull throttles full aft.

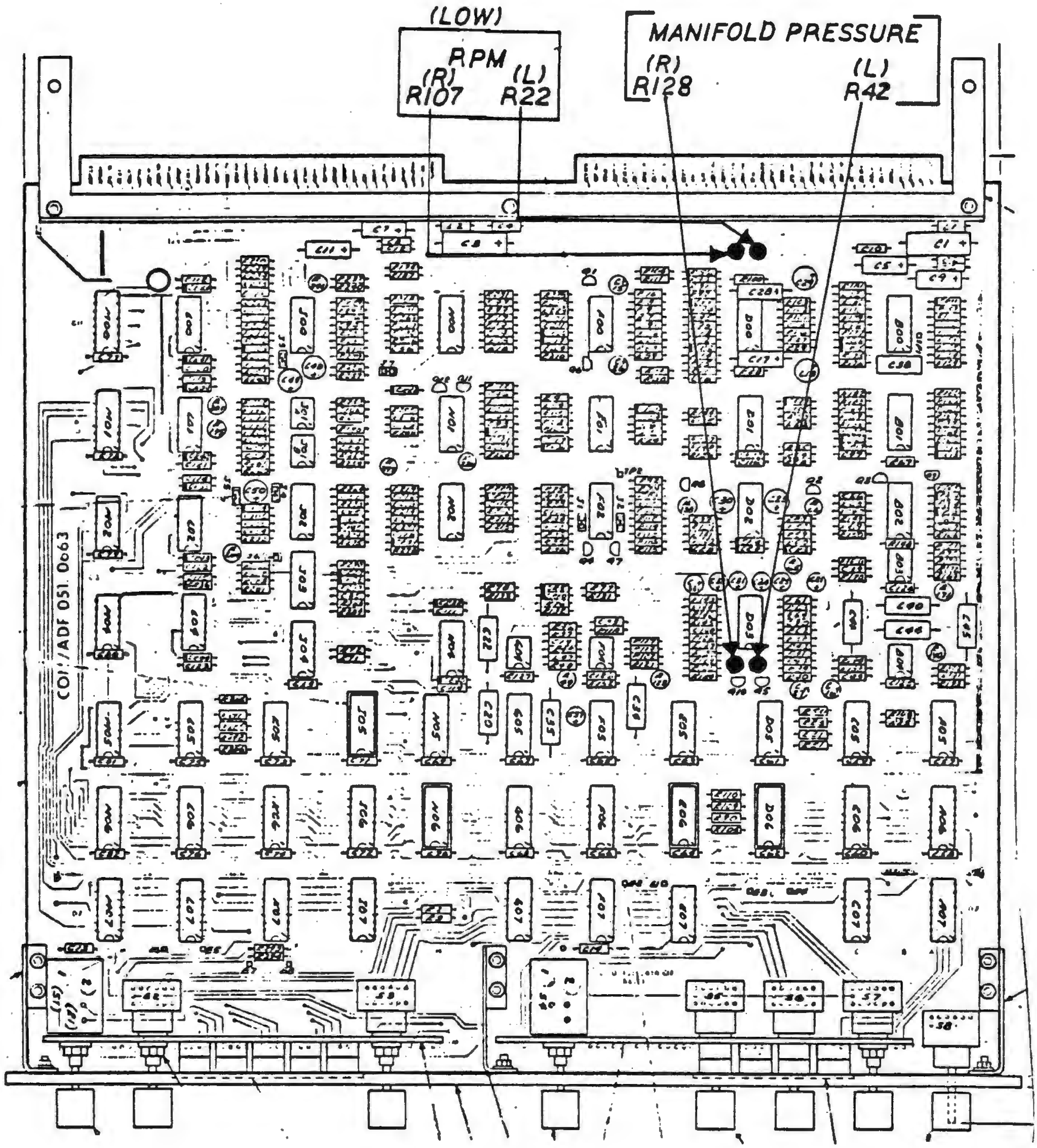
4.19.3.2 Adjust R22(L) for an indication of 600 RPM on the left RPM gauge.

4.19.3.3 Adjust R107(R) for an indication of 600 RPM on the right RPM gauge.

4.19.4 (RPM High Adjust)

(See Figure 4.12)

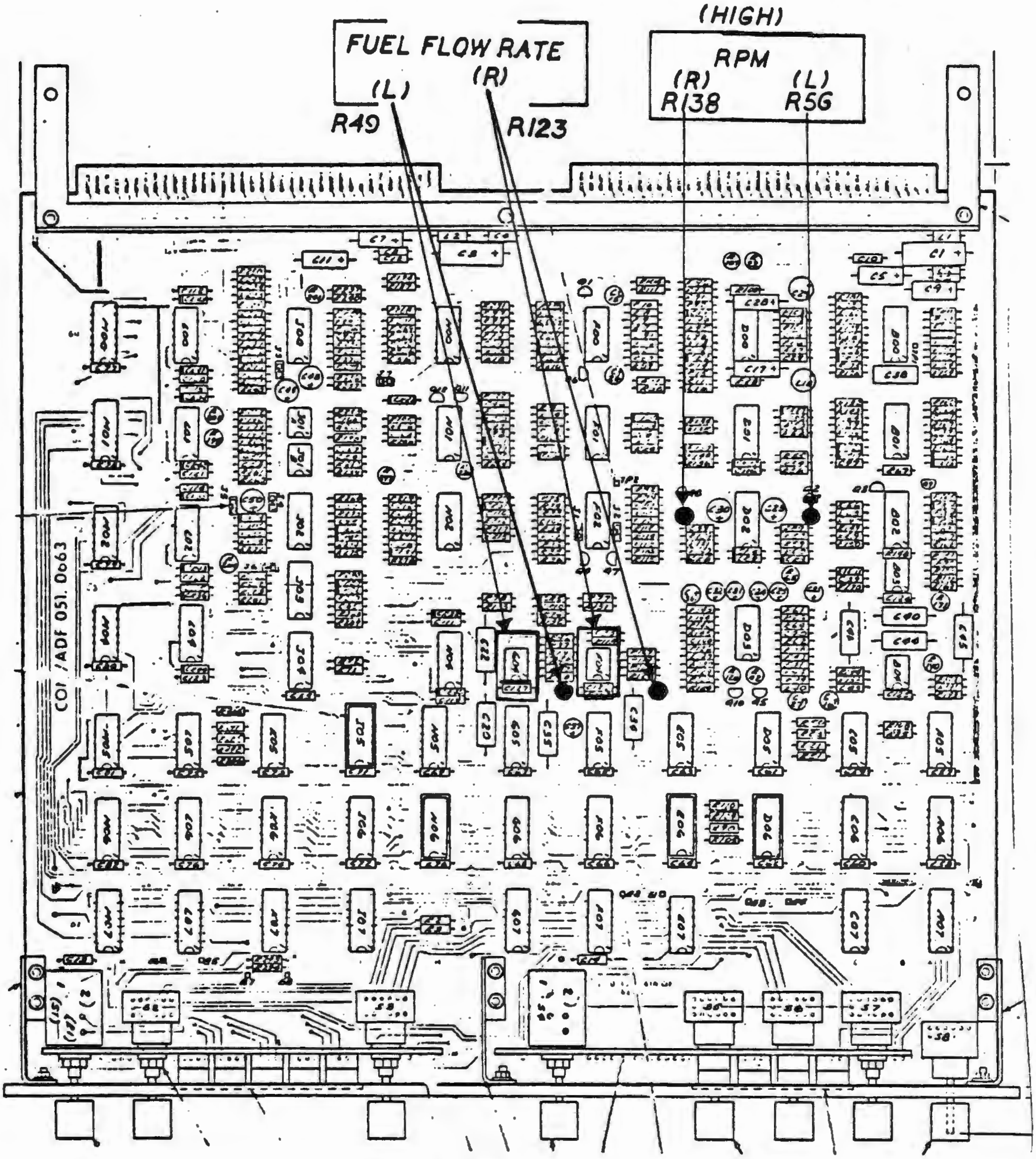
4.19.4.1 Push throttles full forward.



51.663-0

COM/ADF

Figure 4.11



51.663-0

COM/ADF

Figure 4.12

4.19.4.2 Adjust R56(L) for an indication of 2575 on the left RPM gauge.

4.19.4.3 Adjust 138(R) for an indication of 2575 on the right RPM gauge.

4.19.5 (Fuel Flow Rate Adjust)

4.19.5.1 <u>Without Fuel Flow Meter</u>

4.19.5.2 RPM and Mixtures full forward.

4.19.5.3 Set Throttles to 30 inches of manifold pressure.

4.19.5.4 Connect freq. Counter to G04-3 and adjust R49 to 320 Hz as indicated on the freq. counter.

4.19.5.5 Move freq. counter to F04-3 and adjust R123 to 320 Hz.

4.19.5.6 <u>With Fuel Flow Meter</u>

4.19.5.7 Both mags ON, prop and throttles full forward.

4.19.5.8 Prop speed governor control centered on fault panel, and airspeed at zero knots.

4.19.5.9 Adjust R4 (R10) to a reading of 255 lbs. per hour on respective fuel flow meters.

4.19.5.10 Set throttles to achieve an indicated fuel flow of 100 lbs. per hour on each engine.

4.19.5.11 Connect freq. counter to G04-3 (F04-3) and adjust R49 (R123) to 161 Hz. as indicated on freq. counter.

4.19.6 (Eng. Sound Adjust)

(See Figure 4.13)

4.19.6.1 Set throttles full forward.

4.19.6.2 Set prop. controls for a reading of 2200 on RPM meter.

4.19.6.3 Set engine audio at a suitable level; adjust R65 until audible sync is accomplished.

4.19.7 (Air Speed Adjust)

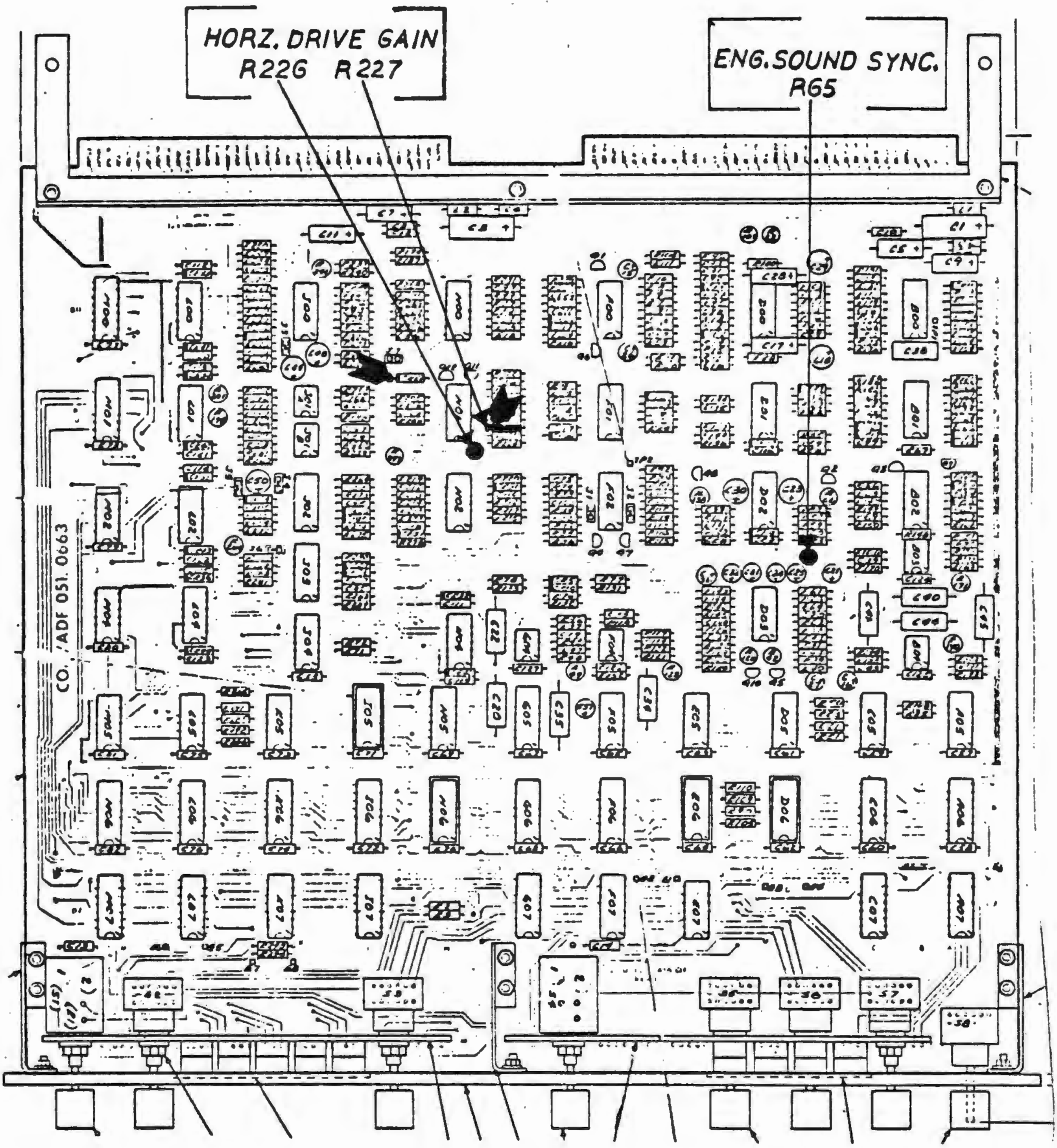
(See Figure 4.14)

4.19.7.1 Turn COM1 to 120.95.
XPDR to 1011.

4.19.7.2 Adjust power controls to achieve 31.5" M.P. and 2200 RPM. Set gear UP, cowl flaps closed, and flaps 0°.

4.19.7.3 Push PRESET. *If equipped with variable scale plotter option, follow preset instructions in Paragraph 4.25.

4.19.7.4 Maintain wings level and 0 FPM rate of climb.



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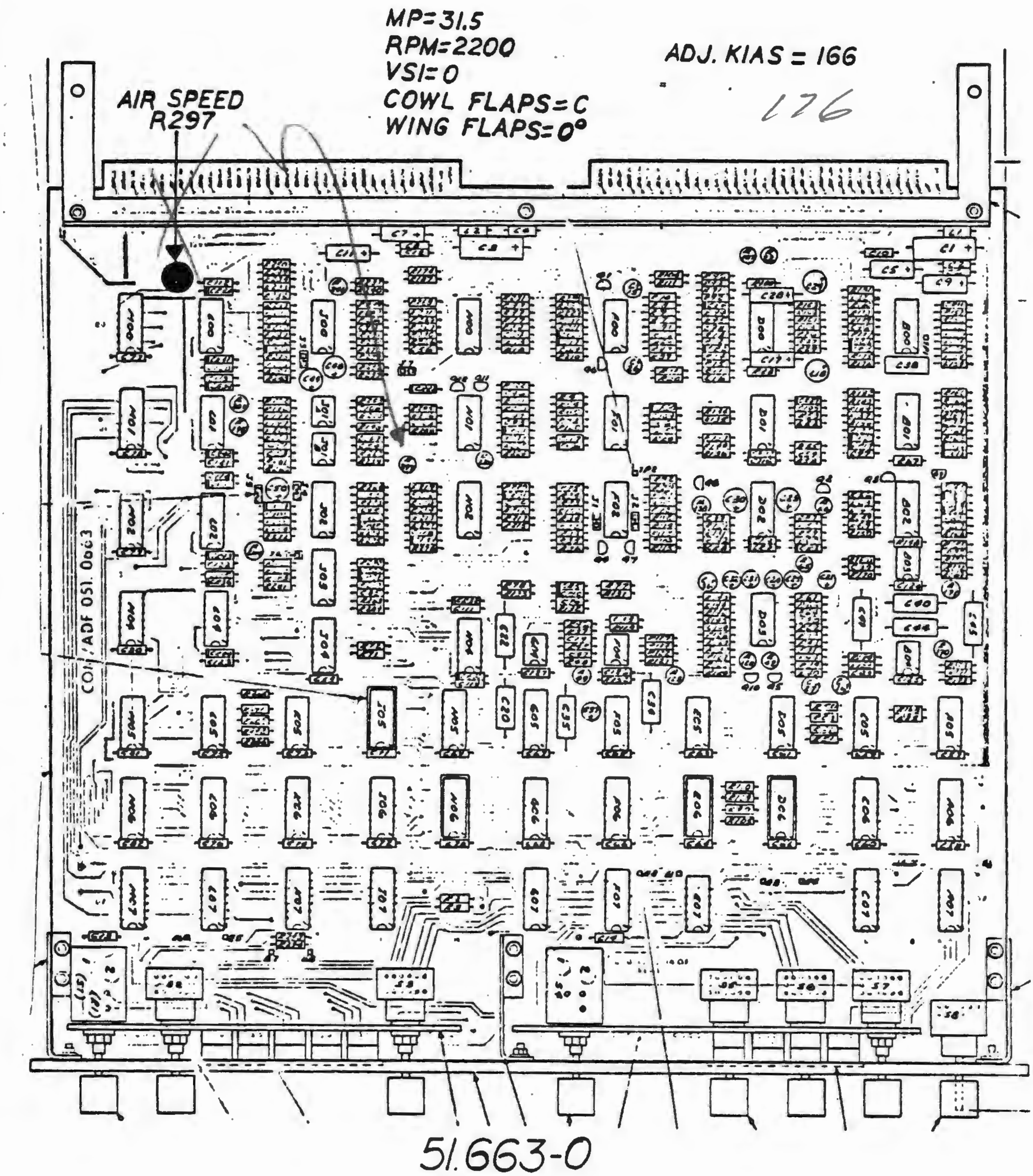
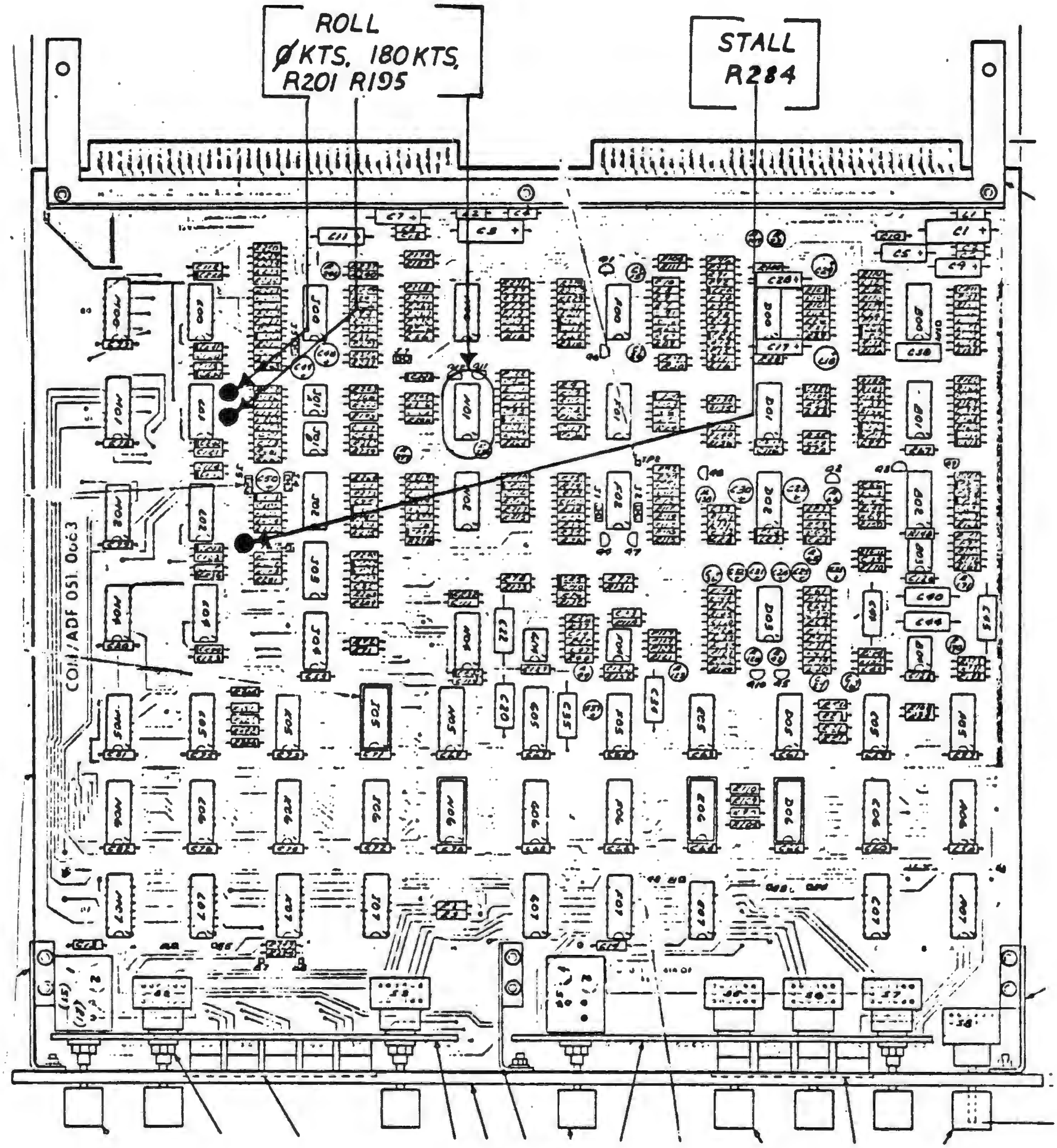
COM/ADF

Figure 4.13



COM/ADF

Figure 4.14



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COM/ADF

Figure 4.15

4.19.7.5 After achieving stable flight and 0 VSI, adjust R297 for 166 knots airspeed.

4.19.8 Roll Zero, Low and High Conditions

(See Figure 4.15)

4.19.8.1 Push TAKEOFF.

4.19.8.2 Attitude indicator showing wings level.

4.19.8.3 With airspeed at 180 knots adjust R201 for 0 at amp HOI Pin 8.

4.19.8.4 Push PRESET. *If equipped with variable scale plotter option, follow preset instructions in Paragraph 4.25.

4.19.8.5 With airspeed at 180 knots adjust R195 for 0 at the same point.

4.19.9 Stall Speed Conditions

(See Figure 4.15)

4.19.9.1 Flaps 0 degrees.

ADJ FOR 80

4.19.9.2 Adjust R284 until stall begins when indicated airspeed is 75 KIAS ± 1 KIAS.

90

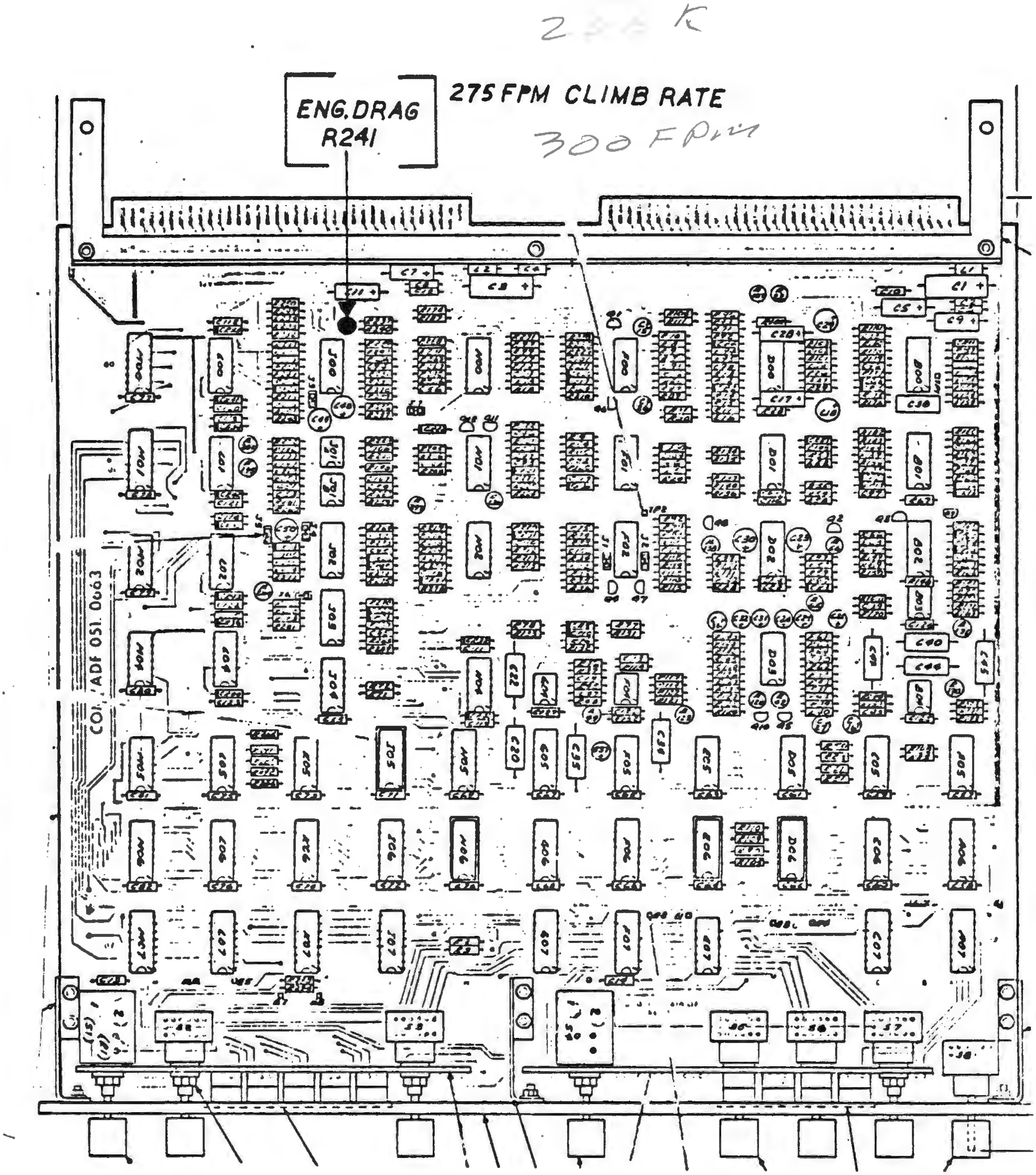
4.19.10 Single Engine Drag Conditions (See Figure 4.16)

4.19.10.1 One engine running at 2500 RPM and 41 inches manifold pressure, other engine feathered.

4.19.10.2 Landing gear UP, flaps 0 degrees.

4.19.10.3 Altitude approximately 100 ft.

4.19.10.4 Bank 5° toward running engine, airspeed 106 knots indicated.



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COM/ADF

Figure 4.16

4.19.10.5 Adjust R241 for 275 FPM climb rate.

4.20 System Fault Panel Functional Tests

KEYLOCK OFF.

KEYLOCK ON.

PARKING BRAKE Master Switch ON.

- Start engines.
- PROP. CONT. max RPM position.
- Mixture full RICH.
- Adjust throttle control for 1,000 RPM.
- Alternator CB L/R ON.
- Gear DOWN.

4.20.1 Annunciator Light Tests

- All pilot annunciator lights OUT.
- All instructor panel annunciator lights OUT.
- PUSH TO TEST, all annunciator lights ON.
- Press Instructor Fault Panel (IFP) NOSE/BAG annunciator light ON.
- NOSE/BAG DR AJAR annunciator light ON.
- Push OFF.
- Push CABIN DOOR IP light ON.
- Push OFF.
- Repeat with R PNEU INOP.
- Pull RIGHT BOOST PUMP CB.
- IP RIGHT BOOST annunciator light ON.
- R FUEL BOOST INOP light ON.
- Push CB IN.
- Push IP R LOW FUEL FLOW.
- R LOW FUEL FLOW light ON.
- Push light OFF.
- Push R ALT INOP IP light ON.

- R ALT INOP light ON.
- Push R ALTERNATOR PUSH TO TEST button.
- ALTERNATOR CURRENT less than 10 AMPS.
- Push R ALT INOP IP light OFF.
- Push L Alt INOP IP light ON.
- L ALT INOP light ON.
- Push L ALTERNATOR PUSH TO TEST button.
- ALTERNATOR CURRENT more than 10 Amps.
- Push L ALT INOP IP light OFF.
- Test L LOW FUEL FLOW IP annunciator light.
- Pull L BOOST PUMP CB.
- IP L BOOST annunciator light ON.
- L Fuel BOOST INOP light ON.
- Push L BOOST PUMP CB IN.
- Test L PNEU INOP IP light.
- Turn FLAPS ASYMMETRICAL IP control clockwise until FLAP IP annunciator light and FLAP annunciator light goes ON.
- Annunciator lights should go ON when control is between 2-3 o'clock.
- Turn IP FLAPS ASYMMETRICAL control CCW.
- Flap light should go ON when control is between 9-10 o'clock.
- Rotate FLAP control to NORM position.

4.20.2 Landing Gear Fault Mode

* IFP will mean Instructor Fault Panel

- Push IFP LANDING GEAR NOT UP switch.
- Push gear switch UP.
- NOT LOCKED UP red light will remain ON.
- Push IFP NOT UP switch to NORM.
- Red NOT LOCKED up gear light OFF.
- Push landing gear switch DOWN.
- Push IFP LANDING GEAR switch to NOT DOWN.
- Lower right green gear light goes OUT.

- Push IFP GEAR switch to NORM.
- Lower right gear light goes ON.

4.20.3 For the following tests, establish 55% Cruise with 31.5" MP, 2200 RPM, preset altitude to approximately 1,500, wings level, VSI 0 FPM.

- LDG GR UP.
- ALTERNATOR CB SWITCH L&R ON.
- PITOT HEAT OFF.
- Surface DEICE OFF.
- Cowl Flaps CLOSED.
- Flaps UP.
- Flight Mode Freeze.

4.20.4 Prop Speed Governor Control

- Turn LEFT control fully CW.
- Left RPM goes to 2500 to 3000 RPM.
- Turn LEFT control fully CCW.
- Left RPM goes to 1,500 to 2,000 RPM.
- Turn LEFT control to NORM.
- Repeat the test using the RIGHT GOVERNOR control.

4.20.5 Cylinder Head Temperature Control

- Turn LEFT control fully CW.
- CYL TEMP should stop at 440° ± 10°F.
- OIL TEMP should stop at 220° ± 10°F.
- Turn LEFT control fully CCW.
- CYL and OIL TEMP should go to 100° ± 20°F and 50° ± 10°F respectively.
- Turn LEFT control to NORM.
- Repeat the test using the RIGHT CYL HD control.

4.20.6 Oil Pressure Control

- Turn LEFT control to DEC.
- LEFT OIL press decreases to Ø PSI.
- Turn fully CCW to actuate switch.
- LEFT engine will fail.
- MP will drop to 10".
- RPM will remain at 2,200 RPM.
- Return LEFT OIL PRESSURE control to NORM position.
- Engine will restart.
- Repeat procedure for RIGHT ENGINE.

4.20.7 Fuel Boost Pressure

- Rotate LEFT control fully CCW.
- LEFT FUEL PRESSURE should drop approximately 8-10 psi.
- LEFT FUEL BOOST INOP annunciator light should light.
- Press ON LEFT FUEL PUMP switch.
- LEFT FUEL PRESSURE should increase 2-3 psi.
- Rotate LEFT control fully CW to NORM position.
- Repeat for RIGHT.

4.20.8 Gyro Pressure

- Rotate GYRO PRESS control fully CCW.
- GYRO PRESS gauge should drop to 3".
- Roate control fully CW.

4.20.9 Icing

- VSI should show 0 FPM.
- Rotate IP SURFACE control to MAX position.
- VSI descent rate should increase to 500 FPM ± 150 FPM.
- Actuate the SURFACE DEICE switch and VSI will go back to 0 FPM.

- Turn SURFACE DEICE switch OFF.
- Rotate IP SURFACE ICING control to OFF position.
- Rotate PITOT HEAT switch ON.
- Indicated airspeed will drop about 90KTS. ± 10 knots.
- Turn PITOT HEAT switch ON.
- Airspeed will return to initial speed.
- Turn PITOT HEAT OFF.
- Rotate PITOT HD ICING control to OFF.

4.20.10 Turbulence

- Turn TURBULENCE control to Position 2.
- Moderate ROLL and VSI changes should be observed.
  - VSI = UP/DOWN
  - ROLL = LEFT/RIGHT
- Turn to Position 5.
- More violent ROLL and VSI changes should occur.
- Rotate control to OFF position.

4.21 Radio Nav. Tests (Sandy Hook Special Airport VOR/LOC/ADF)

*If equipped with variable scale plotter option, follow preset instructions in Paragraph 4.25.

4.21.1 Map Selection 1

- Flight Mode Freeze.
- COM1 120.95.
- NAV1 108.05 (VOR).
- NAV2 108.05 (VOR).
- ADF 0200 (LOM).
- DME NAV1.
- TRANS 5050.
- Press Flt Mode SW to Takeoff.
- Transponder 0771-PRESET.

4.21.2 Establish Approach Speed

- MP 26".
- RPM 2200.
- Flaps 15°.
- Gear UP.
- VSI 0 FPM.
- Airspeed should be 125 KTS. ± 10 knots.
- Altitude 1500 feet.
- Turn to a 360° HDG by pushing FREEZE to NORM.
- When at 360° HDG push FREEZE.

4.21.3 VOR Indicator Check *If equipped with variable scale plotter option, follow preset instructions in Paragraph 4.25.

- XPDR 0111 (PRESET).
- HSI VOR/FROM 45 ± 6°.
- VOR/FROM IND within ±4° of HSI VOR reading.
- RMI VOR tail 45 ± 10°.
- XPDR 1111 (PRESET).
- HSI VOR/FROM 135 ± 6°.
- VOR/FROM IND ± 4° of HSI VOR.
- RMI VOR tail 135 ± 10°.
- XPDR 2111 (PRESET).
- DME 7.0 ± .2 NM.
- Repeat test for 225°.
- XPDR 3111 (PRESET).
- Repeat test for 315°.

4.21.4 ADF Indicator Test *If equipped with variable scale plotter option, follow preset instructions in Paragraph 4.25.

Switch RMI to ADF

- XPDR 1211 (PRESET).
- ADF arrow at 270 ± 10°.

- XPDR 1031 (PRESET).
- ADF arrow at 360 ± 10°.
- XPDR 2211 (PRESET).
- ADF arrow at 90 ± 10°.
- XPDR 0011 (PRESET).
- ADF arrow at 180 ± 10°.
- XPDR 0761 (PRESET).
- ADF arrow at 215 ± 10°.
- Establish a right standard rate turn on TURN COORDINATOR.
- TRIM for 0 VSI ± 100 FPM.
- PUSH FREEZE TO NORM.
- Make 360° TURN and note RMI ADF arrow should track within ±5° as the turn is made.
  Stop turn at 360°.

4.21.5 Glide Slope Approach Test *If equipped with variable scale plotter option, follow instructions in Paragraph 4.25.

XPDR 1021 PRESET

- RMI to ADF position.
- TURN MKR AUDIO toggle switch to UP position.
- NAV1 108.15 (SANDY HOOK ILS FREQ).
- HSI glide Slope Flag should just come into view on top side of Glide Slope indication within 10 secs.
- TURN HSI arrow to 360°.
- HSI LOC needle should be centered ±½ DOT.
- APPROACH SPEED set up should still be the same as in 35.1 above.
- Set Wind velocity to zero.
- NAV2 108.05 (SANDY HOOK VOR).
- DME NAV2 10.0 ± .5 NM.
- DME NAV1 10.0 ± .5 NM.
- PUSH FREEZE to NORM.
- KEEP HSI LOC needle centered and maintain 1500 ft. alt.

- GLIDE SLOPE indicator should smoothly move down from top "out of view" position at approximately NAV1 DME reading of 7.5 ± .5 NM.
- PUSH FREEZE and note DME reading.
- PUSH NORM and continue flying.
- When GLIDE SLOPE needle is almost down to ON G/S position (centered) PUSH landing GEAR switch DOWN.
- This should occur at about 6.3 DME ± .2 NM (with A/C altitude still at 1500' ± 20 ft.). The OM blue marker light should be heard and station passage should be indicated on the RMI/ADF by the needle swinging from 360° to 180° at 6.1 ± .2NM.
- With the GEAR DOWN a descent VSI of approximately 500 ± 200 should be indicated.
- Track the G/S down by making slight pitch and roll corrections with the control wheel.
- When the MM orange light and audio flash and sound PUSH THE FREEZE switch.
- Note the NAV 1 DME of 1.9 ± .2 NM.
- Push VERIFY FLD IN SIGHT button - button should light.
- Push FREEZE to NORM and continue down G/S.
- INNER marker (A) should briefly flash at about 1.2 ± .2 NM.
- TOUCH DOWN should occur at a DME NAV1 of 0 ± .2 NM at which time apply brake to decelerate A/C to stop.
- During the entire G/S approach until the MM light, the HSI LOC needle and G/S needles should have displayed smooth motion without sticking or erratic motion.
- Turn simulator KEYLOCK OFF.

4.22 Plotter Test (if applicable)

*If equipped with variable scale plotter option, follow preset instructions in Paragraph 4.25.

Connect Plotter to simulator

- TURN POWER SWITCH on plotter to ON.
- PUSH PLOTTER PEN switch UP.
- Put rectangular coordinate .1 inch graph paper on plotter.

Turn Simulator KEYLOCK ON

- Push NORM/FREEZE switch to FREEZE.
- Turn MAP Selector to 1.
- Push PLOTTER scale to 10 NM/in.
- COM1 120.95.
- Push TAKEOFF switch.
- Push PLOTTER PEN switch DOWN.
- Carefully align the bottom horizontal line on the graph paper so that it is parallel to the + and - alignment marks on the plotter. Simultaneously position the paper so the that pen point rests on an X/Y coordinate intersection.
- XPDR 0660 (PRESET).
- PEN should move 3.0 ± .05" to the right and 3.0 ± .05" up.
- Push PLOTTER SCALE TO 15 NM/IN.
- Pen will move to .5 ± .05" to the left of start point and .5 ± .05" down.
- Push PRESET.
- PEN should not move in X or Y but should lift UP for approximately 1 second then go down again.

4.23 Audio Headset Test

- Connect pilot's headset to Panel.
- Connect instructor's headset to Fault Panel.
- Turn KEYLOCK ON.
- The COM1 VOL Control controls the pilot headset volume.
- While the instructor talks into his mike the pilot should hear him. Check pilot's VOL control operation on COM1 receiver.
- The instructor cannot hear his own voice in his headset.

- The pilot's voice can be heard on both pilot and instructor headsets when the pilot depresses the mike switch on the control wheel.
- While the pilot talks, check operation on the instructors VOL control on the Fault Panel.

4.24 ATC-810 VARIABLE SCALE PLOTTER OPTION

Description

The ATC-810 Variable Scale Plotter Option enables the operator to use any flight chart (Approach Plate, Area Chart, Low Altitude Enroute, etc.), which is scaled from 3.00 to 15.00 NM/IN and which falls within the EPROM's 150x150 NM program area. The Variable Scale Option also enables the operator to preset at or around any NAV-AID or Start Airport. When presetting around a NAV-AID or Start Airport, the operator can select any radial (0-359°), distance (00.00-49.99 NM) and altitude (0000-9999 ft). The 150x150 NM Navigational Area remains the same regardless of the plotter scale selected. When using an expanded scale flight chart (less than 15 NM/IN), the operator first selects a NAV-AID or Start Airport to represent the chart center. The simulator repositions the location of the selected NAV-AID or Start Airport to the center of the plotter surface. The new flight chart must then be aligned on the plotter surface with magnetic north oriented to true north and the selected chart center at the center of the plotter surface.

4.25 OPERATING INSTRUCTIONS

Preliminary Set-Up and Chart Centering

o Set the transponder to standby prior to entering the set-up mode.

o Set the plotter scale selector switch (located on the simulator's lower front subpanel) to the 15 NM/IN position.

- Place the "PROGRAM-AT-A-GLANCE" overlay on the plotter surface.

- Precisely align the overlay's (+) and (-) alignment marks with the (+) and (-) marks on the plotter surface.

- Turn the key switch ON.

- Depress the NORMAL/FREEZE switch to FREEZE.

- Set the COM receiver to frequency 120.95.

- Depress the PRESET/TAKEOFF switch to TAKEOFF.

- Using the X-Y adjustment screws, align the plotter pen precisely over the cross ( ) located at the center of the "PROGRAM-AT-A-GLANCE" overlay.

- Remove the "PROGRAM-AT-A-GLANCE" overlay from the plotter surface.

The plotter is now properly adjusted for use with any flight chart which is scaled between 3.00 and 15.00 NM/IN. INSURE THAT MAGNETIC NORTH ON THE FLIGHT CHART IS ALWAYS <u>PRECISELY</u> ALIGNED WITH TRUE NORTH ON THE PLOTTER SURFACE AND THAT THE SELECTED CHART CENTER IS ALWAYS ALIGNED WITH THE CENTER OF THE PLOTTER SURFACE.

4.25.1 Programming Set-Up Modes

1. Select an airport or NAV-AID to be the center of the plotting area. Enter the selected airport or NAV-AID frequency (tower, ILS, VOR or NDB) in the respective COM, NAV 1 or ADF receiver. Depress the IDENT button. By depressing the IDENT button, the selected chart center is stored in the computer and the set-up mode is stepped to Mode 2.

2. Mode <u>02</u> is displayed in the DME window. Set the appropriate chart scale (NM/IN) in the transponder windows and depress the IDENT button.

NOTE: The acceptable selection range is 0300-1500 (3-15 NM/IN). The selected scale is stored and the set-up mode is stepped to Mode 3.

3. Mode 03 is displayed in the DME window. Select an airport or NAV-AID to be the point around which radial and distance information will be based when presetting. Enter the desired tower or NAV-AID frequency in the COM, NAV 1 or ADF receiver. Depress the IDENT button. The selected preset center is stored and the set-up mode is stepped to Mode 4.

4. Mode 04 is displayed in the DME window. Select a radial and distance from the airport or NAV-AID (preset center) selected in Mode 3. Enter the desired radial (0-359°) in the ADF receiver. Enter the desired distance (00.00-49.99 NM) in the transponder. Depress the IDENT button. The selected radial and distance is set and the set-up mode is stepped to Mode 5.

5. Mode 05 is displayed in the DME window. Select an altitude above the airport or NAV-AID selected in Mode 3. Enter the desired altitude (0000-9999 ft) in the transponder. Depress the IDENT button. The selected altitude is set and the set-up mode is stepped to Mode 6.

6. Mode 06 is displayed in the DME window. Select starting fuel quantity. Enter the desired fuel quantity in the transponder. The first two digits dictate the fuel quantity in the inboard tanks; and the second two digits dictate the fuel quantity in the outboard tanks. On units equipped with an optional two tank fuel management system, set the first two digits to one-half the fuel quantity desired in the left tank. Set the second two digits to one-half the fuel quantity desired in the right tank. Depress the IDENT button. The selected fuel quantity is set and the set-up mode is stepped to Mode 1. Note: The maximum fuel capacity is displayed on each fuel management panel. Entering more that the maximum allowable fuel quantity will result in erroneous fuel quantity indications. Tanks are refilled to the selected quantity each time the TAKEOFF switch is depressed.

Programming is now complete. Leave the set-up mode by either depressing the PRESET/TAKEOFF switch to PRESET, or by depressing the NORMAL/FREEZE switch to NORMAL. "PRESET" will position the simulator to the location selected in Modes 3, 4 and 5. "NORMAL" will simply release the simulator from the set-up mode. The original frequency settings return in the NAV/COM receivers after the set-up mode is left. REMEMBER TO RESET FREQUENCIES AS REQUIRED!

Example:

Obtain the ILS 31R Approach Plate (NOS) for John F. Kennedy International Airport. Set appropriate radio frequencies: COM 119.10, NAV 1 111.50, NAV 2 111.20, ADF 0268. Turn to a heading of 313°. For convenience, GRIMM LOM will be used as the center of the plotting area.

1. Depress the NORMAL/FREEZE switch to the FREEZE position.

2. Depress the plotter scale switch to the 15 NM/IN position.

3. Position the transponder to STBY and depress the IDENT button. (Set-up mode entered. 01 displayed in the DME window.)

4. Set the ADF receiver to frequency 0268 and depress the IDENT button. (GRIMM LOM selected as chart center. 02 displayed in the DME window.)

5. Set the transponder to 0681 and depress the IDENT button. (6.81 NM/IN map scale selected. 03 displayed in the DME window.)

6. Set the ADF receiver to 0268 and depress the IDENT button. (GRIMM LOM selected as center from which preset will be based. 04 displayed in the DME window.)

7. Set the ADF receiver to 0000 and the transponder to 0000. Depress the IDENT button. (Bearing and distance from GRIMM LOM selected; in this case, no displacement. 05 displayed in the DME window.)

8. Set the transponder to 0000 and depress the IDENT button. (0 ft MSL selected. 06 displayed in the DME window.)

9. Set the transponder to 5337 and depress the IDENT button. (Fuel quantity selected. 01 displayed in the DME window.)

10. Depress the PRESET/TAKEOFF switch to PRESET. (Simulator preset to selected position.)

Obtain the "PROGRAM-AT-A-GLANCE" overlay.* Center the (+) and (-) overlay alignment marks over the (+) and (-) plotter alignment marks. Next, slide the Approach Plate under the overlay, and center GRIMM LOM under the center cross-located at the center of the compass rose. Insure that the 10 NM Arc is precisely aligned with the dark outer ring of the compass rose and that the inbound heading (313°) is precisely aligned with 313° on the light inner ring of the compass rose. The Approach plate should now be in proper alignment on the plotter surface. The plotter pen should drop in the center of the GRIMM LOM symbol. If it does not, refer to the Plotter Owner's Manual to readjust the X and Y axis of the plotter.

NOTE: The Approach Plate will be tilted clockwise since magnetic north is not aligned with the 12 o'clock position on the Approach Plate.

Depress the IDENT button three times. Mode 03 will appear in the DME window. Set frequency 111.20 (Deer Park VOR) in the NAV 1 receiver and depress the IDENT button. Mode 04 will appear in the DME window. Set code 0228 (228° R DPK) in the ADF receiver, code 1840 (18.40 NM from DPK) in the transponder, and depress the IDENT button. Mode 05 will appear in the DME window. Set code 2000 (2000 ft MSL) in the transponder and depress the IDENT button. Depress the PRESET/TAKEOFF switch to the PRESET position. The simulator and plotter are now positioned at LORAC intersection with the altimeter indicating 2000 ft MSL. Insure that proper radio frequencies are set. Depress the NORMAL/FREEZE switch to the NORMAL position and fly the ILS/RWY 31R approach into JFK.

*The "PROGRAM-AT-A-GLANCE" overlay should only be used to align Approach Plates on the plotter surface.

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810 TEST PROCEDURE

TEST EQUIPMENT REQUIRED

DVM
SCOPE 130A
FREQ. COUNTER
EXTENDER BOARD AND SUPPORT
TEST JUMPERS
TEST PLUGS 2 each
CARD EXTRACTORS

1.0 45. 0186-0 with cards 1 through 4 removed
Resistance Check, No Power, Key OFF

1.1 (AC) Measure resistance between J1-1 and J1-2, it should read open.
Repeat for J1-1 to J1-3, J1-2 to J1-3, both should read open.
With unit unplugged, turn key ON.
Measure resistance between J1-1 and J1-2 it should read > 1.0 ohms.

1.2 (DC) On back plane (47.312-0) measure between GND and ±12V and +5V lines. All should read >100 ohms.

2.0 Voltage Check (Power ON)

2.1 Turn key lock OFF, remove HSI connector and unplug the A,B,C and D cards. Plug line cord into rear of unit, then to ac source. Turn key lock ON. Measure ±12V at back plane and adjust PS2 (10.651-0) TOL ±.012V. (See Figure 1A)

Measure +5V at back plane and adjust PS1 (10.636-0) TOL ± .005V.

± 15.0V ± .6V

+ 24.0V ± 1.0V

+ 5V Switched ± .2V

Turn key lock OFF.

Install fault panel jumper plug.

3.0 Instrument Check (Less cards 1-4)

3.1 Key ON. All other controls OFF, NORM/FREEZE IN FREEZE. Check for following conditions:

Post lamps ON, fan ON, clock operating, gear down lamps ON, (gear up/down switch should operate).

Seat belt/no smoking lamps operate.

Trim controls operate meters.

Field in sight lamp operates.

Turn key OFF.

3.2 Horz. Drive Gain Adjust. (Figure 3) (M2)

Measure resistance between pins 5 and 6 on attitude indicator connector. On the COM/ADF Board adjust R226 until the combined resistance of R226 and R227 equals the value measured above.

*(Horizon should be level, if not adjust motor coupling, and check setscrews). Refer to Appendix 2

4.0 Voltage Adjust, Test Mode Check

4.1 Install boards 1-4, HSI connector and plugs for cards A,B,C and D. Turn keylock ON and recheck/adjust ±12V and +5V.

4.2 Install test jumper between P1-71 and GND on backplane.
Turn ON left and right master switches.
Turn the following radios ON: Transponder, COM1, ADF, NAV1, NAV2 and DME. (Transponder switch to stdby).
Turn OFF (center or down) all audio panel toggle swtiches.
Reset the simulator by simultaneously depressing FIELD IN SIGHT AND IDENT.
The simulator should enter the test mode - the three marker indicators sequence in rotation.

4.3 Read the voltage on the roll pot and pitch pot wipers, adjust roll pot = ØV ± .01V.
Pitch pot = -1.5V ± .01V with shaft 10.5 inches from control panel to center of wheel.

5.0 (DIAG 0)

Operate the Audio Control Panel switches (NAV1, NAV2, ADF, DME and MKR) and verify that the transponder displays the decimal equivalent of the binary code. (DIAG. Test 0)

*(0 to 31)

6.0 (DIAG 1)

Turn all Audio Panel switches OFF except MKR. Reset by pushing IDENT and F.I.S., unit should go to DIAG. Test 1.

Operate each transponder code switch and each ADF frequency switch. The display above each should cycle in sequence ... 6-5-3...as the switch is rotated clockwise and in the opposite sequence...3-5-6 as it is rotated counterclockwise. (DIAG. Test 1)

7.0 (DIAG 2)

Turn all Audio Control Panel switches OFF except DME. Reset by pushing IDENT and F.I.S., unit should go to DIAG Test 2.

Operate each COM, NAV1, and NAV2 Radio "Frequency Select" switch. The display window associated with each (indicated by lines on radio panel) should cycle in sequence...6-5-3...as the switch is rotated clockwise and in the reverse sequence (...3-5-6...) as it is rotated counterclockwise.

8.0 (DIAG. 3)

Turn all Audio Control Panel switches OFF except DME and MKR. Reset by pushing IDENT and F.I.S., unit should go to DIAG 3.

Operate the four right most audio control switches as shown below and verify the resulting displays.

AUDIO SW N A A D M V D M K 2 F E R	NUMERIC DISPLAYS XPONDER	ADF	COM	NAV1	(NAV1) DME	NAV2
0 0 0 0	0000	0000	100.00	100.00	00.0	100.00
0 0 0 1	1111	1111	111.11	111.11	11.1	111.11
0 0 1 0	2222	0222	122.22	102.22	22.2	102.22
0 0 1 1	3333	1333	133.33	113.33	33.3	113.33
0 1 0 0	4444	0444	104.44	104.44	44.4	104.44
0 1 0 1	5555	1555	115.55	115.55	55.5	115.55
0 1 1 0	6666	0666	126.66	106.66	66.6	106.66
0 1 1 1	7777	1777	137.77	117.77	77.7	117.77
1 0 0 0	8888	0888	108.88	108.88	88.8	108.88
1 0 0 1	9999	1999	119.99	119.99	99.9	119.99
1 0 1 0		0	12 .	10 .	.	10 .

9.0 (DIAG.4)

Turn power OFF. Remove fault panel jumper plug and install fault panel cable. Turn power ON. Turn all Audio Control Panel switches OFF except ADF. Reset by pushing IDENT and F.I.S., unit should go to DIAG 4.

Operate the switches shown below. Verify the resulting transponder display as shown.

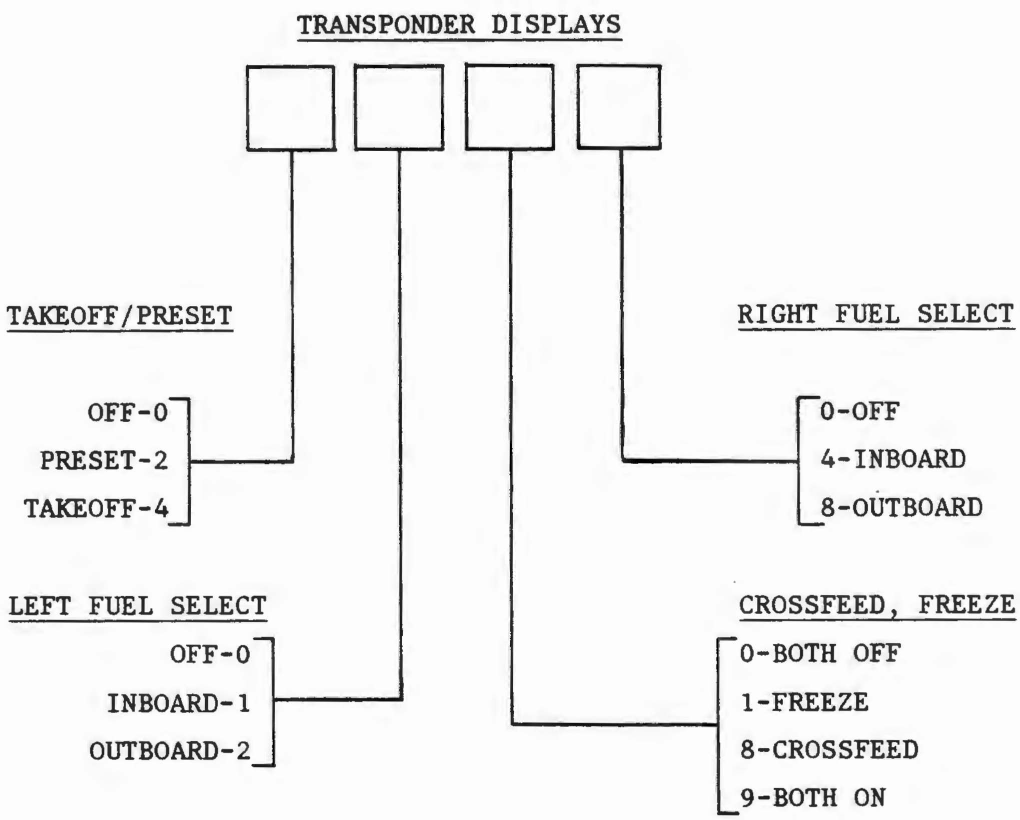
		ON FAULT PANEL	
TRANSPONDER MODE	IDENT BUTTON	RUNWAY SELECT	TRANSPONDER DISPLAY
STY	OFF	1	0
STY	OFF	2	1
STY	OFF	3	2
STY	OFF	4	3
STY	ON	1	4
ON or ALT	X	1	8

10.0 (DIAG 5)

Turn all Audio Control Panel switches OFF except ADF and MKR. Reset by pushing IDENT and F.I.S., unit should go to DIAG. 5.

OPERATE PRESET/TAKEOFF,
LEFT ENGINE FUEL SELECT,
RIGHT ENGINE FUEL SELECT,
CROSSFEED, and FREEZE.

Verify that each switch affects one transponder display as shown below - and no other.



FUEL MANAGEMENT SWITCH FUNCTION TEST (DIAG. 5)

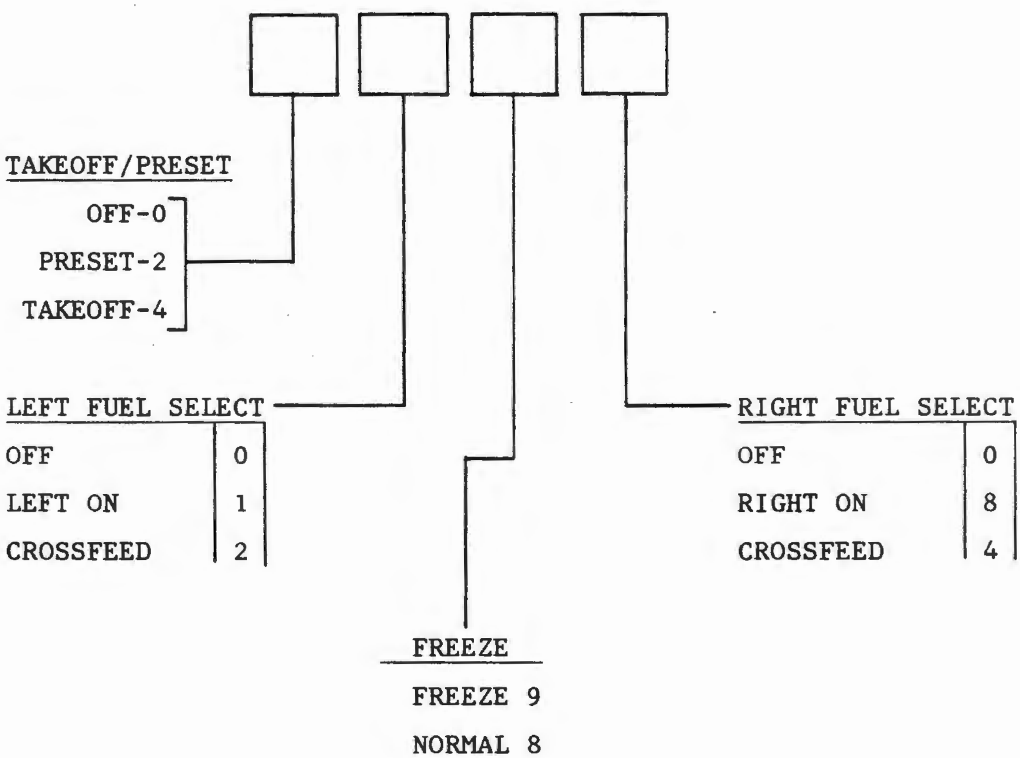
* Optional Two Tank Fuel Management Systems

Turn all Audio Control Panel switches OFF except ADF and MKR. Reset by pushing IDENT and F.I.S., unit should go to DIAG. 5.

OPERATE PRESET/TAKEOFF,
LEFT ENGINE FUEL SELECT,
RIGHT ENGINE FUEL SELECT,
FREEZE.

Verify that each switch affects one transponder display as shown below - and no other.

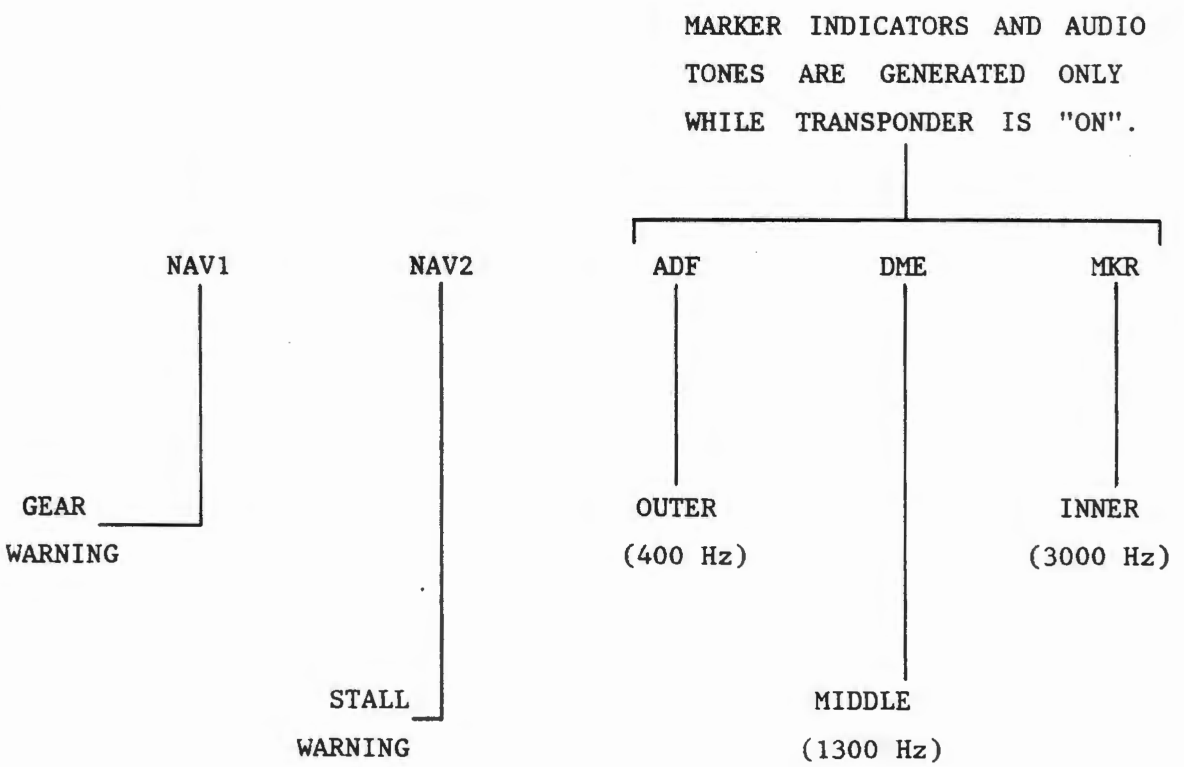
'B' or 'C' TRANSPONDER DISPLAY



11.0 (DIAG 6)

Turn all Audio Control Panel switches OFF except ADF and DME. Reset by pushing IDENT and F.I.S., unit should go to DIAG 6. Return all switches OFF.

Operate the Audio Panel switches as shown below, verifying that each switch causes the correct marker indicator or warning. Verify that when the transponder is "ON" the marker audio tones are generated as well.



*Operate HI/LO test switch and hear a change in volume.

12.0 (DIAG 7)

Turn all Audio Control Panel switches OFF except ADF, DME and MARKER. Reset by pushing IDENT and F.I.S., unit should go to DIAG 7. Return all switches OFF.

Operate the Audio Control Panel switches as shown below. Verify that the response of the HSI/CDI needles and flags is as shown (both instruments):

NAV1	NAV2	ADF	DME	MKR	HSI NAV FLAG	CDI NEEDLE	TO/FROM FLAG	CDI GS FLAG	GS NEEDLE CDI (HSI)
0	0	0	X	0	ON	CENTER	CENTER	ON	CNTR (NOT VIZ)
0	0	0	X	1	ON	CENTER	TO	ON	CNTR (NOT VIZ)
0	0	1	X	1	ON	CENTER	TO	OFF	DOWN
0	1	1	X	1	OFF	RIGHT	TO	OFF	DOWN
0	1	1	X	0	OFF	RIGHT	FROM	OFF	DOWN

Operate the DME Select switch as well and VERIFY DME displays as shown below:

NAV1	NAV2	ADF	DME	MKR	DME SELECT SWITCH	DME DISPLAY	
0	X	X	1	X	NAV1	11.1	
0	X	X	1	X	OFF		
0	X	X	1	X	NAV2	22.2	
0	X	X	0	X	NAV2	...	
0	X	X	0	X	NAV1	...	
1	X	X	1	X	NAV1	11.1	Operate "NAV1" toggle switch before "DME"
1	X	X	1	X	NAV2	...	

13.0 (DIAG 8 Plotter Scale Adjust)

Turn OFF power to unit and extend the audio/transponder board. Turn power ON, turn all Audio Control Panel switches to the OFF position and reset by pushing IDENT and F.I.S., unit should go to DIAG 0. Turn ON NAV2 switch and reset again. Unit should go to DIAG 8. Return NAV2 switch OFF.

Operate the "DME: and "MKR" Audio Control switches, the transponder code, and the plotter scale switch and verify the corresponding DAC output.

DME	MKR	TRANSPONDER CODE	PLOTTER SCALE	DAC OUTPUT	(Use J2-5 Plotter Jack for GND Adjust)	
0	0	0 0 0 0	15	0V (±30MV)	TP5 & TP6	___
0	0	1 7 7 7	10	1.5V (±10MV)	TP-5	R28
0	0	1 7 7 7	10	1.5V (±10MV)	TP-6	R31
				(Observe)		
0	0	1 7 7 7	15	1.0V (±100M)	TP-5	___
0	0	1 7 7 7	15	1.0V (±10MV)	TP-6	___

Repeat last two steps until both scales are correct without further adjustment.

14.0 (Fuel Meter Adjust)

Set Audio Control switches "DME" and "MKR" OFF. Set DAC values (transponder code, first three digits) as shown and verify fuel gauge readings as shown.

TRANSPONDER CODE	GAUGE READING (GAL)	
0 0 0 0	0	
3 6 0 0	53.3	Adjust full scale R10-right, R8-left for this reading. (See Figure 7) ● ○ ○ ○ R R10 / ○ ● ○ ○ L R8
0 5 5 0	10	
1 3 2 0	20	
2 0 7 0	30	± 3 GAL
2 6 4 0	40	
3 4 1 0	50	

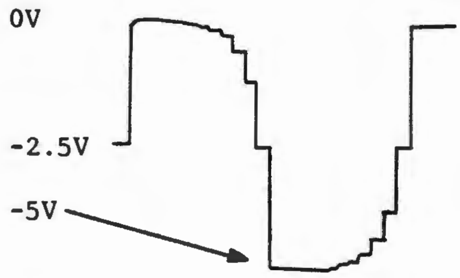
15.0 (SPD/Alt DAC. Check)

Turn OFF power to unit. Reinstall audio/transponder board. Remove COM/ADF board and jumper +5V to connector P6-17 on backplane. Extend NAV1 board. Turn power ON. Turn all Audio Control Panel switches to OFF and reset by pushing IDENT and F.I.S., unit should go to DIAG 0. Turn ON NAV2 switch and reset again. Unit should go to DIAG. 8.

Set Audio Control switches and DAC value (transponder code) as shown and verify DAC output voltage.

DME	MKR	TRANSPONDER CODE	ASCORR (P6-16)
0	0	0 0 0 0	0 ± .1V
0	0	3 7 7 0	-5 ± .25V
1	0	3 7 7 0	See Figure 8C

Figure 8C



CODE	OUTPUT (V)
200	-2.5
100	-1.25
040	- .75
020	- .38
010	- .19
004	- .09
002	- .05
001	- .02

NOTES:

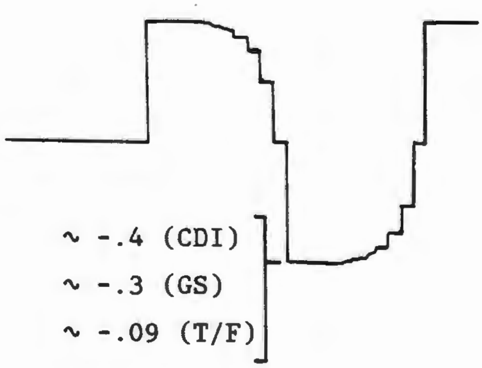
1. All 8 steps can be seen (use HP130A - Put 1µf across input to filter.
2. Voltages are approximate. (This DAC is used for a small effect on speed with altitude.)

16.0 (NAV1 CDI/GS/T/F Adjust)

Unplug Meter, P8 (HSI).
Set Audio switches "DME" and "MKR" both OFF.
Set Transponder code to 0000.
Set "DME" switch ON and verify waveforms of Figure 8D.

Figure 8D ON NAV1 BOARD

Test PT
E3 (CDI)
E1 — E7 (GS)
E2 (T/F) 0



DAC waveforms with meter unplugged.

All 8 steps can be seen (use HP 130A- put .01µf across INPUT to filter noise)

Reinstall Meter P8

Set "DME" and "MKR" both OFF and transponder code to 2000.

Adjust pots on CDI, GS, and T/F DACS to center needles (flag).

Check calibration at other points on meter face.

(See Figure 8)

	DOT ON METER FACE	R18 CDI/HSI CDI DAC VALUE (±6 LSB)		R9 CDI GS DAC VALUE (±10 OCTAL)		HSI GS DAC VALUE (±)	
	4	L	0700	UP	0340		CDI=R18
	3	L	1120	UP	0650		T/F-R14
On	2	L	1340	UP	1160		GS=R9
Jewell CDI,	1	L	1560	UP	1470		
Circle is	1	R	2220	DN.	2310		
first dot	2	R	2440	DN.	2620		
	3	R	2660	DN.	3130		
	4	R	3100	DN.	3440		

17.0 (DIAG 9 NAV1 HSI Heading Adjust)

Turn all Audio Control Panel switches OFF except NAV2 and MKR. Reset by pushing IDENT and F.I.S., unit should go to DIAG 9. Return switches to OFF position. (ADF/RMI selector in ADF position.) (See Figure 9)

Adjust R34 for 5 volts peak ±.5V at TP7. (G00-1)

Select 60° heading on OBS. Set R40 for transponder display of 0060.

Select 150° heading on OBS. Set R25 for transponder display of 0150.

Iterate until both 60° and 150° OK without further adj.

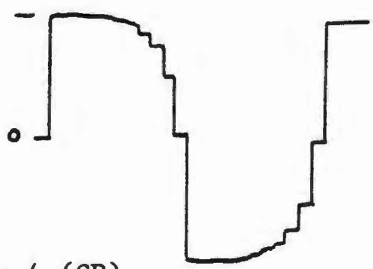
Use the OBS knob to select various headings around the dial. Verify that the indicated heading matches that shown in the transponder displays ±3 degrees.

18.0 (NAV2, CDI/GS/T/F Adjust)

Turn OFF power to unit. Reinstall NAV1 Board and put NAV2 Board on extender. Turn power ON. Turn all Audio Control panel switches OFF, and reset by pushing IDENT and F.I.S., unit should go to DIAG 0. Switch NAV2 switch ON and reset. Unit should go to DIAG 8. Unplug meter P9, and return the NAV2 switch to the OFF position.

Set transponder code 0000.
Set "DME" SW. ON and verify waveforms of Figure 8D.

Figure 8D



Test PT

E3 (CDI)

E1 (GS)

E2 (T/F) 0

~ -.4 (CD)

~ -.3 (GS)

~ -.09 (T/F)

DAC waveforms with meter unplugged.

All 8 steps can be seen (use HP 130A- put .01µf across to filter noise)

Reinstall Meter P9

Set "DME" and "MKR" both OFF and transponder code to 2000.

Adjust pots on CDI, GS, and T/F DACS to center needles (flag). (See Figure 10)

Check calibration at other points on meter face.

		R18	R9	
	DOT ON METER FACE	CDI/HSI CDI DAC VALUE (±6 LSB)	CDI GS DAC VALUE (±10 OCTAL)	HSI GS DAC VALUE (±)
	4	L 0700	UP 0340	
	3	L 1120	UP 0650	
On	2	L 1340	UP 1160	
Jewell CDI,	1	L 1560	UP 1470	
Circle is	1	R 2220	DN. 2310	
first dot	2	R 2440	DN. 2620	
	3	R 2660	DN. 3130	
	4	R 3100	DN. 3440	

CDI=R18
T/F=R14
GS=R9

19.0 (NAV2 Heading Adjust)

Turn all Audio Control Panel switches OFF except NAV2 and MKR. Reset by pushing IDENT and F.I.S., unit should go to DIAG 9. Return switches to OFF position. Set MKR switch ON.
Adjust R34 for 5 volts peak ±.5V at TP7 on NAV2 Board. (See Figure 11)

Select 60° heading on OBS.
Set R40 for transponder display of 0060.

Select 150° heading on OBS.
Set R25 for transponder display of 0150.

Iterate until both 60° and 150° OK without further adj.

Use the OBS knob to select various headings around the dial. Verify that the indicated heading matches that shown in the transponder displays ±3 degrees.

20.0 (DIAG 10 Counter Check)

Turn OFF power to unit. Remove +5V to P6-17 jumper. Reinstall NAV2 board. Remove COM/ADF Board and NAV1/DME Board. Install test jumper plug on P1 of backplane. (Remove GND from P1-71 also, pin is GNDED in Test Plug.)

Turn power ON and position all Audio Panel switches to OFF position. Reset by pushing IDENT and F.I.S., unit should go to DIAG 0. Switch NAV2 and DME switches ON and reset, unit should go to DIAG 10.

NAV1	NAV2	ADF	DME	MKR	TRANSPONDER DISPLAY	COUNTER IN TEST
		X	0	0	COUNTS UP (00-63, 3pps)	
0	0	X	1	0	COUNTS DOWN	X
		X	X	1	HOLDS PRESENT COUNT	
		X	0	0	COUNTS UP (00-63, 3pps)	
0	1	X	1	0	COUNTS DOWN	Y
		X	X	1	HOLDS PRESENTS COUNT	
		0	0	0	COUNTS UP (00-15,.75pps)	
		1	0	0	HOLDS PRESENT COUNT	ALTITUDE
1	0	X	1	0	COUNTS DOWN	
		X	X	1	HOLDS PRESENT COUNT	
		X	0	0	COUNTS UP (00-15,.75pps)	
1	1	X	1	0	COUNTS DOWN	HEADING
		X	X	1	HOLDS PRESENT COUNT	

Depress "FIELD IN SIGHT" button. Lamp should light when Audio Switch "DME" is OFF and should not illuminate when the switch is ON.

21.0 (DIAG 12 Alt/HDG Rate Adjust)

Turn OFF power to unit. Remove Rudder connections. Remove test jumper plug and reinstall jumper from GND to P1-71. Reinstall NAV1 board and put COM/ADF board on extender 51.663-GRD P4-19; 51.671-GRD P4-50 without Rudder-GRD P31-2. Turn power ON and switch all Audio Control Panel switches OFF. Push IDENT and F.I.S., unit should go to DIAG 0. Switch NAV2 and ADF ON and reset. Unit should go to DIAG. 12.

Turn wind velocity to 0 on fault panel.

J5

On COM/ADF Card:

- Remove jumpers J5, J6, and J7. J6

- Use "Daisy Chain" jumper to connect:
  TP2 (Roll Trim) J7
  to TP1 (VSI)
  to J5 - R260 side (airspeed)
  to J7 - R179 side (turn coordinator)

(See Figure 12)

Rotating the roll trim will now directly control climb rate (vertical speed), airspeed, and the turn coordinator. (J6 is left open to defeat stall.)

To check or adjust the voltage-to-frequency converters in the table below:

1. Connect P8-34 (counter input) to pin shown.
2. Use roll trim to set conditions shown.

Note: X&Y rate checks require specific headings. Use TEST 11 to drive compass. ("NAV2" and "DME" SW. ON.)

3. Read pulse frequency on transponder display.

3a. Before jumping J6, make sure that the VSI indicates approximately 1000 fpm climb. (This will insure that one side of J6 has +5V on it.)

4. Install J6 jumper, then remove it (this is done to get a reading on the counter).

Y/F CONVERTER	OUTPUT (TOP8-34)	TEST CONDITIONS	POT (CARD)	FREQ. ±1 DIGIT)	
ALT RATE	P3-9	CLIMB RATE = 1000	R171 (COM/ADF)	192	B03
					(COM/ADF)
HDG RATE (See Fig. 14)	P3-14	STD RATE TURN (R)	R190 (COM/ADF)	96	
		STD RATE TURN (L)		96	B04

- After HDG rate, remove daisy chain jumpers, counter jumper and replace jumpers on the COM/ADF board.

- Before adjusting X&Y rate, install the daisy chain jumper, counter jumper and remove jumpers J5, J6, J7 and J24 on the 51.669 board. After adjusting X&Y rate remove daisy chain jumper, counter jumper and replace all jumper connectors on the COM/ADF board.

(Do not make these adjustments until after Step 33.0)	Y RATE	P5-27	AIRSPEED=180 KNTS HEADING = NORTH WIND VELOCITY=0	R92 (NAV1/DME)	350	B00
			WIND=N @ 50 KNTS	Check	253 ±25	
			S @ 50 KNTS	Check	447 ±25	(NAV 1)
	X RATE	P5-25	AIRSPEED=180KNTS HEADING = EAST WIND VELOCITY=0	R75 (NAV1/DME)	350	B01
			WIND=E @ 50 KNTS	Check	253 ±25	
			W @ 50 KNTS	Check	447 ±25	

22.0 (DIAG 15 Fuel Pressure Check)

FIELD IN SITE

Turn all Audio Control Panel switches OFF except NAV2, ADF, DME and MKR. Reset by pushing IDENT and F.I.S., unit should go to DIAG 15.

Return all control panel switches OFF. Right and left fuel pressure reads 0. Switch DME ON. Left fuel pressure reads > 30psi. Switch NAV2 ON, DME OFF. Right fuel pressure > 30psi. Switch DME ON. Right and left fuel pressure > 30psi.

23.0 (DIAG 11 Alt/RMI Pos. Set)

(Motor Binding Check) On Audio Control Panel, turn all switches OFF except NAV2, DME and MKR. Reset by pushing IDENT and F.I.S., unit should go to DIAG. 11.

Set OTHER Audio switches and rotate the OBS knob $\approx 45^\circ$ in the direction indicated. Verify altimeter, ADF needle, and heading (compass and compass roses) movement shown.

NAV2	ADF	DME	MKR	(NAV2) OBS	INSTRUMENT MOVEMENT
X	0	0	1		RMI NEEDLE CW
					RMI NEEDLE CCW
0	0	1	0	X	HEADING DOESN'T MOVE
1	0	1	0		HEADING ANGLE INCREASES
					HEADING ANGLE DECREASES
0	1	0	0	X	ALTIMETER DOESN'T MOVE
1	1	0	0		ALTITUDE INCREASES
					ALTITUDE DECREASES

*Go below 24000 Ft and be sure sensor arm clears the screw.

For each instrument in the list below, perform the following steps:

	ALTIMETER ("ADF" SW)
	RMI NEEDLE ("MKR" SW)
(These may not agree on heading angle)	RMI COMPASS ROSE ("DME" SW)
	HSI (or HI) COMPASS ROSE
	MAGNETIC COMPASS ("DME" SW)

23.1 Turn on the specified Audio Control switch and "NAV2". Use OBS knob to set instrument pointer to a convenient starting point (i.e. NORTH on compass).

** Take note of direction of motor movement to reach starting point.

23.2 Turn OFF all Audio Control switches. Transponder display goes to 0000.

23.3 Turn ON "NAV2" and other specified Audio switch. Use OBS knob to move instrument motor...

** in same direction as noted in step 1 to minimize effects of gear backlash on results

.. through several revolutions at varying speeds the transponder display is counting pulses issued.

23.4 Stop the motor when the count is at some increment of 1440 pulses (see table below) and verify the instrument pointer is at its starting position. There should be no noticeable misalignment.

23.5 Establish a new starting point, but approach from the other direction. Then repeat test in this direction.

	COUNT		
REVOLUTIONS	UP	DOWN	
1	1440	8560	
2	2880	7120	
3	4320	5680	
4	5760	4240	
5	7200	2800	
6	8640	1360	
7	0080	9920	
8	1520	8480	SECOND TIME AROUND ON COUNTER
9	2960	7040	
10	4400	5600	

Set "NAV2" and other Audio Control switch specified below and operate the OBS in the direction indicated. As the instrument nears its "home" position (go slowly), stop when the specified marker indicator first lights. (The magnetic sensor has been detected.)

Verify instrument position shown.

	OBS	INSTRUMENT	POSITION	AOM
ADF		Altimeter	0 ± 5 feet	A
DME		RMI Compass	NORTH ±2°	O
MKR		RMI Needle	TICMARK±2°	M

<u>NOTE</u>

All 3 compass indicators may not agree.

Set "NAV2" and "DME" Audio Control switches and use OBS knobs to drive compass(es).

DME

A1. Drive compass until "YCOMPS" (P6-12) is at its maximum positive voltage.

A2. Fine-tune by monitoring XCOMPS (P6-11) and moving compass until it is ØV ± 30MV.

** Note direction of final motor steps **

The compass pot is now at north. If the magnetic compass dial does not agree, loosen set screw and move the dial.

Disconnect magnetic compass (M18)

Drive HSI compass rose until it reads north. Approach from same direction as in step 2 above.

Disconnect HSI (M8)

Drive RMI compass rose until it reads north. Approach from same direction as in step 2 above.

Reconnect compass and HSI or HI)

24.0 Engine Adjustments

Turn off power.

Extend COM/ADF card.

Perform the following engine operation adjustments for left and right engines.

Remove jumper at P1-71.

Turn power ON.

* Audio Transponder	5337
COM1	119.10
ADF	0373
NAV1	109.50
DME (NAV1)	0.00±.2
NAV2	112.30
Check 4 MAP selections	

Turn both mags ON.

Push throttles full forward.

Push prop. controls full forward.

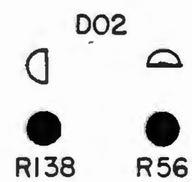
Push mix. controls full forward.

Pull parking brake on (air speed = 0).

Prop. speed governor control centered on fault panel.

Start Engines.

25.0 (RPM High Adjust)



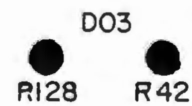
(See Figure 2)

Push throttles full forward.

Adjust R56(L) for an indication of 2575 on the left RPM needle.

Adjust 138(R) for an indication of 2575 on the right RPM needle.

26.0 (M.P. Adjust)



(See Figure 1)

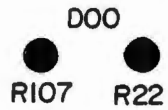
Adjust R42(L) for an indication of 43 inches of manifold pressure on the left gauge.

Adjust R128(R) for an indication of 43 inches of manifold pressure on the right gauge.

* EGT reads 1400°F (adjust meter).

Oil pressure reads 85 psi ± 10 psi (but not in the yellow) adjust fault panel.

27.0 (RPM Low)



(See Figure 1)

Pull throttles full aft.

Adjust R22(L) for an indication of 600 RPM on the left RPM needle.

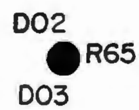
Adjust R107(R) for an indication of 600 RPM on the right RPM needle.

Keeping R&L throttle knobs exactly aligned with one another, slowly vary the MP from 20" to 40" (needles should track within 2" MP of each other). Keeping R&L throttle controls exactly aligned with one another, slowly vary the RPM from 3000 to 2,500 RPM (needles should track within 100 RPM of each other).

28.0 (Fuel Flow Rate Adjust)

See Appendix 1.

29.0 (Eng. Sound Adjust)



(See Figure 3)

Set throttles full forward.

Set prop. controls to a 2200 RPM indication.

Set engine audio to a suitable level and adjust R65 until audible sync. is accomplished.

30.0 Air Speed Adjust

(See Figure 4)

Turn COM1 to 120.95.

XPDR to 1011,

Adjust power controls to achieve 31.5" M.P and 2200 RPM. Set gear up, cowl flaps closed and flaps to 0°.

Push PRESET.

Maintain wings level and 0 VSI.

After achieving stable flight and 0 VSI, adjust R297 for 166 knots of airspeed.

Power OFF.

Connect rudder.

30.1 Rudder Pedal and Servo Adjustments

NOTE: Units without R86 gain pot.

(a) With power OFF, place the servo card in an operational system with the pedals in the Neutral Position. Disconnect the rudder pedal ac plug. (WHT. connector)

(b) With power ON, check pins 13 and 15 on the servo card for zero volts ± 200 mV. (wiper of R1 and R2)

(c) Turn simulator off and connect the rudder pedal ac into the system.

NOTE: Units with R86 gain pot.

(d) Place the servo card in an operational system with the pedals in the Neutral Position, and the rudder pedal ac plug disconnected.

(e) Turn power ON - do not start engines. Insure that the torque and rudder pots are at zero volts ± 200 mV on pins 13 and 15 of the servo card.

(f) Monitor TP1 and TP2 with a dual trace oscilliscope. Set the vertical scale at 5V/division and the horizontal trace at 100 MSEC/division.

(g) Adjust R86 to the center position.

(h) Adjust R11 until the 60 Hz modulated waveform on TP1 is just on the verge of appearing.

(i) Adjust R26 until the 60 Hz modulated waveform on TP2 is just on verge of appearing.

(j) Turn the simulator OFF and connect the Rudder Pedal ac into the system.

(k) Turn the simulator ON, start engines and set up the following conditions:

1. Cruise flight,
2. Flaps up,
3. Gear up,
4. NORMAL/FREEZE switch in FREEZE,
5. A/H indicating level flight,
6. Roll trim indicator centered,
7. Nose trim indicator centered.

(l) Place the simulator in a steep dive to gain a maximum air speed of 190 KTS.

(m) Adjust gain pot R86 fully CCW; (max. gain) kick rudder pedals and adjust R86 CW until no oscillations occur after kicking the rudder pedals.

NOTE: * For 230V 50 Hz operation, R87 and R88 are removed from rudder servo card. Also C5 = .1µf 500V.

31.0 Flight Characteristic Tests

* When equipped with Variable Scale Plotter Option, refer to Appendix 3 for PRESET instructions.

- Turn KEYLOCK ON.
- COM 1 to 120.95.
- MAP SELECT to #1.
- XPDR to 1011.
- Start L&R engines.
- Set MP to 31.5" and RPM to 2200.
- GEAR UP.
- COWL FLAPS CLOSED.
- FLAPS 0°.
- NORM to FREEZE.
- Push PRESET.
- FREEZE to NORM.
- Maintain wings level and 0 FPM rate of climb.

31.1 Cruise/Climb/Descent

Establish straight and level flight at an altitude between 1,000 and 2,000 ft. Adjust BIRD in Attitude Indicator to the 0°

pitch position. With wings level, ball centered and zero rate of climb, adjust the THROTTLE and PROP controls to achieve the MP and RPM indication shown in the table below.

Position: GEAR - UP
COWL FLAPS - CLOSED
FLAPS - 0°

Adjust the PITCH TRIM to achieve zero climb rate.

	TEST	MP	RPM	KIAS	VSI	COWL FLAPS	WING FLAPS
1.	55% Cruise	27.2"	2200	(153 ± 5)	0 FPM	C	0°
2.	65% Cruise	31.5	2200	(166 ± 5)	0	C	0
3.	75% Cruise	33.7	2400	(177 ± 6)	0	C	0
4.	Cruise Descent*	28.7	2200	(75% Cruise A/S)	(-500 ± 150)	C	0

* Maintain 75% Cruise A/S by carefully adjusting pitch trim. "Bird" should pitch down 2° to 4°.

	TEST	MP	RPM	KIAS	VSI	COWL FLAPS	WING FLAPS
5.	Climb*	38	2400	115	(1250 ± 200)	C	0

* With 38" MP and 2400 RPM achieve 115 KT IAS by adjusting pitch trim. Pitch attitude 10.0° ± 2°.

	TEST	MP	RPM	KIAS	VSI	COWL FLAPS	WING FLAPS
6.	Approach Descent	26	2200	(151 ± 5)	0	C	0
		26	2200	(133 ± 5)	0	C	15°
	Gear DN	26	2200	(122 ± 5)	-500 ± 100	C	15°

7. Gear UP

75% Cruise	33.7	2400	(177 ± 6)	0	C	0°
Then						
Climb*	33.7	2400	(154 ± 10)	+500	C	0°

* Climb by pitching up until +500 FPM climb rate is achieved, then note A/S. Pitch attitude should be +4 to 7° up.

32.0 Roll Zero, Low and High Conditions

NOTE: When equipped with Variable Scale Plotter Option, refer to Appendix 3 for PRESET instructions.

(See Figure 5)
Push TAKEOFF,
Attitude indicator showing wings level,

With airspeed at 0 knots adjust R201 for 0 at amp HOI Pin 8.
Push PRESET.
With airspeed at 180 knots adjust R195 for 0 at the same point.

33.0 Stall Speed Conditions

(See Figure 5)
Flaps 0 degrees,
Refer to Figure 5.
Adjust R284 until stall begins at 75 KIAS ± 1 KIAS.

34.0 Single Engine Drag Conditions

(See Figure 6)

One engine running at 2500 RPM and 41 inches manifold pressure,

Other engine feathered,

Landing gear up,

Flaps 0 degrees,

Altitude approximately 100 ft.

Bank 5° toward running engine, airspeed 106 knots indicated,

Refer to Figure 6.

Adjust R241 for 275 FPM climb rate.

34.1 Return to Step 21.0 and perform X and Y rate adjust per diagram 12. (See Figure 13) Extend Nav 1 board.

35.0 Engine Out Tests

- o COM 1 to 120.95
- o XPDR to 1011
- o MAP SELECT to POSITION 1.
- o ILS RWY SELECT 2.

35.1 Left Engine Failure/Rudder Pedal/Feather Test

* When equipped with Variable Scale Plotter Option, refer to Appendix 3 for PRESET instructions.

Establish a 75% cruise configuration as follows:

- XPDR 5337.

- PUSH TAKEOFF.

- XPDR 1011 PRESET.

- Manifold to pressure: 33.7 inches.
- RPM: 2200.
- Cowl Flaps Closed.
- Gear Up.
- Wing Flaps Up.
- Wings Level.
- Climb Rate or Vertical Speed: Zero.
- The airspeed should indicate approximately 177 knots.
- Put the flight mode switch in the freeze position.
- Reset the altitude to 1500 feet (push PRESET).

COMMENT:

During the engine failure test, disregard the need to maintain a vertical speed of zero feet per minute. Allow the aircraft pitch attitude to fall. It will only be necessary to use the control wheel to keep the wings approximately level as indicated by the attitude indicator. Press the rudder pedals to center the ball.

Pull the left firewall fuel shutoff valve to the OFF position. Immediately apply hard right pedal pressure until the ball is centered while simultaneously keeping the wings level. The left manifold pressure should go to 10 inches, the RPM should remain at 2200.

Next, pull the left throttle to the fully closed position. Note the gear warning sound, then advance the left throttle control until the gear warning sound just goes off. Move the left prop control to the feathered position and note that the rudder pedal pressure required to keep the ball centered is now reduced. Left engine RPM should drop to zero, and the left alternator inop light should illuminate. The manifold pressure indicating 10 inches should slowly rise to a reading of 27 to 30 inches.

Next, push the left fuel shutoff valve in, move the left engine prop control back to its original position, and move the left throttle back to approximately 33 inches of manifold pressure.

Next, press the left engine starter switch. The foot pedal pressure required to maintain proper steering control should be reduced to zero, the wings should go back to level, the manifold pressure should go back to approximately 33 inches, and the RPM should rise to approximately 2200 RPM. The left engine control should now be readjusted back to the original cruise configuration and the entire sequence should be repeated for a right engine failure test.

35.2 Right Engine Failure Test at 75% Cruise Power Configuration

Pull the right firewall fuel shutoff lever to the OFF position and apply considerable left rudder pedal pressure to center the ball. Simultaneously maintain a wings level attitude by rotating the control yoke as necessary. The indicated airspeed should remain approximately constant at 177 knots, the tachometer should continue to indicate 2200 RPM and the right manifold pressure should indicate 10 hg. Reduce the right throttle control to the closed position and note that the gear warning sound occurs, then advance the throttle control until the gear warning sound just goes off.

Next, reduce the right prop control lever to the feathered position and note that the left rudder pressure required to keep the ball centered is now reduced. Note that the RPM indication goes to zero and the manifold pressure rises to an indication of 27 to 30 inches.

Next, restart the right engine. Push the right fuel shutoff valve ON, advance the right prop control to approximately the 2200 RPM position, advance the right throttle control to approximately 33 inches, and press the right engine starter control. Note that the right manifold pressure goes up to approximately 33 inches, the right tachometer indication goes up to approximately 2200 RPM, and the rudder pressure required to center the ball goes to zero. Airspeed should again settle down to approximately 173 knots with the wings level and a zero climb rate.

35.3 Engine Out Tests at Reduced Power and Airspeed

Reduce the manifold pressure on both engines to 26 inches. Set the gear down and move the wing flap lever to 40°. Use the pitch trim control to achieve an indicated airspeed of approximately 90 knots. The simulator wings should be leveled. The simulator will have a vertical descent rate of approximately 500 to 900 feet per minute.

Next, left engine failure - pull the left fuel shutoff valve OFF, apply right rudder pedal pressure to center the ball, and use the control wheel to achieve a wings level attitude. Important, note that it is now necessary to push the right rudder pedal considerably farther at 90 knots to center the ball than it was at 180 knots. Move the left engine throttle control to the closed position (there should be no gear warning sound since the landing gear is down), and move the left prop control to the feathered position.

Again, note that the tachometer indication decreases to approximately zero RPM, the left alternator light goes ON, and the manifold pressure increases to approximately 29 inches. Note that the rudder pedal pressure had to be reduced in order to keep the ball centered, and also that the amount the rudder moved was more than at the prior setting of approximately 180 knots.

Next, achieve an engine start by moving the left prop control back to its original position at approximately 2200 RPM. Move the left throttle to approximately where it was at 26 inches. Push the shutoff lever ON and press the left engine starter switch. RPM will go back to approximately 2200 RPM and the manifold pressure should go back to approximately 26 inches.

36.0 Fuel Management Switch Function Tests

* When equipped with Variable Scale Plotter Option, refer to Appendix 3 for PRESET instructions.

Establish a normal 65% cruise configuration; manifold pressure 31.5hg, RPM 2200, flight mode switch in the FREEZE position, and transponder to code 4020.

Next, press the flight mode switch to TAKEOFF position. This will put 40 gallons in the inboard tanks and 20 gallons in the outboard tanks.

Next, with both left and right fuel selector switches in the inboard position, note that the fuel quantity gauge indicates 40 gallons plus or minus 4 gallons in each tank. Switch the fuel selector switches to the outboard positions. The fuel quantity indications should drop to 20 gallons plus or minus 4 gallons for both right and left outboard tanks.

XPDR 1011 PRESET

Next, Fuel Management Tests In Flight. Set the right engine fuel selector switch to the OFF position. In approximately 3 seconds the right engine will fail as indicated by the manifold pressure drop. Set the fuel selector switch back to the outboard position and the engine will restart. Switch the crossfeed switch to the ON position and repeat the test with the right fuel selector switch back to the OFF position. No engine failure should occur, but the right fuel quantity indicator should go to zero. Set the crossfeed switch to the OFF position and engine failure should occur in approximately 3 seconds. Set the right engine fuel selector switch to the inboard position and the engine should restart. Repeat the same test with the left fuel selector switch. Move the left fuel selector switch from the outboard position to the OFF position. Left engine failure should occur in approximately 3 seconds and the fuel indication should go to zero. Put the switch back to the outboard position and the engine should restart. Place the left fuel selector switch to the inboard position. The engine should continue to run. Place the crossfeed switch to the ON position, left engine fuel select OFF. The left engine should continue to run without interruption and the fuel quantity indication should go to zero.

37.0 System Fault Panel Functional Tests

KEYLOCK OFF.

PARKING BRAKE ON.

MASTER SWITCH ON.

KEYLOCK ON.

- START ENGINES.
- PROP. CONTROLS MAX RPM POSITION.
- MIXTURE FULL RICH.
- ADJUST THROTTLE CONTROL FOR 1,000 RPM.
- ALTERNATOR CB L/R ON.
- GEAR DOWN.

Annunciator Light Tests

- All pilot annunciator lights OUT.
- All instructor panel annunciator lights OUT.
- PUSH TO TEST, all annunciator lights ON.
- Press Instructor Fault Panel (IFP) NOSE/BAG annunciator light ON.
- NOSE/BAG DR AJAR annunciator light ON.
- Push OFF.

- Push CABIN DOOR IFP light ON.

- Push OFF.

- Repeat with R PNEU INOP.

- Pull RIGHT BOOST PUMP CB.

  * With fuel pumps OFF meter should be in the red. Adjust fuel pressure meter for red line.

- IFP RIGHT FUEL BOOST annunciator light ON.

- R FUEL BOOST INOP light ON.

- Push CB IN.

- Push IFP R LOW FUEL FLOW.

- R LOW FUEL FLOW light ON.

- Push light OFF.

- Push R ALT INOP IFP light ON.

- R ALT INOP light ON.

- Push R ALTERNATOR PUSH TO TEST button.

- ALTERNATOR CURRENT less than 10 AMPS.

- Push R ALT INOP IFP light OFF.

- Push L Alt INOP IFP light ON.

- L ALT INOP light ON.

- Push L ALTERNATOR PUSH TO TEST button.

- ALTERNATOR CURRENT less than 10 Amps.

- Push L ALT INOP IFP light OFF.

- Test L LOW FUEL FLOW IFP annunciator light.

- Pull L BOOST PUMP CB

  * With fuel pumps OFF, meter should be in the red. Adjust fuel pressure meter for red line.

- IFP L BOOST annunciator light ON.

- L Fuel BOOST INOP light ON.

- Push L BOOST PUMP CB IN.

- Test L PNEU INOP IFP light.

- Turn FLAPS ASYMMETRICAL IFP control clockwise until IFP and FLAP annunciator lights go ON.

- Annunciator lights should go ON when control is between 2-3 o'clock.

- Turn IFP FLAPS ASYMMETRICAL control CCW.

- Flap light should go ON when control is between 9-10 o'clock.

- Rotate FLAPS ASYMMETRICAL control to the NORM position.

Landing Gear Fault Mode

* IFP will mean Instructor Fault Panel

- Depress IFP LANDING GEAR NOT UP switch.
- Lift gear handle UP.
- Red light will remain ON indicating GEAR NOT UP and LOCKED.
- Depress IFP GEAR NOT UP switch to NORM.
- Red NOT UP and LOCKED gear light OFF.
- Depress landing gear handle DOWN.
- Depress IFP LANDING GEAR switch to NOT DOWN.
- Lower right green gear light goes OUT.
- Depress IFP GEAR switch to NORM.
- Lower right gear light illuminates.
- Establish 65% Cruise using 31.5 hg, 2200 RPM, and an altitude of approximately 1,500 ft. Maintain straight and level flight.
- LDG GR UP.
- ALTERNATOR CB SWITCH L&R ON.
- PITOT HEAT OFF.
- Surface DEICE OFF.

- Cowl Flaps CLOSED.

- Flaps UP.

- Flight Mode FREEZE.

Prop Speed Governor Control

- Turn LEFT control fully CW.

- Left RPM rises to between 2500 and 3000 RPM.

- Turn LEFT control fully CCW.

- Left RPM drops to bewteen 1,500 and 2,000 RPM.

- Turn LEFT control to NORM.

- Repeat the test using the RIGHT GOVERNOR control.

Cylinder Head Temperature Control

- Turn LEFT control fully CW.

- CYL HEAD TEMP should rise to 440° ± 10°F.

- OIL TEMP should rise to 220° ± 10°F.

- Turn LEFT control fully CCW.

- CYL HEAD and OIL TEMP should drop to 100° ± 20°F and 50° ± 10°F respectively.

- Turn LEFT control to NORM.
- Repeat the test using the RIGHT CYL HEAD Temp control.

Oil Pressure Control

- Turn LEFT control to DEC.
- LEFT OIL pressure decreases to Ø psi.
- Turn control fully CCW to actuate engine fail switch.
- LEFT engine will fail.
- MP will drop to 10".
- RPM will remain at 2,200 RPM.
- Return LEFT OIL PRESSURE control to the NORM position.
- Engine will restart.
- Repeat procedure for RIGHT ENGINE.

Fuel Boost Pressure

- Rotate LEFT control fully CCW.
- LEFT FUEL PRESSURE should drop approximately 8-10 psi.
- LEFT FUEL BOOST INOP annunciator light should illuminate.
- Press LEFT FUEL PUMP switch ON.

- LEFT FUEL PRESSURE should increase 2-3 psi.

- Rotate LEFT control fully CW to the NORM position.

- Repeat the test using the right Fuel Boost Pressure control.

Gyro Pressure

- Rotate GYRO PRESS control fully CCW.

- GYRO PRESS gauge should drop to 3".

- Rotate control fully CW.

Icing

- VSI should indicate 0 FPM.

- Rotate IFP SURFACE control to the MAX position.

- VSI descent rate should indicate 1000 FPM ± 150 FPM.

- Actuate the SURFACE DEICE switch and the VSI will go back to 0 FPM.

- Turn SURFACE DEICE switch OFF.

- Rotate IFP SURFACE ICING control to OFF.

- Rotate IFP PITOT HD ICING control fully CW.

- Indicated airspeed will drop about 90 KNTS ± 10 knots.

- Turn PITOT HEAT switch ON.

- Airspeed will return to initial speed.

- Turn PITOT HEAT SWITCH OFF.

- Rotate IFP PITOT HD ICING control OFF.

Turbulence

- Turn TURBULENCE control to Position 2.

- Moderate ROLL and VSI changes should be observed.

  VSI = UP/DOWN

  ROLL = LEFT/RIGHT

- Turn to Position 5.

- More violent ROLL and VSI changes should occur.

- Rotate control to OFF position.

38.0 Radio Nav. Tests

38.1 Sandy Hook Special Airport/VOR/LOC/ADF

* When equipped with Variable Scale Plotter Option, refer to Appendix 3 for PRESET Instructions.

Map Selection 1

- Flight Mode FREEZE.

- COM1 120.95 (Tower).

- NAV1 108.05 (VOR).

- NAV2 108.05 (VOR).
- ADF 0200 (LOM).
- DME NAV1.
- TRANS 5050.
- Depress Flt Mode SW to TAKEOFF.
- Transponder 0771-PRESET.

Establish Approach Speed

- MP 26".
- RPM 2200.
- Flaps 15°.
- Gear UP.
- VSI 0 FPM.
- Airspeed should be 125 KNTS. ± 10 knots.
- Alt 1500 feet.
- Turn to a 360° HDG by setting NORM/FREEZE switch to NORM.
- When at 360° HDG depress FREEZE switch.

38.2 VOR Indicator Check

Switch RMI to VOR.

* When equipped with Variable Scale Plotter Option, refer to Appendix 3 for PRESET instructions.

- XPDR 0111 (PRESET).
- HSI/VOR/FROM IND 45° ± 6°.
- VOR/FROM IND within ±4° of HSI VOR reading.
- RMI VOR tail 45° ± 10°.
- XPDR 1111 (PRESET).
- HSI VOR/FROM 135° ± 6°.
- VOR/FROM IND ± 4° of HSI VOR.
- RMI VOR tail 135° ± 10°.
- XPDR 2111 (PRESET).
- DME 7.0 ± .2 NM.
- Repeat test for 225°.
- XPDR 3111 (PRESET).
- Repeat test for 315°.

38.3 ADF Indicator Test

Switch RMI to ADF

* When equipped with Variable Scale Plotter Option, refer to Appendix 3 for PRESET instructions.

- XPDR 1211 (PRESET).
- ADF arrow at 270° ± 10°.
- XPDR 1031 (PRESET).
- ADF arrow at 360° ± 10°.
- XPDR 2211 (PRESET).
- ADF arrow at 90° ± 10°.
- XPDR 0011 (PRESET).
- ADF arrow at 180° ± 10°.
- XPDR 0761 (PRESET).
- ADF arrow at 225° ± 10°.
- Establish a right standard rate turn on TURN COORDINATOR.
- TRIM for 0 VSI ± 100 FPM.
- PUSH FREEZE TO NORM.

- Make 360° TURN and note RMI arrow should track within ±5° as the turn is made.
  Stop turn at 360°
  Check L/R standard rate turns 2 minutes ± 2 sec.

39.0 Turns During Flight Test

- Preset altitude to between one and two thousand feet.

- GEAR UP, FLAPS 0°, COWL FLAPS/CLOSED.

- Achieve straight and level flight.
  VSI 0 FPM
  Use appropriate MP to maintain 180 knots.

- Initiate a SRT (Standard Rate Turn) to the right or left without changing the pitch attitude. This is accomplished by only turning the control yoke until the turn coordinator shows a standard rate turn.

- The VSI should show a descent rate of -100 to -200 feet per minute.

- The attitude indicator should show a 24° ± 5° bank angle.

- Use the control yoke to establish a bank angle of 45° without changing the pitch attitude.

- The A/S should remain unchanged at 180 KNTS ± 8 knots.

- The VSI should indicate -250 to -350 FPM.

- Set MP to 22", RPM 2200,VSI 0 FPM.

- Achieve straight and level flight.

- Use FLAPS to adjust and maintain A/S at 100 knots.

- Initiate a R or L SRT.

- VSI should indicate -100 to -200 FPM.

- Bank angle should indicate 15° ± 4°.

40.0 Glide Slope Approach Test

* When equipped with Variable Scale Plotter Option, refer to Appendix 3 for PRESET instructions.

XPDR 1021 PRESET

- RMI to ADF position.

- TURN MKR AUDIO toggle switch to UP position.

- NAV1 108.15 (SANDY HOOK ILS FREQ).

- HSI glide Slope Flag should just come into view on top side of Glide Slope indication within 10 secs.

- TURN HSI arrow to 360°.

- HSI LOC needle should be centered ±½ DOT.

- APPROACH SPEED set up should still be the same as in 38.1 above.

- Set Wind velocity to zero.

- NAV2 108.05 (SANDY HOOK VOR).

- DME NAV2 10.0 ± .5 NM.

- DME NAV1 10.0 ± .5 NM.

- PUSH FREEZE to NORM.

- KEEP HSI LOC needle centered and maintain 1500 feet.

- GLIDE SLOPE indicator should smoothly move down from top "out of view" position at approximately NAV1 DME reading of 6.5 ± .5 NM.

- PUSH FREEZE and note DME reading.

- PUSH NORM and continue flying.

- When GLIDE SLOPE needle is almost down to ON G/S position (centered) PUSH landing gear handle DOWN.

- This should occur at about 5.2 ± .2 NM (with A/C altitude still at 1500 feet). The (OM) blue marker light should flash and AUDIO should sound. Station passage should be indicated on the RMI by the needle swinging from 360° to 180° at 5.0 ± .2NM.

- With the GEAR DOWN a descent rate of approximately 500 FPM ± 200 FPM should be indicated.

- Track the G/S down making slight pitch and roll corrections as necessary with the control yoke.

- When the (MM) orange light flashes and audio is heard, depress the FREEZE switch.

- Note NAV 1 DME of .7 ± .2 NM.

- Push VERIFY FLD IN SIGHT button - button should illuminate.

- Push FREEZE to NORM and continue down G/S.

- INNER marker (A) should flash briefly at .3 ± .2 NM.

- TOUCHDOWN should occur at a NAV1 DME of 0 ± .2 NM. Apply brakes and decelerate A/C to a stop.

- During the entire G/S approach to the MM the HSI LOC needle and the G/S indicators should have displayed smooth motion with no sticking or irratic motion.

- Turn simulator KEYLOCK OFF.

41.0 Plotter Test

* When equipped with Variable Scale Plotter Option, refer to Appendix 3 for PRESET instructions.

Connect Plotter to simulator

- TURN POWER SWITCH on plotter ON.

- PUSH PLOTTER PEN selector switch on lower subpanel of simulator UP.

- Align rectangular coordinate .1 inch graph paper on the plotter surface.

Turn Simulator KEYLOCK ON

- Push NORM/FREEZE switch to FREEZE.

- Turn MAP Selector to 1.

- Push PLOTTER scale selector switch to 10 NM/in.

- Set COM1 to 120.95.

- Push PRESET/TAKEOFF switch to TAKEOFF.

- Push PLOTTER PEN selector switch DOWN.

- Carefully align the bottom horizontal line on the graph paper with the + and - alignment marks on the plotter surface. Simultaneously position the paper so that the point of the plotter pen rests on an X/Y coordinate intersection.

- XPDR 0660 (PRESET).

- PEN should move 3.0 ± .05" to the right and 3.0 ± .05" up.

- Push PLOTTER SCALE SELECTOR SWITCH TO 15 NM/IN.

- Pen will move .5 ± .05" to the left of start point and .5 ± .05" down.

- Push PRESET.

- PEN should not move in X or Y but should lift UP for approximately 1 second then go down again.

42.0

Audio Headset Test

- Connect pilot's headset to Simulator Panel.
- Connect instructor's headset to Fault Panel.
- Turn KEYLOCK ON.
- The COM1 VOL Control selects the pilot's headset volume.
- Speak into the instructor's mike. The instructor's voice should be audible through the pilot's headset. Check the pilot's VOL control operation on the COM1 receiver.
- The instructor cannot hear his own voice in his headset.
- The pilot's voice can be heard on both pilot and instructor headsets when the pilot depresses the push to talk mike switch on the control yoke.
- Transmit through the pilot's mike and check instructor's VOL control by rotating the VOL control knob located on the instructor fault panel.

43.0 Switch Position Table

L/R Master Switch	OFF
L/L Magneto Switch	OFF

R/R Magneto Switch	OFF
CB Fuel Boost Pump L	IN
CB Fuel Boost Pump R	IN
CB Cowl Flap Left	IN
CB Cowl Flap Right	IN
CB Starter/Flap Sol	IN
CB Cowl Flap Motor	IN
L/R Alternator Switch	OFF
Pitot Heat	OFF
Surface Deice	OFF
L/R Fuel Pump SWS	OFF
Cowl Flaps	CLOSED
Wing Flap Control	UP
NORM/FREEZE SW	FREEZE
Plotter Scale Selector	15 NM/IN
Plotter Pen SW	UP
Map Selector	POSITION 1
Keylock	OFF

Fuel Mgmt.

Cross Feed	OFF
L Cut Off	PUSH
R Cut Off	PUSH
L Fuel Select	OFF
R Fuel Select	OFF

Power Quadrant

L/R Throttles	CLOSED
L/R Prop Control	INC MAX
L/R Mixture	CUT OFF

Radios

Transponder	OFF
COM 1	OFF
ADF	OFF
NAV 1	OFF
DME	OFF
NAV 2	OFF
Parking Brake	ON (Pull)

Fault Panel

All controls	NORMAL or OFF
ILS Runway Selector	POSITION 2
Wind Velocity	ZERO

44.0 Simulator - Engine Startup and Run Tests

44.1 Simulator Turn ON

Put all switches as shown in Switch Position Table 43.0.
Turn KEYLOCK ON.
Simulator initializes

- Altimeter goes to 12' ± 10 feet.
- MP indicates 27 to 30 inches.
- Panel lamps ON.
- HSI lamps ON.

- Turn PANEL LIGHT Control from DIM to BRIGHT and note change in post lamp brightness.

- Check all panel lights ON.

- Verify card file cooling fan ON.

- RMI, HSI and MAG COMP all read 360 ± 3°.

- Set clock to correct time and check operation.

- Set RED HANDS to show 12:15 o'clock.

- A/H indicates 0° ± 5° ROLL.

- TURN COORDINATOR indicates 0 ± 1/4 SRT.

- SLIP BALL centered with rudders at neutral.

- LANDING GEAR LIGHTS show 3 down and locked.

- PUSH TO TEST 4 landing gear lights.

- Push LANDING GEAR SW UP.

- Three green lights go OUT, red light goes ON, 6 secs ± 2 secs later red NOT LOCKED light goes OFF.

- Move throttles forward 1" to stop gear warning sound.

- Push LANDING GEAR SW DOWN.

- Push SEAT BELTS sign ON.

- Push NO SMOKING sign ON.

44.2 Cockpit - Panel Tests

Turn MASTER SWITCH L and R ON.

- Depress push to test annunciator light switch.
- All annunciator lights should illuminate.
- L/R PNEU INOP and L/R ALT INOP annunciator lights should be ON.
- Turn LEFT FUEL SELECT switch to INBOARD.
- Left FUEL QTY gauge should indicate 53 ± 4 gals.
- Left FUEL PRESS 35 ± 4 PSI.
- Turn LEFT FUEL SELECT to OUTBD.
- Left FUEL PRESS 35 ± 4 PSI.
- Left FUEL QTY 37 ± 4 gals.
- Pull LEFT BOOST PUMP CB.
- Left FUEL BOOST INOP annunciator light goes ON.
- Left FUEL PRESS gauge goes to 0 ± 3 PSI.
- Push LEFT boost pump CB IN.

- Push LEFT FUEL PUMP switch ON.
- FUEL PRESS goes to 46 ± 4 PSI.
- Turn RIGHT FUEL SELECT switch to INBOARD.
- Right FUEL QTY gauge should indicate 53 ± 4 gals.
- Right FUEL PRESS 35 ± 4 PSI.
- Turn RIGHT FUEL SELECT to OUTBD.
- Right FUEL PRESS 35 ± 4 PSI.
- Right FUEL QTY 37 ± 4 gals.
- Pull RIGHT BOOST PUMP CB.
- Right FUEL BOOST INOP annunciator light ON.
- Right FUEL PRESS gauge goes to 0 ± 3 PSI.
- Push RIGHT BOOST PUMP CB IN.
- Push RIGHT FUEL PUMP switch ON.
- FUEL PRESS goes to 46 ± 4 PSI.
- Turn ALTERNATOR CB switch LEFT and RIGHT ON.
- ALTERNATOR CURRENT - 50 amps.
- EGT L&R less than 800°F.

- OIL press L&R less than 10 PSI.

- CYL TEMP L&R less than 200°F.

- OIL TEMP L&R less than 125°F.

Turn ON all Radios and TRANSPONDER to STY.

- ILS RWY SELECT to position 1.
- Reinitialize by turning KEYLOCK OFF, then ON.
- TRANSPONDER should indicate 5337.
- COM 1 119.10
- ADF 0373
- NAV 1 109.50
- DME . . . (positioned to NAV 2)
- DME 00.0 ± .2 (positioned to NAV 1)
- NAV 2 112.30
- AUDIO panel HI-LO-TEST switch to TEST.
- A/O/M marker lights ON when in TEST position.

44.3 Engine Startup Tests

Turn ENGINE AUDIO VOL control 3/4 loud.
Push LEFT ENGINE STARTER ON.

- Engine sound should indicate engine cranking.

- Left RPM should go to 450 ± 50 RPM.

- Left MP should drop to 10" MP.

- Left PNEU INOP annunciator light should go OUT.

- Engine will NOT start (since left magneto switches are OFF).

Turn RIGHT ENGINE STARTER ON.

- Same observations except for RIGHT engine.

44.4 LEFT Engine

Start LEFT ENGINE

- Turn both left engine magneto switches ON.
- Move left throttle control to the CLOSED position.
- Move left PROP CONTROL full forward.
- Engage LEFT ENGINE STARTER switch for approximately 5 seconds.
- Disengage starter and before the LEFT RPM drops move the LEFT MIXTURE control from IDLE CUTOFF to RICH.
- Engine should run.
- LEFT RPM at 600 ± 50 RPM.
- LEFT MP at 10" ± 1.0".
- Move MIXTURE control to IDLE CUTOFF position.
- Engine should stop in approximately 2 to 5 seconds.
- Engage LEFT STARTER switch and hold engaged.

- Slowly advance the MIXTURE control from the cutoff position until engine just starts. Engine start should occur when the MIXTURE control is positioned 1/4 to 3/4 inches from the CUTOFF position.

- Push L MIX Control to RICH.

- Set THROTTLE in CLOSED position.

- GYRO PRESS gauge 4.5 to 5.5 PSI (with either engine running).

- Slowly advance the LEFT throttle and note the RPM indication when the L ALT INOP annunciator light goes OUT. L RPM should indicate between 620 and 750 RPM. ALTERNATOR current should indicate 0 AMPS.

- Move LEFT throttle back to the CLOSED position.

- OIL PRESS 25 to 40 PSI.

- Slowly move the LEFT THROTTLE to 2000 RPM.

- Turn the left LEFT MAGNETO switch OFF.

- RPM should drop approximately 150 to 175 RPM.

- Turn the left LEFT MAG switch ON.

- Turn the right LEFT MAG switch OFF.

- RPM should drop approximately 150 to 175 RPM.

- Turn the left LEFT MAG OFF.
- Engine should STOP running in approximately one to three seconds.
- Turn both LEFT MAG switches ON.
- Press LEFT STARTER.
- LEFT engine should start.
- Move PROP control to FEATHER position.
- RPM will quickly decay. When L ALT INOP light goes ON move PROP control back to maximum position.
- Move LEFT throttle to fully OPEN position.
- LEFT mixture to full RICH position.
- LEFT MP should indicate 43 ± 1".
- LEFT RPM 2575 ± 50 RPM.
- LEFT EGT 1400°F.
- LEFT OIL PRESS 85 ± 10 PSI (but not in the yellow).
- Adjust L MIX Control toward LEAN until L EGT = 1500°F.
- LEFT CYL 370° ± 30°F. Adjust fault panel as RQD.

- LEFT OIL TEMP 185° ± 15°F. Adjust fault panel as RQD.

- Slowly move LEFT MIX control toward LEAN and carefully adjust for a max. EGT temperature. Temperature should indicate above 1650°F.

- Reduce LEFT throttle until LEFT CYL temp reads 400°F.

- LEFT OIL TEMP should drop approximately 25°F to 200° ± 25°F.

- Move LEFT COWL FLAP to the OPEN position.

- LEFT CYL and OIL TEMP should drop approximately 75° to 125° and 50° to 70°F respectively.

- Close LEFT COWL FLAP.

- Shut down left engine by moving the LEFT mixture control to IDLE CUTOFF.

44.5 Right Engine

Go to paragraph 44.3 above and repeat all tests for the RIGHT ENGINE.

45.0 Taxi Tests

* When equipped with Variable Scale Plotter Option, refer to Appendix 3 for PRESET instructions.

Set transponder to 5337

- Push PRESET switch to TAKEOFF (this fills the tanks).

Start L&R engines and set to full power (throttles, PROPS and MIXTURES fully forward).

Brake tests.

- Pull PARKING BRAKE ON.
- Push NORM/FREEZE switch to NORM.
- Landing gear DOWN.
- Turn COM 1 to 120.95.
- Turn NAV 1 to 108.15.
- Turn NAV 2 to 108.05.
- Turn ADF to 0200.
- Turn MAP SELECT to Position 1.
- ILS RWY SELECT to Position 2.
- Press FLIGHT MODE switch to TAKEOFF.
- Turn DME selector switch to NAV 1.
- DME should read 0 ± .1 NM.
- Set PITCH TRIM wheel for slight nose down trim as indicated by PITCH TRIM indicator.

- Push PARKING BRAKE IN.

- Use rudder pedals and turn to a heading of 360°.

- Pull PARKING BRAKE ON.

- Press FLIGHT MODE switch to TAKEOFF.

- Push PARKING BRAKE OFF.

- Use rudder pedals to maintain heading of 360°.

- Note airspeed increasing.

- Note DME increasing from 0 to .1 NM.

- When DME reads .4 NM depress both rudder pedal TOE BRAKES to maximum deflection and simultaneously pull both throttles to IDLE.

- Note airspeed decays to 55 KNTS (DME stops at .6 ±.1 NM) 51.671 no stop.

- Pull PARKING BRAKE ON.

- Press TAKEOFF switch.

- Push PARKING BRAKE OFF.

- Apply full RIGHT RUDDER pedal deflection.

- Slip ball should deflect fully to the left.

- TURN RATE should indicate right turn in excess of SRT.

- A 180° turn should require 20 to 35 secs.

- Repeat the test using full left rudder pedal deflection.

- Pull PARKING BRAKE ON.

- Put GEAR DOWN.

- COWL FLAPS open.

- Press PARKING BRAKE OFF.

- Measure time required to reach 100 KNTS. It should require 17.3 secs.± 3 secs.

- Turn power OFF.

46.0 Connect Elapsed Time Meter and Verify Operation

APPENDIX 1

1.0 FUEL FLOW METER AND RATE ADJUSTMENTS

If the fuel flow meter is not supplied with the system under test, install an arbitrary meter, temporarily, to make the Fuel Flow Meter Full Scale and Fuel Flow Rate Adjustments.

2.0 FUEL FLOW METER FULL SCALE ADJUSTMENTS

Both mags ON.
Throttle controls full forward.
Prop controls full forward.
Mixture controls full forward.
Prop speed governor centered (on fault panel).
Airspeed = 0

Adjust R4 (R10) for a reading of 255 lbs/hr on the respective Fuel Flow meters.

3.0 FUEL FLOW RATE ADJUSTMENT CONDITIONS

A. Insure conditions and adjustments described in 2.0.

B. Set throttles to achieve indicated fuel flow of 100 lbs per hour on each engine.

C. Adjust left and right Fuel Flow Rates to 161 pulses per second. Reference Figure 2.

With frequency counter connected to G04 pin 3 adjust R49.
With frequency counter connected to (F04 pin 3) adjust (R123).

4.0 FUEL FLOW RATE ADJUST WITHOUT FUEL FLOW METER

(See Figure 2)

A. Set prop and mixture controls full forward.

B. Set throttles to 30 inches of manifold pressure.

C. Connect frequency counter to G04-3 and adjust R49 for 320 Hz.

D. Move frequency counter to F04-3 and adjust R123 for 320 Hz.

APPENDIX 2

1.0 ATTITUDE INDICATOR CHECK DURING TEST AND ALIGNMENT

1. Adjust ± 12V power supplies if necessary (12V± .012).

2. Measure the ±12V at the attitude pot.

3. Attach DVM to center tap of pot and ground on the backplane.

4. Initialize the 810 system without engines running. (FREEZE/ TAKEOFF mode)

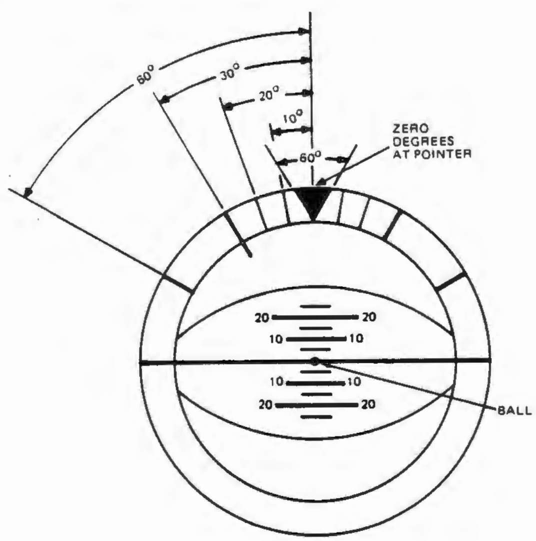
5. The voltage at the center tap should be less than 20mV.

6. Check that dial equals 0°.

7. Ball aligned to A/H dial.

8. Ball to center.

9. Preset to 1500 feet and fly unit. Check for ± .020V on center tap of pot at straight and level.



APPENDIX 3

1.0 VARIABLE SCALE PLOTTER OPTION

SCOPE:

This option allows any flight chart (low altitude enroute, approach plates, etc.) scaled from 3 to 15 NM per inch, to be used on the ATC-810 Simulator. The ability to preset radial, distance and altitude from any airport or navaid and the ability to load the tanks with a selected amount of fuel is also provided in this option.

In order to utilize these functions, a separate setup mode is entered.

The 150 x 150 NM flight area of the selected map remains the same regardless of the plotter scale selected.

2.0 DESCRIPTION:

There are six selectable modes:

1) Center Frequency Selection- An airport, ILS, VOR or ADF frequency is selected by the respective COM1, NAV1 or ADF radio. The airport or navaid selected will be the center of the plotting area. See Chart Centering.

2) Map Scale Selection - The scale, in nautical miles per inch, is selected using the transponder. The range is 03.00 to 15.00 NM per inch and is displayed in the XPDR window.

3) Preset Location - Simulator position to be preset is selected by setting any one (COM1, NAV1 or ADF) radio to the desired tower or navaid frequency.

4) Radial and Distance Offset - The angle and distance of simulator position from the airport or navaid selected in Step Three above, can be selected in this mode. Enter the angle (0-359°) in the ADF radio. Enter the distance (00.00-49.99 NM) in the transponder.

5) Altitude Preset - The Simulator altitude above an airport or navaid selected in Step Three can be set in this mode. Enter the altitude (0000-9999 ft.) in the transponder. Note preset altitude is referenced to sea level, not the altitude at the navaid.

6) Fuel Tank Preset - The fuel amount loaded in each tank is selected in this mode. Set inboard amount in the most significant two digits of the transponder. Set outboard amount in the least significant two digits. The maximum amount of fuel each tank holds is printed on the Fuel Management Panel. Entering more fuel than amount printed will result in an erroneous amount.

Anytime TAKEOFF is depressed, the tanks will be loaded with the selected fuel quantity.

3.0 OPERATION:

1) To enter setup mode:

- Place Simulator in FREEZE
- Audio/Transponder in STBY, press IDENT

The aircraft attitude will be frozen. Mode 1 of setup mode will be entered and Mode 1 displayed in the DME window. When setup mode is entered, 01 will be displayed.

2) Make selection according to mode displayed (see Mode Description 1 through 6), then press IDENT. Pressing IDENT stores the selection then steps to the next mode. Six modes of information can be preset in this manner. The cycle will repeat after mode six.

3) To exit from setup mode, do any one of the following:

   a) Press NORM/PRESET switch to NORM. The flight in process before entering setup mode will continue from that point.

   b) Press PRESET/TAKEOFF switch to TAKEOFF. The tanks will be loaded with the fuel quantity selected in mode 6 of the setup mode. Simulator will be positioned on the runway selected by the previous COM radio and runway setting selected before entering the setup mode.

   c) Press PRESET/TAKEOFF switch to PRESET. The simulator will be positioned to the airport or navaid selected by mode 3, offset by the radial and distance selected by mode 4 and altitude set by mode 5.

4.0 PLOTTER CHART CENTERING

Initial plotter centering procedure

- Turn keylock OFF then ON.

- Plotter scale switch to 15 NM/in.

- Transponder in STBY.

- FREEZE/NORM switch to FREEZE

- Push IDENT 3 times (set up mode 3 is entered; 03. is displayed in DME window).

- NAV 1 to 115.90 - Push IDENT (DME: 04.).

- Push PRESET.

- Align the bottom and left border of a standard ATC 15 NM/in. New York area plotter chart (B00 499.0230-1) with the + and - alignment marks on the plotter. Adjust plotter so that the pen point is located directly above the Kennedy VORTAC symbol (115.90).

5.0 CHART CENTERING EXAMPLE

For convenience, we will use the 10 NM/in. New York area plotter chart (B00 499.0230-0) and select Doylestown NDB (237) to be the center.

- Plotter scale switch to 15 NM/in.

- Transponder in STBY.

- FREEZE/NORM switch to Freeze.

- Push IDENT (setup mode 1 entered; DME: 01.).

- ADF to 237 - Push IDENT (DME: 02.) (selects NDB 237 as plotter center).

- XPDR to 1000 - Push IDENT (DME: 03.) (selects map scale of 10 NM/in.).

- ADF to 237 - Push IDENT (DME: 04.) (selects NDB 237 as simulator pre-position).

- XPDR to 0000

- ADF to 0000 - Push IDENT (DME: 05.) (selects offset from navaid 0000 NM at 0000 degrees).

- XPDR to 0000 - Push IDENT (DME: 06.) (selects altitude of zero feet above sea level).

- XPDR to 5337 - Push IDENT (DME: 01.) (loads 53 gal. in inboard tanks, 37 gal. in outboard tanks).

- Push Preset.

- The plotter pen point is now located above the Doylestown NDB. Align the 10 NM/in. New York chart so that the plotter pen point is located over the Doylestown NDB symbol and the lower border is parallel to the plotter + and - alignment marks.

- Any 3 to 15 NM/in. chart can be centered in this manner. Be sure, in all cases, that magnetic North/South line of the symbol being aligned is parallel to the plotter Y axis.

6.0 SYSTEM TEST REQUIREMENT

The following sections of PN B001.0406 OT are replaced by the Variable Scale Plotter Option.

6.7

9.0

10.0. 10.1

11.0

13.1, 2, 3, 4

14.

All other sections of B001.0406 OT will operate as originally specified.

Procedure:

- Install option per 2.2343 OH.

- Follow original B001.0406 OT substituting new sections specified.

6.7 Airspeed Gauge Adjustment

- Turn COM 1 Volume control ON.

- COM 1 to 120.95.

- Push NORM/FREEZE switch to FREEZE.

- MAP SELECT to #1.

- ILS RWY SELECT on Instructor Fault Panel to 2.

- Start L&R engines.

- Set MP to 31.5" and RPM to 2200.

- GEAR UP.

- COWL FLAPS CLOSED.

- FLAPS 0°.

- Push IDENT 3 times (enter setup mode 3, DME: 03.).

  - COM 1 to 120.95 - Push IDENT (DME: 04.)

  - XPDR to 0500

  - ADF to 0180 - Push IDENT (DME: 05.)

  - XPDR to 1500 - Push IDENT (DME: 06.)

- Push PRESET.

- Maintain wings level and 0 FPM rate of climb.

- Reference Figure 4.

- After achieving stable flight and 0 VSI, carefully adjust R297 on the COM 1/ADF board for an airspeed of 166 knots.

9.0 FLIGHT CHARACTERISTIC TESTS

- Turn KEYLOCK ON.

- COM 1 to 120.95.

- MAP SELECT to #1.

- Start L&R engines.

- Set MP to 31.5" and RPM to 2200.

- GEAR UP.
- COWL FLAPS CLOSED.
- FLAPS 0°.
- NORM/FREEZE switch to FREEZE.
- Push IDENT 3 times (enter setup mode 3, DME: 03.)
    - COM 1 to 120.95 - Push IDENT (DME: 04.)
    - XPDR to 0500
    - ADF to 0180 - Push IDENT (DME: 05.)
    - XPDR to 1500 - Push IDENT (DME: 06.)
- Push PRESET.
- NORM/FREEZE switch to NORM.
- Maintain wings level and 0 FPM rate of climb.

10.0 ENGINE OUT TESTS

- COM 1 to 120.95.
- Push IDENT 3 times (enter setup mode 3, DME: 03.).
    - COM 1 to 120.95 - Push IDENT (DME: 04.)
    - XPDR to 0500

- ADF to 0180 - Push IDENT (DME: 05.)

- XPDR to 1500 - Push IDENT (DME: 06.)

- MAP SELECT to Position 1.

- ILS RWY SELECT 2.

10.1 Left Engine Failure/Rudder Pedal/Feather Test

- Establish a 75% cruise configuration as follows:

  - Push TAKEOFF

  - Push PRESET

  - Manifold pressure: 33.7 inches

  - RPM: 2200

  - COWL Flaps Closed

  - GEAR UP

  - Wing Flaps Up

  - Wings Level

  - Climb Rate or Vertical Speed: Zero

  - Airspeed should indicate approximately 177 knots (± 6 Knots)

  - Set the flight mode switch in the FREEZE position

- Reset the altitude to 1500 feet (Push PRESET)

COMMENT:

During this engine failure mode test, disregard the need to maintain a vertical speed of zero feet per minute. Allow the aircraft pitch attitude to fall, it is not necessary to keep it level. It will only be necessary to use the control yoke to keep the wings approximately level as indicated by the attitude indicator. Press the rudder pedals so that the ball is centered.

Pull the left fuel shutoff valve to the OFF position. Immediately apply hard right rudder pedal pressure until the ball is centered while simultaneously keeping the wings level. The left manifold pressure gauge should indicate 10 inches and the RPM should remain at 2200.

Next, pull the left throttle to the fully closed position, note the gear warning sound, then advance the left throttle control until the gear warning sound just goes off. Move the left prop control to the feathered position and note that the rudder pedal pressure required to keep the ball centered is now reduced. Engine RPM should drop to zero and the left alternator inop light should illuminate. The manifold pressure indicating 10 inches should slowly rise to a reading of 27 to 30 inches.

Next, push the left fuel shutoff valve DOWN, move the left engine prop control back to its original position and move the left throttle back to where it was at approximately 33 inches of manifold pressure.

Next, press the left engine starter switch. The rudder pedal pressure required to maintain proper steering control should be reduced to zero, the wings should return to level, the manifold pressure should return to approximately 33 inches, and the RPM should have risen to approximately 2200 RPM. The left engine control should now be readjusted back to the orginal cruise configuration and the entire sequence will now be repeated for a right engine failure test.

11.0 FUEL MANAGEMENT SWITCH FUNCTION TESTS

Establish a nominal 65% cruise configuration; manifold pressure 31.5 hg., RPM 2200, the flight mode switch in the FREEZE position. Push IDENT 6 times (causes entry into setup mode 6, DME: 06.), set the transponder code to 4020, push IDENT (DME: 01.).

Next, press the flight mode switch to TAKEOFF. This action will put 40 gallons in the inboard tanks and 20 gallons in the outboard tanks.

Next, with both left and right fuel selector switches in the inboard position, note that the blue fuel quantity indication should be 40 plus or minus 4 gallons. Switch the fuel selector switches to the outboard positions. The fuel quantity indications should drop to 20 gallons plus or minus 4 for both right and left tanks.

Push IDENT 3 times (enter setup mode 3, DME: 03.)

- COM 1 to 120.95 - Push IDENT (DME: 04.).

- XPDR to 0500.

- ADF to 0180 - Push IDENT (DME: 05.).

- XPDR to 1500 - Push IDENT (DME: 06.).

- Push PRESET.

Next, Fuel Management Tests In Flight. Put the right engine fuel selector switch to the OFF position. In approximately 3 seconds, the right engine will fail as indicated by the manifold pressure drop. Put the fuel selector switch back to the outboard position and the engine will restart. Switch the crossfeed switch to the ON position and repeat the test with the right fuel selector switch back to the OFF position. No engine failure should occur, but the right fuel quantity indicator should go to zero. Put the crossfeed switch to the OFF position and engine failure should occur in approximately 3 seconds. Put the right engine fuel selector switch to the inboard position and the engine should restart. Repeat the same test with the left fuel selector switch. Move the left fuel selector switch from the outboard position to the OFF position. Left engine failure should occur in approximately 3 seconds and the fuel indication should go to zero. Put the switch back to the outboard position and the engine should restart. Place the left fuel selector switch in the inboard position. The engine should continue to run. Place the crossfeed switch in the ON position, left engine fuel selector OFF. The left engine should continue to run without interruption and the fuel quantity indication should go to zero.

13.1 Sandy Hook Special Airport/VOR/LOC/ADF

- Map Selection 1

  - Flight Mode Freeze

  - COM 1 120.95

- NAV 1 108.05 (VOR)
- NAV 2 108.05 (VOR)
- ADF 0200 (LOM)
- DME NAV 1
- Push IDENT 3 times (enter setup mode 3, DME: 03.)
    - COM 1 120.95 - Push IDENT (DME: 04.)
    - XPDR 4950
    - ADR 0045 - Push IDENT (DME: 05.)
    - XPDR 1500 - Push IDENT (DME: 06.)
    - XPDR 5050 - Push IDENT (DME: 01.)
- Push TAKEOFF
- Push PRESET

- Establish Approach Speed
    - MP 26"
    - RPM 2200
    - Flaps 15°
    - GEAR UP

- VSI 0 FPM
- Airspeed should be 125 KNTS. ± 10 knots
- Alt. 1500 feet.
- Push the NORM/FREEZE switch to NORM
- Turn to 360°
- When at 360° HDG push FREEZE

13.2 VOR Indicator Check

- Push IDENT 4 times (enter setup mode 4, DME: 04.)
    - XPDR 0707 - Push IDENT (DME: 05.)
    - Push PRESET
- HSI VOR/FROM 45 ± 6°
- VOR/FROM IND within ± 4° of HSI VOR reading
- RMI VOR tail 45 ± 10°
- Push IDENT 4 times
    - ADF 0135 - Push IDENT (DME: 05.)
    - Push PRESET
- HSI VOR/FROM 135 ± 6°

- VOR/FROM IND ± 4° of HSI VOR
- RMI VOR tail 135 ± 10°
- Push IDENT 4 times
    - ADF 0225 - Push IDENT (DME: 05.)
    - Push PRESET
- DME 7.0 ± .2 NM
- HSI VOR/FROM 225 ± 6°
- VOR/FROM IND ± 4° of HSI VOR
- RMI VOR tail 225 ± 10°
- Push IDENT 4 times
    - ADF 0315 - Push IDENT (DME: 05.)
    - Push PRESET
- HSI VOR/FROM 315 ± 6°
- VOR/FROM IND ± 4° of HSI VOR
- RMI VOR tail 315 ± 10°

13.3 ADF Indicator Test

- Switch RMI to ADF

- Push IDENT 3 times (enter setup mode 3, DME: 03.)
    - ADF 0200 - Push IDENT (DME: 04.)
    - XPDR 1000
    - ADF 0090 - Push IDENT (DME: 05.)
    - Push PRESET
- ADF arrow at 270 ± 10°
- Push IDENT 4 times (enter setup mode 4, DME: 04.)
    - ADF 0180 - Push IDENT (DME: 05.)
    - Push PRESET
- ADF arrow at 360 ± 10°
- Push IDENT 4 times
    - ADF 0270 - Push IDENT (DME: 05.)
    - Push PRESET
- ADF arrow at 90 ± 10°
- Push IDENT 4 times
    - ADF 0000 - Push IDENT (DME: 05.)
    - Push PRESET
- ADF arrow at 180 ± 10°

- Push IDENT 4 times
  - XPDR 4300
  - ADF 0035 - Push IDENT (DME: 5.)
  - Push PRESET
- ADF arrow at 215 ± 10°
- Establish a right standard rate turn on TURN COORDINATOR
- TRIM for 0 VSI ± 100 VSI
- Push FREEZE to NORM
- Make 360° TURN and note RMI ADF arrow should track within ± 5° as the turn is made.
- Stop turn at 360°

13.4 Glide Slope Approach Test

- Push IDENT 3 times (enter setup mode 3, DME: 03.)
- COM 1 120.95 - Push IDENT (DME: 04.)
- XPDR 1000 = 10 NM
- ADF 0180 - Push IDENT (DME: 05.)
- Push PRESET

- RMI to ADF position

- TURN MKR AUDIO toggle switch to UP position

- NAV 1 108.15 (SANDY HOOK ILS FREQ)

- HSI glide Slope Flag should just come into view on top side of Glide Slope indicator within 10 secs.

- Turn HSI arrow to 360°.

- HSI LOC needle should be centered ± ½ DOT.

- APPROACH SPEED set up should still be the same as in 13.1 above.

- Set Wind velocity to zero.

- NAV 2 108.05 (SANDY HOOK VOR)

- DME NAV 2 10.0 ± .5 NM

- DME NAV 1 10.0 ± .5 NM.

- PUSH FREEZE to NORM.

- KEEP HSI LOC needle centered and maintain 1500 ft. alt.

- GLIDE SLOPE indicator should smoothly move down from top "out of view" position at approximately NAV 1 DME reading of 6.5 ± .5 NM.

14.0 PLOTTER TEST

- Connect Plotter to simulator
    - TURN POWER SWITCH on plotter to ON.
    - PUSH PLOTTER PEN switch UP.
    - Align rectangular coordinate .1 inch graph paper on the plotter surface.
- TURN Simulator KEYLOCK ON.
    - PUSH NORM/FREEZE switch to FREEZE
    - Turn MAP Selector to 1
    - Push Plotter scale selector switch to 10 NM/in.
    - Set COM 1 to 120.95
    - Push IDENT (enter setup mode 1, DME: 01.)
    - COM 1 120.95 - Push IDENT (DME: 02.)
    - XPDR 1500 - Push IDENT (DME: 03.)
    - COM 1 120.95 - Push IDENT (DME: 04.)
- PUSH TAKEOFF switch.
- PUSH PLOTTER PEN selector switch DOWN.

- Carefully align the bottom horizontal line on the graph paper with the + and - alignment marks on the plotter surface. Adjust plotter so that the pen point is located on an X/Y coordinate intersection.

    - Push IDENT 4 times (enter setup mode 4, DME: 04.)

    - XPDR 4243

    - ADF 0045 - Push IDENT (DME: 05.).

- Push PRESET.

- PEN should move 3.0 ± .05" to the right and 3.0 ± .05" up.

- PUSH PLOTTER SCALE to 15 NM/in.

- PEN will move to .5 ± .05" to the left of start point and .5 ± .05" down.

- Push PRESET.

- PEN should not move in X or Y but should lift UP for approximately 1 second then go down again.

- Push TAKEOFF.

- Push PLOTTER PEN selector switch UP.

- Readjust plotter so that the pen point is located on the X/Y coordinate intersection 5" from the left and bottom borders.

- Push PLOTTER PEN selector switch down.
- Push IDENT twice (enter setup mode 2, DME: 02).
  - XPDR 0300 - Push IDENT twice (DME: 04.)
  - XPDR 1273
  - ADF 0315 - Push IDENT (DME: 05.)
- Push PRESET
- PEN should move 3.0 ± .05" to the left and 3.0 ± .05" up.
- Push IDENT twice (enter setup mode 2, DME: 02.).
  - XPDR 0725 - Push IDENT twice (DME: 04.)
  - XPDR 3076
  - ADF 0225 - Push IDENT (DME: 05.)
- Push PRESET.
- PEN should move 3.0 ± .05" to the left and 3.0 ± .05" down.
- Push IDENT twice (enter setup mode 2, DME: 02.).
  - XPDR 1133 - Push IDENT twice (DME: 04.)
  - XPDR 4808

- ADF 0135 - Push IDENT (DME: 05.)

- Push PRESET.

- PEN should move 3.0 ± .05" to the right and 3.0 ± .05" down.

HOLD68(A)

810 TEST MODE PROGRAMS

TEST NO.	
0	Microprocessor Checks. Switches.
1	Transponder, ADF, Panel
2	COM, NAV2, NAV2, Panel Switches.
3	Numeric Displays.
4	Transponder MODE & IDENT. Runway Select Switch.
5.	Fuel Management Switches Flight Mode Switches
6	Marker Indicators Warning Horns
7	NAV Card Control Registers.
8	Digital-Analog Converters
9	OBS Resolver/Digitizer
10	Position Counters
11	Stepper Motors & Drivers. Magnetic Sensors.
12	Voltage - Frequency Converters
13	ROM Verification
14	Microprocessor RAM Test.
15	Fuel Valves Fuel Counters

In these procedures the statement "EXECUTE TEST n" means:

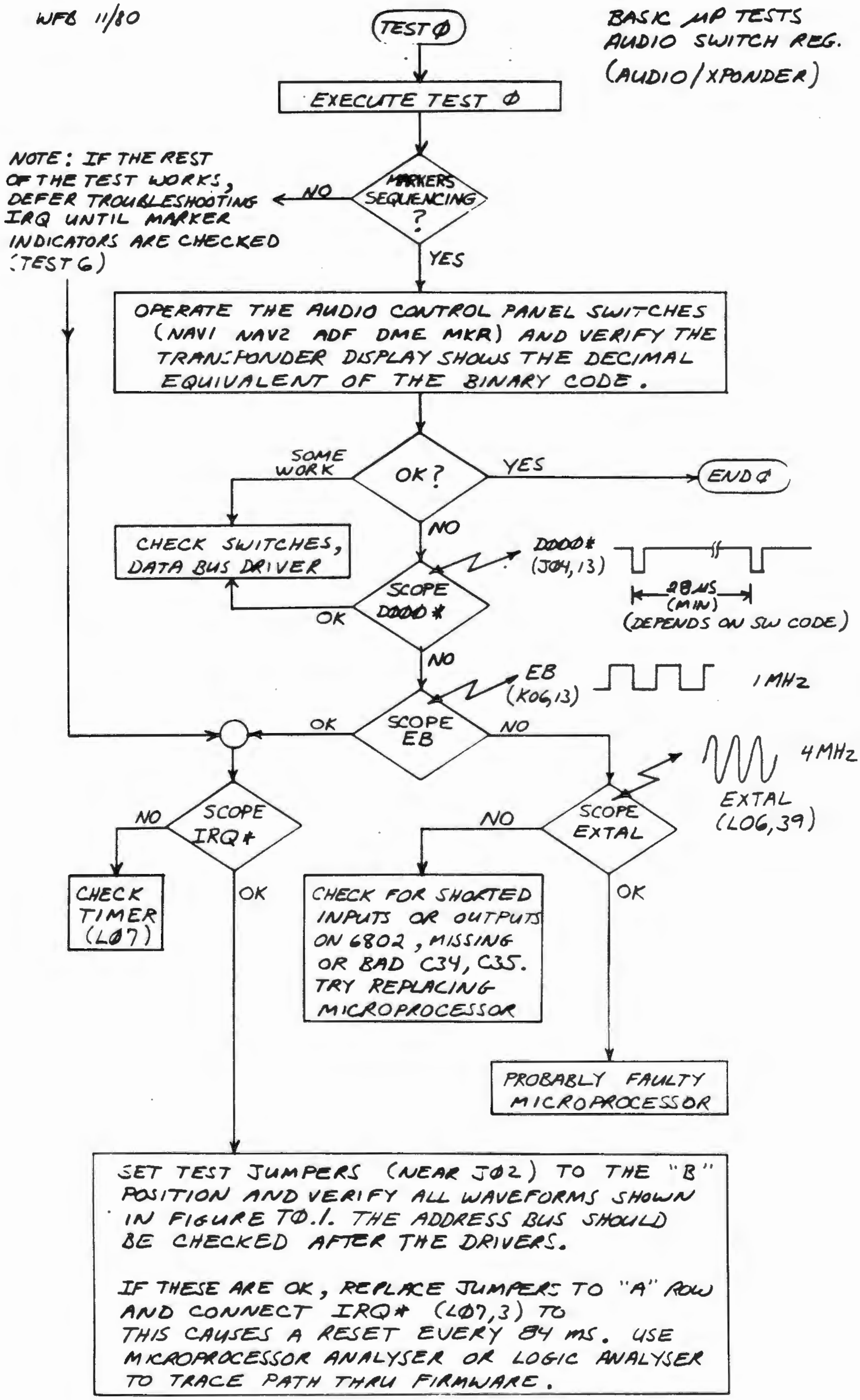
- Ground P1-71 on AUDIO/TRANSPONDER Card.
- Turn off (center or down) all AUDIO PANEL toggle switches.
- Reset the simulator by simultaneously depressing "VERIFY FIELD IN SIGHT" and "IDENT". (with Transponder in "STY")

The Simulator enters the TEST mode - the three Marker indicators sequence in rotation as a prompt.

- Use the AUDIO PANEL switches "NAV1"(MS), "NAV2", "ADF", "DME", and MKR"(LS) to enter the test number "n". This is displayed on the TRANSPONDER panel.
- Again Reset the simulator. The system begins executing the selected test.

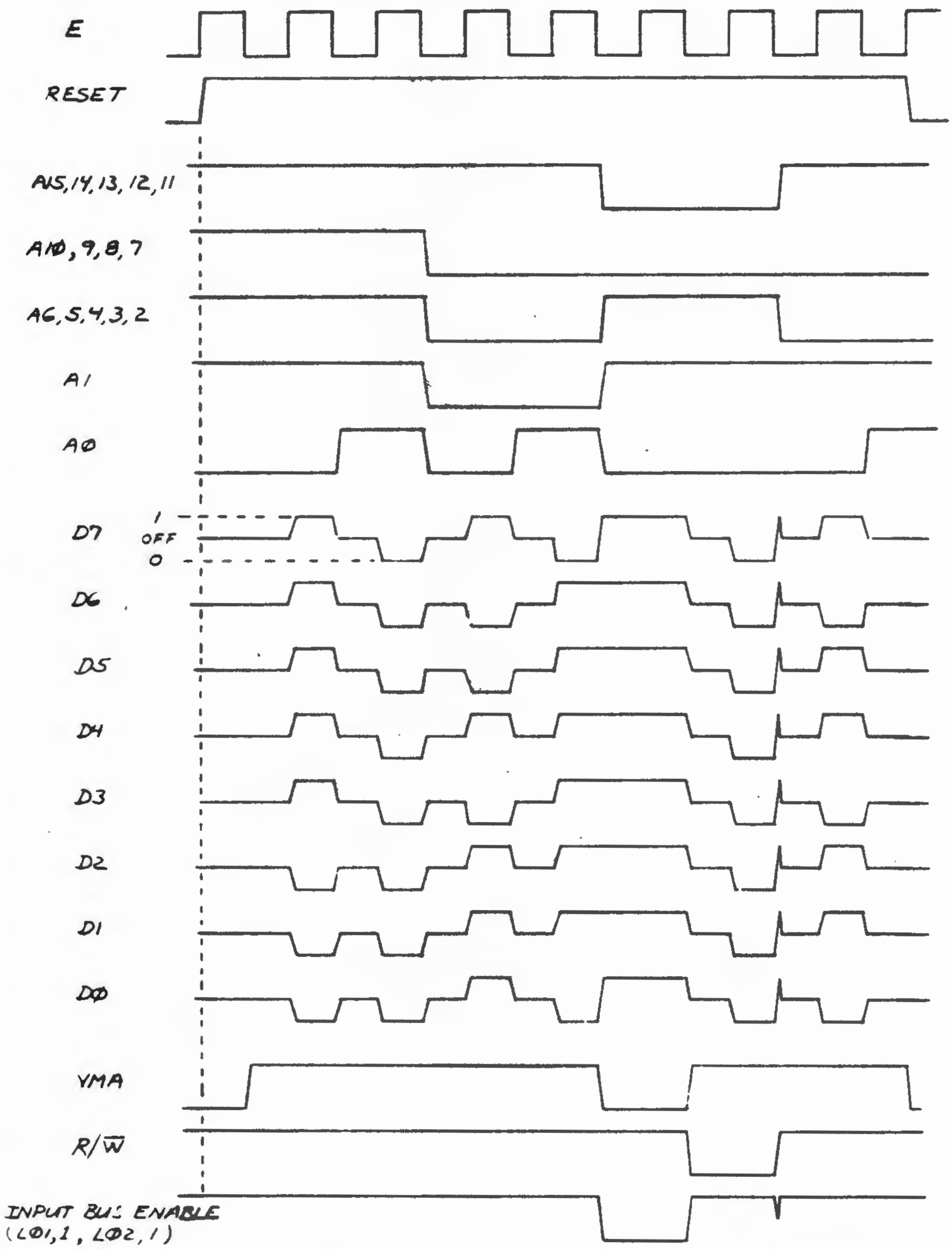
WFB 11/80

BASIC µP TESTS
AUDIO SWITCH REG.
(AUDIO/XPONDER)



WB 12/80

FIGURE TØ.1 - MICROPROCESSOR WAVEFORMS
(JUMPER PLUG IN POSITION "B")

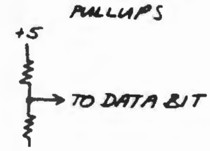


HEX	ADDRESS	FFFE		FFFF		F8ØØ		F8Ø1		ØØ7E	ØØ7E		F8Ø2	
	DATA	XX	F8	XX	ØØ	XX	97	XX	7E	FF	XX	ØØ	XX	86

RESTART SEQUENCE — STA A INSTRUCTION — LDA A

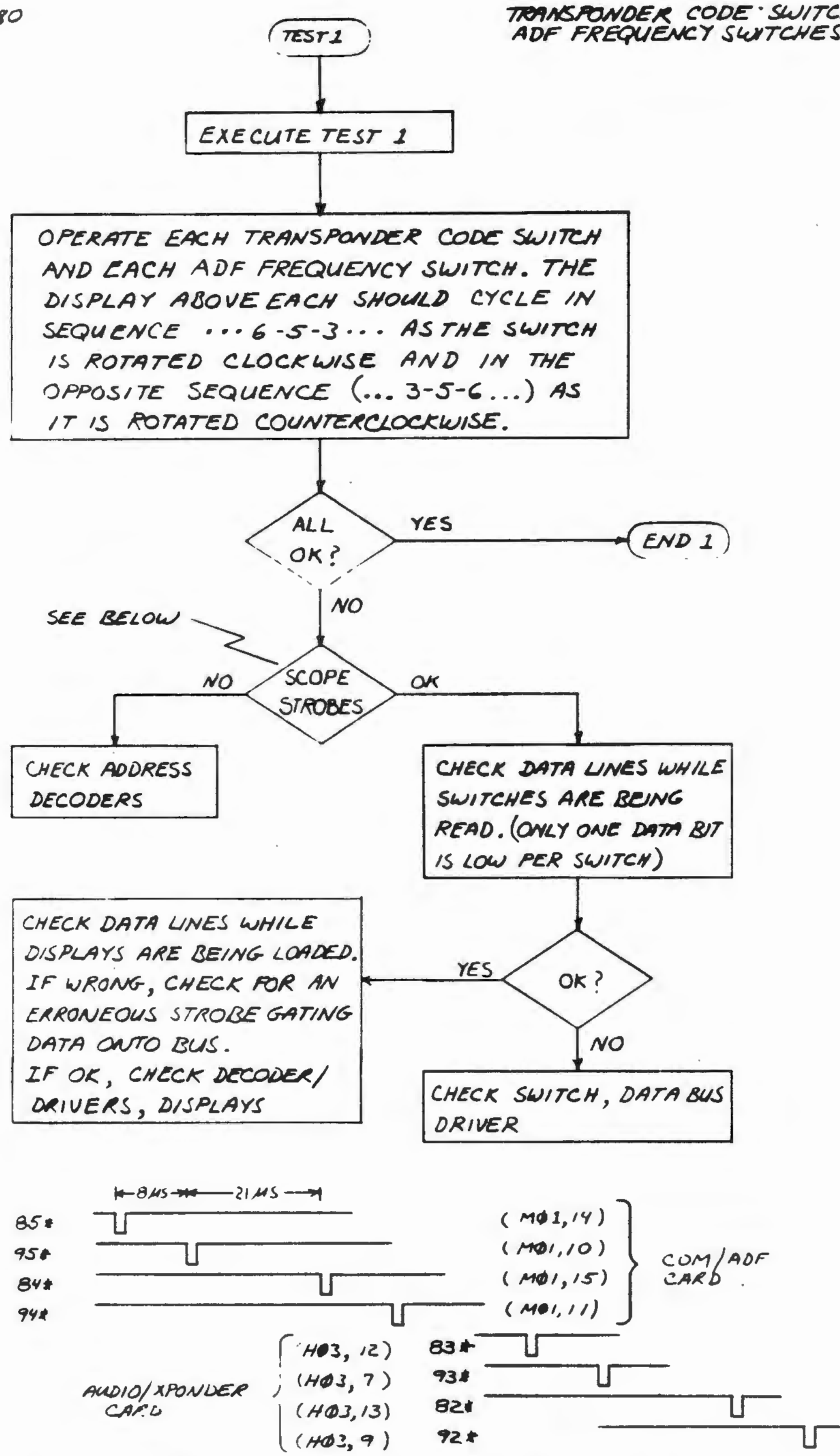
DATA ALL ONES VIA PULLUPS

NOTE: TO VIEW OFF STATE AS A MID-RANGE VOLTAGE AS SHOWN, USE VOLTAGE DIVIDER



WFB 11/80

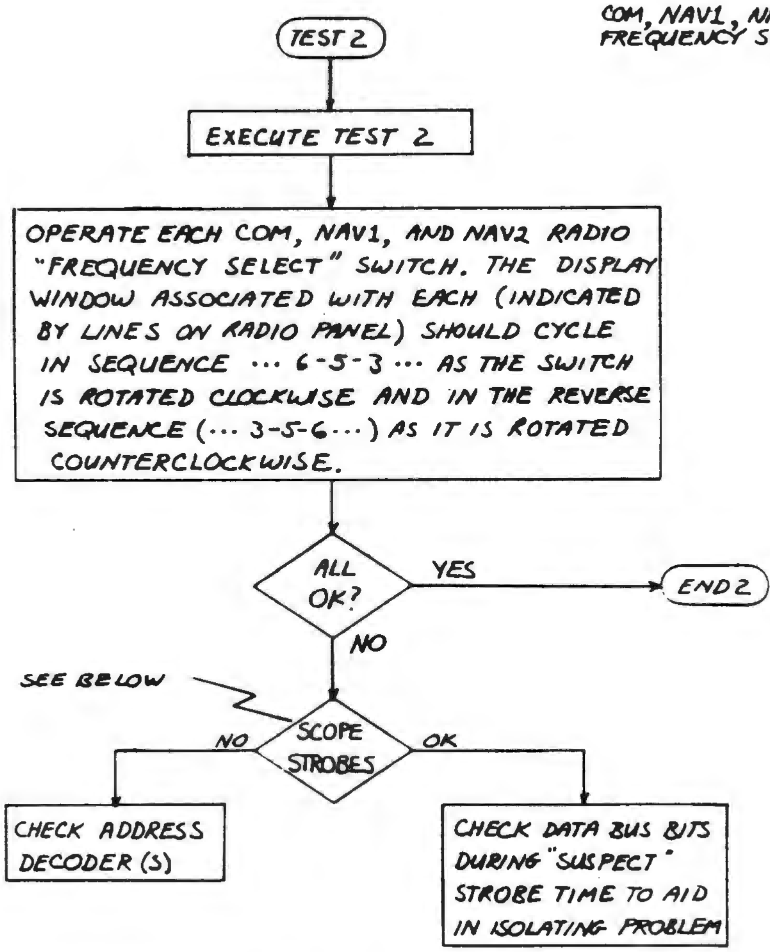
TRANSPONDER CODE SWITCHES
ADF FREQUENCY SWITCHES



- THE PROGRAM GENERATES STROBES IN THE SEQUENCE SHOWN.
- ALL STROBES USE THE "ENABLE" SIGNAL FROM THE MICRO-PROCESSOR AS A REQUIREMENT AND SO ARE .5MS WIDE.
- THE (BUFFERED) DATA BUS HAS PULLUP RESISTORS, SO ANY DATA BITS NOT IMPLEMENTED IN A PARTICULAR BYTE ARE READ AS "1".
- THE MS DIGIT OF THE ADF DISPLAY SHOULD BE "1" DURING THIS TEST.

WB 11/80

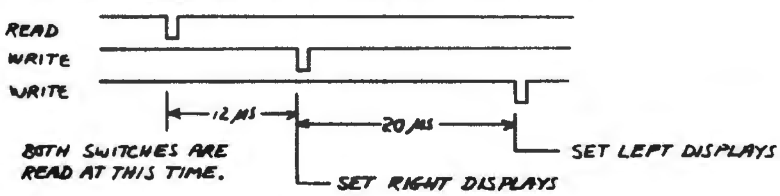
COM, NAV1, NAV2
FREQUENCY SWITCHES



THE PROGRAM GENERATES READ AND WRITE STROBES IN THE FOLLOWING SEQUENCE:

NAV2 CARD	8D – READ NAV2 SWITCHES	(GØ2, 14)
	9D – SET NAV2 RIGHT DISPLAYS	(GØ2, 10)
	9C – SET NAV2 LEFT DISPLAYS	(GØ2, 11)
NAV1/DME CARD	89 – READ NAV1 SWITCHES	(GØ2, 14)
	99 – SET NAV1 RIGHT DISPLAYS	(GØ2, 10)
	98 – SET NAV1 LEFT DISPLAYS	(GØ2, 11)
COM/ADF CARD	87 – READ COM SWITCHES	(MØ1, 12)
	97 – SET COM RIGHT DISPLAYS	(MØ1, 7)
	96 – SET COM LEFT DISPLAYS	(MØ1, 9)

A TYPICAL SEQUENCE IS SHOWN BELOW:



NOTE: TWO ADJACENT DISPLAYS ARE SET BY EACH WRITE STROBE. THE DATA TO THE LEFT ONE IS CLEARED, SO IT SHOULD SHOW "0" DURING THIS TEST.

THE MS DIGIT OF EACH RADIO FREQUENCY SHOULD BE "1", AND THE DECIMAL POINT SHOULD BE BETWEEN THE THIRD & FOURTH DIGIT AS LONG AS THE RADIO IS 'ON' AND EITHER AVIONICS MASTER SWITCH IS ON.

WB 11/80

NUMERIC DISPLAYS

TEST 3

EXECUTE TEST 3

OPERATE THE FOUR RIGHTMOST AUDIO CONTROL SWITCHES AS SHOWN BELOW AND VERIFY THE RESULTING DISPLAYS.

AUDIO SW (NAV2 ADF DME MKR)	NUMERIC DISPLAYS XPONDER	ADF	COM	NAV1	(NAV1) DME	NAV2
0000	0000	0000	100 00	100.00	00.0	100.00
0001	1111	1111	111.11	111.11	11.1	111.11
0010	2222	0222	122.22	102.22	22.2	102.22
0011	3333	1333	133.33	113.33	33.3	113.33
0100	4444	0444	104.44	104.44	44.4	104.44
0101	5555	1555	115.55	115.55	55.5	115.55
0110	6666	0666	126.66	106.66	66.6	106.66
0111	7777	1777	137.77	117.77	77.7	11777
1000	8888	0888	108.88	108.88	88.8	108.88
1001	9999	1999	119.99	119.99	99.9	119.99
1010		0	12 .	10 .	.	10 .

ALL OK?

YES → END 3

NO

SCOPE SUSPECTED STROBE

NO → CHECK ADDRESS DECODER (S)

OK → DME SHOWING [. . .]?

YES → CHECK "DME BIT" (BIT 5) OF NAV1 CONTROL BYTE (ADDRESS BB). USE TEST 7.

CHECK DATALINES DURING STROBE TIME OF BAD DISPLAY (S). DATA BITS 0-3 AND 4-7 SHOULD BE THE BCD CODE IN THE TABLE. IF OK, CHECK 7-SEGMENT OUTPUTS.

BCD-TO-7SEGMENT (4511) TRUTH TABLE

BCD CODE	OUTPUT PIN 9	10	11	12	13	14	15
0	1	1	1	1	1	0	1
1	0	0	1	1	0	0	0
2	1	1	0	1	1	1	0
3	0	1	1	1	1	1	0
4	0	0	1	1	0	1	1
5	0	1	1	0	1	1	1
6	1	1	1	0	0	1	1
7	0	0	1	1	1	0	0
8	1	1	1	1	1	1	1
9	0	0	1	1	1	1	1

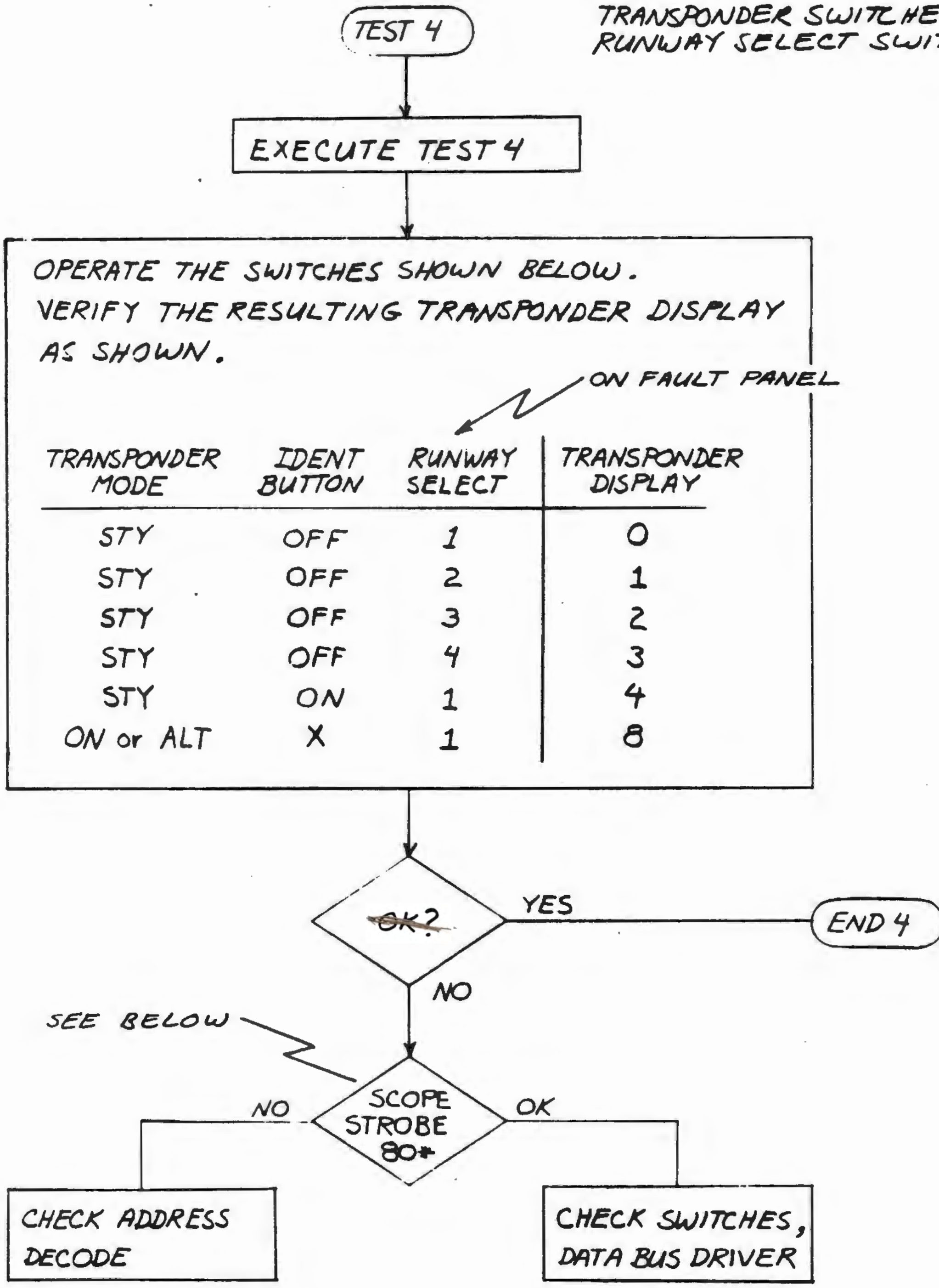
(0 = .1V MAX, 1 = 4.1V MIN)

NOTES

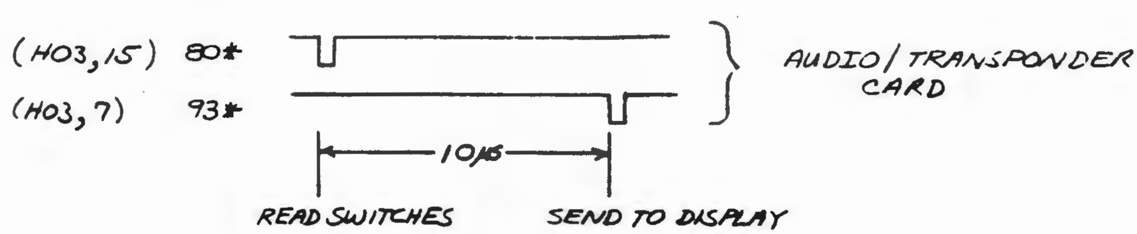
1. THE MS DIGIT OF THE ADF AND SECOND DIGIT OF THE COM & NAV HAVE SOME OF THE DECODER INPUTS GROUNDED. THEY ARE LIMITED TO GENERATING "0" AND "1" DISPLAYS. (0-3 ON COM)

WFB 1/83

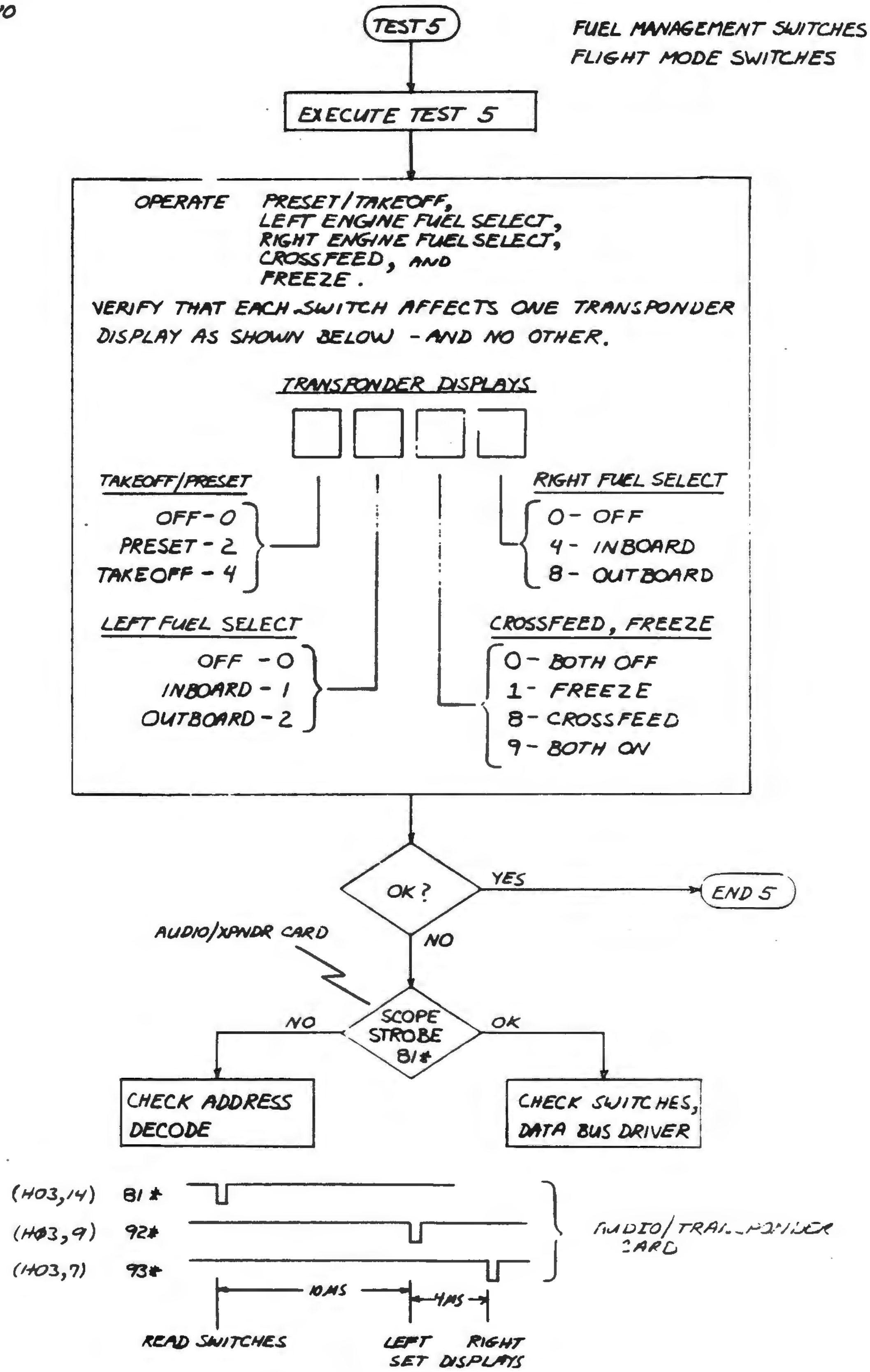
TRANSPONDER SWITCHES
RUNWAY SELECT SWITCH



TRANSPONDER MODE	IDENT BUTTON	RUNWAY SELECT	TRANSPONDER DISPLAY
STY	OFF	1	0
STY	OFF	2	1
STY	OFF	3	2
STY	OFF	4	3
STY	ON	1	4
ON or ALT	X	1	8

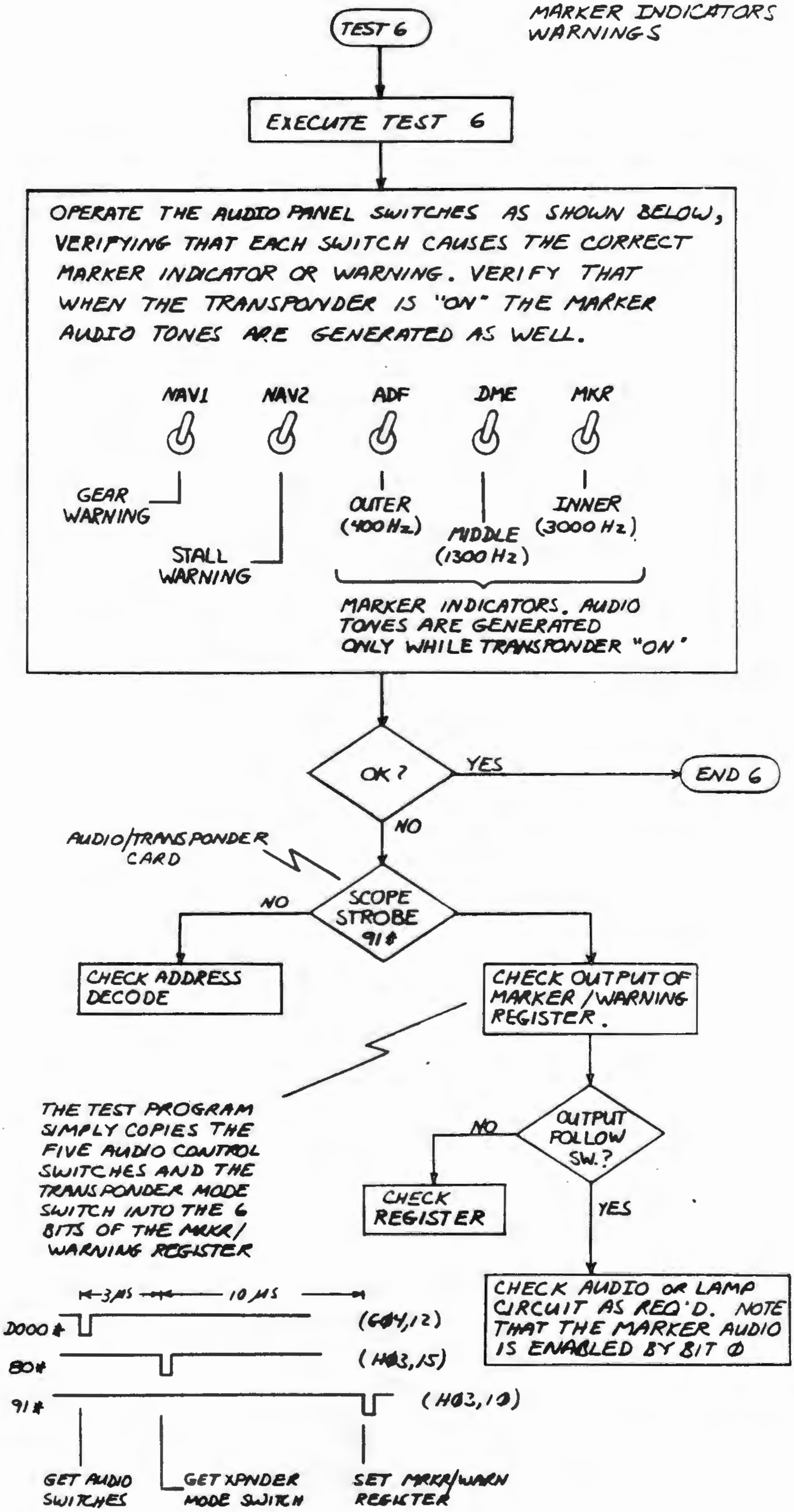


WB 11/80


FUEL MANAGEMENT SWITCHES
FLIGHT MODE SWITCHES
TEST 5
EXECUTE TEST 5
OPERATE PRESET/TAKEOFF, LEFT ENGINE FUEL SELECT, RIGHT ENGINE FUEL SELECT, CROSSFEED, AND FREEZE.
VERIFY THAT EACH SWITCH AFFECTS ONE TRANSPONDER DISPLAY AS SHOWN BELOW - AND NO OTHER.
TRANSPONDER DISPLAYS
TAKEOFF/PRESET
OFF - 0
PRESET - 2
TAKEOFF - 4
RIGHT FUEL SELECT
0 - OFF
4 - INBOARD
8 - OUTBOARD
LEFT FUEL SELECT
OFF - 0
INBOARD - 1
OUTBOARD - 2
CROSSFEED, FREEZE
0 - BOTH OFF
1 - FREEZE
8 - CROSSFEED
9 - BOTH ON
OK?
YES
END 5
NO
AUDIO/XPNDR CARD
SCOPE STROBE 81*
NO
OK
CHECK ADDRESS DECODE
CHECK SWITCHES, DATA BUS DRIVER
(H03,14) 81*
(HØ3,9) 92*
(H03,7) 93*
CARD
10MS
4MS
READ SWITCHES
LEFT RIGHT
SET DISPLAYS

WC 11/80

MARKER INDICATORS
WARNINGS



TEST 7

EXECUTE TEST 7

OPERATE THE AUDIO CONTROL PANEL SWITCHES AS SHOWN BELOW. VERIFY THAT THE RESPONSE OF THE HSI/CDI NEEDLES AND FLAGS IS AS SHOWN (BOTH INSTRUMENTS):

NAV1	NAV2	ADF	DME	MKR	HSI NAV FLAG	CD NEEDLE	TO/FROM FLAG	CDI GS FLAG	GS NEEDLE CDI (HSI)
0	0	0	X	0	ON	CENTER	CENTER	ON	CNTR (NOT VIZ)
0	0	0	X	1	ON	CENTER	TO	ON	CNTR (NOT VIZ)
0	0	1	X	1	ON	CENTER	TO	OFF	DOWN
0	1	1	X	1	OFF	RIGHT	TO	OFF	DOWN
0	1	1	X	0	OFF	RIGHT	FROM	OFF	DOWN

OPERATE THE DME SELECT SWITCH AS WELL AND VERIFY DME DISPLAYS AS SHOWN BELOW:

NAV1	NAV2	ADF	DME	MKR	DME SELECT SWITCH	DME DISPLAY
0	X	X	1	X	NAV1	11.1
0	X	X	1	X	OFF	
0	X	X	1	X	NAV2	22.2
0	X	X	0	X	NAV2	. . .
0	X	X	0	X	NAV1	. . .
1	X	X	1	X	NAV1	11.1
1	X	X	1	X	NAV2	. . .

OPERATE "NAV1" TOGGLE SWITCH BEFORE "DME"

OK?
- DME SELECT SWITCH ERROR → CHECK DME DISPLAY MULTIPLEXER ON NAV1 BOARD. THIS MPXER SELECTS THE ORIGIN OF LOAD STROBES & BLANKING SIGNALS FOR DME DISPLAY.
- ALL OK → END 7
- CONTROL BIT ERROR(S) → SCOPE STROBE BB, BC

SCOPE STROBE BB, BC
- → CHECK ADDRESS DECODE
- → CHECK OUTPUT OF CONTROL REGISTER

THE PROGRAM PUTS THE "NAV2", "ADF", "DME", AND MKR SWITCHES INTO BITS 7-4 RESPECTIVELY & SETS THE CONTROL REGISTERS. (THE DACS ARE SET TO MAKE NEEDLE MOVEMENTS WHEN THE CONTROL IS REMOVED)

DOES OUTPUT FOLLOW SW.?
- YES → CHECK BIT FUNCTION
- NO → CHECK REGISTER

CHECK BIT FUNCTION

BIT 4 - WHEN SET, ILSFLG * REMOVES GRND FROM PIN 15 OF TO/FROM DAC. ITS OUTPUT GOES +, FORCING "TO"

BIT 5 - WHEN NOT SET, DMEBLANK * IS LOW, BLANKING DME DIGITS -AND- DP13 IS HIGH, LIGHTING DECIMAL PTS 1 & 3.

BIT 6 - WHEN NOT SET, GLIDE SLOPE DAC REGISTER IS HELD RESET AND CURRENT IS SHUNTED FROM THE G.S. FLAG.

BIT 7 - WHEN NOT SET, COURSE DEVIATION & TO/FROM DAC REGS ARE HELD RESET AND CURRENT IS SHUNTED FROM THE NAV FLAG (ON HSI)

WB 11/80

X & Y DACS

8A

AUDIO/TRANSPONDER ON EXTENDER

EXECUTE TEST 8

OPERATE THE "DME" AND "MKR" AUDIO CONTROL SWITCHES, THE TRANSPONDER CODE, AND THE PLOTTER SCALE SWITCH AND VERIFY THE CORRESPONDING DAC OUTPUT.

DME	MKR	TRANSPONDER CODE	PLOTTER SCALE	DAC OUTPUT (TP5-X, TP6-Y, TP4-GND)
0	0	0000	15	0V ±30mv
1	0	0000	15	SEE FIGURE 8A
0	0	1777	15	1.5V ±30mv ADJUST
0	0	1777	10	1.0V ±30mv ADJUST

REPEAT LAST TWO STEPS UNTIL BOTH SCALES ARE CORRECT WITHOUT FURTHER ADJUSTMENT

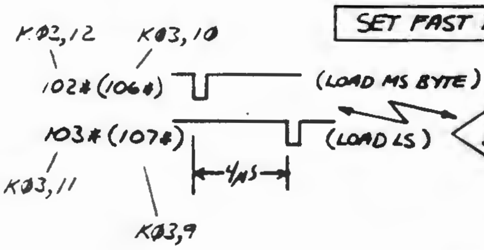
1 LSB ~ 1.46 mv (PLOTTER SCALE = 15)

FULL SCALE ADJ. R28-X, R31-Y

OK? — YES → END

PLOTTER SCALE SWITCH ERROR → CHECK SCALING CIRCUITRY R58 & 59 ON AUDIO/XPNDR, R18 & 19 ON CARD "A"

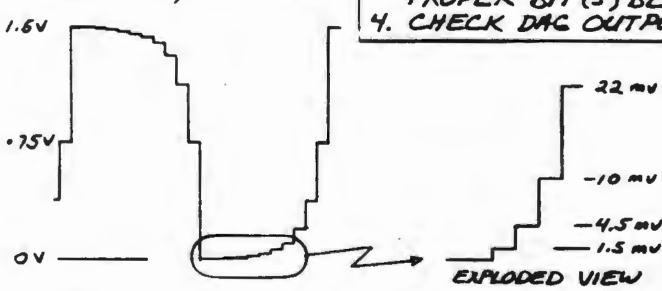
SET FAST MODE ("MKR" ON)



SCOPE STROBES → CHECK ADDRESS DECODE

USE THE PROGRAM IN THE FOLLOWING MANNER TO AID IN ISOLATING THE PROBLEM:
1. WITH "MKR" SWITCH OFF, SELECT AN OCTAL VALUE TO BE LOADED (TRANSPONDER CODE).
2. TURN ON "MKR" SWITCH. (FAST MODE FOR EASIER SCOPE VIEWING)
3. CHECK THE REGISTER OUTPUTS FOR THE PROPER BIT(S) BEING SET.
4. CHECK DAC OUTPUT VOLTAGE.

FIG. 8A
OUTPUT WAVEFORMS
XDAC (TP5), YDAC (TP6)



CODE	OUTPUT (MV)
1000	750.0
0400	375.0
0200	187.5
0100	93.75
0040	46.88
0020	23.44
0010	11.72
0004	5.86
0002	2.92
0001	1.46

NOTE: WAVEFORM WILL BE AS SHOWN ONLY IF DAC IS INITIALIZED TO 0000 FIRST.
USE HP 130A OR EQUIV. SCOPE.

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FUEL GUAGE DACS

AUDIO/TRANSPONDER ON EXTENDER

EXECUTE TEST 8

SET AUDIO CONTROL SWITCHES "DME" & "MKR" OFF.

SET DAC VALUES (TRANSPONDER CODE, FIRST THREE DIGITS) AS SHOWN AND VERIFY FUEL GUAGE READINGS AS SHOWN.

TRANSPONDER CODE	GUAGE READING (GAL)	
000	0	
360	53.3	ADJUST FULL SCALE (R8-LEFT, R10-RIGHT) FOR THIS READING.
055	10	±3 GAL
132	20	±3 GAL
207	30	±3 GAL
264	40	±3 GAL
341	50	±3 GAL

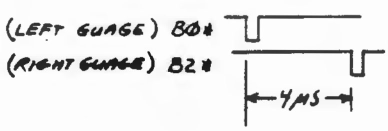
1 LSB ~.22 GAL

OK ? — YES → END

NO ↓

SET FAST MODE ("MKR" ON)

SCOPE STROBES — NO → CHECK ADDRESS DECODE



OK ↓

UNPLUG THE FUEL GUAGES (CONN P15) AND GROUND PINS P1-43 & 44.

USE THE TRANSPONDER CODE SWITCHES TO LOAD EACH BIT IN THE DAC. THE DAC OUTPUT VOLTAGE SHOULD BE AS SHOWN IN THE TABLE BELOW.

NOTE THAT THE "SHIFT MODE" (DME SW. ON) CANNOT BE USED HERE BECAUSE OF THE LARGE CAPS ON THE DAC OUTPUTS.

CODE	OUTPUT (TP2, TP3)
200	2 V
100	1 V
040	.5V
020	.25V
010	125 mV
004	62.5 mV
002	31.3 mV
001	15.6 mV

READINGS ARE APPROXIMATE. THIS TEST IS JUST TO ASSURE ALL BITS ARE WORKING.

WFB 11/80

8C

ALTITUDE DAC (NAV1 CARD)

REMOVE COM/ADF CARD
CONNECT +5 VOLTS TO CONN P6-17

EXECUTE TEST 8

SET AUDIO CONTROL SWITCHES AND DAC VALUE (TRANSPONDER CODE) AS SHOWN AND VERIFY DAC OUTPUT VOLTAGE.

DME	MKR	TRANSPONDER CODE	ASCORR (P6-16)
0	0	000	0 ± .1 V
0	0	377	-5 ± .25 V
1	0	377	SEE FIG. 8C

OK ?

YES

NO

SET FAST MODE ("MKR" ON)

STROBE AA* (HØ2,13 ON NAV1/DME)

SCOPE STROBE

NO

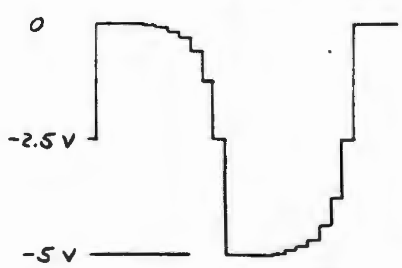
CHECK ADDRESS DECODE

OK

USE THE PROGRAM IN THE FOLLOWING MANNER TO AID IN ISOLATING THE PROBLEM:

1. WITH "MKR" SWITCH OFF, SELECT AN OCTAL VALUE TO BE LOADED. (TRANSPONDER CODE)
2. TURN ON "MKR" SWITCH. (FOR FAST MODE)
3. SCOPE REGISTER INPUTS & OUTPUTS FOR PROPER BIT(S) BEING SET.
4. CHECK DAC OUTPUT VOLTAGE.

FIG 8C



CODE	ASCORR OUTPUT (V)
200	- 2.5
100	- 1.25
040	- .75
020	- .38
010	- .19
004	- .09
002	- .05
001	- .02

NOTES 1) ALL 8 STEPS CAN BE SEEN (USE HP 130A - PUT .1 μf ACROSS INPUT TO FILTER

2) VOLTAGES ARE APPROXIMATE. (THIS DAC IS USED FOR A SMALL EFFECT ON SPEED WITH ALTITUDE.)

WFB 11/80

8D CDI/HSI DACS

UNPLUG METER, P8 (P9)
PUT NAV1 (NAV2) ON EXTENDER

EXECUTE TEST 8

NOTE : DAC MUST BE INITIALIZED TO Ø TO OBTAIN WAVE-FORM SHOWN.

SET AUDIO SWITCHES "DME" & "MKR" BOTH OFF.
SET TRANSPONDER CODE TO 0000.
SET "DME" SW. ON AND VERIFY WAVEFORMS OF FIG 8D.

OK? — NO / YES

ADJUSTMENT POTS
COURSE DEV. - R18.
GLIDESLOPE - R9
TO/FROM FLG. - R14

REINSTALL METER, P8 (P9)
SET "DME" & "MKR" BOTH OFF AND TRANSPONDER CODE TO 2000.
ADJUST POTS ON CD, GS, & T/F DACS TO CENTER NEEDLES (FLAG).
CHECK CALIBRATION AT OTHER POINTS ON METER FACE.

DOT ON METER FACE	CDI/HSI CD DAC VALUE (± 6 LSB)	CDI GS DAC VALUE (± 10 OCTAL)	HSI GS DAC VALUE (±)
4	(L) 070	(U) 034	
3	(L) 112	(U) 065	
2	(L) 134	(U) 116	
1	(L) 156	(U) 147	
1	(R) 222	(D) 231	
2	(R) 244	(D) 262	
3	(R) 266	(D) 313	
4	(R) 310	(D) 344	

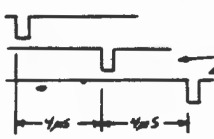
ON JEWELL CDI, CIRCLE IS FIRST DOT

CD : 1 LSB ≈ 1.67 μA
GS (CDI) : 1 LSB ≈ 1.19 μA
GS (HSI) : 1 LSB ≈

OK? — YES → END; NO

SET FAST MODE ("MKR" ON)

[H02,10] B9# (BD#)
[H02,9] BA# (BE#)
[H02,7] BB# (BF#)

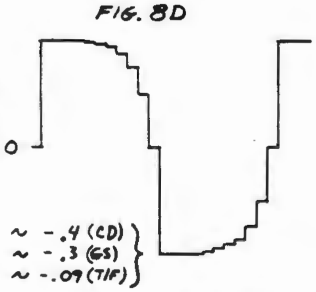


SCOPE STROBES

CHECK ADDRESS DECODE.

FIG. 8D

TEST PT.
E3 (CD)
E1 (GS)
E2 (T/F)



USE THE PROGRAM IN THE FOLLOWING MANNER TO AID IN ISOLATING THE PROBLEM:
1. WITH "MKR" SWITCH OFF, SELECT AN OCTAL VALUE TO BE LOADED (TRANSPONDER CODE)
2. TURN ON "MKR" SWITCH. (FAST MODE FOR EASIER SCOPE VIEWING.)
3. CHECK THE REGISTER OUTPUTS FOR THE PROPER BIT (S) BEING SET.
4. CHECK DAC OUTPUT.

REPEAT 1-4 FOR ANY DESIRED BIT CONFIG.

DAC WAVEFORMS WITH METER UNPLUGGED.
ALL 8 STEPS CAN BE SEEN (USE HP 130A - PUT .01 μf ACROSS INPUT TO FILTER NOISE)

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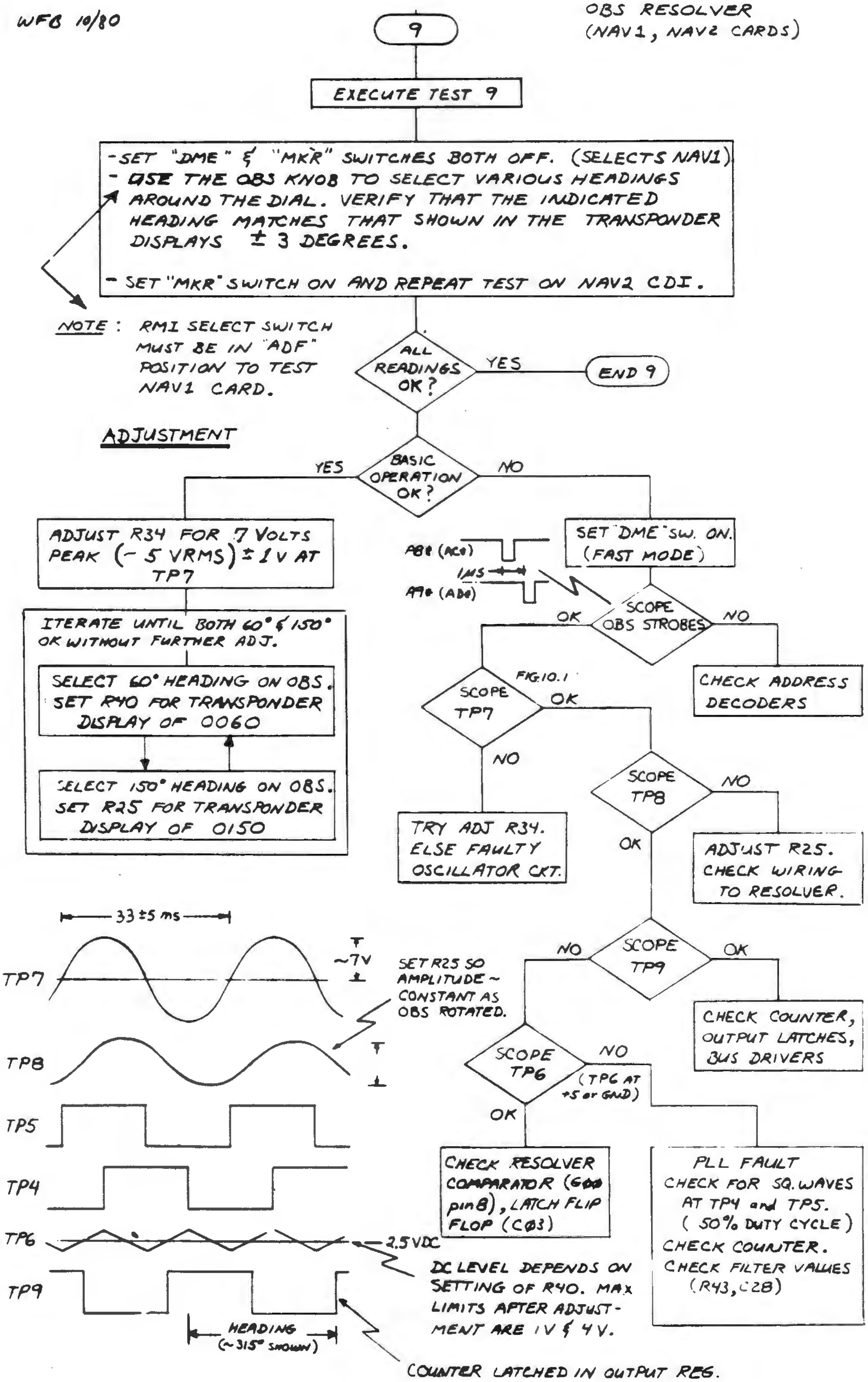
OBS RESOLVER
(NAV1, NAV2 CARDS)



WFB 11/80

POSITION COUNTERS
(AUDIO/XPNDER CARD)

10

REMOVE COM/ADF CARD
REMOVE NAV1/DME CARD
INSTALL TEST JUMPER (NEXT PAGE)

EXECUTE TEST 10

SET AUDIO CONTROL SWITCHES AS SHOWN BELOW AND VERIFY TRANSPONDER DISPLAYS SHOWN

NAV1	NAV2	ADF	DME	MKR	TRANSPONDER DISPLAY	COUNTER IN TEST
		X	O	O	COUNTS UP (ØØ-63, 3 pps)	
O	O	X	/	O	COUNTS DOWN	X
		X	X	/	HOLDS PRESENT COUNT	
		X	O	O	COUNTS UP (ØØ-63, 3 pps)	
O	/	X	/	O	COUNTS DOWN	Y
		X	X	/	HOLDS PRESENT COUNT	
		O	O	O	COUNTS UP (ØØ-15, .75 pps)	
		/	O	O	HOLDS PRESENT COUNT	
/	O	X	/	O	COUNTS DOWN	ALTITUDE
		X	X	/	HOLDS PRESENT COUNT	
		X	O	O	COUNTS UP (ØØ-15, .75 pps)	
/	/	X	/	O	COUNTS DOWN	HEADING
		X	X	/	HOLDS PRESENT COUNT	

NAV1 & NAV2 SWITCHES ARE READ BY THE TEST PROGRAM TO DETERMINE WHICH COUNTER TO DISPLAY.

OK → NO → ER10

YES

DEPRESS "VERIFY FIELD IN SIGHT" BUTTON.
LAMP SHOULD LIGHT WHEN AUDIO SWITCH "DME" IS OFF AND SHOULD BE DARK WHEN THE SWITCH IS ON.

THIS IS THE NORMAL FUNCTION OF BIT 6 OF THE HOLD REGISTER.

OK? → YES → END 10

(RE-INSTALL COM/ADF & NAV1/DME AND REMOVE TEST JMPR.)

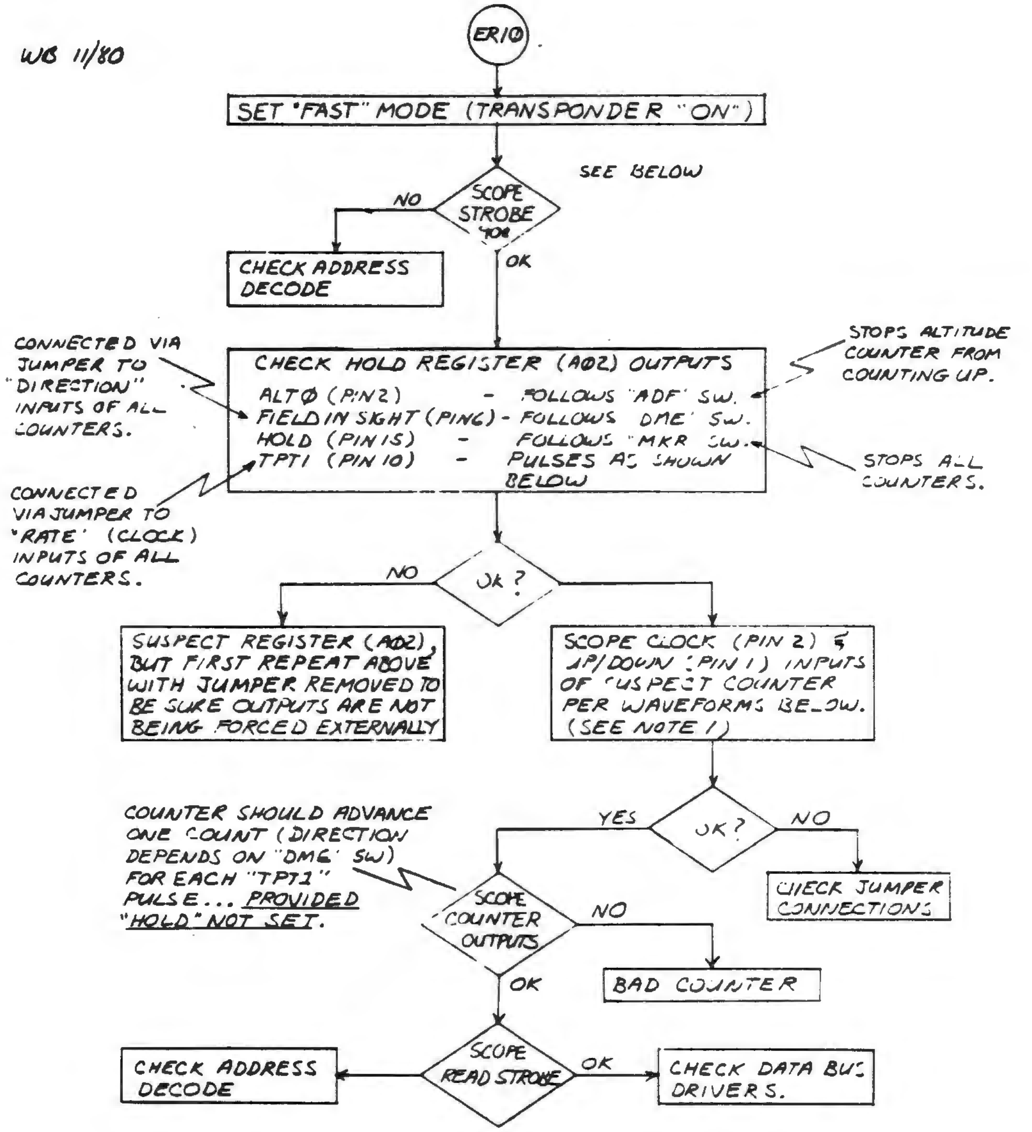
NO

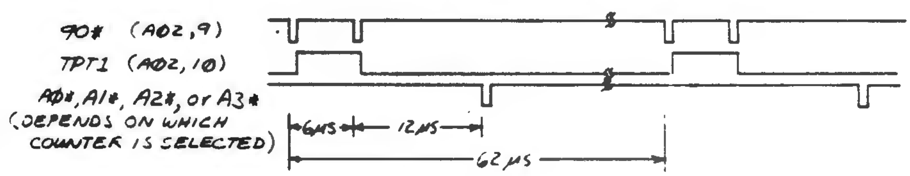
CHECK "FIELD IN SIGHT" (AØ2, 6)

FOLLOWS "DME" SW ? → NO → ER10

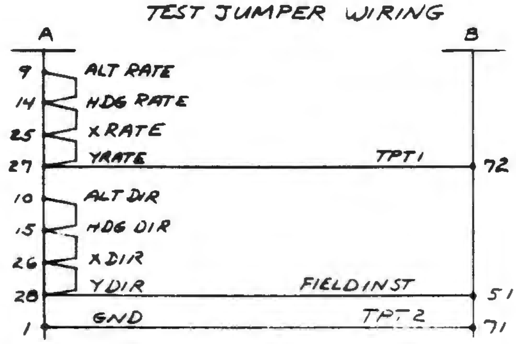
YES → CHECK BACKPLANE, CABLE (19.), LAMP DRIVER CKT ('A' CARD)

WB 11/80





TEST JUMPER WIRING

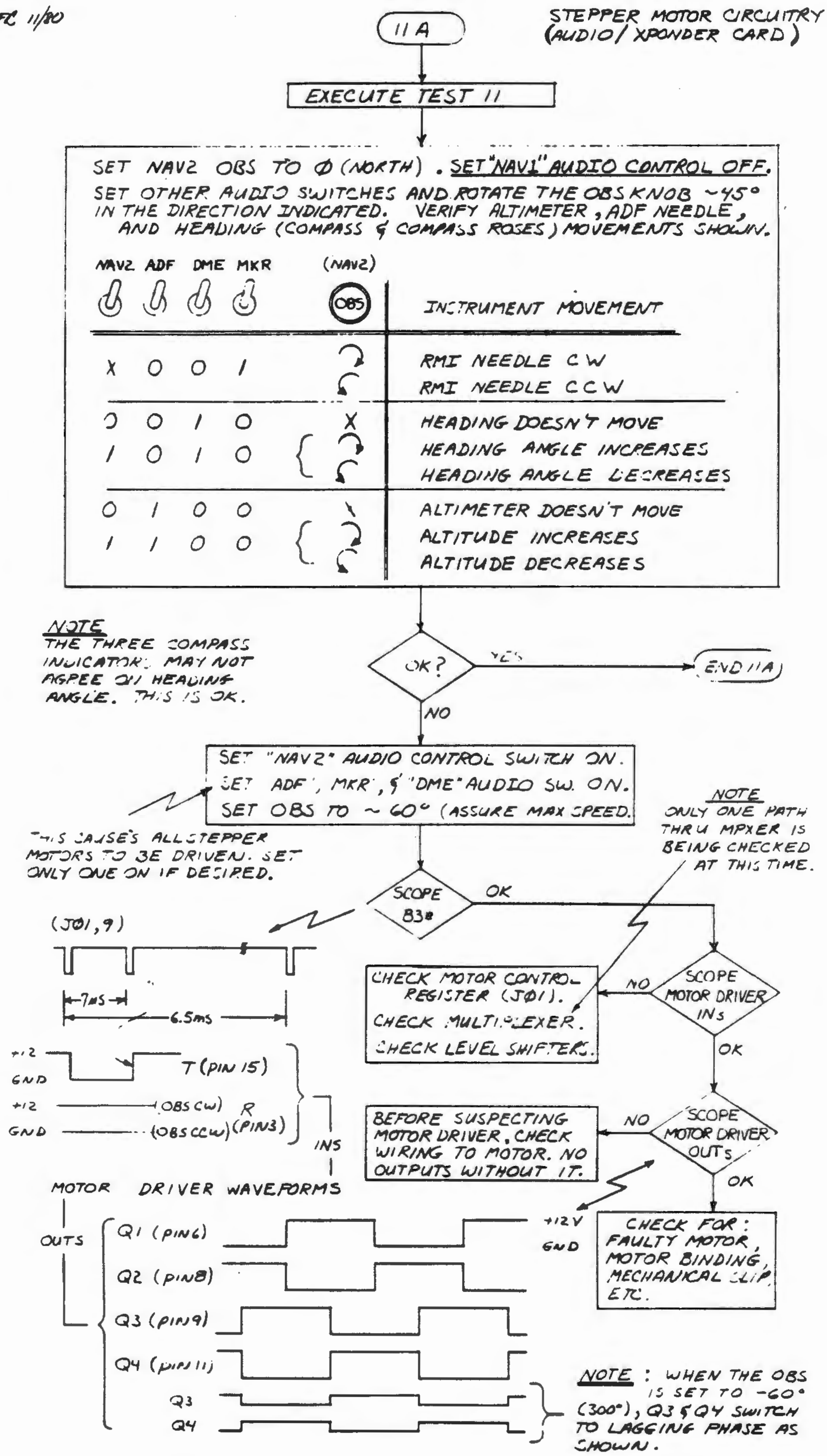


A&B ARE CONNECTOR BLOCKS, .125 X .25 SPACING, CUT DOWN FROM 542.1836

A - 14/28 POSITIONS
B - 11/22 POSITIONS

PINS ARE 674.0356

WFC 11/80


11 A
STEPPER MOTOR CIRCUITRY (AUDIO/XPONDER CARD)
EXECUTE TEST 11
SET NAV2 OBS TO Ø (NORTH). SET "NAV1" AUDIO CONTROL OFF.
SET OTHER AUDIO SWITCHES AND ROTATE THE OBS KNOB ~45° IN THE DIRECTION INDICATED. VERIFY ALTIMETER, ADF NEEDLE, AND HEADING (COMPASS & COMPASS ROSES) MOVEMENTS SHOWN.
NAV2 ADF DME MKR
(NAV2)
OBS
INSTRUMENT MOVEMENT
X 0 0 1
RMI NEEDLE CW
RMI NEEDLE CCW
0 0 1 0
X
HEADING DOESN'T MOVE
1 0 1 0
HEADING ANGLE INCREASES
HEADING ANGLE DECREASES
0 1 0 0
ALTIMETER DOESN'T MOVE
1 1 0 0
ALTITUDE INCREASES
ALTITUDE DECREASES
NOTE
THE THREE COMPASS INDICATORS MAY NOT AGREE ON HEADING ANGLE. THIS IS OK.
OK?
YES
END 11A
NO
SET "NAV2" AUDIO CONTROL SWITCH ON.
SET ADF, MKR, & "DME" AUDIO SW. ON.
SET OBS TO ~60° (ASSURE MAX SPEED.)
THIS CAUSES ALL STEPPER MOTORS TO BE DRIVEN. SET ONLY ONE ON IF DESIRED.
NOTE
ONLY ONE PATH THRU MPXER IS BEING CHECKED AT THIS TIME.
SCOPE B3
OK
(JØ1, 9)
7mS
6.5ms
+12
GND
T (PIN 15)
+12
GND
(OBS CW)
(OBS CCW)
R (PIN3)
INS
CHECK MOTOR CONTROL REGISTER (JØ1).
CHECK MULTIPLEXER.
CHECK LEVEL SHIFTERS.
NO
SCOPE MOTOR DRIVER INs
OK
BEFORE SUSPECTING MOTOR DRIVER, CHECK WIRING TO MOTOR. NO OUTPUTS WITHOUT IT.
NO
SCOPE MOTOR DRIVER OUTs
OK
MOTOR DRIVER WAVEFORMS
OUTS
Q1 (PIN6)
Q2 (PIN8)
Q3 (PIN9)
Q4 (PIN 11)
Q3
Q4
+12V
GND
CHECK FOR: FAULTY MOTOR, MOTOR BINDING, MECHANICAL SLIP, ETC.
NOTE: WHEN THE OBS IS SET TO -60° (300°), Q3 & Q4 SWITCH TO LAGGING PHASE AS SHOWN.

WB 11/80

11B

STEPPER MOTOR,
MECHANICAL BINDING

EXECUTE TEST 11

FOR EACH INSTRUMENT IN THE LIST BELOW, PERFORM THE FOLLOWING STEPS:

ALTIMETER ("ADF" SW)
RMI NEEDLE ("MKR" SW)

(THESE MAY NOT AGREE ON HEADING ANGLE) — RMI COMPASS ROSE, HSI (OR HI) COMPASS ROSE, MAGNETIC COMPASS ("DME" SW)

1. TURN ON AUDIO CONTROL SWITCH SPECIFIED AND "NAV2". USE OBS KNOB TO SET INSTRUMENT POINTER TO A CONVENIENT STARTING POINT (NORTH ON COMPASS, FOR EXAMPLE.

   ** TAKE NOTE OF DIRECTION OF MOTOR MOVEMENT TO REACH STARTING POINT.

2. TURN OFF ALL AUDIO CONTROL SWITCHES. TRANSPONDER DISPLAY GOES TO ØØØØ.

3. TURN ON "NAV2" AND OTHER SPECIFIED AUDIO SWITCH. USE OBS KNOB TO MOVE INSTRUMENT MOTOR ...

   ** IN SAME DIRECTION AS NOTED IN STEP 1 TO MINIMIZE EFFECTS OF GEAR BACKLASH ON RESULTS

   ... THRU SEVERAL REVOLUTIONS AT VARYING SPEEDS. THE TRANSPONDER DISPLAY IS COUNTING PULSES ISSUED.

4. STOP THE MOTOR WHEN THE COUNT IS AT SOME INCREMENT OF 1440 PULSES (SEE TABLE BELOW) AND VERIFY THE INSTRUMENT POINTER IS AT ITS STARTING POSITION. THERE SHOULD BE NO NOTICEABLE MISALIGNMENT.

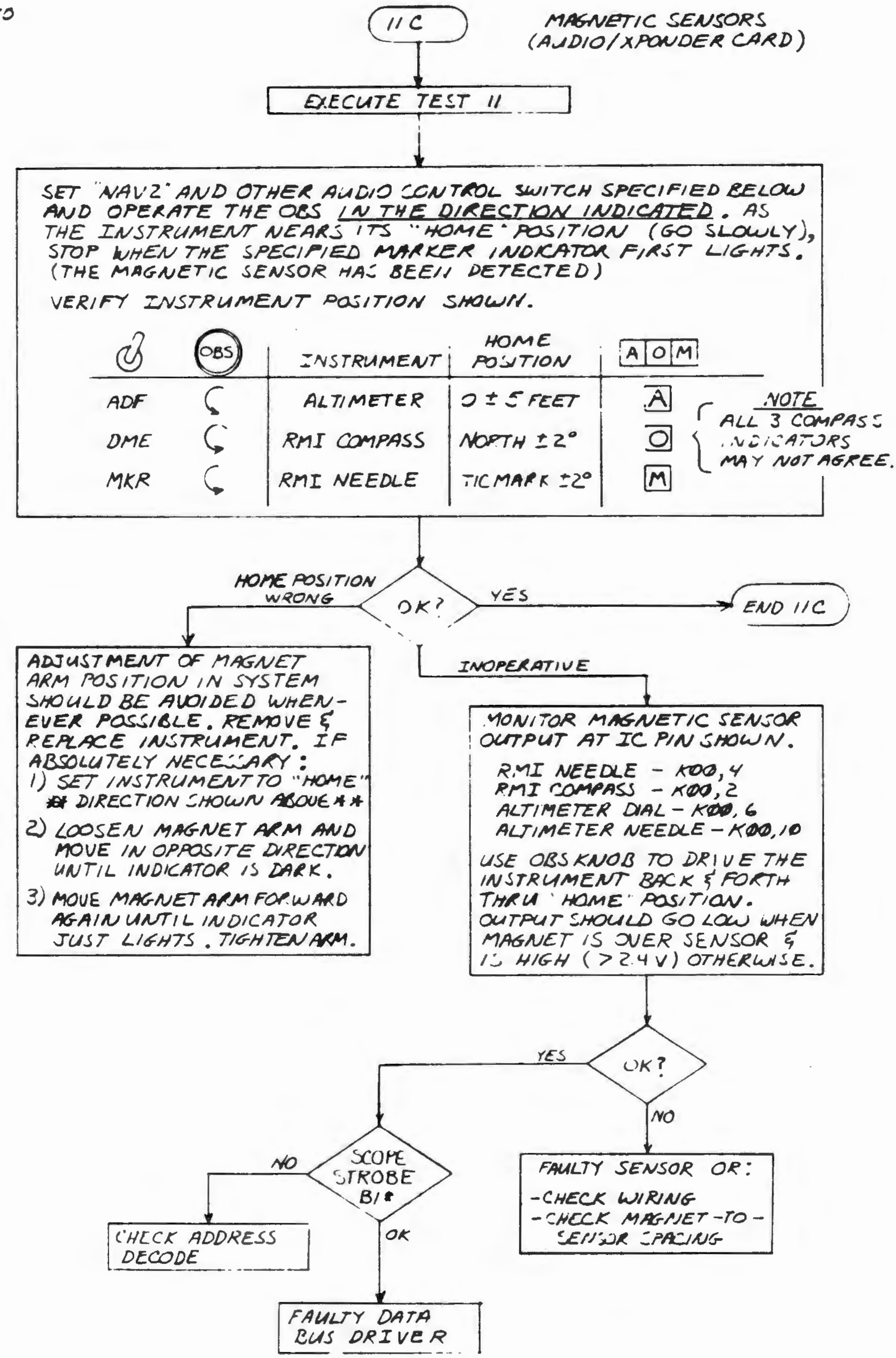
5. ESTABLISH A NEW STARTING POINT, BUT APPROACH FROM THE OTHER DIRECTION. THEN REPEAT TEST IN THIS DIRECTION.

REVOLUTIONS	COUNT UP	COUNT DOWN	
1	1440	8560	
2	2880	7120	
3	4320	5680	
4	5760	4240	
5	7200	2800	
6	8640	1360	SECOND TIME AROUND ON COUNTER
7	0080	9920	SECOND TIME AROUND ON COUNTER
8	1520	8480	SECOND TIME AROUND ON COUNTER
9	2960	7040	SECOND TIME AROUND ON COUNTER
10	4400	5600	SECOND TIME AROUND ON COUNTER

OK? → END 11B

CAREFULLY CHECK MOTOR DRIVER WAVEFORMS FOR EVIDENCE OF IMPROPER PHASING, ETC.
IF OK, PROBLEM IS MOST LIKELY IN INSTRUMENT.
REMOVE AND REPLACE.

WB 11/80


11C
MAGNETIC SENSORS (AUDIO/XPONDER CARD)
EXECUTE TEST 11
SET "NAV2" AND OTHER AUDIO CONTROL SWITCH SPECIFIED BELOW AND OPERATE THE OBS IN THE DIRECTION INDICATED. AS THE INSTRUMENT NEARS ITS "HOME" POSITION (GO SLOWLY), STOP WHEN THE SPECIFIED MARKER INDICATOR FIRST LIGHTS. (THE MAGNETIC SENSOR HAS BEEN DETECTED)
VERIFY INSTRUMENT POSITION SHOWN.
OBS
INSTRUMENT
HOME POSITION
A O M
ADF
ALTIMETER
0 ± 5 FEET
A
DME
RMI COMPASS
NORTH ± 2°
O
MKR
RMI NEEDLE
TIC MARK ± 2°
M
NOTE
ALL 3 COMPASS INDICATORS MAY NOT AGREE.
HOME POSITION WRONG
OK?
YES
END 11C
INOPERATIVE
ADJUSTMENT OF MAGNET ARM POSITION IN SYSTEM SHOULD BE AVOIDED WHENEVER POSSIBLE. REMOVE & REPLACE INSTRUMENT. IF ABSOLUTELY NECESSARY:
1) SET INSTRUMENT TO "HOME" ** DIRECTION SHOWN ABOVE **
2) LOOSEN MAGNET ARM AND MOVE IN OPPOSITE DIRECTION UNTIL INDICATOR IS DARK.
3) MOVE MAGNET ARM FORWARD AGAIN UNTIL INDICATOR JUST LIGHTS. TIGHTEN ARM.
MONITOR MAGNETIC SENSOR OUTPUT AT IC PIN SHOWN.
RMI NEEDLE - K00,4
RMI COMPASS - K00,2
ALTIMETER DIAL - K00,6
ALTIMETER NEEDLE - K00,10
USE OBS KNOB TO DRIVE THE INSTRUMENT BACK & FORTH THRU "HOME" POSITION. OUTPUT SHOULD GO LOW WHEN MAGNET IS OVER SENSOR & IS HIGH (>2.4V) OTHERWISE.
OK?
YES
NO
FAULTY SENSOR OR:
-CHECK WIRING
-CHECK MAGNET-TO-SENSOR SPACING
SCOPE STROBE B1*
NO
OK
CHECK ADDRESS DECODE
FAULTY DATA BUS DRIVER

COMPASS ADJUSTMENT
COMPASS SLAVING

11D

EXECUTE TEST 11

SET "NAV2" AND "DME" AUDIO CONTROL SWITCHES & USE OBS KNOB TO DRIVE COMPASS(ES).

1. DRIVE COMPASS UNTIL "YCOMPS" (P6-12) IS AT ITS MAXIMUM POSITIVE VOLTAGE.
2. FINE-TUNE BY MONITORING XCOMPS (P6-11) AND MOVING COMPASS UNTIL IT IS Ø ±30 mV.

** NOTE DIRECTION OF FINAL MOTOR STEPS **

THE COMPASS POT IS NOW AT NORTH. IF THE MAGNETIC COMPASS DIAL DOES NOT AGREE, LOOSEN SET SCREW AND MOVE THE DIAL.

DISCONNECT MAGNETIC COMPASS (M18)

DRIVE HI (OR HSI) COMPASS ROSE UNTIL IT READS NORTH. APPROACH FROM SAME DIRECTION AS IN STEP 2 ABOVE.

DISCONNECT HI (M5) [OR HSI (M8)]

DRIVE RMI COMPASS ROSE UNTIL IT READS NORTH. APPROACH FROM SAME DIRECTION AS IN STEP 2 ABOVE.

RECONNECT COMPASS AND HI (OR HSI)

END 11D

JFL 11/83

12

VOLTAGE-FREQUENCY CONVERTER ADJ.

CONNECT FAULT PANEL AND ENSURE WIND VELOCITY = 0

ON COM/ADF CARD:
- REMOVE JUMPERS J5, J6, AND J7.
- USE "DAISY CHAIN" JUMPER TO CONNECT:

TP2 (ROLL TRIM)
TO TP1
TO J5 - R[illegible] SIDE
TO J7 - R179 SIDE

ROTATING THE ROLL TRIM WILL NOW DIRECTLY CONTROL CLIMB RATE (VERTICAL SPEED), AIRSPEED, AND THE TURN COORDINATOR.
(J6 IS LEFT OPEN TO DEFEAT STALL.)

EXECUTE TEST 12

TO CHECK OR ADJUST THE VOLTAGE-TO-FREQUENCY CONVERTERS IN THE TABLE BELOW:

1. CONNECT P8-34 (COUNTER INPUT) TO PIN SHOWN.
2. RELEASE BRAKES & USE ROLL TRIM TO SET CONDITION SHOWN.

   NOTE: X & Y RATE CHECKS REQUIRE SPECIFIC HEADINGS. USE TEST 11 TO DRIVE COMPASS. ("NAV2" & "DME" SW. ON)

3. READ PULSE FREQUENCY ON TRANSPONDER DISPLAY.

V/F CONVERTER	OUTPUT (TO P8-34)	TEST CONDITIONS	POT (CARD)	FREQ. (±1 DIGIT)	
ALT RATE	P3-9	CLIMB RATE = 1000	R171 (COM/ADF)	192	
HDG RATE	P3-14	STD RATE TURN (R)	R190 (COM/ADF)	96	
Y RATE	P5-27	AIRSPEED = 180 KN HEADING = NORTH WIND VELOCITY = 0	R92 (NAV1/DME)	350	
		WIND = N @ 50Kn	–	253 ±25	*
		S @ 50Kn	–	447 ±25	*
X RATE	P5-25	AIRSPEED = 180 KN HEADING = EAST WIND VELOCITY = 0	R75 (NAV1/DME)	350	
		WIND = E @ 50Kn	–	253 ±25	*
		W @ 50Kn	–	447 ±25	*

NOTE: IF RUDDER ASSEMBLY NOT INSTALLED, JUMPER P4-19 TO GND.

END 12

* THESE ARE CHECKS, NOT ADJUSTMENTS. THE CIRCUITRY IS ON THE FAULT PANEL & NAV1/DME.

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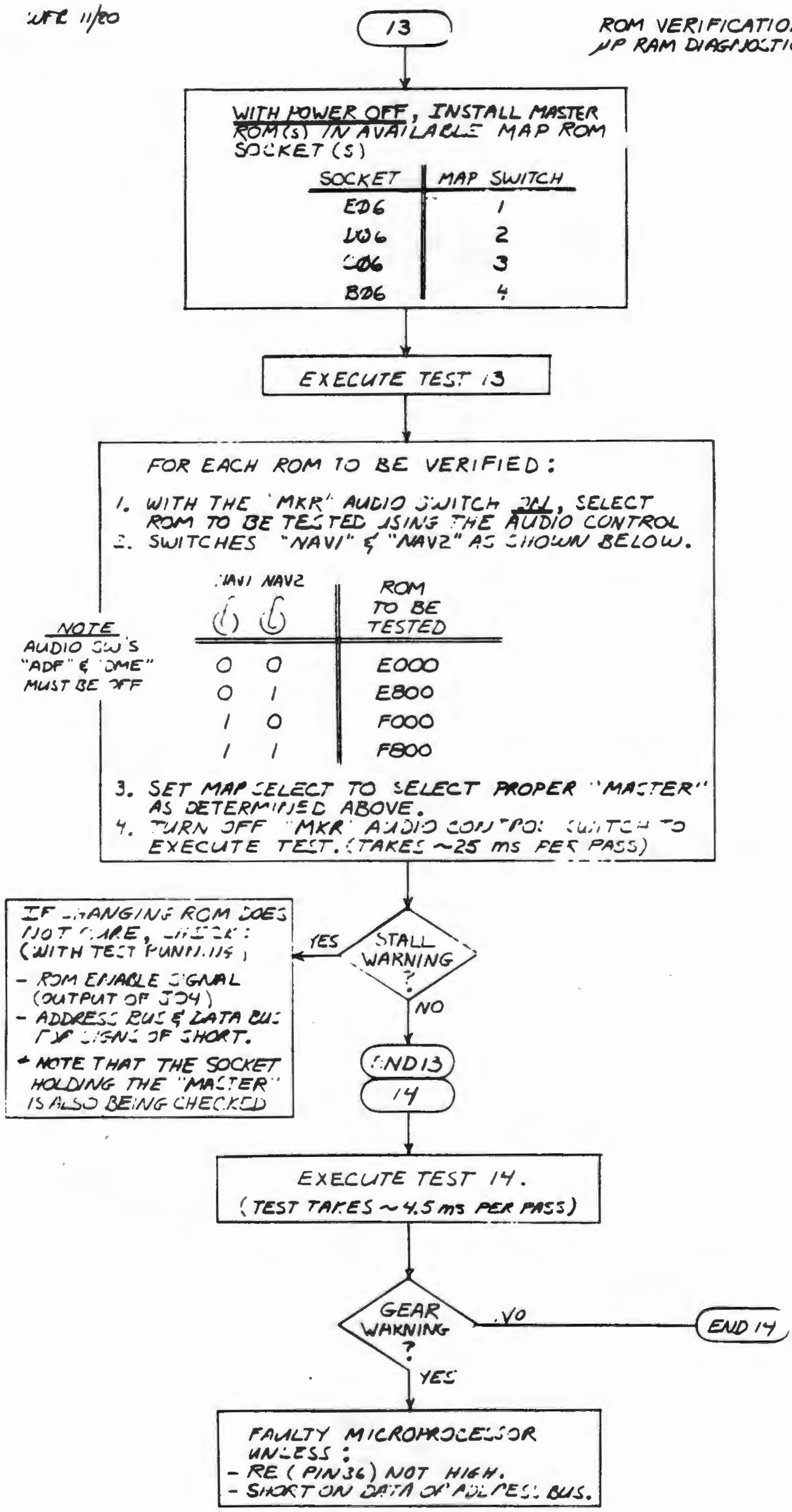
ROM VERIFICATION
μP RAM DIAGNOSTIC



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FUEL CONTROL
(COM/ADF CARD)