TECHNICAL MANUAL

DIRECT AND GENERAL SUPPORT MAINTENANCE MANUAL

NAVIGATIONAL SET, TACAN
AN/ARN-103(V)
(FSN 5826-167-1027 V1)
(FSN 5826-167-1026 V2)

This copy is a reprint which includes current pages from Changes 1.

HEADQUARTERS, DEPARTMENT OF THE ARMY

DECEMBER 1973

WARNING

DEATH OR SERIOUS INJURY may result from electrical hazards unless proper safety measures are observed when operating and maintaining this equipment. Up to 2000 volts and 4.0 kilowatts are present when the equipment is energized.

TECHNICAL MANUAL

No. 11-5826-234-34

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON. D.C., *28 December 1973*

Direct and General Support Maintenance Manual
NAVIGATION SET, TACAN AN/ARN-103(V)
(FSN 5826-167-1027 V1)
(FSN 5826-167-1026 V2)

LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1-1.Scope

a. This manual describes the functioning of Navigational Set, TACAN AN/ARN-103(V)(fig. 1-1) and covers the direct and general support maintenance categories. Also included are testing, troubleshooting, and replacement and repair of parts authorized for the direct and general support maintenance levels.

b. The description of the navigational set, as well as installation, operation, and organizational maintenance are contained in TM 11-5826-243-20.

c. Instructions for depot maintenance work requirements are contained in DMWR 11-5826-243.

d. Refer to TM 11-5826243-24P for repair parts and special tools list.

1-2. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficencies. Fill out and forward DD Form 6 (report of Packaging and Handling Deficiencies) as prescribed in AR 700-58 (Army)/NAYSUP Pub 378 (Navy)/AFR 71-4 (Air Force)/and MCO P4030.29 (Marine Corps).

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38 (Army)INAVSUP Pub 459 (Navy)/AFM 75-34 (Air Force)/and MCO P4610.19 (Marine Corps).

1-3. Destruction of Army Materiel to Prevent Enemy Use

Demolition of the equipment will be accomplished only upon the order of the Commander. Refer to TM 750-244-2 for procedures to prevent enemy from using or salvaging this equipment.

1-4. Administrative Storage

For procedures, forms, records, and inspections required during administrative storage of this equipment refer to TM 740-90-1.

1-5. Reporting of Equipment Publication Improvements

The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded directly to the Commander, U.S. Army Electronics Command, ATTN: AMSEL-MA-AN, Ft. Monmouth, NJ 07703.

CHAPTER 2

FUNCTIONING OF EQUIPMENT

Section I.

2-1. Scope

The purpose of this chapter is to provide direct and general support maintenance personnel with an overall understanding of the operation of Navigational Set, TACAN AN/ARN-103(V) to aid them in the performance of maintenance on the equipment.

a. During tactical deployment, the navigational set operates with other items of airborne and surface electronic equipment including a surface TACAN beacon transponder, a horizontal situation indicator, a bearing-distance-heading indicator, and a computer. These items are interconnected as shown in figure FO-2. Information relating to the functional operation and characteristics of these equipments is included in this section to the extent necessary to understand the overall operation of the navigational set. Particular emphasis is placed on the characteristics of the signals transmitted between the surface beacon and the navigational set because an understanding of these signals is essential to understanding the system functional operation.

b. Section II provides an overall function description of the major units of the navigational set.

c. Sections III through VI contain a circuit analysis of each major unit and modules in terms of block diagrams and associated schematic diagrams.

d. Abbreviations of the signals and functions used throughout this chapter are defined when mentioned for the first time. In addition all abbreviations (Mnemonics) are listed in the glossary.

2-2. System Functional Description

The navigational set is a combination transmitter, receiver, decoder, digital computer, and digital-to-analog converter that performs a number of major navigational functions and combinations of functions for the aircraft.

a. Control Functions. The particular function, or combination of functions, performed by the navigational set at any given time depends on the mode of operation selected at the control unit. Four modes are available with either X or Y mode coding: REC (receive), T/R (transmit-receive), A/A (air-to-air), and AUTO (automatic). The operating mode selected depends on the requirements of the existing tactical situation and the type of navigational information desired by the pilot.

(1) In the REC mode, the navigational set determines the bearing of the aircraft with respect to a surface beacon, and provides a beacon identity tone to the pilot. The transmitter is inhibited in this mode, so that radio silence is maintained. The navigational set receives coded, amplitude-modulated if pulse pairs from the beacon, and detects, decodes, and demodulates the signals to extract the bearing and identification signals. The bearing signals are digitally processed to derive digital bearing information, then converted into analog signals to operate the bearing-distance-heading and horizontal situation indicators. The beacon identification signals are converted into 1350 Hz audio tone signals and connected to the pilot’s intercom.

(2) In the T/R mode, the navigational set determines slant range and bearing from the aircraft to the beacon, and beacon identification information. To measure slant range, the navigational set transmits interrogation pulses to the beacon, which responds by transmitting reply pulses. The navigational set receives, detects, and decodes the reply pulses, and computes the slant range. Slant range is computed, in general, by measuring the total elapsed time (minus known system delays) between the transmission of interrogation pulses and the reception of reply pulses. The resulting digital slant range is converted into analog signals by the navigational set to operate the distance indicators.

(3) The A/A mode is used to measure the slant range between two or more similarly equipped aircraft. If more than two aircraft are involved, one aircraft acts as a reference for the others and all range measurements are made

with respect to the reference aircraft. To accomplish this, each navigational set transmits a reply pulse when interrogated. Interrogations are distinguished from replies in that an interrogation consists of a coded pulse pair and a reply consists of a single pulse. When a reply pulse is recognized, it is processed to determine the elapsed time between transmission of the interrogation pulses and reception of the reply pulse to determine slant range. When interrogation pulses are recognized, they are processed to cause the navigational set to transmit a reply pulse. Slant range is computed using the same basic principles described for the T/R mode.

(4) In the AUTO mode, the external computer selects the operating mode and channel. The computer sends control word information to the digital interface assembly in the navigational set. The interface assembly processes this information and uses it to control the TACAN channel and operating mode. Upon request from the external computer, the digital interface assembly sends either control word information, range data, or bearing data to the computer. Range and bearing are computed in the same manner as for the T/R and A/A modes.

(5) The navigational set has a built-in self test circuit that provides visual GO/NO-GO indications of its operational status. In the event of a malfunction, the control unit displays the fault. A more comprehensive test is made (continuous monitor) during an interruptive test cycle.

(6) The navigational set also has an electronic countermeasures (ECM) detection circuit which senses the presence of additional on-channel TACAN type signals and provides the proper stimulus to illuminate the ECM WARN lamp on the control unit.

(7) The REC, T/R, and A/A operating modes can be X and Y, mode coded. The coding is selected by the X/Y MODE switch on the control unit.

b. Operational Functions. To understand the functional operation of the navigational set in performing bearing and slant range measurements and in producing a beacon identification signal, it is first necessary to understand the characteristics of the signals transmitted by the surface beacon. The beacon transmits on one of 252 preselected frequencies: 962 to 1024 MHz (channels 1X through 63X), 1151 to 1213 MHz (channels 64X through 126X), 1088 to 1150 MHz (channels 1Y through 63Y), or 1025 to 1087 MHz (channels 64Y through 126Y). These frequencies correspond to the frequencies that the navigational set is capable of receiving when operated in the REC or T/R modes. The beacon receiver operates on a frequency 63 MHz above or below its transmitting frequency; 1025 through 1087 MHz (channels 1 through 63); or 1088 through 1150 MHz (channels 64 through 126). These frequencies correspond to the transmitter frequencies of the navigational set in the T/R mode. The difference between channel frequencies within a band is 1 MHz per channel. For example, if the beacon is operating on channel 2X, its transmitting frequency is 963 MHz and its receiving frequency is 1026 MHz. In this case, the navigational set would be tuned to a receiving frequency of 963 MHz and a transmitting frequency of 1026 MHz.

(1) The beacon continuously transmits pulse pairs at a repetition rate of approximately 3600 pulse pairs per second, regardless of whether it is interrogated or not. These pulse pairs normally consist of randomly-spaced (squitter) pulse pairs, reply pulse pairs, 15 coarse reference pulse group and 120 fine reference pulse groups. All signals transmitted by the beacon are, in effect, amplitude modulated by a modified cardioid radiation pattern caused by the beacon antenna system. This modulation has a fundamental frequency of 15 Hz, and a ninth harmonic of the fundamental, 135 Hz. The coarse and fine reference pulse groups are transmitted at fixed intervals that are in direct relationship to the physical direction of the main lobe of the radiation pattern, and serve as reference points from which to make bearing computations.

(2) The reference pulse groups account for a total of 900 of the 3600 pulse pairs per second transmitted by the beacon when in X mode of operation. The remaining 2700 pulse pairs consist of any combination of randomly-spaced pulse pairs and reply pulse pairs, in a ratio which depends on the number of aircraft interrogating the beacon. In the absence of interrogations, the beacon transmits 2700 randomly spaced pulse pairs and no reply pulses. When the beacon receives interrogations from one or more aircraft, it transmits one reply pulse pair for each interrogation pulse pair received, and the number of randomly-spaced pulse pairs transmitted is correspondingly reduced. The beacon can reply to interrogations from a maximum of approximately 100 aircraft.

(3) At intervals of 37.5 seconds, the beacon transmits an identification pulse train in place of the randomly-spaced and reply pulse pairs. The identity tone consists of a series of pulse

pairs, in Morse code, transmitted at a repetition rate of 1350 pulse pairs per second. The signals are coded so that 0.125 second represents a dot and 0.375 second represents a dash. An equalizing pulse pair is transmitted 100 microseconds after each identity tone pair to maintain a constant duty cycle for the beacon. The beacon continues to transmit the reference pulse groups while transmitting the identity tone. Reply pulse pairs and randomly-spaced pulse pairs are transmitted during the intervals between dots and dashes of the Morse code signal.

(4) All pulses transmitted by the beacon have a 3.5-microsecond pulse width at the 50-percent amplitude point. The X coded coarse reference pulse groups comprise 15 pulse groups per second. Each group contains 12 pulse pairs. The pairs are spaced 30 microseconds apart and the pulses in the pair are spaced 12 microseconds apart (fig. 2-1A). The Y coded coarse reference pulse groups comprise 15 pulse groups per second. Each group contains 13 single pulses. The pulses are spaced 30 microseconds apart (fig. 2-lB). The X coded fine reference pulse groups comprise 120 pulse groups per second. Each group contains 6 pulse pairs. The pairs are spaced 24 microseconds apart and the pulses in the pair are spaced 12 microseconds apart. The Y coded fine reference pulse groups comprise 120 pulse groups per second. Each group contains 13 single pulses. The pulses are spaced 15 microseconds apart. Reply pulse pairs are distinguishable from randomly-spaced pulse pairs only by their occurrence in time, i.e., synchronized with and immediately following the time of reception of the interrogation signals.

(5) In omnirange measurements, it is necessary to establish known reference points with respect to bearing, and to cause signal variations from which phase measurements can be made. This provides a basis for making bearing computations. The coarse and fine reference pulse groups establish the reference points required; the 15 and 135 Hz amplitude modulations create variations in signal level (at the point of reception) that are in direct relationship to the bearing of the aircraft with respect to the beacon.

(6) All signals transmitted by the beacon are amplitude modulated by the beacon antenna system at a fundamental rate of 15 Hz, with the ninth harmonic (135 Hz) superimposed on the fundamental. The beacon antenna consists basically of a central radiating element around which an inner reflector and nine outer reflectors are rotated at 15 revolutions per second (fig. 2-2). The inner reflector is displaced from the central element to cause the fundamental cardioid radiation pattern shown in figure 2-3A. Due to the rotation of the reflector around the radiating element, the radiation pattern rotates around the beacon at a rate of 15 revolutions per second. At a given point away from the beacon antenna, the effective result is

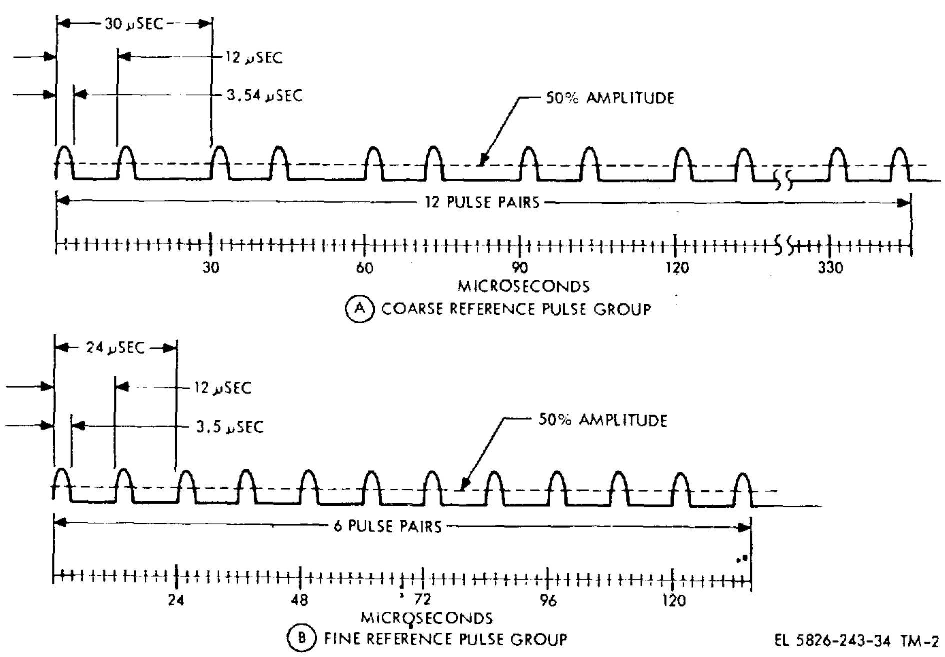


Figure 2-1. Reference pulse groups for X-coded channels.

a 15 Hz, amplitude-modulated signal. The nine outer reflectors are spaced uniformly (40 degrees apart) around the radiating element, causing the radiation pattern shown in figure 2-3B. The composite pattern caused by the combination of the inner reflector and the outer reflectors is shown in figures 2-3C and 2-3D. Due to the integral rotation of the inner and outer reflectors, this composite pattern rotates around the beacon antenna in a clockwise direction at 15 revolutions per second. The effective result is a 135-Hz amplitude-modulated signal superimposed on a 15-Hz amplitude-modulated signal.

(7) Each time the maximum point on the main lobe of the radiation pattern passes through magnetic east, the beacon transmits the coarse reference pulse group. Each ninth of a revolution thereafter (40 degrees), the beacon transmits the fine reference pulse group. A priority circuit in the beacon insures that the reference pulse groups are transmitted regardless of other signals at the time. A basic bearing determination may be made by comparing the time of transmission of the coarse reference pulse group with the phase of the fundamental 15 Hz modulation envelope at the point of reception. This one-to-one relationship between bearing and phase is susceptible to errors due to reflections, antenna siting errors, and in-, strumentation inaccuracies. To minimize these errors, additional comparisons are made between the fine reference pulse groups and the phase of the 135 Hz modulation envelope. In this way, the 15 Hz measurements determine the proper bearing sector, and the 135 Hz measurements determine the precise bearing within the sector. One electrical degree of the 15 H7 modulation signal corresponds to one degree in bearing, and one electrical degree of 135 Hz signal corresponds to one-ninth degree in bear. ing. Theoretically, bearing measurements made using the 135 Hz signal are nine times more accurate than bearing measurements made using only the 15 Hz signal.

(8) The waveform in figure 2-4A illustrates the relationship of the coarse and fine reference pulse groups to the 15 and 135 Hz modulation signals that would be detected by an aircraft located directly east of the beacon (90 degrees). In this case, the aircraft bearing indicators, which display the direction of the beacon with respect to the aircraft, would indicate 270 degrees. For comparison purposes, the waveform in figure 2-4B illustrates the relationship of the reference pulse groups to the modulation signals for an aircraft located due south of the beacon 180 degrees), which would cause a 0-degree bearing display.

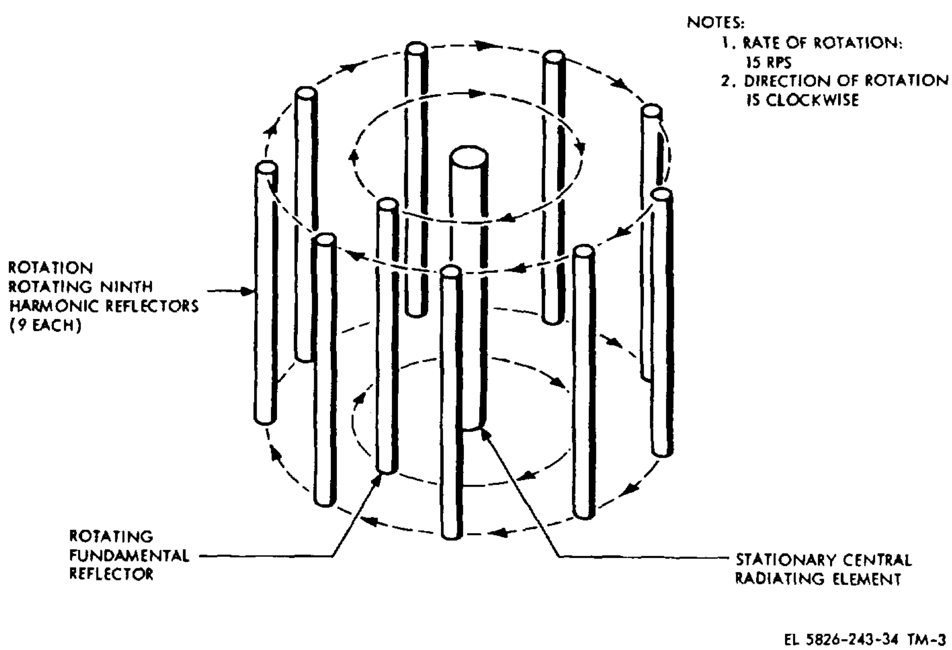


Figure 2-2. Principles of beacon antenna.

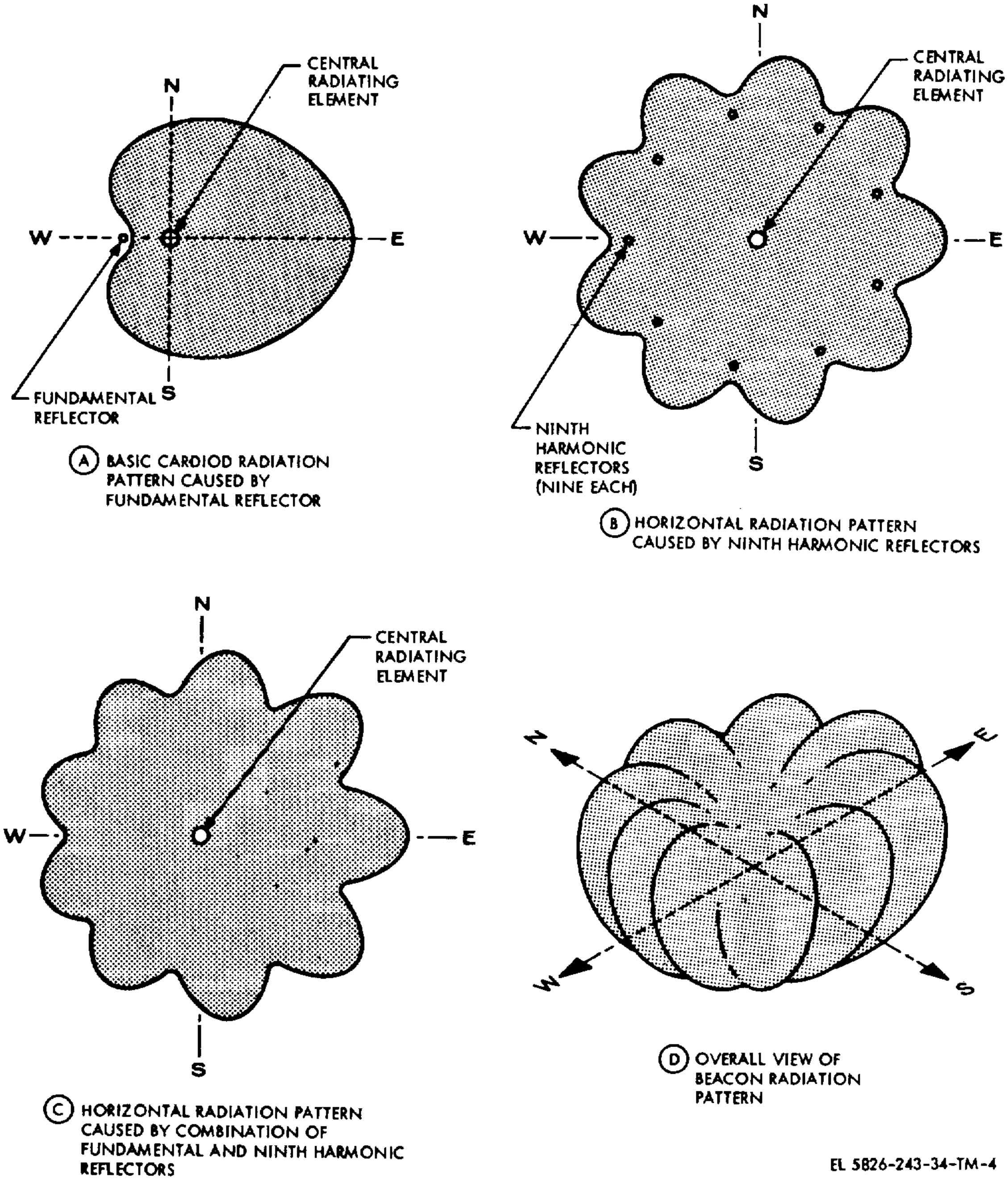


Figure 2-3. Beacon radiation pattern.

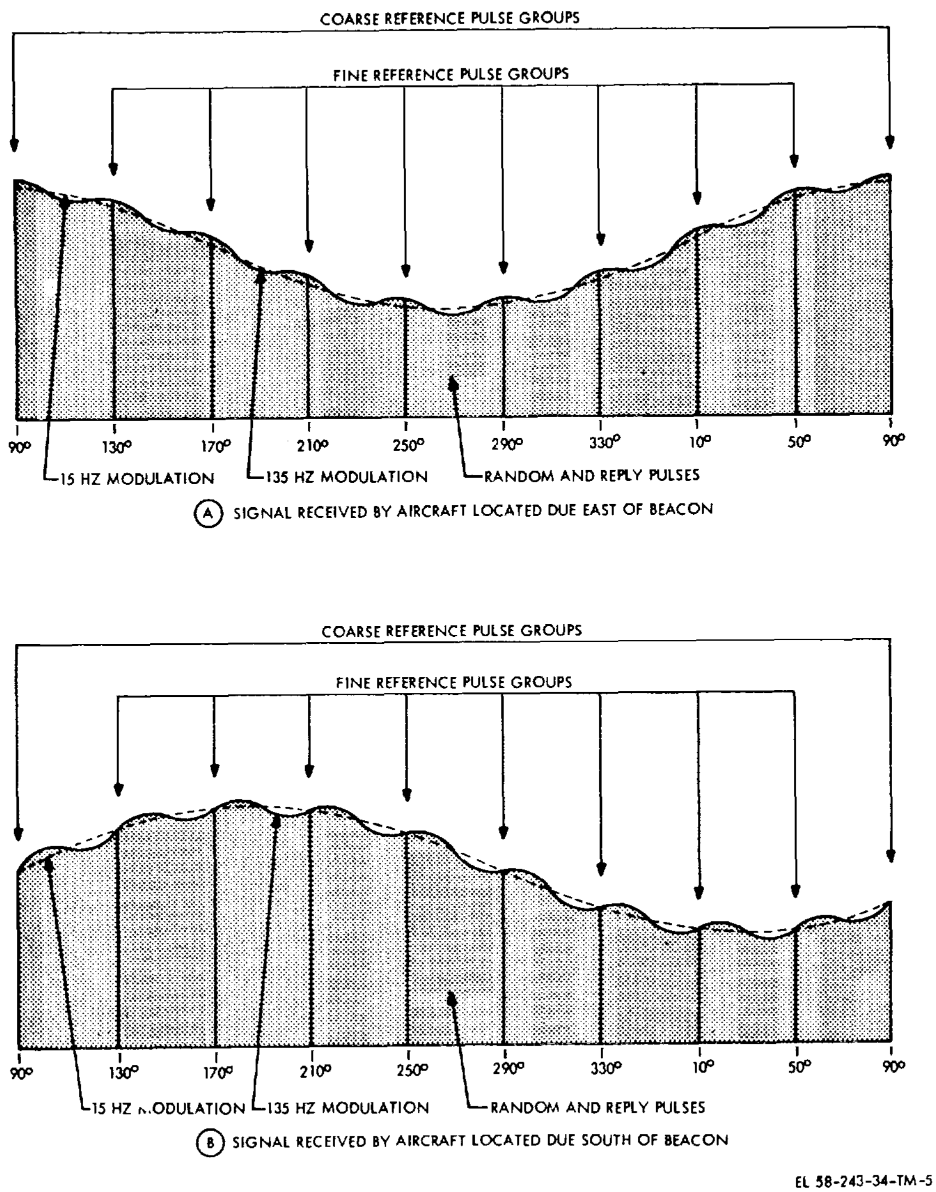


Figure 2-4. Relationship of modulation to reference pulse groups.

Section II. FUNCTIONS OF MAJOR UNITS

2-3. Scope

The following paragraphs provide a brief description of the functions performed by each of the major units making up the navigational set. Figure FO-3 is a functional block diagram of the navigational set.

2-4. Mounting Adapter Functions

The mounting adapter provides a mounting vehicle for the receiver-transmitter and the converter. The unit consists of an adapter connector and a base shock mount.

a. Adapter Connector. The adapter connector provides an interface between the aircraft wiring and control unit and the receiver-transmitter and converter. All output and input power is routed through the adapter connector.

A transient suppression filter is provided on the 28 vdc line.

b. Shock Mount. The shock mount dampens the aircraft vibrations from damaging the receiver-transmitter and converter.

2-5. Control Unit Functions

a. The control unit contains front panel controls for selecting the operating mode, channel, X/Y mode, volume adjustment of the beacon identity signal, and initiation of self test. The control unit also provides a turn on command (TOC) to the power control relay in the converter, which provides operating power to the navigational set.

b. The control unit provides channel selection data, operating mode selection, and X/Y code commands to the receiver-transmitter as a serial data pulse train. The operating mode selector which has five positions: OFF, REC, T/R, A/A, and AUTO. The CHAN selector consists of two rotary switches; one for selecting units and one for selecting tens. The BIT switch and its associated STATUS lamps are used for determining the operational readiness of the system. When pressed, the BIT switch inserts a self test bit into the serial data train to the receiver. transmitter, which allows the status of the control unit to be checked. Pressing the BIT switch also causes self test signals to be processed throughout the navigational set. The results of the self test are displayed as aGO or NO-GO indication by the STATUS lamps. ECM WARN lamp is displayed when an on-channel electronic countermeasures signal is attempting to jam the TACAN.

2-6. Converter Functions

a. The converter contains the range and bearing couplers, buffer, and digital interface assembly. The range and bearing couplers convert the digital outputs from the range and bearing computers into appropriate analog signals to drive the horizontal situation and the bearing-distance-heading indicators. It also contains the power turn-on relay, antenna switch driver, beacon identity tone transformer, and radio frequency interference (RFI) suppression filters.

b. The buffer converts the input signals from the computer to voltage levels compatible with the digital interface logic.

c. The interface assembly receives control word information from the external computer, processes this information, and uses it to control the TACAN channel and operating mode. Upon request from the external computer, the digital interface transmits either control word information, range data, or bearing data to the computer.

2-7. Receiver-Transmitter Functions

The receiver-transmitter performs the basic functions of transmitting and receiving pulse rf signals, detecting, decoding, and demodulating the received signals, computing bearing and slant range information, and processing the beacon identification signals. The receiver-transmitter performs a self test automatically whenever a self test command is initiated at the control unit. The receiver-transmitter also detects an ECM situation and provides the necessary display command to the control unit. The receiver-transmitter continuously monitors critical internal signals and provides a NO GO status if a failure occurs.

a. Transmitter Functions. When the navigational set is operated in the T/R mode, the transmitter output consists of rf pulse pairs that are transmitted to interrogate the surface beacon. In the A/A mode, the transmitter output consists of rf pulse pairs to interrogate other aircraft, and signal pulse replies that are transmitted in response to received interrogations. The transmitter pulse repetition frequency (PRF) in the T/R mode is controlled by the range computer, which generates trigger signals to pulse the modulator, and is approximately 150 pulse pairs per second for range search and 27 pulse pairs per second for range track. The pulse rate in the A/A mode is the sum of the range computer generated pulses and the pulses generated in response to received interrogations.

(1) The transmitting frequency depends on the channel selected at the control unit, and may be any one of 126 frequencies, starting at 1025 MHz for channel 1 and advancing in 1 MHz increments to 1150 MHz for channel 126. When operating in the A/A mode, one aircraft must use a channel that is either 63 channels higher or lower than the remaining aircraft to enable reception of the transmitted signals. The frequency synthesizer module provides a signal of the selected frequency to the power amplifier during the period of time that pulses **are** to be transmitted. The power amplifier, when pulsed by the modulator, provides a high-power rf pulse that is applied, through the circulator and coupler-filter, to the antenna.

(2) A voltage controlled oscillator (VCO) in the frequency synthesizer is the frequency

source for all 126 transmitting channels. The output of the VCO is phase-locked to a single crystal-controlled oscillator to provide frequency and phase accuracy and stability throughout the entire frequency range. This signal is also the local oscillator signal for the receiver.

b. Receiver Functions. The receiver receives rf pulses from the antenna via the circulator, converts the rf pulses into IF pulses, and amplifies and detects the IF pulses to produce video output pulses to the decoder. The inputs to the receiver consist of amplitude-modulated, coded rf pulse pairs in the REC and T/R modes, and coded rf pulse pairs and single rf pulses in the A/A mode. The gain of the IF amplifiers is controlled by AGC-voltages from the decoder module, so that the video outputs of the receiver are of almost constant amplitude regardless of the strength of the received pulses or variations in individual pulse amplitudes.

(1) The preselector is electrically tuned to pass only frequencies corresponding to the channel and operating mode selected at the control unit, while limiting and attenuating rf signals of excessive power levels to protect the mixer crystals. For any operating mode or channel that is selected at the control unit, the preselector is automatically and rapidly tuned to a frequency 63 MHz above or below the transmitter frequency. In the REC or T/R modes, the preselector is tuned to a frequency from 962 to 1024 MHz, corresponding to channels 1X through 63X, 1151 to 1213 MHz, corresponding to channels 64X through 126X, 1088 to 1150 MHz, corresponding to channels 1Y through 63Y, or from 1025 to 1087 MHz, corresponding to channels 64Y through 126Y. In the A/A mode, the preselector is tuned to 1088 through 1150 MHz for channels 1 through 63, or to 1025 through 1087 MHz for channels 64 through 126.

(2) The receiver uses double-conversion techniques to produce a first IF of 63 MHz and a second IF of 11.5 MHz. A passive filter located prior to the second IF controls the receiver bandwidth, and allows wideband IF amplifier circuits to be used. Two types of automatic gain control (AGC) voltages, fast and slow, are used to control the gain of the IF amplifiers. The fast AGC is used to recover the bearing modulations by controlling the gain on a pulse pair-to-pulse basis. The slow AGC controls the receiver gain on a long-term basis to compensate for variations in overall signal strength.

c. Decoder Functions. The decoder receives the video pulses from the receiver, and performs the following major functions:

(1) Decodes the pulses to recognize valid pulse pairs and provides an appropriate output to the range computer.

(2) Generates fast and slow AGC voltages to control receiver gain in accordance with the F amplitude of the video input pulses.

(3) Demodulates and filters the 15 and 135 Hz bearing modulations, and routes the resultant signals to the bearing computer.

(4) Decodes and separates the coarse and fine reference pulse groups, and provides appropriate pulses to the bearing computer.

(5) Generates a reply pulse to trigger the transmitter in the A/A mode in response to an interrogation.

(6) Decodes the beacon identification signal, and provides a corresponding audio tone signal output. The decoder recognizes acceptable pulse patterns by using a high-frequency clock to time counter-gating circuits that check for the presence of pulses at specified time intervals. The counter, when triggered by the receipt of an input pulse, counts out a predetermined time interval, then causes a gate to be generated. If the second pulse is present during this gated time, it is recognized by the decoder as the second pulse of a valid pulse pair, and the decoder provides a corresponding output pulse to the range computer. The counter also continues to count to determine whether this pulse pair represents the start of a main or auxiliary reference pulse group. If the correct number of pulse pairs is present at the correct time, the decoder provides an appropriate output pulse to the bearing computer. If not, the decoder repeats this procedure upon receipt of the next valid pulse pair. All valid pulse pairs are applied to the identity tone circuits. If they occur at a 135-Hz repetition rate, these circuits provide a corresponding 1350-Hz audio output signal. In the A/A mode, the decoder recognizes an interrogation pulse pair and initiates an appropriate reply command. It also recognizes single-pulse replies from other navigational sets and routes them to the range computer.

d. Range Measurements. Range measurements are accomplished by measuring the elapsed time between the transmission of interrogation pulses and the reception of valid reply pulses, and subtracting known system delays. This is accomplished by the range computer, which operates in two modes: a range search mode and a range track mode. In the range search mode, the range computer counts outward, systematically from range zero, until a valid reply is obtained and verified. This condition causes the range computer to switch into the range track mode, in which the range of the return is constantly tracked and converted to digital signals that represent the distance in nautical miles. These signals are sent to the range coupler module in the converter for conversion into analog signals to operate the distance indicators in the aircraft.

e. *Bearing Measuremnents.* Bearing measurements are accomplished by comparing the phase of the bearing modulation signals with the time position of the coarse and fine reference pulse groups. The bearing computer contains phase-lock loop circuits that lock onto the bearing modulation signals and reference pulse groups, and count in 0.25-degree steps from the coarse reference pulse to the zero crossover point on the 15 Hz modulation signal. Since the coarse reference pulse group is always transmitted by the beacon at fixed time in relation to its antenna radiation pattern, the zero crossover time on the 15-Hz modulation waveform occurs at a time that is directly proportional to the bearing of the aircraft with respect to the beacon. The 135-Hz modulation waveforms and the fine reference pulse groups are used to provide a fine bearing determination within the previously established bearing sector. The bearing computer also contains memory-tracking circuits that allow the bearing signals to be lost for short periods of time without loss of the bearing output signals. The output signals consist of digital numbers from a static register. These signals are applied to the bearing coupler module in the converter for conversion into analog signals to drive the bearing indicators in the aircraft.

f. Self Test Functions. Self test status and other critical signals are continuously monitored throughout the navigational set. The self test operates in both continuous and interruptive modes. Any malfunction occurring during self test are displayed by status indicators located on the front panel of the receiver-transmitter and on the control unit.

(1) The continuous self test monitors critical functions and modules through individual internal signals and module status signals. The functions or modules monitored are power supply status, the presence of transmitted pulses at the digital and RF levels, peak power, antenna VSWR, and the receiver and frequency synthesizer modules. If any malfunctions result during continuous self test the NO-GO status indicator on the control unit is illuminated.

(2) The interruptive self test is initiated by the BIT switch on the control unit. The internal RF beacon is turned on and the navigational set locks on zero range and bearing. In addition to the functions monitored continuously, the control unit, range and bearing computers, and analog couplers are also tested. The test results are displayed during the last 10 seconds of the 30 second long interruptive cycle.

g. ECM Function. When TACAN type electronic countermeasures signals are being received, and are within 4.4 db of the desired signal, the internal control module detects this condition and provides a signal to activate the ECM WARN lamp drive circuit in the control unit.

h. Blower. The blower provides airflow to the receiver-transmitter and converter. The blower operates with 115 vac 400 Hz power input and is capacitor started. The blower rotates at 14,000 revolutions per minute at sea level and increases up to 22,000 revolutions per minute at an altitude of 70,000 feet. The increase in revolutions is from the decrease in air density and the requirement to maintain constant mass airflow at varying altitudes.

Section III. MOUNTING ADAPTER CIRCUIT ANALYSIS

2-8. General

Base, Shock Mount, Electrical Equipment MT-4411/ARN-103 is an aluminum Perry Shock mount that provides a firm shock resistant mounting installation for the receiver-transmitter and the converter. Two self-locking fasteners secure the receiver-transmitter and converter to the mount.

2-9. Assembly Analysis

a. Adapter Connector. The adapter-connector contains the interconnecting wiring between the aircraft, control unit, external computer, and converter (fig. FO-2. All input power, output analog drive signals, and computer interface signals are routed by the adapter-connector through six connectors. The main (connector X4P1) plugs into the converter. The other five connectors provide the interface with the aircraft cables (fig. FO-4).

b. Shock Mount Base. The shock mount provides vibration damping and a mounting base for the receiver-transmitter and converter. Two self-locking fasteners secure the receiver-transmitter to the mount. Four vibration isolators dampen shocks caused by the aircraft.

Section IV. CONTROL UNIT CIRCUIT ANALYSIS

2-10. General

All controls needed to operate the navigational set are on the control unit. The control unit applies power and provides channel, operating mode, and X/Y code commands to the navigational set, initiates an interruptive self test cycle, displays fault and ECM indications, and controls the volume of the beacon identify tone.

2-11. Assembly Analysis

The operating mode select switch, when set to any position other than OFF, connects +28 vdc to the turn on command (TOC) line (fig. 2-5 and fig. FO-5). The TOC energizes a relay in the converter which applies all input power to the navigational set. In the AUTO position, the T/R and A/A outputs from the decoding gates are connected together. An external computer then automatically takes control of the system.

2-12. Module Analysis

a. The control unit provides channel select data (mixed binary and binary coded decimal) and operating mode select commands to the receiver-transmitter over a single line. A time multiplexing scheme produces a serial data train which contains all the channel and operating mode information. The serial data train is produced by clocking a 14-bit counter, which contains seven flip-flops, at a 400 Hz rate. The 400 Hz clock pulses are produced by clipping the 26 vac, 400 Hz aircraft power and shifting the dc level of the resultant pulses. The counter counts from 0 to 14 and back to 0. The 14 count bits are decoded and converted to 14 parallel bits by 14 NOR gates for coding by the channel select and operating mode select switches. Then the switch outputs and counter outputs are summed in the output logic to produce the serial data train. The control unit is normally synched to the X beacon channels. In the Y position of the MODE switch, the Y output from the decoding gages is connected to the output logic circuit to change the coding of the serial data train to make the receiver-transmitter detect Y channels only.

b. A flip-flop in the output logic flips each time the 14-bit counter completes a cycle. The flip-flop output is summed with the serial data to alternately produce 14 serial bits of data and 14 zero bits. The output logic then establishes a dc reference of +28 vdc for logic 0 bits and 0 vdc for logic 1 bits. Table 2-1 describes the contents and uses of the serial data. Figure 2-6 shows the composition of the serial data train for A/A, X mode, channel 105 when the BIT switch is depressed.

Table 2-1. Serial Data Train Contents

Channel or bit	Description
1	Channel 1 is the sync bit. This bit is always logic 1, and provides for synchronizing the decoding logic in the receiver-transmitter.
2	Channel 2 is the self test bit. This bit is logic 0 until the BIT switch on the controlunit is pressed. Then it becomes logic 1. This bit is used to check the control unit operation during the self test cycle.
3	Channel 3 contains the X/Y mode bit. (Logic 1 is Y mode; logic 0 is X mode).
4	Channel 4 contains the A/A bit. This bit' tells the receiver-transmitter that the air-to-air mode has been selected.
5	Channel 5 contains the T/R bit*.
6	
7	Channels 6 through 9 are the units bits of the channel data and represent 1, 2, 4, respectively.
8	
9	
10	
11	Channels 10 through 13 are the tens bits of the channel data and represent 10, 20, 40, 80, respectively.
12	
13	
14	Channel 14 is a spare position.

*When the AUTO operating mode is selected both the A/A bit and the T/R bit will be true.

c. The control unit provides a visual indication during the interruptive self test cycle. The interruptive self test cycle is initiated when the BIT switch is pressed (self test initiate). When the BIT switch is pressed, +28 vdc is applied to the SMS line from the control unit to the receiver-transmitter. During the time the BIT switch is pressed, a logic 1 is present in the self test position of the control unit serial data train. This allows the self test module in the receiver-transmitter to check the operation of the control unit. The +28 vdc on the SMS line causes the navigational set to enter an interruptive test

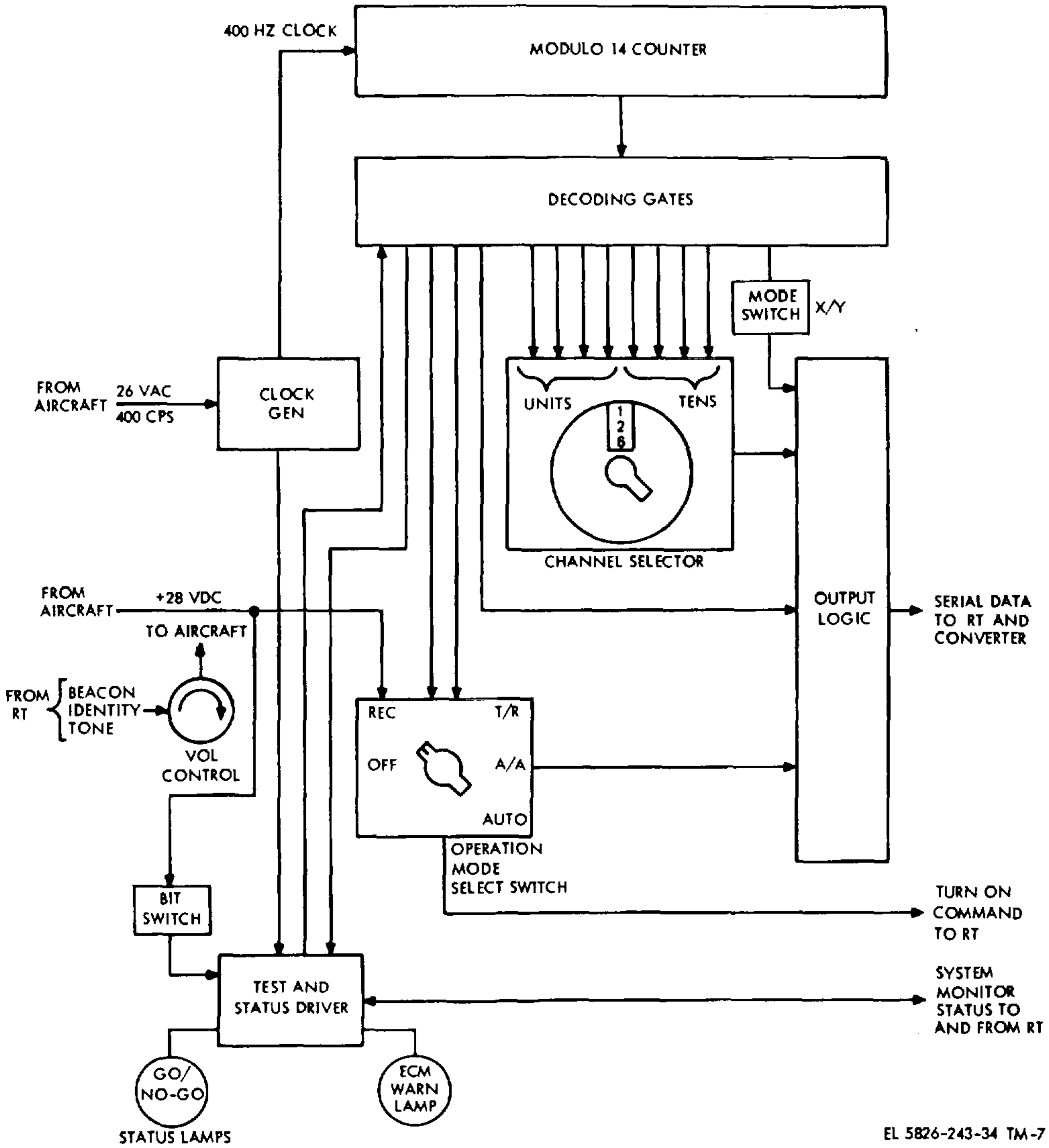


Figure 2-5. Control unit block diagram.

cycle. Pressing the BIT switch illuminates the GO, NO-GO, and ECM WARN lamps on the control unit to provide a lamp test feature. When the BIT switch is released, all lamps extinguish until the display period when either a TACAN GO or NO-GO is indicated. The entire interruptive test cycle lasts approximately 25 to 30 seconds. During the last 10 seconds, the results either GO or NO-GO, are displayed at the control unit. A continuous NO-GO indication is displayed if any of the monitored navigational set functions fail.

d. If a -12 vdc ECM signal is present on the SMS line from the internal control module, it is decoded by the lamp drive circuit in the control unit, which illuminates the ECM WARN lamp. An ECM signal is generated when a TACAN type signal within 4.4 db of the desired signal is being received. Similarly, if a + 12 vdc (GO) or +5 vdc (NO-GO) signal is received from the self test module, it is decoded by the lamp drive circuit in the control unit, which illuminates the GO or NO-GO lamps, respectively. However, the interruptive test results, GO or NO-GO, override the

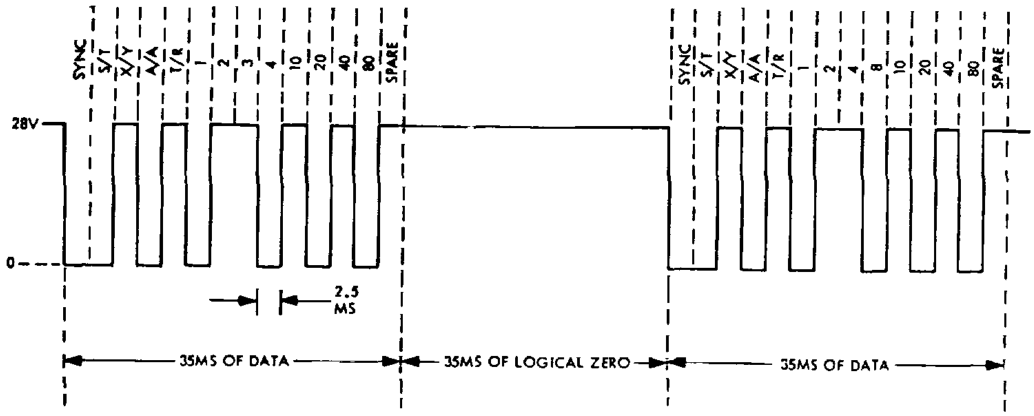


Figure 2-6.

5826-243-34 TM-8

ECM signal. During the display period of the self test cycle, the ECM signal is inhibited and only the GO/NO-GO indication is displayed. When the test cycle is over, the ECM WARN indication returns, if present. The self test initiate (+28 vdc), self test display (GO is +12 vdc and NO-GO is +5 vdc), and ECM signals (-12 vdc) are sent to and returned from the receiver-transmitter and converter on the SMS line.

e. The volume of the identity tone is controlled by a potentiometer which adjusts the amplitude of the detected identity tone signal. The identity tone signal is then fed to the aircraft intercom.

Section V. CONVERTER CIRCUIT ANALYSIS

2-13. General

The converter houses the range coupler, bearing coupler, digital interface, and buffer modules. The range and bearing couplers convert digital range and bearing voltages into analog currents to drive the range and bearing position indicators. The digital interface module processes digital-data to and from an external computer. The buffer converts external computer logic levels to the necessary levels for processing by the digital interface assembly.

2-14. Assembly Analysis

Relay K1 (fig. FO-6) routes 115 vac and 26 vac power throughout the navigational set on receipt of a turn on command (TOC) from the control unit. Filter FL1 isolates RFI from the input power lines. Transformer T2 drive is adjusted by the COARSE centering potentiometer on the receiver-transmitter. Transistors Q1 and Q2 are an antenna switch driver that boosts the antenna switch drive signal from the receiver-transmitter to a level needed to drive the antenna aircraft switch. Transformer T1 is an impedance matching transformer that matches the output from the identity tone generator in

ER CIRCUIT ANALYSIS

the receiver-transmitter to the aircraft intercom system. The volume of the identity tone is controlled by the VOL control on the control unit.

2-15. Module Analysis

a. Range Coupler. The D/A converter (fig. FO-7) converts parallel digital signals from the range computer into serial analog voltages to drive the range coupler servo system. The digital signals are summed and converted to serial analog voltages in encapsulating resistor ladder network Z17. Switching amplifiers convert the micrologic inputs to +5.2 vdc and 0 vdc logic levels to drive the resistor ladder. The output of the D/A converter is fed to a unity gain amplifier to provide buffering between the ladder and fine loop servo.

(1) The range coupler is a coarse-fine servo system in which potentiometers provide the feedback signals. The coarse servo loop initially uses the more significant input data bits (greater than 12.8 miles) to drive the system to a coarse null position. When the coarse servo error is nulled, the coupler switches to the fine servo loop. The-fine servo loop uses the less significant input data bits (less than 12.8 miles) to

drive the system to a final null position. Dual fine potentiometers eliminate the ambiguity between 355 and 360 degrees on the individual potentiometers.

(2) The dc error voltage from the coarse/fine select circuit is chopped by a 400-Hz signal which has been phase shifted by 90 degrees from the input to the reference winding of the motor. The 400-Hz modulated error signal is fed to a driver which provides the power for the control winding of the motor. The coarse and fine outputs are combined through a diode network. This network provides a smooth transition between the coarse and fine loops and allows the coarse error to drive the power amplifier only when it exceeds a required level.

(3) The full range of the coarse potentiometer is from 0 to 307.5 miles (the full range of the navigational set). The full range of the fine potentiometers is 12.8 miles. The fine potentiometers require 25 revolutions to cover full range.

(4) The servo loops drive three output synchros. The synchros are connected by 10:1 gear mechanisms which split the synchro input drives into signals representative of units, tens, and hundreds of miles.

(5) The range synchros are driven to zero range during self test. A microswitch detects the zero range condition and provides a range status signal (RET) to the self test module.

b. Bearing Coupler. The D/A converter (fig. FO-8) converts parallel digital signals from the bearing computer into serial analog voltages to drive the bearing coupler servo system. The digital signals are summed and converted to serial analog voltages in an encapsulated resistor ladder network Z13. Switching amplifiers convert the micrologic inputs to +5.2 vdc and 0 vdc logic levels to drive the resistor ladder. The output of the D/A converter is fed to an unity gain amplifier to provide buffering between the ladder and fine servo loop.

(1) The bearing coupler is a coarse-fine servo system in which potentiometers provide the feedback signals. The coarse servo loop initially uses the more significant input data bits (O to 360 degrees) to drive the system to a coarse null position. When the coarse servo error is nulled, the coupler switches to the fine servo loop. The fine servo loop uses the less significant input data bits (O to 8 degrees) to drive the system to a final null position. Dual potentiometers in the coarse and fine loops drive the output shaft in both directions between 0 and 360 degrees. This causes the bearing indicator to move in the direction which involves the shorter angular coverage between the position at the time of signal application and the position of correct bearing display. The output shaft rotates continuously in the absence of a bearing signal. When the bearing computer is unlocked. The bearing valid command opens the coarse and fine loops and provides an error input which forces the coupler to rotate continuously.

(2) The dc error voltage from the coarse/fine select circuit is chopped by a 400-Hz signal which has been phase shifted by 90 degrees from the input to the reference winding of the motor. The 400-Hz modulated error signal is fed to a driver which provides the power for the control winding of the motor. The coarse and fine outputs are combined through a diode network. This network provides a smooth transition between the coarse and fine loops and allows the coarse error to drive the power amplifier only when it exceeds a required level.

(3) The servo loops drive the synchro and resolver outputs. The synchro outputs are derived by using a differential synchro which combines the magnetic heading-bearing signal from the aircraft compass with the TACAN bearing angle to provide the automatic bearing output. The resolver outputs provide a TACAN station magnetic bearing.

(4) The phase detector accepts the outputs from the course resolver in the bearing indicator and produces the course deviation and to/from indicator signals. COURSE potentiometers on the receiver-transmitter chassis allow the course deviation indication to be adjusted between 2.5 and 15 degrees full scale.

(5) The resolver and differential synchro is driven to zero bearing angle during self test. A microswitch detects the zero bearing angle and provides a bearing zero status (BZT) signal to the self test module.

c. Buffer. The buffer (fig. 2-7) converts several of the differential and single-ended transistor-transistor logic. (TTL) signals from the external computer to voltage levels compatible with the emitter coupled logic (ECL) used in the digital interface assembly. The signals processed by the buffer are: channel select clock, input data control, input data line, and input shift clock. In the AUTO mode of TACAN operation, the buffer module generates a 100-millisecond transmit suppress command each time the external computer executes a TACAN channel change. The transmit suppress command causes the range computer memory to be dumped. This action allows rapid acquisition of range data on the new channel and the transmitter is suppressed to prevent transmission during channel change.

d. Interface Assembly. The digital interface (fig. FO-9) assembly provides the navigational set with the ability to interface with an external computer. The digital interface assembly receives, in digital serial format, control word information from the external computer, processes this information, and then uses it to control the TACAN channel and operating mode. Upon request from the external computer, the digital interface transmits, in digital serial format, either control word information, range data, or bearing data to the external computer.

(1) The TACAN channel and operating mode can be controlled by the computer only when the navigational set is in the automatic mode. The automatic mode is enabled by setting the operating mode select switch on the control unit to the AUTO position. This action disables the channel and operating mode data being sent by the control unit, and allows the interface assembly to substitute the channel and operating mode information sent by the computer.

(2) Upon request from the computer, the digital interface assembly will take the parallel TACAN range, bearing, or control word information, process this data, and place it in the output shift register in the data transfer and storage for transmission to the computer. Range, bearing, or control word information can be requested and taken by the computer in either the manual modes (REC, T/R, and A/A) or the AUTO mode.

(3) Nine signal lines are required to transmit and control the data flow between the navigational set and computer (table 2-2).

(4) Level converters in the buffer and level converter convert the computer TTL logic levels to the ECL levels required by the navigational set. Data lines from the navigational set to the computer are driven by discrete component line drivers in the request decoder and data output cards.

Table 2-2. Description of Digital Interface Signal Lines.

Signal	Description
1. Data Request A	Computer uses these lines to select either a range, bearing, or control word.
2. Data Request B	
3. Input Shift Clock	Carries clock signal which shifts range, bearing, or control word from navigational set to computer (originates in computer).
4. Channel Select Clock	Carries clock signal which shifts control word from computer to navigational set (originates in computer).
5. Input Data Line	Carries address and control word data from computer to navigational set.
6. Input Data Control	Indicates to navigational set when address has been sent. Enables digital interface logic to check for TACAN address.
7. Output Data Line	Carries range, bearing, and control word data from navigational set to computer.
8. Data Valid	Indicates to computer that the requested range, bearing, or control word data is valid and is in the data transfer and storage ready for transmission to the computer.
9. T.I. Discrete	A ground on this line indicates to the computer that the AUTO mode has been selected.

e. *Automatic Channel and Operating Mode Control.* When the AUTO mode is selected, the T/R and A/A bits in the control unit serial data train are set to logic 1. The control unit serial data train is Flocked through the digital interface assembly before being sent to the internal control in the receiver-transmitter. The serial data is held for one clock time (2.5 milliseconds) in the interface assembly where the condition of the A/A and T/R bits is examined. If both the T/R and A/A bits are logic 1 (AUTO select), the interface logic sets the serial data from the control unit to zero and substitutes the control word data from the computer. If no control word data has been sent by the computer, the digital interface replaces the control unit serial data with all zeros. The zeros are clocked to the internal control and the navigational set is set to channel 000 and put into receive mode. The navigational set stays in this control state until the computer sends a control word.

(1) If both the T/R and A/A bits are not logic 1, no action is taken by the interface logic and the control unit data is allowed to go to the internal control. Each time the control unit serial data shifts into the interface assembly, the condition of the A/A and T/R bits is examined and the AUTO or not AUTO decision is made by

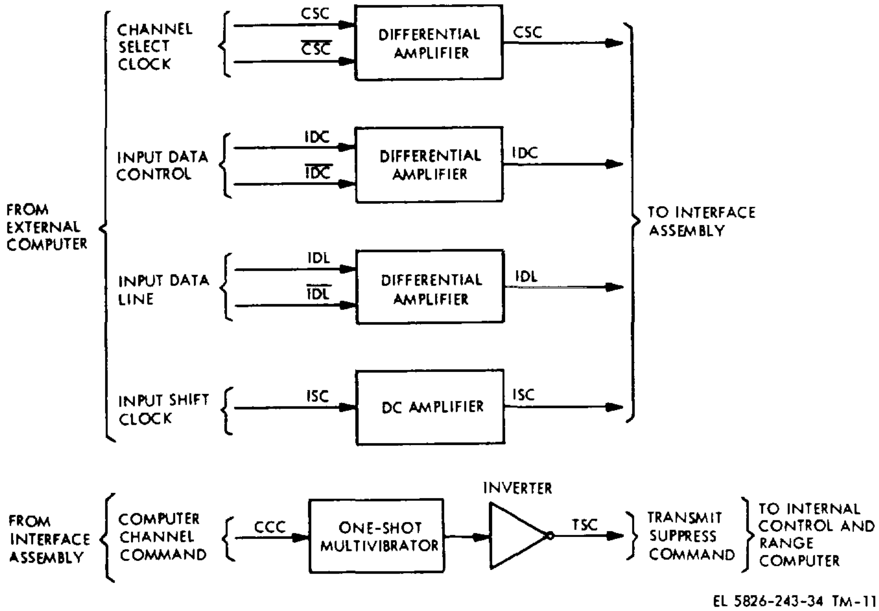


Figure 2-7. Buffer 4A1 block diagram.

the interface logic. The input serial data to the internal control is at the same 400-Hz data rate in both manual or AUTO operating modes.

(2) When the AUTO mode is selected, the interface logic generates a TACAN interface discrete (TID) signal, (ground) to the computer which indicates to the computer that external channel and operating mode control can be accomplished. When the computer receives the TID signal, a control word containing channel and operating mode data is sent to the navigational set (fig. 2-8).

(3) A continuous 500 KHz channel select clock from the computer shifts the bits on the input data line into a 4-bit address register in the decoder and transfer logic. When the input data control line from the computer goes to logic 1, the interface logic checks the contents of the 4-bit address register for the TACAN address 0010, and then disables this register. If the address is other than 0010, no action is taken. If the address is 0010, the next 14 bits of data on the input data line are TACAN channel and operating mode information. The interface assembly then divides the 500-KHz clock by two and clocks the next 14 bits of data into a 14-bit shift register in the data multiplexer at a 250-KHz rate. This clocking sequence begins on the second clock pulse after the input data control line goes true. Figure 2-9 shows the data content of the input control word from the computer. The 14 bits of data are stored and substituted for the control unit serial data train each time the control unit word is shifted into the interface assembly. When the navigational set is switched out of the AUTO mode, the computer. data is disabled and the control unit serial data train is allowed to go to the internal control.

f. Range, Bearing, and Control Word Output. Range, bearing, or control word data can be requested and taken by the external computer in manual or automatic operating modes. Figure 2-10 shows the timing diagram for outputting a range word.

(1) The type of data being requested (range, bearing, or control word) is determined by the state of the two data request lines, data request A (DRA), and data request B (DRB). The state of the two request lines for each type of data request are:

	DRA	*DRB*
No data requested	0	0
Range	1	1
Bearing	1	0
Control word	0	1

(2) When a request for data occurs, the interface module begins processing the request. When the requested data is valid, the interface logic takes the parallel range, bearing, or control word data from the receiver-transmitter and transfers this data into a 14-bit recirculating shift register in the data transfer and storage. When this parallel transfer is complete, the data valid line goes to logic 1. This indicates to the computer that the requested data is valid

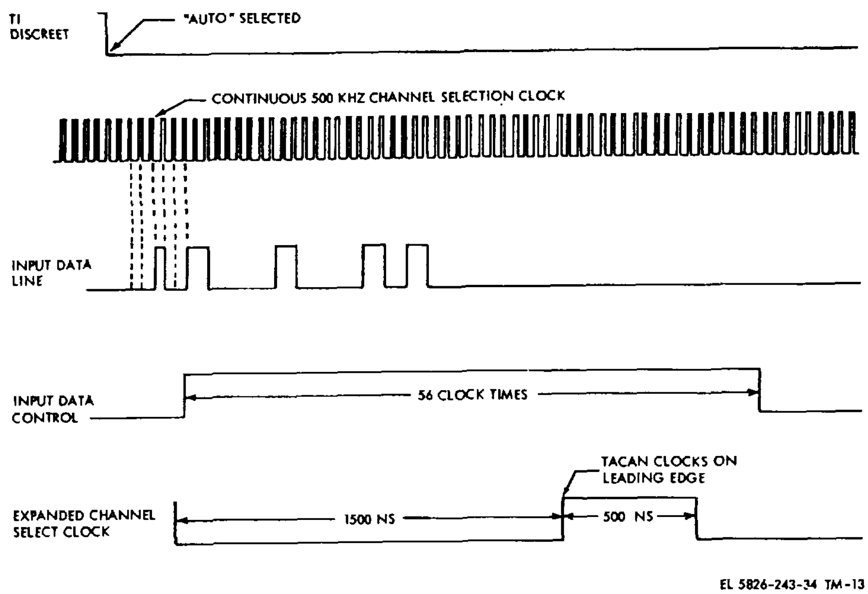


Figure 2-8.

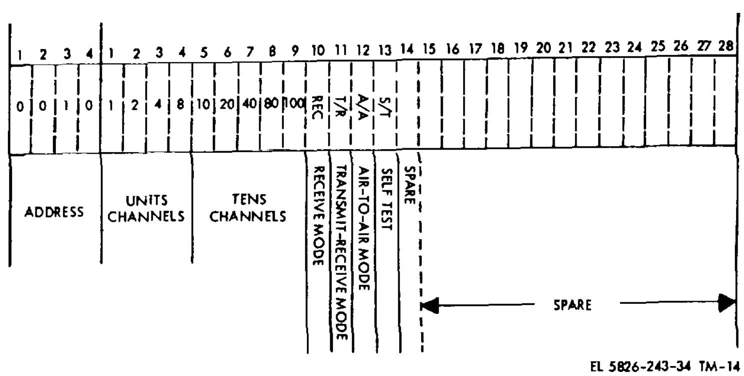


Figure 2-9. Input control word format from computer.

and in the output shift register ready transmission.

(3) The computer then sends a burst of 14 or 28 clock pulses, at a 1-MHz rate, which shifts one or two 14-bit words from the navigational set to the computer. After the shift cycle, both data request lines are set to logic 0 causing the data valid line to go invalid and the information transfer is complete. If new data is required this cycle must be repeated.

(4) The timing diagram for outputting a bearing or control word is the same as for the range word except for the states of the request lines and the output data content (fig. 2-11).

(5) Figures 2-11 and 212 show the output format for range, bearing, and control words.

g. ECM. An ECM circuit in the digital interface assembly detects a -12 vdc (ECM condition) on the SMS line. When this occurs, a logic 1 is inserted into the ECM alarm bit position in the output control word to the external computer.

h. Self Test. The self test (STR) signal from the digital interface assembly is connected to the STX line from the self test module. When an interruptive test or self test hold (STH) condition is in progress, STX goes high which causes

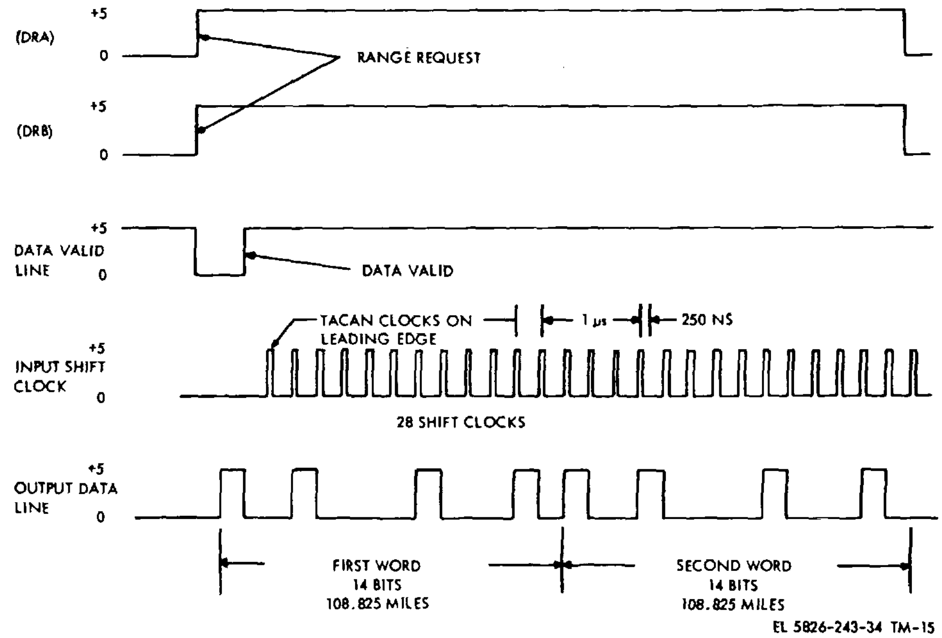


Figure 2-10.

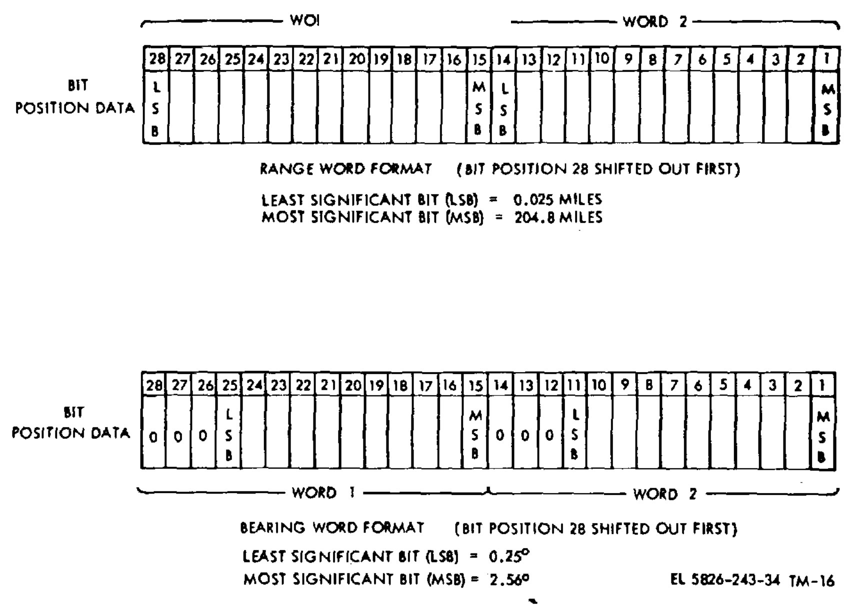


Figure 2-11. Output range and bearing word format.

the interface to load a self test bit in the control word serial data sent to the computer to notify the computer that the TACAN is in **self** test (S/T).

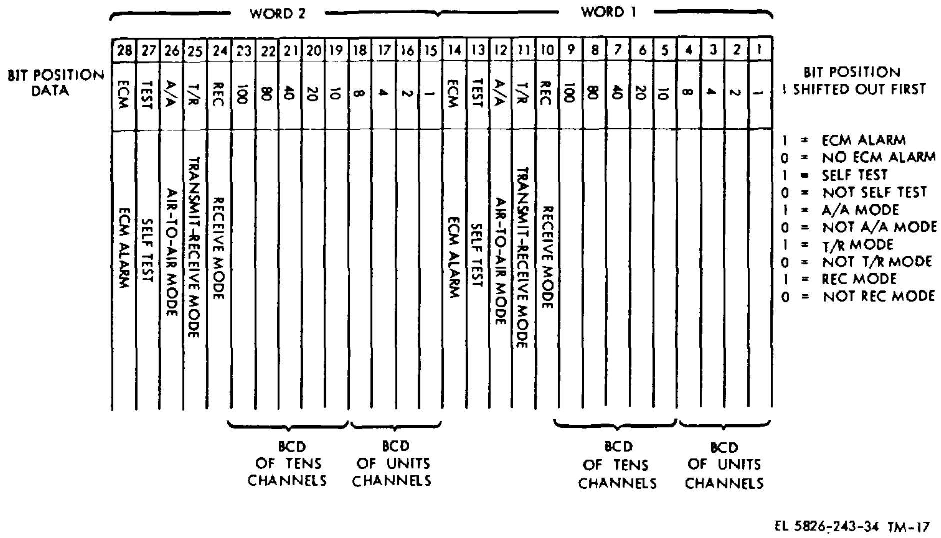


Figure 2-12.

Section VI. RECEIVER-TRANSMITTER CIRCUIT ANALYSIS

2-16. General

a. The receiver-transmitter is the principal unit of the navigational set. It consists of 12 replaceable modules mounted on a chassis assembly and enclosed by rf-tight covers. The receiver-transmitter mounts on the shock mount base and connects to the converter through a multiple-pin connector on the rear of the unit.

b. The chassis assembly contains a wiring harness, a plenum for conducting cooling air, and provisions for mounting the individual modules. Solid-state and microelectronic integrated circuit techniques are used throughout the receiver-transmitter, with the exception of four vacuum tubes required for power amplification of the transmitted signal. Electronic tuning and tracking circuits eliminate the necessity for mechanical linkage between modules. Forced air cooling from the blower maintains the components within their required temperature ranges. The components are conductively cooled through transfer of heat to the assembly case, thereby avoiding contamination that might be caused by contact of the cooling air with the components.

c. The individual modules in the receiver-transmitter are:

(1) Power Supply
(2) Circulator
(3) Receiver
(4) Decoder
(5) Range Computer
(6) Bearing Computer
(7) Internal Control
(8) Frequency Synthesizer
(9) Power Amplifier-Modulator
(10) Coupler-Filter
(11) Self Test
(12) Blower

Of these, the circulator and coupler-filter (passive devices) and the blower are nonrepairable. The power amplifier-modulator module and the power supply module contain primarily discrete component circuitry. The power amplifier-modulator module, although not pressurized, is airtight, when sealed, to prevent high-voltage arcing at high altitudes.

d. The receiver module contains six subassemblies: the preselector, balanced mixer, self test circuits, band pass filter, and two IF amplifier subassemblies. The IF amplifiers are constructed without printed circuit boards to prevent regeneration and oscillation, which might otherwise occur due to imperfect grounding. The IF components are shielded from the power supply and filter components by a metal shield, separating the IF components on one side from the remaining components on the opposite side. A cover is installed over each IF amplifier subassembly to form an enclosed box that provides an electrical shield and a mechanically rigid structure. The receiver module is enclosed by an additional cover assembly that provides double shielding for the IF amplifiers..

e. The modulator section of the power amplifier-modulator module develops high-voltage pulses for modulating the power amplifier section. The power amplifier then amplifies the low level RF signal from the frequency generator module to the proper power level for transmitting. The power amplifier section contains four ceramic triode tubes that provide power amplification over the complete range of transmitting frequencies. The power amplifier also contains line and tuning capacitors that tune the power amplification stages to the correct frequencies. These capacitors are factory-adjusted, and will normally require readjustment only when the vacuum tubes are replaced. The modulator section uses only solid-state circuitry to develop the high-voltage pulses to drive the power amplifier. The two assemblies are packaged together in one module to reduce the length of the required high-voltage interconnections.

f. The remaining modules are primarily of the data processing type, containing microelectronic integrated circuits and other solid-state circuit components. Each of the modules uses printed circuit boards to provide electrical interconnections, with two-layer boards used where possible.

g. Thermal requirements do not allow cooling air to come into direct contact with the electronic comp'onents. This necessitates the use of low resistance heat paths from the heat-generating components to the cooling air. In general, this requires heat conduction from the heat-generating component to the metal module cover, and convection between the cover and the cooling air. In the' modules containing printed circuit boards, the low resistance heat path is formed by a copper ground plane on each board and a beryllium-copper clip soldered to the module cover. The copper ground plane provides a low resistance to heat, and is an electrical shield to isolate the circuits from one another. The heat must be removed to prevent the junction temperatures from reaching undesirably high levels. The majority of the heat from these components is conducted out through the leads from the junctions. The copper ground planes are placed close to the junctions, which minimizes the temperature rise between the junction and ground plane. The heat is conducted from the junction through the copper ground plane to the edge of the board, and from the edge of the board to the module case through a beryllium-copper clip. The cooling air. removes excess heat from the module case by convection. In the power supply and power amplifier-modulator modules, the low resistance heat path is obtained by keeping the conduction path very short. This is accomplished by mounting the high power dissipating components directly on the convective heat transfer surface.

h. The convection process is achieved by parallel airflow to each module from the air distribution plenum in the receiver-transmitter. Cooling air is allocated to each module in proportion to its power dissipation, eliminating the necessity to compensate for cumulative temperature rises. Due to the parallel flow paths of the cooling air, the pressure drop along each path is identical. Each pressure drop consists of the pressure drop in the plenum, the pressure drop across the module cooling surface, and the pressure drop across the orifices in the receiver-transmitter dust cover. In the high power dissipation paths, the largest percentage of the pressure drop occurs across the module cooling surface, resulting in the highest possible heat heat transfer efficiency. This high drop is equalized in the other paths by the plenum and cover orifices.

i. When the modules are installed in the receiver-transmitter and the covers are prop erly secured in place, the unit constitutes an rf-tight enclosure. The removable side-covers, the connectors, and the auxiliary air inlet all contain rf gaskets. The connector between the receiver-transmitter and the converter has filter pins to suppress any conducted rf. Power line filters and other suppression devices are in the converter to prevent interference between the navigational set and external electronic equipment. Transient suppressors on each circuit board prevent leakage of signals. The ground circuits also minimize or eliminate unwanted coupling.

2-17. Assembly Analysis

The receiver-transmitter performs the major functions of transmitting and receiving coded rf pulse pairs and single rf pulses, decoding the received pulses to recover bearing and range information, and performing bearing and range computations (fig. FO-10 and fig. FO-11. Transmission and reception of signals is accomplished over a common antenna system (not supplied as part of the navigational set). The antenna system consists of two identical antennas that are switched at a 0.1-Hz rate when the system is not locked in range or bearing. The signal for switching the antennas is developed by the receiver-transmitter.

a. The frequency synthesizer provides the basic transmitting frequency for the transmitter and the local oscillator signal for the receiver. These signals are identical in frequency regardless of the operating mode or channel selected. The output frequency of the frequency synthesizer is controlled by channel selection signals that originate at the control unit and are processed by the internal control module. Table 2-3 is a frequency allocation chart for all channels and operating modes.

Table 2-3. Frequency Allocation Chart

Transmitter			Receiver	
Mode	Channels	Frequencies	Channels	Frequencies
REC		1Xto63X	1X to 63X	962 to 1024 MHz
			64X to 126X	1151 to 1213 MHz
			1Y to 63Y	1088 to 1150 MHz
			64Y to 126Y	1025 to 1087 MHz
T/R	1 to 63 (X or Y)	1025 to 1087 MHz	1X to 63X	962 to 1024 MHz
	64 to 126 (X or Y)	1088 to 1150 MHz	64X to 126X	1151 to 1213 MHz
	1 to 63 (X or Y)	1026 to 1087 MHz	1Y to 63Y	1088 to 1160 MHz
	64 to 126 (X or Y)	1088 to 1150 MHz	64Y to 126Y	1025 to 1087 MHz
A/A	1 to 63 (X or Y)	1025 to 1087 MHz	1X or Y to 63X or Y	1088 to 1150 MHz
	64 to 126 (X or Y)	1088 to 1150 MHz	64X to Y to 126X or Y	1025 to 1087 MHz

b. The power amplifier, when pulsed by the modulator, amplifies the signal from the frequency generator to provide high-power rf output pulses of the correct frequency, pulse shape, and coding for the mode of operation being used. The output of the power amplifier is applied to the coupler-filter through a circulator.

c. The circulator provides high efficiency connections from the power amplifier to the antenna and from the antenna to the receiver, while maintaining high isolation between the power amplifier and the receiver. Because of this isolation, the lead lengths interconnecting the antenna, receiver, and transmitter are not critical. The coupler-filter also contains a signal monitor circuit for monitoring transmitter peak power and VSWR.

d. The preselector is an electronically-tuned solid-state device that passes only signals of the correct receiver frequency, while limiting and attenuating those signals which are excessively strong or of an incorrect frequency. The attenuation characteristics of the preselector protect the balanced mixer from damage and provide excellent electronic countermeasures (ECM) capabilities.

e. The time required to change from one channel to another depends on the speed with which the frequency generator and preselector can be tuned to a new frequency, because other circuitry involved in transmitting and receiving requires no tuning adjustments. Because both the frequency generator and the preselector are tuned electronically, there is no mechanical inertia to overcome, and channel selection is accomplished rapidly.

f. The balanced mixer in the receiver module mixes the local oscillator signal with the received rf pulses to produce IF pulses of 63 MHz. The receiver uses a double conversion technique, with 11.5 MHz being the second IF frequency. A passive filter between the first and second IF amplifiers ensures proper bandwidth response. All of the receiver components, with the exception of the band pass filter between the output of the frequency generator and the input to the balanced mixer, are contained in the receiver module.

g. The video output signals from the receiver are applied to the decoder module, which develops automatic gain control (AGC) voltages to control the gain of the receiver, and recovers the bearing modulation signals from the received pulses. This module also decodes the received pulses to recognize valid reply pulses, reference pulse groups, interrogation pulses and beacon identity signals. The range and bearing signals are processed, separated, and routed to the range and bearing computers, respectively. The beacon identity tone is an audio tone signal used by the pilot in determining location and identity of the beacon.

h. The range computer processes the range signals from the decoder to determine slant range (in nautical miles), and provides digital output signals to drive the range coupler in the converter. The range computer determines the slant range from the aircraft to a surface beacon, or from the aircraft to another aircraft equipped with a navigational set.

i. The bearing computer processes bearing signals from the decoder to determine the bearing (in degrees) from the aircraft to a ground beacon, and provides digital output signals to drive the bearing coupler in the converter. It does not compute the bearing between two air- craft.

j. The internal control module processes digital command data from the control unit to control the channel and mode of operation of the receiver-transmitter. This module also contains the antenna switching and logic circuitry required to switch between antennas, and to select the antenna providing an adequate signal.

k. The self test module contains the circuitry for processing all self test signals for the system. In the event of a malfunction, it provides a signal to one of the four fault isolation indicators on the front panel of the receiver- transmitter to indicate which portion of the system is at fault; the receiver-transmitter, control unit, antenna, or converter. The self test module also provides the stimulus to activate the GO/NO-GO lamp drive circuit in the control unit.

2-18. Module Analysis

The following functional descriptions. of the receiver-transmitter modules are presented as an aid in understanding signal generation and data processing by the system. Only the most significant functions performed by each module are described.

a. Power Supply. The power supply module (fig. FO-12) supplies six closely regulated dc voltages, three unregulated dc voltages, and one unregulated ac voltage. Each regulated supply voltage has short circuit, overcurrent, and overvoltage protection. The power supply furnishes the following dc potentials and currents throughout the system:

(1) +5.2'vdc, 1 amp, ripple less than 5 millivolts, regulation ±1 percent. Used throughout the system for analog and digital processing.

(2) -5.2 vdc, 7 amps, ripple less than 5 millivolts, regulation +1 percent. Used throughout the system mainly for digital processing.

*(3) +12 vdc, 7 amps, ripple less than 10 mil-*livolts, regulation +1 percent. Used throughout the system for analog processing.

(4) -12 vdc, 220 milliamps, ripple less than 10 millivolts, regulation ±1 percent. Used throughout the system for analog processing.

(5) +80 vdc, 440 milliamps, ripple less than 15 millivolts, regulation ±1 percent. Used in the frequency generator multiplier chain.

(6) +180 vdc, 130 milliamps, ripple less than 0.5 vdc, regulation ±1 percent, +110 vdc,$80 milliamps, ripple less than 0.2 vdc. Drives power amplifier-modulator.

(7) +50 vdc unregulated, 140 milliamps. Drives coupler motors and pulse suppression circuits.

*(8) +9 vdc unregulate*d, 2.6 amps. Provides power to filament regulator in power amplifier.

(9) -10 vdc unregulated, 20 milliamps. Provides control for filament regulator in power amplifier.

(10) 19 vac, 200 milliamps. Provides YIG pre-
selector heater current.

(a) All supply voltages are divided from a multiple winding transformer with center tapped secondaries to drive the full wave rectifiers. The voltage regulators are microelectronic integrated circuits in series regulator form.

(b) The low voltage regulators are all similar except for minor differences due to voltage level, polarity, and current requirements. The output voltage of each supply is compared with an internal reference voltage. The output of the comparison amplifier is then used to control the impedance of the series regulator transistors. A single internal reference voltage is established in the supply to provide the reference for all the low voltage regulated supplies. The output voltage of each supply is then deter- mined by a precision resistance ratio between the regulator output and the reference voltage.

(c) During an overload condition of the regulated supplies, an overcurrent detector is activated which removes the drive current to the pass transistor regulators. This gives a fold- back to the voltage versus current characteristics of the supply, i.e., during overload conditions the output supply voltage and current is reduced to protect the regulator transistors from overdissipation. When the overload condition is removed, the supply voltage automatically. returns to its regulation level and will again provide the required current.

(d) The high voltage regulator used to drive the power amplifier-modulator differs from the low voltage regulators in that it functions as a current regulator to supply an aver-

age current to the pulse forming network in the power amplifier-modulator. The peak current required by the pulse forming networks (PFN's) is transformed from the output filter capacitor of the regulator to the PFN after each pulse, and the regulator then recharges the capacitor between pulses at a lower average current.

(e) The high voltage supply contains its own reference voltage which is developed by using a constant current source and a fixed im- pedance. The reference voltage then establishes the output potential for the low duty cycle mode of operation.

(f) During the high duty cycle operation in the air-to-air mode, the average current is sampled to activate a voltage divider between the reference supply and the regulator transistors, which effectively reduces the reference voltage to the regulator. Thus the output voltage is reduced as a function of average current, so that the power amplifier tubes will not dissipate excessive power during high duty operation.

(g) A second current trip point is built into the regulator which will limit the output current from the regulator during overload conditions so the regulator will not be damaged. This overload protection is again automatically reset in the event that the overload is removed.

(h) Continuous monitoring of each dc regulated voltage is provided so that if any voltage exceeds a preset high or low limit a NO-GO status signal is generated. This signal is sup- plied to the self test module for a continuous indication of power supply status.

(i) The power supply mechanical configuration is such that all components with high dissipation are mounted on a heat exchanger which is cooled by the plenum chamber air sup- ply.

b. Circulator and Coupler Filter. The cir- culator acts as a duplexer to permit the use of a common antenna for both transmitting and receiving. The coupler filter monitors the reflected power from the antenna and the incident power of the transmitted pulses.

(1) The circulator is a four-port integrated microwave ferrite circulator that couples the received pulses from the antenna port to the receiver port and the transmitted pulses from the transmitter port to the antenna port. It provides a minimum of 15 db isolation between the transmitter port and the receiver port. It also provides a 0.5 db insertion loss between the transmitter port and the antenna port and 1.0 db insertion loss between the antenna port and the receiver port. The fourth port is terminated internally.

(2) The coupler filter provides a power monitor circuit for sampling the transmitted incident power (CFREF). The sample signals are fed into the self test module to provide operational status indications of the transmitter.

c. Receiver. The receiver (fig. FO-13) is completely solid-state, and uses double-conversion techniques to produce a first IF of 63 MHz and a second IF of 11.5 MHz. The receiver input frequency is controlled by the preselector, which is tuned electronically to the frequency corresponding to the channel selected at the control unit. The receiver gain is controlled by two types of AGC voltages from the decoder module: (1) a slow AGC voltage (SGC) proportional to the average power level of the received signals and (2) a fast AGC voltage (FGC) that allows the 15 and 135 Hz bearing modulation signals to be recovered from the input signals. This method of controlling the gain of the IF amplifiers al- lows the receiver to produce video output pulses of virtually constant amplitude, as required for making accurate range measurements, without reducing the dynamic range of the receiver. The receiver module consists of six subassemblies.

(1) *Preselector.* The preselector is a four- section, electronically-tuned Yttrium-Iron-Garnet (YIG) filter that enables rapid tuning to the correct receiver frequency, and protection for the crystals in the balanced mixer. The pre- selector limits and attenuates excessively strong input signals to provide an effective rejection factor for the receiver of 100 db or more. In addition, it eliminates intermodulation problems, i.e., a weak signal of the correct frequency will not be suppressed or modulated by a stronger signal of an incorrect frequency. The preselector limits signals to a maximum level of approximately 10 dbm. This is above the level of the normal received signals, but below the level that could cause mixer damage. The limiting function is a result of the type of YIG material used and the temperature of the internal spheres. The temperature is maintained in the required range by an internal heating element. Because the receiver-transmitter uses a single antenna, an antenna mismatch could cause transmitter pulses of excessively high power to be present at the receiver input. The limiting characteristics of the preselector prevent mixer damage even if the transmitter should inadvertently be tuned to the receiver frequency.

(2) Balanced Mixer. The balanced mixer is a three-port device using stripline techniques to

achieve minimum size and weight. It provides isolation between the ports and high rf rejection at the IF port. The mixer produces 63 MHz IF pulses by mixing the local oscillator output from she frequency synthesizer with the received rf pulses from the preselector.

(3) First IF Amplifier. The first IF amplifier subassembly consists of a low noise transistor amplifier, two integrated IF amplifier circuits, a transistor mixer circuit, and a crystal- controlled transistor second local oscillator (LO), i.e., conversion oscillator. The IF amplifiers operate over a wide AGC range, and provide high resistance to overloading and jamming. Overload recovery time is approximately 3 microseconds, so that receiver blanking during pulse transmissions is unnecessary. The subassembly has the following characteristics:

Maximum gain:	60 db
AGC range:	50db
Noise figure:	1.7 db
Input center frequency:	63'MHz
Bandwidth:	9 MHz
Type of tuning:	synchronous
Second LO frequency:	51.5 MHz
Second LO stability:	0.005 percent
Output center frequency:	11.5 MHz

(4) Bandpass Filter. The center frequency and bandwidth of the receiver are controlled by a passive filter located between the first and second IF amplifier subassemblies. The 11.5 MHz IF pulses from the first IF amplifier are applied, through the band pass filter, to the second IF amplifier subassembly. The filter has a gaussian response curve with a center fre- quency of 11.5 MHz and a bandwidth at the 3-db points of approximately 300 KHz. To achieve the required adjacent channel rejection, the filter provides over 60-db rejection to frequencies 1 MHz above or below the center frequency.

(5) Second IF Amplifier. The second IF amplifier subassembly consists of two integrated IF amplifier circuits, two transistorized IF amplifier circuits, and an output video detector circuit. The amplifiers are tuned to a center frequency of 11.5 MHz and have a bandwidth of approximately 2 MHz, so that the response curve of the band pass filter determines the receiver bandwidth. The video detector circuit detects the IF pulses at a level of approximately -5 volts, and provides video output pulses to the decoder module and the receiver status circuits. This subassembly has the following characteristics:

Gain:	70 db
AGC range:	50 db
Input center frequency:	11.5 MHz
Bandwidth:	2 MHz

(6) Receiver Status. The video output pulses from the second IF amplifier subassembly are monitored by the receiver status circuits to verify correct receiver operation. The amplitude of the video pulse outputs from the receiver will always be above a given level when a valid signal has been acquired. When a signal has not been acquired, the average of the noise peaks must correspond to the nominal signal level. A true output from the monitor circuits indicates a loss of receiver gain.

d. Decoder. The decoder module (fig. FO-14) receives and processes video pulses from the receiver to recognize valid pulse pairs, and uses these valid pulse pairs to develop fast and slow AGC voltages to control the gain of the receiver. The fast AGC voltage is also used to recover the 15 and 135 Hz bearing modulation signals for the bearing computer. When a valid pulse pair is recognized, the decoder provides an appropriate output pulse to the range computer, and continues to process the following pulses to deter- mine whether a coarse or fine reference pulse group or beacon identity tone is being received. If either of the reference pulse groups is recognized, the decoder provides an appropriate out- put pulse to the bearing computer. If a beacon identity tone is recognized, the decoder provides a 1350-Hz output signal to the converter and the control unit, where it is further processed before being applied to the pilot's intercom system. In the A/A mode, the decoder processes the received pulses to recognize and separate interrogation pulse pairs from single pulse replies. When a valid interrogation pulse pair is recognized, the decoder generates a reply pulse command to cause the transmitter to transmit a single pulse reply to the other aircraft. When a reply pulse from another aircraft is recognized, the decoder provides an appropriate output pulse to the range computer.

(1) The negative-going video pulses from the receiver are applied to three pulse height discriminators in the pulse height detector. The pulse height discriminators operate at levels of 1, 3, and 4 volts. In normal pulse pair recognition, the 3-volt discriminator generates an out- put pulse whenever the leading edge of a video pulse passes through the 3-volt point. The result is a series of digital pulses that are time synched to the received pulses.

(2) These digital pulses are applied to the digital counter and decoder circuits, which has a 12.946 MHz range clock to check for all possible

pulse patterns. Whenever a permissible pulse pattern is recognized and verified, such as a reference pulse group or a reply to an interrogation, these circuits provide an output pulse to the bearing or range computer, as applicable. In the A/A mode, the 1, 3, and 4-volt discriminators all operate. The strongest signals control the AGC voltage, using the 4-volt discriminator, while any other signals within 12 db of the strongest are detected by the 1-volt discriminator.

(3) The data rate limiter contains the AGC transfer and overload detector circuits. The AGC transfer circuit transfers a voltage proportional to the input pulse amplitude to the AGC sampling amplifier after a valid pulse pair is verified. The overload detector circuit reduces the receiver gain if a receiver overload occurs, then allows the gain to increase slowly until normal AGC action takes over. This is necessary because the IF amplifiers will saturate during a receiver overload and a valid pulse pair cannot be recognized and no AGC action to reduce the receiver gain would take place. The recovery time is approximately 3 seconds for a recovery to maximum gain from an overload of 0 dbm.

(4) A similar overload occurs if the receiver receives a signal from its own associated transmitter or from another transmitter in the air- craft. But in this case, immediate recovery is essential or short range replies cannot be received. In this event, the overload detector circuit is inhibited. The receiver overloads, but re- covers in less than 5 microseconds and no change in AGC voltage takes place. The first pulse command (FPC) from the range computer inhibits the overload circuit by driving a monostable multivibrator. This inhibits the overload circuit for approximately 50 microseconds without affecting receiver operation at zero range, since beacon delay is equal to 50 microseconds. Other transmitters in the aircraft generate suppression pulses for this purpose, although the width of these pulses depends on the characteristics of the particular transmitter.

(5) The data rate limiter circuit maintains the decoder pulse detection rate at approximately 3600 pulse pairs per second, regardless of the number of pulses received by the receiver. If the received pulse rate or the number of noise pulses exceeds this figure, the data rate limiter raises the 1 and 3 volt pulse height discriminator levels, thereby limiting the number of pulse pairs accepted by the decoder. In the A/A mode, the data rate limiter operates from single pulse inputs.

(6) The AGC sampling amplifier receives an AGC input only when a valid pulse pair is verified, and operates on a sample and hold principle. When the second pulse of a valid pulse pair is confirmed, a holding capacitor charges (or discharges) to the pulse level, and remains at that level until the next valid pulse pair is received. Only one pulse pair of any reference pulse group is accepted to avoid introducing bearing inaccuracies. The charge on the holding capacitor is compared to the level of the input pulse in a differential amplifier circuit, and any difference between the two causes the charge on the capacitor to increase or decrease accordingly, thereby changing the AGC voltage. The output of the AGC sampling amplifier is a stair- case waveform reflecting the 15 and 135 Hz modulation waveforms present on the input train.

(7) The slow AGC amplifier establishes the overall gain of the receiver and is controlled by the average power level of the received pulses. A gradual change in the received pulse level (such as when the aircraft flies toward or away from a beacon) causes a corresponding change in the slow AGC voltage level that is independent from the bearing modulations.

(8) The 15 and 135 Hz filters receive the staircase waveform from the AGC sampling amplifier and filter it to produce the coarse and fine bearing modulation signals from the bearing computer. The fine bearing modulation signal is connected directly to the bearing computer, while the coarse bearing signal is amplified in the fast AGC amplifier before being routed to the bearing computer.

(9) The coarse and fine bearing modulation signals are summed in the fast AGC amplifier, and amplified to produce the fast AGC voltage. This voltage is connected to the receiver module to provide pulse-to-pulse control qf the receiver gain. This gain control is essential so that the leading edges of the video pulses will not vary in time due to variations in amplitude, which would result in inaccuracies in range measurements.

(10) The beacon identity tone, when present, causes a 1350-Hz tuned circuit to be driven into operation. If a pulse pair is missed for any reason, the equalizing pulse pair 100 microseconds later sustains oscillations. If an adequate signal is present, the tuned circuit rings hard enough to overcome a threshold detector and drive a 1350-Hz nonlinear oscillator. The

oscillator produces a 1350-Hz output that is rich in harmonics. This signal is amplified and connected to the aircraft intercom via a tone transformer in the converter and the volume control on the control unit.

(11) For pulse pattern recognition, the decoder receives a 12.946-MHz clock signal from the range computer, and uses this clock to time countergating circuits. These circuits generate gates that automatically check for acceptable patterns in any particular mode.

(12) For basic pulse pair recognition, a 4-microsecond gate is generated 10 microseconds after the receipt of a pulse. Since a 2-microsecond tolerance is allowable for any pulse pair, a second pulse occurring during the gated time would be recognized as the second pulse of a valid pulse pair. This causes AGC transfer to occur, and an output pulse to be provided to the range computer. If a second pulse does not occur during the gate interval, the counter is reset and AGC transfer does not occur.

(13) After a valid pulse pair has been identified, the counter continues to count in order to identify the third pulse of a possible coarse or fine reference pulse group. If a third pulse occurs at the expected time, a reference pulse counter is enabled to confirm the presence of a reference pulse group. The counter counts both missing and received pulses to minimize the chance of error. If a reference pulse group is confirmed, the decoder provides an appropriate signal to the bearing computer; main reference pulse (MRP) for coarse reference pulse group; auxiliary reference pulse (ARP) for fine reference pulse group. The criteria for recognition of the different pulse patterns are listed in table 2-4.

Table 2-4. Pulse Pattern Recognition Criteria

Type of signal	Characteristics	Recognition criteria
X coded coarse reference pulse group	12 pulse pairs, each pulse pair spaced 30 microseconds apart	First 7 pulses
X coded fine reference pulse group	6 pulse pairs, each pulse pair spaced 24 microseconds apart	First 3 pulses and any 4 of the next 6 pulses
Y coded coarse reference pulse group	13 single pulses, each pulse spaced 30 microseconds apart	First 5 pulses
Y coded fine reference pulse group	13 single pulses, each pulse spaced 15 microseconds apart	First 2 pulses and any 5 of the next 8 pulses
Beacon identity tone	Valid pulse pairs, each followed by an an equalizing pulse pair 100 microseconds later, transmitted at a rate of 1350 pulse pairs per second.	Adequate to drive identity tone circuit

e. Range Computer. The range computer (fig. FO-15) determines slant range in nautical miles in the T/R and A/A modes. The output range data is sent, in digital parallel form, to the range coupler for conversion to serial analog signals needed to drive the aircraft range indicators, and to the digital interface, where it is stored until range data is requested by the external computer. In the T/R mode, the range computer computes slant range between the aircraft and a surface beacon. In the A/A mode, the range computer computes the slant range to another aircraft, if the other aircraft also is equipped with a. navigational set operating in the A/A mode. The navigational set can transpond to five TACAN sets at the same time. Basically, range is computed by measuring the elapsed time interval between the transmission of interrogation pulses to the reception of appropriate reply pulses, and subtracting the counting and averaging the number of clock pulses between a zero reference pulse (PIP) and a valid reply pulse (FPV).

(1) The range counter is initially set to zero. When a range search is started, the control counter generates the interrogation pulse pair; first pulse command (FPC) and second pulse command (SPC). The delay counter counts out 50 microseconds (beacon delay) pulse the system delay (approximately 24 microseconds), and the range counter starts to count cycles of the basic range clock. The range clock pulses (PZT) are generated by dividing the output of a crystal-controlled oscillator (high frequency clock) operating at 12.946 MHz by four. One count is equal to 0.308 microsecond, which is equivalent to 0.025 nautical mile. The range counter continues to count. until the first decoded pulse (FPV) is received.

(2) When the range counter receives a de- coded pulse (FPV) from the decoder, it stops counting and holds a tentative range number. Prior to the next post interrogation pulse (PIP) time, this, tentative range number (PPG-PPN) is present into the delay counter. The delay counter then begins to count down at PIP time. When it reaches zero, the control counter generates an early-late gate which, if the received pulses represent valid returns, will bracket the next received pulse. This process is repeated approximately four times to verify that a true return is being received. If at least three of five returns are verified by the majority decision logic to be true returns, the track integrator is changed from a few interrogation cycles to approximately 10 seconds. Unless three of five true returns are verified by the majority decision logic, the system continues in range search. In this event, the range counter starts counting from the range of the previously received pulse instead of from zero range. If maximum range is reached without obtaining a true return, range search is automatically restarted from zero range. This process continues until a true re- turn is received and confirmed.

(3) When a true return is. confirmed, the range computer switches into a range track mode, and the number in the range counter is continuously increased or decreased, as applicable, by a range track loop. In addition, the number is continuously modified between inter- rogations by the track integrator, thereby providing greater accuracy at high track rates and allowing the use of a lower PRF. The PRF is automatically reduced from approximately 142 pulse pairs per second. for range search to approximately 27 pulse pairs per second for range track. The PRF is continuously jittered in both modes to insure a difference in PRF's between aircraft.

(4) The range track loop has a velocity memory capability. A time discriminator in the track loop develops an output proportional to the difference in time between the return pulse and the center of the early-late gate. The early- late gate output is passed through the track loop filter and applied to the input of the VCO. The first interrogation is provided by the track loop filter, the second by the VCO. The normal frequency of the VCO is 0 Hz, and its output frequency varies (from 0 Hz to 120 Hz) in accordance with the absolute value of the input (O to +5 vdc) error voltage. A zero-biased level up- down detector determines the polarity of the input voltage and switches logic gates in the range counter to cause it to count up or down (UDT), thereby causing the early-late gate to follow the return pulse in time. The VCO is inhibited when the system is not in track. In the event that valid replies are lost, the system memory continues in range track for approximately 10 seconds before range search is resumed.

(5) The PRF generator generates PRF of approximately 142 pulse pairs per second during range search, and approximately 27 pulse pairs per second during range track. The PRF is continuously jittered to ensure distinction between the interrogations and replies for two or more aircraft that may be operating simultaneously at approximately the same range from the beacon. The pulse pair spacing is established by counting cycles of the basic range clock, and is 12 microseconds in the X mode and 36 microseconds in the Y mode.

(6) The data output from the range counter (RBA-RBN) is a 14-bit binary number with the least significant bit representing 0.025 nautical mile. The range counter provides a readout of this number to the nearest bit, resulting in a quantization error of +0.0125 nautical mile (+½ of the least significant bit).

(7) The total system delay time between the transmission of an interrogation pulse pair and the recognition of a valid reply pulse pair is comprised of the following factors for the T/R mode:

	X Mode	**Y Mode**
Modulator and trans- mitter delay	4 µsec	4 µsec
Beacon reply delay	50 µsec	56 µsec
Two-way range prop- agation delay	TR µsec	TR µsec
Receiver delay	4 µsec	4 µsec
Decoder delay	14 µsec	32µ sec
Total	(72 + TR) µsec	(96 + TR) µsec

The total system delay is composed of a fixed delay pulse the range delay. The range computer subtracts the fixed delay from the total delay to obtain the range delay. The fixed delay varies according to the mode of operation. This delay is preset into the delay counter by the preset logic. The range computer delays consist of the following for the T/R mode:

	X Mode	**Y Mode**
Pulse pair spacing	12 µsec	36 µsec
Preset system delay plus variable calibra- tion delay	57, µsec	57µ sec
Two-way range propa- gation	TR µsec	TR µsec

	X Mode	Y Mode
Range gate delay	3 µsec	3 µsec
Total	(72 + TR) µsec	(96 + TR) µsec

(8) Range track is established when the early-late gate (ELG) coincides with the decoded reply pulse (FPV). This condition occurs when the computer range delay is equal to the actual system range delay. To accomplish this, the range counter must be set to minus 3 counts since the range counter starts counting before the early-late gate is enabled. This preset count ensures that the reply pulse will set the correct count in the range counter so that, on the next interrogation, the early-late gate will coincide with the time of the previous reply. When lock is not confirmed or has been lost, the range counter starts counting at the time when the previous reply occurred and continues until an additional reply is received, or until maximum range is reached.

(9) When maximum range (approximately 300 nautical miles) has been attained, range search is automatically restarted from zero range by range limit (RLM). To avoid negative range indications which could occur if the system delays were incorrect, the range counter is programmed to indicate not less than zero range.

(10) In AUTO mode, a transmit suppress command (TSC) is generated each time the external computer executes a TACAN channel change. The TSC causes the range computer memory to be dumped to allow rapid acquisition of range data on the new channel.

f. Bearing Computer. The bearing computer (fig. FO-16) receives the 15- and 135-Hz bearing modulation signals and the coarse and fine reference pulses from the decoder, and computes the bearing of the surface beacon with respect to the aircraft. This module provides parallel digital outputs to the bearing coupler for con- version to serial analog signals needed to operate the aircraft bearing indicators, and to the digital interface, where bearing data can be re- quested by the external computer. If the 135-Hz modulation signal is lost or is adequate, the bearing computer continues to operate using the 15-Hz signal alone. In addition, the bearing computer contains memory circuits that allow the 15-Hz signal to be lost or be inadequate for approximately 3 to 5 seconds without loss of the bearing indication.

(1) Basically, bearing information is computed by starting a counter with the coarse reference pulse (zero reference time) and counting in 0.25-degree steps until the positive-going zero crossover point occurs on the 15-Hz modulation waveform. Three independent phase-lock loops detect the 15- and 135-Hz modulation waveforms and the reference pulses. The phase-lock loops perform essentially the same functions as zero crossing detectors, but are more precise. Precision is achieved because the dc phase error voltage produced is generated by integrating over a full period of the fundamental input signal, providing a high resistance to noise. (2) The reference pulses and crossover times are obtained from internally-generated waveforms that are phase-locked to the bearing and reference inputs. This insures that all errors are averaged over a complete cycle. Second-order servo systems provide velocity tracking and velocity memory capabilities.

(3) The reference pulse loop is phase-locked at 135 Hz to both the coarse and fine reference pulse inputs and provides stable operation even when the detection rate for the reference pulse groups is very low. The Y3s-frequency divider is self-resetting, so that the system will continue to operate even without a coarse reference pulse as long as the loop remains locked.

(4) The 15- -and 135-Hz modulation waveforms are applied simultaneously to two independent phase-locked loops. The 15-!Hz loop incorporates a memory and a level detector to determine when the loop is in lock and when bearing data is valid. One output of the loop, a 15-Hz square wave at 90 degrees, is a reference for the 15-Hz loop phase detector. A second out- put, a 15-Hz signal at 0 degrees, is a reference for the 15-Hz lock phase detector and, if the 135-Hz signal is inadequate, is a reference for the 135-Hz loop. A third output is a gate centered on the positive-going zero crossover point of the 15-Hz square wave. The gate width extends ±20 degrees from the zero crossover point. This gate selects the proper sector of the 135-Hz waveform provided that the phase difference between the two signals is less than ±20 degrees at 15 Hz.

(5) The 135-Hz loop differs from the 15-Hz loop in that it contains a lock amplitude detector to measure the amplitude of the modulation signal. When this signal is inadequate, the 135-Hz bearing valid signal goes false, causing the 15/135-loop selector circuit to use the zero crossover point on the 15-Hz square wave as the bearing reference. Simultaneously, the input to the 135-Hz loop phase detector is switched from the 135-Hz modulation input to a 135-Hz square

wave generated by the 15-Hz loop. Therefore, the loop will continue to operate from the 15-Hz modulation input alone. If the 135-Hz modulation signal again becomes valid, the loop switches back to tracking the 135-Hz input and the gated zero crossing of the 135-Hz signal is the bearing reference.

(6) The voltage controlled oscillator (VCO) in the 135-Hz loop provides an output frequency of 21.6 KHz, which corresponds to one cycle for each 0.25 degree of bearing. Slight changes in the 135-Hz modulation frequencies do not affect bearing measurement accuracy since the second-order loop automatically compensates for such frequency drift. The bearing readout is made by setting a counter to zero with the synthetic, locally-generated north pulse, counting in 0.25-degree increments, and reading the number from the counter when the gated zero crossing occurs on the synthetic 15-Hz or synthetic gated 135-Hz signal. The readout is an 11-bit bearing number that is stored in the 1440 output counter, and is continuously available to the bearing coupler for conversion to an analog signal or for digital readout.

g. Internal Control. The internal control module (fig. FO-17) synchronizes, receives, decodes, and stores time-multiplexed digital command data from the control unit, and processes these data for use by the rest of the system. This module also contains the antenna switching logic and switch driver circuitry, and the electronic countermeasures warning logic. The internal control generates the YIG tuning current for preselecting the receiver input tuning as a function of channel number and operating mode.

(1) The 14-bit serial data train from the control unit, containing channel and operating mode select commands, is clocked into the 14-bit shift register at 400 bits per second. The frame sync recognizer generates a transfer pulse when the sync bit (always a logic 1) reaches the last stage of the register. This pulse transfers the entire data frame into the storage register and, on the next 400-Hz clock pulse, the shift register is cleared of its contents. A new data frame now moves into the shift register and the cycle is repeated.

(2) The first 14 bits consist of serial data; the following 14 bits are set to logic zero so that the effective data transfer rate is 14.3 data frames per second. On each subsequent frame, the storage register changes only if the serial data has changed in the previous 14 bits. Each data frame consists of the information listed in Table 2-1.

(3) The frame sync recognizer generates a transfer pulse when the sync bit reaches the last stage of the register. The transfer pulse causes the entire data frame to be transferred in parallel into the storage register, and the next 400-Hz clock pulse causes the shift register to be cleared. A new data frame is then clocked into the shift register, and the entire process is repeated at a rate of 14.3 frames per second. Bit synchronization between the control unit and the internal control module is maintained by deriving the 400 Hz clock pulses from a common 400 Hz input signal.

(4) After data transfer is completed, the data storage register contains 8 bits of channel select data and 4 bits of operating mode command data that are continuously available for use by the system. The channel select data controls the output frequency of the frequency generator and the frequency of the preselector. A 9-bit binary coded decimal (BCD) weighted digital-to-analog (D/A) converter changes the channel number to a current for tuning the YIG preselector in the receiver. The decoder and range computer modules receive the X/Y and A/A function data bits from the storage register. These commands set the pulse pair spacing and generate the proper reply delay in the A/A mode.

(5) T/R commands are sent directly to the range computer. In the T/R mode, range search is conducted over the full 0 to 297.6 nautical miles. The T/R command instructs the range computer to generate transmit pulses. These transmit pulses are inhibited by a separate inhibit transmitter command from the internal control module if the REC mode has been selected, if an incorrect channel number has been selected, or if the frequency generator is out of lock.

(6) The internal control module also generates a 0.1-Hz signal for antenna switching if the system is not locked in range or bearing. Upon receipt of a bearing valid status (BVS) signal from the bearing computer or a range valid status (RVS) signal from the range computer, the antenna switching circuits cause the system to stop switching. If a loss of lock occurs due to a weak signal condition, the antenna switch is enabled and the alternate antenna is selected. If the signal from this antenna is strong enough to reestablish lock, further switching is inhibited.
If not, antenna switching continues until an adequate signal is received from either of the antennas.

(7) The internal control module contains the circuit for detecting an ECM condition. This circuit consists of a threshold detector, video integrator, and a data rate decision. The composite receiver video, which consists of negative going 5-volt pulses, is applied to a comparator. The comparator produces an output each time the receiver output crosses the -3.0-volt level. The output of the comparator triggers a 3-microsecond one-shot multivibrator which establishes a precise pulse width for each -3.0-volt crossing. The -3.0-volt threshold is 4.4 db down from the -5-volt video level, which al- lows the ECM detection circuit to respond to on-channel jamming signals that are within 4.4 db of the desired signal. The 3-microsecond one-shot output is applied to the data rate decision circuit which integrates the 3-microsecond pulses and produces a -12 vdc level on the SMS line when these pulses exceed a predetermined rate. The -12 vdc on the SMS line causes the ECM WARN lamp on the control unit to illuminate.

(8) To prevent an ECM indication from being produced when no signal is being received (only receiver noise is applied to the ECM detector circuit), a video integrator monitors the average level of the receiver output and disables the 3-microsecond one-shot when this condition is present.

h. Frequency Synthesizer. The frequency synthesizer (fig. 2-13) generates the L-band transmitter drive signal and local oscillator for the receiver. The closed-loop Frequency Synthesizer uses a single-crystal reference frequency (13.333 MHz) in a phase lock-loop to control a variable-frequency oscillator operating in the range from 341.666 to 383.333 MHz. This output is amplified and tripled to obtain the required L-band frequencies. One output of the funds,- mental frequency signal, after passing through dividers, is compared with a precision reference frequency in a digital phase detector. Any frequency difference between the two will cause an error voltage to be generated, which will correct the variable oscillator frequency, bringing it within the phase-lock range of the loop; at this point, a fixed phase error will keep oscillator at the desired frequency. Channel selection is accomplished by changing the division ratio of one of the digital dividers.

(1) Channel control is accomplished by mixing the VCO output signal which has been divided in frequency by 8 with a signal derived from the master oscillator via a multiplier to produce a frequency which can be divided by a digitally controlled divider (a form of preset binary counter). The output from the controlled divider is compared in a phase detector with a signal divided down from the master crystal oscillator. The error signal derived from the phase detector is then applied to drive the VCO to the desired frequency. The desired channel number is supplied in BCD form to one side of a digital comparator. The binary outputs of a preset BCD counter are connected to the other side of the comparator. When the contents of the counter match the programmed channel number, an output is produced, and the counter is preset. The counter must be preset to a number 64 less than its full count (159) +2, since Channel 1 corresponds to divide by 65. Thus, the counter is always preset to the number 97, and proceeds through 0 before digital comparison is initiated.
The inhibit flip-flop prevents comparator output during this period.

(2) As was previously stated, the VCO is the fundamental RF signal source. The choice of VCO frequency is generally a compromise between desiring it to be as high as possible to eliminate close-in spurious responses at the transmit frequency but low enough to allow it to be divided down in an efficient and reliable manner for final phase comparison with the master crystal oscillator. The divide by 8 function is accomplished in 3 stages of transformer steered astable multivibrator circuits. This al- lowed the VCO to be designed to operate at a nominal 360 MHz. The VCO is a varactor tuned Clapp oscillator capable of a 20'mW CW power output from 340 MHz to 358 MHz. The output is fed through 3 stages of isolation amplifier and supplied to the divide-by-eight counter and to a buffer amplifier. The amplifier is a Class AB stage capable of 1 W CW output. Its output is supplied to the tripler circuit. The tripler circuit has a varying load caused by the switching of its output to the power amplifier or a fixed dummy load. In addition, the tripler load varies during the interval when the power amplifier is being modulated. Without the isolation obtained through the tripler, buffer amplifier and isolation amplifiers, the VCO load would also vary, causing the VCO to pull in frequency. The tripler circuit consists of a varactor tripler and an inter-digital filter. This circuit provides a 300 mW CW output but supplies it from 1,025 MHz to 1,150 MHz. The filter provides the necessary rejection of the nominal 360 MHz fundamental and harmonics other than the third to insure that the spurious response requirements are

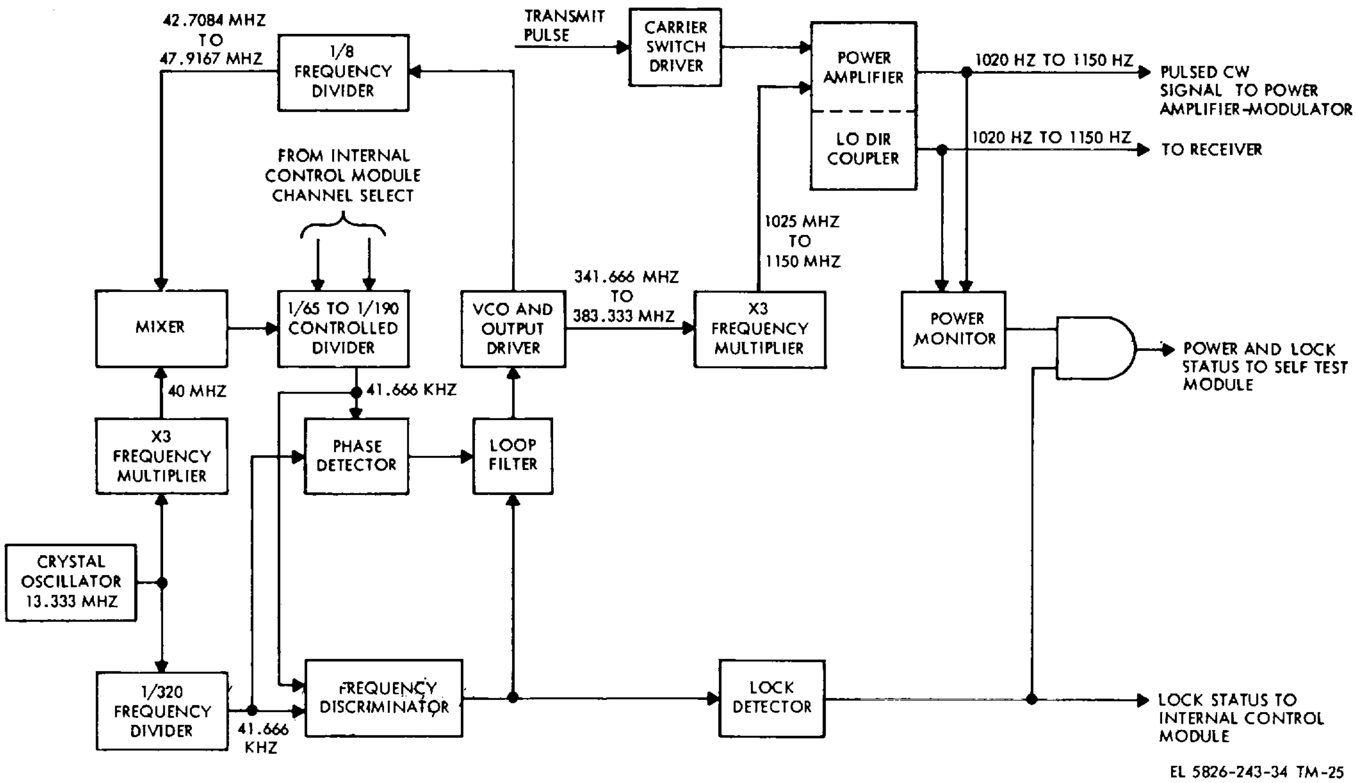


Figure 2-13.

satisfied. The tripler output is coupled to a pulsed Class C power amplifier.

(3) The pulsed power amplifier provides a means of gating the output power of the tripler to minimize the average power delivered to the power amplifier. It switches the power to the amplifier or an internal dummy load. Part of the tripler power in the power amplifier is also coupled to the L.O. directional coupler.

(4) The L.O. directional coupler decouples a portion of the RF power which is supplied to the mixer in the receiver as local oscillator drive. The power is set to the minimum level that provides good mixer conversion efficiency. By holding the drive level at a minimum, the resultant wideband noise of the drive is also minimized and does not affect system sensitivity.

(5) Also included in the module are two status indicating circuits. The parameters monitored are frequency generator power output and lock. status of the phase lock loop. The power monitor detects the RF output level and triggers a voltage comparator to a NO-GO state if inadequate power exists. The lock detector monitors the loop circuits and generates a NO- GO state if a lack of lock exists. The power monitor and lock detector outputs are logically "anded" to form a self-test GO/NO-GO status indication of the frequency synthesizer which is supplied to the self-test module. The lock detector output is also supplied directly to the inter-

nal control module which utilizes it to mute the transmitter in the event of a malfunction or during the channel switching interval when the phase lock loop is out of lock.

i. Power Amplifier-Modulator. The power amplifier (fig. FO-18) receives a continuous wave signal from the frequency synthesizer, and, when pulsed by high-voltage pulses from the modulator, provides high-power, pulsed rf out- put pulses for transmitting. The output pulses from the power amplifier are coupled to the antenna system through the circulator and the coupler-filter assemblies.

(1) Each time the modulator is triggered by a command pulse from the range computer, it generates three simultaneous high-voltage, gaussian-shaped output pulses to drive the power amplifier. The output pulses are developed by causing a pulse-forming network (PFN) to discharge through an output pulse modulation transformer. Since normal transmissions require that two closely-spaced pulses be transmitted, two separate PFN's are used, one for the first pulse command and one for the second pulse command. This allows the PFN's to recover after discharging. The PFN's are con- trolled by separate silicon-controlled rectifier (SCR) switching circuits driven by the first and second pulse commands from the range computer. To generate the single pulse replies required in the A/A mode, only the first SCR switching circuit and PFN is used. The trigger pulse for this function is received from the decoder module over the first pulse command line.

(2) The first pulse command also drives a monostable multivibrator to generate at 47 +5 microsecond suppression (or blanking) pulse. This pulse is routed to other electronic equipments in the aircraft to blank their respective receivers while the navigational set is transmitting, thereby preventing possible interference.

(3) The PFN's are electrically identical but independent in operation. They are essentially energy storage circuits that are charged to a high voltage and then caused, by the SCR switching circuits, to discharge through the primary of the output pulse transformer. Two PFN's are required because the charging time of each (approximately 100 microseconds) is greater than the spacing between pulses in a normal pulse pair. The secondary of the pulse transformer is tapped to provide simultaneous output pulses of approximately 600, 1000, and 2000 volts each time one of the PFN's discharges. The 600-volt pulses are used to drive the first two stages in the power amplifier, the 1000-volt pulses drive the third stage, and the 2000-volt pulses drive the fourth and last stage.

(4) Power Amplifier Section. The power amplifier contains four broad-band rf amplifier stages, each of which contains a ceramic planar triode. These are the only vacuum tubes in the navigational set. These stages provide rf amplification over the complete 1025- to 1150-MHz transmitting range without requiring mechanical tuning or alignment. The rf input from the frequency generator is connected to the input of the first stage; the remaining three stages are connected in series with the first stage. When the high-voltage pulses are received from the modulator, the rf input signal is amplified to a level between 1.5 and 4.0 kilowatts peak power. The first two stages are driven by a shaped pulse from the modulator of approximately 600 volts, the third stage by approximately 1000 volts, and the fourth stage by approximately 2000 volts. The rf output pulses are coupled through the circulator and coupler-filter assemblies to the antenna.

j. Circulator. The circulator provides isolation for the power amplifier from the load presented by the coupler filter, since this load changes with a change in transmitting frequency. The constant load thus presented to the power amplifier enables the power output to be held relatively constant (1.5 to 4.0 kilowatts) over the entire TACAN frequency band.

k. Self Test. The self test module (fig. FO-19) provides the capability of performing a complete self test of the navigational set. The self test module operates in both a continuous monitoring mode and an active interruptive mode. In the event of a malfunction the self test circuits provide fault isolation signals in addition to a system status signal. The total system response is indicated by the GO NO-GO STATUS indicators on the control unit. A malfunction in the receiver-transmitter, converter, antenna, or control unit is indicated one of four magnetic latching fault indicators on the front panel of the receiver-transmitter.

(1) The self test status signals from the receiver, frequency synthesizer, and power supply are continuously monitored. In addition, in the R/T and A/A modes, the first and second pulses at both the digital and rf levels are checked as well as peak power and antenna status (VSWR). Any fault occurring will be displayed by the GO/NO-GO STATUS indicator on the control unit. The magnetic fault latches on the receiver-transmitter are only activated during active (interruptive) self test.

(2) The active self test cycle is initiated by pressing and releasing the BIT switch on the control unit. This action causes a self test bit (STB) to be inserted into the serial data train from the control unit to the internal control module. It also causes a self test command to be sent to the self test module' on the system monitor status (SMS) line. When the self test module receives the SMS, it initiates a test cycle that lasts approximately 25-30 seconds. An initial period of 15-20 seconds allows the self test functions to be performed, and then the system status is displayed for 10 seconds. Self test is accomplished on whichever channel is selected at the control unit. If the system is in the REC mode, only' the Receive Mode functions are checked.

(3) At the start of the self test cycle, a command, to set the output register in the bearing computer to zero, is generated. A RF beacon signal is injected and the range and bearing computers lock at zero. The range and bearing couplers then slew to zero and generate range zero status (RZT) and bearing zero status (BZT) signals. The range and bearing indicators also slew to zero and provide their own self test indications. Receipt of STB is recognized in the internal control module, which generates a con-

(4) During the 10 seconds of system status display time, all of the various system status signals are examined and the individual LRU status indicators are set. In addition, a system status reply to activate either the GO or NO-GO indicator on the control unit is produced. This indication is displayed at the control unit for 10 seconds and then is canceled. The LRU indicators continue to display the status of the individual units until the problem is fixed and the test reinitiated. The status signals used to check each unit are described in table 2-5.

(5) The GO/NO-GO driver produces a +12 vdc system GO or +5 vdc system NO-GO signal. This signal is combined with the -12 vdc ECM signal from the internal control module and sent to the control unit on the SMS line. When either a +5 vdc (NO-GO) or a + 12 vdc (GO) signal is present on the SMS line at the same time that a -12 vdc signal (ECM condition) is present, the -12 vdc signal is over-ridden and only the GO or NO-GO signal is sent to the control unit. At the completion of the test cycle the GO or NO-GO signal on the SMS line is terminated and the -12 vdc ECM signal returns if the ECM condition exists.

(6) The RF beacon generator is enabled by the SMS. This signal enables a frequency divider and a ring counter which produces the bearing. identity and range signals.

Table 2-5. Self Test Status Signals

Unit	Signal	Description
Control Unit	$\overline{\text{CUS}}$	Indicates that internal control module has received test bit from control unit
Receiver-Transmitter	$\overline{\text{FGS}}$	Indicates that frequency generator output is correct
	Incident Power	Indicates that peak power of transmitted pulse is greater than 750 watts
	RCS	Indicates that receiver sensitivity is correct
	PSS	Indicates that power supplies are operating correctly
	C FINC	Indicates peak power is correct
Converter	RZT	Indicates that range coupler has slewed to zero as commanded
	BZT	Indicates that bearing coupler has slewed to zero as commanded
R/T	DCC	Indicates that the range and bearing computers have locked onto zero range and bearing
Antenna	Reflected Power	Indicates that the TACAN PA is properly terminated (antenna OK) by checking the VSWR

(9) The output of the self test modulator is a composite pulse grouping consisting of bearing, range, and identity tone signals. The RF multiplexer section of the self test is a passive device which permits the simulated signal to be applied to the TACAN receiver. The 63 MHz oscillator is crystal controlled and applied to the mixer (fig. 214). One input of the mixer consists of the local oscillator signal from the frequency generator. The sum, or difference, of both signals is applied to the pin diode and the output of the pin diode modulator is a pulse modulated signal. The simulated signal is applied to the TACAN receiver group by way of the directional coupler at a level of -77 ±3 dbm.

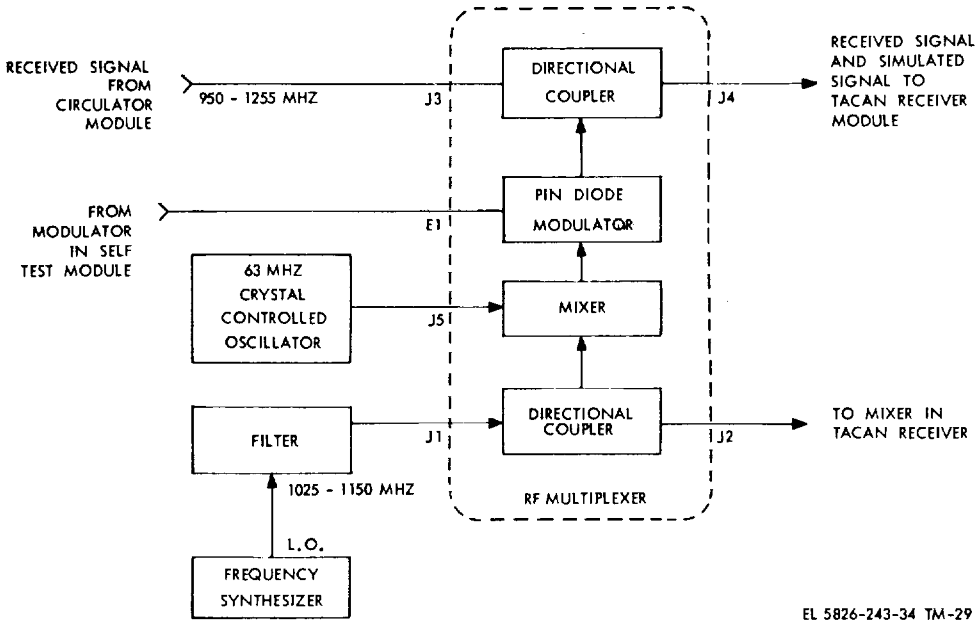


Figure 2-14. RF self test simplified block diagram.

CHAPTER 3

DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

NOTE

At the direct support maintenance level a visual inspection of the LRU's submitted by organizational maintenance is performed. All discrepancies will be noted and the LRU is then referred to general support maintenance.

CHAPTER 4

GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I.

4-1. Scope

This chapter contains instructions for troubleshooting, inspection, and performance (bench) testing of the navigational set. Removal and re- placement of assemblies and modules, and adjustment procedures after replacement, are also included. Maintenance functions beyond the scope of general support maintenance are refer- red to depot maintenance.

a. Voltage, Resistance, and Waveform Measurements. Unless otherwise specified in the troubleshooting and performance testing procedures, make TACAN voltage, resistance, and waveform measurements by connecting the Multimeter or oscilloscope to the TEST POINTS jacks on the test set front panel. Figure 4-1 shows TACAN voltage and signal characteristics available at the TEST POINTS jacks.

b. Bench Testing. Bench testing procedures for the TACAN are in section VI. The troubleshooting procedures in section III are keyed to the bench testing procedures.

4-2. Tools and Test Equipment Required

All the equipment required for general support maintenance of the navigational set as authorized by the Maintenance Allocation Chart are listed below:

a. Tools. Tool Kit TK-100/G
Insulated Screwdriver, GFD 5284

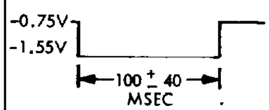
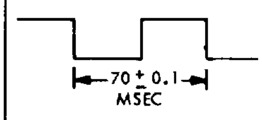
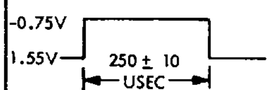
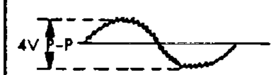
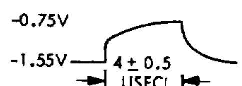
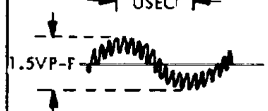
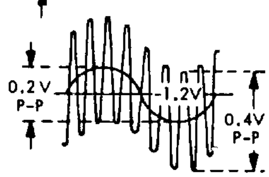
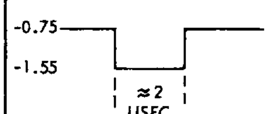
b. Test Equipment.

Nomenclature	Common Name
Test set, Navigational Set, TACAN TS-3134/ARN-103	Test Set
Test Set, Radio AN/ARM-156	Beacon Simulator
Multimeter ME-26/U	Multimeter
Headset H-104/G	Headset
Oscilloscope AN/USM-281A	Oscilloscope
Course Deviation Indicator ID-387	CDI

TACAN SIGNAL	TEST SET TEST POINTS SELECTORS SWITCH SETTINGS A	B	VDC LOGIC 0	LOGIC 1	OPER MODE	WAVEFORM OR VOLTAGE	REMARKS
$\overline{RBA}$	1	1	-1.55	-0.75	ALL		LOGIC 0 WHEN BIT IS SELECTED
$\overline{RBB}$	1	2					
$\overline{RBC}$	1	3					
$\overline{RBD}$	1	4					
$\overline{RBE}$	1	5					
$\overline{RBF}$	1	6					
$\overline{RBG}$	1	7					
$\overline{RBH}$	1	8					
$\overline{RBI}$	1	9					
$\overline{RBJ}$	1	10					
$\overline{RBK}$	1	11					
$\overline{RBL}$	1	12					
$\overline{RBM}$	2	1					
$\overline{RBN}$	2	2					LOGIC 0 WHEN BIT IS SELECTED
RVC	2	3					LOGIC 1 IS VALID
RSM	2	4	-1.55	-0.75	ALL		LOGIC 1 IS VALID
FPCR	2	5			T/R AND A/A	-0.75V; -1.55V; ≥400 NS	SEARCH: RATE IS 135 TO 150 PPS TRACK: RATE IS 22 TO 30 PPS
SPC	2	6			T/R AND A/A	SAME AS FPCR	SAME AS FPCR
ELT	2	7			ALL	4.9 ± 0.2 USEC; 0.75V	BRACKETS RANGE REPLY PULSE
$\overline{PIT}$	2	8			ALL	-1.55V; -0.75V; -1.55V; ≥400 NS	
$\overline{BBA}$	2	9	-1.55	-0.75	ALL		LOGIC 0 WHEN BIT IS SELECTED
$\overline{BBB}$	2	10					
$\overline{BBC}$	2	11					
$\overline{BBD}$	2	12					
$\overline{BBE}$	3	1					
$\overline{BBF}$	3	2					
$\overline{BBG}$	3	3					
$\overline{BBH}$	3	4					
$\overline{BBI}$	3	5					
$\overline{BBJ}$	3	6					
$\overline{BBK}$	3	7					LOGIC 0 WHEN BIT IS SELECTED
BLT	3	8	-1.55	-0.75	ALL	-0.75V; -1.55V; 5 TO 100 USEC	PULSE WIDTH DEPENDS ON PHASE OF FBM; RATE IS 135 PPS.
BOT	3	9			ALL	-0.75V; -1.55V; 20 ± 1 USEC	RATE IS 135 PPS
AVT	3	10	-1.55	-0.75	ALL		LOGIC 1 IS VALID.
BVS	3	11					LOGIC 1 IS VALID.
BVC	3	12					LOGIC 1 IS VALID.
$\overline{CSA}$	4	1					LOGIC 0 WHEN BIT IS SELECTED
$\overline{CSB}$	4	2					
$\overline{CSC}$	4	3					
$\overline{CSD}$	4	4					
$\overline{CSE}$	4	5					
$\overline{CSF}$	4	6					
$\overline{CSG}$	4	7					
$\overline{CSH}$	4	8	-1.55	0.75	ALL		LOGIC 0 WHEN BIT IS SELECTED.

EL 5826-243-34 TM-44 ①

Figure 4-1. TACAN AGE signals, voltages, and waveforms.

TACAN SIGNAL	TEST SET TEST POINTS SELECTORS SWITCH SETTINGS A	B	VDC LOGIC 0	LOGIC 1	OPER MODE	WAVEFORM OR VOLTAGE	REMARKS
$\overline{AAC}$	4	9	-1.55	-0.75	ALL		LOGIC 0 WHEN A/A MODE IS SELECTED.
RTM	4	10	-1.55	-0.75	ALL		LOGIC 1 WHEN R/T MODE IS SELECTED.
$\overline{YYC}$	4	11	-1.55	-0.75	ALL		LOGIC 0 WHEN Y MODE IS SELECTED.
STC	4	12	-1.55	-0.75	ALL		LOGIC 0 WHEN BIT SWITCH IS PRESSED.
ASD	5	1			ALL	+28 VDC OR +14 VDC	+28 VDC - ANTENNA SWITCH OFF; +14 VDC - ANTENNA SWITCH ON.
TSC	5	2	-1.55	-0.75	ALL		LOGIC 0 FOR UNINHIBITED TRANSMIT; LOGIC 1 FOR TRANSMIT INHIBIT.
FSC	5	3			ALL		RATE IS 0.2 PPS.
$\overline{PTT}$	5	4				+ 1.5 TO + 1.62 VDC OR + 1.75 TO + 1.9VDC	LINEAR RAMP VOLTAGE IS APPROXIMATELY 1.5 TO 1.62 VDC FOR CHANNELS 1 THROUGH 63 AND APPROXIMATELY 1.75 TO 1.9 VDC FOR CHANNELS 64 THROUGH 126.
$\overline{CUS}$	5	5		-0.75	ALL		LOGIC 1 WHEN BIT SWITCH IS NOT PRESSED; 14.3 HZ, 50% DUTY CYCLE SQUARE WAVE WHEN BIT SWITCH IS PRESSED.
SDT	5	6			ALL		SEE FIGURE 2-6.
CVT	5	7			T/R AND A/A		T/R MODE-RATE IS 2700 PPS; A/A MODE-RATE IS 25 TO 900 PPS. DOES NOT INCLUDE PULSES TRANSMITTED FROM TACAN.
MRT	5	8			ALL		RATE IS 15 HZ.
CBT	5	9			ALL		RATE IS 15 HZ; MODULATION IS 27-1/2%.
ART	5	10			ALL		RATE IS 135 PPS; PULSE IS GENERATED WHEN EITHER A MAIN OR AUXILIARY BURST IS DETECTED.
FBT	5	11			ALL		RATE IS 135 HZ; MODULATION IS 27-1/2%
SGT	5	12			ALL		VARIABLE FROM -1 VDC (MINIMUM GAIN) TO -6 VDC (MAXIMUM GAIN).
FGT	6	1			ALL		MAIN AC RATE IS 15 HZ WITH 27-1/2% MODULATION; AUXILIARY AC RATE IS 135 HZ WITH 27-1/2% MODULATION.
$\overline{FPV}$	6	2			T/R AND A/A		T/R MODE: RATE IS 2700 PPS; A/A MODE: RATE IS 25 TO 750 PPS.

EL 5826-243-34 TM-44 ②

Figure 4-1 (2). TACAN AGE signals, voltages, and waveforms.

TACAN SIGNAL	TEST SET TEST POINTS SELECTORS SWITCH SETTINGS A	B	VDC LOGIC 0	LOGIC 1	OPER MODE	WAVEFORM OR VOLTAGE	REMARKS
FPCD	6	3			T/R AND A/A	-0.75, -1.55, ≥400 NS	T/R MODE: SEARCH-RATE IS 135 TO 150 PPS; TRACK-RATE IS 22 TO 30 PPS. A/A MODE: RATE IS 22 TO 900 PPS.
IDD	6	4			ALL	+14V, OV, 747 ±10 USEC	RATE IS 1350 PPS (SQUARE WAVE).
	6	5					TEST SIGNAL DELETED.
$\overline{FST}$	6	6	-1.55	-0.75	ALL		LOGIC 0 IS GO; LOGIC 1 IS NO-GO.
$\overline{RST}$	6	7	-1.55	-0.75	ALL		LOGIC 0 IS GO; LOGIC 1 IS NO-GO.
$\overline{RZT}$	6	8			ALL	0 VDC FOR RANGE ≤ 2 NM; +5.2 VDC FOR RANGE >2 NM	
$\overline{BZT}$	6	9			ALL	0 VDC FOR BEARING 0° ± 2°; +5.2 VDC FOR BEARING NOT 0° ± 2°.	
STS	6	10			ALL	0 VDC IS NO-GO; +5.2 VDC IS GO.	DURING INTERRUPTIVE SELF TEST ONLY.
STH	6	11			ALL	+5.2 VDC OR 0 VDC	NORMALLY +5 VDC (OPEN);0 VDC WHEN SELF TEST HOLD IS INITIATED.
FPC	6	12			ALL	SAME AS FPCD	SAME AS FPCD
	7	1			ALL		TEST SIGNAL DELETED
	7	2					TEST SIGNAL DELETED
PSS	7	3	-1.55	-0.75	ALL		LOGIC 0 IS GO; LOGIC 1 IS NO-GO.
+5.2V	7	4			ALL	+5.2 ±0.26 VDC	
-5.2V	7	5			ALL	-5.2 ±0.26 VDC	
+12V	7	6			ALL	+12 ± 0.6 VDC	
-12V	7	7			ALL	-12 ± 0.6 VDC	
-10V	7	8			ALL	-9.5 ±2.0 VDC	
+30V	7	9			ALL	+30 ± 1.5 VDC	
HVT	7	10			T/R AND A/A	170 ± 10 VDC	LOW PRF.
FHC	7	11			ALL	11.5 ± 2.5 VP-P	RATE IS 800 HZ; 9 VRMS.
PHC	7	12			ALL	30.0 ± 2.0 V P-P	RATE IS 400 HZ.

EL 5826-243-34 TM-44 (3)

Figure 4-1(3). TACAN AGE signals, voltages, and waveforms

Section II. TROUBLESHOOTING

4-3. General

General support troubleshooting procedures in this section supplement those procedures de- scribed in the Organizational Maintenance Manual, TM 11-5826-243-20. Systematic troubleshooting begins at organizational maintenance where a fault is sectionalized to a major unit of the navigational set (receiver- transmitter, converter, control units, or the antenna) by using the built-in test function. At general support maintenance, a fault is localized and isolated to a defective assembly or module by using tools and test equipment.

4-4. Receiver-Transmitter/Converter Trouble-shooting Tests

Troubleshooting procedures for the receiver- transmitter and converter are based on the results of the electrical tests performed in Section VI. The procedures listed in subparagraph c are in the same sequential order as the electrical tests listed in subparagraph 4-24c. When an electrical test fails to meet the required performance standards, the isolation of the malfunction to a module or assembly begins with sequential checks of input and output voltages, or waveforms, of the affected module or assembly.

To facilitate the location of the malfunction, voltage, resistance, and waveforms charts, parts location illustrations, and schematic diagrams are referenced in the procedures. Faulty modules and assemblies are referred to depot maintenance for further action. The test set is used to control TACAN operation and display fault indications. The beacon simulator is used to simulate the functions of a TACAN beacon. Removal and replacement procedures and required adjustments are described in section IV. If normal reading is obtained during first step of troubleshooting procedure and no fault is apparent, return to beginning of electrical test procedure (para 4-20) and repeat electrical tests. If the trouble cannot be located using the troubleshooting procedures, refer the test set to depot level maintenance.

a. Bench Test Setup. Connect the equipment for bench testing per paragraph 4-20.

b. Initial Test Equipment Control Settings. Set controls and switches to initial settings listed in paragraph 4-20.

NOTE

Whenever a removed or replaced module is found not faulty in sub- paragraphs c and d, reinstall module before continuing troubleshooting procedures.

C. TACAN Static Troubleshooting.

Item No.	Item checked	Test condition	Point of measurement	Normal reading	Corrective action
1	Blower 1B1	Test Set 115 VAC ON/OFF ON TEST SET RADIO SET CONTROL Operation mode T/R	None	Blower operating	a. Remove and check fuse 1F1. Replace if faulty. Repeat electrical tests (para 4-20c). If fuse is not faulty, proceed to Item 1A. b. If fuse blows a second time, proceed to Item 1D.
1A	Blower 1B1	Same as Item 1	None	TTM operating	Check blower 1B1 blades move freely and blower connector 1A1P1 (2, figure 44) for continuity. Remove and replace blower if faulty (para 4-6*f* and 4-7 *f)* If TTM is operating, proceed to Item 1B.
1B	Blower 1B1	Same as Item 1	None	Blower operating	Remove and replace blower 1B1 (para 4-6*c* and 4-7*f*). Repeat electrical tests (para 4-20c). If trouble persists, proceed to Item 1C.
1C	Relay 4KI and diode 4CR1 in Converter.	Same as Item 1	None	Blower operating	Check relay 4K1 and diode 4CR1. If faulty, remove and replace (para 4-11*i* and 4-12*i*). Repeat electrical tests (para 4-20c). If trouble persists, refer navigational set to depot.
1D	TTM wiring	Same as Item 1	None	Blower operating	Check for short in TTM terminal connections. If wires shorted, re pair. Repeat electrical tests (para 4-20*c*). If trouble persists, proceed to Item 1E.
1E	Power Supply 1PS1	Same as Item 1	None	Blower operating	Remove and replace power supply 1PS1 (para 4-6 and 4c7). Repeat electrical tests (para 420c). If trouble persists, proceed to Item 1F.
1F	Relay 4K1 and diode 4CR1 in converter	Same as Item 1	None	Blower operating	Check relay 4K1 and diode 4CR1. If faulty, remove and replace (para 4- 11*i* and 4-12*i*). Repeat electrical tests (para 4-20c). If trouble persists, refer navigational set to depot.

Item No.	Item checked	Test condition	Point of measurement	Normal reading	Corrective action
2	TTM	Test Set 115 VAC ON/OFF ON	None	TTM Operating	Check for open wires at TTM. Repair if open; otherwise, remove and replace ITM (para 46*s*and 4-7*s*). If trouble is cleared, continue electrical tests starting at (para 4-20*c*), step 3. If trouble persists, refer navigational set to depot.
3	Power Supply 1Psi	*Test Set RADIO SET CONTROL:* Set MODE to position where trouble appeared Set CHANnel to position where trouble appeared Operation mode REC *Test Set* SELF TEST HOLD/SELF TEST RELEASE HOLD TEST INITIATE Press and release	None	PWR SPLY NO GO lamp not illuminated	*a.* If lamp illuminates, remove and replace power supply 1PS1 (para 4-6*l* and 4-7*l*). Repeat TEST INITIATE test. If trouble is cleared, repeat electrical tests(para 4-20*c*), step 3. If trouble persists, refer navigational set to depot *b.* If lamp does not illuminate, remove and replace Interface 4A3 (para 4-11*c* and 4-12*c*), or signal distribution adapter (para 4-11*f* and 4-12*f*) in Converter. Continue electrical tests starting at para4-20c, step 3. If trouble persists refer navigational set to depot
4 . . :	Power Supply 1PS1	*Test Set RADIO SET CONTROL:* Set MODE to position where trouble appeared Set CHANNEL to posi-tion where trouble appeared Operation mode REC *Test Set* SELF TEST HOLD/SELF TEST RELEASE HOLD TEST INITIATE Press and release	None	PWR SPLY NO GO lamp not illuminated	*a.* If lamp illuminates, remove and replace power supply 1PS1 (para 4-6*l* and 4-7*l*). Repeat TEST INITIATE test. If trouble is cleared, repeat electrical tests starting at (para 4-20*c*), Step 3. If trouble persists, proceed to Step 4b *b*. If lamp does not illuminate, remove and replace interface 4A3 (para 4-11*c* and 4-12*c*), or signal distribution adapter (para 4-11*f* and 4-12*f*) in converter. Repeat electrical tests starting at (para 4-20*c*), step 3. If trouble persists, refer navigational set to depot.
5	Internal Control A4	None	None	None	Remove and replace internal con-trol 1A4 (para 4-6*h* and 4-7*h*). Repeat electrical tests starting at (para 4-20c), Step 5. If trouble persists, refer navigational set to depot.
6	Receiver-Transmitter Modules	*Test Set RADIO SET* CONTROL MODE X CHANnel 64 Operation mode T/R *Test Set:* SELF TEST HOLD/SELF TEST RELEASE HOLD TEST INITIATE Press and release	None	After 20 seconds, no NO GO INDICATIONS lamp illuminated	*a.* Remove and replace faulty module indicated. Repeat TEST INITIATE test and replace mod-ules until all NO GO INDICA-TIONS lamps remain not illumi-nated. Continue electrical tests starting at (para 4-20*c*), Step 7, except after replacing Internal Control 1A4 start electrical tests at (para 4-20*c*), Step 5. *b.* If a RCVR NO GO occurs more than once, proceed to Item 6A. If a PWR AMP NO GO occurs more than once, proceed to Item 6C. If a PWR SPLY NO GO occurs more than once, proceed to Item 6E.

Item No.	Item checked	Test condition	Point of measurement	Normal reading	Corrective action
					c. If trouble persists, refer navigational set to depot.
6A	Receiver 1RE1	Same as Item 6	None	NO GO INDICA-TIONS lamp not illuminated	Check all RF cables (table 4-1). If cable faulty, remove and re-place. Repeat Item 6. If cables not faulty, proceed to Item 6B.
6B	Receiver 1RE1	Same as Item 6	None	NO GO INDICA-TIONS lamp not illuminated	Sequentially remove and replace each of the following modules: Frequency Synthesizer 1A2 (para 4-6*p* and 4-7*p*) self test 1A7 (para 4-6*g* and 4-7*g*) Circulator 1HY1 (para 4-6*m* and 4-7*m*) Coupler/Filter 1FL1 (para 4-6*n* and 4-7*n*). Repeat Item 6 after each module is removed and replaced.
6C	Power Amplifier/Modulator 1A1	Same as Item 6	None	NO GO INDICA TIONS lamp not illuminated	Check all RF cables (table 4-1). If cable faulty, remove and re-place. If cables not faulty, pro ceed to Item 6D.
6D : -	Same as Item 6C	Same as Item 6	None	NO GO INDICA-TIONS lamp not illuminated	Sequentially remove and replace each of the following modules Circulator 1HY1 (para 4-*6m* and 4-7*m*) Coupler/Filter 1FL1 (para 9-4*n* and 4-7*n*) Frequency Synthesizer 1A2 (para 4*p* and 4-7*p*). Repeat Item 6 after each module is removed and replaced.
6E	Power Supply 1PS1	Same as Item 6	None	NO GO INDICA-TIONS lamp not illuminated	Remove and replace power supply 1PS1 (para 4-6*l* and 4-7*l*). Repeat Item 6.
7	Receiver-Transmitter Modules	*Test Set RADIO SET CONTROL:* MODE Y CHANnel 1 Operation mode T/R *Test Set:* SELF TEST HOLD/SELF TEST RELEASE HOLD TEST INITIATE Press and release	None	Same as Item 6	Same as Item 6
8	Receiver-Transmitter Modules	*Test Set RADIO SET CONTROL:* MODE X CHANnel 63 Operation Mode T/R *Test Set:* SELF TEST HOLD/SELF TEST RELEASE HOLD TEST INITIATE Press and release	None	Same as Item 6	Same as Item 6
9	Receiver-Transmitter Modules	Test Set RADIO *SET CONTROL:* MODE Y CHANnel 126 Operation mode T/R *Test Set:* SELF TEST HOLD/SELF TEST RELEASE HOLD TEST INITIATE Press and release	None	Same as Item 6	Same as Item 6

Item No.	Item checked	Test condition	Point of measurement	Normal reading	Corrective action
10	Receiver-Transmitter Modules	*Test Set RADIO SET CONTROL:* MODE X CHANnel 63 Operation mode A/A *Test Set:* SELF TEST HOLD/SELF TEST RELEASE HOLD TEST INITIATE Press and release	None	Same as Item 6	Same as Item 6
11	Receiver-Transmitter Modules	*Test Set RADIO SET CONTROL:* X/Y MODE Y CHANnel 126 Operation mode A/A *Test Set:* SELF TEST HOLD/SELF TEST RELEASE HOLD TEST INITIATE Press and release	None	Same as Item 6	Same as Item 6
12	Internal Control 1A4	*Test Set RADIO SET CONTROL:* MODE X CHANnel 64 Operation mode T/R *Test Set:* SELF TEST HOLD/SELF TEST RELEASE HOLD	None	ANT SWITCH and ANT DRIVE indicators either both ON or both OFF (not blinking)	*a.* If indicators are blinking, remove and replace internal control 1A4 (para 4 and 4-7h). Repeat electrical tests starting at (para 4-20c), Step 5. If trouble persists, refer navigational set to depot. *b.* If indicators are not blinking but one indicator is OFF and the other ON, remove and replace board 4A2 (para 4-1li and 4-12i) in converter. Repeat electrical tests starting at (para 4-20c), Step 12. If trouble persists, refer navigational set to depot.
13	Antenna Switching circuitry	*Test Set RADIO SET CONTROL:* *MODE X* CHANnel 64 Operation mode T/R *Test Set:* SELF TEST HOLD/SELF TEST RELEASE RELEASE	None	After 60 seconds, ANT SWITCH and ANT DRIVE indicators both blinking ON and OFF.	*a.* If both indicators not blinking, sequentially remove and replace internal control 1A4 (para 4-6*h* and 4-7*h*) and board 4A2 (para 4-11*i* and 4-12*i*) in converter. Repeat electrical test (para 4-20*c*), Step 13. If trouble is cleared after replacing Internal Control 1A4, repeat electrical tests starting at (para 4-20*c*), Step 5. If - trouble is cleared after replacing board 4A2, repeat electrical tests starting at (para 4-20c), Step 12. If trouble persists, refer navigational set to depot. *b.* If ANT DRIVE indicator is blinking and ANT SWITCH is not, remove and replace board 4A2 (para 4- 11*i* and 4-12*i*) in converter. Repeat electrical test (para 4-20*c*), Step 13. If trouble is cleared, repeat electrical tests, starting at (para 4-20*c*, Step 12. If trouble persists, refer navigational set to depot. Test Set

Item No	Item checked	Test condition	Point of measurement	Normal reading	Corrective action
14	Receiver-Transmitter Modules	*Test Set* TEST INITIATE Press and release	None	*a.* After 20 seconds, *A* NO GO INDICA-TIONS lamp illuminates for 10 seconds indicating faulty module *b* ID Tone audible on headset.	*a.* Same as Item 6 *b* If ID Tone not audible check, transformer 4T1 in converter. If transformer 4T1 is good, replace board 4A2 (para 4-11*i* and 4-12*i*) in converter. If transformer 4T1 is bad, replace transformer 4T (para4-lli and 412i). Repeat electrical tests starting at (para 4-20c), Step 12. If trouble persists, refer navigational set to depot.
15	Self Test 1A7	*Test Set* SELF TEST HOLD/SELF TEST RELEASE RELEASE *Test Set RADIO SET CONTROL:* MODE X CHANnel 64 Operation mode T/R BIT Press and release	None	GO NO GO STATUS and ECM WARN lamps illuminated	Remove and replace self test 1A7 (para 4-6*g* and 4-7*g*). Repeat BIT test. If trouble is not cleared, refer navigational set to depot. If trouble is cleared, repeat electrical tests starting at (para 4-20c), Step 6.
16	Self Test 1A7	Observe GO STATUS 15 to 20 seconds after BIT is released	None	GO STATUS lamp illuminated.	Remove and replace self test 1A7 (para 4-9*g* and 4-7*g*). Repeat BIT test. If trouble cleared repeat electrical tests starting at (para 4-20c), Step 6. If trouble persists, refer navigational set to depot.
17	Self Test 1A7	Observe 4 FAULT latch indicators on front panel of receiver-transmitter	None	All 4 FAULT indicators are black (GO)	a. Remove and replace self test 1A7 (para 4-g and 479). Repeat BIT test. If trouble is cleared, repeat electrical tests starting at (para 4-20c), Step 6. If trouble is not cleared, proceed to Item 17A.
17A	FAULT Latch Indicators	Same as Item 17	None	Same as Item 16	Remove and replace FAULT latch indicator (para 4- and 4-7t) Repeat BIT test. f trouble is cleared, continue electrical tests starting at (para 4-20c), Step 18. If trouble persists, refer navigational set to depot.
18	Same as Steps 15 thru 17	Set operation mode and MODE on RADIO SET CONTROL as follows: T/R Y A/A X A/A Y	None	Same as Items 15 thru 17	Same as Items 15 thru 17

Table 4-1. Receiver-Transmitter RF Cables

	From		To		
Ref Des	Connector	Fig. 4-3 Location	Connector	Fig. 4-3 Location	Signal Term
1WI	1A7A11J2	56	1RELI5	11	LOS
1W2	1RE1J1	9	1A7A1L14	57	RSL
1W3	1HY1J1	31	1A7A11J3	58	RCV
1W4	1A2J1	47	1A7A1U1	55	CCW
IW5	1A2J2	49	1A1J1	44	PCW

	From		To		
Ref Des	**Connector**	**Fig 4-3 Location**	**Connector**	**Fig 4-3 Location**	**Signal Term**
1W6	1A1J2	42	1HYlJ2	34	TSL
1W7	1FL1J1	39	1HYJ3	33	RTS
1W8	1FL1J2	36	1A7JI	54	CF INC
1W9	1FL1J3	38	1A7J2	52	CF REF

d. Converter Interface-Buffer Static Troubleshooting.

Item No	Item checked	Test condition	Point of measurement	Normal reading	Corrective action
1	Digital Interface 4A3 and Buffer 4A1	*Test Set TS-3134* *RADIO SET CONTROL:* MODE X CHANnel 64 Operation Mode T/R *Test Set:* DISPLAY SELECT DIGITAL INTERFACE FUNCTION SELECT CONTROL UPDATE/ STOP UPDATE SELF TEST HOLD/ SELF TEST RELEASE HOLD	None	CONTROL lamps 4 illuminated. DATA VALID indicator blinking	Remove and replace interface 4A3 S/T, T/R, 40, 20, and (para 4-11*c* and 4-12*c*). Repeat electrical tests (para 4-20*d*). If trouble persists, remove and replace buffer 4A1 (para 4-11*d* and 4-12*d*). Repeat electrical tests (para 4-20*d*). If trouble not cleared, refer navigational set to depot.
2	Same as Item 1	Same as Item 1 except set test set FUNCTION SELECT to BEARING	None	BEARING lamps 356 to 360, or 0 to 2 illuminated DATA VALID indicator blinking.	Same as Item 1
3	Same as Item 1	Same as Item 1 except set test set FUNCTION SELECT to RANGE	None	RANGE lamps O to 0.5 illuminated. DATA VALID indicator blinking	
4	Same as Item 1	*Test Set RADIO SET CONTROL:* Operation mode AUTO *Test Set:* FUNCTION SELECT CONTROL SELF TEST HOLD/ SELF TEST RELEASE RELEASE	None	AUTO lamp illuminated.	Same as Item I
5	Same as Item 1	Same as Item 4 except set test set PROGRAM SELECT to 1. Press and release ENTER switch after each program	None	CONTROL lamps REC, 40, 20, 10, 4, 2, and 1 illuminated. DATA VALID indicater blinking.	Same as Item 1
6	Same as Item 1	Same as Item 5 except set test set PROGRAM SELECT to 1	None	CONTROL lamps T/R, 80, and 8 illuminated. DATA VALID indicator blinking	Same as Item 1
7	Same as Item 1	Same as Item 5 except set test set PROGRAM SELECT to3	None	CONTROL lamps A/A, 80, 20, and 8 illuminated. DATA VALID indicator blinking	Same as Item 1
8	Same as Item 1	Same as Item 5 except set test set PROGRAM SELECT to4	None	CONTROL lamps S/T, T/R, 80, and 8 illuminated. DATA VALID indicator blinking.	Same as Item 1

Item No.	Item checked	Test condition	Point of measurement	Normal reading	Corrective action
9	Same as Item 1	Same as Item 5 except set test set PROGRAM SELECT to5	None	Same as Item 8	Same as Item 1

e *TACAN Fault Indicators Troubleshooting*

Ite m No.	Item checked	Test condition	Point of measurement	Normal reading	Corrective action
1	Self Test 1A7	Apply short across navigational set AGE connector pins 30 and 102. *Test Set RADIO SET CONTROL:* Operation mode T/R BIT Press and release	None	After 30 seconds, NO GO STATUS lamp illuminated and CONT FAULT latch indicator white.	*a*. If a GO STATUS lamp is illuminated, remove and replace self test 1A7 (para *46q* and 4-7q). Repeat BIT test. If trouble is cleared, repeat electrical tests (para 4-20e). If trouble persists, refer navigational set to depot. *b* If CONT FAULT latch indicator is not white and NO GO STATUS lamp illuminated, remove and replace self test 1A7 (para 4-6*q* and 4-7*q*). Repeat BIT test. If trouble is cleared, repeat electrical tests (para 4-20*e*). If trouble is not cleared, proceed to Item 1A.
1A	CONT FAULT - Latch Indicator	Same as Item 1	None	Same as Item 1	Remove and replace CONT FAULT latch indicator (para 4-6*t* and 4-7*t*). Repeat BIT test. If trouble cleared, repeat electrical tests (para 4-20*e*). If trouble persists, refer navigational set to depot.
2	Self Test 1A7	Remove short from AGE connector. *Test Set RADIO SET CONTROL:* BIT Press and release	None	After 30 seconds, all 4 FAULT latch indicators on front panel of receiver-transmitter are black (GO).	Remove and replace self test 1A7 (para 4-6*q* and 4-7*q*). Re peat BIT test. If trouble is cleared, repeat electrical tests (para 4-20*e*). If trouble is not cleared, proceed to Item 2A.
2A	FAULT Latch Indicators	Same as Item 2	None	Same as Item 2	Remove and replace FAULT latch indicator (para 4-6*t* and 4-7t). Repeat BIT test. If trouble is cleared, repeat electrical tests (para 4-20e). If trouble persists, refer navigational set to depot.
3	Same as Step 2	Remove range coupler 4DC2 from converter *Test Set RADIO SET CONTROL:* Operation mode REC BIT Press and release	None	After 30 seconds, NO GO STATUS lamp illuminated and CONV FAULT latch indicator is white.	*a.* If a GO STATUS lamp is illuminated, remove and replace self test 1A7 (para 4-6*q* and 4-7*q*). Repeat BIT test. If trouble is cleared, repeat electrical tests (para 4-20*e*). If trouble persists, refer navigational set to depot. *b.* If CONV FAULT latch indicator is not white and NO GO STATUS lamp illuminated, remove and replace self test 1A7 (para 4-6*q* and 4-7*q*). Repeat BIT test. If trouble is cleared, repeat electrical tests (para 4-20e). If trouble is not cleared, proceed to Item 3A.
3A	CONV FAULT Latch I ndicator	Same as Item 3	None	Same as Item 3	Remove and replace CONV FAULT latch indicator (para 4-6*t*) and 4-7*t*). Repeat BIT test.

Item No	Item checked	Test condition	Point of' measurement	Normal reading	Corrective action
					If trouble cleared, repeat electrical tests (para 4-20*e*). If trouble persists, refer navigational set to depot.
4	Self Test 1A7	Replace range coupler 4DC2 *Test Set RADIO SET CONTROL* BIT: Press and release	None	After 30 seconds, all FAULT latch indicators on front panel of receiver-transmitter are black (GO).	Same as Item 2.
5	Self Test 1A7	Disconnect test set cable W-1 from ANTENNA connector on front panel of receiver-transmitter *Test Set RADIO SET CONTROL:* Operation mode T/R BIT Press and release	None .	After 30 seconds, NO GO STATUS lamp illuminates and ANT FAULT latch indicator is white (NO GO).	*a.* If a GO STATUS lamp is illuminated, remove and replace self test 1A7 (para 4-6*q* and 4-7*q*). Repeat BIT test. If trouble is cleared, repeat electrical tests (para 4-20*e*). If trouble persists, refer navigational set to depot. b. If ANT FAULT latch indicator is not white and NO GO STATUS lamp illuminated, remove and replace self test 1A7 (para 4-6*q* and 4-7*q*). Repeat BIT test. If trouble is cleared, repeat electrical tests (para 4-20*e*). If trouble is not cleared, proceed to Item 5A.
5A	ANT FAULT Latch Indicator	Same as Item 5	None	Same as Item 5	Remove and replace ANT FAULT latch indicator (para 4-6*t)* and 4-7t). Repeat BIT test. If trouble cleared, repeat electrical tests (para 4-20*e*). If trouble persists, refer navigational set to depot.
6	Self Test 1A7	Reconnect test set cable W-1 to ANTENNA connector on front panel of receiver-transmitter. *Test Set RADIO SET CONTROL:* Operation mode T/R BIT Press and release.	None	After 30 seconds, all FAULT latch indicators on front panel of receiver-transmitter are black (GO).	Same as Item 2.
7	Same as Step 6	*Test Set* TEST POINTS SELECTORS A 7 B 3 Apply chassis ground to TEST POINTS connector J2 *Test Set RADIO SET CONTROL:* Operation mode T/R BIT Press and release	None	After 30 seconds, NO GO STATUS lamp illuminates and RT FAULT latch indicator is white.	*a.* If a GO STATUS lamp is illuminated, remove and replace self test 1A7 (para 4*q* and 4-7*q*). Repeat BIT test. If trouble is cleared, repeat electrical tests (para 4-20*e*). If trouble persists, refer navigational set to depot. *b.* If RT FAULT latch indicator is not white and NO GO STATUS lamp illuminated, remove and replace self test 1A7 (para 4*q* and 4-7*q*). Repeat BIT test. If trouble is cleared, repeat electrical tests (para 4-20*e*). If trouble is not cleared proceed to Item 7A.
7A	RT FAULT Latch Indicator	Same as Item 7	None	Same as Item 7	Remove and replace RT FAULT latch indicator (para 4-6*t* and

Item No.	Item checked	Test condition	Point of measurement	Normal reading	Corrective action
					4-7t). Repeat BIT test. If trouble cleared, repeat electrical tests (para 4-20e). If trouble persists, refer navigational set to depot.
8	Self Test 1A7	Disconnect short from TEST POINTS connector J2. Test Set RADIO SET CONTROL: BIT Press and release	None	After 30 seconds, all FAULT latch indicators on front panel of receiver-transmitter are black (GO).	Same as Item 2.

Section III. MAINTENANCE OF RECEIVER-TRANSMITTER

4-5. General

This section covers the repair procedures for the receiver-transmitter. The procedures consist of removal and replacement of modules, assemblies, and specific components. Adjustment procedures following replacement of modules (para 4-8) is also provided. After the receiver- transmitter has been repaired, perform the course centering and course width adjustment procedures per paragraph 4-9.

NOTE

The power amplifier-modulator (1A) must be replaced every 600 hours.

4-6. Removal Procedures

Each module, assembly, or specific component removal procedure is completely self-contained. To remove a module, assembly, or component go directly to the subparagraph for that particular item.

NOTE

If mounting adapter is not present, skip paragraph 4-6a.

a. Removal of Receiver-Transmitter/Converter from Mounting Adapter.

(1) Loosen the knurled nuts (1, fig. 4-2) securing the receiver transmitter/converter to the mounting adapter (2).

(2) Pull the receiver-transmitter/converter away from adapter connector (3).

b. Removal of Adapter Connector.

(1) Remove receiver-transmitter/converter per subparagraph a.

(2) Remove four screws (11, fig. 4-2) from front of adapter connector (3).

(3) Remove two screws (12) located on top of adapter connector.

(4) Lift adapter connector out from mounting adapter (2).

c. Removal of Mounting Adapter Isolators.

(1) Remove receiver-transmitter/converter per subparagraph a.

(2) Remove screw and washer (not shown) located on top of isolater (13, fig. 4-2).

(3) Remove isolater from mounting adapter (2).

d. Removal of Receiver-Transmitter from Converter.

(1) Remove receiver-transmitter/converter from -mounting adapter per subparagraph a.

(2) Remove the two captive screws (4, fig. 4-2) located at rear of converter (5).

(3) Carefully pull receiver-transmitter (6) away from converter (5) taking care not to damage the mating connector (7).

e. Removal of-Receiver-Transmitter Cover.

(1) Remove receiver-transmitter/converter from mounting adapter per subparagraph a.

(2) Remove receiver-transmitter from converter per subparagraph b, steps (2), (3), and (4).

(3) Remove two screws (8, fig. 4-2) securing cover (9) to receiver-transmitter chassis (6).

(4) Slide cover (9) off from receiver-transmitter.

f. Removal of Blower 1B1.

(1) Remove cover per subparagraph e.

(2) Disengage two jack screws (1, fig. 4-3) that secure blower connector 1BIP1 (2) to chassis connector 1J2 (3) by turning each jack screw counterclockwise a few turns until they both turn freely.

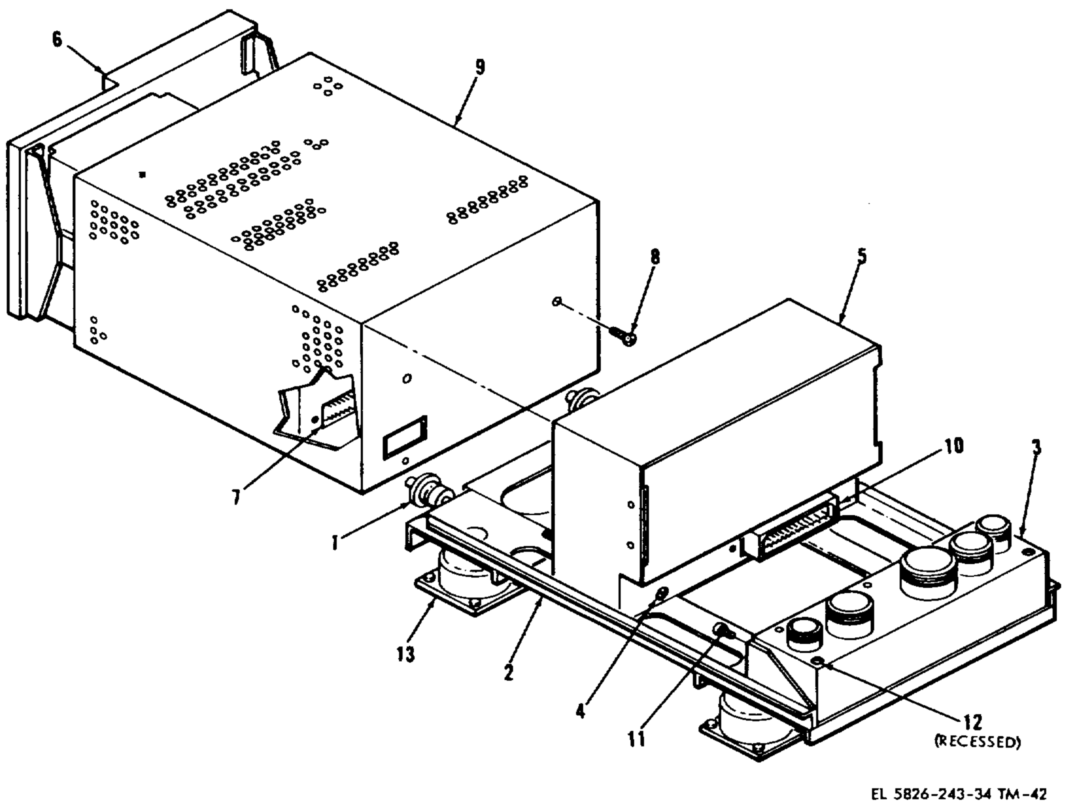
(3) Lift connector 1B1P1 straight out from chassis.

(4) Remove and retain four screws (4) that secure blower 1Bi (5) to chassis.

(5) Twist blower 1Bl until blower body is clear of clamps (6) and lift blower 1B1 straight out.

(6) Remove and retain two set screws (7) that secure shroud (8) to blower iB1.

(7) Pull shroud off blower 1B1.



1 Knurled nuts (Z)
2 Mounting adapter
3 Adapter connector
4 Captive screws (2)
5 Converter
6 Receiver-transmitter
7 Receiver-transmitter connector
9 Screw (2)
9 Cover
10 Converter connector
11 Screw (4)
12 Screw (2)
13 Isolator (4)

Figure 4-2. Receiver-transmitter and converter removal.

g. Removal or Receiver 1RE1.

(1) Remove cover per subparagraph e.

(2) Disconnect chassis connector 1W2P1 (9, fig. 4-3) from connector 1REiJ1 on receiver 1RE1 (10).

(3) Disconnect chassis connector lW1P2 (11) from connector 1RElJ5 on receiver IRE1.

(4) Disengage two receiver captive screws (12) by turning each screw counterclockwise a few turns until they both turn freely.

(5) Carefully pull receiver IRE1 straight out from connector 1XRE1P1 (13) and connector 1XRE1P2 (14).

h. Removal of Internal Control 1A4.

(1) Remove cover per subparagraph e.

(2) Disengage two internal control captive screws (15, fig. 4-3) by turning each screw counterclockwise a few turns until they both turn freely.

(3) Carefully pull internal control 1A4 (16) straight out from connector 1XA4P1 (17).

i. Removal of Bearing Computer 1A5.

(1) Remove cover per subparagraph e.

(2) Disengage two bearing computer captive screws (18, fig. 4-3) by turning each screw counterclockwise a few turns until they both turn freely.

(3) Carefully pull bearing computer 1A5 (19) straight out from connector IXA5Pi (20).

j. Removal of Range Computer iA6.

(1) Remove cover per subparagraph e.

(2) Disengage two range computer captive screws (21, fig. 4-3) by turning each screw counterclockwise a few turns until they both turn freely.

(3) Carefully pull range computer 1A6 (22) straight out from connector 1XA6P1 (23).

k. Removal of Decoder 1A3.

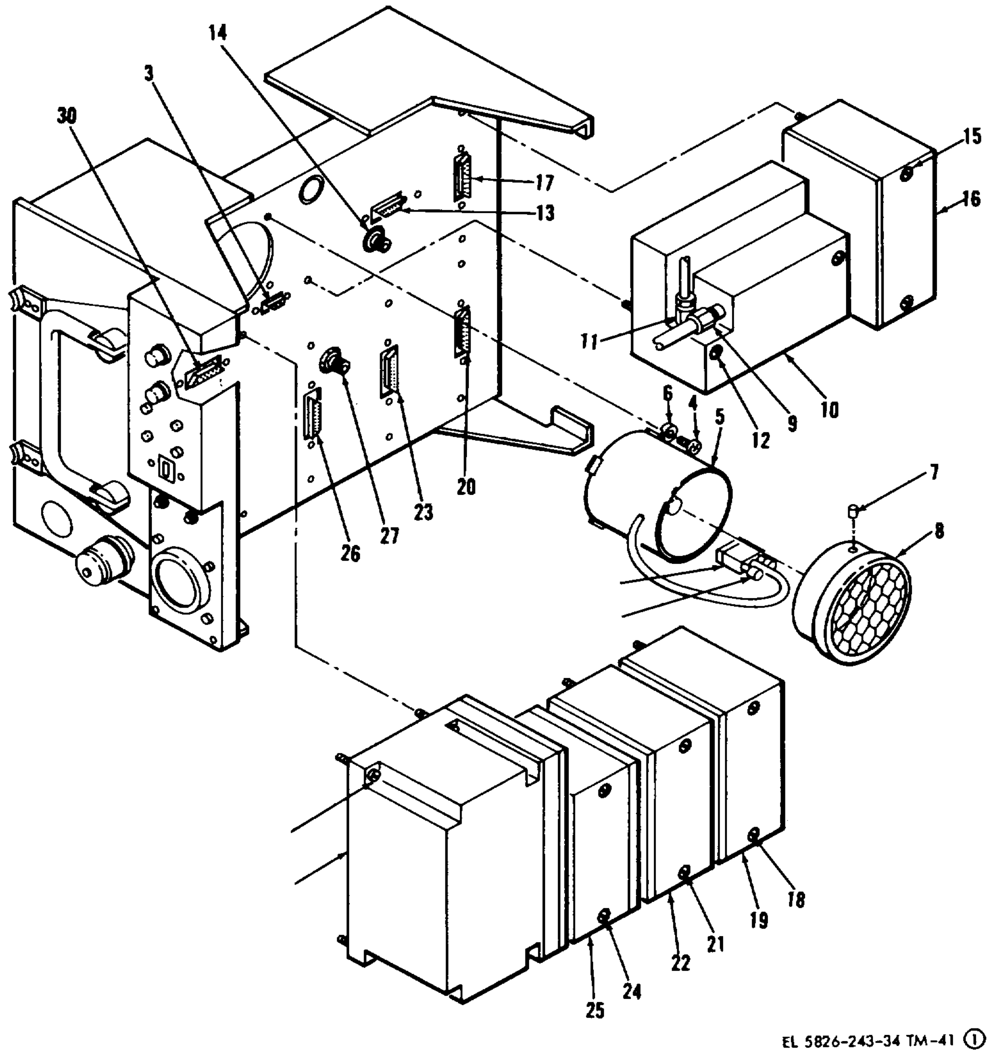


Figure 4-3. (1) Receiver-transmitter parts location Sheet 1 of 2)

1 Jack screw (2)
2 Blower connector 1B1P1
3 Connector 1J2
4 Screw (4)
5 Blower 1B1
6 Clamp (4)
7 Set screw (2)
8 Shroud
9 Connector lW2P1
10 Receiver 1REl
11 Connector lW1P2
12 Receiver captive screw (2)
13 Connector 1XRE1P1
14 Connector 1XRE1P2
15 Internal control captive screw (2)
16. Internal control 1A4
17 Connector 1XA4P7
18 Bearing computer captive screw (2)
19 Bearing computer 1A5
20 Connector 1XA5P7
21 Range computer captive screw (2)
22 Range computer 1A6
23 Connector 1XA6P7
24 Decoder captive screw (2)
25 Decoder 1A3
26 Connector 1XA3P1
27 Connector 1XA3P2
28 Power supply captive screw (4)
29 Power supply 1PS1
30 Connector 1XPSLP1

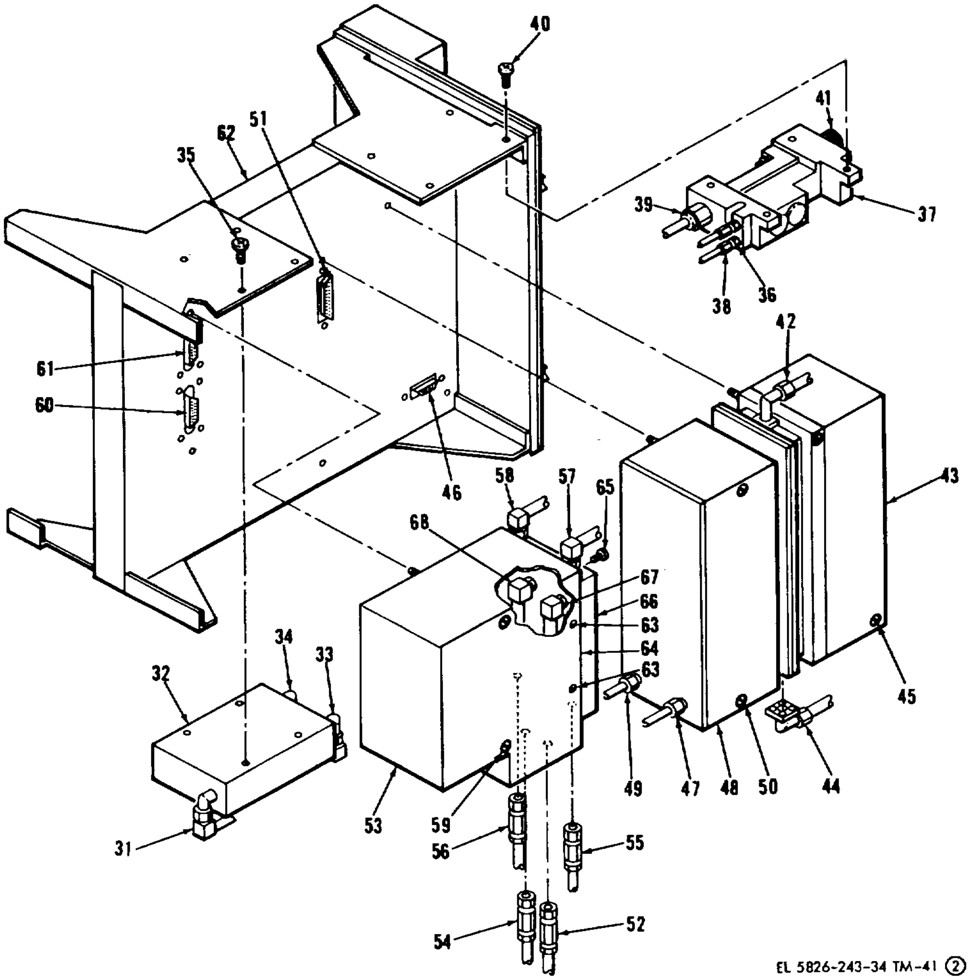


Figure 4-3. (2) Receiver-transmitter parts location
(Sheet 2 of 2)

32 Circulator 1HT1
33 Connector 1W7P2
34 Connector 1W6P1
35 Screw (4)
36 Connector 1W8P1
37 Coupler/filter 1FL1
38 Connector 1W9P1
39 Connector 1W7P1
40 Screw (4)
41 ATENNA connector J1029
42 Connector 1W6P2
43 Power amplifier/modulator 1A1
44 Connector 1W5P1
45 Power amplifier/modulator captive screw (2)
46 Connector 1XA1P1
47 Connector 1W4P1
48 Frequency synthesizer 1A2
49 Connector 1W5P2
51 Connector 1A2P2
52 Connector 1W9P2
53 Self test 1A7
54 Connector 1W8P2
55 Connector 1W4P2
56 Connector 1WlP1
57 Connector 1W2P2
58 Connector 1W3P1
59 Self test captive screw (2)
60 Connector 1XA7P1
61 Connector 1XA7P2
62 Receiver-transmitter chassis assembly
63 Screw (2)
64 Cover
65 Screw (4)
66 Multiplexer 1A7A77
67 Connector 1A7A11P2
68 Connector 1A7A11P1

(1) Remove cover per subparagraph e.

(2) Disengage two decoder captive screws (24, fig. 4-3) by turning each screw counterclockwise a few turns until they both turn freely.

(3) Carefully pull decoder 1A3 (25) straight out from connector 1XA3P1 (26) counter 1XA3P2 (27).

l. Removal of Power Supply 1PS1.

(1) Remove cover per subparagraph e.

(2) Disengage four power supply captive screws (28, fig. 4-3) by turning each screw counterclockwise a few turns until they both turn freely.

(3) Carefully pull power supply 1PS1 (29) straight out from connector 1XPSlP1 (30).

m. Removal of Circulator 1HY1.

(1) Remove cover per subparagraph e.

(2) Disconnect chassis connector 1W3P2 (31, fig. 4-3) from connector 1HYIJ1 on circulator 1HY1 (32).

(3) Disconnect chassis connector 1W7P2 (33) from connector 1HYlJ3 on circulator 1HY1.

(4) Disconnect chassis connector 1W6P1 (34) from connector 1HYiJ2 on circulator IHY1.

(5) Remove and retain four screws (35) that secure circulator 1HY1 to chassis.

(6) Lift circulator 1HY1 straight out from chassis.

n. Removal of Coupler/Filter 1FL1.

(1) Remove cover per subparagraph e.

(2) Disconnect chassis connector 1W8P1 (36, fig. 4-3) from connector 1FLlJ2 on coupler/filter 1FL1 (37).

(3) Disconnect chassis connector 1W9P1 (38) from connector 1FLlJ3 on coupler/filter IFL1.

(4) Disconnect chassis connector 1W7P1 (39) from connector 1FLIJ1 on coupler/filter 1FL1.

(5) Remove and retain four screws, lockwashers, and flat washers (40) that secure coupler/filter 1FL1 to chassis.

(6) Push coupler/filter 1FL1 away from front panel until ANTENNA connector J1029 (41) is disengaged and then lift coupler/filter 1FL1 straight out from chassis.

o. Removal of Power Amplifier/Modulator 1A1

(1) Remove cover per subparagraph e.

(2) Disconnect chassis connector 1W6P2 (42, fig. 4-3) from connector 1AlJ2 on power amplifier/modulator 1A1 (43).

(3) Disconnect chassis connector lW5P1 (44) from connector lAIJ1 on power amplifier/ modulator 1A1.

(4) Disengage two power amplifier/modulator captive screws (45) by turning each screw counterclockwise a few turns until they both turn freely.

(5) Carefully pull power amplifier/modulator 1A1 straight out from connector 1XA1P1 (46).

p. Removal of Frequency Synthesizer 1A2.

(1) Remove cover per subparagraph e.

(2) Disconnect chassis connector 1W4P1 (47, fig. 4-3) from connector 1A2J1 on frequency synthesizer 1A2 (48).

(3) Disconnect chassis connector 1W5P2 (49) from connector 1A2J2 on frequency synthesizer 1A2.

(4) Disengage two frequency synthesizer captive screws (50) by turning each screw counterclockwise a few turns until they both turn freely.

(5) Carefully pull frequency synthesizer 1A2 straight out from connector 1XA2P2 (51).

q. Removal of Self Test 1A7.

(1) Remove cover per subparagraph e.

(2) Disconnect chassis connector 1W9P2 (52, fig. 4-3) from connector 1A7J2 on self test 1A7 (53).

(3) Disconnect chassis connector 1W8P2 (54) from connector 1A7J1 on self test 1A7.

(4) Disconnect chassis connector 1W4P2 (55) from connector 1A7A11J1 on self test 1A7.

(5) Disconnect chassis connector 1W1Pl (56) from connector 1A7A11J2 on self test 1A7.

(6) Disconnect chassis connector 1W2P2 (57' from connector 1A7AllJ4 on self test 1A7.

(7) Disconnect chassis connector 1W3P1 (58, from connector 1A7AllJ3 on self test 1A7.

(8) Disengage two self test captive screws (59) by turning them counterclockwise a few turns until they both turn freely.

(9) Carefully pull self test 1A7 straight out from connector 1XA7P1 (60) and connector 1XA7P2 (61).

NOTE

Do not perform step (10) unless directed to remove multiplexer 1A7A 1 from self test 1A7.

(10) Remove multiplexer 1A7All from self test 1A7 as follows:

(a) Remove and retain two screws (63) that secure cover (64) to self test 1A7 and remove cover.

(b) Remove and retain four screws (65) that secure multiplexer 1A7All (66) to self test 1A7.

(c) Disconnect connector 1A7Y1P2 (67) from multiplexer connector 1A7AllJ5.

(d) Disconnect connector 1A7AllP1 (68) from multiplexer connector 1A7AllJ6.

(e) Separate multiplexer 1A7All from self test 1A7.

r. Removal of Chassis Assembly.

(1) Remove cover per subparagraph e.

(2) Remove blower 1BL from chassis assembly (62, fig. 4-3) per subparagraph f (steps 1 through 5).

(3) Remove receiver 1RE1 from chassis assembly per subparagraph g.

(4) Remove internal control 1A4 from chassis assembly per subparagraph h.

(5) Remove bearing computer' 1A5 from chassis assembly per subparagraph i.

(6) Remove range computer 1A6 from chassis assembly per subparagraph j.

(7) Remove decoder 1A3 from chassis assembly per subparagraph k.

(8) Remove power supply 1PSl from chassis assembly per subparagraph 1.

(9) Remove circulator 1HY1 from chassis assembly per subparagraph m.

(10) Remove coupler/filter 1FL1 from chassis assembly per subparagraph n.

(11) Remove power amplifier/modulator 1A1 from chassis assembly per subparagraph o.

(12) Remove frequency synthesizer 1A2 from chassis assembly per subparagraph p.

(13) Remove self test 1A7 from chassis assembly per subparagraph q.

s. Removal of TTM Indicator DS5.

(1) Remove cover per subparagraph e.

(2) Remove blower 1Bl from chassis assembly per subparagraph f (steps 1 through 5).

(3) Remove power supply 1PS1 from chassis assembly per subparagraph 1.

(4) Remove the two retaining screws and washers securing DS5 to front panel.

(5) Push DS5 back until it is free from the front panel.

(6) Tag and unsolder wiring to DS5.

(7) Remove DS5 from chassis assembly.

t. Removal of Magnetic Latching FAULT Indicators DS1 through DS4.

(1) Remove cover per subparagraph e.

(2) Remove blower 1B1 from chassis assembly per subparagraph f (steps I through 5).

(3) Remove power supply 1PSI from chassis assembly per subparagraph 1.

(4) Tag and unsolder wiring to indicator.

(5) Remove nut and lockwasher securing indicator to front panel.

(6) Pull indicator back from panel.

(7) Remove indicator from chassis assembly.

4-7. Replacement Procedures

Each module or assembly replacement procedure is completely self-contained. To replace a module, assembly, or component part, go directly to the subparagraph for that particular unit.

NOTE

If mounting adapter is not required, skip paragraph 4-7a.

a. Installation of Receiver-Transmitter/Converter On Mounting Adapter.

(1) Slide the receiver-transmitter/converter onto mounting adapter (2, fig. 4-2) and mate the converter connector (10) to the adapter connector.

(2) Secure the receiver-transmitter/converter with two knurled nuts (1) located on the front of the receiver-transmitter.

b. Installation of Adapter Connector.

(1) Install adapter connector (3, fig. 4-2) on mounting adapter (2).

(2) Secure adapter connector to mounting adapter with two screws (12) and four screws (11).

(3) Install receiver-transmitter/converter per subparagraph a.

c. Installation of Mounting Adapter Isolators.

(1) Install isolator (13, fig. 4-2) in position under mounting adapter (2).

(2) Secure isolator to mounting adapter with screw and washer.

(3) Install receiver-transmitter/co nverter per subparagraph a.

d. Installation of Receiver-Transmitter to Converter.

(1) Carefully mate the receiver-transmitter (6, fig. 4-2) to the converter (5) taking care not to damage the pins on the electrical connectors.

(2) Secure the converter (5) to the receiver-transmitter (6) with two screws (4).

(3) Install the receiver-transmitter (6) on mounting adapter (2) per subparagraph a.

e. Installation of Receiver-Transmitter Cover.

(1) Slide cover (9, fig. 4-2) over receiver-transmitter.

(2) Secure with two captive screws (8).

(3) Mate converter and receiver-transmitter per subparagraph d.

(4) Install receiver-transmitter/converter on mounting adapter per subparagraph a.

f. Installation of Blower 1B1.

(1) Install shroud (8, fig. 4-3) on blower 1B1 (5).

(2) Install and tighten two setscrews (7) that secure shroud to blower 1B1.

(3) Install blower 1B1 into chassis and position blower flanges into clamps (6).

(4) Install and tighten four screws (4) that secure blower 1B1 (5) to chassis.

(5) Carefully push blower connector 1B1Pl (2) onto chassis connector 1J2 (3). Do not force connector 1B1Pl. If connector 1B1Pl cannot be easily installed, remove it and check to see if it is : correctly aligned or if there are any bent pins.

(6) Secure connector lB1Pl with two jackscrews (1) by turning each jackscrew a few turns clockwise until they are finger tight.

(7) Install cover per subparagraph e.

g. Installation of Receiver IRE1.

(1) Note orientation of connector 1REIPI and connector IRE 1P2 on receiver 1RE1 (10, fig. (4-3) and connector 1SREIPl (13) and connector 1XREIP2 (14) on chassis assembly (62).

(2) Carefully push receiver 1RE1 onto connector 1XREIP1 and connector 1XREIP2. Do not force receiver. If receiver cannot be easily installed, remove it and check to see if it is correctly aligned or if there are any bent connector pins.

(3) Secure receiver with two captive screws (12) by turning each screw clockwise a few turns until they are finger tight.

(4) Connect chassis connector 1W1P2 (11) to connector 1REIJ5 on receiver.

(5) Connect chassis connection 1W2PI (9) to connector 1REIJl on receiver.

(6) Check dynamic performance parameters per maximum performance adjustment procedures in paragraph 4-9.

(7) Install cover per subparagraph e.

h. Installation in Internal Control 1A4.

(1) Note orientation of connector 1A4Pl on internal control 1A4 (16, fig. 4-3) and connector 1XA4P1 (17) on chassis assembly (62).

(2) Carefully push internal control 1A4 onto connector 1XA4P1. Do not force internal control. If internal control cannot be easily installed, remove it and check to see if it is correctly aligned or if there are any bent connector pins.

(3) Secure internal control with two captive screws (15) by turning each screw clockwise a few turns until they are finger tight.

(4) Check dynamic performance parameters per maximum performance adjustment procedures in paragraph 4-9.

(5) Install cover per subparagraph e.

i. Installation of Bearing Computer 1A5.

(1) Note orientation of connector lA5Pi on bearing computer 1A5 (19, fig. 4-3) and connector 1XA5PI (20) on chassis assembly (62).

(2) Carefully push bearing computer 1A5 onto connector 1XA5PI. Do not force bearing computer. If bearing computer cannot be easily installed, remove it and check to see if it is correctly aligned or if there are any bent connector pins.

(3) Secure bearing computer with two captive screws (18) by turning each screw clockwise a few turns until they are finger tight.

(4) Check dynamic performance parameters per maximum performance adjustment procedures in paragraph 4-9.

(5) Install cover per subparagraph e.

j. Installation of Range Computer 1A6.

(1) Note orientation of connector 1A6P1 on range computer 1A6 (22, fig. 4-3) and connector 1XA6P1 (23) on chassis assembly (62).

(2) Carefully push range computer 1A6 onto connector 1XA6P1. Do not force range computer. If range computer cannot be easily installed, remove it and check to see if it is correctly aligned or if there are any bent connector pins.

(3) Secure range computer with two captive screws (21) by turning each screw clockwise a few turns until they are finger tight.

(4) Check dynamic performance parameters per maximum performance adjustment procedures in paragraph 4-9.

(5) Install cover per subparagraph e.

k. Installation of Decoder 1A3.

(1) Note orientation of connector 1A3P1 and connector 1A3P2 on decoder 1A3 (25, fig. 4-3), and connector IXA3Pl (26) and connector 1SA3P2 (27) on chassis assembly (62).

(2) Carefully push decoder 1A3 onto connector 1XA3P1 and connector 1XA3P2. Do not force decoder. If decoder cannot be easily installed, remove it and check to see if it is correctly aligned or if there are any bent connector pins.

(3) Secure decoder with two captive screws (24) by turning each screw clockwise a few turns until they are finger tight.

(4) Check dynamic performance parameters per maximum performance adjustment procedures in paragraph 4-9.

(5) Install cover per subparagraph e.

l. Installation of Power Supply IPSI.

(1) Note orientation of connector 1PSIP1 on power supply 1PS1 (29, fig. 4-3) and connector 1XPSIP1 (30) on chassis assembly (62).

(2) Carefully push power supply 1PS1 onto connector 1XPSIP1. Do not force power supply. If power supply cannot be easily installed, remove it and check to see if it is correctly aligned or if there are any bent connector pins.

(3) Secure power supply with two captive

screws (28) by turning each screw clockwise a few turns until they are finger tight.

(4) Install cover per subparagraph e.

m. Installation of Circulator 1HY1.

(1) Install circulator 1HY1 (32, fig. 4-3) onto chassis assembly (62).

(2) Install and tighten four screws (35) that secure circulator 1HY1 to chassis assembly.

(3) Connect chassis connector 1W6P1 (34) to connector 1HYlJ2 on circulator.

(4) Connector chassis connector 1W7P2 (33) to connector 1HYlJ3 on circulator.

(5) Connect chassis connector lW3P2 (31) to connector 1HYIJ1 on circulator.

(6) Install cover per subparagraph e.

n. Installation of Coupler/Filter IFLI.

(1) Install coupler/filter IFLI (37, fig. 4-3) onto chassis assembly (62). Insure ANTENNA connector J1029 (41) protrudes from front panel hole.

(2) Install and tighten four screws, lock washers, and flat washers (40) that secure coupler/filter 1FL1 to chasis assembly.

(3) Connect chassis connector 1W7P1 (39) to connector IFLIJ1 on coupler/filter.

(4) Connect chassis connector lW9P1 (38) to connector 1FLIJ3 on coupler/filter.

(5) Connect chassis connector 1W8P1 (36) to connector 1FL2J2 on coupler/filter.

(6) Install cover per subparagraph e.

o. Installation of Power Amplifier/Modulator 1A1.

(1) Note orientation of connector 1A1P1 on power amplifier/modulator (43, fig. 4-3) and connector 1XA1P1 (46) on chassis assembly (62).

(2) Carefully push power amplifier/ modulator 1A1 onto connector 1XAlPl. Do not force power amplifier/modulator. If power amplifier/modulator cannot be easily installed, remove it and check to see if it is correctly aligned or if there are any bent connector pins.

(3) Secure power amplifier/modulator with two captive screws (45) by turning each screw clockwise a few turns until they are finger tight.

(4) Connect chassis connector lW5P1 (44) to connector lAlJ1 on power amplifier/modulator.

(5) Connect chassis connector lW6P2 (42) to connector 1AlJ2 on power amplifier/modulator.

(6) Install cover per subparagraph e.

p. Installation of Frequency Synthesizer 1A2.

(1) Note orientation of connector 1A2P2 on frequency synthesizer 1A2 (48, fig. 43) and connector 1XA2P2 (51) on chassis assembly (62).

(2) Carefully push frequency synthesizer 1A2 onto connector 1XA1P2. Do not force frequency synthesizer. If frequency synthesizer cannot be easily installed, remove it and check to see if it is correctly aligned or if there are any bent connector pins.

(3) Secure frequency synthesizer with two captive screws (50) by turning each screw clockwise a few turns until they are finger tight.

(4) Connect chassis connector 1W5P2 (49) to connector 1A2J2 on frequency synthesizer.

(5) Connect chassis connector 1W4P1 (47) to connector 1A2J1 on frequency synthesizer.

(6) Install cover per subparagraph e.

q. Installation of Self Test 1A7.

NOTE

Skip step (1) if multiplexer 1A7A11 is installed on self test 1A7.

(1) Install multiplexer 1A7All on self test 1A7 as follows:

(a) Install multiplexer 1A7All11 (66, fig.(4-3) into position on self test 1A7 (53).

(b) Connect connector 1A7A1OP1 (68) on multiplexer connector 1A7A11J6.

(c) Connect connector 1A7Y1P2 (67) on multiplexer connector 1A7A11J5.

(d) Secure multiplexer 1A7All to self test 1A7 with four screws (65).

(e) Install cover (64) on self test 1A7 and secure with two screws (63).

(2) Note orientation of connector 1A7P1 an(connector 1A7P2 on self test 1A7 (53, fig. 4-3), and connector 1XA7P1 (60) and connector 1XA7P2 (61) on chassis assembly (62).

(3) Carefully push self test 1A7 onto connector 1XA7P1 and connector 1XA7P2. Do not force self test. If self test cannot be easily installed, remove it and check to see if it is correctly aligned or if there are any bent connector pins.

(4) Secure self test with two captive screws (59) by turning each screw clockwise a few turns until they are finger tight.

(5) Connect chassis connector 1W3P1 (58) to connector 1A7A11J3 on self test.

(6) Connect chassis connector 1W2P2 (57) to connector 1A7A11J4 on self test.

(7) Connect chassis connector 1W1Pl (56) to connector 1A7A11J2 on self test.

(8) Connect chassis connector 1W4P2 (55) to connector 1A7A11J1 on self test.

(9) Connect chassis connector 1WSP2 (54) to connector 1A7J1 on self test.

(10) Connect chassis connector 1W9P2 (52) to connector 1A7J2 on self test.

(11) Check dynamic performance parameters per maximum performance adjustment procedures in paragraph 4-9.

(12) Install cover per subparagraph e.

r. Installation of Chassis Assembly.

(1) Install blower lBI onto chassis assembly (62, fig. 1-3) per subparagraph f.

(2) Install receiver IRE1 onto chassis assembly per subparagraph g.

(3) Install internal control 1A4 onto chassis assembly per subparagraph h.

(4) Install bearing computer 1A5 onto chassis assembly per subparagraph i.

(5) Install range computer 1A6 onto chassis assembly per subparagraph j.

(6) Install decoder 1A3 onto chassis assembly per subparagraph k.

(7) Install power supply 1PS1 onto chassis assembly per subparagraph 1.

(8) Install circulator 1HY1 onto chassis assembly per subparagraph n.

(9) Install coupler/filter]FL1 onto chassis assembly per subparagraph n.

(10) Install power amplifier/modulator 1A1 onto chassis assembly per subparagraph o.

(11) Install frequency synthesizer 1A2 onto chassis assembly per subparagraph p.

(12) Install self test 1A7 onto chassis assembly per subparagraph q.

(13) Install cover per subparagraph e.

s. Installation TTM indicator DS5.

(1) Resolder wiring to terminals on DS5.

(2) Install DS5 in position through rear of front panel.

(3) Secure DS5 to front panel with two retaining screws and washers.

(4) Install power supply IPS1 in chassis assembly per subparagraph 1.

(5) Install blower 1B1 in chassis assembly per subparagraph f(steps 3 through 7).

t. Installation of Magynetic Latching FAULT Indicators DS1 through DS5.

(1) Insert indicator in position through back of front panel.

(2) Secure indicator to chassis with retaining nut and lockwasher.

(3) Resolder wiring to indicator.

(4) Install power supply 1PS1 in chassis assembly per subparagraph 1.

(5) Install blower 1BI in chassis assembly per subparagraph f (steps 3 through 7).

4-8. Course Centering and Width Adjustments

a. Hook up equipment per figure 44.

b. Set controls and switches on test equipment per table 4-2.

c. Adjust CDI COURSE SET control for 360 on COURSE indicator.

d. Adjust receiver-transmitter CENTER potentiometer (fig. 4-5) until CDI vertical deviation indicator is centered.

e. Set beacon simulator BEARING control to 350.0.

f. Adjust receiver-transmitter WIDTH potentiometer (fig. 4-5) until CDI vertical deviation indicator is centered over second left dot.

g. Repeat steps b through f several times to insure indications do not drift h. Set beacon simulator BEARING control to 360.0.

i. Verify that CDI TO indicator is visible.

j. Repeat steps c and d..

k. Set beacon simulator BEARING control to 370.0.

l. Adjust receiver-transmitter WIDTH potentiometer until CDI vertical deviation indicator is centered over second right dot.

m. Repeat steps b, c, d, i, and k several times to insure indications do not drift.

n. Set beacon simulator BEARING control to 180.0.

o. Verify that CDI FROM indicator is visible.

4-9. Maximum Performance Adjustments

Adjustments to any replaced modules or assemblies are not necessary to ensure an operational TACAN. However, to achieve maximum performance and accuracy above operational requirements, the following adjustments should be made when these modules are removed and replaced. Use an insulated screwdriver (GFD 5284 or equivalent) to make the adjustments.

Module replaced	Maximum Performance Adjustments	Paragraph
Range computer	Range zero	4-9a
Bearing computer	Bearing Zero	4-9b
Decoder	A/A delay	4-9c
	Range zero	4-9a
Receiver	YIG tuning	4-9d
	Range zero	4-9a
	A/A delay	4-9c
Internal Control	YJG tuning	4-9d
Self Test	Self test adj.	4-9e

a. *Range Zero Adjustment*

(1) Remove converter from receiver transmitter (para 4-6(C(l), (2), and (3).

(2) Remove cover from receiver transmitter.

(3) Install converter on receiver transmitter (para 4-7a(2), (3), and (4)).

(4) Hook up equipment per figure 4-4.

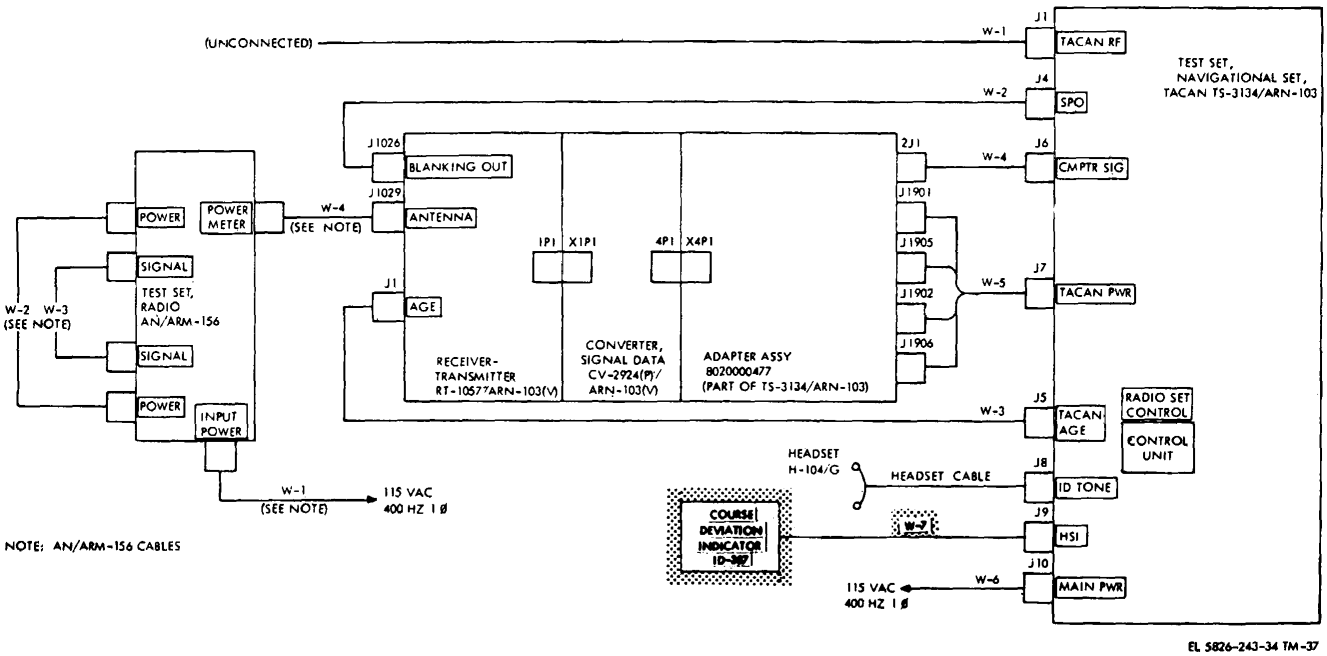


Figure 4-4. Receiver-transmitter/converter bench test and adjustment setup.

Table 4-2. Initial Control Settings for Adjustments

Control	Position
BEACON SIMULATOR AN/ARM-156	
RF UNIT	
SELECT	1
OUTPUT ATTENUATOR	060
RISE TIME	2.5 is
PULSE MOD	2
CHANNEL SELECT	064
VIDEO UNIT	
SELECT A	1
SELECT B	3
MODE	G/A X
MAIN BURST	ON
AUX BURST	ON
N REF TRIG	OFF
SQUITTER RATE X100	27
BEARING	000.0
BEARING RATE	OFF 00
% MOD 15HZ	ON 20
% MOD 135HZ	ON 20
PHASE SHIFT 15HZ	OFF 00.0
ANT SP (% 15HZ RPS)	OFF 0.00
RANGE	030.0
RANGE RATE X100	OFF 00
REPLY EFF X10%	9
A/A PRF	0000
DEAD TIME	ON
SYNC SELECT	I
ID TONE	ON
PULSE SPACING	NOM 0.0
PRGM	I
LEVEL(-dbm)	-77
POWER	ON

Control	Position
TEST SET T3134	
TEST SET	
DISPLAY SELECT	BEARING
115 VAC ON/OFF	ON
RADIO SET CONTROL	
CHANnel	64
MODE X/Y	X
Operation mode	T/R
VOLume	Mid-position

(5) Set controls and switches on test equipment per table 4-1.

(6) Verify that blower operates.

(7) Wait 90 seconds and verify that beacon simulator DISPLAY B is 0 degrees and audio tone is present on headset.

(8) Set beacon simulator ID TONE switch to OFF.

(9) Set test set DISPLAY SELECT switch to RANGE.

(10) Verify test set RANGE display lamps indicate 30.0 +0.25 nautical miles. If not, scrape RTV coating from RANGE ZERO potentiometer (fig. 4-5) and adjust potentiometer until test set' RANGE display lamps indicate 30.0 +0.25 nautical miles.

(11) Set test set RADIO SET CONTROL operation mode switch to OFF.

(12) Coat adjustment potentiometer with RTV.

(13) Remove converter from receiver-transmitter.

(14) Install cover on' receiver-transmitter.

(15) Install converter on receiver-transmitter.

b. Bearing Zero Adjustment.

(1) Perform steps (1) through (8) of paragraph 4-9a.

(2) Set test set DISPLAY SELECT switch to BEARING.

(3) Verify test set BEARING display lamps indicate 0.0' +0.5 degrees. If not, scrape-RTV coating from BEARING ZERO potentiometer (figure 4-5) and adjust potentiometer until test set BEARING display lamps indicate 0.0 ±0.5 degrees.

(4) Perform steps (11) through (15) of paragraph 4-9a.

c. A/A Delay Adjustment.

(1) Perform steps (1) through (8) of paragraph 4-9a.

(2) Set test set RADIO SET CONTROL operation mode select switch to REC.

(3) Connect oscilloscope CHANNEL A input to beacon simulator TRANS PULSE jack; connect oscilloscope TRIGGER INPUT jack; con

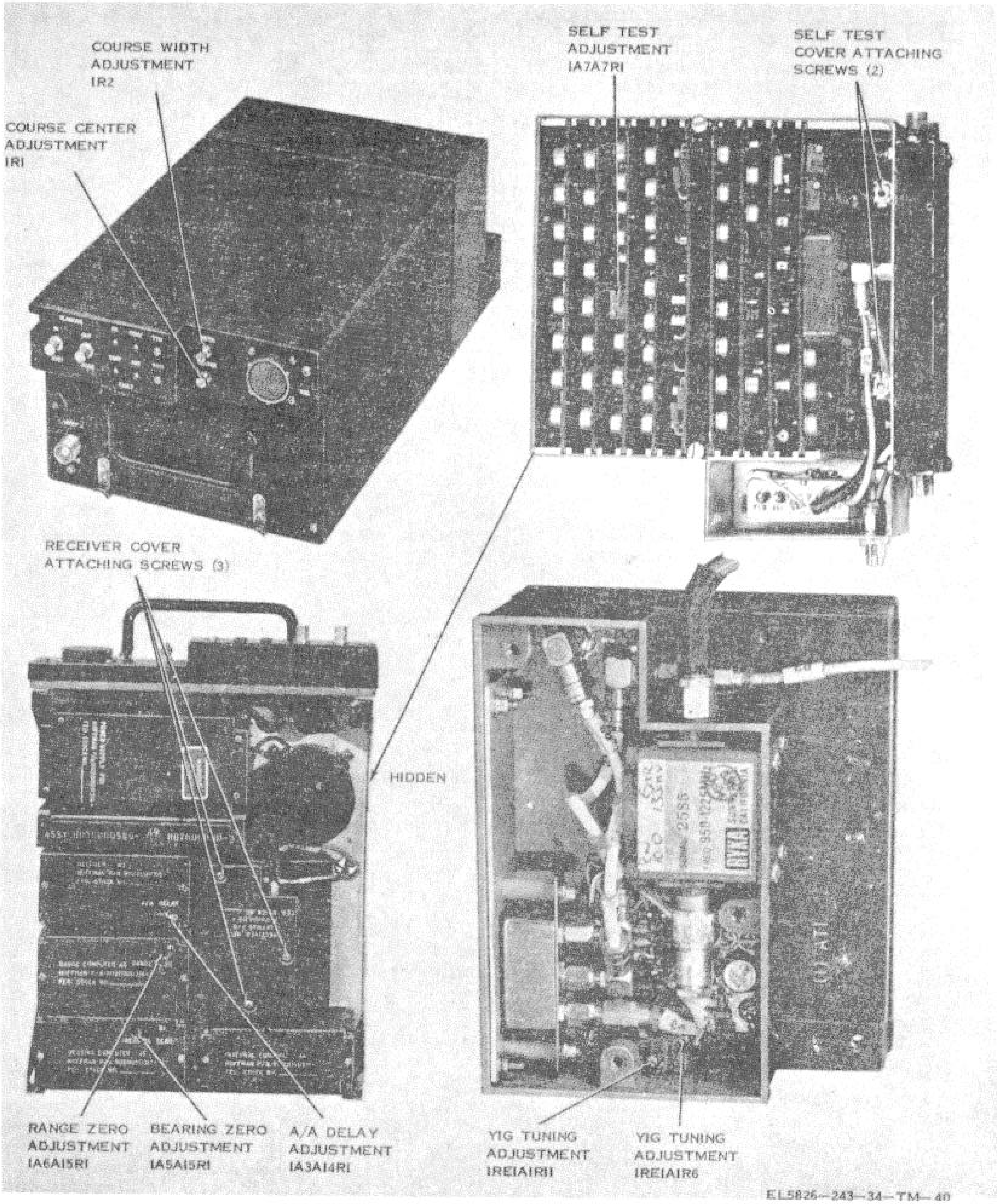


Figure 4-5. Location of adjustments on Receiver-transmitter

nect oscilloscope TRIGGER INPUT jack to beacon simulator SYNC jack.

(4) Set controls and switches on beacon simulator as follows:

Control	*Position*
CHANNEL SELECT	001
DISPLAY SELECT A	7
DISPLAY SELECT B	8
MODE	A/A X
% MOD 15 HZ	ON 00
% MOD 135 HZ	On 00
A/A PRF	0200
RANGE	000.0

(5) Set test set RADIO SET CONTROL operation mode switch to A/A.

(6) Verify beacon simulator DISPLAY B indicates 62.0 +0.3 microseconds. If not, scrape RTV coating from A/A DELAY potentiometer (fig. 4-5) and adjust potentiometer until beacon simulator DISPLAY B indicates 62.0 +0.3 microseconds.

(7) Perform steps (11) through (15) of paragraph 4-9a.

d. YIG Tuning Adjustments.

(1) Perform steps (1) through (7) of paragraph 4-9a.

(2) Remove cover from receiver 1RE1.

(3) Set beacon simulator CHANNEL SELECT switch to 001 and OUTPUT ATTENUATOR control to 093.

(4) Set test set RADIO SET CONTROL CHANnel switches to 1.

(5) Verify presence of audio tone on headset. If audio tone is not present or is cracking, adjust YIG tuning potentiometer R6 (fig. 4-5) until audio is present on headset.

(6) Set beacon simulator CHANNEL SELECT switch to 064.

(7) Set test set RADIO SET CONTROL CHANnel switches to 064.

(8) Verify presence of audio tone on headset. If audio tone is not present or is cracking, adjust YIG tuning potentiometer R11 (fig. 4-5) until audio is present on headset.

(9) Set beacon simulator CHANNEL SELECT switch to 063.

(10) Set test set RADIO SET CONTROL CHANnel switches to 63.

(11) Verify presence of audio tone on headset. If audio tone is not present or is cracking, adjust YIG tuning potentiometer R6 until audio tone is present on headset.

(12) Set beacon simulator CHANNEL SELECT switch to 126.

(13) Set test set RADIO SET CONTROL CHANnel switches to 126.

(14) Verify presence of audio tone on headset. If audio tone is not present or is cracking, adjust YIG tuning potentiometer R11 until audio tone is present on headset.

(15) Repeat steps c through n several times to verify that audio tone is present on all channels tested.

(16) Install cover on receiver 1RE1.

(17) Perform steps (11) through (15) of paragraph 4-9a.

e. Self Test Adjustment.

(1) Perform steps a through h of paragraph 4-10.

(2) Connect test set RF cable W-1 between TACAN RF connector J1 on test set and ANTENNA connector J1029 on navigational set.

(3) Set test set DISPLAY SELECT switch to RANGE.

(4) Press test set SELF TEST HOLD/SELF TEST RELEASE switch and verify that SELF TEST HOLD indicator illuminates.' If SELF TEST HOLD indicator is extinguished, press switch again.

(5) Remove cover from self test.

(6) Verify test set RANGE display lamps indicate between 0.025 and 0.175 nautical miles. If not, adjust potentiometer A7R1 (fig. 4-5) until test set RANGE display lamps indicate between 0.025 and 0.175 nautical miles.

(7) install cover on self test.

(8) Perform steps (11) through (15) of paragraph 4-9a.

Section IV. MAINTENANCE OF CONVERTER

4-10. General

This section contains repair procedures for the converter. The procedures consist of removal and replacement of modules and assemblies. No adjustments are required after replacement.

NOTE

If the converter nameplate states "COMPATIBLE WITH AN/ASN-86," then the converter contains an interface and a buffer, and is the AN/ARN-103 (V)1 configuration. If the nameplate states "NOT COMPATIBLE WITH AN/ASN-86," then the converter contains a signal distribution adapter in place of the interface and buffer, and is the AN/ARN-103(V)2 configuration.

4-11. Removal Procedures

Each module or assembly removal procedure is completely self-contained. To remove a module or assembly, go directly to the subparagraph for that particular unit.

a. Removal of Cover.

(1) Remove and retain four screws, lockwashers, and flat washers (1, fig. 4-6) that secure module compartment cover (2) to converter chassis assembly (18).

(2) Lift off cover.

b. Removal of Range Coupler 4DC2.

(1) Remove cover per subparagraph a.

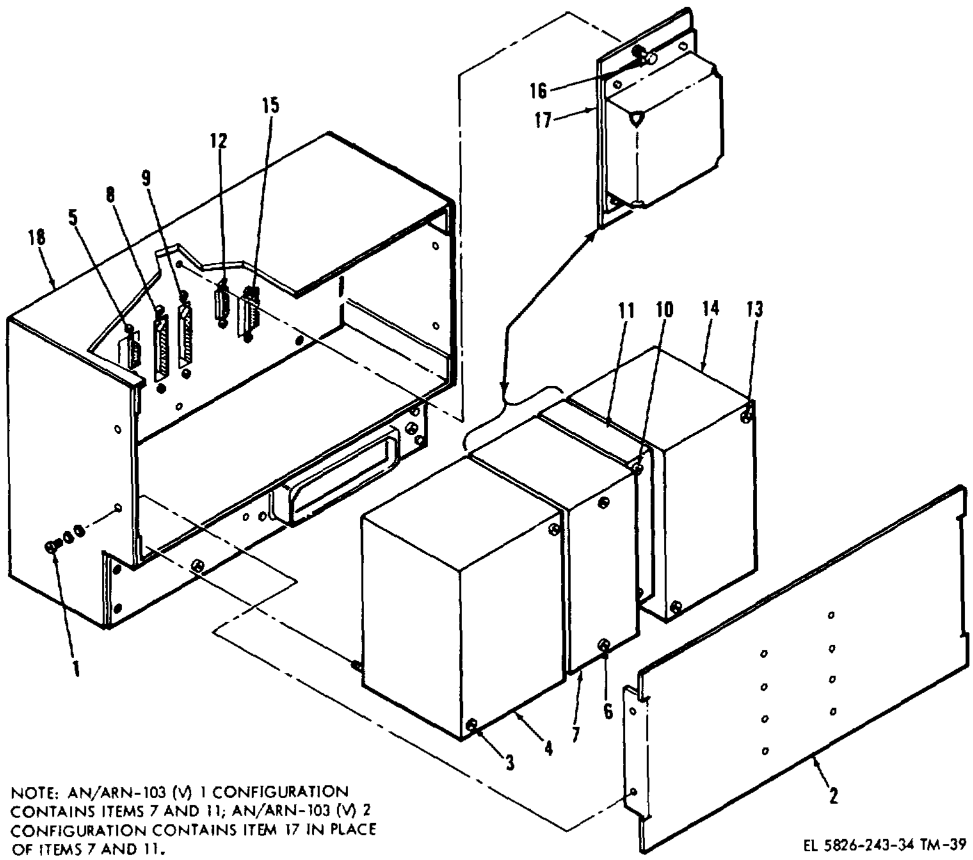
(2) Disengage two range coupler mounting studs (3) by turning each stud counterclockwise a few turns until they both turn freely.

(3) Carefully pull range coupler 4DC2 (4) straight out from connector 4XDC2P1 (5).

c. Removal of Interface 4A3 (AN/ARN103(V)1 Configuration).

(1) Remove cover per subparagraph a.

(2) Disengage two interface captive mounting screws (6) by turning each screw counterclockwise a few turns until they both turn freely.



1 Screw (4)
2 Module compartment cover
3 Range coupler mounting stud (2)
4 Range coupler 4DC2
5 Connector 4XDC2P7
6 Interface captive mounting-screw (2)
7 Interface 4A3
8 Connector 4XA3P1A
9 Connector 4XA3P1B
10 Buffer captive mounting screw (2)
11 Buffer 4A1
12 Connector 4XA1P1
13 Bearing coupler mounting stud (2)
14 Bearing coupler 4DC1
15 Connector 4XDC1Pl
16 Adapter captive screw (2)
17 Signal distribution adapter
18 Converter chassis assembly

Figure 4-6. Converter parts location.

(3) Carefully pull interface 4A3 (7) straight out from connectors 4XA3P1A (8) and 4XA3P1B (9).

d. Removal of Buffer 4A1 (AN/ARN-1OS(V)1 Configuration).

(1) Remove cover per subparagraph a.

(2) Disengage two buffer captive mounting screws (10) by turning each screw counterclockwise a few turns until they both turn freely.

(3) Carefully pull buffer 4A1 (11) straight out from connector 4XAIP1 (12).

e. Removal of Bearing Coupler 4DC1.

(1) Remove cover per subparagraph a.

(2) Disengage two bearing coupler mounting studs (13) by turning each stud counterclockwise a few turns until they both turn freely.

(3) Carefully pull bearing coupler 4DC1 (14) straight out from connector 4XDClP1 (15).

f. Removal of Signal Distribution Adapter (AN/ARN-103(V)2 Configuration.

(1) Remove cover per subparagraph a.

(2) Disengage two adapter captive screws (16) by turning each screw counterclockwise a few turns until they both turn freely.

(3) Pull signal distribution adapter (17) straight out from connector 4XA3P1B (9).

g. Removal of Chassis Assembly (AN/ARN103(V)l Configuration.

(1) Remove cover per subparagraph a.

(2) Remove range coupler 4DC2 from chassis assembly (18, fig. 4-6) per subparagraph b.

(3) Remove interface 4A3 from chassis assembly per subparagraph c.

(4) Remove buffer 4A1 from chassis assembly per subparagraph d.

(5) Remove bearing coupler 4DC1 from chassis assembly per subparagraph e.

h. Removal of Chassis Assembly (AN/ARN103(V)2 Configuration).

(1) Remove cover per subparagraph a.

(2) Remove range coupler 4DC2 from chassis assembly (18, fig. 4-6) per subparagraph b.

(3) Remove bearing coupler 4DC1 from chassis assembly per subparagraph e.

(4) Remove signal distribution adapter from chassis assembly per subparagraph f.

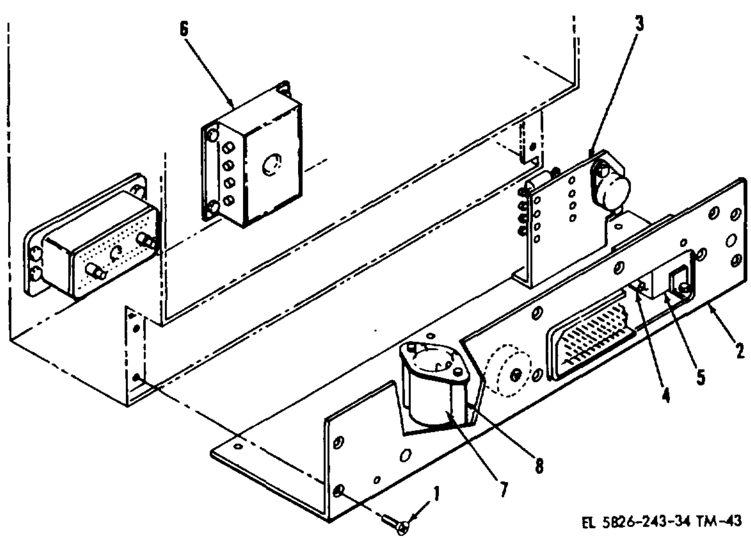
i. Removal of Parts from Chassis Assembly.

(1) Removal of Electronic Component Subassembly 4A2.

(a) Remove 12 screws (1, fig. 4-7) and pull out lower cover (2) for access to electronic component subassembly 4A2 (3).

(b) Note wire colors and terminal connections on terminals of subassembly 4A2. Then remove conformal coating, and tag and unsolder wires from terminals.

(c) Remove two screws, nuts, lockwashers, and four flat washers (not shown) and remove subassembly 4A2 from lower cover (2).



1 Screw (12)
2 Lower cover
3 Electronic component subassembly 4A2
4 Diode 4CR1
5 Relay 4K1
6 Filter 4FL1
7 Transformer 4T1
8 Spacer (2)

Figure 4-7. Converter chassis assembly parts location

(2) Removal of Diode 4CR1.

(a) Remove 12 screws (1, fig. 4-7) and pull out lower cover (2) for access to diode 4CR1 (4).

(b) Remove conformal coating, and tag and unsolder diode 4CR1 leads from terminals 6 and 7 of relay 4K1 (5)

(3) Removal of Relay 4K1.

(a) Remove diode 4CR1 per subparagraph (2).

(b) Note wire colors and terminal connections on terminals of relay 4K1, (5, fig. 4-7). Then remove conformal coating, and tag and unsolder remaining leads from terminals.

(c) Remove two screws and flat washers, relay 4K1, and flat insulator.

(4) Removal of Filter 4FL1.

(a) Remove 12 screws (1, fig. 4-7) and pull out lower cover (2) for access to filter 4FL1 (6).

(b) Note wire colors and terminal connections on terminals of filter 4FL1. The remove conformal coating, and tag and unsolder leads from terminals.

(c) Remove four screws from bottom of filter 4FL1.

(5) Removal of Transformer 4T1.

(a) Remove 12 screws (1, fig. 4-7) and pull out lower cover (2) for access to transformer 4T1 (7).

(b) Note terminal connections of transformer 4T1. Then remove conformal coating, tag, and unsolder wires from terminals.

NOTE

It may be necessary to hold the two spacers (8) to prevent them from turning during the next step. The spacers should be left in place.

(c) Remove two screws, lock washers, and flat washers (not shown) and remove transformer 4T1.

4-12. Replacement Procedures

Each module or assembly replacement procedure is completely self-contained. To replace a module or assembly, go directly to the subparagraph for that particular unit.

a. Installation of Cover.

(1) Place cover (2, fig. 4-6) over module compartment.

(2) Install and tighten four screws, lockwashers, and flat washers (1) that secure cover to converter.

b. Installation of Range Coupler 4DC2.

(1) Note orientation of connector 4DC2P1 on range coupler 4DC2 (4, fig. 4-6) and connector 4XDC2P1 (5) on chassis assembly (18).

(2) Carefully push range coupler 4DC2 onto connector 4XDC2P1. Do not force range coupler. If range coupler cannot be easily installed, remove it and check to see if it is correctly aligned or if there are any bent connector pins.

(3) Secure range coupler with two mounting studs (3) by turning each stud clockwise a few turns until they are finger tight.

(4) Install cover per subparagraph a.

c. Installation of Interface 4A3 (AN/ARN103(V)1 Configuration).

(1) Note orientation of connectors 4A3P1A and 4A3P1B on interface 4A3 (7, fig. 4-6) and connectors 4XA3P1A (8) and 4XA3P1B (9) on chassis assembly (18).

(2) Carefully push interface 4A3 onto connectors 4XA3P1A and 4XA3P1B. Do not force interface. If interface cannot be easily installed, remove it and check to see if it is correctly aligned or if there are any bent connector pins.

(3) Secure interface with two captive mounting screws (6) by turning each screw clockwise a few turns until they are finger tight.

(4) Install cover per subparagraph a.

d. Installation of Buffer 4A1 (AN/ARN103(V)1 Configuration).

(1) Note orientation of connector 4AlP1 on buffer 4A1 (11, fig. 4-6) and connector 4XA1P1 (12) on chassis assembly (18).

(2) Carefully push buffer 4A1 onto connector 4XAlP1. Do not force buffer. If buffer cannot be easily installed, remove it and check to see if it is correctly aligned or if there are any bent connector pins.

(3) Secure buffer with two captive mounting screws (10) by turning each screw clockwise a few turns until they are finger tight.

(4) Install cover per subparagraph a.

e. Installation of Bearing Coupler 4DC1.

(1) Note orientation of connector 4DClP1 on bearing coupler (14, fig. 4-6) and connector 4XDC1P1 (15) on chassis assembly (18).

(2) Carefully push bearing coupler 4DC1 onto connector 4XDClP1. Do not force bearing coupler. If bearing coupler cannot be easily installed, remove it and check to see if it is correctly aligned or if there are any bent connector pins.

(3) Secure bearing coupler with two mounting studs (13) by turning each stud clockwise a few turns until they are finger tight.

(4) Install cover per subparagraph a.

f. Installation of Signal Distribution Adapter (ANIARN-103(V)2 Configuration.

(1) Note orientation of connector 4A3P1B on signal distribution adapter (17, fig. 4-6) and

connector 4XA3P1B (9) on chassis assembly (18).

(2) Carefully push signal distribution adapter onto connector 4XA3P1B. Do not force adapter. If adapter cannot be easily installed, remove it and check to see if it is correctly aligned or if there are any bent connector pins.

(3) Secure adapter with two captive screws (16) by turning each screw clockwise a few turns until they are finger tight.

(4) Install cover per subparagraph a.

g. Installation of Chassis Assembly (AN/ARN-10o(V)1 Configuration).

(1) Install range coupler 4DC2 onto chassis assembly (18, fig. 4-6) per subparagraph b.

(2) Install interface 4A3 onto chassis assembly per subparagraph c.

(3) Install buffer 4A1 onto chassis assembly per subparagraph d.

(4) Install bearing coupler 4DC1 onto chassis assembly per subparagraph e.

(5) Install cover per subparagraph a.

h. Installation of Chassis Assembly (ANI ARN-103(V)2 Configuration).

(1) Install range coupler 4A3 onto chassis assembly (18, fig. 4-6) per subparagraph b.

(2) Install bearing coupler 4DC1 onto chassis assembly per subparagraph e.

(3) Install signal distribution adapter onto 'chassis assembly per subparagraph f.

(4) Install cover per subparagraph a.

i. Replacement of parts on Chassis Assembly.

(1) Replacement of Electronic Component Subassembly 4A2.

TM 11-5826243-34 (a) Install subassembly 4A2 (3, fig. 4-7) in position on converter chassis (5).

(b) Resolder wiring to terminals.

(c) Install lower cover (2) and secure with 12 screws (1).

(2) Replacement of Diode 4CR1.

(a) Set diode 4CR1 (4, fig. 4-7) in position.

(b) Resolder leads to terminals 6 and 7 of relay 4K1 (5).

(c) Install lower cover (2) and secure with 12 screws (1).

(3) Replacement of Relay 4K1.

(a) Install relay 4K1 (5, fig. 4-7) in position.

(b) Secure with two screws and flatwashers.

(c) Resolder wires to terminals on relay.

(d) Replace diode 4CR1 (4) per subparagraph (2).

(4) Replacement of Filter 4FL1.

(a) Resolder wiring to terminals of filter 4FL1 (6, fig. 4-7).

(b) Install filter 4FL1 in position and secure with four screws.

(c) Install lower cover (2) and secure with 12 screws (1).

(5) Replacement of Transformer 4T1.

(a) Install transformer 4T1 (7, fig. 4-7) in position on spacers (8).

(b) Secure with two screws, lock washers, and flatwashers.

(c) Resolder wires to terminals.

(d) Install lower cover (2) and secure with 12 screws (1).

Section V. GENERAL SUPPORT TESTING PROCEDURES

4-13. General

a. Testing procedures are used by Signal Field Maintenance Shops and Signal Service Organizations responsible for general support maintenance to establish specific requirements that repaired equipment must meet before it is returned to the using organization. These procedures are used to localize a fault to a functional section and to verify performance of repaired equipment. When a test fails, the troubleshooting procedures in Section III are used to isolate the fault to a module or assembly. After repair, these procedures must be repeated to verify performance of repaired equipment.

b. Comply with the instructions preceding each chart before proceeding to the chart. Perform each step in sequence. Do not vary the sequence. For each step, perform all the actions required in the Control settings columns, then perform each specific test procedure and verify it against its performance standard.

c. If any defects are noted during physical inspections, make repairs within the capabilities of general support maintenance. If repair is beyond the scope of general support maintenance, send the equipment to depot maintenance.

d. If any of the electrical tests fail to meet the performance standard, refer to the troubleshooting procedures in Section III. The troubleshooting procedures are listed in the same sequential order as the electrical tests in this section.

e. The performance standards listed in the tests are based on the assumption that the modification work orders listed in DA Pam 310-7 have been performed.

4-14. After Connector Physical Tests and Inspection

None required. ,

4-15. Adapter Connector Electrical Tests

a. Test Equipment Materials.
Multimeter

b. Test Connections and Conditions. If indications in subparagraph *c* cannot be obtained refer mounting adapter to depot level maintenance

c. Adapter Electrical Test Procedure.

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
1	Set up multimeter to measure resistance on Rx1 scale	Refer to figure FO4 and perform continuity checks on adapter	Observe indication of2 ohms or less at each check

4-16. Control Unit Inspection

None Required.

4-17. Control Unit Electrical Tests

a. Test Equipment and Materials.
Test Set
Headset

b. Test Connections and Conditions. Install control unit to be tested into test set. If indications in subparagraph c cannot be obtained, refer control unit to depot.

NOTE

TACAN PWR at J7 of Test Set must be disconnected for this test.

c. Control Unit Electrical Test Procedures.

No	Test Equipment	Equipment Under Test	Test Procedure	Performance Standard
1	Test Set: 115 VAC 400 Hz ON DISPLAY SELECT CONTROL UNIT	*Control Unit:* Operation mode REC MODE X CHAN 000 VOL mid-position	Observe test set CONTROL display lamps	All CONTROL display lamps not illuminated.
2	N/A	*Control Unit* Operation mode T/R	Observe test set CONTROL display lamps.	T/R lamp illuminated.
3	N/A	*Control Unit* Operation mode A/A	Observe test set CONTROL display lamps	A/A lamp illuminated.
4	N/A	*Control Unit* Operation mode AUTO	Observe test set CONTROL display lamps	T/R and A/A lamps illuminated.
5	N/A	*Control Unit* Operation mode REC Press and hold BIT switch	Observe test set CONTROL display lamps and control unit lamps	Test set S/T lamp illuminated, control unit ECM WARN, GO, and NO-GO lamps illuminated.
6	N/A	*Control Unit* Release BIT switch	Observe control unit lamps WARN lamps sequentially illuminated once	NO-GO, GO, and NO-GO ECM
7	N/A	*Control Unit:* CHAN 1 through 9	Observe test set CONTROL display lamps indicate total selected	Lamps indicate selection of channels 1 through 9 corresponding I setting of CHAN control
8	N/A	*Control Unit* CHAN 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, and 120	Observe test set CONTROL display lamps indicate total selected	Lamps indicate selection of channels 10, 20, 30, 40, 50, 60, 70, 80, 80, 90,100, 110, and 120 corresponding to setting of CHAN control

4-18. Receiver-Transmitter Physical Tests and Inspection

a. Test Equipment and Materials. None required.

b. Test Connections and Conditions. None.

Step No	Control Settings: Test Equipment	Control Settings: Equipment Under Test	Test Procedure	Performance Standard
9	N/A	Control Unit MODE Y	Observe test set CONTROL display lamps.	Y MODE lamp illuminated.
10	N/A	Control Unit MODE X	Observe test set CONTROL display lamps.	Y MODE lamp not illuminated.
11	N/A	N/A	Insert headset into test set ID TONE jack J8 and listen for audio tone.	Audio tone present
12	N/A	Control Unit Vary VOL control from maximum ccw to maximum cw	Listen for audio tone on headset	Audio tone increases as VOL control is varied.
13	Test Set 115 VAC 400 HZ OFF	N/A	N/A	N/A

c. Receiver-Transmitter Inspection Procedures.

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
1	N/A	Remove cover from receiver-transmitter (para 4-6e)	None
2	N/A	Inspect chassis for loose or missing screws, washers, or nuts	Screws, washers, and nuts must be secure, none missing
3	N/A	Inspect chassis for broken connectors and bent pins.	No broken connectors or bent pins.
4	N/A	Check blower connector for damage and bent pins.	No broken connector or bent pins.
5	N/A	Check that blower fan rotates freely	Fan rotates freely without binding.

4-19. Converter Physical Tests and Inspection

a. Test Equipment and Materials. None Required.
b. Test Connections and Conditions. None.

4-20. Receiver-Transmitter/Converter Electrical Tests

The receiver-transmitter and converter must be tested together.

a. Test Equipment and Materials.

Test set
Beacon simulator
Oscilloscope Headset

b. Test Connections and Conditions.

(1) Set test equipment controls and switches to initial settings per table 4-2..

(2) Perform preliminary operational checks on the test set per TM 11-6625-2595-14.

(3) Connect equipment as shown in figure 4-4.

(4) Perform the navigational set static tests (subparagraph c) first to determine if the navigational set contains a fault and to locate the trouble.

(5) Perform the interface and buffer electri cal tests (subparagraphs d and n) only when the con verter nameplate states, "COMPATIBLE WITH THE AN/ASN-86 INS." If the converter nameplate states, "NOT COMPATIBLE WITH THE AN/ASN-86 INS," skip subparagraphs d and n).

(6) Navigational set dynamic tests (sub paragraphs through n) contain no associated troubleshooting data. If any of these tests fail, per form the static electrical tests in subparagraphs c and d to locate the trouble. The purpose of the dynamic tests is to verify navigational set per f6rmance with a simulated target. The beacon simulator is also used to check dynamic performance parameters after module replacement (para 4-9).

NOTE

Any time power is applied to navigational set in subparagraphs c through n, allow 90 seconds for warmup before observing any indications.

c. Converter Inspection Procedure.

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
1	N/A	Remove cover from converter (para 4-16a).	None.
2	N/A	Inspect chassis for loose or missing screws, washers, or nuts	Screws, washers, and nuts must be secure, none missing.
3	N/A	Inspect chassis for broken connectors and bent pins.	No broken connectors or bent pins.

c. TACAN Static Electrical Test Procedures.

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
1	Test Set RADIO SET CONTROL: Operation mode OFF Test Set: 115 VAC ON/OFF ON	a. Connect test set cable W-1 to TACAN RF connector J1 and ANTENNA connector on navigational set. b. Set test set RADIO SET CONTROL operation mode to T/R. CAUTION If blower is not operating, turn equipment OFF immediately can occur. c. Verify blower 1B1 is operating.	a. None b. None c. Blower is operating. Damage to modules
2	Same as Step 1	Verify TTM is operating	TM is operating
3	Test Set RADIO SET CONTROL: CHANnel 0 Test Set: DISPLAY SELECT CONTROL UNIT SELF TEST HOLD/SELF TEST RELEASE-RELEASE	Observe test set CONTROL display lamps while performing following: (1) Set test set RADIO SET CONTROL operation mode to REC, T/R, A/A, AUTO and back to T/R. (2) Set test set RADIO SET CONTROL X/Y MODE to X, Y, and back to X (3) Press test set RADIO SET CONTROL BIT switch. (4) Release test set RADIO SET CONTROL BIT switch. (5) Set test set RADIO SET CONTROL operation mode to REC and CHANnel to channels 1 thru 9, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, and 120.	Refer to table 4-3 for CONTROL display lamps indications.
4	Test Set: DISPLAY SELECT SERIAL DATA Test Set RADIO SET CONTROL: CHANnel 0	Observe test set CONTROL display lamps while performing following: (1) Set test set RADIO SET CONTROL operation mode to REC, T/R, A/A, and back to T/R. (2) Set test set RADIO SET CONTROL X/Y MODE to X, Y, and back to X. (3) Press test set RADIO SET CONTROL BIT switch. (4) Release test set RADIO SET CONTROL BIT switch. (5) Set test set RADIO SET CONTROL CHANnel to channels 1 thru 9, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, and 120.	Refer to table 4-4 for CONTROL display lamps indications.
5	Test Set: DISPLAY SELECT CONTROL WORD	Same as Step 4 NOTE In steps 6 through 11, wait for TEST INITIATE indicator toillu-minate before proceeding to next step.	Refer to table 4-5 for CONTROL display lamps indications

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
6	Test Set RADIO SET CONTROL: CHANnel 0 Test Set: RADIO SET CONTROL MODE X CHANnel64 Operation mode T/R Test Set: SELF TEST HOLD/SELF TEST	Press and release test set TEST INITI- ATE switch test set NO GO INDICATIONS lamps.	No NO GO INDICATIONS lamps illuminated After 20 seconds, observe
	Test Set RADIO SET CONTROL: MODE Y CHANnel 1	Same as Step 6	Same as Step 6
8	Test Set RADIO SET CONTROL: MODE X CHANnel 63	Same as Step 6	Same as Step 6
9	Test Set RADIO SET CONTROL: MODE Y	Same as Step 6	Same as Step 6
10	Test Set RADIO SET CONTROL: MODE X CHANnel 63	Same as Step 6	Same as Step 6
11	Test Set RADIO SET CONTROL: MODE Y	Same as Step 6	Same as Step 6
12	Test Set RADIO SET CONTROL: CHANnel 126 MODE X CHANnel 64	Observe test set ANT SWITCH and ANT DRIVE indicators ANT DRIVE indicators.	Both indicators ON or OFF (not blinking). (not blinking)
13	Test Set: SELF TEST HOLD/SELF TEST RELEASE RELEASE	Within 60 seconds, observe test set ANT SWITCH and ANT DRIVE indicators.	Both indicators alternately blinking ON and OFF.
14	Test Set RADIO SET CONTROL: MODE X CHANnel O Operation mode T/R VOLUME fully cw Test Set: SELF TEST HOLD/SELF TEST RELEASE HOLD Insert headset in ID TONE jack J8 Audible on headset	Sequentially set test set RADIO SET CONTROL CHANnel to channels 1, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110 120, and 126 (allow 10 seconds lock-on for each channel) Observe test set indicators, IDI63, and listen for ID Tone on headset Bearing-356 to 360, or O to 2 degrees Range flag-not in view	Indicators: RANGE VALID-illuminated BEARING VALID-illuminated RANGE FLAG DRIVE-illuminated BEARING FLAG DRIVE-illuminated ID-663: Range-O.O to 0.5 nautical miles.
15	Test Set RADIO SET CONTROL: MODE X CHANnel 64 Operation mode T/R VOLume Mid-range SELF TEST HOLD/SELF TEST RELEASE RELEASE	Press and hold test set RADIO SET CONTROL BIT switch and observe GO and NO GO STATUS, and ECM WARN lamps. **NOTE**: In steps 16 through 18, do not press BIT switch until STATUS lamp is extinguished from previous test.	GO and NO GO STATUS, and ECM WARN lamps illuminated.
16	Same as Step 15	Release BIT switch and after 15 to 20 seconds, observe GO STATUS lamp.	GO STATUS lamp illuminated.
17	Same as Step 15	Observe 4 FAULT magnetic latch in- dicators on receiver-transmitter front panel	All 4 FAULT indicators are black (GO).

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
18	Same as Step 15	a. Repeat Steps 15 thru 17 setting RADIO SET CONTROL operation mode and X/Y MODE as follows: T/R-Y A/A-X b. Set test set RADIO SET CONTROL A/A-Y operation mode to REC.	a. Same as Steps 15 thru 17 b. None

Table 4-3. Control Word Test Indications (CONTROL UNIT)

Control	Position	CONTROL display lamp
Operation mode	REC	REC, T/R,A/A not illuminated
	T/R	T/R illuminated
	A/A	A/A illuminated
	AUTO	T/R and A/A illuminated
MODE	X	Y MODE not illuminated
	Y	Y MODE illuminated
BIT	Pressed	S/T and T/R illuminated
CHANnel	1	1 illuminated
	2	2 illuminated
	3	2 and 1 illuminated
	4	4 illuminated
	5	4 and 1 illuminated
	6	4 and 2 illuminated
	7	4, 2, and 1 illuminated
	8	8 illuminated
	9	8 and 1 illuminated
	10	10 illuminated
	20	20 illuminated
	30	20 and 10 illuminated
	40	40 illuminated
	50	40 and 10 illuminated
	60	40 and 20 illuminated
	70	40, 20, and 10 illuminated
	80	80 illuminated
	90	80 and 10 illuminated
	100	80 and 20 illuminated
	110	80, 20, and 10 illuminated
	120	80 and 40 illuminated

Table 4-4. Control Word Test Indications (CONTROL UNIT)

Control	Position	CONTROL display lanp
Operation mode	REC	REC, T/R, A/A not illuminated
	T/R	T/R illuminated
	A/A	A/A illuminated
MODE	X	Y MODE not illuminated
	Y	Y MODE illuminated
BIT Pushbutton	Pressed	S/T and T/R illuminated
CHANnel Select	1	1 illuminated
	2	2 illuminated
	3	2 and 1 illuminated
	4	4 illuminated
	5	4 and 1 illuminated
	6	4 and 2 illuminated
	7	4, 2, and 1 illuminated
	8	8 illuminated
	9	8 and 1 illuminated
	10	10 illuminated
	20	20 illuminated
	30	20 and 10 illuminated

Control	Position	CONTROL display
	40	40 illuminated
	50	40 and 10 illuminated
	60	40 and 20 illuminated
	70	40, 20, and 10 illuminated
	80	80 illuminated
	90	80 and 10 illuminated
	100	80 and 20 illuminated
	110	80, 20, and 10 illuminated
	120	80 and 40 illuminated

Table 4-5. Control Word Test Indication (CONTROL UNIT)

Control	Position	CONTROL display lamp
Operation mode	REC	REC illuminated
	T/R	TIR illuminated
	A/A	A/A illuminated
MODE	X	Y MODE not illuminated
	Y	Y MODE illuminated
BIT	Pressed	SIT and TIR illuminated
CHANnd	1	1 illuminated
	2	2 illuminated
	3	2 and 1 illuminated
	4	4 illuminated
	5	4 and 1 illuminated
	6	4 and 2 illuminated
	7	4, 2, and 1 illuminated
	8	8 illuminated
	9	8 and 1 illuminated
	10	10 illuminated
	20	20 illuminated
	30	20 and 10 illuminated
	40	40 illuminated
	60	40 and 10 illuminated
	60	40 and 20 illuminated
	70	40, 20, and 10 iluminated
	80	80 illuminated
	90	80 and 10 iluminated
	100	80 and 20 illuminated
	110	80, 20, and 10 illuminated
	120	80 and 40 illuminated

d. Converter Interface and Buffer Static Electrical Test Procedures.

NOTE

Skip this test if navigational set does not contain an interface and buffer module.

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
1	TV Set DISPLAY SELECT DIGITAL INTERFACE FUNCTION SELECT CONTROL SELF TEST HOLDI SELF TEST RELEASE HOLD test Set RADIO SET CONTROL: MODE X CHANnel 64	Set test set UPDATE/STOP switch to UPDATE and ohsere CONTROL display lamps and indicators DATA VALID blinking	CONTROL lamps: S,T, T/R, 40, 20, 4 illuminated. Indicators:
2	Test Set UNCTION SELECT BEARING	Observe test set BEARING display lamps and indicators	BEARING lamps: 356 to 360, or O to 2 degrees illuminated. Indicators:

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
			DATA VALID blinking
3	Test Set FUNCTION SELECT RANGE	Observe test set RANGE display lamps and indicators.	RANGE lamps: 0 to 0.5 NM illuminated. DATA VALID blinking
4	Test Set: FUNCTION SELECT CONTROL SELF TEST HOLDISELF TEST RELEASE RELEASE Test Set RADIO SET CONTROL: Operation mode AUTO	Observe test set AUTO CONTROL display lamp.	AUTO lamp illuminated.
5	Test Set: PROGRAM SELECT 1	Press and release test set, ENTER switch Observe CONTROL display lamps and indicators	CONTROL lamps: REC, 40, 20, 10, 4, 2, and 1 illuminated. Indicators: DATA VALID blinking
6	Test Set: PROGRAM SELECT 2	Same as Step 5	CONTROL lamps: T/R, 80, and 8 illuminated DATA, VALID blinking
7	Test Set PROGRAM SELECT 3	Same as Step 5	CONTROL Lamps: A/A, 100 and 8 illuminated Indicators: DATA VALID blinldking
8	Test Set- PROGRAM SELECT 4	Same as Step 5	CONTROL lamps: SIT, T/R, 80, and 8 illuminated. DATA VALID blinking
9	Test Set, PROGRAM SELECT 5	a b. Set test set RADIO SET CONTROL operation mode to REC.	Same as Step 5 b. None

e. TACAN FAULT Indicators Dynamic Performance Test.

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
1	Test Set RADIO SET CONTROL MODE X Operation mode T/R	a. Disconnect cable W3 from AGE connector on navigational set and connect a short across pins 30 and 102 b. On RADIO SET CONTROL, press and release BIT switch After 20 seconds, observe NO GO STATUS lamp and 4 FAULT latch indicators on front panel of receiver-transmitter.	a. None b. NO GO STATUS lamp illuminated: CONT indicator is white (NO-GO): RT, CONV, and ANT indicators are black (GO)
2	Same as Step 1	a. Disconnect short from AGE connector and connect W4 to AGE connector. b. On RADIO SET CONTROL, press and release BIT switch. After 30 seconds, observe 4 FAULT latch indicators on front panel of receiver-transmitter.	a. None b. All FAULT latch indicators are black (GO).
3	Test Set RADIO SET CONTROL Operation mode OFF	a. Remove range coupler 4DC2 from converter (para 4-15b). b. On RADIO SET CONTROL, set operation mode to TeR. c. On RADIO SET CONTROL, press and release BIT switch After 20 seconds, observe NO GO STATUS lamp and 4 FAULT latch indicators on front panel of receiver-transmitter.	a. None b. None c. NO GO STATUS lamp illuminated: CONV indicator, is white (NO GO): RT, CONT
4	Same as Step 3	a. Replace range coupler 4DC2 in converter (para 4-165). b. On RADIO SET CONTROL, set operation mode to TIR.	a. None b. None

Stop	Test Equipment Control Setting	Test Procedure	Performance Standard
		c. On RADIO SET CONTROL, press and release BIT switch After 30 seconds, observe 4 FAULT latch indicators on front panel of receiver-transmitter.	c. ALL FAULT latch indicators are black (GO).
5	Same as step 3	a. Disconnect test set cable W-1 from ANTENNA connector on receiver-transmitter.	a. None
		b. On RADIO SET CONTROL, set operation mode to T/R.	b. None
		c. On RADIO SET CONTROL, press and release BIT switch After 20 seconds, observe NO GO STATUS lamp and 4 FAULT latch indicators on front panel of receiver-transmitter.	c. NO GO STATUS lamp illuminated: ANT indicator is white (NO GO): RT, CONT, CONV indicators are black (GO)
6	Same as Step 3	a. Reconnect test set cable W-1 to ANTENNA connector on front panel of receiver-trumanitter.	a. None
		b. On RADIO SET CONTROL, set operation mode to T/R.	b. None
		c. On RADIO SET CONTROL, press and release BUT switch After 30 seconds, observe 4 FAULT latch indicators on front panel of receiver-transmitter.	c. All FAULT latch indicators are black (GO).
7	Test Set TEST POINT SELECTORS A 7 B 3	a. Apply chassis ground to test set TEST POINTS connector J2.	a. None
		b. On RADIO SET CONTROL, press and release BIT switch. After20 seconds, observe NO GO STATUS lamp and 4 FAULT latch indicators on front panel of receiver-transmitter.	b. NO GO STATUS lamp illuminated: RT indicator is white (NO GO): ANT, CONT, and CONV indicators are black (GO).
8	Same as Step 7	a. Disconnect short from TEST POINTS connector J2.	a. None
		b. On RADIO SET CONTROL, press and release BIT switch seconds, observe 4 FAULT latch indicators on front panel of receiver-transmitter.	b. All FAULT latch indicators are After 30
		c. On RADIO SET CONTROL, set operation mode to REC.	c. None

f. Transmitter Power in TIR Mode Dynamic Performance Test.

Step	Test Equipment Control Setting	Test Procedure	Performance Standard
1	Refer to table 44 Teat Set RADIO SET CONTROL: Operation mode T/R	Observe DISPLAY on beacon simulator RF unit.	100 to 4000 watts
2	Same as. Step 1 RADIO SET CONTROL to channels 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, $0, 40, 50, 60, 70, 80, 90, 100, 110, 120, and 126 and observe beacon simulator RF unit DISPLAY for each channel selected 5 seconds between each channel selected.	a. Set CHANnel switch on test set Wait	
	b. Set test set RADIO SET CONTROL operation mode to REC.	b. None	

Table 4-6. Initial control settings for Receiver-Transmitter/Converter Transmitter Power Output Dynamic Performance Verification Table

Control	Position	Control	Position
BEACON SIMULATOR AN/ARM-156		TEST SET TS-S14	
RF UNIT		TEST SET	
SELECT	1	DISPLAY SELECT	RANGE
OUTPUT AT'ENUATOR	060	116 VAC ON/OFF	ON
RISE TIME	2.5		
PULSE MOD	2	RADIO SET CONTROL	
		CHANnel	1
CHANNEL SELECT	001	MODE	X
VIDEO UNIT		Operation mode	REC
SELECT A.	11	VOLume	Mid-position
SELECT B.	7		
MODE	G/A X		
MAIN BURST	ON		
AUX BURST	ON		
N REF TRIG	OFF		
SQUITTER RATE X100	27		
BEARING	000.0		
BEARING RATE	OFF 20		
% MOD 15HZ	OFF 00		
% MOD 135HZ	OFF 00		
PHASE SHIFT 15HZ	OFF 15.0		
ANT SP (% 15HZ RPS)	OFF 0.00		
RANGE	E12.0		
RANGE RATE X100	OFF45		
REPLY EFF X10%	9		
DEAD TIME	ON		
SYNC SELECT	1		
ID TONE	OFF		
PULSE SPACING	NOM 0.0		
PRGM	1		
LEVEL (-dbm)	0		
POWER	ON		

g. Transmitter Pouwr in A/A Mode Dynamic Peformance Teat.

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
1	Refer to table 4-6 Beacon Simulator CHANNEL SELECT 123 MODE A/A X A/A PRF 0750 Test Set RADIO SET CONTROL CHANnel mode A/A Operation mode A/A	a. Observe DISPLAY B on beacon simulator Video Unit. b. Observe DISPLAY on beacon imu- lator RF Unit.	a. 70 pulse pairs per second. b. 750 to 4000 watts
2	Same as Step 1	a. Set CHANnel switch on test set RADIO SET CONTROL to 120 and CHANNEL SELECT switch on beacon simulator RF Unit to 057. b. Set test set RADIO SET CONTROL b. None operation mode to REC.	a. 750 to 4000 watts

h. ID Tone/Receiver Sensitivity Dynamic Performance Test.

Step	Test Equipment Control Settings	Test Procedures	Performance Standard
1	Refer to table 4-7 Test Set RADIO SET CONTROL Operation mode T/R	Set test set RADIO SET CONTROL VOLume control as follows and listen to ID tone on headset: (1) From mid-position to fun cw (2) From mid-position to full ccw	 (1) Audio level increases. (2) Audio level decreases.
2	Beacon Simulator: OUTPUT ATTENUATOR 090 CHANNEL SELECT 001 Teat Set RADIO SET CONTROL CHANnel 1 VOLume ful cw	a. Verify presence of ID tone on headset b. Increase OUTPUT ATTENUATOR on beacon simulator until ID tone is no longer continuously audible trol setting. NOTE After each channel test, set OUTPUT ATTENUATOR back to -90 dbm.	a. Audio is present on headset. b. -90 dbm or more Observe con-
3	Same as Step 2	a. Simultaneously set CHANnel switch on test set RADIO SET CONTROL and CHANNEL SELECT switch on beacon simulator to channels 2, 3; 4, 65, 6, 7, 8, 9, 10, 20, 30, 40, 60, 60, 70, 80, 90, 100, 110, 120 and 126, and increase OUTPUT ATTENUATOR control for each channel selected until ID tone is no longer continuously audible on headset and observe control settingL b. Set test set RADIO SET CONTROL operation mode to REC.	a. -90 dbm or more b. None

Table 4-7. Initial Control Setting for Receiver-Transmitter/Converter ID Tone/Receiver Sensitivity Dynamic Performance Verification Test.

Control	*Position*	*Control*	*Position*
BEACON SIMULATOR AN/ARM-156		TEST SET TS-3134	
RF UNIT		TEST SET	
SELECT	1	DISPLAY SELECT	RANGE
OUTPUT ATTENUATOR	010	115 VAC/ON/OFF	ON
RISE TIME	2.5µs		
PULSE MOD	2	RADIO SET CONTROL	
CHANNEL SELECT	064	CHANnel	64
		MODE	x
VIDEO UNIT		Operation mode	REC
SELECT A. 1		VOLume	Mid-position
SELECT B. 2			
MODE	G/A X		
MAIN BURST	ON		
FUX BURST	ON		
N REF TRIG	OFF		
SQUITTER RATE X100	27		
BEARING	000.0		
BEARING RATE	OFF 20		
% MOD 15HZ	OFF 20		
% MOD 135HZ	OFF 20		

Control	Position	Control	Position
PHASE SHIFT 15HZ	OFF 15.0		
ANT SP (% 15HZ RPS)	OFF 0.00		
RANGE RATE X100	OFF 45		
REPLY EFF X10%	9		
A/A PRF	0000		
DEAD TIME	ON		
SYNC SELECT	1		
ID TONE	ON		
PULSE SPACING	NOM 0.0		
PRGM	1		
LEVEL (-dbm)	0		
POWER	ON		

i. Digital and Analog Distance (Range) Accuracy Dynamic Performance Verification Test.

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
1	Refer to table 4-7 Beacon Simulator OUTPUT ATTENUATOR 090 RANGE 048.0 ID TONE OFF Test Set RADIO SET CONTROL Operation mode T/R	Observe indications as follows: (1) Test set RANGE display lamps (2) Test set ID663 NOTE Wait 20 seconds after performing Steps 2 through 5.	 (1) 48.0 ±0.2 nautical miles (2) 48.0 ±0.5 nautical miles
2	Beacon Simulator RANGE 288.0	Observe indications as follows: (1) Test set RANGE display lamps (2) Test set ID4l6i3	 (1) 288.0 ±0.2 nautical miles (2) 288.0 ±0.5 nautical miles
3	Beacon Simulator RANGE RATE X100 +45	Observe last test set ID-663 range indication before range flag drops.	297 ±3 nautical miles
4	Beacon Simulator RANGE RATE X100 OFF 45 RANGE 312.0	Observe test set RANGE FLAG DRIVE indicator	**NOTE** RANGE FLAG DRIVE indicator may illuminate momentarily due to noise. RANGE FLAG DRIVE indicator extinguished
5	Beacon Simulator RANGE 212.0 OUTPUT ATTENUATOR 090	a. Increase beacon simulator OUTPUT ATTENUATOR in 1-dbm increments (wait 15 seconds between settings) until test set RANGE FLAG DRIVE indicator extinguishes Observe OUTPUT AT TENUATOR control setting. b. Set test set RADIO SET CONTROL b. None operation mode to REC.	a. Not less than -90 dbm

j. Analog Distance (Range) Memory Dynamic Performance Verification Test.

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
1	Refer to table 4-7 Beacon Simulator OUTPUT ATTENUATOR 090 RANGE 048.0 e MOD 15 HZ ON 20 % MOD 135 HZ ON 20	Observe indications as follows: (1) Test set ID63 (2) Test set RANGE FLAG DRIVE indicator	 (1) 48 +0.5 nautical miles (2) RANGE FLAG DRIVE indicator illuminated

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
	ID TONE OFF Test Set RADIO SET CONTROL Operation mode T/R		
2	Same as Step 1	a. Wait 10 seconds Set beacon simulator ID TONE switch to ON and determine delay time from time ID TONE switch is turned ON until range flag drops on test set ID-663. b. Set test set RADIO SET CONTROL operation mode to REC.	a. 10 +2 seconds b. None

k. Distance (Range) Tracking Rate Dynamic Performance Verification Test.

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
1	Refer to table 4-7 Beacon Simulator: OUTPUT ATTENUATOR 090 RANGE 048.0 % MODE 15 HZ ON 20 % MOD 135 HZ ON 20 REPLY EFF X10% 5 ID TONE OFF Test Set RADIO SET CONTROL: Operation mode T/R	Set beacon simulator RANGE RATE X100 to +45 and observe test set IID663 and beacon simulator DISPLAY A.	Within 10 seconds, ID-663 locks on and smoothly tracks beacon simulator DISPLAY A for at least 60 seconds.
2	Beacon Simulator: RANGE RATE X100 OFF 45 tions as follows: RANGE 248.0	Set beacon simulator RANGE RATE X100 switch to -45 and observe indica- (1) Test set IDi63 and beacon simu- later DISPLAY (2) Test set RANGE FLAG DRIVE indicator NOTE RANGE FLAG DRIVE indicator may illuminate momentarily in steps 3 and 4 due to noise.	(1Within 10 seconds, ID-663 locks on and U A. smoothly tracks beacon simulator DIS PLAY A for at least 60 seconds. (2) RANGE FLAG DRIVE indicator illuminated.
3	Beaeon Simulator: RANGE RATE X100 -45 RANGE 248.0	a. Set beacon simulator ID TONE switch to ON and wait for test set RANGE FLAG DRIVE indicator to extinguish. b. Set beacon simulator ID TONE switch to OFF and observe indications as follows: (1) Test set ID-663 and beacon simulator DISPLAY A. and tracks beacon simulator DISPLAY A. (2) Test set RANGE FLAG DRIVE indicator	a. None b. As follows: (1)Within 1O seconds, ID63 locks on A (2) RANGE FLAG DRIVE indicator illuminated.
4	Beacon Simulator: RANGE RATE X100 -45 RANGE -048.0	a. Set beacon simulator RANGE RATE X100 switch to +45, ID TONE switch to ON, and wait for test set RANGE FLAG DRIVE indicator to extinguish. b. Set beacon simulator ID TONE switch to OFF and observe indications as follows: (1) Test set ID-663 and beacon simulator DISPLAY A.. (2) Test set RANGE FLAG DRIVE indicator c. Set test set RADIO SET CONTROL operation mode to REC.	a. None b. As follows: (1) within 10 seconds, ID68 locks on and tracks beacon simulator DISPLAY A (2) RANGE FLAG DRIVE indicator illuminated. c. None

l. Digital and Analog Bearing Accuracy Dynamic Performance Verification Test.

Step	Test Equipment Control Setting	Test Procedure	Performance Standard
1	Refer to table 44 Test Set RADIO SET CONTROL: Operation mode T/R	Observe indications as follows: (1) Test set BEARING display lamps (2) Test set ID-663	 (1) 0.0 ±0.5 degree (2) 0.0 ±2.5 degree
2	Same as Step 1	Set beacon simulator BEARING control sequentially to 090, 180, 270, and 315, and observe following indications at each con- (1) Test set BEARING display lamps (2) Test set ID663 (3) Test set BEARING FLAG DRIVE indicator	 (1) 090-90 ±0.5 degrees 180--180 ±0.5 degrees 270-270 ±0.5 degrees 315-315 ±0.5 degrees (2) 090-90 ±2.5 degrees 18-180 ±2.5 degrees 270-270 ±2.5 degrees 315-315 ±2.5 degrees (3) BEARING FLAG DRIVE indicator illuminated at each BEARING control set-ting.
3	Beacon Simulator: OUTPUT ATTENUATOR 080 % MOD 15 HZ ON 07 % MOD 135 HZ ON 07	Observe indications as follows: (1) Test set BEARING display lamps (2) Test set ID-663	 (1) 315 ± degrees (2) 315 +2.5 degrees
4	Beacon Simulator: OUTPUT ATTENUATOR 090	a. Increase beacon simulator OUTPUT ATTENUATOR control in 1-dbm incre-ments (wait 10 seconds between each control setting) and observe last OUTPUT ATTENUATOR control setting before test set BEARING FLAG DRIVE indica-tor extinguishes. b. Set test set RADIO SET CONTROL b. None operation mode to REC.	a. -90 dbm minimum

Table 4-8. Initial Control Settings for Bearing Accuracy Dynamic Performance Verification Test

Control	Position	Control	Position
BEACON SIMULATOR AN/ARM-156		TEST SET TS3134	
RF UNIT		TEST SET	
SELECT	1	DISPLAY SELECT	BEARING
OUTPUT ATTENUATOR	080	115 VAC AN/OFF	ON
RISE TIME	2.5 us		
		RADIO SET CONTROL	
PULSE MOD	2		
CHANNEL SELECT	001	CHANnel	1
		MODE	X
VIDEO UNIT		Operation mode	REC
		VOLume	Mid-position
SELECT A. 1			
SELECT B. 3			
MODE	G/A X		
MAIN BURST	ON		
AUX BURST	ON		
N REF TRIG	OFF		
SQUITTER RATE XI00	2		
BEARING	000.0		
BEARING RATE	OFF20		
% MOD 15HZ	ON 27		
PHASE SHIFT 15HZ	OFF 15.0		
ANT SP (% 15HZ RPS)	OFF 0.00		
RANGE.0			
RANGE RATE X1000	OFF 45		

Control	*Position*	*CONTROL display lamp*
REPLY EFF X10%	9	
A/A PRF	0000	
DEAD TIME	ON	
SYNC SELECT	1	
ID TONE	ON	
PULSE SPACING	NOM 0.0	
PRGM	I	
LEVEL (-dbm)	O	
POWER	ON	

m. Bearing Tracking Rate Dynamic Performance Verification Test.

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
1	Refer to table 48 Beacon Simulator: CHANNEL SELECT 064 DISPLAY SELECT A 4 BEARING 045.0 BEARING RATE +20 Test Set RADIO SET CONTROL CHANnel 64	Observe indications as follows: (1) Beacon simulator Video Unit DIS- PLAY B. degrees per second. (2) Test set ID-663 cw per second.	 (1) DISPLAY B increases at a rate of 20 (2) ID663 tracks at a rate of 20 degrees
2	Same as Step I	a. Set beacon simulator BEARING RATE to -20 and observe indications as (1) Beacon simulator Video Unit DIS follows: PLAY B. degrees per second. (2) Test set II663 b. Set test set RADIO SET CONTROL operation mode to REC.	 (1) DISPLAY B decreases at a rate of 20 (2) ID-663 tracks at a rate of 20 degrees ccw per second. b. None

n. Digital Interface Dynamic Performance Verification Test.

NOTE

Skip this test if navigational set does not contain an interface and buffer module.

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
1	Refer to table 4-9 Test Set RADIO SET CONTROL: Operation mode T/R (1) Test set RANGE display lamps (2) Test set DATA VALID indicator	 Wait 30 seconds and observe indications as follows:	 (1) 24.00 ±0.25 nautical miles. (2) DATA VALID indicator blinks.
2	Beacon Simulator RANGE 048.0	Repeat Step 1	(1) 48.00 ±0.25 nautical miles. (2) DATA VALID indicator blinks
3	Beacon Simulator RANGE 096.0	Repeat Step 1	(1) 96.00 ±0.25 nautical miles. (2) DATA VALID indicator blinks.
4	Beacon Simulator: RANGE 192.0	Repeat Step 1	(1) 192.00 ±0.25 nautical miles. (2) DATA VALID indicator blinks.
5	Beacon Simulator RANGE 288.0	Repeat Step 1	(1) 288.00 ±0.25 nautical miles. (2) DATA VALID indicator blinks.
6	Beacon Simulator: ID TONE ON Beacon Simulator: ID TONE OFF RANGE 024.0	Observe test set DATA VALID indicator Wait 30 seconds and observe indications as follows: (1) Test set BEARING display lamps (2) Test set DATA VALID indicator	DATA VALID indicator extinguished. (1) 45.0 t0.5 degrees (2) DATA VALID indicator blinks

Step	Test Equipment Control Settings	Test Procedure	Performance Standard
	Test Set: FUNCTION SELECT BEARING		
8	Beacon Simulator: BEARING 090.0	Repeat step 7	(1) 90.0 ±0.5 degrees (2) DATA VALID indicator blinks
9	Beacon Simulator: BEARING 180.0	Repeat step 7	(1) 180.0 ±0.5 degrees (2) DATA VALID indicator blinks
10	Beacon Simulator: BEARING 270.0	Repeat step 7	(1) 270.0 ±0.5 degrees (2) DATA VALID indicator blinks
11	Beacon Simulator: MAIN BURST OFF	a. Wait 30 seconds and observe DATA. VALID indicator. b. Set test set RADIO SET CONTROL operation mode to REC.	a. DATA VALID indicator extinguished. b. None

Table 4-9. Initial Control Settings for Digital Interface Dynamic Performance Verification Test.

Control	Position	Control	Position
BEACON SIMULATOR AN/ARM-156		TEST SET TS134	
RF UNIT		TEST SET	
SELECT	1	DISPLAY SELECT	DIGITAL INTERFACE
OUTPUT ATTENUATOR	060	FUNCTION SELECT	RANGE
RISE TIME	2.5 µs	UPDATE/STOP	UPDATE
PULSE MOD	2	115 VAC ON/OFF	ON
CHANNEL SELECT	001		
		RADIO SET CONTROL	
VIDEO UNIT			
		CHANnel	1
SELECT A. 1		MODE	x
SELECT B. 3		Operation mode	REC
MODE	G/A X	VOLume	Mid-position
MAIN BURST	ON		
AUX BURST	ON		
N REF TRIG	OFF		
SQUITTER RATE X100	27		
BEARING	045.0		
BEARING RATE	OFF 20		
% MOD 15HZ	ON 27		
% MOD 135HZ	ON 27		
PHASE SHIFT 15HZ	OFF 15.0		
ANT SP (% 15 HZ RPS)	OFF 0.00		
RANGE	024.0		
RANGE RATE X100	OFF 45		
REPLY EFF X10%	9		
A/A PRF	0000		
DEAD TIME	ON		
SYNC SELECT	1		
ID TONE	OFF		
PULSE SPACING	NOM 0.0		
PRGM	1		
LEVEL (Odbm)	0		
POWER	ON		

APPENDIX
REFERENCES

Following is a list of references available to the Direct and General Support Maintenance of the navigational set.

DA Pam 310-4	Military Publications: Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, 9), Supply Bulletins and Lubrication Orders.
DA Pam 3107	Military Publications: US Army Equipment Index of Modification Work Orders.
SB 11-573	Painting and Preservation Supplies Available for Field Use for Electronics Command Equipment.
SB 38-100	Preservation, Packaging, Packing and Marking Materials, Supplies and Equipment' Used by the Army.
TB 746-10	Field Instructions for Painting and Preserving Electronics Command Equipment.
TM 38-750	The Army Maintenance Management System (TAMMS).
TM 11-5826243-20	Organizational Maintenance Manual for Navigational Set, TACAN AN/ARN103(V).
TM 11-5826-243-24P	Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Navigational Set AN/ARN-103(V1), AN/ARN-103(V2).
TM 740-90-1	Technical Manual: Administrative Storage of Equipment.
TM 750-244-2	Technical Manual: Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).

GLOSSARY

SIGNAL TERM	DESCRIPTION	SOURCE
AAC	Air-to-Air Command	Internal Control
ADG	Adapter Status GO	Self Test
ADN	Adapter Status NO-GO	Self Test
AMG	Auto Mode GO	Control Unit
ANT	Antenna Port	Circulator
ARP	Fine Reference Position Pulse	Decoder
ART	Fine Reference Position Pulse Test	Decoder
ASC	Antenna Switch Control	Adapter/Connector
ASD	Antenna Switch Drive	Internal Control
ASG	Antenna Switch Drive Return	Internal Control
ATG	Antenna Status GO	Self Test
ATN	Antenna Status NO-GO	Self Test
AVT	Fine Bearing Valid Test	Bearing Computer
BBA	Bearing Bit 256°	Bearing Computer
BBB	Bearing Bit 128°	Bearing Computer
BBC	Bearing Bit 64°	Bearing Computer
BBD	Bearing Bit 32°	Bearing Computer
BBE	Bearing Bit 16°	Bearing Computer
BBF	Bearing Bit 8°	Bearing Computer
BBG	Bearing Bit 4°	Bearing Computer
BBH	Bearing Bit 2°	Bearing Computer
BBI	Bearing Bit 1°	Bearing Computer
BBJ	Bearing Bit 0.5°	Bearing Computer
BBK	Bearing Bit 0.25°	Bearing Computer
BFC+	Bearing Flag Control + (+28 vdc)	Adapter/Connector
BFC	Bearing Valid Flag Control	Bearing Computer
BLT	Bearing Loop Test	Bearing Computer
BOT	Bearing Output Pulse Test	Bearing Computer
BVC.	Bearing Valid Signal	Bearing Computer
BVS	Bearing Valid Status	Bearing Computer
BZT	Bearing Zero Status	Bearing Coupler
CBM	Course Bearing Modulation	Decoder
CBT	Course Bearing Modulation Test	Decoder
CCC.	Control of TSC.	Interface
CCL	Course Centering Left	Coarse Centering Pot
CCR	Course Centering Right	Coarse Centering Pot
CCW	Course Centering Wiper	Frequency Synthesizer
CDT	Control Divider Test	Frequency Synthesizer
CF INC	Center Frequency Incident	Coupler Filter
CF REF	Center Frequency Reflected	Coupler Filter
CFT	Coarse Loop VCO Test	Bearing Computer
CIR	Compass Input Return	Adapter/Connector
CIX	Compass Input X	Adapter/Connector
CIY	Compass Input Y	Adapter/Connector
CLT	Coarse Loop Error Test	Bearing Computer
CNT	Coarse 90° Test	Bearing Computer
CRA.	Course Resolver Stator 1	Adapter/Connector

SIGNAL TERM	DESCRIPTION	SOURCE
CRB	Course Resolver Stator 2	Adapter/Connector
CRC	Course Resolver Rotor 1	Adapter/Connector
CRD	Course Resolver Rotor 2	Adapter/Connector
CRE	Course Resolver Common	Adapter/Connector
CRF	Course Resolver Common	Adapter/Connector
CSA	Channel Select Bit 1	Internal Control
CSB	Channel Select Bit 2	Internal Control
CSC	Channel Select Bit 4	Internal Control
CSC	Channel Select Clock	Adapter/Connector
CSD	Channel Select Bit 8	Internal Control
CSE	Channel Select Bit 10	Internal Control
CSF	Channel Select Bit 20	Internal Control
CSG	Channel Select Bit 40	Internal Control
CSH	Channel Select Bit 80	Internal Control
CST	Carrier Switch Test	Frequency Synthesizer
CUD	Control Unit Update	Internal Control
CUG	Control Unit Status GO	Self Test
CUN	Control Unit Status NO-GO	Self Test
CUS	Control Unit Status GO	Internal Control
CVO	Composite Video Output	Receiver
CVT	Composite Video Output Test	Decoder
DAT	Digital-to-Analog Test	Internal Control
DEL	Deviation Left	Adapter/Connector
DHX	Distance Hundreds X	Range Coupler
DHY	Distance Hundreds Y	Range Coupler
DRA	Data Request A	Adapter/Connector
DRB	Data Request B	Adapter/Connector
DTV	Data Train Valid	Interface
DTX	Distance Tens X	Range Coupler
DTY	Distance Tens Y	Range Coupler
DUX	Distance Units X	Range Coupler
DUY	Distance Units Y	Range Coupler
DVL	Deviation Left	Adapter/Connector
DVR	Deviation Right	Range Coupler
ELT	Early/Late Gate Test	Range Computer
FBM	Fine Bearing Modulation	Decoder
FBT	Fine Bearing Modulation Test	Decoder
FCT	Frequency Converter Test	Frequency Synthesizer
FDT	Fixed Divider Test	Frequency Synthesizer
FET	Frequency Synthesizer Loop Error Test	Frequency Synthesizer
FFT	540/4 Clock	Bearing Computer
FGC	Fast AGC Control	Decoder
FGS	Fast AGC Shield Sig Reference	Decoder
FGS	Frequency Synthesizer Status	Frequency Synthesizer
FGT	Fast AGC Test	Decoder
FHC	Filament Heater Current	Power Supply
FHR	Filament Heater Current Return	Power Supply
FLS	Frequency Synthesizer Locked Status	Frequency Synthesizer
FLT	Frequency Locked Status	Frequency Synthesizer
FNT	Fine 90° Test	Bearing Computer
FPC	First Pulse and A/A Transmit Command	Range Computer
FPCD	First Pulse Command Decoder	Decoder
FPCR	First Pulse Command Range Computer	Self Test
FPT	Frequency Synthesizer Power Status	Frequency Synthesizer

SIGNAL TERM	DESCRIPTION	SOURCE
FPV	First Pulse Valid	Decoder
FRO	Filament Regulated Output Test	Power Amplifier/Modulator
FSC	Five Second Clock	Internal Control
FST	Frequency Synthesizer Status Test	Frequency Synthesizer
FTP	First Pulse Test Point	Power Amplifier/Modulator
FTT	Frequency Synthesizer Tuning Test	Frequency Synthesizer
FVT	Fine Loop VCO Test Clock	Bearing Computer
HFC	High Frequency Clock	Range Computer
HFCA	High Frequency Clock AGE	Self Test
HFCA	High Frequency Clock AGE Complement	Self Test
HFCD	High Frequency Clock Decoder	Decoder
HVT	High Voltage Test	Power Supply
HVM	High Voltage Modulation	Power Supply
HVP	High Voltage Pulse	Power Amplifier/Modulator
HVR	High Voltage Return	Power Supply
IDC	Input Data Clock	Adapter/Connector
IDC	Input Data Clock Complement	Adapter/Connector
IDD	Identity Tone Drive	Decoder
IDL	Input Data Line	Adapter/Connector
IDL	Input Data Line Complement	Adapter/Connector
IDO	Identity Tone Output	Control Unit
ISC	Input Shift Clock	Adapter/Connector
ISC	Input Shift Clock Complement	Adapter/Connector
LOS	Local Oscillator Signal	Frequency Synthesizer
MOP	Modulator Output Pulse	Power Amplifier/Modulator
MRP	Coarse Reference Pulse	Decoder
MRT	Coarse Reference Pulse Test	Decoder
NRL	Normal Range Limit	Range Computer
OCT	Oscillator Control Test	Frequency Synthesizer
OLT	Fine Loop Error Test	Bearing Computer
OPT	Fine Loop Phase Detector Input Test	Bearing Coupler
PCW	Pulsed CW	Frequency Synthesizer
PDT	Phase Detector Test	Frequency Synthesizer
PHC	Preselector Heater Current	Power Supply
PHR	Preselector Heater Return	Power Supply
PIP	Post Interrogation Pulse	Range Computer
PIT	Post Interrogation Pulse Test	Range Computer
PRT	PRF Generator Test	Range Computer
PSS	Power Supply Status	Power Supply
PTC	Preselector Tuning Current Cathode	Internal Control
PTG	Preselector Tuning Current Grid	Internal Control
PTR	Preselector Tuning Current Reference	Internal Control
PTT	Preselector Tuning Current Test	Internal Control
PZT	Range Clock Phase Zero Test	Range Computer
RBA	Range Bit 204.8	Range Computer
RBB	Range Bit 102.3	Range Computer
RBC	Range Bit 51.2	Range Computer
RBD	Range Bit 25.6	Range Computer
RBE	Range Bit 12.8	Range Computer
RBF	Range Bit 6.4	Range Computer
RBG	Range Bit 3.2	Range Computer
RBH	Range Bit 1.6	Range Computer
RBI	Range Bit 0.8	Range Computer
RBJ	Range Bit 0.4	Range Computer

SIGNAL TERM	DESCRIPTION	SOUTRCE
RBK	Range Bit 0.2	Range Computer
RBL	Range Bit 0.1	Range Computer
RBM	Range Bit 0.05	Range Computer
RBN	Range Bit 0.025	Range Computer
RBT	Fine Reference Phase Zero Test	Bearing Computer
RCS	Receiver Status	Receiver
RCT	Range Track Test	Range Computer
RCVR	Receiver Port	Circulator
RET	Reference Loop Error Test	Bearing Computer
RFC	Range Valid Flag Control	Range Computer
RNA	Chassis Ground	Chassis Ground
RNC	Signal Ground	Power Supply
RPA	Range Potentiometer No	1 Low Range Coupler
RPB	Range Potentiometer No	1 Arm Range Coupler
RPC	Range Potentiometer No	1 High Range Coupler
RPD	Range Potentiometer No	2 Low Range Coupler
RPE	Range Potentiometer No	2 Arm Range Coupler
RPF	Range Potentiometer No	2 High Range Coupler
RPT	Reference Phase Test	Frequency Synthesizer
RRC	Resolver Rotor No	2 Bearing Coupler
RSL	Received Signal	Receiver
RSM	Range Short Memory	Range Computer
RST	AGE Data	Receiver
RTG	Receiver-Transmitter Status GO	Self Test
RTM	Receiver-Transmitter Mode Command	Internal Control
RTN	Receiver-Transmitter Status NO-GO	Self Test
RTS	Receive/Transmit Signal	Coupler Filter
RVC	Range Valid-Signal	Range Computer
RVT	Reference Loop VCO Test	Bearing Computer
RZT	Range Zero Status	Range Coupler
SDC	Serial Data Clock	Internal Control
SDT	Serial Data Train	Internal Control
SGC	Slow AGC Control	Decoder
SGS	Slow AGC Control Shield	Decoder
SGT	Slow AGC Test	Decoder
SMS	System Monitor Status	Self Test
SPC	Second Pulse Transmit Command	Range Computer
SPI	Suppression Pulse Input	Adapter/Connector
SPO	Suppression Pulse Output	Power Amplifier/Modulator
SRM	Short Range Mode	Internal Control
STA	Self Test Level	Self Test
STB	Self Test Bit	Internal Control
STC	Self Test Command Internal Control	Internal Control
STH	Self Test Hold	Self Test
STP	Second Pulse Test	Power Amplifier/Modulator
STR	Self Test Command	Self Test
STS	Self Test Status	Self Test
STX	Self Test Command Self Test	Self Test
TPAD	TACAN Data	Interface
TAD	TACAN Data Complement	Adapter/Connector
TBX	TACAN Bearing X	Bearing Coupler
TBY	TACAN Bearing Y	Bearing Coupler
TFA	To/From Arrow Control	Bearing Coupler
TFR	To-From Arrow Return	Adapter/Connector
TID	Auto Mode Selected (TI Discrete)	Interface

SIGNAL TERM	DESCRIPTION	SOURCE
TOC	Turn-On Command	Control Unit
TRF	TACAN Radio Frequency	ANTENNA Connector
TRM	Transmit Receive Mode	Frequency Synthesizer
TSC	Transmit Suppress Command	Internal Control
UDT	Up/Down Test	Range Computer
VCT	Range VCO Test	Range Computer
VET	Range Velocity Error Test	Range Computer
XMTR	Transmitter Port	Circulator
YYC	Y Mode Command	Internal Control

INDEX

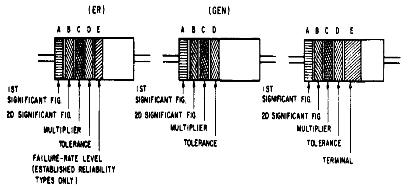
By Order of the Secretary of the Army:

CREIGHTON W ABRAMS
General, United States Army
Chief of Staff

Official:
VERNE L BOWERS
Major General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 1231, Direct/General Support requirements for avionics literature, OV-1A, B, and C, OV-1D and U-21 aircrafts.

U.S. GOVERNMENT PRINTING OFFICE : 261-872 (20660)



COLOR CODE MARKING FOR COMPOSITION TYPE RESISTORS.

COLOR-CODE MARKING FOR FILM-TYPE RESISTORS.

TABLE I
COLOR CODE FOR COMPOSITION TYPE AND FILM TYPE RESISTORS.

BAND A		BAND B		BAND C		BAND D		BAND E		
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)	COLOR	FAILURE RATE LEVEL	TERM.
BLACK.....	0	BLACK......	0	BLACK	1			BROWN .	M=1.0	
BROWN.....	1	BROWN.....	1	BROWN....	10			RED	P=0.1	
RED.......	2	RED.......	2	RED.......	100			ORANGE..	R=0.01	
ORANGE....	3	ORANGE....	3	ORANGE...	1,000			YELLOW..	S=0.001	
YELLOW....	4	YELLOW...	4	YELLOW...	10,000	SILVER.	±10 (COMP. TYPE ONLY)	WHITE...	....	SOLD-ERABLE
GREEN.....	5	GREEN.....	5	GREEN....	100,000	GOLD...	±5			
BLUE......	6	BLUE......	6	BLUE.....	1,000,000	RED....	±2 (NOT APPLICABLE TO ESTABLISHED RELIABILITY).			
PURPLE.. (VIOLET)	7	PURPLE.... (VIOLET)	7							
GRAY......	8	GRAY ..	8	SILVER...	0.01					
WHITE....	9	WHITE.....	9	GOLD	0.1					

BAND A — THE FIRST SIGNIFICANT FIGURE OF THE RESISTANCE VALUE (BANDS A THRU D SHALL BE OF EQUAL WIDTH.)

BAND B — THE SECOND SIGNIFICANT FIGURE OF THE RESISTANCE VALUE.

BAND C — THE MULTIPLIER (THE MULTIPLIER IS THE FACTOR BY WHICH THE TWO SIGNIFICANT FIGURES ARE MULTIPLIED TO YIELD THE NOMINAL RESISTANCE VALUE.)

BAND D — THE RESISTANCE TOLERANCE.

BAND E — WHEN USED ON COMPOSITION RESISTORS, BAND E INDICATES ESTABLISHED RELIABILITY FAILURE-RATE LEVEL (PERCENT FAILURE PER 1,000 HOURS). ON FILM RESISTORS, THIS BAND SHALL BE APPROXIMATELY 1-1/2 TIMES THE WIDTH OF OTHER BANDS, AND INDICATES TYPE OF TERMINAL.

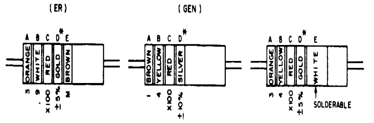
RESISTANCES IDENTIFIED BY NUMBERS AND LETTERS
(THESE ARE NOT COLOR CODED)

SOME RESISTORS ARE IDENTIFIED BY THREE OR FOUR DIGIT ALPHA NUMERIC DESIGNATORS. THE LETTER R IS USED IN PLACE OF A DECIMAL POINT WHEN FRACTIONAL VALUES OF AN OHM ARE EXPRESSED. FOR EXAMPLE:

2R7 = 2.7 OHMS 10R0 = 10.0 OHMS

FOR WIRE-WOUND-TYPE RESISTORS COLOR CODING IS NOT USED, IDENTIFICATION MARKING IS SPECIFIED IN EACH OF THE APPLICABLE SPECIFICATIONS.

EXAMPLES OF COLOR CODING



NOMINAL RESISTANCE 3,900 OHMS
RESISTANCE TOLERANCE ±5%
FAILURE RATE LEVEL M

NOMINAL RESISTANCE 1,400 OHMS
RESISTANCE TOLERANCE ±10%

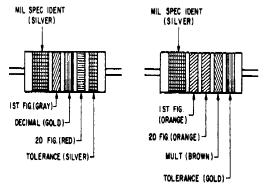
NOMINAL RESISTANCE 3,400 OHMS
RESISTANCE TOLERANCE ±5%
TERMINAL SOLDERABLE

COMPOSITION-TYPE RESISTORS

FILM-TYPE RESISTORS

* IF BAND D IS OMITTED, THE RESISTOR TOLERANCE IS ±20% AND THE RESISTOR IS NOT MIL-STD.

A. COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS.



(A) 8.2UH ±10% (B) 330UH ±5%

COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES. AT A, AN EXAMPLE OF OF THE CODING FOR AN 8.2UH CHOKE IS GIVEN. AT B, THE COLOR BANDS FOR A 330UH INDUCTOR ARE ILLUSTRATED.

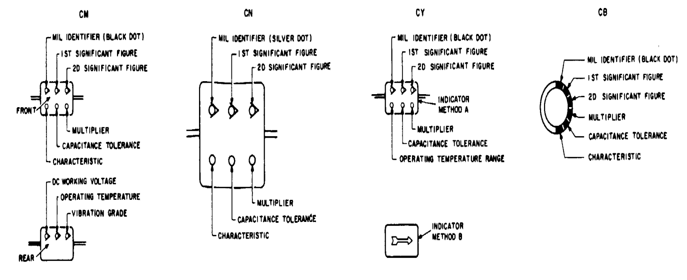
TABLE 2
COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES.

COLOR	SIGNIFICANT FIGURE	MULTIPLIER	INDUCTANCE TOLERANCE (PERCENT)
BLACK	0	1	
BROWN	1	10	1
RED	2	100	2
ORANGE	3	1,000	3
YELLOW	4		
GREEN	5		
BLUE	6		
VIOLET	7		
GRAY	8		
WHITE	9		
NONE			20
SILVER			10
GOLD	DECIMAL POINT		5

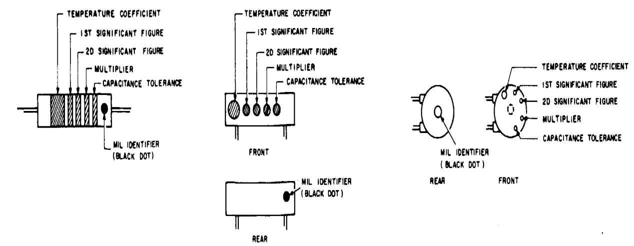
MULTIPLIER IS THE FACTOR BY WHICH THE TWO COLOR FIGURES ARE MULTIPLIED TO OBTAIN THE INDUCTANCE VALUE OF THE CHOKE COIL.

B. COLOR CODE MARKING FOR MILITARY STANDARD INDUCTORS.

CAPACITORS, FIXED, VARIOUS-DIELECTRICS, STYLES CM, CN, CY, AND CB.



MICA-DIELECTRIC PAPER-DIELECTRIC GLASS-DIELECTRIC, GLASS CASE MICA, BUTTON TYPE



AXIAL LEAD RADIAL LEAD DISK-TYPE

TABLE 3 – FOR USE WITH STYLES CM, CN, CY AND CB.

COLOR	MIL ID	1ST SIG FIG.	2D SIG FIG.	MULTIPLIER[1]	CAPACITANCE TOLERANCE				CHARACTERISTIC[2]			DC WORKING VOLTAGE	OPERATING TEMP. RANGE	VIBRATION GRADE
					CM	CN	CY	CB	CM	CN	CB	CM	CY, CM	CM
BLACK	CM, CY CB	0	0	1			±20%	±20%		A			-55° TO +70°C	10-55 HZ
BROWN		1	1	10					B	E	B			
RED		2	2	100	±2%		±2%	±2%	C				-55° TO +85°C	
ORANGE		3	3	1,000		±30%			D		D	300		
YELLOW		4	4	10,000					E				-55° TO +125°C	10-2,000Hz
GREEN		5	5		±5%				F			500		
BLUE		6	6										-55° TO +150°C	
PURPLE (VIOLET)		7	7											
GRAY		8	8											
WHITE		9	9											
GOLD				0.1			±5%	±5%						
SILVER	CN			0.01	±10%	±10%	±10%	±10%						

TABLE 4 — TEMPERATURE COMPENSATING, STYLE CC.

COLOR	TEMPERATURE COEFFICIENT[4]	1ST SIG FIG.	2D SIG FIG.	MULTIPLIER[1]	CAPACITANCE TOLERANCE		MIL ID
					CAPACITANCES OVER 10 UUF	CAPACITANCES 10 UUF OR LESS	
BLACK	0	0	0	1		±2.0 UUF	CC
BROWN	-30	1	1	10	±1%		
RED	-80	2	2	100	±2%	±0.25 UUF	
ORANGE	-150	3	3	1,000			
YELLOW	-220	4	4				
GREEN	-330	5	5		±5%	±0.5 UUF	
BLUE	-470	6	6				
PURPLE (VIOLET)	-750	7	7				
GRAY		8	8	0.01*			
WHITE		9	9	0.1*	±10%		
GOLD	+100			0.1		±1.0 UUF	
SILVER				0.01			

1. THE MULTIPLIER IS THE NUMBER BY WHICH THE TWO SIGNIFICANT (SIG) FIGURES ARE MULTIPLIED TO OBTAIN THE CAPACITANCE IN UUF.

2. LETTERS INDICATE THE CHARACTERISTICS DESIGNATED IN APPLICABLE SPECIFICATIONS: MIL-C-5, MIL-C-25D, MIL-C-11272B, AND MIL-C-10950C RESPECTIVELY.

3. LETTERS INDICATE THE TEMPERATURE RANGE AND VOLTAGE-TEMPERATURE LIMITS DESIGNATED IN MIL-C-11015D.

4. TEMPERATURE COEFFICIENT IN PARTS PER MILLION PER DEGREE CENTIGRADE.

* OPTIONAL CODING WHERE METALLIC PIGMENTS ARE UNDESIRABLE.

C. COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS.

ESC-FM 913-73

Figure FO-1. MIL-STD resistor and capacitor color code markings.

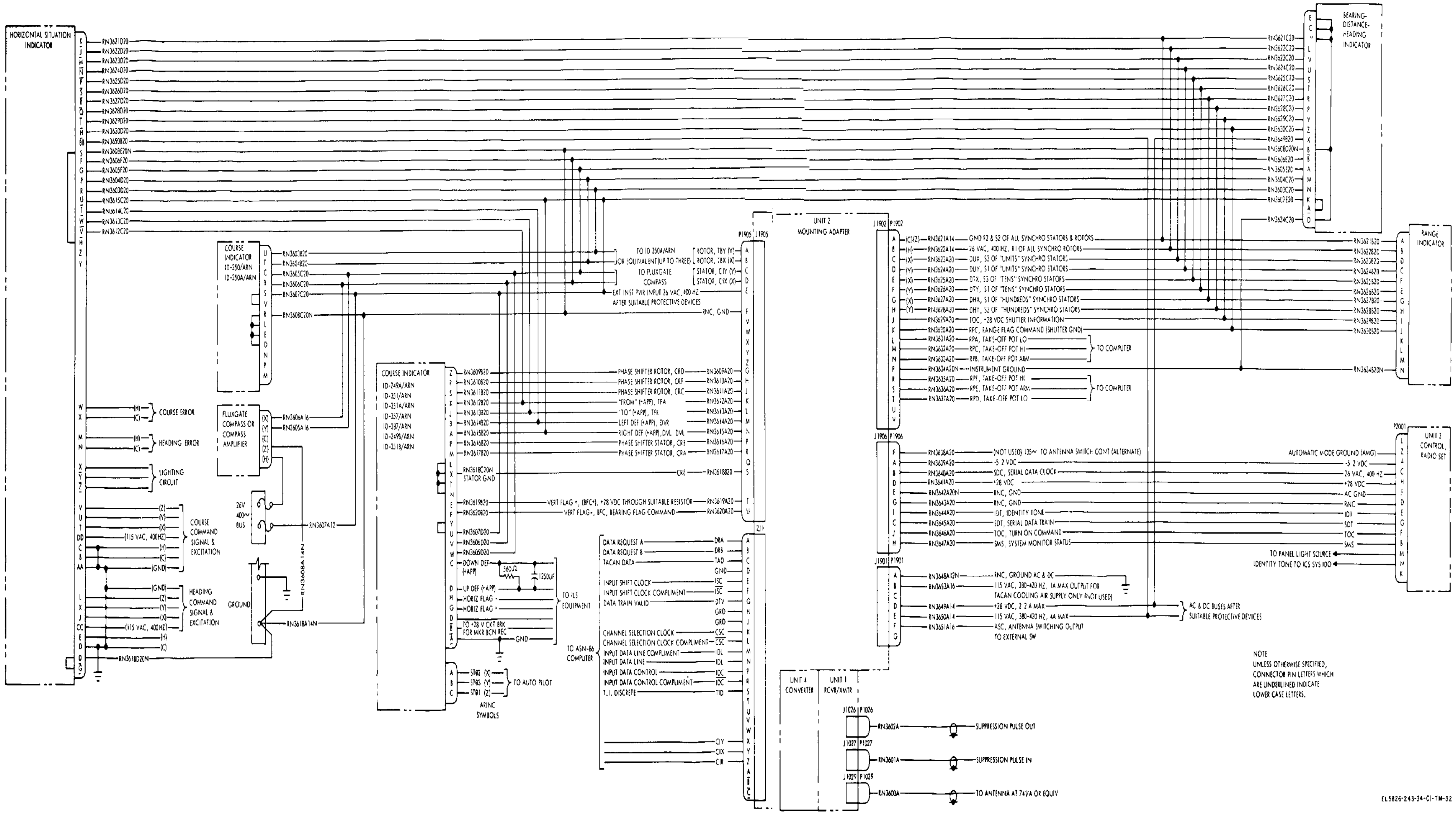


Figure FO-2. Navigational Set, TACAN AN/ARN-103 (V) external wiring diagram.

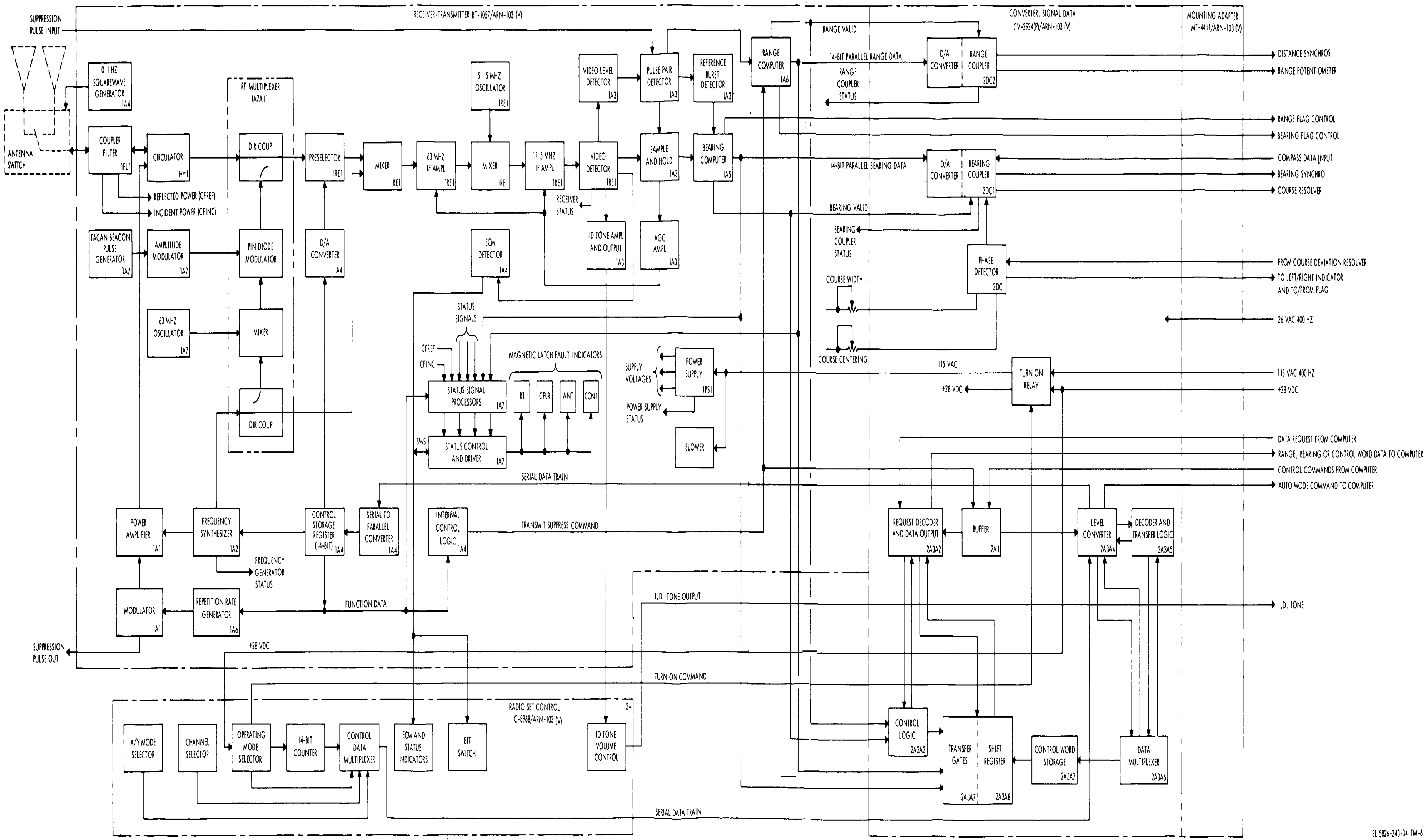


Figure FO-3. Navigational set block diagram.

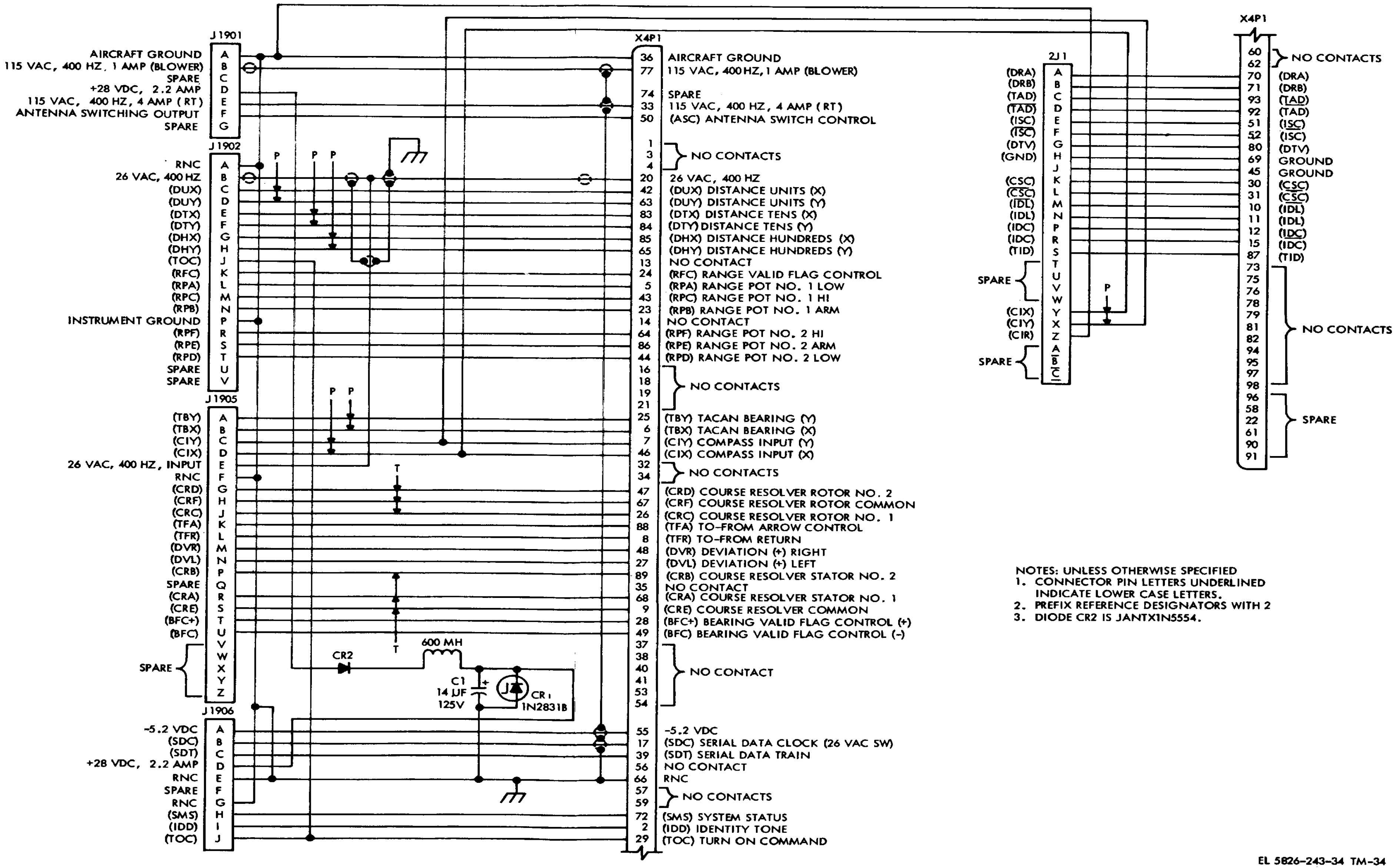


Figure FO-4. Adapter connector schematic diagram.

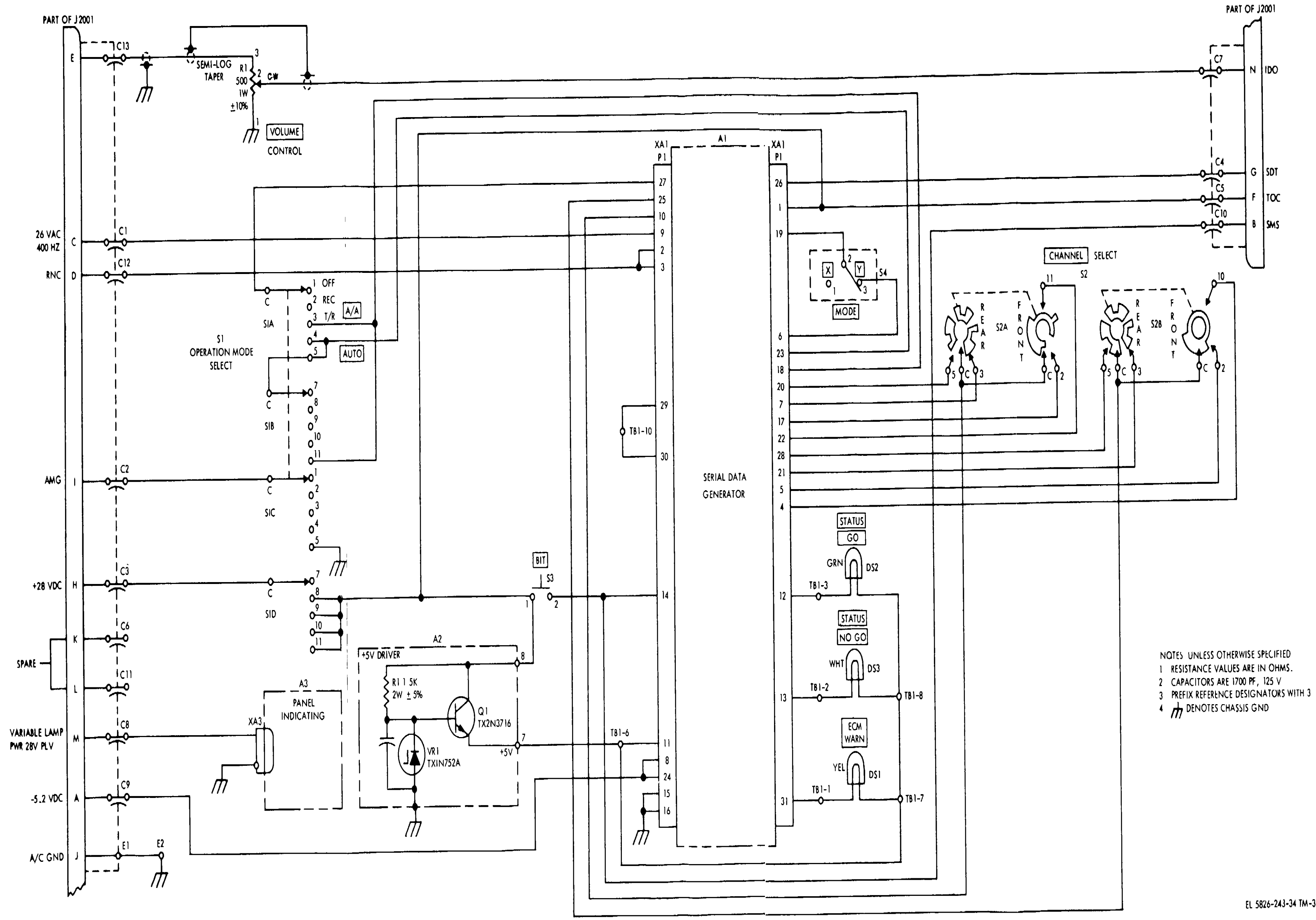
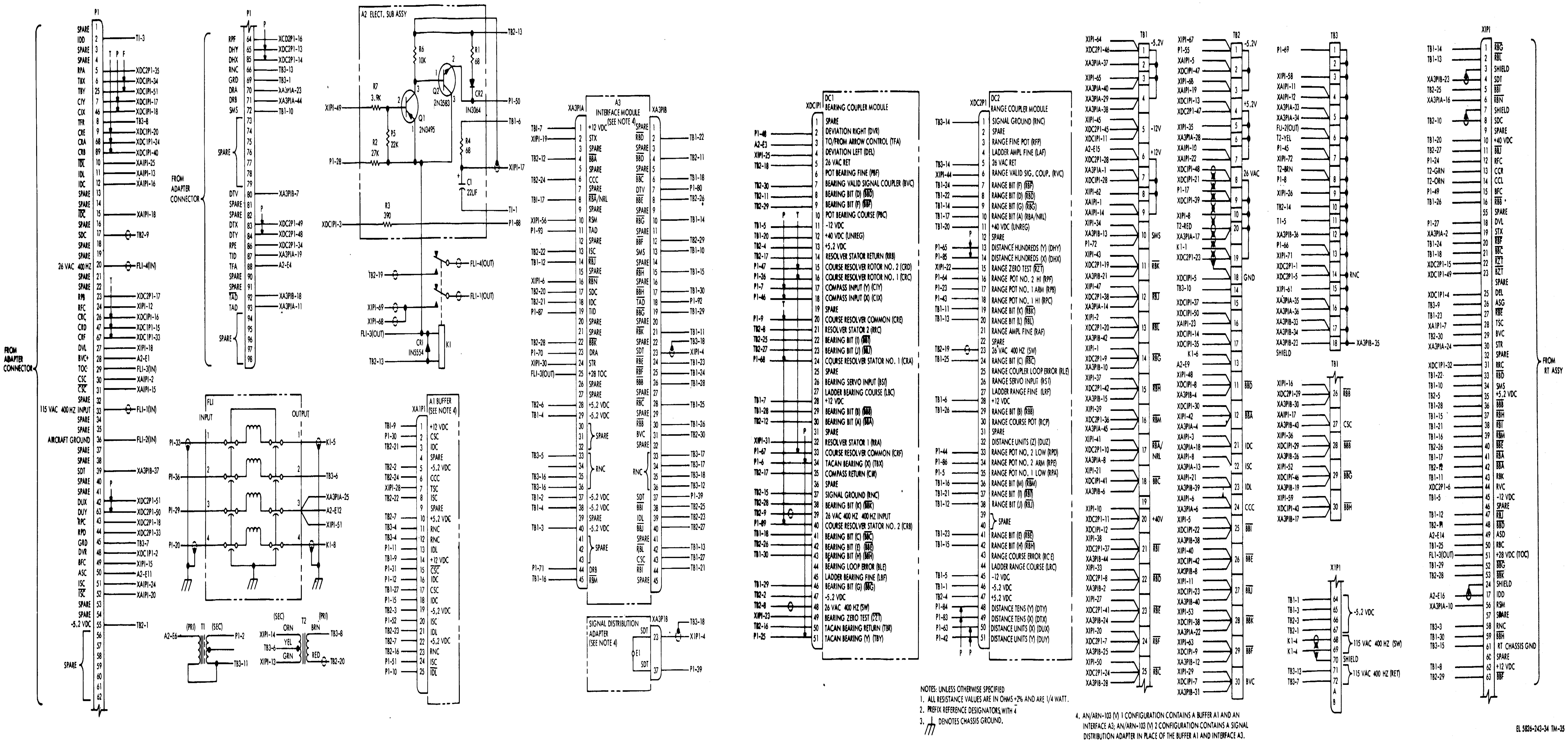


Figure FO-5. Control, Navigational Set C-8968/ARN-103 (V) interconnect diagram.



Signal Data CV-2924(P)/ARN-103(V) interconnect diagram.

Figure FO-6. Converter, Signal Data CV-2924 (P)/ARN-103 (V) interconnect diagram.

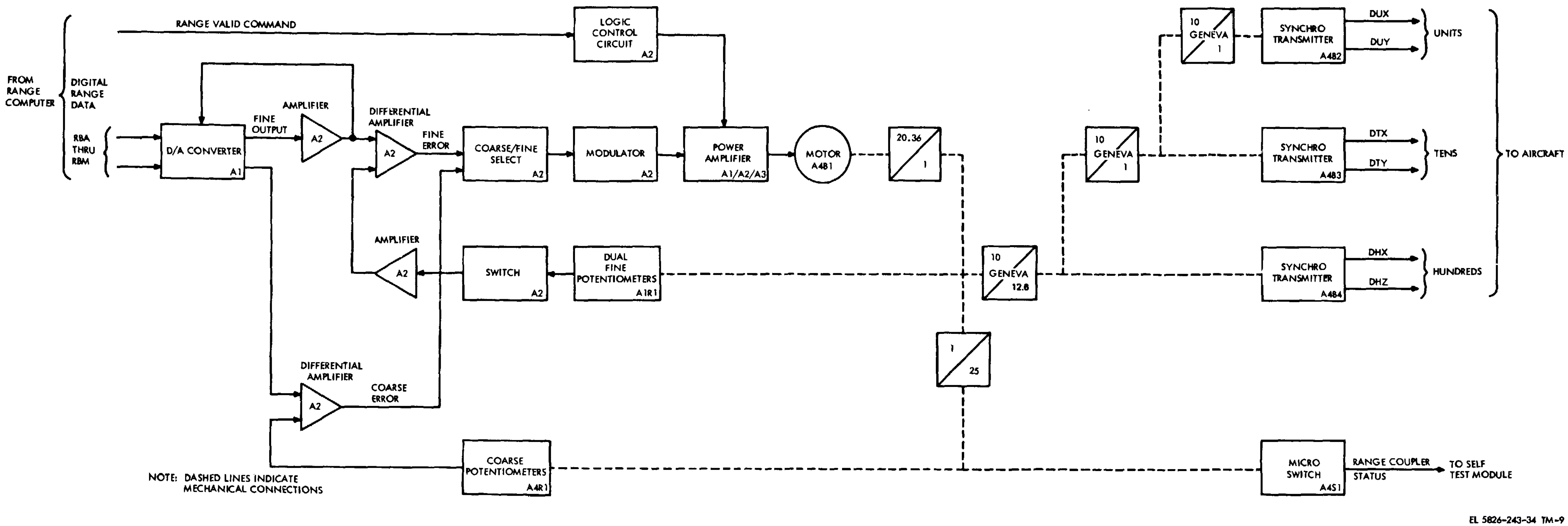


Figure FO-7. Range coupler 4DC2 block diagram.

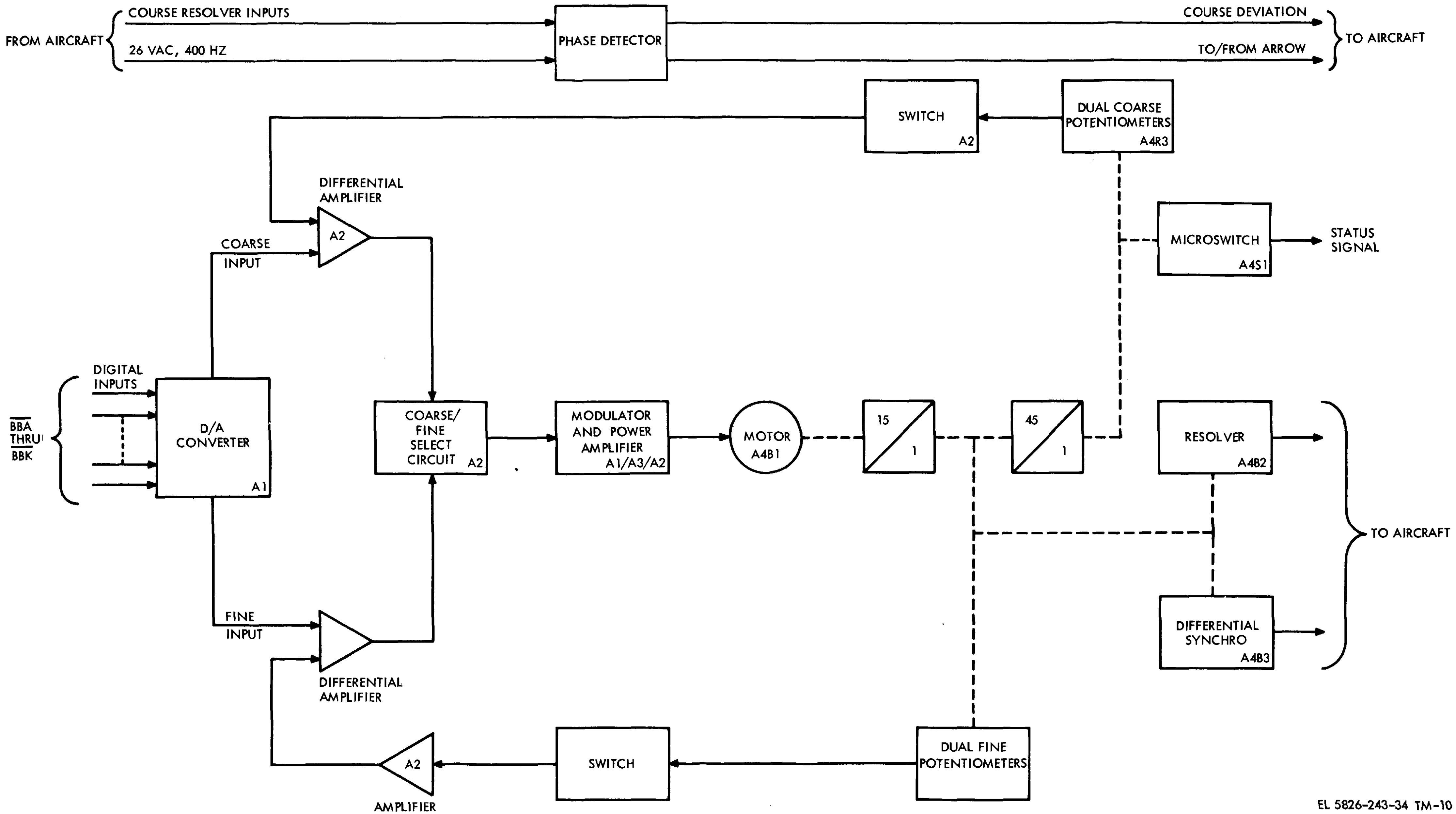


Figure FO-8. Bearing coupler 4DC1 block diagram.

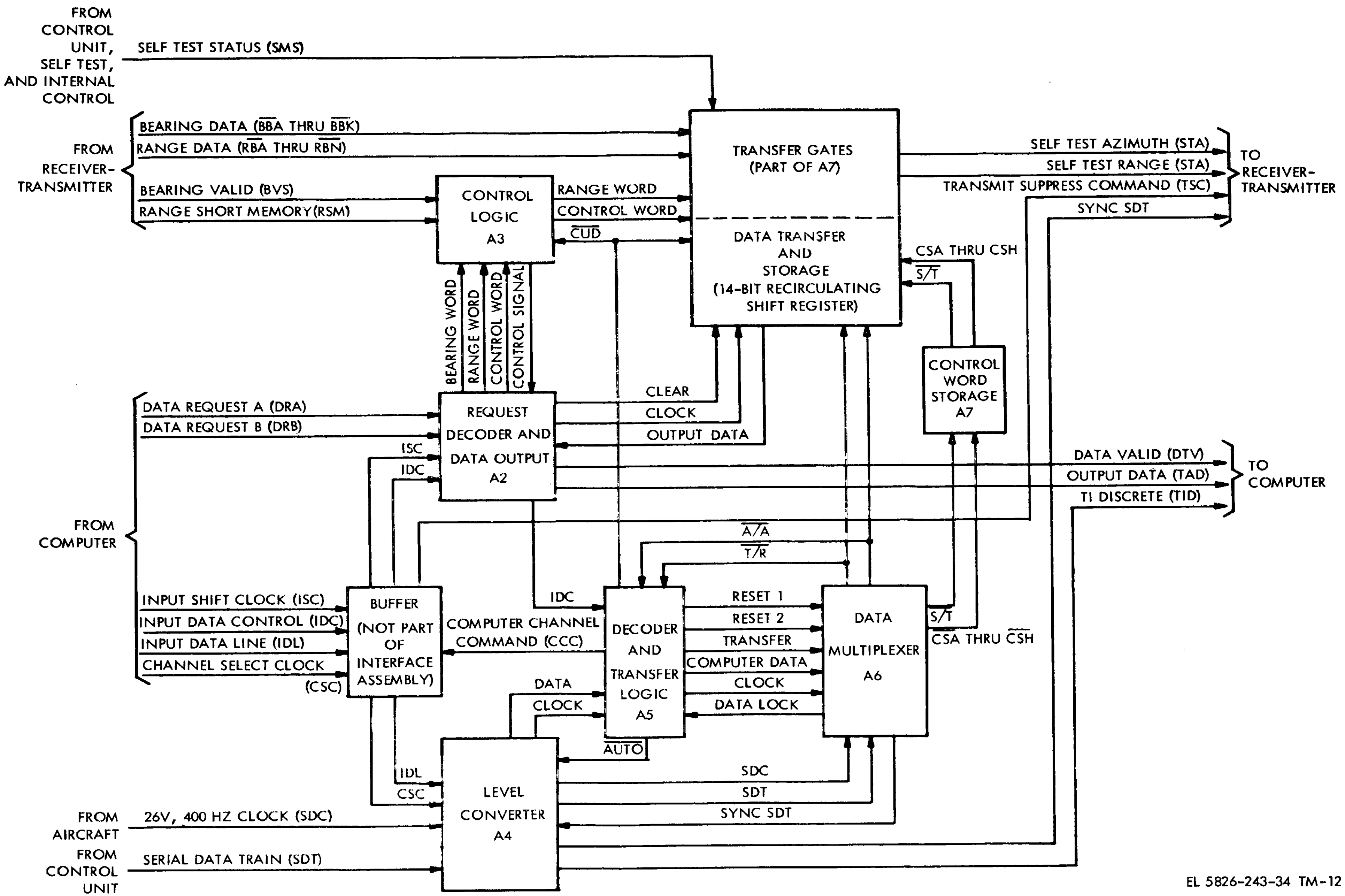


Figure FO-9. Interface 4A3 block diagram.

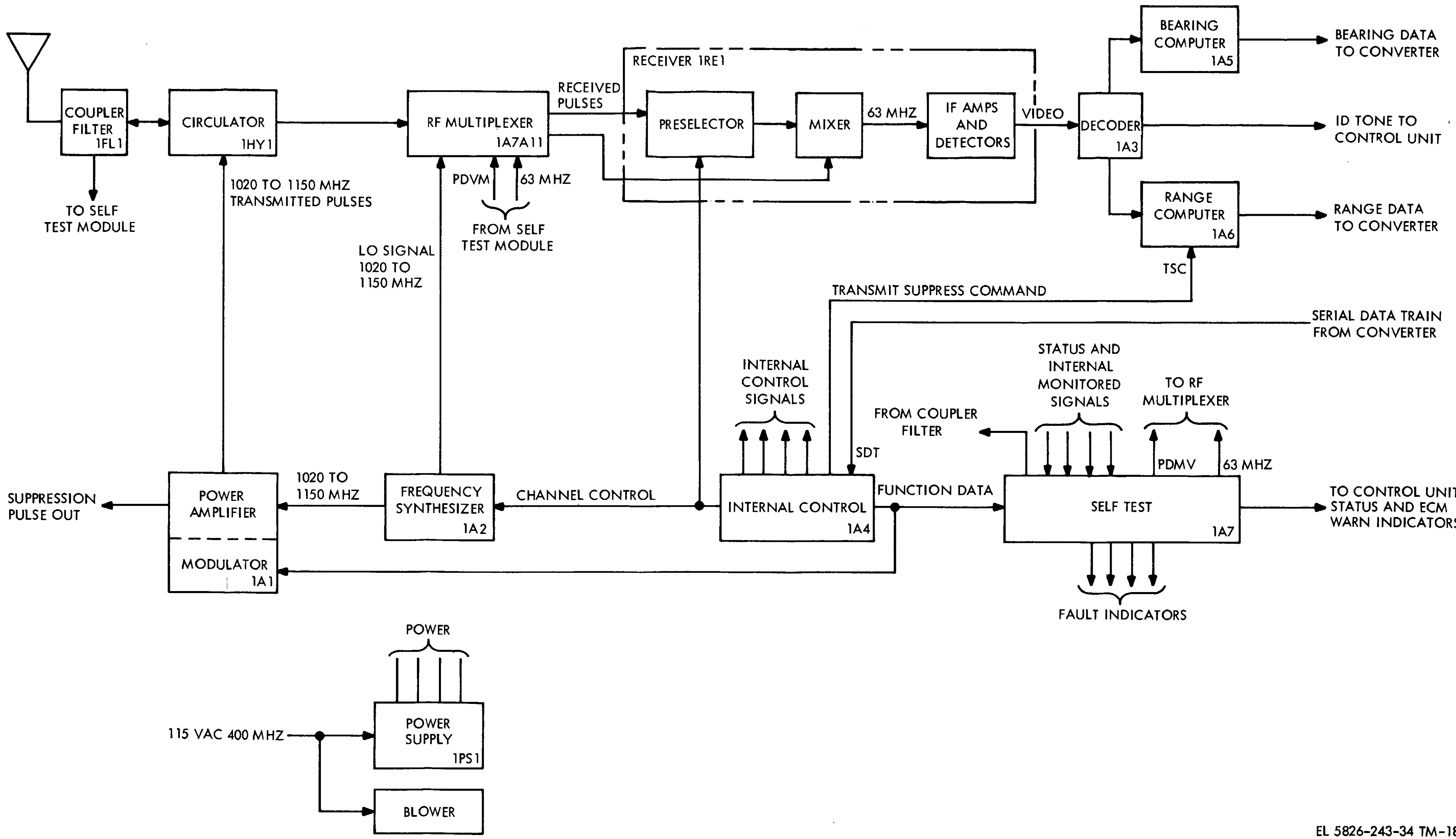


Figure FO-10. Receiver-transmitter block diagram.

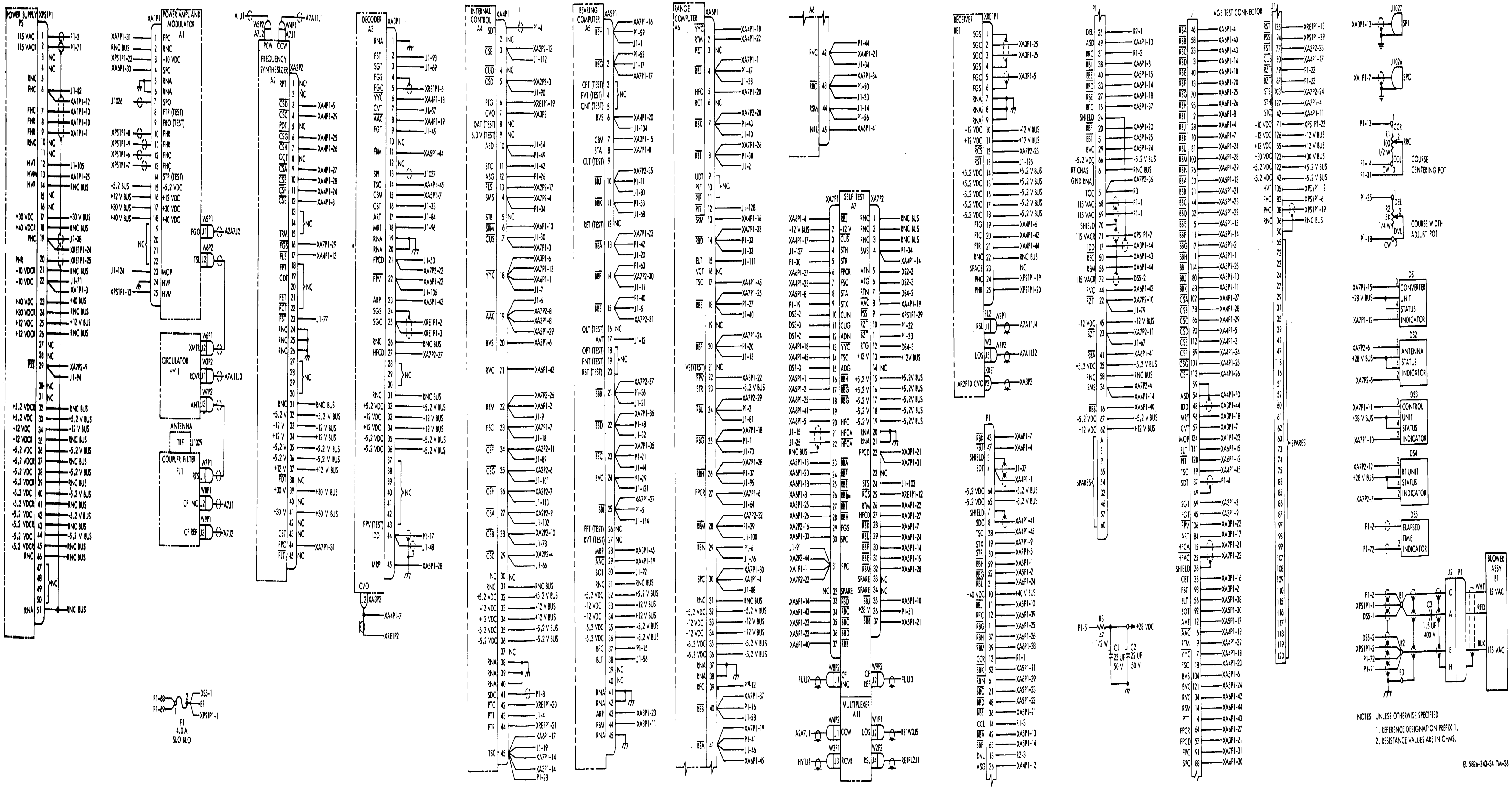


Figure FO-11. Receiver-Transmitter RT-1057/ARN-103 (V) interconnect diagram.

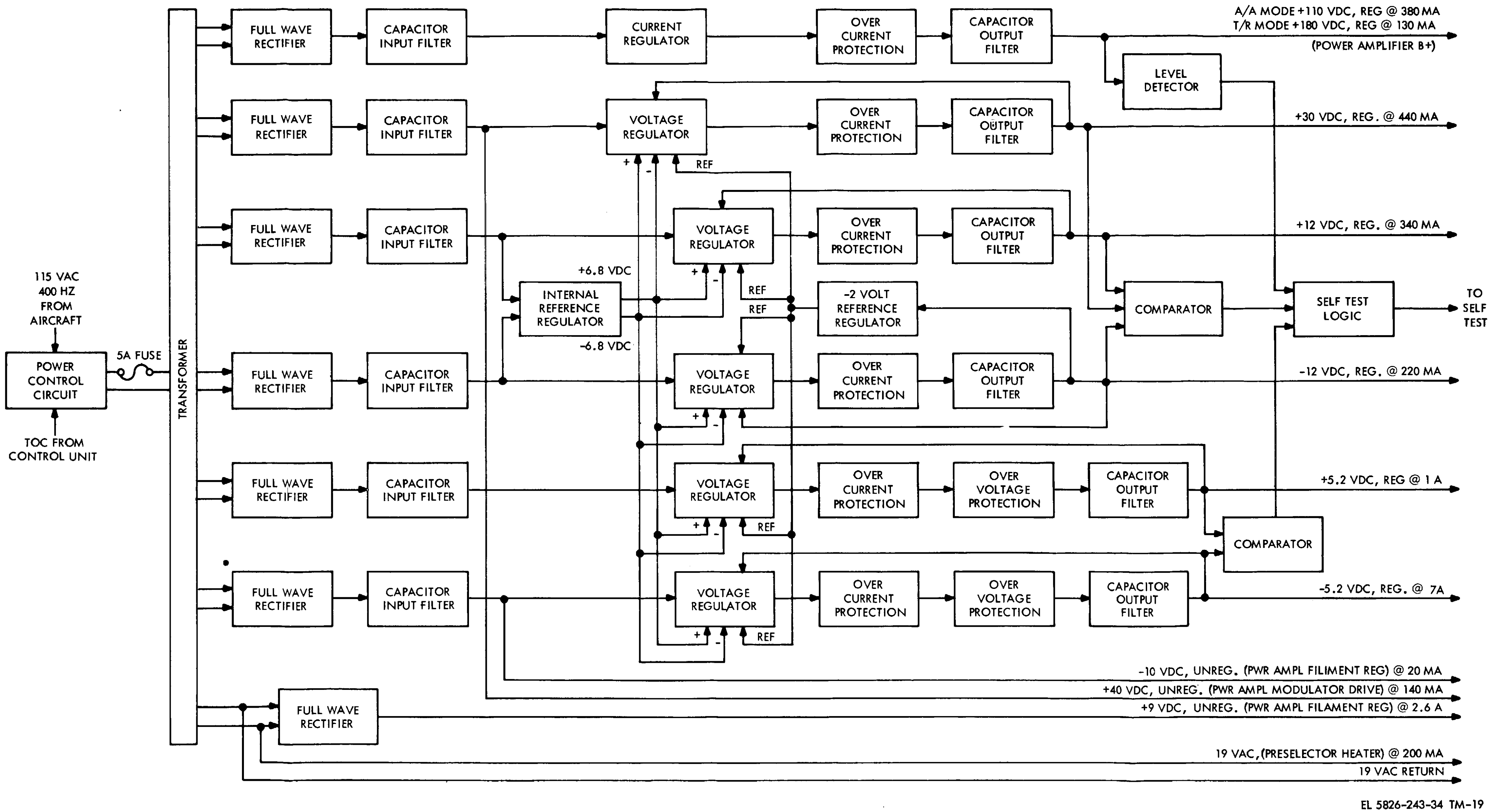


Figure FO-12. Power supply 1PS1 block diagram.

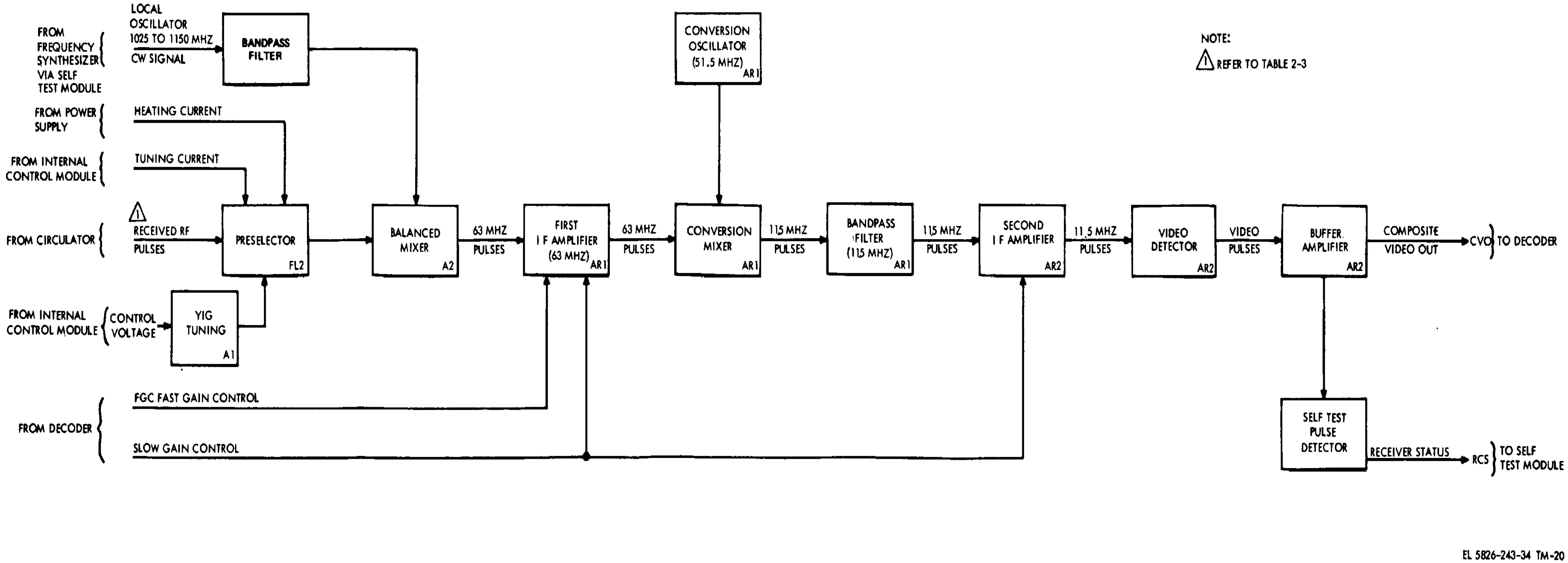


Figure FO-13. Receiver 1RE1 block diagram

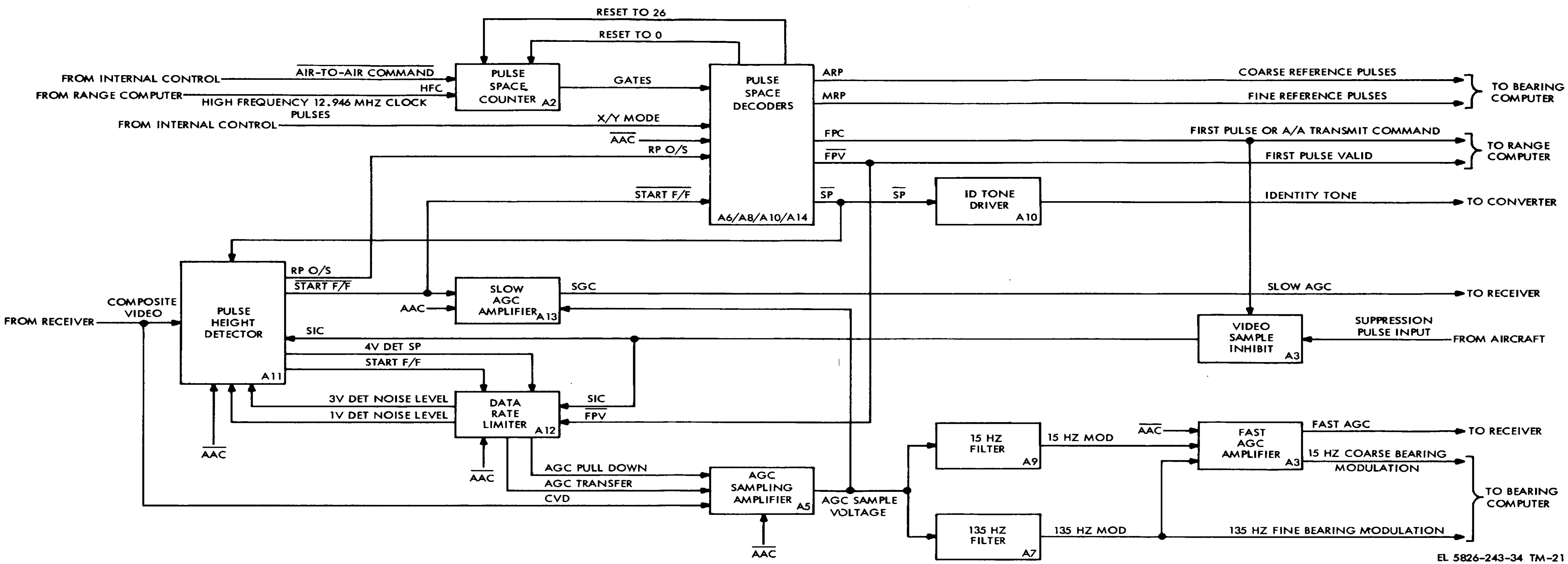


Figure FO-14. Decoder 1A3 block diagram.

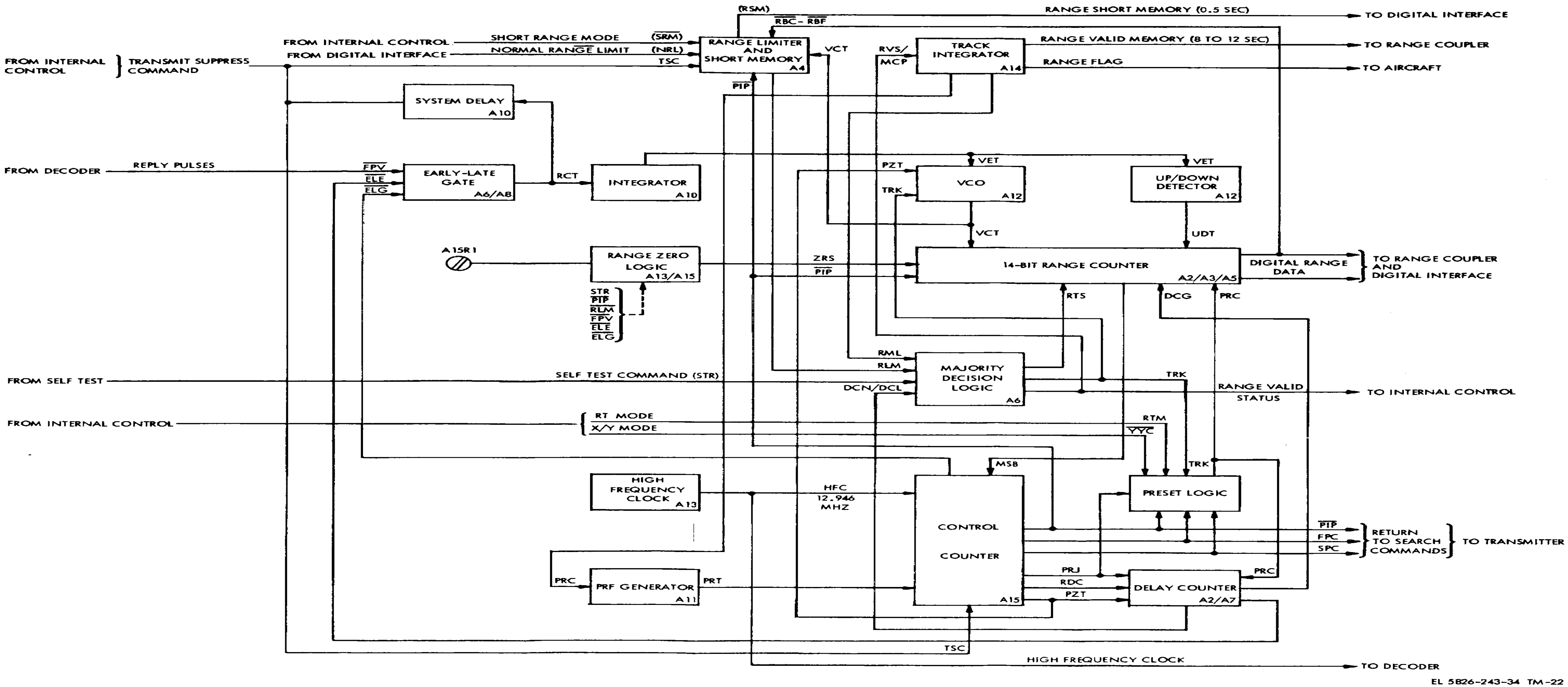


Figure FO-15. Range computer 1A6 block diagram.

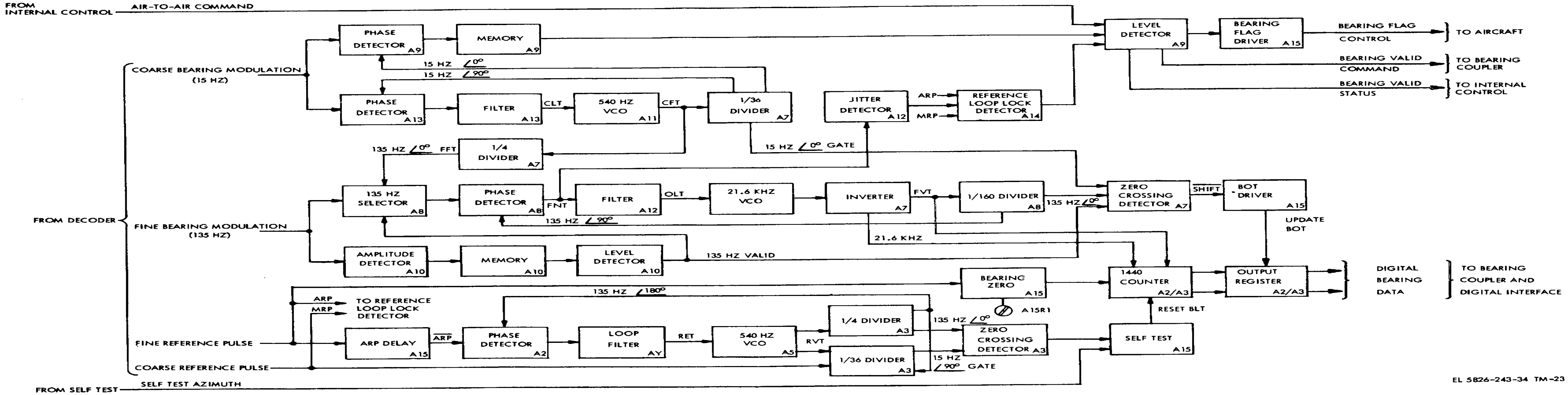


Figure FO-16. Bearing computer 1A5 block diagram.

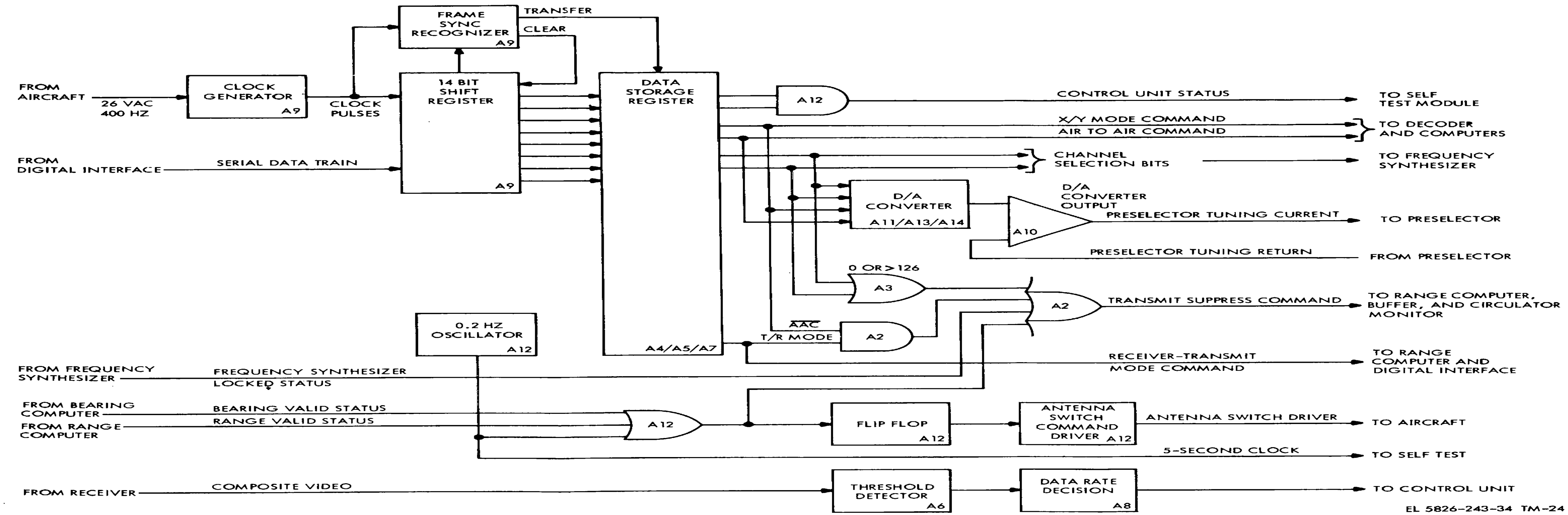


Figure FO-17. Internal control 1A4 block diagram

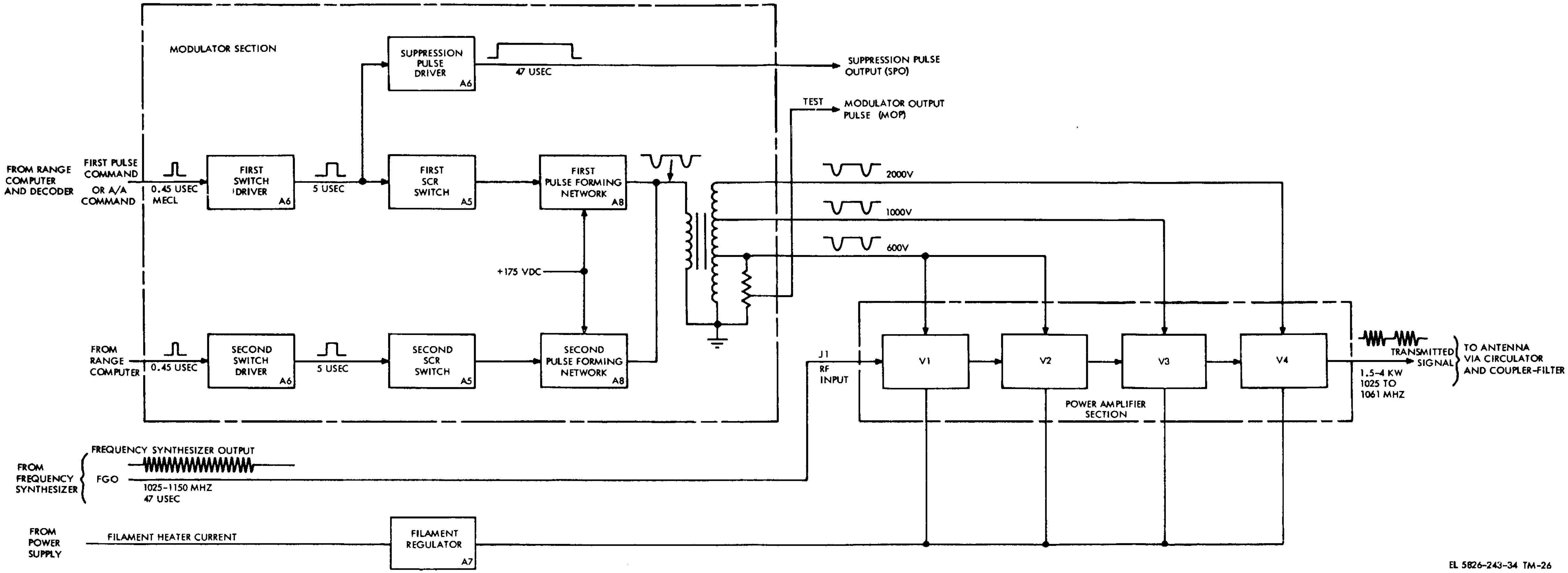


Figure FO-18. Power amplifier 1A1 block diagram

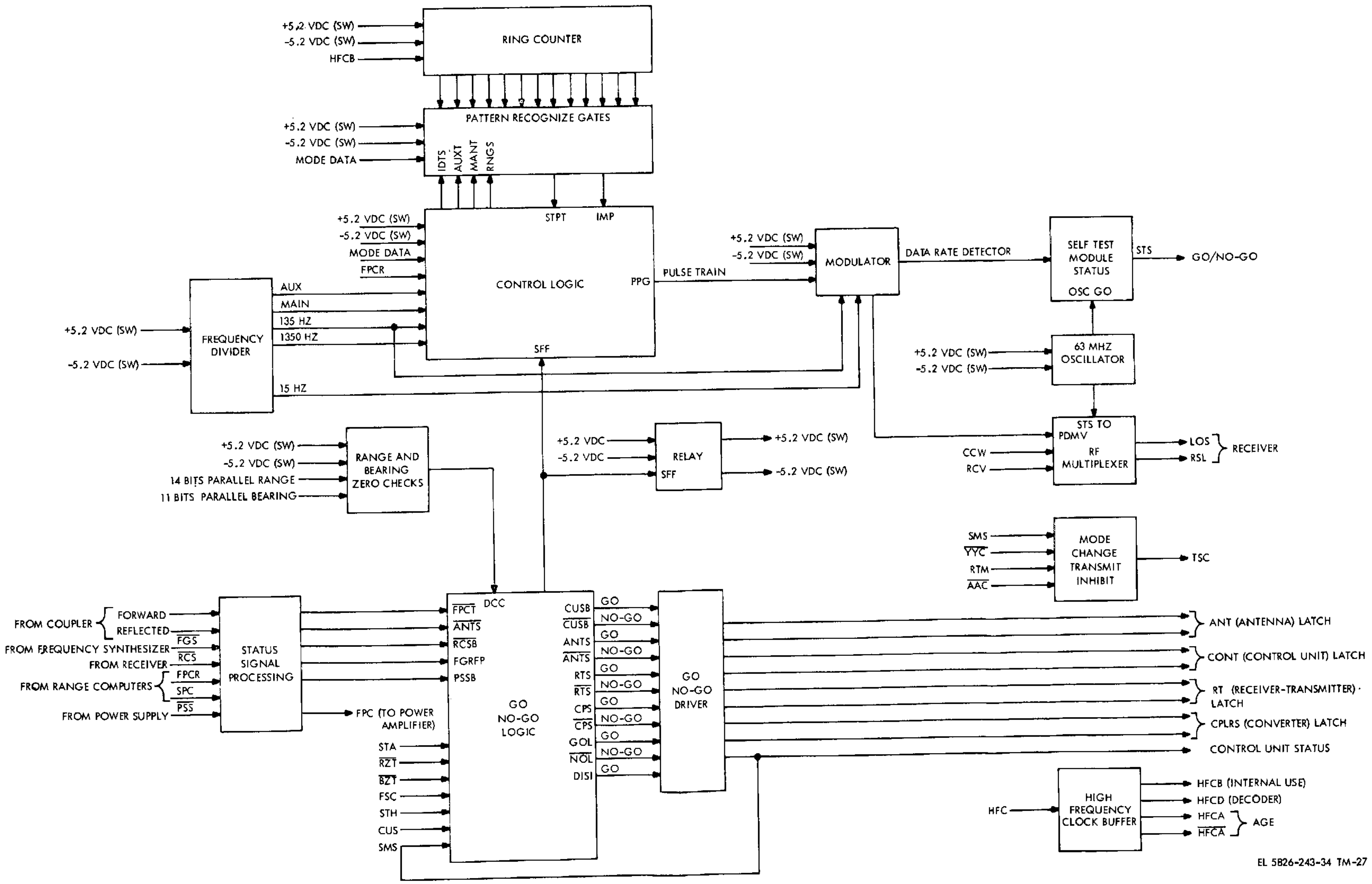


Figure FO-19. Self test 1A7 block diagram.

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

SOMETHING WRONG WITH THIS PUBLICATION?

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

BE EXACT. . .PIN-POINT WHERE IT IS				IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
PAGE NO.	PARA-GRAPH	FIGURE NO	TABLE NO.	

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER	SIGN HERE:

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS • ARE OBSOLETE.

P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

TEAR ALONG PERFORATED LINE

PIN: 023023-000